

TECHNICAL SPECIFICATION



**Safety of machinery – Electro-sensitive protective equipment –
Part 4-2: Particular requirements for equipment using vision based protective
devices (VBPD) – Additional requirements when using reference pattern
techniques (VBPDP)**

Document Preview

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SAFETY OF MACHINERY – ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT –

Part 4-2: Particular requirements for equipment using vision based protective devices (VBPD) – Additional requirements when using reference pattern techniques (VBPDP)

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC TS 61496-4-2:2014. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC TS 61496-4-2 has been prepared by IEC technical committee TC 44: Safety of machinery – Electrotechnical aspects. It is a Technical Specification.

This second edition cancels and replaces the first edition published in 2014. This edition constitutes a technical revision.

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

- a) Some requirement clauses and test procedures have been adapted or removed because they have been consolidated in IEC 61496-1:2020 (e.g. 5.4.6.2 of IEC 61496-1:2020 Light sources or Clause A.9)

The text of this document is based on the following documents:

Draft	Report on voting
44/933/DTS	44/955A/RVDTS

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

The language used for the development of this document 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>.

This document is to be used in conjunction with IEC 61496-1:2020.

This document supplements or modifies the corresponding clauses in IEC 61496-1:2020 to specify particular requirements for the design, construction and testing of electro-sensitive protective equipment (ESPE) for the safeguarding of machinery, employing vision based protective devices (VBPD) using reference pattern techniques (VBDPP) for the sensing function.

Where a particular clause or subclause of IEC 61496-1:2020 is not mentioned in this document, that clause or subclause applies as far as is reasonable. Where this document states "addition", "modification" or "replacement", the relevant text of IEC 61496-1:2020 is adapted accordingly.

Clauses and subclauses which are additional to those of IEC 61496-1:2020 are numbered sequentially, following on the last available number in IEC 61496-1:2020. Terminological entries (in Clause 3) which are additional to those in IEC 61496-1:2020 are numbered starting from 3.4201. Additional annexes are lettered from AA onwards and additional tables are numbered with prefix 42

A list of all 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 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
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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.

The working group responsible for drafting this document was concerned that, due to the complexity of the technology, there are many issues that are highly dependent on analysis and expertise in specific test and measurement techniques. In order to provide a high level of confidence, independent review by relevant expertise is ~~required~~ recommended. They considered that if this high level of confidence could not be established these devices would not be suitable for use in safety related applications.

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SAFETY OF MACHINERY – ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT –

Part 4-2: Particular requirements for equipment using vision based protective devices (VBPD) – Additional requirements when using reference pattern techniques (VBPDP)

1 Scope

Replacement:

This document specifies requirements for the design, construction and testing of non-contact electro-sensitive protective equipment (ESPE) designed specifically to detect persons as part of a safety-related system, employing vision-based protective devices (VBPDs) using ~~passive~~ reference patterns techniques (VBPDP) for the sensing function. Special attention is directed to features which ensure that an appropriate safety-related performance is achieved. An ESPE ~~may~~ can include optional safety-related functions, the requirements for which are given in Annex A of IEC 61496-1:2012/2020 and this document.

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

Where this document does not contain all necessary provisions, then IEC TS 62998-1 applies.

It is also possible, for those aspects not considered in this document, to use provisions from IEC TS 62998-1 additionally.

This document does not specify the dimensions or configurations of the detection zone and its disposition in relation to hazardous parts for 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.

A VBPDP is defined as consisting of a single image-sensing device viewing on a passive reference pattern as the background and where the detection principle is based on blocking or partially preventing the view of the pattern. Information about the thickness, shape, surface characteristics or location of the object is not required for detection. For multi-image sensing devices, additional techniques, requirements and test procedures can be necessary.

- This document is limited to automatic vision-based ESPEs that do not require human intervention for detection.
- It is limited to automatic vision-based ESPEs that detect objects entering into, or are present in, a detection zone(s).
- It is limited to ESPEs using active illumination technique.
- Excluded from this technical specification are VBPDPs employing radiation at wavelengths outside the range 400 nm to 1 500 nm.
- This document does not address those aspects required for complex classification or differentiation of the object detected.

This document is relevant for VBPDPs having a stated detection capability up to 200 mm.

NOTE The positioning of VBPD in respect of parts of the human body is presented in Annex AA of this document.

This document does not deal with EMC emission requirements.

2 Normative references

Addition:

IEC 60825-1:~~2007~~2014, *Safety of laser products – Part 1: Equipment classification and requirements*

IEC 61496-1:~~2012~~2020, *Safety of machinery – Electro-sensitive protective equipment – Part 1: General requirements and tests*

IEC 62471:2006, *Photobiological safety of lamps and lamp systems*

ISO 13855:2010, *Safety of machinery – Positioning of safeguards with respect to the approach speeds of parts of the human body*

ISO 20471:~~2013~~, *High-visibility clothing – Test methods and requirements*

3 Terms and definitions

This clause of IEC 61496-1:2020 is applicable except as follows:

Replacement:

3.3

detection capability

ability to detect the specified test pieces (see 4.2.13) in the specified detection zone

Note 1 to entry: Detection capability is generally measured by the size of object that can be detected. An increase in detection capability means that a smaller object can be detected.

[SOURCE: IEC 61496-1:~~2012~~2020, 3.3, modified – The text has been changed to make it more relevant to vision based sensors and Note 1 has been added]

Additions:

3.4201

image

snap shot representation of the scene in different planes of the VBPDPP in the form of a two dimensional matrix

3.4202

imaging sensor

optoelectronic device which produces electrical signals representing the characteristics of an image

3.4203

passive reference pattern

static (i.e. fixed location and not changing) regular (periodic) combination of pattern elements on a background that covers at least the detection zone and the tolerance zone – blocking the view of part of the pattern causes detection

Note 1 to entry: Regularity of the pattern refers only to the physical pattern and not to the image of the pattern as seen by the imaging sensor.

3.4204

pattern element

local part of the passive reference pattern

EXAMPLE Black and white checker board – one black square or one white square.

3.4205

pixel, <of a sensor>

smallest light sensitive element of an imaging sensor array

3.4206

pixel, <of an image>

area of the smallest element that can be distinguished from its neighbouring elements

3.4207

sensing zone

three-dimensional volume defined by the field of view of the image sensor and with the apex at the optical window of the ~~sensor~~ sensing device

Note 1 to entry: The volume could be in the shape of a pyramid or cone.

Note 2 to entry: A zone of limited detection capability, a detection zone and tolerance zone(s) are contained within the sensing zone. The zone of limited detection capability is located between the optical window of the ~~sensor~~ sensing device and the detection zone.

3.4208

tolerance zone

zone outside of and adjacent to the (configured) detection zone within which the specified test piece may not be detected

3.4209

vision-based protective device

VBPD

ESPE using an imaging sensor ~~and active illumination~~, operating in the visible and near infrared light spectrum to detect an object in a defined field of view

Note 1 to entry: This note applies to the French language only.

3.4210

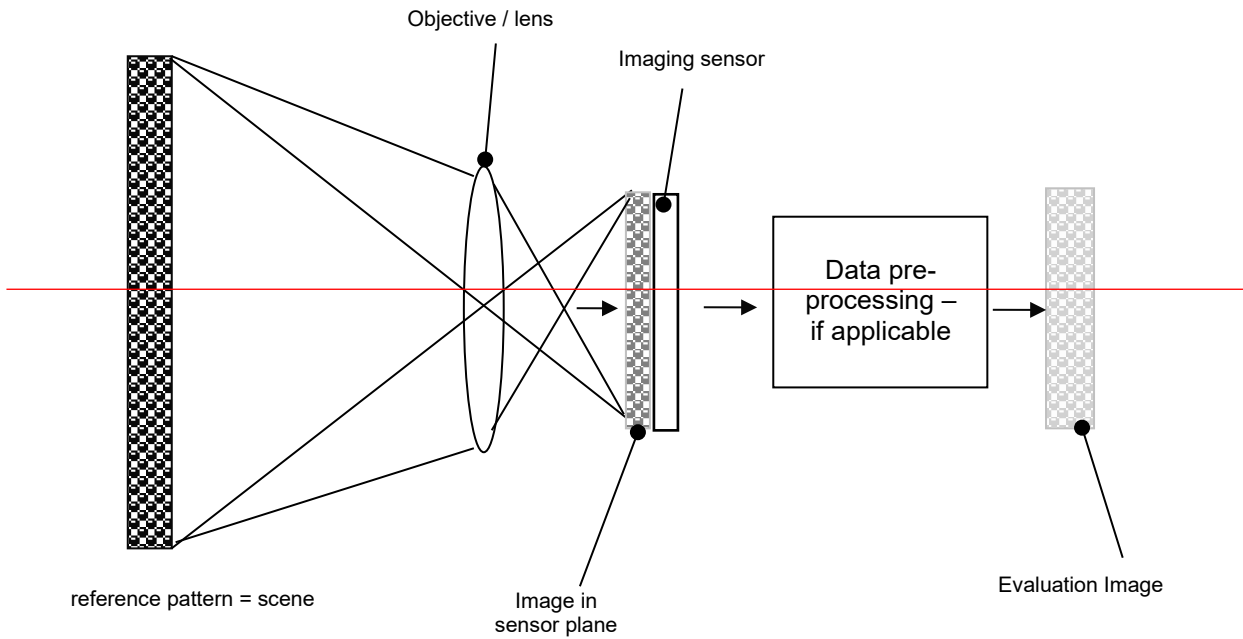
vision-based protective device using passive reference pattern techniques

VBPDPP

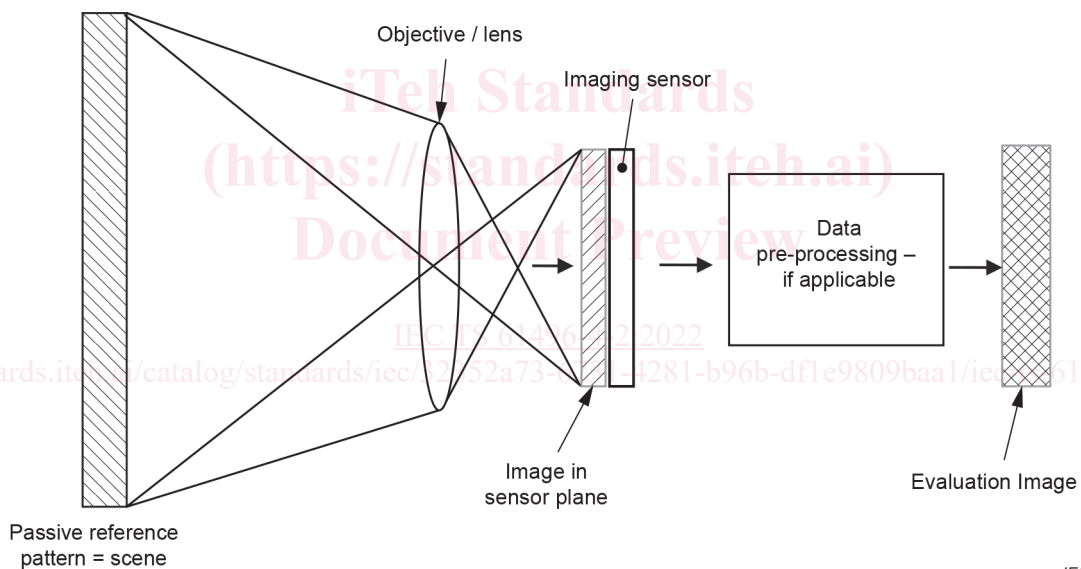
VBPD using a single imaging device ~~and active illumination~~ viewing on a passive reference pattern as background

Note 1 to entry: The various parts of a VBPDPP and their relationship to the viewed scene is shown in Figure 1.

Note 2 to entry: This note applies to the French language only.



IEC 1464/14



IEC

Figure 1 – Image planes in VBPDP

3.4211

zone with limited detection capability

volume between the detection zone and the optical window(s) of the sensing device which does not achieve the stated detection capability

Note 1 to entry: The dimensions and appropriate information for use of the zone with limited detection capability are provided by the supplier.

4 Functional, design and environmental requirements

This clause of IEC 61496-1:2020 is applicable except as follows:

4.1 Functional requirements

4.1.1 ~~Normal operation~~

~~This subclause of Part 1 is applicable.~~

4.1.2 Sensing function

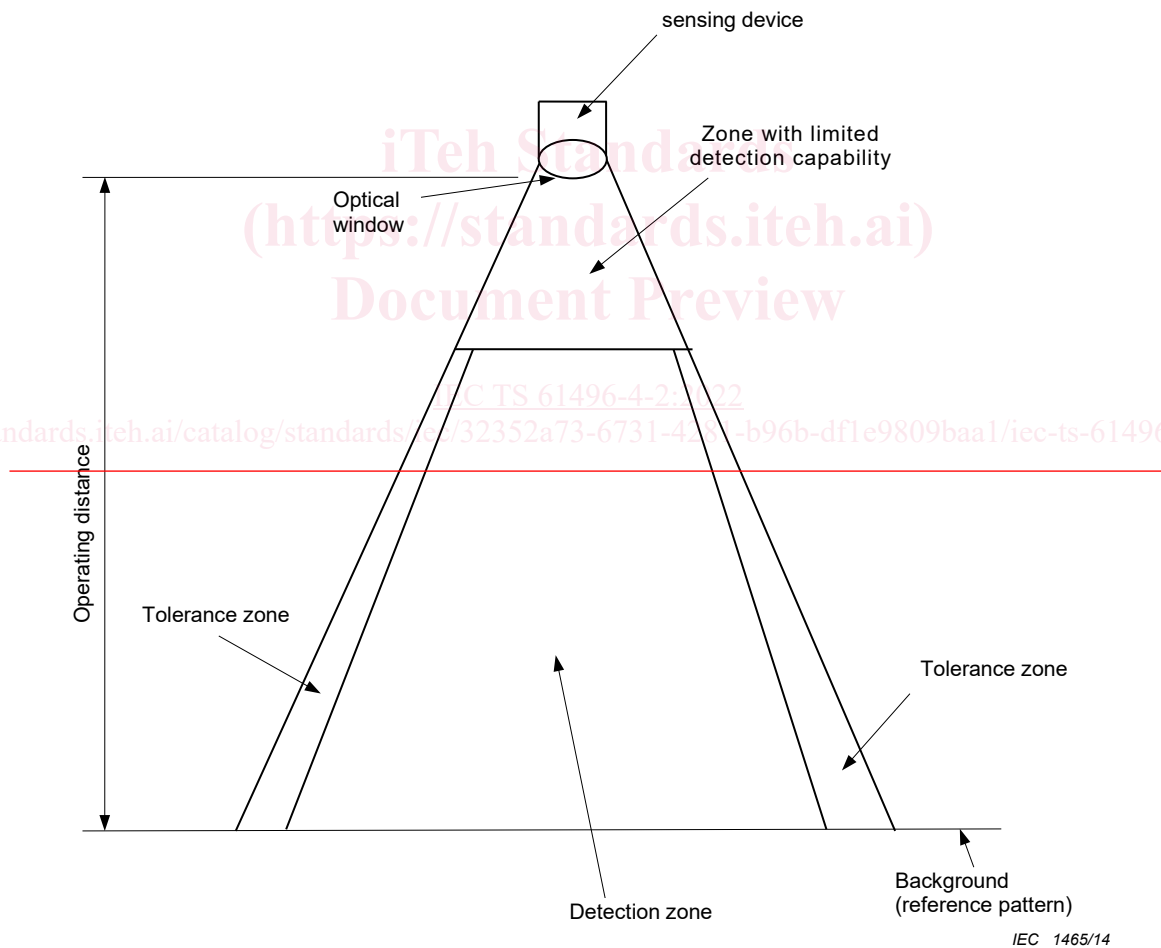
Replacement:

4.1.2.1 General

The detection zone shall begin at the border of the zone of limited detection capability and end at the passive reference pattern (see Figure 2).

NOTE It is possible that only parts of the passive reference pattern are used to define the detection zone.

Object(s) in the zone of limited detection capability shall not reduce the detection capability within the detection zone. Any reduction of the detection capability shall be detected and the VBPDPP shall go to lock-out condition (see 4.2.2.4).



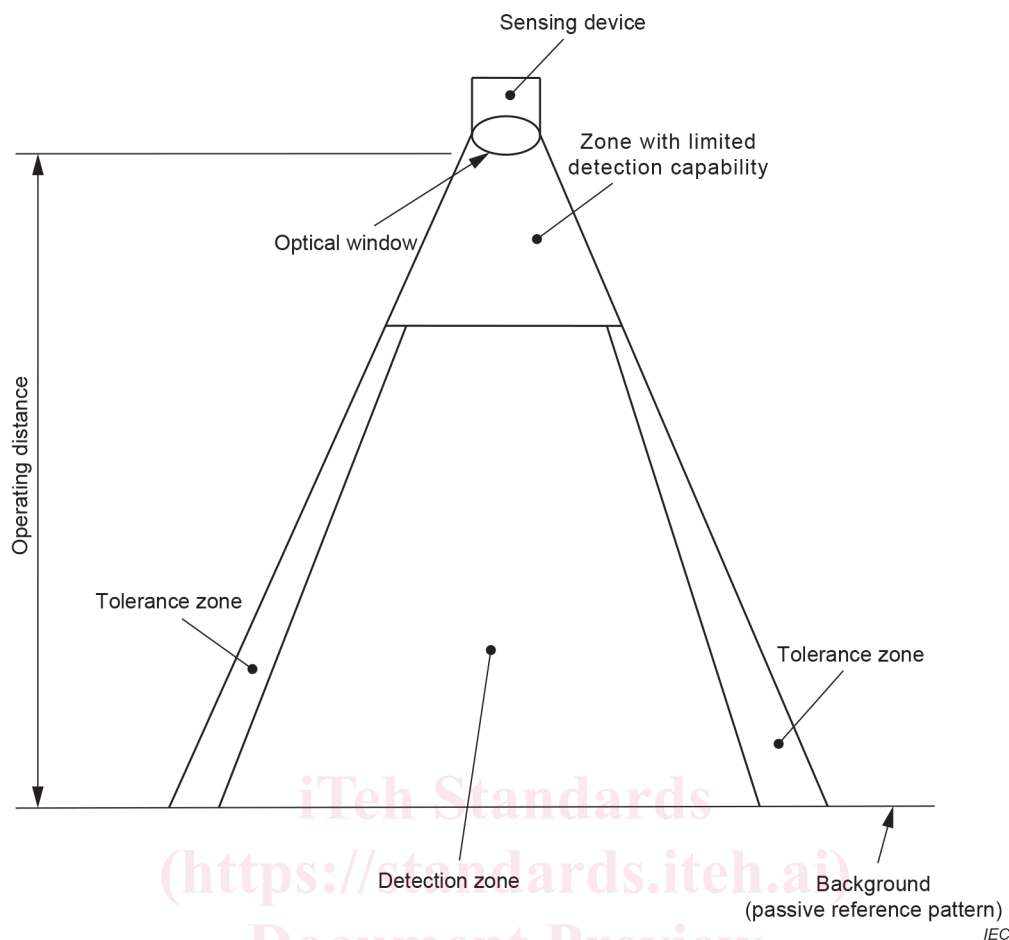


Figure 2 – Side view of VBDPP using a passive reference pattern

4.1.2.2 Additional functional requirements

The sensing function shall be effective over the specified detection zone. No adjustment of the detection zone or detection capability shall be possible without the use of a security measure (e.g. key, key-word or tool).

The sensing device of a VBDPP shall respond by giving (an) appropriate output signal(s) when a test piece is placed anywhere within the detection zone either static or moving.

The supplier shall specify the limits of detection capability. The supplier shall take into account worst case scenario including, for example, signal-to-noise ratio, light intensity in the image on the sensor plane, contrast in the image on the sensor plane, position of the image on the sensor, considering all influences listed in this document.

4.1.2.3 Optical performance

The VBDPP shall be designed and constructed to

- limit the possibility of malfunction during exposure to extraneous radiation in the range of 400 nm to 1 500 nm;
- limit the effects of environmental influences (temperature, vibration and bumps, dust, moisture, ambient light, extraneous reflections, changing illumination, shadows, background reflectivity);
- limit the misalignment at which normal operation is possible.