NZS 4332:1997

NON-DOMESTIC PASSENGER AND GOODS LIFTS

Superseding NZS 4332P:1994

Single User PDF Terms & Conditions

You have material which is subject to strict conditions of use. Copyright in this material is owned by the New Zealand Standards Executive. Please read these terms and conditions carefully, as in addition to the usual range of civil remedies available to Standards New Zealand on behalf of the New Zealand Standards Executive for infringement of copyright, under New Zealand law every person who infringes copyright may be liable to a fine of up to $10,000 for every infringing copy or imprisonment of up to 5 years, or a fine of up to $150,000 or imprisonment not exceeding 5 years.

You have access to a single-user licence to read this non-revisable Adobe Acrobat PDF file and print out and retain ONE printed copy only.

We retain title and ownership of the copyright in this PDF file and the corresponding permitted printed copy at all times.

Under this license use of both the PDF file and the single permitted printed copy of this PDF file you may make are restricted to you. Under no circumstances are you permitted to save, sell, transfer, or copy this PDF file, the one permitted printed copy of this PDF file, or any part of either of them.

You undertake that you will not modify, adapt, translate, reverse engineer, decompile, disassemble or create derivative works based on any of the downloaded PDF file, nor will you merge it with any other software or document, even for internal use within your organization.

Under no circumstances may this PDF file be placed on a network of any sort without our express permission.

You are solely responsible for the selection of this PDF file and any advice or recommendation given by us about any aspect of this PDF file is intended for guidance only and is followed or acted upon entirely at your own risk.

We are not aware of any inherent risk of viruses in this PDF file at the time that it is accessed. We have exercised due diligence to ensure, so far as practicable, that this file does not contain such viruses.

No warranty of any form is given by us or by any party associated with us with regard to this PDF file, and you accept and acknowledge that we will not be liable in any way to you or any to other person in respect of any loss or damage however caused which may be suffered or incurred or which may arise directly or indirectly through any use of this PDF file.

Regardless of where you were when you received this PDF file you accept and acknowledge that to the fullest extent possible you submit to New Zealand law with regard to this licence and to your use of this PDF file.

COMMITTEE REPRESENTATION

This Standard was prepared by committee ME/4/NZ Lift Installations, operating as a national subcommittee under the terms of the Active Co-operation Agreement between Standards New Zealand and Standards Australia, and also for the Standards Council, established under the Standards Act 1988. The committee consisted of representatives from the following interested parties and organizations:

Building Industry Authority
Building Owners and Managers Association
Engineering consultants
Marine and Industrial (M & I)
Ministry of Commerce
New Zealand Lift and Escalator Association
Major lift manufacturers

ACKNOWLEDGEMENT

Standards New Zealand wishes to acknowledge the help of the Department of Labour, Occupational Safety and Health, Engineering Safety, during the transition of the Power Lift Rules from the Department to Standards New Zealand.

© COPYRIGHT

AMENDMENTS

No	*Date of issue*	*Description*	*Entered by, and date*

CONTENTS **PAGE**

Contents continued overleaf

Contents continued

Contents continued overleaf

Contents continued

Contents continued overleaf

Contents continued

Contents continued overleaf

Contents continued

Contents continued overleaf

Contents continued

PART 5 REQUIREMENTS FOR PEOPLE WITH DISABILITIES

Section

Appendix

Table

Contents continued overleaf

Figure

RELATED DOCUMENTS

NEW ZEALAND STANDARDS

NZS 2139:1967	Specification for heat actuated fire detectors
NZS 3000:1997	Electrical installations – Buildings, structures and premises
NZS 3101:1995	Concrete structures standard
NZS 3109:1987	Specification for concrete construction
NZS 3404:1992	Steel structures standard
NZS 4121:1985	Code of practice for design for access and use of buildings and facilities by disabled persons
NZS 4203:1992	General structural design and design loadings for buildings
NZS 4223:- - - Part 3:1993	Code of practice for glazing in buildings Human impact safety requirements
NZS 4512:1994	Fire alarm systems in buildings
NZS/BS 4620:1970	Specification for rivets for general engineering purposes
NZS 4711:1984	Qualification tests for metal-arc welders
NZS/BS 4848:- - - Part 2:1991	Hot-rolled structural steel sections Hot-finished hollow sections

AUSTRALIAN STANDARDS

AS B66:1969	Worm gearing
AS B118:1953	Dimensions of small rivets for general purposes
AS 1159:1988	Polyethylene pipes for pressure applications
AS 1163:1991	Structural steel hollow sections
AS 1237:1973	Flat metal washers for general engineering purposes (metric series)
AS 1442:1992	Carbon steels and carbon-manganese steels – Hot-rolled bars and semifinished products
AS 1443:1994	Carbon steels and carbon-manganese steels – Cold-finished bars

AS 1444:1986	Wrought alloy steels – Standard and hardenability (H) series and hardened and tempered to designated mechanical properties
AS 1448:1981	Carbon steels and carbon-manganese steels – Forgings
AS 1654:1995	ISO system of limits and fits
AS 1722:- - - - Part 1:1975	Pipe threads of Whitworth form Sealing pipe threads
AS 1735:- - - - Part 2:1993	Lifts, escalators and moving walks Passenger and goods lifts – Electric
AS 1979:1993	Electric cables – Lifts – Flexible travelling
AS 2784:1985	Endless wedge belt and V-belt drives
AS 2938:1993	Gears – Spur and helical – Guide to specification and rating
AS 3133:1989	Approval and test specification – Air break switches
AS 3569:1989	Steel wire ropes
AS 3791:1991	Hydraulic hose
AS 4058:1992	Precast concrete pipes
AS 4100:1990	Steel structures

JOINT AUSTRALIAN/NEW ZEALAND STANDARDS

SANZ/SAA HB 18.25:1991	Guide 25 – General requirements for the competence of calibration and testing laboratories
AS/NZS 1110:1995	ISO metric precision hexagon bolts and screws
AS/NZS 1111:1980	ISO metric hexagon commercial bolts and screws
AS/NZS 1112:1980	ISO metric hexagon nuts, including thin nuts, slotted nuts and castle nuts
AS/NZS 1252:1983	High strength steel bolts with associated nuts and washers for structural engineering
AS/NZS 1427:1974	ISO metric machine screws
AS/NZS 1554.1:- - - - Part 1:1995	Structural steel welding Welding of steel structures
NZS/AS 1830:1986	Iron castings – Grey cast iron

NZS/AS 1831:1985 Iron castings – Spheroidal or nodular graphite cast iron

NZS/AS 1832:1985 Iron castings – Malleable cast iron

NZS/AS 2074:1982 Steel castings

AS/NZS 2544:1995 Grey iron pressure fittings

AS/NZS 3679:- - - Structural steel
Part 1:1990 Hot-rolled bars and sections
Part 2:1991 Welded I sections

ISO/IEC STANDARD

ISO/IEC Guide 25:1990 General requirements for the competence of calibration and testing laboratories

AMERICAN STANDARDS

ANSI/ASME A17.1 Handbook-1993 Elevators, escalators, and moving walks

ANSI/ASME BI.20.1-1983 Pipe threads, general purpose

ASTM D97-1993 Test method for pour point of petroleum products

ASTM D2270-1993 Practice for calculating viscosity index from kinematic viscosity at 40 and 100 ºC

SAE J516-1994 Hydraulic hose fittings

SAE J517-1996 Hydraulic hose

BRITISH STANDARDS

BS 4:- - - - Structural steel sections
Part 1:1993 Specification for hot-rolled sections

BS 29:1976 Specification for carbon steel forgings above 150 mm ruling section

BS 46:- - - - Keys and keyways and taper pins
Part 1:1958 Specification. Keys and keyways

BS 302:- - - - Stranded steel wire ropes
Part 4:1987 Specification for ropes for lifts

BS 436:- - - - Spur and helical gears

BS 463:- - - - Specification for sockets for wire ropes

BS 721:- - - - Specification for worm gearing

BS 3601:1987	Specification for carbon steel pipes and tubes with specified room temperature properties for pressure purposes
BS 3602:- - - -	Specification for steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties
BS 3603 :1991	Specification for carbon and alloy steel pipes and tubes with specified low temperature properties for pressure purposes
BS 3604:- - - -	Steel pipes and tubes for pressure purposes: ferritic alloy steel with specified elevated temperature properties
BS 3790:1981	Specification for endless wedge belt drives and endless V-belt drives
BS 3832:1991	Specification for wire reinforced rubber hoses and hose assemblies for hydraulic installations
BS 4278:19484	Specification for eyebolts for lifting purposes
BS 4500:- - - -	ISO limits and fits
BS 4586:1992	Specification for spiral wire reinforced rubber covered hydraulic hoses and hose assemblies
BS 5655:- - - -	Lifts and service lifts
BS 6977:1991	Specification for insulated flexible cables for lifts and for other flexible connections

OTHER DOCUMENTS

EN 81:- - - -	Safety rules for the construction and installation of lifts and service lifts

NEW ZEALAND LEGISLATION

Building Act 1991

New Zealand Building Code

The users of this Standard should ensure that their copies of the above-mentioned New Zealand Standards or of overseas Standards approved as suitable for use in New Zealand are the latest revisions or include the latest amendments. Such amendments are listed in the annual Standards New Zealand *Catalogue* which is supplemented by lists contained in the monthly magazine *Standards* issued free of charge to committee and subscribing members of Standards New Zealand.

FOREWORD

NZS 4332:1997 *Non-domestic passenger and goods lifts*, supersedes NZS 4332P:1994 *Non-domestic passenger and goods lifts.* It is intended that this Standard will provide a means of compliance with clause D2 of the New Zealand Building Code and referenced as an Acceptable Solution in the BIA Approved Document D2/AS1.

NZS 4332P:1994 was a provisional standard based on the Power Lift Rules 1989 (PLR) issued by the Maritime Transport Division. It was produced as an interim step following the PLR responsibility being passed to Standards New Zealand in 1993. It included the changes to the PLR as mentioned in the BIA Approved Document D2.

This new Standard has been developed following the consideration of comments received during the interim period of the 1994 provisional standard. Where previously the clause numbering had remained the same as for the PLR, (and therefore where a clause (rule) was deleted, the clause (rule) number remained but with the word "Void" inserted) the new Standard has been reformatted and there are no references to deleted clauses (rules). This has resulted in some changes to the clause numbering.

NZS 4332:1997 includes updated standard references and numerous sub-clause rewording to bring it into line with current and overseas practice.

Normative appendices are integral parts of the Standard which for reasons of convenience are placed after all other normative elements.

Informative appendices give additional information, and are placed after the normative elements of a standard. They do not contain requirements.

REVIEW OF STANDARDS

Suggestions for improvement of this Standard will be welcomed. They should be sent to the Chief Executive, Standards New Zealand, Private Bag 2439, Wellington 6020.

NOTES

NEW ZEALAND STANDARD

NON-DOMESTIC PASSENGER AND GOODS LIFTS

PART 1 GENERAL REQUIREMENTS

1 SCOPE

1.1
The scope of this Standard is the design, construction, operation and testing of passenger carrying lifts including goods lifts with car controls.

It is not intended for lifts in single unit dwellings.

This Standard applies to new building work being either the installation of a new lift or new work associated with an existing installation.

New work includes the complete or substantial replacement of a major part of the lift such as occurs with:

(a) An increase in the carrying load requiring a new hoisting machine and new ropes;

(b) An extension of travel by addition of a new floor or floors; and

(c) A conversion of hydraulic or belt driven lift to electric drive.

It does not include routine maintenance, or repair or replacement of any component or assembly with a comparable component or assembly.

NOTE –

(1) A conversion or assembly replacement that results in a speed increase will count as new work if the resulting installation can no longer comply with the speed-related requirements of this Standard such as top and bottom clearances etc. A refit of a lift car that significantly increases the car weight may also count as new work. An increase in car weight requires the balancing to be checked and a review of the lift drive capacity, guide rail capability etc.

(2) The structural design of the building necessary to support the installation of the lift shall comply with clause B1 of the NZBC, and is not covered by the Standard.

2 GENERAL

2.1 Earthquake loadings
NZS 4203 *General structural design and design loadings for buildings* shall be used for determining loadings due to seismic accelerations on lift machinery, lift guides, lift car and landing doors and standby equipment. Alternatively, these shall be calculated by using the seismic coefficient details from the lift particular sheets (see 5.2 and 31.2). The appropriate risk factor shall be determined from table 2.1 and seismic zone from Appendix B.

Table 2.1 – Risk factors

Building category	Description	Risk factor *R*
1	Structures containing highly hazardous contents	2.0
2a	Buildings which are intended to remain functional in the Emergency Period for major earthquakes	1.6
2b	Buildings whose failure could cause high loss of life in the surrounding area	1.6
3a	Buildings which should be functioning in the Restoration Period for major earthquakes	1.3
3b	Buildings whose contents have a high value to the community	1.3
4	Buildings with normal occupancy or usage	1.0

2.2 Drawings and particulars of the lift installation

The design and construction of each lift or group of lifts shall be recorded on drawings, calculation sheets, data sheets and certificates. See Appendix D for details on how this information can be presented.

NOTE –

(1) These documents are required to ensure a safe design and to assist in the correct construction of the lift. The documents may be required by the territorial authority as plans and specifications and supporting information for a building consent, and during subsequent inspections of the lift installation.

(2) The lift designer needs to convey all necessary information (such as the requirements for machine room and pit sizes, mass of components and clearances) to enable the building design to properly cater for the lift installation.

2.2.1 *Certificates*

The following aspects of the design and/or construction of the lift installation shall be verified for compliance with this Standard by a certificate from an appropriate accredited or certified testing laboratory, or qualified signatory. Certificates originating from overseas are acceptable providing their equivalence is recognized by a mutual recognition scheme or arrangement, or by acceptance of professional qualifications.

(a) The hoist ropes (see 16.1);

(b) Oil buffers (see 10.5);

(c) Strength of liftwell enclosures (see 12.2);

(d) Strength of car and landing doors (see 13.3.1);

(e) Welder qualification certificates (to be available for inspection);

(f) For caisson used to protect hydraulic cylinder (see 34.3.7).

2.2.2 *Lift particulars*

Lift particulars shall be recorded as detailed in 5.2 for electric lifts and 31.2 for hydraulic lifts.

2.3 Lift security system

2.3.1 *Location*
Equipment pertaining to the security systems for lifts may be located in the lift machine room in accordance with section 7.

2.3.2 *Securing*
The securing of all security equipment shall be in accordance with 2.1.

2.3.3 *Requirements*
Lifts fitted with security systems shall comply fully with these clauses. Attention is drawn specifically to the requirements for operation of the lifts under normal, emergency, earthquake and fire conditions.

2.3.4 *Failure*
The failure of any equipment associated with a lift security system shall not affect the reliability or safety of the lift.

2.4 Building security system

Where a building or floor or floors of a building are protected by a security system the owners or occupiers of the building, floor or floors concerned shall, on consultation with the lift contractor, provide a safe and adequate access route to the lift machine room for lift service personnel. It may also be necessary for lift service personnel to gain access to the liftwell from any car landing area.

2.5 Maintenance and inspection

To ensure continued safe operation of the lift installation, the following information shall be provided:

(a) A maintenance schedule of regular servicing, checks, adjustment and lubrication work to be carried out by competent service personnel. The schedule shall prescribe a maximum time between service visits of no more than 6 months; and

(b) An itemized check list of all safety, operating, indicating and communication devices and other equipment to be inspected by a competent person. The check list shall prescribe a maximum time between inspections but shall be no more than 12 months; and

(c) Electrical drawings and an operating manual to enable the safe operation and maintenance of the lift installation.

(d) A schedule of any inspections to be carried out by the building owner, such as checking the glazing of any observation lift for damage.

(e) Details of any tasks to be carried out by the owner, such as the procedures and safeguards to be observed for the safe cleaning of glass inside the liftwell of an observation lift.

3 DEFINITIONS

3.1
For the purpose of this Standard, unless inconsistent with the context, the following definitions apply.

NOTE – A number of terms which do not appear in the Standard have been included for the convenience of architects, engineers and manufacturers as a means of promoting standardization of nomenclature in the lift industry.

ACCREDITED/CERTIFIED TESTING LABORATORY. A laboratory that is approved to, and operates to, the requirements of SANZ/SAA HB 18.25:1991 (ISO/IEC Guide 25:1990) is deemed to comply.

ANNUNCIATOR, CAR. An electrical device in the car which indicates visually the landings at which a lift landing signal registering device has been actuated.

APPROVED. Approved in writing by the territorial authority or a building certifier acting within the scope of their approval under the Building Act 1991.

APRON. See 3.23 'Car Apron or Landing Apron'.

ASTRAGAL. A moulding applied to the meeting faces of a door panel and/or door jambs.

ATTENDANT. A person who has been specially employed or authorized in that behalf by the owner of the lift or by his/her agent to be in charge of operating the lift.

ATTENDANT CONTROLLED LIFT. A lift which is directly under the control of an attendant (refer above) and which can be started only by means of a starting switch or button in the car, and cannot be controlled from landing pushes.

AUTHORIZED PERSON. A person authorized or selected by the owner or person in charge of a building to carry out duties, other than those of lift attendant, in connection with the lift.

BOW MEMBER. The top horizontal member of the car frame.

BUFFER. A device designed to absorb the impact of a lift car or counterweight.

BUFFER CLEARANCE, CAR. The distance between the car buffer striker plate and the striking surface of the fully extended car buffer when the car floor is level with the bottom landing.

BUFFER CLEARANCE, COUNTERWEIGHT. The distance between the counterweight buffer striker plate and the striking surface of the fully extended counterweight buffer when the car floor is level with the top terminal landing.

BUFFER MEMBER. The bottom horizontal member of the car frame.

BUFFER, OIL. A buffer using oil as a medium which absorbs and dissipates the kinetic energy of the descending car or counterweight.

BUFFER, OIL, STROKE. The oil-displacing movement of the buffer, plunger or piston, excluding the travel of the buffer plunger accelerating device.

BUFFER, SOLID. A device, other than an oil or spring buffer, designed to stop a descending car or counterweight by absorbing the impact.

BUFFER, SPRING. A buffer which is capable of absorbing, in a spring, the kinetic energy of the descending car or counterweight.

BUFFER, SPRING, LOAD RATING. The load required to compress the spring an amount equal to its stroke.

BUFFER, SPRING, STROKE. The maximum distance the contact end of the spring can move under a compressive load.

CAM (RAMP). A wedge-shaped device fixed in a liftwell or on a car or counterweight and serving to operate control apparatus by means of the movement of the car or counterweight.

CAM, RETIRING. A device incorporating a cam attached to a car and arranged to retract automatically from its operating position.

CAR. The load-carrying unit including its platform, car frame enclosure and car door.

CAR APRON OR LANDING APRON. A protective screen, attached to the underside of the car platform or lift landing sill to prevent objects being trapped between the car platform and landing threshold.

CAR DOOR. A single or multipanel door that closes a car entrance.

CAR ENCLOSURE. The enclosing body of the lift car which comprises the sides and roof, and which is built upon the platform.

CAR ENTRANCE. The opening in the car enclosure through which normal access is available between the lift car and landings.

CAR FRAME. The supporting frame to which the car platform, upper and lower sets of guide shoes, car safety gear and the hoisting ropes or hoisting-rope sheaves are attached.

CAR FRAME, OVERSLUNG. A car frame to which the hoisting-rope fastenings or hoisting-rope sheaves are attached to the top horizontal member of the car frame.

CAR FRAME, UNDERSLUNG. A car frame to which the hoisting-rope fastenings or hoisting-rope sheaves are attached to the bottom horizontal member of the car frame.

CAR PLATFORM. The structure which forms the floor of the car and which directly supports the load.

CLEARANCE, MAN, BOTTOM CAR. The clear vertical distance from the pit floor to the lowest structural or mechanical part, equipment or device installed beneath the car platform, excepting guide shoes, guide rollers, safety jaw assemblies and platform aprons or guards, when the car rests on its stops or fully compressed buffer.

CLEARANCE, MAN, TOP CAR. The shortest vertical distance between the top of the car crosshead or between the top of the car where no crosshead is provided and the nearest part of the overhead structure, when the car floor is level with the top terminal landing.

CLEARANCE, MECHANICAL, BOTTOM CAR. The clear, vertical distance from the pit floor to any fitting attached to the car when the car rests on its stops or fully compressed buffer.

CLEARANCE, MECHANICAL, TOP CAR. The shortest vertical distance between the top of the car crosshead or between the top of the car, or equipment, mounted on the car roof where no crosshead is provided and the nearest part of the overhead structure, when the car floor is level with the top terminal landing.

CLEARANCE, TOP COUNTERWEIGHT. The shortest vertical distance between any part of the counterweight or component mounted thereon and the nearest part of the overhead structure or any other obstruction when the car floor is level with the bottom terminal landing.

COMPENSATING ROPES OR CHAINS. Ropes or chains suspended from the car frame will counterweight to balance the weight, or part of the weight, of the hoist ropes throughout the travel of the car.

CONTACT, CAR DOOR. A contact operated by the movement of a car door in such a manner that electrical contact Is made only when the door is closed.

CONTACT, ENCLOSURE OR LANDING DOOR. A contact operated by the enclosure or landing door in such a manner that electrical contact is made only when the door is closed.

CONTACTOR. An electro-magnetically-operated switch for making or breaking a main electrical circuit.

CONTROL. The system governing the starting, stopping, direction of motion, acceleration, speed and retardation of the lift.

CONTROL, RHEOSTATIC. A system of control which is accomplished by varying resistance and/or reactance in the armature/rotor and/or field/stator circuit of the driving machine motor.

CONTROLLER. A device or group of devices which directs the operation of the equipment and/or its auxiliaries.

COUNTERWEIGHT. A moving weight employed to balance the weight of the lift car and part of the rated load.

COUNTERWEIGHT, FLYING. A counterweight attached directly to the lift car by suspension ropes which are not driven by the driving machine. Where 2 or more counterweights are employed, one of which is driven by the machine and the other is attached to the car, the former is termed 'the counterweight' and the latter 'the flying counterweight'.

CROSSHEAD, BEAM, OR TOP MEMBER. As for Bow Member; the top horizontal member of the car frame.

DOOR, BIPARTING. A vertically or horizontally sliding door, consisting of 2 or more sections so arranged that the sections or groups of sections open away from each other and so interconnected that all sections operate simultaneously.

DOOR, LANDING. A single or multipanel door that opens and closes the landing entrance.

DOOR LOCK, ELECTRO-MECHANICAL. A combination in one unit of a door contact with a door locking device.

DOOR, LOCKING DEVICE, LANDING. A device which secures a landing door in the closed position unless the car is stopped at that landing and the unlocking of which is controlled by the position of the lift car.

DOOR, MANUALLY OPERATED. A door which Is opened and closed solely by hand.

DOOR, POWER OPERATED. A door which Is opened and/or closed by motive power other than hand power.

DOOR, SELF-CLOSING. A door which is opened manually and which closes automatically when released.

DRUM OR SHEAVE DIAMETER. The 'diameter' of a drum, sheave or pulley, shall mean the centre to centre measurement of the rope wound on it.

FIRE-RESISTANCE RATING. The measured time in hours or fractions thereof that the material or construction will withstand fire exposure as determined by fire tests conducted in conformity to recognized Standards.

FIRE-RESISTIVE CONSTRUCTION. A method of construction which prevents or retards the passage of hot gases or flames as defined by the fire-resistance rating.

GOVERNOR, SPEED. An automatic device which brings a lift car or counterweight to rest by operating the safety gear in the event of the speed exceeding a predetermined limit.

GUIDE BRACKET. A member attached to the building or structure and to which the guides are fixed.

GUIDE RAILS. The rails by which the car and counterweight are kept true in their motion.

GUIDE SHOES OR ROLLERS. Attachments to the car frame and counterweight by which they are continuously aligned with the guides.

INCHING DEVICE, MANUAL. A mechanism which, when controlled by the operator by means of up and down continuous pressure switches, will move the car within the inching zone towards the landing, but not away from it.

INSTALLATION. A complete lift including its liftwell, liftwell enclosure and related construction and all machinery and equipment necessary for its operation.

LANDING. That portion of a floor, balcony or platform used to receive and discharge passengers and/or goods.

LANDING, BOTTOM. The lowest terminal landing.

LANDING, BUTTON. A switch operated by a push button or other manual device located at a landing for the purpose of calling the lift car to that landing.

LANDING, TOP. The highest terminal landing.

LANDING ZONE. A zone extending above and below a landing by a specified distance.

LEVELLING (OR ANTI-CREEP) DEVICE. A mechanism associated with electrohydraulic lifts which will automatically correct a change in the car level caused by leakage in the hydraulic system.

LEVELLING DEVICE, CAR. Any mechanism which will move the car, at a reduced speed, within the levelling zone towards the landing only, and stop It automatically at the landing.

LEVELLING ZONE. The limiting distance above or below a landing within which the levelling device may cause movement of the car towards the landing.

LIFT. An appliance used for raising and lowering persons or goods by means of a car, the movement of which in a vertical or approximately vertical direction is maintained by guides; and includes the supports, well, enclosures, car, and the whole of the mechanical and electrical apparatus required in connection with the operation and safety of a lift.

LIFT, ELECTRIC. A lift the machinery of which is driven by an electric motor.

LIFT, GOODS. A lift designed primarily for the carriage of goods.

LIFT, HYDRAULIC. A lift in which the motion of the platform or car is obtained from the action of liquid under pressure acting on a piston or ram.

LIFT HYDRAULIC, DIRECT ACTING. A drive In which the ram or piston is directly attached to the car or platform .

LIFT, HYDRAULIC, SUSPENDED (ROPED). A drive in which the relative motion of the ram or piston and cylinder is transmitted to the car or platform by a rope or ropes by which the car or platform is suspended.

LIFT, OBSERVATION. A passenger lift in which the car and liftwells enclosure when used, have large transparent panels whereby the passengers may have a panoramic outlook.

LIFT, OVERSLUNG. Refer car frame, overslung.

LIFT, PASSENGER. A lift designed primarily for carrying passengers.

LIFT, POWER. A lift in which the motion of the car is obtained through the application of any form of energy other than manual energy and/or gravitational force.

LIFT, SUSPENDED, DRUM. A lift in which the suspension rope(s) are fastened to and wind on a drum.

LIFT, SUSPENDED (ROPED). A lift in which motion of the platform or car is obtained from a rope or ropes attached directly or indirectly to the platform or car.

LIFT, SUSPENDED, TRACTION. A lift in which the motion of the car is obtained through friction between the suspension rope(s) and the sheave.

LIFT, UNDERSLUNG. Refer Car frame, underslung.

LIFTWELL, EMERGENCY ACCESS DOOR. An access door provided in the liftwell enclosure for emergency or maintenance purposes and which is distinct from the normal landing doors.

LIFTWELL ENCLOSURE. Any structure which separates the liftwell from its surroundings.

LIFTWELL (LIFTSHAFT). A liftwell is an enclosure which provides an accessway for the travel of a lift or group of lifts.

Where 2 to 4 lifts are grouped together, they may be housed in a common enclosure providing it is of uniform cross section and height.

In other cases separate enclosures (liftwells) shall be provided.

LIFTWELL, MULTIPLE. A liftwell for more than one lift.

LIFTWELL, SINGLE. A liftwell for a single lift.

MACHINE, DRIVING. The power unit which applies the energy necessary to raise and lower the car.

MACHINE DRUM. A driving machine in which the hoist ropes are fastened to and wind on a drum.

MACHINE, ELECTRIC. A driving machine In which the energy is applied by an electric motor. It includes the motor and brake, the driving sheave or drum together with its connecting gearing.

MACHINE, GEARED. A driving machine in which the energy is applied by an electric motor. It includes the motor and brake, the driving sheave or drum together with its connecting gearing.

MACHINE, GEARLESS. A driving machine in which power is transmitted to the driving sheave from the motor without intermediate reduction gearing.

MACHINE, HYDRAULIC. A driving machine in which the motion of the car is obtained from the action of a liquid under pressure acting on a piston or ram.

MACHINE, TRACTION. A driving machine in which the motion of the car is obtained through friction between the hoist ropes and the sheave.

MACHINE ROOM. The enclosed space used to house the driving machinery and control gear of a lift.

OPERATING DEVICE. A car switch, push-button, wheel, lever or other device employed to actuate the control equipment.

OPERATION. The method of actuating the control equipment.

OPERATION, CAR SWITCH (ATTENDANT CONTROLLED). A method of operation by which the movement of the lift car is directly under the control of an attendant.

OPERATION, DUAL (PASSENGER AND ATTENDANT CONTROLLED). A method of operation which can be switched to provide for either passenger control or attendant control.

OVERHEAD STRUCTURE. All the structural members, platforms, etc., supporting the lift machinery sheaves and equipment at the top of the liftwell.

OVERTRAVEL (OVERRUN). Refer Runby, Top.

PASSENGER. A person other than an attendant who is carried by a passenger lift.

PASSENGER CONTROLLED LIFT. A lift in which the operation is designed to be under the control of a person other than an attendant.

PIT. The space in the liftwell below the level of the bottom landing sill.

PLATFORM. The structure which forms the floor of the car and which directly supports the load.

POSITION INDICATOR. A device situated at the lift landings and/or in the car, which indicates the position of the car in the liftwell.

QUALIFIED SIGNATORY. A competent person who by way of appropriate qualifications and experience, who have access to all relevant technical information, is deemed to comply.

RATED LOAD. The load which the lift is designed to carry.

RATED SPEED. The speed at which the equipment is designed to operate.

RELAY. An electro-magnetically-operated switch for making or breaking a control or auxiliary circuit.

RE-OPENING DEVICE. A device which when actuated causes power-operated doors to stop closing and fully re-open.

RETIRING CAM. A lock operating cam, usually attached to the car and arranged to retract automatically from its operating position.

ROPING RATIO, SUSPENDED (ROPED) HYDRAULIC LIFT. The ratio of the speed of the ram to that of the lift car.

ROPING RATIO, TRACTION LIFT. The ratio of the speed of the rope to that of the lift car.

RUNBY (OVERTRAVEL), TOP. The distance a lift car can travel above its top terminal landing before the ram strikes its mechanical stop.

SAFETY GEAR. A mechanical device attached to the car frame or to the counterweight, to stop and hold the car or counterweight to the guides, in case of predetermined overspeed or free fall.

SECONDARY FLOOR. That floor immediately below the machine room floor and used to house sheaves and/or auxiliary equipment.

SHEAVE. A grooved wheel around which one or more ropes are arranged to pass.

SHEAVE, COMPENSATING ROPE. The sheave around which the compensating rope(s) pass.

SHEAVE, DIVERTER. A sheave interposed between the overhead sheave and the counterweight to provide lateral separation between the counterweight and car.

SHEAVE, TRACTION OR DRIVE. A powered sheave which, through friction, moves suspension rope(s) to provide motion of the lift car.

SLING MEMBERS, UPRIGHTS OR STILES. The vertical members of a car frame connecting the bow and buffer members.

SWITCH, DERAILMENT. A device actuated by the derailment of the counterweight at any point in the liftwell to provide information to the control that the counterweight has left its guides.

SWITCH, FINAL LIMIT. An emergency switch operated by the movement of the car, to stop the lift by causing the power to be removed from the lift motor and brake, in the event of the car travelling a predetermined distance beyond a terminal landing.

SWITCH, SLACK ROPE. A switch or combination of switches arranged to stop the lift if any of the hoist ropes slacken by a predetermined amount.

SWITCH, STOP. A switch designed to open the control circuit and so cause the lift car to stop when the switch is operated.

TRAVEL. The vertical distance between the top and bottom landings serviced by the lift.

UPRIGHTS. Refer Sling Members.

WORKING PRESSURE. The pressure measured at the cylinder of an hydraulic lift when lifting the car and its rated load at rated speed.

3.2
For the purposes of this Standard the word "shall" refers to practices that are mandatory for compliance with this Standard, while the word "should" refers to practices which are advised or recommended.

4 MATERIALS AND METHODS OF CONSTRUCTION

4.1 Materials
Where a material is nominated for use in the construction of a lift installation, it shall comply with all the appropriate requirements of one of the Standards listed in 4.2 – 4.7 inclusive.

4.2 Steel (other than castings)

4.2.1 *Structural steel sections and plates*
Steel used in the construction of a lift installation shall comply with one of the following Standards:

AS 1163	Structural steel hollow sections
AS/NZS 3679	Structural steel
Part 1	Hot-rolled bars and sections
Part 2	Welded I sections

BS 4:	Structural steel sections
Part 1	Specification for hot-rolled sections
NZS/BS 4848	Hot-rolled structural steel sections
Part 2	Hot-finished hollow sections

4.2.2 *Forgings*
Steel forgings shall comply with:

AS 1448	Carbon steels and carbon-manganese steels – Forgings
BS 29	Specification for carbon steel forgings above 150 mm ruling section

4.2.3 *Rivets*
Steel rivets shall comply with:

AS B118	Dimensions of small rivets for general purposes
NZS/BS 4620	Rivets for general engineering purposes

4.2.4 *Studs, bolts, nuts and washers*

4.2.4.1 *Materials*
Steel for studs, bolts, nuts and washers shall comply with one of the following standards:

AS/NZS 1252	High-strength steel bolts with associated nuts and washers for structural engineering
AS 1442	Carbon steels and carbon-manganese steels – Hot-rolled bars and semifinished products
AS 1443	Carbon steels and carbon-manganese steels – Cold-finished bars
AS 1444	Wrought alloy steels – Standard and hardenability (H) series and hardened and tempered to designated mechanical properties

4.2.4.2 *Dimensions*
The dimensions of studs, bolts, nuts and washers shall conform to the following Standards:

AS/NZS 1110	ISO metric precision hexagon bolts and screws
AS/NZS 1111	ISO metric hexagon commercial bolts and screws
AS/NZS 1112	ISO metric hexagon nuts, including thin nuts, slotted nuts and castle nuts
AS 1237	Flat metal washers for general engineering purposes (metric series)
AS/NZS 1252	High-strength steel bolts with associated nuts and washers for structural engineering
AS/NZS 1427	ISO metric machine screws

4.2.5 *Tubing*
See 35.2.1 and 35.3.1 for hydraulic lines.

4.3 Castings

4.3.1 *Steel castings*
Carbon steel castings shall comply with:

NZS/AS 2074 Steel castings

4.3.2 *Grey iron castings*
Grey iron castings shall comply with the following Standards:

NZS/AS 1830 Iron castings – Grey cast iron

AS/NZS 2544 Grey iron pressure fittings

4.3.3 *Malleable castings*
Malleable iron castings shall comply with the following Standards:

NZS/AS 1832 Iron castings – Malleable cast iron

4.3.4 *Spheroidal or nodular graphite iron castings*
Iron castings with spheroidal or nodular graphite shall comply with NZS/AS 1831.

In designing components to be made of spheroidal or nodular graphite cast iron and subject to shock stress, account shall be taken of the fact that the nominal impact strength of spheroidal graphite iron is only one-third of that of cast mild steel; in particular the design and machining of components shall be such as will avoid excessive stress concentrations or notch effects in any region.

4.4 Timber
Timber shall not be used for any of the structural parts of the lift car or lift guiding system. Small amounts of timber for fixing, packing, and for architraves are acceptable.

NOTE – Where liftwell enclosures are constructed of timber, connections through which loads are transmitted from the lift machinery, guide rails and other equipment are to be by means of through bolting or equivalent. Nailed or screwed connections are not acceptable.

4.5 Concrete

4.5.1 *Structural concrete*
All concrete shall comply with NZS 3109.

4.6 Welding
All welding used in the construction of lift installations shall comply with AS/NZS 1554.1.

All structural welding shall be carried out by welders who have passed the relevant tests specified in NZS 4711.

4.7 Glass
The use of glass in lift installations shall take account of the increased degree of hazard, compared with other uses of glass, associated with lift car movement, possible racking of the lift car structure and the inability of passengers to move quickly away from any breaking glass.

Safety glass shall comply with NZS 4223: Part 3 – Grade A.

PART 2
ELECTRIC LIFTS: PASSENGER AND GOODS

5 GENERAL

5.1 Scope

This Part of the Standard 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 this Standard. As goods lifts must be attendant controlled and are often used by passengers, it is not intended to treat them as a separate entity.

5.2 Electric lift particulars to be documented

(All dimensions in millimetres unless otherwise specified)

Owner's name .....
Address .....
Location of lift .....

Lift maker
Lift submitter
Reference no. of submitter
Date of submission
Observation lift: Yes/No
Type of lift (Passenger/Passenger and Goods/Attended Goods)
Serial number(s) of lift(s) which comply with NZS 4121
Machine maker
Clearance under lifting beam

Internal car floor particulars

(measured 1000 m above the car floor, ignore handrails etc.):
Internal car floor width
Internal car floor depth

Masses:

Car (kg)
Rated load (kg)
No. of persons
Counterweight (kg)

Car details:

Platform weight (kg)
Platform direct on buffer members/isolators
Floor details
Sides and top details
Plank or platform support members
Bow members
Weight of additional machinery on bow members (kg)
Buffer members
Sling members
Free length of sling member

Miscellaneous

Total lift travel (m)
No. of floors of travel/openings served
Maximum speed (m/s)
Governor tripping speed (m/s)
Machine type – drum/traction/geared traction
If drum: overtravel to fixed stop
Terminal speed checking and stopping device: fitted/not fitted
If fitted: speed at contact with buffer (m/s)

Guide shoe data:

Vertical distance between guide shoe centres – car
– counterweight
Eccentricity of car guide shoes with respect to c.o.g. of car
Toe-to-toe distance between guide rails – car; (D.B.G.)
– counterweight
Distance from toe of guide rail to centre of guide roller

Clearances for car and counterweight:

Top clearances with car at top landing
Above guide shoes
Mechanical clearance
Man clearance
Clearance above counterweight

Bottom clearances:

Mechanical clearance
Man clearance
Below counterweight, on fully compressed buffer
Car-buffer clearance
Counterweight – buffer clearance (including rope stretch)

Car buffers

Type — solid/spring/hydraulic
No. of buffers
Stroke of the counterweight buffers

Seismic categories

$C_{P\ max}$: Zone A = 0.6; Zone B = 0.5; Zone C = 0.4
Seismic design coefficient $C_d = R \times C_{P\ max}$
See Appendix B for seismic zones and table 2.1 for risk factor (R)

Car guide rails data:

Type of rail
Distance between fixings
Tie bracket section: modulus Z_{yy} (cm^3)
Height

Safety gear type:

None/A/B/C/D

Counterweight guide rails data:

- Type of rail
- Distance between fixings
- Tie bracket section:
  - modulus Z_{yy} (cm^3)
  - height
- Safety gear fitted? Yes/No
  - Type: None/A/B/C/D

Liftwell enclosure (description):

Landing entrances:

- Clear opening height
- Clear opening width
- Door locks type/maker

Terminal stopping device:

- Cam operated from car
- Selector in machine room driven by car
- Electro-mechanical inductors

Final terminal stopping devices (description):

Hoist ropes:

- Roping 1:1 2:1 3:1
- Rope diameter
- Ropes total length (m)
- Rope effective no.
- Breaking strength/rope (tonnes)
- Maker
- Rope construction
- Eye bolt dia.

Machine position:

- Traction sheave dia.
- Diverter sheave dia.
- Weight (kg)
- Gear ratio
- Traction sheave shaft dia.
- Diverter sheave shaft dia.
- Motor (kw)
- Motor r.p.m.
- Governor type
- Governor rope dia.

Drawings list:

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 2.1).

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 foundations 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*
These shall comply with the appropriate design codes listed below:

NZS 4203 General structural design and design loadings for buildings

NZS 3404 Steel Structures Standard

NZS 3101 Concrete Structures Standard

6.3 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.

6.4 Bolts, studs and washers for supporting and overhead structures, car frames, counterweights and guide rail supports

6.4.1 *General*
The maximum permissible tensile stresses and safe working loads for bolts and studs shall be those specified in NZS 3404.

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.

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

6.4.3 *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.

6.5 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.

6.6 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 6.2.3.

7 MACHINE ROOMS

7.1 Construction
Machine rooms shall be enclosed spaces independent of other areas in the building. The enclosure shall be pierced only to the extent necessary for the running clearances required by the lift equipment and for the passage of services. (See also Appendix C2).

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 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 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*

Doors to machine rooms shall be provided with a night-type latch that can be opened from without only by the use of a key and shall not require a key to open it from within the machine room.

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 machine rooms shall be restricted to authorized persons. (See also Appendix C3).

7.5 Means of access to machine rooms

A suitable access route shall be provided to lift machine rooms. (See also Appendix C4 and C5).

7.6 Headroom in machine room

Where a false floor or elevated walkway is provided the minimum headroom of 2000 mm shall be measured from the walking surface of such a structure.

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 clearance

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 walls*

On at least 2 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 2 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.

There shall be sufficient access to permit removal and replacement of the thrust bearing of a geared machine.

7.7.3 *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 24.3).

7.7.4 *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 2 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 7.7.5).

(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 2 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 over-travel switch or machine adjustment is past this type of governor, 450 mm clearance shall exist at that side of the governor.

7.7.5 *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 floors (including platform 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 6.2.1 where applicable.

Where a false floor or elevated walkway is provided it shall have a non-slip finish. The material shall be of a non-deteriorating type or shall be treated to resist deterioration by rotting, corroding etc.

7.9 Hatches in machine rooms
Hatches shall be provided in the floor or wall of a lift machine room above its associated liftwell, to permit the removal of machinery for maintenance and/or replacement.

Hatches in machine rooms shall comply with the following requirements:

(a) Covers shall be hinged whenever practicable.

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

(g) Ceilings and walls or partitions below hatches shall be arranged to give clear access to the top floor served by lifts.

(See also Appendix C5.2)

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

See Appendix C5.

7.12 Machine room stop switch

A stop switch complying with 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:

(a) In a secondary floor space; or

(b) 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 7.12 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 lubrication 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:

(a) 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.

(b) Where the components of the governor gear can be safely accessed for repair and maintenance from the top of the car without the aid of additional platforms.

Where sheave shaft centres and dead-end anchorages are more than 2300 mm above the uppermost 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 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 shall be provided for access to governors, floor controllers, selectors, and similar devices located above the liftwells but not in a machine room, except where such equipment can be safely accessed from the top of the car without the aid of additional platforms etc. 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. (See also Appendix C5).

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 with 7.4 and 7.5.

Fixed rung-type ladders may be used provided:

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

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

(c) 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 items of equipment such as motor-generator sets and floor selectors are installed in a secondary floor space, that space shall be provided with access that allows the equipment to be removed or replaced without manhandling. A machinery hatch complying with 7.9, plus a suitable lifting device is acceptable.

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 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. When a machine room is illuminated by means of fluorescent lights, twin tube fittings must be used.

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 ^{o}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 ^{o}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 of machine parts, with at least one beam over a hatchway in the floor, or running up to a hatchway in the wall of the machine room.

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:

(a) They shall not be provided with counter-weights;

(b) The rated speed of the lift shall not exceed 0.25 M/s;

(c) 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 8.3 and shall be not less than:

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

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

(c) 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 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 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 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 18.1.

8.5.3 *Diameter*
The diameter of sheave or drum shall comply with the requirements of 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 2 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:

(a) In steel, the diameter of the screw or stud;

(b) In cast iron, 1.5 times the diameter of the screw or stud;

(c) In other materials permitted by this Standard such length of thread in engagement as will ensure the failure of the screw or stud before failure of the 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 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 minimize 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 territorial authority 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, 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 and AS 1654.

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, and AS 2938 or BS 436, 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.

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

8.11 Brakes
Every lift machine shall be provided with a brake that is mechanically applied and electrically held off and which shall comply with the following requirements:

(a) No frictional device shall be interposed between the brake drum and traction sheave or winding drum.

(b) The brake shall be capable of stopping (without the assistance of any other braking agency) and holding the lift car with 125 % of its rated load, from a test speed not exceeding 110 % of the rated speed.

(c) Brakes shall have at least 2 brake shoes with individual springs.

(d) Brake linings shall be of non-combustible material and shall be so secured to the brake shoe that normal wear will not weaken their fixings.

(e) A toggle shall not be used in the normal operation of the brake. Brakes shall not be released in normal operation unless power is applied to the lift motor.

(f) When springs are used to apply brake shoes, such springs shall be in compression and adequately guided and supported. The springs shall be so designed and arranged that, in the event of failure of a spring the brake will still operate to a significant extent. For gearless machines the springs shall operate independently of one another.

(g) No single electrical fault, such as an earth fault or short circuit, nor residual magnetism shall prevent the brake from being applied when the power supply to the lift motor is interrupted.

(h) Any means for releasing the brake in emergency shall ensure the immediate reapplication of the brake as soon as hand pressure is released (see 26.3).

(i) After the brake springs have been adjusted so that the brake stops the descending car when tested for compliance with foregoing paragraph (b), a marker hole shall be drilled behind the locking nut, after the brake has been adjusted to hold at least 125 % 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 % 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 3.

8.13.4 *V-belts and sheaves*

All V-belts and sheaves shall in all respects comply with AS 2784 or BS 3790, 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 % under normal working conditions.

8.15 Rope traction

The following conditions shall apply with respect to rope traction:

(a) 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 % 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. ➤

(b) 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 8.11 (h), the hand winding means shall be either of the smooth disc type or interlocked so as to interrupt the control circuit in one of the following ways:

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

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

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 figures 9.1.1 and 9.1.2) at the bottom of the car as follows:

(a) 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.

(b) Man clearance. The man clearance shall be not less than 600 mm between the pit floor and the buffer striker plate, the underside of the auxiliary safety plank of Type D Safety Gear (see 29.2.4), the guards of underslung car sheaves, the lowest mechanical part, equipment or device installed beneath the car platform. This clearance shall be maintained over the whole car area except for:

(i) Guide shoes or rollers and safety gear components;

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

(iii) Cams, side braces, their end attachments, or other items located within 150 mm horizontally from the perimeter of the car platform.

(iv) 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.

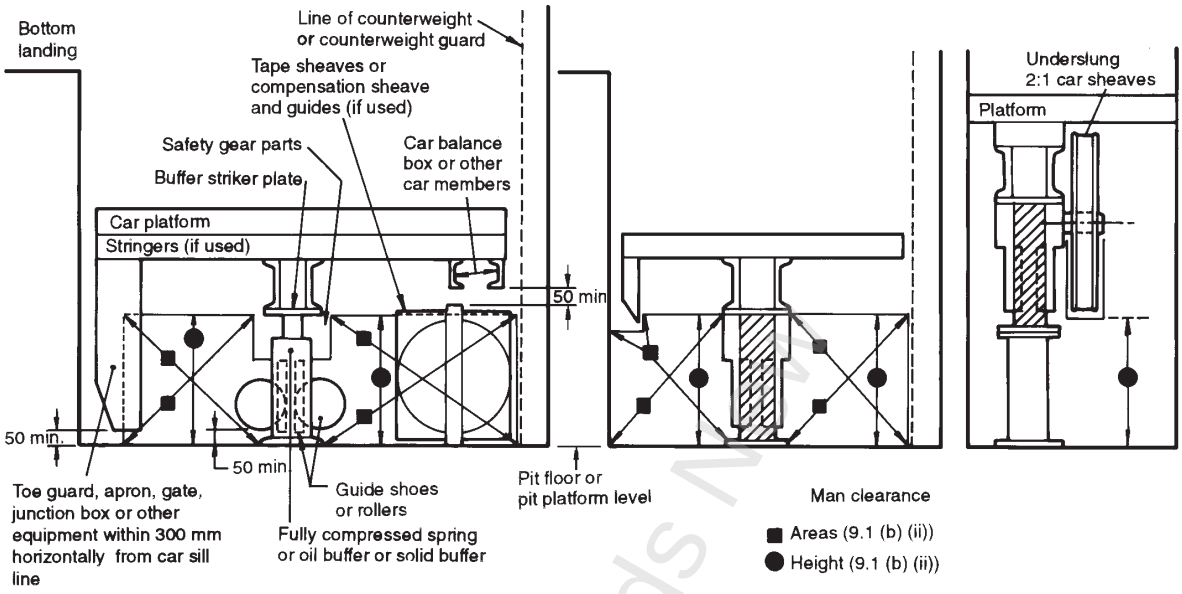
Where the crouching space of 1370 mm x 450 mm floor area is not provided, then the standing area shall be clearly outlined or otherwise indicated.

9.2 Car buffer clearance

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

(a) For oil buffers – not less than 230 mm nor more than 600 mm;

(b) For spring buffers – not less than 300 mm nor more than 600 mm.

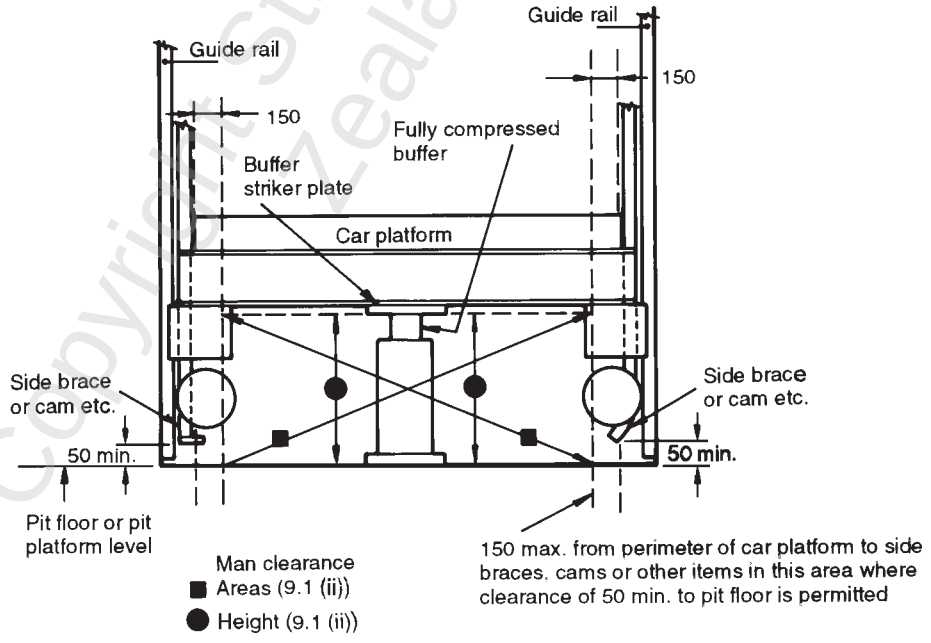


(a) General conditions: medium and large lift cars

(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

Figure 9.1.1 – Bottom car clearances – Types A, B and C safety gear

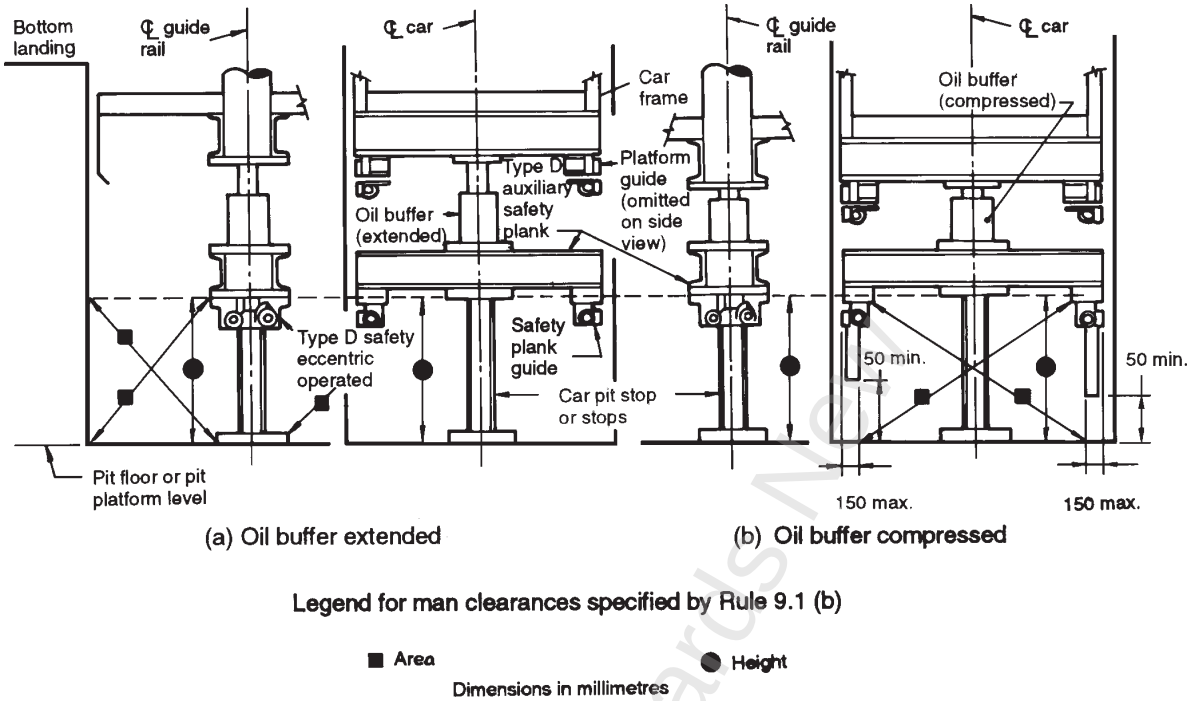


Figure 9.1.2 – Clearances below the car – Type D safety gear

9.3 Clearance of car at top landing

9.3.1 *Top of 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 figure 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 9.4

d = counterweight buffer stroke that is provided, in mm

Y = allowance for car jump

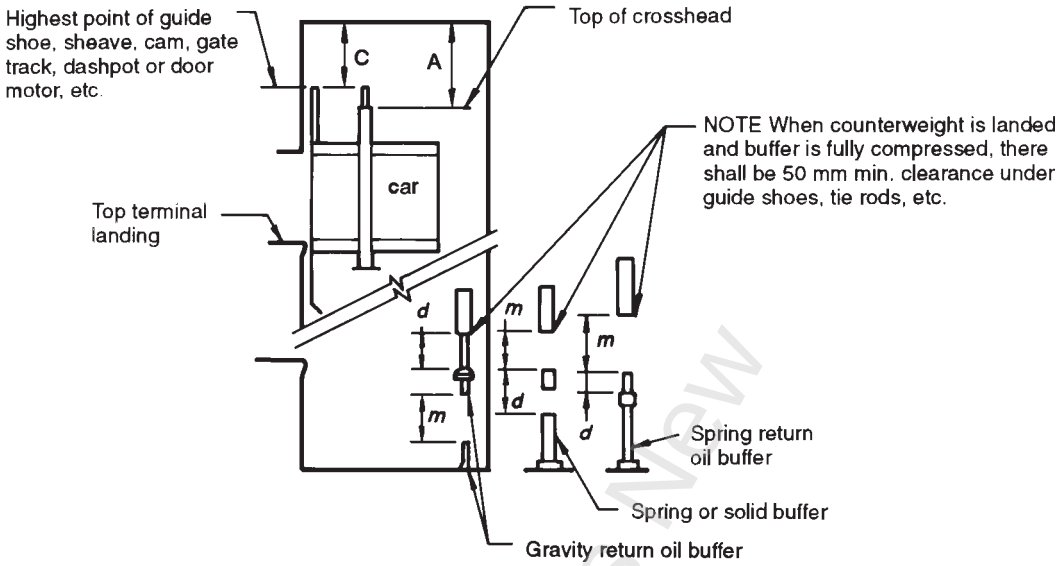
= $S - S_2$ (which shall not be less than zero)

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 foredrive lifts, which shall be not less than 250 mm or more than 460 mm.



NOTE – For legend, see 9.3.1.

Figure 9.3.1 – Clearances above the car for rope suspended lifts and below the counterweight

9.3.2 *Top of car man clearance*

Except for overhead diverter sheaves under conditions prescribed in 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 figure 9.3.1):

For traction machines:

$A = m + d + Y + 760$

For drum machines:

$A = OS + 900$

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 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 provisions 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 250 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 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 figure 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 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 figure 9.3.3.):

(a) The sheave shaft is within 10º 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

During acceptance tests of a lift, the counterweight buffer clearance shall be not more than (R + 460 mm) nor less than:

(a) For oil buffers: R + 230 mm; or

(b) For spring or solid buffers: R + 300 mm,

where

R = allowance for rope stretch, in mm

= 6.5 LM

L = length of hoist ropes, in metres, 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 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 rope length 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 figure 9.5) shall be not less than that determined by the following formula:

$f = h + i + j + Y_1$

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.

➤ To page 52

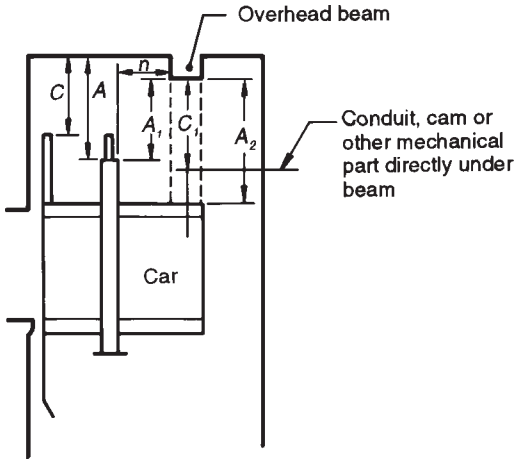


Figure 9.3.2 – Clearance above the car where overhead beam protrudes below liftwell ceiling

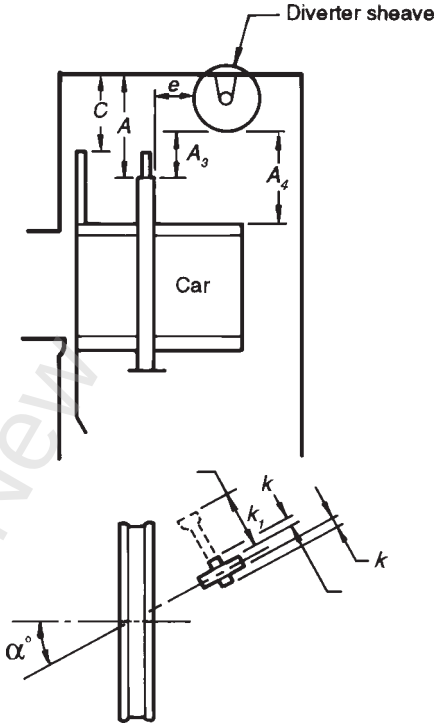


Figure 9.3.3 – Clearances above the car where overload diverter sheave protrudes below liftwell ceiling

Legend to figures 9.3.2 and 9.3.3

n = distance measured horizontally between overhead beam and crosshead
where
n is 500 mm or less, A_1 shall be not less than A and C_1 shall be not less than C
n is greater than 500 mm, A_1 may be ignored, but A_2 shall be not less than A and C_1 shall be not less than C

A_1 = distance measured vertically between lowest part of overhead beam and top of crosshead

A_2 = distance measured vertically between lowest point of beam and car roof

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

e = distance measured horizontally between rim of diverter sheave and nearest part of crosshead
where
e is 500 mm or less, A_3 may be reduced by 20 mm for each 10 mm of e and A_4 shall be not less than A, provided that:
(a) α^o is not more than 10°; and
(b) k is not more than 175 mm.
where
α^o is more than 10°, A_3 shall be not less than A
k is more than 175 mm, refer to legend for k_1, below
e is more than 500 mm, A_3 may be ignored but A_4 shall be not less than A

A_3 = distance measured vertically from lower edge of sheave to top of crosshead

A_4 = distance measured vertically from lower edge of sheave to roof of car

α^o = angle that sheave axis is out of parallel with crosshead

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

k_1 = where k exceeds 175 mm, the vertical clearances for the shaft or brackets are to be established as for overhead beams.

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

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

Y_1 = allowance for counterweight jump

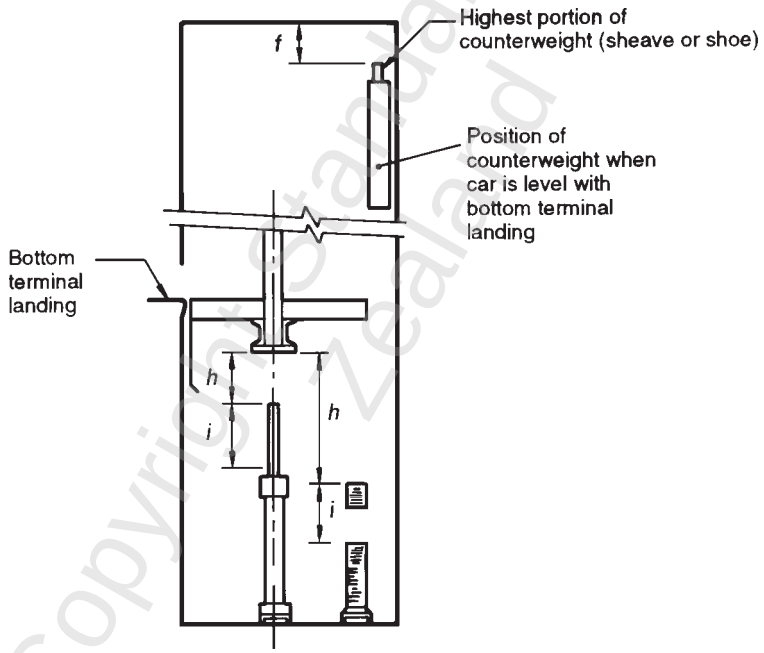
= $S - S_1$

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 car at counterweight 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.



NOTE – For legend, see 9.5

Figure 9.5 – Clearances above the counterweight

9.6 Clearance at bottom of counterweight

When the counterweight rests on its stop 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.

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 symmetrically with reference to the vertical centreline 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 3 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 3 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 compliance with the requirements of this Standard;

(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 % of rated speed. Table 10.5 indicates the minimum buffer strokes (gravity stopping distances) related to values of 115 % of the most usual rated speeds.

(b) Where an emergency terminal speed limiting device complying with 27.4 is installed so as to limit the speed at which the car or counterweight can strike its buffer, the stroke may be based on this reduced speed. However, the stroke shall not be less than:

(i) 50 % of the stroke calculated according to 10.5.2(a) if the rated speed does not exceed 4 m/s;

(ii) 33 $^1/_3$ % of the stroke calculated according to 10.5.2(a) if the rated speed exceeds 4 m/s.

In any event the stroke shall not be less than 420 mm.

Table 10.5 – Minimum stroke of oil buffers

Rated speed (m/s)	**115 % of rated speed** (m/s)	**Minimum stroke** (mm)
1.00	1.15	67
1.125	1.294	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*

10.5.3 *Retardation*
The maximum retardation developed shall not exceed 24.5 m/s^2 over a period exceeding 0.04 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 % of rated speed for buffers conforming to 10.5.2(a);

(b) 115 % of the predetermined reduced speed for buffers conforming to 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 % or more in a gauge length of 50 mm;

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

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

(d) 5 for materials having an elongation of less than 10 % 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.

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

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.

11 PITS

11.1 Provision of pits
A pit shall be provided at the bottom of every liftwell 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

11.4.1 *Purpose*

Precautions shall be taken to prevent service personnel in a lift pit from inadvertently moving into the path of travel of an adjacent lift or counterweight. However, the ability to move deliberately between adjacent lift pits may be desirable in some lift installations.

11.4.2 *Provision of guards*

Guards of substantial steel construction shall be provided between adjacent pits. Screens shall be of sheet steel at least 1.6 mm thickness or 50 mm x 3.15 mm diameter crimped wire mesh, or other which can be proved to be not less suitable.

11.4.3 *Pits at the same level*

Where adjacent pits are at the same level, the guard shall extend at least from 830 mm to 1800 mm above pit floor level.

The guard may be omitted where the clearance between the underside of the car frame, at its lowest point of travel under normal operation, and the bottom of the pit is not less than 2500 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.

NOTE – The bottom rail of the guard should be clearly visible; if necessary it should be painted in warning colours or have a light fitting attached.

11.4.4 *Pits at different levels*

Where adjacent pits are at different levels, the guard shall extend from the floor of the higher pit to a minimum height of 1800 mm.

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 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 doorway opening shall have a clear height of no less than 1965 mm.

(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 26.1.18).

(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 11.5.3.

11.5.3*Access from 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. The ladder shall:

(a) Be of non-combustible material;

(b) Be vertical;

(c) Have rungs of not less than 20 mm diameter spaced evenly at between 250 mm and 400 mm centres;

(d) Have a width between styles no less than 350 mm nor more than 500 mm;

(e) Have a clearance of at least 300 mm from the ladder centre to each side;

(f) Have a minimum clearance of 100 mm between the rungs and any solid objects behind the ladder;

(g) Extend not less than 1150 mm above the sill of the landing door;

(h) Have rungs all the way to the top of the ladder, with one rung at landing sill height;

(j) Be located so that if the ladder is mounted on the side wall of the pit the distance from the inside edge of the landing door jamb to the stile is no more than 900 mm; or,

(k) Be located so that if the ladder is mounted on the front face of the pit the distance from the inside edge of the landing door jamb to the stile is no more than 750 mm.

NOTE – These requirements differ from NZBC Approved Document D1/AS1 but are considered acceptable for this specific application.

11.5.3.1 *Ladder mounted on side of liftwell (at right angles to sill line)*
Access ladders which are mounted at right angles to the sill line shall be accessible from the bottom landing of every lift.

11.5.3.2 *Ladder mounted on front face of liftwell (parallel to sill line)*
If mounting a ladder to the side of a liftwell would cause the nearest stile to be more than 900 mm from the landing door jamb then the ladder shall be mounted to the front face of the liftwell.

When a ladder is mounted on the front face of the liftwell, the horizontal distance of the ladder stile from the inside edge of the landing door jamb, shall be no more than 750 mm.

11.6 Lighting of pits
The pit of each lift shall be provided with at least one 100 W incandescent or 40 W 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 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 9.1) the minimum car buffer clearance (see 9.2), and the minimum counterweight buffer clearance (see 9.4).

11.9 Dryness of pits

Lift pits shall be of waterproof construction to ensure that the pits remain dry.

To cater for emergency situations every lift pit shall drain to a sump which is fitted with a non slip lid that is not easily displaced. In addition one of the following shall be provided:

(a) The sump shall be connected to 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 an emergency but shall be no less than 50 mm diameter.

(b) A permanently installed pump of sufficient capacity to remove water that may enter the lift pit in an emergency;

(c) Sensors in the pit to detect water before it reaches the level of any electrical or other equipment vulnerable to water damage. Upon detection the lift shall move immediately to a floor – stop – open its doors – and close down, remaining at that floor with its doors open. The lift shall not be returned to service until such time as the water level has been lowered and the installation has been checked, cleared and reset by lift service-person.

Drains shall not be run into pits.

NOTE –

(1) Methods of waterproofing are not covered in this Standard but shall be specified in the documentation supporting the building consent application.

(2) It is preferable for a lift to stop at a floor where it does not block access to the pit.

(3) It is recommended that additional sensors be installed at levels lower than the critical water level so that early warning of a water problem is given. This should enable the problem to be rectified without the need to take the lift out of service.

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:

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

(b) The cars and counterweights shall be provided with spring or oil buffers meeting the requirements of 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 % of rated speed or at governor tripping speed where a governor-operated safety gear is used.

(c) 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 % of rated speed where no governor is provided.

NOTE – 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 11.11(b):

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

$$p = R$$

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, safe means of access shall be provided to elevated equipment (see also Appendix C4).

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 (see also Appendix C2).

12.2 Strength

Enclosures shall be so supported and braced as to deflect not more than 25 mm 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 1.0 g in any horizontal direction.

12.3 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 this Standard. Recesses and ledges shall be as specified in 15.1.3.2.

12.4 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 25.7.

12.5 Observation lifts

Observation lifts may be installed with or without enclosed liftwells subject to compliance of the lift installation with the requirements of either 12.5.1 or 12.5.2.

12.5.1

Liftwells need not enclose the car throughout its entire travel but must extend at least 2.5 m from any level that building users have access to. If a liftwell is not continuous it must be of a construction that has no components within a height of 760 mm above the floor that could provide a toehold.

Pit drainage shall comply with 11.9, taking account all possible sources of flooding from both inside and outside the building.

Unauthorised access to the liftwell shall be prevented by encasing the lower portion with a wall or glazed barrier not less than 2.5 m high above any levels accessible to the public, to the satisfaction of the territorial authority, who may also require guarding of the wall against accidental damage. Provision shall be made to deter attempts to climb onto or over the wall.

12.5.2

Glazing used in liftwells shall meet the requirements of section 12 and be Grade A safety glass complying with NZS 4223: Part 3.

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 2 entrances.

13.2 Types of doors allowed

Sliding doors of the unperforated panel type shall be fitted on all lifts. Shutter doors may be used on goods lifts and when manually operated on passenger lifts.

NOTE –

(1) Lattice gates shall not be used.

(2) Manually operated doors are not permitted in lift installations which are required to comply with the requirements of 25.6.

13.3 Construction of doors

13.3.1 *Design*

All doors shall be of metal and fire resistant construction (see also Appendix C2). The doors and their ancillary equipment shall be designed to withstand without distortion or displacement an accelerating force as determined by 2.1, 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*

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.

On the 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 resistant 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:

(a) A vision panel;

(b) Hand grips which allow for a positive hold. They must be so designed and located as to preclude all possibility of injury to their 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:

(a) The area of any single vision panel shall be not less than 325 cm^2 and the total area of one or more vision panels in any landing door shall be not more than 650 cm^2.

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

(c) 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 closed automatically. They shall comply with the following:

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

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

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

(d) They shall be suspended by a minimum of 2 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.

(e) 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 15º nor more than 30º 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 15º nor more than 30º from the vertical.

(f) Counterweights shall be suspended by a minimum of 2 steel wire ropes, plate or roller link chains per counterweight.

13.8 Horizontally sliding doors

Horizontal sliding doors shall meet the following requirements:

(a) 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-slide 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.

(b) 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-slide doors this distance shall be measured from the nearest door panel.

(c) 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.

(d) 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.

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

Maximum landing zones shall be:

(a) Lifts without automatic levelling devices – 150 mm.

(b) Lifts with levelling devices and manually operated doors – 300 mm.

(c) 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

Door locks shall meet the following requirements:

(a) 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.

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

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

(d) 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.

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

(i) 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.

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

(iii) If not designed for prelocking 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.

(iv) 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 each door from the landing, when the car is not within the particular landing zone. This shall be accomplished with the aid of a key to fit the unlocking triangle as defined in Appendix B of EN 81:Part 1 or such other specially shaped key that is in established use in the country. The key 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.)

15 CLEARANCE 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 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 15.1.2.

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*

Recesses 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^{o} 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^{o} or more than 30^{o} 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 15.1.3.2 for the full distance that the car entrance can overtravel above the top landing to 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^{o} nor more than 30^{o} 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 Clearance 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:

(a) Measurement of clearances. The clearances shall be measured with no load on the car floor.

(b) Between car and liftwell enclosures. The clearance between the car and any projection in the liftwell enclosure 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 12.2. The clearance between the car and any counterweight screen shall not be less than 25 mm.

(c) 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.

(d) Between counterweight and liftwell enclosures or screens. The clearance between the counterweight and any counterweight screen shall be not less than 25 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 12.2.

(e) 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.

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 302:Part 4 or AS 3569.

A certificate in respect of the above shall be furnished by the manufacturer 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.

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 2 planes each at 3 places at least 1500 mm apart along the length of the rope.

The measuring jaws should be of sufficient length to lap at least 2 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 2 for drum drive lifts and 3 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 = manufacturer's 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 (except for roped hydraulic lifts), 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, 3 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;

(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 manufacturer's 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.

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 territorial authority.

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 of the following approved types:

(a) Spliced eye;

(b) Individual tapered babbitted rope socket;

(c) Wedge-type socket;

(d) Swaged fitting;

(e) Other types of rope fastenings approved by the territorial authority.

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 4278, or equivalent national Standards.

17.4 Methods 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 3 full tucks of the whole strand of the rope and 2 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

(a) Sockets shall comply with BS 463. The method of socketing shall also comply with the appropriate Appendix of that specification.

(b) Sockets complying with AS 1735.2 shall also be accepted provided they are accompanied by the relevant certification, and tested to show the strength of rope sockets is such that the rope will break before the socket is perceptibly deformed.

17.6 Equalizers

Spring equalizers 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 equalizers. 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 equalizers shall not be used for car or counterweight ropes.

18 SHEAVES AND DRUMS

18.1 Grooving of sheaves and drums

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

(a) 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.

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

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

(d) 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.

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

(f) 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.

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^{o} wrap or less, and 2 guards for a wrap in excess of 30^{o}. 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.

Table 18.1 – Groove seats of sheaves and drums

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

18.3 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 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:

(a) Prevent the ropes leaving their correct grooves in the sheaves in accordance with 18.2;

(b) Prevent fingers or tools being caught between the ropes and the sheaves;

(c) 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 m 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.

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 2 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 retain the filler weights securely in place on the buffer engagement or the nominated earthquake loading, in such a manner as to prevent the shifting of the filler weights.

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 of 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 20.15.

19.5 Lift car as counterweight

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

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 % 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 this Standard.

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 figure 20.5 and table 20.5.

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

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

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

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

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

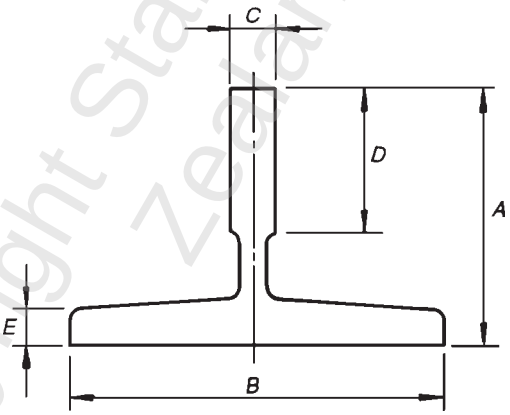


Figure 20.5 – T-section rail guide

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-18 1/2	27.53	107.9	139.7	19.05	50.8	12.7
T-22 1/2	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:

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

(b) Each span of the car guide rail or counterweight guide rails where there are no intermediate tie brackets (see 20.8) shall be considered as a beam having ends supported, such as to result in a deflection formula of:

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

and a stress formula of

$$\sigma = \frac{WL}{6Z \times 10^3} \quad \text{(MPa)}$$

where

W = load on guide rail (N)

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

E = modulus of elasticity of material (2×10^5 MPa 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).

(i) Car guide rails:
The stress and deflection shall not exceed 124 MPa and 6 mm respectively for the rail loaded as defined in 22.10.

(ii) 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 2.1. The stress and deflection shall not exceed 85 % of the minimum specified yield stress and 12 mm respectively.

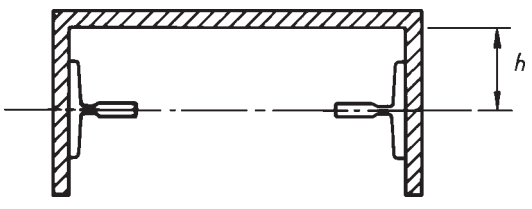


Figure 20.8 – Intermediate tie bracket for counterweight guide rails

20.7 Stresses and deflections in counterweight guide rails

For counterweights without safety gear where the 2 guides are secured one to the other (see 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 20.6.

20.8 Intermediate tie brackets for counterweight guide 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:

$$Z_{yy} = \frac{m \times h \times C_d}{24.8 \times 10^3}$$

where

Z_{yy} = 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.

C_d = seismic design coefficient obtained from 2.1 and 5.2.

Rolled sections which must be fabricated, shall 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 20.10.2 of such design and strength as will withstand the forces specified in 20.6 and 20.7 within the deflection limits specified therein.

The position of guide rail joints shall be kept within 15 % 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 above. If fish plates are fabricated from flat plates they shall have continuous full strength butt welds all around.

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 4 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 above may be used, subject to the approval of the territorial authority, 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-18$^{1}/_{2}$	27.53	20	18
T-22$^{1}/_{2}$	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. Sufficient clear space shall be provided at the top of the guide rails to allow for building movement and to ensure that no vertical forces are imposed on the guide rails 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:

(a) Withstand the application of the car or counterweight safety gear when stopping either the car and its rated load or the counterweight, without exceeding the stresses defined in 22.10.3.

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

(c) Withstand seismic forces (see 2.1) 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 % 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 the territorial authority.

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

Where trimmer beams are used for the support of guide rails they shall be designed for the forces given in this section.

20.12.3 *Guide rail brackets and anchors*
The design of other than type approved 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.

20.12.4 *Use of friction grip bolts on guide brackets*
Where friction grip bolts are used on guide rail brackets the following requirements shall be met:

(a) Calculations shall be submitted to prove that the brackets can withstand without slip, deformation or deflection the maximum loadings that they may be subjected to as derived from the design conditions of the lift, and that these loadings are within the safe design limits for the brackets.

(b) The lift Installer must provide evidence to show that the friction grip bolts have been tightened to the required torque loading and further evidence to show that 12 months later the torque loading has been re-checked to ensure that relaxation of the fasteners has not occurred.

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 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 that 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-18 1/2	27.53	18
T-22 1/2	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 counterweight shall be provided with at least 4 guide shoes, 2 at the top and 2 at the bottom of each car or counterweight 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.

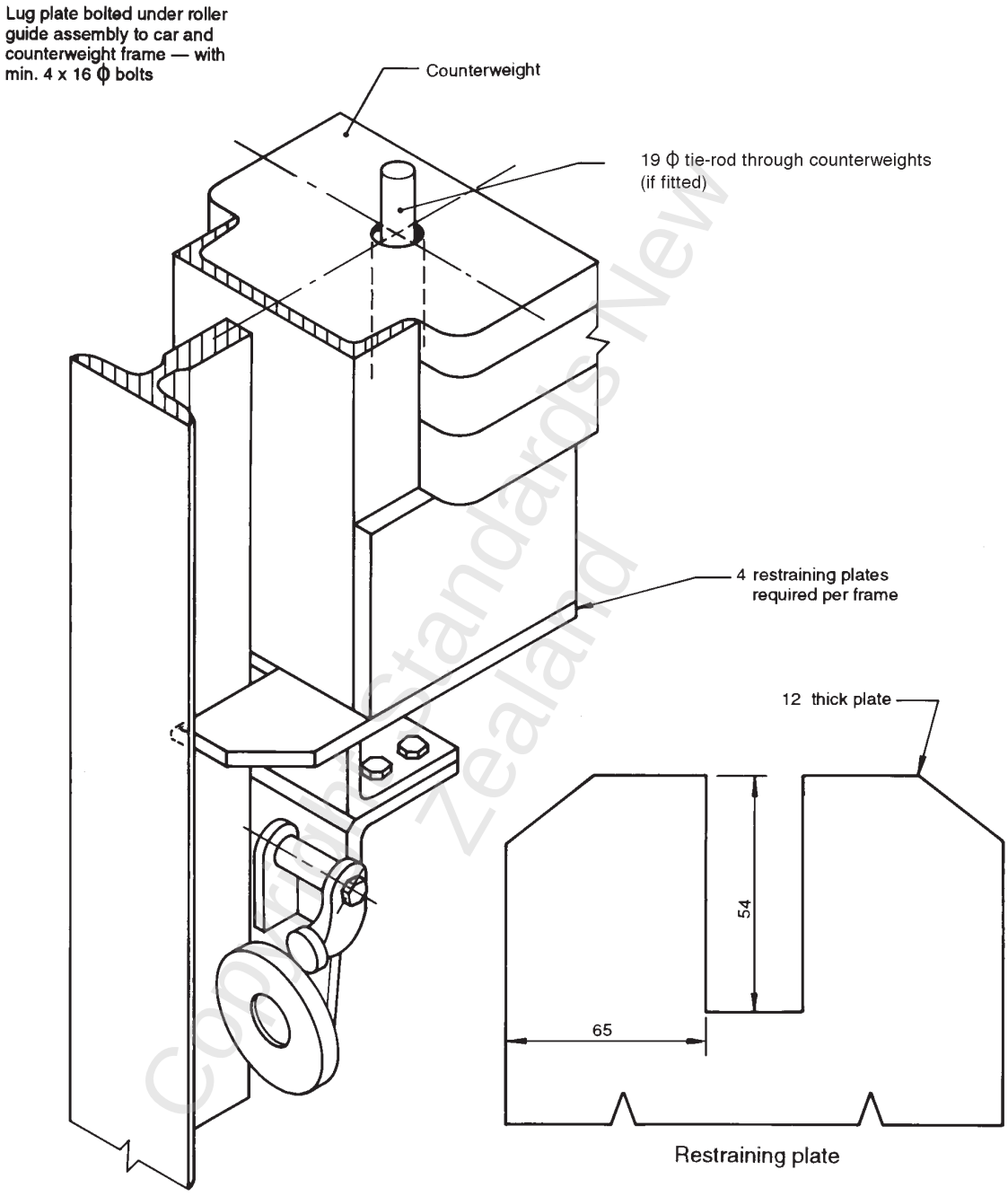
20.15.5 *Strength of guide shoes*

Guide shoes, not used in conjunction with roller guides, shall be capable of resisting the horizontal forces without exceeding the stresses defined in 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 and cars shall be provided with 4 restraining plates each, the engaging depth of which are at least 36 mm. Refer figure 20.16.



All dimensions are in mm.

Figure 20.16 – Lift counterweight and car frame anchorage – typical arrangement

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 measured 1000 mm above the car floor between the inside face of any panels or wall surfaces, but not including any space in doorways, as shown in figure 21.1 (see also 21.2).

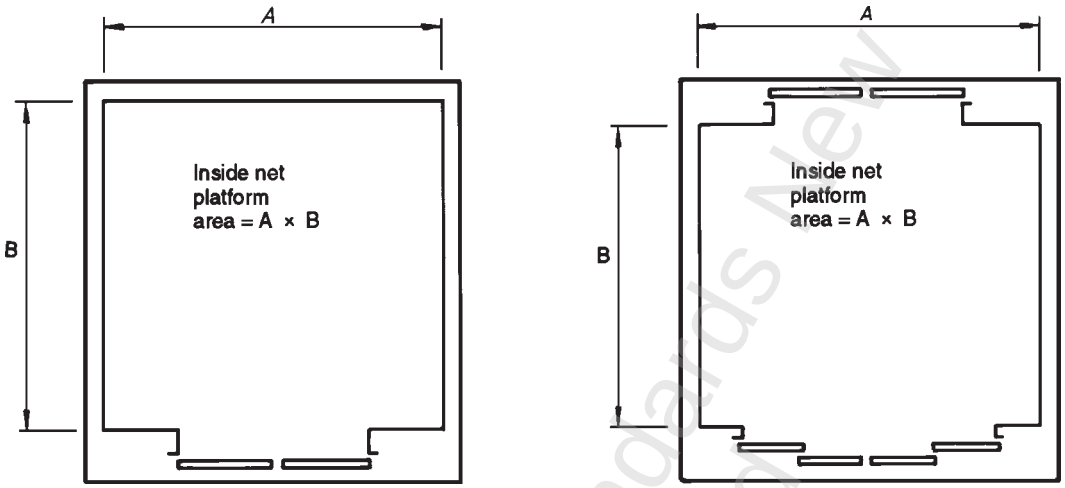


Figure 21.1 – Inside net platform areas for passenger lifts

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

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

(a) For a lift having an inside net platform area of not more than 4.6 m^2:

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

(b) For a lift having an inside net platform area of more than 4.6 m^2:

$$W = 2.454A^2 + 610.3A - 620.1$$

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	Minimum rated load (kg)	Maximum car floor area (m^2)	Maximum passenger capacity	Minimum rated load (kg)	Maximum car floor area (m^2)
1	68	0.204	45	3060	5.890
2	136	0.400	50	3400	6.421
3	204	0.589	55	3740	6.950
4	272	0.771	60	4080	7.477
5	340	0.947	65	4420	8.001
6	408	1.118	70	4760	8.523
7	476	1.284	75	5100	9.044
8	544	1.446	80	5440	9.562
9	612	1.603	85	5780	10.078
10	680	1.756	90	6120	10.593
11	748	1.906	95	6460	11.105
12	816	2.052	100	6800	11.616
13	884	2.196	105	7140	12.124
14	952	2.336	110	7480	12.631
15	1020	2.474	115	7820	13.136
16	1088	2.609	120	8160	13.639
17	1156	2.741	125	8500	14.140
18	1224	2.871	130	8840	14.639
19	1292	2.999	135	9180	15.137
20	1360	3.125	140	9520	15.632
21	1428	3.249	145	9860	16.126
22	1496	3.371	150	10200	16.619
23	1564	3.491	155	10540	17.109
24	1632	3.609	160	10880	17.598
25	1700	3.726	165	11220	18.085
26	1768	3.841	170	11560	18.571
27	1836	3.955	175	11900	19.055
28	1904	4.067	180	12240	19.537
29	1972	4.177	185	12580	20.018
30	2040	4.287	190	12920	20.497
35	2380	4.822	195	13260	20.974
40	2720	5.357	200	13600	21.450

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

21.1.1 *Vehicle lifts*

These shall have a rated load of not less than 200 kg/m^2 and shall satisfy the territorial authority of the following criteria:

(a) They shall be used only for private motor vehicles and for this reason shall have built-in security to guarantee restricted access.

(b) They shall be used by drivers or attendants who have received instruction on their safe and reasonable use.

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 in figures of at least 6 mm shall be fitted in each lift car.

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 no further 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 frame 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).

When the sling members are comprised of 2 individual members these members shall be effectively tied together (to form an effective composite member) at least 3 positions in the middle third of the span.

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 % of the distance between the guide rails.

22.5 Car platforms

Every lift car shall have a platform consisting of a non-perforated non-slip 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:

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

(b) 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 section 4 of this Standard.

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:

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

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

(c) All welding and the qualifications for welders shall be in accordance with the appropriate Standard as per 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:

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

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

(c) Additional for goods lifts, no less than one-quarter of the static rated load concentrated on the midpoint of the sill.

22.10.2 *Decelerating force to be considered*

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

(a) The force due to safety gear operation being that resulting from a deceleration of 2 G (gravity) 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 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 22.10.1	100 MN/m^2	80 MN/m^2
As per 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, reinforcing 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 either 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 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 persons 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 2 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 9.3.

22.15 Car roof trapdoor
Every lift car roof shall be provided with a hinged or sliding trapdoor in accordance with the following requirements:

(a) The trapdoor opening shall measure not less than 350 mm x 500 mm.

(b) 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.

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

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

(e) 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.

(f) 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 Observation lift cars

Lift car glazing shall be designed and installed as non-load bearing and non-structural elements. Glazing can only be used as infill between structural frames and must be designed to carry all imposed loadings such as wind and human impact. Mounting shall ensure the glazing can withstand without damage the tests on the lift installation specified by this Standard. The frame or surround shall be capable of withstanding all horizontal forces, such as those resulting from earthquake and including those imposed by users of the lift, with out permanent movement or deformation.

Glass shall be Grade A laminated safety glass in accordance with NZS 4223: Part 3 with each of the 2 glass plies not less than 5 mm thick and a minimum interlayer thickness of 1.5 mm (nominal minimum overall thickness 11.5 mm).

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 cars

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 lamp with a minimum output of 750 lumens to afford general illumination. This light shall be controlled by a pull switch situated centrally underneath the car and behind the apron. The pull cord should be long enough to be reached from the landing below that at which the car may be stopped.

22.20.1.2 *Top of car*

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

(a) If it is capable of illuminating all equipment requiring servicing and inspection on the car roof: a single light with a minimum rated output of 900 lumens.

(b) Where a single fixed light will not give effective illumination as in (a) above, several lights each with a minimum rated output of 750 lumens shall be provided. One of these may be an approved type of hand lamp, permanently connected to a ceiling rose or a connection box with cord clamp, and provided with a suitable reel or cleat to enable the lead and hand lamp to be secured in position.

All switches, ceiling roses, etc, shall be impact resistant and not susceptible to damage from oil or grease. Control switch or switches for the top of car lights shall be clearly visible from a landing when the roof of the car is substantially level with that landing.

22.20.2 Internal lighting

22.20.2.1 *Light supply and illumination required*

Lift cars shall have a minimum of 2 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 unauthorized 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 authorized persons.

22.20.2.6 *Light fittings 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 – Clause 22.20.2.6 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:

(a) 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.

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

(c) It shall provide an average of at least 10 lux on the floor of the car, plus sufficient lighting at the telephone and alarm button to enable their effective use.

(d) At least 2 lamps of approximately equal wattage shall be used.

(e) 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 2.1.

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:

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

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

The deflection shall not reduce the running clearance below the minimum specified in 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:

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

(b) 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.

(c) 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 15º nor more than 30º from the vertical.

(d) 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.

(e) 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 from the floor, except where ventilating apertures are required in accordance with 22.25. Car walls may be of timber or metal or shall comply with 22.18.

22.25 Ventilation of lift cars

Cars with imperforate doors shall be provided with ventilation apertures in the upper and lower parts of the car.

The effective area of ventilation apertures situated in the upper part of the car shall be at least 1 % of the available car area, and the same also applies for the apertures in the lower part of the car.

The gaps round the car doors may be taken into account in the calculation of the area of the ventilation holes, up to 50 % of the required effective area.

Ventilation apertures shall be built or arranged in such a way that it is not possible to pass a straight rigid rod 10 mm in diameter through the car walls from the inside.

22.26 Use of annealed glass in lift cars

Annealed glass shall be used only to cover small notices or certificates etc., or for annunciators, signal devices and lamps.

22.27 Lining of lift cars

Where a mirror or other glass is used in a lift car for a wall or panel, the glass shall be Grade A safety glass in accordance with NZS 4223: Part 3. Where no supporting subpanel is provided behind the glass, the glass shall be not less than 10 mm thick. Where a supporting subpanel is provided behind the glass, the glass shall be not less than 6 mm thick.

23 POWER OPERATION OF CAR AND LANDING DOORS

23.1 Type 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 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 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 23.4.1.

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

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

23.5 Kinetic energy and force limitations for power door operations (horizontal)

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

(a) 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:

(i) 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. ➤

(ii) 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.

(b) 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, the car door or the door opening shall be provided with a passenger-protective device meeting the following requirements:

(a) The passenger protective device shall not rely on physical contact but shall detect an obstruction (such as a wrist or ankle) in the doorway and shall prevent the door closing until the obstruction is removed unless the delayed closing feature as per 23.6.2 is fitted.

(b) If the door is closing when an obstruction is detected the doors shall stop and re-open partially or fully whilst the device is activated.

(c) If the car doors are also fitted with a torque limiting device or mechanical safety edge which relies on physical contact for its actuation, the lift may remain in service if the detection device fails, until repairs have been carried out, providing the kinetic energy of the doors when closing does not exceed 3.4 J and an audible warning is sounded in the car during closing of the doors.

The door motor shall be in direct control of the opening and closing motion of the doors.

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 re-opening 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 re-opening 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 23.5(a)(i) and 23.5(a)(ii).

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.

24 ELECTRICAL INSTALLATION (GENERAL, EARTHING AND WIRING)

24.1 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 26.7.

24.2 General purpose power point on top of car

A general purpose power point of an impact-resistant type shall be provided on the top of each lift car.

24.3 Clearances around controllers

24.3.1 *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.

24.3.2 *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 90º.

(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.

24.4 Electrical supply

(a) The supply of electricity shall be by a submain or subcircuit that is taken from the main switchboard of the building and is dedicated exclusively to the lift drive and control system, and car lighting (refer also clause 22.20.2.1).

(b) The main switch on any switchboard to which a lift is connected and all switches controlling lift supply sub-mains shall be clearly and legibly marked “THIS SWITCH SUPPLIES A LIFT”.

(c) The supply of electricity to a lift (apart from the secondary lighting supply as prescribed in 22.20.2.1) shall not be interrupted automatically by a fire-alarm system.

24.5 Emergency electrical supply

When the distance between any 2 consecutive landings of a lift exceeds 10 metres, any lift to which the public has access, shall be supplied with emergency power for lift operation (from a standby generator in addition to its normal electrical supply), or it shall be equipped with an automatic rescue device.

This requirement does not apply to hydraulic lifts which comply with 36.6.

24.6 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 28.3.

24.7 Position of circuit-breakers

Circuit-breakers or isolators 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 or isolator, isolation arrangements shall be provided (see also 7.12).

24.8 Wiring

The following general requirements shall be observed in the installation of electrical wiring (see also Appendix C6):

(a) Wiring, cables, trunking, etc., shall not be laid on the floor in access ways (refer to 7.7.3). It may be laid in the floor (see 7.7.4(d)) or against the wall, or at a height of 2 metres above the floor of the machine room, provided access ways are not obstructed.

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

(c) All wiring shall comply with NZS 3000.

24.9 Travelling cables to cars

24.9.1 *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 1979 or BS 6977.

24.9.2 *Connection*

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

24.9.3 *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.

24.9.4 *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.

24.10 Lift circuit diagram in machine room

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

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

(b) 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.

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

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 attendants hand is removed. 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 devices 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 device shall comply with the following requirements:

(a) It shall be of the metal protected type, and shall be fixed between the car cross-head 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.

(b) It shall be of the continuous pressure button type, 2 of which must be pressed to operate the lift in either direction.

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

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

(e) 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.

(f) 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 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 22.23.

25.4.7 *Flushness of liftwell below landing sill*
The extent of flushness below landing sills shall be in accordance with 15.1.3 and 15.1.4.

25.5 Car control buttons

The level of the building's final exit shall be indicated by a raised or indented star symbol placed alongside the car control button. Where a building has more than one final exit level, all such levels shall be indicated. These symbols shall be at least 15 mm high and be as shown on figure 70.4.1.

25.6 Operation of lifts under fire or other emergency conditions (excluding earthquakes)

25.6.1 *Application*
Clause 25.6 shall apply in all emergencies except under earthquake conditions (see 2.1 and 25.8).

All lifts having a travel of 15 metres or more, shall comply with 25.6. However, compliance is recommended as a safety precaution for all lifts.

25.6.2 *Requirements*
The requirements for lift operation shall meet the following:

(a) A recall switch, being a 2 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 mm 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 compatible with the existing national pattern, 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 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.

(b) 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.

(c) On any car returning to the main floor in accordance with (a) 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;

(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 within 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) Warning 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.

25.7 Detection of fire in machine rooms (including sheave rooms and governor rooms containing electronic equipment) and liftwells

25.7.1 *Application*

Clause 25.7 shall apply to all lifts with a travel exceeding 2 levels and to all lifts installed in buildings where the machine rooms and/or liftwells are protected by an automatic fire sprinkler system (see 7.2 and 12.4).

Clause 25.7 shall also apply to lifts in buildings where sprinkler systems are added at a date later than the initial installation of the lift.

25.7.2 *Requirements*

(a) A system for detecting excessive temperatures, and consisting of a number of excessive temperature switches, shall be fitted in the machine room and liftwell.

(b) Excessive temperature switches:

(i) In the machine room shall operate at a temperature of 45 ºC, or 11 ºC below the operating temperature of any sprinkler head fitted, whichever is the lower;

(ii) In the liftwell shall operate at a temperature of 75 ºC, or 11 ºC below the operating temperature of any sprinkler head fitted, whichever is the lower;

(iii) Shall be installed within 300 mm radius of each sprinkler head and heat detector forming part of the building fire alarm system. Where sprinkler heads or heat detectors are not fitted, excessive temperature switches shall be located in accordance with the requirements of NZS 4512 for positioning heat detectors.

(c) Sprinkler heads, heat detector sensors and excessive temperature switches shall be protected from accidental damage by approved guards.

(d) Operation of an excessive temperature switch shall take all lifts, except those operating on inspection service, non-stop to the main floor and then render them inoperative with the doors open.

(e) While returning to the main floor the following sign shall be illuminated in each lift car, "LIFT RETURNING TO MAIN FLOOR".

(f) The lifts shall remain inoperative until such time as the power driving circuit is reset by competent lift service personnel who are satisfied that the lift installation is safe.

(g) The excessive temperature switches shall be fixed temperature, heat actuated fire detectors complying with NZS 2139, constructed and installed for operation at extra low voltage. The definition of "extra low voltage" as given in the Electricity Regulations 1993 means "any voltage normally not exceeding 32 volts a.c. or 115 volts d.c.".

25.8 Operation of lifts under earthquake conditions

25.8.1 Major component displacement detector

All lifts with a travel exceeding 15 metres, shall be fitted with a counterweight derailment switch. This device (see figure 25.1) shall be actuated when the displacement of the counterweight in any one direction of the horizontal plane exceeds 20 mm.

25.8.2 Operation

Upon operation of this device every lift shall:

(a) If in motion, immediately decelerate and stop at the next possible floor and remain stopped with the doors open;

(b) If stopped at a floor, remain in that position with the doors open.

For lifts in a common shaft, all lifts shall follow this procedure if the device is operated by any one or more lifts in the shaft.

NOTE – All lifts which have been stopped in this manner shall not be put back into operation until a thorough inspection of the lifts and liftwells has been carried out and certified to be satisfactory by competent lift service personnel.

26 ELECTRICAL PROTECTIVE DEVICES

26.1 Protective devices – General

26.1.1 *Stop switch on top of car*

A stop switch, complying with 24.1, shall be provided on the top of every electric and every electrically controlled lift car.

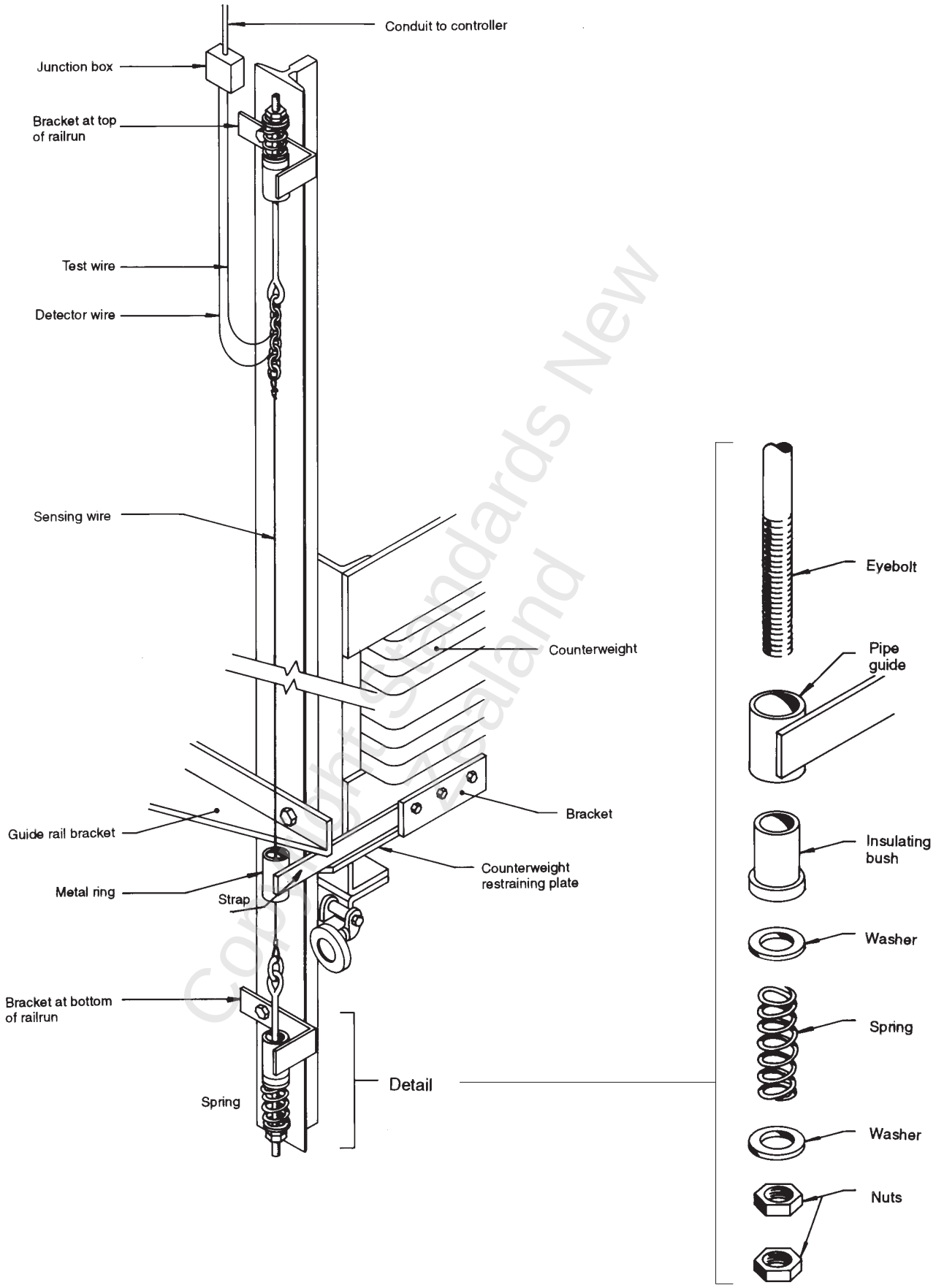


Figure 25.1 – Major component displacement detector

26.1.2 *Emergency stop switch in car*
It is not permitted to fit an emergency stop switch (which can be operated by passengers from within the car) in any lift car except where lattice gates still exist and until such time as they are replaced. This shall apply to all lifts regardless of the date of original commissioning.

26.1.3 *Pit stop switch*
A stop switch, complying with 26.7, shall be provided in the pit of every electric and electrically controlled lift. (See also 11.7).

26.1.4 Machine room stop switch
Where required by 7.12, a stop switch complying with that clause shall be provided in the machine room.

26.1.5 *Stop switch for sheave room or platform*
Where required by 7.12, a stop switch complying with that clause shall be provided for the sheave room or platform.

26.1.6 *Broken tape switch*
A broken tape, rope, wire or chain switch complying with 27.2.4 shall be provided in respect of normal limit switches located in machine rooms of traction lifts.

26.1.7 *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.

26.1.8 *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.

26.1.9 *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.

26.1.10 *Safety gear switch*
A safety gear switch shall be provided as required by 29.7

26.1.11 *Governor switch*
Governor switches shall be provided in accordance with 30.3.

26.1.12 *Overtravel limit switches*
Overtravel limit switches complying with 27.3 shall be provided for every electric lift.

26.1.13 *Terminal speed checking and stopping devices*
When reduced stroke oil buffers are provided as permitted by 10.5.2(b), terminal speed checking devices complying with 27.4 shall be provided.

26.1.14 *Buffer switches for oil buffers used with Type D safety gear*
Oil level and compression switches complying with 29.8.2 (g) and (h) shall be provided for all oil buffers used with Type D safety gear.

26.1.15 *Landing door contacts*
Landing door contacts complying with 14.3 shall be provided for every electric or electrically controlled lift.

26.1.16 *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 14.1. Contact shall be made only when the door is in a closed position.

26.1.17 *Pit access door contact*
A pit access door contact complying with 11.5.2(b) shall be provided for every electric or electrically controlled lift.

26.1.18 *Normal limit switches*
Normal Limit switches complying with 27.2 shall be provided for every electric or electrically controlled lift.

26.1.19 *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.

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

26.2 Phase-reversal and failure protection
Lifts having multiphase alternating current power supply shall be arranged to prevent the starting of the lift motor in the wrong direction if:

(a) The phase rotation is in the wrong direction; *or*

(b) There is 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:

(a) The operating device of a lift car switch or continuous pressure operation button is in the stop position;

(b) A floor stop device functions;

(c) Any of the electrical protection devices functions.

Under condition (a) and (b), 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:

(a) 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.

(b) 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.

(c) 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.

(d) 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.

(e) The control circuits shall be so designed and installed that the lift car speed in the down direction with 125 % of the rated load in the lift car, under normal operating conditions with the power supply on or off, shall not exceed 120 % of the rated speed.

(f) Where generator field control is used, means shall be provided to restrict the car speed dynamically under conditions of brake-off with power supply connected and motor generator running to:

(i) 0.25 m/s for geared machines;

(ii) One-seventh of the rated speed of the lift for gearless machines.

(g) Where lift motors employ static power control without motor generators, the lift shall comply with the following requirements:

(i) Not less than 2 devices shall be provided to remove power independently from the lift motor. One of the devices at least shall be an electromechanical contactor, arranged so that it shall open the lift machine brake circuit each time the car stops.

(ii) An additional contactor shall be provided to open the lift machine brake circuit. This contactor is not required to, but may, have contacts in the lift motor circuit.

(iii) The electrical protective devices required by this section shall control the solid state device and both contactors; however, levelling can take place with power opening of doors as provided for in 23.3.

(iv) After each stop, the car shall not respond to a signal to start, unless both the contactors required by (i) and (ii) above are in the de-energized position.

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 % of the rated speed.

26.6 Overload weighing devices

Load weighing devices, if fitted, shall 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:

(a) They shall be of the manually opened and closed type.

(b) They shall be capable of being positively opened mechanically and not solely dependent on springs. Commercial switches shall comply with AS 3133.

(c) They shall be conspicuously and permanently indicated 'Emergency Stop' and the emergency stop position shall be clearly indicated.

(d) When opened the switch shall open the control circuit so as to stop the car and prevent the power doors from operating.

27 TERMINAL STOPPING DEVICES

27.1 General requirements

Normal limit switches (slow down and stopping) as required by 27.2 may use mechanically operated, magnetically operated, optical operated or static type switches.

Overtravel limit switches required by 27.3 and emergency terminal speed limiting position sensing switches as required by 27.4(b) shall use only mechanically operated switches and shall comply with the following requirements:

(a) 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.

(b) 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 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 other operating devices 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 26.1.6 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 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 27.3.2;

(b) Traction drive – mechanically operated control current overtravel limit switch complying with 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 mechanisms.

27.3.3 *Overtravel limit switch (control current)*
Overtravel limit switches shall comply with 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 2 or more separate and independent controller switches or contactors are provided, 2 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 counterweight 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 % 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 % 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 open 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 10.5.2(b)) shall be installed where reduced stroke buffers are used and shall comply with the following requirements:

(a) Their operation shall be entirely independent of the operation of the normal slow down and stopping switches required by 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.

(b) One acceptable method of meeting the requirements of item (a) 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 is 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.

(c) 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.

(d) They shall provide a retardation not in excess of 9.8 m/s^2;

(e) They shall not apply the car safety gear;

(f) 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;

(g) 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.

28 INDICATORS, ANNUNCIATORS, ALARMS, TELEPHONES, ETC.

28.1 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.

28.2 Emergency communication and alarm

28.2.1

All lifts shall be provided with an emergency audible alarm as per 28.2.2.

28.2.2 *Audible alarm*

Audible alarms shall:

(a) Be a bell 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 28.2.4;

(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. A notice shall be affixed adjacent to the bell in plain view and shall read 'LIFT ALARM' in letter sizes which can be easily distinguished from a normal standing position;

➤

(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 alarm button complying with the requirements of 70.4.1 for lifts for access by disabled persons.

28.2.3 *Telephone alarm system*
All lifts shall be provided with a telephone alarm system, which shall be so designed that:

(a) They provide direct communication to a location which is attended continuously 24 hours per day. It shall be a direct dialling system, push button or voice activated, and shall be constructed and installed so as to be vandal proof;

(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 28.2.4 unless supplied by another permanent power source;

(d) The location of the lift and the lift number shall be clearly displayed by the telephone;

(e) They are positioned in accordance with requirements of 70.4.1 for lifts for access by disabled persons.

28.2.4 *Power for emergency communication and alarm systems*
The power supply required in 28.2.2 and 28.2.3 shall be provided from an emergency power source complying with the following:

Automatically recharged batteries shall have sufficient capacity for 2 hours operation of the system. The batteries shall be automatically recharged within not more than 45 minutes of each 15 minutes of use.

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 22.20.2.7.

28.3 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

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 29.2. The safety gear shall be attached to 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 4 types of safety gears, described in the following 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 similar devices without the deliberate introduction of any flexible medium to

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

limit the retarding force and increase the stopping distance. 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, 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 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 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 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 is 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 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 section 66.

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 figures 29.4.1 and 29.4.2. Table 29.4 gives the minimum and maximum stopping distances based on the maximum governor tripping speeds associated with typical car speeds.

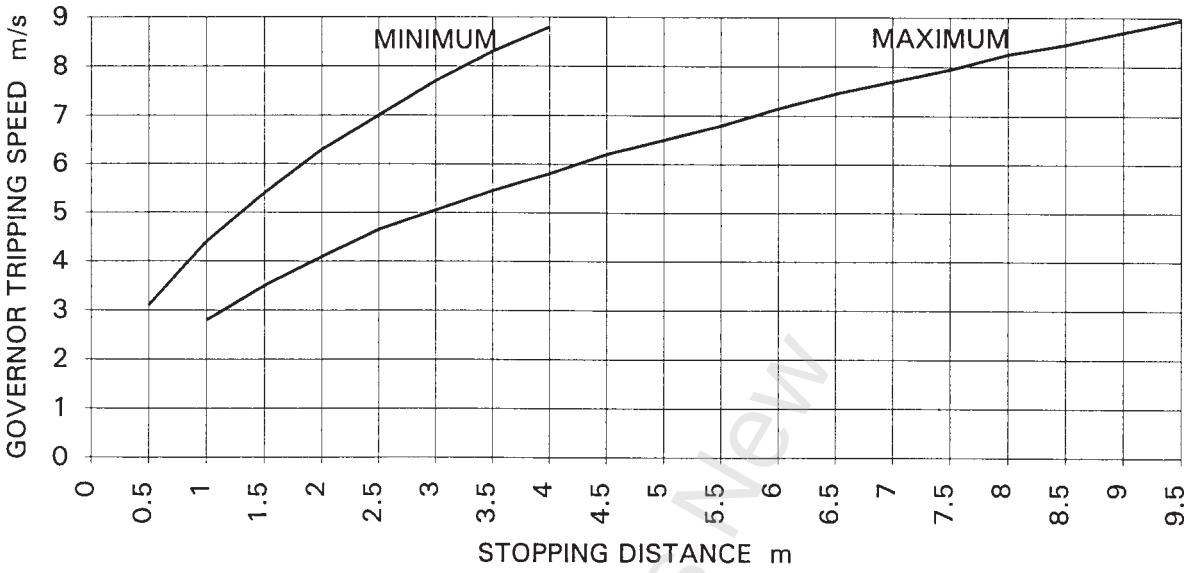
Type C safety gear shall stop the car with its rated load from governor tripping speed within the range of stopping distances shown by figure 29.4.3.

For Type D safety gear the stopping distance is equal to the effective stroke of the incorporated oil buffers specified in 29.8.2(b) and (c).

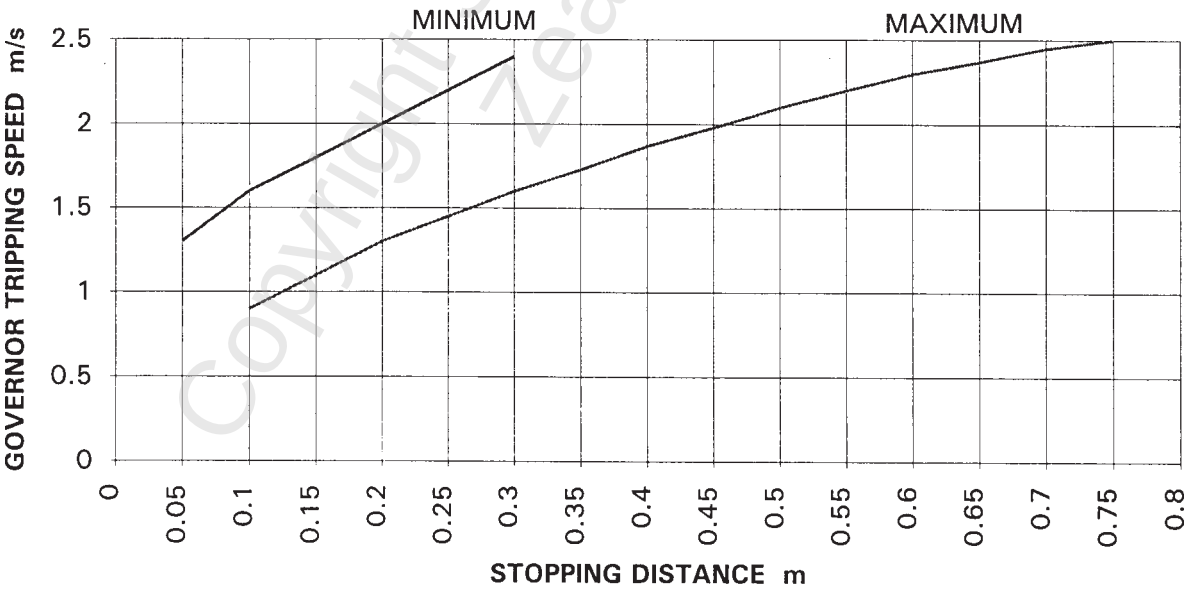
Table 29.4 – Type B safety gear stopping distances*

Rated speed (m/s)	**Maximum governor tripping** (m/s)	**Permitted stopping distances** (m)			
		Drive-in acceptance test (see 66.4.2)		**Runway acceptance test** (see 66.4.3)	
		min.	max.	min.	max.
0 – 0.65	0.90	0.021	0.096	0.018	0.083
0.75	1.07	0.029	0.136	0.025	0.117
0.90	1.25	0.040	0.185	0.034	0.159
1.00	1.40	0.064	0.233	0.054	0.200
1.12	1.54	0.095	0.281	0.080	0.242
1.25	1.68	0.130	0.335	0.109	0.288
1.50	1.97	0.198	0.460	0.171	0.396
1.75	2.26	0.261	0.606	0.225	0.521
2.00	2.55	0.332	0.772	0.286	0.664
2.25	2.85	0.412	0.957	0.355	0.823
2.50	3.12	0.497	1.16	0.428	0.993
3.00	3.70	0.698	1.62	0.602	1.40
3.50	4.27	0.930	2.16	0.802	1.86
4.00	4.85	1.20	2.79	1.03	2.40
4.50	5.42	1.50	3.49	1.29	3.00
5.00	6.00	1.84	4.27	1.58	3.67
5.50	6.60	2.22	5.17	1.92	4.44
6.00	7.20	2.64	6.15	2.28	5.29
6.50	7.80	3.10	7.22	2.68	6.21
7.00	8.40	3.60	8.37	3.10	7.20
7.50	9.00	4.13	9.61	3.56	8.27

* Intermediate values may be obtained from figure 29.4.1.

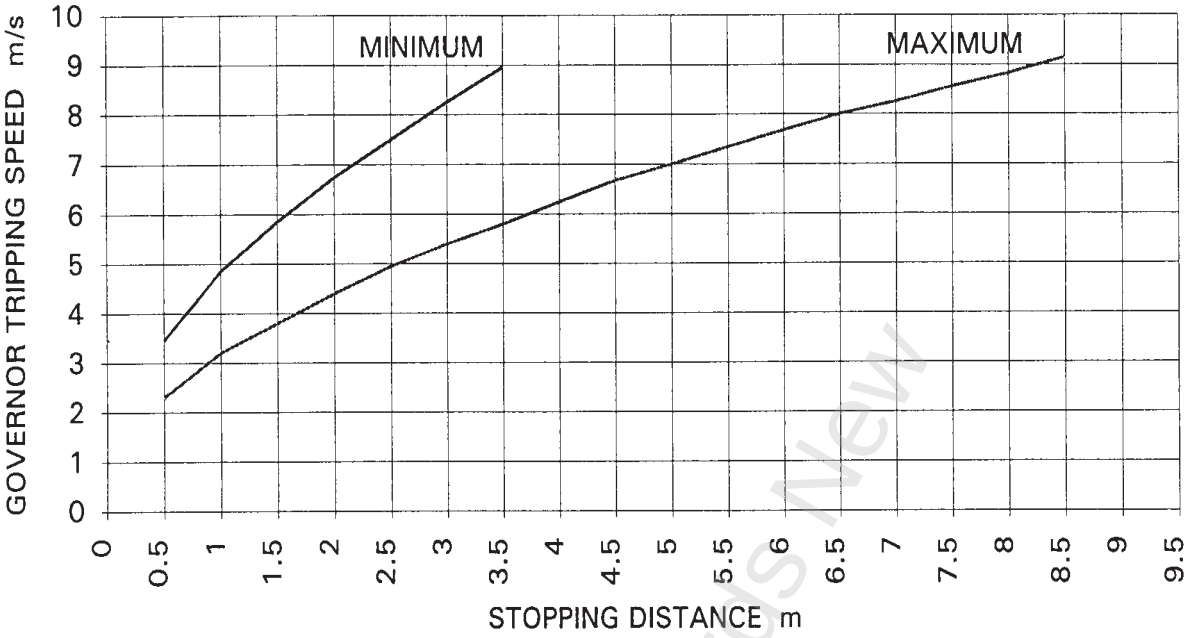


(a) Governor tripping speeds > 2.5 m/s

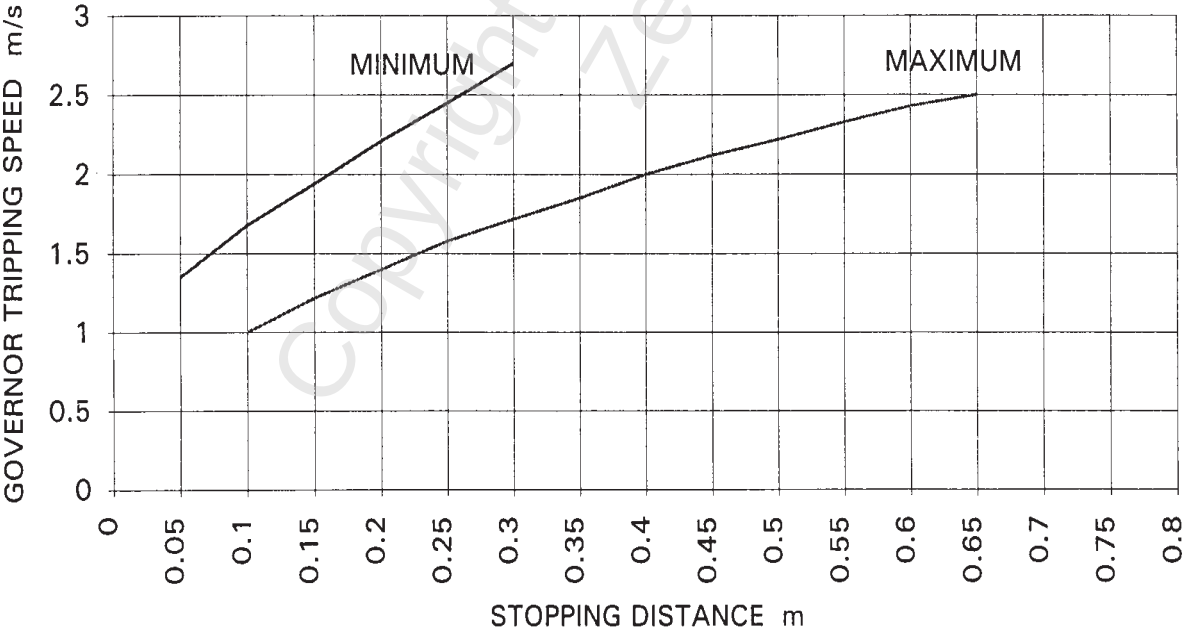


(b) Governor tripping speeds < 2.5 m/s

Figure 29.4.1 – Drive-in acceptance tests – permitted stopping distances for Type B safety gear

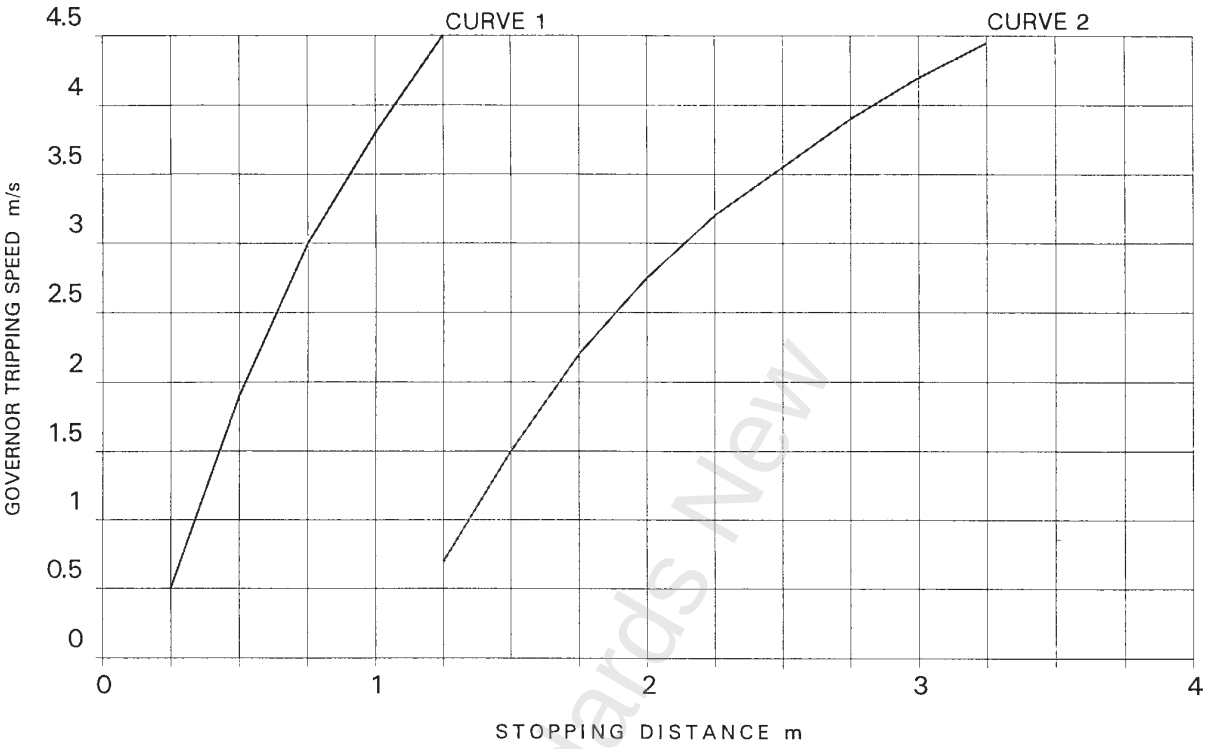


(a) Governor tripping speeds > 2.5 m/s



(b) Governor tripping speeds < 2.5 m/s

Figure 29.4.2 – Runaway acceptance tests – permitted stopping distances for Type B safety gear



Legend:

Curve 1 gives minimum stopping distance for car with 100 % load or counterweight
Curve 2 gives maximum stopping distance for car with 100 % load or counterweight

Figure 29.4.3 – Minimum and maximum permitted stopping distances of car and counterweight with wedge clamp Type C safety gear

29.5 Counterweight safety gear

Counterweight safety gear where provided shall comply with the requirements for car safety gear, except where otherwise specified in this Standard. 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 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 29.5, one of the following requirements shall be met:

(a) The safety gear shall be provided with a switch complying with 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 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). It 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 66.6 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 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 % 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 2 oil buffers of substantially identical 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 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 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 % 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 loaded 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 % 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 66.4).

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 % 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 % 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 % 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. (See 30.6).

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 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:

(a) For dry rail operation, notice to read:

SAFETY WARNING: THESE RAILS ARE NOT TO BE LUBRICATED

(b) 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.

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 % 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 % 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 over-speed 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 a 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.

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).

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 over-speed switch operates in down direction** (m/s)
0 – 0.65	0.90	0.90
0.75	1.07	0.95
0.90	1.25	1.12
1.00	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 figure 30.2.

(c) The governor switch, when set as specified in either paragraph (a) or (b) above, shall open in the up direction at a speed not greater than the speed at which the governor is set to trip in the down direction.

30.4 Sealing and painting of speed governors

Speed governors shall have their means of speed adjustment sealed after calibration. If speed governors are painted after sealing, all bearing or rubbing surfaces shall be freed of paint and a hand test shall be made to determine that all parts operate freely as intended. Sealing shall be effected so as to prevent readjustment of the governor tripping speed, without disturbing the seal.

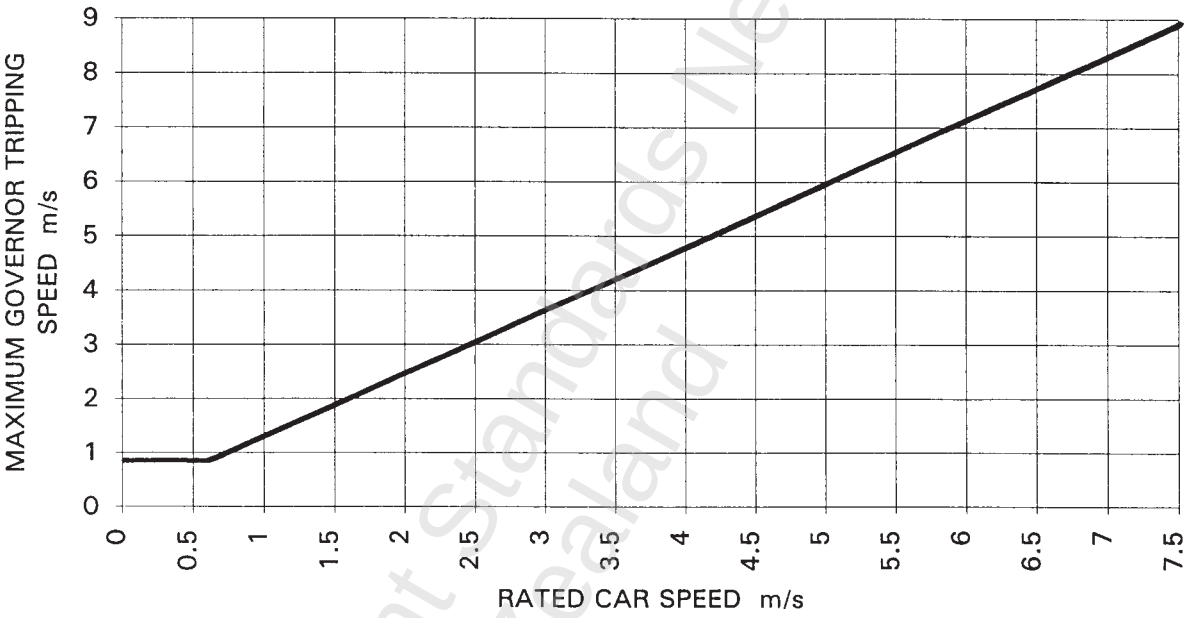


Figure 30.2 – Maximum governor tripping speeds

30.5 Governor ropes

30.5.1 *Material and factor of safety*

Governor ropes shall fully comply with the requirements of BS 302 : Part 4. Governor ropes shall be of not less than 6 mm diameter and shall have a minimum factor of safety of not less than 8.

30.5.2 *Governor rope clearance*

During normal operation of the lift, the governor rope shall run free and clear of the governor jaws, rope guards and other stationary parts.

30.5.3 *Friction type governors*

Friction type governors are acceptable providing they comply with the relevant requirements of EN 81:Part 1.

30.6 Rope grip jaws of speed governors (where fitted)

Speed governors shall be provided with a rope grip jaw or jaws which shall effectively arrest the governor rope when the governor trips. The jaw or jaws shall develop a maximum grip such as will permit the governor rope ultimately to pull through when its tension is not more than one-fifth of the guaranteed breaking strength of the rope. (See also 29.14).

Governor jaws shall be of such shape and length that no appreciable damage to or deformation of the rope shall result from the stopping action of the jaws in operating the car or counterweight safety gear.

The jaws of governors controlling the car safety gear of Type B shall be incapable of spontaneously resetting clear of the governor rope in the event of the car jumping upwards after operation of its safety gear. Corresponding provision shall be made in respect to governors controlling the counterweight safety gear of Type B.

30.7 Design of speed governor sheaves and traction between rope and sheave

The arc of contact between the governor rope and governor sheave shall, in conjunction with a governor rope tension device, provide sufficient traction to cause proper functioning of the governor.

Governor and tension sheave grooves shall comply with the relevant parts of section 18.

The ratio of the pitch diameter of governor sheave to governor rope diameter when using 6-strand ropes, shall be based on the rope speed shown in table 30.7.

When using 8-strand ropes, the sheave ratio for rope speeds exceeding 3.5 m/s need not be more than 32:1.

Table 30.7 – Minimum ratio of governor sheave to rope diameter

Speed of rope (m/s)	**Minimum ratio of sheave to rope diameter**
Up to and including 1.25	25
Over 1.25 up to and including 3.5	30
Over 3.5 up to and including 5.0	33
Over 5.0 up to and including 6.0	35
Over 6.0	37

30.8 Speed governor marking plate

A metal plate shall be securely attached to each speed governor and shall be marked in a legible and permanent manner with letters and figures not less than 3 mm high indicating the following:

(a) The maker's name or trademark;

(b) The rated speed and tripping speed in metres per second at which the governor is set and sealed to trip;

(c) The size, material, construction and breaking load of the governor rope on which the governor jaws were designed to operate.

30.9 Guarding of nip-points

The rope nip-points of governor tension sheaves shall be adequately guarded to comply with 18.6 (see also 18.2).

PART 3 ELECTROHYDRAULIC LIFTS

31 GENERAL

31.1 Scope

This Part of the Standard applies to electrohydraulic lifts as defined in 3.1. The liquid pressure is generated by a pump driven by an individual electric motor. These clauses are complementary to Parts 1 and 2. Should there be conflict, the requirements of this Part take precedence over corresponding requirements of Part 2.

31.2 Drawings and particulars

Drawings and particulars of the lift installation to be documented.

(All dimensions in millimetres unless otherwise specified)

Owner's name .....
Address .....
Location of lift .....

Lift maker
Lift submitter
Reference number of submitter
Date of submission
Observation lift: Yes/No
Type of Lift: Passenger/Pass & Goods/Attended Goods
Serial number(s) of lift(s) which comply with NZS 4121

Internal car floor particulars

(Measured 1000 mm above the car floor; ignore handrails etc.):
Internal car floor width
Internal car floor depth
Area (cm^2)

Masses:

Car (kg)
Rated load (kg)
No. of persons
Flying counterweight (kg)

Car details:

Platform weight (kg)
Platform direct on buffer members/isolators
Floor details
Sides and top details
Plank or platform support members
Bow members
Weight of additional machinery on bow members (kg)
Buffer members
Sling members
Free length of sling member

Miscellaneous

Total lift travel (m)
No. of floors of travel/openings served
Rated speed of car (m/s)
Maximum full load down speed (m/s)
Self-closing doors fitted? Yes/No
Top overtravel limiter; none/switch/cushioned ram

For suspended lift:

Governor tripping speed (m/s)
Overtravel limit switch: fitted/not fitted

Guide shoe data:

Vertical distance between car guide shoes' centres
Eccentricity of car guide shoes with respect to c.o.g. of car
Toe-to-toe distance between guide rails (D.B.G.)
Distance from toe of guide rail to centre of guide roller

Clearances and overtravel: clearances at top landing above following equipment:

Above guide shoes
Above equipment 300 mm within perimeter of roof
Above region 450 mm either side of bows
Above car roof
Above all other equipment
Top overtravel of car

Bottom clearances:

Mechanical clearance
Man clearance
Car-buffer clearance
Clearance to landing sill
Clearance to liftwell
Compressed ram clearance

Car buffers:

Type: solid/spring/hydraulic:
No. of buffers
Stroke of the buffers

Seismic categories

$C_{P\ max}$: Zone A = 0.6; Zone B = 0.5; Zone C = 0.4
Seismic design coefficient $C_d = R \times C_{P\ max}$
See Appendix B for seismic zones and table 2.1 for Risk factors (R)

Car guide rails' data: Type of rail:

Distance between fixings
Tie bracket section description (if fitted):
Modulus Z_{yy} (cm^3)
Height

Safety gear type: None A/B/C/D:

Flying counterweight guide rails' data: Type of rail:
- Distance between fixings
- Buffer type
- Buffer stroke
- Buffer clearance
- Top clearance
- Bottom clearance

Tie bracket section description (if fitted):
- Modulus Z_{yy} (cm^3)
- Height

Liftwell enclosure (description):

Landing entrances:
- Clear opening height
- Clear opening width
- Door locks type/maker

Terminal stopping device:
- Cam operated from car
- Selector in machine room driven by car
- Electro-mechanical inductors

Normal limit switches; maker – description:

Anti-creep levelling device; fitted/not fitted:

Hydraulic system:
- Working pressure (kPa)
- Relief valve pressure (kPa)
- Ram hollow and subject to external pressure: Yes/No

Cylinder:
- Outside diameter
- Inside diameter
- Corrosion allowance (if provided)
- Cylinder material
- Cylinder yield strength

Type of end:
- Flat/concave/convex to pressure
- Thickness

For dished end:
- Radius to which end is dished

Ram:

	Stage 1	Stage 2	Stage 3
Outside diameter			
Inside diameter			
Free length			
Mass (kg)			
Ram follower guide fitted/not fitted			
Ram material			
Ram yield strength (N/mm^2)			

Type of end:

Flat/concave/convex to pressure
Thickness

For dished end:

Radius to which end is dished
Door lock valve (maker)
Check valve (maker)
Flow restriction valve (maker)

For roped (suspended) hydraulic lifts:

Hoist ropes:

Roping 1:1 1:2 1:3 (for speed) (for rope load)
Rope diameter
Ropes total length (m)
No. of ropes used
Breaking strength/rope (kg)
Maker
Rope construction
Eye bolt dia.

Machine position:

Diverter sheave dia.
Diverter sheave shaft dia.
kW rating
rpm
Governor type
Governor rope dia.

Drawing references

31.3 Maximum permissible speed

The rated speed (see 3.1) of an electrohydraulic lift shall not exceed 1 m/s.

For all lifts designed for carrying passengers or goods, the speed in the down direction, under full load conditions, shall comply with the requirements in table 31.3.

Table 31.3 – Maximum speed in down direction

Rated speed	Maximum down-speed increase over rated speed (%)
Not more than 0.5 m/s	50
More than 0.5 m/s but not more than 1 m/s	40

31.4 Cylinder supports and foundations

The adequacy of the design and construction of the supports and foundations for the hydraulic cylinder shall be certified by an appropriately qualified and experienced engineer.

31.5 Pressure test after erection

After erection, before being put into service and in the presence of a suitably qualified person, equipment subject to hydraulic pressure on the cylinder side of the check valve and down stop valve shall be tested in accordance with section 68.

31.6 Devices to hold car above lowest floor

For direct-acting electrohydraulic lifts, devices shall be provided to hold the car above the lowest floor, in accordance with the following requirements:

(a) Suitable means shall be provided to:

(i) Support the car above the lowest landing so as to give an access space of at least 600 mm during service and repair of hydraulic equipment in the pit;

(ii) Hold down the car during pressure tests required by 31.5. The supporting means required in (a)(i) above, or equivalent means, shall also be in position during such tests, as a precaution against the car descending in the event of any failure;

(b) The equipment provided may be a combined unit to meet the requirements of (a) above.

(c) The equipment under (a)(i) above shall remain on site and, where practicable, in the pit, provided that it will not restrict the mechanical and man clearances specified in 38.1, alternatively this equipment shall be stored in the machine room.

Such equipment shall be identified as to its use.

(d) Permissible stresses in the means of support shall comply with the requirements of approved standards, and fixings thereof, if used, shall be designed with a factor of safety of 2 on yield strength, based on the fully loaded car.

31.7 Materials, components and equipment complying with approved Standards

Materials, components, and equipment, which have been proven as follows:

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

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

(c) In the United Kingdom and used under the Lift Code BS 5655 with the approval of the authorized inspection authorities, or

(d) In Europe and used under the CEN Lift Standard EN 81 with the approval of the authorized inspection authorities,

are approved for use with this Standard.

32 MACHINE ROOMS AND MACHINERY SPACES

32.1 Machine rooms

All central control operating equipment shall be grouped together in a machine room which shall comply with the relevant requirements of section 7.

The machine room shall be located adjacent to the liftwell and shall be equipped with a means to see some part of the motion of the lift car from the lift control position.

NOTE – An opening fitted with a metal grid on the liftwell side in the common wall of the liftwell and machine room could achieve this objective. The construction of the grid should comply with 12.2. The opening must be effectively plugged with a fire-resistant block of the appropriate rating (see 12.1) when not in use.

33 ACCESS TO OVERHEAD SHEAVES

Where an electrohydraulic lift has overhead sheaves such as for counterweight ropes, access to these shall be provided by means of a sheave room or platform.

Such sheave room or platform shall comply with relevant requirements of 7.13.

34 HYDRAULIC DRIVING MACHINES

34.1 Type

The requirements of this section apply particularly to hydraulic driving machines of the direct-acting ram type, but where a lift is of the suspended type, then the driving machine for such lift shall comply with the relevant clauses in this section.

34.2 Rams

34.2.1 *General*

Rams may be single or multi-stage. They shall be of uniform diameter and have a uniform smooth finish on the outside to ensure maximum life of packings and minimum oil leakage. If of hollow construction, they shall have substantially uniform wall thickness.

34.2.2 *Material*

Rams shall be of steel or other approved ductile metal. Grey cast iron or other brittle material shall not be used for the ram or its connecting couplings to the car.

34.2.3 *Ram design*

34.2.3.1 *General*

Rams shall be designed and constructed in accordance with the equations in 34.2.3.2, 34.2.3.3 and 34.2.3.4. The maximum permissible slenderness ratio (λ) of a hollow ram shall be 300, and of a solid ram shall be as calculated by the following equation:

$$\lambda = 0.67 \sqrt{\frac{EA_n}{M}}$$

Having regard to the requirements of 22.2 that guide shoes be provided at the top and bottom of each car frame, rams shall not be subjected to eccentric loading.

34.2.3.2 *Buckling calculations*

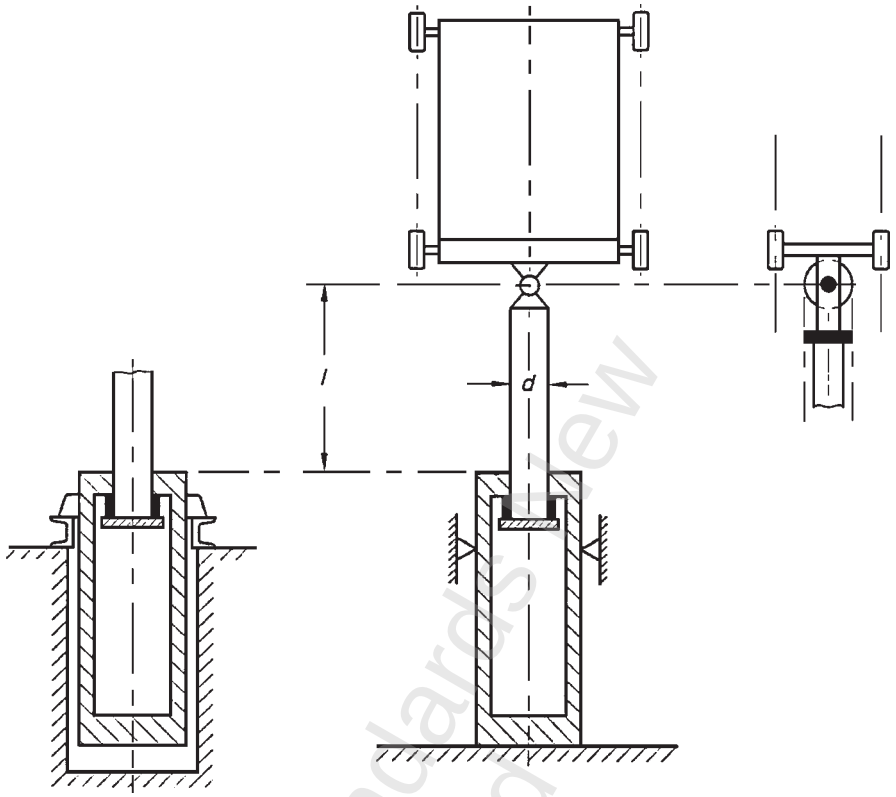
Solid or hollow rams under compressive loads shall be designed and constructed such that in their fully extended position, and under the forces resulting from a pressure equal to 1.4 times full load pressure, a safety factor of at least 2 against buckling is assured. The calculation shall be carried out in accordance with the equations given in figures 34.2.3.2(a), (b) or (c), as appropriate.

34.2.3.3 *Pressure calculations*

Hollow rams subject to external pressure shall be designed such that under the forces resulting from a pressure equal to 2.3 times the full load pressure, a safety factor of at least 1.7 referred to the proof stress $R_{p_{0.2}}$ is assured. The calculations shall be carried out in accordance with 34.3.2.

34.2.3.4 *Tensile stress calculations*

Solid or hollow rams under tensile loads shall be designed such that under the forces resulting from a pressure equal to 1.4 times full load pressure, a safety factor of at least 2 referred to the proof stress $R_{p_{0.2}}$ is assured.



For $\lambda_n < 100$:

$$F_s \leq \frac{A_n}{2}\left[R_m - (R_m - 210)\left(\frac{\lambda_n}{100}\right)^2\right]$$

$$F_s = 1.4\ g_n\ [c_m\ (P_3 + Q) + 0.64\ P_r + P_{rh}\ ]^*$$

For $\lambda_n \geq 100$:

$$F_s \leq \frac{\pi^2 E J_n}{2l^2}$$

$$F_s = 1.4\ g_n\ [c_m\ (P_3 + Q) + 0.64\ P_r + P_{rh}\ ]^*$$

* Valid for rams extending in upward direction.

Figure 34.2.3.2(a) – Single stage ram and cylinder

34.2.5 *Ram connection*

Any direct-acting ram shall be attached to the car frame with a connecting coupling of sufficient strength to support the mass of the ram with a factor of safety of not less than 4 on ultimate tensile strength. Such connections shall be designed to prevent eccentric loading of the ram.

Connection between car and ram shall be designed to a factor of safety of 4 on ultimate tensile strength to prevent disengagement of a ram from the car when the ram strikes the ram stops, with the car travelling upward at rated speed.

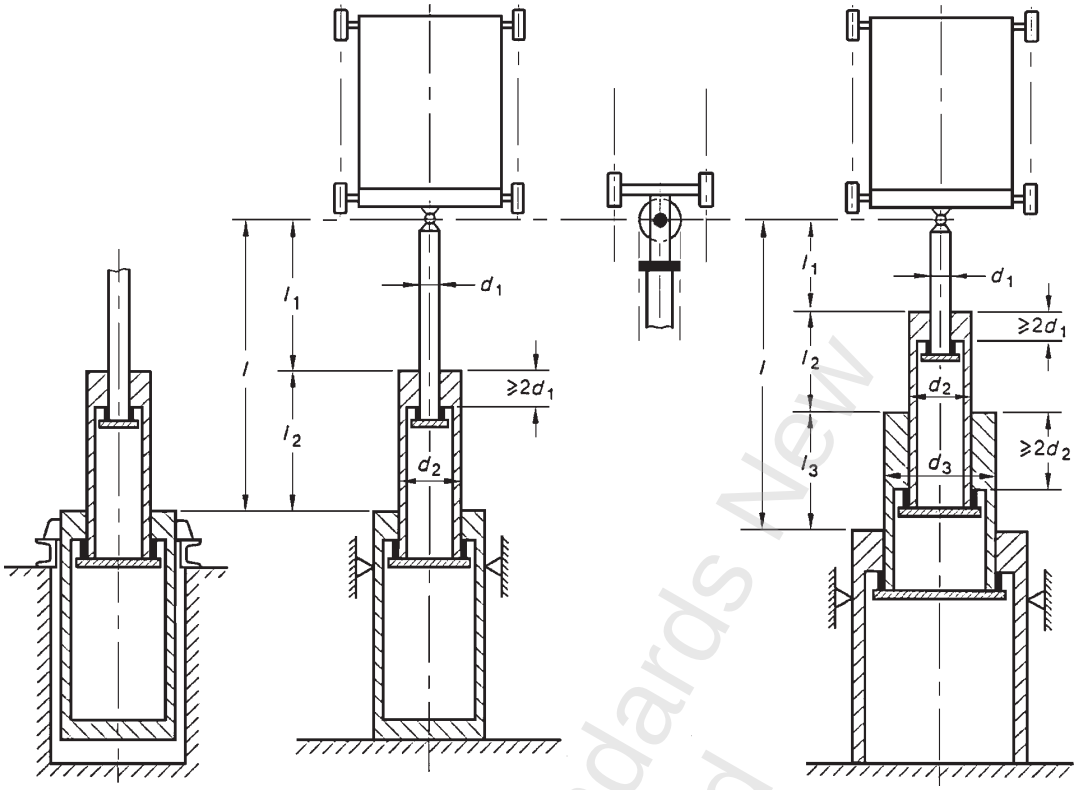
When isolated ram connections are provided, measures are to be taken to ensure the rams do not become dislodged from the coupling.

34.2.6 *Ram joints*

Rams composed of more than one section shall have the joints designed and constructed to:

(a) Carry in tension the mass of all ram sections below the joint; and

(b) Transmit in compression the gross load on the ram with a factor of safety of not less than 5 based on ultimate tensile strength.



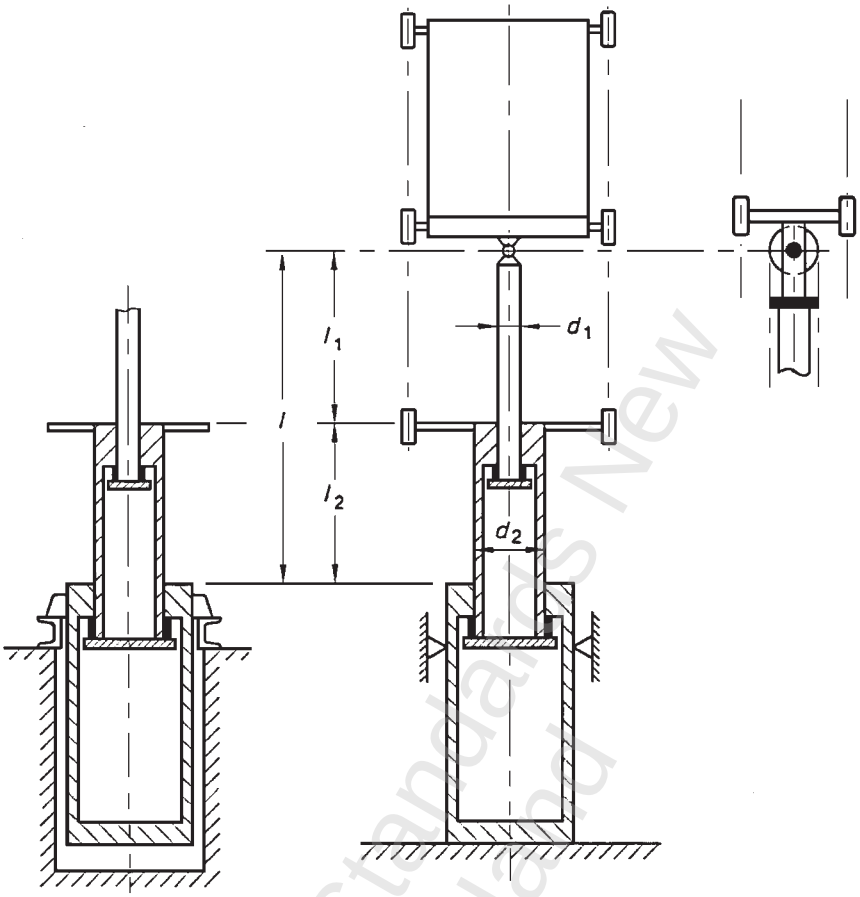
2 Sections:	3 Sections:
$l = l_1 + l_2, \quad l_1 = l_2$	$l = l_1 + l_2 + l_3, \quad l_1 = l_2 = l_3$
$\upsilon = \sqrt{\frac{J_1}{J_2}}; \quad (J_2 > J_1)$	$\upsilon = \sqrt{\frac{J_1}{J_2}}; \quad (J_3 \geq J_2 > J_1)$
$\phi = 1.25\ \upsilon - 0.25$	(assumption for simplified calculation: $J_3 = J_2$)
	$\phi = 1.5\ \upsilon - 0.2$; for $0.22 < \upsilon < 0.65$
	$\phi = 0.65\ \upsilon + 0.35$; for $0.65 < \upsilon < 1$

$$\lambda_e = \frac{l}{i_e} \text{ with } i_e = \frac{d_m}{4}\sqrt{\sqrt{\phi}\left[1+\left(\frac{d_{mi}}{d_m}\right)^2\right]}$$

For $\lambda_e < 100$:	For $\lambda_e \geq 100$:
Calculation of the section with the smallest solid cross section	
$F_s \leq \frac{A_n}{2}\left[R_m - (R_m - 210)\left(\frac{\lambda_n}{100}\right)^2\right]$	$F_s \leq \frac{\pi^2 E J_2}{2l^2} \cdot \phi$
$F_s = 1.4\ g_n\ [c_m\ (P_3 + Q) + 0.64\ P_r + P_{rh} + P_{rt}]$*	$F_s = 1.4\ g_n\ [c_m\ (P_3 + Q) + 0.64\ P_r + P_{rh} + P_{rt}]$ *

* Valid for rams extending in upward direction.

Figure 34.2.3.2(b) – Telescopic ram and cylinder without external head guidance



For λ_n < 100:	For λ_n ≥ 100:
Calculation of the section with the smallest solid cross section	
$F_s \le \frac{A_n}{2}\left[R_m - (R_m - 210)\left(\frac{\lambda_n}{100}\right)^2\right]$ $F_s = 1.4\ g_n\ [c_m\ (P_3 + Q) + 0.64\ P_r + P_{rh} + P_{rt}]$*	$l = l_1,\ l_2$ $F_s \le \frac{\pi^2 E J_n}{2l^2}$ $F_s = 1.4\ g_n\ [c_m\ (P_3 + Q) + 0.64\ P_r + P_{rh} + P_{rt}]$ *

* Valid for rams extending in upward direction.

NOTE – As a deviation from the buckling equations above, more complex calculation methods may be used provided that at least the same safety factor is assured.

Figure 34.2.3.2(c) – Telescopic ram and cylinder

34.2.7 *Ram stops*
Stops shall be provided to prevent rams from moving out of their cylinders under full load pressure at maximum speed.

The stops shall be of solid metal. They may be provided with hydraulic cushioning.

Where ram stops are used as car stops, they shall:

(a) Maintain the clearances required in sections 38 and 39;

(b) Maintain the lift car level; or

(c) Prevent the car leaving its guides.

A hydraulic cushioned stop or a top overtravel limit switch shall be provided for lifts with full load-up speed of more than 0.5 m/s.

The cushioned stop shall retard the lift to a maximum speed of 0.5 m/s with a retardation not greater than 1 g before reaching the limit of travel. The top overtravel limit switch, complying with 60.3, shall cause the lift to retard to a maximum speed of 0.5 m/s with a retardation not greater than 1 g.

34.2.8 *Car stops for upward travel*
Car stops may be provided to limit the top overtravel where a ram stop does not provide the required limit.

Car stop devices shall:

(a) Be of the impact-absorbing type;

(b) Be external to the ram;

(c) Be outside the car roof area;

(d) Maintain the clearances required in sections 38 or 39 as applicable;

(e) Maintain the lift car level;

(f) Prevent the car leaving its guides; and

(g) Be able to absorb the mechanical energy of the system:

(i) Under full load pressure at maximum speed;

(ii) Within their strokes;

(iii) Without permanent deformation of the equipment;

(iv) Without causing eccentric loading on the ram; and

(v) At a retardation not greater than 1 g.

34.2.9 *Ram ends subject to fluid pressure*
Ram ends subject to fluid pressure shall comply with the requirements of 34.3.4.

34.2.10 *Ram-follower guide*
Ram-follower guides may be used on single stage rams. In such cases, the guide shall be roped to the car so that it is always approximately at the midpoint of the extended part of the ram. Means shall be provided to open the control circuit should the supporting ropes of a ram-follower fail.

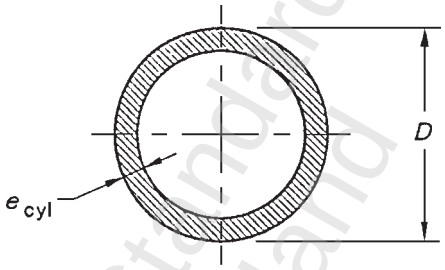
34.2.11 *Head guide*
Head guides for telescopic rams and cylinders, where required, shall be designed to prevent lateral movement of the head.

34.3 Cylinders

34.3.1 *Materials*
Cylinders shall be of steel or other approved ductile metal.

34.3.2 *Cylinder design*
Cylinders shall be designed such that under the forces resulting from a pressure equal to 2.3 times the full load pressure, a safety factor of at least 1.7 referred to the proof stress $R_{p_{0.2}}$ is assured. The calculations shall be carried out in accordance with the equation given in figure 34.3.2.

For the calculation of the various elements of a telescopic ram and cylinder assembly which has hydraulic synchronization, the full load pressure shall be replaced by the highest pressure which occurs in an element due to the means of hydraulic synchronizing.



DIMENSIONS IN MILLIMETRES

$$e_{cyl} \geq \frac{2.3 \times 1.7 \times p}{R_{p_{0.2}}} \times \frac{D}{2} + e_o$$

e_o = 1.0 mm for wall and base of cylinders and rigid pipes between the cylinder and the rupture valve, if any
= 0.5 mm for rams and other rigid pipes
2.3 = factor for friction losses (1.15) and pressure peaks (2)
1.7 = safety factor referred to the proof stress

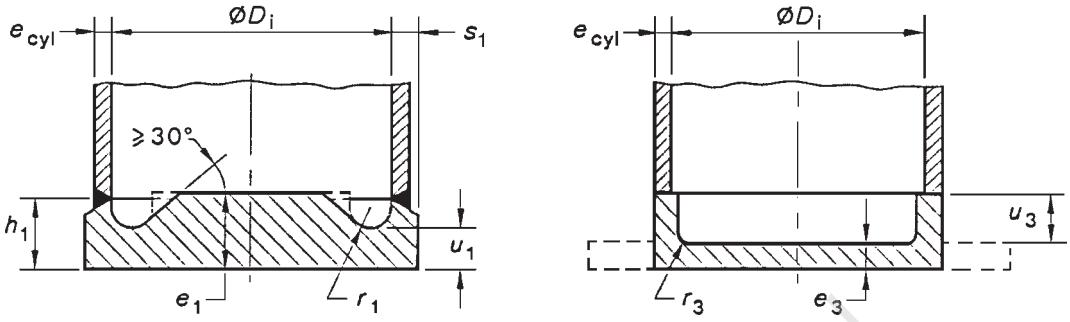
Figure 34.3.2 – Cylinder wall thickness

34.3.3 *Clearance at bottom of cylinder*
Clearance shall be provided at the bottom of the cylinder so that the bottom of the ram will not strike the bottom of the cylinder when the car is resting on its fully compressed buffer.

34.3.4 *Cylinder and ram ends*

34.3.4.1 *General*
Ends of cylinders and ends of rams shall be welded or positively retained.

34.3.4.2 *Thickness of cylinder end*
The thickness of the cylinder and ram ends (e_1, e_2 and e_3) shall be determined by the equations given in figure 34.3.4.2.



Conditions for the stress relief of the welding seam:

$r_1 \geq 0.2\ s_1$ and $r_1 \geq 5$

$u_1 \leq 1.5\ s_1$

$h_1 \geq u_1 + r_1$

$$e_1 \geq 0.4 D_i \sqrt{\frac{2.3 \times 1.7 \times p}{R_{p0.2}}} + e_o$$

$$u_1 \geq 1.3\left(\frac{D_i}{2} - r_1\right) \times \frac{2.3 \times 1.7 \times p}{R_{p0.2}} + e_o$$

(a) Flat end with relieving groove

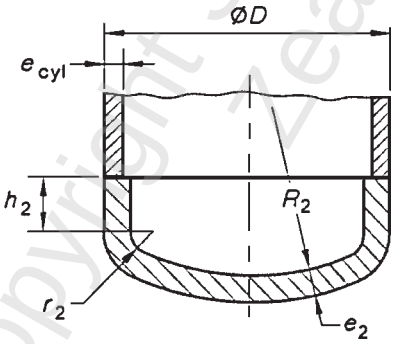
Conditions:

$u_3 \geq e_3 + r_3$

$$r_3 \geq \frac{e_{cyl}}{3} \text{ and } r_3 \geq 8$$

$$e_3 \geq 0.4 D_i \sqrt{\frac{2.3 \times 1.7 \times p}{R_{p0.2}}} + e_o$$

(b) Flat end with welding flange



Conditions:

$h_2 \geq 3.0\ e_2$

$r_2 \geq 0.15\ D$

$R_2 = 0.8\ D$

$$e_2 \geq \frac{2.3 \times 1.7 \times p}{R_{p0.2}} \frac{D}{2} + e_o$$

(c) Concave end

Dimensions in millimetres

Figure 34.3.4.2 – Cylinder ends

34.3.4.3 *Dished seamless ends convex to pressure*
Dished seamless ends, convex to pressure, shall have a maximum allowable working pressure of not more than 60 % of that for ends of the same dimension with pressure on the concave sides.

34.3.4.4 *Reinforced ends*
Reinforced ends shall be designed and constructed so that the maximum stress at rated capacity will not exceed the limits specified in 34.3.2, 34.3.4.2 and 34.3.4.3.

34.3.5 *Collection of oil leakage*
Means shall be provided to collect any oil leakage from the cylinder packing gland for convenient disposal.

34.3.6 *Bleeding-off air or gas*
Cylinders shall be provided with means for bleeding-off air or gas.

34.3.7 *Cylinder protection*
Where a cylinder or part thereof is below the ground level, it shall be enclosed in a waterproof caisson of medium density polyethylene (MDPE), concrete, or mild steel. Concrete pipes shall comply with AS 4058. Steel pipes shall comply with BS 3601, BS 3602, BS 3603 or BS 3604, as appropriate. MDPE shall comply with AS 1159.

Caissons of mild steel, concrete or MDPE shall be of the following minimum wall thicknesses and factors of safety (FoS), (FoS shall be based on ultimate tensile strength):

(a) Mild steel: 6 mm, FoS 2;

(b) Concrete: 25 mm, FoS 4;

(c) MDPE type 80 MRS: 10 mm, FoS 2 (on base) FoS 4 (on wall). (See Appendix A for details of MDPE).

The caisson shall extend to not less than 150 mm above the floor of the liftwell and the space between the caisson and the cylinder shall be provided with a detachable cover or covers to facilitate inspection.

Adequate provisions shall be made to restrain the caisson from floating upwards. The lower end shall be capable of withstanding the hydrostatic pressures that may occur.

The outer surfaces of the cylinder shall be protected against corrosion.

For inspection purposes, the mean space between the cylinder and the caisson shall be not less than 75 mm, i.e. the bore of the caisson shall exceed the outside diameter of any part of the cylinder by not less than 150 mm. The cylinder should be concentric with the caisson but any part of the cylinder and cylinder assembly shall be clear of the caisson by not less than 25 mm. The space between the cylinder and caisson shall be left unfilled.

Hydrostatic pressure shall be considered for the purpose of design, and shall be taken from ground level to the bottom of the caisson.

34.3.8 *Cylinder restraints*
Cylinders supported at the base shall be restrained from lateral movement. Such restraint shall be provided close to the top of the cylinder and the bottom of the cylinder. For centrally located cylinders under the lift car, support means shall be provided close to the head of the cylinder.

34.3.9 *Multiple cylinders*
If several ram and cylinder units are used to raise the car, they shall be hydraulically connected to ensure pressure equilibrium.

Symbols

Symbols used in section 34 of this Standard, together with their explanations are given below:

A_n = cross-sectional area of the material of the ram to be calculated (mm^2) (n = 1, 2, 3)

c_m = reeving ratio

d_m = outside diameter of the biggest ram of a telescopic ram and cylinder (mm)

d_{mi} = inner diameter of the biggest ram of telescopic ram and cylinder (mm)

E = modulus of elasticity (N/mm^2) (for steel: E = 2.1 x 105 N/mm^2)

e_o = additional wall thickness (mm)

F_s = actual buckling force applied (N)

g_n = standard acceleration of free fall (m/s^2)

i_e = equivalent radius of gyration of a telescopic ram and cylinder (mm)

i_n = radius of gyration of the ram to be calculated (mm) (n = 1, 2, 3)

J_n = second moment of area of the ram to be calculated (mm^4) (n = 1, 2, 3)

l = maximum length of rams subject to buckling (mm)

M = mass supported by the ram including half of the ram mass (kg)

P_3 = sum of the mass of the empty car and the mass of the portion of the travelling cables suspended from the car (kg)

P_r = mass of the ram to be calculated (kg)

P_{rh} = mass of the ram head equipment, if any (kg)

P_{rt} = mass of the rams acting on the ram to be calculated (in the case of telescopic rams and cylinder) (kg)

p = full-load pressure (MPa) = static pressure exerted in the system while the lift car with rated load being at rest at the highest landing level

Q = rated load (mass) displayed in the car (kg)

R_m = tensile strength of material (N/mm^2)

$R_{p_{0.2}}$ = proof stress (non-proportional elongation) (N/mm^2)

$\lambda_e = \frac{l}{i_e}$ = equivalent slenderness ratio of a telescopic ram and cylinder

$\lambda_n = \frac{l}{i_n}$ = slenderness ratio of the ram to be calculated

υ = ϕ = Factors used to represent approximate values given by experimentally determined diagrams

1.4 = over-pressure factor

2 = safety factor against buckling

35 HYDRAULIC LINES

35.1 General

35.1.1 *Permitted types*
Hydraulic lines shall be either rigid metallic pipes, or flexible hydraulic hoses, or a combination of both.

35.1.2 *Length*
The length of hydraulic lines shall be as short as possible and the number of joints and fittings shall be kept to the reasonably practicable minimum.

Joints shall not be used in hoses to achieve the required length.

35.1.3 *Supports*
Hydraulic lines shall be supported to eliminate undue stresses in pipes, joints and fittings, particularly at any section subject to vibration (see also 35.3.5). Piping supports to restrain transverse motion shall be provided near changes in direction and particularly near valves and joints and shall comply with the requirements of 6.3.

35.1.4 *Joints and connections*
Joints and connections of hydraulic lines external to the power unit shall be welded flange fittings or flared screwed connections complying with SAE J516. However, where the pressure in a hydraulic line does not exceed 3.5 MPa, taper-to-taper screwed connections complying with AS 1722:Part 1, or ANSI Bl.20.1, or other approved connections may be used.

35.1.5 *Sound-isolating joints*
Approved sound-isolating joints may be used in the pressure pipe, provided that failure of the resilient sealing element shall not permit separation of the connected parts. Such joints, where used, shall be factory made and fitted requiring only assembly in the field.

35.2 Rigid lines

35.2.1 *Material*
All hydraulic pipes, fittings and flanges shall be of steel and shall comply with an approved standard specification suitable for the use of pressurized oil lines in hydraulic lift installations, such as AS 1074 for pipes; AS 1074, BS 1640, or BS 1740 for fittings.

35.2.2 *Wall thickness*
The wall thickness of steel piping shall be not less than that determined by the following formula:

$$t = \frac{PD}{2S} + C$$

where

t = minimum wall thickness, in millimetres

P = working pressure, MPa.

D = outside diameter of pipe, in millimetres

C = for threaded pipe up to 9.5 mm 1.25

= for threaded pipe over 9.5 mm .... depth of thread, in millimetres

= for grooved pipe .... depth of groove, in millimetres

= for other pipe of unreduced thickness .... zero

S = allowable stress (i.e. 0.4 times the yield strength), MPa.

35.2.3 *Plain end metallic non-ferrous piping or tubing*
Plain end metallic non-ferrous piping or tubing shall have a wall thickness not less than that determined by the formula in 35.2.2 using C = zero.

35.3 Hoses

35.3.1 *Material*
Hoses shall be of double braided wire construction complying with approved standards such as Class 100 R2 Type A hose conforming to AS 3791; SAE J517 100R2; BS 4586; BS 3832. The minimum burst pressure for the relevant hose shall be at least 10 times the maximum working pressure in the hose.

35.3.2 *Hose fittings*
Hose fittings shall be factory fitted and of a non-reusable (swaged) type.

35.3.3 *Location*
Hose assemblies shall be visible and able to be inspected.

The locations of hoses and connections shall permit replacement of the hoses and the connections.

Flexible connections shall not be installed between the cylinder and flow-restriction valve required by 36.5.

35.3.4 *Supports*
Hoses shall be supported to prevent undue stress on the hose and its fittings. Distances between centres of adjacent supports shall not exceed 3000 mm vertically or 1000 mm horizontally.

Because of possible flexing of hoses during lift operation, they may require additional fixings to maintain the required car running clearances.

Loops and bends shall be adequately supported or guarded where they could be stood upon.

During construction, horizontal runs of flexible hose in the liftwell shall be covered to prevent damage caused by falling objects.

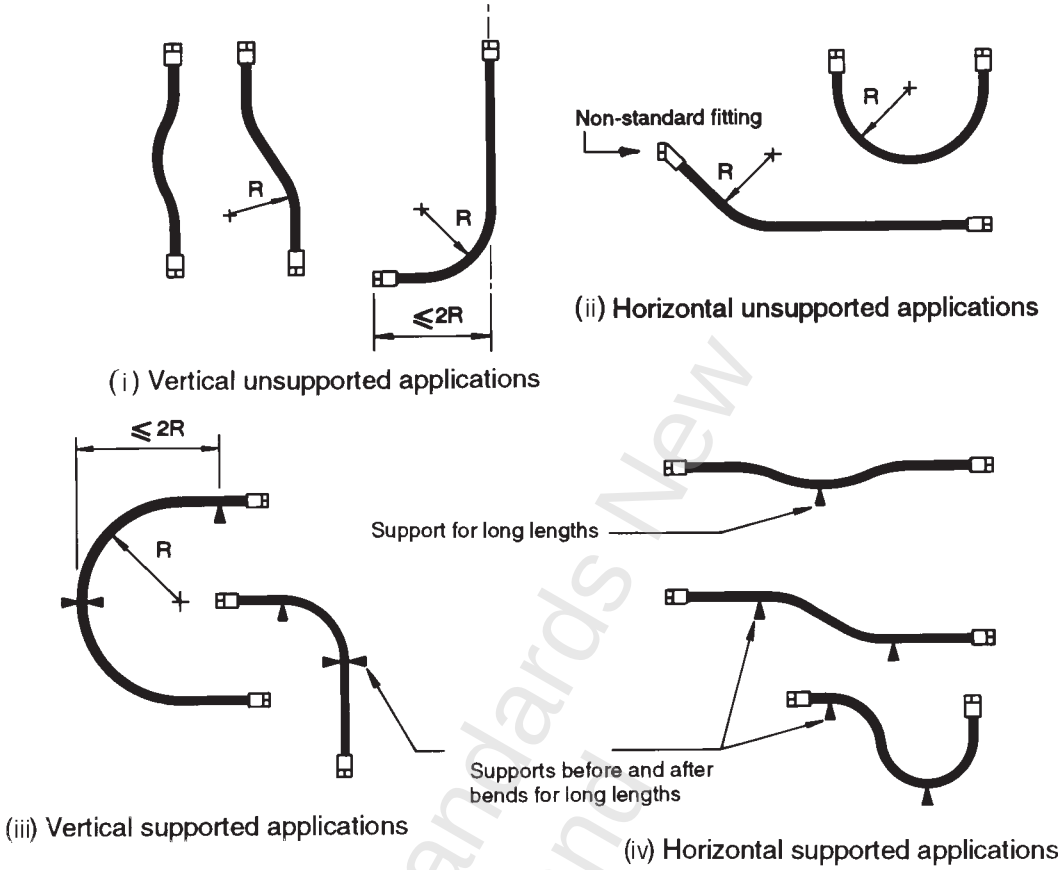
35.3.5 *Installation*
Hydraulic hoses shall be installed in accordance with recommended practice, examples of which are illustrated in figure 35.3.5(a). Incorrect practices, examples of which are illustrated in figure 35.3.5(b), shall not be used.

The radii of bends in hoses shall be not less than those recommended by the manufacturer nor less than the relevant minimum inside radius specified in table 35.3.5.

Long lengths of hose shall be supported before and after the bends to reduce strain on the hose and its fittings.

Table 35.3.5 – Minimum inside radius of bends

Hose size, BSP pipe thread (inch)	**Minimum inside radius of bend** (mm)
1 1/4	420
1 1/2	500
2	630



NOTE – For minimum values of *R*, see table 35.3.5.

Figure 35.3.5 (a) – Recommended practices for positioning hydraulic hoses

Figure 35.3.5 (b) – Prohibited practices for positioning hydraulic hoses

36 VALVES

36.1 Working pressures

Valves shall not be subjected to working pressures exceeding those recommended by the manufacturer for the type of service for which they are used.

The working pressure shall be legibly and permanently marked on the marking plate mounted on the power unit assembly.

36.2 Pump relief valve

36.2.1 *Provision*
Each pump or group of pumps shall be equipped with a relief valve.

36.2.2 *Type and location*
The relief valve shall be located between the pump and the check valve, and shall be of such a type and so installed in a by-pass connection that the valve cannot be shut off from the hydraulic system.

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

36.2.4 *Size*
The size of the relief valve and by-pass shall be sufficient to pass the maximum rated capacity of the pump without raising the pressure more than 20 % above that at which the valve opens. More than one relief valve may be used to obtain the required capacity.

36.2.5 *Sealing*
Relief valves having exposed pressure adjustments shall have their means of adjustment sealed after setting to the correct pressure.

NOTE – No relief valve is required for centrifugal pumps driven by induction motors provided that the shut-off or maximum pressure which the pump can develop is not greater than 135 % of the design working pressure at the pump.

36.3 Check valve
A check valve shall be provided, and shall be installed so that it will hold the lift with rated load at any point when the pump stops or the maintained pressure drops below the minimum operating pressure.

36.4 Door lock valve
A door lock valve shall be provided in the machine room of every electrohydraulic lift and interposed between the cylinder and the lowering valve. The door lock valve shall:

(a) Be solenoid-operated and arranged so as to close and prevent down travel of the lift for so long as any landing door contact is open with the car away from the levelling zone; and

(b) Be of a cushion-closing type and allow fluid flow to move the lift car in the up direction while the valve coil is de-energized.

36.5 Flow restriction valve
A flow restriction valve shall be provided for every direct-acting electrohydraulic lift and shall comply with the following requirements:

(a) The valve shall not be electrically operated;

(b) The valve shall be installed in the pressure-line as close as practicable to the cylinder;

(c) In the event of pressure-line failure, the valve shall operate to restrict the full-load down speed to not more than 0.05 m/s;

(d) The valve shall be set to operate at a lift speed not exceeding 30 % above the normal full-load down speed of the lift;

(e) Where the rated speed exceeds 0.5 m/s the valve shall be of a cushion-closing type;

(f) The valve shall be tested as follows:

(i) An overspeed test, simulating a broken line condition or loss of pressure, shall be carried out on site to demonstrate its effective operation

(ii) Where the pipe or valve capacity limits the ability to overspeed the lift, factory certified test certificates detailing the flow required to actuate the valve shall be provided by the manufacturer

(iii) Where external adjustment to the valve is provided, the overspeed test on site shall be performed.

36.6 Manual lowering

Means shall be provided within the machine room to lower the lift in an emergency, under manual control, with a lowering speed not exceeding 0.2 m/s.

37 TANKS

37.1 Material

Atmospheric storage and discharge tanks shall be of metal.

37.2 Capacity

Tanks shall be of sufficient capacity to provide for a liquid reserve adequate to prevent the entrance of air or other gas into the system.

37.3 Means for checking liquid level

Tanks shall be provided with means for checking the liquid level. Such means shall be accessible without the removal of any cover or other part. A dipstick is permissible.

The permissible minimum liquid level with the car at the highest landing served shall be permanently marked with the words:

LOWEST PERMISSIBLE LEVEL – CAR AT HIGHEST LANDING

If a dipstick is used it shall be marked with a line worded MIN. and the above notice shall be affixed to the tank adjacent to the dipstick.

If external glass gauges are used they shall be suitably protected.

37.4 Covers and venting

Tanks shall be covered and suitably vented to atmosphere.

37.5 Factor of safety

Tanks shall be designed and constructed so that when they are completely filled the factor of safety will be at least 4 based on the tensile strength of the material.

37.6 Fittings and protection

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

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

Means for draining the tank shall be provided.

All sides of the tank shall be fully visible for examination and protected by a substance unaffected by the working fluid. Where a tank has one or 2 sides adjacent to walls, there must be a minimum clearance of 100 mm to the wall.

Means shall be provided to prevent the tank from being overturned or displaced. Such means shall comply with 6.3.

38 DIRECT-ACTING ELECTROHYDRAULIC LIFTS – CLEARANCES FOR CARS AND COUNTERWEIGHTS

38.1 Clearance at bottom of car

38.1.1 *General*
For direct-acting electrohydraulic lifts, when the car rests on the stop or fully compressed buffer, there shall be vertical clearances at the bottom of the car which comply with 38.1.2 and 38.1.3.

38.1.2 *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.

38.1.3 *Man clearance*
The man clearance shall be not less than 600 mm between the pit floor and 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;

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

(c) Floor selector tape or rope sheaves; and

(d) Hydraulic lines and fittings;

(e) Buffer members for cantilevered lifts.

Provided that in all cases, including small cars, the following requirements are complied with:

(f) A minimum space for man clearance shall be provided adjacent to 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 450 mm wide by 1200 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;

(g) The pressure pipe and fittings shall have a clearance of not less than 450 mm in all directions from its axis to the under side of the car platform or equipment installed beneath the car platform and not less than 300 mm from the buffer striker plate and underbeams, excluding the area immediately adjacent to the cylinder;

(h) There shall be a vertical clearance of 300 mm between the car under-beam and any cylinder support or buffer-beam.

38.2 Car buffer clearance

When the car floor is level with the bottom landing, the car buffer clearance shall be as follows:

(a) Not more than 230 mm, but such clearance may be increased up to a maximum of 600 mm, provided that the lowest landing door, or doors, are self-closing, in accordance with the requirements of section 43;

(b) Not less than 75 mm for rated speeds of 0.5 m/s or less;

(c) Not less than 150 mm for rated speeds exceeding 0.5 m/s.

38.3 Top overtravel

The travel of the car above the top landing before the ram engages its stop shall be not greater than 600 mm for any rated speed and not less than the distance given in table 38.3.

Table 38.3 – Minimum top overtravel

Rated speed (m/s)	**Minimum overtravel** (mm)	
	Without hydraulic cushioning	**With hydraulic cushioning**
≤ 0.25	150	100
> 0.25 ≤ 0.5	225	150
> 0 5 ≤ 0 75	300	225
> 0.75 ≤ 1.0	450	300

38.4 Clearances above car (with ram fully extended against its stop)

The vertical clearances from overhead obstructions, with the ram fully extended against its stop, shall be not less than the following:

(a) 150 mm to guide shoes;

(b) 230 mm for rated speeds not greater than 0.25 m/s and 300 mm for rated speeds greater than 0.25 m/s, to equipment other than guide shoes which is not more than 300 mm inside the perimeter of the car roof;

(c) Where the crosshead does not encroach over the car by more than 75 mm, 380 mm to the crosshead;

(d) Where the crosshead spans the car or encroaches over the car by more than 75 mm, 760 mm to the crosshead. Where any beam or projection from the ceiling is within 450 mm measured horizontally from the crosshead, a vertical clearance of 760 mm shall be provided between the underside of such beam and the upper plane of the crosshead;

(e) 900 mm to the car roof;

(f) 450 mm to all other equipment.

38.5 Clearance at top of flying counterweight

Where a flying counterweight is provided, the clearance in millimetres at the top of the flying counterweight when the car floor is level with the bottom terminal landing shall be not less than that determined by the following formula:

$$f = h + i + 150$$

where

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

h = car buffer clearance, in millimetres.

i = stroke of car oil or spring buffer, where provided, in millimetres.

38.6 Clearance at bottom of flying counterweight

Where a flying counterweight is provided, such counterweight shall not land on an emergency block when the car ram is fully extended. The clearance to be maintained between the flying counterweight and the emergency block shall be not less than the sum of the following:

(a) The distance the car can travel above the top landing until the ram engages its mechanical stop;

(b) 150 mm;

(c) For lifts with newly installed ropes, an allowance for rope stretch (in millimetres) of 6.5 times the length of suspension rope in metres measured between terminations.

39 SUSPENDED ELECTROHYDRAULIC LIFTS – CLEARANCES FOR CARS AND COUNTERWEIGHTS

39.1 Clearance at bottom of car

39.1.1 *General*

For suspended electrohydraulic lifts, when the car rests on the stop or fully compressed buffer, there shall be vertical clearances at the bottom of the car which comply with 39.1.2 and 39.1.3.

39.1.2 *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.

39.1.3 *Man clearance*

The man clearance shall be not less than 600 mm between the pit floor and 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; and

(c) At compensation or tape sheaves.

A minimum space for man clearance shall be provided adjacent to 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 450 mm wide by 1200 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.

39.2 Car buffer clearance

The car buffer clearance shall be as follows:

(a) For oil buffers, not less than 230 mm nor more than 600 mm;

(b) For spring buffers, not less than 300 mm nor more than 600 mm.

39.3 Compressed ram clearance

When the car is resting on its bottom stop or fully compressed buffer and with newly installed unstretched suspension ropes, the ram shall have available a further travel of not less than 75 mm before it is fully retracted.

39.4 Clearance of car at top landing

39.4.1 *Top car mechanical clearance*
The clearance between any equipment mounted on top of the car and the nearest obstruction overhead, measured vertically, shall be not less than that determined by the following formula:

$C = X + R + Y + K$

where

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

X = allowance for ram overtravel

= $O \times M$

O = available overtravel of ram to its stop when the car is at the top landing, in millimetres

M = 1 for 1:1 roping, and

= 2 for 1:2 roping, etc

R = rope stretch, in millimetres

= 6.5 mm per metre of suspension rope measured between terminations

Y = 50 mm, to allow for car jump (equivalent to gravity stopping distance for 1 m/s)

K = 150 mm.

39.4.2 *Top car man clearance*
The clearance measured vertically between the car roof and the nearest overhead obstruction within 500 mm horizontally to the nearest part of the bow members shall be not less than that determined by the following formula:

$A = X + R + Y + L$

where

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

X = allowance for ram overtravel, as given in 39.4.1

R = rope stretch, in millimetres

= 6.5 mm per metre of suspension rope measured between terminations

Y = 50 mm, to allow for car jump (equivalent to gravity stopping distance for 1 m/s)

L = 750 mm.

39.5 Top overtravel

With newly installed unstretched suspension ropes (for any rated speed), the travel of the car above the top landing before the ram engages its stop shall be not greater than 900 mm and the minimum top overtravel values given in table 38.3 shall be increased by a rope stretch allowance of a value equal to the factor R in 39.4.1.

39.6 Clearance at top of flying counterweight

The clearance at the top of a flying counterweight shall be in accordance with 38.5.

39.7 Clearance at bottom of flying counterweight

The clearance at the bottom of a flying counterweight shall be in accordance with 38.6.

40 CAR AND COUNTERWEIGHT BUFFERS

40.1 Car buffers

Car buffers shall be provided and shall comply with the relevant requirements of 10.2 to 10.6. The types of buffers provided shall be in accordance with table 40.1(a) according to the full load down speed of the car. The strokes of such buffers shall be in accordance with tables 40.1(b) and 40.1(c).

Table 40.1(a) – Types of stops and buffers for cars

Full load down speed of car (m/s)	**Minimum buffer requirement**
≤ 0.45	Solid buffers or impact absorbing stops
> 0.45 ≤ 1.2	Spring buffers or oil buffers
> 1.2 ≤ 1.4	Oil buffers

Table 40.1(b) – Minimum stroke of spring buffers for cars

Full load down speed of car (m/s)	**Minimum stroke** (mm)
≤ 0.6	38
> 0.6 ≤ 0.9	63
> 0.9 ≤ 1.2	100

Table 40.1(c) – Minimum stroke of oil buffers for cars

Full load down speed of car (m/s)	**Minimum stroke** (mm)
≤ 1.3	110
> 1.3 ≤ 1.4	130

Car buffers shall be located so that the car will come to rest on the fully compressed buffer before the ram reaches its downward limit of travel.

40.2 Counterweight buffers

Where counterweight buffers are provided, counterweight stops for suspended electrohydraulic lifts shall be integral with the machine, and shall be designed so as to prevent the ram leaving the cylinder under the erection test pressure conditions specified in 31.5.

40.3 Flying counterweight buffers

Flying counterweights, where provided, shall not be fitted with buffers; however emergency blocks shall be provided at the pit floor to ensure that a vertical clearance of not less than 50 mm will be maintained between any fitting attached to the counterweight and floor of the pit, in the event of excessive stretch of the counterweight ropes. (See 38.6 for clearance at bottom of flying counterweight).

41 PITS

41.1 General requirements

Pits shall be provided in accordance with the requirements of 11.1 to 11.10. In addition, the requirements of 41.2 shall be complied with.

41.2 Pits not extending to lowest floor of building

Where the space below the liftwell is used for a passageway or is occupied by persons or, if unoccupied, is not secured against unauthorized access, the following requirements shall be complied with:

(a) The cylinder and car buffer shall be supported by a structure, or structures, of sufficient strength to support the entire load that may be imposed upon it;

(b) The car buffer shall be capable of fully absorbing the impact of the fully loaded car descending at 125 % of the full load down speed or, for a rope-suspended lift, at governor tripping speed where a governor-operated safety gear is used;

(c) The car buffer supports shall be of sufficient strength to withstand, without permanent deformation, the impact resulting from the conditions under paragraph (b) above;

(d) Where a flying counterweight is provided, the pit shall be arranged so that the counterweight will land on solid earth or an abutment which extends down to solid earth;

(e) For rope-suspended electrohydraulic lifts with downward-acting rams, such rams shall be positioned so that the ram head, sheaves or counterweight lands on solid earth or an abutment thereto at a distance of not less than 75 mm nor more than 150 mm beyond the permanent stop, and in no case shall the ram leave the gland assembly,

42 LIFTWELL ENCLOSURES

Liftwell enclosures shall comply with the requirements of section 12.

43 LANDING DOORS

Liftwell landing entrances shall be provided with landing doors which shall comply with 13.1 to 13.8.

44 LOCKING OF LANDING DOORS

44.1 General requirements

Locking of landing doors shall comply with the requirements of section 14.

44.2 Door locks

Door locks shall comply with the requirements of section 14.

45 CLEARANCES IN LIFTWELLS AND ENCLOSURES

Clearances in liftwells and enclosures shall comply with the requirements of section 15.

46 PIPING ETC. IN MACHINE ROOMS OR LIFTWELLS

Refer to the requirements of 7.2 and 12.4.

47 SUSPENSION ROPES

Suspension ropes shall comply with the requirements of section 16 however, for suspended electrohydraulic lifts or flying counterweights, a minimum of 2 ropes shall be used. The wire rope data plate specified in 16.6 shall be permanently fixed, adjacent to the hitch point, to the crosshead or the flying counterweight or the machine.

48 ROPE ATTACHMENTS AND FITTINGS

Rope attachments and fittings shall comply with the relevant requirements of section 17.

49 SHEAVES AND PULLEYS

Sheaves and pulleys shall comply with the relevant requirements of section 18.

50 COUNTERWEIGHTS AND FLYING COUNTERWEIGHTS

50.1 General requirements

50.1.1 *Compliance with section 19*

Counterweights and flying counterweights shall comply with the requirements of section 19.

50.1.2 *Pit guards*

The path of travel of the counterweight in the pit of the liftwell shall be screened to a height of 1800 mm, measured from the pit floor or auxiliary pit floor, and the lower edge of the screen shall be substantially level with the bottom of the counterweight, when the car is at its uppermost point of overtravel. In no case shall the lower edge of the screen be more than 600 mm from the pit floor.

50.1.3 *Flying counterweight overtravel limit switch*

A flying counterweight overtravel limit switch shall be provided and positioned so that if any flying counterweight approaches within 150 mm of the bottom emergency blocks, the switch will open the main control circuit and prevent further movement of the lift in either direction.

50.2 *Mass of flying counterweight*

The mass of a flying counterweight for a direct-acting or suspended electrohydraulic lift shall not exceed either of the following:

(a) A value that ensures reliable descent of the empty car under normal operation and also, for direct-acting lifts, in the event of the ram becoming detached from the car;

(b) 50 % of the combined value of the mass of the car and the rated load and also, for direct-acting lifts, 50 % of the mass of the ram.

51 GUIDES FOR LIFT CARS AND COUNTERWEIGHTS

Guides for lift cars and counterweights shall comply with the requirements of section 20. Upper and lower position restraints attached to the car frame shall be provided. The distance between the upper and lower position restraints shall be not less than the height of the car frame. (See figure 20.16 of section 20 for details of restraining plates).

52 RATED CAR CAPACITY

The rated loading capacity for passenger and/or goods lifts shall comply with section 21.

53 CAR CONSTRUCTION

53.1 General requirements

The construction of lift cars shall comply with relevant requirements of section 22, except that for direct-acting lifts 22.1, 22.10.2(a) and (c) do not apply and in lieu of which the requirements of 53.2 shall apply.

53.2 Car frames for direct-acting lifts

Every direct-acting lift shall have a car frame consisting of a bow, sling and buffer members or their equivalent for cantilevered cars. Stresses and deflections in the car frame and platform members shall be determined by the formulae listed in section 64.

54 CAR DOORS

Car doors shall comply with the requirements of section 13.

55 POWER OPERATION OF CAR AND LANDING DOORS

Power operation of car and landing doors shall comply with the requirements of section 23.

56 ELECTRICAL INSTALLATION

Electrical installation shall comply with the requirements of section 24. In addition, the circuit-breaker or isolator specified in 24.7 therein shall be provided with a notice on, or adjacent to it, bearing the following words:

THIS SWITCH SUPPLIES A LIFT

57 PRECAUTIONS IN WIRING

The precautions to be taken in the general wiring of a lift installation shall be in accordance with section 24.

58 OPERATING DEVICES AND CONTROL EQUIPMENT

Operating devices and control equipment shall comply with the requirements of section 25.

NOTE – Where a manual inching device is provided, this is to be supplementary to the anti-creep levelling device required by 60.4.

59 ELECTRICAL PROTECTIVE DEVICES

59.1 General requirements

Electrical protective devices shall comply with the relevant part of section 26.

59.2 Top overtravel limit switch

A top overtravel limit switch complying with 60.3 shall be provided, where the rated speed exceeds 0.5 m/s and a hydraulically cushioned stop is not provided (see 34.2.7).

59.3 Anti-creep levelling device

An anti-creep levelling device complying with 60.4 shall be provided for every electrohydraulic lift.

59.4 Normal limit switches

Normal limit switches shall be provided for every electrohydraulic lift in accordance with 60.2.

59.5 Door lock valve

A door lock valve and test switches shall be provided for every electrohydraulic lift in accordance with 36.4.

59.6 Flying counterweight overtravel limit switch

A flying counterweight overtravel limit switch shall be provided for every flying counterweight in accordance with 50.1.3.

60 TERMINAL STOPPING DEVICES

60.1 General requirements

Normal and overtravel limit switches shall comply with 27.1.

60.2 Normal limit switches (slowing down and stopping)

60.2.1 *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 top overtravel limit switch. The switch shall be designed and installed so that it will continue to function until the ram is fully extended against its stop, or the car is resting on the fully compressed buffer.

60.2.2 *Location*

Normal limit switches for electrohydraulic lifts shall be operated by the movement of the lift and located:

(a) On the lift car; or

(b) In the liftwell; or

(c) In the machine room.

60.2.3 *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 device to the life and used as a driving means, shall be provided with a broken tape switch complying with 26.1.6 which will open the control circuit and stop the lift machine if such driving means fail.

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 60.1 and 60.2.

60.3 Top overtravel limit switches

60.3.1 *Operation*

Top overtravel limit switches, where required under 59.2 shall comply with the following:

(a) Be located in the liftwell;

(b) Be operated by a metal cam on the car;

(c) Comply with 60.1;

(d) Not control the same controller switches or contactors as the normal limit switches unless 2 or more separate and independent controller switches or contactors are provided, 2 of which shall be closed to complete the circuit of the pump motor and of the upvalve solenoid where such is used. The control circuit shall be designed and installed so that a single earth fault or short-circuit may prevent either one but not both the normal stopping limits and top overtravel limit switch circuits from stopping the pump motor.

60.3.2 *Setting*
The setting of top overtravel limit switches shall be such that the following requirements will be complied with:

(a) The switch shall not function with the normal operation of the lift;

(b) The switch shall open before the lift car has travelled beyond the top landing, by a distance not exceeding one-third of the available top overtravel provided in 38.3;

(c) The switch shall be designed and installed so that it will remain open when the ram is fully extended against its stop;

(d) Where top overtravel limit switches are provided with adjustable mountings, they shall be pinned in position after final adjustment of position has been made.

60.4 Anti-creep levelling device
Every electrohydraulic lift shall be provided with an anti-creep levelling device complying with the following requirements:

(a) It shall prevent the car from sinking more than 150 mm below the landing, irrespective of whether the landing door is open or closed;

(b) It shall comply with the relevant requirements of 25.4;

(c) Its operation may depend on the availability of electric power, and to this end the circuit-breaker or isolator shall be kept in the closed position at all times except during maintenance, repairs and inspection and during an emergency;

(d) The electrical protective devices required in section 59 shall not, as far as practicable, cause power to be removed from the anti-creep device, provided however that the following switches shall cause power to be removed from the anti-creep device:

(i) Stop switch on top of car;

(ii) Pit stop switch.

60.5 Flying counterweight bottom overtravel limit switch
A flying counterweight bottom overtravel limit switch shall be provided in accordance with 50.1.3.

61 INDICATORS, ANNUNCIATORS, ALARMS, TELEPHONES, ETC
Indicators, annunciators, alarms, telephones, etc, shall comply with the requirements of section 28.

62 CAR AND COUNTERWEIGHT SAFETY GEAR
Car and counterweight safety gear shall comply with the relevant requirements of section 29 provided that**:**

(a) For electrohydraulic lifts under the conditions of 41.2(b) Type A safety gear (see 29.8.1) may be permitted on counterweights for rated speeds up to 1 m/s and arranged to operate on free fall; and

(b) Safety gear shall not be installed on the car of a direct-acting electrohydraulic lift.

63 SPEED GOVERNORS
Speed governors shall comply with the relevant requirements of section 30 provided that:

(a) For safety gears on suspended cars and for Types B, C and D safety gears on roped counterweights, the speed values in column 1 of table 30.2 shall refer to the full-load down speed of the car, and columns 2 and 3 shall apply as shown therein; and ➤

(b) For safety gears on counterweights where a governor is used, the governor shall be provided with a switch which shall open the control circuit before or at the time the governor grips the governor rope. The setting of the switch and of the speed of mechanical trip shall be such as will prevent operation of the switch or mechanical tripping (or striking of flyweights) when the fully loaded car is travelling downwards.

64 CAR FRAME AND PLATFORM STRESSES AND DEFLECTIONS FOR DIRECT-ACTING ELECTROHYDRAULIC LIFTS

64.1 General

The stresses and deflections in the car frame and platform members of direct-acting hydraulic lifts shall be based on the formulae in this section and evaluated for:

(a) The operating condition;

(b) The buffer engagement condition.

For assessing the stresses and deflections in the car frame and platform members of suspended electrohydraulic lifts the relevant sections of Part 2 shall be applied.

For cars with car frame located off the platform centre-line by more than 1/8 of the distance from front to back of the platform or other special car frame and platform construction, the formulae and specified methods of calculation of loads and the resulting stresses and deflections shall be modified to suit the specific conditions and requirements in each case.

The conditions of loading shall be determined in accordance with the relevant requirements of 22.10.1 and 22.10.2.

The maximum permissible stresses and deflections of car frame and platform members shall not exceed those permitted by 22.10.3 and 22.10.4 unless otherwise specified in this section.

64.2 Bow members

The stresses in the bow members shall be based on the dead load of the members and the total load if any, supported by the bow members.

The bow members and connection between the bow member and sling shall be designed to resist the bending moment, shear and axial forces transferred between the sling and the bow members.

64.3 Buffer members

64.3.1 *Platform members supported directly by buffer members*

The bending stresses in the buffer members shall be based on the maximum rated load uniformly distributed over the length of the buffer members and half the total weight of the car acting at each end of the buffer members.

64.3.2 *Platform members supported on isolators at or adjacent to the ends of the buffer member*

The concentrated loads equal to one-half of the total maximum static load on the ram shall be applied at each end of the buffer members to determine the bending stresses in the buffer members.

64.4 Platform members

The bending stresses in the platform members shall be based on the rated load and the platform weight uniformly distributed along the length of the members for conditions of loadings as specified in 22.10.1. For passenger and goods lifts, the stresses in the platform members shall also be determined for the condition specified in 22.10.1(c).

64.5 Sling members

The stresses in each sling member due to bending and compression and the slenderness ratio of each sling member and its moment of inertia under the conditions of loading as specified in 22.10.1 shall be determined in accordance with the following formulae.

64.5.1 *Bending stresses*

$$f_b = \frac{ML}{4HZ}$$

where

f_b = the bending stress in each sling member about the axis normal to the plane of the car frame (MPa)

M = turning moment due to one-half of the rated load distributed over half the area of the total platform (N-mm)

$$M = \frac{WD}{8}$$

where

W = rated load (N)

D = inside width of car (mm)

L = free length of sling member (distance from lowest fastening in bow member to top fastening in buffer member).

H = vertical centre distance between guide shoes or rollers (mm)

Z = section modulus of one sling member about the neutral axis normal to the plane of the car frame which is usually the weaker axis (mm^3).

64.5.2 *Compressive stresses*

The compressive stresses in the sling members shall be based on the weight supported on the bow members if any and also the dead loads of the bow member and sling members.

If side braces are used to fasten the sling members and the platform, the compressive loads in the sling member due to the platform loads coming up through the side braces shall be considered in addition to the above loadings.

f_a = compressive stress in each sling member.

64.5.3 *Combination of stresses in the sling members*

The maximum stresses in the sling members subject to bending and axial compression shall be so proportioned that the quantity $[(f_a/P_a) + (f_b/P_b)]$ does not exceed unity;

where

f_a = actual axial compressive stress (MPa)

f_b = actual bending stress (MPa)

P_a = permissible axial compressive stress [not exceeding $117 - 0.0033\,(L/R)^2$] (MPa)

P_b = permissible bending stress as specified in 22.10.3 (MPa)

L = free length of sling member (mm)

R = least radius of gyration of sling member (mm).

64.5.4 *Slenderness ratio*
The slenderness ratio L/R for sling members subject to compressions other than those resulting from buffer engagement shall not exceed one hundred and twenty (120). Where no side-brace is fitted or the upper side–brace connections on the sling members are located at a point less than 2/3 of L from bottom, (top fastening in buffer member) a slenderness ratio of L/R not exceeding 160 shall be permissible.

64.5.5 *Moment of inertia*
The moment of inertia of each sling member shall be not less than that derived by the following formula:

$$I = \frac{ML^3}{457EH}$$

where

I = moment of inertia about the neutral axis normal to the plane of the car frame (mm^4)

E = modulus of elasticity of the material used (MPa), other symbols are as defined in 64.5.1.

64.6 Buffer engagement
The decelerating force [as specified in 22.10.2(b)] resulting from buffer engagement shall be applied to determine the stresses in the bow, the sling and the buffer members.

PART 4 TESTS

65 SCOPE

This Part of the Standard sets out the tests for non domestic passenger and goods lifts. It includes requirements for tests where required by Parts 1, 2 and 3 to which it is complementary.

66 FIRST INSPECTION TESTING OF SAFETY GEAR

66.1 Application

After final installation, each safety gear shall pass the tests set out in this section.

66.2 General test conditions

66.2.1 *Test load*

For the testing of safety gear on lift cars, the lift car shall be loaded with 100 % of rated load, the load being centred on each quarter of the platform symmetrically about the centrelines of the platform.

For the testing of safety gear on counterweights, there shall be no load in the lift car.

66.2.2 *Governor tripping speed*

Prior to testing safety gear, the governor tripping speed shall be measured by a tachometer and, if necessary, adjusted to comply with the requirements of 30.2, 30.3, and 30.4.

66.2.3 *Lift car safety gear switches*

The operation of lift car safety gear switches shall be checked and shall comply with 29.7.

66.2.4 *Governor rope tension*

The force necessary to pull the governor rope through the governor jaws shall be demonstrated by suitable means. The force shall be not less than twice that required to bring the safety gear into contact with the guide rails (see 29.14).

66.2.5 *Levelness of car platform*

After each test and before the safety gear is released, the levelness of the car platform shall be checked for compliance with 29.9.2.

66.3 Speed test at normal speed

66.3.1 *Applicability*

This test applies to the following lifts:

(a) Lifts equipped with a direct current lift motor and having a rated speed of less than 0.5 m/s.

(b) Lifts equipped with an alternating current lift motor and for which the tests covered by 66.4 are impracticable.

66.3.2 *Test procedure*

The following procedure shall apply:

(a) Render the safety gear switches ineffective for the duration of the test;

(b) Run the car or counterweight, as applicable, at its normal speed in the down direction and trip the governor jaws by hand;

(c) After the safety gear has stopped the lift, maintain power to the lift motor for sufficient time to demonstrate that the safety gear is effectively engaged.

66.3.3 *Test requirements*
The safety gear shall operate and comply with the relevant requirements of 66.5.

66.4 Speed tests at governor tripping speed

66.4.1 *Applicability*
Lifts not covered by 66.3.1 shall pass either the drive-in test as specified by 66.4.2 and 66.4.4 or the runaway test as specified by 66.4.3 and 66.4.4. The company or organization carrying out the test shall have the option of deciding which method will be used.

66.4.2 *Drive-in test procedure*
The drive-in test procedure shall be as follows:

(a) During the test, render the overspeed switch and any overspeed regulating switch on the governor and the safety gear switches on the lift car ineffective;

(b) Gradually increase the lift motor speed under power until the governor causes the safety gear to operate;

(c) After the safety gear has stopped the lift, maintain power to the lift motor for sufficient time to demonstrate that the safety gear is effectively engaged.

66.4.3 *Runaway test procedure*
The runaway test procedure shall include the following consecutive tests:

(a) Brake tests. Demonstrate the effectiveness of the lift machine brake with rated load in the lift car and without regenerative braking using the following consecutive procedures:

  (i) With the lift travelling at approximately 10 % of rated speed;

  (ii) With the lift travelling at approximately 50 % of rated speed;

  (iii) At a speed at which the governor overspeed switch operates.

(b) Runaway test. After passing the above brake tests, pass the following runaway tests:

  (i) Allow the car with rated load or the counterweight to run away by holding the brake lifted until the safety gear has stopped the lift. Power may be applied to accelerate the lift to rated speed;

  (ii) After the safety gear has stopped the lift, apply power to the lift motor for sufficient time to demonstrate that the safety gear is effectively engaged.

66.4.4 *Test requirements*
The safety gear shall operate and comply with the relevant requirements of 66.5.

66.5 Speed test requirements

66.5.1 *Type A safety gear*
Type A safety gear shall stop the car or counterweight and the stopping distance shall be a very short distance without significant slide.

66.5.2 *Type B safety gear*
Type B safety gear shall stop the car or counterweight and the stopping distance shall comply with the relevant requirements of 29.4. The stopping distance shall be based on the actual speed at which the safety gear operated and shall be determined by one of the following measurements:

(a) The actual distance traversed by the lift between the position at which the safety gear first engages with the guide rail and the position at which the lift car stops.

Such distance may be determined from the average of the overall length of the marks on each side of each guide rail made by the safety gear jaws, minus the length of the safety gear jaws or wedges used, plus the energizing dimension.

The energizing dimension is the vertical movement within the safety gear of the safety gear jaw or wedge between the first position of firm contact with the guide rail and the fully actuated position.

Where marking is indefinite, an average of several readings shall be accepted. Any marking medium used to clarify the position of jaw engagement and the length of jaw slide shall not affect the performance of the safety gear.

(b) Where there is a definite relationship between the stopping distance of the car or counterweight and the stopping distance of the governor rope, that stopping distance determined by an effective system using governor rope markings.

66.5.3 *Type C safety gear*
Type C safety gear shall stop the car or counterweight and the stopping distance shall comply with the relevant requirements of 29.4. The stopping distance shall be based on the actual speed at which the safety gear operated and shall be the average of the overall length of the marks made by the safety gear jaws, on each side of each guide rail, minus the length of the safety gear jaws used.

Where marking is indefinite, an average of several readings shall be accepted.

The governor rope, pull-out shall comply with 29.11.

66.5.4 *Type D safety gear*
Type D safety gear shall comply with the following:

(a) Stopping distance. The safety gear shall stop the car or counterweight. The stopping distance shall be equal to the stroke of the buffer located between the lower member of the car frame and the auxiliary safety plank and shall comply with the requirements of 29.8.2.

When the safety gear stops the car, the levelness of the auxiliary safety plank shall comply with 29.8.2(f).

(b) Buffer compression switch and oil level device. The buffer compression switch and oil level device shall be tested for compliance with 29.8.2(g) and (h).

66.6 Inertia application test for Type A safety gear
Type A safety gear operated by a governor or inertia rope shall be subjected to the following inertia application test, to demonstrate compliance with the inertia actuation requirements of 29.8.1.

(a) Test procedure:

(i) The person demonstrating the effectiveness of the safety gear shall determine the mass of the test weight to be added to the governor rope or inertia rope;

(ii) The test weight to be added to the governor rope or inertia rope shall be that necessary to reproduce inertia operation of the safety gear equal to 0.9 g (gravity).

(iii) The test weight shall be attached to the return run of the governor rope or inertia rope;

(iv) The lift car shall be stationary during testing;

(v) The test weight shall be released.

(b) Test requirement. The test weight shall move the safety gear parts into contact with the rails.

66.7 Broken suspension rope test for Type A safety gear

Type A safety gear without governors, operated only as a result of the breaking or slackening of a suspension rope, shall first be tested with the car stationary, by obtaining the necessary slack rope to cause the safety gear to engage.

The safety gear shall then be engaged at rated speed by independent means and shall cause the lift to stop.

67 FIRST INSPECTION TESTING OF OIL BUFFERS

67.1 Application

After final installation, each oil buffer shall pass the tests set out in this section.

67.2 Oil level test

The oil level shall be within the maximum and minimum allowable limits (see 10.5.7).

67.3 Plunger return tests

Buffers shall pass the following plunger return tests:

(a) The buffer shall be correctly filled with oil;

(b) The plunger shall be fully compressed and when released shall return to the fully extended position within 90 s;

(c) For spring return type buffers, a weight of 9 kg shall be placed on the plunger and the plunger shall be depressed 50 mm and then released. When released, the plunger with the weight resting on it shall return to the fully extended position within 30 s.

67.4 Load and speed tests

Buffers shall pass the following load and speed tests:

(a) Test procedure:

(i) Prior to the test, the use of the correct buffer shall be confirmed by ensuring that the buffer nameplate information (see 10.5.1) satisfies the requirements of 10.5;

(ii) The normal terminal limit switches shall be made temporarily ineffective;

(iii) The final terminal limit switches may remain operative, but if used shall be temporarily relocated so as to open just before the buffer fully compresses;

(iv) For car buffers, run the car with rated load onto the buffer.

For counterweight buffers, run the counterweight with no load in the lift car onto the buffer.

The speed at which buffer engagement occurs shall be:

(A) Where buffers operate at normal stroke, the rated speed; or

(B) Where buffers operate at reduced stroke, the reduced striking speed as specified in 10.5.2(b).

(b) Test requirement. The measured buffer stroke shall comply with 10.5.2.

68 FIRST INSPECTION TESTING OF ELECTROHYDRAULIC EQUIPMENT

Equipment subject to hydraulic pressure on the cylinder side of the check valve and down stop valve shall pass the following test:

(a) The test shall be made after erection but before being put into service;

(b) The equipment shall be subjected to a test pressure not less than the greater of:

(i) 2 times the working pressure required to raise the rated load at rated speed; and

(ii) 1.6 times the pressure at which the relief valve is set to by-pass .

The test pressure shall hold for not less than 30 min without failure of any part or external leakage, except for slight leakages at glands.

(c) Where such leakage appears excessive, a further test shall be carried out by placing the fully loaded lift car at the top landing. While the oil is cool enough to prevent oil volume changes due to temperature effects, the downward car movement during a 4-hour test period shall be not more than 13 mm;

(d) Flow restriction valve test in accordance with the requirements of 36.5.

69 ROUTINE INSPECTION, ADJUSTMENT AND TESTING OF SAFETY GEAR

69.1 Periodic inspection and tests

69.1.1 *Frequency*
Governors and safety gear shall be inspected, adjusted, and tested in accordance with this section at periods not more than 3 years.

69.1.2 *Governors*
Governors shall be cleaned down, lubricated, inspected, adjusted where necessary, and operated by hand to ensure that all parts operate freely and correctly and are without excessive wear. The mechanical tripping speed for the governor and the speed at which the governor overspeed switches operate shall be determined. This may be done by driving the governor by hand or by a motor-driven device with gradual acceleration to the required speed. Adjustments shall be made as required. Where adjustment involves the breaking of a seal, the seal shall be replaced.

69.1.3 *Inspection and adjustment of safety gear*
The safety gear shall be cleaned down, lubricated, inspected, adjusted, and tested where necessary to ensure that it is in satisfactory working condition and that there is adequate clearance between each gripping member and its associated guide rail when the safety gear is in the unoperated condition.

69.1.4 *Test for Type A safety gear*
Type A safety gear shall be tested in accordance with 66.3, except that the car shall be without load and shall descend at the slowest operating speed. The governor, where provided, shall be tripped by hand. The safety gear shall stop the car in a very short distance without significant slide.

69.1.5 *Test for Types B, C, and D safety gear*
Types B, C, and D safety gear shall be operated by tripping the governor by hand with the car unloaded and descending at the slowest operating speed. The safety gear shall stop the car promptly. The stopping distance is not required to comply with the minimum stopping distance nominated in 29.4.

69.2 Tests following any alteration affecting safety gear

69.2.1 *General*

Where a lift is modified in such a way as will affect the performance of the safety gear, the governor and safety gear shall be tested and shall pass the relevant tests detailed in 69.2.2 and 69.2.3. Such modifications include increase of rated load, alteration of car involving an increase in its dead weight, alteration or replacement of safety gear, and replacement of guide rails.

69.2.2 *Governors*

Governors, where provided, shall be cleaned down, inspected, adjusted, and tested in accordance with 69.1.2.

69.2.3 *Safety gear*

69.2.3.1 *Inspection and adjustment*

The safety gear shall be cleaned down, inspected, lubricated, and adjusted in accordance with 69.1.3.

69.2.3.2 *Tests*

The safety gear shall be tested with rated load in the car in accordance with section 66, except that stopping distances shall comply with Standards or regulations applying when the lift was installed.

PART 5 REQUIREMENTS FOR PEOPLE WITH DISABILITIES

70 REQUIREMENTS FOR LIFTS ON ACCESS ROUTES FOR PEOPLE WITH DISABILITIES

Lifts shall meet the following requirements when installed as part of an access route to and within buildings when the access route is designated and marked suitable for people with disabilities.

70.1 Levelling

Under all conditions of loading the levelling accuracy of the lift car shall be ±20 mm.

70.2 Lift car size

The minimum interior dimensions of the lift car shall be 1400 mm x 1400 mm.

70.3 Car and landing doors

Car and landing doors shall be power operated and fitted with passenger protective devices complying with 23.6.1. The doors shall remain open for at least 5 seconds before they start to close.

NOTE – The time necessary for the doors to stay fully open to safeguard people with disabilities depends on a number of factors including:

– notification method of lift arrival.

– distance from call button to the lift.

– number and configuration of lifts.

– type of passenger protective devices

Alternative solutions with different delay times may be acceptable, provided it can be demonstrated that people with disabilities have sufficient time to move into the lift car without being struck by the closing doors.

70.3.2

The doors shall provide a minimum opening width of 900 mm.

70.3.3

The doors shall be clearly colour contrasted with their surroundings.

70.4 Lift controls

70.4.1

All controls including landing controls, shall be located within a height of 900 mm and 1500 mm (optimum 1000 mm) from the floor level. An acceptable layout for a control panel inside the lift car is shown in figure 70.4.1.

70.4.2

Call and control buttons shall have:

(a) A positive movement on actuation; and

(b) A width or diameter of at least 20 mm.

70.4.3

Control buttons shall have raised or indented designations immediately to the left of the button. These designations shall be as shown on figure 70.4.1 and shall be at least 15 mm high.

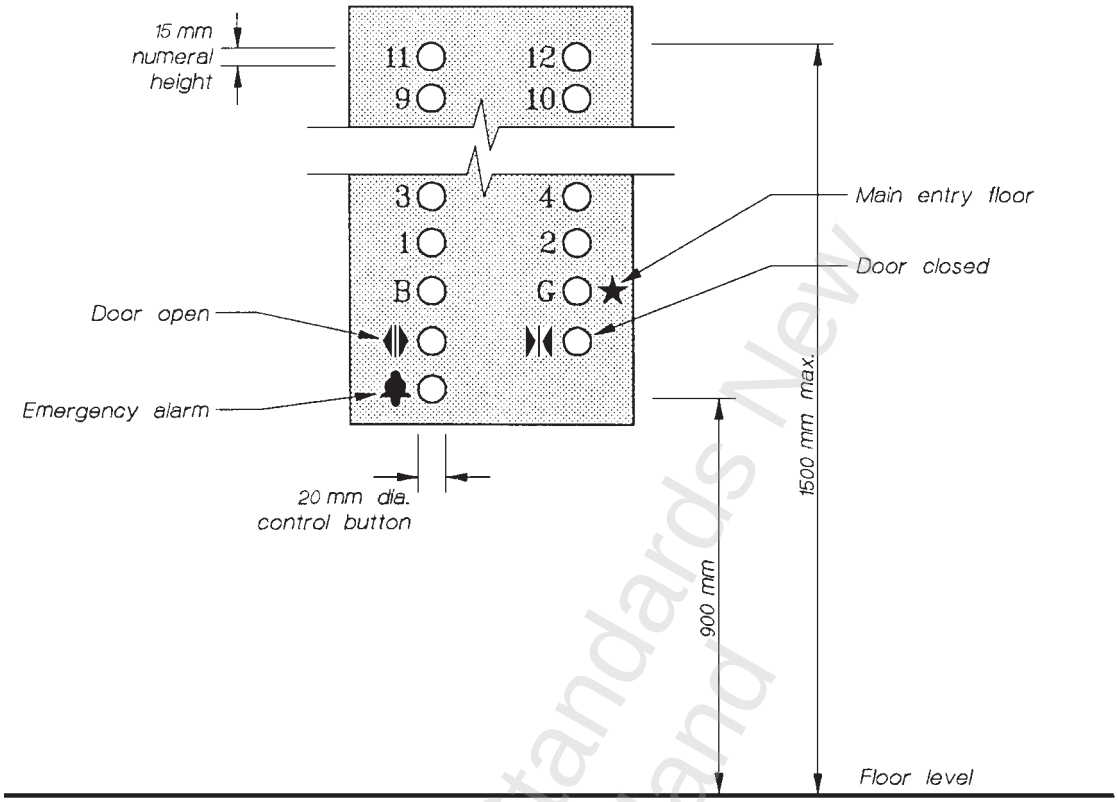


Figure 70.4.1 – Control panel for passenger carrying lifts

70.4.4
Call buttons shall have a tactile distinction from the wall or faceplate in which they are positioned.

70.4.5
Destination oriented lift control systems shall have a keypad or other means for entry of destination information. Keypads, if provided, shall be in a standard telephone keypad arrangement. The number five shall have a single raised dot. The dot shall be 3 mm base diameter. Destination orientated lift control systems shall be provided with visual and audible signals which indicate which lift car to enter.

70.5 Lift indicators

70.5.1
Each landing shall have:

(a) A “lift coming” or “call accepted” indicator; and

(b) Audible and visual signals notifying the arrival of the lift and its direction of travel.

70.5.2
An acceptable audible signal is 2 gongs for downward travel and one gong for upward travel. An acceptable visual signal is an illuminated arrow.

70.5.3
Inside the lift car a position indicator shall be fitted in a location easily read by passengers facing the main doorway.

70.5.4
Raised, tactile numbers shall be provided on the leading edge of the landing doors, or if this is not possible, on the entrance architrave as close as practicable to the landing doors, to advise of floor level. These numbers shall be positioned between 900 mm and 1500 mm above floor level and be at least 20 mm high.

70.6 Support rails

70.6.1
Support rails shall be provided in lifts. The support rails shall be on all walls except those in which doors are installed. Such rails shall provide for a minimum clear finger space of 30 mm from the wall surface and shall be installed between 950 mm to 1050 mm above the finished floor level. The rails shall be smooth, graspable, provide support, and be of adequate strength and rigidity.

APPENDIX A
MEDIUM DENSITY POLYETHYLENE (MDPE)
(Normative)

A1
The following minimum thickness for MDPE Type 80 (MRS) shall apply:

(a) Minimum base thickness, where $b = 3.24 \times 10^{-4}\ D\sqrt{h}$, shall be as follows:

h depth from ground to base of caisson (m)	**Caisson outside diameter** (mm)						
	1000	**800**	**710**	**630**	**500**	**450**	**400**
50	72.5	58.0	51.5	45.7	36.3	32.7	29.0
40	64.9	51.9	46.1	40.9	32.5	29.2	26.0
30	56.2	45.0	39.9	35.4	28.1	25.3	22.5
20	45.9	36.7	32.6	28.9	23.0	20.7	18.4
10	32.5	26.0	23.1	20.5	16.3	14.6	13.0

(b) Minimum wall thickness, where $\frac{0.014\ h\ R}{t} < 11400$, shall be as follows:

h depth from ground to base of caisson (m)	**Caisson outside diameter** (mm)						
	1000	**800**	**710**	**630**	**500**	**450**	**400**
50	29.7	23.8	21.1	18.8	14.9	13.4	11.9
40	24.0	19.2	17.0	15.1	12.0	10.0	10.0
30	18.1	14.5	12.9	11.4	10.0	10.0	10.0
20	12.1	10.0	10.0	10.0	10.0	10.0	10.0
10	10.0	10.0	10.0	10.0	10.0	10.0	10.0

where

h = base distance of caisson below ground level outside the building (mm)

t = wall thickness (mm)

b = base thickness (mm)

D = outside diameter (mm)

R = mean radius (mm)

APPENDIX B
SEISMIC ZONES
(Normative)

B1
Figure B1 shows the seismic zones when used in conjunction with 5.2 and 31.2.

Figure B1 – Seismic zones

APPENDIX C
NEW ZEALAND BUILDING CODE (NZBC) REQUIREMENTS FOR ASSOCIATED BUILDING WORK
(Informative)

C1 GENERAL
Certain clauses of the NZBC other than clause D2 (Mechanical installations of access) contain requirements for lift installations of which lift designers and installers should be aware. Some of these are covered in this Appendix.

C2 SPREAD OF FIRE
NZBC clause C3 (Spread of fire) may impose fire resistance requirements on lift landing doors, liftwell and lift machine room enclosures. It may also require the presence of sprinklers and alarms within the areas used for the lift installation.

C3 SIGNS
NZBC clause F8 (Signs) requires signs to be provided to identify potential hazards. A potential hazard is represented by unauthorised people being in a lift machine room. The requirements of NZBC in this regard are met by providing a sign as shown in figure C1, adjacent to every lift machine room door.

The word "DANGER" is printed in 50 mm high letters and the remainder of the notice in letters at least 25 mm high. The sign should be placed where it is not obscured when the door is in the open position. It is recommended that the sign be coloured safety red on a white background.

DANGER
ENTRY OF UNAUTHORISED
PERSONS PROHIBITED

Figure C1 – Sign identifying potential hazard

C4 ACCESS ROUTES
NZBC clause D1 (Access routes) is relevant to access to lift machine rooms and lift pits. BIA Approved Document D1 (Access routes) including Acceptable Solution D1/AS1 should be referred to.

Rung type ladders shall not be used for any part of an access route to a lift machine room, and stairs are preferred over step type ladders.

C5 SAFETY FROM FALLING
NZBC clause F4 (Safety from falling) applies where there are differences in floor levels in machine rooms of 1 metre or more, and to platforms affording access to overhead sheaves and other equipment that do not extend over the entire liftwell.

C5.1 Provision of barriers
In the case described in clause C5, barriers shall be provided and shall have a minimum height of 1000 mm. Any openings shall have maximum dimensions of 300 mm horizontally (between vertical balusters) or 460 mm vertically (between longitudinal rails).

C5.2 Guarding of access hatches
A machine room access hatch shall be provided with suitable guarding when the hatch is open. This guarding, where practicable, shall be an integral part of or an extension of the hatch cover. Guarding shall be either a barrier of the form described in C5.1 or shall consist of a minimum of a top rail at 1000 mm plus a toeboard extending more than 225 mm above the platform.

C6 ELECTRICITY
NZBC clause G9 (Electricity) applies to lift installation wiring. The requirements of section 24 of this Standard are additional.

APPENDIX D
QUALITY OF DRAWINGS AND PARTICULARS
(Informative)

D1 QUANTITY
The lift supplier shall provide sufficient copies of the documents to enable all legitimate checks and inspections to be carried out.

D2 QUALITY
All documentation shall be fully legible, and shall be of microfilm quality or available in a commonly used electronic format.

D3 CONTENT

1. All drawings shall be in the English language. Units shall be in metric or in accordance with the relevant section of this Standard and shall be fully built working drawings, fully dimensioned in all respects.

2. Weld details shall be shown on each relevant drawing.

3. Each drawing shall bear an individual and unique number. Where an amendment or modification is made, then the new drawing shall:

   (a) Identify each amendment or modification cumulatively; and

   (b) Bear a sequential modification number or letter.

For example: A drawing to a revision B shall identify all the changes from the initial drawing to revision A and also identify all the changes from revision A to revision B.

D4 PRESENTATION
Drawings are required to show arrangement and construction of:

(a) Liftwell enclosure, machine rooms, sheave rooms, etc., and pits, and their relative locations in building structure, location and sizes of access and openings, and clearances required on the lift particulars sheet.

(b) Lift car and components as necessary to cover dimensions and details required on the lift particulars sheet.

(c) Diagrammatic reeving of ropes for suspended lifts.

(d) For observation lifts, to clearly show the extent of glazing in car and liftwell, method of fixing and specification of glass. For open type liftwells, details of floor level partitions are to be shown.

NOTES

Approved by the Standards Council on 23 December 1997 to be a New Zealand Standard pursuant to the provisions of the Standards Act 1988.

First published: 6 March 1998

The following references relate to this Standard:

Project No. P 4332
Draft for comment No. DZ 4332
Printing code: 150-1998/7007/14006
Typeset by: Standards New Zealand
Printed by: Standards New Zealand