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Titre	Ascenseurs pour le transport de personnes et d'objets - Partie 1: Règles de sécurité pour la construction et l'installation d'ascenseurs et d'ascenseurs de charge (ISO/FDIS 8100-1:2025)
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Balloters are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

FINAL DRAFT
International Standard

ISO/FDIS 8100-1

ISO/TC **178**

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Voting begins on:
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Lifts for the transport of persons and goods —

Part 1:
Safety rules for the construction and installation of passenger and goods passenger lifts

Ascenseurs pour le transport de personnes et d'objets —

Partie 1: Règles de sécurité pour la construction et l'installation d'ascenseurs et d'ascenseurs de charge

IMPORTANT — Please use this updated version dated 2025-11-28, and discard any previous version of this FDIS. Annex ZA has been modified.

ISO/CEN PARALLEL PROCESSING

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

ISO draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). ISO takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, ISO had not received notice of (a) patent(s) which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at www.iso.org/patents. ISO shall not be held responsible for identifying any or all such patent rights.

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 178, *Lifts, escalators, passenger conveyors,* in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 10, *Lifts, escalators and moving walks,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 8100-1:2019), which has been technically revised.

The main changes are as follows:

— requirements for vertically sliding landing and car doors have been added;

— requirements for suspension means other than steel wire ropes have been added;

— requirements for automatic rescue operation have been added;

— requirements for traction lifts with increased available car area have been added;

— requirements for SIL-rated circuits (previously called PESSRAL) have been revised;

— requirements for a working platform in the pit have been added;

— requirements to avoid the dragging of hands in doors have been extended;

— requirements for compensation means entering the refuge space in the pit have been added;

— requirements for the brake have been aligned with overload limits;

— performance and monitoring of the machine brake have been revised;

— requirements for pit access ladders have been revised;

— fire classification of electric cables has been specified;

— requirements for cybersecurity have been added;

— requirements for emergency operation have been revised;

— bypassing normal travel limits in inspection operation has been added;

— SIL levels of the electric safety devices (Annex A) have been revised;

— short circuit between adjacent conductors of travelling cable has been added to electric fault list;

— mechanical strength of luminaires for the well lighting system has been specified;

— requirements for information for use have been revised;

— requirements for tripping the safety gear by electrical means have been added,

— the position of the inspection operation switch has been revised;

— the document structure has been revised as per the ISO/IEC Directives, Part 2.

For relationship with this document and ISO 8100-20:2018, see Annex D, which is an integral part of this document.

ISO/TS 8100-3:2019 provides information on the differences between this document local standards (ASME A17.1/CSA B44 and JIS A 4307 1/JIS A 4307-2) not included in this document.

A list of all parts in the ISO 8100 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document is a type C standard as stated in ISO 12100:2010.

This document is of relevance, in particular, for the following stakeholder groups representing the market players with regard to machinery safety:

— machine manufacturers (small, medium and large enterprises);

— health and safety bodies (regulators, accident prevention organizations, market surveillance, etc.).

Others can be affected by the level of machinery safety achieved with the means of the document by the above-mentioned stakeholder groups:

— machine users/employers (small, medium and large enterprises);

— machine users/employees (e.g. trade unions, organizations for people with special needs);

— service providers, e.g. for maintenance (small, medium and large enterprises);

— consumers (in case of machinery intended for use by consumers).

The above-mentioned stakeholder groups have been given the possibility to participate in the drafting process of this document

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

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

Lifts for the transport of persons and goods —

Part 1: Safety rules for the construction and installation of passenger and goods passenger lifts

1 Scope

This document specifies the safety rules for lifts permanently serving buildings and constructions and intended for the transport of persons or persons and goods. It applies to traction lifts, positive drive lifts and hydraulic lifts that:

— serve specific levels; and

— have a rated speed exceeding 0,15 m/s; and

— have an enclosed car; and

— move along guide rails inclined not more than 15° to the vertical; and

— are indoor or weather-protected.

This document also applies to the electrical equipment of these lifts including the lighting and socket outlets in the well.

This document specifies safety rules related to:

— persons to be safeguarded:

  — users, including passengers, maintenance and inspection personnel;

  — persons at the landings and outside of the well, or any machinery space and pulley room, who can be affected by the lift.

— property to be safeguarded:

  — loads in the car;

  — components of the lift installation;

  — building in which the lift is installed

This document does not specify additional requirements for:

— lifts serving buildings with requirements for seismic conditions;

— lifts serving buildings with requirements for accessibility;

— lifts exposed to vandalism;

— lifts which can be used for firefighting and evacuation purposes under firefighters control;

— lifts which can be used to support faster evacuation of persons with disabilities;

— the behaviour of the lift when the control system of the lift receives a recall signal(s) in the event of fire in a building.

This document is not applicable to passenger and goods passenger lifts, which are installed before the date of its publication.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 1219-1:2012, *Fluid power systems and components — Graphical symbols and circuit diagrams — Part 1: Graphical symbols for conventional use and data-processing applications*

ISO 3008-2:2017, *Fire-resistance tests — Part 2: Lift landing door assemblies*

ISO 4344:2022, *Steel wire ropes for lifts — Minimum requirements*

ISO 4190-5:2006, *Lift (Elevator) installation — Part 5: Control devices, signals and additional fittings*

ISO 4413:2010, *Hydraulic fluid power — General rules and safety requirements for systems and their components*

ISO 6743-4:2015, *Lubricants, industrial oils and related products (class L) — Classification — Part 4: Family H (Hydraulic systems)*

ISO 7000:2019[1)], *Graphical symbols for use on equipment — Registered symbols*

ISO 7010:2019[1)], *Graphical symbols — Safety colours and safety signs — Registered safety signs*

ISO 8100-2:2025, *Lifts for the transport of persons and goods —Part 2: Design rules, calculations, verifications and tests of lift components*

ISO 8100-33:2022, *Lifts for the transport of persons and goods — Part 33: T-type guide rails for lift cars and counterweights*

ISO 8102-1:2020, *Electrical requirements for lifts, escalators and moving walks — Part 1: Electromagnetic compatibility with regard to emission*

ISO 8102-2:2021, *Electrical requirements for lifts, escalators and moving walks — Part 2: Electromagnetic compatibility with regard to immunity*

ISO 8102-20:2022, *Electrical requirements for lifts, escalators and moving walks — Part 20: Cybersecurity*

ISO 12100:2010, *Safety of machinery — General principles for design — Risk assessment and risk reduction*

ISO 12543-2:2021, *Glass in building — Laminated glass and laminated safety glass — Part 2: Laminated safety glass*

ISO 12543-3:2021, *Glass in building — Laminated glass and laminated safety glass — Part 3: Laminated glass*

ISO 13857:2019, *Safety of machinery — Safety distances to prevent hazard zones being reached by upper and lower limbs*

ISO 14122-2:2016, *Safety of machinery — Permanent means of access to machinery — Part 2: Working platforms and walkways*

ISO 14122-3:2016, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ISO 14122-4:2016, *Safety of machinery — Permanent means of access to machinery — Part 4: Fixed ladders*

ISO 29584:2015, *Glass in building — Pendulum impact testing and classification of safety glass*

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1) The graphical symbol collections of ISO 7000 and ISO 7101 can be previewed and purchased on the Online Browsing Platform (OBP), www.iso.org/obp

IEC 60204-1:2016+A1:2021, *Safety of machinery — Electrical equipment of machines — Part 1: General requirements*

IEC 60227-6:2001, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V — Part 6: Lift cables and cables for flexible connections*

IEC 60332-1-2:2004+AMD1:2015, *Tests on electric and optical fibre cables under fire conditions — Part 1-2: Test for vertical flame propagation for a single insulated wire or cable — Procedure for 1 kW pre-mixed flame*

IEC 60364-4-41:2005+AMD1:2017, *Low voltage electrical installations — Part 4-41: Protection for safety — Protection against electric shock*

IEC 60364-6:2016, *Low voltage electrical installations — Part 6: Verification*

IEC 60417:2002[2)], *Database — Graphical symbols for use on equipment*

IEC 60529:1989+AMD1:1999+AMD2:2013, *Degrees of protection provided by enclosures (IP Code)*

IEC 60598-1:2024, *Luminaires — Part 1: General requirements and tests*

IEC 60617:2025, *Database — Graphical symbols for diagrams*

IEC 60664-1:2020, *Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests*

IEC 60947-4-1:2023, *Low-voltage switchgear and controlgear — Part 4-1: Contactors and motor-starters — Electromechanical contactors and motor-starters*

IEC 60947-5-1:2024, *Low-voltage switchgear and controlgear — Part 5-1: Control circuit devices and switching elements — Electromechanical control circuit devices*

IEC 61310-3:2007, *Safety of machinery - Indication, marking and actuation — Requirements for the location and operation of actuators*

IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 1: General requirements*

IEC 61800-5-2:2016, *Adjustable speed electrical power drive systems — Part 5-2: Safety requirements. Functional*

IEC 61810-1:2015+AMD1:2019, *Electromechanical elementary relays — Part 1: General requirements*

IEC 61810-3:2015, *Electromechanical elementary relays - Part 3: Relays with forcibly guided (mechanically linked) contacts*

EN 81-28:2025, *Safety rules for the construction and installation of lifts — Lifts for the transport of persons and goods — Part 28: Two-way communication system to contact a rescue service*

EN 81-58:2022, *Safety rules for the construction and installation of lifts — Examinations and tests — Part 58: Landing door fire resistance test*

EN 13411-3:2022, *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 13411-7:2021, *Terminations for steel wire ropes — Part 7: Safety. Symmetric wedge socket*

EN 13411-8:2011, *Termination for steel wire ropes — Part 8: Safety. Swage terminals and swaging*

EN 13501-1:2018, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

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2) The graphical symbol collections of IEC 60417 can be previewed and purchased on the Online Browsing Platform (OBP), www.iso.org/obp

EN 13501-6:2018+A1:2022, *Fire classification of construction products and building elements — Part 6: Classification using data from reaction to fire tests on electric cables*

EN 50214:2024, *Flat polyvinyl chloride sheathed flexible cables*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12100:2010 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
apron
smooth vertical part extending downwards from the sill of the landing or car entrance

3.2
automatic operation
operation in which start of the movement of the car happens in response to the momentary actuation of operating devices or in response to any other automatic starting function

Note 1 to entry: See Annex E for additional information.

3.3
automatic rescue operation
device or function that operates automatically in case of failure or loss of power supply to move the lift car to a landing

3.4
average probability of dangerous failure on demand
PFD_{avg}
mean unavailability of a E/E/PE safety-related system to perform the specified safety function when a demand occurs from the lift or lift control system

[SOURCE: IEC 61508-4:2010, 3.6.18, modified — replaced "EUC or EUC control system" with "lift or lift control system"; deleted Notes 1, 2 and 3]

3.5
average frequency of a dangerous failure per hour
PFH
average frequency of a dangerous failure of a E/E/PE safety-related system to perform the specified safety function over a given period of time

[SOURCE: IEC 61508-4:2010, 3.6.19, modified — deleted Notes 1, 2, 3 and 4.]

3.6
balancing weight
mass which compensates all or part of the mass of the car

3.7
buffer
device with characteristics to dissipate or store kinetic energy

3.8
car
part of the lift which carries passengers and goods

3.9
carbon fibre reinforced polymer
CFRP
material consisting of carbon filaments and resin

3.10
counterweight
mass which compensates the mass of the car and a part of the rated load

3.11
direct acting lift
hydraulic lift where the ram or cylinder is directly attached to the car or the car sling

3.12
down direction valve
electrically controlled valve in a hydraulic circuit for controlling the descent of the car

3.13
drive control system
system controlling and monitoring the running of the lift machine

3.14
electrical anti-creep system
measure for hydraulic lifts against the danger of the car moving slowly away from the floor level

3.15
electric safety device
safety contact, safety circuit or SIL-rated circuit, having the required reliability of operation

3.16
electric safety chain
total of the electric safety devices

3.17
full load pressure
static pressure exerted on the piping, jack, valve block, etc., with the car and rated load being at rest at the highest landing level

3.18
goods passenger lift
passenger lift with additional measures for the transport of goods

3.19
headroom
part of the well between the highest landing served by the car and the ceiling of the well

3.20
hold-to-run control device
control device which initiates and maintains machine functions only as long as the manual control (actuator) is actuated

[SOURCE: ISO 12100:2010, 3.28.3]

3.21
hydraulic lift
lift in which movement of the car is operated by hydraulic fluid

3.22
indirect acting lift
hydraulic lift where the ram or cylinder is connected to the car or the car sling by suspension means

3.23
instantaneous safety gear
safety gear without limitation of retardation

3.24
jack
combination of a cylinder and a ram forming a hydraulic actuating unit

3.25
levelling
operation which achieves the stopping accuracy at a landing

3.26
levelling accuracy
vertical distance between car sill and landing sill

3.27
lift machine
unit which drives and stops the lift, including any motor, gear, machine brake, sheave/sprockets and drum (traction or positive drive lift) or comprising the pump, pump motor and control valves (hydraulic drive lift)

3.28
machine room
fully enclosed machinery space outside of the well with ceiling, walls, floor and access door(s) in which machinery as a whole or in parts is placed

3.29
machinery
control cabinet(s) and drive system, lift machine, main switch(es), and devices for emergency and test operation

3.30
machinery space
volume(s) inside or outside of the well where the machinery as a whole or in parts is placed, including the working areas associated with the machinery

3.31
machinery cabinet
fully enclosed volume outside of the well and machine room where the machinery as a whole or parts of it are placed

Note 1 to entry: Related working area is located outside of the machinery cabinet.

3.32
maintenance
process of examination, lubrication, cleaning and adjustments of lift parts to ensure the safe and intended functioning of the lift and its components after the completion of the installation and throughout its life cycle

[SOURCE: ISO 8100-20:2018, 3.19]

3.33
minimum breaking force
MBF
specified value in kilonewtons below which the measured breaking force is not allowed to fail in a breaking force test

3.34
mission time
maximum time interval between manufacturing date and replacement date

3.35
non-return valve
valve preventing the discharge of the hydraulic fluid when the pressure is removed from the inlet side

3.36
normal operation
automatic operation wherein the lift is used for transport of passenger or goods, and wherein the car is stopped automatically at the landings

Note 1 to entry: See Annex E for additional information.

3.37
one-way restrictor
valve which allows free flow in one direction and restricted flow in the other direction

3.38
overspeed governor
device to detect excessive speed of the lift and to trigger the operation of devices to stop the lift

3.39
passenger
any person transported in the car

3.40
pawl device
mechanical device for stopping involuntary descent of the car, and maintaining it stationary on fixed supports

3.41
pit
part of the well situated below the lowest landing served by the car

3.42
positive drive lift
lift which is directly driven (not reliant on friction) by drum and ropes or by sprockets and chains or by sprockets and timing belts

3.43
power cycle
restoration of the power supply after it has been unavailable

3.44
preliminary operation
energizing of the lift machine as preparation to a normal run when the car is in the door zone and doors are not closed and not locked

3.45
pressure relief valve
valve to automatically discharge the hydraulic fluid when the pre-set pressure is exceeded

3.46
progressive safety gear
safety gear with limited retardation

3.47
pulley room
room not containing the lift machine, in which pulleys are located, and in which the overspeed governor can also be housed

3.48
rated load
load which is intended to be carried in the car, e.g. passengers or goods, in normal operation

3.49
rated speed
speed, *v*, in metres per second of the car for which the equipment has been built

Note 1 to entry: For hydraulic drive lifts:

— v_m is the rated speed upward in metres per second;

— v_d is the rated speed downward in metres per second;

3.50
re-levelling
operation to correct the car position, after the lift has stopped at a landing

3.51
residual breaking force
RBF
Force that the suspension means can withstand at the end of the lifetime

3.52
restrictor
component in which the inlet and outlet are connected through a restricted passageway

3.53
rupture valve
valve that closed automatically when the hydraulic flow exceeds a pre-set amount

3.54
safety circuit
circuit based on electrical and/or electronic components

Note 1 to entry: Electrical components include electromechanical devices like contacts and relays. Electronic components include solid-state non-programmable electronic devices.

3.55
safety gear
mechanical device gripping on the guide rails

3.56
safety integrity level
SIL
discrete level corresponding to a range of safety integrity values, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

[SOURCE: IEC 61508-4:2010, 3.5.8, modified.]

3.57
safety rope
auxiliary rope attached to the car, the counterweight or balancing weight for the purpose of tripping a safety gear in case of a suspension failure

3.58
shut-off valve
manually operated two-way valve permitting or preventing flow in either direction

3.59
SIL-rated circuit
circuit based on electrical (E), and/or electronic (E), and/or programmable electronic (PE) components with a defined safety integrity level (SIL)

Note 1 to entry: The term is intended to cover any and all devices or systems operating on electrical principles.

EXAMPLE Electrical/electronic/programmable electronic technology includes:

a) electromechanical devices (electrical);

b) solid-state non-programmable electronic devices (electronic);

c) electronic devices based on computer technology (programmable electronic).

3.60
special tool
tool unique to the equipment required for maintenance or for emergency operation

3.61
stopping accuracy
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

3.62
tension member
load-bearing structural element

3.63
traction lift
lift which is driven by friction between the driving sheave and the suspension means

3.64
travelling cable
flexible electric cable for connection between the car, the counterweight, the balancing weight or a fixed point

3.65
unlocking zone
zone, extending above and below the landing level, where the car enables the corresponding landing door to be unlocked

3.66
user
person making use of a lift installation which includes passengers and persons waiting at the landings

3.67
well
space in which the car, the counterweight or the balancing weight travels

4 Safety requirements and/or protective measures

4.1 General

4.1.1 Passenger and goods passenger lifts shall be in accordance with the safety requirements and/or protective measures of the following clauses. In addition, the passenger and goods passenger lifts shall be designed in accordance with the principles of ISO 12100:2010 for hazards relevant but not significant that are not dealt with by this document.

NOTE ISO 14798:2009 methodology can be used for specific risks.

4.1.2 The fixing system of guards shall remain attached to the guard or to the equipment when the guard is removed as per 6.2.4.

4.1.3 Textual information shall be in the accepted language(s) of the country where the lift is installed.

4.1.4 Labels, notices, markings and signs:

— shall be permanently affixed;

— shall not become unreadable by use of cleaning agents, oil and grease as instructed in 6.2.4;

— shall not be hidden behind parts of the product, excluding enclosures.

4.2 Well, machinery spaces and pulley rooms

4.2.1 General provisions

4.2.1.1 Arrangement of lift equipment

4.2.1.1.1 All lift components covered by this document, shall be accessible only by use of a key, except those provided for use by passengers.

All lift components covered by this document, except those provided for use by passengers, shall be located:

— in a machine room; or

— in a pulley room; or

— in a machinery cabinet; or

— in the well.

4.2.1.1.2 Where parts (lift machine, controller, overspeed governor, switches, etc.) of a lift are installed in a machine room and/or a pulley room which contains parts from other lifts, parts belonging to that lift shall be identified by consistently used number, letter or colour unique to that lift.

4.2.1.2 Lighting

The well shall be provided with permanently installed electric lighting, giving the following intensity of illumination, even when all doors are closed, at any position of the car throughout its travel in the well:

a) at least 50 lx, 1,00 m above the car roof within its vertical projection;

b) at least 50 lx, 1,00 m above the pit floor, and above the pit platform, if provided, and everywhere a person can stand, work and/or move between the working areas;

c) at least 20 lx outside of the locations defined in 4.2.1.2 a) and 4.2.1.2 b), excluding shadows created by the car or other components.

To achieve this, luminaires shall be fixed throughout the well enclosure and, where necessary, additional luminaires on the car roof as a part of the well's lighting system.

The mechanical strength of permanently installed luminaires shall be in accordance with:

— IEC 60598-1:2024, 7.13 level 1 or IEC 62262:2002+AMD1:2021, IK03 for fixed luminaires; and

— IEC 60598-1:2024, 7.13 level 3 or IEC 62262:2002+AMD1:2021, IK05 for movable luminaires.

For the electrical supply for this lighting, see 4.10.7.1.

The light meter sensor shall be facing directly towards the light source when taking lux level readings.

4.2.1.3 Electric equipment in the pit area, in machinery spaces and in pulley rooms

4.2.1.3.1 There shall be in the pit area:

a) at the access door to the pit, and at the landing door(s) provided with a ladder to enter the pit (see 4.2.2.1), an inspection operation switch as per 4.12.1.5.1.2 a) and a means to control the well lighting (see 4.2.1.2) both,

   — within a vertical distance of minimum 0,90 m and maximum 1,20 m above the access floor;

   — within a horizontal distance of maximum 0,75 m from the door frame inner edge.

b) permanently installed inspection operation control devices as per 4.12.1.5 without inspection operation switch, at a horizontal clear distance not exceeding 0,30 m of a refuge space;

c) socket outlet(s) as per 4.10.7.2

d) in case of a pit platform and where there are moving parts below the pit platform; a stopping device located below the pit platform within a vertical distance of maximum 1,20 m above the floor below the pit platform.

4.2.1.3.2 There shall be in machinery spaces and pulley rooms:

a) means to switch the lighting of the spaces and rooms as per 4.10.8.2;

b) a socket outlet (4.10.7.2) for each space and room.

4.2.1.3.3 There shall be in pulley rooms a stopping device, as per 4.12.1.11, close to each access point.

4.2.1.4 Alert initiation

Alert initiation device(s) shall be installed:

— on the car roof, where it is not possible to alert via inside the car as per 4.2.6.4.3.1 c); and

— in the pit or underneath the car, where an access door to the pit is not provided.

The alert initiation device(s) shall:

a) be connected to a two-way communication system in accordance with EN 81-28:2025; or

b) activate an acoustic device with a sound level of 80 dB(A) at 1,00 m distance, located on the car roof or at a landing. The acoustic device shall be powered by the emergency supply as per 4.10.11.

NOTE National or local regulation can require a).

4.2.1.5 Forces

4.2.1.5.1 The vertical force beneath each guide rail shall be calculated considering the relevant forces among the following: the force due to the mass of the guide rails, loads due to components fixed or linked to the guide(s) and/or any additional reaction, occurring during emergency stopping (e.g. load on traction sheave due to rebound when machine on rails), the reaction at the moment of operation of the safety gear and any push through force exerted by the guide rails clips (see 4.7.2.3.5).

NOTE Freely hanging rails do not contact the pit floor during normal operation, but there are spot cases where forces can be transmitted to the pit floor (i.e. during guide rail installation and during a safety device actuation on the guide rails).

4.2.1.5.2 The vertical force beneath the car buffer supports shall be calculated as four times the static load imposed by the mass of the fully loaded car, evenly distributed between the total number of car buffers [see Formula (1)]:

$$F = 4 \cdot g_n \cdot (P + Q) \quad (1)$$

where

F is the total vertical force in newtons;
g_n is the standard acceleration of free fall, [9,81 (m/s^2)];
P is the mass of the empty car and components supported by the car, i.e. part of the travelling cable, compensation means (if any), etc. in kilograms;
Q is the rated load, in kilograms.

4.2.1.5.3 The vertical force beneath the counterweight buffer supports shall be calculated as four times the static load imposed by the mass of the counterweight, evenly distributed between the total number of counterweight buffers [see Formula (2)]:

$$F = 4 \cdot g_n \cdot (P + q \cdot Q) \quad (2)$$

where

F is the total vertical force in newtons;
g_n is the standard acceleration of free fall, [9,81 (m/s^2)];
P is the mass of the empty car and components supported by the car, i.e. part of the travelling cable, compensation means (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.

4.2.1.5.4 For hydraulic lifts, the vertical force beneath each jack shall be calculated as the loads and forces (in newtons) imposed to it.

4.2.1.5.5 For lifts equipped with a device as per 4.6.5 or 4.4.2.2.1 d) 1), the fixed stops shall be able to withstand the vertical force imposed on the stops by the device as calculated by:

a) Formula (3) for devices provided with energy accumulation type buffers;

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

b) Formula (4) for devices provided with energy dissipation type buffers.

$$F = \frac{2 \cdot g_n \cdot (P + Q)}{n} \quad (4)$$

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/s^2)];
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, compensation means (if any), etc. in kilograms;
Q is the rated load, in kilograms.

4.2.2 Access to the pit

4.2.2.1 A means to enter the pit (see Figure 1) shall be provided consisting of:

a) In case a pit platform is not provided:

   1) where the pit depth does not exceed 2,50 m, either:

      — an access door to the pit; or

      — a pit access ladder as per Annex C;

   2) where the pit depth exceeds 2,50 m:

      — an access door to the pit.

b) In case a pit platform is provided, either:

   1) an access door to the pit, a ladder to access the platform and an access trap door; or

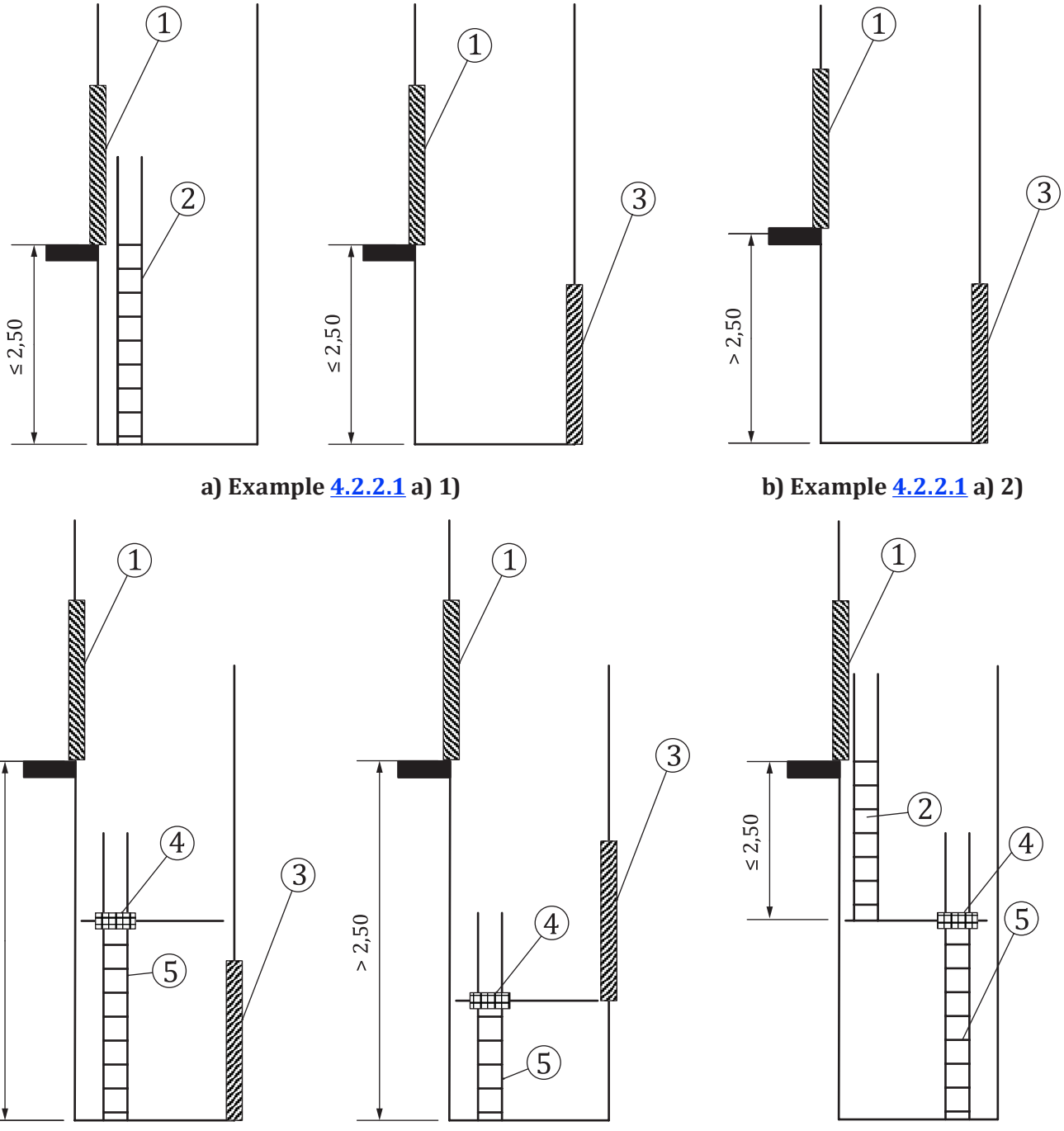
   2) an access door to the pit platform, a ladder to access the pit and an access trap door; or

   3) a pit access ladder as per Annex C where the distance from the floor of the door giving access to the pit platform does not exceed 2,50 m, a ladder to access the pit and an access trap door. Where the falling height below the pit platform is 3,00 m or more, the ladder shall be fitted with a safety cage in accordance with ISO 14122-4:2016, 5.5.1.

The access door(s) to the pit shall be in accordance with the requirements of 4.2.3.

Where the vertical distance between a door giving access to the pit and the pit floor exceeds 0,5 m a pit access ladder shall be provided.

Dimensions in metres



a) Example 4.2.2.1 a) 1)

b) Example 4.2.2.1 a) 2)

c) Example 4.2.2.1 b) 1)

d) Example 4.2.2.1 b) 2)

e) Example 4.2.2.1 b) 3)

Key

1	landing door
2	pit access ladder
3	access door to the pit
4	access trap door
5	ladder

Figure 1 — Examples for access to the pit

4.2.2.2 A pit platform shall be provided when the vertical distance exceeds 2,20 m from the standing area(s) on the pit floor to:

— equipment mounted on the underside of the car which needs to be maintained with the car at its lowest possible position during pit inspection operation (see 4.12.1.5.2.1 f) 4); or

— equipment placed in the pit which needs to be maintained.

Where a pit platform is provided, the following shall apply:

a) the vertical distance from the floor of the standing area(s) on the pit platform to equipment which needs to be maintained from the pit platform shall not exceed 2,20 m;

b) the clear vertical height between the bottom of the pit and the lowest parts of the pit platform shall be at least 1,50 m where access is required as per 6.2.4;

c) refuge space(s) according 4.2.5.8.1 shall be available on the pit platform;

d) clearances between the pit platform and the car shall be in accordance with 4.2.5.8.2;

e) the horizontal perpendicular distance between the outer edges of the pit platform and the walls of the well or components of the lift shall not exceed 0,30 m, unless the pit platform is provided with a balustrade as per 4.4.7.4. The horizontal distance between the door giving access to the pit platform and the leading edge of the pit platform shall not exceed 20 mm;

f) the pit platform shall be provided with a toe board of a minimum height of 100 mm on the outer edges excluding the leading edge between the pit platform and the door giving access to the pit platform;

g) openings in the pit platform for e.g. guide rails, buffers and electric cables shall be provided with ferrules projecting at least 50 mm above the pit platform;

h) no load bearing component of the lift, e.g. guide rails, or hydraulic jack, shall be supported by the pit platform;

i) the pit platform shall have a strength to support the maximum number of persons, as per 4.2.5.8.1. In addition, the pit platform shall resist a minimum force of 2 000 N at any position on the pit platform over an area of 0,30 m × 0,30 m without causing permanent deformation greater than 1 mm;

j) the maximum permissible load shall be indicated on the pit platform with the warning sign in accordance with ISO 7010:2019, W001 supplemented by the symbol in accordance with ISO 7000:2019, 1321B with the text “≤ xxx kg” (see Figure 2), where xxx is the value of maximum permissible load in kilograms;

k) the pit platform shall be designed as follows:

   — slip resistant in accordance with ISO 14122-2:2016, 4.2.4.7;

   — plane surface;

   — where the flooring is perforated, the maximum opening shall be in accordance with ISO 14122-2:2016, 4.2.4.5.1.

Figure 2 — Maximum permissible load on a platform

4.2.3 Access doors, emergency doors, access trap doors and inspection doors

4.2.3.1 When the distance between consecutive landing door sills exceeds 11 m measured vertically, one of the following conditions shall be fulfilled. There shall be:

a) intermediate emergency doors, to permit access at every 11 m; or

b) adjacent cars each fitted with an emergency door, provision for which is made in 4.4.6.2.

NOTE "Consecutive" is understood to mean two adjacent floors, with landing doors, regardless of open through or open adjacent configurations.

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

a) access doors to machine rooms and the access door to the pit shall have a minimum height of 2,00 m and a minimum width of 0,60 m;

b) access doors to pulley rooms 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 opening of at least 0,80 m × 0,80 m, and the handling force shall not exceed 150 N;

d) emergency doors shall have a minimum height of 1,80 m and a minimum width of 0,50 m;

e) inspection doors shall have a maximum height of 0,50 m and a maximum width of 0,50 m;

f) access trap doors on the pit platform shall give a clear opening of at least 0,50 m × 0,70 m, and the handling force shall not exceed 150 N.

4.2.3.3 Access, emergency and inspection doors shall:

a) not open towards the inside of:

   — the well,

   — the machine room,

   — the pulley room.

b) be provided with a key-operated lock, capable of being closed without the use of a key and automatically locked when closed;

c) be openable from the inside without a key, even when locked;

d) be provided with an electric safety device as per 4.11.2, checking the closed position;

   An electric safety device is not required in the case of:

   1) access door(s) to machine and pulley rooms; and

   2) access door(s) to the pit (4.2.2.1), if the access door(s) to the pit 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 automatic operation and the bottom of the pit or the pit platform is at least 2,00 m. The presence of travelling cables, compensation means and their equipment, tensioning pulleys for the overspeed governor and similar installations is not regarded as being hazardous.

e) be imperforate;

f) have a mechanical strength such that when a force of 1 000 N, being evenly distributed over an area of 0,09 m^2 in round or square section, is applied at right angles at any point from outside the well, it shall resist without elastic deformation greater than 15 mm.

g) The emergency doors shall be provided with an openable barrier to avoid persons falling into the well. After opening of the emergency door, an additional action shall be required to open the barrier. The barrier shall not open towards the inside of the well and shall be self-closing.

4.2.3.4 Access trap doors shall be in accordance with the following:

a) when they are closed, they shall be able to support 2 000 N on an area of 0,30 m × 0,30 m at any position;

b) trap doors shall not open downward. Hinges, if any, shall be of a type which cannot be unhooked;

c) trap doors not used for access of persons shall be unlocked from the inside only;

d) when a trap door is in the open position, precautions shall be taken to prevent the fall of persons (e.g. a guardrail) and prevent the trap door from closing such as to cause a crushing hazard (e.g. by counterbalance).

4.2.4 Notices

4.2.4.1 A notice bearing the following minimum inscription:

“Lift Machinery — Danger — Access forbidden to unauthorized persons”

shall be affixed to the outside surface of access doors or trap doors (excluding landing doors and doors of emergency and test panels) giving access to machine room and pulley rooms.

In the case of trap doors, a notice shall indicate:

“Danger of falling — Reclose the trap door”

4.2.4.2 A notice bearing the following minimum inscription:

"Lift well — Danger — Access forbidden to unauthorized persons"

shall be affixed to the outside surface of access doors, inspection doors and emergency doors giving access to the well.

4.2.5 Well

4.2.5.1 General provisions

4.2.5.1.1 The well may contain one or more lift cars.

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

4.2.5.1.3 For hydraulic lifts, jacks shall be in the same well as the car. They may extend into the ground or other spaces.

4.2.5.2 Well enclosure

4.2.5.2.1 The lift shall be installed in an imperforate well enclosure.

4.2.5.2.2 If the well is partially enclosed, the height of the enclosure shall be;

— minimum 3,50 m at a landing door side (see Figure 3);

— minimum 2,50 m at other sides and with a minimum horizontal distance of 0,50 m to moving parts of the lift (see Figure 3). 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 at a distance of 2,00 m (see Figure 4).

— the enclosure shall be located within 0,15 m maximum of the edges of floors, stairs or platforms (see Figure 3);

4.2.5.2.3 Openings in the well enclosure shall be protected by:

a) landing doors as per 4.3;

b) access doors, emergency doors and inspection doors as per 4.2.3;

c) measures as per 4.2.6.3.3 for openings between the well and the machine room;

d) measures as per 4.2.6.7.2 for openings between the well and the pulley room;

e) means in accordance with ISO 13857:2019, Table 5 for ventilation;

4.2.5.2.4 Any horizontal projection from the wall into the well or any horizontal beam - including separator beams - greater than 0,15 m in width and 0,25 m in length, shall be protected from a person standing there by one of the following means:

a) the projection is chamfered to at least 45° to the horizontal where the projection is greater than 0,15 m;

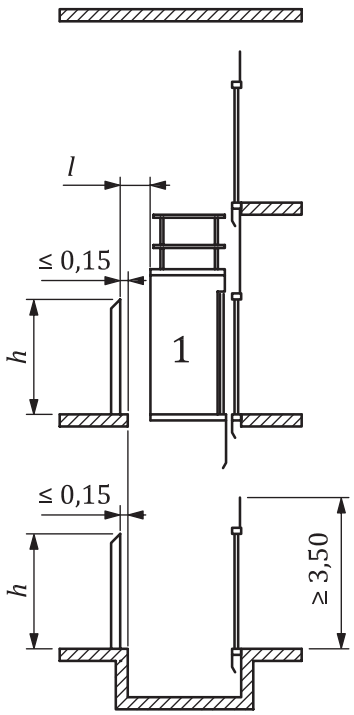
b) using a deflector on top of the projection forming an inclined surface of minimum 45° to the horizontal, capable of resisting a force of 300 N applied at right angles to the deflector at any point, distributed evenly over a surface of 5 cm^2 in round or square section, such that it shall resist:

   — without permanent deformation greater than 1 mm;

   — without elastic deformation greater than 15 mm.

c) access is prevented by a car top balustrade as per 4.4.7.4.

Dimensions in metres

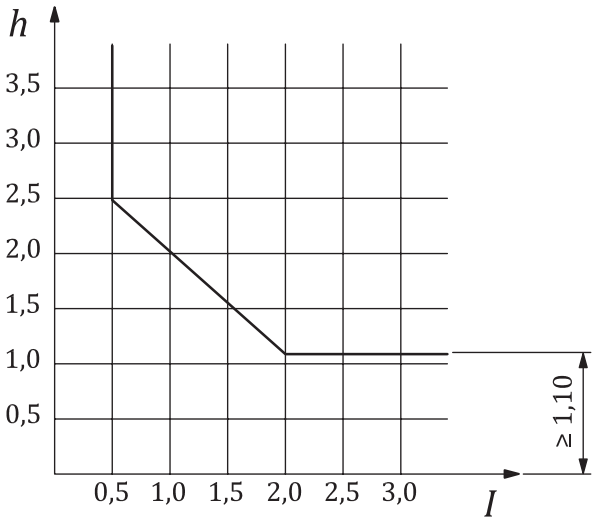


Key

1	car
h	height of the enclosure
l	distance to moving parts of the lift (see Figure 4)

Figure 3 — Partially enclosed well

Dimensions in metres



Key

h	height of the enclosure
l	distance to moving parts of the lift

Figure 4 — Partially enclosed well — Distances

4.2.5.3 Clearances related to the walls of the well and landing doors facing a car entrance

4.2.5.3.1 The horizontal distance between the inner surface of the well and:

— the sill of the car,

— the door frame of the car, and

— the closing edge of car sliding doors

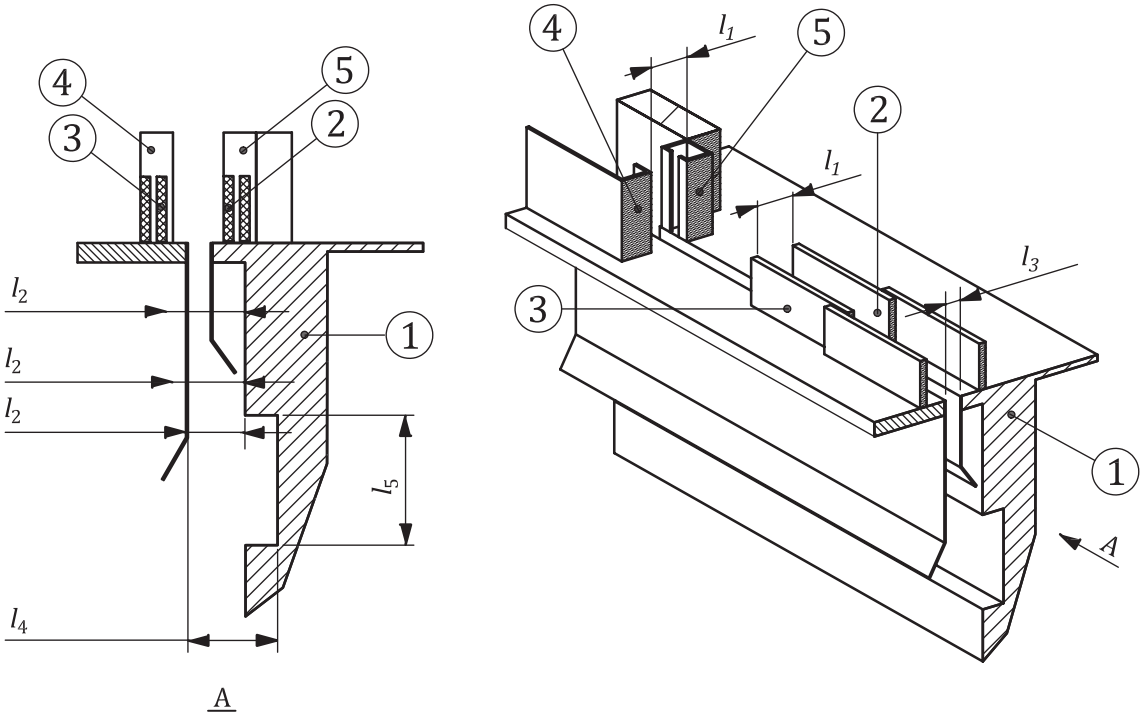
shall not exceed 0,12 m, over the full height of the well (See Figure 5), unless permitted here after.

The distance given above:

a) shall not exceed 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;

b) shall not exceed 0,15 m throughout the travel on goods passenger lifts in which the landing doors are vertically sliding;

c) is not limited if the car is provided with a mechanically locked door as per 4.3.9.2, which can only be opened in the unlocking zone of a landing door.



Key

1	lift well wall
2	landing door leading panel
3	car door leading panel
4	car door frame
5	landing door frame
l_1	distance ≤ 0,10 m [4.3.4.2]
l_2	distance ≤ 0,12 m [4.2.5.3.1]
l_3	distance ≤ 35 mm [4.3.4.1]
l_4	distance ≤ 0,20 m [4.2.5.3.1 a)]
l_5	distance ≤ 0,50 m [4.2.5.3.1 a)]

Figure 5 — Clearances between car and wall facing the car entrance

4.2.5.3.2 Below each landing door sill the surface facing the car apron shall be in accordance with the following:

a) it shall form a vertical surface:

1) 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; or

2) when the vertical floor to floor distance does not allow the required height of the vertical surface as per 4.2.5.3.2 a) 1):

— the vertical surface shall close the gap between the landing sill and the locking device of the lower landing door and shall be at least 100 mm height; and

— the unlocking zone shall be limited to maximum ±150 mm.

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 cm^2 in round or square section, it shall resist:

   1) without permanent deformation greater than 1 mm;

   2) without elastic deformation greater than 15 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.

4.2.5.4 Protection of any spaces located below the well

Where accessible spaces exist below the well, the counterweight or balancing weight shall be fitted with a safety gear.

4.2.5.5 Protection in the well

4.2.5.5.1 The travelling area of the counterweight or the balancing weight in the pit area shall be guarded by a screen(s):

— where the vertical distance of the lowest point of the counterweight resting on its fully compressed buffer(s) or of the balancing weight in its lowest position, is less than 2,00 m from the pit floor;

— where a pit platform is provided, and the vertical distance of the lowest point of the counterweight resting on its fully compressed buffer(s) or of the balancing weight in its lowest position, is less than 2,00 m from the pit platform and the horizonal distance between the pit platform edges and the counterweight or the balancing weight is less than 0,50 m.

The screen shall be in accordance with the following:

a) if this screen is perforate, it shall be in accordance with ISO 13857:2019, 4.2.4.1;

b) 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 2,00 m from the pit floor or pit platform, if provided;

c) in no case shall the lowest part of the screen be more than:

   — 0,30 m from the pit floor;

   — 0,10 m from the pit platform;

   For buffers travelling with the counterweight, see 4.8.1.1.

d) the width shall be at least equal to that of the counterweight or balancing weight;

e) if the gap between the counterweight/balancing weight guide rails and the well wall exceeds 0,30 m then this area shall also be guarded as per 4.2.5.5.1 b) and 4.2.5.5.1 c);

f) the screen may have slot(s) of maximum 0,30 m width to permit free passage of compensation means or for the purpose of visual inspection;

g) the screen shall not deflect to cause the counterweight or balancing weight to collide with it when a force of 300 N being evenly distributed over an area of 5 cm^2 in round or square section is applied at right angles at any point of the screen;

4.2.5.5.2 Where the well contains several lifts there shall be a partition between the moving parts of different lifts. This partition shall be in accordance with the following.

a) If this partition is perforated it shall be in accordance with ISO 13857:2019, 4.2.4.1.

b) The partition shall not deflect to cause the moving parts to collide with it when a force of 300 N being evenly distributed over an area of 5 cm^2 in round or square section is applied at right angles at any point of the partition.

c) The partition shall extend from a height of 0,30 m above the pit floor up to a height of:

   — 2,50 m above the pit floor.

   — 2,50 m above the pit platform and

   — 2,50 m above the top rung of the ladders or steps giving access to the pit or pit platform.

   The width shall prevent access from one pit to another, with the maximum free distance of 0,15 m to the adjacent wall.

   Where the free vertical distance between the lowest parts of car, counterweight or balancing weight including guide shoes, apron, etc. during automatic operation and the bottom of the pit or the pit platform is at least 2,00 m, such a partition screen below the lowest point of the travel of the car is not required.

d) The partition shall extend through the full height of the well where the horizontal distance between the inner edge of any car 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.

4.2.5.5.3 The car and its associated components shall be at a distance of at least 50 mm from the counterweight or balancing weight, and its associated components.

4.2.5.6 Guided travel of car, counterweight and balancing weight

4.2.5.6.1 Extreme position of car, counterweight and balancing weight

4.2.5.6.1.1 The extreme positions of car, counterweight and balancing weight as per Table 1 shall be considered for requirements on guided travel as per 4.2.5.6, and refuge spaces and clearances as per 4.2.5.7 and 4.2.5.8.

Table 1 — Extreme positions of car, counterweight and balancing weight

Position	Traction drives	Positive drives	Hydraulic drives
Highest position of car	Counterweight on fully compressed buffer $+0{,}035v^{2}$ a)	Car on fully compressed upper buffer	Ram in its ultimate position achieved through the means of ram stroke limitation $+0{,}035v_{m}{}^{2}$
Lowest position of car	Car on fully compressed buffer	Car on fully compressed lower buffer	Car on fully compressed buffer
Highest position of counterweight/balancing weight	Car on fully compressed buffer $+0{,}035v^{2}$	Car on fully compressed lower buffer $+0{,}035v^{2}$	Car on fully compressed buffer $+0{,}035v_{d}{}^{2}$
Lowest position of counterweight/balancing weight	Counterweight on fully compressed buffer	Car on fully compressed upper buffer	Ram in its ultimate position achieved through the means of ram stroke limitation $+0{,}035v_{m}{}^{2}$

a) $0{,}035v^{2}$ represents half the gravity stopping distance corresponding to 115 % of the rated speed: $\frac{1}{2}\cdot\frac{(1{,}15\cdot v)^{2}}{2\cdot g_{n}}=0{,}033\ 7v^{2}$, rounded to $0{,}035v^{2}$.

4.2.5.6.1.2 When for traction lifts the slowdown of the lift machine is monitored, as per 4.12.1.3, the value of $0{,}035v^{2}$, in Table 1 is permitted to be calculated with the speed at which the car or counterweight comes into contact with the buffer [see 4.8.2.2.1 b)].

4.2.5.6.1.3 For traction lifts which are fitted with compensation means having a tensioning pulley equipped with an anti-rebound device (braking or lock-down device), the value of $0{,}035v^{2}$ in Table 1 is permitted to be replaced by a value for the movement of the car related to the possible travel of that pulley 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.

4.2.5.6.1.4 In the case of a direct acting lift, the value of $0{,}035v^{2}$ mentioned in Table 1 may be omitted.

4.2.5.6.2 In the case of traction lifts

When the car or counterweight is at its highest position as per 4.2.5.6.1, its guide rail lengths shall be such as would accommodate a further guided travel of at least 0,10 m.

4.2.5.6.3 In the case of positive drive lifts

4.2.5.6.3.1 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.

4.2.5.6.3.2 When the balancing weight, if provided, is at its highest position as per 4.2.5.6.1, its guide rail lengths shall be such as would accommodate a further guided travel of at least 0,30 m.

4.2.5.6.4 In the case of hydraulic lifts

4.2.5.6.4.1 When the car is at its highest position as per 4.2.5.6.1, its guide rail lengths shall be such as would accommodate a further guided travel of at least 0,10 m.

4.2.5.6.4.2 When the balancing weight, if provided, is at its highest position as per 4.2.5.6.1, its guide rail lengths shall be such as would accommodate a further guided travel of at least 0,10 m.

4.2.5.6.4.3 With the balancing weight, if provided, at its lowest position as per 4.2.5.6.1, its guided length shall be such as would accommodate a further guided travel of at least 0,10 m.

4.2.5.7 Refuge spaces on car roof and clearances in headroom

4.2.5.7.1 When the car is at its highest position as per 4.2.5.6.1, at least one clear area on the car roof shall provide a refuge space selected from Table 2.

For type 2 refuge spaces, the reduction to accommodate parts fixed on the car roof shall not exceed 0,10 m wide by 0,30 m high (see Figure 6).

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

In the case of more than one refuge space, they shall be of the same type and not interfere with each other.

Dimensions in metres

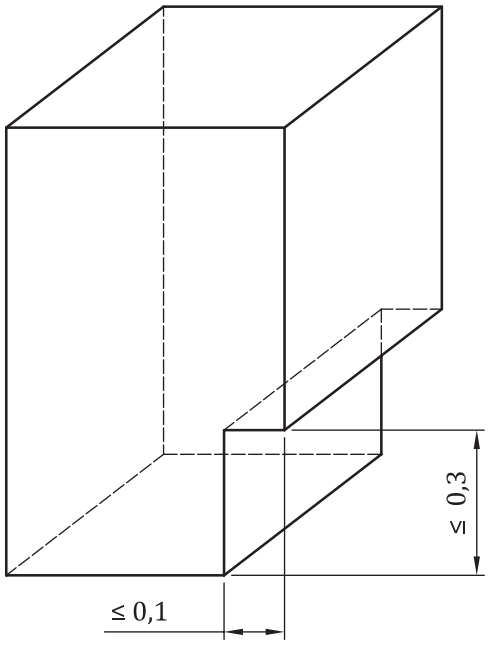


Figure 6 — Maximum dimensions of a reduction in the refuge space

A warning sign on the car roof visible from the landings giving access to the car roof shall indicate the allowed number of persons and the type of posture (see Table 2) considered for the refuge space(s) accommodation. The warning sign shall be in accordance with ISO 7010:2019, W020 and shall be supplemented by the corresponding sign as per Table 2. The height of the warning sign triangle shall be at least 100 mm.

Where a counterweight is used a sign shall be placed on or near the counterweight screen (see 4.2.5.5.1) stating the maximum allowed clearances between the counterweight and the counterweight buffer when the car is at its upmost landing level.

Table 2 — Dimensions of refuge spaces in headroom

Type	Posture	Sign	Horizontal dimensions of the refuge space m	Height of the refuge space m
1	Upright		0,40 × 0,50	2,00
2	Crouching		0,50 × 0,70	1,00

4.2.5.7.2 When the car is at its highest position as per 4.2.5.6.1, there shall be clear distances between the lowest parts of the well above the car, including beams and parts situated under the ceiling (see Figure 7):

a) of at least 0,50 m in any vertical or inclined direction within the projection of the car above equipment fixed on the car roof, except for those covered in b), c) and d);

b) of at least 0,10 m in any vertical direction within a horizontal distance of 0,40 m within the projection of the car above;

   — the highest part of the guide shoes or rollers, and:

   — the suspension means termination, and:

   — the header or parts of vertically sliding doors, if any:

c) above the balustrade including the components permanently fixed to the balustrade of at least:

   1) 0,30 m in the vertical direction within a horizontal distance of:

      — 0,40 m from the inside of the balustrade, and

      — 0,10 m from the outside of the balustrade;

   2) 0,50 m in any inclined distance beyond 0,40 m within the projection of the car.

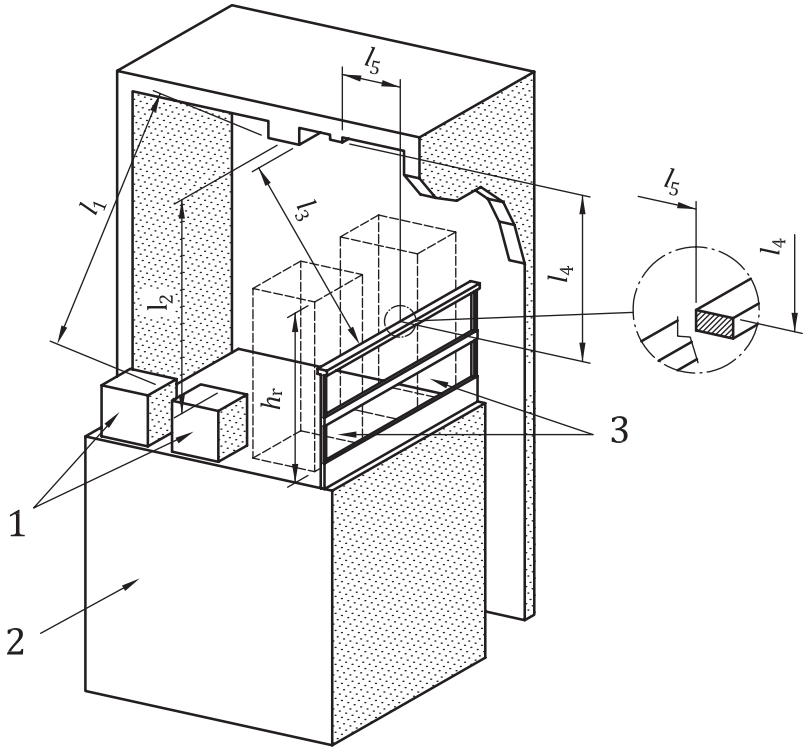
d) above the toe board of at least:

   1) 0,40 m in the vertical direction where no balustrade is provided:

   2) 0,10 m in the vertical direction on the outside of the toe board, above:

      — the car roof, and;

      — the equipment fixed on the car roof, if any.



Key

l_1	distance ≥ 0,50 m [4.2.5.7.2 a)]
l_2	distance ≥ 0,50 m [4.2.5.7.2 a)]
l_3	distance ≥ 0,50 m [4.2.5.7.2 c) 2)]
l_4	distance ≥ 0,30 m [4.2.5.7.2 c) 1)]
l_5	distance ≤ 0,40 m [4.2.5.7.2 c) 1)]
1	highest parts installed on the car roof
2	car
3	refuge space(s)
h_r	height of refuge spaces (Table 2)

Figure 7 — Minimum distances between parts fixed on car roof and lowest parts fixed to ceiling of well

4.2.5.7.3 Any single continuous area on the car roof, or on equipment on the car roof, with a minimum clear area of 0,12 m^2 and the minimum dimension of the smallest side being greater than 0,25 m, is considered as a place where a person can stand. When the car is at its highest position as per 4.2.5.6.1, the vertical clearance (including towards beams and parts situated under the ceiling) above any such area shall have the same height as the refuge space(s) provided on this car roof.

4.2.5.7.4 When the car is at its highest position as per 4.2.5.6.1, 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.

4.2.5.8 Refuge spaces and clearances in the pit

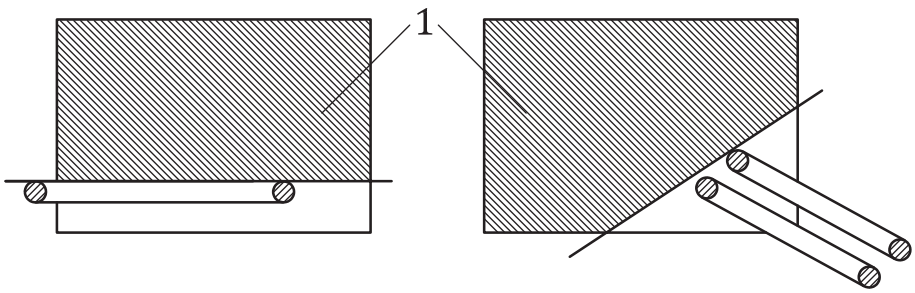
4.2.5.8.1 When the car is at its lowest position as per 4.2.5.6.1, at least one clear area on the pit floor or on the pit platform, if provided [see 4.2.2.2 c)], shall provide a refuge space selected from Table 3. Pit access ladders, in their stored position, shall not interfere with the refuge space. If the pit access ladder is not a

fixed ladder (see Annex C, Type 1), its stored position shall be checked by an electric safety device as per 4.11.2.

If more than one person is necessary in the pit to carry out inspection and maintenance work, an additional refuge space shall be provided for each additional person.

The presence of travelling cable(s) and compensation means in a refuge space is permitted under the following conditions:

a) The free area of the refuge space shall be at least 75 % when a straight line is drawn tangentially to the compensation means and the travelling cables at an angle corresponding to a maximum free area, see Figure 8;



Key

1 free area of the refuge space at least 75 %

Figure 8 — Example of top view of free refuge space area measurement

b) The force, to push all travelling cables and compensation means together away from the refuge space, shall not exceed 300 N when the car is at its lowest position;

c) The compensation means shall have a smooth surface and be free of snags;

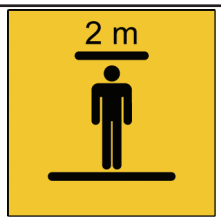
d) The warning sign in accordance with ISO 7010:2019 W001, with a minimum height of 120 mm, supplemented with the text “Flexible component in the refuge space!” (see Figure 9) shall be placed in the pit, visible from the entrance to the well.

Figure 9 — Warning sign for flexible component

In the case of more than one refuge space, they shall be of the same type and not interfere with each other.

A warning sign in the pit visible from the entrance(s) shall indicate the allowed number of persons and the type of posture (see Table 3) considered for the refuge spaces(s) accommodation. The warning sign shall be in accordance with ISO 7010:2019 (i.e. ISO 7010-W020) and shall be supplemented by the corresponding sign as per Table 3. The height of the warning sign triangle shall be at least 100 mm.

Table 3 — Dimensions of refuge spaces in the pit

Type	Posture	Sign	Horizontal dimensions of the refuge space m	Height of the refuge space m
1	Upright		0,40 × 0,50	2,00
2	Crouch-ing		0,50 × 0,70	1,00
3	Kneeling		0,50 × 1,00	0,70
4	Laying		0,70 × 1,00	0,50

4.2.5.8.2 When the car is at the lowest position as per 4.2.5.6.1, the following conditions shall be satisfied.

a) The free vertical distance between the pit floor or the pit platform, if provided, and the lowest parts of the car shall be at least 0,50 m. This distance may be reduced:

   1) for parts of the apron or parts of the vertically sliding car door(s) within a maximum horizontal distance from the adjacent wall(s) in accordance with Figure 11;

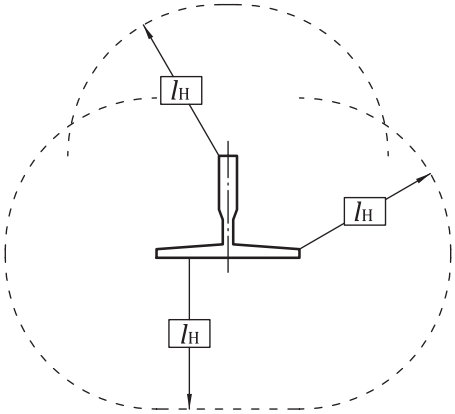
   2) for car frame parts, safety gears, guide shoes, pawl devices, within a maximum horizontal distance from the guide rails in accordance with Figure 10 and Figure 11.

b) The free vertical distance between the highest parts fixed in the pit and on the pit platform, for instance a tensioning device for compensation means being in its highest position, jack supports, pipes and other fittings, and the lowest parts of the car, except for items detailed in 4.2.5.8.2 a) 1) and 2), shall be at least 0,30 m.

4.2.5.8.3 In case of hydraulic lift, the following additional conditions shall also be satisfied.

a) 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. When access under the ram head assembly is prevented by providing screens as per 4.2.5.5.1, this free vertical distance may be reduced from 0,50 m to 0,10 m minimum.

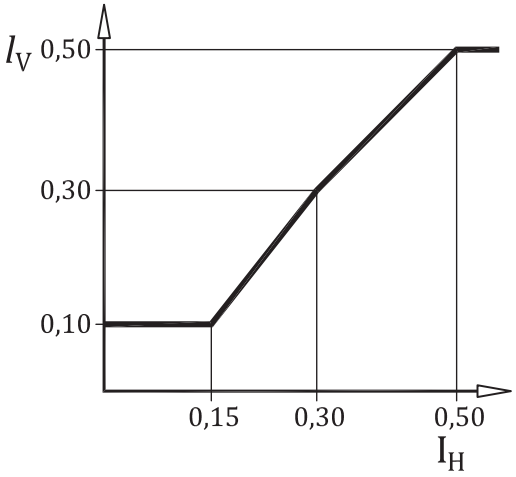
b) The free vertical distance between the bottom of the pit and the lowest guiding yoke of a telescopic jack below the car of a direct acting lift shall be at least 0,50 m.



Key

I_H horizontal distance around guide rail

Figure 10 — Horizontal distance around guide rail



Key

I_V minimum vertical distance [m]

I_H horizontal distance X_H [m]

Figure 11 — Minimum vertical distances

4.2.6 Machinery spaces and pulley rooms

4.2.6.1 General provisions

Machinery spaces and pulley rooms shall be in accordance with 4.2.6.2 to 4.2.6.7.

4.2.6.2 Notices

4.2.6.2.1 Notices shall be provided to permit identification of the main switch(es) and the light switch(es) as per 4.10.5.2, 4.2.1.1.2 and 4.10.10.

4.2.6.2.2 In the machine room (4.2.6.3), the machinery cabinet (4.2.6.5.1) or at the emergency and tests panel(s) (4.2.6.6), there shall be detailed notices to be followed in the event of lift breakdown (6.2.5), particularly concerning the use of the devices for emergency operation as per 4.9.2.3.2/4.9.3.9 and the emergency unlocking key for landing doors.

4.2.6.3 Machinery in a machine room

4.2.6.3.1 Traction sheave in the well

Where the traction sheave is installed in the well, means shall be provided to carry out examinations and the tests and the maintenance operations as per 6.2.4, from the machine room.

4.2.6.3.2 Dimensions

4.2.6.3.2.1 In the machine room a clear height of at least 2,00 m shall be provided 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 × 0,60 m in front of:

   — moving parts where maintenance and inspection are required as per 6.2.4 b), and

   — emergency operation, if provided (4.9.2.3.4).

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

The access ways to the clear spaces mentioned in 4.2.6.3.2.1 shall have:

a) a width of at least 0,50 m; or

b) a width of at least 0,40 m where there are no moving parts and where component surface temperatures don't exceed the values in accordance with Table 20, line 'Parts intended to be touched but not hand-held'.

4.2.6.3.3 Protection of openings in the slab and the floor

The following shall apply:

— the distance between part(s) and edges of openings shall not exceed 150 mm;

— ferrules, projecting at least 50 mm above the slab and the floor shall be provided.

4.2.6.4 Machinery inside the well

4.2.6.4.1 General provisions

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

4.2.6.4.1.2 In the case of:

— a retractable platform (4.2.6.4.5) and/or movable stops [4.2.6.4.5.2 b)]; and

— manually operated mechanical device(s) (4.2.6.4.3.1, 4.2.6.4.4.1).

The instructions for operation shall be affixed at the operation location(s) of those device(s).

4.2.6.4.2 Dimensions of working areas inside the well

In the well a clear height of at least 2,00 m shall be provided 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;

   Car balustrades are not considered as an obstacle.

b) a clear horizontal area of at least 0,50 m × 0,60 m in front of parts where maintenance and inspection are required as per 6.2.4 b).

   Car balustrades are not considered as an obstacle.

4.2.6.4.3 Working from inside the car or from the car roof

4.2.6.4.3.1 Where maintenance/inspection work on the machinery is to be carried out from inside the car or from the car roof, and the instructions as per 6.2.4 do not exclude uncontrolled car movement, the following shall apply:

a) a mechanical device shall be provided. When engaged it shall prevent movement of the car;

b) the retracted position of the mechanical device shall be checked by an electric safety device as per 4.11.2;

c) when this mechanical device is in its active position and cannot be disengaged due to forces exerted on it; there shall be a gap of at least 0,50 m width and 0,70 m height from the car roof to the landing or from the inside the car to the landing;

   Where the gap is not located at the working area, an emergency trap door in the car roof as per 4.4.6. shall be provided;

   Steps, ladder and/or hand hold(s) shall be provided;

   Instructions regarding the escape procedure shall be given in the instructions.

   The escape procedure shall be given in the instructions as per 6.2.4 e).

4.2.6.4.3.2 If inspection doors are located in the walls of the car, they shall:

a) be in accordance with 4.2.3.2 e);

b) not give access to openings to the well that would allow a ball with a diameter of 0,30 m to pass through;

c) not open towards the outside of the car;

d) be provided with a key-operated lock, capable of being closed without the use of a key and automatically locked when closed;

e) be provided with an electric safety device as per 4.11.2, checking the locked position;

f) satisfy the requirements as the walls of the car as per 4.4.3.2.2.

4.2.6.4.3.3 Where it is necessary to move the car from inside with an open inspection door, the following shall apply:

a) inspection operation control devices as per 4.12.1.5 shall be available at the inspection door;

b) these inspection operation control devices shall be accessible only by use of a key and arranged so that it is only possible to be operated from inside the car;

c) when the inspection door is open and 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.

4.2.6.4.4 Working from the pit

4.2.6.4.4.1 Where maintenance or inspection work on the machinery is to be carried out from the pit, and the instructions as per 6.2.4 do not exclude uncontrolled car movement, the following shall apply:

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 2,00 m between the floor of the working area and the lowest parts of the car, excluding those mentioned in 4.2.5.8.2 a) 1) and 4.2.5.8.2 a) 2). The retardation of the car by mechanical devices other than safety gears shall not exceed that produced by the buffers (see 4.8.2);

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 the door(s) giving access to the pit shall be checked by an electric safety device as per 4.11.2, which prevents all further movement of the lift. Movement shall only be possible under the requirements given in f) below;

e) the retracted position of the mechanical device shall be checked by an electric safety device as per 4.11.2;

f) the active position of the mechanical device shall be checked by an electric safety device as per 4.11.2, when the mechanical device is in its active position movement of the car shall only be possible in inspection operation;

g) the return of the lift to automatic operation shall require intentional reset on site, outside of the well, within a horizontal distance of less than 2,00 m from the door giving access to the pit [see 6.2.4 f)].

4.2.6.4.4.2 When the car is stopped by a mechanical device as per 4.2.6.4.4.1 a), there shall be either:

a) an opening from the lowest edge of the car apron to the sill of the landing door giving access to the pit of at least 0,50 m of height with a minimum width of 0,70 m; or

b) an access door to the pit as per 4.2.3.2 and 4.2.3.3.

4.2.6.4.5 Working from a platform

4.2.6.4.5.1 Where machinery is to be maintained or inspected from a platform, this platform shall be:

a) permanently installed; and

b) retractable if it is in the travel path of the car or counterweight/balancing weight.

4.2.6.4.5.2 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 as per 4.2.6.4.3.1 a) and 4.2.6.4.3.1 b); or

b) where the car needs to be moved, the travel path of the car, the counterweight or the balancing weight shall be limited by movable stops, working with any load up to rated load and from any speed up to rated speed, in such a way that the car, the counterweight or the balancing weight are stopped:

   1) at least 2,00 m above the platform when running down with rated speed towards the platform;

   2) below the platform as per 4.2.5.7.2, when running up with rated speed towards the platform.

4.2.6.4.5.3 The platform shall be:

a) able to support at any position the mass of two persons, each counting for 1 000 N over an area of 0,20 m × 0,20 m without elastic deformation greater than 15 mm and without permanent deformation greater than 1 mm.

b) provided with a balustrade as per 4.4.7.4;

c) fitted with means ensuring that:

1) the vertical distance 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.

d) designed in accordance with 4.2.2.2 k).

4.2.6.4.5.4 In addition to 4.2.6.4.5.3, any retractable platform shall be provided with:

a) an electric safety device as per 4.11.2, checking the 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 by use of a key. The manual effort for operation of the platform shall not exceed 150 N;

c) 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.

4.2.6.4.5.5 In the case of 4.2.6.4.5.2 b), movable stops shall be automatically operated when the platform is lowered. They shall be provided with:

a) buffers as per 4.8;

b) an electric safety device as per 4.11.2, checking the retracted position of the stops;

c) an electric safety device as per 4.11.2, checking the fully extended position of the stops and allowing car movement with a lowered platform.

4.2.6.4.5.6 Where it is necessary to move the car from the platform, inspection operation control devices as per 4.12.1.5 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 in inspection operation.

4.2.6.4.5.7 The maximum permissible load shall be indicated on the platform with a warning sign in accordance with ISO 7010:2019, W001, supplemented by the symbol in accordance with ISO 7000:2019, 1321B with the text "≤ xxx kg" (see Figure 2), where xxx is the value of maximum permissible load in kilograms.

4.2.6.4.6 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 as per 4.2.6.3.2.1 and 4.2.6.3.2.2 shall be provided outside of the well. Access to this equipment shall be possible by an inspection door as per 4.2.3.

4.2.6.5 Machinery outside of the well and machine room

4.2.6.5.1 Machinery cabinet

4.2.6.5.1.1 Where machinery is located outside of the well and machine room(s) machinery shall be located in a machinery cabinet.

The machinery cabinet shall not be used for purposes other than the lift. It shall not contain ducts, cables or devices other than for the lift.

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

The only permissible openings are:

a) ventilation apertures;

b) openings necessary 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.

Openings of the machinery cabinet, except openings from the cabinet to the well, to the machine room and to the pulley room, shall be in accordance with the following:

— protection in accordance with ISO 13857:2019, Table 5 against contact with danger zones; and

— degree of protection of at least IP2XD to IEC 60529:1989+AMD1:1999+AMD2:2013 against contact with electrical equipment.

4.2.6.5.1.3 The door(s) shall:

a) not open towards the inside of the cabinet;

b) be provided with a key-operated lock, capable of being closed without the use of a key and automatically locked when closed.

4.2.6.5.2 Working area

The working area in front of a machinery cabinet shall be in accordance with 4.2.6.4.2.

4.2.6.6 Devices for emergency operation and tests

4.2.6.6.1 In the case of 4.2.6.4.3, 4.2.6.4.4 and 4.2.6.4.5, the devices for emergency operation and tests shall be provided on emergency and test panel(s) suitable for carrying out from outside of the well all emergency operation and dynamic tests of the lift such as tests of traction, brakes, safety gear, buffer, ascending car overspeed protection means, unintended car movement protection, rupture valve, restrictor, pawl device, cushioned stop and pressure.

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

a) does not open towards the inside of the well;

b) is provided with a key-operated lock, capable of being closed without the use of a key and automatically locked when closed.

4.2.6.6.2 The panel(s) shall provide the following:

a) emergency operation devices as per 4.9.2.3 or 4.9.3.9, together with an intercom system as per 4.12.3.2;

b) devices which enables dynamic tests to be carried out;

c) direct observation of the lift machine or display device(s) powered by an emergency supply as per 4.10.11, which give(s) indication of:

— the direction of movements of the car;

— the speed of the car; and

— the reaching of an unlocking zone as per 4.9.2.3.5 or 4.9.3.9.3; the indication shall become active when the unlocking zone is reached.

4.2.6.6.3 The devices on the panel(s) shall be lit by a permanently installed electric lighting with an intensity of at least 200 lx measured at the device.

The light meter sensor shall be facing directly towards the light source when taking lux level readings.

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

For the electrical supply for this lighting, see 4.10.7.1.

4.2.6.6.4 There shall be working areas as per 4.2.6.3.2.1 in front of emergency and test panels.

4.2.6.7 Construction and equipment of pulley rooms

4.2.6.7.1 Dimensions

Pulley room dimensions shall provide:

a) a clear height for movement of at least 1,50 m.

b) a clear horizontal area, of at least 0,50 m × 0,60 m, in front of moving parts where maintenance and inspection are required as per 6.2.4 b).

c) access ways to these areas having:

1) a width of at least 0,50 m.

2) a width of at least 0,40 m where there are no moving parts and where component surface temperatures don't exceed the values in accordance with Table 20, line 'Parts intended to be touched but not hand-held'.

4.2.6.7.2 Protection of openings in the slab and the floor

The following shall apply:

— the distance between part(s) and edges of openings shall not exceed 150 mm;

— ferrules, projecting at least 50 mm above the slab and the floor shall be provided.

4.3 Landing and car doors

4.3.1 General provisions

4.3.1.1 Landing levels shall be provided with landing doors and the access of passengers into the car shall be through a car door.

4.3.1.2 The landing and car doors shall be imperforate.

4.3.1.3 When closed, the landing and car doors shall, apart from the clearances as per 4.3.1.4, completely close the landing and car entrances.

4.3.1.4 When closed, the clearance between door panels, and between panels and uprights, lintels and sills, shall not exceed 6 mm. Each clearance, due to wear, shall not exceed 8 mm, except for doors as required in 4.3.6.2.2.1 i) and 4.3.6.2.2.1 j) (see Table 4). These clearances are measured at the back of recesses, if present.

Table 4 — Door clearances

Type of panel	Type of door	According to	Design clearances mm	Clearances due to wear mm
Steel Panel	Car and landing door	4.3.1.4	6	8
Glass panel	Car and landing door	4.3.6.2.2.1 i) 1)	6	8
		4.3.6.2.2.1 i) 2)	4	5
		4.3.6.2.2.1 i) 3)	6	8
Steel panel with a mirrored surface	Car and landing door	4.3.6.2.2.1 i) 1)	6	8
		4.3.6.2.2.1 i) 2)	4	5
Steel Panel	Car door	4.3.6.2.2.1 j) 1)	6	8
		4.3.6.2.2.1 j) 2)	5	6

4.3.1.5 In the case of hinged car door(s), they shall strike stops to prevent them swinging outside the car.

4.3.1.6 In the case of hinged landing doors, they shall strike stops to prevent them swinging inside the well.

4.3.1.7 In the case of vertically sliding doors, the fast panel shall be composed of an upper rigid part and a flexible part at the leading edge as follows:

a) The height of the flexible part of the fast panel shall be between 25 mm and 50 mm when the door is fully closed.

b) A flexible non-shearing, and non-crushing member of either the meeting or overlapping type shall be provided on the leading edge of the fast panel to close the distance between the rigid door sections when in contact with the stops. This member shall allow a minimum compressible clearance of 20 mm.

c) Rigid members that overlap the meeting edge within the opening width are prohibited.

4.3.2 Height and width of entrances

4.3.2.1 Height

Landing and car doors shall be such that a minimum clear height of the entrance is 2,00 m.

4.3.2.2 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.

4.3.3 Sills, guides, door suspension

4.3.3.1 Sills

Every landing door and car door shall incorporate a sill withstanding forces as defined in 4.7.2.3.6 to withstand the passage of loads being introduced into the car.

NOTE A slight counter slope provided in front of each landing sill helps to avoid water from washing, sprinklers, etc., draining into the well.

4.3.3.2 Guides

4.3.3.2.1 Landing and car doors shall be designed to prevent derailment, mechanical jamming, and displacement.

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

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

4.3.3.3 Suspension of vertically sliding doors

4.3.3.3.1 Panels of vertically sliding landing and car doors shall be fixed to two independent suspension ropes, chains or belts.

The failure of one suspension rope, chain or belt shall by design not permit a panel to fall or means shall be provided to prevent the panel from falling if one suspension rope, chain or belt fails.

In the event of a failure of at least one suspension rope, chain or belt the door shall not operate further.

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

4.3.3.3.3 The pitch diameter of suspension rope pulleys shall be at least 20 times the rope diameter.

4.3.3.3.4 Suspension ropes, chains or belts shall be guarded against leaving the pulleys, pulley grooves or sprockets.

4.3.3.3.5 Vertically sliding panels shall be counterbalanced so that they will not open or close by gravity.

Fastenings shall be provided to prevent the fall and the detachment or dislodgment of the balancing weights ballast.

Balancing weight(s) shall be fixed to the supporting system. Where more than one suspension rope, chain or belt is fastened to one balancing weight, they shall be individually fixed to the balancing weight. Balancing weights shall not be fixed using clamping screws only. The method of fixing shall ensure that accidental displacement is prevented.

4.3.4 Horizontal door clearances

4.3.4.1 The horizontal distance between the sill of the car and sill of the landing doors shall not exceed 35 mm (see Figure 5).

4.3.4.2 The horizontal distance giving access to the well shall not exceed 0,10 m (see Figure 5):

a) between the leading edges of the car door and the landing doors during their operation cycle;

b) between the door uprights at the closing side of side opening doors;

c) between the door uprights of vertically sliding doors up to a height of 2,50 m.

4.3.4.3 In the case of;

a) the combination of:

— a hinged landing door and a folding car door (see Figure 12);

— a hinged landing door and a horizontally sliding car door [see Figure 13 a) and Figure 13 b)]; except a hinged landing door and a horizontally sliding car door 3 panel side-opening or 6 panel centre-opening having a door width more than 0,90 m [see Figure 13 c)];

— horizontally sliding car and landing doors, which are not mechanically coupled (see Figure 14);

it shall not be possible to place a ball with a diameter of 0,12 m as per Figure 12, Figure 13 a), Figure 13 b) or Figure 14 respectively in any gap between the closed door.

b) the combination of:

— a hinged landing door and a horizontally sliding car door 3 panel side-opening or 6 panel centre opening having a door width of more than 0,90 m [see Figure 13 c)];

it shall not be possible to place a ball with a diameter of 0,15 m as per Figure 13 c) in any gap between the closed doors.

c) the combination of:

— a hinged landing door and a vertically sliding car door (see Figure 15);

it shall not be possible to place a ball with a diameter of 0,15 m as per Figure 15 between the closed landing door and fast panel(s) of the car door.

The top edge of the fast panel and the inner lower edge of the following panel shall be chamfered to at least 45° to the horizontal (see Figure 17).

d) the combination of:

— a vertically sliding landing door and a vertically sliding car door, which are not mechanically coupled (see Figure 16);

it shall not be possible to place a ball with a diameter of 0,15 m as per Figure 16 in any gap between the leading edge of the fast panel of one door and the fast panel of the opposite door.

For slide-up-to-open vertically sliding doors, the top edge of the fast panel and the inner lower edge of the following panel of landing and car doors shall be chamfered to at least 45° to the horizontal (see Figure 17).

Dimensions in metres

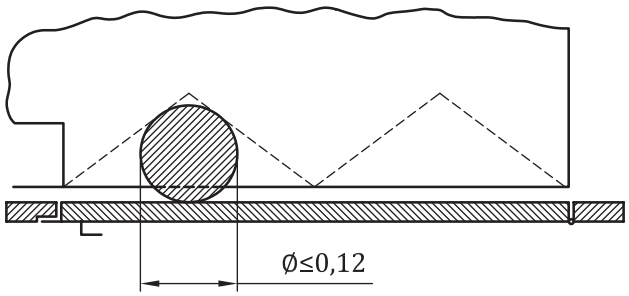
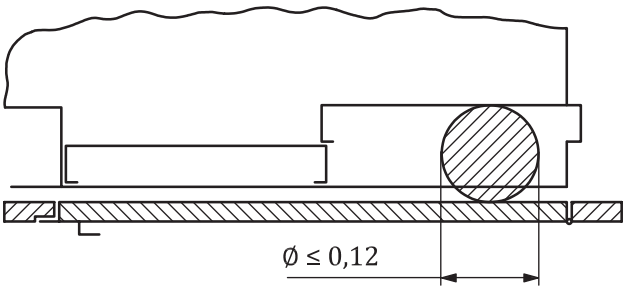
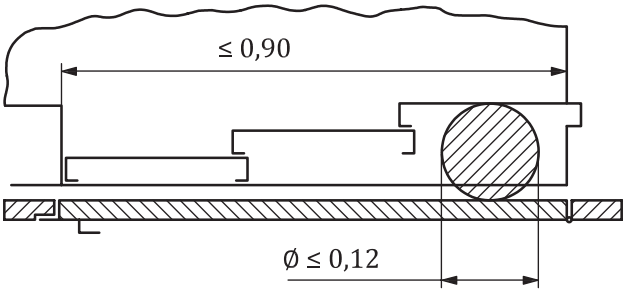


Figure 12 — Hinged landing door and folding car door

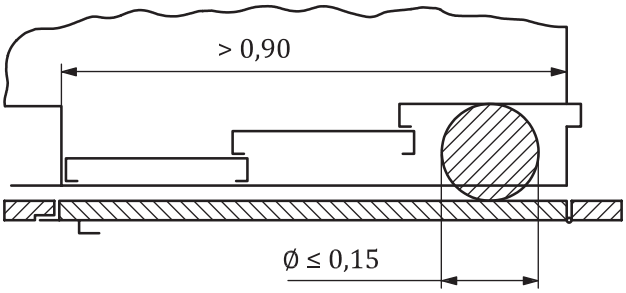
Dimensions in metres



a) 2-panel side opening



b) 3-panel side-opening, ≤ 0,90 m opening width



c) 3-panel side-opening, > 0,90 m opening width

Figure 13 — Hinged landing door and horizontally sliding car door

Dimensions in metres

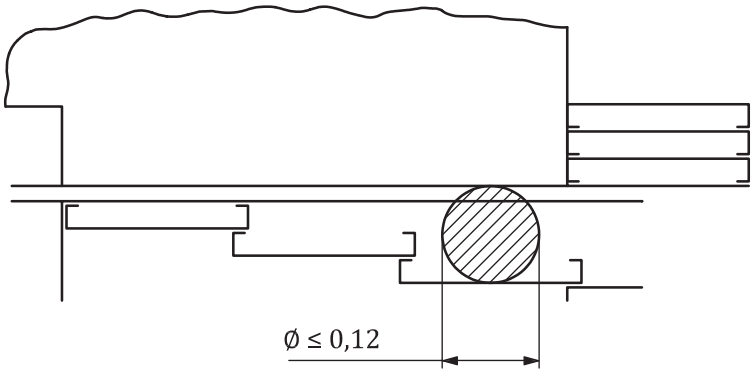
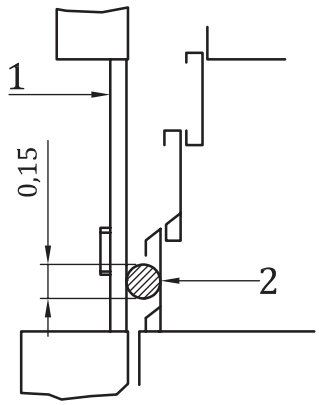


Figure 14 — Horizontally sliding car and landing doors, not mechanically coupled

NOTE Figure 14 is also applicable for the “car door closed and landing door open” situation.

Dimensions in metres

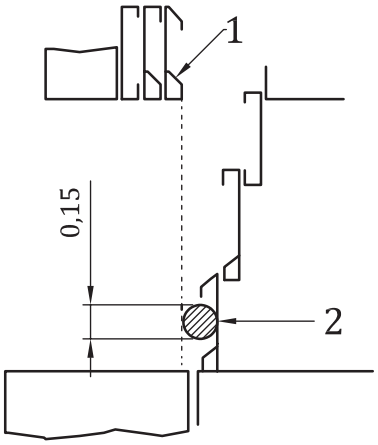


Key

1 hinged landing door
2 fast panel

Figure 15 — Hinged landing door and vertically sliding car door

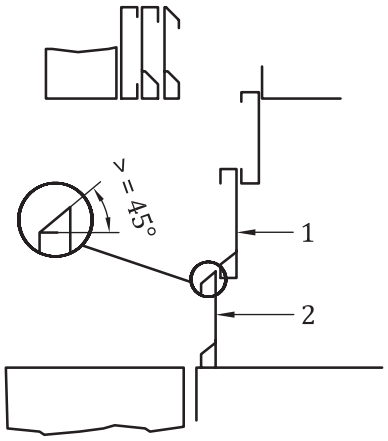
Dimensions in metres



Key

1 leading edge of the fast panel
2 fast panel of opposite door

Figure 16 — Vertically sliding landing door and vertically sliding car door, not mechanically coupled



Key

1	following panel
2	fast panel

Figure 17 — Chamfers on vertically sliding car door

4.3.5 Strength of landing and car doors

4.3.5.1 Complete landing doors, with their locks, and car doors with their locks when provided, shall have a mechanical strength such that in the locked position of landing doors and closed/locked position of car door(s):

a) when a static force of 300 N, being evenly distributed over an area of 5 cm^2 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 greater 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 static force of 1 000 N, being evenly distributed over an area of 100 cm^2 in round or square section, is applied:

   — at right angles at any point of the panel or frame with width larger than 100 mm, from the landing side for landing doors(); and

   — from the inside of the car at right angles at any point of the car doors,

   they shall resist without permanent deformation affecting the safety functions [see 4.3.1.4 (maximum clearance 8 mm)]. For glass doors, and for steel doors with a mirrored surface see 4.3.6.2.2.1 i) 2). For the car door(s), see 4.3.6.2.2.1 j) 2).

4.3.5.2 Horizontally sliding doors and folding doors on the landing and car shall be provided with retainers for keeping the door panel(s) in position if any of their guiding elements fails.

Retainers shall be metallic devices, which are either structural parts of the guiding means or part of the door panel or hanger.

Hanger plate retainer(s) shall overlap its counterpart.

Lower retainers in the sill shall be secured against self-loosening and shall be marked indicating the required engagement with the sill to withstand the pendulum shock test as per 4.3.5.4 a).

The complete door assembly (including side frames on landing doors wider than specified in 4.3.5.4) and all door panels shall withstand a pendulum shock test as per 4.3.5.4 a) at striking points as per Table 5 and Figure 18.

The test shall be performed for each panel with the door assembly in the closed position including the upper guiding means in place and the lower guiding means removed.

The door shall resist the pendulum shock test also with the normal guiding means installed.

4.3.5.3 Under the application of a manual force of 150 N in the direction of the opening of the leading landing door panel(s) of horizontally sliding doors and folding doors, at less than 25 mm above the sill level, the clearances defined in 4.3.1.4 shall not exceed:

a) 30 mm for side opening doors;

b) 45 mm in total for centre opening doors.

4.3.5.4 In addition, for:

— landing doors with glass panels;

— car door(s) with glass panels, and;

— side frames of landing doors that are wider than 0,15 m, including additional panels to the side of the door frame used to enclose the well;

the following shall be fulfilled (see Figure 18):

a) when an impact energy equivalent to a falling height of 0,80 m of the soft pendulum shock device (ISO 8100-2:2025, 4.16) is striking the middle of;

   — the glass panel(s) in doors, or

   — side frames, or

   — glass panel(s) in the side frames.

   at striking points as per Table 5 or Table 6, from the landing side in the case of landing doors or from the inside of the car in the case of the car door(s), the following shall be satisfied:

   1) there shall be no loss of integrity of the door assembly. The door assembly shall remain in place with no gaps greater than 0,12 m;

   2) for glass elements, there shall be no cracks;

   After the pendulum test the doors do not need to be able to operate.

b) when an impact energy equivalent to a falling height of 0,50 m of the hard pendulum shock device (ISO 8100-2:2025, 4.16) is applied on glass doors or glass panels bigger than stated in 4.3.7.1 a), striking in the middle of;

   — the glass door, or

   — glass panel(s) in doors, or

   — glass panel(s) in the side frames if they are part of the door assembly,

   at striking points from the landing side or from the inside of the car as per Table 5 or Table 6, there shall be:

   1) no cracks;

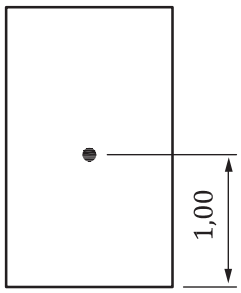
   2) no damage on the surface of the glass except chips of 2 mm maximum in diameter.

Where the visible width of the door panel next to a door upright is less than 0,24 m, the striking point shall be 0,15 m from the door upright [see Figure 18 h)], to prevent hitting the door upright.

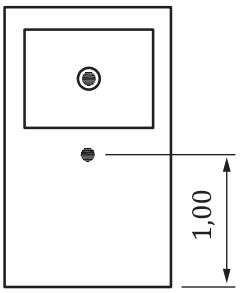
Table 5 — Striking points on horizontally sliding doors, folding doors and hinged doors

Pendulum shock test	Soft pendulum		Hard pendulum	
Falling height	0,80 m		0,50 m	
Striking point height	1,00 m ± 0,10 m	Centre of glass	1,00 m ± 0,10 m	Centre of glass
Door panel or frame > 0,15 m without glass panel Figure 18 a) and 14 g)	X			
Door panel or frame > 0,15 m with small glass panel Figure 18 b)	X	X		X
Door panel or frame > 0,15 m with more than one glass panel Figure 18 c) Tests on whichever glass panel represent the worst case	X	X		X
Door panel or frame > 0,15 m with big glass panel or full glass Figure 18 d)	X (Impact on glass)		X (Impact on glass)	
Door with glass panel or frame > 0,15 m starting at > 1,00 m or ending at < 1,00 m height Figure 18 e)	X	X		X
Door with glass panel or frame > 0,15 m starting at > 1,00 m or ending at < 1,00 m height Figure 18 f)	X (Impact on glass)		X (Impact on glass)	
Door with vision panel (4.3.7)	X	X		

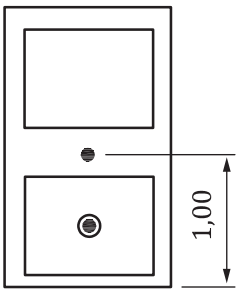
Dimensions in metres



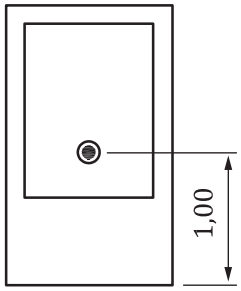
a) Door panel without glass panel



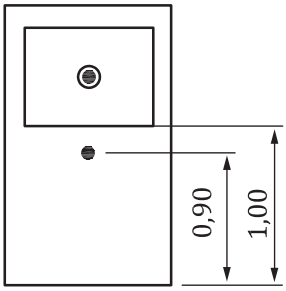
b) Door panel with glass panel



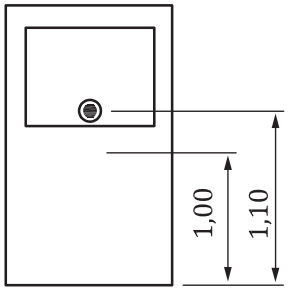
c) Door panel with more than one glass panel



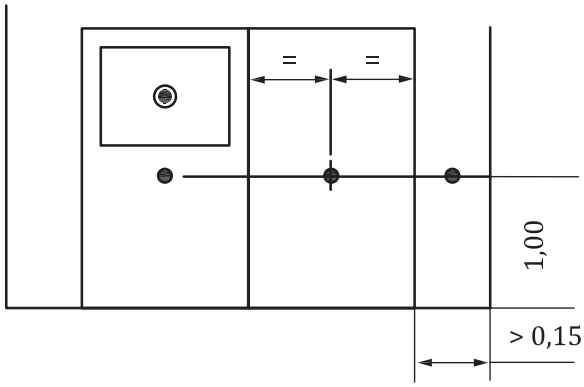
d) Door panel with glass panel or full glass



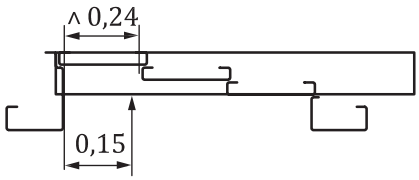
e) Door panel with glass panel above 1,00 m



f) Door panel with glass panel above 1,00 m



g) Complete landing door with door panels and side frames [example as per a) and b)]



h) Visible width of door panel less than 0,24 m

Key

- • striking point for soft pendulum shock test
- ○ striking point for hard pendulum shock test

NOTE 1 Figures 14 e) and 14 f) are alternative solutions.

NOTE 2 For striking points defined by 1,00 m, the tolerance is ±0,10 m.

NOTE 3 For Figure 18 e), 0,90 m is the lower end of the tolerance.

NOTE 4 For Figure 18 f), 1,10 m is the upper end of the tolerance.

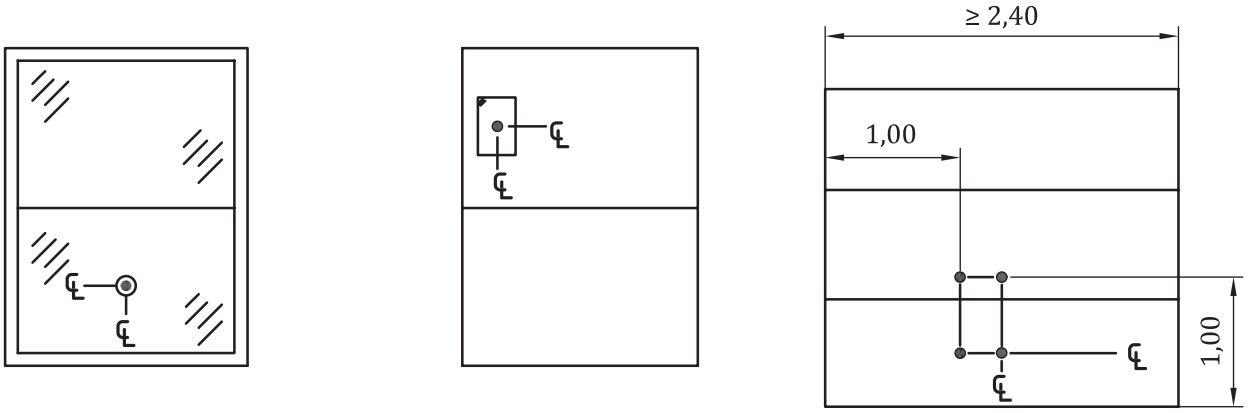
Figure 18 — Horizontal door panels — Pendulum shock tests — Striking points

The worst case shall be tested. If it is not possible to determine the worst case, both or all variants shall be tested.

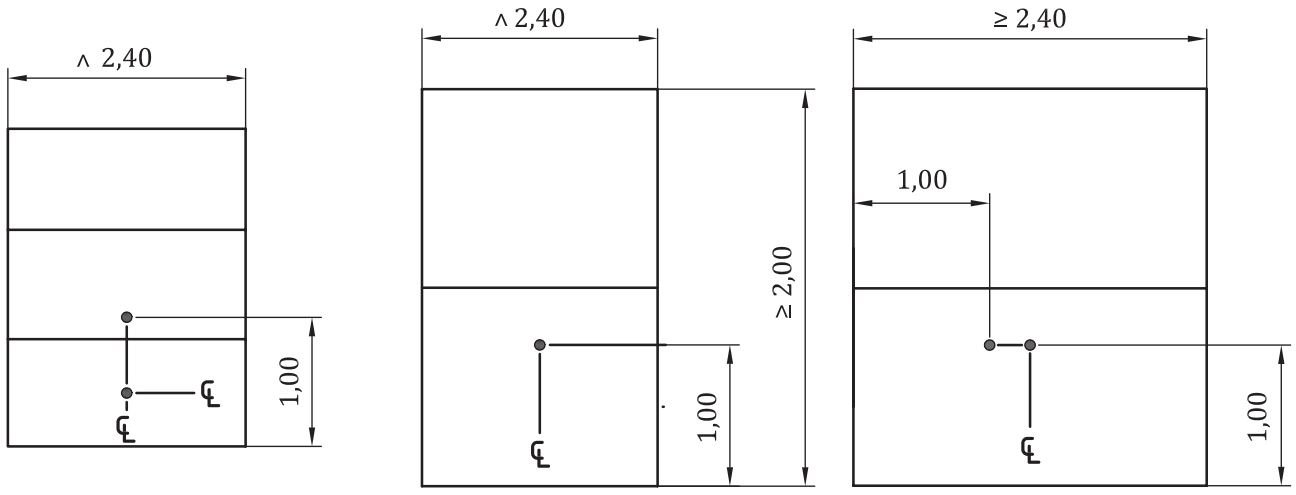
Table 6 — Striking points on vertically sliding doors

Pendulum shock test	**Soft pendulum**					**Hard pendulum**
Falling height	0,80 m					0,50 m
Striking point position	1,00 ± 0,10 m height / centre of the panel width	1,00 ± 0,10 m height / 1,00 m from one side	Centre of the lower panel(s)	Centre of the lower panel(s) height / 1,00 m from one side	Centre of glass if present	Centre of glass
1 panel below 1,00 m less than 2,40 m width Figure 19 e)	x				x	x
1 panel below 1,00 m equal to or more than 2,40 m width Figure 19 f)	x	x			x	x
More than 1 panel below 1,00 m, less than 2,40 m width Figure 19 d)	x		x		x	x
More than 1 panel below 1,00 m, equal to or more than 2,40 m width Figure 19 c)	x	x	x	x	x	x
Side frames > 0,15 m Figure 18 g)	x					
Additionally, any panel with vision panel (4.3.7) Figure 19 b)					x	

Dimensions in metres



a) Striking points for glass panels **b) Striking point for vision panels** **c) More than 1 panel below 1,00 m equal to or more than 2,40 m width**



d) More than 1 panel below 1,00 m less than 2,40 m width **e) 1 panel below 1,00 m less than 2,40 m width** **f) 1 panel below 1,00 m equal to or more than 2,40 m width**

Key

•	striking point for soft pendulum shock test
○	striking point for hard pendulum shock test
℄	centre line of panel or glass

Figure 19 — Vertical door panels — Pendulum shock tests — Striking points

4.3.5.5 Doors and door frames with glass shall use laminated glass in accordance with ISO 12543-3:2021.

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

4.3.5.7 The glass panels shall have markings indicating:

a) name of the manufacturer or trade mark;

b) a reference to the applied standard as per 4.3.5.5;

c) the thickness given in the format xx,y where x is the nominal thickness of each glass panel in millimetres and y the number of interlayers in multiples of 0,38 mm.

The marking shall be located at least 25 mm from the edge(s) of the glass panel. The minimum height of the characters shall be 5 mm.

4.3.5.8 Vertically sliding landing and car doors shall be provided with retainers for keeping the door panel(s) in position if any of their guiding elements fails.

Retainers shall be metallic devices which are either:

a) devices separated from the guiding elements which do not need to be removed for replacement of the normal guiding elements; or

b) non-removable or integrated part of the door panel / hanger with or without integrated guiding element.

All door panels in their complete door assembly shall withstand a pendulum shock test as per 4.3.5.4 a) at striking points as per Table 6 and Figure 19.

The test shall be performed with the door assembly in the closed position and the normal guiding means removed.

The door shall resist the pendulum shock test also with the normal guiding means installed.

4.3.5.9 Vertical sliding landing doors and vertical sliding car doors provided with a locking device as per 4.3.9.2, when closing, shall not lock:

a) if an obstacle of 30 mm diameter is placed at any position between the sill and the fast panel of a slide-up-to-open vertically sliding door, or

b) if an obstacle of 45 mm diameter is placed at any position between the leading edges of the panels of a bi-parting vertically sliding door.

4.3.6 Protection in relation to door operation

4.3.6.1 General

To avoid the risk of shearing during operation, the face of automatic power-operated sliding doors, from the landing and from inside the car shall not have recesses or projections exceeding 3 mm. The edges of these shall be chamfered in the opening direction of movement.

Exception to these requirements is made for the access to the unlocking triangle defined in 4.3.9.3.

4.3.6.2 Power-operated doors

4.3.6.2.1 General

4.3.6.2.1.1 In the case of coupled car and landing doors operated simultaneously, the requirements 4.3.6.2.2 or 4.3.6.2.3 shall apply.

4.3.6.2.1.2 In the case of a combination of manually or power-operated hinged landing door and power-operated car door, the following shall apply:

a) the car door shall only start closing after the landing door is closed;

b) the car door shall fully reopen if the landing door is opened while the car door is closing;

c) the landing door shall be locked at the latest when the closing car door has moved 50 mm from the fully open position;

d) the landing door shall remain locked until the opening car door is 50 mm from the fully open position.

NOTE Crossing the entrance is impossible with a locked landing door, see 4.3.6.2.2.1 and 4.3.6.2.3.2 a) 4).

4.3.6.2.2 Horizontally sliding doors and folding doors

4.3.6.2.2.1 Automatic power-operated doors

The following shall apply:

a) the kinetic energy of the landing and/or car door and the mechanical elements which are rigidly connected to it, calculated or measured at the average closing speed shall not exceed 10 J.

   The average closing speed of a sliding door shall be 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;

b) a protective device shall automatically initiate re-opening of the door(s) in the event of crossing the entrance during the closing movement. The protective device may be rendered inoperative in the last 20 mm of door closing gap;

   1) the protective device shall cover at least the protected zone over the vertical distance of 25 mm up to 1,60 m above the car door sill;

   2) the protective device shall be capable of detecting obstacles with a diameter of 50 mm;

   3) in case of failure, or deactivation of the protective device, the kinetic energy of the doors shall be limited to 4 J at its maximum closing speed, if the lift is kept in operation, and an acoustic signal shall operate at any time the door(s) is (are) closing. The sound level of the acoustic signal shall be adjustable between 35 dB(A) and 65 dB(A). The sound level shall be measured at 1,00 m height at 1,00 m distance from the centre of the door at car and landing side with the doors fully open.

      NOTE 1 The protective device of the car door and the landing doors can be the same.

c) the static force causing the closing door to stop shall not exceed 150 N, excluding the first third of the travel of the door;

   NOTE 2 The measurement of the force can be carried out during the closing of the door movement by an increasing counterforce until activation of the re-opening [4.3.6.2.2.1 d)].

d) the prevention of the door from closing shall initiate a minimum 50 mm reopening of the door;

e) the force required 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;

f) if a folding car door is opening into a recess:

   1) the recess shall be chamfered with a minimum of 135° [see Figure 20 a)] and the distance between the outer edge of the door fold and the chamfer of the recess in the open position shall be at least 25 mm [see Figure 20 a)]; or

   2) the recess shall be 90° [see Figure 20 b)] and the distance between the outer edge of the door fold and the recess in the open position shall be at least 35 mm [see Figure 20 b)];

g) if labyrinths or chicanes are used on the front edges of leading door panels, or on the combination of leading door edge and fixed upright, 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. The edges of the glass shall be ground or chamfered.

h) the force required to prevent a horizontally sliding door from opening shall not exceed 150 N, measured from the fastest panel, excluding the first third of the travel of the door. When this effort is exceeded, the door opening shall be stopped, and automatic door movement shall be prevented for at least 20 seconds;

i) to avoid dragging of children's hands, when the doors are opening, automatic power-operated horizontally sliding doors:

— made of or containing glass of dimensions greater than in 4.3.7.1 a), or

— with a mirrored surface

shall be protected by:

1) sensing the presence of fingers as per 4.3.6.2.2.1 j) 1); or

2) limiting the gap between door panels and between door panels and uprights to maximum 4 mm (including recesses), up to at least 1,60 m above sill. This value due to wear shall not exceed 5 mm; or

3) for glass: 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.

Recesses (framed glass, etc.) shall not exceed 1 mm and shall be included in the value of the gap. The radius on the outer edge of the frame adjacent to the door panel shall not exceed 4 mm.

j) the automatic power-operated horizontally sliding car door(s) shall:

1) be provided with means of detecting a test object [with dimensions in accordance with Figure 22 a)] during door opening.

The object shall be placed vertically between 25 mm and 1,60 m above the sill and horizontally over the full width of each panel with the thinner part oriented to the clearance, [see Figure 22 b)]. The detection of the object shall be tested for each clearance between door panels, or between panels and uprights.

The door movement shall be stopped in the opening direction within a maximum horizontal distance of 50 mm after the object entered the clearance:

— between door panel(s) and upright(s); or

— between door panels;

2) or, have a limited gap:

— between door panels and uprights; and

— in-between door panels;

of maximum 5 mm between 25 mm and 1,60 m above the sill. This value due to wear shall not exceed 6 mm.

k) the vertical hidden edges [see Figure 21 a)] of:

— door panels; and

— uprights (car front wall);

of automatic power-operated horizontally sliding car and landing doors shall be:

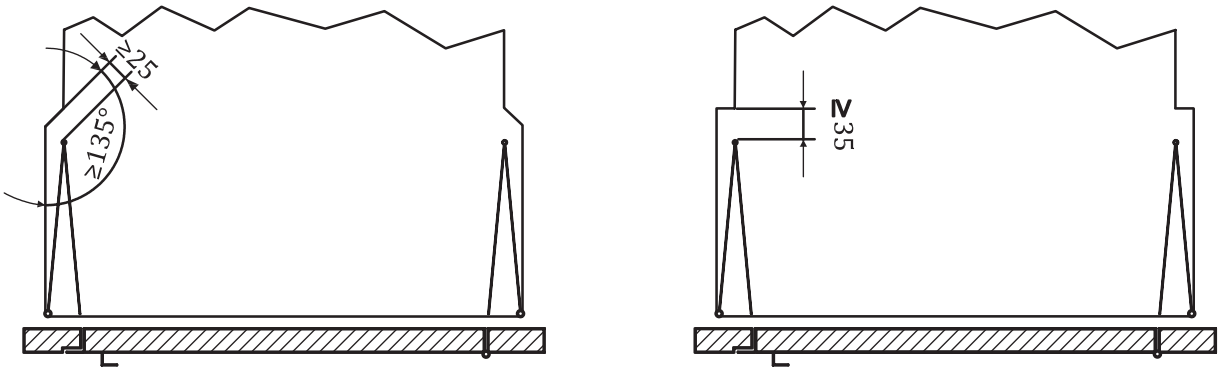
— bent to at least 90° [see Figure 21 b)]; or

— be rounded with a minimum radius of 0,5 mm or be chamfered by minimum 0,5 mm when the plate thickness is 2 mm or more [see Figure 21 c)]; or

— be designed as a closed structure in accordance with Figure 21 d). For a closed structure made of multiple parts, a sheet metal thickness of more than 1 mm shall be rounded with a minimum radius of 0,5 mm [see Figure 21 d)] or be chamfered by minimum 0,5 mm.

Panel cladding shall have a minimum distance of 10 mm to the edge [see Figure 21 e)]. Panel cladding with a thickness of more than 1 mm shall be rounded with a minimum radius of 0,5 mm [see Figure 21 e)] or be chamfered by minimum 5 mm.

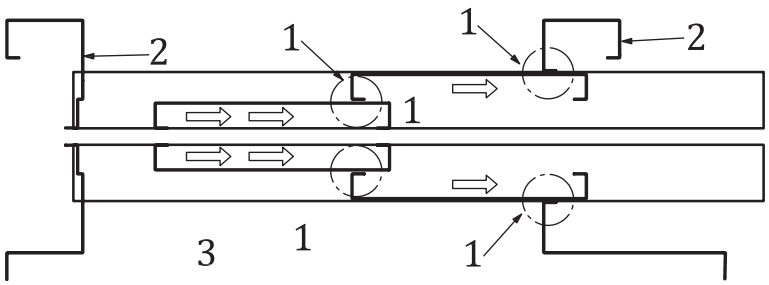
Dimensions in millimetres



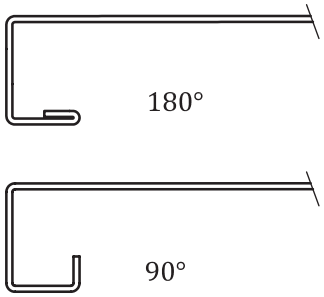
a) Chamfered recess **b) 90° recess**

Figure 20 — Folding door recess

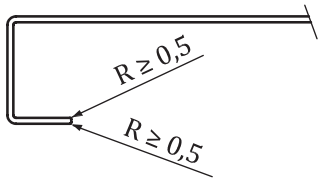
Dimensions in millimetres



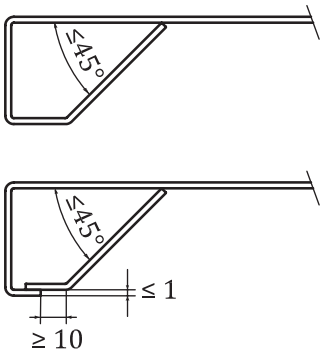
a) Vertical hidden edges



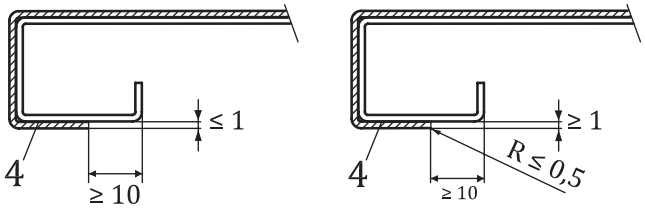
b) Bending



c) Radius



d) Closed



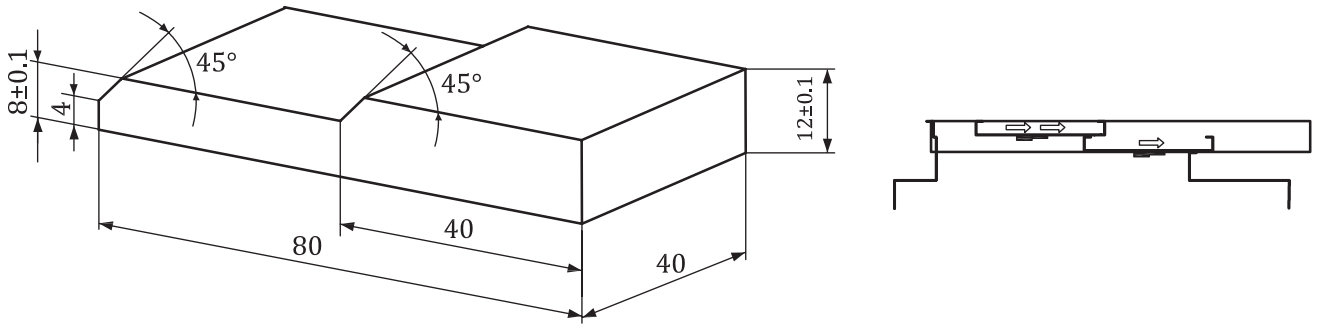
e) Cladding

Key

1	vertical hidden edges
2	car front wall
3	car
4	cladding

Figure 21 — Door panels and uprights — Vertical hidden edges

Dimensions in millimetres



a) Test object dimensions **b) Test object location**

Figure 22 — Test object

4.3.6.2.2.2 Non-automatic power-operated doors

When the closing of the door is carried out by hold-to-run control, the average closing speed of the fastest panel shall be limited to 0,30 m/s, when the kinetic energy as per 4.3.6.2.2.1 a) exceeds 10 J.

4.3.6.2.3 Vertically sliding doors

4.3.6.2.3.1 General

The following shall apply.

a) The combination of vertically sliding car door and vertically sliding landing door shall only be used for goods passenger lifts.

b) The door closing speed shall not exceed 0,30 m/s for:

— slide-up-to-open vertically sliding landing doors, and

— each panel of a bi-parting vertically sliding landing door.

c) The average closing speed shall not exceed 0,60 m/s for a slide-up-to-open vertically sliding car door.

d) For vertically sliding landing doors combined with vertically sliding car door in the case of doors operating in parallel, an optical and acoustic warning starting at least 2 s prior to door closing, shall be visible and audible from car and landing before and during closing movement.

For vertically sliding landing doors combined with vertically sliding car door in the case of doors operating in sequence, an optical and acoustic warning starting at least 2 s prior to door closing, shall be visible and audible from within the car.

The sound level shall be adjustable between 35 dB(A) and 80 dB(A). The sound level shall be measured in 1,50 m height at 0,50 m distance from the centre of the door at car and landing side with the door fully open. Where the combination of hinged landing door and vertically sliding car door is used, the warning is not required on the landing.

e) A roller shutter door or a bi-parting door shall be considered as vertically sliding door.

4.3.6.2.3.2 Automatic power-operated vertically sliding doors

The variants a), b) and c) below define different configurations for automatic power-operated vertically sliding landing doors. One of these options and the technical requirements within shall apply:

a) For landing and car doors in parallel operation [see Figure 24 b)] or the car door in case of sequence operation [see Figure 24 a)] as per 4.3.6.2.3.4 or the car door in combination with a hinged landing door [see Figure 24 c)]:

   1) the kinetic energy of the landing and/or car door and the mechanical elements which are rigidly connected to it, calculated or measured at the average closing speed as per 4.3.6.2.3.1 b) shall not exceed 10 J.

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

      i) 0,025 m at each end of the travel in the case of bi-parting doors;

      ii) 0,050 m at each end of the travel in the case of slide-up-to-open vertically sliding doors.

   2) the force required to prevent the door from closing shall not exceed 150 N. This force shall be measured between the main closing edge of the door and the opposing edge (floor) at the following points (see Figure 23):

      i) at a distance of 0,20 m from each lateral border of the horizontal clear distance of the door opening and; at the centre of the clear opening;

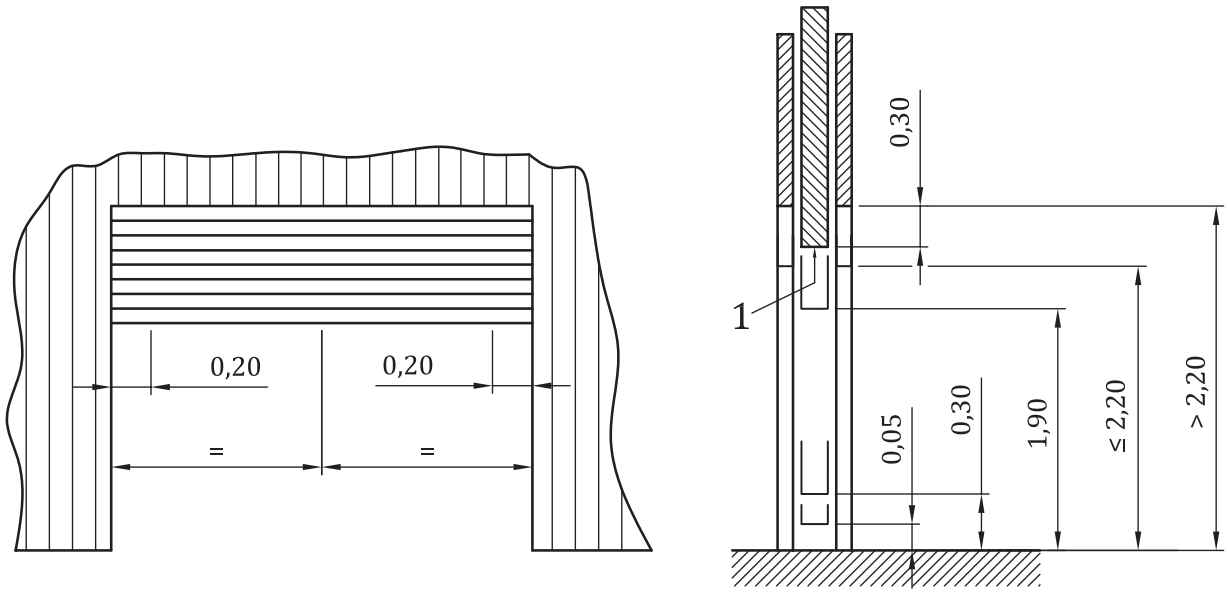
      ii) and at the closing vertical gaps of:

         — 0,05 m;

         — 0,30 m;

         — 1,90 m, or 0,30 m below the fully open position of the door in case the clear opening of the door height exceeds 2,20 m.

Dimensions in metres



Key

1 main closing edge of the door

Figure 23 — Points of measuring the maximum closing force of vertically sliding doors

3) the prevention of the door from closing shall initiate a minimum 50 mm reopening of the door;

4) a protective device shall automatically initiate re-opening of the door(s) in the event of crossing the entrance during the closing movement.

i) the protective device shall cover the zone in which the test object must be detected over the vertical distance between at least 25 mm and 1,80 m above the car door sill;

ii) the protective device shall be capable of detecting obstacles of 50 mm diameter;

iii) in case of failure, or deactivation of the protective device, the kinetic energy of the doors shall be limited to 4 J), if the lift is kept in operation.

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

b) For landing and car doors in parallel operation [see Figure 24 b)] or the car door in case of sequence operation [see Figure 24 a)] as per 4.3.6.2.3.4:

1) the prevention of the door from closing shall initiate a minimum 50 mm reopening of the door;

2) during the closing movement a protective device shall detect the object defined in i) passing through the zone in which the test object shall be detected defined in ii) and iii) at any position within this zone, stop the door and initiate re-opening of the door:

i) the test object shall be a cylinder with a diameter of 50 mm and a length of 150 mm, with the axle parallel to the floor and perpendicular to the protected zone;

ii) the zone in which the test object shall be detected in parallel operation shall be between the car side of the car door leading panel and landing side of the landing door leading panel and between at least 0,025 m up to a height of 1,80 m from the door sill [see Figure 24 b)];

iii) the zone in which the test object shall be detected in sequence operation shall be between the car side of car door leading panel and the well side of car door leading panel and between at least 0,025 m up to a height of 1,80 m from the sill [see Figure 24 a)];

iv) in case of failure, or deactivation of the protective device the automatic door closing shall be disabled (door re-open buttons shall remain active).

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

c) For the car door in combination with a hinged landing door in a goods passenger lift [see Figure 24 c)]:

1) the prevention of the car door from closing shall initiate a minimum 50 mm reopening of the door;

2) a protective device shall detect the object defined in i) entering from car side through the zone in which the test object shall be detected defined in ii) at any position within this zone, stop the door and initiate re-opening of the door during the closing movement.

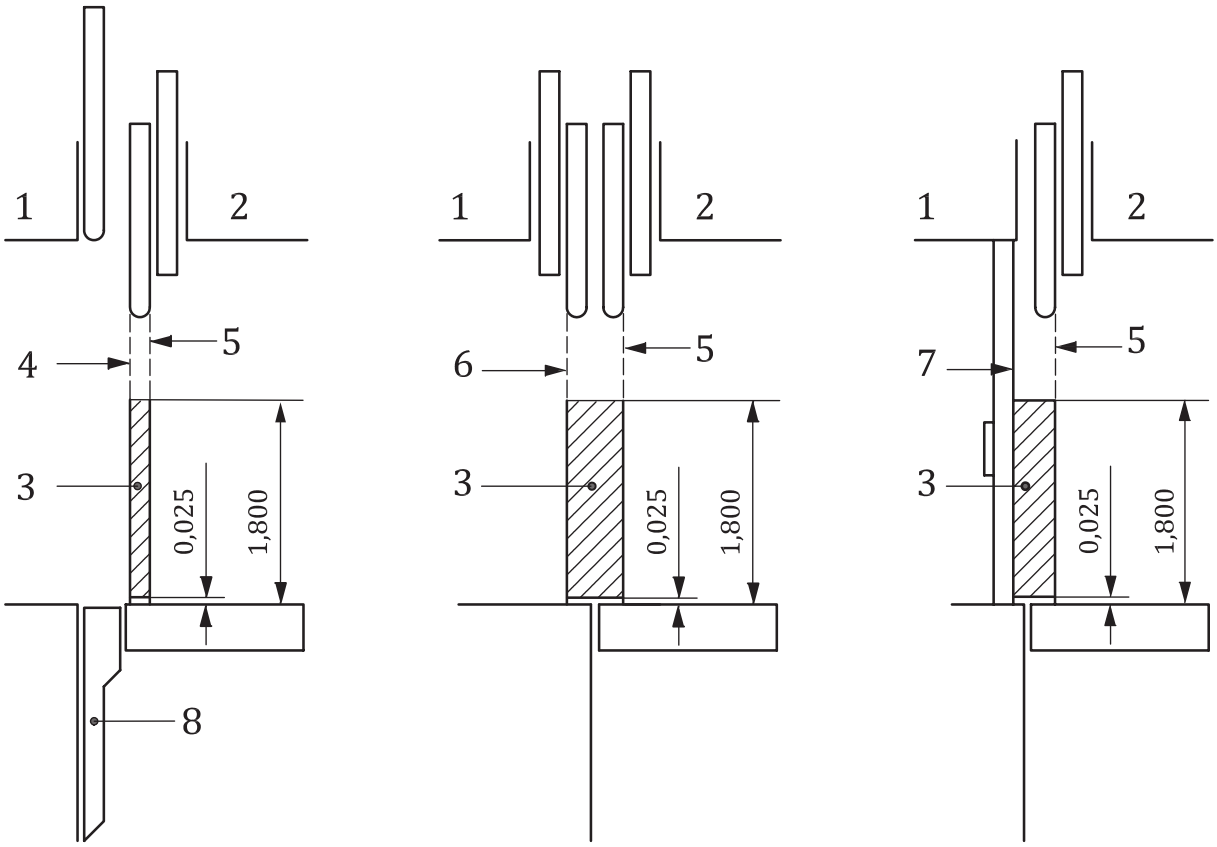
i) the test object shall be a cylinder with a diameter of 50 mm and a length of 150 mm, with the axle parallel to the floor and perpendicular to the zone in which the test object shall be detected;

ii) The zone in which the test object shall be detected shall be between the car side of the leading car door panel to the well side of the hinged landing door and between at least 0,025 m up to a height of 1,80 m from the door sill [see Figure 24 c)];

iii) in case of failure, or deactivation of the protective device the automatic door closing shall be disabled (door re-open buttons shall remain active).

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

Dimensions in metres



a) Bi-parting landing door Sequence operation

b) Slide-up-to-open doors Parallel operation

c) Vertical car door in combination with hinged landing door

Key

1	landing
2	car
3	zone in which the test object shall be detected
4	well side of the car door leading panel
5	car side of the car door leading panel
6	landing side of the landing door leading panel
7	well side of the hinged landing door
8	lower panel of a bi-parting landing door

Figure 24 — Zone in which the test object shall be detected — Vertically sliding doors

4.3.6.2.3.3 Non-automatic power-operated vertically sliding doors

Closing of non-automatic power-operated doors shall be operated by a hold-to-run control device. The following conditions shall be fulfilled simultaneously:

a) when the manual actuator is released, re-opening shall be initiated automatically;

b) the closing movement shall not be initiated by any controls other than the manual actuator of the hold-to-run device;

c) Re-closing shall only start if the closing command was released and is re-initiated;

d) The requirements of 4.3.6.2.3.2 a) 1) and 4.3.6.2.3.2 a) 2) shall apply in addition.

4.3.6.2.3.4 Power-operated vertically sliding doors with sequence operation

In the case of sequence operation it shall be as follows:

a) The car door closes first. The landing door shall only start to close when the leading edge of the fast panel of the car door is within a distance of 0,50 m above the floor;

b) The protective device of the car door remains active until the landing door is closed;

c) A control button at the landing with the door re-open symbol in accordance with ISO 4190-5:2006, Table C.1 No.2 shall allow to re-open the doors when the car is at the landing.

4.3.7 "Car here" indication

4.3.7.1 In the case of manually operated landing doors, one of the following solutions shall be provided:

a) the landing door shall have one or more transparent or translucent vision panels in accordance with:

   1) the vision panel shall not detach from the door during the door pendulum shock test as per 4.3.5.4 a); and

   2) laminated glass in accordance with ISO 12543-3:2021 with a minimum thickness of 33,2 shall be used. The vision panels shall have markings indicating:

      i) the name of the manufacturer or trademark;

      ii) the reference to the applicable standard;

      iii) the thickness given in the format xx,y where x is the nominal thickness of each glass panel in millimetres and y the number of interlayers in multiples of 0,38 mm. The marking shall be located at least 25 mm from the edge(s) of the glass panel. The minimum height of the characters shall be 5 mm.

   3) a minimum transparent or translucent area per landing door of 0,015 m^2 with a minimum area of 0,01 m^2 per vision panel shall be provided; and

   4) the width of the vision panel(s) shall be at least 60 mm, and shall not exceed 150 mm; and

   5) the lower edge of vision panels which are wider than 80 mm shall be at least 1,00 m above the floor level,

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, but shall light again when the call button of the landing where the car is parked is activated. The signal shall be positioned at a height of at least 0,85 m and not exceeding 2,50 m. The minimum height of the text shall be 7 mm.

4.3.7.2 The car door shall be fitted with a vision panel(s) if the landing door has a vision panel(s) as in 4.3.7.1 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 4.3.7.1 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.

4.3.8 Locking and closed landing door check

4.3.8.1 Protection against the risk of falling

It shall not be possible in automatic 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 coupled car and landing doors operating simultaneously, the unlocking zone may extend to a maximum of 0,35 m above and below the landing level.

4.3.8.2 Protection against shearing

With the exception of 4.12.1.4 and 4.12.1.8, it shall not be possible 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.

4.3.9 Locking and emergency unlocking of landing and car doors

4.3.9.1 Landing door locking devices

4.3.9.1.1 Each landing door shall be provided with a locking device satisfying the conditions of 4.3.8.1. The locking element shall be protected to prevent unlocking with a straight round object 300 mm long and with a diameter of 1 mm from the landing side.

Each component specified in 4.3.9, 4.3.10, 4.3.11, 4.3.14 forms part of the locking device.

With the exception of 4.12.1.4 and 4.12.1.8, the effective locking of the landing door in the closed position shall precede the movement of the car. The locking shall be checked by an electric safety device as per 4.11.2.

4.3.9.1.2 The electric safety device shall not be activated unless the locking elements are engaged by at least 7 mm (see Figure 25).

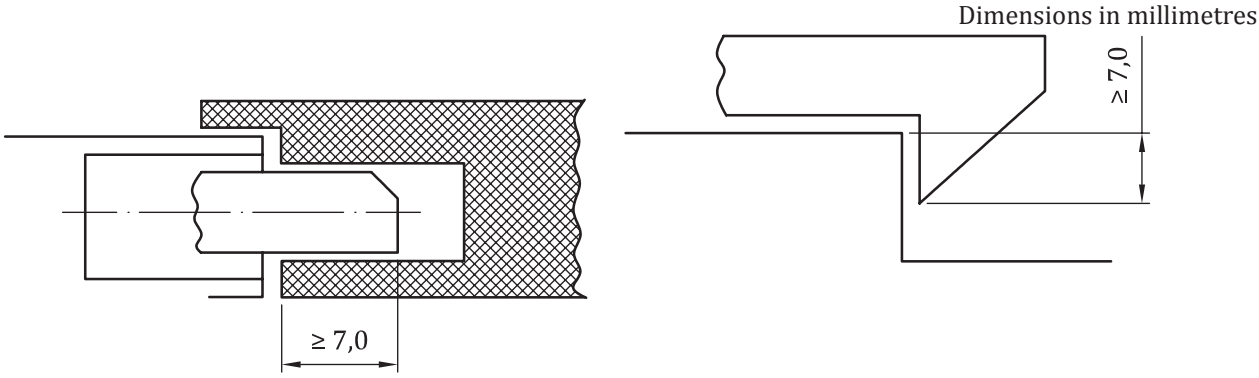


Figure 25 — Examples of locking elements

4.3.9.1.3 The electric safety device checking the locked condition of the door panel(s) shall be operated by the locking element without any intermediate mechanism.

4.3.9.1.4 For hinged doors, locking shall be effected as within a maximum distance equal to 10 % of the width of the door panel to the vertical closing edge(s) of the doors, and maintained even in the case of panels sagging.

4.3.9.1.5 The engagement of the locking elements shall be achieved in such a way that a force of 300 N applied at the position of the locking device and acting in the opening direction of the door does not diminish the effectiveness of locking.

4.3.9.1.6 The locking device in the locked position shall resist, without permanent deformation or breakage in the opening direction of the door:

a) under a minimum force of:

   1) 1 000 N at a height of 1,50 (±0,1) m from the sill level, in the case of horizontally sliding doors and folding doors;

   2) 3 000 N on the locking pin, in the case of hinged doors;

   3) 1 000 N applied in the opening direction of the door at a distance not exceeding 0,30 m from the locking element, in the case of vertically sliding doors;

   4) for the locking force limiter, the force as per 4.3.9.1.12 f) that releases the flap, in the case of flap type locking device.

b) the impact of a rigid mass of 4 kg falling in free fall from a height of 0,50 m.

4.3.9.1.7 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 case of loss of force provided by permanent magnets or springs, gravity on its own shall not cause unlocking.

4.3.9.1.8 Visual inspection of the locking elements shall be possible without the need to remove any obstruction. If a cover is used, it shall be transparent.

4.3.9.1.9 Where access to the locking elements and electrical safety device(s) requires removal of a cover, plate or housing, the fixing(s) shall be of the captive type.

4.3.9.1.10 The locking device shall be verified in accordance with ISO 8100-2:2025, 4.2.

4.3.9.1.11 A data plate shall be fixed on the locking devices, indicating:

a) the name of the manufacturer;

b) its identification.

4.3.9.1.12 Flap type locking devices shall be in accordance with the following:

a) Flap type locking devices shall only be used for goods passenger lifts;

b) The flap(s) shall overlap the door leave(s) with the door closed over their entire width at least 15 mm in the vertical direction, but at least 10 mm more than the height of the lower door gap (see 4.3.1.4);

c) In every position of the open door, the flap shall be secured against falling into the closed position by a horizontal overlap of at least 15 mm with the top of the door leaf. Stops on the floor limiting the door panel movement are not sufficient to prevent the flap from falling into the closed position;

d) It shall be prevented that the locking device is being engaged when the landing door is not fully in the closed position;

e) All components of the flap type locking device shall be connected positively, except the locking force limiter;

f) To prevent operation of the lift with a locking device deformed by excessive opening force, a locking force limiter shall be provided to prevent deformation of the flap. This device shall withstand a force of at least 3 500 N acting on the closing edge of the panel at a height of 300 mm ± 100 mm above the sill level. The activation of the force limiter shall be checked by an electric safety device as per 4.11.2. This device shall be in common with the contacts of the landing doors (4.3.9.4) or the landing door locks (4.3.9.1). The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)].

4.3.9.2 Car door locking devices

If the car door needs to be locked [see 4.2.5.3.1 c)], the locking device shall be designed to meet the requirements given in 4.3.9.1.

This device shall be inaccessible from inside the car when the car door is in the closed position.

The car door locking device shall be verified in accordance with ISO 8100-2:2025, 4.2.

4.3.9.3 Emergency unlocking

4.3.9.3.1 Each of the landing doors shall be capable of being unlocked from the outside with the aid of an emergency unlocking key, which fits the unlocking triangle, as defined in Figure 26.

Dimensions in millimetres

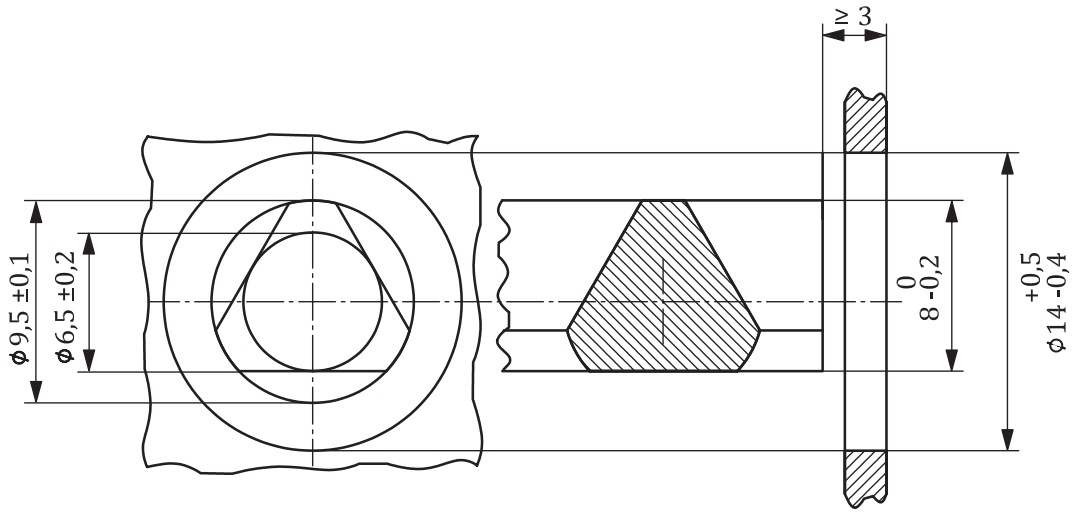


Figure 26 — Unlocking triangle

4.3.9.3.2 The position of the unlocking triangle shall be:

— on the door panel; or

— on the door frame, or

— within a distance not exceeding 0,30 m to the door 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 keyhole downward in the horizontal plane, the maximum height of the unlocking triangle hole from the landing floor shall be 2,70 m. The length of the emergency unlocking key shall be at least equal to the height of the door minus 2,00 m.

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

4.3.9.3.4 In the case of landing doors driven by the car door, excluding vertically sliding landing doors, 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 closing and locking of the landing door.

4.3.9.3.5 If the door giving access to the pit, is the landing door, the door lock or a permanently installed landing door lock operating device shall be:

— within a height of 1,80 m; and

— within a maximum horizontal distance of 0,80 m;

from the pit access ladder.

NOTE In case of big vertically sliding doors having two locking devices, two persons might be needed to unlock the door.

4.3.9.3.6 When the car is outside the unlocking zone, it shall be possible to relock the landing door without the use of a tool, including the emergency unlocking key.

4.3.9.3.7 In the case of vertically sliding doors the manual effort to open or to close a door from the landing, the pit or the car roof shall not exceed 300 N:

If the force exceeds 300 N, mechanical or electrical means shall be permanently available on site to keep the manual force within 300 N.

Electrical means shall fulfil the following:

— powered by supply independent from the main power supply;

— it shall be possible to open the door within 1 h after main power lost.

If the force exceeds 300 N the means to open the door for maintenance or rescue shall be stated in the instructions.

4.3.9.3.8 For vertically sliding doors, where the emergency unlocking device is located behind a cover opened by the emergency unlocking key, this cover shall be self-closing and self-locking, and provided with a switch disabling automatic door operation when the cover is opened.

4.3.9.3.9 The emergency unlocking key shall be available at the installation site in the space where the main switch is located. The key shall have a label attached, drawing attention to the danger which is involved in using this key and the need to make sure that the door is locked after it has been closed.

4.3.9.4 Electric safety device for proving the landing door closed

4.3.9.4.1 Each landing door shall be provided with an electric safety device as per 4.11.2 for proving the closed position, so that the requirements of 4.3.8.2 are satisfied.

4.3.9.4.2 In the case of horizontally sliding landing doors, coupled with a car door, 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.

4.3.9.4.3 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.

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

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

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

4.3.11 Sliding landing doors with multiple, mechanically linked panels

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

a) place the device required in 4.3.9.4.1 or 4.3.9.4.2, on a single panel; and

b) 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 of 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 a device as per 4.3.9.4.1 or 4.3.9.4.2 on all panels.

The strength of the hook elements must be checked in accordance with the requirements of 4.3.11.3 and ISO 8100-2:2025, 4.2. The linkage shall be ensured even in case of wear or rupture of guiding means. Simultaneous wear or rupture of upper and lower guiding means needs not to be taken into consideration.

NOTE The hanger plate is part of the locking device.

4.3.11.2 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 checked by an electric safety device as per 4.11.2.

4.3.11.3 The devices providing direct mechanical linkage between panels as per 4.3.11.1, or indirect mechanical linkage as per 4.3.11.2, are considered as forming part of the locking device.

They shall be capable of resisting the force of 1 000 N as per 4.3.9.1.6 a), even if the force of 300 N mentioned in 4.3.5.1 is acting simultaneously.

4.3.12 Closing of automatically operated landing doors

When lift landing doors are fire rated, they shall be closed in automatic operation, at the latest after 120 s in the absence of a command for the movement of the car, the information related to door closing shall be provided in the information for use in 6.2.3.

4.3.13 Electric safety device for proving the car door closed

4.3.13.1 With the exception of 4.12.1.4 and 4.12.1.8, it shall not be possible 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.

4.3.13.2 Each car door shall be provided with an electric safety device as per 4.11.2 for checking the closed position, so that the conditions imposed by 4.3.13.1 are satisfied.

4.3.14 Sliding or folding car door with multiple, mechanically linked panels

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

a) to place the device required in 4.3.13.2;

   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 4.2.5.3.1 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 or folding doors.

A back fold of the sheet of each panel of a telescopic door and hooking of 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 4.3.13.2 on all panels. The strength of the hook elements must be checked in accordance with the requirements of 4.3.11.3 and ISO 8100-2:2025, 4.2. The linkage shall be ensured even in case of wear or rupture of guiding means. Simultaneous wear or rupture of upper and lower guiding means needs not to be taken into consideration.

NOTE The hanger plate is part of the locking device.

4.3.14.2 If a sliding door comprises several indirectly mechanically linked panels (e.g. by rope, belt or chain), it is permitted to place the device requested in 4.3.13.2 on a single panel, provided that:

a) it is not the driven panel; and

b) the driven panel is directly mechanically linked to the door driving element.

4.3.15 Opening the car door

4.3.15.1 It shall be possible, to open the mechanically coupled car and landing door(s) by hand from the landing, and from inside the car, with a force not exceeding 300 N, when:

a) the landing door is unlocked; and

b) the car is stationary in the unlocking zone as per 4.3.8.1; and

c) there is no electrical power to the door operator (e.g. main switch is off).

4.3.15.2 In order to limit the opening of the car door by persons inside the car, a means shall be provided such that:

a) when the car is moving, the opening of the car door shall require a force of more than 50 N; and

b) when the car is outside of the zone defined in 4.3.8.1, it shall not be possible to open the car door more than 50 mm with a force of 1 000 N at the limiter mechanism, nor shall the door open under automatic power operation.

4.3.15.3 It shall be possible, at least where the car is stopped within the distance defined in 4.6.7.5, once the corresponding landing door has been opened, to open a car door from the landing without tools, other than the emergency unlocking key or tools provided with the lift. This shall apply also to a car door fitted with a locking device as per 4.3.9.2.

4.4 Car, counterweight and balancing weight

4.4.1 Height of car

The interior clear height of the car shall be at least 2,00 m.

4.4.2 Available car area, rated load, number of passengers

4.4.2.1 General case

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

To this effect the relationship between rated load and maximum available car area is given in Table 7.

Table 7 — 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	1 000	2,40
300	0,90	1 050	2,50
375	1,10	1 125	2,65
400	1,17	1 200	2,80
450	1,30	1 250	2,90
525	1,45	1 275	2,95
600	1,60	1 350	3,10
630	1,66	1 425	3,25
675	1,75	1 500	3,40
750	1,90	1 600	3,56
800	2,00	2 000	4,20
825	2,05	2 500[c]	5,00

[a] Minimum for 1 person lift.

[b] Minimum for 2 persons lift.

[c] Beyond 2 500 kg, add 0,16 m^2 for each extra 100 kg.

For intermediate loads, the area is determined by linear interpolation.

4.4.2.1.2 The car area shall be measured inside the car body, from wall to wall, excluding finishes, at a height 1,00 m from the floor.

4.4.2.1.3 Recesses and extensions in the car walls, even of height less than 1,00 m, whether protected or not by separating doors, shall only be permitted if their area is taken into account in the calculation of maximum available car area.

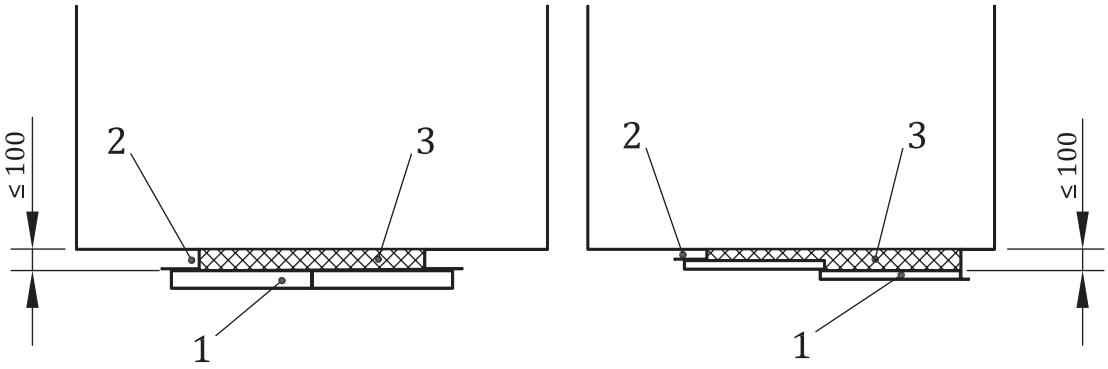
Recesses or extensions above the car floor level, which cannot accommodate a person due to equipment placed in them shall not be taken into account for the calculation of the maximum available car area (e.g. niches for tip-up seats, recesses for intercoms).

Where there is an available area between the entrance frame uprights when the doors are closed, the following shall apply:

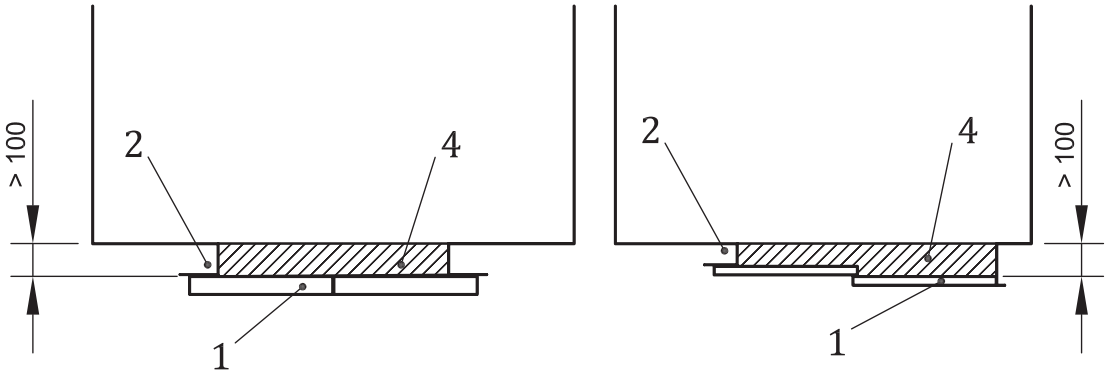
a) where the area is less than or equal to 100 mm deep up to all door panels (including fast and slow doors in the case of multi-panel doors), then it shall not be included in the floor area see Figure 27 a);

b) where the area is greater than 100 mm deep, to at least one door panel, the total available area shall be included in the floor area. See Figure 27 b);

Dimensions in millimetres



a) Not included



b) Included

Key

1 door panel
2 frame upright
3 not included area
4 included area

NOTE If a car door area needs to be included for cars with more than one car door, it is to be determined for is each car door individually.

Figure 27 — Car floor area in recesses and extensions

4.4.2.1.4 Overloading of the car shall be monitored in accordance with 4.12.1.2.

4.4.2.2 Special cases for goods passenger lifts

4.4.2.2.1 For goods passenger lifts, where the relationship between rated load and maximum available car area is as per Table 7, and where handling devices are used for loading and unloading the car, but are not transported with the load, and their weight is not included in the rated load, the following shall apply:

a) rated load plus the weight of handling devices shall be the base for the design of:

   1) the car, and

   2) the car sling, and

   3) the guide rails for the load case loading and unloading, and

   4) the mechanical device as per 4.4.2.2.1 d) 1); and

   5) in the case of a direct acting lift without mechanical device as per 4.4.2.2.1 d) 1), the connection between the car and the ram (cylinder), the rupture valve, the restrictor/one-way restrictor, the pawl device, the buffer(s), the unintended movements protection means and re-levelling.

b) rated load shall be the base for the design of all other components during running, safety device operation and bouncing scenarios;

c) for hydraulic lifts, the pressure resulting from rated load plus the weight of handling devices shall not exceed 1,4 times the pressure that the jack and the piping are designed for (see 4.9.3.2 and 4.9.3.3);

d) downward movement of the car due to loading shall be limited to maximum 20 mm by:

   1) a mechanical device, which:

      i) shall be able to hold the car even if the machine brake is released or the down valve on a hydraulic lift is opened;

      ii) shall have the retracted position checked by an electric safety device as per 4.11.2. This electric safety device is permitted to be made inactive within the unlocking zone (4.3.8.1) by an electric safety device as per 4.11.2;

      iii) shall be in accordance with 4.6.5.1, 4.6.5.6 and 4.6.5.7, where it extends by spring(s) and/or gravity;

      iv) shall have an electric circuit in accordance with:

         — 4.11.2.3; or

         — 4.11.2.4 with SIL 3,

         ensuring that it extends only if the car is stopped in the unlocking zone, where it extends by other means than springs and/or gravity.

   2) in the case of a direct acting lift, the design of the hydraulic system as per 4.4.2.2.1 a) 5).

e) an electric circuit in accordance with:

   — 4.11.2.3; or

   — 4.11.2.4 with SIL 3;

   shall ensure that the mechanical device as per 4.4.2.2.1 d) 1):

   1) is in the extended position before the door(s) can open; and

   2) can only be retracted if:

      i) the landing doors are closed and locked, and

ii) the load in the car does not exceed the rated load by more than 10 %.

f) the load monitoring as per 4.4.2.2.1 e) 2) ii) shall be in accordance with:

1) 4.11.2.3; or

2) 4.11.2.4 with SIL 3.

g) an indication of the maximum weight of the handling devices in accordance with Figure 28 shall be positioned at the landings between 1,80 m and 2,50 m above the floor level. The height of the characters shall be at least 100 mm.

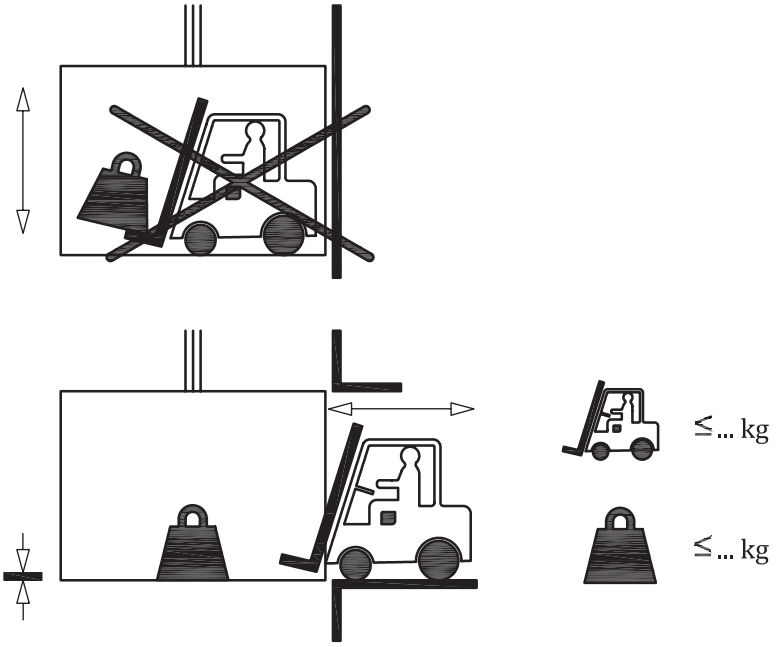


Figure 28 — Sign at landings for loading by handling devices

4.4.2.2.2 For goods passenger lifts, where the available car area exceeds the value determined from Table 7, the following shall apply:

a) where handling devices are used for loading and unloading the car, the weight of handling devices shall be included in the rated load;

b) the available car area shall not exceed the value determined from Table 8 for the corresponding rated load;

Table 8 — Rated load and maximum available car area (for 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	1 000	3,60
525	2,08	1 050	3,72
600	2,32	1 125	3,90
630	2,42	1 200	4,08
675	2,56	1 250	4,20

[a] Beyond 1 600 kg, add 0,40 m^2 for each 100 kg extra.

For intermediate loads, the area is determined by linear interpolation.

Table 8 *(continued)*

Rated load, mass kg	Maximum available car area m^2	Rated load, mass kg	Maximum available car area m^2
750	2,80	1 275	4,26
800	2,96	1 350	4,44
825	3,04	1 425	4,62
900	3,28	1 500	4,80
		1 600[a]	5,04

[a] Beyond 1 600 kg, add 0,40 m^2 for each 100 kg extra.

For intermediate loads, the area is determined by linear interpolation.

c) a load resulting from Table 7 shall be the base for the design of:

1) the car, and

2) the car sling, and

3) the guide rails for the load case loading and unloading, and

4) devices as per 4.4.2.2.2 f);

5) in the case of a direct acting lift without mechanical device as per 4.4.2.2.2 f), the connection between the car and the ram (cylinder), the rupture valve, the restrictor/one-way restrictor, the pawl device, the buffer(s), the unintended movements protection means and re-levelling.

d) rated load shall be the base for the design of all other components during running, safety device operation and bouncing scenarios;

e) for hydraulic lifts, the pressure resulting from a load in the car as per Table 7 shall not exceed 1,4 times the pressure that the jack and the piping are designed for (see 4.9.3.2 and 4.9.3.3);

f) except in the case of a direct acting lift as per 4.4.2.2.2 c) 5), one of the following shall be provided to limit downward movement of the car:

1) a mechanical device as per 4.4.2.2.1 d) 1);

2) a safety gear tripped by downward movement of the car as per 4.6.2.2.4 limiting the downward movement to maximum 120 mm;

3) a pawl device as per 4.6.5, except 4.6.5.9 and 4.6.5.10, limiting the downward movement to maximum 120 mm.

g) an electric circuit in accordance with:

— 4.11.2.3; or

— 4.11.2.4 with SIL 3,

shall ensure the that the device as per 4.4.2.2.2 f):

1) is in the extended position before the door(s) can open; and

2) can only be retracted if:

i) the landing doors are closed and locked, and

ii) the load in the car does not exceed the rated load by more than 10 %.

h) the load monitoring as per 4.4.2.2.2 g) 2) ii) shall be in accordance with:

1) 4.11.2.3; or

2) 4.11.2.4 with SIL 3.

4.4.2.3 Number of passengers

4.4.2.3.1 The number of passengers shall be obtained from the smaller value of the following:

a) either, the result of Formula (5) rounded down to the nearest whole number:

$$\frac{Q}{75} \quad (5)$$

where Q is the rated load, in kilograms; or

b) Table 9.

NOTE The average weight of a person is assumed to be 75 kg.

Table 9 — Number of passengers and minimum car available area

Number of passengers	Minimum available car area m^2	Number of passengers	Minimum available car area m^2
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[a]	3,13

[a] Beyond 20 passengers, add 0,115 m^2 for each extra passenger.

4.4.2.3.2 In the car, the following shall be displayed:

a) the manufacturer/installer's name;

b) the installation identification number;

c) the year of construction;

d) the rated load of the lift in kilograms;

e) the maximum number of persons, as per 4.4.2.3.1.

The notice shall be made as follows: "**... kg ... PERS**." or by using symbols for weight and persons.

EXAMPLE For persons:  and for load: 

NOTE 1 Symbols can be before or after the number, above or below each other, and in any order.

NOTE 2 Person symbol per ISO 7000:2019, 5840. Mass symbol per ISO 7000:2019, 1321B.

The minimum height of the characters and symbols for d) and e) shall be:

— 10 mm for capital letters and numbers and symbols;

— 7 mm for small letters.

4.4.2.3.3 For goods passenger lifts, a sign at the landing loading areas shall display the rated load with minimum height of 50 mm for the characters.

4.4.3 Walls, floor and roof of the car

4.4.3.1 The car shall be completely enclosed by walls, floor and roof. The only permissible openings are as follows:

a) car doors;

b) emergency trap doors and emergency doors;

c) inspection doors;

d) ventilation apertures.

4.4.3.2 The assembly comprising the car sling, guide shoes, walls, floor, ceiling and roof of the car shall have mechanical strength to satisfy the following sub-clauses.

4.4.3.2.1 In case of safety device operation as per 4.7.4.1, the floor of the car shall not incline more than 5 % from its normal position with:

— the empty car; and

— the car loaded with a uniformly distributed rated load.

4.4.3.2.2 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 cm^2 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 greater than 1 mm;

   — elastic deformation greater than 15 mm.

b) when a force of 1 000 N, being evenly distributed over an area of 100 cm^2 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 permanent deformation greater than 1 mm.

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

4.4.3.2.3 Car walls made of glass or partly glass shall be laminated glass in accordance with ISO 12543-3:2021.

When an impacting energy equivalent to a falling height of 0,50 m of the hard pendulum shock device (ISO 8100-2:2025, 4.16.2.1) and an impacting energy equivalent to a falling height of 0,7’ m of the soft pendulum shock device (ISO 8100-2:2025, 4.16.2.2) is striking the glass wall at a point 1,00 m above the floor on the centre line of the panel or for partial glass walls at the centre of the glass element, the following shall be satisfied:

a) there shall be no cracks on the wall element;

b) there shall be no damage on the surface of the glass except chips of 2 mm maximum in diameter;

The above tests shall be carried out on the inside face of the car wall.

These tests are not needed if car wall elements made of flat glass, as per Table 10, are framed on all sides.

Table 10 — Flat glass panels to be used in walls of the car

Type of glass	Minimum thickness mm	
	Diameter of inscribed circle of 1,00 m maximum	Diameter of inscribed circle of 2,00 m maximum
Laminated safety glass (ISO 12543-2:2021)	8 (4 + 4 + 0,76)	10 (5 + 5 + 0,76)
Laminated glass (ISO 12543-3:2021)	10 (5 + 5 + 0,76)	12 (6 + 6 + 0,76)

4.4.3.2.4 The fixing of the glass in the wall shall ensure that the glass cannot slip out of the fixings during all shock conditions encountered in both directions of travel, inclusive of safety device operation.

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

a) the name of the manufacturer or trademark;

b) the reference to the applied standard per 4.4.3.2.3;

c) the thickness given in the format xx,y where x is the nominal thickness of each glass panel in millimetres and y the number of interlayers in multiples of 0,38 mm

The markings shall be located at least 25 mm from the edge(s) of the glass panels. The minimum height of the characters shall be 5 mmm.

4.4.3.4 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.

4.4.4 Car door(s), floor, wall, ceiling and decorative materials

The load bearing structure of the car shall meet the requirements of EN 13501-1:2018, class A1 or A2 or B.

The materials for the finishes of the floor, walls, ceiling and door(s) inside the car shall be in accordance with EN 13501-1:2018 as listed:

— flooring: C_{fl}-s2;

— walls and car door(s): C-s2, d1;

— ceiling: C-s2, d0.

Excluded from the above requirements are:

— paint finishes;

— laminates up to 0,30 mm on the walls, ceiling and car door(s);

— fixtures such as operating devices, lighting and indicators.

Mirrors or other glass finishes, where provided within the car, shall be in accordance with ISO 29584:2015, 6.3 mode B or C, if broken.

4.4.5 Apron

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

Any projections on the face of the apron, such as fixings, shall not exceed 5 mm. Projections and recesses exceeding 2 mm shall be chamfered at least 75° to the horizontal.

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

4.4.5.3 When a force of 300 N, being evenly distributed over an area of 5 cm^2 in round or square section, is applied at right angles from the landing side to the apron at any point along the lower edge of the vertical section, the apron shall resist without:

a) permanent deformation greater than 1 mm;

b) elastic deformation greater than 35 mm.

4.4.6 Emergency trap doors and emergency doors

4.4.6.1 Emergency trap doors

Where an emergency trap door is provided in the car roof, it shall:

a) have minimum clear opening dimensions of 0,40 m × 0,50 m;

NOTE When space allows, a trap door of 0,50 m × 0,70 m is preferable.

b) be provided with a means for manual locking:

1) to open it from outside the car without a key; and

2) only in case the emergency trap door is needed for maintenance purpose [see 4.2.6.4.3.1 c)], it is to open it from inside the car with the emergency unlocking key; and

3) provided with an electric safety device as per 4.11.2 checking the locked position.

c) not open towards the inside of the car;

d) in the open position not project beyond the edge of the car.

4.4.6.2 Emergency doors in the car

Emergency doors to move from one car to the other are permitted to be provided in the case of adjacent cars.

In this case:

— the horizontal distance at the location of the emergency doors of the adjacent cars shall not exceed 1,00 m; and

— each car shall be provided with a means of determining the position of the adjacent car.

Where the distance between car emergency doors exceeds 0,20 m, a portable/movable bridge or a bridge integrated into the car, with a minimum width of 0,50 m fitting in the opening of the emergency door, shall be provided. When the bridge is deployed it shall be provided with a balustrade as per 4.4.7.4 a), b) and e).

The bridge shall resist a minimum force of 2 500 N at any position on the bridge over an area of 0,30 m × 0,30 m without causing elastic deformation greater than 15 mm and without permanent deformation greater than 1 mm.

The use of the bridge shall be described in the instruction manual.

Emergency doors shall:

a) have minimum clear opening dimensions of at least 1,80 m high and 0,40 m wide.

b) be provided with a means for manual locking:

   1) to open it from outside the car without a key; and

   2) to open it from inside the car only with the emergency unlocking key.

   3) provided with:

      i) an electric safety device as per 4.11.2 checking the locking; and

      ii) an additional electric safety device as per 4.11.2 to stop the adjacent lift when unlocked.

c) not open towards the outside of the car.

d) 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.

4.4.7 Car roof

4.4.7.1 In addition to 4.4.3, the car roof shall fulfil the following requirements:

a) the car roof shall have a mechanical strength to support the maximum number of persons, as per 4.2.5.7.1.

   In addition, the car roof shall resist a minimum force of 2 000 N at any position on the car roof over an area of 0,30 m × 0,30 m without causing permanent deformation greater than 1 mm.

b) the surface of the car roof where a person needs to work and move between working areas shall be slip resistant in accordance with ISO 14122-2:2016, 4.2.4.7.

4.4.7.2 The following protection shall be provided:

a) the car roof shall be provided with a toe board a minimum of 0,10 m high (see Figure 30), positioned either:

   1) at a maximum distance of 0,05 m to the outer edge of the car roof; or

2) between the outer edge and the position of the balustrade, where a balustrade (4.4.7.4) is provided;

b) where the free distance in a horizontal plane, beyond and perpendicular to the outer edge of the car roof to the wall of the well exceeds 0,30 m, a balustrade shall be provided to the dimensions given in 4.4.7.4.

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.

c) where a balustrade is required on the access side of the car it shall consist of a self-closing gate which shall:

1) meet the requirements of the adjacent balustrade; and

2) have a minimum width of 0,50 m

d) where there are any horizontal projections from the wall into the well or any horizontal beam – greater than 0,15 m in width and 0,25 m in length, a balustrade shall be provided to the dimensions given in 4.4.7.4.

4.4.7.3 Where lift component(s) located between the outer edge of the car roof and the wall of the well due to their position prevent falling throughout the travel of the car (see Figure 29), the following conditions shall be fulfilled simultaneously:

a) where the distance between the outer edge of the car roof and the well wall exceeds 0,30 m, it shall not be possible to place a horizontal circle with a diameter greater than 0,30 m between:

1) the outer edge of the car roof and these lift component(s);

2) these lift components;

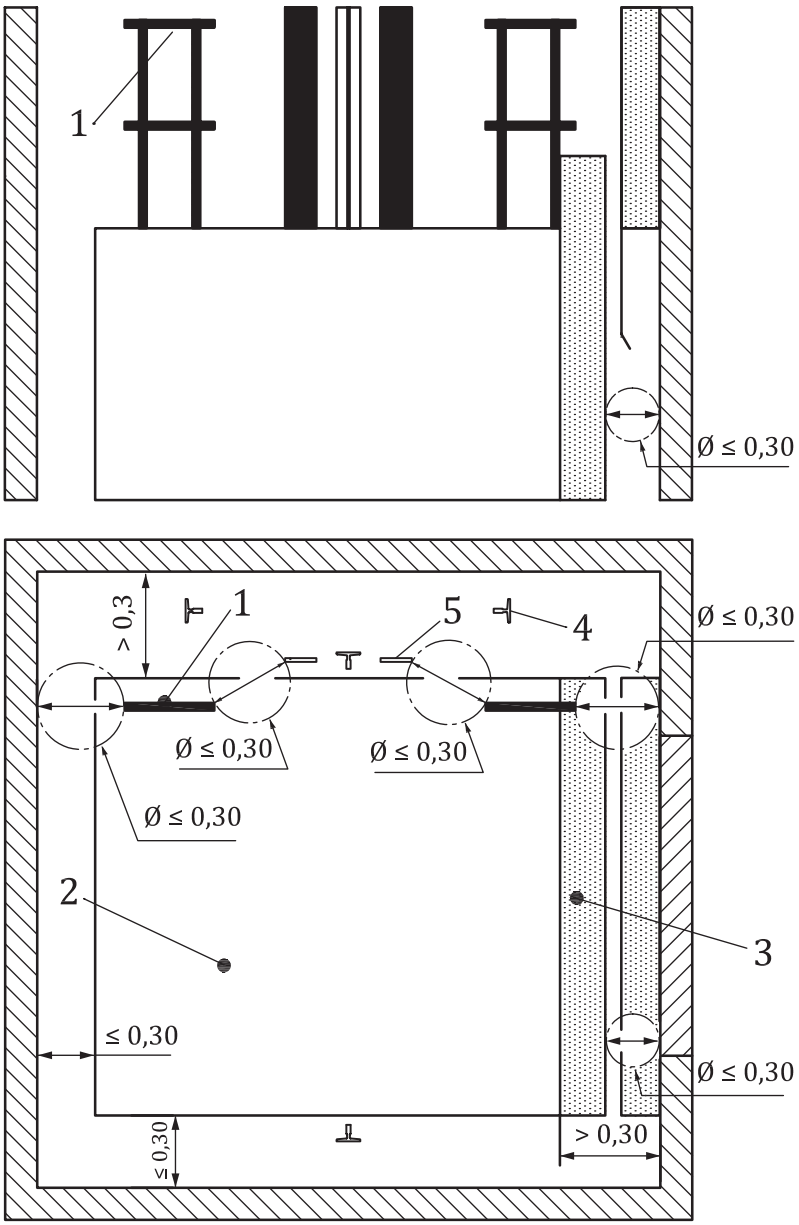
3) the end of the balustrade and these lift component(s);

4) these lift component(s) on the car to the wall of the well;

5) these lift component(s) on the car to components in the well.

b) when a force of 300 N is applied horizontally at right angles to any point to the component, it shall not cause the component to deflect to a point where a) is no longer fulfilled.

Dimensions in metres



Key

1	balustrade(s)
2	car roof
3	door operator
4	guide rails
5	suspension means

Figure 29 — Example of components providing protection from falling

4.4.7.4 Balustrades shall fulfil the following requirements (see Figure 30).

a) They shall consist of a handrail and at least one intermediate bar. The vertical opening between handrail, intermediate bar and toe board shall not exceed 0,50 m;

b) Considering the free distance in a horizontal plane beyond the inner edge of the handrail of the balustrade and the well wall, its height shall be at least:

   1) 0,70 m where the distance does not exceed 0,50 m;

2) 1,10 m where the distance exceeds 0,50 m;

c) The balustrade shall be located:

1) at a maximum horizontal distance of 0,15 m from the parallel edge(s) of the car roof; or

2) at any horizontal distance where the area beyond the balustrade is protected from persons standing there by a deflector from the edge of the car roof to the balustrade as per 4.2.5.2.4 b);

3) in such a way, that the horizontal distance between the end(s) of the balustrade and

— the wall of the well; or

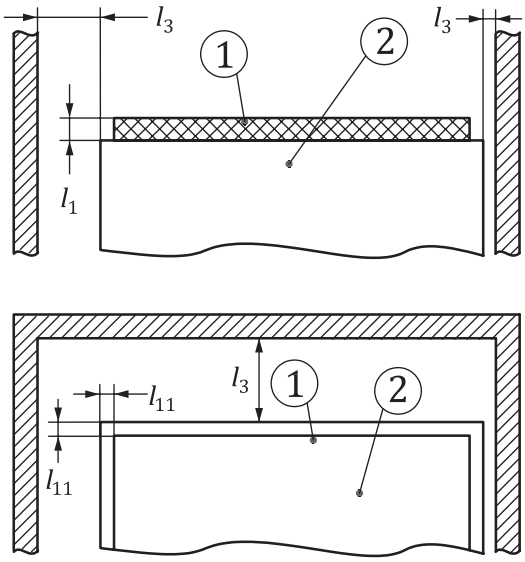
— components in the well as per 4.4.7.3;

does not exceed 0,30 m.

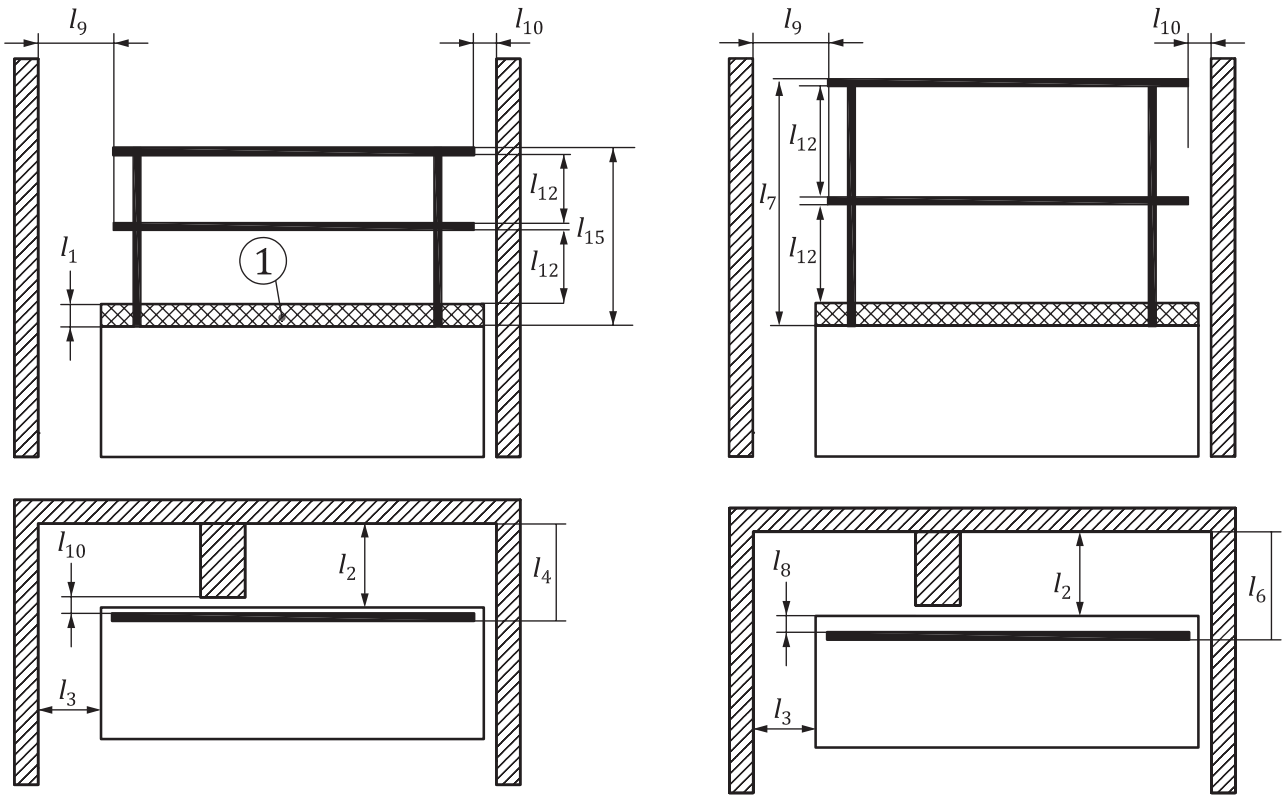
d) The horizontal distance between the outer edge of the handrail (including the handrail posts, joint- and fixing parts) and any part in the well (counterweight or balancing weight, switches, rails, brackets, etc.) shall be at least 0,10 m.

e) When a force of 1 000 N is applied horizontally at right angles to any point at the top of the balustrade, it shall resist without permanent deformation greater than 1 mm and without elastic deformation greater than 50 mm.

f) The horizontal distance of equipment/component(s) requiring maintenance from the car roof shall not exceed 0,70 m from the inside of the balustrade.



a) Toe board only



b) 0,70 m height, $l_4 \leq$ 0,50 m

c)1,10 m height, $l_6 >$ 0,50 m

Key

l_1	≥ 0,10 m [4.4.7.2 a)]
l_2	> 0,30 m [4.4.7.2 b)]
l_3	≤ 0,30 m [4.4.7.2 b)]
l_4	≤ 0,50 m [4.4.7.4 b) 1)]
l_5	≥ 0,70 m [4.4.7.4 b) 1)]
l_6	> 0,50 m [4.4.7.4 b) 2)]
l_7	≥ 1,10 m [4.4.7.4 b) 2)]
l_8	≤ 0,15 m [4.4.7.4 c) 1)]
l_9	≤ 0,30 m [4.4.7.4 c) 3)]
l_{10}	≥ 0,10 m [4.4.7.4 d)]
l_{11}	≤ 0,05 m [4.4.7.2 a) 1)]
l_{12}	≤ 0,50 m [4.4.7.4 a)]
1	toe board
2	car

Figure 30 — Car roof balustrade

4.4.7.5 Any glass used for the car roof shall be laminated safety glass in accordance with ISO 12543-2:2021. The glass panels shall have markings indicating:

a) the name of the manufacturer or trademark;

b) the reference to the applied standard;

c) the thickness given in the format xx,y where x is the nominal thickness of each glass panel in millimetres and y the number of interlayers in multiples of 0,38 mm.

The marking shall be located at least 25 mm from the edge(s) of the glass panel. The minimum height of the characters shall be 5 mm.

4.4.8 Equipment on top of the car

The following shall be installed on top of the car:

a) inspection operation switch(es) as per 4.12.1.5.2.1 a), at a horizontal clear distance not exceeding 0,75 m from each access point to the car roof. The horizontal clear distance shall be measured from the inner edge of the landing door sill to access the car roof;

b) permanently installed inspection operation control devices as per 4.12.1.5 without inspection operation switch, at a horizontal clear distance not exceeding 0,30 m from a refuge space (4.2.5.7.1). These devices may be combined with 4.4.8 a) if requirements of both are satisfied;

c) a socket outlet as per 4.10.7.2.

4.4.9 Ventilation

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

4.4.9.2 The effective area of ventilation apertures shall be:

— at least 1 % of the available car area, situated in the upper part of the car; and

— at least 1 % of the available car area, situated in the lower part of the car.

Where the gaps around the car door(s) are taken into account, they can be taken into account for a maximum of 25 % of the required ventilation apertures in the upper part of the car and 25 % of the required ventilation apertures in the lower part of the car.

4.4.9.3 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 from the inside.

4.4.10 Lighting

4.4.10.1 The car shall be provided with electrical lighting that is permanently installed ensuring a light intensity of at least 100 lx on the control devices and at 1,00 m above the floor at any point not less than 100 mm from any wall.

The light meter sensor shall be facing directly towards the light source when taking lux level readings.

4.4.10.2 There shall be at least two individual light sources connected in parallel.

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

4.4.10.4 There shall be emergency lighting with an automatically rechargeable emergency supply as per 4.10.11, It shall ensure a lighting intensity of at least 5 lx:

a) at each alert initiation device in the car and as per 4.2.1.4;

b) in the centre of the car, 1,00 m above the floor;

c) in the centre of the car roof, 1,00 m above the floor.

The light meter sensor shall be facing directly towards the light source when taking lux level readings.

This lighting shall come on automatically upon failure of the lighting supply.

4.4.11 Counterweight and balancing weight

4.4.11.1 The use of a balancing weight is defined in 4.9.2.1.1 for positive drive lifts and in 4.9.3.1.3 for hydraulic lifts.

4.4.11.2 The filler weights used for the counterweight or the balancing weight shall be retained and secured in the frame.

4.4.11.3 Non-metallic filler weights when stood up on their short side and three times tilted until falling in one direction and then three times in the opposite direction (see Figure 31) shall not:

a) loose their integrity; and

b) loose more than 2 % of their original mass.

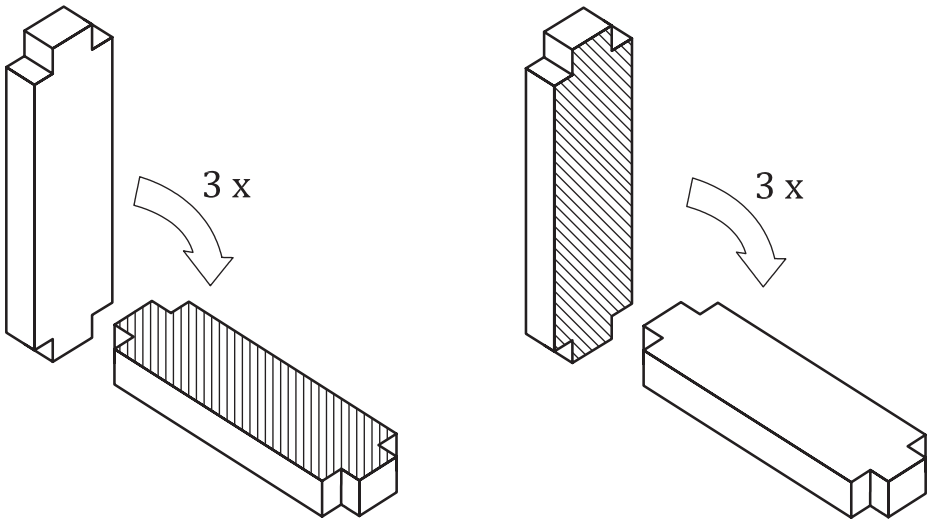


Figure 31 — Filler weight test

4.5 Suspension means, compensation means and related protection means

4.5.1 Suspension means and related sheaves/drums/sprockets

4.5.1.1 Cars, counterweights or balancing weights shall be suspended from one of the following suspension means:

a) steel wire ropes in combination with steel/cast iron traction sheaves, drums and pulleys of hydraulic lifts;

b) steel wire ropes in combination with elastomeric coated traction sheave grooves;

c) steel wire ropes in combination with non-metallic replaceable traction sheave groove liners;

d) elastomeric coated steel wire ropes in combination with metallic traction sheaves;

e) elastomeric coated traction belts in combination with metallic traction sheaves;

f) elastomeric coated timing belts in combination with metallic sprockets;

g) chains with parallel links (Galle type) or roller chains in combination with metallic sprockets;

4.5.1.2 Material and construction of steel wire ropes and elastomeric coated suspension means shall be in accordance with the following.

4.5.1.2.1 Steel wire ropes shall:

a) be in accordance with ISO 4344:2022; or

b) be in accordance with Table 11.

Table 11 — Steel wire rope diameters and constructions

Diameter	Construction	Test
4 ≤ d < 6 mm	6 outer strands; WSC (Wire Strand Core)	ISO 8100-2:2025, 4.13.5
6 ≤ d < 8 mm	6-8 outer strands; IWRC (Independent Wire Rope Core)	ISO 8100-2:2025, 4.13.5

For wire tensile strength grade higher than 1 770 N/mm^2 hardened metallic traction sheave grooves shall be used.

For wire tensile strength grade higher than 1 960 N/mm^2 up to 3 500 N/mm^2 elastomeric coated traction sheave grooves shall be used.

4.5.1.2.2 Elastomeric coated steel wire ropes shall be in accordance with the following:

a) only steel wires shall be considered as tension member;

b) the wire tensile strength grade shall be as specified in the instructions as per ISO 8100-2:2025, 4.13.9;

c) the elastomeric coating shall prevent any direct contact of the tension members to the traction sheave and pulley(s);

d) the steel wire rope shall have a minimum diameter of 4 mm in a non-tensioned condition, the wires shall have a minimum diameter of 0,2 mm;

e) the tolerance of the outside diameter including coating shall be ±2 % when loaded at 10 % of its MBF;

f) the elastomeric coated steel wire ropes shall be verified in accordance with ISO 8100-2:2025, 4.13.1 and 4.13.7.

4.5.1.2.3 Elastomeric coated traction belts and elastomeric coated timing belts shall be in accordance with the following:

a) only steel wires or carbon fibre reinforced polymer (CFRP) elements shall be considered as tension member;

b) the tensile strength grade shall be as specified in the instructions as per ISO 8100-2:2025, 4.13.9;

c) the elastomeric coating shall prevent any direct contact of the tension members to the traction sheave, pulley(s) and sprocket(s);

d) the tension members shall have a minimum diameter of 1,0 mm in a non-tensioned condition and be made from wires with a minimum diameter of 0,1 mm, and a single CFRP shall have a minimum diameter or height of 1,0 mm;

e) the tension members shall be arranged in such a way that under load no rotation occurs;

f) when the straight belt is loaded up to 10 % of the MBF of the belt, the following tolerances shall apply:

   — ±5 % of nominal width, and

   — ±5 % of nominal thickness.

g) for elastomeric coated timing belts the number of teeth shall be at least seven, when the belt is in wrap contact with the sprocket pulley;

NOTE exemplary profile systems are shown in ISO 13050:2022 or ISO 17396:2024;

h) elastomeric coated traction belts and elastomeric coated timing belts shall be verified in accordance with ISO 8100-2:2025, 4.13.1 and 4.13.7;

i) elastomeric coated traction belts with CFRP tension member shall be verified in accordance with ISO 8100-2:2025, 4.13.1, 4.13.7 and 4.13.8.

4.5.1.3 The minimum number of suspension means 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.

4.5.1.4 Suspension means shall be independent of each other.

4.5.1.5 Elastomeric coated traction sheave grooves shall be in accordance with the following:

a) the traction sheave body shall be made of steel or cast iron;

b) the elastomeric coating shall be secured by positive mechanical connection or adhesively bonded, preventing any rotation of the coating layer to the sheave body;

c) the groove shape of the coating shall be semi-circular without undercut;

d) the difference of the running radius for all grooves shall not exceed 0,1 % at any point of the circumference;

e) the geometry of the metallic sheave body shall be designed to ensure the traction requirements as per 4.5.3 in case of coating loss;

f) the thickness of the elastomeric coating shall be between 20 % and 75 % of the steel wire rope nominal diameter;

g) the elastomeric coated traction sheave grooves shall be verified in accordance with ISO 8100-2:2025, 4.13.2.

4.5.1.6 Traction sheaves for elastomeric coated ropes and elastomeric coated traction belts shall be in accordance with the following:

a) the traction sheave body shall be made from steel, cast iron or aluminium;

b) the geometry of the traction sheave or retainers shall prevent the suspension means running off the sheave in lateral direction under the fleet angle to be defined and verified in ISO 8100-2:2025, Table 2 and ISO 8100-2:2025, 4.13.5;

c) the contact surface roughness of the traction sheave shall be in accordance with the instructions as per ISO 8100-2:2025, Table 2;

4.5.1.7 The driven sprockets for elastomeric coated timing belts shall be in accordance with the following:

a) the sprocket shall be made from steel, cast iron or aluminium;

b) the geometry of the sprocket shall be designed to prevent the suspension means running off the sprocket in lateral direction;

c) the contact surface roughness and tooth geometry of the sprocket shall in accordance with the instructions as per ISO 8100-2:2025, Table 2;

4.5.1.8 Non-metallic replaceable traction sheave groove liners shall be in accordance with the following:

a) the traction sheave body shall be made of steel or cast iron;

b) the non-metallic replaceable traction sheave groove liners shall be secured by positive mechanical means or adhesively bonded, preventing rotation within the sheave body;

c) the groove shape of the non-metallic replaceable traction sheave groove liner shall be semi-circular without undercut;

d) the difference of the running radius for all grooves, as manufactured, shall not exceed 0,2 % at any point of the circumference;

e) the geometry of the metallic sheave body shall ensure the traction requirements as per 4.5.3 in case of groove liner failure;

f) only steel wire ropes as per 4.5.1.2.1 a) shall be used with:

— a minimum diameter of 12 mm;

— a rope construction with eight or nine outer strands;

— a fibre core (FC) or an independent wire rope core (IWRC);

— ordinary lay or lang lay;

g) the minimum number of ropes shall be three.

4.5.2 Minimum diameter ratio, safety factor, fatigue lifetime and suspension means terminations

4.5.2.1 Bending diameter definition for tension members

The minimum ratio between the pitch diameter, *D*, of sheaves, pulleys, drums and sprockets and the nominal diameter, *d*, of suspension means shall be in accordance with Table 12.

For elastomeric coated traction belts, elastomeric coated timing belts and elastomeric coated steel wire ropes, the diameter or thickness of the tension member shall be taken as the nominal diameter to be used in Table 12.

Table 12 — Minimum diameter ratio D/d

Suspension means	Minimum diameter ratio for suspension means D/d
Steel wire ropes as per 4.5.1.2.1 a)	40
Steel wire ropes with lifetime testing as per 4.5.1.2.1 b)	30
Steel wire ropes with elastomeric coated traction sheave grooves as per 4.5.1.5	40
Steel wire ropes with non-metallic replaceable traction sheave groove liners as per 4.5.1.8	40
Elastomeric coated traction belts with steel wire tension member as per 4.5.1.2.3	40
Elastomeric coated traction belts with CFRP tension member as per 4.5.1.2.3	150
Elastomeric coated steel wire ropes as per 4.5.1.2.2	24
Elastomeric coated timing belts as per 4.5.1.2.3	40

4.5.2.2 Safety factor of the suspension means

4.5.2.2.1 The safety factor is the ratio between the MBF of one suspension means and the maximum force in this suspension means when the car is stationary at the lowest landing, with its rated load.

For elastomeric coated suspension means and for steel wire ropes as per 4.5.1.2.1 b) the MBF shall be verified in accordance with ISO 8100-2:2025, 4.13.4.

For positive and hydraulic drives, the safety factor of balancing weight suspension means shall be calculated as above, in relation to the suspension means force due to the weight of the balancing weight.

4.5.2.2.2 The safety factor for steel wire ropes as per 4.5.1.2.1 a) without fatigue lifetime testing as per Table 13 or chains 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 with ropes;

d) 10 in the case of chains;

e) the safety factor calculated in accordance with ISO 8100-2:2025, 4.12, in the case of traction drive with steel or cast-iron traction sheaves, with ropes;

f) the safety factor calculated in accordance with ISO 8100-2:2025, 4.12, in the case of traction drive with non-metallic replaceable traction sheave groove liners as per 4.5.1.8.

4.5.2.2.3 The safety factor of elastomeric coated suspension means and steel wire ropes as per 4.5.1.2.1 b) with fatigue lifetime testing as per Table 13 shall not be less than:

a) 12 in case of the RBF is equal or higher than 60 % of the MBF and traction drive with three suspension means or more;

b) 12 in case of the RBF is equal or higher than 80 % of the MBF and traction drive with two suspension means;

c) 16 in case of the RBF is equal or higher than 60 % of the MBF and traction drive with two suspension means.

4.5.2.3 Fatigue lifetime

4.5.2.3.1 General provisions

The methods for fatigue lifetime testing and monitoring in accordance with Table 13 shall be followed.

Table 13 — Methods for fatigue lifetime testing and monitoring

	Fatigue lifetime testing ISO 8100-2: 2025, 4.13.5	Verification of elastomeric coated traction sheave ISO 8100-2: 2025, 4.13.2	Bending counter 4.5.2.3.2, 4.5.2.3.3	Suspension means physical strength monitoring 4.5.2.3.2, 4.5.2.3.4	Diameter reduction check with special tool 4.5.2.3.5	Visual inspection with discard criteria acc. ISO 8100-2: 2025, 4.14
Steel wire ropes as per 4.5.1.2.1 a)						x
Steel wire ropes as per 4.5.1.2.1 b) 6 mm ≤ d < 8 mm RBF ≥ 80 % MBF	x		x			x
Steel wire ropes as per 4.5.1.2.1 b) 4 mm ≤ d < 6 mm RBF ≥ 80 % MBF	x		x		x	x
Steel wire ropes as per 4.5.1.2.1 in combination with elastomeric coated traction sheave grooves as per4.5.1.5RBF ≥ 80 % MBF	x	x	x			x
Elastomeric coated suspension means, RBF ≥ 80 % MBF	x		x[a]	x[a]		x
Elastomeric coated traction belts with CFRP tension members as per 4.5.1.2.3 RBF ≥ 80 % MBF	x		x	x		x
Elastomeric coated suspension means, RBF ≥ 60 % to 80 % MBF	x			x		x
x all methods marked shall be combined x[a] at least one method shall be selected						

4.5.2.3.2 General discarding monitoring means operational requirements

The bending counter or the physical strength monitoring shall be in accordance with the following:

a) When the monitoring means becomes inoperative or indicates discard condition has been reached, the start of the lift in automatic operation shall be prevented.

b) Once the lift has been taken out of automatic operation as per 4.5.2.3.2 a), it shall only be allowed to move the car under emergency operation, inspection operation and emergency electrical operation.

c) When the monitoring means has taken the lift out of automatic operation as per 4.5.2.3.2 a), this shall be indicated, either by a built-in system or by an external tool provided with the lift.

d) The monitoring means shall maintain the discard status data through power loss conditions and in case of monitoring means failure:

   — for the bending counter the discard status data are the actual counter value and the maximum number of allowed trips, N_{lift};

   — for the physical strength monitoring the discard status data are the physical parameter values corresponding to the initial MBF, the actual breaking force and the limit value for the RBF as per Table 13.

The discard status data shall be maintained/transferred after repair/replacement of the monitoring means [see 6.2.4 j)]. The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)].

e) The monitoring means shall be provided with a device for resetting after replacement of the suspension means; the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)].

f) The monitoring means may be a part of the control system or a separate monitoring device.

4.5.2.3.3 Bending counter

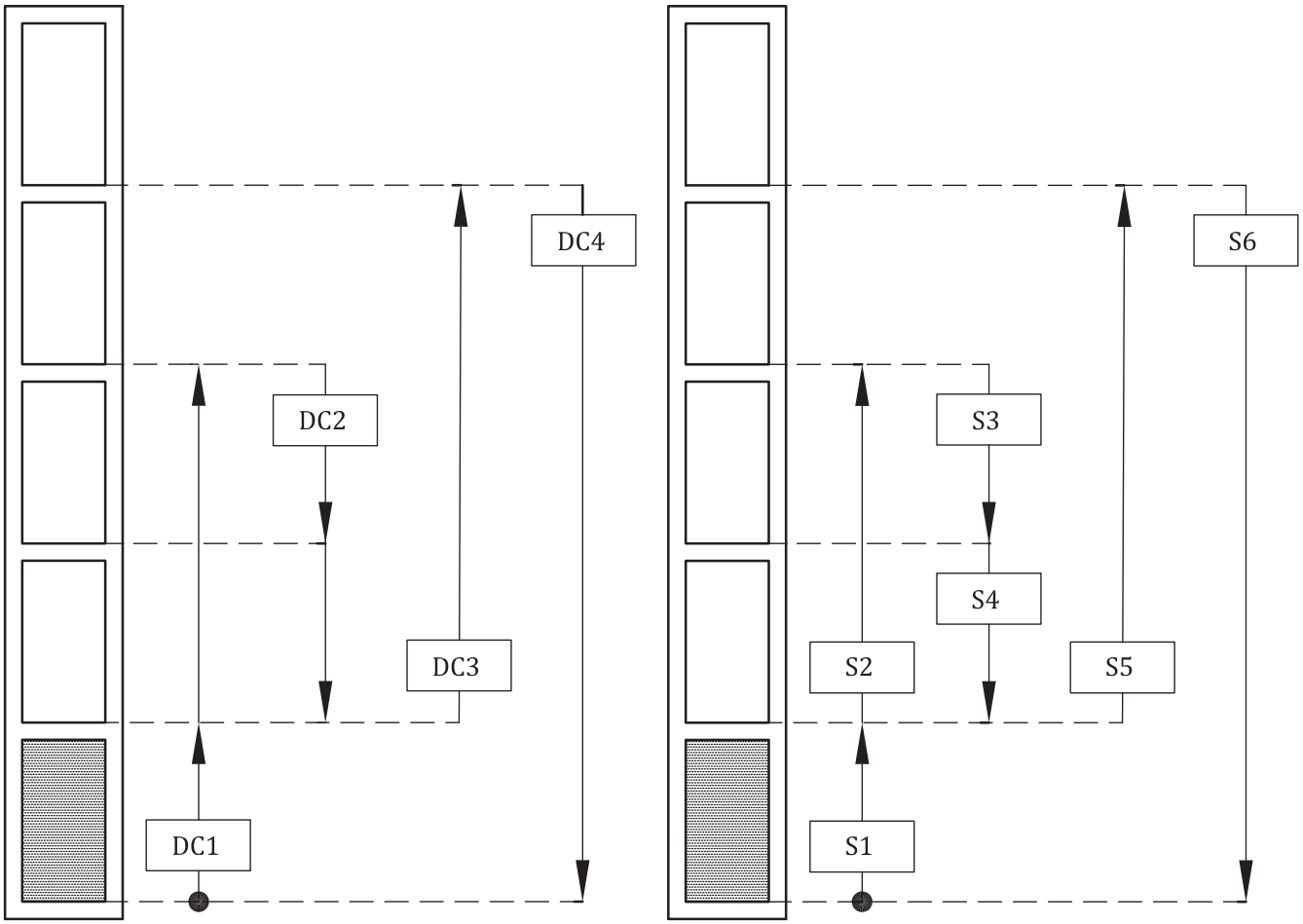
4.5.2.3.3.1 General

The bending counter, if provided, shall count:

a) every direction change [see Figure 32 a)]; or

b) every start [see Figure 32 b)].

When the actual counter value has reached the maximum number of allowed trips, N_{lift}, the monitoring means shall indicate the discard condition. Releveling trips, inspection operation and emergency electrical operation can be excluded from the counter.



a) Direction change counting **b) Start counting**

Key

DC1…n direction change 1…n

S1…n start 1…n

a) Applying the direction change counter method, the 4 direction changes shall be considered as 4 full trips in the bending counter

b) Applying the start counter method, the 6 starts shall be considered as 6 full trips in the bending counter

Figure 32 — Example for the number of full trips to be considered

NOTE A full trip is defined as a trip from the lowest landing to the highest landing - or from the highest landing to the lowest landing.

4.5.2.3.3.2 Calculation of the number of bendings

Based on the sheave and pulley arrangement the number of simple bending and reverse bending experienced by the most stressed suspension means section during one full trip of the lift shall be considered.

To determine the stress of the most stressed section the different stresses caused by the different bendings shall be accumulated. It shall be differentiated between:

Simple bending:

For one simple bend (n_{SB} = 1) of a suspension or compensation means the sequence is:

straight – bend – straight  when the means is running over one sheave or pulley; or

bend – straight – bend  when the movement of the means is starting from a bend situation on a sheave or pulley and is stopping in a bend situation on a sheave or pulley with the same bending direction; or

a half simple bend (n_{SB} = ½)

straight – bend  , or bend – straight 

before or after a full simple or full reversed bending

Reverse bending:

For one reverse bend (n_{RB} = 1) of a suspension means the sequence is:

bend – straight – reverse bend  , or  when the direction of bending of the means is changing during movement on to the next sheave or pulley.

For steel wire ropes and elastomeric coated steel wire ropes a bend shall only be considered to be a reverse bend if the distance from the rope contacts on two consecutive pulleys or sheaves, which have a fixed distance between their axles, is less than 200 times the rope diameter, and the bending planes are rotated through more than 120°.

For elastomeric coated timing belts and elastomeric coated traction belts, regardless of the distance in between the sheaves and pulleys, reverse bends shall always be considered unless twisted to prevent reverse bend.

Figure 33 shows two examples for counting of simple and reverse bends.

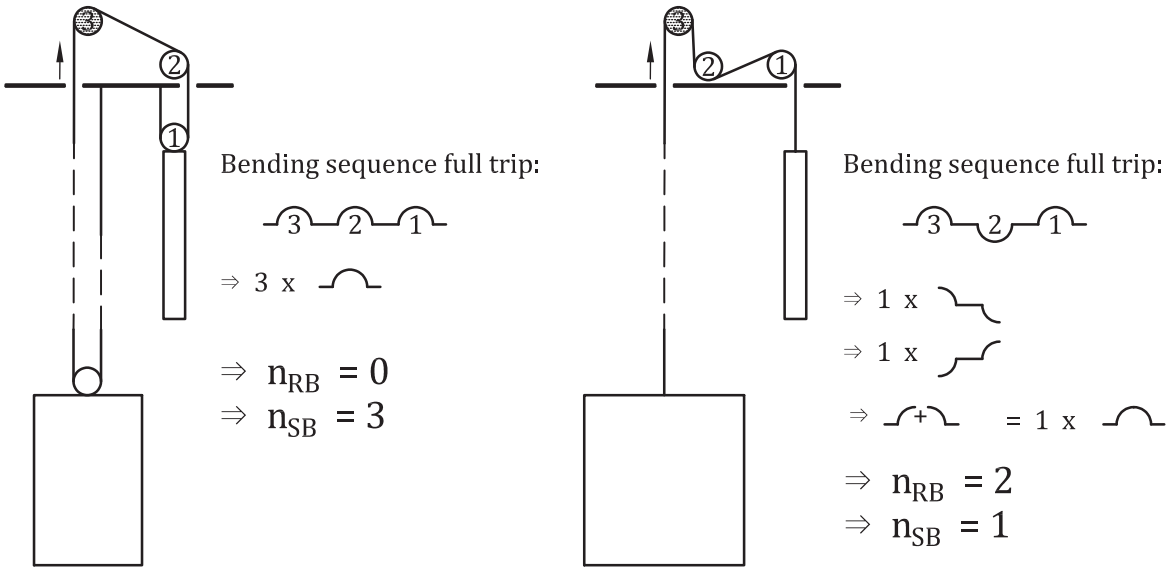


Figure 33 — Examples of full trip bending sequences and the resulting number of simple bends n_{SB} and reverse bends n_{RB} to be considered for the most stressed suspension means section

The maximum allowed number of trips for the lift application shall be calculated in accordance with Formulae (6) to (8):

$$N_{\text{lift}} = \frac{N}{1{,}5}, \text{or} \tag{6}$$

$$N_{\text{lift}} = N - 600\,000 \tag{7}$$

whichever is smaller,

with:

$$N = \frac{1}{\left[\left(\frac{n_{\text{SB}}}{N_{\text{SB}}}\right) + \left(\frac{n_{\text{RB}}}{N_{\text{RB}}}\right)\right]} \tag{8}$$

where

N_{lift} is the maximum number of allowed trips for the lift application;

N is the calculated number of trips;

n_{SB} is the number of simple bends experienced by the most stressed suspension means section during one full trip of the lift;

n_{RB} is the number of reverse bends experienced by the most stressed suspension means section during one full trip of the lift;

N_{SB} is the number of simple bends tested as per ISO 8100-2:2025, 4.13.5;

N_{RB} is the number of reverse bends tested as per ISO 8100-2:2025, 4.13.5.

If different sheaves and pulleys are used in the lift system, either the sheave or the pulley with the smallest D/d ratio shall be considered, or individual N_{SB1}, N_{SB2}, ... and N_{RB1}, N_{RB2}, values for each D/d ratio shall be combined using the Palmgren-Miner rule [see Formula (9)]:

$$N = 1 \,/\, [(n_{\text{SB1}}/N_{\text{SB1}}) + (n_{\text{SB2}}/N_{\text{SB2}}) + \ldots\ldots + (n_{\text{RB1}}/N_{\text{RB1}}) + (n_{\text{RB2}}/N_{\text{RB2}}) + \ldots\ldots] \tag{9}$$

4.5.2.3.4 Suspension means physical strength monitoring

The physical strength monitoring systems, if provided, shall be applied to each suspension means or the entire suspension system of the lift.

The monitoring system shall:

a) measure the physical parameter(s) of the installed elastomeric coated suspension means in order to determine the strength degradation as the elastomeric coated suspension means fatigues;

b) based on the physical measurement(s), the device determines when the RBF of any suspension means is reduced to its limit (60 % or 80 % as per Table 13);

c) either continuously measure the entire suspension means or, for those systems that determine the location of the fatigued parts of the suspension, keep a record of all suspension sections and their respective degradation;

To correlate the measured physical parameter(s) to residual strength, the elastomeric coated suspension means shall be fatigued in accordance with the method described in ISO 8100-2:2025, 4.13.5.

4.5.2.3.5 Diameter reduction of steel wire ropes d<6 mm

The tool applied to measure the diameter reduction shall be verified in accordance with ISO 8100-2:2025, 4.13.5. The tests shall prove that at a diameter reduction of 6 % related to the nominal diameter the RBF is not less than 80 % of the MBF.

4.5.2.4 Connection between suspension means and terminations

4.5.2.4.1 The junction between the suspension means and its termination, shall be able to resist at least 80 % of the MBF of the suspension means.

4.5.2.4.2 The ends of steel wire ropes shall be fixed to the car, counterweight or balancing weight, or suspension points of the dead parts of reeved ropes by one of the following means:

a) asymmetric wedge sockets, in accordance with EN 13411-6:2004+A1:2008;

b) symmetric wedge sockets, in accordance with EN 13411-7:2021;

c) ferrule secured eyes in accordance with EN 13411-3:2022, in case an eyebolt is used to connect these terminations to fixing plates, it shall be made of a single piece and without a collar;

d) swage terminals in accordance with EN 13411-8:2011;

e) terminations verified in accordance with ISO 8100-2:2025, 4.13.3.

4.5.2.4.3 The eyebolt connecting the termination as per 4.5.2.4.2 a), 4.5.2.4.2 b), 4.5.2.4.4 and 4.5.2.4.5 to the car, counterweight or balancing weight, or suspension points of reeved ropes, shall withstand a force of at least 80 % of the MBF of the suspension means after the fatigue test, and shall be tested in accordance with EN 13411-6:2004+A1:2008, 6.2.5 or ISO 8100-2:2025, 4.13.3.5.

4.5.2.4.4 The ends of elastomeric coated steel wire ropes and elastomeric coated traction belts shall be fixed with terminations in accordance with the following:

a) terminations shall be made of metal and of self-tightening wedge style;

b) to allow checking the correct matching of the interacting component parts, the socket body and the wedge shall be marked with:

   1) the identification of the elastomeric coated steel wire rope/belt compatible with the termination;

   2) the highest permissible MBF of the elastomeric coated steel wire rope/belt;

   3) the minimum height of the characters shall be 2,5 mm;

c) for elastomeric coated suspension means which do not apply a U-bolt wire rope grip, the wedge shall be protected against falling out of the socket in case of a slack suspension situation.

d) the terminations shall be verified in accordance with ISO 8100-2:2025, 4.13.3

4.5.2.4.5 The ends of elastomeric coated timing belts shall:

a) be fixed with terminations as per 4.5.2.4.4; or

b) be clamped with positive secured terminations in accordance with the following:

   — at least 7 teeth shall be clamped; and

   — the positive secured termination fatigue lifetime shall be verified in accordance with ISO 8100-2:2025, 4.13.3;

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

4.5.2.4.7 The ends of each chain shall be fixed to the car, 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 MBF of the chain.

4.5.3 Suspension means traction/transmission

4.5.3.1 Car loading condition

Suspension means traction/transmission shall be such that the car shall be maintained at floor level without slip when loaded to 125 % of rated load, as per 4.4.2.

a) for steel wire ropes with steel/cast iron traction sheaves, steel wire ropes with elastomeric coated traction sheave, steel wire ropes with non-metallic replaceable traction sheave groove liners, elastomeric coated steel wire ropes and elastomeric coated traction belts this shall be calculated in accordance with ISO 8100-2:2025, 4.11;

b) for elastomeric coated timing belts and sprockets the tooth strength shall be verified in accordance with ISO 8100-2:2025, 4.13.6.3.

4.5.3.2 Emergency braking condition

When the braking system is activated as per 4.9.2.2.1.1, suspension means traction/transmission shall be such that, the car, empty and with rated load, shall be decelerated to a speed which is lower or equal than the speed for which the buffers are designed, including reduced stroke buffer.

a) for steel wire ropes with steel/cast iron traction sheaves, steel wire ropes with elastomeric coated traction sheave, steel wire ropes with non-metallic replaceable traction sheave groove liners, elastomeric coated steel wire ropes and elastomeric coated traction belt this shall be calculated in accordance with ISO 8100-2:2025, 4.11;

b) for elastomeric coated timing belts and sprockets the tooth strength shall be verified in accordance with ISO 8100-2:2025, 4.13.6.3.

4.5.3.3 Car/counterweight stalled condition

If the car or the counterweight is stalled in any position of the travel:

a) for steel wire ropes with steel/cast iron traction sheaves, steel wire ropes with elastomeric coated traction sheave, steel wire ropes with non-metallic replaceable traction sheave groove liners, elastomeric coated steel wire ropes and elastomeric coated traction belts:

   1) the suspension means shall slip on the traction sheave and this shall be calculated in accordance with ISO 8100-2:2025, 4.11; or

   2) the slack suspension means shall be checked by an electric safety device as per 4.11.2. The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)];

b) for elastomeric coated timing belts and sprockets, the slack suspension means shall be checked by an electric safety device as per 4.11.2. The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)].

4.5.4 Winding up of ropes for positive drive lifts

4.5.4.1 The drum, which can be used in the conditions laid down in 4.9.2.1.1 b), shall be helically grooved and the grooves shall be suited to the ropes used.

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

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

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

4.5.5 Distribution of load between the suspension means

4.5.5.1 An automatic device shall be provided for equalizing the tension of:

a) suspension means, at least at one of their ends;

b) chains or elastomeric coated timing belts engaging with sprockets, at both of their ends.

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

4.5.5.3 Protection in the case of abnormal extension or slack suspension means shall be provided as follows:

a) in the case of two suspension means of the car, the abnormal relative extension of one suspension means shall be checked by an electric safety device as per 4.11.2;

b) for positive drive lifts and hydraulic lifts, the slack suspension means shall be checked by an electric safety device as per 4.11.2.

The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. For hydraulic lifts with two or more jacks, this requirement shall apply for each suspension set.

4.5.5.4 The devices for adjusting the length of suspension means shall be made in such a way that these devices cannot work themselves loose after adjustment.

4.5.5.5 For chains or elastomeric coated timing belts in the case of multiple return sprockets on the same shaft, these sprockets shall be able to rotate independently.

4.5.6 Compensation means

4.5.6.1 Compensation for the weight of the suspension means, in order to ensure adequate traction or hoisting motor power, is permitted. If provided it shall be in accordance with the following.

a) For rated speeds exceeding 1,75 m/s, compensation means without tensioning shall be guided above the loop in the straight vertical portion of the compensation means.

b) For rated speeds not exceeding 3,00 m/s, if compensation means are provided only chains, belts, steel wire ropes, elastomeric coated ropes or elastomeric coated belts shall be used.

c) For rated speeds exceeding 3,00 m/s, steel wire ropes, elastomeric coated ropes or elastomeric coated belts shall be provided as compensation means.

d) For rated speed exceeding 3,50 m/s, an anti-rebound device shall be provided and the operation of the anti-rebound device shall be checked by an electric safety device as per 4.11.2.

4.5.6.2 Where steel wire ropes, elastomeric coated ropes or elastomeric coated belts are provided as compensation means, the following shall apply:

a) they shall be in accordance with:

   — 4.5.1.2.1 a) for steel wire ropes;

   — 4.5.1.2.2 for elastomeric coated steel wire ropes;

   — 4.5.1.2.3 for elastomeric coated belts;

b) the terminations and junctions to the terminations shall be in accordance with 4.5.2.4.1, 4.5.2.4.2, 4.5.2.4.3 and 4.5.2.4.4.

c) tensioning pulleys shall be used;

d) the ratio between the pitch diameter of the tensioning pulleys and the nominal diameter of the compensation means shall be:

   — at least 30 for steel wire ropes;

   — at least 24 for elastomeric coated steel wire ropes;

   — at least 40 for elastomeric coated belts;

   — at least 150 for elastomeric coated belts with CFRP tension member

e) tensioning pulleys shall be protected as per 4.5.7;

f) the tension shall be provided by gravity;

g) the tension shall be checked by an electric safety device as per 4.11.2;

h) the tensioning device shall withstand the jumping situations during application of the machine brakes, or safety device operation;

i) elastomeric coated compensation means shall have discarding monitoring means as per 4.5.2.3.

4.5.6.3 Compensation means and their terminations and junction in-between, shall withstand:

— with a safety factor of 5 for steel wire ropes, belts, and chains; and

— with safety factors as per 4.5.2.2.3 for elastomeric coated compensation means,

all static forces to which the means is subjected, including the maximum suspended weight of the compensation means, with the car or counterweight at the top of its travel, and one-half total weight of tension pulley assembly, where provided.

4.5.7 Protection for sheaves, pulleys and sprockets

4.5.7.1 For sheaves, pulleys and sprockets, overspeed governors, tension weight pulleys, devices shall be provided in accordance with Table 14:

Table 14 — Protection for sheaves, pulleys and sprockets

Location of sheaves, pulleys and sprockets			Devices preventing body injury	devices preventing the introduction of objects between ropes/ belts/ chains and pulleys/sprockets
At the car	on the roof		x	x
	under the floor			x
On the counterweight/balancing weight				x
In machine and pulley rooms			x[a]	x[b]
In the well	Headroom	above car	x[a]	
		beside car	x	
	Between pit and headroom			x[b]
	Pit		x[a]	x

x Devices shall be provided.

[a] Devices shall be nip guards as a minimum, preventing accidental access to areas where ropes/ belts/chains enter or leave the sheaves, pulleys and sprockets (nip guards, see Figure 34).

[b] Required only if the ropes/belts/chains are entering the traction sheave and the pulley/sprocket horizontally and at any angle above the horizontal, up to a maximum of 90°.

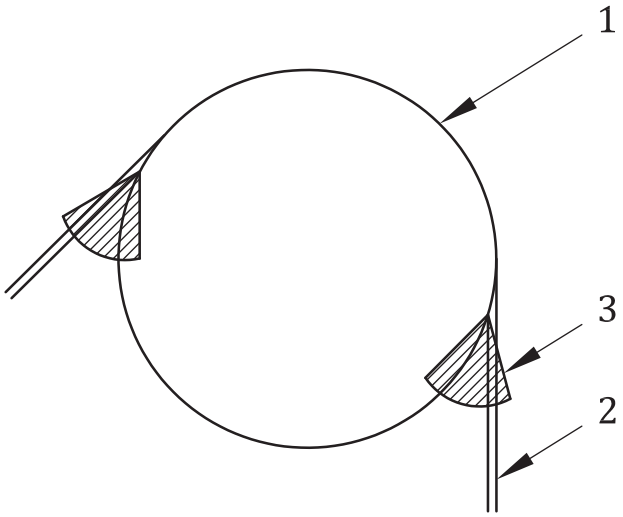
Table 14 *(continued)*

Location of sheaves, pulleys and sprockets		Devices preventing body injury	devices preventing the introduction of objects between ropes/ belts/ chains and pulleys/sprockets
Jack	Extending upwards	x[a]	
	Extending downwards		x[b]
	With mechanical synchronizing means	x	x

x Devices shall be provided.

[a] Devices shall be nip guards as a minimum, preventing accidental access to areas where ropes/ belts/chains enter or leave the sheaves, pulleys and sprockets (nip guards, see Figure 34).

[b] Required only if the ropes/belts/chains are entering the traction sheave and the pulley/sprocket horizontally and at any angle above the horizontal, up to a maximum of 90°.



Key

1 pulley, sprocket

2 suspension / compensation means or overspeed governor rope

3 nip guard

Figure 34 — Example of nip guard

The devices used shall be constructed using partial cover, transparent cover or perforated cover in accordance with ISO 13857:2019, Table 4, and shall not hinder visual examination, maintenance operation and shall enable recognition of any rotational movement.

The dismantling shall be necessary only in the following cases:

a) replacement of a rope/belt/chain;

b) replacement of a pulley/sprocket;

c) re-cutting of the grooves.

The devices used shall resist a minimum force of 300 N from all directions.

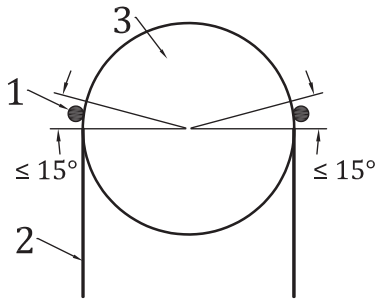
4.5.7.2 Retainers shall be provided to prevent the ropes/belts/chains from leaving the grooves, contact surface of pulleys and sprockets if slack.

The retainers shall be located at maximum 15° from the points where the ropes/belts/chains enter and leave the pulleys/sprockets, see Figure 35 a).

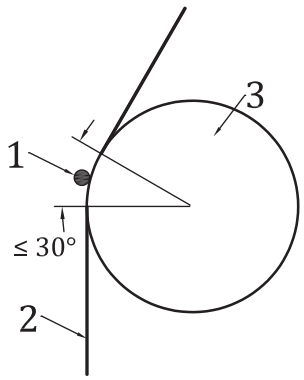
Where the angle of wrap is equal to, or less than, 30° one retainer positioned centrally is sufficient, see Figure 35 b).

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° at least one intermediate retainer shall be provided, see Figure 35 c). This shall not apply for double wrap solutions, see Figure 35 d).

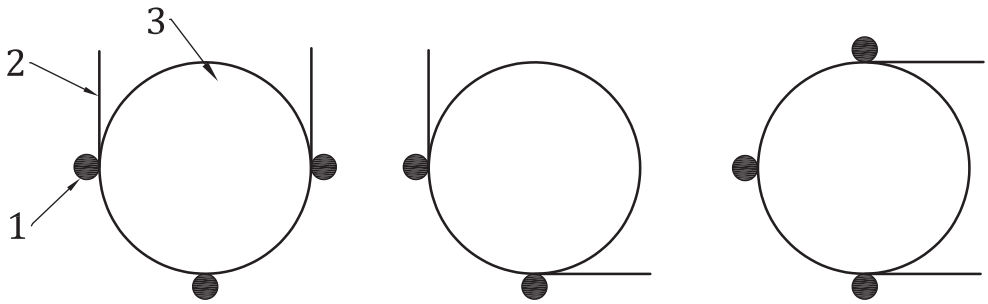
Pulleys for flat belts shall be provided with axial retainers to prevent the belt from leaving of the pulley.



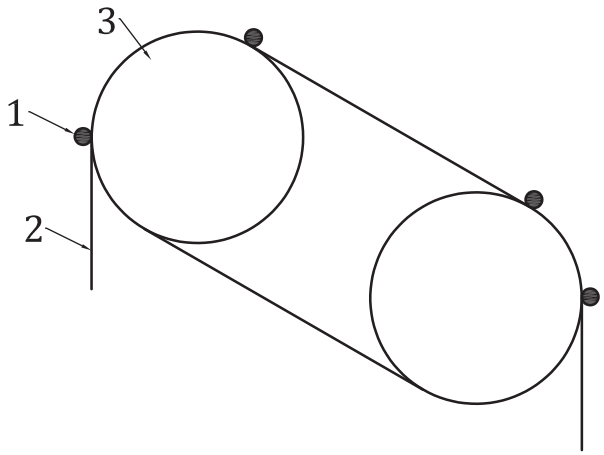
a) 15° tolerance



b) Angle of wrap less than 30°



c) Retainer below the pulley axis



d) Double wrap

Key

1	retainer
2	rope, belt, chain
3	pulley, sprocket

Figure 35 — Examples of arrangements of rope retainers

4.5.8 Traction sheaves, pulleys and sprockets

Traction sheaves, pulleys and sprockets of all suspension means located in the well including those fixed on the car or counterweight, shall meet the following.

a) There shall be retaining devices to prevent traction sheaves, pulleys and sprockets from falling in the event of a mechanical failure (e.g. bearing failure). These devices shall be able to support the weight of the traction sheave, pulley and sprockets and the suspended loads.

b) There shall be mechanical interlocking in axial direction between the support structure and the axle of pulleys and sprockets. If rolling bearing(s) are stuck, this locking shall prevent:

   1) separation of the pulleys and sprockets from car or counterweight (balancing weight) frame;

   2) separation of suspension means from car or counterweight (balancing weight) frame;

   3) loss of pulleys and sprockets axial positioning between the support structure and the axle.

c) To reduce high axial forces in case of bearing failure, the distance (gap) between the pulley and supporting structure shall be:

   1) smaller than half of the bearing rolling element to prevent a wedge effect, or

   2) at least 10 % larger than the bearing roller element to freely pass through the gap.

d) Where traction sheaves, pulleys/sprockets are placed in the vertical projection of the car, then clearances in the headroom shall be in accordance with 4.2.5.7.

e) Where non-metallic pulleys are used, they shall be marked with the following information:

   — the name of the manufacturer;

   — its identification;

   — the week and year of its manufacturing in the format YYYY-WW, where YYYY is the year and WW is the week;

   — the minimum height of the characters shall be 2,5 mm.

4.5.9 Marking of suspension means and compensation means

4.5.9.1 Suspension means and compensation means shall have markings, directly on the coating or on a tag indicating:

— the name of the manufacturer;

— its identification;

— the nominal diameter of the steel wire rope or tension member;

— the wire tensile strength grade of the steel wires;

— the MBF;

— the minimum height of the characters shall be 2,5 mm.

4.5.9.2 If tag(s) are provided they shall be fixed to the end termination after installation of the suspension means and compensation means.

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

4.6.1 Application of protections means

4.6.1.1 Protection means for traction lifts and positive drive lifts

For traction lifts and positive drive lifts, the following protection means in Table 15 shall be provided.

Table 15 — Protection means for traction and positive drive lifts

Hazardous situation	Protection means
Free fall and excessive speed in down direction of car	Car safety gear (4.6.2.1) tripped by an overspeed governor (4.6.2.2.1) or electrical means (4.6.2.2.5)
Free fall of counterweight or balancing weight in the case of 4.2.5.4	Counterweight or balancing weight safety gear (4.6.2.1) tripped by an overspeed governor (4.6.2.2.1), or electrical means (4.6.2.2.5), or for rated speeds not exceeding 1,00 m/s: — tripped by breakage of suspension means (4.6.2.2.2); or — tripped by safety rope (4.6.2.2.3).
Excessive speed in up direction (traction lifts only)	Ascending car overspeed protection means (4.6.6)
Unintended car movement with open doors	Protection against unintended car movement (4.6.7)

4.6.1.2 Protection means for hydraulic lifts

For hydraulic lifts, protection against unintended car movement as per 4.6.7 and relevelling as per 4.12.1.1.3 shall be provided. In addition, at least one combination of devices and their actuation, shall be provided in accordance with Table 16.

The electrical anti-creep system (see 4.12.1.10) as precaution against creeping (see Table 16) shall only be used, as one of the options, where the landing doors are driven by the car door as per 4.3.9.3.4.

Table 16 — Protection means for hydraulic lifts

Type of lifts	Alternative combinations to be selected	Precautions against creeping in addition to re-levelling (4.12.1.1.3)		
		Tripping of safety gear by downward movement of the car (4.6.2.2.4)	Pawl device (4.6.5)	Electrical anti-creep system (4.12.1.10)
Direct acting lifts	Safety gear (4.6.2.1), tripped by overspeed governor (4.6.2.2.1) or electrical means (4.6.2.2.5)	X	X	X
	Rupture valve (4.6.3)		X	X
	Restrictor (4.6.4)		X	
Indirect acting lifts	Safety gear (4.6.2.1), tripped by overspeed governor (4.6.2.2.1) or electrical means (4.6.2.2.5)	X	X	X
	Rupture valve (4.6.3) plus safety gear (4.6.2.1) tripped by breakage of suspension means (4.6.2.2.2) or by safety rope (4.6.2.2.3)	X	X	X
	Restrictor (4.6.4) plus safety gear (4.6.2.1) tripped by breakage of suspension means (4.6.2.2.2) or by safety rope (4.6.2.2.3)	X	X	

4.6.2 Safety gear and its tripping means

4.6.2.1 Safety gear

4.6.2.1.1 General provisions

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

A safety gear which has the additional function of operating in the upward direction may be used in accordance with 4.6.6.

4.6.2.1.1.2 The safety gear shall be verified in accordance with ISO 8100-2:2025, 4.3.

4.6.2.1.1.3 A data plate shall be fixed on the safety gear, indicating:

a) the name of the manufacturer;

b) its identification;

c) the limits of the applicable masses;

d) the maximum tripping speed;

e) the minimum height of the characters shall be 2,5 mm.

4.6.2.1.2 Conditions of use for different types of safety gear

4.6.2.1.2.1 The 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.

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

4.6.2.1.2.3 The safety gear of the counterweight or balancing weight shall be of the progressive type, if the rated speed exceeds 1,00 m/s. Otherwise, the safety gear may be of the instantaneous type.

4.6.2.1.3 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 1,0 g_n.

4.6.2.1.4 Release

4.6.2.1.4.1 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.

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

a) by means defined for emergency operation (4.9.2.3 or 4.9.3.9); or

b) by application of procedures as described in the instructions [see 6.2.5 a)].

4.6.2.1.4.3 After the release of the safety gear, the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

4.6.2.1.5 Electrical checking

The retracted position of the car safety gear shall be checked by an electric safety device as per 4.11.2, mounted on the car. This device shall operate before or at the moment of safety gear operation.

4.6.2.1.6 Constructional conditions

4.6.2.1.6.1 Jaws or blocks of safety gears shall not be used as guide shoes.

4.6.2.1.6.2 If the safety gear is adjustable, the final setting shall be sealed in such a way to prevent re-adjustment without breaking the seal.

4.6.2.1.6.3 Accidental tripping of the safety gear shall be prevented by a clearance to guide rails [see 6.2.4 m)].

4.6.2.2 Means of tripping the safety gear

4.6.2.2.1 Tripping by overspeed governor

4.6.2.2.1.1 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) 0,80 m/s for instantaneous safety gears, except for the captive roller type; or

   2) 1,00 m/s for car safety gears of the captive roller type; or

   3) 1,50 m/s for counterweight or balancing weight safety gears of the captive roller type; or

   4) 1,50 m/s for progressive safety gear used for rated speeds not exceeding 1,00 m/s; or

   5) The value calculated in accordance with Formula (10) for progressive safety gear used for rated speeds exceeding 1,00 m/s.

$$v_{trip} = 1{,}25 \cdot v + \left(\frac{0{,}25}{v} \right) \quad (10)$$

where

v is the numerical value of the rated speed in metres per second

v_{trip} is the tripping speed expressed in metres per second

b) overspeed governors using only traction to produce the tripping force shall have grooves which:

   — have been submitted to an additional hardening process; or

   — have an undercut in accordance with ISO 8100-2:2025, 4.11.2.3.1;

c) the direction of rotation, corresponding to the operation of the safety gear in down direction, shall be marked on the overspeed governor;

d) the tensile force in the overspeed governor rope produced by the governor, when tripped, shall be at least the greater of the following two values:

   — twice that necessary to engage the safety gear; or

   — 300 N.

e) the maximum tripping speed of the overspeed governor in a free fall situation shall not exceed the maximum tripping speed of the safety gear.

4.6.2.2.1.2 Response distance

To ensure that the safety gear is activated before its maximum tripping speed is reached, the maximum distance corresponding to the movement of the overspeed governor rope between the activation points shall not exceed:

a) 250 mm for operating a progressive safety gear; and

b) 100 mm for operating an instantaneous safety gear.

4.6.2.2.1.3 Overspeed governor ropes

The rope of an overspeed governor shall satisfy the following conditions:

a) the overspeed governor shall be driven by a steel wire rope in accordance with ISO 4344:2022;

b) the MBF 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 ratio between the pitch diameter of the pulleys for the overspeed governor rope and the nominal rope diameter shall be at least 30;

d) the overspeed governor rope shall be tensioned by a tensioning weight. The tensioning weight or its pulley shall be guided;

e) 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.

4.6.2.2.1.4 Accessibility

If the overspeed governor is located in the well it shall:

a) be in accordance with 4.2.6.4.6; or

b) fulfil the following three conditions:

   1) the tripping of the overspeed governor as per 4.6.2.2.1.5 shall be effected by means of a remote control, except cableless, from outside the well, protected against involuntary operation;

   2) the overspeed governor shall be located:

      i) between 0,40 m and 2,00 m above the pit floor; or

      ii) within a horizontal distance of 0,60 m from the working area on the car roof;

   3) the overspeed governor shall return 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. This shall not influence the normal function of the overspeed governor.

4.6.2.2.1.5 Possibility of tripping the overspeed governor

It shall be possible to trip the overspeed governor manually.

If the overspeed governor is adjustable, the final setting shall be sealed in such a way to prevent re-adjustment without breaking the seal.

4.6.2.2.1.6 Electrical checking

The following shall be met:

a) An electric safety device as per 4.11.2 shall check that the speed up and down is:

   1) less or equal than the tripping speed of the overspeed governor for rated speeds not exceeding 1,0 m/s; or

   2) less than the tripping speed of the overspeed governor for rated speeds exceeding 1,0 m/s.

   This electric safety device shall be either on the overspeed governor or shall be a separate component.

b) if, after release of the safety gear (4.6.2.1.4), the overspeed governor does not automatically reset itself, the reset position of the overspeed governor shall be checked by an electric safety device as per 4.11.2;

c) the breakage and slackening of the overspeed governor rope shall be checked by an electric safety device as per 4.11.2.

4.6.2.2.1.7 Verification

The overspeed governor shall be verified in accordance with ISO 8100-2:2025, 4.4.

4.6.2.2.1.8 Marking

A data plate shall be fixed on the overspeed governor, indicating:

a) the name of the manufacturer;

b) its identification;

c) its tripping speed;

d) the minimum height of the characters shall be 2,5 mm.

4.6.2.2.2 Tripping by breakage of suspension means

When the safety gear is tripped by the breakage of the suspension means, the following shall apply:

a) the tensile force exerted by the actuating mechanism 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 without the need to enter the well during the test;

   To this end, a means shall be provided so that it is possible, while the car/counterweight/balancing weight is descending, to activate the safety gear by a loss of tension in the suspension means.

   Where the means provided is mechanical, the force required to operate it shall not exceed 400 N.

   NOTE It is acceptable for the equipment to operate the means to be stored within the well and moved outside when a test is performed.

d) the maximum activation distance of the tripping mechanism shall ensure that the safety gear is activated before its maximum tripping speed is reached.

4.6.2.2.3 Tripping by safety rope

When the safety gear is tripped by a safety rope, the following shall apply:

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 accordance with 4.6.2.2.1.3;

c) the rope shall be tensioned by gravity or by guided compression springs;

d) during the engagement of the safety gear, the safety rope and its terminations shall remain intact;

e) the breakage and slackening of the safety rope shall be checked by an electric safety device as per 4.11.2;

f) pulleys used for carrying the safety rope shall be mounted independently of any shaft or pulley assembly that carries the suspension means;

g) protection devices shall be provided as per 4.5.7.1:

h) the maximum activation distance of the tripping mechanism shall ensure that the safety gear is activated before its maximum tripping speed is reached.

4.6.2.2.4 Tripping by downward movement of the car

4.6.2.2.4.1 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 4.6.2.2.1.3, attached to the safety gear, shall be blocked with a force defined in 4.6.2.2.3 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) movement of the car for emergency operations in the up direction shall be possible;

e) the retracted position of the rope blocking mechanism shall be checked by an electric safety device as per 4.11.2. This electric safety device is permitted to be made inactive within the unlocking zone (4.3.8.1) by an electric safety device as per 4.11.2;

f) involuntary tripping of the safety gear by the rope in case of disconnection of the electric power supply during a downward movement of the car shall be prevented;

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.

4.6.2.2.4.2 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) movement of the car for emergency operation in the up direction shall be possible;

e) 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 shall be prevented;

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) an electric device shall prevent any normal movement of the car when the tripping lever is not in its extended position after normal stopping, the car door(s) shall be closed and the lift shall be taken out of operation;

h) the retracted position of the tripping lever shall be checked by an electric safety device as per 4.11.2. This electric safety device is permitted to be made inactive within the unlocking zone (4.3.8.1) by an electric safety device as per 4.11.2.

4.6.2.2.5 Tripping by electrical means

4.6.2.2.5.1 General

When the safety gear is tripped by electrical means the following shall apply:

The electrical means shall consist of:

— a speed monitoring element to detect the overspeed and/or free fall, and

— a tripping element to trip the safety gear.

The loss of the main power supply on its own shall not trip the safety gear until the car has stopped.

During emergency operation the electrical means shall be operational, even in case of the loss of the main power supply.

If the tripping element has been tripped due to the loss of the main power supply, it shall be possible to disengage the tripping element during emergency operations.

The electrical means shall be powered by an emergency supply.

4.6.2.2.5.2 Response time

The maximum response time of the speed monitoring element and the tripping element together, combined with the tripping speed as per 4.6.2.2.5.5, shall not cause the car or counterweight to reach a speed higher than the maximum tripping speed of the safety gear.

4.6.2.2.5.3 Accessibility

Inspection and maintenance of the speed monitoring element and the tripping element shall be possible from the machinery space, the car roof, through an inspection door (see 4.2.3) or from the pit.

It shall be possible to manually trigger the speed monitoring element.

If the speed monitoring element or the tripping element are located in the well the following conditions shall be fulfilled:

a) the tripping of the speed monitoring element shall be possible by remote control from outside the well, protected against involuntary operation;

b) after the release of the safety gear (4.6.2.1.4) the reset of the speed monitoring element and of the tripping element shall be automatic or by remote control from the outside of the well;

If the speed monitoring element is adjustable, the setting shall be sealed in such a way, that a modification will be detected.

4.6.2.2.5.4 Electrical checking

The following shall be met:

a) the speed monitoring element shall be provided with an electric safety device as per 4.11.2 which shall check that the speed up and down is:

   1) less or equal than the actuation means tripping speed for rated speeds not exceeding 1,0 m/s, or

   2) less than the actuation means tripping speed for rated speeds exceeding 1,0 m/s.

b) an electric safety device as per 4.11.2 shall check that the electrical actuation means is not in the position ready to trip the safety gear.

c) if the speed monitoring element is relying on information from a belt or tape the breakage or stretch shall be checked by an electric safety device as per 4.11.2.

4.6.2.2.5.5 Tripping speed

The triggering of the tripping element shall occur at a speed in accordance with 4.6.2.2.1.1 a).

Where acceleration detection is provided additionally, a minimum tripping speed as per 4.6.2.2.1.1 a) is permitted not to be applied.

4.6.2.2.5.6 Tripping element

The tripping force produced by the tripping element for the safety gear shall be at least twice the force necessary to engage the safety gear.

If the tripping force is relying on friction, the minimum and maximum friction force shall be considered for the application of the tripping element such as minimum or maximum speed, guide rail type and surface conditions.

The tripping element shall operate by guided compression springs or permanent magnets or stored electrical energy.

If the tripping element requires stored electrical energy to operate, the tripping element shall have a failure rate not exceeding SIL 3 failure rate. Additionally, the following conditions shall be fulfilled:

— the stored energy to operate the tripping element shall be monitored; and

— the connection between the electrical energy storage and the tripping element shall be also monitored; and

— the electrical energy storage shall be located at the tripping element location; and

— if the stored electrical energy is less than double that what is needed to operate the tripping element with the required force, the system shall cause the lift to stop at the next landing and after the stopping it shall activate the tripping element.

The tripping element shall be operated automatically at least once a month to verify its mechanical functioning.

If any failure is detected:

— an electric safety device as per 4.11.2 shall be operated;

— car and landing doors shall be closed or remain closed; and

— the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

Reset of the tripping element shall only be possible when the speed monitoring element is operational.

The tripping element shall always be able to trip the safety gear even after the safety gear is released and the reset of the tripping element is interrupted.

In case of multiple tripping elements, the triggering of a single tripping element shall automatically trip the other tripping elements without delay.

4.6.2.2.5.7 Design and verification

The speed monitoring element, including the related electric safety device, shall be in accordance with 4.11.2.4 with SIL 3 and 4.11.2.1.5.

The electrical part of the tripping element including monitoring of stored electrical energy and tripping capability shall be in accordance with 4.11.2.3 or 4.11.2.4 with SIL 3, and 4.11.2.1.5.

The tripping element shall be verified in accordance with ISO 8100-2:2025, 4.19

4.6.2.2.5.8 Marking

A data plate shall be fixed on the speed monitoring element, indicating:

a) the name of the manufacturer;

b) its identification;

c) the tripping speed for which it has been adjusted;

d) the minimum height of the characters shall be 2,5 mm.

A data plate shall be fixed on the tripping element, indicating:

a) the name of the manufacturer;

b) its identification;

c) the minimum tripping force of the tripping element;

d) the minimum height of the characters shall be 2,5 mm.

The data plate information is permitted to be combined in a single data plate.

4.6.3 Rupture valve

4.6.3.1 The rupture valve shall be capable of stopping the car in downward movement, and of maintaining it stationary. The rupture valve shall be tripped at the latest when the speed reaches a value equal to rated speed downward, v_d, plus 0,30 m/s.

The rupture valve shall be selected so that the average retardation, a, lies between 0,2 g_n and 1,0 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 Formula (11):

$$a = \frac{Q_{\max} \cdot r}{6 \cdot A \cdot n \cdot t_{\mathrm{d}}} \tag{11}$$

where

a is the average retardation;
A is the area of jack where pressure is acting, expressed in square centimetres;
N is the number of parallel acting jacks with one rupture valve;
$Q_{\max}$ is the maximum flow, expressed in litres per minute;
R is the reeving factor;
t_{d} is the braking time, expressed in seconds.

4.6.3.2 The rupture valve shall be located:

a) between 0,40 m and 2,00 m above the pit floor; or

b) within a horizontal distance of 0,60 m from the working area on the car roof.

4.6.3.3 The rupture valve shall be:

a) integral with the cylinder;

b) directly and rigidly flange-mounted;

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 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, shall not be used between the cylinder and the rupture valve.

4.6.3.4 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 prevent the floor of the car from inclining by more than 5 % from its horizontal position.

4.6.3.5 The housing of the rupture valve shall be calculated as the cylinder as per 4.9.3.2.1.1.

4.6.3.6 If the closing speed of the rupture valve is controlled by a restricting device, a filter shall be located adjacent to this device.

4.6.3.7 There shall be, in the machinery space, a means which can be manually operated from outside of the well, 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 neutralize the safety devices adjacent to the jack.

4.6.3.8 The rupture valve shall be verified in accordance with ISO 8100-2:2025, 4.9.

4.6.3.9 A data plate shall be fixed on the rupture valve, indicating:

a) the name of the manufacturer;

b) its identification;

c) the tripping flow for which it has been adjusted.

4.6.4 Restrictors

4.6.4.1 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 downward, v_d, by more than 0,30 m/s.

4.6.4.2 The restrictor shall be located:

a) between 0,40 m and 2,00 m above the pit floor; or

b) within a horizontal distance of 0,60 m from the working area on the car roof.

4.6.4.3 The restrictor shall be:

a) integral with the cylinder;

b) directly and rigidly flange-mounted;

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 shall not be used between the cylinder and the restrictor.

4.6.4.4 The housing of the restrictor shall be calculated as the cylinder as per 4.9.3.2.1.1.

4.6.4.5 In the machinery space, there shall be a means which can be manually operated from outside of the well, 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 neutralize the safety devices adjacent to the jack.

4.6.4.6 Only the one-way restrictor where mechanical moving parts are used shall be verified in accordance with ISO 8100-2:2025, 4.9.

4.6.4.7 A data plate shall be fixed on the one-way restrictor where mechanical moving parts are used (4.6.4.6), indicating:

a) the name of the manufacturer;

b) its identification;

c) the tripping flow for which it has been adjusted;

d) the minimum height of the characters shall be 2,5 mm.

4.6.5 Pawl device

4.6.5.1 The pawl device shall operate only in the downward direction, and be capable of stopping the car, with rated load, and maintaining it stationary on fixed stops:

a) for lifts provided with a restrictor or one-way restrictor: from a speed of v_d + 0,30 m/s; or

b) for all other lifts: from a speed equal to 115 % of the downward rated speed, v_d.

4.6.5.2 At least one electrically retractable pawl shall be provided, designed in its extended position to stop the downwards moving car against fixed supports.

4.6.5.3 For each landing, supports shall be provided to prevent the car from sinking below the lower end of the unlocking zone.

4.6.5.4 The movement of the pawl(s) to the extended position shall be effected by guided compression spring(s) and/or gravity.

4.6.5.5 The supply to the electric retraction device shall be interrupted when the lift machine is stopped.

4.6.5.6 The design of the pawl(s) and supports shall be such that, whatever the position of the pawl(s), they cannot stop the car and cause any damage during the upward movement.

4.6.5.7 Buffers of the following types shall be incorporated in the pawl device or in the fixed supports:

a) energy accumulation type buffers as per 4.8.1.5 and 4.8.2.1; or

b) energy dissipation type buffers as per 4.8.2.2.

4.6.5.8 When several pawls are provided, all pawls shall engage on their respective supports, even in the case of disconnection of the electrical power supply during a downward movement of the car.

4.6.5.9 The retracted position of the pawl shall be checked by an electric safety device as per 4.11.2. This electric safety device is permitted to be made inactive within the unlocking zone (4.3.8.1) by an electric safety device as per 4.11.2.

4.6.5.10 The pawl device shall be checked electrically in the extended position when the car stops.

If the pawl device is not in the extended position:

a) an electric device as per 4.11.2.2, shall prevent the opening of the doors and automatic operation;

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.

The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

4.6.5.11 If energy dissipation buffers [4.6.5.7 b)] are used, the normal extended position of the buffer shall be checked by an electric safety device as per 4.11.2. This electric safety device is permitted:

a) to act only on the equipment controlling the supply to the lift machine as per 4.9.3.4.3; or

b) to be made inactive within the unlocking zone (4.3.8.1) by an electric safety device as per 4.11.2.

4.6.6 Ascending car overspeed protection means

4.6.6.1 The means, comprising speed monitoring and speed reducing elements, shall detect overspeed of the ascending car (see 4.6.6.10) and shall cause the car to stop, or shall at least reduce its speed to that for which the counterweight buffer is designed. The means shall be active in:

a) automatic operation;

b) emergency operation unless the brake is released as per 4.9.2.3.9;

c) emergency electrical operation unless there is a direct visual observation of the lift machine or the speed is limited by other means to less than the speed to that for which the counterweight buffer is designed;

c) inspection operation.

4.6.6.2 The means shall be capable of performing as required in 4.6.6.1 without assistance from any lift component that controls the speed or retardation, or stops the car during automatic operation, unless there is built-in redundancy and correct operation is self-monitored.

In the case of using the machine brake, self-monitoring shall be in accordance with 4.9.2.2.2.8.

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.

4.6.6.3 The means shall not allow a retardation of the empty car in excess of 1,0 g_n during the stopping phase.

4.6.6.4 The means shall act on one of the following:

a) the car;

b) the counterweight;

c) the suspension or compensation steel wire ropes;

d) the traction sheave;

e) the same shaft as the traction sheave, provided that the shaft is only statically supported in two points.

4.6.6.5 In case of speed reducing elements as per:

a) 4.6.6.4 a), b) or c), the retracted position of the speed reducing elements shall be checked by an electric safety device as per 4.11.2;

b) 4.6.6.4 d) or e), the release of the speed reducing elements shall be monitored as per 4.9.2.2.2.3 g).

4.6.6.6 The release of the means shall not require access to the well.

4.6.6.7 When the means has been activated or the self-monitoring has indicated a failure of the speed reducing element of the means, the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

4.6.6.8 After its release, the means shall be in a condition to operate.

4.6.6.9 If any part of the means requires energy other than guided compression springs to operate, the absence of energy shall cause the lift to stop and keep it stopped.

4.6.6.10 The speed monitoring element of the lift, which causes the ascending car overspeed protection means to actuate, shall be, either:

a) an overspeed governor as per 4.6.2.2.1; or

b) a device in accordance with;

1) 4.6.2.2.1.1 a) or 4.6.2.2.1.6 regarding the tripping speed;

2) 4.6.2.2.1.2 regarding the response time;

3) 4.6.2.2.1.4 regarding accessibility;

4) 4.6.2.2.1.5 regarding the possibility of tripping;

5) 4.6.2.2.1.6 b) regarding the electrical checking;

6) 4.6.2.2.1.6 a) regarding the electrical actuation;

7) 4.6.2.2.1.3 a), 4.6.2.2.1.3 b), 4.6.2.2.1.3 e) and 4.6.2.2.1.6 c) when the speed monitoring is directly linked by a rope, belt or chain.

c) a speed monitoring element as per 4.6.2.2.5.

4.6.6.11 The ascending car overspeed protection means shall be verified in accordance with ISO 8100-2:2025, 4.7.

4.6.6.12 A data plate shall be fixed on the ascending car overspeed protection means, indicating:

a) the name of the manufacturer;

b) its identification;

c) the actual tripping speed for which it has been adjusted;

d) the minimum height of the characters shall be 2,5 mm.

4.6.7 Protection against unintended car movement

4.6.7.1 Lifts shall be provided with a means to prevent or stop unintended car movement away from the landing, where a fault of the lift machine (excluding traction sheave, sudden loss of traction, flexible hoses, steel piping and cylinder) or drive control system causes the lift to move unintentionally with the landing door not in the locked position and the car door not in the closed position.

No detection of the unintended car movement needs to be provided in lifts without levelling, re-levelling and preliminary operations with doors open as per 4.12.1.4, if the stopping element is the machine brake as per 4.6.7.3 and 4.6.7.4.

Any slip due to the traction conditions at unintended movement stopping shall be taken into account for calculation and or verification of the stopping distance.

4.6.7.2 The means shall detect unintended movement of the car, cause the car to stop, and keep it stopped.

4.6.7.3 The means shall be capable of performing as required in 4.6.7.2 without assistance from any lift component that, controls the speed or retardation, stops the car or keeps it stopped during automatic operation, unless there is built-in redundancy and correct operation is self-monitored.

In the case of using the machine brake, self-monitoring shall be in accordance with 4.9.2.2.2.8.

In the case of using two electrically commanded hydraulic valves operating in series for slowing and stopping in automatic operation, self-monitoring implies separate verification of correct opening or closing of each valve under the empty car static pressure.

4.6.7.4 The stopping element of the means shall act on:

a) the car;

b) the counterweight;

c) steel wire as suspension or compensation means;

d) the traction sheave;

e) the same shaft as the traction sheave, provided that the shaft is only statically supported in two points; or

f) the hydraulic system (including the motor/pump in up direction by isolation of the electrical supply).

The stopping element of the means, or the means keeping the car stopped may be the same as those used for:

— preventing overspeed in down direction;

— preventing ascending car overspeed (4.6.6).

The stopping elements of the means may be different for the downward direction and for the upward direction.

4.6.7.5 The means shall stop the car in a distance under the following conditions (see Figure 36):

a) the stopping distance shall not exceed 1,20 m from the landing where the unintended car movement has been detected;

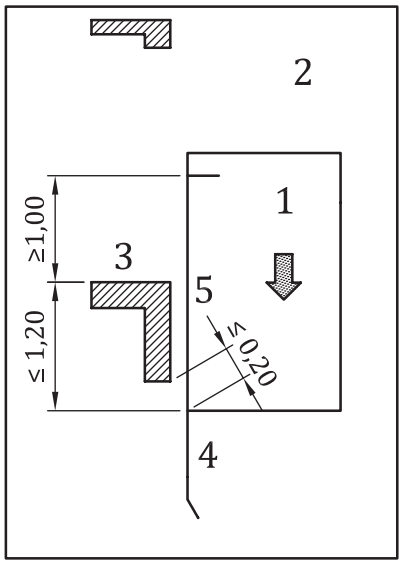
b) the vertical distance between the landing sill and the lowest part of the car apron shall not exceed 0,20 m;

c) the distance between the car sill and the surface below the landing sill facing the car entrance shall not exceed 0,20 m as per Figure 36 a;

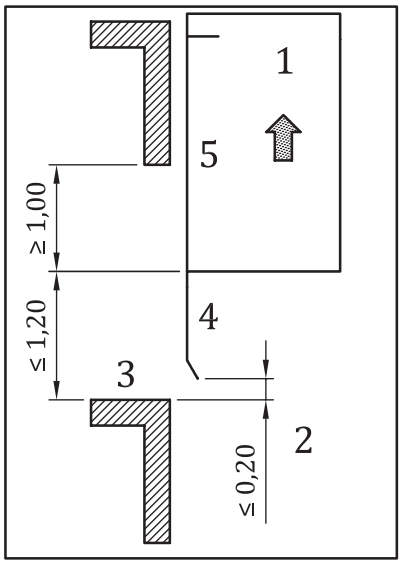
d) the vertical distance from the car sill to the landing door lintel, and from the landing sill to the car door lintel shall not be less than 1,00 m.

These values shall be obtained with any load in the car, up to rated load, moving away from a standstill position at landing level.

Dimensions in metres



a) Downward movement



b) Upward movement

Key

1	car
2	well
3	landing
4	car apron
5	car entrance

Figure 36 — Unintended car movement — Downward and upward movement

4.6.7.6 During the stopping phase, the stopping element of the means shall not allow a retardation of the car in excess of

— 1,0 g_n for unintended movements in the upward direction with an empty car;

— the values accepted for devices protecting against free fall in the downward direction.

4.6.7.7 The unintended movement of the car shall be detected by an electric safety device as per 4.11.2 at the latest when the car leaves the unlocking zone (4.3.8.1).

4.6.7.8 In case of stopping elements as per:

a) 4.6.7.4 a), b) or c), the retracted position of the stopping element(s) shall be checked by an electric safety device as per 4.11.2;

NOTE This can be common to the switching device of 4.6.7.7.

b) 4.6.7.4 d) or e), the release of the stopping element(s) shall be monitored as per 4.9.2.2.2.3 g);

c) 4.6.7.4 f), the stopping element(s) shall be monitored as per 4.6.7.3.

4.6.7.9 When the means has been activated or the self-monitoring has indicated a failure of the stopping element of the means, the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

4.6.7.10 The release of the means shall not require access to the well.

4.6.7.11 After its release, the means shall be in condition to operate.

4.6.7.12 If any part of the means requires energy other than guided compression springs to operate, the absence of energy shall cause the lift to stop and keep it stopped.

4.6.7.13 The unintended car movement with open doors protection means shall be verified in accordance with ISO 8100-2:2025, 4.8.

4.6.7.14 A data plate shall be fixed on the unintended movement protection means, either for the complete system or subsystems in accordance with ISO 8100-2:2025, 4.8.1, indicating:

a) the name of the manufacturer;

b) its identification;

c) the minimum height of the characters shall be 2,5 mm.

4.7 Guide rails

4.7.1 Guiding of the car, counterweight or balancing weight

4.7.1.1 The car, counterweight or balancing weight shall each be guided by at least two steel guide rails.

4.7.1.2 Guide rails for the car, and for the counterweight or balancing weight with safety gear shall be in accordance with ISO 8100-33:2022.

4.7.1.3 Guide rails for counterweights or balancing weights without safety gear shall be in accordance with ISO 8100-33:2022, or shall be made of formed sheet metal.

4.7.1.4 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 can be released shall be prevented.

4.7.1.5 For guide rail fixings containing non-metallic elements, the failure of these elements shall be taken into account for calculation of permissible deflections.

4.7.2 Forces and load cases

4.7.2.1 General provisions

4.7.2.1.1 The guide rails, their joints and attachments shall withstand the 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) the stresses on the guide rails shall not exceed the permissible stresses as per 4.7.5.1 to ensure the guidance of the car, counterweight and balancing weight;

b) the deflections of the guide rails shall be limited taking into account:

   1) the permissible deflections as per 4.7.5.2; and

   2) the gap distances to prevent unintended unlocking of the doors; and

   3) the engagement of safety devices with the guide rail to ensure the operation; and

   4) the gaps to prevent collision of moving parts with other parts.

4.7.2.1.2 The combination of deflections of guide rails and deflections of the fixings (brackets, separation beams), play in the guide shoes and straightness of the guide rails shall be taken into account in order to ensure safe operation of the lift as per 4.7.2.1.1.

The building structure shall be taken as non-deformable for the guide rail stress and deflection calculation unless otherwise indicated (e.g. in the case of wood or specific well structure). Horizontal movement of the building structure due to external forces (e.g. wind) shall not be considered in the guide rail calculation.

NOTE The deflections of the fixings resulting from the application of loads on the guide rail include the horizontal displacement of the fixing point. Only deflections that result in a relative displacement between parts are relevant for the calculations.

4.7.2.2 Load cases

The following load cases shall be considered:

— running;

— loading and unloading;

— safety device operation as per 4.7.4.1;

— bouncing scenarios as per 4.7.2.3.8.

NOTE For each load case, a combination of forces can act on the guide rails (see 4.7.2.3.1).

4.7.2.3 Forces on guide rails

4.7.2.3.1 The following forces on guide rails shall be taken into account for calculation of permissible stresses and deflections of guide rails:

a) horizontal forces from guide shoes due to masses of the car and its rated load, compensation means, travelling cables, etc. and the counterweight/balancing weight, taking into consideration their suspension points and dynamic impact factors.

b) vertical forces from:

   1) forces of safety devices acting on guide rails;

   2) auxiliary parts fixed on the guide rail;

   3) weight of guide rail, and

   4) push through forces of rail clips;

c) torques and horizontal forces due to auxiliary equipment including dynamic impact factors, if applicable, as per 4.7.4.

4.7.2.3.2 The acting point, *P*, of the masses of the empty car and components supported by the car, such as ram, part of travelling cable, compensation means (if any) shall be the mass centre of gravity of them.

4.7.2.3.3 The guiding forces of a counterweight or balancing weight shall be evaluated taking into account:

— the acting point of the mass;

— the suspension; and

— the forces due to compensation means (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.

4.7.2.3.4 In load cases “running” and “safety device operation”, the rated load, *Q*, of the car shall be evenly distributed over those three quarters of the car area resulting in the highest horizontal forces.

In car “bouncing scenario”, both shall be considered:

— the empty car; and

— the car with the rated load evenly distributed over those three quarters of the car area resulting in the highest horizontal forces.

If different load distribution conditions are specified (e.g. see 4.4.2.2), and they lead to higher horizontal forces, calculations shall take these into account. The load distribution condition information shall be provided in the instructions [see 6.2.3 c)].

4.7.2.3.5 The vertical force, F_v, of the car, counterweight or balancing weight resulting in compression or tension force shall be evaluated in accordance with Formulae (12) to (15).

$$F_v = \frac{k_1 \cdot g_n \cdot M_{total}}{n} + N_v \qquad (12)$$

For load cases where there is no safety device acting on the guide rail, there is no vertical impact factor k_1 and therefore, k_1 shall be taken as zero in Formula (12).

For car, counterweight or balancing weight rails resting on the pit floor:

$$N_v = \left(M_g \cdot g_n\right) + F_p \quad (13)$$

For car, counterweight or balancing weight rails freely hanging (not resting on the pit floor, supported only by the brackets):

$$N_v = \frac{1}{3} \cdot \left(\left(M_g \cdot g_n\right) + F_p\right) \quad (14)$$

$$F_p = n_b \cdot F_r \quad (15)$$

where

M_{total} is the sum of P and Q for the car, or M_{cwt} for the counterweight, or M_{bwt} for the balancing weight, in kilograms;

N_v is the force to be considered as a result of the vertical forces due to guide rail self-weight and push through forces of the brackets, in newtons;

F_p is the push through forces of all brackets at one guide rail line, in newtons;

F_r is the push through force of all clips per bracket, in newtons;

g_n is the standard acceleration of free fall (9,81 m/s^2);

k_1 is the impact factor as per 4.7.4.1;

M_{bwt} is the mass of the balancing weight, in kilograms;

M_{cwt} is the mass of the counterweight weight, in kilograms;

M_g is the mass of one line of guide rails, in kilograms;

n is the number of guide rail lines;

n_b is the number of brackets for a guide rail line;

P are the masses of the empty car and components supported by the car, i.e. part of the travelling cable, compensation means (if any), etc., in kilograms;

Q is the rated load, in kilograms.

For travel heights not exceeding 40 m or for buildings older than 5 years, F_p is permitted to be taken as zero.

NOTE F_p depends on the way the guide rail is supported, the number of fixations, brackets, clip design and the compression of the well. For buildings older than 5 years or for small travels (i.e. not exceeding 40 m) the effect of the compression of the well (not made of timber) is small and is absorbed by the flexibility of the brackets.

The design shall consider clearances above and/or below the guide rails depending on the fixation to address the compression of the well.

4.7.2.3.6 While loading or unloading a car, a vertical force on the sill, F_S, acting centrally on the sill of the car entrance shall be considered for calculating the horizontal reactions on the guide rail. The amount of the force applied on the sill shall be as Formulae (16) to (18):

$$F_S = 0{,}40 \cdot g_n \cdot Q \text{ for passenger lifts} \quad (16)$$

$$F_S = 0{,}60 \cdot g_n \cdot Q \text{ for goods passenger lifts} \quad (17)$$

$$F_S = 0{,}85 \cdot g_n \cdot Q \text{ for goods passenger lifts,}$$
if the weight of handling devices is not included in the rated load (18)

NOTE 0,85 is based on the assumption of 0,6 × 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 × 0,5 = 0,85.

When applying the vertical force on the sill, the car shall be regarded as empty. At cars with more than one entrance, the vertical sill load on the entrance which is causing the highest horizontal force on the guide rail shall be considered.

When the car is at the landing and the guide shoes (top and bottom of car) are positioned within 10 % of the distance between the vertical guide rail brackets, the bending due to sill forces may be ignored.

4.7.2.3.7 Forces and torques per guide rail, F_{aux}, due to auxiliary equipment fixed to the guide rail and due to bouncing scenarios, shall be considered, except for overspeed governors and their associated parts, switches or positioning equipment.

4.7.2.3.8 Bouncing scenarios shall be considered such as:

a) counterweight or balancing weight bounce when the car is stopped by a safety device; and

b) car bounce when the counterweight or balancing weight is stopped by a safety device.

4.7.3 Combination of masses and forces

The masses and forces and the load cases to be taken into consideration are shown in Table 17.

Table 17 — Masses and forces to be taken into consideration in the different load cases

Load cases	P	Q	M_{cwt}/M_{bwt}	F_s	F_p	M_g	F_{aux}
Running	x	x	x		x[a]	x	x
Loading + unloading	x			X	x[a]	x	x
Safety device operation	x	x	x		x[a]	x	x
Bouncing scenarios	x	x	x		x[a]	x	x

[a] See 4.7.2.3.5.

NOTE Masses and forces might not act simultaneously.

4.7.4 Impact factors

4.7.4.1 Safety device operation

The impact factor due to safety device operation, k_1, (see Table 18) depends on the type of safety device.

The given impact factor shall be considered to calculate:

— the horizontal reactions acting on the guide rails; and

— the vertical forces acting on the guide rail as per 4.7.2.3.5.

Table 18 — Impact factors for safety device operation

Safety device operation	Impact factor	Value
instantaneous safety gear, not of the captive roller type	k_1	5
instantaneous safety gear, of the captive roller type, or pawl device with energy accumulation type buffer, or energy accumulation type buffer		3
progressive safety gear, or pawl device with energy dissipation type buffer, or energy dissipation type buffer, or rupture valve		2
Ascending car overspeed protection and unintended movement protection acting on the guide rail		2 [a]
[a] If the ascending car overspeed protection uses an instantaneous safety gear on the counterweight, the impact factor shall be the one defined for the specific safety gear of the counterweight.		

4.7.4.2 Load case running

In the load case "running", the vertical moving masses of the car, $P + Q$, and counterweight/balancing weight, M_{cwt}/M_{bwt}, shall be multiplied by the impact factor, $k_2 = 1{,}2$, to take into consideration hard braking due to electric safety device actuation or by an accidental interruption of the power supply.

4.7.5 Permissible stresses and deflections

4.7.5.1 Permissible stresses

The permissible stresses shall be determined by Formula (19):

$$\sigma_{perm} = \frac{R_m}{S_t} \tag{19}$$

where

σ_{perm} is the permissible stress, in newtons per square millimetre;
R_m is the tensile strength of the guide rail material, in newtons per square millimetre;
S_t is the safety factor.

The safety factor shall be taken from Table 19.

Table 19 — Safety factors for guide rails

Load cases	Elongation (A_5)	Safety factor (S_t)
Running and loading + unloading	$A_5 > 12\ \%$	2,25
	$8\ \% \le A_5 \le 12\ \%$	3,75
Safety device operation and bouncing scenarios	$A_5 > 12\ \%$	1,8
	$8\ \% \le A_5 \le 12\ \%$	3,0

Materials with elongations less than 8 % are regarded as too brittle and shall not be used.

4.7.5.2 Permissible deflections

For guide rails and their fixings (brackets, separation beams), the maximum calculated permissible deflections, δ_{perm}, shall be:

a) δ_{perm} = 5 mm in both directions for car guide rails for the load cases “running”, “loading and unloading” and “safety device operation”;

b) δ_{perm} = 5 mm in both directions for counterweight/balancing weight guide rails on which safety gears are operating, for the load cases “running” and “safety device operation”;

c) δ_{perm} = 10 mm in both directions for counterweight/balancing weight guide rails on which safety gears are not operating for the load case “running” and “safety device operation”;

d) δ_{perm} = 10 mm in both directions for car and counterweight/balancing weight guide rails for “bouncing scenarios”.

4.7.5.3 Calculation

Guide rails shall be calculated in accordance with ISO 8100-2: 2025, 4.10.

4.8 Buffers

4.8.1 General provisions

4.8.1.1 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 counterweight or the balancing weight, 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 0,30 m.

An obstacle is not required for buffer(s) fixed to the counterweight or balancing weight where a screen as per 4.2.5.5.1 is extended to not more than 50 mm above the pit floor.

4.8.1.2 In addition to the requirements of 4.8.1.1, positive drive lifts shall be provided with buffers on the car top to function at the upper limit of travel.

4.8.1.3 For hydraulic lifts, when the buffer(s) of a pawl device is (are) used to limit the travel of the car at the bottom, the pedestal as per 4.8.1.1 is also required, unless the fixed stops of the pawl device are mounted on the car guide rails, and the car is not able to pass with pawl(s) retracted.

4.8.1.4 For hydraulic lifts, when buffers are fully compressed, the ram shall not hit the base of the cylinder.

This shall not apply to devices ensuring re-synchronisation of telescopic cylinders, where at least one stage shall not hit its down travel mechanical limit.

4.8.1.5 Energy accumulation type buffers, with linear and non-linear characteristics, shall only be used if:

a) the rated speed of the lift does not exceed 1,00 m/s; or

b) the rated speed of the lift does not exceed 1,75 m/s; and

   1) the normal slowdown of the lift shall be monitored as per 4.12.1.3; and

   2) buffers for a rated speed of 1,0 m/s shall be used.

4.8.1.6 Energy dissipation type buffers can be used regardless of the rated speed of the lift.

4.8.1.7 The energy accumulation type buffers with non-linear characteristics and energy dissipation type buffers shall be verified in accordance with ISO 8100-2:2025, 4.5.

4.8.1.8 A data plate shall be fixed on buffers other than those with linear characteristics (4.8.2.1.1), indicating:

a) the name of the manufacturer;

b) its identification;

c) the type and designation of the liquid, in the case of hydraulic buffers;

d) the minimum height of the characters shall be 2,5 mm.

4.8.2 Stroke of buffers

4.8.2.1 Energy accumulation type buffers

4.8.2.1.1 Buffers with linear characteristics

4.8.2.1.1.1 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 calculated with Formula (20). However, the stroke shall not be less than 0,065 m.

$$l_{\mathrm{B}} = 2 \cdot \frac{(1{,}15 \cdot v)^2}{2 \cdot g_{\mathrm{n}}} = 0{,}135 \cdot v^2 \qquad (20)$$

where

g_n is the standard acceleration of free fall, [9,81 (m/s^2)];
l_{B} is the total possible stroke of the buffer expressed in metres
v is the rated speed expressed in metres per seconds (m/s).

4.8.2.1.1.2 Buffers shall be designed to cover the stroke defined in 4.8.2.1.1.1 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 or the balancing weight).

4.8.2.1.2 Buffers with non-linear characteristics

4.8.2.1.2.1 Energy accumulation type buffers with non-linear characteristics shall fulfil the following requirements when hitting the buffer(s) with the mass of the car and its rated load or of the counterweight the balancing weight, in case of free fall with a speed of 115 % of the rated speed:

a) the retardation in accordance with ISO 8100-2:2025, 4.5.3.2.6.1 a) shall not be more than 1,0 g_n;

b) the 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 or the balancing weight shall not exceed 1,00 m/s;

d) there shall be no permanent deformation after actuation;

e) the maximum peak retardation shall not exceed 6,0 g_n.

4.8.2.1.2.2 The term “fully compressed”, mentioned in Table 1 means a compression of 90 % of the installed buffer height, without considering fixation elements of the buffer, which can limit the compression to a lower value.

4.8.2.2 Energy dissipation type buffers

4.8.2.2.1 The total possible stroke of the buffers, being expressed in metres, shall be at least equal to the gravity stopping distance corresponding to:

a) 115 % of the rated speed (0,067 4 × v^2); or

b) the speed at which the car/ counterweight/balancing weight comes into contact with the buffers, when the slowdown of the lift machine at the ends of its travel is monitored as per 4.12.1.3. However, the stroke shall not be less than 0,173 m.

4.8.2.2.2 Energy dissipation type buffers shall fulfil the following requirements:

a) hitting the buffer with the mass of the car or the mass of the counterweight / balancing weight with its rated load, in case of free fall with a speed of 115 % of the rated speed or the reduced speed as per 4.8.2.2.1 b), the average retardation shall not be more than 1,0 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.

4.8.2.2.3 The buffer shall be provided with an electric safety device as per 4.11.2 , checking the normal extended position.

4.8.2.2.4 Buffers, if hydraulic, shall be constructed so that the hydraulic fluid level can be checked.

4.9 Lift machinery and associated equipment

4.9.1 General provision

4.9.1.1 Each lift shall have one or more lift machines of its own.

4.9.1.2 Protection shall be provided for 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 as per 4.5.7, hand winding wheels, brake drums and any similar smooth, round parts. Such parts shall be painted yellow, at least in part.

4.9.2 Lift machine for traction lifts and positive drive lifts

4.9.2.1 General provisions

4.9.2.1.1 The following two methods of drive are permissible by:

a) traction (use of sheaves and ropes/belts);

b) positive drive, i.e. either:

   1) use of a drum and ropes with a rated speed not exceeding 0,63 m/s, counterweights shall not be used, the use of a balancing weight is permitted; or

2) use of sprockets and chains with a rated speed not exceeding 0,63 m/s, the use of a balancing weight is permitted, or

3) elastomeric coated timing belts with a rated speed not exceeding 1,75 m/s.

When calculating driving elements the possibility of the counterweight, balancing weight or the car resting on its buffers shall be taken into account.

4.9.2.1.2 Use may be made of a belt or belts for coupling the motor(s) to the component on which the machine brake (4.9.2.2.1.2) operates.

4.9.2.2 Braking system

4.9.2.2.1 General provisions

4.9.2.2.1.1 The lift shall be provided with a braking system which operates automatically in the event of loss of:

a) the supply to the drive control system;

b) the supply to control circuits.

4.9.2.2.1.2 The braking system shall have a friction type machine brake (4.9.2.2.2), but may, in addition, have other braking means (e.g. electric).

4.9.2.2.2 Machine brake

4.9.2.2.2.1 The machine brake on its own shall be capable of stopping the lift machine when the car is travelling downwards at the rated speed and with the rated load plus 25 %. In these conditions, the average retardation of the car shall not exceed that resulting from operation of the safety gear or stopping on the buffer.

The brake release shall be done either by electromagnets, or by hydraulic cylinders. All the mechanical components of the machine brake which take part in the application of the braking action on the braking surface and in the release of the brake shall be installed at least in two sets.

The brakes shall be designed so that if one of the brake sets is not working due to failure of a component, a minimum braking torque shall be provided to decelerate, stop and hold the car:

a) when travelling downwards at rated speed with the car loaded with the higher of either:

   — rated load; or

   — the load corresponding to the overload detection setting (see 4.12.1.2.2); and

b) when travelling upwards at rated speed with empty car.

The mechanical manual release of the brake (4.9.2.3.1) shall be independent for each brake set if the brake is used as stopping means for ascending car overspeed protection or unintended car movement protection.

Any electromagnet plunger, cylinder, valve and hydraulic filter is considered to be a mechanical part, any electromagnet coil is not.

In case of hydraulic cylinders the following shall apply:

a) The operation of each brake set shall be performed by independent cylinders, valves and pressure release circuits. Valves shall be energized by means as per 4.9.2.2.2.3. Valves shall release pressure from the cylinders when de-energized.

b) The hydraulic pressure source may be installed as a single set.

c) Hydraulic filters shall be used to prevent harmful contaminations effecting operation of cylinders and valves.

d) Hydraulic filters shall not cause the failure of the application of the braking action.

e) The hydraulic equipment shall be provided with means to prevent leaking oil penetrating the brake friction elements.

4.9.2.2.2.2 The component on which the machine brake operates shall be coupled to the traction sheave or drum or sprocket by positive mechanical means.

4.9.2.2.2.3 The release of the machine brake shall require a continuous flow of current, except as permitted by 4.9.2.3.1.

The following shall be met:

a) the interruption of this current, initiated by an electric safety device as required in 4.11.2.1.5, shall be made by one of the following means:

   1) Safety circuit as per 4.11.2.3, or

   2) SIL-rated circuit as per 4.11.2.4 fulfilling SIL 3 requirements, with a PFH ≤ $2{,}5\times10^{-8}$, or

   3) directly by the electric safety devices, provided that the current through the switching element(s) is less than half of their rated current.

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 machine brake to be fed directly by the motor;

c) when initiated by an electric safety device, braking shall become effective after opening of the brake power supply circuit without delay in addition to components to operate the brake and to those passive acting electrical components (e.g. diode, capacitor or varistors) that reduces sparking;

d) operation of an overload and/or over current protective device (if any) for the machine brake shall initiate the simultaneous de-energization of the lift machine;

e) current shall not be applied to the machine brake until the motor has been powered except during manual emergency operation, automatic rescue operation or verification of machine brake holding capability as per 4.9.2.2.2.7 and 4.9.2.2.2.8 b);

f) at least where the machine brake is part of the means to stop the car as per 4.6.6, 4.6.7 or 4.12.1.3, an electric device in addition to a) shall be used to interrupt the brake current such that the failure of the means defined in a) shall not prevent this additional electric device from interrupting the brake current;

g) The release of each brake set shall be monitored. If a failure is detected:

   — any further movement shall be prevented;

   — car and landing doors shall be closed or remain closed, the door re-open buttons (see 4.12.1.1.5) shall remain active;

   — the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

   Failure to continuous “0” or “1” state of this monitoring function shall have the same result.

h) means shall be provided to prevent lubricants from the lift machine penetrating the brake linings.

4.9.2.2.2.4 The brake shoe or pad pressure shall be exerted by guided compression springs or weights.

4.9.2.2.2.5 Band brakes shall not be used.

4.9.2.2.2.6 Brake linings shall be incombustible.

4.9.2.2.2.7 It shall be possible to operate each brake set independently from outside of the well to test the remaining brake set(s).

4.9.2.2.2.8 If the machine brake is used to decelerate the lift in:

— normal operation; or

— ascending car overspeed protection (4.6.6.2); or

— protection against unintended car movement (4.6.7.3); or

— the case of reduced stroke buffer (4.12.1.3);

the machine brake shall be monitored by one of the following means:

a) automatic detection of the maximum wear of the brake lining material;

b) automatic static verification of machine brake holding capability at least once every day of normal operation. Monitoring shall verify that if each individual brake set is not working, the remaining brake set(s) are able to generate sufficient braking torque to hold the empty car, and the car loaded with rated load at a landing. In case of a balance factor q equal to 0,5 as per 4.9.2.3.3, no motor torque is required for the verification.

If a failure is detected by the monitoring as per 4.9.2.2.2.8 a) or 4.9.2.2.2.8 b), the car and landing doors shall be closed, and the return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

Machine brakes which are used to decelerate the lift in normal operation shall not be used as stopping means for ascending car overspeed protection (4.6.6.2) or as stopping means for protection against unintended car movement (4.6.7.3).

4.9.2.3 Emergency operation

4.9.2.3.1 The lift machine shall be capable of having the machine brake released by a continuous manual operation which is protected against involuntary action. The operation can be mechanical (e.g. lever) or electrical, powered by an emergency supply as per 4.10.11.

In case of hydraulically released machine brakes, the machine brake release shall be either mechanical (e.g. by lever), or by a hand pump. In case of a hand pump, the valve used to release the machine brake shall require continuous manual operation to release the machine brake. Removal of the manual force shall immediately cause the application of the machine brake. These valves shall be operated either mechanically or electrically powered by an emergency supply as per 4.10.11.

A single fault in the means for manual release shall not cause a failure of the braking function. Additionally, for electrical operation if a fault in the brake releasing circuit combined with another fault can lead to a dangerous situation, automatic operation, inspection operation and emergency electrical operation of the lift shall be prevented after occurrence of the first fault. Faults may be excluded under conditions described in 4.11.1.3, 4.11.1.4 and /or ISO 8100-2:2025, 4.17.

4.9.2.3.2 The instructions for emergency operation [see 6.2.5 a)] shall be fixed on or near means to operate the machine brake manually. In the case of reduced stroke buffer, the warning sign in accordance with

ISO 7010:2019, W001, with a minimum height of 25 mm, supplemented with the text “Reduced Stroke Buffer!” (see Figure 37) shall be fixed on the same location.

Figure 37 — Warning sign for reduced stroke buffer

4.9.2.3.3 When the machine brake is manually released under the following conditions:

— the weight of travelling cables, suspension means, and compensation means (if provided) on car and counterweight side are in balance; and

the car is loaded from, see Formula (21):

$$0\ \%\ \text{of rated load to}\ (q - 0{,}1)\ Q\ \text{and from}\ (q + 0{,}1)\ Q\ \text{to}\ 100\ \%\ \text{of rated load} \quad (21)$$

where

q is the balance factor indicating the amount of counterbalance of the rated load by the counterweight;

Q is the rated load, in kilograms.

It shall be possible to move the car to an adjacent floor by either:

a) natural movement due to gravity; or

b) manual operation as per 4.9.2.3.4.

4.9.2.3.4 Where a means of emergency operation is required [see 4.9.2.3.3 b)], it shall consist of either:

a) a mechanical means, where the manual effort to move the car to a landing does not exceed 150 N, which complies with the following:

   1) if the means for moving the car can be driven by the lift moving, then it shall be a smooth, spokeless wheel;

   2) if the means is removable, it shall be located in the machinery space. In the case of more than one lift machine in the machinery space and where the means fits only to a particular machine, it shall be marked to identify the lift machine for which it is intended;

   3) if the means is removable or can be disengaged from the lift machine, an electric safety device as per 4.11.2 shall be actuated at the latest before the coupling with the lift machine starts; or

b) an electrical means in accordance with the following:

   1) it shall be able to move the car with any load up to rated load to an adjacent landing;

   2) it shall be powered by the emergency supply as per 4.10.11;

   3) the speed shall not exceed 0,30 m/s.

4.9.2.3.5 It shall be possible to check from the machinery spaces where the devices for emergency operation are fitted whether the car is in an unlocking zone by a means that is independent of the power supply.

4.9.2.3.6 If the manual effort to move the car in the upward direction with its rated load exceeds 400 N, or if no mechanical means defined in 4.9.2.3.4 a) is provided, a means of emergency electrical operation as per 4.12.1.6 shall be provided.

4.9.2.3.7 The means to actuate the emergency operation shall be located:

— in the machine room (4.2.6.3);

— in the machinery cabinet (4.2.6.5.1); or

— on the emergency and tests panel(s) (4.2.6.6).

4.9.2.3.8 If a hand winding wheel is provided for emergency operation, the direction of movement of the car shall be clearly indicated on the lift machine, close to the hand winding wheel.

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

4.9.2.3.9 With the machine brake manually released, the car speed shall be limited to the speed for which the buffers are designed, unless the brake is released mechanically and there is direct visual observation of the lift machine.

4.9.2.4 Speed

The speed of the car, half loaded, in upwards and downwards 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.

NOTE It is good practice that, in the above conditions, the speed is not lower than a value 8 % below the rated speed.

This tolerance shall apply also for the speed in the case of:

a) levelling [4.12.1.4 c)];

b) re-levelling [4.12.1.4 d)];

c) inspection operation [4.12.1.5.2.1 f) 1), 4.12.1.5.2.1 f) 2) and 4.12.1.5.2.1 f) 4)];

d) emergency electrical operation [4.12.1.6.2.1 c) 2)].

4.9.2.5 Removing the power which can cause rotation of the motor

4.9.2.5.1 General

The removal of power which can cause rotation of the motor, initiated by an electric safety device, as required by 4.11.2.1.4, shall be controlled as detailed below.

4.9.2.5.2 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, while 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 the direction of motion.

Failure to continuous “0” or “1” state of this monitoring function shall have the same result.

4.9.2.5.3 A.C. or D.C. motor supplied and controlled by static elements

One of the following methods shall be used to remove the power which can cause rotation to the motor:

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. Failure to continuous "0" or "1" state 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. Failure to continuous "0" or "1" state of this monitoring function shall have the same result;

   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) safety circuit as per 4.11.2.3;

d) an adjustable speed electrical power drive system in accordance with IEC 61800-5-2:2016, with a safe torque off (STO) function fulfilling SIL 3 and PFH ≤ $2{,}5\times10^{-8}$; or

e) a SIL-rated circuit as per 4.11.2.4 fulfilling SIL 3 and PFH ≤ $2{,}5\times10^{-8}$;

4.9.2.6 Control devices and monitoring devices

Control devices as per 4.9.2.5.3 b) 2), and monitoring devices as per 4.9.2.5.3 b) 3) need not to be safety circuits as per 4.11.2.3 or SIL-rated circuits as per 4.11.2.4.

These devices shall only be used provided that the requirements of 4.11.1 are met to achieve comparability to 4.9.2.5.3 a).

4.9.2.7 Motor run time limiter

4.9.2.7.1 Traction drive lifts shall have a motor run time limiter causing the de-energizing of the lift machine, and keep it de-energized, if:

a) the motor does not rotate when a start is initiated;

b) the car/counterweight is stopped in downward movement by an obstacle.

4.9.2.7.2 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 to travel the longest distance between adjacent landings at the intended motor running speed plus 10 seconds with a minimum of 20 s if the intended travel time is less than 10 s.

4.9.2.7.3 The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. On restoration of the power after a supply disconnection, maintaining the lift machine in the stopped position is not necessary.

4.9.2.7.4 The motor run time limiter even if tripped, shall not prevent inspection operation (4.12.1.5), and emergency electrical operation (4.12.1.6).

4.9.3 Lift machine for hydraulic lifts

4.9.3.1 General provision

4.9.3.1.1 The two following methods of drive are permissible:

a) direct acting;

b) indirect acting.

4.9.3.1.2 In the case of multiple jacks, all the jacks shall be hydraulically connected in parallel, with similar characteristics such as length and number and type of bends in the pipe work, so that they all are lifting 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 synchronize the movement of the rams, in any of the applicable loading conditions mentioned in 4.7.2.2.

4.9.3.1.3 The mass of the balancing weight, if any, shall be calculated such that in case of rupture of the suspension gear (car/balancing weight), the pressure in the hydraulic system does not exceed two times the 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.

4.9.3.1.4 The hydraulic fluids used for the operation of hydraulic lifts shall be in accordance with ISO 6743-4:2015.

4.9.3.2 Jack

4.9.3.2.1 Calculations of cylinder and ram

4.9.3.2.1.1 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 yield strength, $R_{P0,2}$, is assured;

b) for the calculation 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;

   It shall be taken into account that abnormally high pressure conditions can arise during installation, due to incorrect adjustment of 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 stage and telescopic jacks.

d) the calculations shall be carried out in accordance with ISO 8100-2:2025, 4.15.1.

4.9.3.2.1.2 Buckling calculations

Jacks under compressive loads shall fulfil the following requirements:

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 in accordance with ISO 8100-2:2025, 4.15.2.

4.9.3.2.1.3 Tensile stress calculations

Jacks under tensile loads shall be designed such that, under the forces resulting from a pressure equal to 1,4 times the full load pressure, a safety factor of at least 2, referred to the yield strength, $R_{P0,2}$, is assured.

4.9.3.2.2 Connection car/ram (cylinder)

4.9.3.2.2.1 In case of a direct acting lift, the connection between the car and the ram (cylinder) shall be flexible.

4.9.3.2.2.2 The connection between the car and the ram (cylinder) shall be constructed to support the weight of the ram (cylinder) and the additional dynamic forces. The connection means shall be secured.

4.9.3.2.2.3 In case of a ram made with more than one section, the connections between the sections shall be constructed to support the weight of the suspended ram sections and the additional dynamic forces.

4.9.3.2.2.4 In the case of indirect acting lifts, the head of the ram (cylinder) shall be guided.

This requirement shall not apply for pulling jacks, provided that the pulling arrangement prevents bending forces on the ram.

4.9.3.2.2.5 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.

4.9.3.2.3 Limitation of the ram stroke

4.9.3.2.3.1 Means shall be provided to stop the ram with buffered effect in such a position that the requirements of 4.2.5.7.1 and 4.2.5.7.2 can be satisfied.

4.9.3.2.3.2 This limitation of stroke shall be either:

a) by means of a cushioned stop; or

b) 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 4.9.3.2.4.2.

4.9.3.2.4 Cushioned stop

4.9.3.2.4.1 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 projection of the car, the resultant force of which is exerted on the centre line of the jack.

4.9.3.2.4.2 The design of the cushioned stop shall be such that the average retardation of the car does not exceed 1,0 g_n and that, in case of an indirect acting lift, the retardation does not result in slack rope or chain.

4.9.3.2.4.3 In cases 4.9.3.2.3.2 b) and 4.9.3.2.4.1 b), a stop shall be provided inside the jack to prevent the ram from leaving the cylinder.

In the case of 4.9.3.2.3.2 b), this stop shall be positioned such that the requirements of 4.2.5.7.1 and 4.2.5.7.2 are also satisfied.

4.9.3.2.5 Means of protection

4.9.3.2.5.1 Leak and scrape hydraulic fluid from the cylinder head shall be collected.

4.9.3.2.5.2 The jack shall be provided with an air venting device.

4.9.3.2.6 Telescopic jacks

The following requirements shall apply additionally:

4.9.3.2.6.1 Stops shall be provided between successive sections to prevent the rams from leaving their respective cylinders.

4.9.3.2.6.2 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 4.2.5.8.2 a) excluded] shall be at least 0,30 m.

NOTE See also 4.2.5.8.2 d).

4.9.3.2.6.3 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.

4.9.3.2.6.4 These jacks shall be provided with mechanical or hydraulic synchronizing means.

4.9.3.2.6.5 When jacks with hydraulic synchronizing means are used, an electric device shall be provided to prevent a start for a normal journey when the pressure exceeds the full load pressure by more than 20 %.

4.9.3.2.6.6 When ropes or chains are used as synchronizing means, the following shall apply:

a) there shall be at least two independent ropes or chains;

b) the requirements of 4.5.7.1 shall apply;

c) the safety factor shall be at least:

   1) 12 for ropes;

   2) 10 for chains.

   The safety factor is the ratio between the MBF in newtons of one rope (or chain) and the maximum force in this rope (or chain).

   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).

d) 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 0,30 m/s in the event of failure of the synchronizing means.

4.9.3.3 Piping

4.9.3.3.1 General

4.9.3.3.1.1 Piping and fittings which are subject to pressure (connections, valves, etc.) shall be:

a) appropriate to the hydraulic fluid used;

b) in accordance with ISO 4413:2010, 5.4.6.

4.9.3.3.1.2 Fittings shall be installed in machinery spaces. The inspection of pipes and fittings shall be described in the instructions as per 6.2.4.

4.9.3.3.2 Rigid pipes

4.9.3.3.2.1 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 yield strength, $R_{P0,2}$, is assured.

The calculations shall be carried out in accordance with ISO 8100-2:2025, 4.15.1.1.

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.

4.9.3.3.2.2 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.

4.9.3.3.3 Flexible hoses

4.9.3.3.3.1 A flexible hose between cylinder and non-return valve or down direction valve shall be selected with a safety factor of at least 8 as the ratio of bursting pressure to full load pressure.

4.9.3.3.3.2 A flexible hose and its couplings between cylinder and non-return valve or down direction valve shall withstand without damage a test with a pressure of five times the full load pressure.

4.9.3.3.3.3 On the assembly mentioned in 4.9.3.3.3.2 the following information shall be indicated in an indelible manner:

a) the name of the manufacturer or the trademark;

b) the test pressure;

c) the date of the test.

4.9.3.4 Stopping the lift machine and checking its stopped condition

4.9.3.4.1 General

A stop of the lift machine initiated by an electric safety device, as required by 4.11.2.1.4, shall be controlled as per 4.9.3.4.2, 4.9.3.4.3 and 4.9.3.4.4.

4.9.3.4.2 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 a contactor, and the temperature monitoring device of the motor and/or the oil (see 4.9.3.11, 4.10.4.3 and 4.10.4.4) shall act on a switching device other than this contactor, and the supply to the bypass valves as per 4.9.3.5.4.2 shall be interrupted by at least two independent electromechanical devices connected in series in the supply circuit of these valves; or

c) the electric motor shall be stopped by a safety circuit as per 4.11.2.3; or

d) the electric motor shall be stopped by an adjustable speed electrical power drive system in accordance with IEC 61800-5-2:2016, with a safe torque off (STO) function fulfilling SIL 3 and PFH ≤ 5×10^{-8}; or

e) the electric motor shall be stopped by a SIL-rated circuit as per 4.11.2.4 fulfilling SIL 3 and PFH ≤ 5×10^{-8}.

4.9.3.4.3 Downwards motion

For downwards motion, the supply to the down direction valve(s) shall be interrupted by one of the following means:

a) directly by the electric safety devices, provided that the current through the switching element(s) is less than half of their rated current; or

b) safety circuit as per 4.11.2.3, or

c) SIL-rated circuit as per 4.11.2.4 fulfilling SIL 3 requirements with a PFH ≤ $2{,}5\times10^{-8}$.

4.9.3.4.4 Checking of the stopped condition

If, while the lift is stationary, one of the contactors [4.9.3.4.2 a) or 4.9.3.4.2 b)] has not opened the main contacts or if one of the electromechanical devices [4.9.3.4.2 b)] has not opened, a further start shall be prevented, at the latest at the next change in the direction of motion. A failure to continuous “0” or “1” state of this monitoring function shall have the same result.

4.9.3.5 Hydraulic control

4.9.3.5.1 Shut-off valve

4.9.3.5.1.1 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).

4.9.3.5.1.2 It shall be located on the lift machine.

4.9.3.5.2 Non-return valve

4.9.3.5.2.1 A non-return valve shall be provided. It shall be installed in the circuit between the pump(s) and the shut-off valve.

4.9.3.5.2.2 The non-return valve shall be capable of holding the car with the rated load at any point when the supply pressure drops below the minimum operating pressure.

4.9.3.5.2.3 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.

4.9.3.5.3 Pressure relief valve

4.9.3.5.3.1 A pressure relief valve shall be provided. It shall be connected to the circuit between the pump(s) and the non-return valve. It shall not be possible to bypass the pressure relief valve with the exclusion of the hand pump(s). The hydraulic fluid shall be returned to the tank.

4.9.3.5.3.2 The pressure relief valve shall be adjusted so that the pressure does not exceed 50 MPa and is limited to:

a) 140 % of the full load pressure, or

b) a greater selected pressure value not exceeding 170 % of the full load pressure. In this case, for the calculations of the hydraulic equipment (including jack) a fictitious full load pressure shall be used, calculated in accordance with Formula (22), and 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.

$$p_f = \frac{p_1}{1,4} \tag{22}$$

where

p_f is the fictitious full load pressure in megapascals
p_1 is the selected pressure setting in megapascals

4.9.3.5.4 Direction valves

4.9.3.5.4.1 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.

4.9.3.5.4.2 Up direction valves

If the stopping of the lift machine is effected as per 4.9.3.4.2 b), only bypass 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.

4.9.3.5.5 Filters

Filters shall be installed in the circuit between:

a) the tank and the pump(s); and

b) the shut-off valve, the non-return valve(s) and the down direction valve(s).

The filter between the shut-off valve, the non-return valve(s) and the down direction valve shall be accessible for inspection and maintenance.

4.9.3.6 Checking the pressure

4.9.3.6.1 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.

Where a second non-return valve is used for unintended car movement protection (see 4.6.7) then the pressure gauge shall be installed between that valve and the down direction valve(s) or the shut-off valve.

4.9.3.6.2 A gauge shut-off valve shall be provided between the main circuit and the connection for the pressure gauge.

4.9.3.6.3 The connection shall be provided with an internal thread of either M 20 × 1,5 or G 1/2".

4.9.3.7 Tank

The tank shall:

a) be fitted with a hydraulic fluid level indicator;

b) allow complete draining.

The characteristics of the hydraulic fluid shall be indicated on the tank.

4.9.3.8 Speed

4.9.3.8.1 The rated speed upward, v_m, and downward, v_d, shall not exceed 1,00 m/s.

4.9.3.8.2 The speed of the empty car upward shall not exceed the rated speed upward by more than 8 %. The speed of the car with rated load downwards shall not exceed the rated speed downward by more than 8 %. In each case, this relates to the design temperature of the hydraulic fluid as per 4.10.4.4.

For a journey in the upward direction, it is assumed that the supply is at its rated frequency and that the motor voltage is equal to the rated voltage of the equipment.

4.9.3.9 Emergency operation

4.9.3.9.1 Moving the car downwards

4.9.3.9.1.1 The lift shall be provided with a manually operated emergency lowering valve allowing the car to be lowered to a level where the passengers can leave the car, even in the case of a power failure. It shall be located in the relevant machinery space:

— machine room (4.2.6.3);

— machinery cabinet (4.2.6.5.1);

— on the emergency and tests panel(s) (4.2.6.6).

4.9.3.9.1.2 The speed of the car shall not exceed 0,30 m/s.

4.9.3.9.1.3 The operation of this valve shall require a continual manual force.

4.9.3.9.1.4 This valve shall be protected against involuntary action.

4.9.3.9.1.5 The emergency lowering valve shall not cause further sinking of the ram when the pressure falls below the minimum operating pressure.

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.

4.9.3.9.1.6 There shall be a plate near the emergency lowering valve stating:

"**Caution — Emergency lowering**"

4.9.3.9.2 Moving the car upwards

4.9.3.9.2.1 The lift shall be provided with a manually operated hand pump allowing the lift to move in the upward direction to a level where the passengers can leave the car.

It shall be located in the relevant machinery space:

— machine room (4.2.6.3);

— machinery cabinet (4.2.6.5.1);

— on the emergency and tests panel(s).

4.9.3.9.2.2 The hand pump shall be connected to the circuit between the non-return valve or down direction valve(s) and the shut-off valve.

4.9.3.9.2.3 The hand pump shall be fitted with a pressure relief valve limiting the pressure to 2,3 times the full load pressure.

4.9.3.9.2.4 There shall be a plate near the hand pump stating:

"Caution — Emergency lifting".

4.9.3.9.3 Checking of the car position

If the lift serves more than two levels, it shall be possible to check from the machinery spaces where the devices for emergency operation are fitted whether the car is in an unlocking zone by a means independent of the power supply.

4.9.3.10 Motor run time limiter

4.9.3.10.1 Hydraulic lifts shall have a motor run time limiter causing the de-energizing of the motor and keeping it de-energized if the motor does not rotate when a start is initiated, or the car does not move.

4.9.3.10.2 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) the time to travel the longest distance between adjacent landings at the intended motor running speed with rated load, plus 10 s, with a minimum of 20 s if the intended travel time is less than 10 s.

4.9.3.10.3 The return to automatic operation shall only be possible by manual resetting. On restoration of the power after a supply disconnection, maintaining the lift machine in the stopped position is not necessary.

4.9.3.10.4 The motor run time limiter, even if tripped, shall not prevent the inspection operation (4.12.1.5), the emergency electrical operation (4.12.1.6), and the electrical anti-creep system (4.12.1.10).

4.9.3.11 Protection against overheating of the hydraulic fluid

A temperature detecting device shall be provided. This device shall stop the lift machine and keep it stopped in accordance with 4.10.4.4.

4.10 Electric installations and appliances

4.10.1 General provisions

4.10.1.1 Limits of application

4.10.1.1.1 The electromagnetic compatibility shall be in accordance with:

a) ISO 8102-1:2020 for electromagnetic emissions;

b) ISO 8102-2:2021 for electromagnetic immunity.

The electric safety chain and control equipment as per 4.4.2.2.1 e), 4.4.2.2.1 f), 4.4.2.2.2 g) 3), 4.4.2.2.2 h), 4.9.2.2.2.3 a) 1), 4.9.2.2.2.3 a) 2), 4.9.2.5.3 c), 4.9.2.5.3 d), 4.9.2.5.3 e), 4.9.3.4.2 c), 4.9.3.4.2 d), 4.9.3.4.2 e), 4.9.3.4.3 b) and 4.9.3.4.3 c) shall be in accordance with the "all circuits" and the "safety circuit" immunity requirements of ISO 8102-2:2021.

NOTE In the context of this document, ISO 8102-2 term "safety circuit" includes safety circuit as per 4.11.2.3, SIL-rated circuit as per 4.11.2.4 and "STO" as per IEC 61800-5-2.

4.10.1.1.2 Arrangement of actuators of electrical installations and appliances shall be in accordance with IEC 61310-3:2007.

4.10.1.1.3 All control gear (see IEC 60204-1:2016+A1:2021, 3.1.13) 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 2,00 m above the working area. These requirements shall not apply to control gear on the car roof.

4.10.1.1.4 Heat-emitting surfaces (for example heat sinks, power resistors) shall be located so that the temperature of each component in the vicinity remains within the permitted limit.

In their normal operating conditions, the temperature of heat emitting surfaces shall not exceed the limits given in Table 20.

Table 20 — Temperature limits of heat emitting surfaces

Accessible surfaces of	Material of accessible surfaces	Maximum temperatures °C
Parts which are accessible without the use of a key or a tool	Metallic Non-metallic	55 65
Hand-held means of operation	Metallic Non-metallic	55 65
Parts intended to be touched but not hand-held	Metallic Non-metallic	70 80
Parts which need not be touched	Metallic Non-metallic	80 90
Parts located in the lift well or in the machine room, which do not need to be touched and which are marked with the warning sign ISO 7010:2019, W017 with a minimum height of 50 mm	Metallic Non-metallic	100 110
NOTE 1 Source of temperature limits IEC 60364-4-42:2024, Table 1 modified. NOTE 2 Accessible part is a part which can be touched by means of the standard test finger (see IEC 60529:1989+AMD1:1999+AMD2:2013).		

4.10.1.1.5 The lift and the lift components, capable of connectivity to external equipment:

— which is not powered by the main switch as per 4.10.5.1 or by a supply disconnecting device as per 4.10.5.3; and

— which is not located in a machine room, a pulley room, a machinery cabinet or the well as per 4.2.1.1.1;

shall be in accordance with ISO 8102-20:2022 Clause 5 and Clause 6.

4.10.1.1.6 Records of auditable events related to safety functions as per Table 25 which are resulting from requirements of ISO 8102-20:2022, 5.5 shall be persistent for at least five years.

4.10.1.2 Protection against electric shock

4.10.1.2.1 General

The protective measures shall be in accordance with IEC 60364-4-41:2005+AMD1:2017.

4.10.1.2.2 Basic protection (protection against direct contact)

In addition to the requirements of 4.10.1.2.1, the following shall apply:

a) in the lift well, machinery spaces and pulley rooms, protection of the electrical equipment against direct contact shall be provided by means of casings providing a degree of protection of at least IP2X (IEC 60529:1989+AMD1:1999+AMD2:2013);

b) when equipment is accessible without the use of a key, a minimum degree of protection against direct contact corresponding to IP2XD (IEC 60529:1989+AMD1:1999+AMD2:2013) shall apply;

c) when enclosures containing hazardous live parts are opened for emergency operation, access to hazardous voltage shall be prevented by minimum degree of protection of IPXXB (IEC 60529:1989+AMD1:1999+AMD2:2013).

d) when enclosures containing hazardous live parts are opened for resetting, adjusting or to operate controls, access to hazardous voltage shall be prevented by minimum degree of protection of IPXXB (IEC 60529:1989+AMD1:1999+AMD2:2013).

4.10.1.2.3 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:

a) socket outlets depending on the circuit(s) as per 4.10.7.2;

b) control circuits for landing controls and indicators and the electric safety chain with voltage higher than 50 V AC; and

c) circuits on the lift car with voltage higher than 50 V AC.

4.10.1.2.4 Protection against residual voltages

The provisions of IEC 60204-1:2016+A1:2021, 6.2.4 shall apply.

4.10.1.2.5 Warning sign

The provisions of IEC 60204-12016+A1:2021, 16.2.1 shall apply.

4.10.1.3 Insulation resistance of the electrical installation

4.10.1.3.1 The insulation resistance shall be measured between all live conductor and earth except for PELV and SELV circuits rated 100 VA or less.

Minimum values of insulation resistance shall be taken from Table 21.

NOTE Source IEC 60364-6:2016

Table 21 — Insulation resistance

Rated circuit voltage V	Test voltage (D.C.) V	Insulation resistance MΩ
SELV[a] >100 VA PELV[b] >100 VA	250	≥0,5
≤500 including FELV[c]	500	≥1,0
>500	1 000	≥1,0
[a] SELV: safety extra-low voltage as per IEC 60364-4-41:2005+AMD1:2017.		
[b] PELV: protective extra-low voltage as per IEC 60364-4-41:2005+AMD1:2017.		
[c] FELV: functional extra-low voltage as per IEC 60364-4-41:2005+AMD1:2017.		

4.10.1.3.2 The mean value (in direct current) or the Root Mean Square (r.m.s.) value (in alternating current) of the voltage between conductors, and between conductors and earth, shall not exceed 250 V for control and safety circuits.

4.10.2 Incoming supply conductor terminations

The provisions of IEC 60204-1:2016+A1:2021, 5.1 and 5.2 shall apply.

4.10.3 Contactors, contactor relays, components of safety circuits

4.10.3.1 Contactors and contactor relays

4.10.3.1.1 The main contactors, i.e. those necessary to stop the lift machine as per 4.9.2.5 and 4.9.3.4, shall be in accordance with IEC 60947-4-1:2023 and shall be selected for the appropriate utilization category.

The main contactors with their associated short-circuit protective devices shall have type "1" coordination in accordance with IEC 60947-4-1:2023, 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) in accordance with IEC 60947-4-1:2023, Annex F, in order to ensure the functionality as per 4.9.2.5.2, 4.9.2.5.3 a), 4.9.2.5.3 b) 1)and 4.9.3.4.4, i.e. detect the non-opening of a main contact.

4.10.3.1.2 If contactor relays are used to operate the main contactors, those contactor relays shall be in accordance with IEC 60947-5-1:2024.

If relays are used to operate the main contactors, those relays shall be in accordance with IEC 61810-1:2015+AMD1:2019.

They shall be selected in accordance with the following utilisation categories:

a) AC-15 for controlling A.C. contactors;

b) DC-13 for controlling D.C. contactors.

4.10.3.1.3 The contactors referred to in 4.10.3.1.1, the contactor relays and relays referred to in 4.10.3.1.2 shall fulfil the following requirements:

a) the auxiliary contacts of main contactors are mechanically linked contact elements in accordance with IEC 60947-5-1:2024, Annex L;

b) the contactor relays are in accordance with IEC 60947-5-1:2024, Annex L;

c) the relays are in accordance with IEC 61810-3:2015.

4.10.3.2 Components and devices used in or connected to the electric safety chain

4.10.3.2.1 When contactors, contactor relays or relays as per 4.10.3.1.2 are used, the requirements of 4.10.3.1.3 shall apply.

4.10.3.2.2 To prevent dangerous fault in the electric safety chain, components and devices used in or connected to the electric safety chain shall provide electrical isolation between any adjacent electrical circuits and the electric safety chain by fulfilling creepage distances and clearances in accordance with IEC 60664-1:2020 taking into account:

a) the rated voltage of the circuit(s) concerned;

b) pollution degree 3;

c) overvoltage category III;

d) material group III;

e) inhomogeneous field;

f) 2 000 m altitude;

If the protection of the device is IP5X (IEC 60529:1989+AMD1:1999+AMD2:2013) or better, pollution degree 2 may be used.

For fault exclusion on printed circuit boards, requirements as mentioned in ISO 8100-2:2025, 4.17 shall apply.

4.10.4 Protection of electrical equipment

4.10.4.1 For the protection of electrical equipment, IEC 60204-1:2016+A1:2021, 7.1 to 7.4 shall apply.

4.10.4.2 Protection of motors against overheating shall be provided for each motor.

NOTE As per IEC 60204-1:2016+A1:2021, 7.3.1, motors below 0,5 kW do not need to be provided with overheat protection. This exception, however, does not apply in this document.

4.10.4.3 If the design temperature of electrical equipment provided with temperature monitoring devices is exceeded, then the car shall stop at a landing so that the passengers can leave the car. The car shall not automatically return to automatic operation as long as the design temperature is exceeded.

4.10.4.4 If the design temperature of the hydraulic lift machine pump motor and/or oil provided with a temperature monitoring device is exceeded, then the car shall stop directly and return to the bottom landing so that the passengers can leave the car. The car shall not automatically return to automatic operation as long as the design temperature is exceeded.

4.10.5 Main switch, supply disconnecting devices and isolating devices

4.10.5.1 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 be in accordance with IEC 60204-1:2016+A1:2021, 5.3.2 a) to d) and 5.3.3.

NOTE IEC 60204-1:2016+A1:2021 references utilization categories AC-23B and DC-23B. Utilization categories AC-23A and DC-23A also covers respective utilization categories AC-23B and DC-23B.

4.10.5.1.1 This switch shall not cut the circuits feeding:

a) the car's lighting and ventilation;

b) the socket outlet on the car roof;

c) the lighting of machinery spaces and pulley rooms;

d) the socket outlet in the machinery spaces, pulley rooms and in the pit;

e) the lighting of the well.

4.10.5.1.2 This switch shall be located:

a) in the machine room, where it exists;

b) where no machine room exists, in the machinery cabinet, or

c) at the emergency and tests panel(s) (4.2.6.6) 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.

4.10.5.1.3 Where the main switch cannot be accessed, without moving the car from the locations of the following components:

— the control cabinet(s);

— the drive control system;

— the lift machine,

an additional device for isolating electrical equipment in accordance with IEC 60204-1:2016+A1:2021, 5.5 shall be provided at the location of that component.

4.10.5.2 In case of a machine room, the control mechanism for the main switch shall be located within a horizontal distance of maximum 5,00 m from the inner edge of the access door to the machine room. If the machine room is common to several lifts, the control mechanism of the main switches shall be identified as per 4.2.1.1.2.

If the machinery space has several points of access, or if the same lift has several machinery spaces each with its own point(s) of access, a contactor may be used, which shall be controlled by a device which complies with the requirements of IEC 60204-1:2016+A1:2021, 5.3.2 a) to d) and 5.3.3 inserted in the supply circuit to the coil of the contactor.

The position of this device shall be checked by an electric safety device as per 4.11.2 or it shall interrupt the supply to the electric safety chain when in off-position.

The contactor shall have a breaking capacity to interrupt the current of the largest motor when stalled together with the sum of the normal running currents of all other motors and/or loads.

The re-engagement of the contactor shall not be carried out or made possible except by means of the device which caused its release. The contactor shall be used in conjunction with a manually controlled device for isolating electrical equipment in accordance with IEC 60204-1:2016+A1:2021, 5.5 and 5.6.

4.10.5.3 Each incoming source of supply to the lift shall have a supply disconnecting device in accordance with IEC 60204-1:2016+A1:2021, 5.3.2 and 5.3.3 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. This requirement shall not apply to PELV and SELV circuits.

4.10.5.4 If movement of the car or doors other than caused by emergency operation devices as per 4.9.2.3 or 4.9.3.9, cannot be excluded while the main switch has disconnected the supply to the lift (e.g. automatic rescue operation, regenerative power), the position of the main switch shall be checked by an electric safety device as per 4.11.2.

4.10.5.5 A supply disconnecting device in accordance with IEC 60204-1:2016+A1:2021, 5.3.2 shall be provided:

a) for any power supply integrated in the lift which is supplying circuits having rated voltages exceeding 25 VAC or 60 VDC;

b) for any power supply integrated in the lift which is supplying devices which can cause movement of the car or doors.

4.10.5.6 If, after opening of the main switch as per 4.10.5.1, some circuits are live (interconnection between lifts, lighting, power supply integrated in the lift, etc.) and the voltage can exceed 25 VAC or 60 VDC, notice(s) located close to the main switch shall indicate this and allow to identify the supply disconnecting device(s) as per 4.10.5.3 and 4.10.5.5.

If the voltage of such circuits exceeds 25 VAC or 60 VDC:

— the conductors of these circuits shall be identified by the colour ORANGE, or

— these circuits shall be separated from other circuits; or

— connections terminals of these circuits shall be identified by warning signs in accordance with ISO 7010:2019, W012.

4.10.6 Electric wiring

4.10.6.1 Conductors and cables

4.10.6.1.1 Conductors and cables shall be selected in accordance with IEC 60204-1:2016+A1:2021, 12.1, 12.2, 12.3 and 12.4.

4.10.6.1.2 Travelling cables shall be in accordance with EN 50214:2024 or IEC 60227-6:2001, excluding insulation and outer sheath material type requirements of those standards.

4.10.6.1.3 Minimum fire classification of conductors and cables installed outside enclosures shall be in accordance with EN 13501-6:2018+A1:2022 Class E_{ca} or fire reaction shall be in accordance with minimum requirements set in IEC 60332-1-2:2004+AMD1:2015, Annex A.

4.10.6.2 Cross-sectional area of conductors

To ensure adequate mechanical strength, the cross-sectional area of conductors shall not be less than as shown in IEC 60204-1:2016+A1:2021, Table 5.

4.10.6.3 Wiring practices

4.10.6.3.1 The general requirements of IEC 60204-1:2016+A1:2021, 13.1.1, 13.1.2 and 13.1.3 shall apply.

4.10.6.3.2 Conductors and cables shall be installed in conduits or trunkings or equivalent mechanical protection.

Conductors and cables connected to an electric safety device and subject to contact with moving parts or sharp edges shall be protected mechanically.

Double insulated conductors and cables may be installed without conduits or trunkings if they are located as to avoid damage by moving parts.

4.10.6.3.3 The requirement of 4.10.6.3.2 shall 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; and

   2) they are part of SELV or PELV circuits;

b) the wiring of operating or distribution devices in cabinets or on panels between, either:

   1) different pieces of electric equipment, or

   2) these pieces of equipment and the connection terminals.

4.10.6.3.4 If connections, connection terminals and connectors are not located in an enclosure, their IP2X (IEC 60529:1989+AMD1:1999+AMD2:2013) protection shall be maintained when connected and disconnected, and they shall be properly fixed to prevent unintended disconnection.

4.10.6.3.5 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 cable gland.

NOTE Enclosed frames of landing and car doors are regarded as appliance casings.

4.10.6.4 Connectors

Plug socket combinations shall be in accordance with IEC 60204-1:2016+A1:2021, 13.4.5.

Connectors and devices of the plug-in type placed in the circuits of electric safety devices shall be designed so that it shall not be possible to insert them in a position which leads to a dangerous situation.

4.10.7 Lighting and socket outlets

4.10.7.1 The electric lighting supplies to the car, well, machinery spaces and pulley rooms, and emergency and test panel(s) (4.2.6.6), shall be independent of the supply to the lift machine, either through another circuit, or through connection to the lift machine supply circuit on the supply side of the main switch laid down in 4.10.5.

4.10.7.2 The supply shall be taken from the circuits as per 4.10.7.1 for the socket outlets required:

— on the car roof [4.4.8 c)],

— in the machinery spaces and pulley rooms [4.2.1.3.2 b)],

— in the pit [4.2.1.3.1 c)].

These socket outlets shall be of type 2 P + PE, supplied directly.

4.10.8 Control of the supply for lighting and socket outlets

4.10.8.1 A switch shall control the supply to the circuit for lighting and socket outlets of the 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 switch.

4.10.8.2 Well lighting switches (or equivalent) shall be located both in the pit and close to the main switch, so that the well lighting can be operated from either location.

In case additional luminaires are installed on the car roof, they shall be connected to the car light circuit and switched from the car roof.

4.10.8.3 Each circuit controlled by the switches laid down in 4.10.8.1 and 4.10.8.2 shall have its own over current protection devices.

4.10.9 Protective earthing

The requirements of IEC 60364-4-41:2005+AMD1:2017, 411.3.1.1 shall apply.

4.10.10 Identification of electrical components

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/near the fuse holders.

In the case of the use of multiple wire connectors, at least the connector, and not the wires, shall be marked.

4.10.11 Emergency supply

4.10.11.1 One or more emergency supplies shall be provided to ensure power:

a) for at least 1 h for the emergency light as per 4.4.10.4;

b) for at least 1 h (including 15 min two-way voice communication) for the intercom system as per 4.12.3.2;

c) for at least 1 h for the acoustic device as per 4.2.1.4 b) and 4.12.3.1 b), where provided;

d) to hold the machine brake open allowing the car to reach a landing as per 4.9.2.3.1 taking into account 1 h standby time;

e) for at least 1 h for checking the unlocking zone as per 4.9.2.3.5 or 4.9.3.9.3;

f) for at least 1 h for the display devices as per 4.2.6.6.2 c);

g) for at least 1 h to move the car as per 4.9.2.3.4 b) 1);

h) for the automatic rescue operation as per 4.12.1.12, where provided;

i) for at least 1 h for electrical means for tripping of the safety gear as per 4.6.2.2.5.1.

4.10.11.2 The design of the emergency supply shall consider the combined power requirements of all connected devices. A monitoring system shall indicate if the capacity of the emergency supply is less than required.

4.11 Protection against electric faults; failure analysis; electric safety devices

4.11.1 Protection against electric faults; failure analysis

4.11.1.1 Any single fault in the electric equipment of a lift shall not, on its own, be the cause of a dangerous malfunction of the lift. Faults may be excluded under conditions described in 4.11.1.3, 4.11.1.4 and/or ISO 8100-2:2025, 4.17.

4.11.1.2 Failure analysis shall consider at least the following faults:

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, e.g. 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.

k) short circuit between adjacent conductors of travelling cable.

4.11.1.3 The non-opening of a contact need not be considered in the case of safety contacts conforming to the requirements of 4.11.2.2.

4.11.1.4 Short circuit between two conductors may be excluded when the conductors are insulated for the highest voltage to which any of the conductors can be subjected, for example line to line voltage for unearthed systems and phase to earth voltage for earthed systems (see IEC 60204-1:2016+A1:2021, 13.1.3). This shall not apply to adjacent conductors of travelling cable.

4.11.1.5 An earth fault in an energized circuit in which there is an electric safety device, or in a circuit controlling the machine brake as per 4.9.2.2.2.3, or in a circuit controlling the down valve as per 4.9.3.4.3, shall:

a) either cause the immediate stopping of the lift machine; or

b) prevent restarting of the lift machine after the first normal stop.

The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)].

4.11.2 Electric safety devices

4.11.2.1 General provisions

4.11.2.1.1 The electric safety devices shall consist of:

a) safety contact(s) as per 4.11.2.2; or

b) safety circuit(s) as per 4.11.2.3, or

c) SIL-rated circuit(s) as per 4.11.2.4

4.11.2.1.2 Apart from exceptions permitted in this document (see 4.4.2.2.1 d) 1) ii), 4.6.2.2.4.1 e), 4.6.2.2.4.2 h), 4.6.5.9, 4.12.1.4, 4.12.1.5, 4.12.1.6, 4.12.1.8 and 4.12.1.12.2), 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 as per 4.11.2.3.2 and 4.11.2.3.3.

4.11.2.1.3 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 result in a dangerous condition.

4.11.2.1.4 An electric safety device when operating shall initiate immediately stopping of the lift machine and prevent its setting in motion unless it is:

— bypassed by an electric safety device as per 4.11.2 as permitted in 4.11.2.1.2; or

— bypassed by hold-to-run control device as permitted in 4.12.1.5 and 4.12.1.6.

The combined reaction time of the electric safety device and the equipment controlling the supply to the lift machine, to initiate stopping of the machine, shall not exceed 1 s.

The electric safety devices shall act directly on the equipment controlling the supply to the lift machine as per 4.9.2.2.2.3 a), 4.9.2.5 and 4.9.3.4.

If relays or contactor relays as per 4.10.3.1.2 are used to control the equipment controlling the supply to the lift machine, the monitoring of these relays or contactor relays shall be done as defined in 4.9.2.5 and 4.9.3.4.4.

4.11.2.1.5 The electric safety devices and their actuators shall be built so that any of the following conditions will not lead to an actuation failure of the electric safety device or so that this condition results in the operation of the electric safety device:

a) slip on traction or friction;

b) breakage or slack in tape, belt, chain or rope;

c) for sensors of safety circuits and SIL-rated circuits, the mechanical and thermal stresses as per ISO 8100-2:2025, 4.6.3.1.2 a) and 4.6.3.1.2 b) and 4.6.3.2.

In the case of redundancy-type safety circuits and SIL-rated circuits, it shall be ensured by mechanical or geometric arrangements of the sensors that a mechanical fault shall not cause loss of redundancy.

Slip on traction between overspeed governor and overspeed governor rope can be excluded for speed monitoring.

4.11.2.2 Safety contacts

4.11.2.2.1 Safety contacts shall be in accordance with IEC 60947-5-1:2024, Annex K, with a minimum protection degree of IP4X (IEC 60529:1989+AMD1:1999+AMD2:2013) and a mechanical durability suitable for its purpose (at least 10^6 operating cycles). Alternatively, they shall fulfil the following requirements.

4.11.2.2.2 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.

A mechanical durability shall be at least 10^6 operating cycles to avoid 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.

4.11.2.2.3 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 IP4X (IEC 60529:1989+AMD1:1999+AMD2:2013), or 500 V if the degree of protection of the enclosure is less than IP4X (IEC 60529:1989+AMD1:1999+AMD2:2013).

The safety contacts shall belong to the following categories as defined in IEC 60947-5-1:2024:

a) AC-15 for safety contacts in A.C. circuits;

b) DC-13 for safety contacts in D.C. circuits.

4.11.2.2.4 If the degree of protection is less than IP4X (IEC 60529:1989+AMD1:1999+AMD2:2013), the clearances shall be at least 5,5 mm, the creepage distances at least 8 mm and the distances for breaking contacts at least 4 mm after separation.

If the degree of protection is equal to IP4X (IEC 60529:1989+AMD1:1999+AMD2:2013), 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 degree of protection is better than IP4X (IEC 60529:1989+AMD1:1999+AMD2:2013), the creepage distance may be reduced to 3 mm.

4.11.2.2.5 In the case of multiple breaks, the distance after separation between the contacts shall be at least 2 mm.

4.11.2.3 Safety circuits

4.11.2.3.1 Failure analysis of safety circuits required in 4.11.2.3.2 and 4.11.2.3.3 shall take into account faults for the entire circuit, including sensors, signal transmission paths, connectors, power supplies, safety logic and safety output.

4.11.2.3.2 Safety circuits shall be in accordance with 4.11.1.

All components of safety circuit shall be used within their operational limits at operating and environmental conditions indicated as per 6.2.2 k).

Derating shall be applied on components of which fault can result to dangerous situation as per 4.11.2.3.3.

The response time of the safety circuit shall not exceed 1 s.

4.11.2.3.3 Furthermore, as illustrated by Figure 38, 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, can lead to a dangerous situation when combined with a third fault, 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 at the latest prior to a re-start of the lift and, in case of failure, re-starting shall not be possible;

d) on restoration of the power supply after it has been disconnected, maintaining the lift in the stopped position is not necessary, provided that during the next sequence stopping is re-imposed in the cases covered by 4.11.2.3.3 a), b) and c);

e) in redundancy-type circuits, measures shall be taken to prevent faults occurring simultaneously in more than one channel, arising from a single cause.

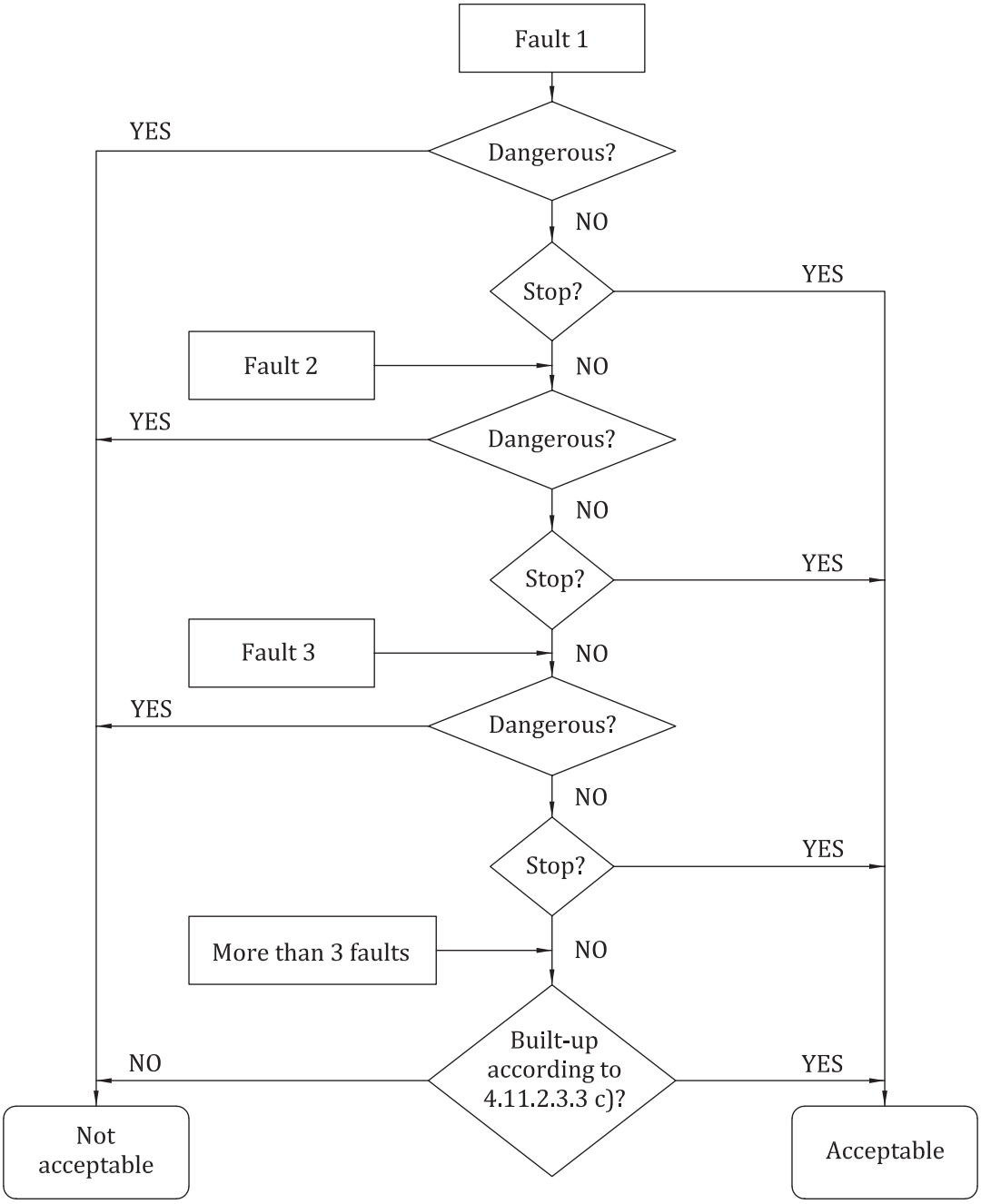


Figure 38 — Diagram for assessing safety circuits

4.11.2.3.4 A Safety circuit where any logic decision or failure detection decision is made using electronic components shall be verified in accordance with ISO 8100-2:2025, 4.6.

Neither safety logic nor failure detection of safety circuit(s) shall contain electronic devices based on computer technology (see 3.54 and 3.59).

4.11.2.3.5 A data plate shall be fixed on safety circuits verified in accordance with ISO 8100-2:2025, 4.6 indicating:

a) the name of the manufacturer

b) its identification.

4.11.2.4 SIL-rated circuits

4.11.2.4.1 General

4.11.2.4.1.1 SIL-rated circuits shall be in accordance with ISO 8100-2:2025, 4.18 and shall have:

— a minimum safety integrity level in accordance with Table A.1 or in the clause referencing the use of SIL-rated circuits;

— a maximum response time of 1 s.

4.11.2.4.1.2 SIL-rated circuits shall be in accordance with 4.11.1.

Failure analysis shall take into account faults for the entire circuit including sensors, signal transmission paths, connectors, power supplies, safety logic and safety output.

All components of SIL-rated circuits shall be used within their operational limits at operating and environmental conditions indicated as per 6.2.2 k).

Derating shall be applied on components that contribute to dangerous failure rate of SIL-rated circuit.

4.11.2.4.1.3 For SIL-rated circuits a proof test interval at least 20 years shall be used in PFD_{avg}/ PFH calculations.

The mission time shall not be longer than the proof test interval.

For SIL-rated circuits, applied as electric safety device listed in Table A.1, high demand as well as low demand mode of operation shall be considered and the calculated PFD_{avg} and PFH values shall be in accordance with the limits given in Table 22.

Table 22 — PFD_{avg} and PFH values

SIL	PFD_{avg}	PFH
1	$< 5\times10^{-2}$	$< 5\times10^{-6}$
2	$< 5\times10^{-3}$	$< 5\times10^{-7}$
3	$< 5\times10^{-4}$	$< 5\times10^{-8}$

NOTE For clarification of terms high demand, low demand and proof test, see IEC 61508-4:2010.

4.11.2.4.1.4 If a SIL-rated circuit and a non-SIL-rated circuit share the same printed circuit board (PCB), the requirements of 4.10.3.2 shall apply for the separation of the two circuits.

If a SIL-rated circuit and a non-safety-related circuit share the same hardware, the requirements for the SIL-rated circuit shall be met.

4.11.2.4.1.5 It shall be possible to identify the failure state of the SIL-rated circuit, either by a built-in system or by an external tool. If this external tool is a special tool, it shall be provided with the lift.

4.11.2.4.1.6 SIL-rated circuits shall be verified in accordance with ISO 8100-2:2025, 4.6.

4.11.2.4.1.7 A data plate shall be fixed on SIL-rated circuits indicating:

a) the name of the manufacturer;

b) its identification;

c) the date of manufacturing;

d) the mission time.

4.11.2.4.2 Software

4.11.2.4.2.1 SIL-rated circuits shall be provided with measures to prevent replacement of the program code without authorization by the manufacturer. Authorization shall follow requirements of IEC 61508-1:2010, 7.16.2.2.

Only software and hardware combinations which have been verified in accordance with the requirements of ISO 8100-2: 2025, 4.6 shall be used.

4.11.2.4.2.2 Replacement of the program code shall only be possible if replacement is enabled by a manual action on site.

When replacement of the program code is enabled the SIL-rated circuit shall achieve or maintain its safe state.

The return to functional state of the SIL-rated circuit shall require manual reset on site . A power cycle by itself shall not provide this reset.

Means to return SIL-rated circuit to its functional state shall fulfil the highest SIL of the SIL-rated circuit.

4.11.2.4.3 Parametrization

4.11.2.4.3.1 General provisions

SIL-rated circuits are permitted to have parameters to enable the system to be matched to its application.

Parameters shall be prevented from unintentional modification.

Parameters shall have defined value ranges.

For documentation see 6.2.

4.11.2.4.3.2 Additional requirements for software driven parametrization

Change of parameter shall only be possible if parametrization is enabled by a manual action on site.

Means for activation and deactivation of parametrization shall fulfil at least the SIL of the safety function to be parametrized.

When parametrization is enabled the SIL-rated circuit shall be in a safe state.

Deactivation of parametrization shall only be possible by an intentional action on site.

Unintentional deactivation of parametrization shall be prevented. Power interruption and restoration shall be considered as unintentional actions.

4.12 Electrical Controls

4.12.1 Control of lift operations

4.12.1.1 Normal operation

4.12.1.1.1 Devices to operate the lift by passengers

The devices located in the lift car and on the landings shall be identified by their shape, with symbols, numbers, text, or any combination thereof.

The devices located on the landings may be used to operate a group of lifts.

The device(s) for re-opening power-operated doors located in the car or on the landing shall be identified with the symbol defined in ISO 4190-5:2006, Table C.1 No.2.

The alert initiation devices(s) shall be identified with the symbol defined in IEC 60417:2002-5013 or ISO 7000:2019-2301 (ISO 4190-5:2006, Table C.1, No.1).

The colour yellow shall not be used for other devices than the alert initiation device(s).

NOTE See Annex E for additional information.

4.12.1.1.2 Indication of the landing

The designation of the landing at which the lift has stopped shall be displayed inside the car.

4.12.1.1.3 Stopping accuracy

The stopping accuracy shall be ±10 mm. If, during loading and unloading phases for example, the levelling accuracy of ±20 mm is exceeded, it shall be corrected to ±10 mm.

Re-levelling, if provided, shall be possible with doors not closed and locked as per 4.12.1.4.

4.12.1.1.4 Door re-open button

If a car door is automatic power-operated, a control button inside the car shall allow to reopen the door(s) when the car is at the landing.

NOTE This is normally referred to as a “door re-open button”.

4.12.1.1.5 Delayed start

The acoustic signal referenced in 4.12.1.8.3 c) shall be activated for duration of at least 2 seconds before any re-start of the lift in automatic operation when stopping was initiated by an electric safety device.

4.12.1.2 Load control

4.12.1.2.1 The lift shall be fitted with a device to prevent starting in automatic operation, including re-levelling, in the event of overload in the car. In the case of hydraulic lifts and in the case of goods passenger lift with mechanical device preventing downwards movement as per 4.4.2.2.1 d) or 4.4.2.2.2 f), the device shall not prevent re-levelling.

4.12.1.2.2 The overload shall be detected at the latest when the rated load is exceeded by 10 %.

4.12.1.2.3 In the event of overload:

a) an acoustic signal adjustable between 35 dB(A) and at least 65 dB(A) shall be provided. For goods passenger lifts, the acoustic signal shall be adjustable up to at least 80 dB(A). The sound level shall be measured at 1,50 m height at the centre of the door opening when the door is fully open

b) an optical signal in the car shall be provided, either in accordance with ISO 4190-5:2006, Table C.1 No.7 or as a word “OVERLOAD”

c) automatic power-operated doors shall be brought into the fully open position;

d) manually operated doors shall remain unlocked;

e) any preliminary operation as per 4.12.1.4 shall be nullified.

4.12.1.3 Monitoring the normal slowdown of the lift machine in case of reduced stroke buffer

4.12.1.3.1 In the case of 4.8.1.5 b) and 4.8.2.2.1 b), electric safety device(s) as per 4.11.2 shall check that the slowdown is effective before arrival at terminal landings.

If the slowdown is not effective, the machine brake shall cause the car speed to be reduced in such a way that if the car or the counterweight comes into contact with the buffers, the striking speed shall not exceed that for which the buffers were designed.

4.12.1.3.2 Once activated, the electric safety device shall keep the lift out of automatic operation. The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

4.12.1.4 Control of levelling, re-levelling and preliminary operation with doors not closed and locked

Movement of the car with landing and car doors not closed and locked is permitted for levelling, re-levelling and preliminary operation on condition that:

a) the unlocking zone (4.3.8.1) shall be checked by an electric safety device as per 4.11.2, limiting the movement to the unlocking zone. During preliminary operations, the car shall be kept within 20 mm from the landing (see 4.12.1.1.3 and 4.4.2.2.1);

b) 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;

c) the speed of levelling shall not exceed 0,80 m/s;

d) the speed of re-levelling shall not exceed 0,30 m/s.

4.12.1.5 Inspection operation

4.12.1.5.1 Control interface

4.12.1.5.1.1 Inspection operation control devices shall be permanently installed:

a) on the car roof (4.4.8 a);

b) in the pit area (4.2.1.3.1 b);

c) in the car in the case of 4.2.6.4.3.3;

d) on a platform in the case of 4.2.6.4.5.6.

4.12.1.5.1.2 The inspection operation control devices shall consist of:

a) a switch (inspection operation switch). This switch, which shall be bi-stable, shall be protected against unintentional operation. Rotary control switches shall have a means of prevention of rotation of the stationary member. Friction alone shall not be considered to be sufficient;

b) direction push buttons “UP” and “DOWN” protected against unintentional operation with the direction of movement clearly indicated;

c) a push button "RUN" protected against unintentional operation;

d) a stopping device as per 4.12.1.11.

It shall be possible to operate the "RUN" button and a direction button with one hand simultaneously.

The distance between the "RUN" button and a stopping device shall not exceed 0,30 m.

The inspection operation control devices on the car roof may also incorporate additional hold-to-run control device(s), protected against unintentional operation, for controlling the mechanism of doors.

4.12.1.5.1.3 The inspection operation control devices shall have a minimum degree of protection of IPXXD (IEC 60529:1989+AMD1:1999+AMD2:2013).

4.12.1.5.2 Control of inspection operation

4.12.1.5.2.1 While an inspection operation switch is in "INSPECTION" position:

a) an electric safety device as per 4.11.2 shall be operated;

b) in case of the emergency electrical operation switch is in the "ON" position;

   1) effects of 4.12.1.6.2.1 c) shall be nullified;

   2) bypass of devices in 4.12.1.6.2.1 b) shall be disabled by electric safety device as per 4.11.2;

c) following electrical safety devices shall be bypassed:

   1) in case of 4.2.6.4.3.3, the inspection operation switch as per 4.12.1.5.1.1 c) shall bypass the electric safety device as per 4.2.6.4.3.2 e);

   2) in case of 4.2.6.4.5.4, the inspection operation switch as per 4.12.1.5.1.1 d) shall bypass the electric safety device as per 4.2.6.4.5.4 a);

   3) in case of 4.2.6.4.5.5, the inspection operation switch as per 4.12.1.5.1.1 d) shall bypass the electric safety device as per 4.2.6.4.5.5 b)

d) in case inspection operation travel beyond the final limit switch is permitted as per 4.12.1.5.2.1 f) 4), the inspection operation switch shall bypass by itself or through another electric device the following electric safety devices:

   1) those mounted on the buffers, as per 4.8.2.2.3;

   2) final limit switches, as per 4.12.2;

e) any automatic power-operated movement of the door(s) shall be prevented;

   1) Manually controlled power-operated closing and locking of the door(s) shall be performed by the operation of a direction push button or simultaneous operation of a direction push button and the "RUN" button as per 4.12.1.5.2.3.

      i) When the inspection operation switch located at the car roof is in the "INSPECTION" position, manually controlled closing of the door(s) shall only be initiated by the inspection operation control devices at the car roof .

      ii) Protective device as per 4.3.6.2.2.1 b) or 4.3.6.2.3.2 a) 4) shall be deactivated and door(s) closing shall be as defined in 4.3.6.2.2.1 b) 3) or 4.3.6.2.3.2 a) 4) iii).

   2) In addition, manually controlled power-operated closing and opening of the door(s) is permitted by operation of additional hold-to-run control device(s) on the car roof, if any.

f) car movement shall be controlled by the hold-to-run control device as per 4.12.1.5.2.3, and:

   1) the car speed shall not exceed 0,63 m/s;

   2) the car speed shall not exceed 0,30 m/s when the vertical distance above any standing area on car roof (see 4.2.5.7.3) or in pit is 2,00 m or less;

   3) the car shall stop before final limit switch;

4) further movement is permitted under following conditions:

i) the speed shall be limited to 0,15 m/s;

ii) the requirements of 4.12.1.8.3 c) shall apply;

iii) the push buttons of the hold-to-run control device shall be released and pressed again.

g) levelling and re-levelling (4.12.1.4) shall be disabled;

h) automatic operation shall be disabled

i) if inspection operation switches are switched to “INSPECTION" position in more than one location as per 4.12.1.5.1.1:

1) the car shall be prevented from moving; or

2) movement of the car shall only be possible by operation of the run button and the same direction push button on the respective locations simultaneously.

4.12.1.5.2.2 While all inspection operation switches are in “NORMAL” position:

a) effects of 4.12.1.5.2.1 shall be nullified

b) bypass of devices in 4.12.1.5.2.1 c) shall be disabled by an electric safety device as per 4.11.2.

c) bypass of devices in 4.12.1.5.2.1 d) shall be disabled by an electric safety device as per 4.11.2.

4.12.1.5.2.3 The hold-to-run control device shall bypass the electric safety device as per 4.12.1.5.2.1 a) at the respective location only (see 4.12.1.5.1.1). The hold-to-run control device shall be a series connection of a direction and the "RUN" push button. These push buttons shall either:

a) belong to the following categories, as defined in IEC 60947-5-1:2024:

— AC-15 for contacts in A.C. circuits;

— DC-13 for contacts in D.C. circuits;

The durability shall be at least 1 000 000 mechanical and electrical operating cycles related to the applied load; or

b) be monitored by an electric safety device as per 4.11.2.

NOTE Series connection means that a direction button and "RUN" push button both can interrupt the bypass.

4.12.1.5.3 Return to automatic operation of the lift

The return of the lift to automatic operation shall only be possible after switching all inspection operation switches back to “NORMAL” position.

Unless the return of the lift to automatic operation requires intentional reset outside of the well, the acoustic signal referenced in 4.12.1.8.3 c) shall be activated for a duration of at least 2 seconds just before the first start of the lift in automatic operation.

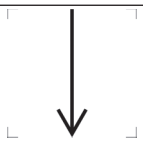
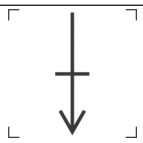
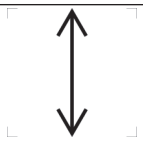
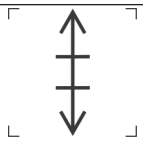
4.12.1.5.4 Inspection operation control devices designations

The following information shall be given on the inspection operation control device(s):

a) the words **“NORMAL”** and **“INSPECTION”** on or near the inspection operation switch;

b) the direction of motion identified by colours, as in Table 23.

Table 23 — Inspection operation control devices — Button designations

			In case inspection operation cannot bypass normal travel limits		In case inspection operation can bypass normal travel limits as permitted in 4.12.1.5.2.1 f) 4)	
Control	**Colour of button**	**Colour of symbol**	**Symbol reference**	**Symbol**	**Symbol reference**	**Symbol**
UP	White	Black	IEC 60417:2002-5022		IEC 60417:2002-2765	
DOWN	Black	White	IEC 60417:2002-5022		IEC 60417:2002-2765	
RUN	Blue	White	IEC 60417:2002-5023		IEC 60417:2002-2764	

4.12.1.6 Emergency electrical operation

4.12.1.6.1 Control interface

4.12.1.6.1.1 Where provided, the emergency electrical operation switch and the movement control device(s) shall be placed as per 4.9.2.3.7 and so that the lift machine can be observed directly or by display device(s) as per 4.2.6.6.2 c);

4.12.1.6.1.2 The emergency electrical operation control interface shall consist of:

a) a switch (emergency electrical operation switch). This switch shall be bi-stable and shall have positions “ON” and “OFF”. Rotary control switch shall have a means of prevention of rotation of the stationary member. Friction alone shall not be considered sufficient.

b) a hold-to-run control device for car movement control.

4.12.1.6.1.3 The emergency electrical operation control interface shall have a minimum degree of protection of IPXXD (IEC 60529:1989+AMD1:1999+ AMD2: 2013).

4.12.1.6.2 Control of emergency electrical operation

4.12.1.6.2.1 While the emergency electrical operation switch is in “ON” position;

a) an electric safety device as per 4.11.2 shall be operated;

b) bypass of the following electric safety devices through hold-to-run control device(s) as per 4.12.1.6.2.3 shall be enabled:

   1) electric safety device as per 4.12.1.6.2.1 a);

   2) electric safety device checking slack rope or chain, as per 4.5.5.3 b);

   3) electric safety device checking car safety gear, as per 4.6.2.1.5;

   4) electric safety device checking overspeed, as per 4.6.2.2.1.6 a) and b);

   5) electric safety device checking the electrical means as per 4.6.2.2.5.4 a) and b)

6) electric safety device checking the ascending car overspeed protection means, as per 4.6.6.5;

7) electric safety device checking buffers, as per 4.8.2.2.3;

8) final limit switches, as per 4.12.2;

c) car movement shall be controlled by the hold-to-run control device(s) as per 4.12.1.6.2.3; and

1) the car speed shall not exceed 0,30 m/s.

2) In case of hydraulic lifts down movements shall only be enabled when the hydraulic system is preventing further sinking of the ram beyond that causing slackening of all ropes/chains.

d) any automatic power-operated movement of the door(s) shall be prevented;

1) Manually controlled power-operated closing and locking of the door(s) shall be performed by the operation of a hold-to-run control device. This hold-to-run control device may be combined with the hold-to-run control device(s) controlling the car movement as per 4.12.1.6.2.3.

2) Protective device as per 4.3.6.2.2.1 b) or 4.3.6.2.3.2 a) 4) shall be deactivated and door(s) closing shall be as defined in 4.3.6.2.2.1 b) 3) or 4.3.6.2.3.2 a) 4) iii).

e) automatic operation shall be disabled.

4.12.1.6.2.2 While the emergency electrical operation switch is in “OFF” position;

a) effects of 4.12.1.6.2.1 shall be nullified

b) bypass of devices in 4.12.1.6.2.1 b) shall be disabled by electric safety device as per 4.11.2.

4.12.1.6.2.3 Hold-to-run control device for activation of bypass of the electric safety devices enabled in 4.12.1.6.2. b) shall be done by one of the following solutions:

a) One or more contacts belonging to the following categories, as defined in IEC 60947-5-1:2024:

— AC-15 for contacts in A.C. circuits;

— DC-13 for contacts in D.C. circuits.

The durability shall be at least 1 000 000 mechanical and electrical operating cycles related to the applied load.

b) At least two devices activated by constant manual force on a control device(s). Correct operation of devices shall be monitored by electric safety device as per 4.11.2.

Rotary control switches shall have a means of prevention of rotation of the stationary member. Friction alone shall not be considered sufficient.

4.12.1.7 Protection for maintenance operations

The control system shall be provided with means to:

— prevent the lift from answering to landing calls and remote commands;

— disable the automatic door operation and prevent the automatic test functions of the lift; and

— give at least terminal floor calls for maintenance.

The means shall be identifiable [see 6.2.4 t)] and shall be accessible only by use of a key.

4.12.1.8 Landing and car door bypass device

4.12.1.8.1 Bypass device(s) shall be provided in the machine room, the machinery cabinet or the emergency and test panel.

4.12.1.8.2 The device(s) shall be either a switch protected against unintended use by mechanically movable means (e.g. cover, security cap) permanently installed, or a plug socket combination.

Following conditions for functioning shall apply and shall satisfy the requirements for electric safety devices as per 4.11.2:

a) bypassing the electrical safety devices of the landing doors (4.3.9.4, 4.3.11.2), the landing door locks (4.3.9.1), the car door(s) (4.3.13.2) and the car door locks (4.3.9.2) shall be possible;

b) it shall not be possible to bypass the electrical safety devices of the car door(s) and landing doors at the same time;

c) in case of manually operated landing doors, it shall not be possible to bypass the electrical safety devices of the landing doors (4.3.9.4) and the landing door lock(s) (4.3.9.1) at the same time;

d) movement of the car shall only be possible in inspection operation (4.12.1.5) and emergency electrical operation (4.12.1.6);

4.12.1.8.3 Other conditions for functioning when any of bypass device(s) is in bypass state:

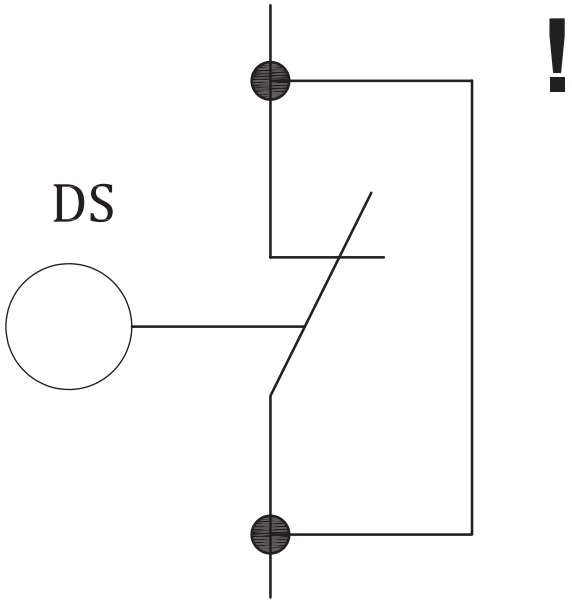
a) normal operation controls (4.12.1.1.1), shall be neutralized, and any automatic movement of power-operated doors shall be prevented;

b) 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 electrical safety device checking car door closed status. This shall also apply if the electrical safety device checking car door closed position and checking the car door locking are combined;

c) an acoustic signal at the car shall be activated at least 1 s before movement and shall remain active during movement. The sound level of the acoustic signal shall be minimum 55 dB(A) below the car at a distance of 1,00 m.

4.12.1.8.4 The landing and car door bypass devices shall be identifiable by the word "**BYPASS**" written on or near to them. In addition, the electrical safety devices to be bypassed shall be indicated with the identifiers as per the electrical diagrams.

Alternatively, the symbol shown in Figure 39 together with an identifier as per electric diagrams can be used.



Key
DS example of designation found on the wiring diagram

Figure 39 — Bypass symbol

The activation state of the bypass device(s) shall be indicated [see 6.2.4 s)].

4.12.1.9 Prevention of automatic operation of the lift with faulty circuits for checking closed and locked position of doors

During automatic operation, the correct operation of:

— the circuit used for checking the closed position of a car door (4.3.13.2);

— the circuit used for checking the locked position of a landing door locking device (4.3.9.1); and

— the monitoring signal referred to in 4.12.1.8.3 b).

shall be checked at least once while the car is in the unlocking zone, the car door is opened and the landing door lock is released.

The contacts of a door assembly may be checked in a series connected circuit

If a circuit or the monitoring signal is detected faulty, automatic operation of the lift shall be prevented.

4.12.1.10 Electrical anti-creep system (see Table 16)

An electrical anti-creep system shall satisfy the following conditions:

a) the car shall be dispatched automatically to the lowest landing within 30 min after the last normal journey, the time can be adjustable from minimum 15 min to maximum 30 mins;

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;

c) there shall be an inscription on or near the main switch as follows:

"Switch off only when the car is at the lowest landing".

4.12.1.11 Stopping devices

4.12.1.11.1 A stopping device shall be provided for stopping, and maintaining the lift out of service, and preventing automatic movement of power-operated doors:

a) at the inspection operation control device(s) [4.12.1.5.1.2 d)];

b) in the pulley room [4.2.1.3.3];

c) in the lift pit below the pit platform if there are moving parts below the pit platform [4.2.1.3.1 d)].

d) at the lift machine, unless another stopping device or a main switch is available at a shortest horizontal clear distance not exceeding 1,00 m. This requirement shall not apply when the lift machine is located in the well;

e) at the test panel(s) (4.2.6.6), when it is separate from the emergency panel (4.10.5.1.2 c) unless another stopping device is available at a shortest horizontal clear distance not exceeding 1,00 m.

The marking "**STOP**" shall be on or near the stopping device.

4.12.1.11.2 The stopping devices shall consist of electric safety devices as per 4.11.2. They shall be bi-stable and such that a return to service cannot result from an involuntary action.

4.12.1.11.3 A stopping device in the car shall not be used.

4.12.1.12 Control of automatic rescue operation

4.12.1.12.1 Automatic rescue operation if provided shall move the lift car to a landing in case of failure or loss of power supply.

4.12.1.12.2 The automatic rescue operation shall not make ineffective any electric safety device unless additional electric safety device provides same safety function.

NOTE As example electric safety devices for overspeed detection and check on retardation can be replaced with additional electric safety device which operates at buffer rated speed or lower.

4.12.1.12.3 Car speed shall not exceed rated speed during automatic rescue operation.

4.12.1.12.4 Stopping accuracy after a car movement with automatic rescue operation shall be ±20 mm. Re-levelling is not required.

Opening of doors during levelling as per 4.12.1.4 shall not be permitted during automatic rescue operation.

An acoustic signal shall operate at any time the doors are not closed and the levelling accuracy exceeds 20 mm for more than 3 seconds.

The sound level of the acoustic signal shall be adjustable between 35 dB(A) and 65 dB(A). The sound level shall be measured at the centre of the car, 1,00 m above the floor.

4.12.1.12.5 In case automatic rescue operation uses emergency supply common with other emergency supplies as per 4.10.11, all corresponding performance requirements shall be fulfilled after automatic rescue operation is ceased..

4.12.2 Final limit switches

4.12.2.1 General

Final limit switches shall be provided:

a) at top and bottom of travel for traction and positive drive lifts;

b) at top of travel only for hydraulic lifts.

Final limit switches shall operate before the car (or counterweight if provided) comes into contact with the buffers or the ram comes into contact with its cushioned stop. The actuation of the final limit switches shall be maintained while the buffers are compressed or the ram is in the zone of the cushioned stop.

4.12.2.2 Actuation of the final limit switches

4.12.2.2.1 Separate actuating devices shall be used for normal terminal stopping and final limit switches.

4.12.2.2.2 In the case of positive drive lifts, actuation of the final limit switches shall be effected by:

a) a device linked to the movement of the lift machine; or

b) the car and by the balancing weight, if provided, at the top of the well; or

c) the car at the top and the bottom of the well, if there is no balancing weight.

4.12.2.2.3 In the case of traction drive lifts, actuation of the final limit switches shall be effected either:

a) directly by the car at the top and bottom of the well; or

b) indirectly by a rope, belt or chain linked to the car.

4.12.2.2.4 In the case of a direct acting lift, actuation of the final limit switch shall be effected either:

a) by the car or the ram, or

b) indirectly by a rope, belt or chain linked to the car.

4.12.2.2.5 In the case of indirect acting hydraulic lifts, actuation of the final limit switch shall be effected:

a) either directly by the ram; or

b) indirectly by a rope, belt or chain linked to the ram.

4.12.2.2.6 In the case of 4.12.2.2.3 b), 4.12.2.2.4 b) and 4.12.2.2.5 b) the breakage of, or slack in, the linkage shall be checked by an electric safety device as per 4.11.2.

4.12.2.3 Method of operation of final limit switches

4.12.2.3.1 The final limit switch(es) shall:

a) directly open by positive mechanical separation the circuits feeding the lift machine; or

b) be an electric safety device as per 4.11.2.

4.12.2.3.2 After the operation of the final limit switches, car movement in response to car and landing calls shall no longer be possible, even in the case of the car leaving the actuation zone due to creeping.

When an electrical anti-creep system as per 4.12.1.10 is used, the automatic dispatch of the car as per 4.12.1.10 a) shall come into operation immediately as soon as the car leaves the actuation zone of the final limit switch.

The return of the lift to automatic operation shall require intentional reset on site [see 6.2.4 f)]. A power cycle by itself shall not provide this reset.

4.12.3 Alert initiation and intercom system

4.12.3.1 Alert initiation device(s) shall be installed in the car. The alert initiation device(s) shall:

a) be connected to a two-way communication system in accordance with EN 81-28:2025; or

b) activate an acoustic device with a sound level of 80 dB(A) at 1,00 m distance, located on the car roof or at a landing. The acoustic device shall be powered by the emergency supply as per 4.10.11.

4.12.3.2 An intercom system, powered by the emergency supply as per 4.10.11, 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.

4.12.3.3 During voice communication of the two-way communication system as per 4.12.3.1 a) or the intercom system as per 4.12.3.2, acoustic signals in the lift (e.g. music, alarm bell), if available, shall be disabled.

4.12.4 Identification of the software

Software relevant for safety functions referenced in Table 25 shall be identified.

When replacement of identified software is possible, software version information shall be available on demand. Software version information shall be available in human readable form, either by a built-in system or by an external tool. If this external tool is a special tool, it shall be provided with the lift.

NOTE A laptop or a mobile phone with freely available application is not considered as a special tool.

5 Verification of the safety requirements and/or protective measures

5.1 Verification methods

Table 24 indicates the methods by which the safety requirements and/or protective measures described in Clause 4 shall be verified. Secondary sub-clauses, which are not listed in Table 24, are verified as part of the quoted sub-clause.

Table 24 — Means of verification of the safety requirements and/or protective measures

Sub-clause	Safety requirements	Inspection[a]	Performance check / test[b]	Measure-ment[c]	Drawing / calculation[d]	User information[e]
4.1	**General**					
4.1.1	Non-significant hazards	✓				✓
4.1.2	Fixing system of guards					✓
4.1.3	Notices and Labels	✓				✓
4.2	**Well, machinery spaces and pulley rooms**					
4.2.1	General provisions	✓	✓	✓	✓	✓
4.2.2	Access to the pit	✓		✓		✓
4.2.3	Access doors, emergency doors, trap doors and inspection doors	✓		✓		✓
4.2.4	Notices	✓				✓
4.2.5	Well	✓	✓	✓	✓	✓
4.2.6	Machinery spaces and pulley rooms	✓	✓	✓	✓	✓
4.3	**Landing and car doors**					
4.3.1	General provisions	✓		✓	✓	
4.3.2	Height and width of en-trances			✓	✓	
4.3.3	Sills, guides, door suspen-sion	✓	✓		✓	
4.3.4	Horizontal door clearanc-es	✓	✓	✓	✓	✓
4.3.5	Strength of landing and car doors	✓	✓	✓	✓	✓
4.3.6	Protection in relation to door operation	✓	✓	✓	✓	✓
4.3.7	“Car here” indication	✓	✓	✓		✓
4.3.8	Locking and closed land-ing door check	✓	✓			✓
4.3.9	Locking and emergency unlocking of landing and car doors	✓	✓			✓
4.3.10	Requirements common to devices for proving the locked condition and the closed condition of the landing door		✓			
4.3.11	Sliding landing doors with multiple, mechanically linked panels	✓	✓		✓	

[a] Inspection is to verify whether the feature called for by the requirement is present

[b] A performance check/test verifies that the features provided perform their function in such a way that the requirement is met.

[c] Measurement verifies, by the use of instruments, that requirements are met to the specified limits.

[d] Drawings/calculations verify that the design characteristics of the components provided meet the requirements.

[e] Verify that the relevant point is dealt with in the instructions or by marking.

Table 24 *(continued)*

Sub-clause	Safety requirements	Inspection[a]	Performance check / test[b]	Measure-ment[c]	Drawing / calculation[d]	User information[e]
4.3.12	Closing of automatically operated landing doors	✓	✓		✓	✓
4.3.13	Electric safety device for proving the car door closed	✓	✓			✓
4.3.14	Sliding or folding car door with multiple, mechanically linked panels	✓	✓		✓	
4.3.15	Opening the car door	✓	✓		✓	
4.4	**Car, counterweight and balancing weight**					
4.4.1	Height of car			✓	✓	✓
4.4.2	Available car area, rated load, number of passengers		✓	✓	✓	✓
4.4.3	Walls, floor and roof of the car	✓			✓	
4.4.4	Car door(s), floor, walls, ceiling and decorative materials	✓			✓	
4.4.5	Apron	✓		✓	✓	
4.4.6	Emergency trap doors and emergency doors	✓		✓	✓	✓
4.4.7	Car roof	✓	✓	✓	✓	✓
4.4.8	Equipment on top of the car	✓	✓			
4.4.9	Ventilation	✓			✓	
4.4.10	Lighting	✓	✓	✓	✓	✓
4.4.11	Counterweight/balancing weight	✓			✓	
4.5	**Suspension means, compensation means and related protection means**					
4.5.1	Suspension means and related sheaves/drums/sprockets	✓		✓	✓	✓
4.5.2	Minimum diameter ratio, safety factor, fatigue lifetime and suspension means terminations	✓		✓	✓	
4.5.3	Suspension means traction/transmission		✓		✓	
4.5.4	Winding up of ropes for positive drive lifts		✓		✓	
4.5.5	Distribution of load between the suspension means	✓	✓		✓	

[a] Inspection is to verify whether the feature called for by the requirement is present

[b] A performance check/test verifies that the features provided perform their function in such a way that the requirement is met.

[c] Measurement verifies, by the use of instruments, that requirements are met to the specified limits.

[d] Drawings/calculations verify that the design characteristics of the components provided meet the requirements.

[e] Verify that the relevant point is dealt with in the instructions or by marking.

Table 24 *(continued)*

Sub-clause	Safety requirements	Inspection[a]	Performance check / test[b]	Measure-ment[c]	Drawing / calculation[d]	User information[e]
4.5.6	Compensation means		✓		✓	
4.5.7	Protection for sheaves, pulleys and sprockets	✓			✓	
4.5.8	Traction sheaves, pulleys and sprockets	✓		✓	✓	
4.5.9	Marking of suspension means and compensation means	✓				✓
4.6	**Precautions against free fall, excessive speed, unintended car movement and creeping of the car**					
4.6.1	Application of protections means	✓			✓	✓
4.6.2	Safety gear and its tripping means	✓	✓		✓	✓
4.6.3	Rupture valve	✓	✓		✓	✓
4.6.4	Restrictors	✓	✓	✓	✓	
4.6.5	Pawl device	✓	✓		✓	
4.6.6	Ascending car overspeed protection means	✓	✓	✓	✓	✓
4.6.7	Protection against unintended car movement	✓	✓	✓	✓	✓
4.7	**Guide rails**					
4.7.1	Guiding of the car, counterweight or balancing weight	✓			✓	✓
4.7.2	Forces and load cases				✓	
4.7.3	Combination of masses and forces				✓	
4.7.4	Impact factors				✓	
4.7.5	Permissible stresses and deflections				✓	
4.8	**Buffers**					
4.8.1	General provisions	✓	✓	✓	✓	✓
4.8.2	Stroke of buffers	✓	✓		✓	✓
4.9	**Lift machinery and associated equipment**					
4.9.1	General provision	✓			✓	
4.9.2	Lift machine for traction lifts and positive drive lifts	✓	✓	✓	✓	✓
4.9.3	Lift machine for hydraulic lifts	✓	✓	✓	✓	✓
4.10	**Electric installations and appliances**					
4.10.1	General provisions	✓	✓	✓	✓	✓

[a] Inspection is to verify whether the feature called for by the requirement is present

[b] A performance check/test verifies that the features provided perform their function in such a way that the requirement is met.

[c] Measurement verifies, by the use of instruments, that requirements are met to the specified limits.

[d] Drawings/calculations verify that the design characteristics of the components provided meet the requirements.

[e] Verify that the relevant point is dealt with in the instructions or by marking.

Table 24 *(continued)*

Sub-clause	Safety requirements	Inspection[a]	Performance check / test[b]	Measure-ment[c]	Drawing / calculation[d]	User information[e]
4.10.2	Incoming supply conductor terminations				✓	
4.10.3	Contactors, contactor relays, components of safety circuits	✓	✓		✓	
4.10.4	Protection of electrical equipment	✓	✓		✓	✓
4.10.5	Main switch, supply disconnecting devices and isolating devices	✓	✓		✓	✓
4.10.6	Electric wiring	✓			✓	
4.10.7	Lighting and socket outlets	✓	✓		✓	✓
4.10.8	Control of the supply for lighting and socket outlets	✓	✓		✓	✓
4.10.9	Protective earthing		✓		✓	
4.10.10	Identification of electrical components	✓			✓	✓
4.10.11	Emergency supply	✓			✓	✓
4.11	**Protection against electric faults; failure analysis; electric safety devices**					
4.11.1	Protection against electric faults; failure analysis	✓	✓		✓	✓
4.11.2	Electric safety devices	✓	✓		✓	✓
4.12	**Electrical controls**					
4.12.1	Control of lift operations	✓	✓	✓	✓	✓
4.12.2	Final limit switches	✓	✓		✓	
4.12.3	Identification of electrical components	✓	✓	✓	✓	✓

[a] Inspection is to verify whether the feature called for by the requirement is present

[b] A performance check/test verifies that the features provided perform their function in such a way that the requirement is met.

[c] Measurement verifies, by the use of instruments, that requirements are met to the specified limits.

[d] Drawings/calculations verify that the design characteristics of the components provided meet the requirements.

[e] Verify that the relevant point is dealt with in the instructions or by marking.

5.2 Specific examinations and tests on installed lift

5.2.1 General

Before the lift is put into service, the particular tests in accordance with 5.2.2 to 5.2.18, as referred to in Table 24, shall be carried out, see also 6.2.4 q).

5.2.2 Braking system (4.9.2.2)

5.2.2.1 The test shall demonstrate that the machine brake on its own stops the lift machine when the car is travelling downwards at the lower half of the well, at rated speed and with rated load plus 25 %.

5.2.2.2 The test shall demonstrate that where one brake set is not working, the remaining brake set(s):

a) decelerate and stop the lift machine when the car is travelling downwards at the lower half of the well, at rated speed with rated load and when travelling upwards with empty car (see 4.9.2.2.2.1) at the higher half of the well.

   It is permitted that the car or counterweight make contact with the buffer(s) to stop the car if the striking speed does not exceed the designed buffer speed (4.8.2); and

b) hold the car, when the car is loaded with rated load at the lowest landing and with empty car at the highest landing.

Tests shall be carried out for each brake set being released during the test.

5.2.2.3 The test shall demonstrate that with the machine brake manually released and the car loaded from, see Formula (23):

0 % of rated load to (q – 0,1) Q and from (q + 0,1) Q to 100 % of rated load (23)

where

q is the balance factor indicating the amount of counterbalance of the rated load by the counterweight;

Q is the rated load, in kilograms.

it shall be verified that the manual release of the machine brake (4.9.2.3.1) causes a natural movement of the lift, or that the means for that purpose [4.9.2.3.3 b)] are available and operational.

The test shall be carried out by loading the weights resulting from Formula (23) into the car, moving the car to a position where the weight of the suspension means is balanced and either releasing the brake or manual operation as per 4.9.2.3.3 b)

5.2.3 Electric installation

The following shall be performed:

a) visual check on correct identification, labelling, coding, colouring, separation, mechanical protections, electrical protections, damages, and loose wires;

b) continuity of the protective conductors in accordance with IEC 60364-6:2016, 6.4.3.2 (4.10.9);

c) measurement of the insulation resistance of the different circuits (4.10.1.3). 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 in accordance with IEC 60364-6:2016, 6.4.3.7 and 6.4.3.8.

5.2.4 Checking of the traction (4.5.3)

5.2.4.1 The traction shall be checked by making several stops. At each test, complete stoppage of the car shall occur.

The test shall be carried out:

a) ascending, with the car empty, in the upper part of the travel;

b) descending, with the car loaded with 125 % of the rated load, in the lower part of the travel.

5.2.4.2 With the car empty the counterweight shall be brought into contact with the buffer(s) and the lift machine shall continue to be turned until:

a) suspension means slippage occurs (see 4.5.3.3); or

b) the electric safety device as per 4.5.3.3 stops the car before its highest position as per 4.2.5.6.1.

5.2.5 Car safety gear (4.6.2)

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 and decorative finishes, safety gear, guide rails and their fixing to the building.

The safety gear shall be tripped while the car is descending, with the required load uniformly distributed over the car area, until the car is stopped by the safety gear only, and under the following conditions:

a) instantaneous safety gear:

   The car shall travel at the rated speed and be loaded with the rated load.

b) progressive safety gear:

   For traction drive lifts:

   1) the car shall be loaded with 125 % of rated load, and travel at the rated speed; or

   2) the car shall be loaded with rated load and travel at the tripping speed of the overspeed governor.

   For positive drive lifts and hydraulic lifts, the car shall be loaded with the rated load, and travel at the rated speed.

After the test, a visual check shall ascertain that no deterioration, except on replaceable friction components, which affects the normal use of the lift has occurred.

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.

5.2.6 Counterweight or balancing weight safety gear (4.6.2)

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 safety gear shall be tripped while the counterweight or the balancing weight is descending with empty car at rated speed. The counterweight or the balancing weight shall be stopped by the safety gear only.

After the test, a visual check shall ascertain that no deterioration, except on replaceable friction components, which affects the normal use of the lift has occurred.

5.2.7 Pawl device (4.6.5)

a) dynamic test:

   The test shall be made while the car is travelling at rated speed downwards, with the load uniformly distributed; the electric safety devices on the pawl (4.6.5.9) and on the energy dissipation buffer (4.6.5.11), if any, being short-circuited to avoid closing of the down direction valves.

   The car shall be loaded with 125 % of the rated load and shall be stopped by the pawl device at each landing.

   After the test, a visual check shall ascertain that no deterioration which affects the normal use of the lift has occurred;

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;

5.2.8 Buffers (4.8)

The test shall be carried out in the following manner:

a) for energy accumulation type buffers:

   1) the car with its rated load shall be placed on the buffer(s);

   2) the suspension means shall be made slack or the pressure in the hydraulic system shall be reduced to the minimum by pressing the emergency manual lowering button.

b) for energy dissipation type buffers the car with its rated load and the counterweight shall be brought into contact with the buffer(s):

   1) at the rated speed; or

   2) at the reduced speed as per 4.8.2.2.1 b).

After the test, a visual check shall ascertain that no deterioration, which affects the normal use of the lift has occurred.

5.2.9 Rupture valve (4.6.3)

A system test shall be carried out, with the rated load uniformly distributed in the descending car at an overspeed (4.6.3.1) to operate the rupture valve.

For lifts with several interconnected rupture valves, the simultaneous closing shall be checked by measuring the inclination of the car floor (4.6.3.4);

5.2.10 Restrictor/one-way restrictor (4.6.4)

Check that the maximum speed, v_{max}, does not exceed v_d + 0,30 m/s:

— either by measuring; or

— by using Formula (24):

$$v_{max} = v_t \sqrt{\frac{p}{p - p_t}} \tag{24}$$

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.

5.2.11 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:

This test shall be carried out after the test of the devices against free fall (4.6), and include any hydraulic elements included in the uncontrolled movement protection means.

5.2.12 Ascending car overspeed protection means (4.6.6)

The test shall be made while the empty car is ascending at not less than rated speed, using only this device for braking. If the means requires self-monitoring (4.6.6.2), its function shall be checked in accordance with the instructions.

5.2.13 Stopping of the car at landings and levelling accuracy (4.12.1.1.3)

The stopping accuracy of the car as per 4.12.1.1.3, shall be verified at all landings, and in both directions for intermediate floors.

It shall be verified that the car maintains the levelling accuracy as per 4.12.1.1.3 during the loading and unloading conditions. This verification shall be made on the bottom or top floor where the loading/unloading of the car causes the largest change in levelling accuracy.

5.2.14 Protection against unintended car movement (4.6.7)

The aim of the test before putting into service is to check detection, activation (if applicable) and stopping elements.

Test requirements: only the stopping element of the means defined in 4.6.7 shall be used for the tests for stopping the lift. The test shall:

— consist in verifying that the stopping element of the means is triggered;

— be made by moving the empty car in the upward direction in the upper part of the well (e.g. from one floor from top terminal) and a fully loaded car in the downward 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 shall confirm that the unintended movement distance will not exceed the value given in 4.6.7.5.

If the means requires self-monitoring (4.6.7.3), its function shall be checked.

NOTE If the stopping element of the means involves elements present at landing floors, it can be necessary to repeat the test for each concerned landing.

5.2.15 Protection against falling/shearing (4.3.9.3.4)

With the car outside of the unlocking zone (see 4.3.8.1) and the landing door held open with a gap of 100 mm, it shall be checked that, when released, the landing door closes and locks.

5.2.16 Balancing of vertically sliding door (4.3.3.3.5)

It shall be checked that a vertically sliding door does not start to open or to close by itself when the door is open with a gap of 100 mm.

5.2.17 Counterweight balance (4.5.3)

Before performing tests of traction, machine brakes, safety gear, ascending car overspeed protection means and unintended car movement protection means, it shall be verified by practical tests using machine current measurement or by weighting of the car and counterweight that the counterweight balance is as stated in the instructions.

5.2.18 Balancing weight balance (4.5.3)

Before performing testing of machine brakes, hydraulic equipment and unintended car movement protection means, it shall be verified by practical testing or measurements that the balancing weight balance is as stated in the instructions.

6 Information for use

6.1 General

The Information for use shall consist of instructions and a logbook.

6.2 Instructions

6.2.1 General

Each lift shall be accompanied by instructions as detailed below.

6.2.2 Basic data and characteristics

The instructions shall include at least the following information:

a) general description of the lift and lift components (characteristics, load, speed, rise, stops, etc.);

b) plans of the installation in the building including;

- Openings in the well, machinery space(s) and pulley room(s) including for the pit and the pit platform as per 4.2.2, if any
- Working and moving areas:
  - in the machine room as per 4.2.6.3, if any
  - in the pulley room as per 4.2.6.7, if any
  - outside of the well as per 4.2.6.4.6, if any
  - in front of a machinery cabinet as per 4.2.6.5.2, if any
  - in front of emergency and test panel as per 4.2.6.6.4, if any
  - inside the well as per 4.2.6.4, if any
- Indication of the calculated forces and loads to the structure of the well, machinery space(s) and pulley room(s) and the point of application for:
  - the metal supports, hooks and suspension point(s) in order to hoist heavy equipment;
  - the machine, diverter pulleys, rope fixations or any other components;
  - the platform in the well as per 4.2.6.4.5.7.
  - the fixings of the guide rails as per 4.7.2.3.1;
  - the fixed stops of the pawl device, if any as per 4.2.1.5.5;
  - the landing doors sills as per 4.3.3.1;
  - the pit as per 4.2.1.5.1, 4.2.1.5.2, 4.2.1.5.3, 4.2.1.5.4;
  - the pit platform as per 4.2.2.2 i);

c) information about fire protection and communication system(s);

d) the type, the maximum weight and maximum loads of handling devices where handling devices are used for loading and unloading the car as per 4.4.2.2

e) electrical diagrams;

The electrical diagrams shall include at least the circuits for understanding of the safety considerations and use IEC 60204-1:2016+A1:2021, 17.2.

Where more than one document is provided, a main document for the electrical equipment as a whole, listing the complementary documents associated with the electrical equipment

Any graphical symbol not shown in IEC 60617:2025 DB shall be separately shown and described on the diagrams or supporting documents. Symbols and identification of components and devices shall be consistent throughout electrical diagrams and in line with those provided on the lift (see also 4.10.10).

The abbreviations used with the symbols shall be explained by means of a nomenclature.

If the electrical diagram has several alternatives, it shall be indicated which alternative is valid.

f) hydraulic circuit diagrams;

The circuit diagrams shall include at least the circuits for understanding of the safety considerations and use symbols from ISO 1219-1:2012. The abbreviations used with the symbols shall be explained by means of a nomenclature.

Hydraulic lifts shall include the following information:

— The full load pressure and the minimum operation pressure;

— pressure relief settings, and

— characteristics or type of hydraulic fluid.

g) configuration record of parameter settings of software as per 4.12.4;

h) the balance factor of the counterweight indicating the amount of counterbalance of the rated load by the counterweight.

i) for glass panels as per 4.3.7.1 a) 2), 4.4.3.2.3 and 4.4.7.5, the:

1) name of manufacturer or trademark;

2) reference to the applied standard;

3) thickness given in the format xx,y where x is the nominal thickness of each glass panel in millimetres and y the number of interlayers in multiples of 0,38 mm:

j) type and number of suspension means.

k) information on the environmental operation conditions for which the lift is designed.

6.2.3 Operating information for use

The instructions shall include in particular the following information on normal use:

a) operation of the lift from the landing and from inside the car;

b) ensuring the machine, pulley rooms, access. emergency and inspections doors are kept locked;

c) safe loading and unloading including the load distribution condition;

d) the precautions to be taken in case of lifts with partially enclosed well to prevent the interference with the operation of the lift by other equipment;

e) the events needing the intervention of a maintenance person;

f) information about the risk of prolonged entrapment in case of failure of alerting.

6.2.4 Information for maintenance, inspection, repair and periodic checks

The instructions shall include in particular the following information for maintenance:

a) content, frequency and procedures for required maintenance to ensure the safe and intended functioning of the installation;

b) list of the components or parts that must be regularly checked in order to detect excessive wear and/or aging;

c) criteria for the repair or replacement of parts subject to wear and/or aging;

d) parameters and procedures for re-adjustment of components, if needed;

e) procedures to leave the well during the maintenance in case of a blocked car, see 4.2.6.4.3.1 c);

f) resetting means, its location and procedures for intentional reset of the lift to automatic operation, including prior checking, as required by 4.2.6.4.4.1 g), 4.3.9.1.12 f), 4.5.2.3.2 d), 4.5.2.3.2 e),4.5.3.3 a) 2), 4.5.3.3 b), 4.5.5.3, 4.6.2.1.4.3, 4.6.2.2.5.6, 4.6.5.10, 4.6.6.7, 4.6.7.9, 4.9.2.2.2.3 g) 4.9.2.2.2.8, 4.9.2.7.3, 4.11.2.4.2.2, 4.12.1.3.2, 4.12.2.3.2;

g) location and use of special tools, if any;

h) keeping the logbook updated;

i) about testing of automatic rescue operation if provided;

j) procedures to transfer discard status data [see 4.5.2.3.2 d)] of discarding monitoring means at repair/ replacement of the monitoring means;

k) for SIL-rated circuits, the instructions shall inform about:

   1) maximum time interval between operations (actuations) for electro-mechanical components (see ISO 8100-2: 2025, A.1);

   2) replacement of device before mission time is elapsed;

   3) identification of the SIL-rated circuit(s)

   4) parameters, their value ranges, dependencies, safe use and safe verification process;

   5) method to compare actual parameter settings to configuration record;

   6) procedures to verify correctness of the parameter settings after change;

   7) method to identify the software-version of SIL-rated circuits.

l) procedures to identify that a friction part of a deceleration or stopping means as per 4.6.6 and 4.6.7 shall be replaced;

m) clearance between the safety gear and the guide rails to avoid accidental tripping of the safety gear;

n) method of lifting of components when they cannot be carried by hand;

o) procedures to measure the clearances as per 4.3.1.4 and the inspection periods;

p) laminated glass used for landing doors, landing door frames, car doors and car walls shall be specified with the name of the supplier and trademark and the thickness of the layers and lamination.

q) methods for performing specific examinations and test on installed lifts described in 5.2 safely.

r) discard criteria for non-metallic counterweight and balancing weight filler subject to wear and/or aging.

s) identification and use of bypass devices (see 4.12.1.8.4)

t) identification and use of protection for maintenance operations (see 4.12.1.7);

u) procedures for isolation of electrical equipment (see 4.10.5.6)

v) for software as per 4.12.4:

1) the method to verify the software version information;

2) parameters, their value ranges, dependencies, safe use and safe verification process;

3) the method to compare actual parameter settings to configuration record;

w) specific instructions for verification of the safety functions listed in Table 25;

x) number of persons allowed on the car roof and in the pit for maintenance and inspection;

y) for non-metallic replaceable traction sheave groove liners as per 4.5.1.8:

— the steel wire ropes discard criteria as per ISO 8100-2: 2025, 4.14.2.3;

— the groove liners replacement criteria as per ISO 8100-2: 2025, 4.14.2.3.

Table 25 — List of safety functions

Clause	Safety function	Functional test procedure needed?
4.3.9	Locking and emergency unlocking of landing and car doors	No
4.4.2.2.1 c)	Prevent car falling during loading/unloading in case handling device is not included in the rated load (not more than 20 mm)	Yes
4.4.2.2.2 e)	Prevent car falling during loading/unloading in case car size as per Table 7 (not more than 120 mm)	Yes
4.6.2	Safety gear and its tripping means	No, unless operated by electrical means
4.6.3	Rupture valve	Yes, if other means than bypass valve are used
4.6.4	Restrictors	No
4.6.5	Pawl device	Yes, when pawl device is used for preventing unintended car movement downwards
4.6.6	Ascending car overspeed protection means	Yes
4.6.7	Protection against unintended car movement	Yes
4.8.1	Car and counterweight buffers	Yes, if test is done at high speed
4.11.1.5	An earth fault in a circuit in which there is an electric safety device,	Yes
4.11.2	Electric safety devices	Yes, for devices listed in Annex A
4.11.2	Electric safety devices including electronic components	Yes, for devices listed in Annex A which are safety components (certificate).
4.12.1.1.3	Stopping accuracy	No
4.12.1.2	Load Control	No

Table 25 *(continued)*

Clause	Safety function	Functional test procedure needed?
4.12.1.3	Limiting the speed of the lift machine in case of reduced stroke buffer	Yes
4.12.1.6	Control of emergency electrical operation	No
4.12.1.7	Protection for maintenance operations	No
4.12.1.8	Landing and car door bypass device	No
4.12.1.10 a)	Electrical anti-creep system	No
4.12.1.11	Stopping devices	No
4.12.1.12.2	Additional electric safety device for automatic rescue operation	Yes
4.12.2	Final limit switches	No
4.12.3	Alert initiation device and intercom system	Yes
4.12.1.1	Normal operation	No

6.2.5 Information for emergency operation

The instructions shall include in particular the following information on emergency operations:

a) instructions for emergency operation in different expected situations, in particular on the release of:
   - the brake;
   - the ascending car overspeed protection means;
   - the unintended car movement protection means;
   - the reduced stroke buffer;
   - the rupture valve;
   - the safety gear; and
   - the clarification on the devices as mentioned in 4.2.6.6;

b) use of the emergency unlocking key, detailing the essential precautions to be taken in order to avoid accidents which could result from an unlocking which was not followed by effective re-locking;

c) identification of special tools, if any.

d) instructions for the use of the alert initiation devices;

e) instructions for use of the communication system;

f) instructions for the use of intercom systems (if any).

6.3 Logbook

A logbook shall be provided for recording notes about repairs and periodic checks, including those specified in the instructions.

7 Building-related boundary conditions

7.1 General provisions

Building-related boundary conditions shall be in accordance with Annex B.

7.2 Plans for the installation in the building

The plans for the installation in the building shall contain information about the building interface, including:

— the dimensions and tolerances of the well, machinery spaces and pulley rooms, and that the placement of equipment shall correspond to the specification of the lift as per 6.2.2 b);

— the structure of the well, machinery spaces and pulley rooms be able to support the loads and forces imposed by the lift components during the lift operation;

— the indication where accessible spaces exist below the well;

— the spaces and the associated working areas for maintenance/inspection work and emergency operation be protected against environmental influences.

Annex A
(normative)

List of the electric safety devices

Table A.1 — List of the electric safety devices

Clause	Devices checked	Minimum SIL
4.2.3.3 d)	Check of the closed position of access, emergency and inspection doors	2
4.2.5.3.1 c)	Check of the locking of car door	2
4.2.5.8.1	Check of the stored position of a pit access ladder	1
4.2.6.4.3.1 b)	Check of the retracted position of the mechanical device	3
4.2.6.4.3.2 e)	Check of the locked position of the inspection door(s) in the car wall	2
4.2.6.4.4.1 d)	Check of the opening of doors providing access to the pit	2
4.2.6.4.4.1 e)	Check of the retracted position of the mechanical device	3
4.2.6.4.4.1 f)	Check of the active position of the mechanical device	3
4.2.6.4.5.4 a)	Check of the retracted position of the working platform	3
4.2.6.4.5.5 b)	Check of the retracted position of movable stops for the working platform	3
4.2.6.4.5.5 c)	Check of the extended position of movable stops for the working platform	3
4.3.9.1.1	Check of the locking of the landing door	3
4.3.9.1.12 f)	Check of the force limiter of flap type locking devices	3
4.3.9.4.1	Check of the closed position of landing doors	3
4.3.11.2	Check of the closed position of the panels without locks	3
4.3.13.2	Check of the closed position of the car door(s)	3
4.4.2.2.1 d) 1) ii)	Check of the retracted position of the mechanical device	3
4.4.2.2.1 d) 1) ii)	Check of the unlocking zone to make inactive the check of the retracted position of the mechanical device	3
4.4.6.1 b) 3)	Check of the locking of the emergency trap door in the car	2
4.4.6.2 b) 3) i)	Check of the locking of the emergency door in the car	2
4.4.6.2 b) 3) ii)	Check of the locking of the emergency door in the car to stop the adjacent lift	2
4.5.3.3	Check raising of car or counterweight	1
4.5.5.3 a)	Check of the abnormal relative extension of each suspension means in case of two suspension means	1
4.5.5.3 b)	Check of slack suspension means for positive drive and hydraulic lifts	2
4.5.6.1 c)	Check of the anti-rebound device	3
4.5.6.2 g)	Check of the tension in the compensation means	3
4.6.2.1.5	Check of the retracted position of the car safety gear	1
4.6.2.2.1.6 a)	Overspeed detection	2
4.6.2.2.1.6 b)	Check of the release of the overspeed governor	3
4.6.2.2.1.6 c)	Check of the breakage and slackening of the overspeed governor rope	3
4.6.2.2.3 e)	Check of the breakage or slackening of the safety rope	3
4.6.2.2.4.1 e)	Check of the retracted position of the rope blocking mechanism	2
4.6.2.2.4.1 e)	Check of the unlocking zone to make inactive the check of the retracted position of the rope blocking mechanism	2
4.6.2.2.4.2 h)	Check of the retracted position of the tripping lever	2

Table A.1 *(continued)*

Clause	Devices checked	Minimum SIL
4.6.2.2.4.2 h)	Check of the unlocking zone to make inactive the check of the retracted position of the tripping lever	2
4.6.2.2.5.4 a	Check of the overspeed detection by speed monitoring element	3
4.6.2.2.5.4 b	Check of the release of the tripping element	3
4.6.2.2.5.4 c	Check of the breakage or excessive stretch of the speed monitoring belt or tape	3
4.6.2.2.5.6	Check of the operation of the tripping element	3
4.6.5.9	Check of the retracted position of the pawl device	1
4.6.5.9	Check of the unlocking zone to make inactive the check of the retracted position of the pawl device	1
4.6.5.11	Check of the normal extended position of energy dissipation type buffers used with pawl device	3
4.6.5.11	Check of the unlocking zone to make inactive the check of the return to normal extended position of energy dissipation type buffers used with pawl device	3
4.6.6.5	Check of the ascending car overspeed protection means	2
4.6.7.7	Detection of unintended car movement with open doors	2
4.6.7.8	Check of the activation of the unintended car movement with open doors protection	1
4.8.2.2.3	Check of the normal extended position of energy dissipation type buffers	3
4.9.2.3.4 a) 3)	Check of the positions of the removable wheel	1
4.10.5.2	Check of the device controlling the contactor where several access points exist	2
4.10.5.4	Check of the main switch	3
4.12.1.3.1	Check of the retardation in the case of reduced stroke buffers	3
4.12.1.4 a)	Check of the unlocking zone for levelling, re-levelling and preliminary operations	3
4.12.1.5.2.1 a)	Inspection operation switch	3
4.12.1.5.2.1 b) 2)	Disabling of the emergency electrical operation bypass in inspection operation	3
4.12.1.5.2.2 b)	Disabling of the bypass of the electric safety device(s) checking locking of the in-car inspection door when not in inspection operation	3
4.12.1.5.2.2 c)	Disabling of the bypass of the electric safety devices checking the final limit and extension of the energy dissipation type buffer when not in inspection operation	3
4.12.1.5.2.3 b)	Check of push buttons in conjunction with inspection operation	1
4.12.1.6.1	Emergency electrical operation switch	3
4.12.1.8.2	Landing and car door bypass device	3
4.12.1.11.1 a)	Stopping device at the inspection operation control devices (4.12.1.5.1.2 d)	3
4.12.1.11.1 b)	Stopping device in the pulley room [4.2.1.3.3]	3
4.12.1.11.1 c)	Stopping device(s) in the lift pit below the pit platform if there are moving parts below the pit platform [4.2.1.3.1 c)].	3
4.12.1.11.1 d)	Stopping device at the lift machine	3
4.12.1.11.1 e)	Stopping device at tests panel (4.2.6.6) and emergency operation panel (4.10.5.1.2 c)	3
4.12.2.2.6	Check of breakage of, or slack in, the linkage to the device actuating the final limit switch	1
4.12.2.3.1 b)	Final limit switches	1

NOTE The SIL levels are only relevant for SIL-rated circuits as described in 4.11.2.4.

Annex B
(normative)

Information on the building-related conditions in which the lift is installed

B.1 General provisions

This annex states technical interfaces of the building or construction in which the lifts is installed.

It shall be instructed, that information about technical interfaces as per B.2 shall be exchanged. The information depends on the phase of building/construction and is exchanged on the characteristics of the lift design and the building/construction in which the lift will be installed.

B.2 Technical interfaces

B.2.1 Type and purpose of lift(s)

It shall be instructed, that the type and purpose/usage of lift(s) shall be specified, including information about the expected traffic (persons/good person lifts, load, building height, etc.) and the accessibility to lifts in the whole building, (entrances, accessible spaces below lift well).

It shall be instructed, that information about requirements regarding seismic conditions, accessibility, vandalism, fire protection and evacuation shall be exchanged.

B.2.2 Layout and access

It shall be instructed, that the lift well, machinery spaces and pulley rooms are not used for purposes other than lifts.

It shall be instructed, that they do not contain ducts, cables, or devices other than for the lift. In the case of a partially enclosed well, such elements shall be located outside of present enclosures or have a minimum distance of 1,50 m from moving parts of the lift.

It shall be instructed, that the lift well, machine rooms and pulley rooms may, however, contain equipment for air-conditioning or heating of these spaces, excluding steam heating and high-pressure water heating. However, any control and adjustment devices of the heating apparatus shall be located outside the well.

It shall be instructed, that the lift well, machine rooms and pulley rooms shall be:

— accessible only by use of a key as per 4.2.3.3;

— not via private premises;

— provided by stairs and guardrails in accordance with ISO 14122-3:2016, or fixed ladders in accordance with ISO 14122-4:2016.

It shall be instructed, that minimum passageways/fire escapes are not obstructed by an open door/trap of the lift.

It shall be instructed, that access, emergency, inspection doors and trap doors are:

— imperforate, and

— fire protected to the same level as the lift well.

It shall be instructed, whether a fire resistance classification for landing doors applies.

NOTE EN 81-58:2022 or ISO 3008-2:2017 specify fire resistance requirements for landing doors.

B.2.3 Environmental conditions

It shall be instructed, that the ambient temperature in the well and the machinery space(s) is maintained between + 5 °C and + 40 °C.

It shall be instructed, that the well, machinery space(s), pulley rooms and the associated working areas for maintenance/inspection work and emergency operation be protected against environmental conditions including:

— temperature;

— humidity;

— ventilation;

— heat emissions;

— chemical substances (salt, chloride);

NOTE 1 See IEC 60364-5-51:2005, Code AA5.

It shall be instructed, that measures be in place for ventilation and air-conditioning of the well where the risk of prolonged entrapment can occur.

NOTE2 IEC 60721-3-3:2019 classifies groups of environmental parameters and their severities to which products are subjected when installed for stationary use at weather protected locations.

It shall be instructed, that the noise levels are less than 80 dB(A) at positions 0,5 m from the microphones and the speakers of any emergency and test communication systems (see 4.12.3).

B.2.4 Forces, lift disposition, equipment

It shall be instructed, that the building related infrastructure withstands the forces of the lift installation in accordance with the information exchanged, e.g. guide rail/buffer forces, suspension forces during installation, etc.

It shall be instructed, that one or more suspension point(s) with the indication of the safe working load, as appropriate, be provided in the machinery spaces and where necessary, at the top of the well, conveniently positioned to permit the hoisting of heavy equipment.

It shall be instructed, that forces of the building which impact on the lift or the lift equipment are communicated to the lift supplier, e.g., building shrinkage, building sway, etc. and included in the preparatory work plan and disposition plan exchanged for the lift.

B.2.4.1 Mechanical strength and forces on the lift well

It shall be instructed, that the walls of the well have a mechanical strength such that when a force of 1 000 N, being evenly distributed over an area of 0,09 m^2 in round or square section, is applied at right angles to the wall at any point, from both inside and outside the well, they shall resist without:

a) permanent deformation greater than 1 mm;

b) elastic deformation greater than 15 mm.

It shall be instructed that in the case of freely hanging guide rails, the wall of the well be able to support the forces as per 4.7.2.3.5.

It shall be instructed, that in the case of partially enclosed wells or when the structure of the well is made of glass panels, plane or formed, be made of laminated glass in accordance with ISO 12543-3:2021.

They and their fixings shall withstand 1 000 N horizontal static force on an area of 0,09 m2 at any point,

from both inside and outside the well, without permanent deformation.

B.2.4.2 Mechanical strength and forces on the lift pit

It shall be instructed, that the floor of the pit be able to support the vertical force(s):

— beneath each guide rail, as per 4.2.1.5.1;

— beneath the car buffer supports, as per 4.2.1.5.2;

— beneath the counterweight buffer supports, as per 4.2.1.5.3.

In the case of hydraulic lifts;

— beneath each jack, as per 4.2.1.5.4.

In the case of pawl devices;

— imposed on the fixed stops as per 4.2.1.5.5.

B.2.4.3 Mechanical strength and forces on the lift well by the working platform

It shall be instructed, that the wall of the well be able to support the forces imposed by the platform to wall of the well as per 4.2.6.4.5.3.

It shall be instructed, that the maximum permissible load be indicated on the platform as per 4.2.6.4.5.7.

B.2.5 Building execution

B.2.5.1 It shall be instructed, that the floor of working areas is:

— slip resistant in accordance with ISO 14122-2:2016, 4.2.4.7:

— level to maximum of 50 mm deviations, except for any buffer and guide rail bases and water drainage devices.

B.2.5.2 It shall be instructed, that the well be constructed to reduce noise and vibration levels in adjacent spaces or rooms created by the lift equipment (e.g. controllers, drives and machines).

B.2.5.3 It shall be instructed, that the lift pit shall be impervious to infiltration of water. Measures to address water congregation in the lift pit shall be by the use of permanently installed drainage and/or drainage pumps, located outside the lift well, to remove water from the lift pit.

For hydraulic lifts, the space, and the ducts, in which the power unit piping or the jack(s) are situated, and the pit shall be impervious so that all the fluid contained in the machinery placed in these areas will be retained if it leaks out or escapes.

In the case that the jack extends into the ground, it shall be installed in a protective tube, sealed at its bottom end.

B.2.5.4 It shall be instructed that where there are any horizontal projections from the wall into the well not prevented by a balustrade as per 4.4.7.2 d) protections be provided in accordance with 4.2.5.2.4 b.

B.2.5.5 It shall be instructed, that where the counterweight or balancing weight is not fitted with a safety gear, there shall be no accessible spaces below the well.

B.2.5.6 It shall be instructed, that the well be totally enclosed by imperforate walls, floor and ceiling.

a) The only permissible openings are:

   1) openings for landing doors;

   2) openings for access doors, emergency doors and inspection doors;

   3) vent openings for escape of gases and smoke;

   4) ventilation apertures;

   5) necessary openings for the functioning of the lift between the well and the machine or pulley rooms.

b) It shall be instructed, that these openings, except openings towards the well, the machine room or the pulley room, shall comply with the following requirements:

   — protection in accordance with ISO 13857:2019, Table 5 against contact with danger zones; and

   — degree of protection of at least IP2XD (IEC 60529:1989+AMD1:1999+AMD2:2013) against contact with electrical equipment.

B.2.5.7 It shall be instructed, that where the well is required to be partially enclosed, e.g. observation lifts in connection with galleries or atriums, tower buildings, etc., the following shall apply:

a) the enclosure is as per 4.2.5.2;

b) the enclosure shall be located at maximum 0,15 m from the edges of floors, stairs or platforms as per 4.2.5.2.2;

c) permissible openings be provided in accordance with B.2.5.6.

B.2.5.8 It shall be instructed that where the machine room floor comprises a number of levels differing by more than 0,50 m, fixed ladders in accordance with ISO 14122-4:2016 or stairways and guardrails in accordance with ISO 14122-3:2016, Clause 7 be provided.

B.2.5.9 It shall be instructed that where a person can work or move between different working areas, recesses in the machine room floor with a depth of more than 0,05 m and a width between 0,05 m and 0,50 m or any ducts, be covered.

B.2.5.10 It shall be instructed, that when the distance between consecutive landing door sills exceeds 11 m, intermediate emergency doors shall be provided where adjacent cars are not fitted with emergency doors.

B.2.6 Electrical requirements

B.2.6.1 It shall be instructed, that the following information for the electrical interface design of the lift, be provided:

— identification of the electrical equipment;

— information on installation and mounting including:

   — description of the electrical equipment's installation and mounting;

   — connection to the electrical supplies and where relevant other supplies;

   — short-circuit current rating at the point of incoming supply terminals;

   — rated voltage, number of phases and frequency (if AC);

   — type of distribution system;

— full-load current for each incoming supply.

— any additional electrical supply requirements.

B.2.7 Lighting

B.2.7.1 It shall be instructed, that machinery spaces and pulley rooms be provided with permanently installed electric lighting with an intensity of at least:

— 200 lx at floor level everywhere a person needs to work; and

— 50 lx at floor level to move between working areas; and

— be in accordance with 4.10.7.1.

It shall be instructed, that in machinery spaces and pulley rooms there is:

— means to switch the lighting of the spaces and rooms close to each access point;

— a socket outlet (see 4.10.7.2) for each space and room.

B.2.7.2 It shall be instructed, that the access way adjacent to any door/trap giving access to the well or to machinery spaces or pulley rooms be lit by a permanent installed electric lighting with an intensity of at least 50 lx as per ISO/CIE 8995-1:2025, Table 9.

B.2.7.3 It shall be instructed, that the lighting of the landings in the vicinity of landing doors shall be at least 75 lx up to 1,0 m in front of the lift at floor level as per ISO/CIE 8995-1:2025, Table 9.

B.2.8 Notices

B.2.8.1 It shall be instructed, that notices shall be provided to permit easy identification of the main switch(es) and the light switch(es).

B.2.8.2 It shall be instructed, that a notice be fixed to the outside of doors or trap doors (excluding landing doors and doors of emergency and test panels) giving access to machine and pulley rooms in accordance with 4.2.4.

Annex C
(normative)

Pit access ladder

C.1 Types of pit access ladder

The following types of pit access ladder shall be used for access and egress to the pit of the lift (see Figure C.1):

a) a fixed ladder (Type 1), which stands upright in one position for both use and storage purposes;

b) a retractable ladder (Type 2a), 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;

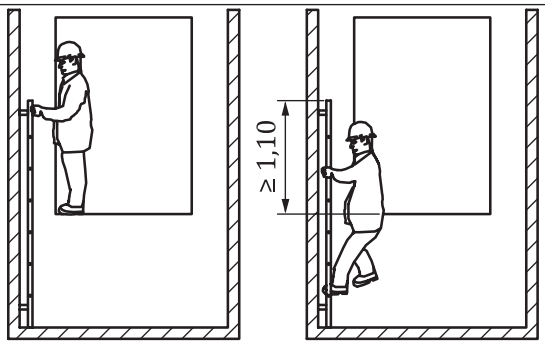
c) a retractable ladder (Type 2b), which stands upright for storage and is manually put in position of use by horizontal sliding of its bottom part;

d) a movable ladder (Type 3), which stands upright for storage and is manually put in an inclined position of use;

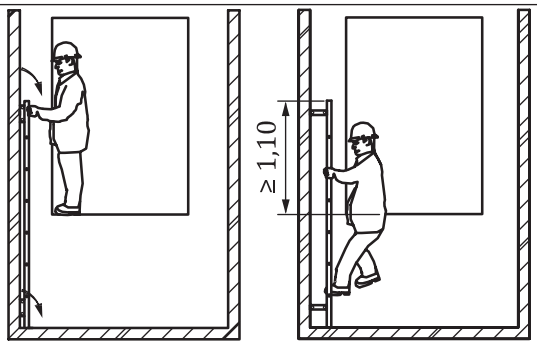
e) a foldable ladder (Type 4a), which is fixed in the pit and then positioned and hooked onto the landing door sill;

f) a foldable ladder (Type 4b), which is fixed in the pit and then positioned and hooked to the wall of the well.

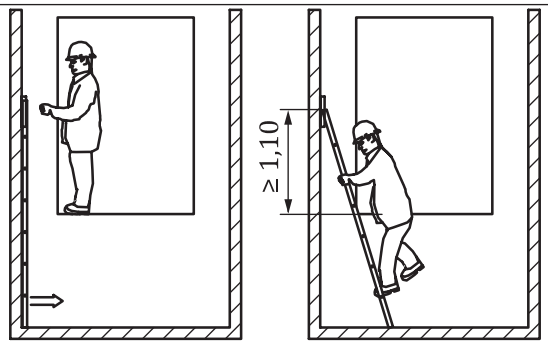
Dimensions in metres



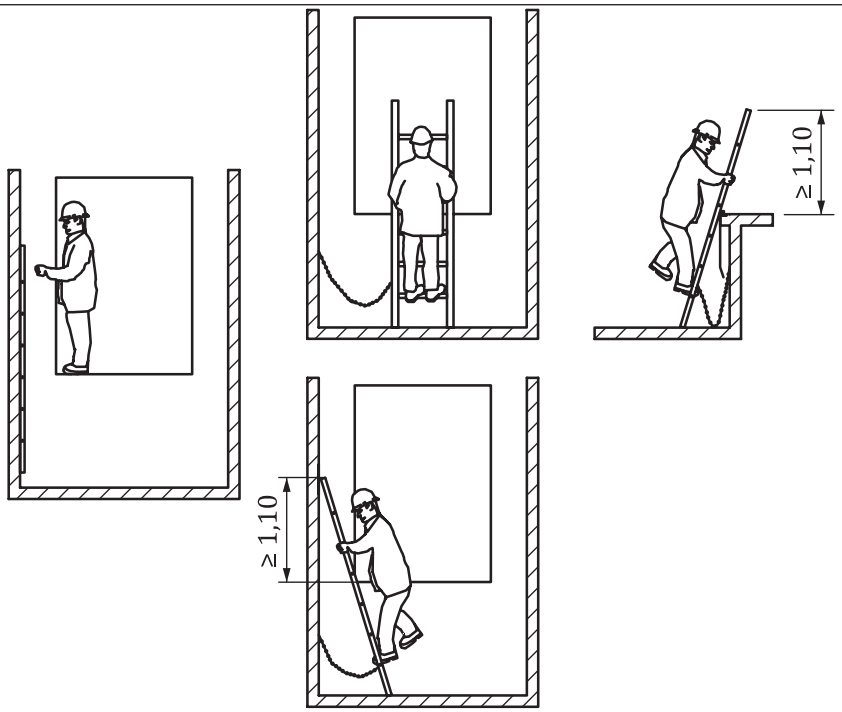
a) Type 1 — Fixed pit ladder



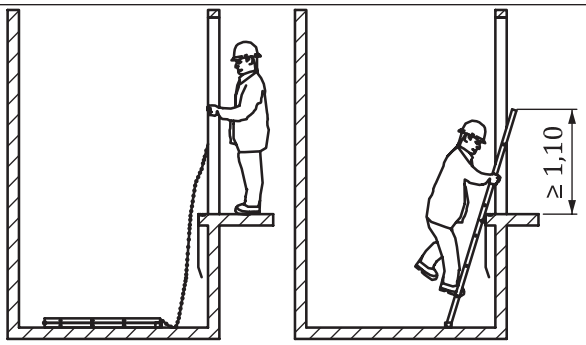
b) Type 2a — Retractable pit ladder



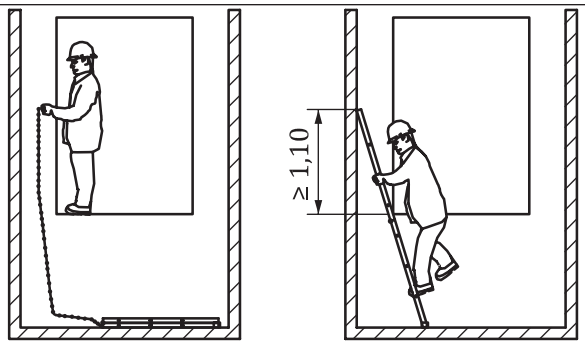
c) Type 2b — Retractable pit ladder



d) Type 3 — Movable pit ladder



e) Type 4a — Foldable pit ladder



f) Type 4b — Foldable pit ladder

Figure C.1 — Types of pit access ladder

C.2 General provisions

C.2.1 It shall not be possible to remove the ladder from the pit.

C.2.2 The ladder shall be:

a) able to withstand a vertical force of 1 500 N;

b) able to withstand a horizontal force of 300 N;

c) made of aluminium or steel.

C.2.3 In the position of use, the ladder stile(s) or handhold(s) shall extend to a minimum height of 1,10 m measured vertically above the landing sill.

For ladders Type 3 and Type 4a with different heights of stiles, see Figure C.3 c), the lowest one shall not extend more than 0.3 m vertically above the landing sill.

C.3 Ladder stiles and rungs

C.3.1 General

The mechanical strength shall be in accordance with ISO 14122-4:2016, Clause 6.

C.3.2 Ladder stiles

The cross-section of the ladder stiles shall not exceed a width of 35 mm, and depth of 100 mm.

C.3.3 Ladder rungs

The ladder rungs shall fulfil the following requirements:

a) the clear width of the ladder rungs shall be between 280 mm and 600 mm;

b) the rungs shall be equally spaced, between 225 mm and 300 mm;

c) The tread walking surface of the rung shall be flat and not less than 20 mm;

d) the surface conditions of the rungs shall be non-slippery, i.e. by means of profiled surface or anti-slippery coating.

C.4 Specific provisions for non-fixed type ladders

For ladders Type 2a, Type 2b, Type 3, Type 4a and Type 4b, the following shall apply:

a) The force to handle the pit access ladder shall not exceed: (see Figure C.2):

   — 150 N for a handling distance D not exceeding 300 mm;

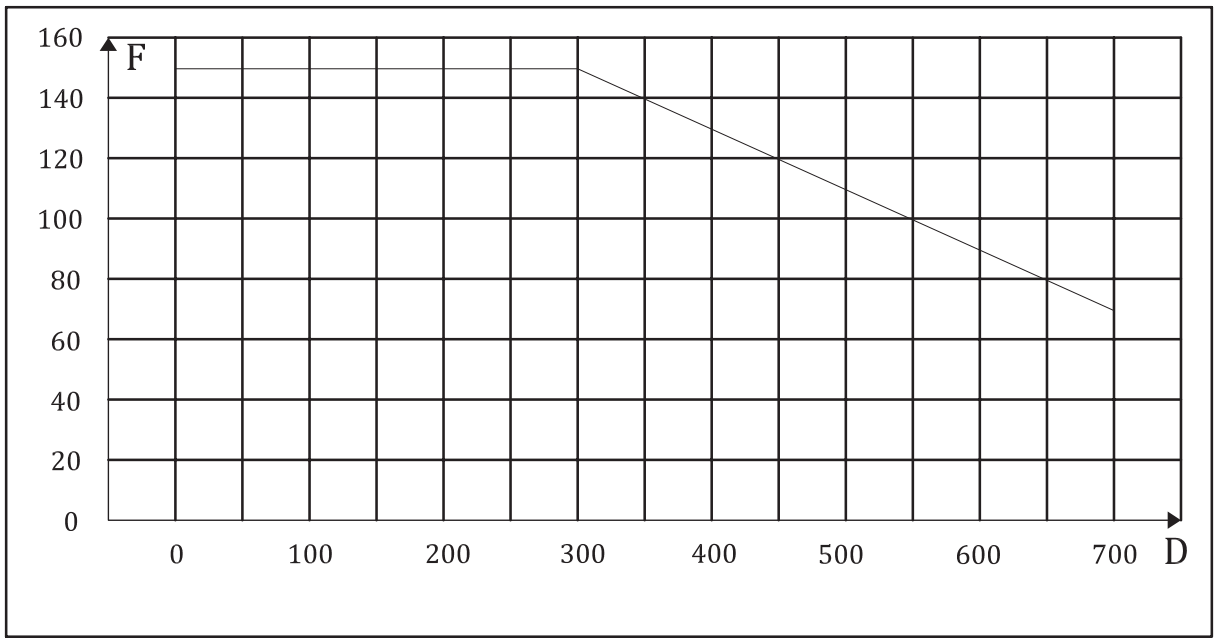
   — the values in accordance with Formula (C.1) for a handling distance D exceeding 300 mm and not exceeding 700 mm.

$$F = 150 - \frac{D - 300}{5} \qquad \text{(C.1)}$$

where

D is the handling distance, in millimetres;

F is the handling force, in newtons.



Key

F handling force [N]

D handling distance [mm]

Figure C.2 — Handling force for movement of ladder

b) in its position of use the ladder shall be fixed to the landing sill, the bottom of the pit, or the wall of the well;

c) fixation as provided in b) shall prevent the ladder from tipping over when a person is standing or grasping the upper part of the ladder (above landing sill level);

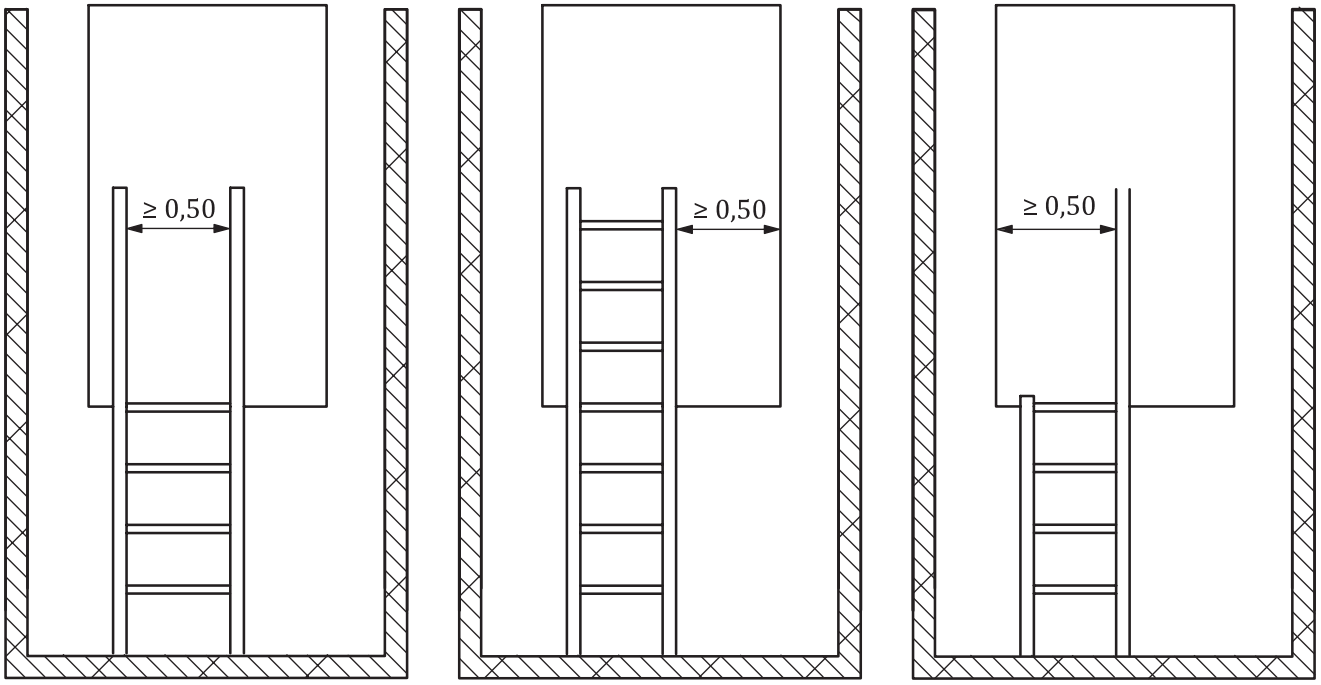
d) for ladders Type 2a, Type 2b, Type 4a and Type 4b, when putting the ladder back to its storage position from its position of use, shearing and/or crushing hands or feet shall be prevented

e) for ladders Type 3 and Type 4a, positioned at the landing door sill, there shall be a free distance of at least 0,50 m:

— between the handholds, see Figure C.3 a); or

— between a stile or a handhold, and the door frame, see Figure C.3 b) and Figure C.3 c);

Dimensions in metres



a) between handholds **b) between stile and door frame** **c) between one stile and door frame**

Figure C.3 — Distance between the handholds or between a stile and the door frame

C.5 Location of the ladder in the pit

The location of the ladder in the pit shall be such that the following are fulfilled:

a) for ladders Type 1 and Type 2a there shall be a clear distance of 0,20 m minimum between the front of any rung and the pit wall, see Figure C.4;

b) the horizontal distance between the edge of the landing entrance and the ladder in its stored position (or the means to access ladders Type 4a and Type 4b) shall not be more than 0,70 m;

c) for ladders Type 1, Type 2a, Type 2b and Type 4b the distance between the edge of the landing entrance and the middle of the rungs of the ladder in position of use shall not exceed 0,60 m;

d) for ladders Type 1, Type 2a, Type 2b and Type 4b, the top surface of a rung of the ladder shall be positioned at not more than 0,15 m below the level of the landing sill.

Dimensions in metres

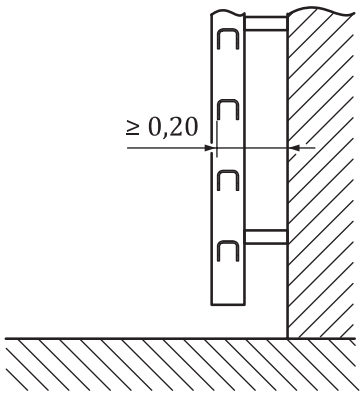


Figure C.4 — distance between the front of a rung and the wall

Annex D
(informative)

Relationship between this document and ISO 8100-20:2018

Table D.1 shows the relation between the global essential safety requirements of ISO 8100-20:2018 and this document.

Table D.1 — Relationship between this document and ISO 8100-20:2018

ISO 8100-20:2018 GESRs	Clause(s)/sub-clause(s) of this document
6.2 Common GESRs related to persons at different locations	
6.2.1 Supports for lift equipment	4.3.3.3, 4.3.5, 4.4.3.2, 4.4.10, 4.4.11.2, 4.5.1, 4.5.2, 4.5.3, 4.5.4, 4.5.5, 4.5.6.3, 4.5.8 a), 4.6.2.1, 4.7, 4.9.2.2.2.1, 4.9.3.2.1, 4.9.3.2.2, 4.9.3.2.3, 4.9.3.2.6.6, 4.9.3.3, 4.9.3.5.3, 6.2.2 b)
6.2.2 Lift maintenance and repair instructions	6.2,
6.2.3 Equipment inaccessible to users and non-users	4.2.1.1.1, 4.2.3.3 b), 4.2.5.2, 4.2.6.4.3.2 d), 4.2.6.4.4.1 d), 4.2.6.5.1.2, 4.2.6.5.1.3 c), 4.2.6.6.1 b) 4.3.1.1, 4.3.4, 4.3.5, 4.3.8, 4.3.9, 4.3.10,
6.2.4 Floors of the LCU and working areas	4.2.2, 4.2.1.5, 4.2.6.3, 4.2.6.7.2 4.4.3, 4.4.4, 4.4.5.1, 4.4.7.1 b), 4.4.7.2, 4.4.7.3, 4.12.1.1.3 B.2.5
6.2.5 Hazards due to relative movement	4.1.2, 4.2.3.3 b), 4.2.3.3 d), 4.2.3.4, 4.2.5.3.1, 4.2.5.5, 4.2.6.4.3.2, 4.2.6.4.3.2 d), 4.2.6.4.3.2 e), 4.2.6.4.3.2 f), 4.2.6.4.4.2, 4.3.1, 4.3.3, 4.3.4.2, 4.3.4.3, 4.3.5.1, 4.3.5.2, 4.3.5.3, 4.3.5.4, 4.3.5.5, 4.3.5.6, 4.3.5.8, 4.3.6, 4.3.8, 4.3.9.1, 4.3.9.2, 4.3.9.3, 4.3.9.4, 4.3.10, 4.3.11, 4.3.13, 4.3.14, 4.3.15.2, 4.4.3.1 4.4.5, 4.4.6.1 b) 3), 4.4.6.2 b) 3), 4.4.7.4, 4.4.11.2, 4.5.7, 4.6.2.1.6.3, 4.7.5.2 4.9.1.2, 4.9.2.3.4 a) 1), 4.9.3.2.6.6 b), 4.12.1.4, 4.12.1.8
6.2.6 Locking landing doors and closing LCU doors	4.2.5.3.1 c), 4.2.6.4.3.2, 4.3.1, 4.3.3, 4.3.5.1, 4.3.5.2, 4.3.5.3, 4.3.5.4, 4.3.5.5, 4.3.5.6, 4.3.5.8, 4.3.8, 4.3.9.1, 4.3.9.2, 4.3.9.3, 4.3.9.4, 4.3.10, 4.3.11, 4.3.13, 4.3.14, 4.3.15.2, 4.4.3.1, 4.12.1.4, 4.12.1.8, 4.12.1.9
6.2.7 Evacuation	4.2.1.4, 4.2.3.1, 4.2.3.2 d), 4.2.3.3 c), 4.2.6.2.2, 4.2.6.4.3.1 c), 4.2.6.6.1, 4.2.6.6.2 a), 4.2.6.6.2 c), 4.3.9.3.1, 4.3.9.3.2, 4.3.9.3.5, 4.3.9.3.7, 4.3.15.1, 4.3.15.3, 4.4.6.2, 4.9.2.3, 4.9.3.9, 4.12.1.6, 4.12.3
6.2.8 Sharp edges	4.2.5.3.2 c), 4.2.5.3.2 d), 4.3.6.1, 4.3.6.2.2.1 g), 4.3.6.2.2.1 i) 2), 4.4.5.1
6.2.9 Hazards arising from the risk of electrical shock	4.10.1.2, 4.10.1.3, 4.10.2 4.10.3, 4.10.4, 4.10.5, 4.10.6, 4.10.9, 4.10.10
6.2.10 Electromagnetic compatibility	4.10.1.1.1

Table D.1 *(continued)*

ISO 8100-20:2018 GESRs	Clause(s)/sub-clause(s) of this document					
6.2.11 Illumination of the LCU and the landings	4.4.10,	4.10.5.1.1 a),	4.10.7.1,	4.10.8,	B.2.7.3	
6.2.12 Effects of earthquakes	not covered					
6.2.13 Hazardous materials	4.4.4, 4.10.4.2	4.9.2.2.2.6,	4.9.3.1.4,	4.9.3.2.5.1,	4.9.3.11,	4.10.4.1,
6.2.14 Environmental influences	4.9.3.11,	4.10.1.1.1	4.10.4.3,	4.10.4.4,	B.2.3	
6.3 GESRs related to persons adjacent to the lift						
6.3.1 Falling into the well (hoistway)	4.3.1.1, 4.3.5.4, 4.3.10,	4.3.1.2, 4.3.5.5, 4.3.11,	4.3.3, 4.3.5.6,	4.3.5.1, 4.3.5.8,	4.3.5.2, 4.3.8,	4.3.5.3, 4.3.9,
6.4 GESRs related to persons at the entrances						
6.4.1 Access and egress	4.3.6.2,	4.12.1.1.3,	4.12.1.1.4,	4.12.1.2.1		
6.4.2 Horizontal sill-to-sill gap	4.3.4.1					
6.4.3 Alignment of the LCU and the landing	4.4.2.2	4.12.1.1.3	4.12.1.2.1			
6.4.4 Self-evacuation from the LCU	4.4.5,	4.3.15,	4.2.5.3.1 c)			
6.4.5 Gap between the landing doors and the LCU doors	4.3.4.2					
6.4.6 Means to reopen doors when the LCU is at the landing	4.3.6.2,	4.12.1.1.4				
6.5 GESRs related to persons in the LCU						
6.5.1 Size and strength	4.3.3.1,	4.3.5.4,	4.4.2,	4.4.3.2.1,	4.4.4	
6.5.2 LCU support/suspension	4.5.1, 4.5.8 a)	4.5.2,	4.5.3,	4.5.4,	4.5.5,	4.5.6
6.5.3 Overloaded LCU	4.4.2.1.4	4.12.1.2				
6.5.4 Falling from the LCU	4.2.5.3.1, 4.3.13, 4.4.6.2	4.2.6.4.3.2, 4.3.14,	4.3.1, 4.3.15.2,	4.3.5.1, 4.4.3.1,	4.3.5.2, 4.4.3.2,	4.3.9.2, 4.4.3.4,
6.5.5 LCU travel path limits	4.2.5.6,	4.12.1.3.1,	4.12.2.2			
6.5.6 Uncontrolled movement of the LCU	4.6					
6.5.7 LCU collision with objects in or beyond the travel path	4.2.5.5.3,	4.4.11.2,	4.7.5.2			
6.5.8 LCU horizontal or rotational motion	4.4.3.2.1,	4.7.5.2				
6.5.9 Change of speed or acceleration	4.2.6.4.4.1 a), 4.6.6.3, 4.8.2.2.2 a),	4.5.3.2, 4.6.7.6, 4.8.2.2.2 b),	4.6.2.1.2, 4.6.5.7, 4.9.2.2.2.1,	4.6.2.1.3, 4.8.2.1.2.1 a), 4.9.3.2.3.2,	4.6.3.1, 4.8.2.1.2.1 b) 4.9.3.2.4.2	4.6.4.1 4.8.2.1.2.1 e),
6.5.10 Objects falling on the LCU	4.2.6.3.3,	4.2.6.7.2,	4.4.3.1,	4.4.11.2,	4.5.8 a)	

Table D.1 *(continued)*

ISO 8100-20:2018 GESRs	Clause(s)/sub-clause(s) of this document					
6.5.11 LCU ventilation	4.4.9					
6.5.12 Fire/smoke in the LCU	4.4.4,	4.10.4.1,	4.10.4.2			
6.5.13 LCU in flooded areas	not covered					
6.5.14 Stopping means inside the LCU	4.12.1.11.3					
6.5.15 Landing and controls indication	4.12.1.1.1,	4.12.1.1.2				
6.6 GESRs related to persons in working areas						
6.6.1 Working area(s) or space(s)	4.2.6.3.2.1,	4.2.6.3.2.2,	4.2.6.4.1.1,	4.2.6.4.2,		
6.6.2 Accessible equipment	4.2.1.1.1, 4.2.6.4.1.1, 4.2.6.4.6,	4.2.1.3.1, 4.2.6.4.2, 4.2.6.7.1	4.2.2, 4.2.6.4.3.1 c), 4.4.8	4.2.3.2, 4.2.6.4.3.2,	4.2.3.3, 4.2.6.4.4,	4.2.6.3.2.1, 4.2.6.4.5,
6.6.3 Access to and egress from working spaces in the well (hoistway)	4.2.2.1, 4.2.6.4.4,	4.2.3.2, 4.2.6.4.5	4.2.3.3,	4.2.6.4.1.1,	4.2.6.4.3.1 c),	4.2.6.4.3.2,
6.6.4 Strength of working area(s)	4.5.3,	4.2.2.2 i),	4.4.7.1,	4.2.3.4 a),	4.2.6.4.5.3 a)	
6.6.5 Restrictions on equipment in lift spaces	4.2.6.5.1.1,	B.2.2				
6.6.6 Falling from working areas	4.2.2.2 e)	4.2.6.4.5.3 b),	4.4.7.1 b),	4.4.7.3,	4.4.7.4,	
6.6.7 LCU movement under control of an authorized person	4.2.1.1.1, 4.3.9.1.1, 4.12.1.8	4.2.1.3.1 a), 4.3.9.3	4.2.1.3.1 b), 4.4.8,	4.2.3.3 b), 4.12.1.5,	4.2.6.4.3.2 d), 4.12.1.6,	4.2.6.6.1 b), 4.12.1.5.3,
6.6.8 Uncontrolled or unintended equipment movement inside the Well (hoist-way)	4.2.5.5, 4.9.2.2.2.8, Annex A	4.2.6.4.4.2, 4.9.2.3.4 a) 1),	4.4.7.4 d), 4.9.2.5,	4.5.7, 4.9.3.4,	4.6.2.1.6.3, 4.11,	4.9.1.2, 4.12,
6.6.9 Means of protection from various hazards	4.2.5.6,	4.2.5.7,	4.2.5.8,	4.10.1.1.4		
6.6.10 Falling objects in the well (hoistway)	4.2.2.2 f), 4.4.7.2 a),	4.2.2.2 g), 4.4.11.2,	4.2.5.4, 4.5.8 a)	4.2.6.3.3,	4.2.6.7.2	
6.6.11 Electric shock in working spaces	4.2.6.5.1.2, 4.10.5,	4.2.6.6.1 b), 4.10.6,	4.3.9.1.1, 4.10.9,	4.10.1.2,	4.10.1.3,	4.10.2,
6.6.12 Illumination of working spaces	4.2.1.2, 4.10.7.1,	4.2.6.6.3, 4.10.8,	4.4.10, 4.10.11	4.10.5.1.1 a),	4.10.5.1.1 c),	4.10.5.1.1 e),

Annex E
(informative)

Operations overview

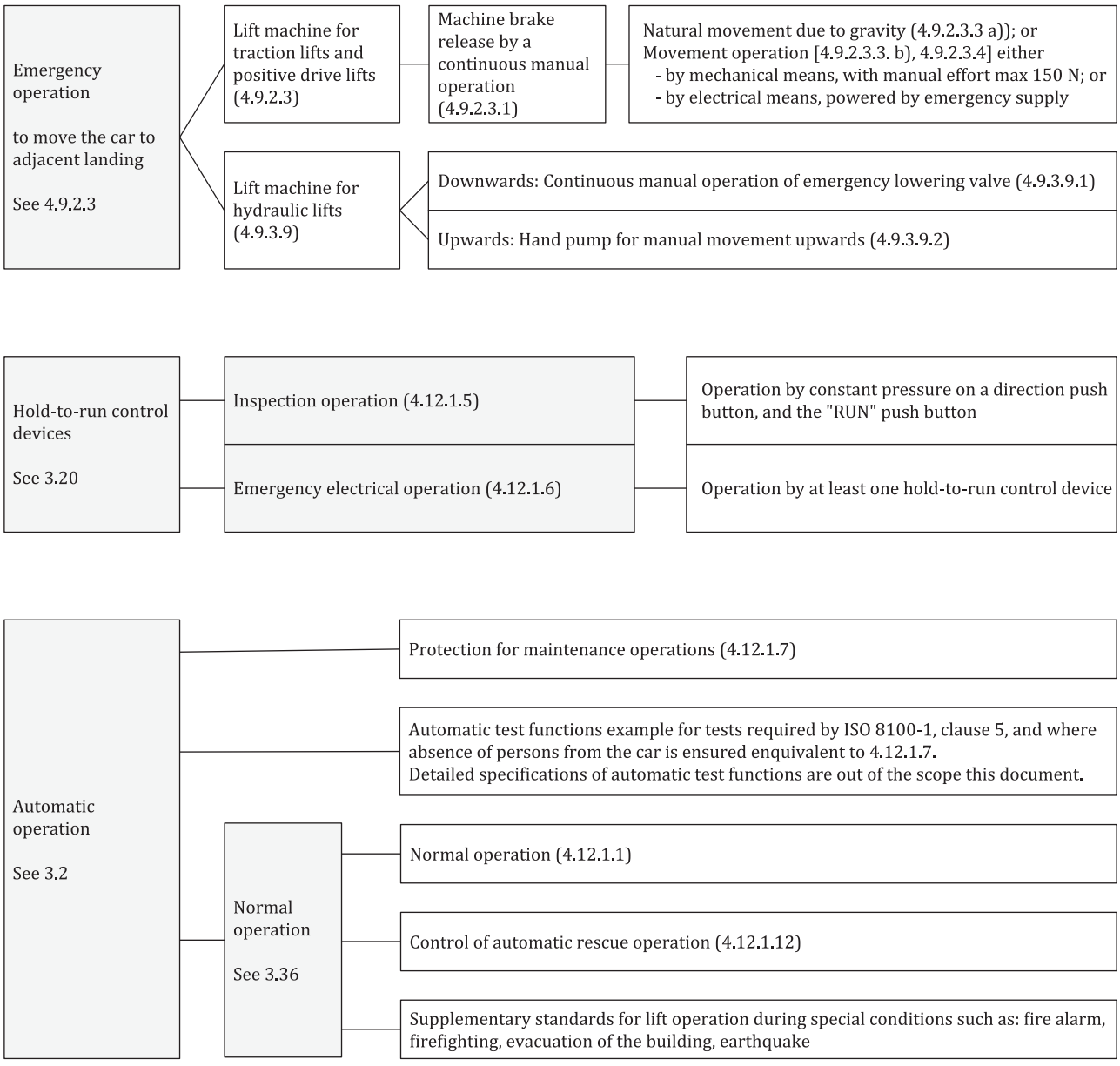


Figure E.1 — Operations overview

Annex ZA
(informative)

Relationship between this European Standard and the essential requirements of Directive 2014/33/EU aimed to be covered

NOTE Annex ZA is not part of the ISO final publication.

This European Standard has been prepared under a Commission's standardization request C(2023) 6588 final ('M/599')[3)] to provide one voluntary means of conforming to requirements of Directive 2014/33/EU of the European Parliament and of the Council of 26 February 2014 as regards lifts and safety components for lifts (OJ L 96, 29.3.2014).

Once this standard is cited in the Official Journal of the European Union under that Directive, compliance with the normative clauses of this standard given in Table ZA.1.1, Table ZA.1.2 and Table ZA.1.3 confers, within the limits of the scope of this standard, a presumption of conformity with the corresponding essential requirements of that Directive and associated EFTA regulations.

Table ZA.1.1 — Correspondence between this European Standard and Annex I of Directive 2014/33/EU

The relevant essential health and safety requirements of Annex I to Directive 2014/33/EU	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.1	See below Table ZA.1.2 and Table ZA.1.3				
1.2 first paragraph	4.2.6.4.3.2 f),	4.3.3.1,	4.3.3.2,	4.3.5.1,	
	4.3.5.2,	4.3.5.4,	4.3.5.5,	4.3.5.6,	
	4.4.1,	4.4.2,	4.4.3.2,	4.4.3.4	
1.2 second paragraph					Not covered
1.3	4.5.1,	4.5.2,	4.5.4,	4.5.5,	
1.4.1	4.4.2.1.4	4.12.1.2			
1.4.2	4.6.1.1,	4.6.1.2	4.6.2.2.1.1,	4.6.2.2.5.5	
	4.6.3.1,	4.6.4.1			
1.4.3	4.8.2.2.1 b),	4.6.2.2.1.6 a) 2),	4.6.2.2.5.4 a) 2),	4.12.1.3	
1.4.4	4.5.3,	4.5.6,	4.5.7.2		
1.5.1	4.9.1.1				
1.5.2	4.2.1.1.1,	4.2.3.3 b),	4.2.5.2.1,	4.2.5.2.2,	
	4.2.6.4.3.2 d),	4.2.6.5.1.2,	4.2.6.5.1.3 b),	4.2.6.6.1 b),	
	4.3.9.1.1,	4.3.9.3			
1.6.1					Not covered
1.6.2	4.3.6.2.3.4 c),	4.12.1.1.1,	4.12.1.1.2		
1.6.3	4.10.5.3				

3) C(2023) 6588, COMMISSION IMPLEMENTING DECISION of 5.10.2023 on a standardisation request to the European Committee for Standardization as regards lifts and safety components for lifts in support of Directive 2014/33/EU of the European Parliament and of the Council

Table ZA.1.1 *(continued)*

The relevant essential health and safety requirements of Annex I to Directive 2014/33/EU	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.6.4	4.2.1.1.2,	4.9.2.5,	4.9.3.4,		
	4.10.1.1.2,	4.10.1.1.3,	4.10.1.2,	4.10.1.3,	
	4.10.2,	4.10.3,	4.10.4,	4.10.5,	
	4.10.6,	4.10.7,	4.10.8.3,		
	4.10.9,	4.10.10	4.11		
2.1	4.2.1.3.1 a),	4.2.3.3,	4.2.5.2,	4.2.5.5.2,	
	4.2.6.4.4.1 d),	4.3.1,	4.3.4,	4.3.5.2,	
	4.3.8,	4.3.9,	4.3.10,	4.4.8 a)	
2.2	4.2.5.6,	4.2.5.7,	4.2.5.8,		
	4.5.3.3,	4.8.1.2,	4.9.3.2.6.2		
2.3	4.3.1.1,	4.3.1.2,	4.3.3,		
	4.3.5.1,	4.3.5.2,	4.3.5.3,	4.3.5.4,	
	4.3.5.5,	4.3.5.6,	4.3.5.8,		
	4.3.8,	4.3.9.1,	4.3.9.3,	4.3.9.4,	
	4.3.10,	4.3.11,	4.12.1.4,	4.12.1.8	
3.1	4.2.5.3.1 c),	4.2.6.4.3.2,	4.3.1,	4.3.9.2,	
	4.3.13	4.3.14,	4.3.15.2,		
	4.4.3.1,	4.4.9.3			
3.2	4.6.1,	4.6.2,	4.6.3.1,	4.6.3.8,	
	4.6.4.1,	4.6.4.6,	4.6.6,	4.6.7,	
	4.7				
3.3	4.2.5.6.1,				
	4.8.1.1,	4.8.1.3,	4.8.1.4,	4.8.2.1.1.1,	
	4.8.2.1.2.2,	4.8.2.2.1			
3.4	4.6.2.1.5,	4.6.2.2.1.6 b),	4.6.2.2.1.6 c),	4.6.2.2.3 e),	
	4.6.2.2.5.4 b),	4.6.2.2.5.4 c),	4.6.2.2.5.6,		
	4.6.6.5,	4.6.7.8			
4.1	4.3.6.2,	4.12.1.1.4			
4.2					not covered
4.3	4.2.5.5.3,	4.4.11.2,	4.4.11.3 a)	4.7.5.2	
4.4	4.2.3.1,	4.2.6.2.2,	4.2.6.6.1 1st paragraph,		
	4.2.6.6.2 a),	4.2.6.6.2 c),	4.3.9.3.1,	4.3.9.3.2,	
	4.3.9.3.7,	4.3.15.1,	4.3.15.3,	4.4.6.2,	
	4.9.2.3.1,	4.9.2.3.3,	4.9.2.3.4,	4.9.2.3.5,	
	4.9.2.3.6,	4.9.2.3.7,	4.9.2.3.9,	4.9.3.9.1.1,	
	4.9.3.9.1.2,	4.9.3.9.1.3,	4.9.3.9.1.4,	4.9.3.9.1.5,	
	4.9.3.9.2.1,	4.9.3.9.2.2,	4.9.3.9.2.3,	4.9.3.9.3,	
	4.10.11,	4.12.1.6,	4.12.3.2		
4.5					not covered
4.6	4.9.3.11,	4.10.4.3,	4.10.4.4		
4.7	4.4.9				

Table ZA.1.1 *(continued)*

The relevant essential health and safety requirements of Annex I to Directive 2014/33/EU	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
4.8	4.4.10.1, 4.4.10.2, 4.4.10.3, 4.4.10.4 b)	
4.9	4.10.11.1 a), 4.10.11.2	
4.10		not covered
5.1	4.4.2.3.2 d), 4.4.2.3.2 e)	
5.2		not covered
6.1		not covered
6.2	6.2, 6.3	

Table ZA.1.2 — Correspondence between this European Standard and Annex I of Directive 2006/42/EC

The relevant essential health and safety requirements of Annex I to Directive 2006/42/EC	Clause(s)/sub-clause(s) of this EN	Remarks/Notes
1.1.2 (a)	4, 5, 6	
1.1.2 (c)	4, 5, 6	
1.1.2 (e)	4, 5, 6	
1.1.3	4.4.4, 4.9.3.1.4, 4.9.3.2.5.1, 4.9.3.7, 4.9.3.11	
1.1.4	4.2.1.2, 4.10.5.1.1 a), 4.10.5.1.1 c), 4.2.6.6.3, 4.10.5.1.1 e), 4.4.10, 4.10.7.1, 4.10.8	
1.1.5	C.4 a)	
1.1.6	4.2.3.2, 4.2.6.3.2.1, 4.2.6.3.2.2, 4.2.6.4.1.1, 4.2.6.4.2, 4.4.6.1 a), 4.12.1.5.1.2, C.3 C.4, C.5	
1.2.1	4.9.2.2.2.3, 4.9.2.3.1, 4.9.2.5, 4.9.2.6, 4.9.2.7, 4.9.3.4, 4.9.3.10, 4.10.3, 4.11, 4.12, Annex A	
1.2.2	4.2.1.3.1 a), 4.2.1.3.1 b), 4.4.8 a), 4.4.8 b), 4.10.1.1.2, 4.12.1.5, 4.12.1.6, 4.12.1.7, 4.12.1.8	
1.2.3	4.2.6.4.4.1 g), 4.3.9.1.12 f), 4.4.6.1 b) 3), 4.4.6.2 b) 3) 4.5.3.3 a) 2), 4.5.3.3 b), 4.6.2.1.4.3, 4.6.2.2.1.6 b), 4.6.2.2.5.4 b), 4.6.5.10, 4.6.6.7, 4.6.6.2, 4.6.7.3, 4.6.7.9, 4.9.2.7.3, 4.9.3.10.3, 4.11.1.5, 4.12.1.3.2, 4.12.1.5, 4.12.1.6, 4.12.1.11.2, 4.12.2.3.2	
1.2.4.1	4.2.1.3.1 d) 4.12.1.11.1, 4.12.1.11.2	
1.2.4.4	4.4.6.2 b) 3) 4.12.1.11.1	
1.2.5	4.12.1.5, 4.12.1.6, 4.12.1.8	

Table ZA.1.2 *(continued)*

The relevant essential health and safety requirements of Annex I to Directive 2006/42/EC	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.2.6	4.6.2.1.4.3, 4.6.7.9, 4.11.2.4.2.2,	4.6.2.2.5.6, 4.9.2.2.2.3 g), 4.11.2.4.3.2,	4.6.5.10, 4.9.2.2.2.8, 4.12.1.3.2,	4.6.6.7, 4.11.1.1, 4.12.2.3.2	
1.3.1	4.2.1.5,	4.9.3.2.6.3			
1.3.2	4.3.3.3, 4.5.2, 4.6.3.3, 4.9.3.2.2, 4.9.3.2.6.5 6.2.4	4.3.5.2, 4.5.6.3, 4.6.4.3, 4.9.3.2.3, 4.9.3.2.6.6,	4.4.3.2, 4.5.8 a), 4.7, 4.9.3.2.6.1, 4.9.3.3.1,	4.4.11.2, 4.6.2.2.1.3, 4.9.3.2.1, 4.9.3.2.6.4 4.9.3.5.3,	
1.3.3	4.2.2.2 f), 4.2.6.7.2,	4.2.2.2 g), 4.4.7.2 a),	4.2.5.4, 4.4.11.3	4.2.6.3.3,	
1.3.4	4.2.5.3.2 c), 4.3.6.2.2.1 g), 4.4.5.1	4.2.5.3.2 d), 4.3.6.2.2.1 i),	4.3.6.1, 4.3.6.2.2.1 j)	4.3.6.2.2.1 f), 4.3.6.2.2.1 k)	
1.3.7	4.2.5.5, 4.5.6.2 e), 4.9.1.2,	4.4.7.4 d), 4.5.7, 4.9.2.3.4 a) 1),	4.6.2.1.6.3, 4.9.2.3.4 a) 3),	4.6.2.2.3 g), 4.9.3.2.6.6 b)	
1.3.8.1	4.2.5.5,	4.5.7.1,	4.9.1.2		
1.3.9	4.2.6.4.3.1,	4.2.6.4.4.1			
1.4.1	4.1.2, 4.2.6.4.3.2 d), 4.4.5,	4.2.3.4, 4.2.6.4.3.2 e), 4.4.6.1 b),	4.2.5.5.1, 4.2.6.4.3.2 f), 4.4.7.4,	4.2.5.5.2, 4.3.9.1.8, 4.5.7	
1.4.2.1	4.1.2,	4.3.9.1.9		4.5.7	
1.4.2.2	4.2.3.3 b), 4.4.6.1 b) 3),	4.2.3.3 d), 4.4.6.2 b) 3)	4.2.6.4.3.2 d),	4.2.6.4.3.2 e),	
1.5.1	4.10.1.1.4, 4.10.2, 4.10.6,	4.10.1.2, 4.10.3, 4.10.9,	4.10.1.3, 4.10.4, 4.10.10	4.10.5,	
1.5.3	4.9.3.1				
1.5.4	4.3.5.2	4.6.2.2.1.1 c),	4.9.2.3.8,	4.10.6.4	
1.5.5	4.10.1.1.4				
1.5.6	4.9.3.11,	4.9.2.2.2.6,	4.10.4.1,	4.10.4.2	
1.5.7					Not covered
1.5.8					Not covered
1.5.11	4.10.1.1.1 b)				
1.5.14	4.2.1.4, 4.3.9.3.5,	4.2.3.3 c), 4.12.1.11.3,	4.2.6.4.3.1 c), 4.12.3.1	4.2.6.4.4.2	
1.5.15	4.2.2.2 e), 4.3.4.3, 4.4.7.2 d), C.3.3 d)	4.2.2.2 k), 4.4.7.1 b), 4.4.7.3,	4.2.6.4.5.3 b), 4.4.7.2 b), 4.4.7.4,	4.2.6.4.5.3 d), 4.4.7.2 c), 4.12.1.1.3	

Table ZA.1.2 *(continued)*

The relevant essential health and safety requirements of Annex I to Directive 2006/42/EC	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.6.1	4.6.3.6, 4.12.1.7,	4.6.3.7, 4.12.1.8,	4.6.4.5, 4.12.1.11.1,	4.12.1.5, 6.2.4	
1.6.2	4.2.2.1, 4.2.6.3.2, 4.2.6.4.3.2, 4.2.6.6.4,	4.2.3.2, 4.2.6.4.1.1, 4.2.6.4.4.2, 4.2.6.7.1,	4.2.3.3, 4.2.6.4.2, 4.2.6.4.5, 4.6.3.2,	4.2.3.4, 4.2.6.4.3.1 c), 4.2.6.4.6, 4.6.4.2	
	C.1	C.2			
1.6.3	4.10.1.2.4,	4.10.5,	4.10.8.1		
1.7.1	4.1.3, 4.2.6.4.5.7, 4.9.2.3.8, 4.10.5.6,	4.2.2.2 j) 4.3.7, 4.9.3.3.3.3, 4.12.1.5.1.2 b),	4.2.5.7.1, 4.4.2.2.1 g), 4.9.3.7, 4.12.1.5.4,	4.2.5.8.1, 4.9.2.3.2, 4.10.1.2.5, 4.12.1.8.4	
1.7.2	4.2.2.2 j), 4.2.5.7.1, 4.3.6.2.3.1 d), 4.10.5.6, 4.12.1.5.3,	4.2.4, 4.2.5.8.1, 4.3.9.3.9, 4.12.1.1.5, 4.12.1.8.3 c),	4.2.6.2, 4.2.6.4.1.2, 4.9.2.3.2, 4.12.1.2.3 a), 4.12.1.10 b),	4.2.6.4.5.7, 4.3.6.2.2.1 b) 3), 4.10.1.2.5, 4.12.1.2.3 b) 4.12.1.10 c)	
1.7.3	4.2.6.4.5.7, 4.4.2.3.2 b), 4.4.2.3.3, 4.6.3.9, 4.8.1.8, 4.11.2.3.5	4.3.9.1.11, 4.4.2.3.2 c), 4.6.2.1.1.3, 4.6.4.7, 4.9.3.3.3.3,	4.4.2.2.1 g), 4.4.2.3.2 e) 4.6.2.2.1.8, 4.6.6.12, 4.9.3.9.1.6,	4.4.2.3.2 a), 4.4.2.3.2 f) 4.6.7.14, 4.9.3.9.2.4,	
4.1.2.3	4.5.3, 4.9.2.2.2.1, 5.2.4, 5.2.10,	4.6.3.5, 4.9.3.3.2, 5.2.5,	4.6.4.4, 4.9.3.3.3.1, 5.2.7	4.7.2.3.1, 4.9.3.3.3.2, 5.2.9,	
4.1.2.4	4.5.1,	4.5.2,	4.5.4,	4.5.6	
4.1.2.8.2	4.4.2.2.1 d),	4.12.1.1.3	4.12.1.2.1,	4.12.1.12.4	
4.2.1	4.9.2.3.1, 4.12.1.6.1.2 b),	4.9.3.9.1.3, 4.12.1.6.2.1 c)	4.12.1.5.2.1 f),	4.12.1.5.2.3,	
4.3.1	4.5.9				
6.3.1	4.2.6.4.4.1 a), 4.6.3.1, 4.8.1.7, 4.8.2.1.2.1 e), 4.9.2.2.2.1 1st paragraph,	4.5.3.2, 4.6.6.3, 4.8.2.1.1, 4.8.2.2.2 a), 4.9.3.2.3.2,	4.6.2.1.2.1, 4.6.7.6, 4.8.2.1.2.1 a), 4.8.2.2.2 b), 4.9.3.2.4.2	4.6.2.1.3, 4.8.1.5, 4.8.2.1.2.1 b),	
6.3.2	4.2.6.4.3.2, 4.4.7.2 c),	4.4.3.2.1, 4.4.7.3,	4.4.6, 4.6.3.4	4.4.7.2 b),	

Table ZA.1.3 — Correspondence between this European Standard and Annex III of Regulation (EU) 2023/1230

The relevant essential health and safety requirements of Annex III to Regulation (EU) 2023/1230	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.1.2 (a)	4, 5, 6				
1.1.2 (c)	4, 5, 6				
1.1.2 (e)	4, 5, 6				
1.1.3	4.4.4, 4.9.3.1.4,	4.9.3.2.5.1,	4.9.3.7,	4.9.3.11	
1.1.4	4.2.1.2, 4.10.5.1.1 a), 4.10.7.1,	4.2.1.3.1 a), 4.10.5.1.1 c), 4.10.8	4.2.6.6.3, 4.10.5.1.1 e),	4.4.10,	
1.1.5	C.4 a)				
1.1.6	4.2.3.2, 4.2.6.4.2,	4.2.6.3.2.1, 4.4.6.1 a),	4.2.6.3.2.2, 4.12.1.5.1.2,	4.2.6.4.1.1, C.3,	
	C.4,	C.5			
1.1.9	4.10.1.1.5, 6.2.4 v)	4.10.1.1.6,	4.12.4,	6.2.4 k) 7),	
1.2.1	4.9.2.2.2.3, 4.9.2.7, 4.10.3,	4.9.2.3.1, 4.9.3.4, 4.11,	4.9.2.5, 4.9.3.10, 4.12,	4.9.2.6, 4.10.1.1.6 Annex A	
1.2.2	4.2.1.3.1 a), 4.4.8 a), 4.12.1.5,	4.2.1.3.1 b), 4.4.8 b), 4.12.1.6,	4.10.1.1.2, 4.12.1.7,	4.12.1.8	
1.2.3	4.2.6.4.4.1 g), 4.5.3.3 a) 2), 4.6.2.1.4.3, 4.6.6.7, 4.9.2.7.3, 4.12.1.5,	4.3.9.1.12 f), 4.5.3.3 b), 4.6.2.2.1.6 b), 4.6.6.2, 4.9.3.10.3, 4.12.1.6,	4.4.6.1 b) 3), 4.6.2.2.5.4 b), 4.6.7.3, 4.11.1.5, 4.12.1.11.2,	4.4.6.2 b) 3) 4.6.5.10, 4.6.7.9, 4.12.1.3.2, 4.12.2.3.2	
1.2.4.1	4.2.1.3.1 d)	4.12.1.11.1,	4.12.1.11.2		
1.2.4.4	4.4.6.2 b) 3)	4.12.1.11.1			
1.2.5	4.12.1.5,	4.12.1.6,	4.12.1.8		
1.2.6	4.6.2.1.4.3, 4.6.7.9, 4.11.2.4.2.2,	4.6.2.2.5.6, 4.9.2.2.2.3 g), 4.11.2.4.3.2,	4.6.5.10, 4.9.2.2.2.8, 4.12.1.3.2,	4.6.6.7, 4.11.1.1, 4.12.2.3.2	
1.3.1	4.2.1.5,	4.9.3.2.6.3			
1.3.2	4.3.3.3, 4.5.2, 4.6.3.3, 4.9.3.2.2, 4.9.3.2.6.5 6.2.4	4.3.5.2, 4.5.6.3, 4.6.4.3, 4.9.3.2.3, 4.9.3.2.6.6,	4.4.3.2, 4.5.8 a), 4.7, 4.9.3.2.6.1, 4.9.3.3.1,	4.4.11.2, 4.6.2.2.1.3, 4.9.3.2.1, 4.9.3.2.6.4 4.9.3.5.3,	
1.3.3	4.2.2.2 f), 4.2.6.7.2,	4.2.2.2 g), 4.4.7.2 a),	4.2.5.4, 4.4.11.3	4.2.6.3.3,	

Table ZA.1.3 *(continued)*

The relevant essential health and safety requirements of Annex III to Regulation (EU) 2023/1230	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.3.4	4.2.5.3.2 c), 4.3.6.2.2.1 g), 4.4.5.1	4.2.5.3.2 d), 4.3.6.2.2.1 i)	4.3.6.1, 4.3.6.2.2.1 j)	4.3.6.2.2.1 f), 4.3.6.2.2.1 k)	
1.3.7	4.2.5.5, 4.5.6.2 e), 4.9.1.2,	4.4.7.4 d), 4.5.7, 4.9.2.3.4 a) 1),	4.6.2.1.6.3, 4.9.2.3.4 a) 3),	4.6.2.2.3 g), 4.9.3.2.6.6 b)	
1.3.8.1	4.2.5.5,	4.5.7.1,	4.9.1.2		
1.3.9	4.2.6.4.3.1,	4.2.6.4.4.1			
1.4.1	4.1.2, 4.2.6.4.3.2 d), 4.4.5,	4.2.3.4, 4.2.6.4.3.2 e), 4.4.6.1 b),	4.2.5.5.1, 4.2.6.4.3.2 f), 4.4.7.4,	4.2.5.5.2, 4.3.9.1.8, 4.5.7	
1.4.2.1	4.1.2,	4.3.9.1.9		4.5.7	
1.4.2.2	4.2.3.3 b), 4.4.6.1 b) 3),	4.2.3.3 d), 4.4.6.2 b) 3)	4.2.6.4.3.2 d),	4.2.6.4.3.2 e),	
1.5.1	4.10.1.1.4, 4.10.2, 4.10.6,	4.10.1.2, 4.10.3, 4.10.9,	4.10.1.3, 4.10.4, 4.10.10	4.10.5,	
1.5.3	4.9.3.1				
1.5.4	4.3.5.2	4.6.2.2.1.1 c),	4.9.2.3.8,	4.10.6.4	
1.5.5	4.10.1.1.4				
1.5.6	4.9.3.11,	4.9.2.2.2.6,	4.10.4.1,	4.10.4.2	
1.5.7					Not covered
1.5.8					Not covered
1.5.11	4.10.1.1.1 b)				
1.5.14	4.2.1.4, 4.3.9.3.5,	4.2.3.3 c), 4.12.1.11.3,	4.2.6.4.3.1 c), 4.12.3.1	4.2.6.4.4.2	
1.5.15	4.2.2.2 e), 4.3.4.3, 4.4.7.2 d), C.3.3 d)	4.2.2.2 k), 4.4.7.1 b), 4.4.7.3,	4.2.6.4.5.3 b), 4.4.7.2 b), 4.4.7.4,	4.2.6.4.5.3 d), 4.4.7.2 c), 4.12.1.1.3	
1.6.1	4.6.3.6, 4.12.1.7,	4.6.3.7, 4.12.1.8,	4.6.4.5, 4.12.1.11.1,	4.12.1.5, 6.2.4	
1.6.2	4.2.2.1, 4.2.6.3.2, 4.2.6.4.3.2, 4.2.6.6.4, C.1,	4.2.3.2, 4.2.6.4.1.1, 4.2.6.4.4.2, 4.2.6.7.1, C.2	4.2.3.3, 4.2.6.4.2, 4.2.6.4.5, 4.6.3.2,	4.2.3.4, 4.2.6.4.3.1 c), 4.2.6.4.6, 4.6.4.2	
1.6.3	4.10.1.2.4,	4.10.5,	4.10.8.1		
1.7.1	4.1.3, 4.2.6.4.5.7, 4.9.2.3.8, 4.10.5.6,	4.2.2.2 j) 4.3.7, 4.9.3.3.3.3, 4.12.1.5.1.2 b),	4.2.5.7.1, 4.4.2.2.1 g), 4.9.3.7, 4.12.1.5.4,	4.2.5.8.1, 4.9.2.3.2, 4.10.1.2.5, 4.12.1.8.4	

Table ZA.1.3 *(continued)*

The relevant essential health and safety requirements of Annex III to Regulation (EU) 2023/1230	Clause(s)/sub-clause(s) of this EN				Remarks/Notes
1.7.2	4.2.2.2 j), 4.2.5.7.1, 4.3.6.2.3.1 d), 4.10.5.6, 4.12.1.5.3,	4.2.4, 4.2.5.8.1, 4.3.9.3.9, 4.12.1.1.5, 4.12.1.8.3 c),	4.2.6.2, 4.2.6.4.1.2, 4.9.2.3.2, 4.12.1.2.3 a), 4.12.1.10 b),	4.2.6.4.5.7, 4.3.6.2.2.1 b) 3), 4.10.1.2.5, 4.12.1.2.3 b) 4.12.1.10 c)	
1.7.3	4.2.6.4.5.7, 4.4.2.3.2 b), 4.4.2.3.3, 4.6.3.9, 4.8.1.8, 4.11.2.3.5	4.3.9.1.11, 4.4.2.3.2 c), 4.6.2.1.1.3, 4.6.4.7, 4.9.3.3.3.3,	4.4.2.2.1 g), 4.4.2.3.2 e) 4.6.2.2.1.8, 4.6.6.12, 4.9.3.9.1.6,	4.4.2.3.2 a), 4.4.2.3.2 f) 4.6.7.14, 4.9.3.9.2.4,	
4.1.2.3	4.5.3, 4.9.2.2.2.1, 5.2.4, 5.2.10,	4.6.3.5, 4.9.3.3.2, 5.2.5,	4.6.4.4, 4.9.3.3.3.1, 5.2.7	4.7.2.3.1, 4.9.3.3.3.2, 5.2.9,	
4.1.2.4	4.5.1,	4.5.2,	4.5.4,	4.5.6	
4.1.2.8.2	4.4.2.2.1 d),	4.12.1.1.3	4.12.1.2.1,	4.12.1.12.4	
4.2.1	4.9.2.3.1, 4.12.1.6.1.2 b),	4.9.3.9.1.3, 4.12.1.6.2.1 c)	4.12.1.5.2.1 f),	4.12.1.5.2.3,	
4.3.1	4.5.9				
6.3.1	4.2.6.4.4.1 a), 4.6.3.1, 4.8.2.1.1, 4.8.2.1.2.1 e), 4.9.2.2.2.1 1st paragraph,	4.5.3.2, 4.6.6.3, 4.8.2.1.2.1 a), 4.8.2.2.2 a), 4.9.3.2.3.2,	4.6.2.1.2.1, 4.6.7.6, 4.8.2.1.2.1 b), 4.8.2.2.2 b), 4.9.3.2.4.2	4.6.2.1.3, 4.8.1.5,	
6.3.2	4.2.6.4.3.2, 4.4.7.2 c),	4.4.3.2.1, 4.4.7.3,	4.4.6, 4.6.3.4	4.4.7.2 b),	

WARNING 1 Presumption of conformity stays valid only as long as a reference to this European Standard is maintained in the list published in the Official Journal of the European Union. Users of this standard should consult frequently the latest list published in the Official Journal of the European Union.

WARNING 2 Other Union legislation may be applicable to the product(s) falling within the scope of this standard.

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