
**Electrical requirements for lifts,
escalators and moving walks —**

**Part 6:
Programmable electronic systems
in safety-related applications
for escalators and moving walks
(PESSRAE)**

*Exigences électriques pour ascenseurs, escaliers mécaniques et
trottoirs roulants —*

*Partie 6: Systèmes électroniques programmables dans les applications
liées à la sécurité pour escaliers mécaniques et trottoirs roulants*

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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 and moving walks*.

This document cancels and replaces ISO 22201-2:2013.

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

0.1 General

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. If computer system technology is to be effectively and safely exploited, 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). Therefore, any safety strategy needs to consider 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 on the guidelines provided in generic standards IEC 62061 and EN 115-1:2008.

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

This document sets out the product-specific requirements for systems comprising programmable electronic elements that are used to perform safety functions in escalators and moving walks. This document has been developed so that consistent technical and performance requirements and rationale can be specified for programmable electronic system in safety-related application for escalators (PESSRAE) and moving walks.

Risk analysis, terminology, and technical solutions have been considered, taking into account the methods of the IEC 61508 series. The risk analysis of each safety function specified in [Table 1](#) resulted in the classification of electric safety functions applied to PESSRAE. [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.

0.2 Harmonization with national escalator and moving walk standards

The application of this document is intended to be by reference within a national escalator and moving walk standards such as escalator and moving walk codes, standards, or laws. There are three reasons for this.

- to allow selective reference by national standards to specific escalator and moving walk safety functions described in this document. Not all escalator and moving walk safety functions identified in this document are called out in every national standard;
- to allow for future harmonization of national standards with escalator and moving walk safety functions identified in this document. Because some differences exist in the requirements for fulfilment of the safety objective of national escalator and moving walk standards and in national practice of escalator and moving walk use and maintenance, there are instances where the requirements for escalator and moving walk safety functions described in this document are based on the consensus work and agreement by ISO/TC 178. National bodies can choose to selectively harmonize with those escalator and moving walk safety functions that differ in the requirements called for by the existing national standards in future revisions;
- to allow for the application of this document where escalator and moving walk safety functions are new or deviate from those specified in this document. More and more, national escalator and moving walk legislations are moving to performance based requirements. For this reason the development of new or different escalator and moving walk safety functions can be foreseen in

product specific applications. For those who require escalator and moving walk 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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Electrical requirements for lifts, escalators and moving walks —

Part 6:

Programmable electronic systems in safety-related applications for escalators and moving walks (PESSRAE)

1 Scope

1.1 This document is applicable to the product family of escalators and moving walks used in residential buildings, offices, hospitals, hotels, industrial plants, etc. This document covers those aspects that need to be addressed when programmable electronic systems are used to carry out electric safety functions for escalators and moving walks (PESSRAE). This document is applicable for escalator and moving walk safety functions that are identified in escalator and moving walk codes, standards, or laws that reference this document for PESSRAE application. The safety integrity levels (SILs) specified in this document are understood to be valid for PESSRAE application in the context of the referenced escalator and moving walk codes, standards, and laws in the Bibliography.

1.2 This document is also applicable for the application of PESSRAE that are new or deviate from those described in this document.

1.3 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.

This document:

- a) uses safety integrity levels (SIL) for specifying the target failure rate for the safety functions to be implemented by the PESSRAE;
- 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 escalator and moving walk applications that meet the minimum requirements of a recognized escalator and moving walk standards, such as EN 115, ASME A17.1/CSA B44 or 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 ISO 22200;
- e) outlines the relationship between escalator and moving walk safety functions and their safe-state conditions;
- f) applies to phases and activities that are specific to design of hardware and software but not the phases and activities which occur post design, for example sourcing and manufacturing;
- h) provides requirements relating to the hardware and software safety validation;
- i) establishes the safety integrity levels for specific escalator and moving walk safety functions;
- j) specifies techniques/measures required for achieving the specified safety integrity levels;

- k) defines a maximum level of performance (SIL 3) which can be achieved for a PESSRAE according to this document and defines a minimum level of performance (SIL 1).

1.4 This document does not cover:

- a) hazards arising from the PE systems equipment itself such as electric shock etc.;
- b) the concept of fail-safe that can be of value when the failure modes are well defined and the level of complexity is relatively low. The concept of fail-safe was considered inappropriate because of the full range of complexity of PESSRAE that are within the scope of this document;
- c) other relevant requirements necessary for the complete application of a PESSRAE in an escalator and moving walk safety function, such as system integration specifications, temperature and humidity, the mechanical construction, mounting and labelling of switches, actuators, or sensors that contain PESSRAE.
- d) foreseeable misuse involving security threats related to malevolent or unauthorized action. This document can be used in cases where a security threat analysis needs to be considered, provided that the specified SIL has been reassessed.

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.

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 61508-4, *Functional safety of electrical/electronic/programmable electronic safety-related systems — Part 4: Definitions and abbreviations*

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*

ISO 22200, *Electromagnetic compatibility — Product family standard for lifts, escalators and moving walks — Immunity*

IEC 62061, *Safety of machinery — Functional safety of safety-related electrical, electronic and programmable electronic control systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61508-4 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 <http://www.electropedia.org/>

3.1**non-SIL relevant safe-state requirement**

required response to the actuation of a 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](#).

3.2**programmable electronic****PE**

based on computer technology which can be composed 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);
- other computer-based devices (for example smart sensors, transmitters, actuators).

3.3**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 systems may perform functions that fulfil requirements for SIL-rated and non-SIL-rated function(s). The SIL rating of a function is only required to consider that portion of PE systems that perform the SIL relevant functional requirements.

Note 3 to entry: The programmable electronics are shown centrally located but can exist at several places in the PE systems.

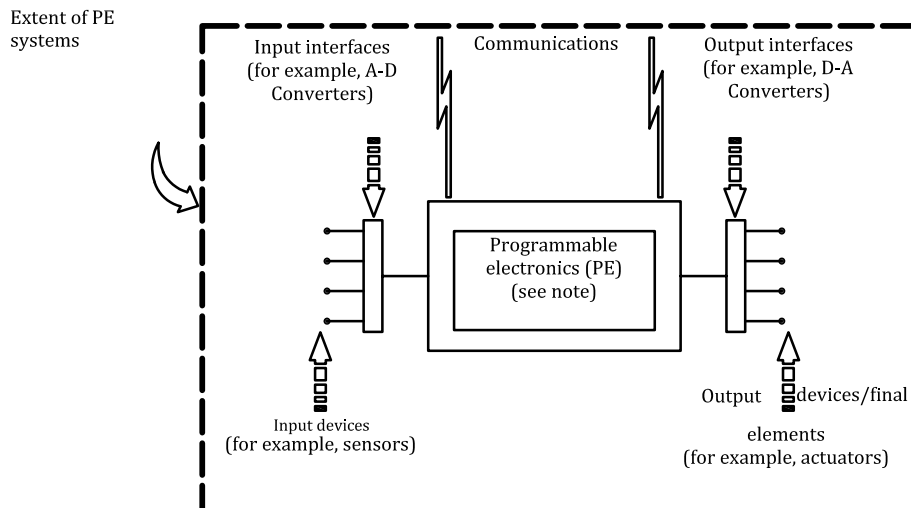


Figure 1 — Basic PE systems structure

3.4 programmable electronic systems in safety-related applications for escalators and moving walks PESSRAE

application of a software-based PE systems in a safety-related system for escalators and moving walks

4.5 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 document, the term “proof test” is used but it is recognized that a synonymous term is “periodical test”.

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Note 2 to entry: The effectiveness of the proof test is 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, it can be necessary to perform an analysis 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.

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.

Note 5 to entry: A repair (including replacement) can be considered restoring the system to “as new”.

3.6 safety circuit

total combination of safety devices that fulfil all or a group of escalator and moving walk safety functions

Note 1 to entry: See [Figure 2](#)