IEC 61496-1

Edition 4.0 2020-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Sécurité des machines – Équipements de protection électrosensibles –
Partie 1: Exigences générales et essais

IEC 61496-1:2020-07(en-fr)

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Part 1: General requirements and tests

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 61496-1 has been prepared by IEC technical committee 44: Safety of machinery – Electrotechnical aspects.

This fourth edition cancels and replaces the third edition published in 2012. This edition constitutes a technical revision.

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

a) It has been clarified that some requirements for ESPEs that are dependent on sensing technology are not included in IEC 61496-1. They are provided in a subsequent part of IEC 61496.
b) Requirements for protection against environmental influences from subsequent parts of IEC 61496 that are common to all ESPEs have been consolidated into IEC 61496-1.

c) Some test procedures in IEC 61496-1 were incomplete. They have been expanded with more detail and step by step procedures.

d) Some requirements and procedures in IEC 61496-1 are now covered by new generic machine safety standards. The requirements in IEC 61496-1 have been harmonized with references to the new generic standards.

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

FDIS	Report on voting
44/874/FDIS	44/877/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all the parts in the 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 "http://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 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 IEC 61496 that provides particular requirements based on the sensing technology.

EXAMPLE This document and IEC 61496-2 are used for AOPDs; this document and IEC 61496-3 are used for AOPDDRs.

Where a part covering the sensing technology does not exist, IEC TS 62998-1 is used.

Where the IEC 61496 series does not contain all necessary provisions, IEC TS 62998-1 is used.

It is an additional possibility to combine those aspects covered by the IEC 61496 series in addition to IEC TS 62998-1.

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, IEC 61508 (all parts), IEC 62046, IEC 62061, and 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.

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

IEC 60417, *Graphical symbols for use on equipment* (Available from: http://www.graphical-symbols.info/equipment)

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

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 TR 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 60947-1:2007, *Low-voltage switchgear and controlgear – Part 1: General rules*
IEC 60947-1:2007/AMD2:2014

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

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 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related 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 13849-2:2012, *Safety of machinery – Safety-related parts of control systems – Part 2: Validation*

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

3.1
blanking
optional function that permits an object of a size greater than the detection capability of the ESPE to be located within the detection zone without causing an OFF-state of the OSSD(s)

Note 1 to entry: Fixed blanking is a technique wherein the locations of the blanked areas of the detection zone do not change during operation. The detection capability of the other parts of the detection zone remains unchanged.

Note 2 to entry: Floating blanking is a technique wherein the blanked area of the detection zone follows the location of a moving object(s) during operation. The detection capability of the other areas remains unchanged.

3.2
controlling/monitoring device
part of the electro-sensitive protective equipment (ESPE) that:

– receives and processes information from the sensing device and provides signals to the output signal switching devices (OSSD),
– monitors the sensing device and the OSSD

3.3
detection capability
sensing function parameter limit specified by the supplier that will cause actuation of the electro-sensitive protective equipment (ESPE)

3.4
detection zone
zone within which a specified test piece will be detected by the electro-sensitive protective equipment (ESPE)

3.5
electro-sensitive protective equipment
ESPE
assembly of devices and/or components working together for protective tripping or presence-sensing purposes and comprising as a minimum

– a sensing device;
– controlling/monitoring devices;
– output signal switching devices and/or a safety-related data interface

Note 1 to entry: The safety-related control system associated with the ESPE, or the ESPE itself, may further include a secondary switching device, muting functions, stopping performance monitor, etc. (see Annex A).

Note 2 to entry: A safety-related communication interface can be integrated in the same enclosure as the ESPE.

3.6
external device monitoring
EDM
means by which the electro-sensitive protective equipment (ESPE) monitors the state of control devices which are external to the ESPE

3.7
failure
termination of the ability of an item to perform a required function

Note 1 to entry: After failure the item has a fault.

Note 2 to entry: 'Failure' is an event, as distinguished from 'fault', which is a state.

Note 3 to entry: This concept, as defined, does not apply to items consisting of software only.

Note 4 to entry: In practice, the terms fault and failure are often used synonymously.

[SOURCE: IEC 60050-191:1990, 191-04-01]

3.8
failure to danger
failure which prevents or delays all output signal switching devices going to, and/or remaining in the OFF-state in response to a condition which, in normal operation, would result in their so doing

3.9
fault
state of an item 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 60050-191:1990, 191-05-01. 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 60050-191:1990, 191-05-01]

3.10
final switching device
FSD
component of the machine's safety-related control system that interrupts the circuit to the machine primary control element (MPCE) when the output signal switching device (OSSD) goes to the OFF-state

3.11
integrated circuit – complex or programmable
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

Note 1 to entry: Examples include ASICs, ROMs, PROMs, EPROMs, PALs, CPUs, PLAs, and PLDs.

Note 2 to entry: The circuits may function in the analogue mode, the digital mode, or a combination of the two modes.

3.12
integrated circuit – simple
monolithic, hybrid or module circuit which satisfies none of the criteria in 3.11

Note 1 to entry: Examples are SSI or MSI logic ICs, comparators.

Note 2 to entry: The circuits may function in the analogue mode, in the digital mode, or in a combination of the two modes.

3.13
lock-out condition
condition, initiated by a fault, preventing normal operation of the electro-sensitive protective equipment (ESPE)

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

3.14
machine primary control element
MPCE

electrically powered element that directly controls the normal operation of a machine in such a way that it is the last element (in time) to function when machine operation is to be initiated or arrested

Note 1 to entry: This element can be, for example, a mains contactor, a magnetic clutch or an electrically operated hydraulic valve.

3.15
machine secondary control element
MSCE
machine control element, independent of the machine primary control element(s), that is capable of removing the source of power from the prime mover of the relevant hazardous parts

Note 1 to entry: When fitted, the MSCE is normally controlled by the secondary switching device (SSD).

Note 2 to entry: This element can be, for example, a mains contactor, a magnetic clutch or an electrically operated hydraulic valve.

3.16
muting
temporary automatic suspension of a safety function(s) by safety-related parts of the control system

Note 1 to entry: For ESPE-muting see Clause A.7.

3.17
OFF-state
state of the output(s) of the ESPE in which the machine under control is caused to stop running and is prevented from starting

Note 1 to entry: For example, the output circuit is interrupted and disables the flow of current.

3.18
ON-state
state of the output(s) of the ESPE in which the machine under control is allowed to run

Note 1 to entry: For example, the output circuit is complete and enables the flow of current.

3.19
output signal switching device
OSSD
component of the electro-sensitive protective equipment (ESPE) connected to the machine control system which, when the sensing device is actuated during normal operation, responds by going to the OFF-state

3.20
overall system stopping performance
time interval resulting from the sum of the electro-sensitive protective equipment (ESPE) response time and the time to the cessation of hazardous machine operation

3.21
response time
maximum time between the occurrence of the event leading to the actuation of the sensing device and the output signal switching devices (OSSD) achieving the OFF-state

Note 1 to entry: When an ESPE 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 ESPE 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 ESPE has both a safety-related data interface and OSSDs, the ESPE can have a different response time for the safety-related data interface and for the OSSDs.

3.22
restart interlock
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 protection equipment (ESPE) sensing device.

3.23
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 ISO 12100:2010, Annex A)

3.24
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, for example de-energizing the machine secondary control element (MSCE).