



European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung



CEN/TC 10 WG1 Secretariat

"Lifts, service lifts"

N° du document :

N 1072

Date :

2011-07-29

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Finalised version of prEN 81-20

Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods – Part 20: Passenger and goods passenger lifts

COMMENTARIES

Dear experts,

Please find hereafter the **finalised version** of prEN 81-20.

This document contains the final changes as agreed at the Oslo meeting as well as editorial improvements made by the editorial committee in June.

This version has been transmitted by CEN TC 10 WG1 secretariat to CMC for launch of CEN Enquiry.

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Safety rules for the construction and installation of lifts — Lifts for the transport of persons and goods — Part 20: Passenger and goods passenger lifts

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Règles de sécurité pour la construction et l'installation des ascenseurs — Ascenseurs pour le transport de personnes et d'objets — Partie 20 : Ascenseurs et ascenseurs de charge

ICS:

Descriptors:

Document type: European Standard

Document subtype:

Document stage: Working Document

Document language: E

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Foreword

This document (prEN 81-20:2011) has been prepared by Technical Committee CEN/TC 10 “Lifts, escalators and moving walks”, the secretariat of which is held by AFNOR.

This document is a working document.

This document, in conjunction with EN 81-50:2011, will supersede EN 81-1:1998+A3:2010 and EN 81-2:1998+A3:2010.

This European Standard has been prepared under a mandate given to CEN by the European Commission and the European Free Trade Association, and supports essential requirements of EU Directive(s).

For relationship with EU Directive(s), see informative **Annex ZA**, which is an integral part of this standard.

This is the first edition of the standard. It is a replacement for the EN 81-1 and EN 81-2 standards and shall be given the status of a harmonised standard. The need for replacement was based on the following points:

- improvement in safety due to changes in available technology;
- the need to reflect changes to the state of the art;
- incorporation of essential health and safety requirements from the relevant EU Directives;
- elimination of obvious errors;
- incorporation of proposals resulting from interpretation requests;
- improvement of the references to other standards according to the progress in that field.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

0 Introduction

This standard is a type C standard as stated in EN ISO 12100.

The machinery concerned and the extent to which hazards, hazardous situations and hazardous events are covered are indicated in the scope of this standard.

When provisions of this type C standard are different from those which are stated in type A or B standards, the provisions of this type C standard take precedence over the provisions of the other standards, for machines that have been designed and built according to the provisions of this type C standard.

0.1 General

0.1.1 The object of this standard is to define safety rules related to passenger- and goods/passenger-lifts with a view to safeguarding persons and objects against the risk of accidents associated with the user-, maintenance- and emergency operation of lifts¹⁾.

0.1.2 A study has been made of the various possible hazards with lifts, see clause 4.

0.1.2.1 Persons to be safeguarded:

- a) Users;
- b) Competent and authorised persons, e.g. maintenance and inspection personnel (see EN 13015);
- c) Persons outside the lift well, the machine room and pulley room (if any).

NOTE EN 81-71 gives additional requirements covering lifts resisting to act of vandalism.

0.1.2.2 Property to be safeguarded:

- a) Loads in car;
- b) Components of the lift installation;
- c) Building in which the lift is installed;
- d) Environment of the lift installation.

0.1.3 When the weight, size and/or shape of components prevent them from being moved by hand, they are:

- a) Either fitted with attachments for lifting gear; or
- b) Designed so that they can be fitted with such attachments (e.g. by means of threaded holes); or
- c) Shaped in such a way that standard lifting gear can easily be attached.

0.2 Principles

In drawing up this standard the following have been used.

0.2.1 This standard does not repeat all the general technical rules applicable to every electrical, mechanical, or building construction including the protection of building elements against fire.

It has, however, seemed necessary to establish certain requirements of good construction, either because they are peculiar to lift manufacture or because in the case of lift utilization the requirements may be more stringent than elsewhere.

0.2.2 This standard does not only address the essential safety requirements of the Lift Directive, but additionally states minimum rules for the installation of lifts into buildings/constructions. There may be in some countries regulations for the construction of buildings etc. which cannot be ignored.

Typical clauses affected by this are those defining minimum values for the height of the machine and pulley rooms and for their access doors dimensions.

1) Within CEN/TC 10 an interpretation committee has been established to answer questions about the spirit in which the experts have drafted the various clauses of this standard. The issued interpretations are available in [CEN TS 81-11](#).

0.2.3 As far as possible the standard sets out only the requirements that materials and equipment have to meet in the interests of safe operation of lifts.

0.2.4 Risk analysis, terminology and technical solutions have been considered taking into account the methods of the EN 61508 series of standards. This led to a necessary classification of safety functions applied to programmable electronic system in safety related applications for lifts (PESSRAL).

0.2.5 In order for prEN 81-20 to be a widely applicable standard the average weight of a person (male or female) has been determined to be 75 kg.

The standard defines the maximum car area related to a determined load in the lift car and the minimum car area to transport a corresponding number of persons, based on 75 kg per person, in order to identify and discourage overloading.

0.3 Assumptions

0.3.1 Negotiations have been made between the customer and the supplier about:

- a) The intended use of the lift;
- b) Type and mass of the handling devices intended to be used in the case of goods passenger lifts;
- c) Environmental conditions;
- d) Civil engineering problems;
- e) Other aspects related to the place of installation.

0.3.2 Possible risks have been considered of each component that may be incorporated in a complete lift installation.

Rules have been drawn up accordingly.

Components are:

- a) Designed in accordance with usual engineering practice and calculation codes, taking into account all failure modes;
- b) Of sound mechanical and electrical construction;
- c) Made of materials with adequate strength and of suitable quality;
- d) Free of defects.

Harmful materials, such as asbestos are not used.

0.3.3 Components are kept in good repair and working order, so that the required dimensions remain fulfilled despite wear.

0.3.4 Components will be selected and installed so that foreseeable environmental influences and special working conditions do not affect the safe operation of the lift.

0.3.5 By design of the load bearing elements, a safe normal operation of the lift is assured for loads ranging from 0 % to 100 % of the rated load.

0.3.6 The requirements of this standard regarding electrical safety devices are such that the possibility of a failure of an electric safety device (see **5.11.2.1.1 b)**) complying with all the requirements of the standard needs not to be taken into consideration.

0.3.7 Users have to be safeguarded against their own negligence and unwitting carelessness when using the lift in the intended way.

0.3.8 A user may, in certain cases, make one imprudent act. The possibility of two simultaneous acts of imprudence and/or the abuse of instructions for use is not considered.

0.3.9 If in the course of maintenance work a safety device, normally not accessible to the users, is deliberately neutralised, safe operation of the lift is no longer assured, but compensatory measures will be taken to ensure users safety in conformity with maintenance instructions.

It is assumed that maintenance personnel is instructed and works according to the instructions.

0.3.10 Horizontal forces and/or energies to consider are indicated in the applicable clauses of the standard. Typically:

- a) The static force that a person normally exerts is of the magnitude of 300 N;
- b) The energies resulting from impact depend on the lift component where the impact can occur; if not otherwise specified the resulting force is assumed to be 1000 N.

0.3.11 With the exception of the items listed below, a mechanical device built according to good practice and the requirements of the standard will not deteriorate to a point of creating hazard without the possibility of detection.

The following mechanical failures are considered:

- a) Breakage of the suspension;
- b) Breakage and slackening of all linkage by auxiliary ropes, chains and belts;
- c) Failure of one of the mechanical components of the electromechanical brake which take part in the application of the braking action on the drum or disk;
- d) Failure of a component associated with the main drive elements and the traction sheave;
- e) Rupture in the hydraulic system (jack excluded);
- f) Small leakage in the hydraulic system (jack included).

0.3.12 The possibility of the safety gear not setting, should the car free fall from the lowest landing, before the car strikes the buffer(s) is considered acceptable.

0.3.13 When the speed of the car is linked to the electrical frequency of the mains up to the moment of application of the mechanical brake, the speed is assumed not to exceed 115 % of the rated speed or a corresponding fractional speed.

0.3.14 The organisation within the building, where the lift is installed, is such that it can respond effectively to emergency calls without undue delay (see **0.3.1**).

0.3.15 Means of access are provided for the hoisting of heavy equipment (see **0.3.1 e)**).

0.3.16 To ensure the correct functioning of the equipment in the lift well and machinery space(s), i.e. taking into account the heat dissipated by the equipment, the ambient temperature in the lift well and the machinery space(s) is assumed to be maintained between + 5 °C and + 40 °C.

NOTE See IEC 60364-5-51, Code AA5 and EN 60721-3-3, Class 3K3.

0.3.17 The well is suitably ventilated, according to national building regulation, taking into consideration the environmental conditions of the lift and the limits given in **0.3.16** e.g. ambient temperature, humidity, direct sunlight, air quality and air tightness of buildings due to energy saving requirements.

NOTE See **0.3.1** and **annex E.3** for further guidance.

0.3.18 Access ways to the working areas are adequately lit (see **0.3.1**).

0.3.19 Minimum passageways required by building regulations are not obstructed by the open door/trap of the lift and/or any protection means for working areas outside of the well, where fitted according to the maintenance instructions (see **0.3.1**).

0.3.20 Where more than one person is working at the same time on a lift, an adequate means of communication between these persons is ensured.

0.3.21 The fixing system of guards, used specifically to provide protection against mechanical, electrical or any other hazards by means of a physical barrier, which have to be removed during regular maintenance and inspection, remains attached to the guard or to the equipment when the guard is removed.

0.3.22 The fluids used for the operation of the hydraulic lift are according to ISO 6743-4.

0.3.23 In the case of lifts provided with a restrictor/one-way restrictor as precaution against descent with excessive speed an impact speed of the car on the buffer (s) or the pawl device equal to rated speed downwards $v_d + 0,3$ m/s should be taken into account.

0.3.24 In the case of goods passenger lifts having a car whose available area in relationship to the rated load is greater than defined in **Table 5**, a complete filling of the car with persons should not create a dangerous situation.

1 Scope

1.1 This standard specifies the safety rules for the construction and installation of permanently installed new passengers- or goods passenger lifts, with traction, positive or hydraulic drive, serving defined landing levels, having a car designed for the transportation of persons or persons and goods, suspended by ropes or chains or jacks and moving between guide rails inclined not more than 15° to the vertical.

1.2 In addition to the requirements of this standard supplementary requirements shall be considered in special cases (potentially explosive atmosphere, extreme climate conditions, seismic conditions, transporting dangerous goods, etc.).

1.3 This standard does not cover:

a) Lifts with:

- 1) Drives other than those stated in **1.1**;
- 2) Rated speed $\leq 0,15$ m/s;

b) Hydraulic lifts:

- 1) With a rated speed exceeding 1 m/s;
- 2) Hydraulic lifts where the setting of the pressure relief valve exceeds 50 Mpa (**5.9.3.5.3**);

c) Installation of passengers- or goods passenger lifts in existing buildings ²⁾ to the extent that space does not permit;

d) Lifting appliances, such as paternosters, mine lifts, theatrical lifts, appliances with automatic caging, skips, lifts and hoists for building and public works sites, ships' hoists, platforms for exploration or drilling at sea, construction and maintenance appliances;

e) Important modifications (see **Annex C**) to a lift installed before this standard is brought into application;

f) Safety during transport, installation, repairs, and dismantling of lifts;

g) Additional requirements necessary for the use of lifts in case of fire.

However, this standard may usefully be taken as a basis.

Noise and vibrations are not dealt with in this standard because these are not relevant to the safe use of the lift.

1.4 This standard is not applicable to passenger and goods passenger lifts which are installed before the date of its publication as EN.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2) Existing building is a building which is used or was already used before the order for the lift was placed. A building whose internal structure is completely renewed is considered as a new building.

CEN/CENELEC standards

EN 81-28:2003, *Safety rules for the construction and installation of lifts – Lifts for the transport of persons and goods - Part 28: Remote alarm on passenger and goods passenger lifts*

prEN 81-50:2011, *Safety rules for the construction and installation of lifts – Examinations and tests - Part 50: Design rules, calculations, examinations and tests of lift components*

EN 81-58:2003, *Safety rules for the construction and installation of lifts - Examinations and tests - Part 58: Landing door fire resistance test*

EN 81-70:2003, *Safety rules for the construction and installation of lifts – Particular applications for passenger and goods passenger lifts - Part 70: accessibility to lifts for persons including persons with disability*

EN 81-71:2005, *Safety rules for the construction and installation of lifts - Particular applications to passenger lifts and goods passenger lifts - Part 71: Vandal resistant lifts*

EN 81-72:2003, *Safety rules for the construction and installation of lifts - Particular applications for passenger and goods passenger lifts - Part 72: Firefighters lifts*

EN 81-73:2005, *Safety rules for the construction and installation of lifts - Particular applications for passenger and goods passenger lifts - Part 73 Behaviour of lifts in the event of fire*

EN 131-2:2010, *Ladders - Requirements, testing, marking*

EN 1993-1-1, *Eurocode 3 - Design of steel structures - Part 1-1: General rules and rules for buildings*

EN 10305-1:2002, *Steel tubes for precision applications - Technical delivery conditions - Seamless cold drawn tubes*

EN 10305-2:2002, *Steel tubes for precision applications - Technical delivery conditions - Welded cold drawn tubes*

EN 10305-3:2002, *Steel tubes for precision applications - Technical delivery conditions - Welded cold sized tubes*

EN 12015:1998, *Electromagnetic compatibility - Product family standard for lifts, escalators and passenger conveyors - Emission*

EN 12016:1998, *Electromagnetic compatibility - Product family standard for lifts, escalators and passenger conveyors - Immunity*

EN 12385-5:2002, *Steel wire ropes - Safety - Stranded ropes for lifts*

EN 13015:2001, *Maintenance for lifts and escalators - Rules for maintenance instructions*

EN 13411-3:2004+A1:2008, *Terminations for steel wire ropes - Part 3: Safety. Ferrules and ferrule-securing*

EN 13411-6:2004+A1:2008, *Terminations for steel wire ropes - Part 6: Safety. Asymmetric wedge socket*

EN 13411-7:2006+A1:2008, *Terminations for steel wire ropes - Part 7: Safety. Symmetric wedge socket*

EN 13501-1:2007+A1:2009, *Fire classification of construction products and building elements - Part 1: Classification using test data from reaction to fire tests*

EN 13732-1:2008, *Ergonomics of the thermal environment - Methods for the assessment of human responses to contact with surfaces - Part 1: Hot surfaces*

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EN 50205:2002, *Relays with forcibly guided (mechanically linked) contacts*

EN 50214:2006, *Flat polyvinyl chloride sheathed flexible cables*

EN 50274:2002, *Low-voltage switchgear and controlgear assemblies - Protection against electric shock - Protection against unintentional direct contact with hazardous live parts*

EN 60204-1:2006, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements (IEC 60204-1:2005, modified) + Amendment 1:2009*

EN 60529:1992, *Specification for degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)*

EN 60617, *Graphical symbols for diagrams*

EN 60664-1:2007, *Insulation coordination for equipment within low-voltage systems - Part 1: Principles, requirements and tests (IEC 60664-1:2007)*

EN 60721-3-3, *Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weatherprotected locations*

EN 60947-4-1, *Low-voltage switchgear and controlgear - Part 4: Contactors and motor-starters - Section 1: Electromechanical contactors and motor-starters (IEC 60947-4-1:2000)*

EN 60947-5-1:2004, *Low-voltage switchgear and controlgear - Part 5: Control circuit devices and switching elements - Section 1: Electromechanical control circuit devices (IEC 60947-5-1:2003)*

EN 60947-5-5:1998, *Low-voltage switchgear and controlgear - Part 5: Control circuit devices and switching elements - Section 5: Electrical emergency stop devices with mechanical latching function*

EN 61310-3, *Safety of machinery - Indication, marking and actuation - Requirements for the location and operation of actuators*

EN 61508-1:2001, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements (IEC 61508-1:1998 + Corrigendum 1999)*

EN 61508-2:2001, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2000)*

EN 61508-3:2001, *Functional safety of electrical/electronic/programmable electronic safety related systems - Part 3: Software requirements (IEC 61508-3:1998 + Corrigendum 1999)*

EN 61508-4:2001, *Functional safety of electrical/electronic/programmable electronic safety related systems - Part 4: Definitions and abbreviations (IEC 61508-4:1998 + Corrigendum 1999)*

EN 61508-5:2001, *Functional safety of electrical/electronic/programmable electronic safety related systems - Part 5: Examples of methods for the determination of safety integrity levels (IEC 61508-5:1998 + Corrigendum 1999)*

EN 61508-7:2001, *Functional safety of electrical/electronic/programmable electronic safety related systems - Part 7: Overview of techniques and measures (IEC 61508-7:2000)*

EN 61800-5-2:2007, *Adjustable speed electrical power drive systems - Part 2: Safety requirements. Functional*

EN 61810-1:2008, *Electromechanical elementary relays - Part 1: General requirements*

EN ISO 6743-4, *Lubricants, industrial oils and related products (class L) - Classification - Part 4: Family H (Hydraulic systems)*

EN ISO 12100, *Safety of machinery - Basic concepts, general principles for design*

EN ISO 13857:2008, *Safety of machinery - Safety distances to prevent danger zones being reached by the upper and lower limbs (ISO 13857:2008)*

IEC standards

IEC 60364-5-51, *Electrical installations of buildings - Part 5-51: Selection and erection of electrical equipment - Common rules*

IEC 60417, *Graphical symbols for use on equipment*

CENELEC Harmonization Documents

HD 60364-4-41, *Low voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

HD 60364-6, *Low voltage electrical installations – Part 6: Verification*

ISO Standards

ISO 1219-1:2006, *Fluid power systems and components - Graphic symbols and circuit diagrams. Part 1: Graphic symbols for conventional use and data-processing applications*

ISO 3864-1, *Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

apron (*garde-pieds*) (*Schürze*)

smooth vertical part extending downwards from the sill of the landing or car entrance

3.2

authorized person (*personne autorisée*) (*befugte Person*)

a competent person with the permission of the owner of the lift to access restricted areas (machinery and pulley spaces, lift well, pit and car roof)

3.3

available car area (*surface utile de la cabine*) (*Nutzfläche des Fahrkorbes*)

area of the car measured at a height of 1 m above floor level, disregarding handrails, which is available for passengers or goods during operation of the lift

3.4

balancing weight (*masse d'équilibrage*) (*Ausgleichgewicht*)

mass which saves energy by balancing all or part of the mass of the car

3.5

brake set (*élément de frein*) (*Bremskreis*)

assembly that make up one brake consisting of brake pads, the parts holding the brake pads in position including any pivot pins, brake arms, springs or other devices creating the braking force and pole piece. Where multiple brakes are used to provide the total braking force required for safe lift operation each brake is considered as a brake set

- 3.6**
buffer (*amortisseur*) (*Puffer*)
a resilient stop at the end of travel, and comprising a means of braking using fluids or springs (or other similar means)
- 3.7**
car (*cabine*) (*Fahrkorb*)
a part of the lift which carries the passengers and/or other loads
- 3.8**
competent person (*personne compétente*) (*sachkundige Person*)
a designated person, suitably trained, qualified by knowledge and practical experience, provided with necessary instructions to safely carry out the required operations for inspecting or maintaining the lift or rescuing users from a stalled car
- 3.9**
counterweight (*contrepoids*) (*Gegengewicht*)
mass which ensures traction
- 3.10**
direct acting lift (*ascenseur à action directe*) (*direkt angetriebener Aufzug*)
hydraulic lift where the ram or cylinder is directly attached to the car or its sling
- 3.11**
down direction valve (*soupape descente*) (*Abwärtsventil*)
electrically controlled valve in a hydraulic circuit for controlling the descent of the car
- 3.12**
drive control system (*système de commande de l'entraînement*) (*Antriebssteuerung*)
system controlling and monitoring the running of the lift machine
- 3.13**
electric safety chain (*chaîne électrique des sécurités*) (*Elektrische Sicherheitskette*)
the total of the electric safety devices connected in series
- 3.14**
full load pressure (*pression à pleine charge*) (*Druck bei Vollast*)
static pressure exerted on the piping directly connected to the jack, the car with the rated load being at rest at the highest landing level
- 3.15**
goods passenger lift (*ascenseur de charge*) ³⁾ (*Lastenaufzug*)
a lift mainly intended for the transport of goods, which are generally accompanied by persons
- 3.16**
guide rails (*guides*) (*Führungsschienen*)
the rigid components which provide guiding for the car, the counterweight or the balancing weight
- 3.17**
headroom (*partie supérieure de la gaine*) (*Schachtkopf*)
part of the well between the highest landing served by the car and the ceiling of the well

3) The French expression “ascenseur de charge” has been introduced into the French language document with the aim of harmonizing the texts in the three languages of CEN and of simplifying the wording. It does not in any way define a particular or supplementary category of lift.

3.18**hydraulic lift** (*ascenseur hydraulique*) (*hydraulischer Aufzug*)

lift in which the lifting power is derived from an electrically driven pump transmitting hydraulic fluid to a jack, acting directly or indirectly on the car (multiple motors, pumps and/or jacks may be used)

3.19**indirect acting lift** (*ascenseur à action indirecte*) (*indirekt angetriebener Aufzug*)

a hydraulic lift where the ram or cylinder is connected to the car or the car sling by suspension means (ropes, chains)

3.20**instantaneous safety gear** (*parachute à prise instantanée*) (*Sperrfangvorrichtung*)

a safety gear in which the full gripping action on the guide rails is almost immediate

3.21**jack** (*vérin*) (*Heber*)

a combination of a cylinder and a ram forming a hydraulic actuating the unit

3.22**laminated glass** (*verre feuilleté*) (*Verbundsicherheitsglas VSG*)

an assembly of two or more glass layers, each of which is bonded together using a plastic film

3.23**levelling** (*nivelage*) (*Einfahren*)

an operation which improves the accuracy of stopping at landings

3.24**levelling accuracy** (*précision du maintien au niveau*) (*Nachregulierungsgenauigkeit*)

vertical distance between car sill and landing sill during loading or unloading of the car

3.25**lift machine** –(*machine*) (*Triebwerk*)

the unit including the motor, gear, brake and sheave/sprockets (traction or positive drive lift) or comprising the pump, pump motor and control valves (hydraulic drive lift) which drives and stops the lift

3.26**machine room** (*local de machines*) (*Triebwerksraum*)

a room in which machine or machines and/or the associated equipment are placed

3.27**machinery** (*machinerie*) (*Triebwerk und Steuerung*)

equipment traditionally placed in the machine room: control cabinet(s) and drive system, lift machine, main switch(es), and means for emergency operations

3.28**machinery space** (*emplacement de machinerie*) (*Aufstellungsort von Triebwerk und Steuerung*)

space(s) inside or outside of the well where the machinery as a whole or in parts is placed

3.29**maintenance** (*maintenance*) (*Instandhaltung*)

Activities specified by the manufacturer in order to ensure that the safe and reliable condition of the equipment is maintained through its life cycle, and/or activities necessary to reinstate the equipment back into service in a safe and effective manner after a malfunction

3.30**minimum breaking load of a rope** (*charge de rupture minimale d'un câble*) (*Mindestbruchkraft eines Seiles*)

the product of the square of the nominal diameter of the rope (in square millimetres) and the nominal tensile strength of the wires (in newtons per square millimetre) and a coefficient appropriate to the type of rope construction

3.31

non return valve (*clapet de non retour*) (*Rückschlagventil*)

a valve which allows flow in one direction only

3.32

one-way restrictor (*clapet freineur*) (*Drossel-Rückschlagventil*)

a valve which allows free flow in one direction and restricted flow in the other direction

3.33

overspeed governor (*limiteur de vitesse*) (*Geschwindigkeitsbegrenzer*)

a device which, when the lift attains a predetermined speed, causes the lift to stop, and if necessary causes the safety gear to be applied

3.34

passenger (*passager*) (*Fahrgast*)

any person transported by a lift in the car

3.35

pawl device (*dispositif à taquet*) (*Aufsetzvorrichtung*)

a mechanical device for stopping involuntary descent of the car, and maintaining it stationary on fixed supports

3.36

pit (*cuvette*) (*Schachtgrube*)

the part of the well situated below the lowest landing served by the car

3.37

positive drive lift (includes drum drive) (*ascenseur à treuil attelé*) (*Trommelaufzug, Kettenaufzug*)

a lift suspended by chains or ropes driven by means other than friction

3.38

programmable electronic system in safety related applications for lifts (PESSRAL)

(*système électronique programmable dans les applications liées à la sécurité des ascenseurs (PESSRAL)*)

(*programmierbares elektronisches System in sicherheitstechnisch relevanten Anwendungen für Aufzüge (PESSRAL)*)

a system for control, protection or monitoring based on one or more programmable electronic devices, including all elements of the system such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices, used in safety related applications as listed in **Tables A.1** and **A.2** of this standard

3.39

progressive safety gear (*parachute à prise amortie*) (*Bremfangvorrichtung*)

a safety gear in which retardation is effected by a braking action on the guide rails and for which special provisions are made so as to limit the forces on the car, counterweight or balancing weight to a permissible value

3.40

pulley room (*local de poulies*) (*Rollenraum*)

a room not containing the machine, in which pulleys are located, and in which the overspeed governor and the electrical equipment can also be housed

3.41

pulley space (*emplacement de poulies*) (*Aufstellungsort von Seilrollen*)

space(s) inside or outside of the well where pulleys are placed

3.42

rated load (*charge nominale*) (*Nennlast*)

the load for which the equipment has been built

3.43**rated speed** (*vitesse nominale*) (*Nenngeschwindigkeit*)

the speed v in metres per second of the car for which the equipment has been built

NOTE For hydraulic drive lifts:

- v_m is the rated speed upwards in metres per second;
- v_d is the rated speed downwards in metres per second;
- v_s is the higher value of both rated speeds v_m and v_d in metres per second.

3.44**re-levelling** (*isonivelage*) (*Nachregulieren*)

an operation, after the lift has stopped, to permit the stopping position to be corrected during loading or unloading, if necessary by successive movements (automatic or inching)

3.45**rescue operations** (*opérations de secours*) (*Notbefreiung*)

specific actions required to safely release persons entrapped in the lift car and well due to a malfunction

3.46**restrictor** (*réducteur de débit*) (*Drossel*)

a valve in which the inlet and outlet are connected through a restricted passage way

3.47**rupture valve** (*soupape de rupture*) (*Leitungsbruchventil*)

a valve designed to close automatically when the pressure drop across the valve, caused by the increased flow in a pre-determined flow direction, exceeds a pre-set amount

3.48**safety circuit** (*circuits de sécurité*) (*Sicherheitsschaltung*)

a circuit containing contacts and/or electronic components which is regarded to fulfill demands of an electric safety device

3.49**safety gear** (*parachute*) (*Fangvorrichtung*)

a mechanical device for stopping, and maintaining stationary on the guide rails, the lift car, counterweight or balancing weight in case of overspeeding or breaking of the suspension

3.50**safety integrity level (SIL)** (*niveau d'intégrité de sécurité*) (*Sicherheits-Integritätslevel*)

a discreet level for specifying the safety integrity requirements of the safety functions to be allocated to the PESSRAL

NOTE In this standard SIL 1 is representing the lowest level and SIL 3 the highest.

3.51**safety rope** (*câble de sécurité*) (*Sicherheitsseil*)

an auxiliary rope attached to the car, the counterweight or balancing weight for the purpose of tripping a safety gear in case of suspension failure

3.52**shut-off valve** (*robinet d'isolement*) (*Absperrventil*)

a manually operated two-way valve which can permit or prevent flow in either direction

3.53**single acting jack** (*vérin à simple effet*) (*einfachwirkender Heber*)

jack in which displacement in one direction is by fluid action and in the other by influence of gravity

3.54

sling (*étrier*) (*Rahmen*)

the metal framework carrying the car, counterweight or balancing weight, connected to the means of suspension. This sling can be integral with the car enclosure

3.55

special tool (*outil spécial*) (*Spezialwerkzeug*)

a tool unique to the equipment required in order to keep the equipment in a safe operating condition or for rescue operations

3.56

stopping accuracy (*précision d'arrêt*) (*Anhaltegenauigkeit*)

vertical distance between car sill and landing sill at the moment when a car is stopped by the control system at its destination floor and the doors reach their fully open position

3.57

system reaction time (*temps de réaction système*) (*Systemreaktionszeit*)

the sum of the following two values:

- a) The time period between the occurrence of a fault in the PESSRAL and the initiation of the corresponding action on the lift;
- b) The time period for the lift to respond to the action, maintaining a safe state

3.58

traction lift (*ascenseur à adhérence*) (*Treibscheiben-Aufzug*)

a lift whose lifting ropes are driven by friction in the grooves of the driving sheave of the machine

3.59

travelling cable (*câble pendentif*) (*Hängekabel*)

flexible cable between the car and a fixed point

3.60

unintended car movement (*mouvement incontrôlé de la cabine*) (*unbeabsichtigte Bewegung des Fahrkorbs*)

non-commanded movement of the car with doors open within the door zone away from the landing, excluding movements resulting from loading/unloading operation

3.61

unlocking zone (*zone de déverrouillage*) (*Enriegelungszone*)

a zone, extending above and below the stopping level, in which the car floor has to be to enable the corresponding landing door to be unlocked

3.62

user (*usager*) (*Benutzer*)

person making use of the services of a lift installation

3.63

well (*gaine*) (*Schacht*)

the space in which the car, the counterweight or the balancing weight travels. This space is usually bounded by the bottom of the pit, the walls and the ceiling of the well

4 List of significant hazards

This clause contains all the significant hazards, hazardous situations and events, as far as they are dealt with in this standard, identified by risk assessment as significant for this type of machinery and which require action to eliminate or reduce the risk (See **Table 1**).

Table 1 - List of significant hazards

No	Hazards as listed in Annex B of EN ISO 12100	Relevant clauses
1	Mechanical hazards due to:	
	Acceleration, deceleration (kinetic energy)	5.2.5; 5.5.3; 5.6.2; 5.6.3; 5.6.6; 5.6.7; 5.8.2; 5.9.2; 5.9.3
	Angular parts	Not Relevant
	Approach of a moving element to a fixed part	5.2.5; 5.2.6; 5.5.8
	Cutting parts	Not relevant
	Elastic elements	Not relevant
	Falling objects	5.2.5; 5.2.6
	Gravity (stored energy)	5.2.5
	Height from the ground	5.3; 5.4.7; 5.5; 5.6
	High pressure	5.4.2; 5.9.3; See also 1.3
	Machinery mobility	Not relevant
	Moving elements	5.2; 5.3; 5.4; 5.5; 5.6; 5.7; 5.8
	Rotating elements	5.5.7; 5.6.2; 5.9.1
	Rough, slippery surface	5.2.1; 5.2.2; 5.4.7
	Sharp edges	Not addressed - See 5.1.1
	Stability	See 0.3.2
	Strength	See 0.3.2
	Vacuum	Not relevant
	- Machine parts or work pieces, e.g.: - Accumulation of energy inside the machinery, e.g.:	
	Crushing hazard	5.2.5; 5.3
	Shearing hazard	5.3
	Entanglement hazard	5.5.7; 5.6.2; 5.9.1
	Drawing-in or trapping hazard	5.2.1; 5.3.1; 5.3.8; 5.4.10; 5.5.3; 5.5.7; 5.6.2; 5.9.1; 5.10.5; 5.12.1; 5.12.3
	Impact hazard	5.8
	Slip, trip and fall of persons (related to machinery)	5.2.1; 5.2.2; 5.3.11; 5.4.7; 5.3; 5.5; 5.6
	- Uncontrolled amplitude of movements	5.2.1; 5.2.5; 5.5.6; 5.8
	- From insufficient mechanical strength of parts	See 0.3.2
	- From inadequate design of pulleys, drums	5.5.3
	- Falling of person from person carrier	5.3; 5.4.3; 5.4.6; 5.4.7
2	Electrical hazards	
	Arc	5.11.2
	Electrostatic phenomena	
	Live parts	5.2.6; 5.11.2; 5.12.1
	Not enough distance to live parts under high voltage	Not relevant
	Overload	5.10.4
	Parts which have become live under faulty conditions	5.10.1; 5.10.2; 5.10.3; 5.11.2

Table 1 - List of significant hazards (continued)

No	Hazards as listed in Annex B of EN ISO 12100	Relevant clauses
2	Electrical hazards (continued)	
	Short-circuit	5.10.3; 5.11.1; 5.11.2
	Thermal radiation	5.10.1
3	Thermal hazards	
	Explosion	Not relevant
	Flame	5.3.6
	Objects or materials with a high or low temperature	5.10.1
	Radiation from heat sources	5.10.1
4	Hazards generated by noise	Not relevant (See 1.3)
	Cavitation phenomena	
	Exhausting system	
	Gas leaking at high speed	
	Manufacturing process (stamping, cutting, etc.)	
	Moving parts	
	Scraping surfaces	
	Unbalanced rotating parts	
	Whistling pneumatics	
5	Hazards generated by vibration	Not addressed (See 1.3)
	Cavitation phenomena	
	Disalignment of moving parts	
	Mobile equipment	
	Scraping surfaces	
	Unbalanced rotating parts	
	Vibrating equipment	
	Worn parts	
6	Hazards generated by radiation	
	Ionising radiation source	Not relevant
	Low frequency electromagnetic radiation	5.10.1.1.3
	Optical radiation (infra-red, visible and ultra-violet), included laser	Not relevant
7	Hazards generated by materials and substances	
	Aerosol	Not relevant
	Biological and microbiological (viral or bacterial) agent	Not relevant
	Combustible	5.4.4
	Explosive	Not addressed (See 1.2)

Table 1 - List of significant hazards (continued)

No	Hazards as listed in Annex B of EN ISO 12100	Relevant clauses
7	Hazards generated by materials and substances (continued)	
	Fibre	Not relevant
	Flammable	5.9.3
	Fluid	5.2.1
	Fume	Not relevant
	Gas	Not relevant
	Mist	Not relevant
	Oxidising	Not relevant
8	Hazards generated by neglecting ergonomic principles in machinery design as, e.g. hazards from:	
	Access	5.2.1, 5.2.2, 5.2.4, 5.2.5, 5.2.6, 5.6.2, 5.9.3, 5.12.1
	Design or location of indicators and visual displays units	5.2.6, 5.3.9, 5.12.1.1, 5.12.4
	Design, location or identification of control devices	5.4.8, 5.10.5, 5.10.8, 5.10.10, 5.12.1.1, 5.12.1.5
	Effort	5.2.1, 5.2.3, 5.2.5, 5.2.6, 5.3.8, 5.3.12, 5.3.14, 5.4.7, 5.9.2
	Flicker, dazzling, shadow, stroboscopic effect	Not relevant
	Local lighting	5.2.1, 5.2.2, 5.2.6, 5.3.10, 5.4.10, 5.10.1, 5.10.5, 5.10.7, 5.10.8
	Mental overload /underload	Not Relevant
	Posture	Not Relevant
	Repetitive activity	5.12.1
	Visibility	5.2.5, 5.9.1, 5.12.1
9	Hazards associated with the environment in which the machine is used	
	Dust and fog	5.2.1
	Electromagnetic disturbance	5.10.1
	Lightning	Not addressed by this standard
	Moisture	5.2.1, 5.2.6
	Pollution	Not relevant
	Snow	Not relevant
	Temperature	5.2.1, 5.2.6, 5.3.12, 5.9.3, 5.10.4
	Water	5.2.1, 5.2.6
	Wind	Not relevant
	Failure of the power supply	5.2.1, 5.2.3, 5.2.4, 5.2.5, 5.2.6, 5.3.12, 5.4.3, 5.4.6, 5.6.2, 5.9.2, 5.9.3, 5.12.1, 5.12.3
	Failure of the control circuit	5.6.7
	Unexpected start-up, unexpected overrun / overspeed (or any similar malfunction) from restoration of energy supply after an interruption	5.2.1, 5.2.6, 5.4.7, 5.6.2, 5.6.5, 5.6.6, 5.6.7, 5.8, 5.10.5, 5.12.2

Table 1 - List of significant hazards (end)

No	Hazards as listed in Annex B of EN ISO 12100	Relevant clauses
10	Combination of hazards	
	e.g. repetitive activity + effort + high environmental temperature	Not relevant

5 Safety requirements and/or protective measures

5.1 General

5.1.1 Passengers and goods passenger lifts shall comply with the safety requirements and/or protective measures of the following clauses. In addition the passengers and goods passenger lifts shall be designed according to the principles of EN ISO 12100 for hazards relevant but not significant that are not dealt with by this document (e.g. sharp edges).

5.1.2 All labels, notices, markings and operating instructions shall be indelible, legible and readily understandable (if necessary aided by signs or symbols). They shall be untearable, of durable material, placed in a visible position, and written in the language of the country where the lift is installed (or, if necessary, in several languages).

5.2 Lift well, machinery spaces and pulley rooms

5.2.1 General provisions

5.2.1.1 Arrangement of lift equipment

5.2.1.1.1 All lift equipment shall be located in the lift well or in machinery spaces or pulley rooms.

5.2.1.1.2 If parts of different lifts are present in one machine-, and/or pulley room each lift shall be identified with a number or letter consistently used for all parts (machine, controller, overspeed governor, switches, etc.).

To facilitate maintenance, etc. on the car roof, in the pit or other places where necessary, the same identification symbol shall appear.

5.2.1.2 Exclusive use of the lift well, machine and pulley room

5.2.1.2.1 The lift well, machine and pulley rooms shall not be used for purposes other than lifts. They shall not contain ducts, cables or devices other than for the lift.

These rooms may, however, contain:

- a) Equipment for air-conditioning or heating of these rooms, excluding steam heating and high pressure water heating; However, any control and adjustment devices of the heating apparatus shall be located outside the well.
- b) Fire detectors or extinguishers, with a high operating temperature, appropriate for the electrical equipment, stable over a period of time, and suitably protected against accidental impact.

5.2.1.2.2 Machine rooms may contain machines for other kinds of lifts.

In the case of lift wells according to **5.2.5.2.2**, it is regarded as “well” in the case where enclosures are:

- a) Present: the area inside the enclosure;

- b) Missing: the area being inside a horizontal distance of 1,50 m from movable components of the lift (see **5.2.5.2.2**).

5.2.1.3 Ventilation of the well and machine rooms

The well and machine rooms shall not be used to provide ventilation of rooms other than those belonging to the lift.

Ventilation shall be such that the motors and equipment, as well as electric cables, etc., are protected from dust, harmful fumes and humidity.

NOTE See **annex E.3** for further guidance.

5.2.1.4 Lighting

5.2.1.4.1 The well shall be provided with permanently installed electric lighting, giving the following intensity of illumination, even when all doors are closed.

- a) At least 50 lux, 1,0 m above the car roof within its vertical projection at any position of the car in the well,
- b) At least 50 lux, 1,0 m above the pit floor everywhere a person can stand, work and/or move between the working areas,
- c) At least 20 lux outside the locations defined in a) and b).

To achieve this, sufficient number of lamps shall be fixed throughout the well and where necessary additional lamp(s), may be fixed on the car roof as a part of the well lighting system.

Note For specific tasks additional lighting may be necessary.

5.2.1.4.2 The working areas at machinery spaces shall be provided with permanently installed electric lighting with an intensity of at least 200 lux at floor level everywhere a person needs to work or to move between working areas. The supply for this lighting shall be in conformity with **5.10.7.1**.

NOTE This lighting may be part of the lighting of the well.

5.2.1.4.3 The pulley room shall be provided with permanently installed electric lighting with an intensity of at least 100 lux at floor level everywhere a person needs to work or needs to move between working areas. The supply for this lighting shall be in conformity with **5.10.7.1**.

5.2.1.5 Electric equipment in the pit and in machinery spaces and pulley rooms

5.2.1.5.1 There shall be in the pit:

- a) Stopping device(s) accessible on opening the door(s) to the pit, and from the pit floor, in conformity with the requirements of **5.12.1.11**. On or near the stopping device there shall be the marking “**STOP**”;
- b) An inspection control station according to **5.12.1.5** accessible from the standing area;
- c) A socket outlet (**5.10.7.2**);
- d) Means to switch the lift well lighting (**5.2.1.4.1**), accessible on opening the door(s) to the pit.

5.2.1.5.2 There shall be in machinery spaces and pulley rooms:

- a) A switch accessible only to authorised persons and placed close to the access point(s) to working area(s), at an appropriate height, shall control the lighting of the areas and spaces.

- b) At least one socket outlet (5.10.7.2) shall be provided at an appropriate place for each working area.
- c) A stopping device, in conformity with 5.12.1.11, shall be installed in the pulley room, close to the point(s) of access. On or near the stopping device there shall be the marking “STOP”

5.2.1.6 Emergency release

If no means to escape are provided for person trapped in the well, additional alarm initiation devices to the alarm system according to EN 81-28 shall be installed at places where the risk of trapping exists.

5.2.1.7 Handling of equipment

One or more metal supports or hooks with the indication of the safe working load, as appropriate, are provided in the machinery spaces, conveniently positioned to permit the hoisting of heavy equipment (see 0.3.1 and 0.3.15).

5.2.1.8 Strength of walls, floors and ceilings

5.2.1.8.1 The structure of the lift well, machinery spaces and pulley rooms shall conform to National Building Regulations and be able to support at least the loads which may be applied by the machine, by the guide rails at the moment of safety gear operation, in the case of eccentric load in the car, by the action of the buffers, by those which may be applied by the anti-rebound device, by loading and unloading the car, etc..

5.2.1.8.2 For the safe operation of the lift the walls of the well shall have a mechanical strength such that when a force of 300 N, being evenly distributed over an area of 5 cm² in round or square section, is applied at right angles to the wall at any point on either face they shall resist without:

- a) Permanent deformation;
- b) Elastic deformation greater than 15 mm.

See also 5.2.5.3.

5.2.1.8.3 Glass panels, plane or formed shall be made of laminated glass.

They shall withstand 1000 N horizontal static force on an area of 0,30 m x 0,30 m at any point without permanent deformation.

5.2.1.8.4 The floor of the pit shall be able to support beneath each guide rail except hanging guide rails the force in newtons, due to the mass in kilograms of the guide rails plus the reaction in newtons at the moment of operation of the safety gear and any push through force exerted by the guide rails clips (see 5.7.2.3.5).

5.2.1.8.5 The floor of the pit shall be able to support beneath the car buffer supports 4 times the static load being imposed by the mass of the fully loaded car:

$$4 \cdot g_n \cdot (P + Q)$$

where:

g_n is the standard acceleration of free fall, [9,81 (m/s²)];

P is the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensating ropes/chains (if any), etc. in kilograms;

Q is the rated load (mass) in kilograms.

5.2.1.8.6 The floor of the pit shall be able to support beneath the counterweight buffer supports, 4 times the static load being imposed by the mass of the counterweight:

$$4 \cdot g_n \cdot (P + q \cdot Q),$$

where:

g_n is the standard acceleration of free fall, [9,81 (m/s²)];

P is the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensating ropes/chains (if any), etc. in kilograms;

Q is the rated load (mass) in kilograms;

q is the balance factor (see **5.7.2.3.5**).

5.2.1.8.7 The floor of the pit shall be able to support beneath each jack the loads and forces (in newtons) imposed to it.

5.2.1.8.8 The total vertical force imposed on the fixed stops during operation of the pawl device can be evaluated approximately according to the following formulae:

a) Pawl devices provided with energy accumulation type spring buffers:

$$F = \frac{3 \cdot g_n \cdot (P + Q)}{n}$$

b) Pawl devices provided with energy dissipation type buffers:

$$F = \frac{2 \cdot g_n \cdot (P + Q)}{n}$$

where:

F is the total vertical force in newtons on fixed stops imposed during operation of pawl device;

g_n is the standard acceleration of free fall, [9,81 (m/s²)];

n is the number of pawl devices;

P is the mass of the empty car and components supported by the car, i.e. part of the travelling cables, compensating ropes/chains (if any), etc. in kilograms;

Q is the rated load (mass) in kilograms.

5.2.1.9 Surfaces of walls, floors and ceilings

Surfaces of walls, floors and ceilings of lift wells, machine and pulley rooms shall be in durable material not favouring the creation of dust.

The surface of the floor where a person needs to work or to move between working areas shall be of non-slip material.

NOTE For guidance see EN ISO 14122-2, clause 4.2.4.6.

The floor of the pit shall be smooth and approximately level, except for any buffer and guide rail bases and water drainage devices

After the building-in of guide rail fixings, buffers, any grids, etc., the pit shall be impervious to infiltration of water.

The space in which the hydraulic power unit is situated and the pit shall be designed in such a way that it is impervious, so that all the fluid contained in the machinery placed in these areas will be retained if it leaks out or escapes.

5.2.2 Access to lift well and to machinery spaces and pulley rooms

5.2.2.1 The lift well, machinery spaces and pulley rooms and the associated working areas shall be accessible. Provisions shall be made to allow access to spaces other than the lift car only to authorised persons (maintenance, inspection and rescue).

5.2.2.2 The access way adjacent to any door/trap giving access to the lift well or to machinery spaces and pulley rooms shall be:

- a) Capable of being properly lit by a permanent electric light fixture(s);
- b) Easy to use in complete safety in all circumstances without necessitating entry into private premises.

5.2.2.3 If there is an access door to the pit, other than the landing door, it shall comply with the requirements of **5.2.3**.

Such a door shall be provided if the pit depth exceeds 2,50 m and if the layout of the building so permits.

If there is no access a ladder shall be provided inside the well, easily accessible from the landing door, to permit persons to descend safely to the floor of the pit.

Ladders shall comply with **Annex F**.

Where there is a risk of the ladder in its deployed position colliding with moving elements of the lift, the ladder shall be provided with an electrical safety device(s) in accordance with **5.11.2** to prevent the lift from operating if it is not in its stored position.

If the device is stored on the pit floor, all pit safety spaces shall be maintained when the device is in use or in its stored position.

5.2.2.4 A safe access for persons to machinery spaces and pulley rooms shall be provided. For preference this should be effected entirely by way of stairs. If it is not possible to install stairs, ladders satisfying the following requirements shall be used:

- a) The access to the machinery spaces and pulley rooms shall not be situated more than 4 m above the level accessible by stairs;
- b) Ladders shall be fastened to the access permanently or at least by rope or chain in such a way that they cannot be removed;
- c) Ladders exceeding 1,50 m in height shall, when in position for access, form an angle between 65° and 75° to the horizontal and shall not be liable to slip or turn over;
- d) The clear width of the ladder shall be at least 0,28 m, the depth of the steps shall not be less than 25 mm and in the case of vertical ladders the distance between the steps and the wall behind the ladder shall not be less than 0,15 m. The steps shall be designed for a load not less than 1500 N;
- e) Adjacent to the top end of the ladder there shall be at least one hand hold within easy reach;
- f) Around a ladder, within a horizontal distance of 1,50 m, the risk of falling by more than the height of the ladder shall be prevented.

5.2.3 Access and emergency doors - Access trap doors - Inspection traps

5.2.3.1 Working areas inside the well shall be accessible through doors in the well enclosure. Doors shall be either the landing doors or doors satisfying the following requirements.

Machine rooms and pulley rooms shall be accessible through access doors or access trap doors.

5.2.3.2 Access and emergency doors, and inspection traps to the well, shall not be used except on grounds of safety to users or the requirements of maintenance.

5.2.3.3 When the distance between consecutive landing doorsills exceeds 11 m, one of the following conditions shall be fulfilled; there shall be:

- Intermediately emergency doors, or
- Emergency electrical operation according to **5.12.1.6**, or
- Adjacent cars, each fitted with an emergency door provision for which is made in **5.4.6.3**.

5.2.3.4 Access and emergency doors, access trap doors and inspection traps shall have the following dimensions:

- a) Access doors to machine rooms shall have a minimum width of 0,60 m and a minimum height of 1,80 m;
- b) Access doors to pulley rooms and access doors to the well shall have a minimum height of 1,40 m and a minimum width of 0,60 m;
- c) Access trap doors for persons to machine and pulley rooms shall give a clear passage of at least 0,80 m x 0,80 m, and shall be counterbalanced;
- d) Emergency doors shall have a minimum height of 1,80 m and a minimum width of 0,35 m;
- e) Inspection traps shall have a maximum height of 0,50 m and a maximum width of 0,50 m and shall:
 - 1) Have sufficient dimensions to carry out the required work through the door/trap;
 - 2) Be as small as possible to avoid falling into the well.

5.2.3.5 Access and emergency doors and inspection traps shall:

- a) Not open towards the inside of the well or machine or pulley room;
- b) Be provided with a key-operated lock, capable of being reclosed and relocked without a key;
- c) Be capable of being opened from inside the well without a key, even when locked;
- d) Be provided with an electrical safety device in conformity with **5.11.2**, checking the closed position;

An electric safety device is not required in case of access door(s) to machine and pulley rooms and to the pit (**5.2.2.3**) provided the pit door(s) does not give access to a hazardous zone. This is regarded to be the case if the free vertical distance between the lowest parts of car, counterweight or balancing weight including guide shoes, apron, etc. during normal operation and the bottom of the pit is at least 2 m.

The presence of travelling cables, compensating ropes/chains and their equipment, tensioning pulleys for the overspeed governor and similar installations is not regarded as being hazardous;

- e) Be imperforate, satisfy the same requirements for mechanical strength as the landing doors, and comply with the regulations relevant to the fire protection for the building concerned.

5.2.3.6 Access trap doors, when they are closed, shall be able to support two persons, each counting for 1000 N on an area of 0,20 m x 0,20 m at any position.

Trap doors shall not open downwards, unless they are linked to retractable ladders. Hinges, if any, shall be of a type which cannot be unhooked.

When a trap door is in the open position, precautions shall be taken to prevent the fall of persons (e.g. a guardrail).

5.2.3.7 Doors or trap doors shall be provided with a key operated lock, capable of being opened without a key from inside the room.

Trap doors used only for access of material may be locked from the inside only.

5.2.4 Notices

5.2.4.1 A notice bearing the following minimum inscription:

**“Lift Machinery - Danger
Access forbidden to unauthorized persons”**

shall be fixed to the outside of doors or trap-doors (excluding landing doors and doors of emergency and test panels) giving access to machinery spaces and pulley rooms.

In the case of trap-doors, a permanently visible notice shall indicate to those using the trap-door:

“Danger of falling - Reclose the trap-door”

5.2.4.2 Outside of the well, near the access doors and emergency doors, if any, there shall be a notice stating:

**"Lift well - Danger of falling
Access forbidden to unauthorised persons"**

5.2.5 Lift well

5.2.5.1 General provisions

5.2.5.1.1 The lift well may contain one or more lift cars.

5.2.5.1.2 The counterweight or the balancing weight of a lift shall be in the same well as the car.

5.2.5.1.3 Jacks of a lift shall be in the same well as the car. They may extend into the ground or other spaces.

5.2.5.2 Well enclosure

A lift shall be separated from the surroundings by:

- a) Walls, floor and ceiling; or
- b) Sufficient space.

5.2.5.2.1 Totally enclosed well

The well shall be totally enclosed by imperforate walls, floor and ceiling.

The only permissible openings are:

- a) Openings for landing doors;
- b) Openings for access and emergency doors to the well and inspection traps;
- c) Vent openings for escape of gases and smoke in the event of fire;
- d) Ventilation openings;
- e) Necessary openings for the functioning of the lift between the well and the machine or pulley rooms;
- f) Openings in partition between lifts according to **5.2.5.5**.

5.2.5.2.2 Partially enclosed well

Where the well is not required to contribute against the spread of fire, e.g. observation lifts in connection with galleries or atriums, tower buildings, etc., the well does not need to be totally enclosed, provided:

- a) The height of the enclosure at places normally accessible to persons shall be sufficient to prevent such persons:
 - being endangered by moving parts of the lift; and
 - interfering with the safe operation of the lift by reaching lift equipment within the well either directly or with hand-held objects.

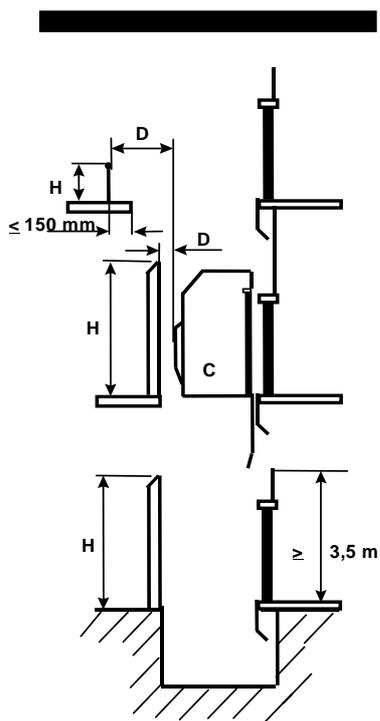
The height is assumed to be sufficient if it is in conformity with Figure 1 and 2, that means:

- 1) minimum 3,50 m at a landing door side;
- 2) minimum 2,50 m at other sides and with a minimum horizontal distance of 0,50 m to moving parts of the lift.

If the distance to moving parts exceeds 0,50 m, the value of 2,50 m can be reduced progressively to a minimum height of 1,10 m in a distance of 2,0 m;

- b) The enclosure shall be imperforate;
- c) The enclosure shall be located within 0,15 m maximum of the edges of floors, stairs or platforms (see **Figure 1**);
- d) Provisions shall be taken to prevent the interference with the operation of the lift by other equipment (see **5.2.1.2.2 b**) and **7.1.1 c**);
- e) Special precautions shall be taken for lifts exposed to weather (see **0.3.4**), e.g. wall climbing lifts installed against the exterior walls of a building.

NOTE Installation of lifts with partially enclosed well should only occur after full consideration of the environmental-/ location conditions.



key

- C Car
- H Height of the enclosure
- D Distance to moving parts of the lift (see Figure 2)

Figure 1 - Partially enclosed well

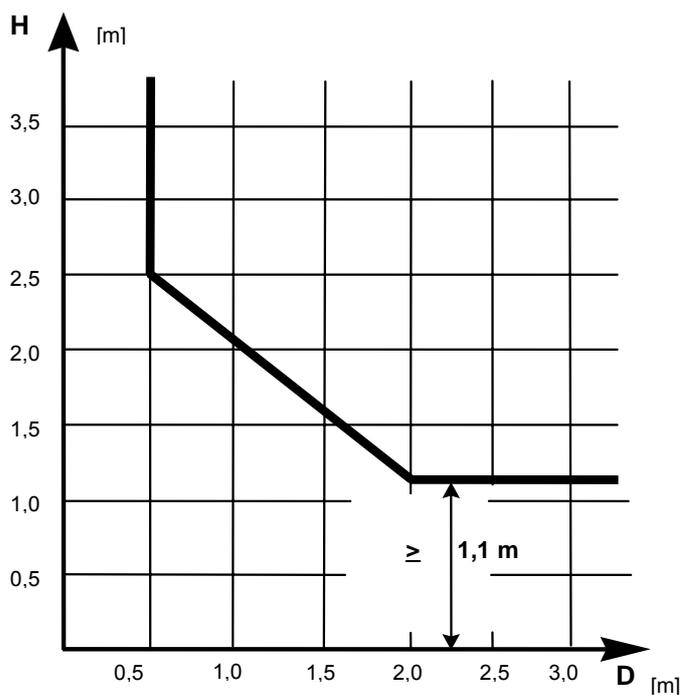


Figure 2 - Partially enclosed well - Distances

5.2.5.3 Construction of the walls of lift wells and landing doors facing a car entrance

5.2.5.3.1 The following requirements relating to landing doors and walls, or parts of walls, facing a car entrance shall apply over the full height of the well.

The operational clearances specified in the standard shall be maintained not only during the examination and tests before the lift is put into service, but also throughout the life of the lift.

The following requirements are illustrated in **Figure 3**.

5.2.5.3.2 The horizontal distance between the inner surface of the lift well and the sill, door frame of the car or closing edge of car sliding doors shall not exceed 0,15 m.

The distance given above:

- may be extended to 0,20 m over a height not exceeding 0,50 m. There shall not be more than one of such recesses in between two consecutive landing doors;
- may be extended to 0,20 m throughout the travel on goods passenger lifts in which the landing doors are vertically sliding;
- is not limited if the car is provided with a mechanically locked door, which can only be opened in the unlocking zone of a landing door.

The operation of the lift shall automatically depend on the locking of the corresponding car door except in the cases covered in **5.3.11.2**. This locking shall be proved by an electric safety device in conformity with **5.11.2**.

5.2.5.3.3 The car and its associated components shall be at a distance of at least 50 mm from the counterweight or balancing weight (if there is one) and its associated components.

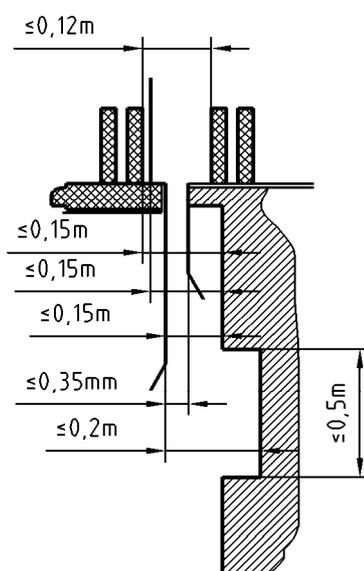


Figure 3 - Clearances between car and wall facing the car entrance

5.2.5.3.4 Below each landing door sill the wall of the lift well shall comply with the following requirements:

- It shall form a vertical surface which is directly connected to the landing door sill, whose height is at least half the unlocking zone plus 50 mm and whose width is at least the clear opening of the car access plus 25 mm on both sides;

- b) This surface shall be continuous and be composed of smooth and hard elements, such as metal sheets, and shall be capable of withstanding a force of 300 N applied at a right angle to the wall at any point, being evenly distributed over an area of 5 cm² in round or square section, it shall resist:
 - 1) without permanent deformation;
 - 2) without elastic deformation greater than 10 mm;
- c) Any projections shall not exceed 5 mm. Projections exceeding 2 mm shall be chamfered at least 75° to the horizontal;
- d) Furthermore, it shall be either:
 - 1) connected to the lintel of the next door; or
 - 2) Extended downwards using a hard smooth chamfer whose angle to the horizontal plane shall be at least 60°. The projection to this chamfer on the horizontal plane shall not be less than 20 mm.

5.2.5.4 Protection of any spaces located below the car, the counterweight or the balancing weight

If accessible spaces do exist below the car, the counterweight or the balancing weight, the base of the pit shall be designed for an imposed load of at least 5 000 N/m², and:

- a) The counterweight or the balancing weight shall be equipped with safety gear; or
- b) There shall be installed below the counterweight buffer or under the travelling area of the balancing weight, a pier extending down to the foundation of the building. The maximum kinetic energy from the free falling counterweight or balancing weight to the pit shall be communicated to the building designers. NOTE Lift wells should preferably not be situated above a space accessible to persons.

5.2.5.5 Protection in the well

5.2.5.5.1 The travelling area of the counterweight or the balancing weight shall be guarded by means of a screen.

This screen shall extend from the lowest point of the counterweight resting on its fully compressed buffer(s) or balancing weight in its lowest position to a minimum height of 2,0 m from the pit floor.

In no case shall it be less than 0,30 m from the pit floor to the lowest part of the screen with the exception of buffers travelling on the counterweight (see **5.8.1.1**).

The width shall be at least equal to that of the counterweight or balancing weight.

It is permitted to have slot(s) in the screen with the minimum width necessary to permit free passage of ropes, chains, etc.

The screen shall have sufficient rigidity to ensure that when a force of 300 N is applied at right angles at any point of the screen, it shall not deflect to cause the counterweight to collide with it.

5.2.5.5.2 Where the well contains several lifts there shall be a partition between the moving parts of different lifts.

If this partition is perforate, EN ISO 13857:2008, subclause 4.2.4.1 shall be respected.

5.2.5.5.2.1 This partition shall extend at least from the lowest point of travel of the car, the counterweight or the balancing weight to a height of 2,50 m above the floor of the lowest landing.

The width shall be as to prevent access from one pit to another, except where the conditions of **5.2.3.5 d)** are met.

5.2.5.5.2.2 The partition shall extend through the full height of the well if the horizontal distance between any balustrade and a moving part (car, counterweight or balancing weight) of an adjacent lift is less than 0,50 m.

This partition shall be at least the width of the moving part and extend a further 0,10 m on each side throughout the height of the well.

5.2.5.6 Guided travel of car, counterweight and balancing weight

5.2.5.6.1 In the case of traction lifts

5.2.5.6.1.1 The car guide rail lengths shall be such as would accommodate a further guided travel, expressed in metres, of at least $0,10 + 0,035 \cdot v^2$ ⁴⁾.

5.2.5.6.1.2 When the car rests on its fully compressed buffers, the counterweight guide rail lengths shall be such as would accommodate a further guided travel expressed in metres, of at least $0,10 + 0,035 v^2$;

5.2.5.6.1.3 When the slowdown of the machine is monitored, in accordance with **5.12.1.3**, the value of $0,035 \cdot v^2$ in **5.2.5.7.3** for calculation of clearances may be reduced taking into account the speed at which the car or counterweight comes into contact with the buffer.

5.2.5.6.1.4 For lifts which are fitted with compensating ropes having a tensioning pulley equipped with an anti-rebound device (braking or lock-down device), the value of $0,035 \cdot v^2$ may be replaced in the calculation of the clearances by a figure related to the possible travel of that pulley (depending on the roping used) plus 1/500 of the travel of the car, with a minimum of 0,20 m to take account of the elasticity of the ropes.

5.2.5.6.2 In the case of positive drive lifts

5.2.5.6.2.1 The guided travel of the car upwards from the top floor until it strikes the upper buffers shall be at least 0,50 m. The car shall be guided to the limit of its buffer stroke.

5.2.5.6.2.2 When the car rests on its fully compressed buffers, the guide rail lengths of the balancing weight, if there is one, shall be such as would accommodate a further guided travel of at least 0,30 m.

5.2.5.6.3 In the case of hydraulic lifts

5.2.5.6.3.1 When the ram is in its ultimate position, achieved through the means of ram stroke limitation according to **5.9.3.2.3**, The car guide rail lengths shall be such as would accommodate a further guided travel, expressed in metres, of at least $0,10 + 0,035 \cdot v_m^2$;

5.2.5.6.3.2 When the car rests on its fully compressed buffers, the balancing weight guide rail lengths shall be such as would accommodate a further guided travel expressed in metres, of at least $0,10 + 0,035 \cdot v_d^2$.

4) $0,035 v^2$ represents half the gravity stopping distance corresponding to 115 % of the rated speed:

$$\frac{1}{2} \cdot \frac{(1,15 \cdot v)^2}{2 \cdot g_n} = 0,0337 \cdot v^2, \text{ rounded to } 0,035 v^2.$$

5.2.5.6.3.3 With the car at its highest position determined by the fully compressed cushioned stop of the jack, the guide lengths of the balancing weight, if there is one, shall be such as would accommodate a further guided travel, expressed in metres, of at least $0,10 + 0,035 \cdot v_m^2$.

5.2.5.6.3.4 The free vertical distance between the lowest parts of the ceiling of the well and the highest parts of an upward travelling ram-head assembly shall be at least 0,10 m;

5.2.5.6.3.5 In the case of direct acting lifts, the value of $0,035 \cdot v_m^2$ mentioned above shall not be taken into account.

5.2.5.7 Safety spaces on car roof and clearances in headroom (see Figure 4)

5.2.5.7.1 When for traction lifts the counterweight rests on its fully compressed buffer(s) or for positive drive lifts the upper buffers are fully compressed by the car or for hydraulic lifts the ram is in its ultimate position, achieved through the means of ram stroke limitation according to **5.9.3.2.3**, there shall be sufficient clear area to accommodate a rectangular safety volume selected from **Table 2**.

Safety volume type 2 (see **Table 2**) may have a reduced horizontal area in the lower part up to a height of 0,30 m not reducing the horizontal area more than 0,10 m from all sides.

If more than one person is necessary on the car roof for carrying out inspection and maintenance work, an additional clear area and safety volume shall be provided for each additional person.

In case of several safety volumes they shall be of the same type and not interfering with each other.

A sign on the car roof readable from the landings giving access to the car roof shall clearly indicate the allowed number of persons.

Any area on the car roof outside an area where the available safety volume can be accommodated shall be clearly marked. The marking shall consist of yellow and black stripes according to ISO 3864-1 figure 17.

Table 2 - Dimensions of safety volumes in headroom

Type	Posture	Horizontal dimensions of the safety volume (m x m)	(Reduced) lower part of the safety volume (standing area) (m x m)	Height of the safety volume (m)
1	Standing	0,40 x 0,50	0,40 x 0,50	$2,00 + 0,035 v^2$
2	Crouching	0,50 x 0,70	(0,30 x 0,50)	$1,00 + 0,035 v^2$

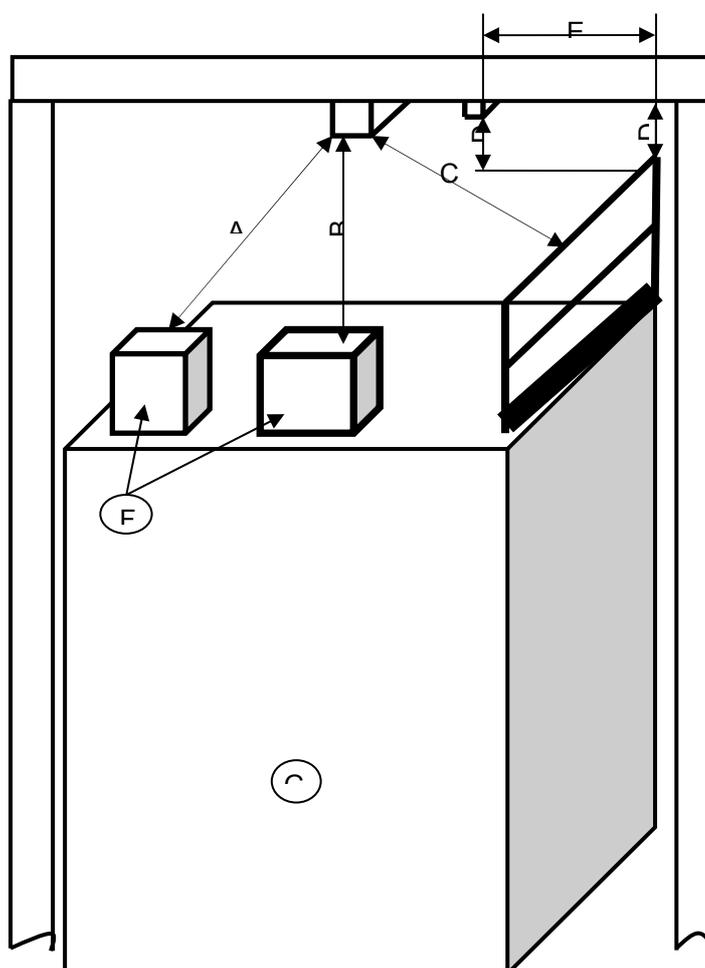
5.2.5.7.2 In the position of the car according to **5.2.5.7.1**, the clear distance, expressed in metres, between the lowest parts of the ceiling of the lift well and:

- a) The highest pieces of equipment fixed on the roof of the car enclosure, except for those covered in b), c) and d) below, shall be at least $0,50 + 0,035 \cdot v^2$ in any vertical or inclined direction within the projection of the car;
- b) The free vertical distance between any part of the car roof having a clear area of 0,12 m² and minimum dimension on one side of 0,25 m where a person might stand and the level of the lowest part of the ceiling of the well above this area shall have at least the height of the safety volume given in **Table 2**;

- c) The highest part of the guide shoes or rollers, of the rope terminations and of the header or parts of vertically sliding doors, if any, shall be at least $0,10 + 0,035 \cdot v^2$ in any vertical direction within a horizontal distance of 0,40 m within the projection of the car;
- d) The highest part of the balustrade shall be at least $0,30 + 0,035 \cdot v^2$ in vertical direction within a horizontal distance of 0,40 m and $0,50 + 0,035 \cdot v^2$ in any inclined direction beyond a horizontal distance of 0,40 m within the projection of the car.

5.2.5.7.3 In the case of traction lifts with reduced buffer stroke or with compensation ropes with anti-rebound devices, see **5.2.5.6.1**.

5.2.5.7.4 For hydraulic lifts the value of $0,035 \cdot v^2$ mentioned in **5.2.5.7.2** shall be replaced by $0,035 \cdot v_m^2$. In the case of direct acting hydraulic lifts, this value shall not be taken into account.



Legend:

- A:** Distance $\geq 0,50 + 0,035 v^2$ (**5.2.5.7.2 a**)
- B:** Distance $\geq 0,50 + 0,035 v^2$ (**5.2.5.7.2 a**)
- C:** Distance $\geq 0,50 + 0,035 v^2$ (**5.2.5.7.2 a**)
- D:** Distance $\geq 0,30 + 0,035 v^2$ (within 0,40 m) (**5.2.5.7.2 d**)
- E:** Distance $\leq 0,40$ m (**5.2.5.7.2 d**)
- F:** Highest parts installed on the lift car roof
- G:** Lift car

Figure 4 - Minimum distances between parts fixed on car roof and lowest parts fixed to ceiling of well

5.2.5.8 Safety spaces and clearances in the pit

5.2.5.8.1 When the car rests on its fully compressed buffer(s), above each standing area there shall be sufficient clear area to accommodate a rectangular safety volume selected from **Table 3**.

If more than one person is necessary in the pit for carrying out inspection and maintenance work, an additional clear area and safety volume shall be provided for each additional person.

In case of several safety volumes they shall be of the same type and not interfering with each other.

A sign in the pit readable from the entrance(s) shall clearly indicate the allowed number of persons.

Any area in the pit outside an area where the available safety volume can be accommodated shall be clearly marked. The marking shall consist of yellow and black stripes according to ISO 3864-1 figure 17. Marking is not needed under aprons if the horizontal distance between the vertical part of the apron and the adjacent vertical inner surface of the lift well is less than 40 mm and under parts according to **5.2.5.8.2 a) 2)**.

Table 3 - Dimensions of safety volume in the pit

Type	Posture	Horizontal dimensions of the safety volume (m x m)	Height of the safety volume (m)
1	Standing	0,40 x 0,50	2,00
2	Laying	0,70 x 1,25	0,50

5.2.5.8.2 When the car rests on its fully compressed buffers, the following conditions shall be satisfied:

- a) The free vertical distance between the bottom of the pit and the lowest parts of the car, shall be at least 0,50 m. This distance may be reduced:
 - 1) for any part of apron or parts of the vertically sliding car door(s) to a minimum of 0,10 m within a horizontal distance of 0,15 m to the adjacent wall(s);
 - 2) for safety gears, guide shoes, pawl devices, within a maximum horizontal distance from the guide rails according to **Figures 5 and 6**;
- b) The free vertical distance between the highest parts fixed in the pit, for instance a tensioning device for compensation ropes being in its highest position, jack supports, pipes and other fittings, and the lowest parts of the car, except for items detailed in **5.2.5.8.2 a) 1) and 2)**, shall be at least 0,30 m;
- c) The free vertical distance between the bottom of the pit or the top of equipment installed there and the lowest parts of the downwards-travelling ram-head assembly of an inverted jack shall be at least 0,50 m.

However, if it is impossible to gain involuntary access under the ram head assembly (for example by providing screens in accordance with **5.2.5.5.1**), this vertical distance may be reduced from 0,50 m to 0,10 m minimum;

- d) The free vertical distance between the bottom of the pit and the lowest guiding yoke of a telescopic jack below the car of a direct acting lift shall be at least 0,50 m.

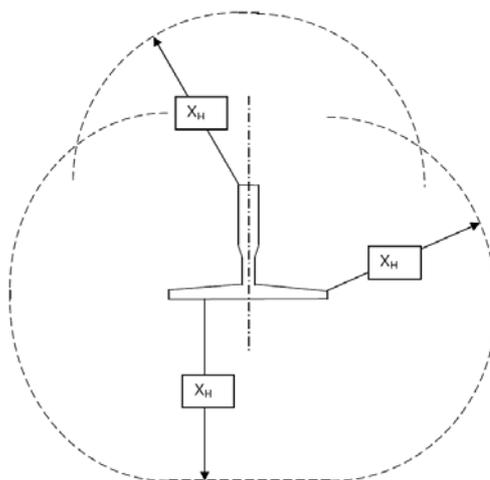
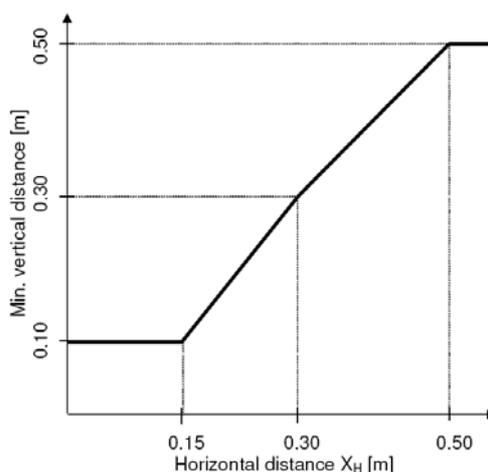
Figure 1: Horizontal distance X_H around guide railFigure 5 - Horizontal distance X_H around guide rail

Figure 2: Min. vertical distances for safety gear, guide shoe and pawl device

Figure 6 - Minimum vertical distances for safety gear, guide shoes and pawl devices

5.2.6 Machinery spaces and pulley rooms

5.2.6.1 General provisions

The spaces and the associated working areas shall be suitably protected against environmental influences to be taken into consideration and provisions made for suitable areas for maintenance/inspection work and emergency operation. See **0.2.2**, **0.3.1** and **0.3.4**. See also **annex D**.

5.2.6.2 Notices, markings and instructions

5.2.6.2.1 Notices shall be provided to permit easy identification of the main switch(es) and the light switch(es).

5.2.6.2.2 If, after release of a main switch, some parts remain live (interconnection between lifts, lighting,...) notice (s) shall indicate this.

5.2.6.2.3 In the machine room (5.2.6.3), the machinery cabinet (5.2.6.5.1) or at the emergency and tests panel(s) (5.2.6.6), there shall be detailed instructions to be followed in the event of lift breakdown, particularly concerning the use of the device for manual or electrical emergency movement, and the unlocking key for landing doors.

5.2.6.2.3.1 The direction of movement of the car shall be clearly indicated on the machine, close to the hand winding wheel.

If the wheel is not removable, the indication may be on the wheel itself.

5.2.6.2.3.2 On or near the emergency electrical operation buttons, there shall be markings to show the corresponding direction of movement.

5.2.6.2.4 In the pulley room the marking “**STOP**” on or near the stopping device(s) shall be given.

5.2.6.2.5 The maximum permissible load shall be indicated on the lifting beam or hooks (see 5.2.1.7).

5.2.6.2.6 The maximum permissible load shall be indicated on the platform (see 5.2.6.4.5).

5.2.6.3 Machinery in machine room

5.2.6.3.1 Traction sheave in the well

The traction sheave may be installed in the well, provided that:

- a) The examinations and the tests and the maintenance operations may be carried out from the machine room;
- b) The openings between the machine room and the well are as small as possible.

5.2.6.3.2 Dimensions

5.2.6.3.2.1 The dimensions of machine rooms shall be sufficient to permit easy and safe working on equipment, especially the electrical equipment.

In particular there shall be provided at least a clear height of 2 m at working areas, and:

- a) A clear horizontal area in front of the control panels and cabinets. This area is defined as follows:
 - 1) depth, measured from the external surface of the enclosures, at least 0,70 m;
 - 2) width, the greater of the following values: 0,50 m or the full width of the cabinet or panel;
- b) A clear horizontal area of at least 0,50 m x 0,60 m for maintenance and inspection of moving parts at points where this is necessary and, if need be, manual emergency operation (5.9.2.3.1).

5.2.6.3.2.2 The clear height for movement shall not be less than 1,80 m.

The access ways to the clear spaces mentioned in 5.2.6.3.2.1 shall have a width of at least 0,50 m. This value may be reduced to 0,40 m where there are no moving parts.

This clear height for movement is taken to the underside of the structural roof beams and measured from the floor of the access area.

5.2.6.3.2.3 There shall be a clear vertical distance of at least 0,30 m above the rotating parts of the machine.

5.2.6.3.2.4 When the machine room floor comprises a number of levels differing by more than 0,50 m, ladders according to **5.2.2.4 b)** or stairways and guardrails shall be provided.

5.2.5.3.2.5 When the floor of the machine rooms has any recesses with a depth of more than 0,050 m and a width between 0,05 m and 0,50 m wide, or any ducts, they shall be covered. This applies only to areas where a person has to work or to move between different working areas.

Recesses with a width of more than 0,5 m have to be considered as different levels, see **5.2.6.3.2.4**.

5.2.6.3.3 Other openings

The dimension of holes in the slab and room floor shall be reduced to a minimum for their purpose.

With the aim of removing the danger of objects falling through openings situated above the well, including those for electric cables, ferrules shall be used, which project at least 50 mm above the slab or finished floor.

5.2.6.4 Machinery inside the well

5.2.6.4.1 General provisions

5.2.6.4.1.1 In the case of wells partially enclosed at the exterior of buildings the machinery shall be suitably protected against the environmental influences.

5.2.6.4.1.2 The clear height for moving inside the well from one working area to another one shall not be less than 1,80 m.

5.2.6.4.1.3 In the case of:

- a retractable platform (**5.2.6.4.5**) and/or movable stops (**5.2.6.4.5.2 b)**),
- or manually operated mechanical device (**5.2.6.4.3.1, 5.2.6.4.4.1**),

a clear notice(s) giving all the necessary instructions for operation shall be affixed at an appropriate place(s) in the well.

5.2.6.4.2 Dimensions of working areas inside the well

5.2.6.4.2.1 The dimensions of working areas at the machinery inside the well shall be sufficient to permit easy and safe working on equipment.

In particular there shall be provided at least a clear height of 2 m at working areas, and:

- a) A clear horizontal working area of at least 0,50 m x 0,60 m for maintenance and inspection of parts at points where this is necessary;
- b) A clear horizontal space in front of the control panels and cabinets, defined as follows:
 - 1) Depth, measured from the external surface of the enclosures, at least 0,70 m;
 - 2) Width, the greater of the following values: 0,50 m or the full width of the cabinet or panel.

5.2.6.4.2.2 There shall be a clear vertical distance of at least 0,30 m above unprotected rotating parts of the machine. If the distance is less than 0,30 m guarding shall be provided according to **5.5.7.1 a)**.

See also **5.2.5.7**.

5.2.6.4.3 Working areas in the car or on the car roof

5.2.6.4.3.1 Where maintenance/inspection work on the machinery is to be carried out from inside the car or from the car roof and if any kind of uncontrolled or unexpected car movement resulting from maintenance/inspection can be dangerous to persons, the following applies:

- a) Any dangerous movement of the car shall be prevented by a mechanical device;
- b) All movement of the car shall be prevented by means of an electric safety device in conformity with **5.11.2** unless the mechanical device is in its inactive position;
- c) When this device is in its active position and cannot be disengaged safely due to forces exerted by the car, the following shall apply; it shall be possible:
 - 1) To leave the car roof
 - directly via the landing door by a clear opening of at least 0,50 m x 0,70 m above the car door header / door drive, or
 - via the car by access through a trap door in the car roof having a clear opening of at least 0,40 m x 0,50 m. Steps, ladder and/or hand hold(s) shall be provided to allow a safe descent into the car, or
 - 2) Exit the well via an emergency door as **5.2.3**.

Proper instructions regarding the escape procedure shall be given in the lift documentation.

5.2.6.4.3.2 The necessary devices for emergency operation and for dynamic tests (such as safety gear tests, buffer tests, etc.) shall be arranged so that they can be carried out from outside of the well in accordance with **5.2.6.6**.

5.2.6.4.3.3 If inspection doors and/or traps are located in the walls of the car, they shall:

- a) Have sufficient dimensions to carry out the required work through the door/trap;
- b) Be as small as possible to avoid falling into the well;
- c) Not open towards the outside of the car;
- d) Be provided with a key-operated lock, capable of being reclosed and relocked without a key;
- e) Be provided with an electrical safety device in conformity with **5.11.2**, checking the locked position;
- f) Be imperforate and satisfy the same requirements for mechanical strength as the walls of the car.

5.2.6.4.3.4 Where it is necessary to move the car from the inside with open inspection door/trap the following applies:

- a) An inspection control station according to **5.12.1.5** shall be available near the inspection door/trap;
- b) The inspection control station in the car shall render inoperative the electric safety device according to **5.2.6.4.3.3 e)**;
- c) The inspection control station in the car shall be accessible only to authorised persons and so arranged that it is not possible to use it to drive the car when standing on the car roof, e.g. by placing it behind the inspection door/trap;

- d) If the smaller dimension of the opening exceeds 0,20 m the clear horizontal distance between the outside edge of the opening in the car wall and equipment installed in the well in front of that opening shall be at least 0,30 m.

5.2.6.4.4 Working areas in the pit

5.2.6.4.4.1 Where machinery is to be maintained or inspected from the pit and if this work requires movement of the car, or is likely to result in uncontrolled or unexpected car movement, the following applies:

- a) A permanently installed device shall be provided to mechanically stop the car with any load up to rated load and from any speed up to rated speed to create a free distance of at least 2 m between the floor of the working area and the lowest parts of the car, excluding those mentioned in **5.2.5.8.2 a) 1) and 2)**. The retardation of mechanical devices other than safety gears shall not exceed that produced by the buffers (**5.8.2**);
- b) The mechanical device shall be able to maintain the car stopped;
- c) The mechanical device can be operated manually or automatically;
- d) The opening by the use of a key of any door providing access to the pit shall be checked by an electric safety device according to **5.11.2** which prevents all further movement of the lift. Movement shall only be possible under the requirements given in f) below;
- e) All movement of the car shall be prevented by means of an electric safety device in conformity with **5.11.2** unless the mechanical device is in its inactive position;
- f) When the mechanical device is in its active position as checked by means of an electric safety device in conformity with **5.11.2**, electrically driven movement of the car shall only be possible from the inspection control station(s);
- g) The return of the lift to normal operation shall only be made by operation of an electrical reset device placed outside of the well and accessible to authorised persons only, e. g. inside a locked cabinet.

5.2.6.4.4.2 When the car is in the position according to **5.2.6.4.4.1 a)**, a vertical distance from the landing door level to the lowest edge of the car apron shall be minimum 0,50 m to allow to leave the pit.

5.2.6.4.4.3 The necessary devices for emergency operation and for dynamic tests (such as brake tests, traction tests, safety gear tests, buffer tests or tests of ascending car overspeed protection means, rupture valve tests or pressure tests, etc.) shall be arranged so that they can be carried out from outside of the well in accordance with **5.2.6.6**.

5.2.6.4.5 Working areas on a platform

5.2.6.4.5.1 Where machinery is to be maintained or inspected from a platform, it shall be:

- a) Permanently installed, and
- b) Retractable if it is in the travel path of the car or counterweight/balancing weight.

5.2.6.4.5.2 Where machinery is to be maintained or inspected from a platform positioned into the travel path of the car, the counterweight or the balancing weight:

- a) The car shall be stationary by using a mechanical device in conformity with **5.2.6.4.3.1 a) and b)**, or
- b) Where the car needs to be moved, the travel path of the car shall be limited by movable stops in such a way that the car is stopped:
 - 1) at least 2 m above the platform if the car runs down towards the platform;

- 2) Below the platform in compliance with **5.2.5.7.2**, if the car runs up towards the platform.

5.2.6.4.5.3 The platform shall be:

- a) Able to support at any position the mass of two persons, each counting for 1000 N over an area of 0,20 m × 0,20 m without permanent deformation. If the platform is intended to be used for handling heavy equipment the dimensions shall be considered accordingly and the platform shall have a mechanical strength to withstand the loads and forces to which it is intended to be subjected (see **5.2.1.7**);
- b) Provided with a balustrade in conformity with **5.4.7.2**;
- c) Equipped with means ensuring that:
- 1) the step rise between the floor of the platform and the level of the access does not exceed 0,50 m;
 - 2) it shall not be possible to pass a ball with a diameter of 0,15 m through any gap between the platform and the sill of the access door;
 - 3) Any gap measured horizontally between the fully open landing door panel and the platform edge does not exceed 0,15 m, unless additional provisions have been taken to prevent falling into the well.

5.2.6.4.5.4 In addition to **5.2.6.4.5.3** any retractable platform shall be provided with:

- a) An electric safety device in conformity with **5.11.2**, checking the fully retracted position;
- b) Means for putting it into or removing it from the working position. This operation shall be possible from the pit or by means located outside of the well and accessible only to authorised persons.

If the access to the platform is not through a landing door, the opening of the access door shall be impossible when the platform is not in the working position, or alternatively, means shall be provided to prevent persons from falling into the well.

5.2.6.4.5.5 In the case of **5.2.6.4.5.2 b)** movable stops shall be automatically operated when the platform is lowered. They shall be provided with:

- a) Buffers in conformity with **5.8**;
- b) An electric safety device in conformity with **5.11.2**, which only allows car movement if the stops are in their fully retracted position;
- c) An electrical safety device in conformity with **5.11.2**, which only allows car movement with a lowered platform if the stops are in their fully extended position.

5.2.6.4.5.6 Where it is necessary to move the car from the platform, an inspection control station according to **5.12.1.5** shall be available for use on the platform.

When the movable stop(s) is(are) in its active position, electrically driven movement of the car shall only be possible from the inspection control station(s).

5.2.6.4.5.7 The necessary devices for emergency operation and dynamic tests (such as brake tests, traction tests, safety gear tests, buffer tests or tests of ascending car overspeed protection means) shall be arranged so that they can be carried out from outside of the well in conformity with **5.2.6.6**.

5.2.6.4.6 Working areas outside of the well

When the machinery is in the well and is intended to be maintained/inspected from outside of the well, the working areas in accordance with **5.2.6.3.2.1** and **5.2.6.3.2.2** may be provided outside of the well. Access to this equipment shall only be possible by a door/trap in conformity with **5.2.3**.

5.2.6.5 Machinery outside of the well

5.2.6.5.1 Machinery cabinet

5.2.6.5.1.1 The machinery of a lift shall be located inside a cabinet which shall not be used for purposes other than the lift. It shall not contain ducts, cables or devices other than for the lift.

5.2.6.5.1.2 The machinery cabinet shall consist of imperforate walls, floor, roof and door(s).

The only permissible openings are:

- a) Ventilation openings;
- b) Necessary openings for the functioning of the lift between the well and the machinery cabinet;
- c) Vent openings for escape of gases and smoke in the event of fire.

These openings when accessible to non-authorised persons shall comply with the following requirements:

- d) Protection according to EN ISO 13857:2008, Table 5 against contact with danger zones, and
- e) Degree of protection of at least IP 2XD against contact with electrical equipment.

5.2.6.5.1.3 The door(s) shall:

- a) Have sufficient dimensions to carry out the required work through the door;
- b) Not open towards the inside of the cabinet;
- c) Be provided with a key-operated lock, capable of being reclosed and relocked without a key.

5.2.6.5.2 Working area

The working area in front of a machinery cabinet shall comply with the requirements according to **5.2.6.4.2**.

5.2.6.6 Devices for emergency and test operations

5.2.6.6.1 In the case of **5.2.6.4.3**, **5.2.6.4.4** and **5.2.6.4.5** the necessary devices for emergency and test operations shall be provided on a panel(s) suitable for carrying out from outside of the well all emergency operations and any necessary dynamic tests of the lift. The panel(s) shall be accessible to authorised persons only. This applies also to means for maintenance where maintenance procedure(s) require(s) moving the car and the work cannot be carried out safely from the intended work areas provided inside the well.

If the emergency and test devices are not protected inside a machinery cabinet, they shall be enclosed with a suitable cover, which:

- a) Does not open towards the inside of the well;
- b) Is provided with a key-operated lock, capable of being reclosed and relocked without a key.

5.2.6.6.2 The panel(s) shall provide the following:

- a) Emergency operation devices according to **5.9.2.3** or **5.9.3.9**, together with an intercom system in conformity with **5.12.3.3**;
- b) Control equipment which enables dynamic tests to be carried out (**5.2.6.4.3.2**, **5.2.6.4.4.3**, **5.2.6.4.5.7**);

c) Direct observation of the lift machine or display device(s), which give indication of:

- the direction of movements of the car;
- the reaching of an unlocking zone, and
- the speed of the lift car.

5.2.6.6.3 The devices on the panel(s) shall be lit by a permanently installed electric lighting with an intensity of at least 50 lux measured at the device.

A switch placed on or close to the panel shall control lighting of the panel(s).

The electrical supply for this lighting shall be in conformity with **5.10.7.1**.

5.2.6.6.4 The panel(s) for emergency and test operations shall be installed only where a working area in accordance with **5.2.6.3.2.1** is available.

5.2.6.7 Construction and equipment of pulley rooms

5.2.6.7.1 Dimensions

5.2.6.7.1.1 Pulley room dimensions shall be sufficient to provide easy and safe access for maintenance personnel to all the equipment.

The requirements of **5.2.6.3.2.1 b)** and **5.2.6.3.2.2**, sentence two and three, are applicable.

5.2.6.7.1.2 The height under the ceiling shall be at least 1,50 m.

5.2.6.7.1.3 There shall be a clear space of at least 0,30 m high above the pulleys.

5.2.6.7.1.4 If there are control panels and cabinets in the pulley room the provisions of **5.2.6.3.2.1** and **5.2.6.3.2.2** apply to this room.

5.2.6.7.2 Openings

The dimensions of holes in the slab and pulley room floor shall be reduced to a minimum for their purpose.

With the aim of removing the danger of objects falling through openings situated over the well, including those for electric cables, ferrules shall be used which project at least 50 mm above the slab or finished floor.

5.3 Landing doors and car doors

5.3.1 General provisions

5.3.1.1 The openings in the well giving access to the lift car shall be provided with landing doors and the access to the lift car shall be through a car door.

5.3.1.2 The doors shall be imperforate, except for car doors on goods passenger lifts, which may use vertically sliding car doors, opening upwards, and these may be in mesh or perforated panel form. The dimensions of the mesh or perforations shall not exceed 10 mm horizontally and 60 mm vertically.

5.3.1.3 The landing and car doors when closed shall, apart from the necessary clearances, completely close the landing and car entrances.

5.3.1.4 When closed, the clearance between door panels, or between panels and uprights, lintels or sills, shall not exceed 6 mm. This value, due to wear, may reach 10 mm. These clearances are measured at the back of recesses, if present. Exception is made for vertically sliding doors, according to **5.3.1.2**.

5.3.1.5 In the case of hinged car doors, they shall strike stops to prevent them swinging outside the car.

5.3.2 Height and width of entrances

5.3.2.1 Height

Landing doors and car doors shall be such that a minimum clear height of the entrance is 2 m.

5.3.2.2 Width

The clear entrance of the landing doors shall not extend more than 50 mm in width beyond the clear car entrance on both sides.

5.3.3 Sills, guides, door suspension

5.3.3.1 Sills

Every landing and car entrance shall incorporate a sill of sufficient strength to withstand the passage of loads being introduced into the car.

NOTE It is recommended that a slight counter slope be provided in front of each landing sill to avoid water from washing, sprinkling, etc., draining into the well.

5.3.3.2 Guides

5.3.3.2.1 Landing and car doors shall be designed to prevent, during normal operation, derailment, mechanical jamming, or displacement.

5.3.3.2.2 Horizontally sliding landing and car doors shall be guided top and bottom.

5.3.3.2.3 Vertically sliding landing and car doors shall be guided at both sides.

5.3.3.3 Suspension of vertically sliding doors

5.3.3.3.1 Panels of vertically sliding landing and car doors shall be fixed to two independent suspension elements.

5.3.3.3.2 Suspension ropes, chains, belts shall be designed with a safety factor of at least 8.

5.3.3.3.3 The pitch diameter of suspension rope pulleys shall be at least 25 times the rope diameter.

5.3.3.3.4 Suspension ropes and chains shall be guarded against leaving the pulley grooves or sprockets.

5.3.4 Horizontal door clearances

5.3.4.1 The horizontal distance between the sill of the car and sill of the landing doors shall not exceed 35 mm (see **Figure 3**).

5.3.4.2 The horizontal distance between the car door and the closed landing doors or the access distance between the doors during the whole of their normal operation shall not exceed 0,12 m (see **Figure 3**).

5.3.4.3 In the case of the combination of a hinged landing door and a folding car door it shall not be possible to place a ball with a diameter of 0,15 m in any gap between the closed doors (see **Figure 7**).

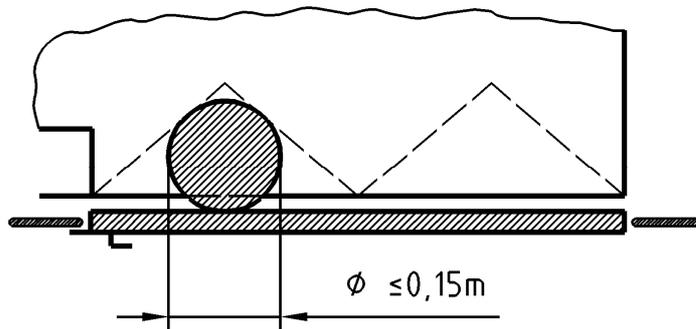


Figure 7 - Hinged landing door and folding car door - Gap

5.3.5 Strength of landings and car doors

Landing doors and their frames and car doors shall be constructed in such a way that they will not become deformed over the course of time.

5.3.5.1 Behaviour under fire conditions

Landing doors shall comply with the regulations relevant to the fire protection for the building concerned. EN 81-58 shall be applied for the testing and certification of such doors.

5.3.5.2 Mechanical strength

5.3.5.2.1 Complete landing doors, with their locks, and car doors shall have a mechanical strength such that in the locked position of landing doors and closed position of car doors:

a) When a force of 300 N, being evenly distributed over an area of 5 cm² in round or square section, is applied at right angles to the panel/frame at any point on either face they shall resist without:

- 1) Permanent deformation (e.g. less than 1 mm);
- 2) Elastic deformation greater than 15 mm;

After such a test the safety function of the door shall not be affected.

b) When a force of 1000 N, being evenly distributed over an area of 100 cm² in round or square section, is applied at right angles at any point of the panel or frame from the landing side or from the inside of the car they shall resist without permanent deformation (e.g. less than 1 mm).

After such a test the safety function of the door shall not be affected.

NOTE For a) & b), the probe surface used to apply the test forces may be of soft material to avoid damage to the door coating.

5.3.5.2.2 In addition for all landing doors, with their locks, and side frames that are wider than 150 mm and car doors with glass panels (see **Figure 8**):

a) When an impacting energy equivalent to a falling height of 800 mm of the soft pendulum shock device (prEN 81-50, 5.14) is striking the panels or frames in the middle of the panel or frame width, at striking points according to **Table 4**, from the landing side or from the inside of the car, the following shall be satisfied:

- 1) They may have permanent deformation;
 - 2) There shall be no loss of integrity of the door assembly, i.e. the door assembly shall remain in place;
 - 3) After the pendulum test the doors do not need to be able to operate;
 - 4) When a force of 300 N, being evenly distributed over an area of 100 cm² in round or square section, is applied at right angles at any point of the panel or frame from the landing side or from the inside of the car it shall not cause the door assembly to collapse;
 - 5) For glass elements, there shall be no cracks of more than 40 mm in length;
- b) When an impact energy equivalent to a falling height of 500 mm of the hard pendulum shock device (prEN 81-50, 5.14) is applied on glass panels and windows bigger than stated in **5.3.7.2**, striking the panels or frames at hitting points from the landing side or from the inside of the car according to **Table 4**, there shall be:
- 1) No cracks with a length of more than 40 mm;
 - 2) No damage on the surface of the glass except chips of 2 mm maximum in diameter.

NOTE In the case of multiple windows the weakest configuration of the windows may be taken into account.

Table 4 - Striking points

Pendulum shock test	Soft pendulum		Hard pendulum	
	800 mm	800 mm	500 mm	500 mm
Dropping height	800 mm	800 mm	500 mm	500 mm
Striking point height	1,0 m	Centre of glass	1,0 m	Centre of glass
Door without window (Figure 8.a)	X			
Door with small window (Figure 8.b and Figure 8.f)	X	X		X
Glass panel (Figure 8.d)	X (Impact on glass)		X	
Door with big window (Figure 8.d)	X (Impact on glass)		X	
Door with window starting or ending at about 1 m height (Figure 8.e)	X	X		X
Door with window starting or ending at about 1 m height (Figure 8.f)	X (Impact on glass)		X	
Door with vision panel (5.3.7.2)	X	X		

Dimensions in millimetres

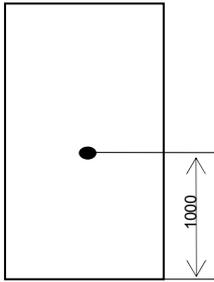


Figure 8.a - Door panel without window

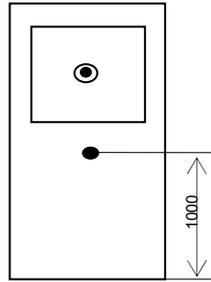


Figure 8.b - Door panel with window

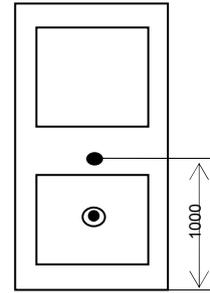


Figure 8.c - Door panel with more than one window

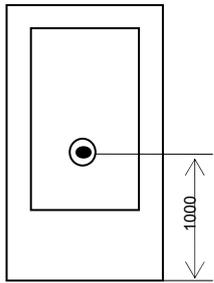


Figure 8.d - Door panel with window or full glass

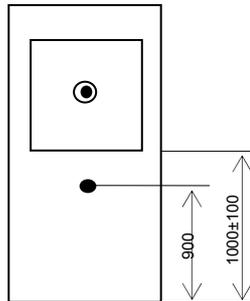


Figure 8.e - Door panel with window above 1,0 m

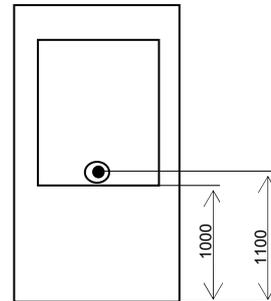


Figure 8.f - Door panel with window above 1,0 m

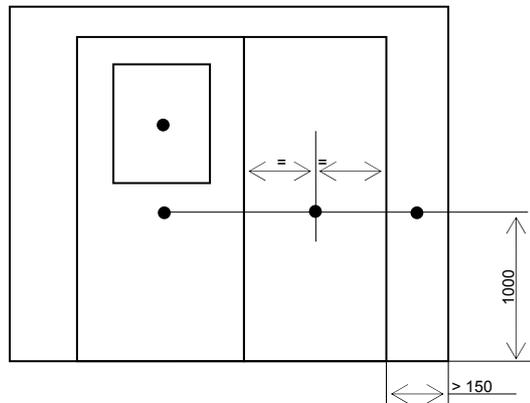


Figure 8.g - Complete landing door with door panels (example according to figure 8.a and figure 8.b)

NOTE 1 Figures 8.e and 8.f are alternative solutions
 NOTE 2 For figure 8.c tests on whichever window represent the worst case.

Legend

- Striking point for soft pendulum shock test
 - Striking point for hard pendulum shock test
- For hitting points defined by 1 m, the tolerance is $\pm 0,10$ m.

Figure 8 - Door panels - Pendulum shock tests - Striking points

5.3.5.2.3 Horizontal sliding doors shall be provided with devices for retaining the door panel in position should the guiding element fixed to the door panel fail. These devices shall withstand on their own a separate pendulum shock test as specified in **5.3.5.2.2 a)**.

5.3.5.2.4 Under the application of a manual force (without a tool) of 150 N in the direction of the opening of the leading landing door panel(s) of horizontally sliding doors and folding doors, at the most unfavourable point, the clearances defined in **5.3.1** may exceed 6 mm, but they shall not exceed:

- a) 30 mm for side opening doors;
- b) 45 mm in total for centre opening doors.

5.3.5.2.5 Doors/frames with glass shall use laminated glass.

5.3.5.2.6 The fixing of the glass in doors shall ensure that the glass cannot slip out of the fixings, even when sinking.

5.3.5.2.7 The glass panels shall have markings giving the following information:

- a) Name of the supplier and trade mark;
- b) Type of glass;
- c) Thickness (e.g. 8/8/0,76 mm).

5.3.5.2.8 To avoid dragging of children hands, automatic power operated horizontally sliding doors made of glass of dimensions greater than stated in **5.3.7.2** shall be provided with means to minimise the risk, such as:

- a) Making the glass opaque on the side exposed to the user by the use of either frosted glass or the application of frosted material to a height of minimum 1,10 m, or
- b) Sensing the presence of fingers at least up to 1,6 m above sill and stopping the door movement in opening direction, or
- c) Limiting the gap between door panels and frame to maximum 4 mm at least up to 1,6 m above sill. Recesses (framed glass, etc.) shall not exceed 1 mm and shall be included in the 4 mm tolerance. The maximum radius on the outer edge of the frame adjacent to the door panel shall not be more than 4 mm.

5.3.6 Protection in relation to door operation

5.3.6.1 General

The doors and their surrounds shall be designed in such a way as to minimize risk of damage or injury due to jamming of a part of the person, clothing or other object.

To avoid the risk of shearing during operation, the face on the landing side or on the car side of automatic power operated sliding doors shall not have recesses or projections exceeding 3 mm. Edges of these shall be chamfered in the opening direction of movement. This is not required for perforated car doors in accordance with **5.3.1.2**.

Exception to these requirements is also made for the access to the unlocking triangle defined in **5.3.9.3**.

5.3.6.2 Power operated doors

Power operated doors shall be designed to reduce to a minimum the harmful consequences of a person being struck by a door panel.

To this effect the following requirements shall be met:

In the case of coupled car and landing doors, operated simultaneously the following requirements are valid for the joint door mechanism.

5.3.6.2.1 Horizontally sliding doors

5.3.6.2.1.1 Automatic power operated doors

The following applies:

- a) The effort needed to prevent the door closing shall not exceed 150 N. This measurement shall not be made in the first third of the travel of the door;
- b) The kinetic energy of the landing and/or car door and the mechanical elements which are rigidly connected to it, calculated or measured ⁵⁾ at the average closing speed shall not exceed 10 J.

The average closing speed of a sliding door is calculated over its whole travel, less:

- 1) 25 mm at each end of the travel in the case of centrally closing doors;
- 2) 50 mm at each end of the travel in the case of side closing doors;
- c) A protective device against impact from the doors shall automatically initiate re-opening of the door(s) in the event of a person being struck, or about to be struck, by the door in crossing the entrance during the closing movement;

NOTE Re-opening does not imply that the door shall open fully, but some reopening shall occur.

- d) If the kinetic energy of the landing door and/or car door and the mechanical elements which are rigidly connected to it exceeds 4J at any point of its movement, a protective device shall automatically initiate re-opening of the door in the event of a person crossing the entrance during the closing movement:
 - 1) The protection device shall cover the opening over the distance between at least 25 mm and 1600 mm above the car door sill (e.g. light curtain);
 - 2) The protection device shall be capable of detecting obstacles minimum of 50 mm height;
 - 3) The protective device may be rendered inoperative in the last 20 mm of door closing;
 - 4) In case of failure, or deactivation of the protective device, the kinetic energy of the door(s) shall be lowered to a maximum of 4 J to keep lift in operation;

NOTE Protective device of the car door and the landing doors could be common.

- 5) To counteract persistent obstructions when closing the door, the protective device may be rendered inoperative after a predetermined time. In this case, the kinetic energy defined in **5.3.6.2.1.1 b)** shall not exceed 4 J during movement of the door with the protective device inoperative;
- 6) An acoustic signal shall operate any time the door(s) is (are)closing and the protective device is inoperative;
- e) The effort needed to prevent a folding door from opening shall not exceed 150 N. This measurement shall be made with the door collapsed such that the adjacent outer edges of the folded panels or equivalent, e.g. door frame, are at a distance of 100 mm;

5) Measured using, for example, a device consisting of a graduated piston acting on a spring with a spring constant of 25 N/mm, and fitted with an easy sliding ring allowing the extreme point of movement at the moment of impact to be measured. An easy calculation allows the graduation corresponding to the limits fixed to be determined.

- f) If a folding car door is going into a recess the distance between any outer edge of the door fold and the recess shall be at least 15 mm;
- g) If labyrinths or chicanes are used (for e.g. limitation of fire transmission) on the front edges of leading door panels, or on the combination of leading door edge and fixed jamb, recesses and protrusions shall not exceed 25 mm.

In the case of glass doors, the thickness of the front edge of the leading panel(s) shall not be less than 20 mm.

5.3.6.2.1.2 Non-automatic power operated doors

When the closing of the door is carried out under the continuous control and supervision of the user, by continuous pressure on a button or similar (hold-to-run control), the average closing speed of the fastest panel shall be limited to 0,3 m/s, when the kinetic energy, calculated or measured as stated in **5.3.6.2.1.1 b)**, exceeds 10 J.

5.3.6.2.2 Vertically sliding doors

This type of sliding door shall only be used for goods passenger lifts.

Power closing shall only be used if the following five conditions are fulfilled at the same time:

- a) The closing is carried out under the continuous control and supervision of the users, e.g. hold-to-run operation;
- b) The average closing speed of the panels is limited to 0,30 m/s;
- c) The car door is of construction as provided for in **5.3.1.2**;
- d) The car door is at least two-thirds closed before the landing door begins to close;
- e) The door mechanism shall be protected against unintentional access.

5.3.6.2.3 Other types of doors

When using other types of doors, e.g. swing doors, with power operation, where there is a risk when opening or closing, of striking persons, precautions similar to those laid down for power operated sliding doors shall be taken.

5.3.6.3 Reversal of closing movement

If car doors are automatic power operated a device permitting the closing movement to be reversed shall be located with the other car controls.

5.3.7 Local landing lighting and "car here" signal lights

5.3.7.1 Local landing lighting

The natural or artificial lighting of the landings in the vicinity of landing doors shall be at least 50 lux at floor level, such that a user can see ahead when he is opening the landing door to enter the lift, even if the car light has failed (see **0.3.1**).

5.3.7.2 "Car here" indication

5.3.7.2.1 In the case of landing doors with manual opening, the user needs to know whether the car is there or not.

To this effect, there shall be installed, either:

- a) One or more transparent vision panels conforming to the following four conditions at the same time:
- 1) Mechanical strength as specified in **5.3.5.2**: breaking or damaging the glass during the door pendulum shock test per **5.3.5.2.2 a)** is not considered as test failure. The glass panel shall not detach from the door;
 - 2) Laminated glass of minimum thickness of 3/0,76/3 mm;
 - 3) Minimum glazed area per landing door of 0,015m² with a minimum of 0,01 m² per vision panel;
 - 4) Width of at least 60 mm, and at most 150 mm. The lower edge of vision panels which are wider than 80 mm shall be at least 1 m above floor level, or
- b) An illuminated “car here” signal which shall light up when the car is about to stop or has stopped at the particular landing. This signal may be switched off when the car is parked and the doors are closed.

5.3.7.2.2 The car door shall be fitted with a vision panel(s) if the landing door has a vision panel(s) (**5.3.7.2.1 a)**) unless the car door is automatic and remains in the open position when the car is stationary at the level of a landing.

When a vision panel(s) is fitted it shall satisfy the requirements of **5.3.7.2.1 a)** and be positioned in the car door such that it is in visual alignment with the landing door vision panel(s) when the car is at the level of the landing.

5.3.8 Locking and closed landing door check

5.3.8.1 Protection against the risk of falling

It shall not be possible in normal operation to open a landing door (or any of the panels in the case of a multi-panel door) unless the car has stopped, or is on the point of stopping, in the unlocking zone of that door.

The unlocking zone shall not extend more than 0,20 m above and below the landing level.

In the case, however, of mechanically operated car and landing doors operating simultaneously, the unlocking zone may extend to a maximum of 0,35 m above and below the landing level.

5.3.8.2 Protection against shearing

5.3.8.2.1 With the exception of **5.3.11.2**, it shall not be possible in normal operation to start the lift nor keep it in motion if a landing door, or any of the panels in the case of a multi-panel door is open. However, preliminary operations for the movement of the car as defined in **5.11.2.4** may take place.

5.3.8.2.2 Operation with doors open is permitted in the unlocking zone to permit levelling or releveilling at the corresponding floor level, provided the requirements of **5.12.1.4** are met.

5.3.9 Locking and emergency unlocking of landing and car doors

Each landing door shall be provided with a locking device satisfying the conditions of **5.3.8.1**. This device shall be protected against deliberate misuse.

5.3.9.1 Landing door locking devices

The effective locking of the landing door in the closed position shall precede the movement of the car. However, preliminary operations for the movement of the car may take place. The locking shall be proved by an electric safety device in conformity with **5.11.2**.

5.3.9.1.1 The car shall not be able to start until the locking elements are engaged by at least 7 mm; see figure 9.

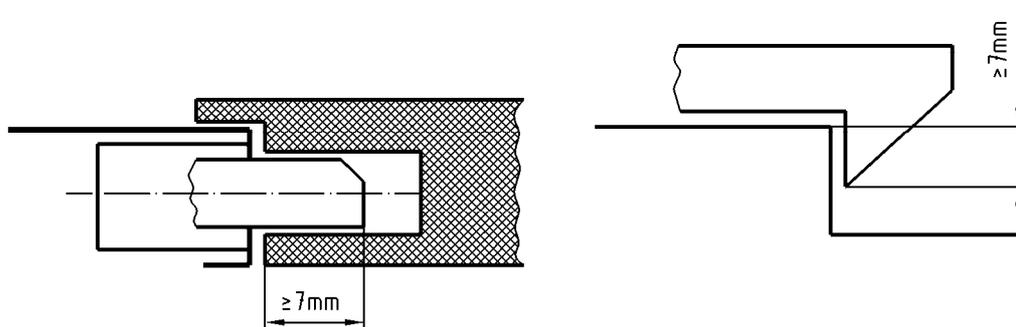


Figure 9 - Examples of locking elements

5.3.9.1.2 The element of the electric safety device proving the locked condition of the door panel(s) shall be positively operated without any intermediate mechanism by the locking element. It shall be foolproof but adjustable if necessary.

Specific case: In the case of locking devices used in installations requiring special protection against risks of humidity or explosion the connection may be only positive, provided the link between the mechanical lock and the element of the electric safety device proving the locked condition, can only be interrupted by destroying deliberately the locking device.

5.3.9.1.3 For hinged doors, locking shall be effected as near as possible to the vertical closing edge(s) of the doors, and maintained even in the case of panels sagging.

5.3.9.1.4 The locking elements and their fixings shall be resistant to shock, and be made or reinforced with metal.

5.3.9.1.5 The engagement of the locking elements shall be achieved in such a way that a force of 300 N in the opening direction of the door does not diminish the effectiveness of locking.

5.3.9.1.6 The lock shall resist, without permanent deformation during the test laid down in prEN 81-50, 5.2, a minimum force at the level of the lock and in the direction of opening of the door of:

- a) 1000 N in the case of sliding doors;
- b) 3000 N on the locking pin, in the case of hinged doors.

5.3.9.1.7 The locking action shall be effected and maintained by the action of gravity, permanent magnets, or springs. The springs shall act by compression, be guided and of such dimensions that, at the moment of unlocking, the coils are not compressed solid.

In the event of the permanent magnet (or spring) no longer fulfilling its function, gravity shall not cause unlocking.

If the locking element is maintained in position by the action of a permanent magnet, it shall not be possible to neutralize its effect by simple means (e.g. heat or shock).

5.3.9.1.8 The locking device shall be protected against the risk of an accumulation of dust, which could hinder its proper functioning.

5.3.9.1.9 Inspection of the working parts shall be easy, as, for example, by use of a vision panel.

5.3.9.1.10 In the case where the lock contacts are in a box, the fixing screws for the cover shall be of the captive type, so that they remain in the holes in the cover or box when opening the cover.

5.3.9.1.11 The locking device is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.2.

5.3.9.1.12 On locking devices a data plate shall be fixed indicating:

- a) The name of the manufacturer of the locking device;
- b) The type examination certificate number;
- c) The type of locking device.

5.3.9.2 Car door locking devices

If the car door needs to be locked (see **5.2.5.3.2 c)**), the locking device shall be designed to meet the requirements given in **5.3.9.1**.

This device shall be protected against deliberate misuse.

The locking device is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.2.

5.3.9.3 Emergency unlocking

5.3.9.3.1 Each of the landing doors shall be capable of being unlocked from the outside with the aid of a key, which will fit the unlocking triangle as defined in following **Figure 10**.

Dimensions in millimetres

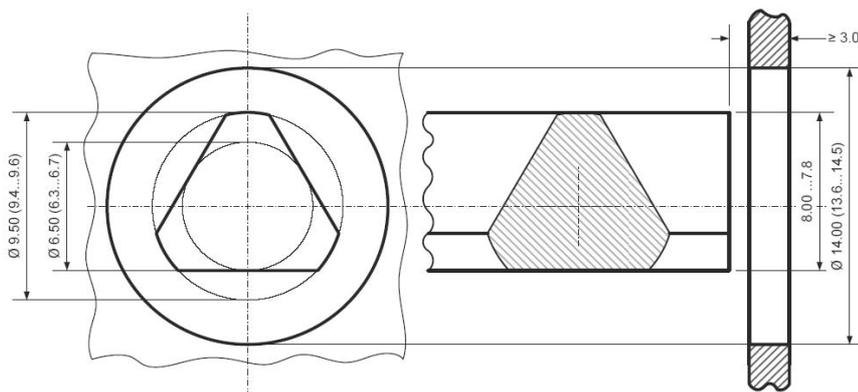


Figure 10 - Unlocking triangle

5.3.9.3.2 The position of unlocking triangle can be on the door panel or frame. When in a vertical plane, on the door panel or frame, the position of the unlocking triangle shall not exceed 2,00 m in height above the landing.

If the unlocking triangle is on the frame and the key hole downwards in the horizontal plane the maximum height of the unlocking triangle hole shall be 2,70 m. The length of the unlocking triangle key shall be at least

equal to the height of the door minus 2,20 m. Emergency unlocking shall be possible without making use of climbing means such as stool, chair or ladder.

5.3.9.3.3 After an emergency unlocking, the locking device shall not be able to remain in the unlocked position with the landing door closed.

5.3.9.3.4 In the case of landing doors driven by the car door, if the landing door becomes open for whatever reason when the car is outside the unlocking zone, a device (either weight or springs) shall ensure automatic closing and locking of the landing door.

5.3.9.3.5 If there is no access door to the pit, other than the landing door, and if the door lock is not reachable safely within a maximum horizontal distance of 1,0 m from the permanent access means according to **5.2.2.3**, a permanent installed device shall allow a person in the pit to unlock the door.

5.3.9.4 Electrical device for proving the landing door closed

5.3.9.4.1 Each landing door shall be provided with an electric safety device in conformity with **5.11.2** for proving the closed position, so that the conditions imposed by **5.3.11.2** are satisfied.

5.3.9.4.2 In the case of horizontally sliding landing doors, coupled with car doors, this device may be in common with the device for proving the locked condition, provided that it is dependent upon the effective closing of the landing door.

5.3.9.4.3 In the case of hinged landing doors, this device shall be placed adjacent to the closing edge of the door or on the mechanical device proving the closed condition of the door and a second switch according to **5.11.2** shall prevent normal operation of the car if any door is open. This switch shall not be accessible without using a tool.

5.3.10 Requirements common to devices for proving the locked condition and the closed condition of the landing door

5.3.10.1 It shall not be possible, from positions normally accessible to persons, to operate the lift with a landing door open or unlocked, after one single action not forming part of the normal operating sequence.

5.3.10.2 The means used to prove the position of a locking element shall have positive operation.

5.3.11 Sliding landing doors with multiple, mechanically linked panels

5.3.11.1 If a sliding landing door comprises several directly mechanically linked panels, it is permitted:

- a) To place the device required in **5.3.9.4.1**, or **5.3.9.4.2** on a single panel, and
- b) To lock only one panel, provided that this single locking prevents the opening of the other panel(s) by hooking the panels in the closed position in case of telescopic doors.

A back fold of the sheet of each panel of a telescopic door and hooking the fast panel to the slow panel when the door is in the closed position, or hooks on the hanger plate realizing the same linkage are considered as a direct mechanical linkage, and therefore does not require device as required in **5.3.9.4.1** or **5.3.9.4.2** on all panels. The linkage shall be ensured even in case of rupture of guiding means. Compliance with the strength requirements of **5.3.11.3** shall be verified with the minimum possible overlapping of the hooking elements of the panels.

Note The hanger plate is not considered as part of the guiding means.

5.3.11.2 If a sliding door comprises several indirectly mechanically linked panels (e.g. by rope, belt or chain), it is permitted to lock only one panel, provided that this single locking prevents the opening of the other panel(s), and that these are not fitted with a handle.

The closed position of the other panel(s), not locked by the locking device, shall be proved by an electric safety device in conformity with **5.11.2**.

5.3.11.3 The devices providing direct mechanical linkage between panels according to **5.3.11.1** or indirect mechanical linkage according to **5.3.11.2** are considered as forming part of the locking device.

They shall be capable of resisting the force of 1000 N as per **5.3.9.1.6 a)** even if the force of 300 N mentioned in **5.3.5.2.1** is acting simultaneously.

5.3.12 Closing of automatically operated landing doors

In the case of lift landing doors participating to the fire protection of the building, they shall be closed and locked in normal operation, after the necessary period of time, which may be defined according to the traffic using the lift, in the absence of a command for the movement of the car.

Note For the requirements for fire fighting lifts and the behaviour of lifts in the event of a fire, further guidance can be found in EN 81-72 and EN 81-73.

5.3.13 Electrical device for proving the car doors closed

5.3.13.1 With the exception of **5.3.8.2.2**, it shall not be possible in normal operation to start the lift nor keep it in motion if a car door (or any of the panels in the case of a multi-panel door) is open. However, preliminary operations for the movement of the car may take place.

5.3.13.2 Each car door shall be provided with an electric safety device for proving the closed position in conformity with **5.11.2** so that the conditions imposed by **5.3.13.1** are satisfied.

5.3.14 Sliding car doors with multiple, mechanically linked panels

5.3.14.1 If a sliding car door comprises several directly mechanically linked panels, it is permitted:

- a) To place the device required in **5.3.13.2**
 - 1) Either on a single panel (the leading panel in the case of telescopic doors), or
 - 2) On the door driving element if the mechanical connection between this element and the panel is direct, and
- b) In the case and conditions laid down in **5.2.5.3.2 c)**, to lock only one panel, provided that this single locking prevents the opening of the other panel(s) by hooking the panels in the closed position in case of telescopic doors.

A back fold of the sheet of each panel of a telescopic door and hooking the fast panel to the slow panel when the door is in the closed position, or hooks on the hanger plate realizing the same linkage are considered as a direct mechanical linkage, and therefore does not require device as required in **5.3.16.2** on all panels. The linkage shall be ensured even in case of rupture of guiding means. Compliance with the strength requirements of **5.3.11.3** shall be verified with the minimum possible overlapping of the hooking elements of the panels.

Note The hanger plate is not considered as part of the guiding means.

5.3.14.2 If a sliding door comprises several indirectly mechanically linked panels (e.g. by rope, belt or chain), it is permitted to place the device (**5.3.13.2**) on a single panel, provided that:

- a) This is not the driven panel, and
- b) The driven panel is directly mechanically linked to the door driving element.

5.3.15 Opening the car door

5.3.15.1 The opening of the car door with the lift in motion shall require a force greater than 50 N.

5.3.15.2 If the lift stops for any reason in the unlocking zone (**5.3.8.1**), it shall be possible with a force not greater than 300 N, to open the car and landing door by hand from:

- a) The landing after the landing door has been unlocked;
- b) Within the car.

5.3.15.3 It shall be possible, at least where the car is stopped within the distance defined in **5.6.7.5**, once the corresponding landing door has been opened, to open the car door from the landing without tools.

5.3.15.4 When the car is stopped outside of the zone defined in **5.6.7.5**, it shall not be possible to open the car door by more than 100 mm from inside the car.

5.3.15.5 In the case of lifts covered by **5.2.5.3.2 c)**, the opening of the car door from inside the car shall be possible only when the car is in the unlocking zone.

5.4 Car, counterweight and balancing weight

5.4.1 Height of car

The interior clear height of the car shall be at least 2 m.

5.4.2 Available car area, rated load, number of passengers

5.4.2.1 General case

To prevent overloading of the car by persons, the available area of the car shall be limited.

The car area shall be measured from wall to wall car body inner dimensions excluding finishes.

To this effect the relationship between rated load and maximum available area is given in **Table 5**.

5.4.2.1.1 Recesses and extensions, even of height less than 1 m, whether protected or not by separating doors, are only permitted if their area is taken into account in the calculation of maximum available car area.

Recesses or extensions which cannot accommodate a person need not be taken into account for the calculation of the maximum available car area (e.g. niches for tip-up seats).

Any available area in the entrance, when the doors are closed, greater than 100 mm deep, shall also be included into the floor area for the purpose of calculation.

Table 5 - Rated load and maximum available car area

Rated load, mass (kg)	Maximum available car area (m ²)	Rated load, mass (kg)	Maximum available car area (m ²)
100 ^a	0,37	900	2,20
180 ^b	0,58	975	2,35
225	0,70	1000	2,40
300	0,90	1050	2,50
375	1,10	1125	2,65
400	1,17	1200	2,80
450	1,30	1250	2,90
525	1,45	1275	2,95
600	1,60	1350	3,10
630	1,66	1425	3,25
675	1,75	1500	3,40
750	1,90	1600	3,56
800	2,00	2000	4,20
825	2,05	2500 ^c	5,00

^a Minimum for 1 person lift.
^b Minimum for 2 persons lift.
^c Beyond 2500 kg add 0,16 m² for each extra 100 kg.
For intermediate loads the area is determined by linear interpolation.

5.4.2.1.2 Overloading of the car shall be monitored by means of a device according to 5.12.1.2.

5.4.2.2 Goods passenger lifts

5.4.2.2.1 The requirements of 5.4.2.1, except 3rd sentence, shall be applied and, in addition, design calculations shall take into account not only the rated load but also the weight of handling devices, which may enter the car.

5.4.2.2.2 For goods passenger lifts, hydraulically driven, the available area of the car may be greater than the value determined from Table 5, but shall not exceed the value determined from Table 6 for the corresponding rated load.

Table 6 - Rated load and maximum available car area (for hydraulic goods passenger lifts)

Rated load, mass (kg)	Maximum available car area (m ²)	Rated load, mass (kg)	Maximum available car area (m ²)
400	1,68	975	3,52
450	1,84	1000	3,60
525	2,08	1050	3,72
600	2,32	1125	3,90
630	2,42	1200	4,08
675	2,56	1250	4,20
750	2,80	1275	4,26
800	2,96	1350	4,44
825	3,04	1425	4,62
900	3,28	1500	4,80
		1600 ^{a)}	5,04

a) Beyond 1600 kg, add 0,40 m² for each 100 kg extra.
For intermediate loads, the area is determined by linear interpolation.

Note Example of calculations:

A hydraulic goods passenger lift is required to carry a rated load of 6000 kg and has dimensions not less than 5,60 m deep by 3,40 m wide (i.e. 19,04 m² car area).

a) The maximum car area to transport a load of 6000 kg using **Table 6**:

- 1600 kg = 5,04 m².
- According to note at bottom of **Table 6**: 6000 kg - 1600 kg = 4400 kg / 100 = 44, then 44 x 0,4 m² = 17,6 m².
- Total maximum car area for rated load = 5,04 m² + 17,6 m² = 22,64 m².

Therefore the chosen car size of 19,04 m² is acceptable to transport 6000 kg since it is less than the maximum allowed.

b) Calculation according to **5.4.2.1**, **Table 5**, equivalent load to area full with passengers is:

- 5 m² = 2500 kg
- According to note 3 at bottom of **Table 5**, 19,04 m² - 5 m² = 14,0 m² / 0,16 m² = 88, then 88 x 100 kg = 8800 kg.
- Total maximum load for area = 2500 kg + 8800 kg = 11300 kg;

c) According to **5.4.2.2.4**, the calculation of lift components as listed, e.g. car sling and safety gear, etc., shall be carried out for a load of 11300 kg;

d) According to **5.4.2.2.1**, where a handling device, which enters the car for loading and unloading, is used the weight of this device shall be incorporated in the maximum load to be transported in a).

— The calculations should take into account the position of loads and loading devices in the car (**5.7.2.3.4**).

— Load to be transported is the negotiated rated load (**0.3.1**) and not the load calculated in step b).

5.4.2.2.3 Nevertheless the available car area of a lift with balancing weight shall be such that a load in the car resulting from **Table 5 (5.4.2.1)** shall not cause a pressure exceeding from 1,4 times the pressure the jack and the piping are designed for.

5.4.2.2.4 The design of the car, the car sling, the connection between the car and the ram (cylinder), the suspension means (of indirect acting lifts), the car safety gear, the rupture valve, the restrictor/one-way restrictor, the pawl device, the guide rails and the buffers shall be based on a load resulting from **Table 5 (5.4.2.1)**.

5.4.2.3 Number of passengers

5.4.2.3.1 The number of passengers shall be obtained from:

- a) Either, the formula, $\frac{\text{rated load}}{75}$, and the result rounded down to the nearest whole number; or
- b) **Table 7** which gives the smaller value.

Table 7 - Number of passengers and minimum car available area

Number of passengers	Minimum available car area (m²)	Number of passengers	Minimum available car area (m²)
1	0,28	11	1,87
2	0,49	12	2,01
3	0,60	13	2,15
4	0,79	14	2,29
5	0,98	15	2,43
6	1,17	16	2,57
7	1,31	17	2,71
8	1,45	18	2,85
9	1,59	19	2,99
10	1,73	20	3,13

Beyond 20 passengers add 0,115 m² for each extra passenger.

5.4.2.3.2 In the car the following shall be displayed:

- a) The rated load of the lift in kilograms as well as the number of persons.
- b) The number of persons shall be determined by reference to **5.4.2.3.1**.

The notice shall be made as follows:

“... kg... PERS.”

The minimum height of the characters used for the notice shall be:

- 1) 10 mm for capital letters and numbers;
 - 2) 7 mm for small letters.
- c) The installer's name and the installation serial number and year of construction;

- d) Instructions to ensure safe usage of the lift shall be placed in the car whenever the need for these is apparent.

5.4.2.3.3 For goods passenger lifts a sign, which is visible from the landing loading area at all times, shall display the rated load.

5.4.3 Walls, floor and roof of the car

5.4.3.1 The car shall be completely enclosed by walls, floor and roof, the only permissible openings being as follows:

- a) Entrances for the normal access of users;
- b) Emergency trap doors and doors;
- c) Ventilation apertures.

5.4.3.2 The assembly comprising the sling, guide shoes, walls, floor, ceiling and roof of the car shall have mechanical strength to resist the forces which will be applied in normal lift operation and the operation of safety devices in accordance with **0.3.3** and **0.3.5**.

5.4.3.2.1 When safety devices are operated, the floor of the car without or with the load uniformly distributed shall not incline more than 5 % from its normal position.

5.4.3.2.2 Each wall of the car shall have a mechanical strength such that:

- a) When a force of 300 N, being evenly distributed over an area of 5 cm² in round or square section, is applied at right angles to the wall at any point from the inside of the car towards the outside, it shall resist without:
 - Any permanent deformation (e.g. less than 1 mm);
 - Elastic deformation greater than 15 mm.
- b) When a force of 1000 N, being evenly distributed over an area of 100 cm² in round or square section, is applied at right angles to the wall at any point from the inside of the car towards the outside it shall resist without visual permanent deformation (e.g. less than 1 mm).

NOTE These forces could be applied on the “structural” wall, excluding mirrors, decorative panels, car operating panel(s), etc.

5.4.3.2.3 Car walls made of glass or partly glass shall be laminated.

The hard pendulum shock shall be carried out for glass car wall and its structural elements with the device according to prEN 81-50, 5.14.2.1, and a falling height of 500 mm (see **prEN81-50, Figure 19**).

The soft pendulum shock shall be carried out for glass car wall and its structural elements with the device according to prEN 81-50, 5.14.2.2 and a falling height of 700 mm (see **prEN 81-50, 19**).

The above tests shall be carried out from the inside of the car.

These tests are not needed if car wall elements made of flat glass, according to **Table 8**, are framed on all sides.

After the pendulum tests, the glass elements shall satisfied the following:

- a) They shall resist without permanent deformation (e.g. less than 1 mm);

- b) There shall be no cracks with a length of more than 40 mm on the wall element;
- c) There shall be no damage on the surface of the glass except chips of 2 mm maximum in diameter.

Car walls with glass placed lower than 1,10 m from the floor shall have a handrail at a height between 0,90 m and 1,10 m. This handrail shall be fastened independently from the glass.

Table 8 - Flat glass panels to be used in walls of the car

Type of glass	Diameter of inscribed circle	
	1 m maximum	2 m maximum
	Minimum thickness (mm)	Minimum thickness (mm)
Laminated toughened or laminated tempered	8 (4 + 4 + 0,76)	10 (5 + 5 + 0,76)
Laminated	10 (5 + 5 + 0,76)	12 (6 + 6 + 0,76)

5.4.3.2.4 The fixing of the glass in the wall shall ensure that the glass cannot slip out of the fixings, even when sinking.

5.4.3.2.5 The glass panels shall have markings giving the following information:

- a) Name of the supplier and trademark;
- b) Type of glass;
- c) Thickness (e.g. 8/8/0,76 mm).

5.4.3.2.6 The car roof shall satisfy the requirements of 5.4.7.

5.4.4 Car floor, wall and ceiling materials

The car floor, wall and ceiling material shall have the minimum fire classification according to EN 13501-1 as listed:

- Flooring: D_{fl} s2;
- Wall: D s2 d1;
- Ceiling: D s2, d1.

Fixtures such as operating devices and indicators are excluded from the above requirements.

5.4.5 Apron

5.4.5.1 Each car sill shall be fitted with an apron, which extends to the full width of the clear landing entrance, which it faces. This vertical section shall be extended downwards by a chamfer whose angle with the horizontal plane shall be greater than 60°. The projection of this chamfer of the horizontal plane shall be not less than 20 mm.

5.4.5.2 The height of the vertical portion shall be at least 0,75 m.

5.4.5.3 When a force of 300 N, being evenly distributed over an area of 5 cm² in round or square section, is applied at right angles to the panel at any point at the lower edge of the vertical section from the landing to the car, the apron shall resist without:

- a) Permanent deformation;
- b) Elastic deformation greater than 35 mm.

5.4.6 Emergency trap doors and emergency doors

5.4.6.1 Assistance to passengers in the car shall always come from outside, being provided in particular by the emergency operation mentioned in **5.9.2.3** or **5.9.3.9**.

5.4.6.2 If there is an emergency trap door in the car roof to permit the rescue and evacuation of passengers, it shall measure at least 0,40 m × 0,50 m.

5.4.6.3 Emergency doors may be used in the case of adjacent cars, provided, however, that the horizontal distance between cars does not exceed 1 m (see **5.2.3.3**).

Each car shall be provided with a means of determining the position of the adjacent car to which persons will be rescued in order to allow it to be brought to a level where rescue can take place.

In the event of rescue a portable/movable bridge with handrails and a minimum width of 0,5 m shall be provided.

The bridge shall be designed to support a minimum force of 2500 N.

This bridge shall be stored in the building where the rescue is to take place. The use of the bridge shall be described in the instruction manual.

If emergency doors exist, they shall measure at least 1,80 m high and 0,50 m wide.

5.4.6.4 If emergency trap doors or doors are installed, they shall conform to **5.4.3.2** and **5.4.4**, also to the following:

5.4.6.4.1 Emergency trap doors and doors shall be provided with a means for manual locking.

5.4.6.4.1.1 Emergency trap doors shall be opened from outside the car without a key and from inside the car with a key suited to the triangle defined in **5.3.9.3**.

Emergency trap doors shall not open towards the inside of the car.

Emergency trap doors in the open position shall not project beyond the edge of the lift car.

5.4.6.4.1.2 Emergency doors shall be opened from outside the car without a key and from inside the car using a key suited to the triangle defined in **5.3.9.3**.

Emergency doors shall not open towards the outside of the car.

Emergency doors shall not be located in the path of a counterweight or a balancing weight or in front of a fixed obstacle (except for beams separating the cars) preventing passage from one car to another.

5.4.6.4.2 The locking called for in **5.4.6.4.1** shall be proved by means of an electric safety device in conformity with **5.11.2**.

This device shall cause the lift to stop if the locking ceases to be effective.

Restoring the lift to service shall only be possible after deliberate relocking.

5.4.7 Car roof

5.4.7.1 In addition to **5.4.3**, the car roof shall fulfil the following requirements:

- a) The car roof shall have sufficient strength to support the maximum number of persons as indicated in **5.2.5.7.1**.

However, the car roof shall resist to a minimum force of 2.000 N at any position on an area of 0,30 m x 0,30 m without permanent deformation.

- b) The surface of the car roof where a person needs to work or to move between working areas shall be of non-slip material.

Note: For guidance see EN ISO 14122-2 clause 4.2.4.6.

5.4.7.2 A protection from falling from the car roof shall be provided.

5.4.7.2.1 The car roof shall be provided with one of the following:

- a) A toe board of 100 mm high on the perimeter of the car roof; or
- b) A balustrade (**5.4.7.3**) where the free distance in a horizontal plane, beyond and perpendicular to its outer edge of the car roof to the wall of the well exceeds 0,30 m. The free distances shall be measured to the wall of the well allowing a larger distance in recesses, the width or height of which is less than 0,30 m.

5.4.7.2.2 Where lift component(s) located between the car roof outer edge and the wall of the well can prevent the risk of falling, the protection against falling shall fulfil the following conditions simultaneously:

- a) It shall not be possible to place a horizontal circle 300 mm diameter between the outer edge of the car roof and the relevant component(s);
- b) The deflection of this component under a horizontal force of 300 N applied at right angles from the inside to outside of the car roof shall be taken into account;
- c) The protection shall be available in all positions of the car roof at least with the same height above the car roof as the height of the balustrade.

5.4.7.3 The balustrade shall fulfil the following requirements:

- a) The balustrade at the access side(s) shall provide safe and easy access to the car roof;
- b) It shall consist of a handrail, a toe board of 0,10 m height and an intermediate bar at half the height of the balustrade;
- c) Considering the free distance in a horizontal plane beyond the outer edge of the handrail of the balustrade (see **Figure 11**), its height shall be at least:
 - 1) 0,70 m where the free distance is up to 0,50 m;
 - 2) 1,10 m where the free distance exceeds 0,50 m.
- d) The balustrade shall be located within 0,15 m maximum of the edges of the car roof;
- e) The horizontal distance between the outer edge of the handrail and any part in the well (counterweight or balancing weight, switches, rails, brackets, etc.) shall be at least 0,10 m.

5.4.7.4 In the case of a balustrade on the car roof and independently of its height, a warning sign or a notice about the danger of leaning over or stepping beyond the balustrade shall be fixed to each section of it.

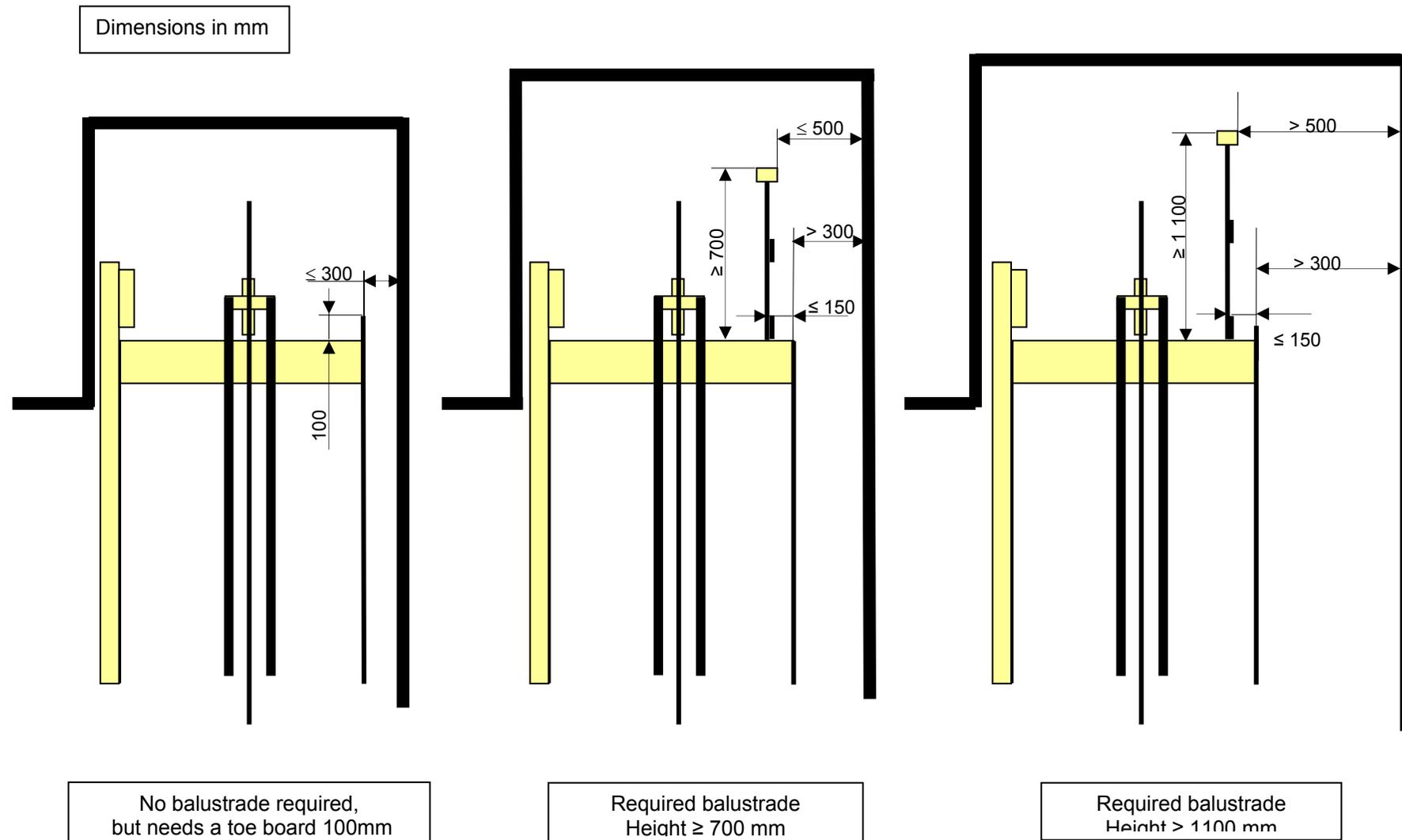


Figure 11 - Car roof balustrade - Height

5.4.7.5 Glass used for the car roof shall be laminated.

5.4.7.6 Pulleys and/or sprockets fixed to the car shall have protection according to **5.5.7**.

5.4.7.7 On the car roof shall be given the marking “**STOP**” on or near the stopping device(s).

5.4.8 Equipment on top of the car

The following shall be installed on top of the car:

- a) Control device in conformity with **5.12.1.5** (inspection operation) accessible within 0,30 m horizontally from an area for standing (**5.2.5.7.1**);
- b) Stopping device in conformity with **5.12.1.11**;
- c) Socket outlet in conformity with **5.10.7.2**.

5.4.9 Ventilation

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

5.4.9.2 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 ventilation holes, up to 50 % of the required effective area.

5.4.9.3 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.

5.4.10 Lighting

5.4.10.1 The car shall be provided with electrical lighting that is permanently installed ensuring a light intensity of at least 50 lux at floor level and on the control devices.

The lighting level of 50 lux on the floor shall be available at any point not less than 100 mm from any wall.

NOTE The configuration of the car may be so that handrail, tip-up seat, etc., may generate shadow that may be ignored.

5.4.10.2 There shall be at least two lamps connected in parallel.

5.4.10.3 The car shall be continuously illuminated except when the car is parked and the doors are closed.

5.4.10.4 There shall be an automatically rechargeable emergency supply, which is capable of ensuring at least a lighting intensity of 1 lux for 1 h at the alarm initiation device and in the centre of the car one meter above the floor. This lighting shall come on automatically upon failure of the normal lighting supply.

5.4.11 Counterweight and balancing weight

The use of a balancing weight is defined in **5.9.2.1.1**.

5.4.11.1 If the counterweight or the balancing weight incorporates filler weights, necessary measures shall be taken to prevent their displacement. To this effect the following shall be used:

- a) Either a frame in which the fillers are secured; or

- b) If the fillers are made of metal, and if the rated speed of the lifts does not exceed 1 m/s, a minimum of two tie-rods on which the fillers are secured.

5.4.11.2 Pulleys and/or sprockets fixed to the counterweight or to the balancing weight shall have protection according to **5.5.7**.

5.5 Suspension means, compensation means and related protection means

5.5.1 Suspension means

5.5.1.1 Cars, counterweights or balancing weights shall be suspended from steel wire ropes, or steel chains with parallel links (Galle type) or roller chains.

5.5.1.2 The ropes shall correspond to the following requirements:

- a) The nominal diameter of the ropes shall be at least 8 mm;
- b) The tensile strength of the wires and the other characteristics (construction, extension, ovality, flexibility, tests....) shall be as specified in EN 12385-5.

5.5.1.3 The minimum number of ropes or chains shall be two.

For hydraulic lifts this shall be a minimum of two per indirect acting jack and two for the connection between car and any balancing weight.

NOTE Where reeving is used the number to take into account is that of the ropes or chains and not the falls.

5.5.1.4 Ropes or chains shall be independent.

5.5.2 Sheave, pulley, drum and rope diameter ratios, rope/chain terminations

5.5.2.1 The ratio between the pitch diameter of sheaves, pulleys or drums and the nominal diameter of the suspension ropes shall be at least 40, regardless of the number of strands of the suspension ropes.

5.5.2.2 The safety factor of the suspension ropes shall not be less than:

- a) 12 in the case of traction drive with three ropes or more;
- b) 16 in the case of traction drive with two ropes;
- c) 12 in the case of drum drive and hydraulic lifts.

In addition the safety factor of suspension ropes for traction lifts shall not be less than that calculated according to prEN 81-50, 5.12.

The safety factor is the ratio between the minimum breaking load, in newtons, of one rope and the maximum force, in newtons, in this rope, when the car is stationary at the lowest landing, with its rated load.

The safety factor of suspension chains shall be at least 10.

For drum drive and hydraulic lifts the maximum force in a balancing weight rope or chain shall be calculated by analogy.

5.5.2.3 The junction between the rope and the rope termination, according to **5.5.2.3.1**, shall be able to resist at least 80 % of the minimum breaking load of the rope.

5.5.2.3.1 The ends of the ropes shall be fixed to the car, counterweight or balancing weight, or suspension points of the dead parts of reeved ropes by means of self tightening wedge type sockets, (e.g. according to EN 13411-6 or EN 13411-7), ferrule secured eyes (e.g. according to EN 13411-3), or swage terminals.

5.5.2.3.2 The fixing of the ropes on drums shall be carried out using a system of blocking with wedges, or using at least two clamps.

5.5.2.4 The ends of each chain shall be fixed to the car, counterweight or balancing weight, or suspension points of the dead parts of reeved chains. The junction between the chain and the chain termination shall be able to resist at least 80 % of the minimum breaking load of the chain.

5.5.3 Rope traction

Rope traction shall be such that the following three conditions are fulfilled:

- a) The car shall be maintained at floor level without slip when loaded to 125 % as per **5.4.2.1** or **5.4.2.2**;
- b) It shall be ensured that any emergency braking causes the car, whether empty or with rated load, to decelerate with a value not exceeding the setting of the buffer, including reduced stroke buffer;
- c) If either the car or the counterweight is stalled (e.g. on the buffers):
 - 1) The ropes shall slip on the traction sheave and not allow the car or the counterweight to be raised,
or
 - 2) The lift drive system shall not allow the empty car or the counterweight to be raised.

The machine torque limit may be adjusted to the value necessary to comply with the requirement. In this case, normal operation of the lift shall be prevented if the torque limit setting is modified to higher value.

NOTE Design considerations are given in prEN 81-50, 5.11.

5.5.4 Winding up of ropes for positive drive lifts

5.5.4.1 The drum, which can be used in the conditions laid down in **5.9.2.1.1 b)** shall be helically grooved and the grooves shall be suited to the ropes used.

5.5.4.2 When the car rests on its fully compressed buffers, one and a half turns of rope shall remain in the grooves of the drum.

5.5.4.3 There shall only be one layer of rope wound on the drum.

5.5.4.4 The angle of deflection (fleet angle) of the ropes in relation to the grooves shall not exceed 4°.

5.5.5 Distribution of load between the ropes or the chains

5.5.5.1 An automatic device shall be provided for equalizing the tension of suspension ropes or chains, at least at one of their ends.

5.5.5.1.1 For chains engaging with sprockets, the ends fixed to the car as well as the ends fixed to the balancing weight shall be provided with such equalization devices.

5.5.5.1.2 For chains in the case of multiple return sprockets on the same shaft, these sprockets shall be able to rotate independently.

5.5.5.2 If springs are used to equalize the tension they shall work in compression.

5.5.5.3 In the case of two rope or two chain suspension of the car an electric safety device in conformity with **5.11.2** shall cause the lift to stop in case of abnormal relative extension of one rope or chain.

For more than 2 ropes or chains an electric device shall cause the lift to stop at the latest at the next possible landing in case of abnormal relative extension of one rope or chain.

After stopping normal operation shall be prevented.

For hydraulic lifts with two or more jacks this requirement applies for each suspension set.

5.5.5.4 The devices for adjusting the length of ropes or chains shall be made in such a way that these devices cannot work themselves loose after adjustment.

5.5.6 Compensation means

5.5.6.1 For speeds not exceeding 3,00 m/s, means (e.g. chains, ropes) to compensate the weight of the suspension ropes can be used, as requested to ensure adequate traction, or hoisting motor power

Whenever compensating ropes are used the following shall apply:

- a) Compensating ropes shall be as specified in EN 12385-5;
- b) Tensioning pulleys shall be used;
- c) The ratio between the pitch diameter of the tensioning pulleys and the nominal diameter of the compensating ropes shall be at least 30;
- d) Tensioning pulleys shall have protection according to **5.5.7**;
- e) The tension shall be provided by gravity;
- f) The minimum tension shall be checked by an electric safety device in conformity with **5.11.2**.

5.5.6.2 For speeds exceeding 3,0 m/s, compensation ropes with tensioning device shall be provided.

5.5.6.3 For lifts whose rated speed exceeds 3,5 m/s there shall be, in addition to **5.5.6.2**, an anti-rebound device.

The operation of the anti-rebound device shall initiate the stopping of the lift machine by means of an electric safety device in conformity with **5.11.2**.

5.5.6.4 Compensation means, such as compensating ropes or chains or belts, and their terminations, shall be capable of withstanding, with a factor of safety of 5, any static forces to which the means is subjected.

The maximum suspended weight of compensation means with car or counterweight at the top of its travel and one-half total weight of tension sheave assembly, where used, shall be included.

5.5.6.5 For rated speeds exceeding 1,75 m/s, compensation means without tensioning shall be guided at the vicinity of the loop.

5.5.7 Protection for traction sheaves, pulleys and sprockets

5.5.7.1 For traction sheaves, pulleys and sprockets, overspeed governors, tension weight pulleys, provisions shall be made according to **Table 9** to avoid:

- a) Bodily injury;
- b) The ropes/chains leaving the pulleys/sprockets, if slack;

c) The introduction of objects between ropes/chains and pulleys/sprockets.

Table 9 - Protection for traction sheaves, pulleys and sprockets

Location of traction sheaves, pulleys and sprockets		Risk according to 5.5.7.1			
		a	b	c	
At the car	on the roof	x	x	x	
	under the floor		x	x	
On the counterweight / balancing weight			x	x	
In machine and pulley rooms		x ²⁾	x	x ¹⁾	
In the well	Headroom	above car	x	x	
		beside car		x	
	between pit and headroom			x	x ¹⁾
	pit		x	x	x
Jack	Extending upwards		x ²⁾	x	
	Extending downwards			x	x ¹⁾
	With mechanical synchronizing means		x	x	x
<p>^x Risk shall be taken into account.</p> <p>1) Required only if the ropes/chains are entering the traction sheave or the pulley/sprocket horizontally or at any angle above the horizontal up to a maximum of 90°.</p> <p>2) Protection shall be nip guards as a minimum.</p>					

5.5.7.2 The devices used shall be constructed so that the rotating parts are visible, and do not hinder examination and maintenance operation. If they are perforated the gaps shall comply with EN ISO 13857:2008, Table 4.

The dismantling shall be necessary only in the following cases:

- a) Replacement of a rope/chain;
- b) Replacement of a pulley/sprocket;
- c) Re-cutting of the grooves.

The devices for preventing the ropes from leaving the grooves of pulleys shall include one retainer near the points where the ropes enter and leave the pulleys and at least one intermediate retainer if more than 60° of the angle of wrap is arranged below the horizontal axis of the pulley and the total angle of wrap is more than 120° (see **Figure 12**).

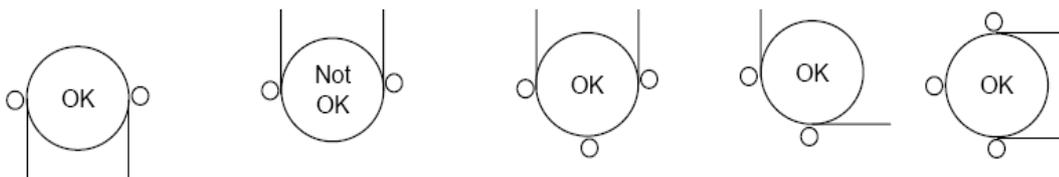


Figure 12 - Examples of arrangements of rope retainers

5.5.8 Traction sheaves, pulleys and sprockets in the well

Traction sheaves, pulleys and sprockets may be installed in the well above the pit under the following conditions:

- a) There shall be retaining devices to prevent traction sheaves, diverter pulleys/sprockets from falling in the event of a mechanical failure. These devices shall be able to support the weight of the traction sheaves, pulley/sprockets and the suspended loads;
- b) Examinations, tests and maintenance operations shall be carried out in complete safety from the car roof, from inside the car (5.2.6.4.3), from a platform (5.2.6.4.5) or from outside of the well;
- c) If traction sheaves, pulleys/sprockets are placed in the vertical projection of the car, then clearances in the headroom shall be according to 5.2.5.7.

5.6 Precautions against free fall, excessive speed, unintended car movement and creeping of the car

5.6.1 General provisions

5.6.1.1 Devices, or combinations of devices and their actuation shall be provided to prevent the car from:

- a) Free fall;
- b) Excessive speed, either downwards, or up and down in the case of traction lifts;
- c) Unintended movement, with open doors;
- d) In the case of hydraulic lifts, creeping from a landing level.

5.6.1.2 For traction and positive drive lifts the protection means according to **Table 10** shall be provided.

Table 10 - Protection means for traction and positive drive lifts

Hazardous situation	Protection means	Tripping means
Free fall and excessive speed in down direction of car	Safety gear (5.6.2.1)	Overspeed governor (5.6.2.2.1)
Free fall of counterweight or balancing weight in the case of 5.2.5.4 a)	Safety gear (5.6.2.1)	Overspeed governor (5.6.2.2.1) or for rated speeds not exceeding 1 m/s - tripping by breakage of suspension means(5.6.2.2.2), or - tripping by safety rope (5.6.2.2.3)
Excessive speed in up direction (traction lifts only)	Ascending car overspeed protection means (5.6.6)	Included in 5.6.6
Unintended car movement with open doors	Protection against unintended car movement (5.6.7)	Included in 5.6.7

5.6.1.3 For hydraulic lifts, devices, or combinations of devices and their actuation, shall be provided in accordance with **Table 11**. In addition protection against unintended movement according to **5.6.7** shall be provided.

Table 11 - Combinations of precautions against free fall of the car, descent with excessive speed and creeping

		Precautions against creeping			
Type of lifts	Alternative combinations to be selected	Additional tripping of safety gear (5.6.2.1) by downward movement of the car (5.6.2.2.4)	Pawl device (5.6.5)	Electrical anti-creep system (5.12.1.10)	
Precautions against free fall or descent with excessive speed	Direct acting lifts	Safety gear (5.6.2.1), tripped by overspeed governor (5.6.2.2.1)	X	X	X
		Rupture valve (5.6.3)		X	X
		Restrictor (5.6.4)		X	X
	Indirect acting lifts	Safety gear (5.6.2.1), tripped by overspeed governor (5.6.2.2.1)	X	X	X
		Rupture valve (5.6.3) plus safety gear (5.6.2.1) tripped by breakage of suspension means (5.6.2.2.2) or by safety rope (5.6.2.2.3)	X	X	X
		Restrictor (5.6.4) plus safety gear (5.6.2.1) tripped by breakage of suspension means (5.6.2.2.2) or by safety rope (5.6.2.2.3)	X	X	

5.6.2 Safety gear and its tripping means

5.6.2.1 Safety gear

5.6.2.1.1 General provisions

5.6.2.1.1.1 The safety gear shall be capable of operating in the downward direction and capable of stopping a car carrying the rated load, or a counterweight or balancing weight at the tripping speed of the overspeed governor, or if the suspension devices break, by gripping the guide rails, and of holding the car, counterweight or balancing weight there.

A safety gear operating in upward direction may be used in accordance with **5.6.6**.

5.6.2.1.1.2 The safety gear is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.3.

5.6.2.1.1.3 On safety gears a data plate shall be fixed indicating:

- a) The name of the manufacturer of the safety gear;
- b) The type examination certificate number;
- c) The type of safety gear;
- d) If adjustable the safety gear shall be marked with the information to be able to clearly identify it with its certificated limits of use.

5.6.2.1.2 Conditions of use for different types of safety gear

5.6.2.1.2.1 Car safety gear:

- a) Shall be of the progressive type, or
- b) May be of the instantaneous type if the rated speed of the lift does not exceed 0,63 m/s.

For hydraulic lifts instantaneous type safety gears other than of the captive roller type which are not tripped by an overspeed governor shall only be used if the tripping speed of the rupture valve or the maximum speed of the restrictor (or one-way restrictor) does not exceed 0,80 m/s.

5.6.2.1.2.2 If the car or counterweight or balancing weight carries several safety gears they shall all be of the progressive type.

5.6.2.1.2.3 The safety gear of the counterweight or balancing weight shall be of the progressive type if the rated speed exceeds 1 m/s, otherwise the safety gear may be of the instantaneous type.

5.6.2.1.3 Retardation

For progressive safety gear the average retardation in the case of free fall of the car with rated load or the counterweight or the balancing weight shall lie between $0,2 g_n$ and $1 g_n$.

5.6.2.1.4 Release

5.6.2.1.4.1 The release and automatic reset of a safety gear on the car, counterweight or balancing weight shall only be possible by raising the car, counterweight or balancing weight.

5.6.2.1.4.2 The release of the safety gear shall be possible at all load conditions up to rated load:

- a) By means defined for emergency operations (**5.9.2.3** or **5.9.3.9**); or
- b) In application of procedures available on site (**7.1.1**).

5.6.2.1.4.3 After the release of the safety gear it shall require the intervention of a competent person to return the lift to service.

Note The activation of the main switch is not sufficient by itself to allow the lift to be returned to service.

5.6.2.1.5 Electrical checking

When the car safety gear is engaged, an electric safety device in conformity with **5.11.2**, mounted on the car shall initiate the stopping of the machine before or at the moment of safety gear operation.

5.6.2.1.6 Constructional conditions

5.6.2.1.6.1 Jaws or blocks of safety gears shall not be used as guide shoes.

5.6.2.1.6.2 If the safety gear is adjustable, the final setting shall be sealed.

5.6.2.1.6.3 Accidental tripping of the safety gear shall be prevented as far as possible, e.g. by sufficient clearance to guide rails to allow horizontal movements of guide shoes.

5.6.2.1.6.4 Safety gears shall not be tripped by devices, which operate electrically, hydraulically or pneumatically.

5.6.2.1.6.5 When a safety gear is tripped either by the breakage of the suspension means or by a safety rope, it shall be assumed that the safety gear is tripped at a speed corresponding to the tripping speed of an appropriate overspeed governor.

5.6.2.2 Means of tripping the safety gear

5.6.2.2.1 Tripping by overspeed governor

5.6.2.2.1.1 General provisions

The following shall be satisfied:

- a) Tripping of the overspeed governor for the safety gear shall occur at a speed at least equal to 115 % of the rated speed and less than:
 - 1) 0,8 m/s for instantaneous safety gears except for the captive roller type; or
 - 2) 1 m/s for safety gears of the captive roller type; or
 - 3) 1,5 m/s for progressive safety gear used for rated speeds not exceeding 1,0 m/s; or
 - 4) $1,25 \cdot v + \frac{0,25}{v}$ in metres per second for progressive safety gear for rated speeds exceeding 1,0 m/s.

NOTE For lifts where the rated speed exceeds 1 m/s, it is recommended to choose a tripping speed as close as possible to the value required in 4).

- b) For lifts with very heavy rated loads and low rated speeds, the overspeed governor shall be specially designed for this purpose.

NOTE It is recommended to choose a tripping speed as close as possible to the lower limit indicated in a).

Overspeed governors using only traction to produce the tripping force (5.6.2.2.1.5) shall have grooves which:

- Have been submitted to an additional hardening process; or
 - Have an undercut in accordance with prEN 81-50, 5.11.2.2.1.
- c) The direction of rotation, corresponding to the operation of the safety gear, shall be marked on the overspeed governor.

5.6.2.2.1.2 Overspeed governor ropes

The rope of an overspeed governor shall satisfy the following conditions:

- a) The overspeed governor shall be driven by a wire rope as specified in EN 12385-5.
- b) The minimum breaking load of the rope shall be related by a safety factor of at least 8 to the tensile force produced in the rope of the overspeed governor when tripped taking into account a friction factor μ_{max} equal to 0,2 for traction type overspeed governor.
- c) The nominal rope diameter shall be at least 6 mm.
- d) The ratio between the pitch diameter of the pulleys for the overspeed governor rope and the nominal rope diameter shall be at least 30.
- e) The overspeed governor rope shall be tensioned by a pulley with a tensioning weight. This pulley or its tensioning weight shall be guided.

The overspeed governor may be a part of the tensioning device provided that its tripping values are not altered by the movement of the tensioning device.

- f) During the engagement of the safety gear, the overspeed governor rope and its terminations shall remain intact, even in the case of a braking distance greater than normal.
- g) The overspeed governor rope shall be easily detachable from the safety gear.

5.6.2.2.1.3 Response time

The response time of the overspeed governor before tripping shall be sufficiently short not to permit a dangerous speed to be reached before the moment of safety gear operation (see prEN 81-50, 5.3.2.3.1).

5.6.2.2.1.4 Accessibility

The overspeed governor shall meet the following conditions:

- a) The overspeed governor shall be accessible and reachable for inspection and maintenance;
- b) If located in the well the overspeed governor shall be accessible and reachable from outside the well;
- c) The above requirement does not apply if the following three conditions are fulfilled:
 - 1) The tripping of the overspeed governor according to 5.6.2.2.1.5 is effected by means of a remote control, except cableless, from outside the well whereby an involuntary tripping is not effected and the actuation device is not accessible to unauthorised persons; and
 - 2) The overspeed governor is accessible for inspection and maintenance from the roof of the car or from the pit; and

- 3) The overspeed governor returns after tripping automatically into the normal position, as the car, counterweight or balancing weight is moved in the upward direction.

However the electrical parts may return into the normal position by remote control from the outside of the well which shall not influence the normal function of the overspeed governor.

5.6.2.2.1.5 Possibility of tripping the overspeed governor

During checks or tests it shall be possible to operate the safety gear at a lower speed than that indicated in **5.6.2.2.1.1 a)** by tripping the overspeed governor in a safe way.

If the overspeed governor is adjustable, the final setting shall be sealed.

5.6.2.2.1.6 Electrical checking

The following shall be met:

- a) The overspeed governor or another device shall, by means of an electric safety device in conformity with **5.11.2**, initiate the stopping of the lift machine before the car speed, either up or down, reaches the tripping speed of the governor.

However, for rated speeds not exceeding 1 m/s, this device may operate at latest at the moment when the tripping speed of the governor is reached.

- b) If after release of the safety gear (**5.6.2.1.4**) the overspeed governor does not automatically reset itself, an electric safety device in conformity with **5.11.2** shall prevent the starting of the lift while the overspeed governor is not in the reset position. This device shall, however, be made inoperative in the case provided for in **5.12.1.6.1 d) 2)**.
- c) The breakage or excessive rope stretch of the governor rope shall cause the motor to stop by means of an electric safety device in conformity with **5.11.2**.
- d) The overspeed governor is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.4.
- e) On the overspeed governor a data plate shall be fixed indicating:
 - 1) The name of the manufacturer of the overspeed governor;
 - 2) The type examination certificate number;
 - 3) The type of the overspeed governor;
 - 4) The actual tripping speed for which it has been adjusted.

5.6.2.2.2 Tripping by breakage of suspension means

When the safety gear is tripped by the breakage of the suspension means the following applies:

- a) The tensile force exerted by the safety rope shall be at least the greater of the following two values:
 - 1) Twice that necessary to engage the safety gear, or
 - 2) 300 N.
- b) When springs are used for the tripping of the safety gear they shall be of the guided compression type;

- c) It shall be possible for a test of the safety gear and its actuating mechanism to be made from outside the well without endangering persons;

To this end a means shall be provided so that it is possible while the car is descending (under normal operation) to activate the safety gear, by a loss of tension in the suspension rope.

Where the means provided is mechanical the force required to operate it shall not exceed 400 N.

After these tests it shall be checked that no distortion or deterioration which could impair the use of the lift has occurred'.

Note It is acceptable for the means to be stored within the well and moved outside when a test is performed.

5.6.2.2.3 Tripping by safety rope

When the safety gear is tripped by a safety rope the following applies:

- a) The tensile force exerted by the safety rope shall be at least the greater of the following two values:
- 1) Twice that necessary to engage the safety gear, or
 - 2) 300 N.
- b) The safety rope shall be in conformity with **5.6.2.2.1.2**;
- c) The rope shall be tensioned by gravity or by at least one guided compression spring;
- d) During the engagement of the safety gear, the safety rope and its terminations shall remain intact, even in the case of a braking distance greater than normal;
- e) The breakage or slackening of the safety rope shall cause the machine to stop by means of an electric safety device (**5.11.2**);
- f) Pulleys used for carrying the safety rope shall be mounted independently of any shaft or pulley assembly that carries the suspension ropes or chains;
- g) Protection devices shall be provided in accordance with **5.5.7.1**;

5.6.2.2.4 Tripping by downward movement of the car

5.6.2.2.4.1 Tripping by rope

Tripping by rope of the safety gear shall be actuated under the following conditions:

- a) After a normal stop, a rope which satisfies **5.6.2.2.1.2** attached to the safety gear shall be blocked with a force defined in **5.6.2.2.3 a)** (for example, the overspeed governor rope);
- b) The rope blocking mechanism shall be released during normal movement of the car;
- c) The rope blocking mechanism shall be actuated by guided compression spring(s) and/or by gravity;
- d) Rescue operation shall be possible in all circumstances;
- e) An electric device associated with the rope blocking mechanism shall cause stopping of the machine at latest at the moment of blocking of the rope, and shall prevent any further normal downward movement of the car;
- f) Precautions shall be taken to avoid involuntary tripping of the safety gear by the rope in case of the disconnection of the electric power supply during a downward movement of the car;

- g) The design of the system of rope and rope blocking mechanism shall be such that no damage is possible during the engagement of the safety gear;
- h) The design of the system of rope and rope blocking mechanism shall be such that no damage is possible by an upward movement of the car.

5.6.2.2.4.2 Tripping by lever

Tripping by lever of the safety gear shall be actuated under the following conditions:

- a) After the normal stopping of the car, a lever attached to the safety gear shall be extended into a position to engage with fixed stops, which are located at each landing;
- b) The lever shall be retracted during the normal movement of the car;
- c) The movement of the lever to the extended position shall be effected by guided compression spring(s) and/or by gravity;
- d) Emergency operation shall be possible in all circumstances;
- e) Precautions shall be taken to avoid involuntary tripping of the safety gear by the lever, in case of the disconnection of the electric power supply during a downward movement of the car;
- f) The design of the lever and stops system shall be such that no damage is possible:
 - 1) during the engagement of the safety gear even in the case of longer braking distances;
 - 2) by an upward movement of the car;
- g) The tripping lever shall be checked electrically in the extended position;
- h) An electric safety device which complies with the requirements of **5.11.2**, shall prevent any normal movement of the car when the tripping lever is not in its extended position after normal stopping and the car doors shall be closed and the lift shall be taken out of operation;
- i) An electric device, which complies with the requirements of **5.11.2**, shall prevent any normal down movement of the car when the tripping lever is not in the retracted position.

5.6.3 Rupture valve

5.6.3.1 The rupture valve shall be capable of stopping the car in downward movement, and maintaining it stationary. The rupture valve shall be tripped at the latest when the speed reaches a value equal to rated speed downwards v_d plus 0,3 m/s.

The rupture valve shall be selected so that the average retardation a lies between $0,2 g_n$ and $1 g_n$.

Retardation of more than $2,5 g_n$ shall not last longer than 0,04 s.

The average retardation a can be evaluated by the formula:
$$a = \frac{Q_{max} \cdot r}{6 \cdot A \cdot n \cdot t_d}$$

where:

- A is the area of jack, where pressure is acting in square centimetres;
- n is the number of parallel acting jacks with one rupture valve;

Q_{\max} is the maximum flow in litres per minute;

r is the reeving factor;

t_d is the braking time in seconds;

the values of which can be taken from the technical dossier and the type examination certificate.

5.6.3.2 The rupture valve shall be accessible for adjustment and inspection directly from the car roof or from the pit.

5.6.3.3 The rupture valve shall be either:

- a) Integral with the cylinder, or
- b) Directly and rigidly flange-mounted, or
- c) Placed close to the cylinder and connected to it by means of short rigid pipes, having welded, flanged or threaded connections, or
- d) Connected directly to the cylinder by threading.
- e) The rupture valve shall be provided with a thread ending with a shoulder. The shoulder shall butt up against the cylinder.

Other types of connections such as compression fittings or flared fittings are not permitted between the cylinder and the rupture valve.

5.6.3.4 On lifts with several jacks, operating in parallel, one common rupture valve may be used. Otherwise the rupture valves shall be interconnected to cause simultaneous closing, in order to avoid the floor of the car from inclining by more than 5 % from its normal position.

5.6.3.5 The rupture valve shall be calculated as the cylinder.

5.6.3.6 If the closing speed of the rupture valve is controlled by a restricting device a filter shall be located as near as possible before this device.

5.6.3.7 There shall be in the machine room a manually operated means allowing to reach the tripping flow of the rupture valve without overloading the car. The means shall be safeguarded against unintentional operation. It shall not neutralise the safety devices adjacent to the jack.

5.6.3.8 The rupture valve is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.9.

5.6.3.9 On rupture valve a data plate shall be fixed indicating:

- a) The name of the manufacturer of the rupture valve;
- b) The type examination sign and its references;
- c) The tripping flow for which it has been adjusted.

5.6.4 Restrictors

5.6.4.1 In the case of a major leakage in the hydraulic system the restrictor shall prevent the speed of the car with rated load in downward movement exceeding the rated speed downwards v_d by more than 0,3 m/s.

5.6.4.2 The restrictor shall be accessible for inspection directly from the car roof or from the pit.

5.6.4.3 The restrictor shall be either:

- a) Integral with the cylinder, or
- b) Directly and rigidly flange-mounted, or
- c) Placed close to the cylinder and connected to it by means of short rigid pipes, having welded, flanged or threaded connections, or
- d) Connected directly to the cylinder by threading.

The restrictor shall be provided with a thread ending with a shoulder. This shall butt up against the cylinder.

Other types of connections such as compression fittings or flared fittings are not permitted between the cylinder and the restrictor.

5.6.4.4 The restrictor shall be calculated as the cylinder.

5.6.4.5 There shall be in the machine room a manually operated means allowing to reach the tripping flow of restrictor without overloading the car. The means shall be safeguarded against unintentional operation. In no case shall it neutralise the safety devices adjacent to the jack.

5.6.4.6 Only the one-way restrictor where mechanical moving parts are used is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.9.

5.6.4.7 On one-way restrictor where mechanical moving parts are used (5.6.4.6) a data plate shall be fixed indicating:

- a) The name of the manufacturer of the one-way restrictor;
- b) The type examination sign and its references;
- c) The tripping flow for which it has been adjusted.

5.6.5 Pawl device

5.6.5.1 The pawl device shall operate only in the downward direction, and be capable of stopping the car, with a load according to **Table 5 (5.4.2.1)** for lifts according to **5.4.2.1** and **5.4.2.2**, and maintaining it stationary on fixed stops:

- a) For lifts provided with a restrictor or one-way restrictor: from a speed of $v_d + 0,3$ m/s, or
- b) For all other lifts: from a speed equal to 115 % of downwards rated speed v_d .

5.6.5.2 There shall be provided at least one electrically retractable pawl designed in its extended position to stop the downward moving car against fixed supports.

5.6.5.3 For each landing supports shall be provided arranged at two levels:

- a) To prevent the car sinking below the landing level by more than 0,12 m, and
- b) To stop the car at the lower end of the unlocking zone.

5.6.5.4 The movement of the pawl(s) to the extended position shall be effected by guided compression spring(s) and/or by gravity.

5.6.5.5 The supply to the electric retraction device shall be interrupted when the machine is stopped.

5.6.5.6 The design of the pawl(s) and supports shall be such that, whatever the position of the pawl, during upward movement the car cannot be stopped nor any damage caused.

5.6.5.7 A buffering system shall be incorporated in the pawl device (or in the fixed supports).

5.6.5.7.1 Buffers shall be of the following types:

- a) Energy accumulation, or
- b) Energy dissipation.

5.6.5.7.2 The requirements of **5.8.2** apply by analogy.

In addition, the buffer shall maintain the car stationary at a distance not exceeding 0,12 m below any loading level when carrying the rated load.

5.6.5.8 When several pawls are provided precautions shall be taken to ensure that all pawls engage on their respective supports even in the case of the disconnection of the electrical power supply during a downward movement of the car.

5.6.5.9 An electric device, which complies with the requirements of **5.11.2.2** shall prevent any normal down movement of the car when a pawl is not in the retracted position.

5.6.5.9.1 The pawl device shall be checked electrically in the extended position when the car stops.

5.6.5.9.2 If the pawl device is not in the extended position:

- a) An electric device, which complies with the requirements of **5.11.2.2**, shall prevent the opening of the doors and any normal movement of the car;
- b) The pawl device shall be fully retracted and the car shall be sent to the lowest level served by the lift, and
- c) The doors shall open to allow persons to leave the car and the lift shall be taken out of operation.

Return to normal operation shall require the intervention of a competent person.

5.6.5.10 If energy dissipation buffers (**5.6.5.7.1 b**) are used, an electric device which complies with the requirements of **5.11.2.2** and **5.11.2.3** shall immediately initiate stopping of the machine if the car is travelling downwards and prevent starting of the machine in downward motion, when the buffer is not in its normal extended position. The power supply shall be interrupted according to **5.9.3.4.2**.

5.6.6 Ascending car overspeed protection means

5.6.6.1 The means, comprising speed monitoring and speed reducing elements, shall detect uncontrolled movement of the ascending car at a minimum 115 % of the rated speed, and shall cause the car to stop, or at least reduce its speed to that for which the counterweight buffer is designed.

5.6.6.2 The means shall be capable of performing as required in **5.6.6.1** without assistance from any lift component that, during normal operation, controls the speed or retardation, or stops the car, unless there is built-in redundancy.

A mechanical linkage to the car, whether or not such linkage is used for any other purpose, may be used to assist in this performance.

5.6.6.3 The means shall not allow a retardation of the empty car in excess of 1 g_n during the stopping phase.

5.6.6.4 The means shall act:

- a) To the car; or
- b) To the counterweight; or
- c) On the rope system (suspension or compensating); or
- d) On the traction sheave (e.g. on the sheave directly or on the same shaft in the immediate vicinity of the sheave).

5.6.6.5 The means shall operate an electric safety device in conformity with **5.11.2** if it is engaged.

5.6.6.6 The release of the means shall not require the access to the car or the counterweight.

5.6.6.7 After the release of the means the return of the lift to normal operation shall require the intervention of a competent person.

5.6.6.8 After its release, the means shall be in a condition to operate.

5.6.6.9 If the means requires external energy to operate, the absence of energy shall cause the lift to stop and keep it stopped. This does not apply for guided compressed springs.

5.6.6.10 The speed monitoring element of the lift to cause the ascending car overspeed protection means to actuate shall be, either:

- a) An overspeed governor conforming to the requirements of **5.6.2.2.1**; or
- b) A device conforming to **5.6.2.2.1.1 a), b), 5.6.2.2.1.3, 5.6.2.2.1.4 a), 5.6.2.7.2.5, 5.6.2.2.1.6 b)**, and where equivalence to **5.6.2.2.1.4, 5.6.2.2.1.2 a), 5.6.2.2.1.2 b), 5.6.2.2.1.2 e), 5.6.2.2.1.5** and **5.6.2.2.1.6 c)** is assured.

5.6.6.11 The ascending car overspeed protection means is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, 5.9.

5.6.6.12 On the ascending car overspeed protection means a data plate shall be fixed indicating:

- a) The name of the manufacturer;
- b) The type examination certificate number;
- c) The actual tripping speed for which it has been adjusted;
- d) The type of ascending car overspeed protection means.

5.6.7 Protection against unintended car movement

5.6.7.1 Lifts shall be provided with a means to stop unintended car movement away from the landing with the landing door not in the locked position and the car door not in the closed position, as a result of failure in any single component of the lift machine or drive control system upon which the safe movement of the car depends, except failure of the suspension ropes or chains and the traction sheave or drum or sprockets of the machine, flexible hoses, steel piping and cylinder.

NOTE A failure of the traction sheave includes a loss of traction.

5.6.7.2 The means shall detect unintended movement of the car, shall cause the car to stop, and keep it stopped.

5.6.7.3 The means shall be capable of performing as required without assistance from any lift component that, during normal operation, controls the speed or retardation, stops the car or keeps it stopped, unless there is built-in redundancy and correct operation is self-monitored.

NOTE Machine brake according to **5.9.2.2.2** is considered to have built-in redundancy.

In the case of using the machine brake, self-monitoring could include verification of correct lifting or dropping of the mechanism or verification of braking force. If a failure is detected, next normal start of the lift shall be prevented.

In the case of using two electrically commanded hydraulic valves operating in series, self-monitoring implies separate verification of correct opening or closing of each valve under the empty car static pressure. If a failure is detected, the next normal start of the lift shall be prevented.

Self-monitoring is subject to type examination.

5.6.7.4 The stopping element of the means shall act on:

- a) The car, or
- b) The counterweight, or
- c) The rope system (suspension or compensating), or
- d) The traction sheave (e.g. on the sheave directly or on the same shaft in the immediate vicinity of the sheave);
- e) The hydraulic system (including the motor/pump in up direction by isolation of the oil supply).

The stopping element of the means, or the means keeping the car stopped may be common with those used for:

- preventing overspeed in down direction,
- preventing ascending car overspeed (**5.6.6**).

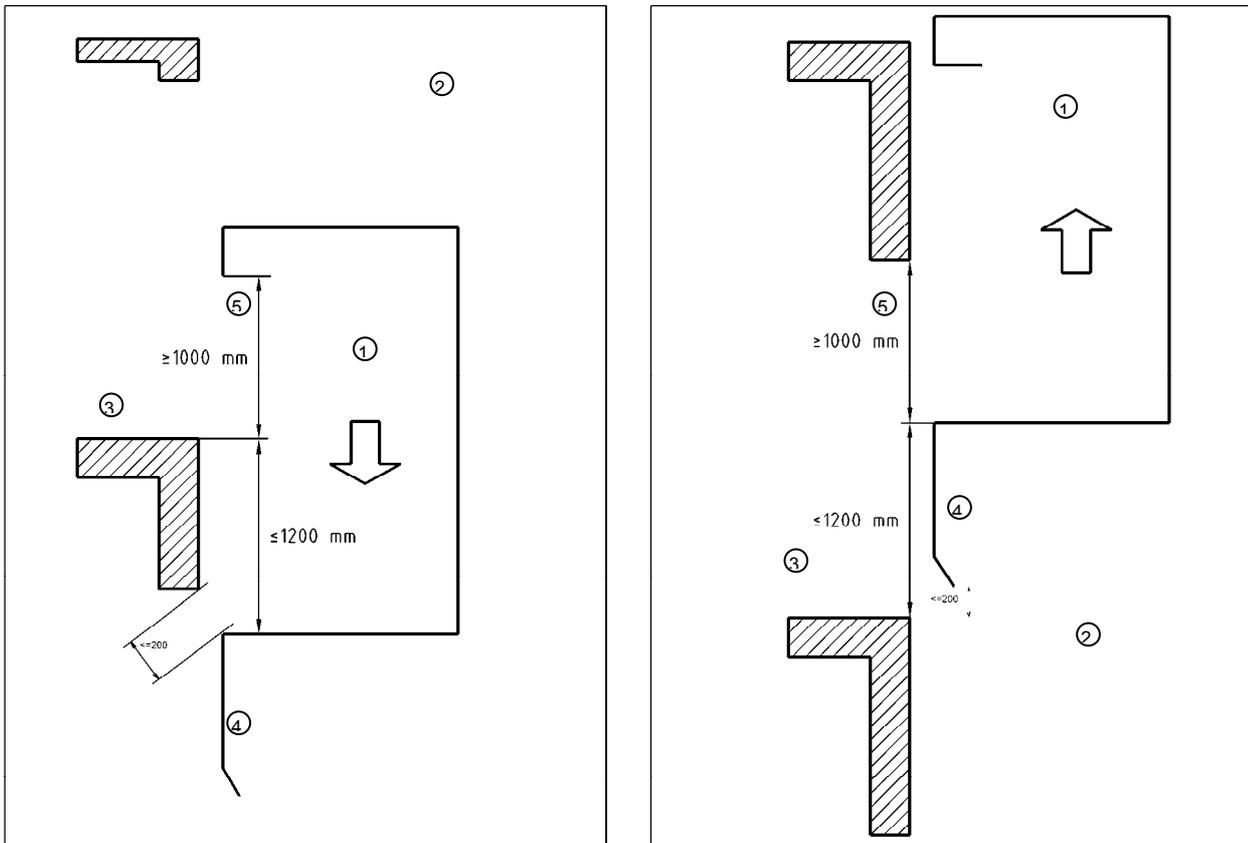
The stopping elements of the means may be different for the down direction and for the up direction.

5.6.7.5 The means shall stop the car in a distance under the following conditions:

- a) The stopping distance shall not exceed 1,20 m from the landing where the unintended car movement has been detected,
- b) The vertical distance between the landing sill and the lowest part of the car apron shall not exceed 200 mm,
- c) In case of enclosures according to **5.2.5.2.2** the distance between the car sill and the lowest part of the well wall facing the car entrance shall not exceed 200 mm (see **Figure 13**);
- d) The free distance from car sill to landing door lintel, or from landing sill to car door lintel shall not be less than 1,00 m (see **Figure 13**).

These values shall be obtained with any load in the car, up to 100 % of rated load, moving away from a standstill position at landing level.

Dimensions in millimetres



Legend

- ① Lift car
- ② Lift well
- ③ Landing
- ④ Car apron
- ⑤ Car entrance

Figure 13 - Unintended car movement - Downwards and upwards movement

5.6.7.6 During the stopping phase, the stopping element of the means shall not allow a retardation of the car in excess of:

- $1 g_n$ for unintended movements in up direction,
- the values accepted for devices for protecting against free fall.

These values shall be obtained with any load in the car, up to 100 % of rated load, moving away from a standstill position at landing level.

5.6.7.7 The unintended movement of the car shall be detected by at least one switching device at latest when the car leaves the unlocking zone (5.3.8.1).

This switching device shall:

- either be a safety contact in conformity with **5.11.2.2**, or
- be connected in such a way as to satisfy the requirements for safety circuits in **5.11.2.3**, or
- satisfy requirements of **5.11.2.6**.

5.6.7.8 The means shall operate an electric safety device in conformity with **5.11.2** if it is engaged.

NOTE This can be common to switching device of **5.6.7.7**.

5.6.7.9 When the means has been activated or the self-monitoring monitoring has indicated a failure of the stopping element of the means, its release or the reset of the lift shall require the intervention of a competent person.

5.6.7.10 The release of the means shall not require the access to the car or the counterweight or balancing weight.

5.6.7.11 After its release, the means shall be in a condition to operate.

5.6.7.12 If the means requires external energy to operate, the absence of energy shall cause the lift to stop and keep it stopped. This does not apply for guided compressed springs.

5.6.7.13 The unintended car movement with open doors protection means is regarded as a safety component and shall be verified according to the requirements in prEN 81-50, **5.8**.

5.7 Guide rails

5.7.1 Guiding of the car, counterweight or balancing weight

5.7.1.1 The car, counterweight or balancing weight shall each be guided by at least two rigid steel guide rails.

5.7.1.2 The guide rails shall be made from drawn steel, or the rubbing surfaces shall be machined, if:

- a) The rated speed exceeds 0,4 m/s;
- b) Progressive safety gears are used regardless of the speed.

5.7.1.3 Guide rails for counterweights or balancing weights without safety gear may be made of formed metal sheet. They shall be protected against corrosion.

5.7.1.4 The fixing of the guide rails to their brackets and to the building shall permit compensation, either automatically or by simple adjustment, of effects due to normal settling of the building or shrinkage of concrete.

A rotation of the attachments by which the guide rails could be released shall be prevented.

5.7.2 Permissible stresses and deflections

5.7.2.1 General provisions

5.7.2.1.1 The guide rails, their joints and attachments shall withstand the loads and forces imposed on them in order to ensure a safe operation of the lift.

The aspects of safe operation of the lift concerning guide rails are:

- a) Car, counterweight or balancing weight -guidance shall be assured;

b) Deflections shall be limited to such an extent, that due to them:

- 1) unintended unlocking of the doors shall not occur;
- 2) operation of the safety devices shall not be affected; and
- 3) Collision of moving parts with other parts shall not be possible.

5.7.2.1.1 The combination of permissible deflections with the deflection of brackets, play in the guide shoes and straightness of the guide rails shall be taken into account.

5.7.2.2 Load cases

The following load cases shall be considered:

- 0 normal operation - running;
- 0 normal operation - loading and unloading;
- 0 safety device operation - safety gear or similar;
- 0 safety device operation - rupture valve.

NOTE For each load case a combination of forces may act on the guide rails (see **5.7.2.3.1**).

5.7.2.3 Forces on guide rails

5.7.2.3.1 The following forces on guide rails shall be taken in account for calculation of permissible stresses and deflections of guide rails:

a) Horizontal forces from guide shoes due to:

- 1) Masses of the car and its rated load, compensation means, travelling cables, etc. or the counterweight/balancing weight, taking into consideration their suspension points and dynamic impact factors, and
- 2) Wind loads in case of lifts outside a building with partially enclosed well.

b) Vertical forces from:

- 1) braking forces of safety gears;
- 2) auxiliary parts fixed on the guide rail;
- 3) weight of guide rail, and
- 4) push through forces or rail clips;

c) Torques due to auxiliary equipment including dynamic impact factors.

5.7.2.3.2 The acting point of the masses of the empty car and components supported by the car such as ram, part of travelling cable, compensating ropes/chains (if any) - P - shall be the centre of gravity of the mass of the car.

5.7.2.3.3 The guiding forces of a counterweight or balancing weight G shall be evaluated taking into account:

- The acting point of the mass;

- The suspension; and
- The forces due to compensating ropes/chains (if any), tensioned or not.

On a counterweight or balancing weight, centrally guided and suspended, an eccentricity of the acting point of the mass from the centre of gravity of the horizontal cross area of the counterweight or balancing weight of at least 5 % of the width and 10 % of the depth shall be taken into consideration.

5.7.2.3.4 In the load cases “normal use” and “safety device operation” the rated load Q of the car shall be evenly distributed over those three quarters of the car area being in the most unfavourable position.

However, if different load distribution conditions are intended after negotiations (**0.3.1**), the calculations shall be made on the basis of this condition.

NOTE It is assumed that the safety devices operate simultaneously on the guide rails and that the braking force is equally distributed.

5.7.2.3.5 The vertical force F_v of the car, counterweight or balancing weight resulting in compression and buckling or tension force shall be evaluated accordingly by using the formula:

$$— F_v = \frac{k_1 \cdot g_n \cdot (P + Q)}{n} + (M_g \cdot g_n) + F_p \text{ for car;}$$

$$— F_v = \frac{k_1 \cdot g_n \cdot (P + q \cdot Q)}{n} + (M_g \cdot g_n) + F_p \text{ for counterweight;}$$

$$— F_v = \frac{k_1 \cdot g_n \cdot q \cdot P}{n} + (M_g \cdot g_n) + F_p \text{ for balancing weight;}$$

$$— F_p = n_b \cdot F_r \text{ in the case of guide rails supported on the pit or hanging (fixed at the top of the well),}$$

where:

F_p is the push trough forces of all brackets at one guide rail (due to normal settling of the building or shrinkage of concrete) in newton;

F_r is the push trough force of all clips per bracket in newton;

g_n is the standard acceleration of free fall (9,81 m/s²);

k_1 is the impact factor according to **Table 13**;

M_g is the masse of one line of guide rails in kilograms;

n is the number of guide rails;

n_b is the number of brackets of a guide rail;

P are the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensating ropes/chains (if any), etc. in kilograms;

Q is the rated load in kilograms;

q is the balance factor indicating the amount of counterbalance of the rated load by the counterweight, or amount of counterbalance of the mass of the car by the balancing weight.

Note F_p is depending on the way the guide rail is supported, the number of fixation, brackets and clip design. For small travel the effect of the settling of the building (not made of timber) is small and can be absorbed by the elasticity of the brackets. In this case the use of non sliding clips is of common practice and the force F_p can be ignored in the formula; this however shall be limited by 40 m travel.

5.7.2.3.6 Whilst loading or unloading a car, a vertical force on the sill F_s has to be assumed to act centrally on the sill of the car entrance. The amount of the force applied on the sill shall be:

- $F_s = 0,4 \cdot g_n \cdot Q$ for lifts with rated loads less than 2 500 kg in private premises, office buildings, hotels, hospitals etc.;
- $F_s = 0,6 \cdot g_n \cdot Q$ for lifts with rated loads of 2 500 kg or more;
- $F_s = 0,85 \cdot g_n \cdot Q$ ⁶⁾ for lifts with rated loads of 2 500 kg or more in case of forklift truck loading.

Applying the force on the sill the car shall be regarded as empty. At cars with more than one entrance the force on the sill needs to be applied at the most unfavourable entrance only.

5.7.2.3.7 Forces and torques per guide rail due to auxiliary equipment fixed to the guide rail M shall be considered, except for overspeed governors and their associated parts, switches or positioning equipment.

If the machine or rope suspensions are fixed to the guide rails, additional load cases according to the **Table 12** shall be considered.

5.7.2.3.8 Windloads WL shall be considered with lifts outside a building with incomplete well enclosure, and be determined by negotiation with the building designer (**0.3.1**).

5.7.3 Combination of loads and forces

The loads and forces and the load cases to be taken into consideration are shown in **Table 12**.

Table 12 - Loads and forces to be taken into consideration in the different load cases

Load cases	Loads and forces	P	Q	G	F_s	F_p	M_g	M	WL
Normal operation	Running	x	x	x		x^a	x	x	x
	Loading + unloading	x			x	x^a	x	x	x
Safety device operation	Safety gear or similar	x	x	x		x^a	x	x	
	Rupture valve	x	x			x^a	x	x	
^a See 5.7.2.3.5 NOTE Load and forces may not act simultaneously.									

⁶⁾ 0,85 is based on the assumption of $0,6 \cdot Q$ and half of the weight of the forklift truck, which - due to experience - is not bigger than half the rated load $0,6 + 0,5 \cdot 0,5 = 0,85$.

5.7.4 Impact factors

5.7.4.1 Safety device operation

The impact factor due to safety device operation k_1 (see **Table 13**) depends on the type of safety device.

5.7.4.2 Normal operation

In the load case “normal operation, running”, the vertical moving masses of the car ($P + Q$) and counterweight/balancing weight (G) shall be multiplied by the impact factor k_2 (see **Table 13**) to take into consideration hard braking due to electric safety device actuation or by an accidental interruption of the power supply.

5.7.4.3 Other operational scenarios

The forces applied to the guide rails of the car, counterweight or balancing weight shall be multiplied with the impact factor k_3 (see **Table 13**) to take into account the possible car, counterweight or balancing weight bounce when the car, counterweight/balancing weight is stopped by a safety device.

5.7.4.4 Values of impact factors

The values of the impact factors are given in **Table 13**.

Table 13 - Impact factors

Impact at	Impact factor	Value
Operation of instantaneous safety gear, neither of the captive roller type	k_1	5
Operation of instantaneous safety gear, both of the captive roller type or pawl device with energy accumulation type buffer or energy accumulation type buffer		3
Operation of progressive safety gear or pawl device with energy dissipation type buffer or energy dissipation type buffer		2
Rupture valve		2
Running	k_2	1,2
Auxiliary parts fixed to the guide rail and other operational scenarios	k_3	(....) ¹⁾
1) The value has to be determined by the manufacturer due to the actual installation.		

5.7.4.5 Permissible stresses

The permissible stresses shall be determined by:

$$\sigma_{perm} = \frac{R_m}{S_t}$$

where:

prEN 81-20:2011 (E)

R_m is the tensile strength in newtons per square millimetre;

σ_{perm} is the permissible stress in newtons per square millimetre;

S_t is the safety factor.

The safety factor shall be taken from **Table 14**.

Table 14 - Safety factors for guide rails

Load cases	Elongation (A_5)	Safety factor
Normal operation and loading/unloading	$A_5 \geq 12 \%$	2,25
	$8 \% \leq A_5 \leq 12 \%$	3,75
Safety device operation	$A_5 \geq 12 \%$	1,8
	$8 \% \leq A_5 \leq 12 \%$	3,0

The strength values shall be taken from the manufacturer.

Materials with elongations less than 8 % are regarded as too brittle and shall not be used.

5.7.4.6 Permissible deflections

For T-profile guide rails and their fixings (brackets, separation beams) the maximum calculated permissible deflections δ_{perm} are:

- a) $\delta_{perm} = 5$ mm in both directions for car, counterweight or balancing weight guide rails on which safety gears are operating;
- b) $\delta_{perm} = 10$ mm in both directions for guide rails of counterweight or balancing weight without safety gears.

Any deflection of building structure shall be taken into account in respect of guide rail displacement. See **0.3.1** negotiations and **Annex E.2**.

5.7.4.7 Calculation

Guide rails shall be calculated according to prEN 81-50, 5.10.

Other equivalent methods may be used:

- EN 1993-1-1, or
- Finite Element Method (FEM)

5.8 Buffers

5.8.1 Car and counterweight buffers

5.8.1.1 Lifts shall be provided with buffers at the bottom limit of travel of the car and counterweight.

In the case of buffer(s) fixed to the car the impact area(s) of the buffer(s) on the pit floor shall be made obvious by an obstacle(s) (pedestal) of a height not less than 300 mm and so that 5.2.5.8 is fulfilled.

An obstacle is not required for buffer(s) fixed to the counterweight where a screen according to 5.2.5.5.1 is extended to not more than 100 mm above the pit floor.

5.8.1.2 In addition to the requirements of 5.8.1.1 positive drive lifts shall be provided with buffers on the car top to function at the upper limit of travel.

5.8.1.3 For hydraulic lifts, when the buffer(s) of a pawl device is (are) used to limit the travel of the car at the bottom, this pedestal is also required unless the fixed stops of the pawl device are mounted on the car guide rails, and not able to pass with pawl(s) retracted.

5.8.1.4 For hydraulic lifts, the buffers shall maintain the car stationary at a distance not exceeding 0,120 m below the level of the lowest landing, when carrying the rated load.

5.8.1.5 When buffers are fully compressed the ram shall not hit the base of the cylinder.

This does not apply to devices ensuring re-synchronisation.

In case of telescopic cylinders at least one stage shall not hit its down travel mechanical limit.

5.8.1.6 Energy accumulation type buffers, with linear and non linear characteristics, shall only be used if the rated speed of the lift does not exceed 1 m/s.

5.8.1.7 Energy dissipation type buffers can be used whatever the rated speed of the lift.

5.8.1.8 The energy accumulation type buffers with non-linear characteristics and energy dissipation type buffers are regarded as safety components and shall be verified according to the requirements in prEN 81-50, 5.5.

5.8.1.9 On the buffers other than those with linear characteristics (5.8.2.1.1), there shall be a data plate showing:

- a) the name of the manufacturer of the buffer;
- b) The type examination certificate number;
- c) The type of the buffer;
- d) The specification of liquid in the case of hydraulic buffers.

5.8.2 Stroke of car and counterweight buffers

5.8.2.1 Energy accumulation type buffers

5.8.2.1.1 Buffers with linear characteristics

5.8.2.1.1.1 The total possible stroke of the buffers shall be at least equal to twice the gravity stopping distance corresponding to 115 % of the rated speed ($0,135 v^2$)⁷⁾, the stroke being expressed in metres.

However, the stroke shall not be less than 65 mm.

7) $\frac{2 \cdot (1,15 v)^2}{2 \cdot g_n} = 0,1348 \cdot v^2$ rounded to $0,135 \cdot v^2$.

5.8.2.1.1.2 Buffers shall be designed to cover the stroke defined in **5.8.2.1.1.1** under a static load of between 2,5 times and 4 times the sum of the mass of the car and its rated load (or the mass of the counterweight).

5.8.2.1.2 Buffers with non-linear characteristics

5.8.2.1.2.1 Energy accumulation type buffers with non linear characteristics shall fulfil the following requirements:

- a) Hitting the buffer(s) with the mass of the car and its rated load or of the counterweight, in case of free fall with a speed of 115 % of the rated speed, the average retardation shall not be more than $1 g_n$;
- b) Retardation of more than $2,5 g_n$ shall not be longer than 0,04 s;
- c) The return speed of the car or the counterweight shall not exceed 1 m/s;
- d) There shall be no permanent deformation after actuation.

5.8.2.1.2.2 The term “fully compressed”, mentioned in **5.2.5.6.1.2**, **5.2.5.6.3.2**, **5.2.5.7.1**, **5.2.5.8.2** and **5.2.5.8.3** means a compression of 90 % of the installed buffer height without considering fixation elements of the buffer which might limit the compression to a lower value.

5.8.2.2 Energy dissipation type buffers

5.8.2.2.1 The total possible stroke of the buffers shall be at least equal to the gravity stopping distance corresponding to 115 % of the rated speed ($0,0674 v^2$), the stroke being expressed in metres.

5.8.2.2.2 When the slowdown of lift at the ends of its travel is monitored according to **5.12.1.3**, the speed at which the car (or the counterweight) comes into contact with the buffers may be used instead of 115 % of the rated speed, when calculating the buffer stroke according to **5.8.2.2.1**. However, the stroke shall not be less than 0,42 m.

5.8.2.2.3 Energy dissipation type buffers shall fulfil the following requirements:

- a) Hitting the buffer with the mass of the car with its rated load, in case of free fall with a speed of 115 % of the rated speed, the average retardation shall not be more than $1 g_n$;
- b) Retardation of more than $2,5 g_n$ shall not be longer than 0,04 s;
- c) There shall be no permanent deformation after actuation.

5.8.2.2.4 The normal operation of the lift shall depend on the return of the buffers to their normal extended position after operation. The device for checking this shall be an electric safety device in conformity with **5.11.2**

5.8.2.2.5 Buffers, if hydraulic, shall be so constructed that the fluid level can easily be checked.

5.9 Lift machinery and associated equipment

5.9.1 General provision

5.9.1.1 Each lift shall have at least one machine of its own.

5.9.1.2 Effective protection shall be provided for accessible rotating parts of machinery, in particular:

- a) Keys and screws in the shafts;

- b) Tapes, chains, belts;
- c) Gears, sprockets and pulleys;
- d) Projecting motor shafts.

Exception is made for traction sheaves with protections according to 5.5.7, hand winding wheels, brake drums and any similar smooth, round parts. Such parts shall be painted yellow, at least in part.

5.9.2 Lift machine for traction lifts and positive drive lifts

5.9.2.1 General provisions

5.9.2.1.1 The following two methods of drive are permissible by:

- a) Traction (use of sheaves and ropes);
- b) Positive drive, i.e.:
 - 1) Either use of a drum and ropes; or
 - 2) Use of sprockets and chains.

The rated speed shall not exceed 0,63 m/s. Counterweights shall not be used. The use of a balancing weight is permitted.

The calculations of the driving elements shall take into account the possibility of the counterweight or the car resting on its buffers.

5.9.2.1.2 Use may be made of belts for coupling the motor or motors to the component on which the electro-mechanical brake (5.9.2.2.1.2) operates. In this case a minimum of two belts shall be used.

5.9.2.2 Braking system

5.9.2.2.1 General provisions

5.9.2.2.1.1 The lift shall be provided with a braking system, which operates automatically in the event of loss of:

- a) The mains power supply;
- b) The supply to control circuits.

5.9.2.2.1.2 The braking system shall have an electro-mechanical brake (friction type), but may, in addition, have other braking means (e.g. electric).

5.9.2.2.2 Electro-mechanical brake

5.9.2.2.2.1 This brake on its own shall be capable of stopping the machine when the car is travelling downward at rated speed and with the rated load plus 25 %. In these conditions the retardation of the car shall not exceed that resulting from operation of the safety gear or stopping on the buffer.

All the mechanical components of the brake which take part in the application of the braking action on the braking surface shall be installed at least in two sets. If one of the components is not working a sufficient braking effort to decelerate the car, travelling downwards at rated speed and with rated load shall continue to be exercised.

Any solenoid plunger is considered to be a mechanical part, any solenoid coil is not.

5.9.2.2.2.2 The component on which the brake operates shall be coupled to the traction sheave or drum or sprocket by direct and positive mechanical means.

5.9.2.2.2.3 To hold off the brake, in normal operation, shall require a continuous flow of current.

The following shall be met:

- a) The interruption of this current, initiated by an electric safety device as required in **5.11.2.4**, shall be controlled by one of the following means:
 - 1) Two independent electrical devices, whether or not integral with those, which cause interruption of the current feeding the lift machine;
 - 2) If, whilst the lift is stationary, one of the electrical devices has not opened the brake circuit, any further movement of the car shall be prevented. A failure of this monitoring function shall have the same result;
 - 3) PESSRAL consisting of a controlling stage and a stage de-energizing the brake together fulfilling SIL3 requirements as given in **5.11.2.6**;
 - 4) An adjustable speed electrical power drive system with a safe brake control function according EN61800-5-2, 4.2.3.12 fulfilling SIL3 requirements.
- b) When the motor of the lift is likely to function as a generator, it shall not be possible for the electric device operating the brake to be fed by the driving motor.
- c) Braking shall become effective without supplementary delay after opening of the brake release circuit.

NOTE The use of a diode or capacitor connected directly to the terminals of the brake coil is not considered as a means of delay.

- d) Operation of an overload and/or over current protective device (if any) for the electro-mechanical brake shall initiate the simultaneous de-energization of the machine.

5.9.2.2.2.4 The brake shoe or pad pressure shall be exerted by guided compression springs or weights.

5.9.2.2.2.5 Band brakes shall not be used.

5.9.2.2.2.6 Brake linings shall be incombustible.

5.9.2.2.2.7 The machine shall be capable of having the brake released by a continuous manual operation, even in the case of power supply failure. The operation can be mechanical (e.g. lever) or electrical by independent supply.

5.9.2.2.2.8 With the brake manually released and the car loaded at 80 % of the value of the balanced load of the car, it shall be possible to move the car to an adjacent floor:

- a) Either by natural movement; or
- b) Manual operation consisting of:
 - 1) Mechanical means, present on site, or
 - 2) Electrical means, powered by supply independent from the mains, present on site.

5.9.2.3 Emergency operation

5.9.2.3.1 If the manual effort required to move the car in the upward direction with its rated load does not exceed 400 N the machine shall be provided with a manual means of emergency operation allowing the car to be moved to a landing. If the means for moving the car can be driven by the lift moving, then it shall be a smooth, spokeless wheel.

5.9.2.3.1.1 If the wheel is removable, it shall be located in an easily accessible place in the machine room. It shall be suitably marked if there is any risk of confusion as to the machine for which it is intended. If the means is removable, it shall be located in an easily accessible place in the machinery space. It shall be suitably marked if there is any risk of confusion as to the machine for which it is intended.

If the means is removable or can be disengaged from the machine, an electric safety device in conformity with **5.11.2** shall be actuated, at the latest when the means is about to be coupled with the machine.

5.9.2.3.1.2 It shall be possible to check easily whether the car is in an unlocking zone. See also **5.2.6.6.2 c)**.

5.9.2.3.2 If the effort defined in **5.9.2.3.1** is greater than 400 N, a means of emergency electrical operation shall be provided in accordance with **5.11.2.4**.

This means shall be located in the relevant machinery space:

- Machine room (**5.2.6.3**),
- Machinery cabinet (**5.2.6.5.1**), or
- On the emergency and tests panel(s) (**5.2.6.6**).

5.9.2.4 Speed

The speed of the lift car, half loaded, in downward motion, in mid-travel, excluding all acceleration and retardation periods, shall not exceed the rated speed by more than 5 %, when the supply is at its rated frequency, and the motor voltage is equal to the rated voltage of the equipment ⁸⁾.

This tolerance is also applicable for the speed in the case of:

- a) Levelling (**5.12.1.4 e**);
- b) Re-levelling (**5.12.1.4 f**);
- c) Inspection operation (**5.12.1.5.2.1 e**);
- d) Emergency electrical operation (**5.12.1.6.1 f**).

5.9.2.5 Removing the power which can cause rotation of the motor

The removal of power which can cause rotation of the motor by means of an electric safety device, in conformity with **5.11.2**, shall be controlled as detailed below.

5.9.2.5.1 Motors supplied directly from A.C. or D.C. mains by contactors

The supply shall be interrupted by two independent contactors, the contacts of which shall be in series in the supply circuit. If, whilst the lift is stationary, one of the contactors has not opened the main contacts, further

8) It is good practice that in the above conditions the speed is not lower than a value 8 % below the rated speed.

movement of the car shall be prevented at the latest at the next change in the direction of motion. A failure of this monitoring function shall have the same result.

5.9.2.5.2 Drive using a “Ward-Leonard” system

5.9.2.5.2.1 Excitation of the generator supplied by classical elements

Two independent contactors shall interrupt, either:

- a) The motor generator loop; or
- b) The excitation of the generator; or
- c) One the loop and the other the excitation of the generator.

If, whilst the lift is stationary, one of the contactors has not opened the main contacts, further movement of the car shall be prevented, at the latest at the next change in direction of motion. A failure of this monitoring function shall have the same result.

In cases b) and c) effective precautions shall be taken to prevent the rotation of the motor in the case of a residual field, if any, in the generator (e.g. suicide circuit).

5.9.2.5.2.2 Excitation of the generator supplied and controlled by static elements

One of the following methods shall be used:

- a) The same methods as specified in **5.9.2.5.2.1**;
- b) A system consisting of:
 - 1) A contactor interrupting the excitation of the generator or the motor generator loop.

The coil of the contactor shall be released at least before each change in direction of motion. If the contactor does not release, any further movement of the lift shall be prevented. A failure of this monitoring function shall have the same result, and
 - 2) a control device blocking the flow of energy in the static elements; and
 - 3) A monitoring device to verify the blocking of the flow of energy each time the lift is stationary.

If, during a normal stopping period, the blocking by the static elements is not effective, the monitoring device shall cause the contactor to release and any further movement of the lift shall be prevented.

Effective precautions shall be taken to prevent the rotation of the motor in the case of a residual field, if any, in the generator (e.g. suicide circuit).

5.9.2.5.3 A.C. or D.C. motor supplied and controlled by static elements

One of the following methods shall be used:

- a) Two independent contactors interrupting the current to the motor.

If, while the lift is stationary, one of the contactors has not opened the main contacts, any further movement shall be prevented, at the latest at the next change in direction of motion. A failure of this monitoring function shall have the same result;
- b) A system consisting of:

- 1) A contactor interrupting the current at all poles.

The coil of the contactor shall be released at least before each change in direction. If the contactor does not release, any further movement of the lift shall be prevented; and

- 2) A control device blocking the flow of energy in the static elements; and
- 3) A monitoring device to verify the blocking of the flow of energy each time the lift is stationary.

If, during a normal stopping period, the blocking of the flow of energy by the static elements is not effective, the monitoring device shall cause the contactor to release and any further movement of the lift shall be prevented;

- c) PESSRAL consisting of a controlling stage and a stage removing the power which can cause rotation of the motor together fulfilling SIL3 requirements as given in **5.11.2.6**;
- d) An adjustable speed electrical power drive system with a safe torque off function according to EN 61800-5-2, 4.2.2.2 fulfilling SIL3 requirements.

5.9.2.6 Control devices and monitoring devices

Control devices according to **5.9.2.5.2.2 b) 2)** or **5.9.2.5.3 b) 2)**, and monitoring devices according to **5.9.2.5.2.2 b) 3)** or **5.9.2.5.3 b) 3)** need not to be safety circuits according to **5.11.2.3**.

These devices shall only be used provided the requirements of **5.11.1** are met to achieve comparability to **5.9.2.5.3 a)**.

5.9.2.7 Safety devices against slack rope or slack chain

Positive drive lifts shall have a slack rope/chain device actuating an electric safety device in conformity with **5.11.2**. This device may be the same as the one required in **5.5.5.3**.

5.9.2.8 Motor run time limiter

5.9.2.8.1 Traction drive lifts shall have a motor run time limiter causing the de-energizing of the machine, and keep it de-energized, if:

- a) The machine does not rotate when a start is initiated;
- b) The car/counterweight is stopped in downwards movement by an obstacle which causes the ropes to slip on the traction sheave.

5.9.2.8.2 The motor run time limiter shall function in a time which does not exceed the smaller of the following two values:

- a) 45 s;
- b) Time for travelling the full travel, plus 10 s, with a minimum of 20 s if the full travel time is less than 10 s.

5.9.2.8.3 The return to normal operation shall only be possible by manual resetting. On restoration of the power after a supply disconnection, maintaining the machine in the stopped position is not necessary.

5.9.2.8.4 The motor run time limiter shall not affect the movement of the car under either the inspection operation or the emergency electrical operation.

5.9.3 Lift machine for hydraulic lifts

5.9.3.1 General provision

5.9.3.1.1 The two following methods of drive are permissible:

- a) Direct acting:
- b) Indirect acting.

5.9.3.1.2 In the case of multiple jacks all the jacks shall be hydraulically connected in parallel so that they all lift with the same pressure.

The structure of the car, car sling, guide rails and car guide shoes/rollers shall keep the car floor orientation and synchronise the movement of the rams, in any of the applicable loading conditions mentioned in 5.7.2.2

NOTE In order to equalize pressure within the cylinders the pipe work from the manifold to each jack should be approximately equal in length and have similar characteristics.

5.9.3.1.3 The mass of the balancing weight, if any, shall be calculated such that in case of a rupture of the suspension gear (car/balancing weight), the pressure in the hydraulic system does not exceed two times full load pressure.

In the case of several balancing weights, the rupture of only one suspension gear shall be taken into consideration for the calculation.

5.9.3.2 Jack

5.9.3.2.1 Calculations of cylinder and ram

5.9.3.2.1.1 Pressure calculations

The following shall be satisfied:

- a) The cylinder and the ram 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 $R_{P0,2}$ is assured.
- b) For the calculation ⁹⁾ of the elements of telescopic jacks with hydraulic synchronizing means the full load pressure shall be replaced by the highest pressure, which occurs in an element due to the hydraulic synchronizing means.
- c) In the thickness calculations a value shall be added of 1,0 mm for cylinder walls and cylinder bases, and 0,5 mm for walls of hollow rams for single and telescopic jacks.

The dimensions and tolerances of the tubes used for the manufacture of the jack shall be according to the applicable standard of the EN 10305 series.

- d) The calculations shall be carried out according to prEN 81-50, 5.13.

5.9.3.2.1.2 Buckling calculations

Jacks under compressive loads shall fulfil the following requirements:

9) It may be possible that, due to incorrect adjustment of the hydraulic synchronizing means, abnormally high pressure conditions arise during installation. Account of this shall be taken.

- a) They shall be designed 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 two against buckling is assured.
- b) The calculations shall be carried out according to prEN 81-50, 5.13.
- c) As a deviation from **5.9.3.2.1.2 b)** more complex calculation methods may be used provided that at least the same safety factor is assured.

5.9.3.2.1.3 Tensile stress calculations

Jacks 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 $R_{P0,2}$ is assured.

5.9.3.2.2 Connection car/ram (cylinder)

5.9.3.2.2.1 In case of a direct acting lift the connection between the car and the ram (cylinder) shall be flexible.

5.9.3.2.2.2 The connection between the car and the ram (cylinder) shall be so constructed to support the weight of the ram (cylinder) and the additional dynamic forces. The connection means shall be secured.

5.9.3.2.2.3 In case of a ram made with more than one section, the connections between the sections shall be so constructed to support the weight of the suspended ram sections and the additional dynamic forces.

5.9.3.2.2.4 In the case of indirect acting lifts, the head of the ram (cylinder) shall be guided.

This requirement does not apply for pulling jacks provided the pulling arrangement prevents bending forces on the ram.

5.9.3.2.2.5 In the case of indirect acting lifts, no parts of the ram head guiding system shall be incorporated within the vertical projection of the car roof.

5.9.3.2.3 Limitation of the ram stroke

5.9.3.2.3.1 Means shall be provided to stop the ram with buffered effect in such a position that the requirements of **5.2.5.7.2** can be satisfied.

5.9.3.2.3.2 This limitation of stroke shall either:

- a) Be by means of a cushioned stop, or
- b) Be effected by shutting off the hydraulic supply to the jack by means of a mechanical linkage between the jack and a hydraulic valve: breakage or stretch of such a linkage shall not result in the retardation of the car exceeding the value specified in **5.9.3.2.4.2**.

5.9.3.2.4 Cushioned stop

5.9.3.2.4.1 This stop shall either:

- a) Be an integral part of the jack, or
- b) Consist of one or more devices external to the jack situated outside the car projection, the resultant force of which is exerted on the centre line of the jack.

5.9.3.2.4.2 The design of the cushioned stop shall be such that the average retardation of the car does not exceed $1 g_n$ and that in case of an indirect acting lift the retardation does not result in slack rope or chain.

5.9.3.2.4.3 In cases **5.9.3.2.3.2 b)** and **5.9.3.2.4.1 b)**, a stop shall be provided inside the jack to prevent the ram from leaving the cylinder.

In the case of **5.9.3.2.3.2 b)**, this stop shall be positioned such that the requirements of **5.2.5.7.2** are also satisfied.

5.9.3.2.5 Means of protection

5.9.3.2.5.1 If a jack extends into the ground it shall be installed in a protective tube. If it extends into other spaces it shall be suitably protected.

In the same manner:

- a) The rupture valve(s)/restrictor(s):
- b) The rigid pipes connecting a rupture valve(s)/restrictor(s) with the cylinder:
- c) The rigid pipes connecting rupture valve(s)/restrictor(s) with each other:

shall be protected.

5.9.3.2.5.2 Leak and scrape fluid from the cylinder head shall be collected.

5.9.3.2.5.3 The jack shall be provided with an air venting device.

5.9.3.2.6 Telescopic jacks

The following requirements apply additionally:

5.9.3.2.6.1 Stop shall be provided between successive sections to prevent the rams from leaving their respective cylinders.

5.9.3.2.6.2 In the case of a jack below the car of a direct acting lift, when the car rests on its fully compressed buffers, the clear distance:

- a) Between the successive guiding yokes shall be at least 0,30 m, and
- b) Between the highest guiding yoke and the lowest parts of the car within a horizontal distance of 0,30 m from the vertical projection of the yoke (parts mentioned in **(5.2.5.8.2 b)** excluded) shall be at least 0,30 m.

NOTE See also **5.2.5.8.2 d)**.

5.9.3.2.6.3 The length of the bearing of each section of a telescopic jack without external guidance shall be at least 2 times the diameter of the respective ram.

5.9.3.2.6.4 These jacks shall be provided with mechanical or hydraulic synchronizing means.

5.9.3.2.6.5 When ropes or chains are used as synchronizing means the following requirements apply:

- a) There shall be at least two independent ropes or chains:
- b) The requirements of **5.5.7.1** apply:
- c) The safety factor shall be at least:
 - 1) 12 for ropes:
 - 2) 10 for chains.

- d) The safety factor is the ratio between the minimum breaking load in newtons of one rope (or chain) and the maximum force in this rope (or chain).
- e) For the calculation of the maximum force the following shall be taken into consideration:
- the force resulting from the full load pressure;
 - the number of ropes (or chains).

A device shall be provided which prevents the speed of the car in downward movement exceeding the rated speed downward v_d by more than 0,3 m/s in the event of failure of the synchronizing means.

5.9.3.3 Piping

5.9.3.3.1 General

5.9.3.3.1.1 Piping and fittings, which are subject to pressure (connections, valves, etc.) as in general all components of the hydraulic system shall be:

- a) Appropriate to the hydraulic fluid used;
- b) Designed and installed in such a way to avoid any abnormal stress due to fixing, torsion or vibration;
- c) Protected against damage, in particular of mechanical origin.

5.9.3.3.1.2 Pipes and fittings shall be appropriately fixed and accessible for inspection.

If pipes (either rigid or flexible) pass through walls or floor they shall be protected by means of ferrules, the dimensions of which allow the dismantling, if necessary, of the pipes for inspection.

No coupling shall be sited inside a ferrule.

5.9.3.3.2 Rigid pipes

5.9.3.3.2.1 Rigid pipes and fittings between cylinder and non-return valve or down direction valve(s) 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 $R_{p0,2}$ is assured.

The calculations shall be carried out according to prEN 81-50, 5.13.1.1.

The dimensions and tolerances of the tubes used for the manufacture of the rigid pipes shall be according to the applicable standard of the EN 10305 series

In the thickness calculations a value shall be added of 1,0 mm for the connection between the cylinder and the rupture valve, if any, and 0,5 mm for the other rigid pipes.

5.9.3.3.2.2 When telescopic jacks with more than 2 stages and hydraulic synchronizing means are used an additional safety factor of 1,3 shall be taken into account for the calculation of the pipes and fittings between the rupture valve and the non-return valve or the down direction valve(s).

Pipes and fittings, if any, between the cylinder and the rupture valve shall be calculated on the same pressure basis as the cylinder.

5.9.3.3.3 Flexible hoses

5.9.3.3.3.1 The flexible hose between cylinder and non-return valve or down direction valve shall be selected with a safety factor of at least 8 relating full load pressure and bursting pressure.

5.9.3.3.3.2 The flexible hose and its couplings between cylinder and non-return valve or down direction valve shall withstand without damage a pressure of five times full load pressure, this test to be carried out by the manufacturer of the hose assembly.

5.9.3.3.3.3 The flexible hose shall be marked in an indelible manner with:

- a) The name of the manufacturer or the trade mark:
- b) The test pressure:
- c) The date of the test.

5.9.3.3.3.4 The flexible hose shall be fixed with a bending radius not less than that indicated by the hose manufacturer.

5.9.3.4 Stopping the machine and checking its stopped condition

A stop of the machine due to the operation of an electrical safety device, in conformity with **5.11.2**, shall be controlled as detailed below.

5.9.3.4.1 Upwards motion

For upwards motion, either:

- a) The supply to the electric motor shall be interrupted by at least two independent contactors, the main contacts of which shall be in series in the motor supply circuit, or
- b) The supply to the electric motor shall be interrupted by one contactor, and the supply to the by-pass valves (in accordance with **5.9.3.5.4.2**) shall be interrupted by at least two independent electrical devices connected in series in the supply circuit of these valves.

In this case the temperature monitoring device of the motor and/or the oil (**5.10.4.3**, **5.9.3.11**) need to act on a switching device other than this contactor in order to stop the machine, or;

- c) The electric motor shall be stopped by a PESSRAL consisting of a controlling stage and a stage stopping the motor together fulfilling SIL3 requirements as given in **5.11.2.6**, or
- d) The electric motor shall be stopped by an adjustable speed electrical power drive system with a safe torque off function (STO) according to EN 61800-5-2, 4.2.2.2 fulfilling SIL3 requirements.

5.9.3.4.2 Downwards motion

For downwards motion, the supply to the down direction valve(s) shall be interrupted either:

- a) By at least two independent electrical devices connected in series, or
- b) Directly by the electrical safety device, provided it is suitable rated electrically, or
- c) By a PESSRAL consisting of a controlling stage and a stage interrupting the supply together fulfilling SIL3 requirements as given in **5.11.2.6**.

5.9.3.4.3 Checking of the stopped condition

If whilst the lift is stationary, one of the contactors has not opened the main contacts or one of the electrical devices has not opened, a further start shall be prevented, at the latest at the next change in the direction of motion. A failure of this monitoring function shall have the same result.

5.9.3.5 Hydraulic control and safety devices

5.9.3.5.1 Shut-off valve

5.9.3.5.1.1 A shut-off valve shall be provided. It shall be installed in the circuit which connects the cylinder(s) to the non-return valve and the down direction valve(s).

5.9.3.5.1.2 It shall be located close to the other valves on the lift machine.

5.9.3.5.2 Non-return valve

5.9.3.5.2.1 A non-return valve shall be provided. It shall be installed in the circuit between the pump(s) and the shut-off valve.

5.9.3.5.2.2 The non-return valve shall be capable of holding the lift car with the rated load at any point when the supply pressure drops below the minimum operating pressure.

5.9.3.5.2.3 The closing of the non-return valve shall be effected by the hydraulic pressure from the jack and by at least one guided compression spring and/or by gravity.

5.9.3.5.3 Pressure relief valve

5.9.3.5.3.1 A pressure relief valve shall be provided. It shall be connected to the circuit between the pump(s) and the non-return valve and shall not be possible to bypass it with the exclusion of the hand pump(s). The hydraulic fluid shall be returned to the tank.

5.9.3.5.3.2 The pressure relief valve shall be adjusted to limit the pressure to 140 % of the full load pressure.

5.9.3.5.3.3 If necessary due to high internal losses (head loss, friction), the pressure relief valve may be set to a greater value but not exceeding 170 % of full load pressure. In this case, for the calculations of the hydraulic equipment (including jack) a fictitious full load pressure equal to:

$$\frac{\text{Selected pressure setting}}{1,4}$$

shall be used.

In the buckling calculation the over pressure factor of 1,4 shall then be replaced by a factor corresponding to the increased setting of the pressure relief valve.

5.9.3.5.4 Direction valves

5.9.3.5.4.1 Down direction valves

Down direction valves shall be held open electrically. Their closing shall be effected by the hydraulic pressure from the jack and by at least one guided compression spring per valve.

5.9.3.5.4.2 Up direction valves

If the stopping of the machine is effected in accordance with **5.9.3.4.1 b)**, only by-pass valves shall be used for this. They shall be closed electrically. Their opening shall be effected by the hydraulic pressure from the jack and by at least one guided compression spring per valve.

5.9.3.5.5 Filters

In the circuit between the tank and the pump(s), and in the circuit between the shut-off valve, the non return valve(s) and the down direction valve(s), filters or similar devices shall be installed. The filter or similar device between the shut-off valve, the non return valve(s) and the down direction valve shall be accessible for inspection and maintenance.

5.9.3.6 Checking the pressure

5.9.3.6.1 A pressure gauge shall be provided for indication of system pressure. It shall be connected to the circuit between the non-return valve or the down direction valve(s) and the shut-off valve.

5.9.3.6.2 A gauge shut-off valve shall be provided between the main circuit and the connection for the pressure gauge.

5.9.3.6.3 The connection shall be provided with an internal thread of either M 20 x 1,5 or G 1/2".

5.9.3.7 Tank

The tank shall be designed and constructed so that it is easy:

- a) To check the level of the hydraulic fluid in the tank;
- b) To fill and drain.

On the tank the characteristics of the hydraulic fluid shall be indicated.

5.9.3.8 Speed

5.9.3.8.1 The rated speed upwards v_m and downwards v_d shall not be greater than 1,0 m/s (see 1).

5.9.3.8.2 The speed of the empty car upwards shall not exceed the rated upward speed v_m by more than 8 %, and the speed of the car with rated load downwards shall not exceed the rated downward speed v_d by more than 8 %, in each case this relates to the normal operating temperature of the hydraulic fluid.

For a journey in the upward direction it is supposed that the supply is at its rated frequency and that the motor voltage is equal to the rated voltage of the equipment.

5.9.3.9 Emergency operation

5.9.3.9.1 Moving the car downwards

5.9.3.9.1.1 The lift shall be provided with a manually operated emergency lowering valve allowing the car, even in the case of a power failure, to be lowered to a level where the passengers can leave the car, and located in the relevant machinery space:

- Machine room (5.2.6.3),
- Machinery cabinet (5.2.6.5.1), or
- On the emergency and tests panel(s) (5.2.6.6).

5.9.3.9.1.2 The speed of the car shall not exceed 0,3 m/s.

5.9.3.9.1.3 The operation of this valve shall require a continual manual force.

5.9.3.9.1.4 This valve shall be protected against involuntary action.

5.9.3.9.1.5 The emergency lowering valve shall not cause further sinking of the ram when the pressure falls below a value predetermined by the manufacturer.

In the case of indirect acting lifts where slack rope/chain can occur, manual operation of the valve shall not cause the sinking of the ram beyond that causing the slack rope/chain.

5.9.3.9.1.6 Near the manually operated valve for emergency downward movement there shall be a plate stating:

“Caution - Emergency lowering”.

5.9.3.9.2 Moving the car upwards

5.9.3.9.2.1 A hand-pump which causes the car to move in the upwards direction shall be permanently available for every lift whose car is fitted with a safety gear.

The pump shall be stored in the building where the rescue is to take place. Provisions for the connection of the pump shall be available at every lift machine.

Where not permanently installed clear indications on where the hand pump is located and how to properly connect it shall be available to maintenance and rescue operators.

5.9.3.9.2.2 The hand-pump shall be connected to the circuit between the non-return valve or down direction valve(s) and the shut-off valve.

5.9.3.9.2.3 The hand-pump shall be equipped with a pressure relief valve limiting the pressure to 2,3 times the full load pressure.

5.9.3.9.2.4 Near the hand pump for emergency upward movement there shall be a plate stating:

“Caution - Emergency lifting”.

5.9.3.10 Motor run time limiter

5.9.3.10.1 Hydraulic lifts shall have a motor run time limiter causing the de-energizing of the motor, and keep it de-energized, if the motor does not rotate when a start is initiated.

5.9.3.10.2 The motor run time limiter shall function in a time which does not exceed the smaller of the following two values:

- a) 45 s;
- b) Time for travelling the full travel with rated load, plus 10 s, with a minimum of 20 s if the full travel time is less than 10 s.

5.9.3.10.3 The return to normal operation, shall only be possible by manual resetting. On restoration of the power after a supply disconnection, maintaining the machine in the stopped position is not necessary.

5.9.3.10.4 The motor run time limiter, even if tripped, shall not prevent the inspection operation (5.12.1.5) and the electrical anti-creep system (5.12.1.10).

5.9.3.11 Protection against overheating of the hydraulic fluid

A temperature detecting device shall be provided. This device shall stop the machine and keep it stopped in accordance with 5.10.4.4.

5.10 Electric installations and appliances

5.10.1 General provisions

5.10.1.1 Limits of application

5.10.1.1.1 The requirements of this standard relating to the installation and to the constituent components of the electrical equipment apply to:

- a) The main switch of the power circuit and dependent circuits;
- b) The switch for the car lighting circuit and dependent circuits.

The lift shall be considered as a whole, in the same way as a machine with its built-in electrical equipment.

NOTE The national requirements relating to electricity supply circuits apply as far as the input terminals of the switches. They apply to the whole lighting and socket outlet circuits of the machine room, the pulley room and the lift well and pit.

5.10.1.1.2 The electrical equipment of the lift shall comply with the requirements of EN 60204-1 as referenced in the clauses of this standard.

When no precise information is given, the electrical components and devices shall be:

- a) Suitable for their intended use;
- b) In conformity with relevant EN or IEC standards;
- c) Applied in accordance with the supplier's instructions.

5.10.1.1.3 The electromagnetic compatibility shall comply with the requirements of EN 12015 and EN 12016.

5.10.1.1.4 Electrical actuators shall be selected, mounted, and identified in accordance with EN 61310-3.

5.10.1.1.5 All control gear shall be mounted so as to facilitate its operation and maintenance from the front. Where access is required for regular maintenance or adjustment, the relevant devices shall be located between 0,40 m and 2,0 m above the servicing level. It is recommended that terminals be at least 0,20 m above the servicing level and be so placed that conductors and cables can be easily connected to them. These requirements are not applicable to control gear on the car roof.

5.10.1.1.6 Heat generating components (for example heat sinks, power resistors) shall be so located that the temperature of each component in the vicinity remains within the permitted limit.

If equipment temperatures exceed the limits given in ISO 13732-1 then the graphical symbol IEC 60417-5041 (IEC 60417-12M) shall be fixed on the component/assembly or adjacent to it.



5.10.1.1.7 In the machinery and pulley spaces protection of the electrical equipment against direct contact shall be provided by means of casings providing a degree of protection of at least IP 2X.

5.10.1.2 Protection against electric shock

5.10.1.2.1 General

The protective measures shall comply with the provisions defined by HD 60364-4-41.

NOTE The protective measures depend on the supply network.

Enclosures that do not otherwise clearly show that they contain electrical equipment that can give rise to a risk of electric shock shall be marked with the graphical symbol IEC 60417-5036 (IEC 60417-12M):

The warning sign shall be plainly visible on the enclosure door or cover:



5.10.1.2.2 Basic protection (protection against direct contact)

Additionally to the requirements of 5.10.1.1.7 the following applies:

- a) When equipment is accessible to non authorized persons, a minimum degree of protection against direct contact corresponding to IP2XD shall be applied;
- b) When enclosures containing hazardous live parts are opened for rescue operations, access to hazardous voltage shall be prevented by minimum degree of protection of IPXXB;
- c) For other enclosures containing hazardous live parts EN 50274 applies.

5.10.1.2.3 Additional protection

Additional protection by means of a residual current protective device (RCD) with a rated residual operating current not exceeding 30 mA shall be provided for socket-outlets depending on the circuit(s) according to 5.10.1.1.1 b).

5.10.1.2.4 Protection against residual voltages

Chapter 6.2.4 of EN 60204-1 applies.

5.10.1.3 Insulation resistance of the electrical installation (HD 60364-6)

5.10.1.3.1 The insulation resistance shall be measured between all live conductor and earth for all circuits:

- a) Which are not PELV;
- b) Exceeding 100 VA.

Minimum values of insulation resistance shall be taken from **Table 15**.

Table 15 - Insulation resistance

Nominal circuit voltage (V)	Test voltage (d.c.) (V)	Insulation resistance (MΩ)
SELV ^a and PELV ^b	250	≥ 0,5
≤ 500 including FELV ^c	500	≥ 1,0
> 500	1000	≥ 1,0
^a SELV: Safety Extra Low Voltage ^b PELV: Protective Extra Low Voltage ^c FELV: Failure Extra Low Voltage		

When the circuit includes electronic devices, phase and neutral conductors shall be connected together during measurement.

5.10.1.3.2 The mean value in direct current or the r.m.s. value in alternating current of the voltage between conductors or between conductors and earth, shall not exceed 250 V for control and safety circuits.

5.10.2 Incoming supply conductor terminations

Chapter 5.1 and 5.2 of EN 60204-1 applies.

5.10.3 Contactors, contactor relays -, components of safety circuits

5.10.3.1 Contactors and contactor relays

5.10.3.1.1 The main contactors, i.e. those necessary to stop the machine as per **5.9.2.5**, shall comply with EN 60947-4-1 and shall be selected according the appropriate utilisation category.

The main contactors with their associated short-circuit protective devices shall have type "1" coordination in accordance with EN 60947-4-1, 8.2.5.1.

Main contactors directly controlling motors shall, in addition, allow 10 % of starting operations to be made as inching/jogging, i.e. 90 % AC-3 + 10 % AC-4.

These contactors shall have mirror contact(s) according EN 60947-4-1, Annex F in order to ensure the functionality according to **5.9.2.5.1**, **5.9.2.5.2.1**, **5.9.2.5.2.2 b) 1)**, **5.9.2.5.3 a)** and **5.9.2.5.3 b) 1)**, i.e. detect the non-opening of a main contact.

5.10.3.1.2 If contactor relays are used to operate the main contactors, those contactor relays shall comply with EN 60947-5-1.

If relays are used to operate the main contactors, those relays shall comply with EN 61810-1.

They shall be selected according to the following utilisation categories:

- a) AC-15 for controlling A.C. contactors;
- b) DC-13 for controlling D.C. contactors.

5.10.3.1.3 For the main contactors referred to in **5.10.3.1.1**, for the contactor relays and relays referred to in **5.10.3.1.2** and for electrical devices interrupting the current to the brake according **5.9.2.2.2.3**, it is necessary for the measures taken to comply with **5.11.1.1 f), g), h), i)**, that:

- a) Auxiliary contacts of main contactors are mechanically linked contact elements according to Annex L of EN 60947-5-1;
- b) Contactor relays comply with Annex L of EN 60947-5-1;
- c) Relays comply with EN 50205, in order to ensure that any make contact(s) and any break contact(s) cannot be in closed position simultaneously.

5.10.3.2 Components of safety circuits

5.10.3.2.1 When contactor relays or relays as per **5.10.3.1.2** are used, the requirements of **5.10.3.1.3** apply.

5.10.3.2.2 Devices used in safety circuits or connected after electrical safety devices shall meet the requirements of

- a) Pollution degree 3;
- b) Overvoltage category III,

for creepage distances and clearances with respect of the nominal voltage of the circuit where they are used (see EN 60664-1).

If the protection of the device is IP5X or better, pollution degree 2 may be used.

For the electrical separation to other circuits, EN 60664-1 applies in the same way as above with respect to the r.m.s. working voltage between adjacent circuits.

Devices meeting the requirements of **5.11.2.2.3** for creepage distances and clearances or which themselves fulfil the requirements of EN 60947-4-1 and EN 60947-5-1 fulfil the above mentioned requirements.

For printed circuit boards requirements as mentioned in prEN 81-50, 5.15, Table 3 (3.6) are applicable.

5.10.4 Protection of electrical equipment

5.10.4.1 For the protection of electrical equipment EN 60204-1:2006, clause 7.1 to 7.4 applies.

5.10.4.2 Protection of motors against overheating shall be provided for each motor. The exception for motors below 0,5 kW of EN 60204-1 does not apply.

5.10.4.3 If the design temperature of electrical equipment provided with a temperature monitoring device is exceeded and the lift should not continue to operate, then the car shall stop at a landing such as the passengers can leave the car. An automatic return to normal operation of the lift shall only occur after sufficient cooling down.

5.10.4.4 If the design temperature of the hydraulic machine motor and/or oil provided with a temperature monitoring device is exceeded and the lift should not continue to operate, then the car shall stop directly and return to the bottom landing such as the passengers can leave the car. An automatic return to normal operation of the lift shall only occur after sufficient cooling down.

5.10.5 Main switches

5.10.5.1 For each lift, a main switch capable of breaking the supply to the lift on all the live conductors shall be provided. This switch shall comply with the requirements of EN 60204-1:2006, 5.3.2 a) to d), 5.3.3 and 5.3.4.

5.10.5.1.1 This switch shall not cut the circuits feeding:

- a) Car lighting and ventilation;
- b) Socket outlet on the car roof;
- c) Lighting of machinery and pulley spaces;
- d) Socket outlet in the machinery and pulley spaces and in the pit;
- e) Lighting of the lift well;
- f) Remote alarm systems in accordance with EN 81-28.

5.10.5.1.2 This switch shall be located:

- a) In the machine room where it exists;
- b) Where no machine room exists, in the control cabinet, except if this cabinet is mounted in the well, or
- c) At the emergency and tests panel(s) (**5.2.6.6**) when the control cabinet is mounted in the well. If the emergency panel is separate from the test panel, the switch shall be at the emergency panel.
 - d) If the main switch is not easily accessible from the control cabinet cabinet(s), the drive system or the lift machine device(s) according to EN 60204-1:2006, 5.5 shall be provided for disconnecting (isolating) electrical equipment to enable work to be carried out when it is de-energised and isolated.

5.10.5.2 The control mechanism for the main switch shall be easily and rapidly accessible from the entrance(s) to the machine room. If the machine room is common to several lifts, the control mechanism of the main switches shall allow the lift concerned to be identified easily.

If the machine room has several points of access, or if the same lift has several machine rooms each with its own point(s) of access, a circuit breaker contactor may be used, release of which shall be controlled by an electric safety device, in conformity with **5.11.2**, inserted in the supply circuit to the coil of the circuit breaker contactor.

The re-engagement of the circuit breaker contactor shall not be carried out or made possible except by means of the device, which caused its release. The circuit-breaker contactor shall be used in conjunction with a manually controlled isolating switch.

5.10.5.3 Each incoming source of supply to the lift shall have a supply disconnecting device according to 5.3 of EN 60204-1:2006 located close to the main switch.

In the case of a group of lifts, if, after the opening of the main switch for one lift, parts of the operating circuits remain live, these circuits shall be capable of being separately isolated in the machine room, if necessary by breaking the supply to all the lifts in the group.

5.10.5.4 Any capacitors to correct the power factor shall be connected before the main switch of the power circuit.

If there is a risk of over-voltage, when for example the motors are connected by very long cables, the switch of the power circuit shall also interrupt the connection to the capacitors.

5.10.5.5 While the main switch has disconnected the supply to the lift, any automatic operated movement of the lift (e.g. automatic battery powered operation) shall be prevented.

5.10.6 Electric wiring

5.10.6.1 Conductors and cables

Conductors and cables shall be selected according to EN 60204-1:2006, clauses 12.1, 12.2, 12.3 and 12.4.

Travelling cables shall be in conformity with EN 50214. Where the lift equipment fall outside of the scope of EN 50214, the travelling cables selected shall be at least of equivalent properties.

5.10.6.2 Cross-sectional area of conductors

To ensure adequate mechanical strength the cross-sectional area of conductors should not be less than as shown in Table 5 in EN 60204-1:2006, except single core wires inside protective conduit, trunking or similar fittings shall not be less than 0,75 mm².

5.10.6.3 Wiring practices

The general requirements of EN 60204-1:2006, clause 13.1.1, 13.1.2 and 13.1.3 applies.

5.10.6.3.1 Conductors and cables shall be installed in conduits or trunkings or equivalent mechanical protection.

Double insulated conductors and cables can be installed without conduits or trunkings if they are located as to avoid accidental damage.

5.10.6.3.2 The requirement **5.10.6.3.1** need not apply to:

a) Conductors or cables not connected to electric safety devices provided that:

- 1) they are not subject to a rated output of more than 100 VA;
- 2) they are part of SELV or PELV circuits;

b) The wiring of operating or distribution devices in cabinets or on panels:

- 1) either between different pieces of electric equipment, or
- 2) between these pieces of equipment and the connection terminals.

5.10.6.3.3 If connections, connection terminals and connectors are not located in protective enclosure, their IP2X protection shall be maintained when connected and disconnected and they shall be properly fixed to prevent unintended disconnection.

5.10.6.3.4 If, after opening of the main switch or switches of a lift, some connection terminals remain live and if the voltage exceeds 25 VAC or 60 VDC, a permanent warning label according to EN 60204-1:2006, clause 16, shall be appropriately placed in proximity to the main switch or switches and a corresponding statement shall be included in the maintenance manual.

Furthermore, for circuits connected to such live terminals, the requirements of labelling, separation or identification by colour shall be fulfilled as given in EN 60204-1:2006, sub-clause 5.3.5.

5.10.6.3.5 Connection terminals whose accidental interconnection could lead to a dangerous malfunction of the lift shall be clearly separated unless their method of construction obviates this risk.

5.10.6.3.6 In order to ensure continuity of mechanical protection, the protective sheathing of conductors and cables shall fully enter the casings of switches and appliances, or shall terminate in a suitably constructed gland.

NOTE Enclosed frames of landing and car doors are regarded as appliance casings.

However, if there is a risk of mechanical damage due to movement of parts or sharp edges of the frame itself, the conductors connected to the electric safety device shall be protected mechanically.

5.10.6.4 Connectors

Plug socket combinations shall comply with the requirements of EN 60204-1:2006, sub clause 13.4.5 except c), d) and i).

Connectors and devices of the plug-in type placed in the circuits of electrical safety devices shall be so designed that it shall not be possible to insert them in a position which leads to a dangerous situation.

5.10.7 Lighting and socket outlets

5.10.7.1 The electric lighting supplies to the car, the well and the machinery and pulley spaces, and emergency and test panel(s) (**5.2.6.6**), shall be independent of the supply to the machine, either through another circuit or through connection to the machine supply circuit on the supply side of the main switch or the main switches laid down in **5.10.5**.

5.10.7.2 The supply to socket outlets required on the car roof, in the machinery and pulley spaces and in the pit, shall be taken from the circuits referred to in **5.10.7.1**.

These socket outlets shall be of type 2 P + PE, 250 V, supplied directly.

The use of the above socket outlets does not imply that the supply cable has a cross-sectional area corresponding to the rated current of the socket outlet. The cross-sectional area of the conductors may be smaller, provided that the conductors are correctly protected against excess currents.

5.10.8 Control of the supply for lighting and socket outlets

5.10.8.1 A switch shall control the supply to the circuit for lighting and socket outlets of the lift car. If the machine room contains several lift machines it is necessary to have one switch per car. This switch shall be located close to the corresponding main power switch.

5.10.8.2 In the machinery spaces, other than those in the well, a switch shall be located near to its access(es) controlling the supply for lighting. See also **5.2.1.4.2**.

Well lighting switches (or equivalent) shall be located both in the pit and close to the main switch so that the well light can be operated from either location.

5.10.8.3 Each circuit controlled by the switches laid down in **5.10.8.1** and **5.10.8.2** shall have its own protection devices.

5.10.9 Protective earthing

The requirements of HD 60364-4-41:2007, 411.3.1.1 apply.

5.10.10 Electrical identification

All control devices, and electrical components shall be plainly identified with the same reference designation as shown in the electrical diagrams.

The necessary fuse specifications such as value and type shall be marked on the fuse or on or near the fuse holders.

In the case of the use of multiple wire connectors, only the connector, and not the wires, needs to be marked.

5.10.11 Marking of equipment

A name plate giving the following information shall be attached adjacent to the incoming supply:

- a) Name or trade mark of supplier;
- b) Year of manufacture;
- c) Serial number;
- d) Rated voltage, number of phases and frequency (if a.c.), and full-load current for each supply;
- e) Short-circuit rating of the equipment.

5.11 Protection against electric faults; failure analysis; electric safety devices

5.11.1 Protection against electric faults; failure analysis

Any single fault listed in 5.11.1.1 in the electric equipment of a lift, if it cannot be excluded under conditions described in 5.11.1.2 and/or prEN 81-50, 5.15 in shall not, on its own, be the cause of a dangerous malfunction of the lift.

For safety circuits, see 5.11.2.3.

5.11.1.1 Faults envisaged:

- a) Absence of voltage;
- b) Voltage drop;
- c) Loss of continuity of a conductor;
- d) Insulation fault in relation to the metalwork or the earth;
- e) Short circuit or open circuit, change of value or function in an electrical component such as for instance resistor, capacitor, transistor, lamp, etc.;
- f) Non-attraction or incomplete attraction of the moving armature of a contactor or relay;
- g) Non-separation of the moving armature of a contactor or relay;
- h) Non-opening of a contact;
- i) Non-closing of a contact;
- j) Phase reversal.

5.11.1.2 The non-opening of a contact need not be considered in the case of safety contacts conforming to the requirements of 5.11.2.2.

5.11.1.3 The earthing to the metalwork or the earth of a circuit in which there is an electric safety device shall:

- a) Either cause the immediate stopping of the machine; or
- b) Prevent restarting of the machine after the first normal stop.

Return to service shall only be possible by manual resetting.

An earth fault in the circuit controlling the brake according to **5.9.2.2.3** shall immediately initiate stopping of the machine and de-energizing of the brake.

5.11.2 Electric safety devices

5.11.2.1 General provisions

5.11.2.1.1 During operation of one of the electric safety devices required in several clauses, movement of the machine shall be prevented or it shall be caused to stop immediately as indicated in **5.11.2.4**.

A list of such devices is given in **Annex A**.

The electric safety devices shall consist of:

- a) Either one or more safety contacts satisfying **5.11.2.2** directly cutting the supply to the contactors referred to in **5.9.2.6** or their relay-contactors; or
- b) Safety circuits satisfying **5.11.2.3**, consisting of one or a combination of the following:
 - 1) either one or more safety contacts satisfying **5.11.2.2** not directly cutting the supply to the contactors referred to in **5.9.2.6** or their relay-contactors;
 - 2) contacts not satisfying the requirements of **5.11.2.2**;
 - 3) components in accordance with prEN 81-50, 5.15;
 - 4) Programmable electronic systems in safety related applications in accordance with **5.11 2.6**.

5.11.2.1.2 Apart from exceptions permitted in this standard (see **5.12.1.4**, **5.12.1.5**, **5.12.1.6**, **5.12.1.8** and **5.12.1.10**), no electric equipment shall be connected in parallel with an electric safety device.

Connections to different points of the electric safety chain are only permitted for gathering information. The devices used for that purpose shall fulfil the requirements for safety circuits according to **5.11.2.3** except for the tests in accordance with prEN 81-50, 5.6.

5.11.2.1.3 The effects of internal or external induction or capacity shall not cause failure of electric safety devices.

5.11.2.1.4 An output signal emanating from an electric safety device shall not be altered by an extraneous signal emanating from another electric device placed further down the same circuit, which would cause a dangerous condition to result.

5.11.2.1.5 In safety circuits comprising two or more parallel channels, all information other than that required for parity checks shall be taken from one channel only.

5.11.2.1.6 Circuits which record or delay signals shall not, even in event of fault, prevent or appreciably delay the stopping of the machine through the functioning of an electric safety device, i. e. the stopping shall occur in the shortest time compatible with the system.

5.11.2.1.7 The construction and arrangement of the internal power supply units shall be such as to prevent the appearance of false signals at outputs of electric safety devices due to the effects of switching.

5.11.2.2 Safety contacts

Safety contacts shall comply with the requirements of EN 60947-5-1:2004, Annex K with a minimum protection degree of IP4X and a mechanical durability suitable for its purpose (at least 10^6 operating cycles) or shall fulfil the following requirements:

5.11.2.2.1 The operation of a safety contact shall be by positive separation of the circuit-breaking devices. This separation shall occur even if the contacts have welded together.

The design of a safety contact shall be such as to minimize the risk of a short-circuit resulting from component failure.

NOTE Positive opening is achieved when all the contact-breaking elements are brought to their open position and when for a significant part of the travel there are no resilient members (e.g. springs) between the moving contacts and the part of the actuator to which the actuating force is applied.

5.11.2.2.2 The safety contacts shall be provided for a rated insulation voltage of 250 V if the enclosure provides a degree of protection of at least IP 4X, or 500 V if the degree of protection of the enclosure is less than IP 4X.

The safety contacts shall belong to the following categories as defined in EN 60947-5-1:2004:

- c) AC-15 for safety contacts in A.C. circuits;
- d) DC-13 for safety contacts in D.C. circuits.

5.11.2.2.3 If the degree of protection is equal or less than IP4X, the clearances shall be at least 3 mm, the creepage distances at least 4 mm and the distances for breaking contacts at least 4 mm after separation. If the protection is better than IP4X the creepage distance can be reduced to 3 mm.

5.11.2.2.4 In the case of multiple breaks, the distance after separation between the contacts shall be at least 2 mm.

5.11.2.2.5 Abrasion of conductive material shall not lead to short circuiting of contacts.

5.11.2.3 Safety circuits

5.11.2.3.1 Safety circuits shall comply with the requirements of **5.11.1** relative to the appearance of a fault.

5.11.2.3.2 Furthermore, as illustrated by **Figure 14** the following requirements shall apply:

- a) If one fault combined with a second fault can lead to a dangerous situation, the lift shall be stopped at the latest at the next operating sequence in which the first faulty element should participate.

All further operation of the lift shall be impossible as long as this fault persists.

The possibility of the second fault occurring after the first, and before the lift has been stopped by the sequence mentioned above, is not considered;

- b) If two faults which by themselves do not lead to a dangerous situation, when combined with a third fault can lead to a dangerous situation, the lift shall be stopped at the latest at the next operating sequence in which one of the faulty elements should participate.

The possibility of the third fault leading to a dangerous situation before the lift has been stopped by the sequence mentioned above is not considered;

- c) If a combination of more than three faults is possible, then the safety circuit shall be designed with multiple channels and a monitoring circuit checking the equal status of the channels.

If a different status is detected the lift shall be stopped.

In case of two channels the function of the monitoring circuit shall be checked prior to a re-start of the lift at the latest, and in case of failure, re-starting shall not be possible;

- d) On restoration of the power supply after it has been disconnected, maintenance of the lift in the stopped position is not necessary, provided that during the next sequence stopping is reimposed in the cases covered by 5.11.2.3.2 a), b) and c);
- e) In redundancy-type circuits measures shall be taken to limit as far as possible the risk of defects occurring simultaneously in more than one circuit arising from a single cause.

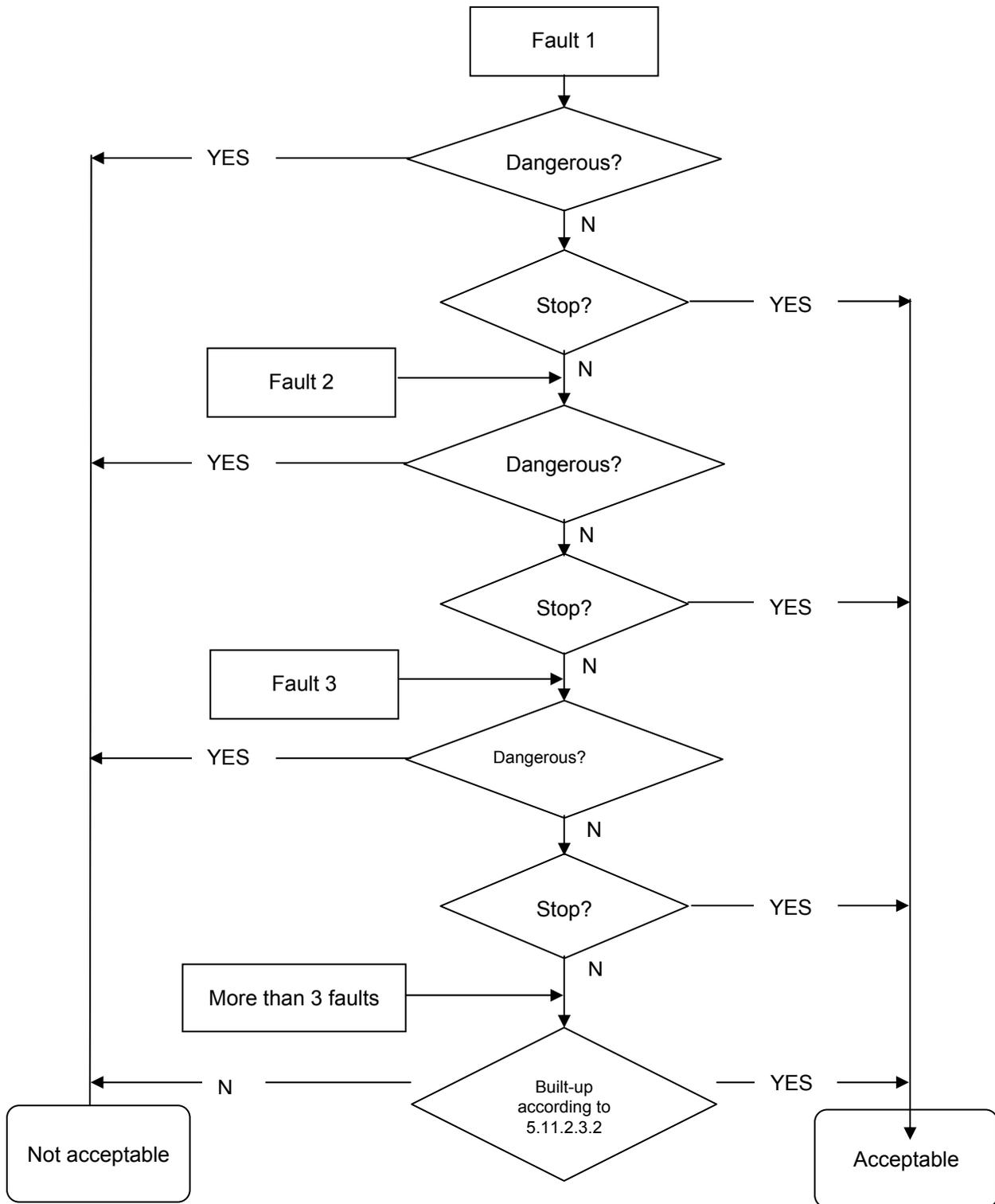


Figure 14 - Diagram for assessing safety circuits

5.11.2.3.3 Safety circuits containing electronic components are regarded as safety components and shall be verified according to the requirements in prEN 81-50, 5.6.

5.11.2.3.4 On safety devices containing electronic components a data plate shall be fixed indicating:

- a) The name of the manufacturer of the safety component;
- b) The type examination certificate number;
- c) The type of electric safety device.

5.11.2.4 Operation of electric safety devices

An electric safety device shall prevent the setting in motion of the machine or initiate immediately its stopping. The electric supply to the brake shall likewise be broken.

In the case of horizontally sliding doors, as preparation to a normal operation (5.12.1.1), it is however permitted, when the car is in the door zone, to energize the machine and the electro-mechanical brake if the landing and car doors are about to terminate their closing movement, and the gap at the leading edges of the panels does not exceed 10 mm.

The electric safety devices shall act directly on the equipment controlling the supply to the machine in accordance with the requirements of 5.9.2.6 and on the equipment controlling the supply to the electromechanical brake in accordance with 5.9.2.2.2.3 a).

If relays or contactor relays according to 5.10.3.1.3 are used to control the main contactors of the machine, these relays or contactor relays shall be considered as equipment directly controlling the supply to the machine for starting and stopping. The monitoring of these relays or contactor relays shall be done as defined in 5.9.2.6.

5.11.2.5 Actuation of electric safety devices

The components actuating the electric safety devices shall be built so that they are able to function properly under the mechanical stresses resulting from continuous normal operation.

If the devices for actuating electric safety devices are through the nature of their installation accessible to persons, they shall be so built that these electric safety devices cannot be rendered inoperative by simple means.

NOTE A magnet or a bridge piece is not considered a simple means.

In the case of redundancy-type safety circuits, it shall be ensured by mechanical or geometric arrangements of the transmitter elements that a mechanical fault shall not cause loss of redundancy.

For transmitter elements of safety circuits, the requirements of prEN 81-50, 5.6.3.1.1 apply.

5.11.2.6 Programmable electronic systems in safety related applications (PESSRAL)

Tables A.1 and A.2 give the safety integrity level for each electric safety device.

Programmable electronic systems designed in accordance with 5.11.2.6 cover the requirements of 5.11.2.3.2.

The minimum requirements of the safety functions common to all SIL's are listed in prEN 81-50, 5.16.

To avoid unsafe modification, measures to prevent unauthorized access to the program code and safety related data of PESSRAL shall be provided, e.g. using EPROM, access code, etc.

If a PESSRAL and a non safety related system share the same PCB, the requirements of **5.10.3.2** shall apply for the separation of the two systems.

If a PESSRAL and a non safety related system share the same hardware, the requirements for PESSRAL shall be met.

When the design of a safety device (listed in **Annex A**) includes software, it shall be possible to identify the failure state of the device, either by built-in system or by an external tool. If this external tool is a special tool, it shall be available on the site.

5.12 Controls - Final limit switches - Priorities

5.12.1 Control of lift operations

Control shall be effected electrically.

5.12.1.1 Control of normal operation

5.12.1.1.1 This control shall be by the aid of buttons or similar devices, such as touch control, magnetic cards, etc. These shall be placed in boxes, such that no live parts are accessible to the user.

The colour yellow shall not be used for other control devices than the alarm initiation device.

5.12.1.1.2 The control devices shall be clearly identified by reference to their function.

NOTE For this purpose it is recommended to follow the requirements of EN 81-70:2003, 5.4.

5.12.1.1.3 Visible notices or signals shall permit persons in the car to know at which landing the lift has stopped.

5.12.1.1.4 The stopping accuracy of the car shall be ± 10 mm and a levelling accuracy of ± 20 mm shall be maintained. If, during e.g. loading and unloading phases, the value of 20 mm is exceeded, it shall be corrected.

5.12.1.2 Load control

5.12.1.2.1 The lift shall be fitted with a device to prevent normal starting, including re-levelling, in the event of overload in the car.

5.12.1.2.2 The overload is considered to occur when the rated load is exceeded by 10 % with a minimum of 75 kg.

5.12.1.2.3 In the event of overload:

- a) Users shall be informed by an audible and a visible signal in the car;
- b) Automatic power operated doors shall be brought into the fully open position;
- c) Manually operated doors shall remain unlocked;
- d) Any preliminary operation in accordance with **5.11.2.4** and shall be nullified.

5.12.1.3 Monitoring the normal slowdown of the machine in case of reduced buffer stroke

5.12.1.3.1 In the case of **5.8.2.2.2**, devices shall check that the slowdown is effective before arrival at terminal landings.

5.12.1.3.2 If the slowdown is not effective these devices shall interrupt the power supply of the machine and the brake.

5.12.1.3.3 The devices for monitoring the speed shall comply with the following:

- a) They shall be operated by a device directly coupled to the car;
- b) The information relating to the car position shall not depend on devices driven by traction or friction;
- c) If a connection by tape, chain or rope is used to transmit the position of the car, breakage of or slack in such a connecting device shall cause the machine to stop through the action of an electric safety device in conformity with **5.11.2**.

5.12.1.3.4 The control and functioning of these devices shall be so designed that together with the normal speed regulation system there results a slowdown control system complying with the requirements of **5.11.2**.

5.12.1.3.5 Information for use and warnings shall be fixed on or near means to operate the machine brake manually.

5.12.1.4 Control of levelling and re-levelling with doors open

In the specific case referred to in **5.3.8.2.2** movement of the car with landing and car doors open is permitted for levelling and re-levelling on condition that:

- a) The movement is limited to the unlocking zone (**5.3.11.1**):

All movement of the car outside the unlocking zone shall be prevented by at least one switching device mounted in the bridge or shunt of the door and lock electric safety devices;

- b) This switching device shall:

- either be a safety contact in conformity with **5.11.2.2**; or
- be connected in such a way as to satisfy the requirements for safety circuits in **5.11.2.3**;

- c) If the operation of the switches is dependent upon a device which is indirectly mechanically linked to the car, e.g. by rope, belt or chain, the breaking of or slack in the connecting link shall cause the machine to stop through the action of an electric safety device in conformity with **5.11.2**;
- d) During levelling operations, the means for making the electric safety devices of doors inoperative shall only function after the stopping signal for this landing has been given;
- e) The speed of levelling does not exceed 0,80 m/s. In addition on lifts with manually controlled landing doors, there shall be a check that:
 - 1) For machines whose maximum speed of rotation is determined by the fixed frequency of the supply, the control circuit for the low speed movement only has been energized;
 - 2) For other machines, the speed at the moment the unlocking zone is reached does not exceed 0,8 m/s;
- f) The speed of re-levelling does not exceed 0,30 m/s.

5.12.1.5 Control of inspection operation

5.12.1.5.1 Design requirements

5.12.1.5.1.1 To facilitate inspection and maintenance, a readily accessible inspection control station shall be permanently available:

- a) On the car roof (**5.4.8**);
- b) In the pit (**5.2.1.5.1**);
- c) In the car in the case of **5.2.6.4.3.4**;
- d) On a platform in the case of **5.2.6.4.5.6**.

5.12.1.5.1.2 The inspection control station shall consist of:

- a) A switch (inspection operation switch) which shall satisfy the requirements for electric safety devices (**5.11.2**).

This switch, which shall be bi-stable, shall be protected against involuntary operation;

- b) Direction push buttons "UP" and "DOWN" protected against accidental operation with the direction of movement clearly indicated;
- c) A push button "RUN" protected against accidental operation;
- d) A stopping device in conformity with **5.12.1.11**.

The control station may also incorporate special switches protected against accidental operation for controlling the mechanism of doors from the car roof.

5.12.1.5.1.3 The inspection control station shall have a minimum degree of protection of IP XXD (EN 60529).

Rotary control switches shall have a means of prevention of rotation of the stationary member. Friction alone shall not be considered sufficient.

5.12.1.5.2 Functional Requirements:

5.12.1.5.2.1 Inspection operation switch

Engagement of the inspection operation switch shall satisfy the following conditions for functioning simultaneously:

- a) Neutralize the normal operation controls;
- b) Neutralize emergency electrical operation (**5.12.1.6**);
- c) Levelling and re-levelling (**5.12.1.4**, **5.12.1.1.4**) shall be disabled;
- d) Any automatic movement of power operated doors shall be stopped immediately. Closing of the door(s) shall depend on:
 - 1) the operation of a direction pushbutton for car movement; or
 - 2) additional switches protected against accidental operation for controlling the mechanism of doors.

- e) The car speed shall not exceed 0,63 m/s;
- f) Before the free vertical distance above the standing areas on the car roof is 2,0 m in inspection operation from the car roof:
 - 1) the speed shall be reduced to 0,30 m/s; or
 - 2) the lift shall be stopped in upwards movement. After stopping of the lift, further upwards movements shall be possible after the up button of the inspection control box is pushed again;
- g) Before the free vertical distance above the standing areas in the pit is 2,0 m in inspection operation from the pit:
 - 1) The speed shall be reduced to 0,30 m/s; or
 - 2) The lift shall be stopped in downwards movement. After stopping of the lift, further downwards movements shall be possible after the down button of the inspection control box is pushed again;
- h) The limits of normal car travel shall not be overrun, i.e. not exceed the stopping positions in normal operation;
- i) The operation of the lift shall remain dependent on the safety devices;
- j) If more than one inspection control station is switched to "INSPECTION", it shall not be possible to move the car from any of them unless the same push buttons on the inspection control stations are operated simultaneously.

The return to normal operation of the lift shall only be effected by another operation of the inspection operation switch(es).

Precautions shall be taken to prevent all involuntary movement of the car in the event of one of the faults listed in 5.11.1.1 appearing in the circuit(s) involved in inspection operation.

5.12.1.5.2.2 Push buttons

The movement of the car in inspection operation shall solely depend on constant pressure on a direction and the "RUN" push-button.

- a) In case of PESSRAL is used in conjunction with inspection operation switch, correct operation of push buttons shall be monitored by this PESSRAL; or
- b) The contact of the inspection operation switch acting on the equipment controlling the supply to the machine according to 5.11.2.4 shall be bypassed by a series connection of a direction and the "RUN" push-button.

These push buttons shall belong to the following categories as defined in EN 60947-5-1:2004:

- AC-15 for safety contacts in A.C. circuits;
- DC-13 for safety contacts in D.C. circuits.

The durability shall be at least 1 000 000 operating cycles mechanical and electrical related to the applied load.

It shall be possible to operate the "RUN" button and a direction button with one hand simultaneously.

5.12.1.5.2.3 Inspection control station(s)

On the inspection control station(s) the following information shall be given (see **Figure 15**):

a) For normal operation, the following pictogram:



b) for inspection operation, the following pictogram:



on or near the inspection operation switch:

c) The direction of motion identified by colours:

- White for the UP direction button;
- Black for the DOWN direction button,

and supported by the following symbols on the inspection buttons:

— UP: IEC 60417- 5022 black in colour;



— DOWN: IEC 60417- 5022 white in colour;



d) The RUN button identified by BLUE colour, supported by the symbol IEC 60417- 5023:

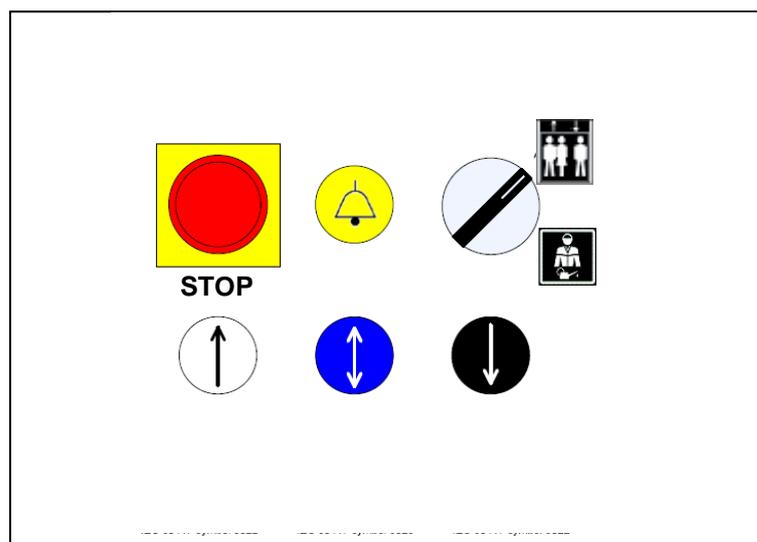


Figure 15 - Inspection control station - Controls and pictograms

5.12.1.6 Control of emergency electrical operation

5.12.1.6.1 If a means of emergency electrical operation is required in accordance with **5.9.2.3.2** an emergency electrical operation switch in conformity with **5.11.2** shall be installed. The machine shall be supplied from the normal main supply or from the standby supply if there is one.

The following conditions shall be satisfied simultaneously:

- a) Operation of the emergency electrical operation switch shall permit the control of car movement by constant pressure on buttons protected against accidental operation. The direction of movement shall be clearly indicated;
- b) After operation of the emergency electrical operation switch, all movement of the car except that controlled by this switch shall be prevented;
- c) The effects of the emergency electrical operation shall be overridden by switching on the inspection operation;
- d) The emergency electrical operation switch shall render inoperative by itself or through another electric switch in conformity with **5.11.2** the following electric devices:
 - 1) Those mounted on the safety gear, according to **5.6.2.1.5**;
 - 2) Those of the overspeed governor, according to **5.6.2.2.1.6 a) and b)**;
 - 3) Those mounted on the ascending car overspeed protection means, according to **5.6.6.5**;
 - 4) Those mounted on the buffers, according to **5.8.2.2.4**;
 - 5) Final limit switches, according to **5.12.2**;
 - 6) Those used for controlling the abnormal relative extension of rope or chain in the case of positive drive lifts according to **5.9.2.7**;
 - 7) Those mounted on pawl devices, according to **5.6.5**;
- e) The emergency electrical operation switch and its push-buttons shall be so placed that the machine can be observed directly or by display devices (**5.2.6.6.2 c)**);
- f) The car speed shall not exceed 0,30 m/s;
- g) The effects of the emergency electrical operation shall be overridden by switching on the inspection operation as follows:
 - 1) When actuating the emergency electrical operation switch whilst the inspection operation is actuated, the emergency electrical operation is inactive, the up-/down-buttons of the inspection operation shall remain effective;
 - 2) When actuating the inspection operation whilst the emergency electrical operation is actuated, the emergency electrical operation becomes inactive, the up-/down-buttons of the inspection operation shall become effective.

5.12.1.6.2 The emergency electrical operation means shall have a minimum degree of protection of IP XXD (EN 60529:1992).

Rotary control switches shall have a means of prevention of rotation of the stationary member. Friction alone shall not be considered sufficient.

5.12.1.7 Protection for maintenance operations

The control system shall be provided with means to prevent the lift from answering to landing calls, to disable the automatic door operation and give at least terminal floor calls for maintenance. The means shall be clearly indicated and only accessible to authorized persons.

5.12.1.8 Landing and car door bypass device

5.12.1.8.1 For maintenance on landing door-, car door- and door locking contacts a bypass device shall be provided in the control panel or emergency and test panel.

5.12.1.8.2 The device(s) shall be a switch protected against unintended use by mechanically movable means (e.g. cover, security cap) permanently installed, or a plug socket combination which shall satisfy the requirements for electric safety devices according **5.11.2**.

5.12.1.8.3 The landing and car door bypass devices shall be identifiable by the word "BYPASS" written on or near to them. In addition, the contacts to be bypassed shall be indicated with the identifiers according to the electrical diagrams.

The activation state of the bypass device(s) shall be clearly indicated.

The following conditions for functioning shall be satisfied:

- a) The normal operation controls, including the operation of any automatic power operated doors shall be neutralized;
- b) Bypassing of the contacts of the landing doors (**5.3.9.4**, **5.3.11.2**), the landing door locks (**5.3.9.1**, **5.3.9.2**), the car door(s) (**5.3.13.2**) and the car door locks (**5.2.5.3.2 c**)) shall be possible;
- c) The contacts of the car door(s) and landing doors shall not be bypassed at the same time;
- d) A separate monitoring signal shall be provided to check that the car door(s) is/are in the closed position in order to allow a car movement with bypassed car door closed contact(s). This applies also if the car door closed contact(s) and the car door locked contact(s) are combined;
- e) In case of manually operated landing doors, the contacts of the landing doors (**5.3.9.4**) and the landing door locks (**5.3.9.1**) shall not be bypassed at the same time;
- f) Movement of the car shall only be possible in inspection operation (**5.12.1.5**) or electrical emergency operation (**5.12.1.6**);
- g) An audible signal at the car and a flashing light under the car shall be activated during movement.

5.12.1.9 Prevention of normal operation of the lift with faulty door contact circuits

Means shall be provided to monitor the position of car doors while the car is in the unlocking zone, in order to prevent normal operation of the car if:

- a) The car door is not closed, even if a car door contact is bypassed;
- b) The lock contact of the landing door is bypassed

except during operations permitted in 5.12.1.4.

5.12.1.10 Electrical anti-creep system

When required by **5.6**, an electrical anti-creep system shall be provided, which satisfies the following conditions:

- a) The car shall be dispatched automatically to the lowest landing within 15 min after the last normal journey;
- b) In the case of a lift provided with manually operated doors, or with power operated doors where closing is carried out under the continuous control of the users, there shall be a notice in the car as follows: «**CLOSE DOORS**». The minimum height of the characters shall be 50 mm.

There shall be an inscription on or near the main switch: “**Switch off only when the car is at the lowest landing**”.

NOTE If the device takes power from the emergency lighting system, the system should still provide the required duration of power as defined by 5.4.10.4.

5.12.1.11 Stopping devices

5.12.1.11.1 A stopping device shall be provided for stopping, and maintaining the lift out of service, including the power operated doors:

- a) In the lift pit (5.2.1.5.1 a));
- b) In the pulley room (5.2.1.5.2 c));
- c) On the car roof (5.4.8 b)), in an easily accessible position and no more than 1 m from the entry point for inspection or maintenance personnel. This device may be the one located next to the inspection operation control if this is not placed more than 1 m from the access point;
- d) At the inspection control device (5.12.1.5.1.2 d));
- e) At the lift machine, unless there is a main switch or another stopping device nearby that is directly accessible within 1 m;
- f) At the test panel(s) (5.2.6.6), unless there is a main switch or another stopping device nearby that is directly accessible within 1 m.

5.12.1.11.2 The stopping devices shall consist of electric safety devices in conformity with 5.11.2. They shall be bi-stable and such that a return to service cannot result from an involuntary action.

Button type devices according to EN 60947-5-5 shall be used as stopping device.

5.12.1.11.3 A stopping device in the car shall not be used.

5.12.2 Final limit switches

5.12.2.1 General

Final limit switches shall be provided.

Final limit switches shall be set to function as close as possible to the terminal floors, without risk of accidental operation.

They shall operate before the car (or counterweight if there is one) comes into contact with the buffers. The action of the final limit switches shall be maintained whilst the buffers are compressed.

5.12.2.2 Actuation of the final limit switches

5.12.2.2.1 Separate actuating devices shall be used for normal terminal stopping and final limit switches.

5.12.2.2.2 In the case of positive drive lifts, actuation of the final limit switches shall be effected:

- a) Either by a device linked to the movement of the machine; or
- b) By the car and by the balancing weight, if there is one, at the top of the well; or
- c) If there is no balancing weight, by the car at the top and the bottom of the well.

5.12.2.2.3 In the case of traction drive lifts, actuation of the final limit switches shall be effected:

- a) Either directly by the car at the top and bottom of the well; or
- b) Indirectly by a device which is linked to the car, e.g. by a rope, belt or chain.

In the case b), breakage of or slack in this linkage shall cause the machine to stop by means of an electric safety device in conformity with **5.11.2**.

5.12.2.2.4 In the case of indirect acting lifts, actuation of the final limit switch shall be effected:

- a) Either directly by the ram; or
- b) Indirectly by a device linked to the ram, e.g. by a rope, belt or chain.

In case b) the machine shall be stopped by means of an electric safety device in conformity with **5.11.2** if breakage or slack in this linkage occurs.

5.12.2.3 Method of operation of final limit switches

5.12.2.3.1 The final limit switch(es) shall open:

- a) Directly by positive mechanical separation of the circuits feeding the motor and brake; or
- b) An electric safety device in conformity with **5.11.2**.

5.12.2.3.2 After the operation of the final limit switches, car movement in response to car and landing calls only shall no longer be possible, even in the case of the car leaving the actuation zone by creeping.

The return to service of the lift shall require the intervention of a competent person.

5.12.2.3.3 When an electrical anti-creep system as per **5.12.1.10** is used, it remains fully active with the exception that the automatic despatch of the car according to **5.12.1.10 a)** shall come into operation immediately as soon as the car leaves the actuation zone of the final limit switch with the doors closed.

5.12.3 Emergency alarm device and intercom system

5.12.3.1 A remote alarm system in accordance with EN 81-28 shall be installed.

5.12.3.2 The alarm initiation device including its symbol shall be in accordance with EN 81-28.

5.12.3.3 An intercom system, or similar device, powered by the emergency supply referred to in **5.4.10.4** shall be installed between inside the car and the place from which the emergency operation is carried out if the lift travel exceeds 30 m or if a direct acoustic communication between both locations is not possible.

5.12.4 Priorities and signals

5.12.4.1 For lifts with manual doors, a device shall prevent the car leaving a landing for a period of at least 2 s after stopping.

5.12.4.2 A user entering the car shall have at least 2 seconds after the doors have closed, to actuate a control device before any external call buttons can become effective.

This requirement need not apply in the case of lifts operating on collective control.

5.12.4.3 In the case of collective control, an illuminated signal, which is clearly visible from the landing, shall indicate to the users waiting on this landing the direction of the next movement imposed on the car.

NOTE For groups of lifts, position indicators on the landings are not recommended. However, it is recommended that the arrival of a car be preceded by an audible signal.

6 Verification of the safety requirements and/or protective measures

6.1 Technical compliance documentation

A technical compliance documentation shall be provided to facilitate the verification according to **6.2**. The technical compliance documentation shall contain the necessary information to ascertain that the constituent parts are correctly designed and the installation is in conformity with this European standard.

NOTE **Annex B** gives guidance on the information to be included in the technical compliance documentation.

6.2 Verification of design

Table 16 indicates the methods by which the safety requirements and/or protective measures described in **clause 5** shall be verified. Secondary subclauses which are not listed in the table are verified as part of the quoted subclause. For example, subclause 5.2.2.4 is verified as part of subclause 5.2.2.

Table 16 - Means of verification of the safety requirements and/or protective measures

Sub-clause	Safety requirements	Visual inspection ^a	Performance check/test ^b	Measurement ^c	Drawing/Calculation ^d	User information ^e
5.1	General					
5.1.1	Non-significant hazards	✓				✓
5.1.2	Notices and Labels	✓				✓
5.2	Lift well, Machinery Spaces and Pulley Rooms					
5.2.1	General provisions	✓	✓	✓	✓	✓
5.2.2	Access to lift well and to machinery spaces and pulley rooms	✓		✓		✓
5.2.3	Access and emergency doors - Access trap doors - Inspection traps	✓		✓		✓
5.2.4	Notices	✓				✓
5.2.5	Lift well	✓	✓	✓	✓	✓
5.2.6	Machinery spaces and pulley rooms	✓	✓	✓	✓	✓
^a Visual inspection will be used to verify the features necessary for the requirement by visual examination of the components supplied. ^b A performance check/test will verify that the features provided perform their function in such a way that the requirement is met. ^c Measurement will verify by the use of instruments that requirements are met, to the specified limits. ^d Drawings/calculations will verify that the design characteristics of the components provided meet the requirements. ^e Verify that the relevant point is dealt with in the instruction handbook or by marking.						

Table 16 - Means of verification of the safety requirements and/or protective measures (continued)

Sub-clause	Safety requirements	Visual inspection ^a	Performance check/test ^b	Measurement ^c	Drawing/Calculation ^d	User information ^e
5.3	Landing doors and car doors					
5.3.1	General provisions	✓		✓	✓	
5.3.2	Height and width of entrances			✓	✓	
5.3.3	Sills, guides, door suspension	✓			✓	
5.3.4	Horizontal door clearances	✓	✓	✓	✓	✓
5.3.5	Strength of landings and car doors	✓	✓	✓	✓	✓
5.3.6	Protection in relation to door operation	✓	✓	✓	✓	✓
5.3.7	Local landing lighting and "car here" signal lights	✓	✓	✓		✓
5.3.8	Locking and closed landing door check	✓	✓			✓
5.3.9	Locking and emergency unlocking of landing and car doors	✓	✓			✓
5.3.10	Requirements common to devices for proving the locked condition and the closed condition of the landing door		✓			
5.3.11	Sliding landing doors with multiple, mechanically linked panels	✓	✓		✓	
5.3.12	Closing of automatically operated landing doors	✓	✓		✓	✓
5.3.13	Electrical device for proving the car doors closed	✓	✓			✓
5.3.14	Sliding car doors with multiple, mechanically linked panels	✓	✓		✓	
5.3.15	Opening the car door		✓		✓	
5.4	Car, counterweight and balancing weight					
5.4.1	Height of car			✓	✓	✓
5.4.2	Available car area, rated load, number of passengers		✓	✓	✓	✓
5.4.3	Walls, floor and roof of the car	✓			✓	
5.4.4	Car floor, wall and ceiling materials	✓			✓	
5.4.5	Apron	✓		✓	✓	
^a	Visual inspection will be used to verify the features necessary for the requirement by visual examination of the components supplied.					
^b	A performance check/test will verify that the features provided perform their function in such a way that the requirement is met.					
^c	Measurement will verify by the use of instruments that requirements are met, to the specified limits.					
^d	Drawings/calculations will verify that the design characteristics of the components provided meet the requirements.					
^e	Verify that the relevant point is dealt with in the instruction handbook or by marking.					

Table 16 - Means of verification of the safety requirements and/or protective measures (continued)

Sub-clause	Safety requirements	Visual inspection ^a	Performance check/test ^d	Measurement ^c	Drawing/Calculation ^d	User information ^e
5.4	Car, counterweight and balancing weight (continued)					
5.4.6	Emergency trap doors and emergency doors	✓		✓	✓	✓
5.4.7	Car roof	✓		✓	✓	
5.4.8	Equipment on top of the car	✓	✓			
5.4.9	Ventilation	✓			✓	
5.4.10	Lighting	✓		✓	✓	✓
5.4.11	Counterweight / balancing weight	✓			✓	
5.5	Suspension means, compensation means and related protection means					
5.5.1	Suspension means	✓		✓	✓	✓
5.5.2	Sheave, pulley, drum and rope diameter ratios, rope/chain terminations	✓		✓	✓	
5.5.3	Rope traction		✓		✓	
5.5.4	Winding up of ropes for positive drive lifts		✓		✓	
5.5.5	Distribution of load between the ropes or the chains	✓	✓		✓	
5.5.6	Compensation means		✓		✓	
5.5.7	Protection for traction sheaves, pulleys and sprockets	✓			✓	
5.5.8	Traction sheaves, pulleys and sprockets in the well	✓		✓	✓	
5.6	Precautions against free fall, excessive speed, unintended car movement and creeping of the car					
5.6.1	General provisions	✓			✓	✓
5.6.2	Safety gear	✓	✓		✓	✓
5.6.3	Rupture valve	✓	✓		✓	✓
5.6.4	Restrictors	✓	✓	✓	✓	
5.6.5	Pawl device	✓	✓		✓	
5.6.6	Ascending car overspeed protection means	✓	✓	✓	✓	✓
5.6.7	Protection against unintended car movement	✓	✓	✓	✓	✓
<p>^a Visual inspection will be used to verify the features necessary for the requirement by visual examination of the components supplied.</p> <p>^b A performance check/test will verify that the features provided perform their function in such a way that the requirement is met.</p> <p>^c Measurement will verify by the use of instruments that requirements are met, to the specified limits.</p> <p>^d Drawings/calculations will verify that the design characteristics of the components provided meet the requirements.</p> <p>^e Verify that the relevant point is dealt with in the instruction handbook or by marking.</p>						

Table 16 - Means of verification of the safety requirements and/or protective measures (continued)

Sub-clause	Safety requirements	Visual inspection ^a	Performance check/test ^b	Measurement ^c	Drawing/Calculation ^d	User information ^e
5.7	Guide rails					
5.7.1	Guiding of the car, counterweight or balancing weight	✓			✓	✓
5.7.2	Permissible stresses and deflections	✓			✓	
5.7.3	Combination of loads and forces				✓	
5.7.4	Impact factors				✓	
5.8	Buffers					
5.8.1	Car and counterweight buffers	✓	✓	✓	✓	✓
5.8.2	Stroke of car and counterweight buffers	✓	✓		✓	✓
5.9	Lift machinery and associated equipment					
5.9.1	General provision	✓			✓	
5.9.2	Lift machine for traction lifts and positive drive lifts	✓	✓	✓	✓	✓
5.9.3	Lift machine for hydraulic lifts	✓	✓	✓	✓	✓
5.10	Electric installations and appliances					
5.10.1	General provisions	✓	✓	✓	✓	✓
5.10.2	Incoming supply conductor terminations				✓	
5.10.3	Contactors, contactor relays -, components of safety circuits	✓	✓		✓	
5.10.4	Protection of electrical equipment	✓	✓		✓	✓
5.10.5	Main switches	✓	✓		✓	✓
5.10.6	Electric wiring	✓			✓	
5.10.7	Lighting and socket outlets	✓	✓		✓	✓
5.10.8	Control of the supply for lighting and socket outlets	✓	✓		✓	✓
5.10.9	Protective earthing		✓		✓	
5.10.10	Electrical identification	✓			✓	✓
5.10.11	Marking of equipment	✓			✓	✓
5.11	Protection against electric faults; failure analysis; electric safety devices					
5.11.1	Protection against electric faults; failure analysis	✓	✓		✓	✓
5.11.2	Electric safety devices	✓	✓		✓	✓
<p>^a Visual inspection will be used to verify the features necessary for the requirement by visual examination of the components supplied.</p> <p>^b A performance check/test will verify that the features provided perform their function in such a way that the requirement is met.</p> <p>^c Measurement will verify by the use of instruments that requirements are met, to the specified limits.</p> <p>^d Drawings/calculations will verify that the design characteristics of the components provided meet the requirements.</p> <p>^e Verify that the relevant point is dealt with in the instruction handbook or by marking.</p>						

Table 16 - Means of verification of the safety requirements and/or protective measures (end)

Sub-clause	Safety requirements	Visual inspection ^a	Performance check/test ^b	Measurement ^c	Drawing/Calculation ^d	User information ^e
5.12	Controls - Final limit switches - Priorities					
5.12.1	Control of lift operations	✓	✓	✓	✓	✓
5.12.2	Final limit switches	✓	✓		✓	
5.12.3	Emergency alarm device and intercom system	✓	✓	✓	✓	✓
5.12.4	Priorities and signals	✓	✓	✓	✓	✓

6.3 Examinations and tests before putting into service

Before the lift is put into service, the following particular tests as referred to in **Table 16** shall be carried out:

6.3.1 Braking system (5.9.2.2)

The test shall demonstrate that:

- a) The electro-mechanical brake on its own is capable of stopping the machine when the car is travelling downwards at rated speed and with the rated load plus 25 %. In these conditions the retardation of the car shall not exceed that resulting from operation of the safety gear or stopping on the buffer;
- b) Additionally it shall be verified by practical tests or calculation that where one brake set is not working a sufficient braking effort is exerted to decelerate the car, travelling downwards at rated speed and with rated load (see **5.9.2.2.2.1**).
- c) Where a brake is made up of more than two sets, in case of failure of one set the remaining combination of sets shall be capable to fulfil the requirements in b) above.
- d) It shall be verified, with the car loaded at 80 % of the balanced load of the car, that the manual release of the brake (**5.9.2.2.2.7**) causes a natural movement of the lift, or that the means for that purpose (**5.9.2.2.2.8**) are available and operative.

6.3.2 Electric installation

The following tests shall be performed:

- a) Visual check (e.g. damages, loose wires, all earth wires connected);
- b) Continuity of the protective conductors according to HD 60364-6, 61.3.2 a);
- c) Measurement of the insulation resistance of the different circuits (**5.10.1.3**). For this measurement all the electronic components shall be disconnected;
- d) Verification of the effectiveness of the measures for fault protection (protection against indirect contact) by automatic disconnection of supply according to HD 60364-6, 61.3.6 and 61.3.7.

6.3.3 Checking of the traction (5.5.3)

The traction shall be checked by making several stops with the most severe braking compatible with the installation. At each test, complete stoppage of the car shall occur.

The test shall be carried out:

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- a) ascending, with the car empty, in the upper part of the travel;
- b) descending, with the car loaded with 110 % of the rated load, in the lower part of the travel;
- c) The counterweight shall be brought into contact with the buffer(s) and the machine shall continue to be turned until rope slippage occurs, or if slippage does not occur the car shall not be raised under the maximum torque-limit the drive-system is set;
- d) it shall be checked that the balance is as stated by the installer;

NOTE The testing procedure to be part of the instruction manual of the lift.

6.3.4 Car safety gear (5.6.2)

The aim of the test before putting into service is to check the correct mounting, correct setting and the soundness of the complete assembly, comprising car, safety gear, guide rails and their fixing to the building.

The test shall be made while the car is descending, with the required load uniformly distributed over the car area, with the machine running until the ropes slip or become slack, and under the following conditions:

- a) Instantaneous safety gear:

The car shall travel at rated speed and be loaded either:

- 1) with rated load when the rated load corresponds with **Table 5 (5.4.2.1)**, or
- 2) with 125 % of the rated load, except that the load shall not exceed the corresponding **Table 5** load when the rated load is smaller than the value given by **Table 5 (5.4.2.1)**;

- b) Progressive safety gear:

For traction drive lifts the car shall be loaded with 125 % of the rated load, and travel at rated speed or lower.

For positive drive lifts and hydraulic lifts, when the rated load corresponds with **Table 5 (5.4.2.1)** the car shall be loaded with rated load, and travel at rated speed or lower.

For hydraulic lifts, when the rated load is smaller than the value given by **Table 5 (5.4.2.1)**, the car shall be loaded with 125 % of the rated load, except that the load shall not exceed the corresponding **Table 5** load, and travel at rated speed or lower.

When the test is made with lower than rated speed, the manufacturer shall provide curves to illustrate the behaviour of the type tested progressive safety gear when dynamically tested with the suspensions attached.

After the test, it shall be ascertained that no deterioration, which could adversely affect the normal use of the lift has occurred. If necessary, friction components may be replaced. Visual check is considered to be sufficient.

NOTE In order to facilitate disengagement of the safety gear, it is recommended that the test be carried out opposite a door in order to be able to unload the car.

6.3.5 Counterweight or balancing weight safety gear (5.6.2)

The aim of the test before putting into service is to check the correct mounting, correct setting and the soundness of the complete assembly, comprising counterweight or balancing weight, safety gear, guide rails and their fixing to the building.

The test shall be made while the counterweight or the balancing weight is descending, and under the following conditions. In case of traction and positive drive lifts, the machine shall be remain running until the ropes slip or become slack:

- a) Instantaneous safety gear tripped by overspeed governor or safety rope:

the test shall be made with empty car at rated speed;

- b) Progressive safety gear:

The test shall be made with empty car at rated speed or lower.

When the test is made with lower than rated speed, the manufacturer shall provide curves to illustrate the behaviour of the type tested progressive safety gear under counterweight or balancing weight application when dynamically tested with the suspensions attached.

After the test, it shall be ascertained that no deterioration, which could adversely affect the normal use of the lift has occurred. If necessary, friction components may be replaced. Visual check is considered to be sufficient.

6.3.6 Pawl device (5.6.5)

- a) Dynamic test:

The test shall be made while the car is travelling at normal speed downwards, with the load uniformly distributed, the contacts on the Pawl device and on the energy dissipation buffer (5.6.5.7), if any, being short-circuited to avoid closing of the down direction valves.

The car shall be loaded with 125 % of rated load and shall be stopped by the pawl device at each landing.

After the test it shall be ascertained that no deterioration which could adversely affect the normal use of the lift has occurred. Visual check is considered to be sufficient;

- b) Visual examination of the engagement of the pawl(s) with all supports, and of the running clearance measured horizontally between the pawl(s) and all supports during travel;
- c) Verification of the stroke of the buffers;

6.3.7 Buffers (5.8.1, 5.8.2)

- a) energy accumulation type buffers:

the test shall be carried out in the following manner: the car with its rated load shall be placed on the buffer(s), the ropes shall be made slack or the pressure in the hydraulic system shall be reduced to the minimum by pressing the emergency manual lowering button, and it shall be checked that the compression corresponds to the figures given in the technical compliance documentation (see **Annex B**);

NOTE It may be necessary to override the minimum pressure device or temporarily modify the setting of the minimum low pressure device.

- b) energy dissipation type buffers:

The test shall be made in the following manner: the car with its rated load and the counterweight shall be brought into contact with the buffers at the rated speed or at the speed for which the stroke of the buffers has been calculated, in the case of the use of reduced stroke buffers with verification of the retardation (5.8.2.2.2).

After the test, it shall be ascertained that no deterioration, which could adversely affect the normal use of the lift has occurred. Visual check is considered to be sufficient;

6.3.8 Rupture valve (5.6.3)

A system test shall be carried out, with rated load uniformly distributed in the descending car at an overspeed (5.6.3.6) to operate the rupture valve. The correct adjustment of the tripping speed can be checked, for instance, by comparison with the manufacture's adjustment diagram (see Annex B).

For lifts with several interconnected rupture valves checking of the simultaneous closing by measuring the inclination of the car floor (5.6.3.4);

6.3.9 Restrictor/one s way restrictor (5.6.4)

Check that maximum speed v_{max} does not exceed $v_d + 0,3$ m/s:

— either by measuring, or

— by using the following formula:
$$v_{max} = v_t \sqrt{\frac{p}{p - p_t}}$$

where:

p is the full load pressure in megapascals;

p_t is the pressure measured during a downward journey with rated load in the car in megapascals;

If necessary pressure losses and friction losses shall be taken into account.

v_{max} is the maximum downward speed in the case of a rupture in the hydraulic system in metres per second:

v_t is the speed measured during a downward journey with rated load in the car in metres per second;

6.3.10 Pressure test

A pressure of 200 % full load pressure is applied to the hydraulic system between the non-return valve and the jack included. The system is then observed for evidence of pressure drop and leakage during a period of 5 min (taking into account the possible effects of temperature change in the hydraulic fluid).

After this test it shall be visually ascertained that the integrity of the hydraulic system is maintained:

NOTE This test shall be carried out after the test of the devices against free fall (5.6) and include any hydraulic elements included in the uncontrolled movement protection means.

6.3.11 Ascending car overspeed protection means (5.6.6)

The test shall be made while the empty car is ascending at not less than rated speed, using only this device for braking.

6.3.12 Stopping of the car at landings and levelling accuracy (5.12.1.1.4)

The stopping accuracy of the car shall be verified to be in compliance with 5.12.1.1.4, at all landings, and in both directions for intermediate floors.

It shall be verify that the car maintains levelling accuracy as per 5.12.1.1.4 during loading and unloading conditions. This verification shall be made at the most unfavourable floor.

6.3.13 Unintended car movement protection means (5.6.7)

The aim of the test before putting into service is to check detection, and stopping elements.

Test-requirements: only the stopping element of the means defined in 5.6.7 shall be used for the tests for stopping the lift. The test shall:

- consist of verifying that the stopping element of the means is triggered as required by type examination;
- be made by moving the empty car in up direction in the upper part of the well (e.g. from one floor from top terminal) and fully loaded car in down direction in the lower part of the well (e.g. from one floor from bottom terminal) with a 'pre-set' speed, e.g. as defined during type testing, (inspection speed etc.);

The test, as defined by the type-examination, shall confirm that the unintended movement distance will not exceed the value given in 5.6.7.5.

If the means requires self-monitoring (5.6.7.3), its function shall be checked.

NOTE If the stopping element of the means involves elements present at landing floors, it could be necessary to repeat the test for each concerned landing.

7 Information for use

The documentation shall consist of, an instruction manual and a logbook.

7.1 Instruction manual

The manufacturer/installer shall provide an instruction manual.

7.1.1 Normal use

The instruction manual shall give the necessary information about the normal use of the lift and rescue operation as described in EN 13015 and in particular about the following:

- a) Keeping the machinery and pulley spaces doors locked;
- b) Safe loading and unloading;
- c) Precaution to be taken in case of lifts with partially enclosed well (5.2.5.2.2 d));
- d) Events needing the intervention of a competent person;
- e) Keeping the logbook updated;
- f) Location and use of special tools, if any (see 7.1.2);
- g) The use of the emergency unlocking key;

Keys of this type shall be given only to a responsible authorized person. They shall be accompanied by a written instruction detailing the essential precautions to be taken in order to avoid accidents which could result from an unlocking which was not followed by effective relocking.

The unlocking key shall have a label attached drawing attention to the danger which may be involved in using this key and the need to make sure that the door is locked after it has been closed. These keys shall be available on the site of the lift installation.

- h) Rescue operation: in particular, detailed instructions shall be given on the release of the brake, ascending car overspeed protection means, unintended car movement protection means, rupture valve and the safety gear, including the identification of special tools, if any.

7.1.2 Maintenance

The instruction manual shall be in accordance with EN 13015.

It shall inform about the identification and use of the special tools.

Accumulation type buffers made from synthetic materials shall be checked periodically on aging considering instructions from the manufacturer (see prEN 81-50, 5.5.1 c) and 5.5.4 i)).

7.1.3 Examinations and tests

The instruction manual shall inform about the following.

- a) Periodical examinations:

When periodical examinations and tests on lifts are carried out after they are placed on the market, to verify that they are in good condition, these periodical examinations and tests should be carried out in accordance with **Annex C** and be recorded in the logbook.

- b) Any specific requirements

7.2 Logbook

7.2.1 A logbook shall be provided in which notes about repairs, examinations after modifications and accidents and periodic checks, including those specified by the manufacturer/installer can be recorded.

7.2.2 The basic characteristics of the lift shall be recorded in the logbook. This register or file shall comprise:

- a) A technical section giving:

- 1) the date the lift was put into service;
- 2) the basic characteristics of the lift;
- 3) the characteristics of the ropes and/or chains;
- 4) the characteristics of those parts for which verification of conformity is required (**Annex B**);
- 5) the plans of installation in the building;
- 6) electric schematic diagrams;

The electric schematic diagrams may be limited to the circuits for the overall understanding of the safety considerations and use IEC 60617-DB (EN 60617) symbols. Any graphical symbol not shown in IEC 60617-DB (EN 60617) shall be separately shown and described on the diagrams or supporting documents. The symbols and identification of components and devices shall be consistent throughout all documents and on the lift.

The abbreviations used with the symbols shall be explained by means of a nomenclature.

If the electrical schematic diagram has several alternatives, it shall be indicated which alternative is valid e.g. by listing of the applicable alternative solutions.

- 7) hydraulic circuit diagrams (using symbols from ISO 1219-1):

The circuit diagrams may be limited to the circuits for the overall understanding of the safety considerations. The abbreviations used with the symbols shall be explained by means of a nomenclature;

- 8) the full load pressure:

- 9) The characteristics or type of hydraulic fluid.

- b) A section intended to keep duplicate dated copies of examination and inspection reports, with observations.

This register or file shall be kept up-to-date in case of:

- 1) important modifications to the lift (**Annex C**);
- 2) replacement of ropes or important parts;
- 3) Accidents.

NOTE This register or file should be available to those in charge of the maintenance, and to the person or organization responsible for the periodical examinations and tests.

Annex A (normative)

List of the electric safety devices

Table A.1 - List of the electric safety devices

Clause	Devices checked	SIL
5.2.1.5.1 a)	Stopping device in the pit	2
5.2.1.5.2 c)	Stopping device in the pulley room	1
5.2.2.3	Check of the deployed position of pit ladder	1
5.2.3.5	Check of the closed position of access and emergency doors and inspection traps	2
5.2.5.3.2 c)	Check of the locking of car door	2
5.2.6.4.3.1 b)	Check of the active position of the mechanical device	2
5.2.6.4.3.3 e)	Check of the locked position of the inspection doors or traps	2
5.2.6.4.4.1 d)	Check of the opening of any door providing access to the pit	2
5.2.6.4.4.1 e)	Check of the active position of the mechanical device	2
5.2.6.4.4.1 f)	Check of the active position of the mechanical device	2
5.2.6.4.5.4 a)	Check of the retracted position of the working platform	2
5.2.6.5.5 b)	Check of the retracted position of movable stops	2
5.2.6.5.5 c)	Check of the extended position of movable stops	2
5.2.6.6	Stopping device at the tests and emergency operation panel	1
5.3.9.1	Check on the locked position of landing door locking device	3
5.3.9.4.1	Check of the closed position of landing doors	3
5.3.9.4.3	Check of the closed position of hinged landing doors	2
5.3.11.2	Check of the closed position of the panels without locks	3
5.3.13.2	Check of the closed position of car door	3
5.4.6.4.2	Check of the locking of the emergency trap and the emergency door in car	2
5.4.8 b)	Stopping device on the car roof	3
5.5.5.3	Check of the abnormal relative extension of a rope or chain in case of two ropes or two chain type suspension	1
5.5.6.1 f)	Check of the tension in the compensation ropes	3
5.5.6.3	Check of the anti-rebound device	3
5.6.2.1.5	Check of the operation of safety gear	1
5.6.2.2.1.6 a)	Over speed detection	2
5.6.2.2.1.6 b)	Check of the release of the over speed governor	3
5.6.2.2.1.6 c)	Check on the tension in the over speed governor rope	3
5.6.2.2.3 e)	Check of the breakage or slackening of the safety rope	3
5.6.2.2.4.2 h)	Check of the extended position of the tripping lever	2
5.6.2.2.4.2 i)	Check of the retracted position of the tripping lever	1

Table A.1- List of the electric safety devices (end)

Clause	Devices checked	SIL
5.6.6.5	Check of the ascending car over speed protection means	1
5.6.7.8	Check of the activation of the unintended car movement with open doors protection	1
5.8.2.2.4	Check of the return to normal extended position of buffers	3
5.9.2.3.1.1	Check of the positions of the removable wheel	1
5.9.2.7	Check for slack rope or slack chain for positive drive lifts	2
5.10.5.2	Control of main switch by means of circuit breaker contactor	2
5.12.1.3.3 c)	Check of the tension in the device for transmission of the car position (slowdown checking device)	2
5.12.1.3.4	Check of the retardation in the case of reduced stroke buffers	2
5.12.1.4 c)	Check of the breakage or slackening of the connecting rope, belt or chain for transmission of the car position (levelling and re-levelling)	2
5.12.1.5.1.2 d)	Stopping device with inspection operation	3
5.12.1.11.2 e)	Stopping device at the lift machine	2
5.12.1.11.2 f)	Stopping device at tests and emergency operation panel	2
5.12.2.2.3 c)	Check of the tension in the device for transmission of the car position (final limit switches)	1
5.12.2.2.4	Check of the tension in the device for transmission of the ram position (final limit switches)	1
5.12.2.3.1 b)	Final limit switches	1

Table A.2 - Electric devices requiring classification of safety function when used in conjunction with programmable electronic systems (PESSRAL)

Clause	Devices checked	SIL
5.6.5.9	Check of the retracted position of the pawl device	1
5.6.5.9.2 a)	Check of the extended position of the pawl device	1
5.6.5.10	Check of the return to normal extended position of buffers where energy dissipation are used in conjunction with pawl device	3
5.6.7.7.	Detection of unintended car movement with open doors	2
5.12.1.5.1.2 a)	Inspection operation switch	3
5.12.1.6.1	Emergency electrical operation switch	3
5.12.1.8.2	Bypass device for landing and car door contacts	3

Annex B (informative)

Technical compliance documentation

The Technical compliance documentation should include the following information, which may be necessary for conformity assessment procedures:

- The name and address of the manufacturer/installer of the lift;
- Details of the place where the lift can be examined;
- A general description of the lift (characteristics, load, speed, rise, stops, etc.);
- Design and manufacturing drawings and/or diagrams (mechanic/electric/hydraulic);
NOTE Drawings or diagrams for understanding design and operation
- A copy of the type examination certificates of the safety components used on the lift;
- Certificates and/or reports, where applicable, of:
 - Ropes or chains;
 - Glass-panels;
 - Door impact-test;
 - Door fire-test;
- Results of any tests or calculations performed or subcontracted by the manufacturer:
 - Traction, guide rail, hydraulic calculations;
- A copy of the instruction manual for the lift:
 - Plans and diagrams;

NOTE Plans and diagrams for performing normal use, maintenance, repair, periodical-inspections and rescue operations.

- Instructions for use of the lift;
- Maintenance instructions (see EN 13015);
- Emergency procedures;
- Manufacturers requirements for periodic inspections;

NOTE Requirements do not include national regulations

- Logbook;

NOTE Logbook for notes about repairs and, where appropriate, periodic checks.

Annex C (informative)

Periodical examinations and tests, examinations and tests after an important modification or after an accident

C.1 Periodical examinations and tests

Periodical examinations and tests shall not be more stringent than those required before the lift was the first time put into service.

These periodical tests should not, through their repetition, cause excessive wear or impose stresses likely to reduce the safety of the lift. This is the case in particular of the test on components such as the safety gear and the buffers. If tests on these components are made, they shall be carried out with empty car and at a reduced speed.

The person appointed to make the periodical test should assure himself that these components (which do not operate in normal operation) are still in an operating condition.

A duplicate copy of the report should be attached to the register or file in the part covered by **7.2.2 b)**.

C.2 Examinations and tests after an important modification or after an accident

The important modifications and accidents shall be recorded in the technical part of the register or file covered in **7.2.2 b)**.

In particular, the following are considered as important modifications:

a) Change of:

- the rated speed;
- the rated load;
- the mass of the car;
- the travel;

b) Change or replacement of:

- the type of locking devices (the replacement of a locking device by a device of the same type is not considered as an important modification) (**5.3.12.1**);
- the control system;
- guide rails or the type of guide rails (**5.6.6**);
- the type of door (or the addition of one or more landing or car doors) (**5.3**);
- the machine or the traction sheave (**5.9.2**);

- the overspeed governor (5.6.2.2.1);
- the ascending car overspeed protection means (5.6.6);
- the buffers (5.8);
- the safety gear (5.6.2.1);
- the unintended car movement protection (5.6.7);
- the pawl device (5.6.5);
- the jack (5.9.3.2);
- the pressure relief valve (5.9.3.5.3);
- the rupture valve (5.6.3);
- the restrictor/one-way restrictor (5.6.4);
- the mechanical device for preventing movement of the car (5.2.6.4.3.1);
- the mechanical device for stopping the car (5.2.6.4.4.1);
- the platform (5.2.6.4.5);
- the mechanical device for blocking the car or movable stops (5.2.6.4.5.2);
- The devices for emergency and tests operations (5.2 6.6).

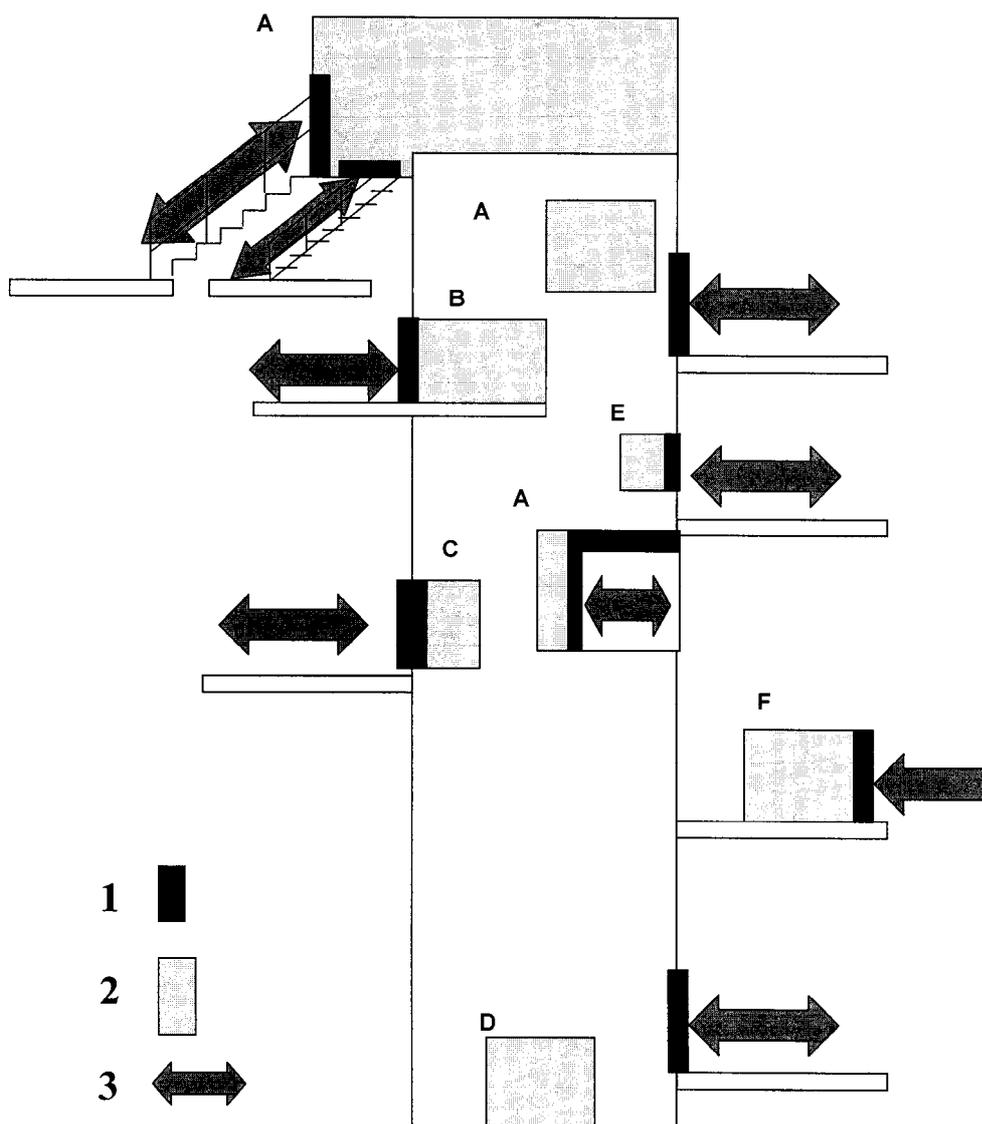
For the tests after an important modification or after an accident the documents and the necessary information shall be submitted to the responsible person or organisation.

Such person or organisation will decide on the advisability of carrying out tests on the modified or replaced components.

These tests will, at the most, be those required for the original components before the lift was put into service.

Annex D
(informative)

Machinery spaces - Access (5.2.3)



Key

- 1 Doors and trap doors § 5.2.3
- 2 Machinery spaces § 5.2.6
- 3 Access § 5.2.2

- A § 5.2.6.4.3
- B § 5.2.6.4.5
- C § 5.2.6.4.6
- D § 5.2.6.4.4
- E § 5.2.6.6
- F § 5.2.6.5

Figure D.1 - Machinery spaces - Access (5.2.3)

Annex E (informative)

Building interfaces

E.1 General provisions

The building structure shall be constructed to withstand loads and forces to which are subjected by lift equipment. If not specified differently in this standard for particular applications, this loads and forces are:

- Values resulting from the static masses; and
- Values resulting from moving masses and their emergency operation. The dynamic effect is represented by an impact factor of 2.

E.2 Support of Guide Rails

It is important that the guide rails of the lift are supported in such a way that the effects of movement of the building structure to which they are connected is minimised.

When considering buildings constructed of concrete, blockwork or bricks it can be assumed that the guide rail brackets which support the guides will not be subjected to displacement caused by movement of the well walls.

However, where the guide brackets are connected to the building fabric by steel beams, or by connection to timber frames, there may be deflection of this structure due to the load imposed by the lift car through the guides and guide brackets. Additionally there may be movement of the lift supporting structure due to external forces such a wind loading, snow loading, etc.

Any deflection of these beams or frames should be taken into account during the calculations required in **5.7**

The total permissible deflection of the guide rails for the safe operation of the safety gear, etc, shall include any displacement of the guide rail due to deflection of the building fabric and the deflection of the guide it's self due to the load imparted on it by the car.

It is therefore important that the persons responsible for the fabrication of these supporting structures communicate with the lift provider in order to ensure that they are suitable under all load conditions.

E.3 Ventilation of car, lift well and machinery spaces

E.3.1 General

See **0.3.1**, **0.3.16** and **0.3.17**.

The requirement to suitably ventilate the lift well and machinery spaces is often contained within local building regulations, either specifically, or as a general requirement as would be given for any building space where machinery is installed or people are accommodated (for leisure, work, etc). As such this standard cannot provide exacting guidance on the specific requirements to ventilate such areas while well and machinery spaces are part of one larger and often complex total build environment.

To do so would bring conflict to these national requirements.

However some general guidance can be given.

E.3.2 Ventilation of the well and car

The comfort and safety of persons riding in the lift, working in the well or those who may become entrapped in the car or well should the lift car become stalled between floors depends on many factors:

- Ambient temperature of the well as part of the building or even totally stand alone;
- Exposure to direct sunlight;
- Volatile Organic Component, CO₂, air quality;
- Fresh air access in well;
- Size of well, both in cross sectional area and height;
- Number, size, gaps around and location of landing doors;
- Expected heat output from installed equipment;
- Fire fighting and smoke evacuation strategy and related BMS (building management system);
- Humidity, dust and fumes;
- Air flow (heat /cooling) and energy saving building technology applied;
- Air tightness of the well and the entire building.

The lift car shall be provided with sufficient ventilation aperture to ensure adequate flow of air for the maximum number of permitted occupants (see clause 5.4.9).

During normal operation and maintenance of the lift, generally the gaps around the landing doors, the opening/closing of these doors and the pump effect of the lift travelling within the well may be sufficient to provide for human needs the necessary air exchange between the staircases, lobbies and the well.

However for technical needs and in some cases for human needs, the air tightness of the well and the entire building, the environmental conditions, particularly higher ambient temperature, radiation, humidity, air quality, will result in the need for a permanent or on demand ventilation aperture(s) and/or (combined with) forced ventilation and/or fresh air entry. This can also be necessary when transporting certain items such as motorized vehicles where exhaust fumes can be hazardous. This can only be decided on a case by case basis.

Furthermore in the event of a prolonged stoppage (considering normal and accidental conditions) of the car, further sufficient ventilation shall be granted.

In particular also attention shall be give for those buildings (new and in case of refurbishing) in which energy efficient design and technology is present.

Lift wells are not intended to be used as a means to ventilate other areas of the building.

In some cases this can be an extremely dangerous practice, such as industrial environments or underground car parks, where the drawing of dangerous gasses through the well may cause additional risk to persons travelling in the car. Under these considerations, the stale air from other areas of the building shall not be used to ventilate the well.

Where the lift well forms part of a fire fighting shaft particular care needs to be taken.

In these cases advice should be obtained by those who specialize in such equipment or from local building and fire regulations.

In order to allow the person responsible for the work on the building or construction to determine if/what ventilation needs to be provided related to the total lift installation as part of the building, the installer of the lift should provide the necessary information to allow suitable calculations and appropriate building design to be made. In other words they should keep each other informed of the facts necessary for and on the other hand, take the appropriate steps to ensure the proper operation and safe use and maintenance of the lift within this building.

E.3.3 Ventilation of Machinery Spaces

The ventilation of the machinery space is normally carried out to provide a suitable working environment for the engineer and the equipment installed into such spaces.

For this reason the ambient temperature of machinery spaces should be kept as given in the assumptions. See clause **0.3.16**. Additional care shall be taken with regard to humidity and air quality to avoid technical problems e.g. condensation.

Failure to maintain these temperatures may result in the lift automatically removing it's self from service until such time as the temperature returns to its intended levels.

In order to allow the person responsible for the work on the building or construction to determine if/what ventilation needs to be provided in these machinery spaces as part of the building, the installer of the lift should provide the necessary information to allow suitable calculations and appropriate building design to be made. In other words they should keep each other informed of the facts necessary for and on the other hand, take the appropriate steps to ensure the proper operation, safe use and maintenance of the lift.

Annex F (normative)

Pit access ladder

F.1 Types of pit ladder

The following types of pit ladder can be used for access and egress to the pit of the lift:

- a) A fixed ladder (Type 1, see **Figure F.1**), which stands upright in one position for both use and storage purposes, or;
- b) A retractable ladder (Type 2a, see **Figure F.2**), which stands upright in two positions, one for use, other for storage. The use position is obtained when a person is placing their weight on the rung, or;
- c) A retractable ladder (Type 2b, see **Figure F.3**), which stands upright for storage and is manually put in position of use by horizontal sliding of its bottom part, or;
- d) A movable ladder (Type 3a, see **Figure F.4**), which stands upright for storage and is manually put in an inclined position of use, or;
- e) A movable ladder (Type 3b, see **Figure F.5**), which lays down on the pit floor for storage and is manually put in an inclined position of use, or;
- f) A foldable ladder (Type 4, see **Figure F.6**), which is stored in the pit and then positioned and hooked onto the landing door sill.

F.2 General provisions

F.2.1 According to the type of pit ladder chosen when designing a lift installation (see **F.1**), the ladder shall be permanently stored in the lift pit so that it cannot be removed from the well or used for other purposes.

F.2.2 The ladder shall be:

- a) Able to withstand the weight of one person counting for 1500 N;
- b) Made of aluminium or steel. In the case of steel, an anti-corrosion protection shall be applied. Wooden made ladder shall not be used.

F.2.3 The length of the ladder shall be such that in position of use the length of the uprights extends to a minimum height of 1,10 m measured vertically above the landing sill;

F.3 Ladder uprights and rungs

F.3.1 Ladder uprights

The cross-section of the ladder uprights shall be so that:

- a) For easy and safe hand grasping, the width does not exceed 35 mm, and depth 100 mm, and
- b) The mechanical strength tests as defined in EN 131-2, clause 5 are fulfilled.

F.3.2 Ladder rungs

The ladder rungs shall fulfilled the following requirements:

- a) The clear width of the ladder rungs shall be minimum 280 mm;
- b) The rungs shall be equally spaced, between 250 mm and 300 mm;
- c) The cross section of the ladder rungs shall be either circular or polygonal (square or more than 4 sides) with a diameter or a flat tread of minimum 25 mm and maximum 35 mm;
- d) The surface conditions of the rungs shall be non slippery, i.e. by means of profiled surface or special durable anti slippery coating.

F.4 Specific provisions for non fixed type ladders

For movable and foldable ladders (type 3 and 4), the following apply:

- a) The maximum weight of the ladder shall not exceed 15 kg in order to allow its easy and safe handling from the landing sill;

 Note National regulations may request a maximum weight less than 15 kg for manual handling.
- b) Safe use of the ladder in position of use shall be ensured by means of a device securing the ladder to the landing sill, or the bottom of the pit, or the wall of the well;
- c) The tipping over of the ladder when a person is standing or grasping the upper part of the ladder (above landing sill level) shall be prevented by means of appropriate devices at bottom end of the ladder uprights;
- d) For retractable ladders (type 2a) and foldable ladders (type 4) provisions shall be fitted so that when putting the ladder back from position of use to stored position risk of shearing and/or crushing of hands or feet is prevented when retracting or folding back the parts of the ladder.

F.5 Location of the ladder in the pit

The location of the ladder in the pit shall be such that in position of use the following are fulfilled:

- a) There shall be a clear distance of 200 mm minimum between back of any rung and wall of the pit in the case of vertical ladder;
- b) The distance between the edge of the landing entrance and the ladder in its stored position shall not be more than 800 mm;
- c) The distance between the edge of the landing entrance and middle of rungs shall be 600 mm maximum for easy reach;
- d) The height of the first rung of the ladder shall be positioned as close as possible at the same level as the landing sill.

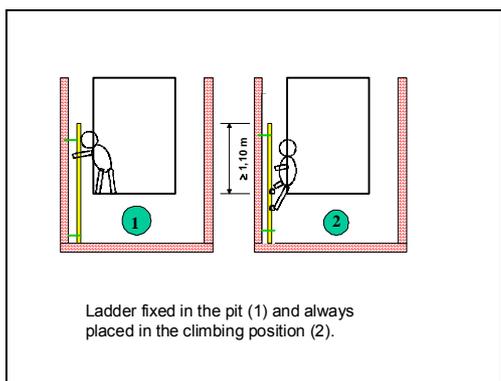


Figure F.1 - Type 1 - Fixed pit ladder

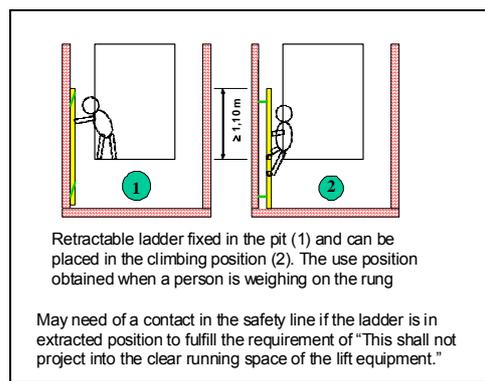


Figure F.2 - Type 2a - Retractable pit ladder

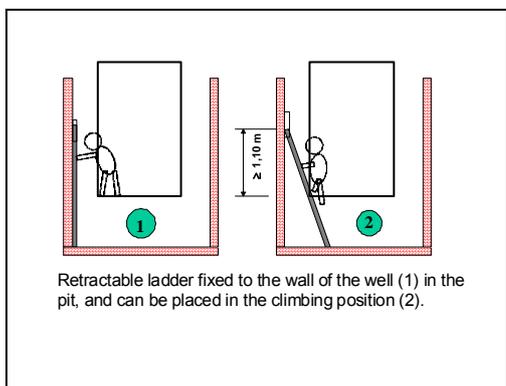


Figure F.3 - Type 2b - Retractable pit ladder

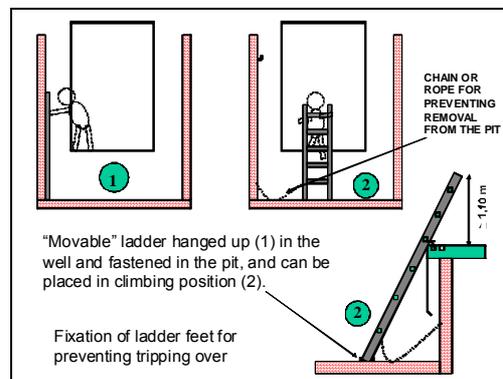


Figure F.4 - Type 3a - Movable pit ladder

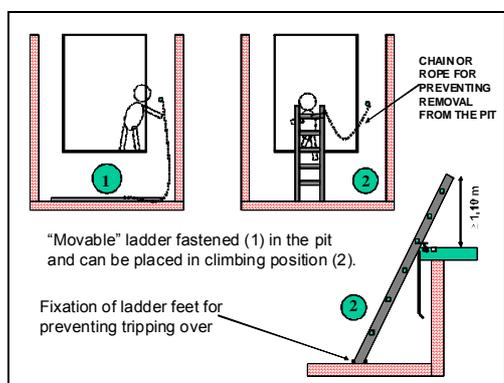


Figure F.5 - Type 3b - Movable pit ladder

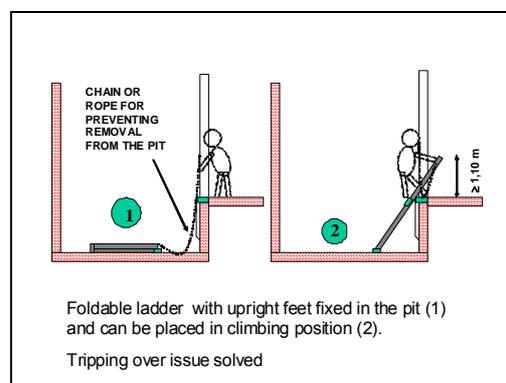


Figure F.6 - Type 4 - Foldable pit ladder

Annex G (informative)

Correlation table between EN 81-1, EN 81-2 and prEN 81-20 and prEN 81-50

G.1 Introduction

This Annex has been prepared to allow the user to compare the existing standards EN 81-1:1998, and EN 81-2:1998, and their respective amendments A1:2005, A2:2004 and A3:2009 with the revision of these standards into prEN 81-20:2011 and prEN 81-50:2011.

The revision of these standards EN 81-1 and EN 81-2 was mandated by CEN with reference to the 10 year updating of European standards and to bring these standards in line with CEN Guide 414 with regards the format and structure.

On this basis the revision of EN 81-1 and EN 81-2 has resulted in a total restructuring of both documents in such a way that:

- a) EN 81-1 and EN 81-2 have been merged where possible in order to avoid repetition of safety requirements in both documents;
- b) This resulting document has been split in two standards: prEN 81-20; and prEN 81-50;
- c) Both these last documents are formatted according to CEN Guide 414 requirements;
- d) The determination of safety requirements has been reviewed on the basis of hazards analysis and risk assessment.

Additionally safety requirements related exclusively to the lift installation are contained in clause 5 of the revised respective standards. Other safety requirements are detailed in annexes, some of which are normative, others informative.

G.2 Correlation between EN 81-1 and EN 81-2, and prEN 81-20 and prEN 81-50

Table G.1 provides a correlation between EN 81-1:1998+A3, respectively EN 81-2:1998+A3 and prEN 81-20:2011 and prEN 81-50:2011 based upon the sequence of chapters, sub clauses and paragraphs of EN 81-1:1998+A3, respectively EN 81-2:1998+A3.

Table G.2 provides a similar correlation but using prEN 81-20:2011 as the base document for comparison to EN 81-1:1998+A3 and EN 81-2:1998+A3.

Table G.3 provides a similar correlation but using prEN 81-50:2011 as the base document for comparison to EN 81-1:1998+A3 and EN 81-2:1998+A3.

Each clause is cross-referenced to its equivalent clause and the table illustrates the status of the text or requirement. Guidance is given on whether the clause remained unchanged, is modified, is new or has been deleted. Where appropriate a short explanation is given in the "Remarks" column to highlight changes and new requirements contained in the revision of EN 81-1:1998+A3 and EN 81-2:1998+A3.

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence

EN 81-1:1998 +A3:2009	EN 81-2:1998 +A3:2009	prEN 81- 20:2011	prEN 81- 50:2011	Unchanged	Modified	New	Deleted	Remarks
0	0	0						Introduction
0.1	0.1	0.1		✓				Introduction - General
0.2	0.2	0.2		✓				Introduction - Principals
0.3	0.3	0.3, 0.3.2			✓			Introduction - Assumptions
1	1	1		✓				Scope
1.1	1.1	1.1		✓				
1.2	1.2	1.2		✓				
1.3	1.3	1.3			✓			
1.4	1.4	1.3			✓			
2	2	2			✓			Normative references
3	3	3			✓			Terms and definitions
4	4	---	---				✓	Units and symbols
4.1	4.1	---	---				✓	
4.2	4.2	---	---				✓	
5	5	5.2.5		✓				Lift well
5.1	5.1	5.2.5.1			✓			Lift well - General provisions
5.2	5.2	5.2.5.2			✓			Lift well - Enclosure
5.3	5.3	5.2.1.8			✓			Lift well - Walls, floor and ceiling
5.4	5.4	5.2.5.3			✓			Lift well - Walls and doors facing the car.
5.5	5.5	5.2.5.4			✓			Lift well - Spaces under pit
5.6	5.6	5.2.5.5			✓			Lift well - Protection
5.7	5.7	5.2.5.6, 5.2.5.7, 5.2.5.8,			✓			Lift well - Headroom and pit
5.8	5.8	5.2.1.2			✓			Exclusive use of well and machinery spaces
5.9	5.9	5.2.1.2			✓			Lighting of well
5.10	5.10	5.2.1.6			✓			Lift well - Emergency release
6	6	5.2.6			✓			Machinery and pulley Spaces
6.1	6.1	5.2.2.1			✓			Machinery and pulley spaces - General
6.2	6.2	5.2.2			✓			Machinery and pulley spaces - Access
6.3	6.3	5.2.6.3			✓			Machinery in a machine room
6.4	6.4	5.2.6.4			✓			Machinery inside the well

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence (continued)

EN 81-1:1998 +A3:2009	EN 81-2:1998 +A3:2009	prEN 81- 20:2011	prEN 81- 50:2011	Unchanged	Modified	New	Deleted	Remarks
6.5	6.5	5.2.6.5			✓			Machinery outside the well
6.6	6.6	5.2.6.6			✓			Devices for emergency and test operation
6.7	6.7	5.2.6.7			✓			Construction and equipment of pulley spaces
7	7	5.3			✓			Landing doors
7.1	7.1	5.3.1			✓			Landing doors - General provisions
7.2	7.2	5.3.5			✓			Landing doors - Strength
7.3	7.3	5.3.2		✓				Landing Doors - Height and width
7.4	7.4	5.3.3			✓			Landing door - Sills, guides and suspension
7.5	7.5	5.3.9			✓			Landing door - protection
7.6	7.6	5.3.10			✓			Landing door - Lighting and "car here"
7.7	7.7	5.3.11			✓			Landing door - Locking and closed check
7.8	7.8	5.3.15			✓			Landing door - Closing of automatic operated doors
8	8	5.4		✓				Car, counterweight and balancing weight
8.1	8.1	5.4.1		✓				Height of car
8.2	8.2	5.4.2			✓			Available car area, rated load, number of passengers
8.3	8.3	5.4.3			✓			Car walls, floor and roof
8.4	8.4	5.4.5			✓			Car apron
8.5	8.5	5.3.18		✓				Car entrance
8.6	8.6	5.3			✓			Car doors
8.7	8.7	5.3.9			✓			Car doors - Protection during operation of doors
8.8	8.8	5.3.9.3			✓			Car doors - Reversal of closing
8.9	8.9	5.3.16			✓			Car doors - Device to prove closed position
8.10	8.10	5.3.14			✓			Car doors - Panel linkage
8.11	8.11	5.3.17			✓			Car door - Opening
8.12	8.12	5.4.6			✓			Car emergency doors and trapdoors
8.13	8.13	5.4.7			✓			Car roof
8.14	8.14	---	---				✓	Car header

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence (continued)

EN 81-1:1998 +A3:2009	EN 81-2:1998 +A3:2009	prEN 81- 20:2011	prEN 81- 50:2011	Unchanged	Modified	New	Deleted	Remarks
8.15	8.15	5.4.8			✓			Equipment on top of the car
8.16	8.16	5.4.9		✓				Car ventilation
8.17	8.17	5.4.10			✓			Car lighting
8.18	8.18	5.4.11		✓				Counterweight and balancing weight
9	9	5.5			✓			Suspension, compensation, overspeed protection and uncontrolled car movement protection
9.1	9.1	5.5.1			✓			Suspension
9.2	9.2	5.5.2			✓			Sheave, pulley, drum and rope chain diameter and rope/chain terminations
9.3	9.3	5.5.3			✓			Rope traction
					✓			Distribution of load
9.4	9.4	5.5.4			✓			Winding up of ropes for positive drive lifts
						✓		Protection for pulleys and sprockets
9.5	9.5	5.5.5			✓			Distribution of load on rope and chain
						✓		Precaution against free fall
9.6	9.6	5.5.6			✓			Compensation with ropes
						✓		Fall of balance weight
9.7	Not used	5.5.7			✓			Protection for traction sheaves, pulleys, sprockets
9.8	9.8	5.6.2.1			✓			Safety gear
9.9	9.9	5.6.2.2.1			✓			Overspeed governor
		----	----					✓
9.10	9.10	5.6.6			✓			Ascending overspeed protection
		5.6.2.2				✓		Tripping means for safety gears and clamping devices
9.11	9.11	5.6.7			✓			Protection against unintended car movement
		5.6.5				✓		Pawl device
---	9.12	5.12.1.10			✓			Electrical anti-creep system
---	9.13	5.6.7			✓			Protection against unintended car movement

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence (continued)

EN 81-1:1998+A3:2009	EN 81-2:1998+A3:2009	prEN 81-20:2011	prEN 81-50:2011	Unchanged	Modified	New	Deleted	Remarks
10	10	5.7, 5.8, 5.12			✓			Guide rails, buffers and final limits
10.1	10.1	5.7.2.1			✓			General provisions
10.2	10.2	5.7.1			✓			Guiding of car, counterweight and balancing weight
10.3	10.3	5.8.1			✓			Car and counterweight buffers
10.4	10.4	5.8.2			✓			Stroke of car and counterweight buffer
10.5	10.5	5.12.2			✓			Final limits
11	11	5.2.5.3		✓				Clearances between car and wall, counterweight
11.1	11.1	5.2.5.3.1		✓				General provision
11.2	11.2	5.2.5.3.2		✓				Clearances
11.3	11.3	5.2.5.3.3		✓				Clearance between car, counterweight and balancing weight
12	12	5.9			✓			Lift machine
12.1	12.1	5.9.1		✓				Independent machine
12.2	12.2	5.9.2			✓			Drive for traction lifts
		5.9.3.2			✓			Jack
12.3	12.3	5.2.6.3		✓				Use of overhung pulleys / sprockets
		5.9.3.3			✓			Piping
12.4	12.4	5.9.2.2			✓			Braking system
		5.9.2.5				✓		Stopping the machine and checking its stopped condition
12.5	12.5	5.9.2.3			✓			Emergency operation
		5.9.3.5				✓		Hydraulic control and safety devices
12.6	12.6	5.9.2.4		✓				Speed
		5.9.3.6				✓		Checking the pressure
12.7	12.7	5.9.2.6			✓			Stopping the machine
		5.9.3.7			✓			Tank
12.8	12.8	5.12.1.3			✓			Monitoring of slowdown
		5.9.2.4			✓			Speed
12.9	12.9	5.5.5.3			✓			Slack rope or chain
		5.9.2.3				✓		Emergency operation

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence (continued)

EN 81-1:1998 +A3:2009	EN 81-2:1998 +A3:2009	prEN 81- 20:2011	prEN 81- 50:2011	Unchanged	Modified	New	Deleted	Remarks
12.10	12.10	5.9.2.8		✓				Run time limiter
		5.5.7		✓				Protection of the pulleys or sprockets on the jack
12.11		5.9.1.2			✓			Protection of machinery
12.12	12.12	5.12.1.1.4		✓				Normal stopping / levelling accuracy
		5.8.2.8		✓				Run time limiter
---	12.13	5.5.5.3			✓			Slack rope or chain device
---	12.14	5.9.3.11		✓				Protection against overheating of the hydraulic fluid
---	12.15	5.12.1.1.4		✓				Normal stopping / levelling accuracy
13	13	5.10		✓				Electrical installation and appliances
13.1	13.1	5.10.1			✓			General provisions
13.2	13.2	5.10.3			✓			Contactors, relay-contactors, components of safety circuits
13.3	13.3	5.10.4			✓			Protection of motors and other equipment
13.4	13.4	5.10.5			✓			Main switches
13.5	13.5	5.10.6			✓			Electric wiring
13.6	13.6	5.10.7			✓			Lighting and socket outlets
14	14	5.11		✓				Protection against electrical faults, controls, priorities
14.1	14.1	5.11.1			✓			Failure analysis and electrical safety devices
14.2	14.2	5.12			✓			Controls
15	15						✓	Notices, markings, operating instructions
15.1	15.1	5.1.2		✓				General provisions
15.2	15.2	5.5.2.3.2			✓			Car
15.3	15.3	5.4.7.7		✓				Car roof
15.4	15.4	5.2.4.1			✓			Machinery and pulley spaces
15.5	15.5	5.2.4.2			✓			Well
15.6	15.6	5.6.2.2.1.6 e)			✓			Overspeed governor
15.7	15.7	5.2.1.5.1			✓			Pit
15.8	15.8	5.8.1.9			✓			Buffers

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence (continued)

EN 81-1:1998 +A3:2009	EN 81-2:1998 +A3:2009	prEN 81- 20:2011	prEN 81- 50:2011	Unchanged	Modified	New	Deleted	Remarks
15.9	15.9	5.12.1.1.3			✓			Landing identification
15.10	15.10	5.10.10			✓			Electrical identification
15.11	15.11	7.1.1			✓			Unlocking key
15.12	15.12	---					✓	Alarm device
15.13	15.13	5.3.9.1.12			✓			Locking device
15.14	15.14	5.6.2.1.3			✓			Safety gear
15.15	15.15	5.2.1.1.2		✓				Groups of lifts
		5.9.3.9.1.6		✓				Emergency lowering valve
15.16	15.16	5.6.6.12			✓			Ascending car overspeed
		5.9.3.9.2.4		✓				Hand pump
---	15.17	5.2.1.1.2		✓				Groups of lifts
---	15.18	5.9.3.7		✓				Tank
---	15.19	5.6.3.9			✓			Rupture valve / one way restrictor
16	16						✓	Examinations, tests, register, maintenance
16.1	16.1	6.1			✓			Examinations and tests
16.2	16.2	7.2			✓			Register
16.3	16.3	7.1			✓			Installer information
Annex A	Annex A	Annex A			✓			List of electrical safety devices
Annex B	Annex B	5.3.12.2			✓			Unlocking triangle
Annex C	Annex C	Annex B			✓			Technical dossier
Annex D	Annex D	6.3			✓			Examinations and test before putting into service
Annex E	Annex E	Annex C			✓			Periodic Examinations and Tests
Annex F	Annex F		5.1	✓				Safety Components - Test procedures for verification of conformity
Annex F.0	Annex F.0		5.1	✓				Introduction
Annex F.1	Annex F.1		5.2	✓				Landing door locks
Annex F.2	Annex F.2	---					✓	Kept free
Annex F.3	Annex F.3		5.3		✓			Safety Gear
Annex F.4	Annex F.4		5.4	✓				Overspeed Governor
Annex F.5	Annex F.5		5.5		✓			Buffers

Table G.1 - Correlation between EN 81-1:1998+A3:2009, respectively EN 81-2:1998+A3:2009 and prEN 81-20:2011 and prEN 81-50:2011 in the order of EN 81-1:1998+A3, respectively EN 81-2:1998+A3:2009 sequence (end)

EN 81-1:1998+A3:2009	EN 81-2:1998+A3:2009	prEN 81-20:2011	prEN 81-50:2011	Unchanged	Modified	New	Deleted	Remarks
Annex F.6	Annex F.6		5.6	✓				Type examination of safety
Annex F.7	Annex F.7		5.7	✓				Ascending car overspeed
			5.9	✓				Rupture valve/ One way restrictor
Annex F.8	---		5.8	✓				Unintended car movement
Annex G	Annex G		5.10				✓	Proof of guide rails
Annex H	Annex H		5.15		✓			Electronic components - Failure
Annex J	Annex J		5.14		✓			Pendulum shock tests
Annex K	Annex K	----	----		✓			Top clearance for traction drive lifts
			5.13				✓	Calculation of jacks
Annex L	Annex L	----	----				✓	Necessary buffer stroke
			Annex C		✓			Measures for failure control
Annex M	Annex M		5.11		✓			Evaluation of traction
		Annex D		✓				Machinery spaces
Annex N	---		5.12		✓			Evaluation of safety factor for suspension ropes
Annex O	---	Annex D		✓				Machinery spaces
Annex P	---		Annex C		✓			Measures for failure control
Annex ZA	Annex ZA	Annex ZA			✓			Relationship between standard and essential safety requirements

Table G.2 - Correlation between prEN 81-20:2011 and EN 81-1:1998+A3 and EN 81-2:1998+A3 in the order of prEN 81-20:2011 sequence

prEN 81-20:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
0	0	0	✓				Introduction
0.1	0.1	0.1	✓				Introduction - General
0.2	0.2	0.2	✓				Introduction - Principals
0.3	0.3	0.3		✓			Introduction - Assumptions
1	1	1	✓				Scope
1.1	1.1	1.1	✓				Scope

Table G.2 - Correlation between prEN 81-20:2011 and EN 81-1:1998+A3 and EN 81-1:1998+A3 in the order of prEN 81-20:2011 sequence (continued)

prEN 81-20:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
1.2	1.2	1.2	✓				Scope
1.3	1.3, 1.4	1.3, 1.4		✓			Scope
2	2	2		✓			Normative references
3	3	3		✓			Terms and definitions
---	4	4				✓	Units and symbols
---	4.1	4.1				✓	
---	4.2	4.2				✓	
4	---	---			✓		List of significant hazards
5.2.1.1.2	---	15.17		✓			Groups of lifts
5.2.1.1.2	15.15		✓				Groups of lifts
5.1.2	15.1	15.1	✓				General provisions
5.2.1.2	5.8	5.8		✓			Exclusive use of well and machinery spaces
5.2.1.2	5.9	5.9		✓			Lighting of well
5.2.1.5.1	15.7	15.7		✓			Pit
5.2.1.6	5.10	5.10		✓			Lift Well - Emergency release
5.2.1.8	5.3	5.3		✓			Lift Well - Walls, floor and ceiling
5.2.2	6.2	6.2		✓			Machinery and pulley spaces - Access
5.2.2.1	6.1	6.1		✓			Machinery and pulley spaces - General
5.2.4.1	15.4	15.4		✓			Machinery and pulley spaces
5.2.4.2	15.5	15.5		✓			Well
5.2.5	5	5	✓				Lift well
5.2.5.1	5.1	5.1		✓			Lift well - General provisions
5.2.5.2	5.2	5.2		✓			Lift well - Enclosure
5.2.5.3	5.4, 11	5.4, 11		✓			Clearances between car and wall, counterweight
5.2.5.3.1	11.1	11.1	✓				General provision
5.2.5.3.2	11.2	11.2	✓				Clearances
5.2.5.3.3	11.3	11.3	✓				Clearances between car, counterweight and balancing weight
5.2.5.4	5.5	5.5		✓			Lift well – Spaces under pit
5.2.5.3	5.4	5.4		✓			Lift well - Walls and doors facing the car
5.2.5.3.1	11.1	11.1		✓			General provision
5.2.5.3.3	11.3	11.3		✓			Clearance between car, counterweight and balancing weight
5.2.5.4	5.5	5.5		✓			Lift well - Spaces under pit
5.2.5.5	5.6	5.6		✓			Lift well - Protection

Table G.2 - Correlation between prEN 81-20:2011 and EN 81-1:1998+A3 and EN 81-1:1998+A3 in the order of prEN 81-20:2011 sequence (continued)

prEN 81-20:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
5.2.5.6	5.7	5.7		✓			Lift well - Headroom and pit
5.2.5.7	5.7	5.7		✓			Lift well - Headroom and pit
5.2.5.8	5.7	5.7		✓			Lift well - Headroom and pit
5.2.6	6	6		✓			Machinery and pulley spaces
5.2.6.3	6.3, 12.3	6.3		✓			Machinery in a machine room
5.2.6.4	6.4	6.4		✓			Machinery inside the well
5.2.6.5	6.5	6.5		✓			Machinery outside the well
5.2.6.6	6.6	6.6		✓			Devices for emergency and test operation
5.2.6.7	6.7	6.7		✓			Construction and equipment of pulley spaces
5.3.1	7, 8.6	7, 8.6		✓			Car and landing doors
5.3.1	7.1	7.1		✓			Landing doors - General provisions
5.3.2	7.3	7.3	✓				Landing doors - Height and width
5.3.3	7.4	7.4		✓			Landing door - Sills, guides and suspension
5.3.5	7.2	7.2		✓			Landing doors - Strength
5.3.9	7.5, 8.7	7.5, 8.7		✓			Protection during operation of doors
5.3.9.3	8.8	8.8		✓			Car doors – Reversal of closing
5.3.10	7.6	7.6		✓			Landing door - Lighting and "car here"
5.3.11	7.7	7.7		✓			Landing door - Locking and closed check
5.3.12.1.12	15.13	15.13		✓			Locking device
5.3.12.2	Annex B	Annex B		✓			Unlocking triangle
5.3.14	8.10	8.10		✓			Car doors - Panel linkage
5.3.15	7.8	7.8		✓			Landing door - Closing of automatic operated doors
5.3.16	8.9	8.9		✓			Car doors - Device to prove closed
5.3.17	8.11	8.11		✓			Car door - Opening
5.3.18	8.5	8.5	✓				Car entrance
5.4	8	8	✓				Car, counterweight and balancing weight
5.4.1	8.1	8.1	✓				Height of car
5.4.2	8.2	8.2		✓			Available car area, rated load, number of passengers
5.4.3	8.3	8.3		✓			Car walls, floor and roof
5.4.5	8.4	8.4		✓			Car apron
5.4.6	8.12	8.12		✓			Car emergency doors and trap doors
5.4.7	8.13	8.13		✓			Car roof
5.4.7.7	15.3	15.3	✓				Car roof

Table G.2 - Correlation between prEN 81-20:2011 and EN 81-1:1998+A3 and EN 81-1:1998+A3 in the order of prEN 81-20:2011 sequence (continued)

prEN 81-20:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
5.4.8	8.15	8.15		✓			Equipment on top of the car
5.4.9	8.16	8.16	✓				Car ventilation
5.4.10	8.17	8.17		✓			Car lighting
5.4.11	8.18	8.18	✓				Counterweight and balancing weight
5.5	9	9		✓			Suspension, compensation, overspeed protection and uncontrolled movement protection
5.5.1	9.1	9.1		✓			Suspension
5.5.2	9.2	9.2		✓			Sheave, pulley, drum and rope chain diameter and rope/chain terminations
5.5.2.3.2	15.2	15.2		✓			Car
5.5.3	9.3	9.3		✓			Rope traction
5.5.4	9.4	9.4		✓			Winding up of ropes for positive drive lifts
5.5.5	9.5	9.5		✓			Distribution of load on rope and chain
5.5.6	9.6	9.6		✓			Compensation with ropes
5.5.7	9.7	9.7, 12.10		✓			Protection for traction sheaves, pulleys, sprockets
5.6.2.1	9.8, 15.14	9.8, 15.14		✓			Safety gear
5.6.2.2.1	9.9	9.10		✓			Tripping by overspeed governor
5.6.3.9	---	15.19		✓			Rupture valve / one way restrictor
5.6.5	---	9.11		✓			Pawl device
5.6.6	9.10, 15.16	---		✓			Ascending overspeed protection
5.6.7	9.11	9.13		✓			Protection against unintended car movement
5.7	10	10		✓			Guide rails, buffers and final limit switches
5.7.1	10.2	10.2		✓			Guiding of car, counterweight and balancing weight
5.7.2.1	10.1	10.1		✓			General provisions
5.8	10	10		✓			Guide Rails, buffers and final limits
5.8.1	10.3, 15.8	10.3, 15.8		✓			Car and counterweight buffers
5.8.2	10.4	10.4		✓			Stroke of car and counterweight buffer
5.8.2.8	12.10	12.12	✓				Run time limiter
5.9	12	12		✓			Lift machine
5.9.1	12.1	12.1	✓				Independent machine
5.9.1.2	12.11	12.11		✓			Protection of machinery
5.9.2	12.2	---		✓			Drive for traction lifts
5.9.2.2	12.3	---		✓			Braking system
5.9.2.3	12.4	12.9		✓			Emergency operation

Table G.2 - Correlation between prEN 81-20:2011 and EN 81-1:1998+A3 and EN 81-1:1998+A3 in the order of prEN 81-20:2011 sequence (continued)

prEN 81-20:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
5.9.2.4	12.6	12.8	✓				Speed
5.9.2.5	12.7	12.4		✓			Stopping the machine and checking its stopped condition
5.9.3.2		12.2		✓			Jack
5.9.3.3		12.3	✓				Piping
5.9.3.5		12.5		✓			Hydraulic control and safety devices
5.9.3.6		12.6		✓			Checking the pressure
5.9.3.7		12.7, 15.18	✓				Tank
5.9.3.9.1.6		15.15	✓				Emergency lowering valve
5.9.3.9.2.4		15.16	✓				Hand pump
5.9.3.11	---	12.14	✓				Protection against overheating of the hydraulic fluid
5.10	13	13	✓				Electrical installation and appliances
5.10.1	13.1	13.1		✓			General provisions
5.10.3	13.2	13.2		✓			Contactors, relay-contactors, components of safety circuits
5.10.4	13.3	13.3		✓			Protection of motors and other equipment
5.10.5	13.4	13.4		✓			Main switches
5.10.6	13.5	13.5		✓			Electric wiring
5.10.7	13.6	13.6		✓			Lighting and socket outlets
5.10.10	15.10	15.10	✓				Electrical identification
5.11	14	14	✓				Protection against electrical faults, controls, priorities
5.11.1	14.1	14.1		✓			Failure analysis and electrical safety devices
5.12	10	10		✓			Guide rails, buffers and final limits
5.12	14.2	14.2		✓			Controls
5.12.1.3	12.8			✓			Monitoring of slowdown
5.12.1.1.3	15.9	15.9	✓				Landing identification
5.12.1.1.4	12.12	12.15	✓				Normal stopping / levelling accuracy
5.12.1.10	---	9.12		✓			Electrical anti-creep system
5.12.2	10.5	10.5		✓			Final limits
6.1	16.1	16.1		✓			Examinations and tests
6.3	Annex D	Annex D		✓			Examinations and test before putting into service
7.1	16.3	16.3		✓			Installer information
7.1.1	15.11	15.11		✓			Unlocking key
7.2	16.2	16.2		✓			Register

Table G.2 - Correlation between prEN 81-20:2011 and EN 81-1:1998+A3 and EN 81-1:1998+A3 in the order of prEN 81-20:2011 sequence (end)

prEN 81-20:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
Annex A	Annex A	Annex A		✓			List of electrical safety devices
Annex B	Annex C	Annex C		✓			Technical dossier
Annex C	Annex E	Annex E		✓			Periodic examinations and tests
Annex D	Annex O	---	✓				Machinery spaces
Annex D	---	Annex M	✓				Machinery spaces
Annex ZA	Annex ZA	Annex ZA		✓			Relationship between standard and essential requirements

Table G.3 - Correlation between prEN 81-50:2011 and EN 81-1:1998+A3 and EN 81-1:1998+A3 in the order of prEN 81-50:2011 sequence

prEN 81-50:2011	EN 81-1:1998+A3 :2009	EN 81-2:1998+A3 :2009	Unchanged	Modified	New	Deleted	Remarks
1	1	1		✓			Scope
2	2	2		✓			Normative references
3	3	3		✓			Terms and definitions
4	---	---				✓	List of significant hazards
5.1	Annex F.0	Annex F.0	✓				Safety Components - Test procedures for verification of conformity
5.2	Annex F.1	Annex F.1		✓			Landing door locks
5.3	Annex F.3	Annex F.3		✓			Safety gear
5.4	Annex F.4	Annex F.4	✓				Overspeed governor
5.5	Annex F.5	Annex F.5		✓			Buffers
5.6	Annex F.6	Annex F.6	✓				Type examination of safety circuits (PESSRAL)
5.7	Annex F.7	---	✓				Ascending car overspeed protection means
5.8	Annex F.8	---	✓				Unintended car movement protection means
5.9	---	Annex F.7	✓				Rupture valve/ One way restrictor
5.10	Annex G	Annex G		✓			Proof of guide rails
5.11	Annex M	---		✓			Evaluation of traction
5.12	Annex N	---		✓			Evaluation of safety factor for suspension ropes
5.13	---	Annex K		✓			Calculations of rams, cylinders, rigid pipes and fittings
5.14	Annex J	Annex J		✓			Pendulum shock tests
5.15	Annex H	Annex H		✓			Electronic components - Failure exclusion
Annex C	Annex P	Annex L		✓			Measures for failure control

Annex ZA (informative)

Relationship between this European Standard and the Essential Requirements of EU Directive 95/16/EC amended by Directive 2006/42/EC

This European standard has been prepared under a Mandate given to CEN by the European Commission and the European Free Trade Association to provide one means of conforming to Essential Requirements of the New Approach Directive 95/16/EC amended by Directive 2006/42/EC.

Once this standard is cited in the Official Journal of the European Communities under that Directive and has been implemented as a national standard in at least one Member State, compliance with the normative clauses of this standard confers, within the limits of the scope of this standard, a presumption of conformity with all Essential Requirement(s) except Annex I, articles 1.6.1, 4.10 and 5.2 of that Directive and associated EFTA regulations.

WARNING - Other requirements and other EU Directive may be applicable to the product(s) falling within the scope of this standard.

Bibliography

- [1] EN ISO 14122-2:2001+A1:2010, *Safety of machinery - Permanent means of access to machinery - Part 2: Working platforms and walkways*
- [2] ISO 7465:2008, *Passenger lifts and service lifts - Guide rails for lifts and counterweights - T type*