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Interested committees:

Title: BS EN IEC 61496-1 Safety of machinery - Electro-sensitive protective equipment

Part 1: General requirements and tests

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

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Submission of Comments

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



44/1055/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER:

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CLOSING DATE FOR COMMENTS:

2025-04-18

SUPERSEDES DOCUMENTS:

44/1047/RR

IEC TC 44 : SAFETY OF MACHINERY - ELECTROTECHNICAL ASPECTS

SECRETARIAT:

United Kingdom

SECRETARY:

Mrs Nyomee Hla-Shwe Tun

OF INTEREST TO THE FOLLOWING COMMITTEES:

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

Safety

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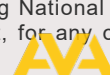
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TITLE:

Safety of machinery - Electro-sensitive protective equipment - Part 1: General requirements and tests

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF MACHINERY - ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT - PART 1: GENERAL REQUIREMENTS AND TESTS –

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This document has been prepared by IEC technical committee 44: Safety of machinery - Electrotechnical aspects. It is an International Standard.

This fifth edition cancels and replaces the fourth edition published in 2020. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- 10) ...;
- 11)

The text of this International Standard is based on the following documents:

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at <http://www.iec.ch/standardsdev/publications>.

A list of all the parts in the [1: IEC 61496] series, published under the general title *Safety of machinery - Electro-sensitive protective equipment*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

An electro-sensitive protective equipment (ESPE) is applied to machinery presenting a risk of personal injury. It provides protection by causing the machine to revert to a safe condition before a person can be placed in a hazardous situation.

This document provides general design and performance requirements of ESPEs for use over a broad range of applications. Essential features of equipment meeting the requirements of this document are the appropriate level of safety-related performance provided and the built-in periodic functional checks/self-checks that are specified to ensure that this level of performance is maintained.

Each type of machine presents its own particular hazards and it is not the purpose of this document to recommend the manner of application of the ESPE to any particular machine. The application of the ESPE is a matter for agreement between the equipment supplier, the machine user and the enforcing authority, and in this context attention is drawn to the relevant guidance established internationally, for example [ISO 12100](#).

This document specifies technical requirements of electro-sensitive protective equipment. The application of this document may require the use of substances and/or test procedures that could be injurious to health unless adequate precautions are taken. Conformance with this document in no way absolves either the supplier or the user from statutory obligations relating to the safety and health of persons during the use of the equipment covered by this document.

The requirements of this document are highly dependent on analysis and expertise in specific test and measurement techniques. In order to provide a high level of confidence, independent review is recommended.

SAFETY OF MACHINERY - ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT - PART 1: GENERAL REQUIREMENTS AND TESTS –

1 Scope

This part of [1: IEC 61496] specifies general requirements for the design, construction and testing of non-contact electro-sensitive protective equipment (ESPE) designed specifically to detect persons or part of a person as part of a safety-related system. Special attention is directed to functional and design requirements that ensure an appropriate safety-related performance is achieved. An ESPE can include optional safety-related functions, the requirements for which are given in [Annex A](#).

NOTE: "Non-contact" means that physical contact is not required for sensing.

This document is intended to be used with a subsequent part of [1: IEC 61496] that provides particular requirements based on the sensing technology.

EXAMPLE: This document and part-2 are used for AOPDs; this document and part-3 are used for AOPDDRs.

Where a part covering the sensing technology does not exist, [2: IEC TS 62998-1] applies. Where the [1: IEC 61496] series does not contain all necessary provisions, [2: IEC TS 62998-1] applies. It is also possible, for those aspects not considered in the [1: IEC 61496] series, to use provisions from [2: IEC TS 62998-1] additionally.

This document does not specify the dimensions or configuration of the detection zone and its disposition in relation to hazards in any particular application, nor what constitutes a hazardous state of any machine. It is restricted to the functioning of the ESPE and how it interfaces with the machine.

While a data interface can be used to control optional safety related ESPE functions ([Annex A](#)), this document does not provide specific requirements. Requirements for these safety-related functions can be determined by consulting other standards (for example, [3: IEC 61508 (all parts)], [4: IEC 62046], [5: IEC 62061], and [6: ISO 13849-1]).

This document can be relevant to applications other than those for the protection of persons, for example for the protection of machinery or products from mechanical damage. In those applications, different requirements can be appropriate, for example when the materials that have to be recognized by the sensing function have different properties from those of persons.

This document does not deal with requirements for ESPE functions not related to the protection of persons (e.g. using sensing unit data for navigation).

This document does not deal with electromagnetic compatibility (EMC) emission requirements.

This document does not provide specific measures for security aspects (e.g. physical, IT-security, cyber security).

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 60050-151:2001, *International Electrotechnical Vocabulary (IEV) - Part 151: Electrical and magnetic devices*

IEC 60050-192:2015, *International Electrotechnical Vocabulary (IEV) - Part 192: Dependability*

IEC 60068-2-6, *Environmental testing - Part 2-6: Tests - Test Fc: Vibration (sinusoidal)*

IEC 60068-2-27, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*

IEC 60068-2-64, *Environmental testing - Part 2-64: Tests - Test Fh: Vibration, broadband random and guidance*

IEC 60204-1, *Safety of machinery - Electrical equipment of machines - Part 1: General requirements*

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

IEC 60417:2024 DB:2024, *Graphical symbols for use on equipment - 12-month subscription to regularly updated online database comprising all graphical symbols published in IEC 60417*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification - Identification of equipment terminals, conductor terminations and conductors*

IEC 60447, *Basic and safety principles for man-machine interface, marking and identification - Actuating principles*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60721-3-5, *Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 5: Ground vehicle installations*

IEC TS 60721-4-3, *Classification of environmental conditions - Part 4-3: Guidance for the correlation and transformation of environmental condition classes of IEC 60721-3 to the environmental tests of IEC 60068 - Stationary use at weatherprotected locations*

IEC 60947-1:2020, *Low-voltage switchgear and controlgear - Part 1: General rules*

IEC 61000-4-2:2008, *Electromagnetic compatibility (EMC) - Part 4-2: Testing and measurement techniques - Electrostatic discharge immunity test*

IEC 61000-4-3:2006, *Electromagnetic compatibility (EMC) - Part 4-3: Testing and measurement techniques - Radiated, radio-frequency, electromagnetic field immunity test*

IEC 61000-4-3:2006/AMD1:2007

IEC 61000-4-3:2006/AMD2:2010

IEC 61000-4-4:2012, *Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical fast transient/burst immunity test*

IEC 61000-4-5:2014, *Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test*

IEC 61000-4-5:2014/AMD1:2017, *Amendment 1 - Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test*

IEC 61000-4-6:2013, *Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields*

IEC 61000-4-11:2020, *Electromagnetic compatibility (EMC) - Part 4-11: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations immunity tests for equipment with input current up to 16 A per phase*

IEC 61000-4-29:2000, *Electromagnetic compatibility (EMC) - Part 4-29: Testing and measurement techniques - Voltage dips, short interruptions and voltage variations on d.c. input power port immunity tests*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for industrial environments*

IEC 61000-6-7:2014, *Electromagnetic compatibility (EMC) - Part 6-7: Generic standards - Immunity requirements for equipment intended to perform functions in a safety-related system (functional safety) in industrial locations*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61508-2, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (see Functional Safety and IEC 61508)*

IEC 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (see Functional Safety and IEC 61508)*

IEC 61508-3, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements (see Functional Safety and IEC 61508)*

IEC 61784-3:2021, *Industrial communication networks - Profiles - Part 3: Functional safety fieldbuses - General rules and profile definitions*

IEC 62061:2021, *Safety of machinery - Functional safety of safety-related control systems*

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

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

ISO 13849-1, *Safety of machinery - Safety-related parts of control systems - Part 1: General principles for design*

ISO 13849-1:2023, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*

ISO 13849-2:2012, *Safety of machinery — Safety-related parts of control systems — Part 2: Validation*

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

IEC 61496, *Safety of machinery – Electro-sensitive protective equipment*

3 Terms and definitions

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

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>

Abbreviations list

DC	diagnostic coverage
EMC	Electromagnetic compatibility
ESPE	Electro-sensitive protective equipment
FMEA	Failure mode and effects analysis
FTA	Fault tree analysis
HFT	hardware fault tolerance
PL	Performance level
PL _r	Required performance level
PFH	Average frequency of dangerous failure per hour
RMS	Root mean square
SIL	Safety integrity level

3.1

blanking

<of the electro-sensitive protective equipment> permits an object of a size greater than the [detection capability](#) to be located within the [detection zone](#) without actuating the [sensing function](#)

3.2

controlling/monitoring device

part of the [electro-sensitive protective equipment](#) which processes information and monitors and interacts with the [sensing device](#) and the [output signal switching device](#)

3.3

detection capability

<of the electro-sensitive protective equipment> [sensing function](#) parameter limit that will cause actuation of the [electro-sensitive protective equipment](#)

3.4

detection zone

<of the electro-sensitive protective equipment> zone within which a [test piece](#) is detected by the [electro-sensitive protective equipment](#)

3.5

electro-sensitive protective equipment

ESPE

assembly of devices and/or components working together for the protection of persons

3.6

external device monitoring

EDM

means by which the [electro-sensitive protective equipment](#) monitors the state of external control devices

3.7

failure

<of an item> loss of ability to perform as required

Note 1 to entry: A failure of an item is an event that results in a [fault](#) of that item: see "fault" ([192-04-08](#)).

Note 2 to entry: Qualifiers, such as catastrophic, critical, major, minor, marginal and insignificant, can be used to categorize failures according to the severity of consequences, the choice and definitions of severity criteria depending upon the field of application.

Note 3 to entry: Qualifiers, such as misuse, mishandling and weakness, can be used to categorize failures according to the cause of failure.

[SOURCE: [IEC 60050-192:2015](#), 192-03-01]

3.8

failure to danger

<of the electro-sensitive protective equipment> [failure](#) which prevents or delays all [output signal switching devices](#) going to, and/or remaining in the [OFF-state](#)

3.9

fault

<of an item> state characterized by inability to perform a required function, excluding the inability during preventive maintenance or other planned actions, or due to lack of external resources

Note 1 to entry: A fault is often the result of a [failure](#) of the item itself but may exist without prior [failure](#).

Note 2 to entry: In English the term "fault" and its definition are identical with those given in [IEC 60050-192:2015](#), 192-04-01. In the field of machinery, the French term "défaut" and the German term "Fehler" are used rather than the terms "panne" and "Fehlzustand" that appear with this definition.

[SOURCE: [IEC 60050-192:2015](#), 192-04-01, modified, definition and notes are adapted for the use in combination with electro-sensitive protective equipment.]

3.10

complex or programmable integrated circuit

monolithic, hybrid or module circuit which satisfies one or more of the criteria below:

- a) more than 1 000 gates are used in the digital mode;
- b) more than 24 functionally different external electrical connections are available for use;
- c) the functions can be programmed

EXAMPLE: ASICs, ROMs, PROMs, EPROMs, PALs, CPUs, PLAs, and PLDs.

Note 1 to entry: The circuits may function in the analogue mode, the digital mode, or a combination of the two modes.

3.11

lock-out condition

<of the electro-sensitive protective equipment> condition, initiated by a **fault**, preventing **normal operation** of the **electro-sensitive protective equipment**

Note 1 to entry: All **output signal switching devices** are signalled to go to the **OFF-state** and, where applicable, all **secondary switching devices** (SSDs) are signalled to go to the **OFF-state**.

3.12

muting

temporary automatic suspension of a safety function(s)

Note 1 to entry: For ESPE-muting see **A.6**.

3.13

OFF-state

<of the OSSD> state of the output(s) of the **electro-sensitive protective equipment** that signals the actuation of the **sensing function**

EXAMPLE 1: the output circuit is interrupted and disables the flow of current.

EXAMPLE 2: state which causes the machine under control to stop running.

3.14

ON-state

<of the OSSD> state of the output(s) of the **electro-sensitive protective equipment** when the **sensing function** is not actuated

EXAMPLE 1: the output circuit is complete and enables the flow of current.

EXAMPLE 2: state in which the machine under control is allowed to run.

3.15

output signal switching device

OSSD

component of the **electro-sensitive protective equipment** connected to the **machine control system** which, when the **sensing device** is actuated during **normal operation**, responds by going to the **OFF-state**

3.16

response time

<of the electro-sensitive protective equipment> maximum time between the occurrence of the event leading to the actuation of the **sensing device** and the **output signal switching devices**(s) achieving the **OFF-state**

Note 1 to entry: When an **electro-sensitive protective equipment** includes a **safety-related data interface**, the **response time** is defined at the output of the **safety-related data interface**.

Note 2 to entry: When a **safety-related communication interface** is included in the **electro-sensitive protective equipment** enclosure, the **response time** is defined at the output of the **safety-related communication interface**. In this case, the **response time** is also dependent on the protocol and architecture of the communication network.

Note 3 to entry: If an **electro-sensitive protective equipment** has both a **safety-related data interface** and a **output signal switching device**(s), the **electro-sensitive protective equipment** can have a different

response time for the [safety-related data interface](#) and for the [output signal switching device\(s\)](#).

3.17

restart interlock

<of the electro-sensitive protective equipment> means of preventing automatic restarting of a machine after actuation of the [sensing device](#) during a hazardous part of the machine operating cycle, after a change in mode of operation of the machine, and after a change in the means of start control of the machine

Note 1 to entry: Modes of operation include inch, single stroke, automatic. Means of start control include foot switch, two-hand control, and single or double actuation of the [electro-sensitive protective equipment sensing device](#).

3.18

safety-related part of a control system

part or subpart(s) of a control system which respond(s) to input signals and generate(s) safety-related output signals

Note 1 to entry: This also includes monitoring systems.

Note 2 to entry: The combined safety-related parts of a control system start at the points where the safety-related signals are initiated and end at the output of the power control elements (see also [\[7: ISO 12100:2010\]](#))

[SOURCE: [ISO 13849-1:2023](#), 3.1.1, modified – text and note are adapted for the use in combination with electro-sensitive protective equipment]

3.19

secondary switching device

SSD

device which, in a [lock-out condition](#) goes to the [OFF-state](#)

Note 1 to entry: It can be used to initiate an appropriate machine control action.

3.20

sensing device

part of the [electro-sensitive protective equipment](#) which uses electro-sensitive means to detect an object which enters or is present in the [detection zone](#)

EXAMPLE: An opto-electronic sensing device would detect an opaque object entering the [detection zone](#).

3.21

start interlock

<of the electro-sensitive protective equipment> means which prevents an automatic machine start when the electrical supply to the [electro-sensitive protective equipment](#) is switched on, or is interrupted and restored

3.22

supplier

entity (for example manufacturer, contractor, installer, integrator) who provides equipment or services associated with the machine

Note 1 to entry: The user organization may also act in the capacity of a [supplier](#) to itself.

[SOURCE: [IEC 60204-1:2016](#), 3.1.62]

3.23

safety-related data interface

direct connection (peer-to-peer) interface between the output of the [electro-sensitive protective equipment](#) and the [safety related communication interface](#) that is used to represent the status of the [output signal switching device\(s\)](#)

Note 1 to entry: A data interface will not have addressing capability.

Note 2 to entry: The safety-related data interface can be bi-directional.

3.24

safety-related communication interface

safety-related connection to a standardized communication network intended for safety related control functions

3.25

type test

conformity test made on one or more items representative of the production

[SOURCE: [IEC 60050-151:2001](#), 151-16]

3.26

fixed blanking

<of the electro-sensitive protective equipment> position of the blanked area of the [detection zone](#) do not change during operation

Note 1 to entry: The [detection capability](#) of the other areas of the [detection zone](#) remains unchanged.

3.27

floating blanking

<of the electro-sensitive protective equipment> blanked area of the [detection zone](#) follows the position of a moving object(s) during operation

Note 1 to entry: The [detection capability](#) of the other areas of the [detection zone](#) remains unchanged.

3.28

machine control system

system which responds to input signals from parts of machine elements, operators, external control equipment or any combination of these and generates output signals causing the machine to behave in the intended manner

Note 1 to entry: The machine control system can use any technology or any combination of different technologies (e.g. electrical/electronic, hydraulic, pneumatic and mechanical).

[SOURCE: [ISO 13849-1:2023](#), 3.1.2]

3.29

normal operation

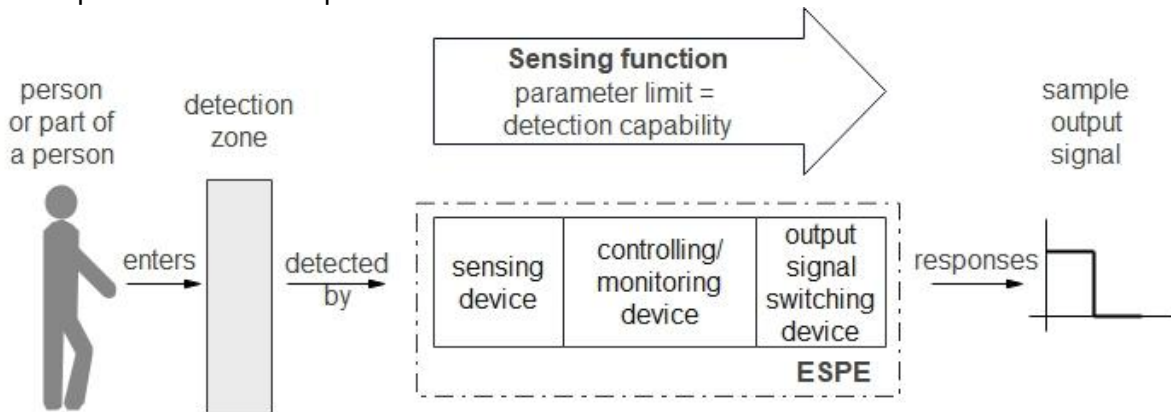
<of the electro-sensitive protective equipment> state where the [output signal switching device\(s\)](#) is allowed to be in the [ON-state](#) or the [OFF-state](#) depending on the state of the [sensing function](#) and operating mode

3.30

sensing function

<of the electro-sensitive protective equipment> function which causes the [electro-sensitive protective equipment](#) to respond by giving an appropriate output signal(s) when a person or

part of a person enters or is present in the [detection zone](#)



Note 1 to entry: The [detection capability](#) defines the [sensing function](#) parameter limit. When the limit is reached the [sensing function](#) is actuated and the [electro-sensitive protective equipment](#) responds by giving (an) appropriate output signal(s)

3.31 test piece

<of the electro-sensitive protective equipment> object used to represent a person or part of a person during verification of the [detection capability](#)

4 Functional, design and environmental requirements

4.1 General

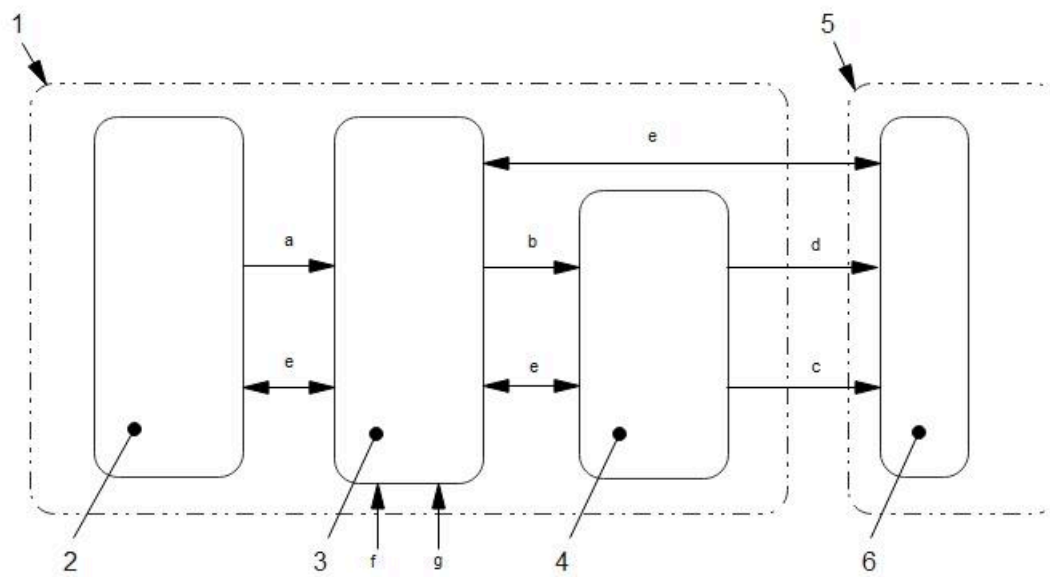
An ESPE used for protective tripping or presence sensing purpose shall perform the [sensing function \(3.30\)](#) described in 4.2.2.

An ESPE (see [Figure 1](#)) consists at minimum of

- a [sensing device \(3.20\)](#)
- a [controlling/monitoring device \(3.2\)](#)
- a [output signal switching device \(3.15\)](#) and/or a [safety-related data interface \(3.23\)](#)

NOTE 1: The safety-related control system associated with the ESPE, or the ESPE itself, may further include [muting \(3.12\)](#) function, [start interlock \(3.21\)](#) , [restart interlock \(3.17\)](#) , etc. (see [Annex A](#))

NOTE 2: A [safety-related communication interface \(3.24\)](#) can be integrated in the same enclosure as the ESPE



Key

- 1 [electro-sensitive protective equipment \(3.5\)](#)
- 2 [sensing device \(3.20\)](#)
- 3 [controlling/monitoring device \(3.2\)](#)
- 4 [output signal switching device \(3.15\) \(s\)](#) / [safety-related data interface \(3.23\)](#)
- 5 [machine control system \(3.28\)](#)
- 6 [part of machine control system \(3.28\) for processing OSSD\(s\) signal / status information](#)
- a [sensing device \(3.20\)](#) information
- b information indicating the status of the [sensing device \(3.20\)](#)
- c OSSD(s) signal
- d status information
- e monitoring signal (optional)
- f signal to initiate [start interlock \(3.21\)](#) (optional)
- g signal to initiate [restart interlock \(3.17\)](#) (optional)

Figure 1 – [electro-sensitive protective equipment \(3.5\)](#)

4.2 Functional requirements

4.2.1 [normal operation \(3.29\)](#)

In [normal operation \(3.29\)](#) , the ESPE shall respond by giving an appropriate output signal(s) when a person or part of a person greater than or equal to the [detection capability \(3.3\)](#) (as specified in the relevant part of IEC 61496) enters or is present in the [detection zone \(3.4\)](#) .

The ESPE [response time \(3.16\)](#) shall not exceed that stated by the [supplier \(3.22\)](#) . No means of adjustment of the [response time \(3.16\)](#) shall be possible without the use of a key, keyword or dedicated tool.

4.2.2 sensing function (3.30)

The [detection capability \(3.3\)](#) shall be effective over the [detection zone \(3.4\)](#) specified by the [supplier \(3.22\)](#) . No adjustment of the [detection zone \(3.4\)](#) , [detection capability \(3.3\)](#) or [blanking \(3.1\)](#) function (monitored, unmonitored, [fixed blanking \(3.26\)](#) or [floating blanking \(3.27\)](#)) shall be possible without the use of a key, keyword or dedicated tool.

4.2.3 Types of ESPE

In this document, three types of ESPEs are considered. The types differ particularly in their performance in the presence of faults and under influences from environmental conditions. In this part, the effects of electrical and electromechanical faults are considered (such faults are listed in [Annex B](#)). Additional requirements are provided in the other parts where faults generated by the particular sensing technology employed are considered. It is the responsibility of the machine supplier and/or the user to specify which type is required for a particular application.

NOTE: Requirements for a type 1 ESPE are not being considered at this time.

A type 2 ESPE shall fulfil the [fault \(3.9\)](#) detection requirements of [4.3.2.3](#).

For a type 2 ESPE, in [normal operation \(3.29\)](#) the output circuit of at least one OSSD shall go to the [OFF-state \(3.13\)](#) when the [sensing function \(3.30\)](#) is actuated, or when power is switched off.

A type 2 ESPE shall have a means of periodic test.

A type 3 ESPE shall fulfil the [fault \(3.9\)](#) detection requirements of [4.3.2.4](#).

A type 4 ESPE shall fulfil the [fault \(3.9\)](#) detection requirements of [4.3.2.5](#).

For a type 3 ESPE and for a type 4 ESPE, in [normal operation \(3.29\)](#) the output circuit of at least two OSSDs shall go to the [OFF-state \(3.13\)](#) when the [sensing function \(3.30\)](#) is actuated, or when power is switched off.

When a single [safety-related data interface \(3.23\)](#) is used to perform the functions of the OSSD(s), then the data interface and associated [safety-related communication interface \(3.24\)](#) shall meet the requirements of [4.3.2.4](#). In this case, a single [safety-related data interface \(3.23\)](#) can substitute for two OSSDs in a type 3 or type 4 ESPE.

4.2.4 Types and required safety performance

An ESPE shall meet a level of safety performance in accordance with either [IEC 62061](#), [ISO 13849-1](#) or [IEC 61508 \(all parts\)](#), as stated in [Table 1](#).

Table 1 – Types and required safety performance

Requirement	Type			
	1	2	3	4
Safety performance in accordance with either IEC 62061 , ISO 13849-1 or IEC 61508 (all parts)	N/A	SIL 1 and/or PL c	SIL 2 and/or PL d	SIL 3 and/or PL e
SIL = safety integrity level; PL = performance level				

NOTE: The device-dependent average frequency of dangerous failure per hour (PFH) values claimed for the control electronics are not restricted (for example, a manufacturer can claim a Type 2 has a PFH lower than 10^{-6}).

4.2.5 Required PL_r or SIL and corresponding ESPE type

In addition to the different levels of safety performance of the electrical parts of an ESPE control system, the potential risk reduction that can be provided by an ESPE is limited also by the systematic capabilities (for example, environmental influences, EMC, optical performance and detection principle). The limits are shown in [Table 2](#).

Table 2 – Required PL_r or SIL and corresponding ESPE type

Requirement	Type			
	1	2	3	4
For a safety function that includes an ESPE, the maximum PL or SIL that can be achieved by the ESPE	N/A	SIL 1 and/or PL _r c	SIL 2 and/or PL _r d	SIL 3 and/or PL _r e

NOTE: The intention of [Table 2](#) is to limit the minimum type that should be employed for the risk reduction of a required safety function. For example: If a safety function requires SIL 2, then from [Table 2](#), it can be seen that a Type 2 would not be sufficient.

4.3 Design requirements

4.3.1 Electrical supply

The ESPE shall be designed to operate correctly with the conditions of the nominal supply as specified below, unless otherwise specified by the user

AC supplies

Voltage: 0,85 to 1,1 of nominal voltage

Frequency: 0,99 to 1,01 of nominal frequency (continuously)
0,98 to 1,02 of nominal frequency (short-time)

Harmonics: Harmonic distortion not to exceed 10 % of the total RMS voltage between live conductors for the sum of the 2nd through to the 5th harmonic. An additional 2 % of the total RMS voltage between live conductors for the sum of the 6th through to the 30th harmonic is permissible.