Part 2

Electric Lifts: Passenger and Goods

SECTION 5 - SCOPE

5.1 SCOPE

This Part of the New Zealand Power Lift Rules applies to electric lifts for carrying passengers and goods. Every electric lift designed for the carrying of passengers and goods shall, in addition to meeting the relevant requirements of Part 1, comply with the requirements of this Part of these Rules. As goods lifts must be attendant controlled and are often used by passengers, it is not intended to treat them as a separate entity.

SECTION 6 - MACHINERY AND SHEAVE BEAMS, SUPPORTS AND FOUNDATIONS

6.1 FLOORS, BEAMS AND SUPPORTS REQUIRED

Lift machinery and sheaves shall be so supported and maintained in place as to effectively prevent any part from becoming loose or displaced under the conditions imposed in service including earthquake. (See rule 2.2).

Supporting beams, if used, shall be of steel, reinforced concrete or prestressed concrete. Beams are not required under machines, sheaves and machinery or control equipment which are supported on floors provided such floors are designed and installed to support the load imposed thereon.

6.2 LOADS ON MACHINERY AND SHEAVE BEAMS, FLOORS OR FOUNDATIONS AND THEIR SUPPORTS

6.2.1 Overhead Beams, Floors and Their Supports Located Directly over Liftwell. Overhead beams, floors and their supports shall be designed for not less than the following loads:

(a) The load resting on the beams and supports which shall include the complete weight of the machine, sheaves, controller, governor and any other equipment together with that portion, if any, of the machine-room floor supported thereon.

(b) Twice the sum of the tensions in all wire ropes passing over sheaves or drums supported by the beams, with the rated load in the car.

Note: The tensions are doubled to include impact and additional stresses due to acceleration and deceleration.

6.2.2 Foundations, Beams and Floors for Machinery and Sheaves Not Located Directly Over the Liftwell. For machines and sheaves 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 loads:

(a) The foundation shall support the total weight of the machine, sheaves and other equipment, and the floor if any.

(b) The sheave beams and the foundation bolts shall withstand twice the vertical component of static tension in all runs of the hoist ropes passing over 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 a horizontal component, if any, of twice the static tension in all runs of the hoist ropes passing over sheaves or drums on the foundation or beams.

(d) The foundation shall withstand twice any upward force or overturning moment developed by the static tension in all runs of the hoist ropes passing over sheaves or drums on the foundation or beams.

6.2.3 Design of Machinery and Sheave Beams or Floors and Their Supports - shall comply with the appropriate design codes listed below:

NZS 4203 - Code of Practice For General Structural Design and Design Loadings for Buildings.

NZS 3404 - Code of Practice For Design of Steel Structures.

NZS 3101P - Code of Practice for Reinforced Concrete Design.

NZSR 32 - Prestressed concrete.

6.3 BEAMS AND FLOORS DIRECTLY SUPPORTING MACHINES OR SHEAVES

Complete plans and specifications for beams and floors which directly support machines, sheaves over which the hoist ropes or governor ropes pass, or control equipment, etc., shall be handed to the Inspecting Engineer Surveyor together with a certificate stating that their design and construction complies fully with NZS 4203 and the relevant design code listed in rule 6.2.3. (see also rule 2.2).

6.4 SECURING OF EQUIPMENT TO THE SUPPORTING STRUCTURES

The fastenings used to attach equipment, (except guide rail brackets which are covered separately under section 20) to the supporting structure shall be designed to withstand seismic forces due to accelerations of 1.5 g (rigidly mounted), 2.5 g (flexible, snubbed) and 4.0 g (flexibly mounted).

Connections between lift machine and lift machine beams and between machine beams and their supports or between lift machine and the floor (where bolted directly), shall be designed for the overturning and bending moments induced in the holding down bolts themselves. Special attention must be paid where anti-vibration mounts are fitted.

The stresses in the equipment and the fastenings shall not exceed the stresses in the appropriate New Zealand standard for the particular material.

6.5 BOLTS, STUDS AND WASHERS FOR SUPPORTING AND OVERHEAD STRUCTURES, CAR FRAMES, COUNTERWEIGHTS AND GUIDE RAIL SUPPORTS.

6.5.1 General. The maximum permissible tensile stresses and safe working loads for bolts and studs shall be those specified in NZS 3404 - Code of Practice for Design of Steel Structures.

There shall be sufficient unthreaded length of bolt to pass through the junction of components being fastened together, or the shear stress calculations shall be based on the area of the bolt at the root of the thread.

6.5.2 Minimum size of bolts. The minimum nominal diameter of bolts used for the structural connections shall be 12 mm.

6.5.3 Washers. Bevelled washers shall be provided for all bolt heads and nuts where the seating would otherwise not be normal to the axis of the bolt. Where nuts are liable to work loose, spring washers, lock nuts or other approved locking devices shall be used.

6.6 CALCULATED DEFLECTIONS OF MACHINERY, SHEAVE AND HITCH BEAMS AND THEIR SUPPORTS

The calculated deflections of machinery and sheave beams and their immediate supports under static load shall not exceed 1/1666 of the span.

6.7 STRENGTH OF BUILDING CONSTRUCTION

The supporting structure of a lift, whether it forms part of a building construction, or is free standing, shall comply with the appropriate design code or codes listed in rule 6.2.3.

SECTION 7 - MACHINE ROOMS

7.1 CONSTRUCTION

Machine rooms shall be enclosed by walls or partitions having a fire resistant rating not less than that required by the New Zealand Building Bylaws. These shall be pierced only to the extent necessary for running clearances required by the lift equipment (see NZS 1900 Chapter 5).

7.2 EQUIPMENT IN MACHINE ROOM

The driving machine control mechanism and all parts of the equipment of a lift (other than those parts which must necessarily be placed elsewhere to perform their function effectively) shall be housed in the machine room.

Piping, conduit ducts or other equipment not associated with the lift installation shall not be installed in a lift machine room (including secondary floor or sheave room), except where for fire protection reasons an automatic fire sprinkler system is installed. The lift installation must then comply with the requirements of rule 25.7.

Where the lift machinery and control equipment are not located at the top of the liftwell, a separate machine room complying with the requirements of this Section shall be provided. This requirement is also to be applied as far as is practicable when the machine room is positioned adjacent to the liftwell. Demountable fire rated partitions are acceptable in this respect, providing they comply with Rule 7.1.

7.3 LIMITATIONS TO THE USE OF THE MACHINE ROOM

A machine room 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. No material of any description shall be stored in a machine room, with the exception of spare parts for lift machinery.

7.4 MACHINE ROOM ENTRANCES

7.4.1 Doors and Locking of Machine Rooms. All entrances to machine rooms shall have a clear opening of minimum height 2000 mm and minimum width 600 mm, and shall be provided with a 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 the key and shall not require a key to open it from within the machine room.

The owner of a lift shall appoint a person to take custody of the keys and be responsible for the machine room door being kept locked.
If the access to the machine room is by way of an area containing other machinery or equipment associated with the operation of the building, the machine room door shall be of the self-closing and self-locking type.

7.4.2 Restrictions to Persons Entering Machine Rooms. The entering of persons to lift machine rooms shall be restricted to Engineer Surveyors and authorised persons. The following notice in permanent characters shall be exhibited in a prominent position adjacent to every machine room door:

DANGER
ENTRY OF UNAUTHORIZED PERSONS PROHIBITED

The word DANGER shall be printed in 50 mm high letters and the remainder of the notice in letters at least 25 mm high.

The notice shall be displayed in such a manner that it is not obscured when the door is in the open position.

7.5 MEANS OF ACCESS TO MACHINE ROOMS

7.5.1 General. Stairways complying with AS 1657, SAA Code for Fixed Platforms, Walkways, Stairways and Ladders shall be provided for access to every machine room from the top floor served by the lift to the machine room floor level.

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

Where the machine room floor is not more than 1250 mm above or below the adjoining floor or roof structure, and is remote from the main access stairs, an inclined rung type ladder complying with AS 1657 may be used.

SECTION 7 - MACHINE ROOMS

7.1 CONSTRUCTION

Machine rooms shall be enclosed by walls or partitions having a fire resistant rating not less than that required by the New Zealand Building Bylaws. These shall be pierced only to the extent necessary for running clearances required by the lift equipment (see NZS 1900 Chapter 5).

7.2 EQUIPMENT IN MACHINE ROOM

The driving machine control mechanism and all parts of the equipment of a lift (other than those parts which must necessarily be placed elsewhere to perform their function effectively) shall be housed in the machine room.

Piping, conduit ducts or other equipment not associated with the lift installation shall not be installed in a lift machine room (including secondary floor or sheave room), except where for fire protection reasons an automatic fire sprinkler system is installed. The lift installation must then comply with the requirements of rule 25.7.

Where the lift machinery and control equipment are not located at the top of the liftwell, a separate machine room complying with the requirements of this Section shall be provided. This requirement is also to be applied as far as is practicable when the machine room is positioned adjacent to the liftwell. Demountable fire rated partitions are acceptable in this respect, providing they comply with Rule 7.1.

7.3 LIMITATIONS TO THE USE OF THE MACHINE ROOM

A machine room 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. No material of any description shall be stored in a machine room, with the exception of spare parts for lift machinery.

7.4 MACHINE ROOM ENTRANCES

7.4.1 Doors and Locking of Machine Rooms. All entrances to machine rooms shall have a clear opening of minimum height 2000 mm and minimum width 600 mm, and shall be provided with a 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 the key and shall not require a key to open it from within the machine room.

Where it is found impracticable to provide stairways complying with AS 1657, stairways at an angle not exceeding 50 degrees and complying with the following requirements may be used.

(a) The angle of inclination of the stairway shall not exceed 50 degrees from the horizontal and the stairway shall be not less than 600 mm clear width between the handrails.

(b) The rise of a stair shall be not less than 220 mm nor more than 250 mm.

(c) The height of rises shall not change unless an intermediate platform not less than 600 mm in length is provided at the change.

(d) The tread shall have a non-slip surface which shall be not less than 200 mm wide for open or closed stair construction with a minimum projected tread of 175 mm.

(e) Every stairway shall be provided with a substantial handrail and midrail on both sides where the stairway is not constructed between adjacent walls; where the stairway is so positioned, one handrail will be acceptable.

Such handrail shall be fixed at a convenient height but not less than 760 mm nor more than 900 mm measured vertically from the nosings. Handrails shall be so supported as to allow unrestricted movement of the hand along its upper surface, and there shall be a hand clearance of not less than 65 mm around the handrail. Handrails shall be continuous on stairways, landings and platforms.

(f) All platforms from which an object could fall a distance of 2000 mm or more, shall be provided with toe boards not less than 100 mm high.

(g) Flights of stairs over 5000 mm slant height shall be provided with intermediate landings.

7.5.2 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 roofs, walkways complying with AS 1657 shall be provided, except where the roof has been designed as a public area.

(b) Where the walkway is over any roof having an unprotected parapet, the walkway shall be provided on both sides with handrails complying with AS 1657.

7.5.3 Lighting of Stairways, Walkways, etc. Stairways, walkways, corridors and any access to machine rooms shall have artificial illumination available at all times.

Stairways shall be provided with illumination not less than 75 lx, and walkways and corridors with not less than 20 lx. The illumination shall be controlled from both ends by either a two-way switch, or by reliable time-delay switching at both ends with an adequate time-delay.

7.6 HEADROOM IN MACHINE ROOMS

There shall be sufficient height in every machine room to enable any portion of the machinery or apparatus to be raised clear for dismantling and in no case shall the clear height from the top of the driving sheave to the underside of the lifting beam be less than one metre.

The minimum headroom from the machine room floor shall be 2000 mm. This clearance shall be over any area that is necessarily used for access to equipment, and shall be measured to any fixtures or projections which may be present, e.g. monorails lighting fixtures, ducts, fire detectors.

7.7 MACHINE ROOM EQUIPMENT-ACCESSIBILITY AND CLEARANCES

7.7.1 General. The machine room shall be of such size as will 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.

7.7.2 Clearance Between Machine and Walls. On at least two sides of the machine there shall be a minimum of 600 mm between any part of the machine and an adjacent wall.

Where there is any part of the machine that requires adjustment, maintenance or inspection on either or both the other two sides of the machine, a clear accessway at least 380 mm wide shall be provided to and between any wall or column or any portion of the building structure, and the item requiring adjustment. Such accessway may be attained by a decking provided at bedplate level.

Where it is not practicable to provide the clearance way specified above, the Inspecting Engineer Surveyor may permit smaller clearances; provided however that there shall be at least sufficient access to permit removal and replacement of the thrust bearing of a geared machine.

NOTES:

1. Accessways to equipment in machine room. A clear accessway at least 450 mm wide shall be provided from the machine room door entrance to the machine, controller, circuit-breaker, motor generator and floor controller or selector.

   A clear accessway at least 380 mm wide shall be available to any main current overtravel switch, governor, or junction box for travelling cables. (See rule 24.11).

2. Clearance adjacent to equipment in machine room. The clear space available adjacent to equipment shall be:

   (a) Floor controller or selectors-1000 mm at the accessway thereto and 380 mm on two other sides. If the accessways to other equipment pass the floor controller or selector, 450 mm should be provided 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-If the operating handle is not on top of the main current over-travel switch or does not face into the accessway a 180 mm clearance shall exist on the handle side.

   If the only access to a governor or machine adjustment is past a main current overtravel switch, 380 mm clearance shall exist on that side of the switch.

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

(e) Governors-

(i) Pawl type-380 mm at accessway side and 180 mm at two other sides. If the only access to a main current overtravel switch or machine adjustment is past this type of governor, 380 mm clearance shall exist at that side of the governor.

(ii) Flyball type-480 mm facing accessway, 380 mm on rope grip jaws side and 180 mm on one other side. If the only access to a main current overtravel switch or machine adjustment is past this type of governor, 450 mm clearance shall exist at that side of the governor.

3. Access to brush gear. Convenient access shall be provided for inspection and maintenance of brush gear. There shall be a minimum clearance of 230 mm between any wall or fixed equipment and the nearest part of the brush gear of any lift machine, driving motor or generator.

7.8 LOADING ON MACHINE ROOM FLOOR (INCLUDING PLATFORMS AND SECONDARY FLOORS)

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

The floor shall be designed to carry a uniformly distributed live load of not less than 5 kPa over the whole area and a concentrated load of 6.7 KN on any square of 0.3 m side. Such floor shall be capable of sustaining any other load which may be imposed on it during periods of normal operation and during dismantling or repair of the lift machine, including those of rule 6.2.1 where applicable.

7.9 HATCHES IN MACHINE ROOM FLOORS

Hatches in machine room floors shall comply with the following requirements:

(a) Covers shall be hinged; provided however that where conditions render the use of hinged covers impracticable, other forms of cover may be used at the discretion of the inspecting Engineer Surveyor.

Loose or detachable covers of single 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) Where a lifting beam is not provided directly above the hatch or hatches, removable covers shall not exceed 70 kg unless alternative mechanical means for lifting are provided.

(c) Hatches shall have flush covers so designed and supported that they can carry a uniformly distributed live load of 5 kPa over the whole area.

(d) Hinges and lifting attachments shall be arranged to eliminate tripping hazards, either by flushing within 3 mm, or by splaying or fairing.

(e) Hatch covers shall have suitable means of lifting, such as eyes, rings, or keys, and shall be situated clear of any access door.

(f) When situated near an access door suitable guarding shall be provided when the hatch is open. This guarding, where practicable, shall be an integral part of or an extension of the hatch cover.

(g) All hatch covers, other than concrete, shall be secured in the closed position when not in use.

7.10 PROTECTION OF FLOOR OPENINGS

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

7.11 DIFFERENCE IN FLOOR LEVELS IN MACHINE ROOMS

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

(a) For differences in level between 300 mm and 600 mm, a step shall be provided.

(b) For differences in level exceeding 600 mm but not exceeding 1500 mm, a guard railing and a ladder or steps in accordance with AS 1657 shall be provided.

(c) For differences in level of 1500 mm or more, a guard railing and a stairway in accordance with AS 1657 shall be provided.

7.12 MACHINE ROOM STOP SWITCH

A stop switch complying with rule 26.7 shall be located in a convenient position 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, if such equipment is -

(i) in a secondary floor space; or

(ii) within any area whose floor is more than 600 mm above or below the floor on which a person would stand to operate the circuit-breaker.

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

If a control-circuit stop switch is provided under this rule for a motor generator set, and if the motor generator set is out of sight of the circuit-breaker, the following notice shall be mounted adjacent to the switch:

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

7.13 PLATFORMS (OTHER THAN MACHINE ROOM FLOORS) AFFORDING ACCESS TO OVERHEAD SHEAVES AND OTHER EQUIPMENT

7.13.1 Access to Sheaves, Dead-ends and other Equipment above Liftwells.

7.13.1.1 Lift Machine above Liftwell. Where the lift machine is above the liftwell, the following provisions shall apply:

(a) For the lubrication of sheaves, safe and convenient access to the lubrioating point shall be available from the machine room, secondary floor or a 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) For the adjustment of dead-end anchorages of multiple-rope lifts, safe and convenient access shall be available from the machine room, secondary floor or a platform unless the adjusting nuts are within safe and convenient reach from and not more than 2000 mm 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) For the repair and/or replacement of sheaves where the sheave is not within the machine room, secondary floor or platform space, special bond-blocks, inserts or permanent brackets shall be provided in the liftwell for the support of temporary staging as required to afford safe access for such work; provided however that such provision is not required for an overhead sheave that can be safely dismantled in the machine room either for attention in the machine room or for lowering down the liftwell.

(d) For the replacement of ropes of multiple-roped lifts, special bond-blocks, inserts or permanent brackets shall be provided in the liftwell for the support of temporary staging, as required to afford safe access to dead-end anchorages, unless these are wholly accessible from the machine room.

7.13.1.2 Lift Machine not above Liftwell. Where the lift machine is not above the liftwell, a platform affording a safe access to sheaves, dead-end anchorages and other necessary equipment shall be installed above the liftwell in all cases except for underslung cars where the centres of sheave shafts and dead-end anchorages are not in excess of 2300 mm from the uppermost landing served.

Where sheave shaft centres and dead-end anchorages are more than 2300 mm above the upper-most landing served, a gallery, either internal or external to the well and with access thereto complying with the relevant parts of this section, shall be provided. When the overspeed governor is not accessible from this access platform or gallery, an access door to the governor complying with the following requirements shall be provided:

(a) The door shall not be installed in the path of movement of any horizontal sliding door.

(b) The door shall provide a minimum clear opening at least 600 mm x 600 mm.

(c) Where practicable the face of the door shall be parallel to the face of the governor sheave.

(d) The door shall be located so that the governor is to one side of the opening, so as to provide a maximum clearance for working on the rope grip device of the governor.

(e) The door shall be locked by a cylinder type lock which is self-locking, and shall be provided with a contact connected in the control circuit. Provision shall be made to lock the doors securely before final contact is made. In opening the door, the electric contact shall be positively opened.

(f) The bottom of the opening shall be level with the base of the governor.

(g) The centreline of the governor shall not be higher than 1500 mm from the nearest floor or platform surface.

7.13.1.3 Devices above Liftwell but not in Machine Room. Platforms or flooring, or other approved access means, shall be provided for access to governors, floor controllers, selectors and similar devices located above the liftwell but not in a machine room. The requirements for access shall comply with the relevant parts of this section.

7.13.2 Extent of Platform or Flooring. The platform or flooring shall fill the entire liftwell when the cross-sectional area of the liftwell is 9 m^2 or less. When the cross-sectional area of the liftwell exceeds 9 m^2, the platform 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 rule 7.10).

7.13.3 Means of Access. Suitable means of access from outside the liftwell shall be provided to all platforms and floorings. Such access shall comply wherever possible with rule 7.4 and 7.5.

Where access is provided from within a machine room to a secondary floor and structural difficulties prevent a stairway being provided, a fixed rung type ladder, complying with AS 1657 and inclined at an angle of between 65 and 75 degrees to the horizontal may be used provided that the following conditions apply:

(i) The vertical height from floor to floor does not exceed 2800 mm.

(ii) A clear space of 600 mm exists between the foot of the ladder and any equipment.

(iii) No obstruction shall be within 760 mm of the foot of a ladder inclined at 75 degrees, increasing proportionately to 960 mm for a ladder inclined at 65 degrees.

(iv) Where equipment is installed in close proximity to the foot of the ladder, the emergency stop switch for such equipment shall be located adjacent to the foot of the ladder. In all cases, stop switches shall be located in a readily accessible position.

Where major equipment such as motor-generator sets and floor selectors are installed in this secondary floor space, a machinery hatch complying with rule 7.9 shall be provided in the machine room or secondary floor space floors, together with suitable lifting means, to facilitate the removal of the equipment when required for maintenance, replacement or repair.

7.13.4 Ceiling Height of Secondary Floors and Platforms. Platforms or secondary floors provided for sheaves and auxiliary equipment for a lift installation shall have a ceiling height of not less than 1700 mm; beams projecting from such ceiling shall have at least 1200 mm clearance from the floor.

However where there is no governor in the secondary floor space, the ceiling height shall not be less than 1370 mm, and the beams projecting from such ceiling, shall have at least 1070 mm clearance from the floor, otherwise alternative access shall be provided.

Where major equipment, such as a motor-generator, selector or floor controller is located in a secondary floor space, a minimum ceiling height of 2000 mm shall be provided where necessary for adequate servicing of such equipment.

7.13.5 Sheave Rooms. Where rooms are provided for the sole purpose of housing sheaves and possibly governor machinery, they shall have a minimum ceiling height of 1700 mm and a minimum door height of 1500 mm. Any beams projecting from the ceiling shall have at least 1200 mm clearance from the floor.

7.13.6 Sheave Room (or Platform) Stop Switch. A stop switch complying with rule 26.7 shall be provided in a convenient position adjacent to sheaves that are located in a sheave room or accessible from a platform.

7.14 LIGHTING OF MACHINE ROOMS (INCLUDING PLATFORMS AND SECONDARY FLOORS)

Permanent electric light shall be provided in all machine rooms and machinery space to illuminate the equipment effectively, including the front and rear of the control panel. The illumination shall be not less than 200 lx measured at floor level and at a distance of 600 mm from any major obstruction such as a machine or control panel. Switches for such lighting shall be installed in the machine room in an accessible position, convenient and adjacent to the entrance.

7.15 PROTECTION OF MACHINE ROOMS AGAINST WEATHER

Every machine room shall be so located as to afford permanent protection against all weather.

Any louvre type openings shall be so constructed and protected as to prevent the ingress of driving rain.

7.16 GENERAL PURPOSE POWER POINT IN THE MACHINE ROOM

At least one general purpose power point shall be provided, conveniently located, in each machine room.

7.17 VENTILATION OF MACHINE ROOMS

7.17.1 General. Every machine room shall have permanent means of ventilation, sufficient to ensure that an adequate volume of air, free of palpable moisture, is passed through the machine room in an effectively distributed manner, to remove heat produced by the equipment and keep the temperature rise of the equipment within designed limits, and to ensure safe and reliable operation of the lift or lifts.

7.17.2 Temperature Limit. The ventilating means shall be such as will limit the temperature, in the working space of the machine room, to a value not more than 8 degrees C above the shade temperature of the outdoor surroundings, having regard to the heat emission from lift machinery and associated equipment and conduction and solar heat gain of the building structure. At no time shall the temperature in the machine room exceed 40 degrees C.

7.17.3 Natural Ventilation. Where a machine room is ventilated by natural means, any doors, windows, etc., that can be closed and any holes communicating between the machine room and liftwell shall not be counted as ventilating means.

If ventilation panels are required they may be of wire mesh. If below a height of 2000 mm, such panels shall be protected by fixed louvres designed to restrict the passage of a 13 mm diameter rod, or they shall be protected with a firmly supported crimped wire mesh of 12 mm X 2 mm diameter or its equivalent.

7.18 MACHINE ROOM LIFTING BEAMS

A beam or beams shall be provided for lifting all machine parts, the beam being adequately fixed and supported.

The special area or areas designated for the temporary storage of machinery, etc., shall be under the run of the lifting beam or beams.

Sufficient clearance shall be allowed for fitting of the hoist and the hoisting of any of the machine components that may need maintenance or repair.

SECTION 8 - MACHINES

8.1 GENERAL

lift machines shall be of a type approved construction.

8.2 TYPES OF DRIVING MACHINES

All driving machines shall be of the traction type, provided however that drum machines may be used subject to the following conditions:

(i) They shall not be provided with counter-weights.

(ii) The rated speed of the lift shall not exceed 0.25 m/s.

(iii) The lift travel shall not exceed 15 m.

8.3 ASSUMED LOADINGS

Lift machine members in bending, shear, tension and compression shall be designed for the actual computed static load coming upon them, with rated load in the lift car. Members subject to torsional stress shall be designed for twice the actual static out-of-balance load with rated load in the lift car, and shall take adequate account of the inertia forces associated with the moving masses of the lift system.

8.4 FACTORS OF SAFETY

The factor of safety used in the design of driving machines shall be based on the loading specified in Rule 8.3 and shall be not less than -

(i) 2 for steel, based on yield stress, if elongation is 14 percent or more in a guage length of 50 mm; 2.5 for steel, based on yield stress, if elongation is less than 14 pecent in a gauge length of 50 mm;

(ii) 2.5 for other ductile metals, based on the yield stress (i.e. those with an elongation of 14 percent or more in a gauge length of 50 mm);

(iii) 5 for grey cast iron in compression and 6 for grey cast iron in tension or bending, both figures based on tensile strength.

Materials of gear teeth shall meet the strength requirements specified in Rule 8.9.2

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 Rule 8.3. Components designed with these factors of safety are normally considered to have adequate reserve strength from the fatigue aspect.

8.5 TRACTION SHEAVES AND DRUMS

8.5.1 Materials. Sheaves and drums shall be of steel or cast iron. The grooves of sheaves may be lined with other materials, provided that in the event of lining failure the rope traction shall comply with Rule 8.15.

8.5.2 Grooving, The sheave or drum shall have machined rope grooves and shall be provided with suitable flanges in compliance with rule 18.1.

8.5.3 Diameter. The diameter of sheave or drum shall comply with the requirements of rule 18.3.

8.5.4 Overhung Sheaves. Where sheaves are overhung there shall be -

(a) effective means to retain the sheave on the shaft independent of reliance on the fit on the shaft;

(b) effective means to prevent the sheave and/or ropes from carrying away in the event of breakage of the shaft or of any rope leaving the sheave;

(c) effective means to prevent the sheave moving more than two rope diameters in the direction of the load, if the shaft fails.

8.6 BOLTS TRANSMITTING TORQUE

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

8.7 THREADS FOR STUDS OR SCREWS IN TENSION

Where internal screw threads are provided in parts of a lift machine, other than nuts, for studs or screws loaded in tension the minimum length of threads in engagement shall be as follows:

(i) in steel, the diameter of the screw or stud;

(ii) in cast iron, 1.5 times the diameter of the screw or stud;

(iii) in other materials permitted by these Rules such length of thread in engagement as will ensure the failure of the screw or stud before failure of the internal thread.

8.8 SHAFTS

8.8.1 **Strength.** The torsional, bending or shear stress in any shaft, each taken separately and not in combination, shall afford a minimum safety factor as specified in rules 8.3 and 8.4.

8.8.2 **Fillets.** Where shafts are stepped (i.e. where there is a change in diameter), fillets shall be provided so as to minimise fatigue effects from excessive concentration of stresses in the shaft.

Where a shaft is stepped to afford an abutting face for a ball or roller bearing, the fillet provided shall not be less than the maximum practicable to accommodate the radius of the inner bearing race.

All fillets shall be smooth and free from machining marks.

NOTE: In the application of this section, due regard must be given to practical experience in the provision of fillets to counter fatigue, particularly for those shafts having torsional stresses in combination with alternating bending stress.

Where it is established that reduction of stress concentration cannot be affected to a sufficient extent by means of fillets alone, the Chief Engineer Surveyor may require compensating provisions by increasing the factor of safety of the smaller diameter portion of the shaft or by other means.

8.8.3 Keys

Keys and keyways shall conform to the dimensions and fits laid down for parallel keys in BS 46, Part 1, Keys and Keyways; provided however that where the dimensions specified in BS 46 are not applicable in any particular design, keys and keyways may be made to other dimensions, provided also that the keys are not mechanically inferior to those which would be used under BS 46 for the forces to be transmitted.

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

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

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

8.8.4 Fit. The fit of a shaft in a member rotating with it shall be an interference fit type H7-t6 in accordance with the requirements of BS 4500, ISO Limits and Fits and AS 1654, Limits and Fits for Engineering.

8.9 GEARS

8.9.1 Material. Worms and worm gears made of cast iron or brass shall not be used in lift machines.

8.9.2 Design. All gears in a lift machine shall comply with the requirements of AS B66 or BS 721 Worm Gearing, and AS B61 or BS 436 Machine Cut Gears, A-Helical and Straight Spur, as appropriate, provided that in any case they shall be designed in strength for a minimum of twice the actual static out-of-balance load on the machine, and shall take adequate account of the inertia forces associated with the moving masses of the lift system.

8.9.3 Gear-case Oil Level. Means shall be provided to ascertain readily the oil level in gear cases.

8.10 BEARINGS

Gear cases shall be provided with suitable journal and thrust bearings. Medium and high speed bearings shall be of the ball, roller, sleeve or other replaceable type. Ball and roller bearings shall be arranged in dustproof housings and provision made for effective lubrication.

(ix) After the brake springs have been adjusted so that the brake stops the descending car when tested for compliance with foregoing paragraph (ii), a marker hole shall be drilled behind the locking nut, after the brake has been adjusted to hold at least 125 percent of the rated load. The nut and lock nut shall be on the spring side of this marker hole at all times. A split pin shall be provided in the marker hole.

8.12 FLAT BELT AND CHAIN DRIVES

Flat belt and chain driven machines shall not be used.

8.13 V-BELT DRIVEN MACHINES

8.13.1 Speed. V-belt driven geared machines may be used provided the rated speed of the car does not exceed 1.75 m/s.

8.13.2 Electrical Protection. A switch shall be fitted to the speed governor of a lift having a V-belt driven machine and shall be so arranged that it will stop the lift if the car exceeds the rated speed by more than 20 percent in either direction of travel; provided however that such a switch is not required if the travel is 5.5 m or less, and the machine has a single start worm.

8.13.3 Minimum Number of Belts. The minimum number of V-belts in any drive shall be three.

8.13.4 V-belts and Sheaves. All V-belts and sheaves shall in all respects comply with AS 1215 or BS 1440, Endless V-belt Drives, and the power correction factor shall be not greater than 0.5.

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

8.14 MAXIMUM SPEED

The maximum speed of a lift machine shall not exceed its rated speed by more than 10 percent under normal working conditions.

8.15 ROPE TRACTION

The following conditions shall apply with respect to rope traction:

(i) The driving sheave grooves of all traction driven machines shall provide adequate traction to the hoist ropes and in particular so as to safely lower at full speed the car loaded with 125 percent rated load and make a normal stop at the lowest landing with negligible rope slip; also, with the empty car running up at full speed, make a normal stop at the top landing without rope slip.

(ii) The tractive effect between driving sheave and hoist 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 lock-down 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 counter weight have been landed on their respective buffers.

Where lock-down compensation is used, no test is necessary.

8.16 EMERGENCY HAND WINDING

Driving machines shall be provided with emergency hand winding facilities, and with brake release means as in rule 8.11(viii), 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:

(i) By the mounting of the device on the machine.

(ii) By the removal of some part of the machine, to allow the device to be mounted.

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TOP AND BOTTOM CLEARANCES AND RUNBYS

APPLICABLE TO DIRECT ACTING RAM OIL HYDRAULIC LIFTS

The clearance and runbys for direct acting ram hydraulic lifts shall comply with the following:

Car bottom clearance. The car bottom clearance shall be as given in rule 9.1 of the Power Lift Rules 1978.

Car bottom runby. The distance the car can travel below the bottom terminal landing before resting on fully compressed buffers shall be, for spring or solid buffers:-

(1) not less than 75 mm or more than 600 mm for rated speeds not exceeding 0.50 m/s.

(2) not less than 150 mm or more than 600 mm for rated speeds exceeding 0.5 m/s.

Car top clearance. The clearance above the car at the top shall be as given in rule 9.3 of the Power Lift Rules 1978 except that the formulae given in 9.3.1 and 9.3.2 shall be:-

9.3.1. $C = TR + 600$)
9.3.2. $A = TR + 760$) where TR = Top runby

Car top runby. The distance the car can travel above the top terminal landing before reaching the limit of the ram stroke shall not be less than 75 mm or more than 600 mm.

SECTION 9 - TOP AND BOTTOM CLEARANCES FOR CARS AND COUNTERWEIGHTS

9.1 CLEARANCE AT BOTTOM OF CAR

When the car rests on its stops or fully compressed buffers there shall be vertical clearances (see Fig 9.1.1) at the bottom of car as follows:

(i) Mechanical clearance. The mechanical clearance shall be not less than 50 mm between any fitting attached to the car and the floor of the pit.

(ii) Man clearance. The man clearance shall be not less than 600 mm between the pit floor and the buffer striker plate, or the guards of underslung car sheaves, or the lowest mechanical part, equipment or device installed beneath the car platform. This clearance shall be maintained over the whole car area except for -

(a) guide shoes or rollers and safety gear components;

(b) platform aprons, guards or other equipment located within 300 mm measured horizontally from the sill line of any lowest floor entrance;

(c) cams, side braces, their end attachements, or other items located within 150 mm horizontally from the perimeter of the car platform;

(d) at compensation or tape sheaves, buffer supports and their steady brackets.

A minimum crouching or standing space for man 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 by 450 mm wide by 600 mm high, provided however that if the length of 1370 mm is not available the space shall be not less than 600 mm long by 500 mm wide by 1290 mm high. Where the attachment of travelling cables unavoidably occurs in this man clearance space, the height shall be measured from the lowest part of the cable support.

Where the crouching space of 1400 mm by 500 mm floor area is not provided, then the standing area shall be clearly outlined or otherwise indicated.

9.2 CAR BUFFER CLEARANCE

The car buffer clearance when the car floor is level with the bottom landing shall be -

(i) for oil buffers - not less than 230 mm nor more than 600 mm;

(ii) for spring buffers - not less than 300 mm nor more than 600 mm.

9.3 CLEARANCE OF CAR AT TOP LANDING

9.3.1 Top Car Mechanical Clearance. The clearance between any equipment mounted on the top of the car which is not more than 300 mm inside the perimeter of the car roof (other than guide shoes) and the nearest obstruction overhead, measured vertically, shall be not less than (see Fig. 9.3.1) -

For traction machines :

$$C = m + d + Y + 150$$

For drum machines :

$$C = OS + 600$$

where

C = mechanical clearance, in mm, when the car platform is level with the top landing

m = maximum allowable counterweight buffer clearance, in mm, as in rule 9.4

d = counterweight buffer stroke that is provided, in mm

Y = allowance for car jump

= $S-S_2$ (which shall not be less than zero)

where S = buffer stroke in accordance with Table 10.5 for oil buffers, and with Table 10.4 for spring buffers, provided however that 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

S_2 = half the stroke of the counterweight buffer used

OS = overtravel to fixed stop for drum drive lifts, which shall be not less than 300 mm or more than 460 mm.

9.3.2 Top Car Man Clearance. Except for overhead diverter sheaves under conditions prescribed in rule 9.3.3 the clearance measured vertically between the crosshead and the nearest overhead obstruction within 450 mm measured horizontally to the nearest part of the crosshead excluding guide shoes or rollers shall be not less than (see Fig. 9.3.1.)

For traction machines:

$$A = m + d + Y + 760$$

For drum machines:

$$A = OS + 1200$$

where

A = top car clearance, in mm, when the car platform is level with the top landing

m = maximum allowable counterweight buffer clearance, in mm, as in sub-section 9.4.

d = counterweight buffer stroke that is provided, in mm

Y = allowance for car jump

= $S - S_2$ (which shall not be less than zero)

where S = buffer stroke in accordance with Table 10.5 for oil buffers, and with Table 10.4 for spring buffers, provided however that 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 of the compensator sheave

S_2 = half the stroke of the counterweight buffer used

OS = overtravel to fixed stop for drum drive lifts, which shall not be less than 300 mm or more than 460 mm

Where there is a projection below the ceiling of the well, e.g. a beam or a sheave not covered by rule 9.3.3, and the projection is more than 500 mm measured horizontally from the nearest part of the crosshead, a clearance of not less than A between that projection and the roof of the car shall be also maintained in addition to the clearance specified above (See Fig. 9.3.2.).

9.3.3 Top of Car Clearance for Overhead Diverter Sheaves. Where the nearest overhead obstruction within 500 mm, measured horizontally to the nearest part of the crosshead, is the rim of an overhead diverter sheave, the clearance A specified in rule 9.3.2, measured vertically between the lower edge of the sheave rim and the crosshead, may be reduced by 20 mm for each 10 mm of distance measured horizontally between the sheave rim and the nearest part of the crosshead, if all the following conditions are fulfilled (see Fig. 9.3.3.):

(a) The sheave shaft is within 10 degrees of parallel with the crosshead.

(b) The shaft or bearings do not protrude more than 175 mm from the side of the diverter sheave.

(c) Full clearance equal to A exists vertically between the lower edge of the sheave rim and the car top when the car platform is level with the top landing.

9.4 COUNTERWEIGHT BUFFER CLEARANCE

Upon acceptance tests of a lift, the counterweight buffer clearance shall be not less than 230 mm nor more than 460 mm for oil buffers and not less than 300 mm nor more than 460 mm for spring or solid buffers, plus an allowance for rope stretch in accordance with the following formula:

$$R = 6.5\ LM$$

where

R = rope stretch, in mm

L = length of hoist ropes, in m, measured between terminations

M = 1 for 1 : 1 roping
0.5 for 2 : 1 roping
0.33 for 3 : 1 roping
0.25 for 4 : 1 roping

If top car clearances exceed the minimum calculated in accordance with rules 9.3.1 and 9.3.2 then a similar length block or blocks not more than this excess distance may be provided between the counterweight and buffer, to assist in the adjustment for rope stretch.

NOTE: For rises over 150 m, consideration can be given to making an allowance for total rope stretch which need not exceed 1200 mm.

9.5 CLEARANCE AT TOP OF COUNTERWEIGHT

The clearance at the top of the counterweight when the car floor is level with the bottom terminal landing (see Fig. 9.5) shall be not less than that determined by the following formula:

$$f = h + i + j + Y$$

where

f = distance, in mm, from the highest portion of the counterweight, e.g. the frame, guide shoes or counterweight sheave to the nearest obstruction directly above it when the car is level with the bottom terminal landing

h = maximum allowable car buffer clearance, in mm (see rule 9.2)

i = stroke of car buffer that is provided, in mm

Y_1 = allowance for counterweight jump

$= S - S_1$

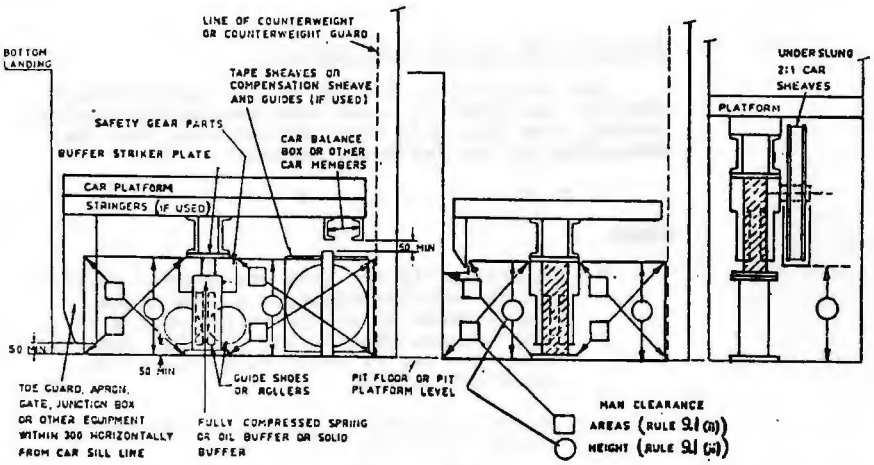
where S = buffer stroke in accordance with Table 10.5 for oil buffers and with Table 10.4 for spring buffers, provided however that Y_1 may be omitted where oil buffers are used and provision is made to prevent jump of the counterweight at car buffer engagement, e.g. by locking down of the compensator sheave

S_1 = half the stroke of the car buffer used

j = 150 mm for traction machine.

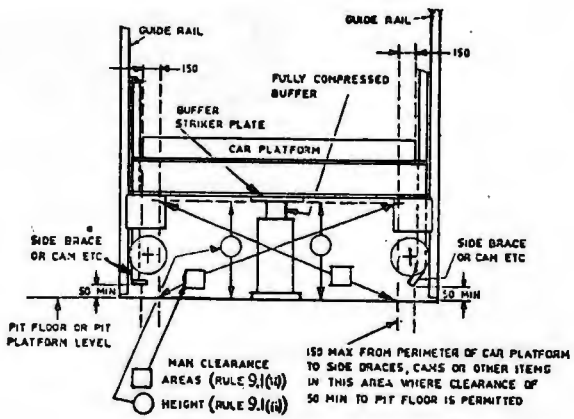
9.6 CLEARANCE AT BOTTOM OF COUNTERWEIGHT

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



(a) General conditions: medium and large lift cars (b) General conditions: light duty and small lift cars (c) General conditions underslung lift cars

SIDE VIEWS

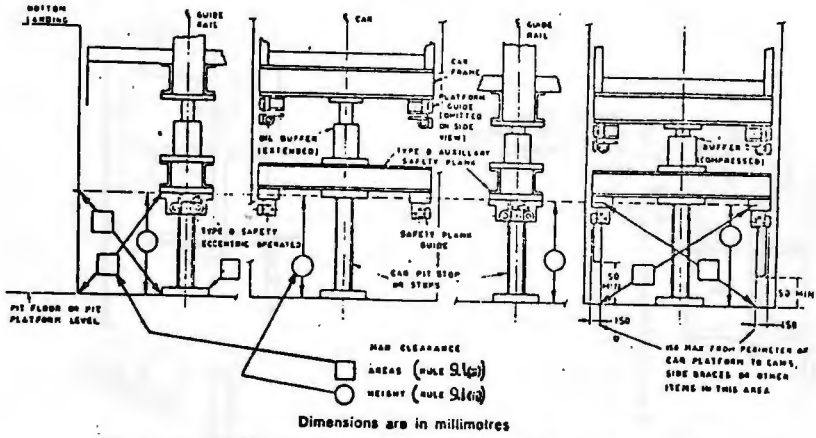


(d) General conditions: all types of lift cars

FRONT VIEW

Dimensions are in millimetres

Fig. 9.1.1. BOTTOM CAR CLEARANCES—TYPES A, B AND C SAFETY GEAR



Dimensions are in millimetres

Fig. 9.1.2. BOTTOM CAR CLEARANCES—TYPE D SAFETY GEAR

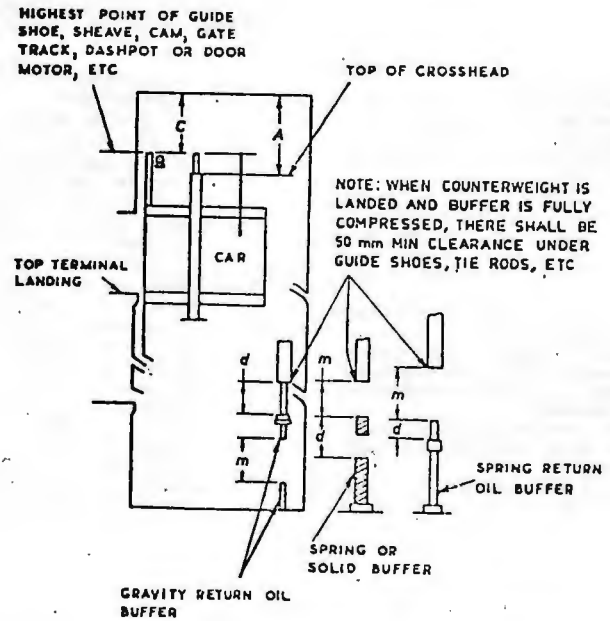


Fig. 9.3.1. TOP CAR CLEARANCES FOR ROPE SUSPENDED LIFTS; ALSO BOTTOM COUNTERWEIGHT CLEARANCE

(For legend see Rule 9.3.1)

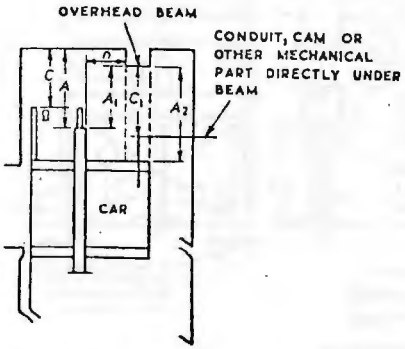


Fig. 9.3.2. TOP CAR CLEARANCES WHERE OVERHEAD BEAM PROTRUDES BELOW LIFTWELL CEILING

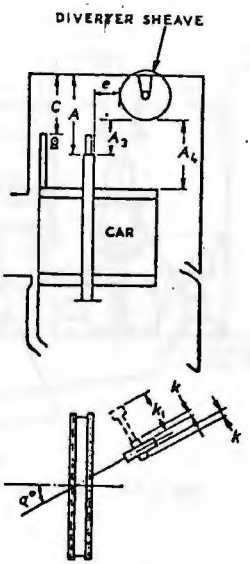


Fig. 9.3.3. TOP CAR CLEARANCES WHERE OVERHEAD DIVERTER SHEAVE PROTRUDES BELOW LIFTWELL CEILING

Legend (see also Rule 9.3.2):

n = distance measured horizontally between overhead beam and crosshead

If n is 500 mm or less, then A_1 shall be not less than A, and C_1 not less than C

If n is greater than 500 mm then A_1 may be ignored, but A_2 shall be not less than A, and C_1 not less than C

A_1 = distance measured vertically from lowest part of overhead beam to top of crosshead

A_2 = distance measured vertically from lowest point of beam to car roof

C_1 = mechanical clearance measured vertically from underside of beam to conduit, cam or other car member mounted directly under the beam

e = distance measured horizontally between rim of diverter sheave and nearest part crosshead

If 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—

(i) $\alpha°$ is not more than 10°

(ii) k is not more than 175 mm

If $\alpha°$ is more than 10°, A_3 shall be not less than A; if k is more than 175 mm refer to legend for k_1 below

If 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

$\alpha°$ = angle that sheave axis is out of parallel with crosshead

k = distance sheave bearing brackets or shaft protrudes from side face of sheave

k_1 = for conditions when shaft extension is more than 175 mm the vertical clearances for shaft or brackets are to be established as for overhead beams (see Rule 9.3.2).

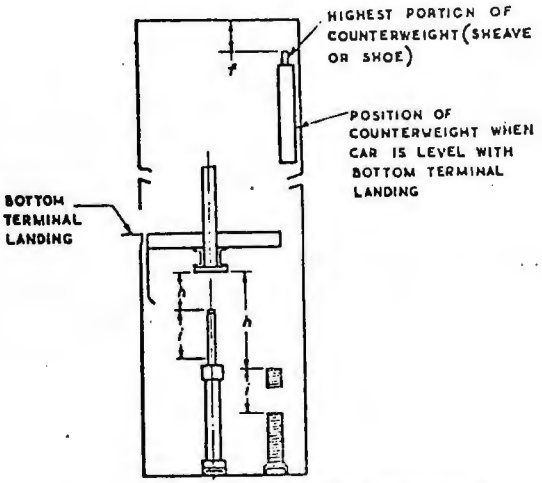


Fig. 95. TOP COUNTERWEIGHT CLEARANCES
(For legend see Rule 9 5)

SECTION 10 - BUFFERS AND STOPS

10.1 PROVISION OF BUFFERS

For the purpose of stopping the lift in the pit, stops or buffers shall be provided for the car and counterweight of all lifts in accordance with the requirements of Table 10.1.

TABLE 10.1
TYPES OF STOPS AND BUFFERS

Rated speeds of car or counterweight m/s	Minimum buffer requirement
Not exceeding 0.4	Solid buffers or impact absorbing stops
Exceeding 0.4 up to 1.0	Spring buffers or oil buffers
Exceeding 1.0	Oil buffers

10.2 LOCATION OF BUFFERS

Buffers or stops shall be located in the pit symetrically with reference to the vertical centre-line of the car or counterweight frame within a tolerance of 50 mm.

10.3 CONSTRUCTION AND REQUIREMENTS FOR SOLID BUFFERS

Solid buffers shall be made of wood or other suitable resilient material 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 used shall be of a type which will resist deterioration or shall be so treated as to resist deterioration.

10.4 CONSTRUCTION AND REQUIREMENTS FOR SPRING BUFFERS

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

10.4.2 Stroke. The stroke of the spring buffer as marked on the buffer rating plate shall be equal to or greater than that shown in Table 10.4.

TABLE 10.4

MINIMUM STROKE OF SPRING BUFFERS

Rated car speed m/s	Minimum stroke mm
Exceeding 0.4 up to 0.5	38
Exceeding 0.5 up to 0.75	63
Exceeding 0.75 up to 1.0	100

10.4.3 Load Rating. All spring buffers for cars shall be so designed that they are at or near the fully compressed state when supporting a static load of not less than twice nor more than three times the sum of the rated loads plus the weight of the car.

All spring buffers for counterweights shall be so designed that they are at or near the fully compressed state when supporting a static load of not less than twice nor more than three times the mass of the counterweight.

10.5 CONSTRUCTION AND REQUIREMENTS FOR OIL BUFFERS

10.5.1 Rating Plate. Every installed oil buffer shall have securely attached thereto a metal plate, marked by the manufacturer in a legible and permanent manner, including -

(a) the maximum and minimum loads and the maximum striking speeds for which the buffer may be used in conformity with the requirements of these Rules;

(b) the make and grade of oil to be used;

(c) the buffer stroke in millimetres.

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

(a) The average retardation shall be 9.80 m/s^2 when the car or counterweight strikes the buffer at 115 percent of rated speed. Table 10.5 indicates the minimum buffer strokes (gravity stopping distances) related to values of 115 percent of the most usual rated speeds.

TABLE 10.5

MINIMUM STROKE OF OIL BUFFERS

Rated speed m/s	115 percent of rated speed m/s	Minimum stroke mm
1.00	1.15	67
1.125	1.294	85
1.25	1.44	105
1.5	1.725	152
1.75	2.00	207
2.00	2.30	270
2.25	2.588	342
2.50	2.875	422
3.00	3.45	607
3.50	4.025	827
4.00	4.60	1080
4.50	5.175	1366
5.00	5.75	1687
5.50	6.325	2041*
6.00	6.90	2429*
6.50	7.475	2851*
7.00	8.05	3306*
7.50	8.625	3795*

*For rated speeds in excess of 5 m/s, an emergency terminal speed limiting device (see Rule 27.4) may be used in conjunction with a buffer having a reduced stroke as allowed by Rule 10.5.2(b).

(b) Where an emergency terminal speed limiting device complying with Rule 27.4 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 at least 115 percent of such reduced striking speed and on an average retardation not exceeding 9.8 m/s^2. In no case shall the stroke used be less than the greater of 1740 mm and 50 percent of the stroke required in (a) above.

10.5.3 Retardation. The maximum retardation developed shall not exceed 24.5 m/s^2 over a period exceeding 0.04 s with any load in the car from rated load to a minimum load of 68 kg when the buffers are struck at an initial speed of not more than -

(a) 115 percent of rated speed for buffers conforming to rule 10.5.2(a).

(b) 115 percent of the predetermined reduced speed for buffers conforming to rule 10.5.2(b).

10.5.4 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) 3 for materials having an elongation of 20 percent or more in a gauge length of 50 mm.

(b) 3.5 for materials having an elongation of from 15 to 20 percent in a gauge length of 50 mm.

(c) 4 for materials having an elongation of from 10 to 15 percent in a gauge length of 50 mm.

(d) 5 for materials having an elongation of less than 10 percent in a gauge length of 50 mm, except that cast iron shall have a factor of safety of 10.

10.5.5 The slenderness ratio (L/R) for Members of Oil Buffers under Compression as Columns. The L/R ratio of members of oil buffers under compression as columns shall be not more than 80.

10.5.6 Plunger-Return Requirements. Oil buffers shall be so designed that:

(a) The buffer plunger of gravity-return and spring-return type oil buffers shall, when released after full compression, return to its fully extended position within 90 s.

(b) The plunger of a spring-return type oil buffer with a 9 kg weight resting on it shall, when released after being depressed 50 mm, return to the fully extended position within 30 s.

10.5.7 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.

10.5.8 Approval of Oil Buffers. (Refer to last paragraph of Rule 2.6). Oil buffers shall be approved by the Chief Engineer Surveyor. Such approval shall be based on the following:

(a) The buffer shall be approved on the basis of the type tests specified in Part 5 made by an approved testing laboratory equipped to make such tests, or by the manufacturer and witnessed by an Engineer Surveyor. Tests shall be made on the buffer of the longest stroke of each type or design to be approved and having the following oil portings:

(i) The porting having the range of the maximum loads for which the buffer is designed.

(ii) The porting having the range of the minimum loads for which the buffer is designed.

The firm or person installing the buffer shall submit to the Chief Engineer Surveyor an authentic copy of the test certificate conforming to the requirements of Part 5 of these rules.

(b) Oil buffers of the approved type or design and having a stroke greater than the minimum required by rule 10.5.2 above may be used and the maximum and minimum load ratings increased, subject to the requirement that the installer certifies on the plans and specifications submitted to the Chief Engineer Surveyor that the maximum retardation of the buffers used will conform to the requirements of rule 10.5.3. In no case shall the forces to which the buffers are subjected exceed those developed in the laboratory tests.

10.6 BUFFER OIL REQUIREMENTS

Oils used in oil buffers shall have a pour point of - 17.8°C or lower (as defined in ASTM D97-66), and a viscosity index of 75 or higher (as defined in ASTM D2270-64).

10.7 PERMANENT STOPS FOR DRUM DRIVE LIFTS

Structural overhead stops shall be provided over the car crosshead and shall be equally spaced either side of the car hitch or 2 : 1 car sheave. The car crosshead shall contact the stops before any other car-mounted equipment meets an overhead obstruction and at engagement the car shall be maintained level without leaving the car guides. Stops and their supports shall have sufficient strength to withstand the total breaking strength of the car-to-drum hoist ropes.

SECTION 11 - PITS

11.1 PROVISION OF PITS

A pit shall be provided at the bottom of every lift well for every power lift. The pit shall extend over the entire area of the lift well.

11.2 PIT FLOORS

The floor of the pit shall be approximately level (sufficient slope shall be allowed for drainage), except for the unavoidable projection into the pit of portions of structural footings.

The floor of the pit shall be capable of withstanding all expected loadings.

11.3 PIT MAINTENANCE

Pits shall be maintained in a clean and dry condition.

11.4 GUARDS BETWEEN ADJACENT PITS

Guards of substantial steel construction, not less than 1800 mm high, at any point between pits, shall be provided between adjacent pits. Where wire mesh, etc., is used the openings shall not exceed 50 mm. The guards may be omitted where the clearance between the underside of the car frame, when resting on the fully compressed buffer, and the bottom of the pit is not less than 2150 mm, and provided that where counterweights are located between pits they shall be guarded on the side away from the lift they serve, even though they may have compensating ropes or chains.

11.5 ACCESS TO PITS

11.5.1 General. Safe and convenient access shall be provided to all pits. Access may be by means of a separate pit access door or from the bottom landing door. Each pit of multiple lift installations shall have a separate means of access except where a separate pit access door is provided and guards between pits are not required (see rule 11.4).

11.5.2 Access Doors. Where the access to the pit is by way of a separate pit door, the door shall comply with the following requirements.

(a) the door way shall not be less than 2000 mm high or less than 600 mm wide (clear opening)

(b) the door shall be self-closing and locking, and shall be provided with a contact connected in the control circuit. Provision shall be made to lock the doors securely before final contact is made. In opening the door, the electrical contact shall be positively opened (see rule 26.1.16).

(c) the full height of the door shall be unobstructed by either of the adjacent cars when resting on the fully compressed buffer.

(d) where the difference in height between adjacent pit floors or the depth below the sill of the pit access door to the pit floor exceeds 600 mm a ladder shall be provided between the levels. The ladder shall comply with rule 11.5.3.

11.5.3 Access from the Bottom Landing Doors. When access to the lift pit is obtained from the bottom landing door, then each lift pit shall be provided with a permanent fixed access ladder of non-combustible material in accordance with rules 11.5.3.1 and 11.5.3.2.

11.5.3.1 Ladder Mounted on Side of Liftwell (at right angles to sill line). Access ladders mounted at right angles to the sill line shall comply with the following requirements:

(a) Ladders shall be accessible from the bottom landing of every lift.

(b) Ladders shall extend not less than 1150 mm above the sill of the landing door, or hand grips shall be provided to the same height. The hand grips shall be mounted above the centreline or above both sides of the ladder.

(c) Ladder width between stiles shall be not less than 380 mm; provided however that the width may be reduced to a minimum of 300 mm where structural difficulties obtain.

(d) Rungs shall extend to the height of the top of the stiles.

(e) Rungs shall be spaced not less than 250 mm nor more than 300 mm apart and there shall be a rung approximately at the level of the lowest landing door sill.

(f) The minimum clearance behind ladder rungs shall be 100 mm.

(g) The minimum clearance at the sides of stiles shall be 65 mm.

(h) Stiles of mild steel shall have cross-sectional area of not less than 480 mm^2 and shall be not less than 50 mm wide and not less than 6 mm thick or, if of tube, shall be not less than 40 mm and not more than 60 mm outside diameter. Other metals may be used provided the stile is of equivalent strength to the mild steel stile. All stiles shall be securely fastened to supports.

(i) Rungs of mild steel shall be solid and not less than 20 mm diameter. The rungs shall be securely fastened to the stiles. In corrosive areas the rungs shall be completely sealed at the point where they enter into or contact the stiles. The point of attachment to the stile shall be smooth and free from projections liable to cause damage to the hands.

(j) The ladder shall be secured at intervals of not more than 3500 mm where flat metal stiles are used. For other types of stile the design of the ladder shall determine the distance apart of fastenings. The fastenings should be on the back of rung-type ladders and should be designed to provide the necessary hand clearance.

11.5.3.2 Ladder Mounted on Front Face of Liftwell (parallel to sill line). Where the distance from the inside edge of the landing door jamb to a ladder stile would result in more than 900 mm if the ladder were located on the side of the liftwell (e.g. centre-opening doors), then consideration should be given to a ladder mounted to the front face of the liftwell.

When a ladder is mounted on the front face of the liftwell, the requirements of rule 11.5.3.1(c), (d), (e), (i) and (j) shall be met and, in addition, the ladder shall comply with the following requirements:

(a) The ladder shall be located so that the horizontal distance to the ladder stile from the inside edge of the landing door jamb shall be not more than 750 mm.

(b) The ladder shall extend at least 1150 mm above the sill line, but may be further extended to provide an easy reach to door locks, etc.

(c) There shall be a minimum clearance of 6 mm between the stile and the landing door, and a minimum clearance of 40 mm between the inside of the rungs and the landing door when open. The ladder shall be positioned so as not to reduce the minimum clearances specified in rule 15.1.2.

(d) There shall be a minimum clearance of 100 mm behind ladder rungs which are located below the landing sill and a minimum clearance of 75 mm behind ladder rungs in all other places.

(e) Ladder rungs shall be so positioned in relation to the sill line as to obtain one rung not less than 125 mm nor more than 175 mm below the sill and one rung not less than 75 mm nor more than 125 mm above the sill.

(f) The landing door sill extension shall be cut back to at least the inside line of the open landing door to reduce interference with hands when gripping the rungs.

(g) Ladder stiles shall be so designed as to discourage their use as hand grips.

11.6 LIGHTING OF PITS

The pit of each lift shall be provided with at least one 100W incandescent or 40W fluorescent light to provide general illumination of the pit. The light fitting shall be protected against possible accidental damage. The switch for the light shall be located at the normal entrance to the pit.

11.7 PIT STOP SWITCH

A pit stop switch, complying with rule 26.7 shall be installed in the pit of every lift. The switch shall be located at the normal entrance to the pit.

11.8 MINIMUM DEPTH OF PITS

The pit depth shall be not less than is required for the installation of the buffers, compensating sheaves, if any, and all other lift equipment to be located therein, and to provide the minimum clearance at bottom of car (see rule 9.1) the minimum car buffer clearance (see rule 9.2), and the minimum counterweight buffer clearance (see rule 9.4).

11.9 DRYNESS OF PITS

Every pit shall be constructed and designed to be waterproofed before installation of the lift equipment by the use of tanks, membranes or other positive means, and shall have a covered sump located therein. Such cover shall be of a non-slip type, and shall not be easily displaced. The sump shall not be connected to any closed drainage system, but may connect into an open ended drain which is below the sump level and which cannot be flooded. The drain shall be designed to cope with all the water that may enter the lift pit in emergency situations.

If the drain is of an insufficient capacity for this purpose or if no drain is provided, then suitable pumps of an adequate capacity shall be installed. Any pump so installed outside the liftwell shall be effectively partitioned from the liftwell, and shall have separate access for maintenance. The level of any external sump shall be such that water cannot flow back into the liftwell.

Drains shall not be run into pits.

NOTE: Pumps should be of a type which do not rely on valves or priming of a suction line for effectiveness.

11.10 POWER POINT IN PIT

Every lift pit shall be fitted with an electrical power point.

11.11 PITS NOT EXTENDING TO THE LOWEST FLOOR OF THE BUILDING

Where the space below the liftwell is used for a passageway or may be occupied by persons, or if unoccupied is not secured against unauthorized access, cars and counterweights shall comply with the following requirements.

(i) Counterweights shall be provided with safety gear complying with rule 29.5 except where their buffers are located on an abutment which extends down to solid earth.

(ii) The cars and counterweights shall be provided with spring or oil buffers meeting the requirements of rules 10.4 and 10.5, as appropriate, except that when spring buffers are used they shall

not be fully compressed when struck by the car with its rated load or by the counterweight at 125 percent of rated speed or at governor tripping speed where a governor-operated safety gear is used.

(iii) Car and counterweight buffer supports shall be of sufficient strength to withstand, without permanent deformation, the impact resulting from buffer engagement at governor tripping speed, or at 125 percent of rated speed where no governor is provided.

NOTES: Impact on Buffer Supports.

1. Oil buffers. The following formulae give the buffer reaction and the impact on the car and counterweight oil buffer supports resulting from buffer engagement:

$$R = M \left(g + \frac{v^2}{2S} \right)$$

$$P = 2R$$

2. Spring buffers. The following formula gives the buffer reaction and the impact on the supports of car and counterweight spring buffers which do not fully compress under the conditions outlined in subsection 11.11(ii):

$$R = 2M \left(g + \frac{v^2}{2S} \right)$$

where

R = buffer reaction, in N
P = impact, in N
M = mass of car plus rated load, in kg
v = speed, in m/s, at impact
S = buffer stroke, in m
g = 9.8 m/s^2.

11.12 SAFE ACCESS TO ELEVATED EQUIPMENT IN THE LIFT PIT AND ON THE UNDERSIDE OF THE CAR

Where the pit floor is more than 2500 mm below the bottom lift landing, or where the means of checking the oil level in oil buffers is more than 2000 mm above the pit floor, means of access shall be provided to elevated equipment within the general guidelines of AS 1657 SAA code and to the satisfaction of the inspecting Engineer Surveyor.

SECTION 12 - LIFTWELL ENCLOSURES

12.1 CONSTRUCTION

Liftwells shall be completely enclosed, (except for landing doors, emergency doors and pit access doors) from the bottom of the pit to the ceiling of the well.

Enclosures shall be made of non-brittle material. The fire-resistant rating of enclosures and doors shall be not less than that required by the New Zealand Building Bylaws.

12.2 STRENGTH

Enclosures shall be so supported and braced as to deflect not more than 25mm when subjected to a force of 450 N applied horizontally on any square of 50 mm side. Enclosures shall not deflect into the minimum running clearance allowed between the lift car or counterweight and the enclosure.

The liftwell enclosure adjacent to the landing openings and the structure supporting the doors and their locks shall be of sufficient strength to support in true alignment the landing doors with their operating mechanisms and locking devices when these are subject to a seismic acceleration of 1.0g in any horizontal direction.

12.3 LIFTWELL VENTILATION

Lift installations having a travel of over four floors or 15 metres whichever is the lesser shall conform with this Rule.

12.3.1 Construction. Each liftwell (see definition of liftwell Rule 3.75) shall be provided with an independent means of venting smoke and hot gases either directly through a vent to the outer air or through fire-resistant ducts and a vent to the outer air in case of fire. The vents shall not be in the form of permanent openings.

12.3.2 Area. The area of the vents shall not be less than 3.5 percent of the area of the liftwell nor less than quarter of a square metre, whichever is the greater.

12.3.3 Control.

(i) Remote means for opening and closing the vents (under normal and emergency power supply conditions) shall be provided on the main floor.

Note: Manually operated controls may be accepted in suitable moderate rise installations provided details are submitted in advance to the local Marine Division office and approved by the Inspecting Engineer Surveyor. They shall be assessed for their qualities of effectiveness, reliability, and accessibility.

(ii) These controls shall be situated adjacent to the "Emergency Fire Recall Switch) (see Rule 25.6.2(a)).

(iii) Access to the control or the operation of the control shall be by means of the same key which is used to operate the "Emergency Fire Recall Switch".

(iv) Liftwells which are situated together may have a common control.

(v) Liftwells which are situated apart shall have independent controls.

12.3.4 Location.

Vents to the outside air shall be located:

(i) In the side of the liftwell enclosure at the top of the liftwell, or

(ii) In the wall or roof of the penthouse or overhead machinery space above the top of the liftwell.

Note: If not vented directly from the liftwell to the outside air then fire-resistant ducts shall be provided see Rule 12.3.1.

12.3.5 Responsibility. The responsibility for maintaining and demonstrating to the Inspecting Engineer Surveyor that the vents and their controls are in good working order shall lie with the owner of the building or his representative.

12.4 FLUSHNESS OF LIFTWELL

The liftwell enclosure shall be substantially flush on the entrance side of the lift car, subject to the provision of landing sills and door tracks, etc., required by other sections of these Rules. Recesses and ledges shall be as specified in Rule 15.1.3.2.

12.5 PIPING ETC.

Piping conduit ducts or other equipment not associated with the lift installation shall not be installed in the liftwell, except where for fire protection reasons an automatic fire sprinkler system is installed. The lift installation must then comply with the requirements of rule 25.7.

SECTION 13 - CAR AND LANDING DOORS

13.1 DOORS REQUIRED

All liftwell enclosures and car entrances shall be provided with doors which shall guard the full height and width of the entrances but shall not open beyond the internal height and width of the lift car. Door tracks shall be kept clear of the lift car entrance. Passenger lifts shall not have more than two entrances.

NOTE The width of lift entrances and the access thereto should conform to the requirements of NZS 4121 : Part 1, Design for Access by Handicapped Persons -Public Buildings and Facilities, where these facilities are required by the Disabled Persons Community Welfare Act, 1975.

13.2 TYPES OF DOORS ALLOWED

(a) Sliding doors of the unperforated panel type on all lifts.

(b) Shutter doors on goods lifts or when manually operated on passenger lifts.

NOTES: (i) Lattice gates shall not be used.

(ii) Manually operated doors are not permitted in lift installations which comply with the requirements of Rule 25.6.

13.3 CONSTRUCTION OF DOORS

13.3.1 Design. All doors shall be of metal and fire resistant construction not less than that required by the New Zealand Building Bylaws. The doors and their ancillary equipment shall be designed to withstand without distortion or displacement an accelerating force as determined by Rule 2.2, in any horizontal direction. Where doors consist of more than one panel, each panel shall be treated as a door.

13.3.2 Projections and Recesses - Panel Doors.

(i) The interior of car doors and the landing side of landing doors shall be flush faced without projections or recesses other than those for vision panels. Recesses for this purpose shall not exceed 4 mm in depth and shall be bevelled at the edges. Door panels may have textured surfaces but the maximum depth of indentations must not exceed 1 mm.

(ii) Liftwell Side. No devices other than those provided for operation and locking of the doors shall project into the liftwell beyond the line of the landing sill.

13.3.3 Guides. Doors shall have continuous guides on both the sliding edges. Guides and guide shoes shall be made of/or reinforced by fire resistive material.

13.3.4 Counterweights. Used in conjunction with door closing or balancing shall be guided and enclosed through their full length of travel. Bottom stops shall be provided and shall be capable of withstanding safely the impact of the door counterweight, (in case of failure of the suspension means) without allowing the weight to leave the guides or the enclosure.

13.4 MANUALLY OPERATED DOORS

Manually operated doors shall be provided with:

(i) A vision panel.

(ii) Hand Grips which allow for a positive hold. They must be so designed and located as to preclude all possibility of injury to the user.

13.5 POWER OPERATION REQUIRED

Doors for entrances greater than 2200 mm high and/or 2500 mm wide shall be power operated.

13.6 REQUIREMENTS FOR VISION PANELS

Landing door vision panels shall comply with the following requirements:

(i) The area of any single vision panel shall be not less than 325 sq.cm and the total area of one or more vision panels in any landing door shall be not more than 650 sq.cm.

(ii) Panel openings shall be glazed with clear wired glass not less than 6 mm thick.

(iii) The centre of the panel shall be located not less than 1400 mm nor more than 1700 mm above the landing.

13.7 VERTICALLY SLIDING DOORS

Vertically sliding doors shall not be fitted to passenger lifts and shall not be automatically operated. They shall comply with the following:

(i) If power operated they shall open and close only by the operation of a continuous pressure button.

(ii) A door panel which slides down to open and form a truckable sill shall be designed to withstand the load specified in rule 22.10.1 (iii). No truckable sill shall project more than 20 mm from the face of the door on the landing side.

(iii) They shall be so counterbalanced that they will not open or close by gravity.

(iv) They shall be suspended by a minimum of two steel wire ropes or chains, independently fastened to the door and to its counterweights. The suspension means and its connections shall have a factor of safety not less than 10 based on static loading.

(v) Truckable sills which project more than 13 mm beyond the liftwell face of the door shall be flared with sheet steel of not less than 1.6 mm thickness at an angle of not less than 15 degrees nor more than 30 degrees from the vertical. Where levelling devices are fitted, the guard shall be parallel for a distance equal to the levelling zone and then bevelled to an angle of not less than 15 degrees nor more than 30 degrees from the vertical.

(vi) Counterweights shall be suspended by a minimum of two steel wire ropes, plate or roller link chains per counterweight.

13.8 HORIZONTALLY SLIDING DOORS

(i) The leading edges shall be smooth and free of sharp projections. The meeting edges of centre-opening doors may be provided with a fire resistive resilient member on one or both doors to form an overlap not exceeding 20 mm. Single-slide and multi-speed doors shall lap the

strike jambs but shall not close into pockets in the strike jambs. The clearance between the landing face of the door and the architrave, and the clearance between overlapping faces of multi-speed doors shall not exceed a maximum of 6.5 mm.

(ii) The doors shall be so located that the distance from the liftwell face of the landing door to the edge of the landing sill shall be not more than 60 mm. For multi-panel doors this distance shall be measured from the nearest door panel.

(iii) The distance from the liftwell side of the car door to the liftwell side of the landing door shall not exceed 140 mm. For multi-panel doors this distance shall be measured from the nearest door panel.

(iv) Multi-panel doors shall be arranged for simultaneous movement of all panels. Interconnection of door panels shall be made such that the locking of one panel shall prevent the opening of all panels. The normal operating linkage between panels shall not be considered as fulfilling this requirement, with the exception of linkages between opposing panels of centre opening doors which are provided with an effective closing device on the panel that is not directly locked.

SECTION 14 - LOCKING DEVICES AND SWITCHES FOR CAR AND LANDING DOORS

14.1 CAR DOORS

Car doors 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 under normal operation for the car door to be opened under power whilst the lift is in motion, except when a levelling device is fitted and the lift car is in the landing zone.

14.2 MAXIMUM LANDING ZONES

(i) Lifts without automatic levelling devices - 150 mm.

(ii) Lifts with levelling devices and manually operated doors - 300 mm.

(iii) Lifts with levelling devices and power operated doors - 500 mm.

14.3 LANDING DOORS

Landing doors shall be provided with a lock which will prevent the opening of the doors from the landing side unless the car is in that particular landing zone. Under normal operation it shall not be possible to start the lift car or keep it in motion unless all landing doors are closed and locked, except that when the car is within the landing zone and under the control of a levelling device it may proceed to floor level with landing doors open.

NOTE: Lifts with a travel not exceeding 4.5 m may start their motion without the door being locked, provided the locking operation takes place before the car has moved 150 mm from the landing.

14.4 REQUIREMENTS FOR DOOR LOCKS

(i) The electrical and mechanical parts of door locks shall be of sound mechanical construction and adequate strength. They shall be designed to withstand reasonable wear without creating unsafe conditions or permitting the use of unsafe practices.

(ii) Springs used shall be in compression under all conditions.

(iii) Failure of the spring shall not render the lock unsafe.

(iv) The locking devices and associated actuating rods or levers shall be so situated or protected as to be reasonably inaccessible from the landing or car.

(v) Electro-mechanical locks shall comply with the following:

(a) Be totally enclosed in one case and the removal of any detachable cover from the case shall not disturb any part of the lock mechanism.

(b) Electrical contacts fitted to a lock designed for pre-locking shall be positively prevented from closing until mechanical locking takes place.

(c) If not designed for pre-locking it shall be so constructed and adjusted that the electrical contacts cannot be closed until the door is in a position to be mechanically locked, and shall be provided with primary and secondary locking positions. The electrical contacts shall be open when the door is held in the secondary locking position.

(d) Opening of the door shall cause the contacts to be positively opened independently of gravity or springs.

14.5 EMERGENCY OPENING ARRANGEMENTS FOR LANDING DOORS

For emergency purposes and for purposes of maintenance and inspection provisions shall be made to open a door from the landing, when the car is not within the particular landing zone. This shall be accomplished by a specially shaped key which shall be kept in a place of security but be readily available in cases of emergency. (The use of a plain rod or bar for this purpose shall be precluded).

SECTION 16 - HOISTING ROPES

16.1 MATERIALS

Steel car or counterweight ropes shall be used for all lifts and shall comply with the relevant requirements of BS 329 - Steel Wire Ropes for Electric Lifts.

A certificate shall be furnished for each size of rope used giving the following information:

(a) the name and address of the manufacturer;

(b) diameter of rope;

(c) number of strands;

(d) number of wires of each strand;

(e) quality of material;

(f) lay of rope;

(g) minimum specified breaking load of rope.

The certificate shall in addition, have the following statement signed by a TELARC approved signatory if in New Zealand or by the test house manager overseas.

"I hereby certify that the wire rope has been tested in accordance with the requirements of BS 329 - Steel Wire Ropes for Electric Lifts and that the rope covered by this certificate fully conforms with the requirements of that standard".

Chain shall not be used for the hoisting or suspension of a car or counterweight.

16.2 METHOD OF MEASURING ROPES

Ropes shall be designated in terms of their diameter.

The diameter of a wire rope is the diameter of the circumscribed circle and shall be measured with a suitable device such as a rope calliper in two planes each at three places at least 1500 mm apart along the length of the rope.

The measuring jaws should be of sufficient length to lap at least two strands on opposite sides of the rope.

16.3 SIZE OF ROPES

The minimum diameter of ropes for cars and counterweight shall be 9.5 mm.

16.4 MINIMUM NUMBER OF ROPES

The minimum number of ropes for cars and counterweights shall be two for drum drive lifts and three for all other types.

16.5 MINIMUM ROPE FACTOR OF SAFETY

The factors of safety for hoisting wire ropes shall not be less than given in Table 16.5.

TABLE 16.5

MINIMUM FACTORS OF SAFETY FOR HOISTING WIRE ROPES

Rope speed not exceeding m/s	Minimum factor of safety	Rope speed not exceeding m/s	Minimum factor of safety
2.25	10.00	5.00	11.55
2.50	10.25	5.50	11.70
3.00	10.70	6.00	11.80
3.50	11.00	6.50	11.85
4.00	11.25	7.00	11.90
4.50	11.45	7.50	11.90

Calculation of the factor of safety shall be by the following formula:

$$F = \frac{SN}{W}$$

where F = factor of safety
S = manufacturers guaranteed breaking strength of one rope
N = number of runs of rope under load (see Note).
W = maximum static load imposed on all car ropes with the car and its rated load at any position in the liftwell, in the same units as S.

Note: For multiple roping, the number of runs of rope N under load will be - for 2:1 roping, twice the number of ropes used; for 3:1 roping, three times the number of ropes used, etc.

16.6 WIRE ROPE DATA PLATE

16.6.1 Data Plate on Lift Car. A plate legibly and indelibly marked with the following information shall be permanently attached to the bow of the lift car:

(a) number of ropes;

(b) size of ropes;

(c) rope construction;

(d) rope material and;

(e) minimum specified breaking load of the ropes.

16.6.2 Data Plate on Ropes. A metal or plastic tag plate shall be securely attached to one of the hoist ropes close to the car bow. The data tag will bear the following wire rope data.

(a) size of rope;

(b) rope construction;

(c) rope material;

(d) minimum specified breaking load of the ropes;

(e) month and year the ropes were installed;

(f) name of person or firm who installed the ropes.

16.7 LENGTHENING OR REPAIRING OF WIRE ROPES

No car or counterweight rope shall be lengthened or repaired by splicing.

16.8 REPLACEMENT OF HOIST ROPES

When wear, corrosion, broken wires, or other factors indicate that ropes or cables have their breaking strength materially reduced below the manufacturers rating, they shall be renewed.

When ropes are renewed, the entire set shall be renewed. A set of ropes shall be considered as all of the hoist ropes or all of the compensating ropes.

SECTION 15 - CLEARANCES IN LIFTWELLS AND ENCLOSURES

15.1 CLEARANCES AT CAR OPENINGS

15.1.1 General. The inside face of the liftwell opposite the path of travel of the car sill for a width at least equal to the clear car opening plus 25 mm on each side, shall form a flush surface within the limitations set out in rules 15.1.2 to 15.1.5. When metal flushing is used, the edges shall be returned or rolled to provide a smooth surface.

15.1.2 Clearance between Car and Landing Sills.

The landing sills shall be not more than 40 mm or less than 13 mm from the car sill.

For vertically sliding landing door panels that slide down to open, the sill side of the truckable sill of the panel shall be deemed to be the landing sill for the purpose of this rule.

15.1.3 Flushness of Liftwell

15.1.3.1 Flushing distances. The liftwell surface shall be flush and plumb with the landing sill for a distance of at least 75 mm below the sill. Where self-levelling or manual inching can occur with doors open, the flushing shall extend below the landing sill for a distance equal to the levelling or inching zone plus 75 mm. Where the distance from the landing sill to the door hanger recess below is less than 150 mm, the following conditions shall be fulfilled.

(a) The car shall be provided with a self-levelling device.

(b) The car doors shall be power operated and shall not commence to open until the car sill is opposite the flush section of the liftwell face under the landing sill.

(c) The car shall level in the 'up' direction only whilst the car and landing doors remain closed. The car may relevel in the 'up' direction with doors open, if the car sill is opposite the flushed portion of the liftwell.

The distance between any part of the liftwell surface and the car sill, other than recesses over landing doors for the location of suspension and locking equipment, shall not exceed 125 mm except that for goods lifts with vertically bi-parting doors the distance may be 150 mm; provided however that the distance may be increased to 200 mm for goods lifts with vertically bi-parting doors, if the car door is mechanically latched closed, until the car is within the flushed levelling zone.

15.1.3.2 Recesses or ledges. Reccesses in any face of the liftwell enclosure, other than those specifically provided for lift maintenance or repair, shall not be permitted. Projecting beams, floor slabs or other building construction shall not create ledges which set back more than 230 mm from the clear plumb line of the liftwell unless the top surface of the ledge or setback is bevelled at an angle of not less than 75 degrees to the horizontal. Trimmer beams between adjacent lifts are not required to have bevels.

Any projection extending inwards from the general surface of the wall of a liftwell and which faces a car entrance shall be bevelled on the underside at an angle of not less than 15 degrees or more than 30 degrees from the vertical. The bevelled surfaces may be integral with the liftwell wall, as in a concrete wall, or may be constructed of rigid metal plate.

15.1.3.3 Overtravel. That portion of the liftwell opposite a car entrance shall comply with Rule 15.1.3.2 for the full distance that the car entrance can overtravel above the top landing or below the lowest landing, when the buffers are fully compressed.

15.1.4 Vertical Bi-parting Doors. Where vertical bi-parting doors are fitted inside the enclosure, the lower edge of the bottom section of the doors shall be bevelled at not less than 15 degrees nor more than 30 degrees from the vertical. In addition, where levelling or inching can occur without the car door being closed, the inside face of the landing door shall be continued flush below the landing sill level, when the landing door is closed, for a distance equal to the length of the levelling or inching zone.

15.1.5 Maximum Clearance between Car and Landing Doors. The clearance between the liftwell face of a car door at its leading edge and the liftwell face of any section of a landing door, and the clearance between the liftwell face of a landing door at its leading edge and the liftwell face of any section of a car door, shall not exceed 150 mm.

15.2 CLEARANCES BETWEEN CARS, COUNTERWEIGHTS AND LIFTWELL ENCLOSURES

The clearance between cars, counterweights and other moving parts in relation to each other, to the liftwell, and to fittings in the liftwell shall be as follows:

(i) Measurement of clearances. The clearances specified in this rule shall be measured with no load on the car floor.

(ii) Between car and liftwell enclosures. The clearance between the car and any projection in the liftwell enclosure and counterweight screen, if provided, shall be not less than 40 mm, with the car at its closest normal position to the liftwell except on the sides used for loading and unloading, providing this clearance is preserved under the deflection test prescribed in rule 12.2.

(iii) Between car and counterweight. The clearance between the car and the counterweight shall be not less than 50 mm with the car and counterweight at their closest normal position.

(iv) Between counterweight and liftwell enclosures or screens. The clearance between the counterweight and any counterweight screen shall be not less than 50 mm and the clearance between counterweight and liftwell enclosure shall be not less than 40 mm with the aforementioned in their closest normal position. This clearance shall not be reduced when the liftwell enclosure is tested for deflection in accordance with rule 12.2.

(v) Between cars in multiple liftwells. The running clearances between the cars, and any equipment attached thereto, of lifts operating in a multiple liftwell shall be not less than 100 mm. However, for cars with the above clearances, no equipment which requires servicing on the roof of a car shall be positioned less than 230 mm from another car. Where equipment is unavoidably positioned within this 230 mm distance, suitable screening shall be provided to this area.

SECTION 17 - ROPE ATTACHMENTS AND FITTINGS

17.1 SECURING OF WIRE HOIST ROPES TO WINDING DRUMS

Car hoist ropes of winding drum machines shall have the drum ends of the ropes secured on the inside of the drum by clamps or by tapered babbitted sockets or by other means approved by the Chief Engineer Surveyor.

Wire hoist ropes of drum type machines shall have not less than one-and-a-half turns of the rope on the drum when the car is resting on the fully compressed buffer.

17.2 ATTACHMENT OF ROPES TO CARS, COUNTERWEIGHTS AND THE OVERHEAD STRUCTURE

The car and counterweight ends of car and counterweight ropes or the stationary hitch-ends where multiple roping is used, shall be fastened in such a manner that all portions of the rope except the portion inside the rope sockets will be readily visible.

Attachments shall be approved and shall be by -

(a) spliced eyes; or
(b) individual tapered babbitted rope sockets; or
(c) wedge rope sockets; or
(d) other types of rope fastenings approved by the Chief Engineer Surveyor.

The attachments for the ropes shall be threaded at either the car or counterweight end to permit individual adjustment of the rope lengths.

17.3 EYEBOLTS

Eyebolts shall comply with the requirements of BS 529:Part 2 - Steel Eyebolts without Collars for Lift Suspension.

17.4 METHOD OF SPLICING EYES IN ROPES

If a spliced eye is used a metal thimble shall be placed within the eye and the splice made with at least three full tucks of the whole strand of the rope and two tucks with one-half of the wire cut out of each strand made under and over against the lay of the rope. The eye shall be drawn tightly around the thimble, the strands drawn tight after each tuck and the tucks smoothly laid. After the last tuck is made each strand shall be cut off not closer than 6 mm from the tuck and beaten down.

17.5 SOCKETS

Sockets shall comply with BS 463 - Sockets for Wire Ropes. The method of socketting shall also comply with the appropriate Appendix of that Specification.

17.6 BULLDOG GRIPS

Bulldog grips shall comply with BS 462 - Bulldog Grips. The method of attachment shall comply with the appropriate Appendix of that Specification. The word 'should' in that Appendix will be interpreted by the Chief Engineer Surveyor as 'shall'.

17.7 EQUALISERS

Spring equalisers shall be fitted on at least one end of all hoist ropes.

For drum drive lifts, the ropes of the car or dead-end hitches shall be individually provided with compression-spring type equalisers. Each spring shall be individually capable of supporting the total weight of the car and rated load without damage or permanent deformation under earthquake conditions.

Single bar equalisers shall not be used for car or counterweight ropes.

SECTION 18 - SHEAVES AND DRUMS

18.1 GROOVING OF SHEAVES AND DRUMS

Grooving of sheaves and drums shall be in accordance with the following requirements:

(i) The seats of all grooves of drums and diverter sheaves shall be machined to the arc of a circle having a diameter exceeding that of the nominal diameter of the rope by an amount within the tolerances shown in Table 18.1.

(ii) All grooves shall have a smooth finish and the edges shall be radiused.

(iii) The groove shall extend over at least one-third of the circumference of the rope.

(iv) Drums shall be long enough to take all the rope in one layer. The flanges shall extend to at least one rope diameter beyond the centre of the rope wound on them. Protective guards shall be fitted.

(v) The top surface of the rope shall not extend above the periphery of traction sheaves by a height greater than 30 percent of the rope diameter.

(vi) Substantial type approved keepers shall be provided to maintain ropes in the grooves of car and counterweight traction, multiplying, diverter and compensating sheaves at all times.

TABLE 18.1

GROOVE SEATS OF SHEAVES AND DRUMS

Nominal rope diameter mm	Tolerance on groove seat diameter, mm	
	min.	max.
6 to 8	0.4	0.8
9 to 20	0.8	1.6
21 to 30	1.2	2.4

18.2 ROPE RETAINER GUARDS

Rope retainer guards shall be provided on deflector sheaves, machine sheaves, compensator rope sheaves, governor tension sheaves and hoist rope sheaves on cars and counterweight to inhibit displacement of ropes in the event ropes become slack.

Rope guards shall be continuous or there shall be one guard for 30 degrees wrap or less, and two guards for a wrap in excess of 30 degrees. The guard or guards shall be located so that the included angle between the outer faces of the guard or guards encloses two-thirds of the angle of contact between the rope and sheave, etc.

18.3 RATIO OF ROPE DIAMETER TO SHEAVE DIAMETER

The minimum ratio of the diameter of any sheave to the diameter of the rope wound on it, measured on rope centres, shall be not less than 40. Sheaves for compensating ropes may have a ratio of not less than 30.

18.4 MECHANICAL DESIGN

The mechanical design of sheaves, shafts and supports shall be in accordance with rules 8.3, 8.4, 8.5, 8.8 and 8.10.

18.5 SHEAVE GUARDS - MULTIPLE ROPING

Multiple sheaves mounted on a car or counterweight shall be provided with a guard to -

(i) prevent the ropes leaving their correct grooves in the sheaves in accordance with rule 18.2.

(ii) prevent fingers or tools being caught between the ropes and the sheaves;

(iii) for cars only, cover any spokes or open webs of the sheave.

If a multiplying sheave is mounted on top of a car or counterweight, it shall be provided with a guard covering entirely the upper half of the sheave or sheaves.

If a multiplying sheave is mounted on top of a car, a substantial hand-hold shall be provided at a convenient height surrounding the ropes as a whole, or individual runs of rope, but at least 50 mm clear of the ropes.

18.6 GUARDING OF NIP-POINTS

Where the car hoist rope lead is diverted by an overhead sheave and the nip-point is under the liftwell ceiling and is less than 2450 mm from the crosshead when the car is level with the top landing, then the rope nip-point shall be adequately guarded.

For single and double wrap sheaves in secondary floors, the nip-points of ropes and the spokes of open-web sheaves which are less than 2450 mm from the floor, shall be adequately guarded.

The nip-points of compensation sheaves and ropes shall be adequately guarded.

SECTION 19 - COUNTERWEIGHTS

19.1 COUNTERWEIGHT CONSTRUCTION

Rod type counterweights may be employed on lifts up to a speed of 1 m/s, the sections being secured by at least two tie-rods passing through holes in all sections, and having lock nuts and split pins at each end.

For speeds above 1 m/s, counterweights shall be in the form of a rigid steel frame containing solid filler weights.

Counterweights shall withstand the effect of buffer impact at governor tripping speed.

Structural metal frames shall be so designed as to retain the filler weights securely in place on buffer engagement or for the nominated earthquake loading in such a manner as to prevent the shifting of the filler weights. Filler weights shall be held in place by not less than two tie-rods passing through holes in all filler weights and through the bottom member of the counterweight frame and shall have lock nuts and split pins at each end.

Stress bearing parts enclosing or supporting the counterweight shall not be of cast iron.

19.2 FACTOR OF SAFETY

Counterweight tie-rods, frame members and their connections shall be of steel and shall have a factor of safety of not less than 5.

The factors of safety shall be calculated on the conditions prevailing when the lift is at rest and the counterweight at the top of its travel, to cover the effect of rope compensation, if provided.

NOTE: Counterweight tie rods shall have a minimum diameter of 19 mm.

19.3 GUARDING OF COUNTERWEIGHTS

Guarding of counterweights shall comply with the following requirements:

(a) The path of travel of the counterweight in the pit of the liftwell shall be screened to a height of 2000 mm measured from the pit floor, and the lower edge of the screen shall be substantially level with the striker plate of the counterweight when fully supported by its buffer or stop.

(b) Where the counterweight of a lift travels adjacent to the car of another lift, the path of travel of the counterweight shall be screened from the other lift throughout its travel by a substantial continuous screen of non-combustible material.

(c) Counterweight screens shall be of sheet steel at least 1.6 mm thickness or 50 mm x 3.15 mm diameter crimped wire mesh, or their equivalents. However where the counterweight passes within 75 mm of a screen, the screen openings shall reject a ball 10 mm diameter.

19.4 COUNTERWEIGHT GUIDE SHOES

Counterweights shall be guided on each guide rail by upper and lower guiding members attached to the counterweight and complying with rule 20.15.

19.5 LIFT CAR AS COUNTERWEIGHT

A lift car shall not be used to counterbalance another lift car.

SECTION 20 - GUIDES FOR LIFT CARS AND COUNTERWEIGHTS

20.1 GUIDE RAILS REQUIRED

All passenger and goods lifts shall be provided with car and counterweight guide rails.

20.2 GUIDE RAIL MATERIAL

Guide Rails, reinforcements, backings, brackets, rail clips, fish plates and their fastenings shall be of steel or other metals conforming to the requirements of this section.

20.3 REQUIREMENTS FOR STEEL

Steel shall be open-hearth steel or its equivalent, guaranteed by the steelmaker for a minimum specified tensile strength of not less than 380 MPa, a yield stress of not less than 228 MPa, and an elongation of not less than 22 percent in a gauge length of 50 mm.

20.4 REQUIREMENTS FOR MATERIALS OTHER THAN STEEL

Metals other than steel may be used provided the factor of safety is not less than and the deflections not more than the values specified in these Rules.

Under no circumstances may cast iron be used, for guide-rails, or fixings. Malleable cast iron may be used for guide shoes only.

20.5 GUIDE RAIL SECTION

Guide rails shall be T-section, conforming to the nominal masses and dimensions shown in fig (20.5) and table (20.5).

Other approved shapes may be used subject to the following requirements:

(i) Provided they comply with the relevant parts of this section.

(ii) They shall have a cross-sectional area sufficient to withstand any compressive forces resulting from the application of the car or counterweight safety device.

(iii) They shall have sufficient bearing area for guiding purposes and for the effective operation of safety gear where provided.

(iv) Rail joints shall have strength, rigidity and accuracy of alignment not inferior to that specified in rule 20.10.

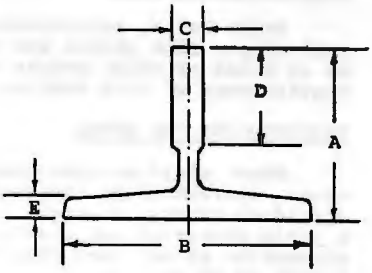


Fig. 20.5 T-SECTION RAIL GUIDE

TABLE 20.5

GUIDE RAILS - NOMINAL MASSES AND DIMENSIONS

Designation	Nominal mass kg/m	Nominal dimensions, mm				
		A	B	C	D	E
T-6	8.93	49.2	69.8	15.88	25.4	7.9
T-8	11.90	61.9	88.9	15.88	31.7	7.9
T-15	22.32	88.9	127.0	15.88	50.0	12.7
T-18½	27.53	107.9	139.7	19.05	50.8	12.7
T-22½	33.48	101.6	139.7	28.58	50.8	14.3
T-30	44.64	127.0	139.7	31.75	57.1	17.5

20.6 STRESSES AND DEFLECTIONS IN STEEL GUIDE RAILS

For cars and counterweights the maximum distance between points of substantial support shall not exceed the lesser of the following -

(i) 180 times the least radius of gyration of the rail.

(ii) Each span of the rail where there are no tie brackets (see rule 20.8) shall be considered as a beam having ends supported, such as to result in a deflection formula of -

$$\frac{WL^3}{96EI \times 10^4} \text{ (mm)}$$

and a stress formula of

$$\frac{WL}{6Z \times 10^3} \text{ (MN/m}^2\text{)}$$

where

W = load on guide rail (N)

L = vertical distance between centres of fastenings to the building structure (mm). When rule 20.8 is complied with then this distance shall be divided by 1.5.

E = modulus of elasticity of material (2×10^5MPa unless certified otherwise), MPa.

I = minimum moment of inertia of guide rail (or of rail and its reinforcement), cm^4.

Z = sectional modulus of the rail, or of the rail and its reinforcement, about a line at right angles to a line passing through the pair of rails, (cm^3).

(a) Car Guide Rails:

The stress and deflection shall not exceed 124 MPa and 6 mm respectively for the rail loaded as defined in rule 22.10.

(b) Car and counterweight guide rails:

For the purpose of determining the deflection and stresses of guides during an earthquake, the loaded car or counterweight shall be assumed to be suspended in any position of travel and acted upon by a continuous horizontal acceleration (in any direction) as determined by Rule 2.2. The stress and deflection shall not exceed 85 percent of the minimum specified yield stress and 12 mm respectively.

20.7 STRESSES AND DEFLECTIONS IN COUNTERWEIGHT GUIDE RAILS

For counterweights without safety gear where the two guides are secured one to the other (See rule 20.8) between points of substantial support, the distance between points of substantial support may be increased to 270 times the least radius of gyration of the rail for steel guides, provided the stresses and deflections do not exceed those specified in rule 20.6.

20.8 INTERMEDIATE TIE BRACKETS FOR COUNTERWEIGHT RAILS

Intermediate steel tie brackets, not required to be tied to the building structure shall be provided between guide rails at mid-span should the distance between fixings exceed 3 metres.

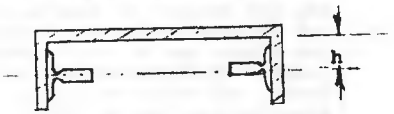
The tie brackets shall be designed to distribute the load such that there is no relative deflection at the point of attachment of the tie brackets to the rails under the various loading conditions, including earthquakes, with the load acting along a horizontal line passing through both rails.

The following formula shall be used to determine the section modulus of the tie bracket.

$$Zyy = \frac{mh \times I \times Cp\ max}{24.8 \times 10^3}$$

where,

Zyy = modulus of section of tie bracket in cm^3.
m = mass of counterweight in kilograms.
h = height of tie bracket in mm, measured from the centre line of the guide rail to the heel of the tie bracket section.
I = importance factor, see table 4, NZS 4203.
$Cp\ max$ = seismic design co-efficient, see table 9 and clause 3.4.9.2 of NZS 4203.



Rolled sections which must be fabricated, should have full strength welds along the entire cross-section of each joint.

20.9 GUIDE RAIL GUIDING SURFACES

Guide rails shall have machine finished guiding surfaces.

20.10 GUIDE RAIL JOINTS AND FISH PLATES

20.10.1 Type and Strength of Joints. Guide rails shall be joined together by fish plates or by other approved means, as specified in rule 20.10.2 of such design and strength as will withstand the forces specified in rule 20.6 and 20.7 within the deflection limits specified therein.

The position of guide rail joints shall be kept within 15 percent of the span, from the points of supports. Joints which fall outside this requirement shall have fish plates with at least the same moment of inertia (in the X-X and Y-Y planes) as the guide rails and shall comply with the relevant requirements of Rule 20.10.2.

20.10.2 Design and Construction of Joints. The joints of T section guide rails shall comply with the following requirements:

(a) The ends of the rails shall be accurately machined with a tongue and matching groove centrally located in the web.

(b) The backs of the rail flanges shall be accurately machined, in relation to the rail guiding surfaces, to a uniform distance front to back of the rails to form a flat surface for the finished fish plates.

(c) The ends of each rail shall be bolted to the fish plates with not less than four bolts.

(d) The width of the fish plate shall be not less than the width of the back of the rail.

(e) The thickness of the fish plate and the diameter of the bolts for each size of guide rail shall be not less than those specified in Table 20.10.

(f) The diameter of bolt holes shall not exceed the diameter of the bolts by more than 1.5 mm for guide rails and 3 mm for fish plates.

Joints of different design and construction to those specified in this rule may be used, subject to the approval of the Chief Engineer Surveyor, if they are equivalent in strength and will adequately maintain the accuracy of the rail alignment.

TABLE 20.10

MINIMUM THICKNESS OF FISH PLATES AND MINIMUM DIAMETER OF FASTENING BOLTS

Designation	Nominal mass kg/m	Minimum thickness of fish plates mm	Minimum diameter of bolts mm
T-6	8.93	11	12
T-8	11.90	14	12
T-15	22.32	17	16
T-18½	27.53	20	18
T-22½	33.48	20	18
T-30	44.64	24	18

20.11 OVERALL LENGTH OF GUIDE RAILS

The top and bottom ends of each run of guide rails shall be so located in relation to the extreme positions of travel of the car and counterweight, that the car and counterweight guiding members cannot travel beyond the ends of the guide rails. A clear space shall be provided over the top end of any guide rails (see Note in rule 20.12.3), so that no vertical forces shall be imposed on the guide rail by the building structure or by the lift machine.

Where overruns are in excess of those required, guide rails shall extend a minimum of 600 mm above the highest point to which a car or counterweight could jump, at the counterweight or car buffer engagement, or shall extend to the underside of the liftwell ceiling, with due regard to the above requirements.

20.12 GUIDE RAIL BRACKETS AND BUILDING SUPPORTS

20.12.1 Design. The guide rail brackets, their anchors and the building construction forming the supports for the guide rail brackets shall be of such design as to:

(i) Safely withstand the application of the car or counterweight safety gear when stopping either the car and its rated load or the counterweight.

(ii) Withstand horizontal forces imposed by car loads as defined by rule 22.10 with a total deflection at the point of support of not more than 3 mm.

(iii) Withstand seismic forces (see rule 2.2.) acting on the loaded car and counterweight in their most adverse position in relation to any bracket without deflecting more than 6 mm and without causing stresses in excess of 85 percent of the yield strength of the material used.

20.12.2 Building Supports. Sufficient care and attention must be exercised in the design of the building construction to ensure that adequate provision is made for the support of the guide rails at positions governed by the lift design as approved by this division.

NOTE: Liftwell enclosure walls of brick, terra cotta, and similar materials, used in building of steel and concrete construction, are usually insufficient in strength to form by themselves adequate supports for the guide rails.

When trimmer beams are used for the support of guide rails they shall be substantiated by a certificate from a practising registered engineer stating that their design, construction and fixture have been checked for the forces as mentioned in this section of the rules and are found to be satisfactory. (See Rule 6.3).

20.12.3 Guide rail brackets and anchors. The design of guide rail brackets shall be supported by engineering calculations. They shall be stiffened where necessary by gusset plates at least 10 mm thick and shall be secured to the building supports by means of approved anchors.

Systems using approved cast in inserts with slots shall have bolt holes in the brackets which are no greater than the diameter of the bolt plus 1.5 mm.

When post fixed anchors are used, slotted holes in the brackets are permissible providing the width of the slot is no greater than the diameter of the bolt plus 1.5 mm and that fitted washers which are at least 6 mm thick are used under the bolt heads. The washers shall be continuously welded to the brackets by fillet welds of 6 mm leg size.

NOTE: In order to provide sufficient clearance in new building construction, due allowance should be made for building settlement subsequent to the guide rail installation.

20.13 FASTENINGS OF GUIDE RAILS TO RAIL BRACKETS

20.13.1 Type of Fastenings. Guide rails shall be secured to their brackets by bolted clips or by through bolts. The diameter of the holes in the brackets shall not exceed the diameter of the bolts used by more than 1.5 mm. Bolts used for fastening shall be of such strength as to withstand the forces and not exceed the stresses of rule 20.12.1.

20.13.2 Size of Bolts for Fastenings. The size of bolts used for fastening the guide rails or rail clips to the brackets shall be not less than those specified in Table 20.13.

TABLE 20.13

MINIMUM SIZE OF RAIL-FASTENING BOLTS

Designation	Nominal mass kg/m	Minimum diameter of bolts mm
T-6	8.93	12
T-8	11.90	12
T-15	22.32	16
T-18½	27.53	16
T-22½	33.48	18
T-30	44.64	18

20.14 GUIDE RAIL GAUGE TOLERANCE

The variation in the gauge (distance between guide rails) shall be not more than 5 mm.

20.15 GUIDE SHOES

20.15.1 Number of Guide Shoes. Every car and counter-weight shall be provided with at least four guide shoes, two at the top and two at the bottom of each car or counter-weight frame. Guide shoes may be of the sliding or roller type.

20.15.2 Play between Guides. Guide shoes shall be mounted and adjusted so that the play between guides will not exceed 10 mm.

20.15.3 Adjustable Guide Shoes. Adjustable guide shoes shall be so designed that their correct adjustment will be maintained independently of the tightness of bolts or screws through slotted holes.

20.15.4 Lift Cars exceeding 0.65 m/s. Sliding guide shoes of passenger lift cars which exceed a speed of 0.65 m/s shall be provided with compression springs or their equivalent in the plane of the guide rails, to ensure close contact with the rails.

20.15.5 Strength of Guide Shoes. Guide shoes, not used in conjunction with roller guides, shall be capable of resisting the horizontal forces without exceeding the stresses defined in rule 20.12.1.

20.16 ROLLER GUIDE SHOES

Where roller guide shoes are used, positive means shall be provided to ensure that the car and counterweight are kept within the guides in the event of failure or loss of a roller tyre, etc. The upper guide shoes of the car and counterweight shall be effectively guarded from above where the rollers make contact with the guides.

Counterweights shall be provided with four restraining plates each, the engaging depth of which are at least 54 mm. Refer fig. 20.16.

LUG PLATE BOLTED UNDER ROLLER GUIDE ASSEMBLY TO CAR AND COUNTERWEIGHT FRAME - WITH MIN. 4 - 16.00 ϕ BOLTS

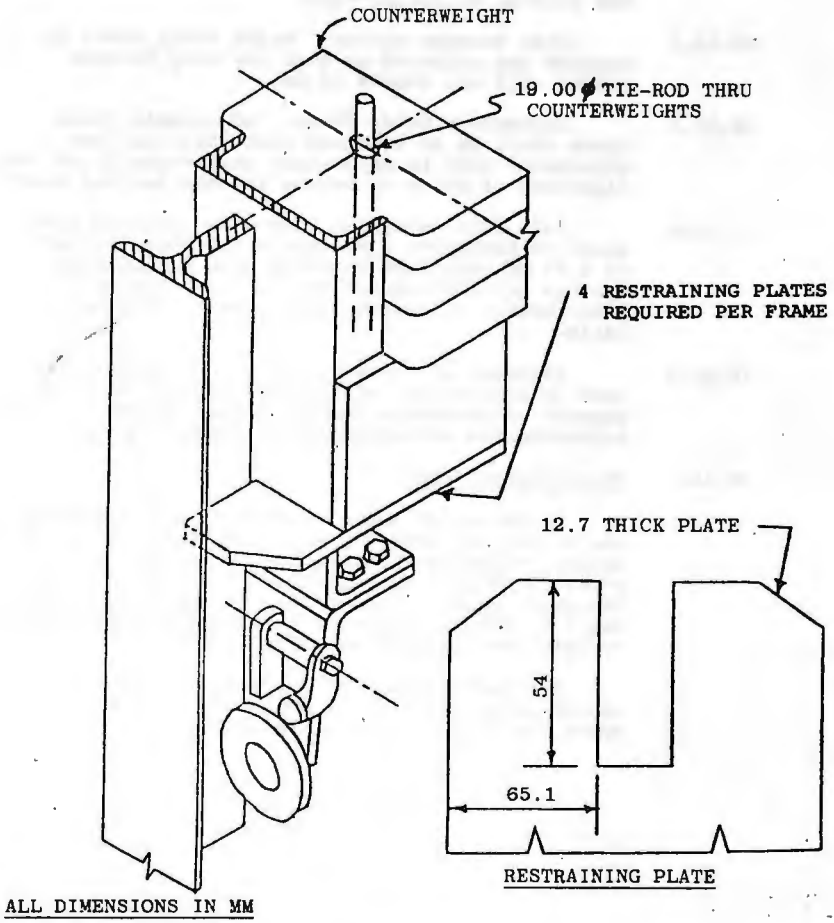


FIG. 20.16 LIFT COUNTERWEIGHT AND CAR FRAME ANCHORAGE - TYPICAL ARRANGEMENT

SECTION 21 - RATED CAR CAPACITY AND CLASSES OF LOADING

21.1 RATED LOADING CAPACITY FOR LIFT CARS

The minimum rated load in kilograms for lifts shall be based on the inside net platform areas. The inside net platform area shall be determined as shown in figure 21.1 (see also rule 21.2).

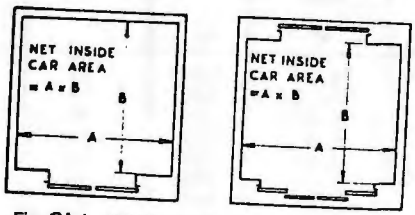


Fig. 21.1 INSIDE NET PLATFORM AREAS FOR PASSENGER LIFTS

Lifts shall be designed and installed to safely lower, stop and hold the car, with an additional load of 25 percent in excess of the rated load.

The following formulae shall be used for determining or checking the minimum rated load of passenger lifts:

(i) for a lift having an inside net platform area of not more than 4.6 m^2 -

$$W = 35.05A^2 + 325.66A$$

(ii) for a lift having an inside net platform area of more than 4.6 m^2 -

$$W = 2.454A^2 + 610.3A - 620.7$$

where W = minimum rated load, kg
A = inside net platform area, m^2

To determine the loading in persons, the rated load in kilograms shall be divided by 68.

Table 21.1 shows inside net platform areas for typical minimum rated loads.

TABLE 21.1

INSIDE NET PLATFORM AREAS FOR TYPICAL MINIMUM RATED LOADS

Maximum passenger capacity	Maximum inside net platform area m^2	Minimum rated load kg	Maximum passenger capacity	Maximum inside net platform area m^2	Minimum rated load kg
1	0.12	68	45	5.90	3060
2	0.39	136	50	6.45	3400
3	0.56	204	55	6.97	3740
4	0.77	272	60	7.49	4080
5	0.93	340	65	8.02	4420
6	1.11	408	70	8.52	4760
7	1.25	476	75	9.05	5100
8	1.45	544	80	9.53	5440
9	1.63	612	85	10.06	5780
10	1.76	680	90	10.56	6120
11	1.90	748	95	11.08	6460
12	2.05	816	100	11.61	6800
13	2.18	884	105	12.11	7140
14	2.32	952	110	12.63	7480
15	2.46	1020	115	13.15	7820
16	2.60	1088	120	13.64	8160
17	2.74	1156	125	14.17	8500
18	2.85	1224	130	14.64	8840
19	3.00	1292	135	15.14	9180
20	3.13	1360	140	15.63	9520
21	3.22	1428	145	16.12	9860
22	3.35	1496	150	16.60	10200
23	3.48	1564	155	17.09	10540
24	3.59	1632	160	17.58	10880
25	3.71	1700	165	18.07	11220
26	3.82	1768	170	18.56	11560
27	3.95	1836	175	19.06	11900
28	4.05	1904	180	19.54	12240
29	4.18	1972	185	20.02	12580
30	4.29	2040	190	20.44	12920
35	4.81	2380	195	20.97	13260
40	5.34	2720	200	21.46	13600

NOTE: All the above rated loads are not necessarily usual industry sizes.

SECTION 21 - RATED CAR CAPACITY AND CLASSES OF LOADING

21.1 RATED LOADING CAPACITY FOR LIFT CARS

The minimum rated load in kilograms for lifts shall be based on the inside net platform areas. The inside net platform area shall be determined as shown in figure 21.1 (see also rule 21.2).

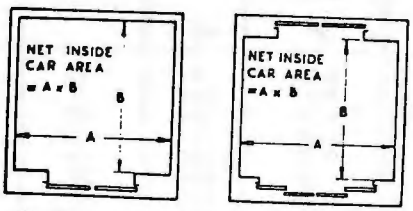


Fig. 21.1 INSIDE NET PLATFORM AREAS FOR PASSENGER LIFTS

Lifts shall be designed and installed to safely lower, stop and hold the car, with an additional load of 25 percent in excess of the rated load.

The following formulae shall be used for determining or checking the minimum rated load of passenger lifts:

(i) for a lift having an inside net platform area of not more than 4.6 m^2 -

$$W = 35.05A^2 + 325.66A$$

(ii) for a lift having an inside net platform area of more than 4.6 m^2 -

$$W = 2.454A^2 + 610.3A - 620.7$$

where W = minimum rated load, kg
A = inside net platform area, m^2

To determine the loading in persons, the rated load in kilograms shall be divided by 68.

21.2 CARS FITTED WITH FALSE WALLS OR PARTITIONS

Where false walls or partitions are installed in lift cars for the purpose of restricting the net platform area for passenger use, they shall be permanently bolted, riveted or welded in place. Doors or handrails shall not be used for this purpose. The false wall or partition shall be so installed as to provide for symmetrical loading about the centre of the car.

21.3 NOTICES IN LIFT CARS

A conspicuous load plate bearing the RATED load of the lift in persons and kilograms shall be fitted in each lift car.

SECTION 22 - CAR CONSTRUCTION

22.1 CAR FRAMES REQUIRED

Every lift suspended by wire ropes shall have a car frame consisting of a bow, side and buffer members and safety gear bearers, located approximately at the middle of the car platform, and in no case farther from the middle than 1/8 of the distance from front to back of the platform.

22.2 GUIDING MEMBERS

Car frames shall be guided on each guide rail by upper and lower guiding members attached to the frame.

22.3 DESIGN OF CAR FRAMES AND GUIDING MEMBERS

The frames and its guiding members shall be designed to withstand the forces resulting from the loading conditions for which the lift is designed (See Section 21).

22.4 UNDERSLUNG CAR FRAMES

Where the car frame is underslung or located entirely below the car platform, the vertical distance between the top and bottom guide shoes shall not be less than 40 percent of the distance between the guide rails.

22.5 CAR PLATFORMS

Every lift car shall have a platform consisting of a nonperforated floor attached to a platform frame supported by the car frame, and extending over the entire area within the car enclosure. The platform frame members and the floor shall be designed to withstand the forces developed under the loading conditions for which the lift is designed and installed.

22.6 MATERIALS FOR CAR FRAMES AND PLATFORM FRAMES

Materials used in the construction of car frames and platforms shall conform to the following:

(i) Car and platform frames and platform joists shall be made of steel or other approved metals.

(ii) Cast iron shall not be used for any part subject to tension, torsion, or bending.

22.7 REQUIREMENTS FOR STEEL

Steel used in the construction of car frames and platform frames shall comply with one of the Standards in Part 2, Section 4 of these Rules.

22.8 REQUIREMENTS FOR METALS OTHER THAN STEEL

Metals other than steel may be used in the construction of car frames and platforms provided the metal used has the essential properties to meet all the requirements as regards allowable stresses and maximum deflections stated in this Section.

22.9 CAR FRAME AND PLATFORM CONNECTIONS

Connections between members of car frames and platforms shall be riveted, bolted, or welded, and shall conform to the following:

(i) Bolts, where used through sloping flanges of structural members shall have boltheads of the tipped-head type or shall be fitted with bevelled washers.

(ii) Nuts used on sloping flanges of structural members shall seat on bevelled washers.

(iii) All welding and the qualifications for welders shall be in accordance with the appropriate standard as per rule 4.6.

22.10 STRENGTH OF CAR FRAMES AND CONDITIONS OF LOADING

22.10.1 Conditions of Car Loading.

In calculating the minimum strength required in any car frame member, including shafts for sheaves, the following conditions of loading shall be considered, in addition to the weight of the car and its associated equipment; the loading due to travelling cables, rope or chain compensation, compensation sheave lockdown, etc;

(i) The rated load distributed over the whole of the platform.

(ii) One-half of the rated load distributed over any portion of the platform having an area equal to half the total platform.

(iii) Additional for goods lifts, one quarter of the static rated load shall be considered as being concentrated on the midpoint of the sill. The Chief Engineer Surveyor may require greater sill loadings for special goods lifts.

22.10.2 Decelerating Force to Be Considered

The following decelerating forces shall be considered in conjunction with conditions of loading in Rule 22.10.1 above:

(a) The force due to safety gear operation being that resulting from a deceleration of 2 g for Type A safety gear (masses involved are multiplied by 3).

1 g for Types B and C safety gear (masses involved are multiplied by 2).

1.5 g for Type D safety gear (masses involved are multiplied by 2.5).

(b) The force due to car buffer engagement, being that resulting from a deceleration of 1 g. (The masses involved are multiplied by 2).

(c) The force developed when the car drops back to the ropes after jumping, for example as a result of earthquake, counterweight buffer or safety gear engagement etc. This force shall be taken to be that resulting from a deceleration of 1 g. (The masses involved are multiplied by 2).

22.10.3 MAXIMUM PERMISSIBLE STRESS IN CAR FRAMES

The stress resulting from the loading conditions in rules 22.10.1 and 22.10.2 shall not exceed the following :

Loading Conditions	Permissible stress in tension, compression or bending or any combination of these	Permissible stress in Shear
As per rule 22.10.1	100 MN/m^2	80 MN/m^2
As per rule 22.10.2	150 MN/m^2	120 MN/m^2

22.10.4 MAXIMUM DEFLECTION IN CAR FRAMES

The maximum deflection in any member, loaded as a simply supported beam and considering only static loads, shall not exceed 1/960 of its span between supports or fixings, or, for cantilevers, 1/480 of the length of the cantilever.

22.11 HOIST ROPE HITCH PLATES

Hoist ropes attached to the car shall be attached to steel hitch plates or to structural steel shapes.

If attachment is by bolts or rivets, the plates or shapes shall be secured to the underside or the webs of the car frame member with the bolts or rivets so located that the tension in the hoist ropes will not develop direct tension in the bolts or rivets.

22.12 CAR FRAME WITH CROSSHEAD SHEAVES

22.12.1 Sheaves Mounted on Car Frame.

Where a hoist rope sheave or sheaves are mounted on the car frame and the sheave shaft extends through the web of a car frame member, the reduction in area of the member shall not reduce the strength of the member below that required. Where necessary, re-inforcing plates shall be welded or riveted to the member to provide the required strength.

22.12.2 Multiplying Sheaves Mounted on Separate Sheave Shafts

Where multiplying sheaves mounted on separate sheave shafts are used, provision shall be made to take the compressive forces, developed by tension in the hoist ropes between the sheaves, on a strut or struts between the sheave-shaft supports, or by providing additional compressive strength in the car frame or car frame members supporting the sheave shaft.

22.12.3 Sheaves Above Car Crosshead. Where sheaves are provided above the car crosshead, there shall be a clear space of at least 380 mm from the guard to the front face of the liftwell or to the rear of the lift car, and 450 mm from the guard to the car guide rails.

22.13 ATTACHMENTS TO CAR FRAME

Where side bracing and similar members are attached to the car frame, the reduction in area of the car frame due to the attachment of the member shall not reduce the strength of the car frame below the requirements of rule 22.10.

22.14 LIFT CAR ROOF

22.14.1 General. Every lift shall have a solid roof which shall cover the whole area of the car.

22.14.2 Construction

22.14.2.1 General. The roof of every lift car shall be so constructed as to provide a sound, even surface of as large an area as practicable and to afford a firm foothold, and shall be of adequate strength to support safely the weight of workmen and any equipment required to be placed thereon.

The roof shall be capable of sustaining a load of 135 kg applied on any square of 600 mm side and 70 kg applied on any square of 50 mm side. Simultaneous application of these loads is not required.

The allowable deflections of car roofs under the foregoing loads shall be not greater than one-hundredth of the roof span.

Glass shall not be used in the construction of a car roof.

22.14.2.2 Standing area. A clear level standing area 750 mm x 300 mm clear of any equipment shall be provided at the front of the lift car on the roof. If by the position of equipment, such as door machines or multiplying sheaves, this is precluded, then two spaces each not less than 380 mm long x 300 mm wide shall be provided, both at the front of the car roof.

If these requirements cannot be met on or near the car roof, a separate platform or platforms of similar dimensions shall be provided.

Raised platforms if provided, shall not infringe the clearance requirements of rule 9.3.

22.15 CAR ROOF TRAPDOOR

Every lift car roof shall be provided with a hinged or sliding trap-door in accordance with the following requirements:

(i) The trapdoor opening shall have an area of not less than $0.25m^2$ and shall measure not less than 400 mm nor more than 625 mm on any one side.

(ii) The trapdoor shall be so located as to provide a clear passageway unobstructed by fixed lift equipment located in or on top of the car.

(iii) The trapdoor, if of the hinged type, shall open upwards.

(iv) The trapdoor shall be capable of being opened from outside the car without the use of tools.

(v) The trapdoor, when partly or fully open shall not foul any part of the liftwell or any fitting in the liftwell or on top of the car. The trapdoor shall remain in the open position by gravity or shall be latched open.

(vi) The trapdoor shall be provided with a contact actuated by a latch so arranged and so connected in the control circuit that the lift cannot move unless the trapdoor is both closed and manually latched.

22.16 EXTENT OF CAR ENCLOSURES

Lift cars shall be permanently enclosed on all sides except for door entrances, and on the roof except for trapdoors.

22.17 SECURING OF CAR WALLS

The car walls shall be securely fastened to the car platform and be so supported that they cannot loosen or become displaced in ordinary service or on the application of the car safety gear, buffer application, or in an earthquake.

22.18 USE OF GLASS IN LIFT CARS

Plain glass shall not be used in lift cars except to cover regulatory notices, certificates, and the like, annunciators, signalling devices and lamps.

Plate glass 6 mm and over in thickness may be used in areas not greater than $0.1m^2$ and wire reinforced glass and tempered glass may be used in areas not greater than $0.2m^2$.

The lowest edge of any glass pane shall be not less than 1000 mm above the car floor.

Larger areas of glass will be considered for observation lifts by the Chief Engineer Surveyor providing their speeds do not exceed 1.5 m/S. Special mention must be made at the time of the submission of the design.

The glass shall be:-

(1) At least 11.5 mm thick laminated type to an approved specification, thus allowing two 5.0 mm glass laminators separated by one 1.5 mm plastic interlay.

(2) Installed and guarded so as to provide adequate protection for passengers in case the glass sheets fracture or are dislodged.

(3) Mounted so as to withstand the required lift tests without damage.

22.19 HEADROOM FOR CARS AND ENTRANCES

The clear height for all car ceilings and entrances shall not be less than 1980 mm.

22.20 LIGHTING OF LIFT CAR

22.20.1 External Lighting

22.20.1.1 Underside of car. The underside of every lift car shall be provided with at least one 75 W incandescent lamp to afford general illumination. This light shall be controlled by a pull switch situated centrally underneath the car and behind the apron.

22.20.1.2 Top of car. The top of every car shall be provided with illumination as follows:

(i) One incandescent lamp of not less than 75 W, where a single fixed light will effectively illuminate all equipment requiring servicing and inspection of the car roof.

(ii) Where a single fixed light will not give effectively illumination as in (i) above, then multiple lights shall be provided, one of which shall be an approved type of hand lamp permanently connected to a ceiling rose. A suitable reel or cleat shall be provided to enable the lead and hand lamp to be secured in position when not in use.

All switches, ceiling roses, etc, shall be of a metal protected type. Fixed lights shall be protected by a wellglass or equivalent fitting. Control switch or switches for the top car lights shall be clearly visible from a landing, when the roof of the car is substantially level with the landing.

22.20.2 Internal Lighting

22.20.2.1 Light supply and illumination required. Lift cars shall have a minimum of two lights, one to be connected to the lift supply and one to be connected to some other part of the electrical installation of the building in which the lift is located or to some other source of supply.

The minimum illumination from the internal car lighting, measured at the car sill, shall not be less than 50 lx for passenger lifts nor less than 30 lx for goods lifts.

22.20.2.2 Light Control Switch.

Light control switches shall be located in the car and must be of the key operated type which are not accessible to unauthorised persons.

22.20.2.3 Guarding of lamps in passenger cars. Lamps in passenger cars shall be so guarded as to prevent injury to passengers from breakage of the bulbs or tubes.

22.20.2.4 Lamp guards for goods cars. Lamps in goods cars shall be equipped with substantial guards to prevent damage by materials being carried.

22.20.2.5 Light fittings in lift cars. Lamps in lift cars shall be so located or guarded as to discourage their removal by other than authorised persons.

22.20.2.6 Light fitting in relation to roof trapdoor. A car light fitting or accessory shall not be mounted in or on a roof trapdoor and it shall not be necessary for a car light fitting to be displaced to gain access to a roof trapdoor.

Car light fittings or lamps shall not be installed within 100 mm of the perimeter of the car roof trapdoor, unless they are suitably and substantially guarded to prevent breakage.

NOTE: This rule does not prohibit access being gained to a roof trapdoor by displacement of a readily removable diffuser panel.

22.20.2.7 Emergency lighting. Emergency lighting shall be provided for every lift car. Such emergency lighting shall comply with the following requirements:

(i) It shall operate automatically with a delay of not more than 15 seconds after failure of the power supply to the lift car lighting circuit-breaker.

(ii) It shall provide continuous illumination for a period of at least 2 hours.

(iii) It shall provide some general illumination of the car of sufficient intensity to distinguish the call buttons, emergency alarm button and telephone dial, where provided.

(iv) At least two lamps of approximately equal wattage shall be used.

(v) The recovery rate of the emergency supply after 2 hours continuous use shall be such that a further 2 hours illumination can be maintained after not more than 16 hours recharging.

22.21 PROTECTION OF EMERGENCY LIGHTING SOURCE

Where batteries provide the emergency lighting source, the batteries shall be secured in such a manner that they cannot be displaced or the contents spilled by the operation of the safety gear or during an earthquake, by a minimum horizontal acceleration as determined by Rule 2.2.

22.22 DEFLECTION OF CAR WALLS

The car walls shall be of such strength and so designed and supported that, when subjected to a force of 330 N applied horizontally over any square of 50 mm side on the walls, the deflection shall be not greater than:

(i) 0.005 times the height or width for timber walls;

(ii) 0.01 times the height or width for metal walls.

The deflection shall not reduce the running clearance below the minimum specified in rule 15.2 nor shall it exceed 25 mm.

22.23 CAR APRONS

The entrance side of the platform of every lift shall be provided with a smooth metal guard plate of sheet steel not less than 1.6 mm thick, or material of equivalent strength and stiffness, adequately reinforced and braced to the car platform and complying with the following requirements:

(i) It shall extend not less than the full width of the widest landing door opening.

(ii) It shall have a straight vertical face, extending below the floor surface of the platform by 100 mm and, if levelling or manual inching is provided, by not less than the extent of the levelling or inching zone plus 75 mm.

(iii) The lower portion of the guard plate shall be bent back for a distance of not less than 100 mm at an angle of not less than 15 degrees nor more than 30 degrees from the vertical.

(iv) The guard plate shall be securely braced and fastened in place to withstand a constant force of not less than 660 N applied at right angles to and at any position on its face without deflecting more than 6 mm and without permanent deformation.

(v) Electric cable junction boxes shall not be situated in the position to be occupied by the car apron.

22.24 MATERIALS FOR CAR ENCLOSURES

Car walls shall be unperforated to a height of 2200 mm, except where ventilating apertures are required in accordance with rule 22.25. Car walls may be of timber, metal or other approved material.

Where required by local by-laws etc, car walls shall comply with the relevant fire-retardant properties.

22.25 VENTILATION OF LIFT-CARS

Ventilation openings shall be provided in the walls of all lift cars above the 1800 mm level and below the 300 mm level. The total area of the openings shall not be less than 5 percent of the car floor area, divided equally between the top and bottom levels. Any opening provided by a ventilating fan shall not be regarded as forming part of the natural ventilation area in that part of the car in which it is fitted.

SECTION 23 - POWER OPERATION OF CAR AND LANDING DOORS

23.1 TYPES OF DOORS PERMITTED

Where both the landing door and a car door are opened and/or closed by power, the landing door and the car door shall both be of the horizontally sliding type or both be of the vertically sliding type.

23.2 MANUAL OPENING OF POWER DOORS

All power-driven car doors shall be capable of being opened manually from within the car in an emergency. When the car is at a landing and within the unlocking zone, the landing doors shall also open with the car doors.

23.3 POWER OPENING OF DOORS

23.3.1 Power Opening of Car Doors. Power opening of a car door shall occur only at a landing when the car is stopping, levelling or at rest, subject to the further limitations prescribed in rule 15.1.3.

23.3.2 Power Opening of Landing Doors. Power opening of landing doors shall meet the following requirements:

(a) Power opening shall occur only at that landing where the car is stopping, levelling or at rest and shall begin only when the car is within the landing zone or is within the levelling zone where an automatic car levelling device is provided. (See rule 14.2).

(b) Power opening may be initiated automatically through control circuits provided that the car is being automatically stopped or levelled and provided further that, when stopping under normal operating conditions, the car is at rest or substantially level with the landings before the landing door is in the fully open position.

23.4 POWER CLOSING OF DOORS

23.4.1 Power Closing Sequence of Doors. The landing doors shall close before the car doors or the car and landing doors shall close simultaneously.

23.4.2 Control of Power-closed Horizontal Car and Landing Doors. Power closing of horizontally sliding car and landing doors by momentary pressure or by automatic means shall be subject to the following conditions:

(a) The power closing shall comply with the relevant requirements of rule 23.4.1.

(b) Doors shall be provided with a passenger protective device complying with rule 23.6.

(c) A momentary pressure switch shall be provided in the car, the operation of which shall cause the doors to stop and reopen.

23.5 KINETIC ENERGY AND FORCE LIMITATIONS FOR POWER DOOR OPERATORS (HORIZONTAL)

Where a power-operated horizontally sliding landing door is closed by momentary pressure or by automatic means (see rule 23.4.2), the closing mechanism shall be designed and installed to comply with the following requirements:

(i) The kinetic energy of the landing door and all parts rigidly connected thereto, computed for the average closing speed, shall not exceed 9.5 J. Where the landing door and the car door are closed in such a manner that stopping either one manually will stop both, the sum of the landing and car door masses as well as all parts connected rigidly thereto shall be used to compute the kinetic energy.

The average closing speed over the full door travel shall be determined by timing the closing door as follows:

(a) With single slide and two-speed doors, measure the time required for the leading edge of the door to travel from a point 50 mm away from the open jamb to a point 50 mm away from the opposite jamb. Divide the distance between these points by the time measured.

(b) 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 away from the open jamb to a point 25 mm away from the centre meeting point of the door. Divide the distance between these points by the time measured.

(ii) The force necessary to prevent closing of the landing door (or car door if power operated) from rest shall be not more than 130 N.

23.6 PASSENGER-PROTECTIVE DEVICE-HORIZONTAL DOORS

23.6.1 **Provision of Device.** Where a horizontally sliding car door of a passenger-controlled lift is power operated in association with the landing doors and the closing is controlled by momentary button pressure or by automatic means, such car door or the car door opening shall be provided with an approved passenger-protective device, and such device shall function to cause the closing power doors to operate as follows:

(a) If the device relies on physical contact for its actuation, the closing power doors shall stop and fully reopen when the protective device is actuated.

(b) If the device does not rely on physical contact for its actuation, the closing power doors shall stop and reopen partially or fully whilst the device is actuated. This type of device shall be used only in conjunction with power-operated doors where the motor is in direct control of the opening and closing motion of the doors.

Acceptable passenger-protective devices include a safety shoe or proximity detecting device on the leading edge of the car door, or a photo-electric device with beams projected across the car entrance.

23.6.2 **Delayed Closing.** If the closing of doors is delayed for a period of not less than 10 s through the operation of the passenger-protective device, the doors may power close with the passenger-protective device ineffective if the kinetic energy then does not exceed 3.4 J and an audible warning is sounded in the car. The timing device used for this purpose shall be fully reset after the car leaves each landing.

23.6.3 Circuit Failure. In the event of an open-circuit failure of the door reopening initiating devices, or the wiring thereto, the door shall not continue to close at normal operating speed, but may continue to close at a lower speed provided that the kinetic energy of the door does not exceed 3.4 J, and an audible warning is sounded in the car.

23.6.4 Secondary Device. Where a secondary door reopening device is used for purposes other than the protection of passengers, failure of this device need not cause a reduction in door speed.

23.7 VERTICALLY SLIDING DOORS-MAXIMUM CLOSING SPEEDS

The average closing speed shall not exceed 0.3 m/s for a vertically sliding counterweighted landing door or for each panel of a bi-parting counterbalanced landing door or car door and shall not exceed 0.6 m/s for a vertical sliding counterweighted car door. Closing speed shall be measured in accordance with the procedure set out in rules 23.5(i)(a) and 23.5(i)(b).

At the point of contact of closing of the doors, the closing speeds for landing doors and car doors shall be half those specified in the foregoing paragraph.

SECTION 24 - ELECTRICAL INSTALLATION (GENERAL, EARTHING AND WIRING)

24.1 MAXIMUM PERMISSIBLE VOLTAGES

The voltage for all circuits in locations other than those specified in rule 24.2 shall not exceed 440V.

24.2 CONTROL CIRCUIT VOLTAGES

The voltage of control circuits shall not exceed 250 V and one side of such circuits shall be at earth potential; provided however that for other than safety circuits higher voltages may be used for frequencies of 25 to 60 Hz alternating current, or for direct current, if the current in the system cannot under normal conditions exceed 8 mA for alternating current or 30 mA for direct current.

24.3 LIGHTING CIRCUIT VOLTAGES

The voltage of lighting circuits for all lifts shall not exceed 250 V between phase conductors and earth.

24.4 AUXILIARY APPARATUS VOLTAGES

The maximum voltage for auxiliary apparatus such as door machine motors, fan motors, etc., shall not exceed 440 V between phase conductors, and the supply shall have an earthed neutral.

24.5 USE OF RECTIFIERS, TRANSFORMERS, ETC., IN CONTROL CIRCUITS

If control circuits are supplied through a device such as a rectifier, autotransformer (see Note) or potentiometer, the door contacts shall be connected between the phase terminal of the supply circuit and the device and such phase terminal shall be at full potential above earth; alternatively, the return side of the control circuit shall be effectively earthed without the interposition of any circuit opening device.

The control circuit shall be so arranged that the lift will be inoperative in the event of an earth fault occuring in the circuit of door locks or other safety devices.

NOTE: Subject to the provisions of Regulation 110(2) of the Electrical Wiring Regulations, 1976.

24.6 JUNCTION BOX TERMINALS FOR TRAVELLING CABLES

Where junction boxes for travelling cables contain terminals of control circuits and of other auxiliary equipment circuits, the terminals shall have voltages labelled and shall be shielded against accidental contact if:

(i) they exceed 250 V between conductors or to other terminals or to earth; or

(ii) the voltage is greater than 32 V alternating current or 115 V direct current and the circuit is not controlled by the circuit-breaker controlling the lift.

24.7 STOP SWITCH ON TOP OF CAR

A stop switch shall be installed on the top of every lift car and shall be clearly visible from a landing. It shall be of such form or so located as to afford effective protection against damage or accidental switching and shall comply with the requirements of rule 26.7.

24.8 GENERAL PURPOSE POWER POINT ON TOP OF CAR

A general purpose power point of the metal protected type complying with NZS 198 shall be provided on the top of each passenger or goods lift car.

24.9 PROTECTION OF INDIVIDUAL AUXILIARY MOTORS

A group of motors associated with one lift machine may be controlled by the one circuit-breaker when connected and interlocked with various switches and relays.

24.10 CAPACITORS

Capacitors shall not be installed in any lift installation where their operation or failure will cause unsafe operation of the lift.

24.11 CLEARANCES AROUND CONTROLLERS

24.11.1 Open Type Controllers. Controllers that are not completely enclosed in cabinets or cubicles shall be so located that there shall be a clear unobstructed passage at the front, and where not wall mounted, at one side and back of the control board, of not less than 1000 mm from any live part, and 450 mm from any projection; provided however that at the front the clearance shall be not less than 600 mm from any projecting part.

24.11.2 Enclosed Controllers. Controllers that are completely enclosed in cabinets or cubicles shall be so designed and located that the following requirements are met:

(a) Access to equipment, where it is required, is by means of clearances between the cabinets and the nearest immovable object of not less than 600 mm.

(b) Sufficient clearance is provided for swing type doors to permit them to open freely through an arc of at least 90 degrees.

(c) Doors are so arranged that egress from any location would not in any circumstances require the manipulation of more than one door against the direction of egress.

(d) Where a control panel or group of panels exceeds 3500 mm in length, access shall be provided from both ends.

24.12 PREVENTION OF CONTACT WITH LIVE PARTS

Live parts of electrical equipment, other than on controllers, floor selectors or floor controllers, and circuit-breaker panels, shall be enclosed or guarded so that persons cannot come inadvertently into contact with such live parts; provided however that partial guarding of live parts of landing door contacts is acceptable if the door contacts are rendered 'dead' by the opening of the car gate contact or an auxiliary landing door contact.

24.13 EARTHING MAIN CURRENT DEVICES

The frame of the motor, the driving machine if not electrically continuous with the motor, the frame of the control panel, the cases and covers of the main current overtravel switch and similar electrical equipment which normally carry the main

current, shall be adequately earthed. The earthing conductor shall be a copper cable not less in cross-sectional area than 2.5 mm^2 (7/0.67), if in a cable, or if a separate earthing continuity conductor it shall be $4mm^2$ (7/0.85) terminated in a lug of the soldered or crimped type in which the conductor is not directly clamped by the terminal bolt or nut. The earthing connection shall be not less than a 6 mm brass bolt, stud or screw.

24.14 EARTHING CONTROL CURRENT DEVICES

All metallic cases and covers of individual door locks, door contacts, call and control buttons, stop buttons, car switches, limit switches, junction boxes and similar electrical fittings which normally carry only the control current, shall be earthed by an earthing conductor at least equivalent to a 2.5 mm^2 (7/0.67) conductor and provided with an earthing terminal at least equivalent to a 4.5 mm brass screw.

24.15 EARTHING OF ELECTRICAL APPARATUS INSTALLED IN LIFT CARS

The exposed metal parts of all individual electrical apparatus, motors, etc., installed on a lift car shall be effectively earthed by an earthing conductor at least equivalent to a 2.5 mm^2 (7/0.67) conductor, connected to a brass earthing terminal not less than 6 mm diameter located in an accessible position on the car cross-head or under-beam, and all earthing conductors shall be connected to this terminal.

In addition to the car being earthed through the hoist ropes, one of the following means of earthing via a travelling cable or cables, shall be provided:

(i) any two paralleled single cores, each not less than 32/0.20; or

(ii) any four paralleled single cores, each not less than 24/0.20

Such insulation shall be coloured green or a combination of green-yellow.

24.16 EARTHING OF CONTROL CIRCUITS

Earth connections to control circuits shall be made at the point of origin of such circuits, and where multiple earth connections are made they shall be permanently bonded together.

24.17 EARTHING OF BELL AND INDICATOR TRANSFORMERS

One side of the secondary circuit of bell and indicator transformers, and their cases if of metal, shall be earthed.

24.18 ELECTRICAL SUPPLY

Refer to the current edition of the Electrical Wiring Regulations.

24.19 IDENTIFICATION OF SWITCHGEAR

Where an installation comprises more than one lift, all switches, circuit-breakers and fuses used in connection with each lift shall be identified by appropriate word or words and/or identification numbers as required by rule 28.4.

24.20 POSITION OF CIRCUIT-BREAKERS

Circuit breakers shall be installed in the machine room in an accessible position, convenient and adjacent to the entrance.

Where the machine, generator and controller are not in clear view of a person operating the circuit-breaker, isolation arrangements shall be provided as required by Electrical Wiring Regulations 1976. (see also rule 7.12).

24.21 WIRING

All wiring, unless specifically exempted in these Rules shall comply with the requirements of the Electrical Wiring Regulations 1976.

The following general requirements shall be observed in the installation of electrical wiring:

(i) All cables (other than trailing cables) installed for any purpose in a lift shall be armoured, or be enclosed in steel conduit, duct, or trunking, or be of the mineral insulated metal-sheathed type or the aluminium sheathed type. Non-metallic conduits and fittings which comply with the following British Standards are acceptable:

(a) BS 4607 : Parts 1 and 2. Rigid PVC conduits and conduit fittings, Metric units and Imperial units respectively.

(b) BS 4607 : Part 3. Pliable corrugated, plain and reinforced conduits of self- extinguishing plastics material.

Note: The plain type of conduit to this standard is not acceptable.

Multicore control cables sheathed with non-flammable thermo-plastic material may be installed on the side of a suitable wood batten if they are mechanically protected by a metallic casing to the satisfaction of the inspecting engineer surveyor.

NOTE: The provisions of this Section apply also to wiring for auxiliary or additional equipment, such as telephones or alarm systems, reticulated music, etc. Reticulated music systems shall be provided with a shut-off switch in or on the car, to close down the system whilst the lift is being maintained.

(ii) Metal trunking may be used with clip, screw or rivet-on lids or inspection covers; provided however that where fixed to the liftwell the lids and inspection covers shall be of the screw-on type. In addition, a minimum of two rivets to every 2000 mm length of trough cover used in the liftwell shall be provided. Such rivets shall be located at the highest point of the cover.

Covers in the liftwell shall be arranged to preclude the entry of oil.

Inspection covers shall be provided at each point where conduits enter or leave troughing, and at branches of troughing. Trunking and fittings in liftwells and machine rooms shall be constructed from steel of minimum gauge 1.6 mm, provided however that troughing having a maximum cross-sectional area of 120 cm^2 may be constructed from steel of minimum gauge 1.0 mm, for use in machine rooms and on the lift car.

(iii) Wiring, cables, trunking, etc. shall not be laid on the floor in accessways (for definition of accessway see Note 1 of Rule 7.7.2). It may be laid in the floor (see (iv)) or against the wall or at a height of 2 metres above the floor of the machine room providing accessways are not obstructed'.

(iv) Where trunking is laid in the floor, covers shall be of a robust and non-slip type, and shall be flush within 3 mm of floor level.

24.22 PRECAUTIONS IN WIRING OF CARS

The securing of all flexible connections, conduit and fittings shall be mechanically sound, with due regard to the conditions created in the running of the car, the operation of the safety gear, the landing of the car and the need for the roof of the car to be used for purposes of maintenance and inspection. (see rule 22.14).

24.23 TRAVELLING CABLES TO CARS

24.23.1 Length. Travelling cables used for connections to lift cars shall be of such length that they will not come into contact with the bottom of the liftwell when the lift car is at its lowest point of normal travel. All travelling cables shall comply with AS C307, Flexible Travelling Cables for Lifts or BS6977 : 1969 Braided Travelling Cables for Electric and Hydraulic Lifts.

24.23.2 Connection. Travelling cables to the lift car shall be connected to an approved junction box or control fitting on the lift car.

24.23.3 Suspension. Travelling cables shall be so suspended at each end as to reduce the strain on the individual copper conductors to a minimum.

Travelling cables exceeding 30 m in length and which have steel supporting strands shall be suspended directly by such strands.

Where non-metallic fillers are used, the cables shall be suspended by being looped around approved supports on non-flammable material, shaped so as not to cause abrasions of the protective covering of the cable. A single core travelling cable may be supported by an approved clamp.

24.23.4 Hazardous Location. Travelling cables for use in hazardous locations shall be of a type specifically approved for the purpose, by the Chief Engineer Surveyor.

24.23.5 Location of and Protection for Cables. Travelling cable supports shall be so located as to minimize the possibility of damage due to the cables coming in contact with the lift car, the liftwell construction or equipment in the liftwell. Where necessary, suitable guards shall be provided to protect the cables against damage.

Travelling cables run on the side or top of the lift car shall be in screwed conduit or metal ducts.

(ii) Metal trunking may be used with clip, screw or rivet-on lids or inspection covers; provided however that where fixed to the liftwell the lids and inspection covers shall be of the screw-on type. In addition, a minimum of two rivets to every 2000 mm length of trough cover used in the liftwell shall be provided. Such rivets shall be located at the highest point of the cover.

Covers in the liftwell shall be arranged to preclude the entry of oil.

Inspection covers shall be provided at each point where conduits enter or leave troughing, and at branches of troughing. Trunking and fittings in liftwells and machine rooms shall be constructed from steel of minimum gauge 1.6 mm, provided however that troughing having a maximum cross-sectional area of 120 cm^2 may be constructed from steel of minimum gauge 1.0 mm, for use in machine rooms and on the lift car.

(iii) Wiring, cables, trunking, etc. shall not be laid on the floor in accessways (for definition of accessway see Note 1 of Rule 7.7.2). It may be laid in the floor (see (iv)) or against the wall or at a height of 2 metres above the floor of the machine room providing accessways are not obstructed'.

(iv) Where trunking is laid in the floor, covers shall be of a robust and non-slip type, and shall be flush within 3 mm of floor level.

24.22 PRECAUTIONS IN WIRING OF CARS

The securing of all flexible connections, conduit and fittings shall be mechanically sound, with due regard to the conditions created in the running of the car, the operation of the safety gear, the landing of the car and the need for the roof of the car to be used for purposes of maintenance and inspection. (see rule 22.14).

24.24 LIFT CIRCUIT DIAGRAM IN MACHINE ROOM

A circuit diagram for each lift installation shall be provided in every machine room. Acceptable means include either of the following:

(i) the diagram shall be suitably glazed or finished with a durable surface and affixed to a rigid board.

(ii) where the diagram consists of a number of sheets, the sheets shall be suitably glazed, finished or protected and shall be collated in book form between durable covers and stored in the machine room.

(iii) The sheets comprising the diagram shall each be placed into a clear eyeletted envelope of polythene or similar plastic material. The envelopes shall be hung from a suitable support fixed to the machine room.

24.25 CERTIFICATE OF COMPLIANCE AND OTHER DOCUMENTATION

(i) A certificiate of compliance with the electrical wiring regulations from the local power authority is mandatory.

(ii) A numbered drawing or drawings giving full details of the electrical installation of the lift is to be forwarded to the Inspecting Engineer Surveyor within four weeks from the date of issue of the initial interim certificate.

(iii) A certificate from a Registered Electrical Engineer certifying that the electrical installation shown in the drawings (see ii above) and the actual installation comply with the requirements of this section of the Rules shall be submitted.

Note: Lift installation companies which have established their competence and use standard electrical and electronic componentry and equipment which has been proven as follows:

(a) In Australia and used under the Lift code SAA 1735 with the "approval" of the respective state inspection authorities, or

(b) the U.S.A. and used under the ANSI/ASME A17.1 Lift code with the "approval": of the respective state inspection authorities, or

(c) the United Kingdom and used under the Lift code BS 5655 with the "approval" of the authorised inspection authorities, or

(d) in Europe and used under the CEN Lift standard EN81 with the approval of the authorised inspection authorities,

may apply to the Marine Division Head Office with all the relevant supporting details and background for permission to issue this certificate.

SECTION 25 - OPERATING DEVICES AND CONTROL EQUIPMENT

25.1 TYPES OF OPERATING DEVICES

All operating devices shall be of the enclosed electric type. Rod or operating devices actuated directly by hand, or rope operating devices actuated by wheels, levers or cranks, shall not be used to directly operate the controller or brake mechanism of an electric lift.

25.2 OPERATION BY CAR SWITCH

Handles of lever-type car switches shall be so arranged that they will return to the stop position and latch there automatically when the attendant removes his hand. If the car switch is of a type so arranged that its centring does not immediately stop the lift, an emergency switch shall be provided for this purpose. The car switch shall be situated adjacent to the car entrance and if of the swing type, shall be so connected as to cause down motion of the car when moved towards this entrance.

25.3 OPERATING DEVICE ON ROOF OF CAR FOR INSPECTION SERVICE

Means shall be provided to operate the lift from the roof of the car, for the purpose of inspection, maintenance and repair. The operating means shall comply with the following requirements:

(i) It shall be of the metal protected type, and shall be fixed between the car crosshead and that side of the car which is nearest to the landing door used for access, and shall be so designed or located that inadvertent operation is prevented.

(ii) It shall be of the continuous pressure button type, two of which must be pressed to operate the lift in either direction.

(iii) It shall operate the car at a speed not exceeding 0.7 m/s.

(iv) It shall operate the car only when the car door is in the closed position and when all landing doors are closed and locked.

(v) It shall incorporate a switch which, when operated, ensures that the movement of the car and operation of any power doors will be solely under the control of the above device and the device shall not be operable when the switch is in the 'off' position.

(vi) When under the control of this controlling device, the upward travel of the car shall be limited so that its roof does not approach closer than 1800 mm from the top of the liftwell. If necessary a supplementary terminal limit switch shall be provided in association with this controlling device to effect the required limitation of travel.

25.4 OPERATION IN LEVELLING OR MANUAL INCHING ZONE

25.4.1 General. The operation of a lift in the self-levelling or manual inching zone at any landing, by an automatic levelling or manual inching device when the landing doors and/or car doors are not in the closed position, is permissible subject to the following rules 25.4.2 to 25.4.7 inclusive.

25.4.2 Manual Inching Devices. A lift having a landing speed not exceeding 0.75 m/s may be provided with an inching device comprising continuous pressure type buttons. Such device shall enable the car to be inched to, but not away from, a landing with the car and landing doors open and shall operate only within the inching zone of any floor landing. It shall be so designed and installed that the lift car will not move out of the inching zone when a single short-circuit or fault occurs in the control circuit, or a mechanical breakdown occurs to the inching device. Each inching button or device shall be clearly and permanently labelled.

25.4.3 Self-levelling Devices. Self-levelling devices shall be so designed and installed that in the event of a single short-circuit or earth fault occurring in the levelling control circuit, or a mechanical breakdown of the levelling device occurring, the lift will not move out of the levelling zone.

25.4.4 Extent of Self-levelling and Inching Zone. The self-levelling zone above and below any landing shall not extend more than 750 mm where an automatic device is used, and the inching zone shall not extend more than 250 mm above and below any landing where a manual inching device is used.

25.4.5 **Levelling Speed.** An automatic levelling device shall not move the car at a speed exceeding 0.5 m/s.

25.4.6 **Car Aprons.** The length of car aprons shall be in accordance with rule 22.23.

25.4.7 **Flushness of Liftwell Below Landing Sill.** The extent of flushness below landing sills shall be in accordance with rules 15.1.3 and 15.1.4.

25.5 CAR CONTROL BUTTONS

Car control buttons shall be placed in the sequence of the landings served. The marking of the buttons shall correspond with the names or numbers of the landings served.

25.6 OPERATION OF LIFTS UNDER FIRE OR OTHER EMERGENCY CONDITIONS (EXCLUDING EARTHQUAKES)

25.6.1 **Application.** This rule shall apply in all emergencies except under earthquake conditions (see rules 2.2 and 25.9).

All lifts having a travel of over four floors or exceeding 15 metres, whichever is the lesser shall conform with this rule. However its inclusion is recommended as a safety precaution for all lifts.

25.6.2 **Requirements:**

(a) Recall Switch - A two position key switch with the key removable in both the 'on' and 'off' positions, shall be provided at a nominated main floor of each single lift, each hospital lift and each group of other than hospital lifts.

The recall switch shall be located at a height between 1650 and 1700 mm from the floor, at the left hand side of the lift entrances at the main floor, and clearly and permanently marked EMERGENCY FIRE RECALL SWITCH together with the "off" and "on" positions. The switch shall be operated by a master key, duplicates of which shall be held by the Fire Brigade and the person in the building who is responsible for the supervision of lift operations. When this switch is in the 'on' position -

(i) all lifts which are not operating on inspection service (see Rule 25.3), shall return non-stop to the main floor and remain parked with the doors open; during this procedure the following sign shall be illuminated in each car, 'LIFT RETURNING TO MAIN FLOOR';

(ii) a lift travelling away from the main floor shall reverse at the next available floor;

(iii) door reopening devices for power-operated doors shall be rendered inoperative;

(iv) All landing calls registered shall be cancelled and landing buttons shall be inoperative.

(v) when it is considered safe to do so, the lifts may be returned to normal service by moving the key switch to the 'off' position.

(b) The return to the main floor shall be initiated immediately on the operation of the recall switch or, for other than hospital lifts on the actuation of the sprinkler, heat, and/or smoke sensing devices in the building excepting those in the lift well or machine room (see Rule 25.7)

(c) On any car returning to the main floor in accordance with sub-rules (a) or (b) the control shall be automatically switched so that:

(i) the lift is operable only by a person in the car;

(ii) it does not respond to landing calls;

(iii) passenger protective devices for power operated doors are rendered inoperative;

(iv) calls from the car may be registered;

(v) when a car call is registered, continuous pressure on a specific Door Close button shall cause the doors to close; the doors shall not close if the car call registered corresponds to the floor at which the car is standing;

25.4 Operation in Levelling or Manual Inching Zone

25.4.1 General. The operation of a lift in the self-levelling or manual inching zone at any landing, by an automatic levelling or manual inching device when the landing doors and/or car doors are not in the closed position, is permissible subject to the following Rules 25.4.2 to 25.4.7 inclusive.

25.4.2 Manual Inching Devices. A lift having a landing speed not exceeding 0.75 m/s may be provided with an inching device comprising continuous pressure type buttons. Such device shall enable the car to be inched to, but not away from, a landing with the car and landing doors open and shall operate only within the inching zone of any floor landing. It shall be so designed and installed that the lift car will not move out of the inching zone when a single short-circuit or fault occurs in the control circuit, or a mechanical breakdown occurs to the inching device. Each inching button or device shall be clearly and permanently labelled.

25.4.3 Self-levelling Devices. Self-levelling devices shall be so designed and installed that in the event of a single short-circuit or earth fault occurring in the levelling control circuit, or a mechanical breakdown of the levelling device occurring, the lift will not move out of the levelling zone.

25.4.4 Extent of Self-levelling and Inching Zone. The self-levelling zone above and below any landing shall not extend more than 750 mm where an automatic device is used, and the inching zone shall not extend more than 250 mm above and below any landing where a manual inching device is used.

25.4.5 Levelling Speed. An automatic levelling device shall not move the car at a speed exceeding 0.5 m/s.

25.4.6 Car Aprons. The length of car aprons shall be in accordance with Rule 22.23

25.4.7 Flushness of Liftwell Below Landing Sill. The extent of flushness below landing sills shall be in accordance with Rules 15.1.3 and 15.1.4

~~**25.5 Car Control Buttons**~~

~~Car control buttons shall be placed in the sequence of the landings served. The marking of the buttons shall correspond with the names or numbers of the landings served.~~

* Start at Main entrance/s.

25.5.

25.6 Operation of Lifts under Fire or Other Emergency Conditions (excluding earthquakes)

25.6.1 Application. This Rule shall apply in all emergencies except under earthquake conditions (see Rules 2.2 and 25.9).

All lifts having a travel exceeding 15 metres, shall conform with this Rule. However its inclusion is recommended as a safety precaution for all lifts.

~~Where the lift machine room and/or liftwell has, or is to be~~ fitted with fire sprinklers, heat ~~sensors shall~~ be fitted and the system ~~shall conform to sections~~ 25.6 and 25.7 of the NZ Power ~~Lift Rules 1989~~.

~~**25.6.2 Requirements - Operation upon Fire Protection System Operation**~~

(a) Upon the operation of any sprinkler, heat detector, manual call point or smoke sensing devices in the building, excepting those in the liftwell or lift machine room (see Rule 25.7), all lifts which are not operating on inspection service shall proceed non-stop to the main floor and open their doors. During this procedure -

(i) the following sign shall be illuminated in each car, "LIFT RETURNING TO MAIN FLOOR".

(ii) a lift travelling away from the main floor shall reverse at the next available floor.

(iii) door re-opening devices for power-operated doors shall be rendered inoperative.

(iv) all landing calls registered shall be cancelled and landing buttons shall be inoperative.

(b) On any car returning to the main floor in accordance with sub-rule (a) the control shall be automatically switched so that:

(i) the lift does not respond to landing calls.

(ii) the lift will respond to car calls.

(iii) After responding to any car calls the lift will return to the main floor and open its doors. The doors shall remain open until a car call is registered.

(c) It shall not be permitted to return the lift to normal service by interconnecting the circuitry through the Fire Service Brigade Alarm Silencing Switch. This clause shall be applied retrospectively.

25.6.2 -Requirements for Recall Switch

(a) Recall Switch - a two position key switch with the key removable in both the 'on' and 'off' positions, shall be provided at a nominated main floor of each single lift, each hospital lift and each group of other than hospital lifts.

Compatable with the existing national pattern.

The recall switch shall be located at a height between 1650 and 1700 mm from the floor, at the left hand side of the lift entrances at the main floor, and clearly and permanently marked EMERGENCY FIRE RECALL SWITCH together with the 'off' and 'on' positions. The switch shall be operated by a master key, duplicates of which shall be held by the Fire Brigade and the person in the building who is responsible for the supervision of lift operations. When this switch is in the 'on' position then for any car returning to the main floor in response to the recall switch the control shall be automatically switched so that:

(i) all lifts which are not operating on inspection service (see Rule 25.3), shall return non-stop to the main floor and remain parked with the doors open; during this procedure the following sign shall be illuminated in each car, 'LIFT RETURNING TO MAIN FLOOR'

(ii) a lift travelling away from the main floor shall reverse at the next available floor.

(iii) the lift is operable only by a person in the car;

(iv) all landing calls registered shall be cancelled and landing buttons shall be inoperative;

(v) passenger protective devices for power operated doors are rendered inoperative;

(vi) calls from the car may be registered;

(vii) when a car call is registered, continuous pressure on a specific Door Close button shall cause the doors to close. The doors shall not close if the car call registered corresponds to the floor at which the car is standing;

(viii) if the Door Close button is released while doors are closing but before the car begins to move, the doors shall immediately reopen; the call shall remain registered;

(ix) as soon as the lift begins to move, the Door Close button may be released without interfering with the established sequence of operations;

(x) if the lift is in motion, further calls to intermediate floors may be registered from within the car;

(xi) all calls registered from the car shall be cancelled when the car reaches its first stop;

(xii) the doors shall only be opened by continuous pressure on a specific Door Open button when the lift is stopped at a floor. If the button is released while the doors are being opened, the doors shall immediately shut.

(xiii) all security systems shall be overridden;

When it is considered safe to do so the lifts may be returned to normal service by moving the key switch to the "OFF" position.

Operation of the recall switch shall override operation upon fire protection system operations.

25.6.7 Notice

A non-illuminated engraved notice shall be provided adjacent to or on each landing call button plate reading 'DO NOT USE LIFT IN EVENT OF FIRE' in clearly legible letters not less than 8 mm high.

Pages 126A/126B follow

(vi) if the Door Close button is released while doors are closing but before the car begins to move, the doors shall immediately reopen; the call shall remain registered;

(vii) as soon as the lift begins to move, the Door Close button may be released without interfering with the established sequence of operations;

(viii) if the lift is in motion, further calls to intermediate floors may be registered from within the car;

(ix) all calls registered from the car shall be cancelled when the car reaches its first stop;

(x) the doors shall only be opened by continuous pressure on a specific Door Open button when the lift is stopped at a floor. If the button is released while the doors are being opened, the doors shall immediately shut.

(xi) all security systems shall be overridden.

(d) A non-illuminated engraved notice shall be provided adjacent to or on each landing call button plate reading 'DO NOT USE LIFTS IN EVENT OF FIRE' in clearly legible letters not less than 8 mm high.

25.7 REQUIREMENTS WHERE MACHINE ROOMS AND/OR LIFTWELLS ARE PROTECTED FROM FIRE BY AN AUTOMATIC FIRE SPRINKLER SYSTEM

25.7.1 Application. This rule shall apply only to those lifts installed in buildings where the machine rooms and/or liftwells are protected by an automatic fire sprinkler system (see rules 7.2 and 12.5).

25.7.2 Requirements:

(i) An approved heat detecting fire alarm system which is proved to operate at least 11°C below the sprinkler head rating shall be fitted.

(ii) For each sprinkler head fitted a heat detector sensor shall be installed in its vicinity.

(iii) Sprinkler heads and heat detector sensors shall be protected from accidental damage by approved guards.

(iv) Operation of the heat detector (in liftwell or machine room) fire alarm shall take all lifts (not operating on special or inspection service) non stop to the main floor and then render them inoperative with the doors open.

(v) While returning to the main floor the following sign shall be illuminated in each lift car, "LIFT RETURNING TO MAIN FLOOR".

(vi) The lifts shall remain inoperative until such time as the power driving circuit is reset by a competent lift serviceman who has satisfied himself that the lift installation is safe.

(vii) The heat detectors shall comply with the following:

(a) The requirements of NZSS 2139 "Specification for Heat Actuated Fire Detectors" for fixed temperature type.

(b) Be constructed, and installed for operation at 'extra low voltage'. For the definition of 'extra low voltage' refer to the current edition of the Electrical Wiring Regulations.

25.8 LIFTS ON SPECIAL SERVICE

To enable any lift to be operated individually on special service while other lifts in the group operate normally, in every lift car shall be provided a key operated switch clearly and permanently marked "SPECIAL SERVICE" together with the "off" and "on" positions. The key shall be removable in both the "off" and "on" positions. When the switch is in the "on" position the lift shall only be operational from inside the car, it shall not respond to lift landing calls and it shall be locked out of the 'Recall Switch' circuit as per Rule 25.6.2.

25.9 OPERATION OF LIFTS UNDER EARTHQUAKE CONDITIONS

25.9.1 Major component displacement detector. All lifts with a travel exceeding 4 floors or 15 metres whichever is the smaller, shall be fitted with a counterweight derailment switch. This device (see fig. 25.1) shall be actuated when the displacement of the counterweight in any one direction of the horizontal plane exceeds 20 mm.

25.9.2 Operation. Upon operation of this device every lift shall:

(i) If in motion, immediately decelerate and stop at the next possible floor and remain stopped with the doors open;

(ii) If stopped at a floor, remain in that position with the doors open.

In a bank of lifts, all lifts shall follow this procedure if the device is operated by any one or more lifts in the bank.

NOTE: All lifts which have been stopped in this manner shall not be put back into operatio until a thorough inspection of the lifts and liftwells has been carried out and certified to be satisfactory by a competen lift serviceman.

MAJOR COMPONENT DISPLACEMENT DETECTOR

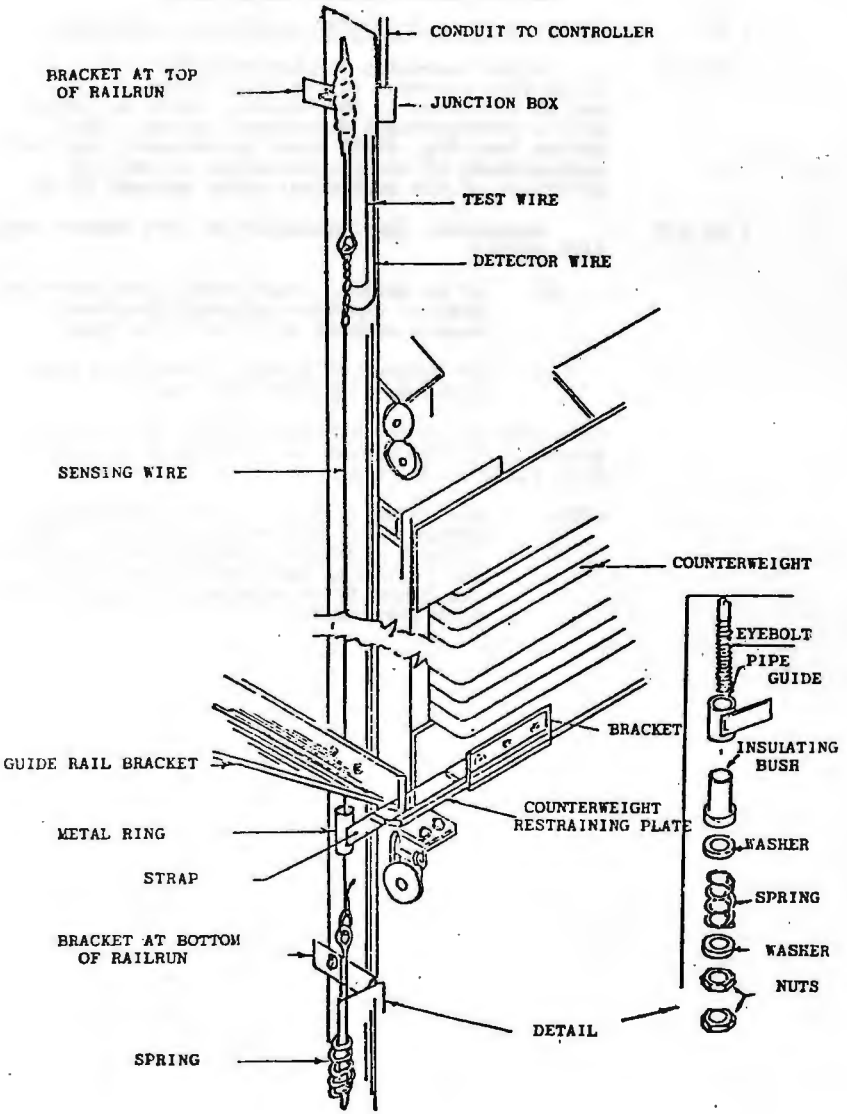


FIG. 25.1

SECTION 26 - ELECTRICAL PROTECTIVE DEVICES

26.1 PROTECTIVE DEVICES-GENERAL

26.1.1 Stop switch on Top of Car. A stop switch, complying with rule 24.7, shall be provided on the top of every electric and every electrically controlled lift car.

26.1.2 Pit Stop Switch. A stop switch, complying with rule 11.7, shall be provided in the pit of every electric and electrically controlled lift.

26.1.3 Machine Room Stop Switch. Where required by rule 7.12, a stop switch complying with that rule shall be provided in the machine room.

26.1.4 Stop Switch for Sheave Room or Platform. Where required by rule 7.12, a stop switch complying with that rule shall be provided for the sheave room or platform.

26.1.5 Broken Tape Switch. A broken tape, rope, wire or chain switch complying with rule 27.2.4, shall be provided in respect of normal limit switches located in machine rooms of traction lifts.

26.1.6 Broken Rope Switch. If the safety gear is not of a type that will operate on the breaking of a single rope, a broken rope switch of the manually reset type shall be provided, and such switch shall automatically open the control circuit and stop the lift in the event of any one rope breaking.

26.1.7 Compensating Sheave Switch. Compensating sheaves shall be provided with a compensating sheave switch or switches, mechanically opened by the compensating sheave before the sheave reaches its upper or lower limit of travel, to open the control circuit and stop the lift machine.

26.1.8 Slack Rope Switch. Lifts having winding drum machines shall be provided with a slack rope switch of the manually reset type, at or adjacent to the machine, which shall open the control circuit and stop the lift machine if any one of the hoist ropes becomes slack.

26.1.9 Safety Gear Switch. A safety gear switch shall be provided as required by rule 29.7.

26.1.10 Governor Switch. Governor switches shall be provided in accordance with rule 30.3.

26.1.11 Overtravel Limit Switches. Overtravel limit switches complying with rule 27.3 shall be provided for every electric lift.

26.1.12 Terminal Speed Checking and Stopping Devices. When reduced stroke oil buffers are provided as permitted by rule 10.5.2(b), terminal speed checking devices complying with rule 27.4 shall be provided.

26.1.13 Buffer Switches for Oil Buffers used with Type D Safety Gear. Oil level and compression switches complying with rule 29.8.2 (g) and (h) shall be provided for all oil buffers used with Type D safety gear.

26.1.14 Landing Door Contacts. Landing door contacts complying with rule 14.3 shall be provided for every electric or electrically controlled lift.

26.1.15 Car Door Contacts. Each car door shall be provided with a car door contact, so located as to be inaccessible from inside the car. When the contact is open it shall prevent movement of the car, except as provided under rule 14.1. Contact shall be made only when the door is in a closed position.

26.1.16 Pit Access Door Contact. A pit access door contact complying with rule 11.5.2(b) shall be provided for every electric or electrically controlled lift.

26.1.17 Normal Limit Switches. Normal Limit switches complying with rule 27.2 shall be provided for every electric or electrically controlled lift.

26.1.18 Motor Generator Overspeed Protection. Where a motor-generator set is driven by a direct current motor, means shall be provided to cause the electric power to be cut off automatically from the lift motor and brake should the motor-generator set overspeed by 20% or more.

26.2 PHASE-REVERSAL AND FAILURE PROTECTION

Lifts having polyphase alternating current power supply shall be arranged to prevent the starting of the lift motor in the wrong direction if -

(i) the phase rotation is in the wrong direction; or

(ii) there is a failure of any phase.

26.3 RELEASE AND APPLICATION OF DRIVING-MACHINE BRAKES

Driving-machine brakes shall not be electrically released until power has been applied to the driving-machine motor.

All power feed-lines to the brake shall be opened and the brake shall apply automatically when -

(i) the operating device of a lift car switch or continuous pressure operation button is in the stop position;

(ii) a floor stop device functions;

(iii) any of the electrical protection devices functions.

Under conditions (i) and (ii), the application of the brake may occur on or before the completion of the slow-down and levelling operations.

The brake shall not be permanently connected across the armature or field of a direct current lift motor.

26.4 CONTROL AND OPERATING CIRCUIT REQUIREMENTS

In the design and installation of the control and operating circuits the following requirements shall be met:

(i) Any springs used to actuate controller switches, contactors or relays in order to break the circuit to stop a lift at the terminal landings, shall be of the compression type and effectively located.

(ii) The completion or maintenance of an electric circuit shall not be used to interrupt the power to the lift motor or brake at the terminal landings, nor to stop the lift car when the emergency stop switch is opened or any of the electrical protective devices operate; provided however that this requirement shall not apply to dynamic braking nor to speed control switches.

(iii) The failure of any single magnetically operated switch, contactor or relay to release in the intended manner, or the occurrence of a single accidental earth fault, shall not permit the lift car to start or run if any landing door or car door contact is in the open position.

(iv) Where generator field control is used, means shall be provided to prevent the generator from building up and supplying sufficient current to the lift motor to move the lift car when the lift motor control switches are in the 'OFF' position. The means used shall not interfere with maintenance of an effective dynamic braking circuit during stopping and standstill conditions.

(v) The control circuits shall be so designed and installed that the lift car speed in the down direction with 125 percent of the rated load in the lift car, under normal operating conditions with the power supply on or off, shall not exceed 120 percent of the rated speed.

(vi) Where generator field control is used, means shall be provided to restrict dynamically the car speed under conditions of brake-off with power supply connected and motor generator running to -

(a) 0.25 m/s for geared machines;

(b) one-seventh of the rated speed of the lift for gearless machines.

Compliance with this requirement shall be demonstrated by a test in the down direction with rated load in the car.

26.5 USE OF RECTIFYING UNITS TO SUPPLY POWER TO DIRECT CURRENT LIFT MOTORS

Where a non-rotating or other type rectifying unit, which is incapable by itself of absorbing the energy generated by the lift motor as a result of overhauling loads, is used to transform alternating current to direct current for the operation of a direct current lift motor or motors, means shall be provided on each lift controller to absorb a sufficient amount of the energy regenerated by the lift motor under overhauling conditions to prevent the lift from attaining at any time a speed of more than 120 percent of the rated speed.

26.6 OVERLOAD WEIGHING DEVICES

Load weighing devices may be used to prevent the closing of power operated doors in the event of a car being overloaded, but shall not be connected so as to cause interruption of the control circuit of the lift motor. Any such device shall be arranged to afford visual and audible warning of the overload.

26.7 STOP SWITCHES - GENERAL REQUIREMENTS

Stop switches shall comply with the following requirements:

(i) They shall be of the manually opened and closed type.

(ii) They shall be capable of being positively opened mechanically and not solely dependent on springs. Commercial switches shall comply with AS C133 Ap., Air-break switches (Endorsed by SANZ).

(iii) They shall be conspicuously and permanently marked 'Emergency Stop', and the emergency stop position shall be clearly marked.

(iv) When opened the switch shall open the control circuit so as to stop the car and prevent the power doors from operating.

SECTION 27 - TERMINAL STOPPING DEVICES

27.1 GENERAL REQUIREMENTS

Normal and overtravel limit switches shall comply with the following requirements:

(i) The switch contacts shall be directly opened mechanically. Arrangements which depend on a spring and/or gravity to open the contacts shall not be used.

(ii) Where located on the lift or in the liftwell, the switches shall be of the enclosed type and securely mounted in such a manner that the movement of the switch lever or roller to open the contacts shall be as nearly as possible in a direction at right angles to a vertical plane through the front face of the car guide rails. Operating cams shall be of metal.

27.2 NORMAL LIMIT SWITCHES (SLOW DOWN AND STOPPING)

27.2.1 General. Upper and lower normal limit switches shall be provided and arranged to slow down and stop the lift automatically, at or near the top and bottom landings, with any load up to and including rated load in the lift and from any speed attained in normal operation. Such switches shall function independently of the operation of the operating device and of the overtravel limit switch. The switch shall be so designed and installed that it will continue to function until the overtravel limit switch operates.

27.2.2 Traction Machines. Normal limit switches for traction machines shall be located on the lift car, or in the liftwell, or in the machine room, and shall be operated by the movement of the lift.

27.2.3 Drum Machines. Normal limit switches for drum machines shall be located on the lift car or in the liftwell and shall be operated by the movement of the lift.

27.2.4 Normal Limit Switches in Machine Rooms. Normal limit switches located in a machine room shall comply with the following requirements:

(a) The switch contacts shall be mounted on and operated by a device mechanically connected to and driven by the lift. Devices depending on friction or traction shall not be used.

(b) Tapes, chains, ropes or similar devices, mechanically connecting a normal limit switch to the lift and used as a driving means, shall be provided with a broken tape switch complying with rule 26.1.5 which will open the control circuit and stop the lift machine if driving means fails.

NOTE: A floor controller or selector may be used as a normal limit switch if its contacts and the means for operating them comply with the relevant requirements of rule 27.1 and 27.2.

27.3 OVERTRAVEL LIMIT SWITCHES

27.3.1 General. Every lift shall be provided with overtravel limit switches according to the type of driving machine, as follows:

(a) Drum drive, all forms of control---mechanically operated main current overtravel switch complying with rule 27.3.2.

(b) Traction drive --- mechanically operated control current overtravel limit switch complying with rule 27.3.3.

27.3.2 Main Current Overtravel Switches. Main current overtravel switches shall ---

(a) completely interrupt electrical supply from all parts of the motor, brake and control panel by the mechanical operation of a switch and also open the brake circuit where the motor is of a type that may act as a generator to hold the brake off, and upon its operation maintain the circuits open and prevent the future movement of the lift in either direction until the switch has been reset manually;

(b) have the switch portion of the mechanism located in the machine room and be of a design and so placed that inspection and testing for correct adjustment may be performed readily and without interference with or manipulation of other portions of the control mechanism.

27.3.3 Overtravel Limit Switch (Control Current). Overtravel limit switches shall comply with rule 27.1 and shall -

(a) be positively operated by the lift car and shall prevent movement of the lift in either direction.

(b) for lifts with variable voltage motor generator control, be installed so that the electrical control of the hoist motor has full dynamic stopping effect and the electrical supply to the motor generator set is not interrupted.

(c) not control the same controller switches or contactors as the normal limit switches unless two or more separate and independent controller switches or contactors are provided, two of which shall be closed to complete the driving machine motor and brake circuit in either direction of travel. The control circuit shall be so designed and installed that a single earth fault or short-circuit may prevent either one but not both the normal stopping limit switches and overtravel limit switch circuits from stopping the lift.

27.3.4 Setting. The setting of overtravel limit switches shall be arranged as follows:

(a) The switches shall not function with the normal operation of the lift.

(b) Where spring or solid buffers are used, the switches shall open before the car or counter-weight strikes its buffer and in no case after the car has travelled more than 225 mm beyond the top or bottom landing.

(c) Where oil buffers are provided, the overtravel switches shall be set to operate when the car has travelled beyond the top landing by a distance not exceeding 25 percent of the counterweight buffer stroke plus 225 mm with a maximum distance of 500 mm and beyond the bottom landing by a distance not exceeding 50 percent of the car buffer stroke plus 225 mm with a maximum distance of 900 mm.

(d) The switch shall be so designed and installed that it will remain opened when the car or counterweight is fully supported by its buffer.

(e) Overtravel limit switches provided with adjustable mountings shall be pinned in position after final adjustment of position has been made.

27.4 EMERGENCY TERMINAL SPEED LIMITING DEVICES

Emergency terminal speed limiting devices (see rule 10.5.2(b)) shall be installed where reduced stroke buffers are used and shall comply with the following requirements:

(i) Their operation shall be entirely independent of the operation of the normal slow down and stopping switches required by rule 27.2 and they shall function to reduce the speed of the car to a value, not in excess of the rated striking speed of the reduced stroke buffers before engagement occurs, should the normal slow down and stopping switches fail to slow down the car at the terminal as intended.

(ii) One acceptable method of meeting the requirements of item (i) would be the provision of a speed measuring device and position sensing switches to compare the speed and position of the lift relative to the terminal landings, the speed measuring device being located in the machine room or secondary floor and driven by the machine, speed governor or other mechanism connected to the lift car, and the position sensing switches being located on the car, in the liftwell or in the machine room and operated by the car directly or via a non-slip drive from the lift car.

(iii) Means shall be provided to open the control circuit and stop the lift machine in the event of failure of any drive incorporating tape, chain, rope, etc, used for the emergency terminal speed limiting device.

Exception - Governor rope where the governor is used to drive the speed measuring device.

(iv) They shall provide a retardation not in excess of 9.8 m/s^2.

(v) They shall not apply the car safety gear.

(vi) They shall be so designed that a single short-circuit caused by a combination of earth faults or other conditions shall not prevent their functioning.

(vii) The same machine room mechanism and connection to the car shall not be used for operating both the normal terminal stopping device and the emergency terminal speed limiting device.

SECTION 28 - INDICATORS, ANNUNCIATORS, ALARMS, TELEPHONES, ETC.

28.1 MARKING OF FLOOR LANDINGS

Each landing shall be clearly marked with the number or name of the floor or corresponding button, if any, in the lift. Such markings shall be not less than 50 mm high and shall comply with the following requirements:

(i) If the landing door is not power operated, the marking shall be located on the liftwell face of the landing door, where it is clearly visible to the attendant in the car, looking horizontally through the car door vision panel when the car is substantially level with the landing and car and landing doors are closed.

(ii) Where both landing and car doors are power operated, the marking shall be located on a wall or partition adjacent to or immediately facing the lift entrance, so that it can be read by the attendant in the car facing the main doorway.

(iii) A vision panel may be provided adjacent to the car control device for identification of landings, and the designation of each landing marked in the liftwell in such a position as will be visible to the attendant when the car is level with the landing.

28.2 POSITION INDICATOR IN CAR

A position indicator shall be fitted in the car of every automatic lift so that it can be read by passengers facing the main doorway.

28.3 EMERGENCY COMMUNICATION AND ALARM

28.3.1 All lifts shall be provided with an emergency audible alarm as per rule 28.3.2.

Those lifts which are situated in buildings whose occupancy or location may negate the effectiveness of the audible alarm, such as office buildings after normal working hours or remote domestic dwellings, shall also be fitted with a telephone alarm system as per rule 28.3.3.

28.3.2 Audible Alarm. Audible alarms shall -

(a) be a bell or similar device having a gong not less than 150 mm diameter (electronic type alarms having a comparable sound intensity may be used in lieu);

(b) be operated from an emergency power supply system as described in rule 28.3.4;

(c) be located outside the liftwell in the main lobby or in another location where it is most likely to be heard by persons located in the building; the bell shall be so positioned or protected as to prevent interference;

(d) if no person is permanently located in the building, have an additional bell located in a position where it will be heard by persons outside the building, together with a notice stating 'Lift Alarm' and giving the name and telephone number of the organization responsible for the maintenance of the lift;

(e) have the alarm button at a height from the floor not exceeding 1140 mm. (see NZS 4121:Part 1: 1971 Code of Practice for Design for Access by Handicapped Persons).

28.3.3 Telephone Alarm System. Telephone alarm systems shall be so designed that -

(a) they provide direct communication if necessary by dialling to a location which is manned continuously, 24 hours per day.

(b) they are accessible from within the car without the use of a key.

(c) they can be operated from the emergency power supply system required by rule 28.3.4 unless supplied from the post office system.

(d) The location of the lift and the lift number shall be clearly displayed by the telephone.

(e) The dial and handset shall be approximately 910 mm above floor level. (see NZS 4121 : Part 1 : 1971 Code of Practice for Design for Access by Handicapped Persons).

28.3.4 Power for Emergency Communication and Alarm Systems. The power supply required in rule 28.3.2 and 28.3.3 shall be provided from an emergency power source complying with the following -

automatically recharged batteries having sufficient capacity for 2 hours operation of the system, having a diversity factor of 0.25 hours on and 0.75 hours off.

Alternatively the power supply for alarms may be provided from the emergency lighting system, in which case that system shall have additional capacity to meet the requirements of this section in addition to rule 22.20.2.7.

28.4 NUMBERING OF LIFTS

In any building having more than one lift, every lift shall be consecutively numbered. Where lifts are in groups, the numbering shall be from left to right, with the observer facing the group of lift entrances at the main floor. The respective lift numbers shall be legibly marked and permanently attached or applied to each of the components listed in Table 28.4.

TABLE 28.4

NUMBERING OF LIFTS

Unit	Minimum size of lettering mm	Position
Car	13	Above control device
Machine	50	Facing access
Controller	40	Front face or side according to access
Selector or floor controller	25	Facing access
Governor	25	Facing access
Circuit-breaker or its enclosure	25	Front
Main current overtravel switch (where provided)	25	Front
Main-room isolating switch (where provided and if not on controller or other numbered device)	25	Front

SECTION 29 - SAFETY GEAR - CAR AND COUNTERWEIGHT

29.1 WHERE REQUIRED AND LOCATION

The car of every lift suspended by wire ropes shall be provided with one or more safety gears of one of the types identified in rule 29.2. The safety gear shall be attached to the car frame and one safety gear shall be located within or below the lower member of the car frame.

29.2 SAFETY GEAR - IDENTIFICATION AND CLASSIFICATION OF TYPES

Safety gears are identified on the basis of performance characteristics after the safety gear begins to apply pressure on the guide rails. On this basis there are four types of safety gears, described in the following rules 29.2.1 to 29.2.4.

29.2.1 Type A (Instantaneous) Safety Gear. Type A safety gear is safety gear which, through its inherent design, develops a rapidly increasing pressure on the guide rails during the stopping interval, the stopping interval being very short and not associated with any significant slide. Type A safety gear applies pressure on the guide rails through rollers, eccentrics, cams or similiar devices without the deliberate introduction of any flexible medium to limit the retarding force and increase the stopping distance. The energising or operating force is derived entirely from the mass and motion of the lift car or counterweight being stopped, once initial contact with the guide rails has been effected by action of the governor rope, inertia of the safety mechanism or slackening of hoist ropes.

29.2.2 Type B (Flexible Guide Clamp) Safety Gear. Type B safety gear is safety gear which, through its inherent design, develops a substantially constant pressure on the guide rails during the stopping interval so as to afford slide, the stopping distance being related to the mass being stopped and the speed at which application of the safety gear is initiated. Type B safety gear applies pressure on the guide rails through wedges, gibs, jaws or similar devices that are subject to a flexible medium to limit the retarding force. The energizing or operating force is derived entirely from the mass and motion of the lift car or counterweight being stopped, once initial contact with the guide rails has been effected by action of the governor rope. Minimum and maximum stopping distances are specified on the basis of governor tripping speed. (see rule 29.4).

29.2.3 Type C (Wedge-clamp) Safety Gear. Type C safety gear is safety gear which, through its inherent design, develops a progressively increasing pressure on the guide rails during at least part of the stopping interval, so as to afford slide, the stopping distance being related to the mass being stopped and the speed at which application of the safety gear is initiated. Type C safety gear applies pressure on the guide rails through gibs, jaws or similar devices actuated by a drum (or the equivalent) and safety rope connected to the governor rope. The energizing or operating force is derived entirely from tension in the governor rope. Minimum and maximum stopping distances are specified on the basis of governor tripping speed. (see rule 29.4).

29.2.4 Type D (Oil Buffer) Safety Gear. Type D safety gear is safety gear which develops retarding forces during the compression stroke of one or more oil buffers interposed between the lower members of the car frame or counterweight and an auxiliary 'safety plank' attached to a governor-operated Type A safety gear applied on the guide rails.

NOTE: Types A, B and D safety gear may usually be released by lifting the car or counterweight to which they are attached.

29.3 MULTIPLE SAFETY GEAR

Where multiple safety gear of unequal capacities are used, the lower safety gear shall be capable of developing not less than one-half of the force required to stop the entire car with the rated load, as defined in rule 21.1.

Multiple safety gears shall function approximately simultaneously. Types A, C and D shall not be used in multiple arrangements.

29.4 FUNCTION AND STOPPING DISTANCE OF SAFETY GEAR

The safety gear, or the combined safety gears where provided, shall be capable of stopping and sustaining the entire car with its rated load from governor tripping speed, when tested in accordance with rule of Part 5.

Type B safety gear shall stop the car with its rated load from maximum governor tripping speed within the range of stopping distances shown by Fig. 29.4(a). Table 29.4 gives the minimum and maximum stopping distances based on the maximum governor tripping speeds associated with typical car speeds.

Type C safety gear shall stop the car with its rated load from governor tripping speed within the range of stopping distances shown by Fig. 29.4(b).

For type D safety gear the stopping distance is equal to the effective stroke of the incorporated oil buffers specified in rule 29.8.2(b) & (c).

TABLE 29.4

TYPE B SAFETY GEAR STOPPING DISTANCES*

Rated speed m/s	Maximum governor trip speed m/s	Stopping distances, m	
		min.	max.
0-0.65	0.9	0.04	0.37
0.75	1.07	0.06	0.42
0.9	1.25	0.08	0.48
1.0	1.40	0.10	0.54
1.12	1.54	0.12	0.60
1.25	1.68	0.14	0.67
1.50	1.97	0.20	0.82
1.75	2.26	0.26	1.00
2.00	2.55	0.33	1.20
2.25	2.84	0.41	1.42
2.50	3.12	0.50	1.60
3.00	3.70	0.70	2.25
3.50	4.27	0.93	2.91
4.00	4.85	1.20	3.69
4.50	5.42	1.50	4.55
5.00	6.00	1.84	5.51
5.50	6.60	2.22	6.61
6.00	7.20	2.64	7.83
6.50	7.80	3.10	9.17
7.00	8.40	3.60	10.60
7.50	9.00	4.13	12.10

*Intermediate values may be obtained from Fig. 29.4(a)

29.5 COUNTERWEIGHT SAFETY GEAR

Counterweight safety gear where provided shall comply with the requirements for car safety gear, except where otherwise specified in these rules provided however that for travel not exceeding 5.5 m counterweight safety gear may be operated as a result of the breaking or slackening of the hoist ropes and may be of the inertia or other approved type without governors. (see rule 30.1).

Counterweight safety gear, when provided, shall be so designed that it can be released by the upward movement of the counterweight.

29.6 SAFETY GEAR NOT TO STOP ASCENDING CAR OR COUNTERWEIGHT

Safety gear shall not stop an ascending car or counterweight.

29.7 SAFETY GEAR SWITCH

29.7.1 Car Safety Gear Switch. The car of every electric lift shall be provided with a safety gear switch which will positively open the control circuit and stop the lift machine should the car safety gear operate. Safety gear switches shall be of a type which will not reset unless the safety gear has been returned to the "off" position.

29.7.2 Counterweight Safety Gear Switch

29.7.2.1 Governor Operated. Where counterweight safety gear is provided and is governor operated, a switch shall be provided on a governor which shall open the control circuit and stop the lift machine at or before the instant that the governor jaws grip the governor rope.

29.7.2.2 Not Governor Operated. Where counterweight safety gear is not governor operated and is in accordance with rule 29.5, one of the following requirements shall be met:

(a) The safety gear shall be provided with a switch complying with rule 29.7.1.

(b) If operated by an independent rope -

(i) a switch shall be provided on the releasing carrier; or

(ii) a positively opened switch shall be provided at the car end of this rope.

(c) A timing device shall be provided which shall operate at not more than 50% in excess of the time taken for the car to travel non-stop at its normal operating speed between terminal floors.

The switch or device under (a), (b) or (c) above shall open the control circuit and stop the lift machine and remain open until the switch or device has been manually reset.

29.8 LIMITS OF USE OF SAFETY GEAR

29.8.1 Type A (Instantaneous) Safety Gear.

Type A safety gear shall not be used in lifts having a rated speed in excess of 0.8 m/s.

When overspeed occurs, with the hoist ropes intact, such safety gear shall be actuated by the governor, except where a governor is omitted under the provision of rule 30.1.

On the parting of the hoist ropes (free fall), Type A safety gear shall apply without appreciable delay; its application shall be independent of the speed action of the governor and of the location of the break in the hoist ropes (inertia application) and may be accomplished by the use of a governor and governor rigging having a sufficiently high value of inertia to apply the safety gear on free fall independently of the speed action of the governor (see rule of Part 5, for inertia application test of Type A car safety gear).

29.8.2 Type D (Oil Buffer) Safety Gear.

Type D safety gear may be used subject to the following requirements:

(a) The rated speed shall be not more than 2.5 m/s.

(b) The oil buffers shall conform to all requirements specified in rule 10.5 for oil buffers, except that the stroke shall be based on governor tripping speed.

(c) After the buffer stroke, as defined in paragraph (b) above, has been completed, provision shall be made for an additional travel of the plunger or piston of not less than 10 percent of the buffer stroke to prevent excessive impact on the buffer parts and the auxiliary safety plank.

(d) Where the distance between guide rails exceeds 2500 mm, the safety gear shall be provided with two oil buffers of substantially identicial calibration; the buffers shall be so located as to develop minimum stresses in the auxiliary safety plank during safety gear operation. Buffers shall be located in line with and symmetrically between the guide rails.

(e) The auxiliary safety plank shall be so supported and guided below the car frame that the clearances specified in rule 29.10 for the safety gear parts are maintained during normal operation.

The auxiliary safety plank shall be so designed that the maximum stresses in the plank will not exceed those specified for similar car-frame members in rule 22.10.3.

(f) The rail gripping device of the auxiliary safety plank shall be so arranged and connected as to prevent the plank from being out of level more than 13 mm in the length of the plank when the safety gear is operated to stop the car.

(g) An electric switch shall be provided and so arranged and connected that the lift cannot be operated by means of the normal operating device if any buffer is compressed more than 10 percent of its stroke.

(h) Means shall be provided to prevent operation of the lift by means of the normal operating device if the oil level in any buffer is below the minimum allowable level.

29.9 APPLICATION AND RELEASE OF SAFETY GEAR

29.9.1 Means of Application. Safety gear shall be applied mechanically. Electric, hydraulic or pneumatic devices shall not be used to apply the safety gear required by this Section nor to hold such safety gear in the retracted position. The forces which provide the stopping action shall be compressive forces on each side of the guide rail section.

For Type C wedge-clamp safety gear, when pressure on the guide rail has attained the requisite value during the latter portion of the stopping interval, the governor rope shall pull through the governor jaws, so preventing further increase in the pressure on the rails and damage to the safety gear.

29.9.2 Level of Car Platform on Safety Gear Application. The application of the safety gear to stop the car with its rated load distributed so that one-quarter of the load is symmetrically located in each quarter of the platform area, shall not cause the platform to be out of level more than 20 mm/m in any direction, or 75 mm total over the maximum length or breadth of the lift car floor.

29.9.3 **Release.** When a safety gear is applied no decrease in tension in the governor rope nor motion in the down direction shall release the safety gear, but such safety gear may be released by motion in the up direction.

29.10 MINIMUM PERMISSIBLE CLEARANCE BETWEEN RAIL GRIPPING FACES OF SAFETY GEAR PARTS

In the normally retracted position of the safety gear the distance between the rail-gripping faces of the safety gear parts shall be not less than the thickness of the guide rail plus 3.5 mm. The minimum clearance on any side between the gripping face and the guide rail shall be not less than 1.5 mm as measured on the side of the rail toward which the car frame is pressed with sufficient force to take up all clearances in the guide shoe assembly. Safety gear jaws, while in the retracted position, shall be so restrained as to prevent a reduction of this minimum clearance.

29.11 TYPE C SAFETY GEAR-ROPE PULL-OUT

For all Type C safety gear, the movement of the governor rope, relative to the car or the counterweight respectively, required to operate the safety mechanism from its fully retracted position to a position where the safety gear jaws begin to exert pressure against the guide rails, shall not exceed 1070 mm for car and counterweight safety gear.

Drum operated car and counterweight safety gears, requiring continual unwinding of the safety drum rope to fully apply the safety gear, shall be so designed that not less than 40 percent of the turns of the safety rope on the drum will remain on the drum after the overspeed test of the safety gear has been made with rated load in the car (see rule of Part 5).

29.12 MINIMUM FACTORS OF SAFETY AND STRESSES OF SAFETY GEAR PARTS AND ROPE CONNECTIONS

29.12.1 Factors of Safety.

29.12.1.1 Parts other than springs. Parts of safety gear, except springs, shall meet the following requirements:

(a) They shall have a factor of safety of not less than 3.5 (based on tensile strength).

(b) The materials used shall have an elongation of not less than 15 percent in a gauge length of 50 mm.

(c) Forged, cast or welded parts shall be stress relieved.

Provided however that safety-rope drums, leading sheaves and their supporting brackets and safety jaw gibs may be made of cast iron or other metals if such parts have a factor of safety not less than 10.

29.12.1.2 Rope. Rope used as a connection from the safety gear to the governor rope, including rope wound on the safety-rope drum, shall be not less than 9.5 mm in diameter and shall be corrosion resistant. The factor of safety of the rope shall be not less than 5.

29.12.1.3 Basis of factors. The factors of safety shall be based on the maximum stresses developed in the parts during the operation of the safety gear when stopping rated load from governor tripping speed.

29.12.2 Springs. Springs may be used in the operation of car or counterweight safety gear. Where used and where partially loaded prior to safety gear operation the load on the spring shall not produce a fibre stress exceeding one-half the elastic limit of the material. During operation of the safety gear, the fibre stress shall not exceed 85 percent of the elastic limit of the material. Helical springs, where used, shall be in compression.

29.12.3 Attachment or Support. Safety-rope leading sheave brackets and other safety operating parts shall not be attached to or supported by wood platform members.

29.13 CORROSION-RESISTANT BEARINGS IN SAFETY GEAR AND SAFETY OPERATING MECHANISMS

Bearings in safety gear and of the safety operating mechanism shall be of corrosion resistant construction with one or both members of a bearing made of, or electroplated with, a corrosion resistant material.

29.14 GOVERNOR ROPE TENSION

The tension in the governor rope, necessary to bring the safety gear initially into contact with the guide rails, shall not exceed 50 percent of the pull through tension developed by the governor. Any releasing carrier shall be designed so that the pull-out tension cannot be adjusted in a normal manner to exceed the amount specified.

29.15 RAIL LUBRICANTS

Rail lubricants or coatings, where used, shall be of a type which will not reduce the holding power of the safety gear or prevent its functioning as required in rule 29.4.

Where Type B or C safety gear is used, a metal plate shall be securely attached to the car crosshead in an easily visible location displaying in letters not less than 6 mm high one of the following as appropriate:

(i) For dry rail operation, notice to read:

SAFETY WARNING : THESE RAILS ARE NOT TO BE LUBRICATED

(ii) For lubricated rails, notice to read:

SAFETY WARNING : USE ONLY .....(BRAND) LUBRICANT..... (GRADE) ON THESE RAILS, FOR ALTERNATIVE GRADES CONSULT MANUFACTURER OF SAFETY GEAR.

29.16 COMPENSATION SHEAVE LOCK-DOWN

For rated speeds of 4 m/s or more, a device shall be provided to lock or tie down the compensation sheave, so that in the event of either buffer engagement or application of the safety gear of the car or counterweight, the jump of the car or counterweight will be restricted.

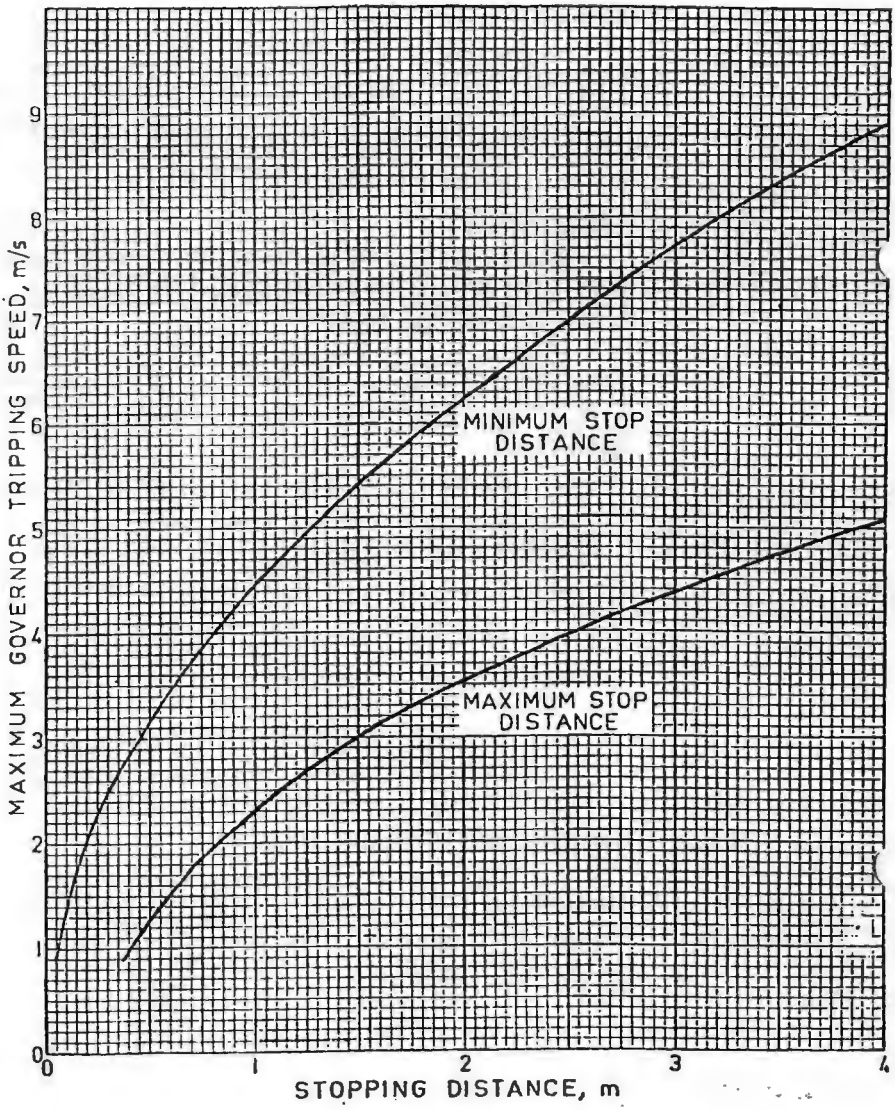


Fig.29.4(a). STOPPING DISTANCES FOR TYPE B SAFETY GEAR

(continued)

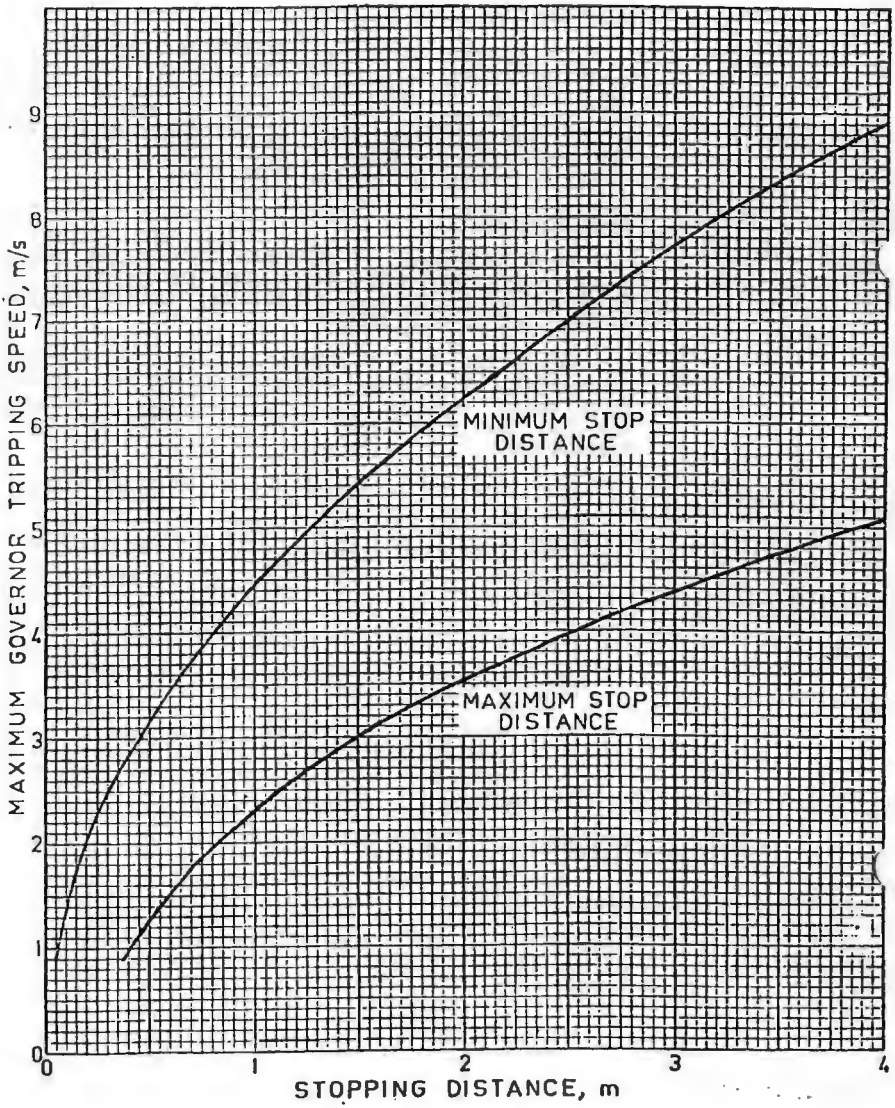


Fig.29.4(a). STOPPING DISTANCES FOR TYPE B SAFETY GEAR

(continued)

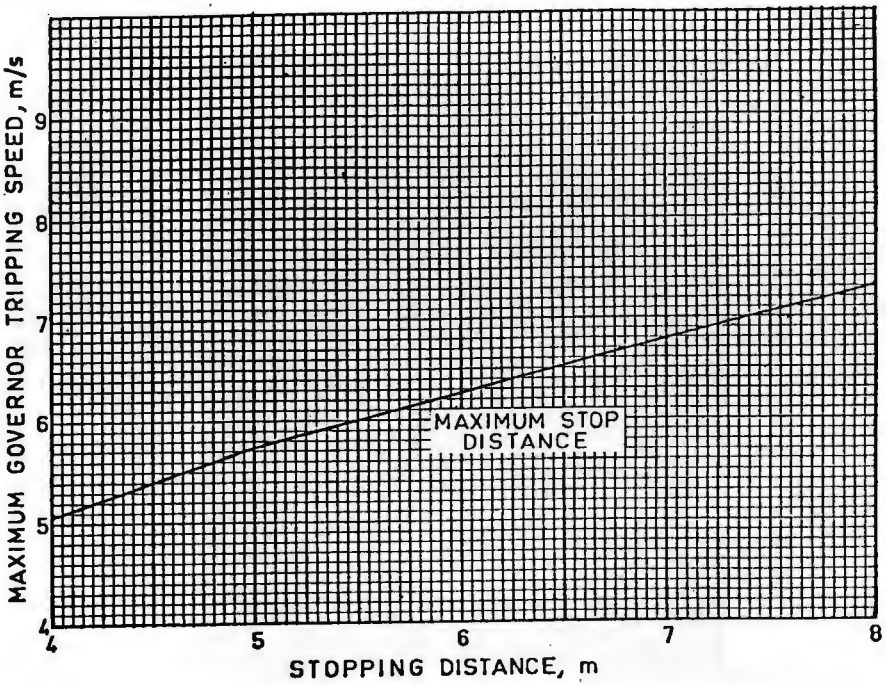
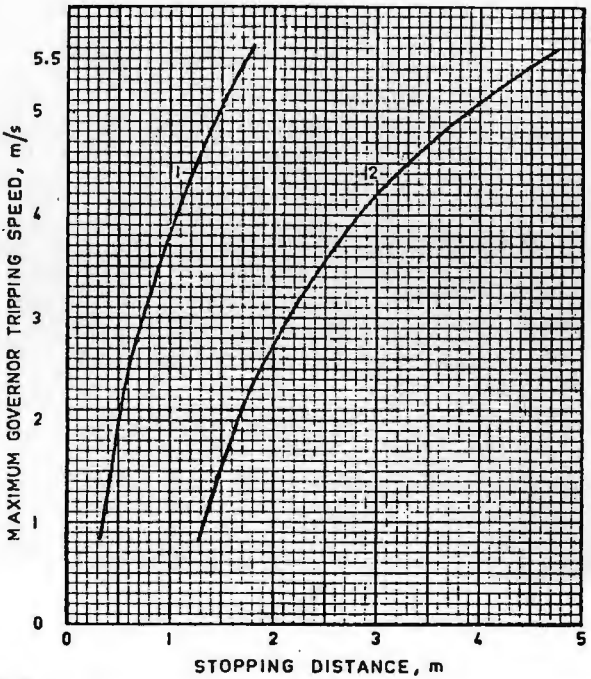


Fig. 29. 4 (a)—continued



Legend:
Curve 1 gives minimum stopping distance for car with 100 percent load or counterweight.
Curve 2 gives maximum stopping distance for car with 100 percent load or counterweight.

Fig. 29.4(b). MINIMUM AND MAXIMUM STOPPING DISTANCES OF CAR AND COUNTERWEIGHT WITH WEDGE CLAMP SAFETY GEAR TYPE C

SECTION 30 - SPEED GOVERNORS

30.1 LOCATION AND REQUIREMENTS OF GOVERNORS

Car safety gear and counterweight safety gear, where provided, shall be activated by separate speed governors; provided however that if the safety gear operates automatically following the breaking of the hoist ropes, a governor need not be provided for the safety gear of a car or counterweight having a travel of 5.5 m or less.

The governors shall be located where they cannot be struck by the car or the counterweight in the case of overtravel and where there is adequate space for full movement of governor parts.

30.2 MECHANICAL TRIPPING SPEEDS FOR GOVERNORS

30.2.1 Car speed Governors. Speed governors for car safety gear shall be set to trip at overspeeds as follows:

(a) At not less than 115 per cent of the rated speed

(b) At not more than the maximum governor tripping speed given in Table 30.2, column 2, appropriate to the rated speed.

30.2.2 Counterweight Speed Governors. Any governor for a counterweight safety gear shall be adjusted to trip at a speed greater than, but not more than 10 percent above, the tripping speed of the car governor.

30.3 GOVERNOR SWITCHES

30.3.1 General. Any governor installed shall be provided with a switch operated by the overspeed action of the governor, where the governor is used -

(a) With Type B or C car safety gear of lifts having a rated speed exceeding 0.65 m/s

(b) With any type of safety gear and the lift machine is V-belt driven and the travel exceeds 5.5 m

(c) With counterweight safety gear.

Such switch shall be positively opened in either direction of lift travel, shall be of the manually reset type, and shall, when opened, interrupt the control circuit and stop the lift machine.

TABLE 30.2

MAXIMUM SPEEDS AT WHICH CAR SPEED GOVERNOR TRIPS AND GOVERNOR OVER-SPEED SWITCH OPERATES*

1	2	3
Rated speed m/s	Maximum governor trip speed m/s	Maximum speed at which governor overspeed switch operates in down direction m/s
0-0.65	0.9	0.90
0.75	1.07	0.95
0.9	1.25	1.12
1.0	1.40	1.26
1.12	1.54	1.38
1.25	1.68	1.51
1.40	1.85	1.66
1.50	1.97	1.77
1.75	2.26	2.03
2.00	2.55	2.29
2.25	2.84	2.56
2.50	3.12	2.81
3.00	3.70	3.51
3.50	4.27	4.06
4.00	4.85	4.60
4.50	5.42	5.15
5.00	6.00	5.70
5.50	6.60	6.27
6.00	7.20	6.84
6.50	7.80	7.41
7.00	8.40	7.98
7.50	9.00	8.55

* Intermediate values may be obtained from Fig 30.2.

30.3.2 Setting of Switch. The setting of the governor switch shall comply with the following requirements:

(a) For rated speeds up to and including 2.5 m/s, the governor switch shall open in the down direction of the lift at not more than 90% of the speed at which the governor is set to trip in the down direction. (see Table 30.2 column 3)

(b) For rated speeds more than 2.5 m/s, the governor switch shall open in the down direction of the lift at not more than 95% of the speed at which the governor is set to trip in the down direction. (see Table 30.2, column 3)