BS ISO 22201-1:2017

BSI Standards Publication

Lifts (elevators), escalators and moving walks — Programmable electronic systems in safety-related applications

Part 1: Lifts (elevators) (PESSRAL)

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National foreword

This British Standard is the UK implementation of ISO 22201-1:2017. It supersedes BS ISO 22201:2009 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee MHE/4, Lifts, hoists and escalators.

A list of organizations represented on this committee can be obtained on request to its secretary.

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ISO 22201-1

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Lifts (elevators), escalators and moving walks — Programmable electronic systems in safety-related applications —

Part 1: Lifts (elevators) (PESSRAL)

Ascenseurs, escaliers mécaniques et trottoirs roulants — Systèmes électroniques programmables dans les applications liées à la sécurité —

Partie 1: Ascenseurs (PESSRAL)

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Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 178, *Lifts, escalators and moving walks*.

This first edition cancels and replaces ISO 22201:2009, which has been technically revised (incorporating ISO 22201:2009/Cor 1:2011) and includes the following changes:

— editorial changes that correct typographical errors and terminology inconsistencies between this document and its reference standards, including between it and the two other standards in the 22201 series.

A list of all parts in the ISO 22201 series can be found on the ISO website.

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Introduction

Systems comprised of electrical and/or electronic elements have been used for many years to perform safety functions in most application sectors. Computer-based systems, generically referred to as programmable electronic systems, are being used in many application sectors to perform non-safety functions and, increasingly, to perform safety functions. In order to effectively and safely exploit computer-system technology, it is essential that those responsible for making decisions have sufficient guidance on the safety aspects on which to make these decisions. In most situations, safety is achieved by a number of protective systems that rely on many technologies (for example mechanical, hydraulic, pneumatic, electrical, electronic, programmable electronic). It is necessary that any safety strategy, therefore, considers not only all the components within an individual system (for example sensors, controlling devices and actuators), but also all the safety-related elements making up the total combination of safety-related systems.

This document is based upon the guidelines provided in the generic IEC 61508 series of standards of the International Electrotechnical Commission (IEC) and EN 81 (all parts) of the Comité Européen de Normalization (CEN).

The requirements given in this document recognize the fact that the product family covers a total range of passenger and goods/passenger lifts used in residential buildings, offices, hospitals, hotels, industrial plants, etc. This document is the product family standard for lifts and takes precedence over all aspects of the generic standard.

This document sets out the product specific requirements for systems comprised of programmable electronic components and programmable electronic systems that are used to perform safety functions in lifts. This document has been developed in order that consistent technical and performance requirements and rational be specified for programmable electronic systems in safety-related applications for lifts (PESSRAL).

Risk analysis, terminology and technical solutions have been considered, taking into account the methods of the IEC 61508 series of standards. The risk analysis of each safety function specified in Table 1 resulted in the classification of electric safety functions applied to PESSRAL. Tables 1 and 2 give the safety integrity level and functional requirements, respectively, for each electric safety function.

The safety integrity levels (SIL) specified in this document can also be applied to other technologies used to satisfy the safety functions specified in this document.

Within the context of the harmonization with national standards for lifts, the application of this document is intended to be by reference within a national standard lift such as lift codes, standards, or laws. The reason for this is threefold:

a) to allow selective reference by national standards to specific lift safety functions described in this document (not all lift safety functions identified in this document are called out in every national standard);

b) to allow for future harmonization of national standards with lift safety functions identified in this document:

   — Because there exist some differences in the requirements for fulfilment of the safety objectives of national lift standards and in national practice of lift use and maintenance, there are instances where the requirements for lift safety functions described in this document are based on the consensus work and agreement by the ISO committee responsible for this document. National bodies may choose to selectively harmonize with those lift safety functions that differ in the requirements called for by the existing national standard in future standard revisions.

   — It is important to note that more than 90 % of the safe-state requirements and more than 80 % of the anticipated SIL requirements by the national standards referenced in this document are already harmonized with the requirements of the lift safety functions specified in this document. The remainder is not harmonized for the reasons given above.

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c) to allow for the application of this document where lift safety functions are new or deviate from those specified in this document. More and more, national lift legislations are moving to performance-based requirements. For this reason, the development of new or different lift safety functions can be foreseen in product specific applications. For those who require lift safety functions that are new or different from those specified in this document, this document provides a verifiable method to establish the necessary level of safety integrity for those functions.

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Lifts (elevators), escalators and moving walks — Programmable electronic systems in safety-related applications —

Part 1: Lifts (elevators) (PESSRAL)

1 Scope

This document is applicable to the product family of passenger and goods/passenger lifts used in residential buildings, offices, hospitals, hotels, industrial plants, etc. This document covers those aspects that it is necessary to address when programmable electronic systems are used to carry out electric safety functions for lifts (PESSRAL). This document is applicable for lift safety functions that are identified in lift codes, standards or laws that reference this document for PESSRAL. The SILs specified in this document are understood to be valid for PESSRAL in the context of the referenced lift codes, standards and laws in Annex B.

NOTE Within this document, the UK term "lift" is used throughout instead of the US term "elevator".

This document is also applicable for PESSRAL that are new or deviate from those described in this document.

The requirements of this document regarding electrical safety/protective devices are such that it is not necessary to take into consideration the possibility of a failure of an electric safety/protective device complying with all the requirements of this document and other relevant standards.

In particular, this document

a) uses safety integrity levels (SIL) for specifying the target failure measure for the safety functions implemented by the PESSRAL;

b) specifies the requirements for achieving safety integrity for a function but does not specify who is responsible for implementing and maintaining the requirements (for example, designers, suppliers, owner/operating company, contractor); this responsibility is assigned to different parties according to safety planning and national regulations;

c) applies to PE systems used in lift applications that meet the minimum requirements of a recognized lift standard such as EN 81, ASME A17.1-2007/CSA B44-07, or lift laws such as the Japan Building Standard Law Enforcement Order For Elevator and Escalator;

d) defines the relationship between this document and IEC 61508 and defines the relationship between this document and the EMC standard for lifts on immunity, ISO 22200;

e) outlines the relationship between lift safety functions and their safe-state conditions;

f) applies to phases and activities that are specific to design of software and related hardware but not to those phases and activities that occur post-design, for example sourcing and manufacturing;

g) requires the manufacturer of the PESSRAL to provide instructions that specify what is necessary to maintain the integrity of the PESSRAL (instruction manual) for the organization carrying out the assembly, connections, adjustment and maintenance of the lift;

h) provides requirements relating to the software and hardware safety validation;

i) establishes the safety integrity levels for specific lift safety functions;

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j) specifies techniques/measures required for achieving the specified safety integrity levels;

k) provides risk-reduction decision tables for the application of PESSRALs;

l) defines a maximum level of performance (SIL 3) that can be achieved for a PESSRAL according to this document and defines a minimum level of performance (SIL 1).

This document does not cover:

— hazards arising from the PE systems equipment itself, such as electric shock, etc.;

— the concept of fail-safe, which can be of value when the failure modes are well defined and the level of complexity is relatively low; the concept of fail-safe is considered inappropriate because of the full range of complexity of the PESSRAL that are within the scope of this document;

— other relevant requirements necessary for the complete application of a PESSRAL in a lift safety function, such as the mechanical construction, mounting and labelling of switches, actuators, or sensors that contain the PESSRAL. It is necessary that these requirements be carried out in accordance with the national lift standard that references this document.

— foreseeable misuse involving security threats related to malevolent or unauthorized action. In cases where a security threat analysis needs to be considered, this standard may be used, provided the specified SIL has been reassessed.

2 Normative references

The following documents are referred to in 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 22200, *Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks — Immunity*

IEC 61249-2-1, *Materials for printed boards and other interconnecting structures — Part two-1: Reinforced base materials, clad and unclad — Phenolic cellulose paper reinforced laminated sheets, economic grade, copper clad*

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

IEC 61508-2, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

IEC 61508-3, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 3: Software requirements*

IEC 61508-5, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 5: Example of methods for the determination of safety integrity levels*

IEC 61508-7:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 7: Overview of techniques and measures*

IEC 62326-1, *Printed boards — Part 1: Generic specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61508-4 and the following apply.

NOTE The definitions in this document take precedence over those in the generic standard.

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

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

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

3.1
manually operated stopping device
stopping device that is intentionally, by human intervention, actuated and de-actuated

EXAMPLE Toggle switch, mushroom type or hand-operated switch.

3.2
non-manually operated stopping device
stopping device that is automatically actuated or de-actuated due to human intervention or detection

3.3
non-SIL-relevant safe-state requirement
required response to the actuation of an SIL-rated safety function where the function performing this response is not required to be SIL rated

Note 1 to entry: See Figure 4 and Table 2.

3.4
programmable electronic
PE
based on computer technology which can be comprised of hardware, software, and of input and/or output units

Note 1 to entry: This term covers microelectronic devices based on one or more central processing units (CPUs), together with associated memories, etc.

EXAMPLE The following are all programmable electronic devices:

— microprocessors;

— micro-controllers;

— programmable controllers;

— field programmable gate array (FPGA);

— application specific integrated circuits (ASICs);

— programmable logic controllers (PLCs); and

— other computer-based devices (for example smart sensors, transmitters, actuators).

3.5
programmable electronic system
PE system
system for control, protection or monitoring based on one or more programmable electronic devices, including all elements of the system, such as power supplies, sensors and other input devices, data highways and other communication paths, and actuators and other output devices

Note 1 to entry: See Figure 1.

Note 2 to entry: A PE system may include elements that perform SIL-rated requirements and non-SIL-rated requirements. The SIL rating is only required for those elements that perform the SIL-relevant functional requirements.

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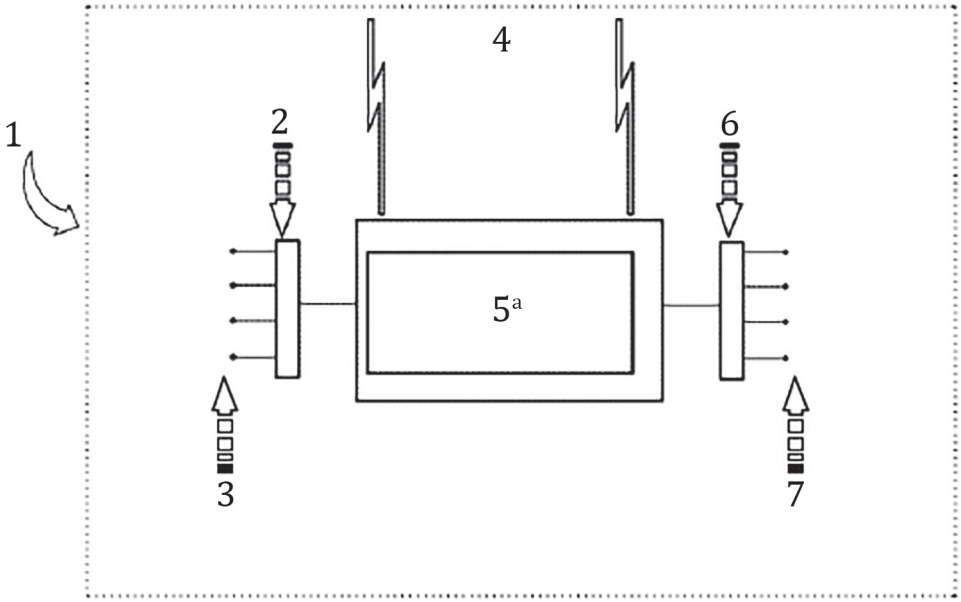

Key

1 extent of PE system
2 input interfaces (for example, A-D converters)
3 input devices (for example, sensors)
4 communications
5 programmable electronics (PEs)
6 output interfaces (for example, D-A converters)
7 output devices/final elements (for example, actuators)
a The programmable electronics are shown centrally located but could exist at several places in the PE system.

Figure 1 — Basic PE systems structure

3.6
programmable electronic systems in safety-related applications for lifts
PESSRAL
application of a software-based PE system in a safety-related system for a lift

3.7
proof test
periodic test performed to detect dangerous hidden failures in a safety-related system so that, if necessary, a repair can restore the system to an "as new" condition or as close as practical to this condition.

Note 1 to entry: In this standard the term "proof test" is used but it is recognized that a synonymous term is "periodical test".

Note 2 to entry: The effectiveness of the proof test will be dependent both on failure coverage and repair effectiveness. In practice, detecting 100 % of the hidden dangerous failures is not easily achieved for other than low-complexity E/E/PE safety-related systems. This should be the target. As a minimum, all the safety functions which are executed are checked according to the E/E/PE system safety requirements specification. If separate channels are used, these tests are done for each channel separately. For complex elements, an analysis may need to be performed in order to demonstrate that the probability of hidden dangerous failure not detected by proof tests is negligible over the whole life duration of the E/E/PE safety-related system.

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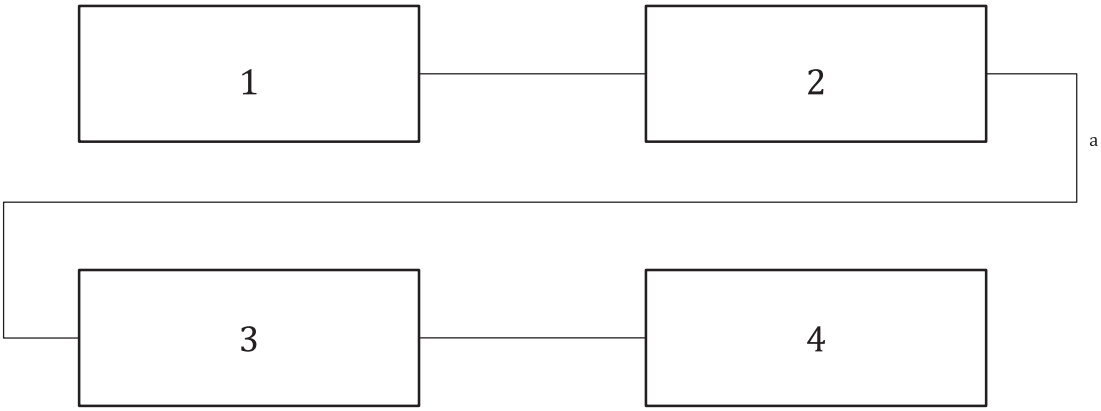
Note 3 to entry: A proof test needs some time to be achieved. During this time the E/E/PE safety-related system may be inhibited partially or completely. The proof test duration can be neglected only if the part of the E/E/PE safety-related system under test remains available in case of a demand for operation or if the EUC is shut down during the test.

Note 4 to entry: During a proof test, the E/E/PE safety-related system may be partly or completely unavailable to respond to a demand for operation. The MTTR can be neglected for SIL calculations only if the EUC is shut down during repair or if other risk measures are put in place with equivalent effectiveness.

3.8
safety chain
total combination of safety devices that fulfil all or a group of lift safety functions

Note 1 to entry: See Figure 2.



Key

1 safety device 1, function 1

2 safety device 2, function 2

3 safety device *n*, function *n*

4 safety device (*n* + 1), function (*n* + 1)

a All or a group of required lift safety functions; see Table 1.

Figure 2 — Safety chain

3.9
safety device
part of the safety-related system, including necessary control circuits, that is designated to achieve, in its own right, a lift safety function and that may consist of PE elements and non-PE elements

Note 1 to entry: See Figure 3 and Table 1.

Key

1 PE elements

2 non-PE elements

Figure 3 — Safety device

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3.10
safety function
function implemented by a safety-related system that is intended to achieve or maintain a safe state of the lift with respect to a specific hazardous event

Note 1 to entry: See Table 1.

Note 2 to entry: A safety function may include non-SIL-relevant requirements; see Table 2.

3.11
safety-related system
one or more safety devices performing one or more safety functions that can be based on programmable electronic (PE), electrical, electronic and/or mechanical elements of the lift

3.12
safety integrity level
SIL
discrete level (one out of a possible four) for specifying the safety integrity requirements of the safety functions allocated to the programmable electronic safety-related system, where safety integrity level 4 has the highest level of safety integrity and safety integrity level 1 has the lowest

Note 1 to entry: The SIL is indicative of a failure rate that includes all causes of failures (both random hardware failures and systematic failures) that lead to an unsafe state, for example hardware failures, software-induced failures and failures due to electrical interference.

Note 2 to entry: In the context of this document, SIL 3 is the highest safety integrity level that shall be applied to lifts.

3.13
SIL-relevant safe-state requirement
part of the safety-related system where it is necessary that the specified SIL of the function be met

Note 1 to entry: See Figure 4 and Table 2.

Key
1 SIL-relevant safe-state requirement(s)
2 non-SIL-relevant safe-state requirement(s)

Figure 4 — Lift safety function

3.14
system reaction time
sum of the following two values:

a) time period between the occurrence of a fault in the PESSRAL and the initiation of the corresponding action on the lift;

b) time period for the lift to respond to the action, maintaining a safe state.

4 Symbols and abbreviated terms

ETSL emergency terminal speed limiting

ETS emergency terminal stopping

EUC equipment under control

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MTTR mean time to repair

PCB printed circuit board

5 Requirements

5.1 General

5.1.1 Table 1 defines the safety-function names, associated lift functional description, applicable lift type and required SIL for the SIL-relevant part of the safety function. A lift is permitted to operate without interruption when safety functions are not actuated.

NOTE Safety functions refer to those lift functions that are identified in codes, standards and laws that reference this document for PESSRAL. See Table B.1.

5.1.2 Table 2 defines the safe-state requirements when the safety functions in Table 1 are actuated. If a safety function should actuate, the safety function shall cause the lift system to revert to the safe-state conditions specified by the requirements of Table 2.

5.1.3 PESSRAL shall consider the reaction time of the lift to respond to the safety function and internal fault detection in the time necessary to achieve the safe-state condition without hazard. Methods that fulfil internal fault detection shall consider the necessary system reaction time required by the SIL (see example).

EXAMPLE If an internal fault is detected by comparison of data in a two-channel system within the time necessary to meet the system's reaction time, then it is not necessary to complete a variable-memory range test within the system reaction time because the safety integrity is verified by the two-channel design.

5.2 Extended application of this document

5.2.1 General

The requirements in 5.2.2 to 5.2.4 are provided to verify SILs and safe-state conditions for lift safety functions that are new or deviate from the requirements provided in 5.3 and 5.4, or are referenced by codes and standards not harmonized with the requirements of codes, standards or laws referenced in Table B.1.

5.2.2 Risk assessment

Where alternatives to the requirements of 5.3 and/or 5.4 are sought, methods for the determination of the required safety integrity level shall be performed in accordance with IEC 61508-5. The same methods shall be used to establish the rationale for a new PESSRAL function and corresponding SIL or a revised PESSRAL function and/or SIL that deviate from the requirements of 5.3 and 5.4. The mean target failure frequency for the worst-case severity of the consequence of any single potential hazard scenario shall not exceed a frequency of 5×10^{-7}/year. See also Annex C.

5.2.3 Limits for specifying SIL for PESSRAL

Target failure measures required for specifying a PE system in a lift safety-related function shall be no less than SIL 1 and no greater than SIL 3. If a target failure measure requires a SIL higher than SIL 3, consideration should be given to redesigning the system such that the required target-failure measure is satisfied with SIL 3 or less. If an SIL lower than SIL 1 is required, a non-SIL-rated PE system may be used but it shall not be classified as a PESSRAL. No PESSRAL shall have a SIL of less than SIL 1 even if it is applied to a safety function requiring less than SIL 1.

Applications that require the use of a single safety function of safety integrity level 4 are not typically required in the lift industry. Such applications shall be avoided because of the difficulty of achieving and

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maintaining such high levels of performance throughout the life cycle of the safety device. If the analysis results in a safety integrity level of 4 or higher being assigned to a lift safety function, consideration shall be given to changing the process design in such a way that it becomes more inherently safe or by adding additional layers of protection. These enhancements can, perhaps, then reduce the safety integrity level requirements for the lift safety function. If the safety integrity level cannot be reduced, the target failure measure for the safety function shall be distributed across multiple PESSRAL of SIL 3 or less that are sufficiently independent and certified in the application.

5.2.4 Safe-state requirements

For lift safety functions that are new or differ from those specified in 5.3 and 5.4, the designer shall identify the safe-state requirements in a manner similar to that in which they are described in Table 2.

5.3 Safety function SIL requirements

Table 1 provides the required SIL for each lift safety function. For further information, see Table B.1.

5.4 SIL-relevant and non-SIL-relevant safe-state requirements

Table 2 provides the required response of the lift to the lift safety functions of Table 1 and the SIL and non-SIL-relevant requirements for each response from actuation of that function. An “X” indicates the response is required for the safe-state condition when the safety function actuates or where the PESSRAL detects an internal fault condition. See corresponding notes where a numerical note reference value is used in place of an “X” for further clarification of the required response.

Table 1 — Safety function SIL requirements

ID no.	Lift safety function	Functional description	Lift type application	SIL
1	Check final stopping limit positive drive	Detects that fewer than 1,5 turns of rope remain on the sheave or when the car has not reached top or bottom travel limit in the shaft and or that the rope is unwinding in the reverse direction	Positive drive (winding drum)	1
2	Check tension, suspension means	Detects loss of tension in the suspension means (e.g. rope or chain)	Positive drive (winding drum) hydraulic	2
3	Check for running motor-generator	Detects loss of motor-generator running condition	Traction	1
4	Check tension, compensation means	Detects loss of tension in the compensation means	Traction	3
5	Check compensation tie-down	Detects if the travel limits have been exceeded for the compensation tie-down means (anti-rebound)	Traction	3
6	Check motor field running current	Detects loss of DC hoist motor field running current	Traction	1
7	Check tension, final limit linkage	Detects loss of tension in the means for the linkage of transmission of car position for the final limit	Traction hydraulic	1
8	Check tension, ETSL linkage	Detects loss of tension in the means for the linkage of transmission of car position for emergency terminal speed limiting (ETSL)	Traction	2

[a] The letter designation on 10.x refers to stop switch location.

[b] The “.1”, “.2”, “.3” designation on 10 is consistent with the function SIL.

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Table 1 *(continued)*

ID no.	Lift safety function	Functional description	Lift type application	SIL
9	Check fully retracted working platform	Detects if working platform is fully retracted	All	3
10 (a,b,c,...i)[a]	Check manually operated stopping device	Detects if a manually operated stopping device (e.g. emergency stop switch) is actuated as applicable at car-top, pit, pulley room, docking operation, passenger/goods (freight) in-car, in-car, machine remote from the motion controller disconnect, machine spaces, control spaces, machine rooms, control rooms, equipment inspection and test access panels and inspection station	All	3
10(i).1[b]	Check non-manually operated stopping device	Detects if non-manually operated stopping device (e.g. switch) is actuated as applicable at pulley room	All	1
10(a,d,g,h).2[b]	Check non-manually operated stopping device	Detects if non-manually operated stopping device (e.g. switch) is actuated as applicable at passenger/goods (freight) in-car, pit, machinery spaces, equipment inspection, emergency and test panels	All	2
10(e).3[b]	Check non-manually operated stopping device	Detects if non-manually operated stopping device (e.g. switch) is actuated as applicable at inspection station	All	3
11	Check car safety gear	Detects if car safety gear has actuated	All	1
12	Check car overspeed (manual reset)	Detects car speed exceeding maximum limit set prior to or up to governor tripping speed; requires manual reset	All	2
13	Check reset of governor (manual type)	Detects if the governor is not in the reset position	All	3
14	Check tension in governor rope (or equivalent)	Detects loss of tension in the governor rope or car safety rope	All	3
15	Check car overspeed (automatic reset permitted)	Detects car speed exceeding the maximum limit set prior to or up to governor tripping speed; may be automatically reset	All	2
16	Check final limit (automatic or inspection)	Detects if car exceeds the final limit	All	1
17	Check for emergency terminal speed limit (ETSL)	Detects insufficient speed reduction in terminal zone where reduced stroke buffers are applied	Traction	2
18	Check tension in two suspension means	Detects loss of tension in a rope or chain in case of two ropes or a two-chain-type suspension	All	1
19	Check manual evacuation means	Detects that the manual means (e.g. wheel) for emergency evacuation is engaged with the machine	Traction winding drum	1
20	Check the fully retracted position of the mechanical device	Detects the fully retracted (inactive) position of the mechanical device	All	3
21	Check proper inactive position of pit protection mechanical device	Detects proper full disengagement of inactive position of the mechanical device that provides clearance protection in pit	All	3

[a] The letter designation on 10.x refers to stop switch location.

[b] The ".1", ".2", ".3" designation on 10 is consistent with the function SIL.

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Table 1 *(continued)*

ID no.	Lift safety function	Functional description	Lift type application	SIL
22	Check proper full engagement of the pit protection mechanical device	Detects proper full engagement of the mechanical device that provides clearance protection in pit	All	3
23	Check movable stops not fully retracted	Detects movable stops not fully retracted	All	3
24	Check movable stops not fully extended	Detects movable stops not fully extended	All	3
25	Check doors providing access to equipment inside hoistway	Detects open access doors providing access to equipment inside the hoistway	All	2
26	Check doors providing access from working area outside hoistway	Detects open access doors, access from working area outside hoistway	All	2
27	Check circuit-breaker release device	Detects activation of the device to release the circuit breaker contactor (replacement of main switch)	All	2
28	Check levelling and re-levelling	Detects if car position is outside the levelling zone, with open doors, during levelling, re-levelling, or electrical anti-creeping	All	2
29	Check tension, levelling zone position rope or equivalent	Detects loss of tension in the means for the linkage of transmission of car position for levelling zone	All	2
30	Check travel limit for docking operation	Detects if the car exceeds the position limits for docking operation	All	2
31	Check docking operation	Detects if docking operation is enabled	All	2
32	Check car/landing door bypass operation	Detects if bypass operation is activated for landing and car door device(s)	All	3
33	Check top of car inspection operation	Detects if top of car inspection operation is enabled	All	3
34	Check in-car inspection operation	Detects if in-car inspection operation is enabled	All	3
35	Check clamping device	Detects engaged clamping device	Hydraulic	1
36	Check emergency electrical operation	Detects if emergency electrical operation (such as machine room, machine space, control room, control space, inspection and test panel, working platform and pit operation) is enabled	All	3
37	Check equipment in-car access panel	Detects if equipment in-car access panel is not closed	All	2
38	Check ascending car over speed	Detects if maximum speed for an ascending car is exceeded	All	2
39	Check uncontrolled car movement	Detects uncontrolled movement of the car	All	2
40	Check pawl device	Detects if the position of the pawl device is not retracted	Hydraulic	1
41	Check buffer position of pawl device	Detects if the buffer is not in normal extended position where the pawl is used	Hydraulic	3
42	Check normal extended position of buffer	Detects if the buffer is not in the normal extended position	All	3

[a] The letter designation on 10.x refers to stop switch location.

[b] The ".1", ".2", ".3" designation on 10 is consistent with the function SIL.

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