

**Varnost strojev – Električno občutljiva zaščitna oprema – Pasivni infrardeči
zaščitni elementi**

Safety of machinery – Electro-sensitive protective equipment – Passive infra-red
protective devices (PIPDs)

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English version

**Safety of machinery -
Electro-sensitive protective equipment -
Passive infra-red protective devices (PIPDs)**

This Technical Specification was approved by CENELEC on 2003-11-01.

CENELEC members are required to announce the existence of this TS in the same way as for an EN and to make the TS available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

This Technical Specification was prepared by the Technical Committee CENELEC TC 44X, Safety of machinery: electrotechnical aspects.

The text of the draft was submitted to the formal vote and was approved by CENELEC as CLC/TS 50418 on 2003-11-01.

This Technical Specification is to be read in conjunction with EN 61496-1:1997.

The following date was fixed:

- latest date by which the existence of the CLC/TS (doa) 2004-04-16
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Introduction

The Technical Specification CLC/TS 50418 has been prepared by CENELEC Technical Committee TC 44X: Safety of machinery – Electrotechnical aspects, in collaboration with IEC Technical Committee 44: Safety of machinery – Electrotechnical aspects.

This Technical Specification is to be read in conjunction with EN 61496-1 and supplements or modifies the corresponding clause in EN 61496-1.

Where a particular clause or subclause of EN 61496-1 is not mentioned in this Technical Specification, that clause or subclause applies. Where this Technical Specification states "*addition*", "*modification*" or "*replacement*", the relevant text of EN 61496-1 is to be adapted accordingly.

This document is being issued in the Technical Specification series of publications (according to the CEN/CENELEC Internal Regulations subclause 11.3) as a "prospective standard for provisional application" in the field of safety of machinery because there is an urgent need for guidance in this field. This document is not to be regarded as a "European Standard". It is proposed for provisional application so that information and experience of its use in practice may be gathered. Comments on the content of this document should be sent to the Secretary of CENELEC TC 44X.

A review of this Technical Specification will be carried out not later than 3 years after its publication with the options of

- extension for another 3 years
- conversion into a European Standard; or
- withdrawal.

An electro-sensitive protective equipment (ESPE) is applied to machinery that presents 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 Technical Specification 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 Technical Specification are the 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. It may be used as guidance in dedicated product standards for the safety of machinery.

This Technical Specification has been prepared as a specification of particular requirements for electro-sensitive protective equipment (ESPE) using PIPDs specifically related to machinery safety and has been developed to meet the needs of manufacturers, industrial users and safety enforcement authorities.

Each type of machine presents its own particular hazards and it is not the purpose of this Technical Specification to recommend the manner of application of the ESPE to any particular machine. The application of the ESPE should be a matter for agreement between the equipment supplier, the machine user and the enforcing authority; in this context, attention is drawn to the relevant guidance established internationally, for example ISO 12100, IEC TS 62046.

Only PIPDs designed for safety-related applications should be used as protective equipment. PIPDs use a relatively new technology which is under consideration by TC44X for possible inclusion in EN 61496. Until a product standard for PIPDs is published, care should be taken in the selection and use of these devices. It is recommended to consult the PIPD manufacturer and other sources of information about their application.

PIPDs can detect the difference between a person and an inanimate object, provided that the thermal radiation from the person is different from that of the background. Some PIPDs can only detect moving persons so they shall not be used as presence sensing devices.

PIPDs detect thermal radiation, and spurious tripping can be caused by the thermal radiation from objects other than persons, e.g. hot process material, space heaters.

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1 Scope

This clause of EN 61496-1 is replaced by the following:

This Technical Specification is to be read in conjunction with EN 61496-1:1997. It specifies requirements for the design, construction and testing of electro-sensitive protective equipment (ESPE) for the safeguarding of machinery, employing passive infra-red protective devices (PIPDs) for the sensing function. Special attention is directed to features that ensure an appropriate safety-related performance is achieved. An ESPE may include optional safety-related functions, the requirements for which are given in Annex A of EN 61496-1.

This Technical Specification does not specify the different means of thermal radiation detection nor 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.

PIPDs are devices that have a detection zone specified in three dimensions wherein persons or parts of persons are detected as a result of their thermal radiation.

Excluded from this part are PIPDs operating at wavelengths outside the range 6 μm to 14 μm .

This Technical Specification may be relevant to applications other than those for the protection of persons, for example the protection of machinery or products from mechanical damage. In those applications additional requirements may be necessary, for example when materials that are not intended to be recognized by the sensing function have similar properties to those of persons.

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

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2 Normative references

This clause of EN 61496-1 is applicable with the following addition:

EN 61496-1:1997, Safety of machinery - Electro-sensitive protective equipment – Part 1: General requirements and tests (IEC 61496-1)

3 Definitions

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

Amendment: replace 3.5 of EN 61496-1 by the following

3.5 detection zone (DZ)

zone within which the specified test piece(s) will be detected by the electro-sensitive protective equipment (ESPE) under all conditions specified in this standard (see Figures 1 and 2)

Additional definitions:

3.401 passive infrared protective device (PIPD)

device whose sensing function is performed by a receiving element(s) detecting thermal radiation emitted by an object placed in, or moving within, the specified detection zone

3.402

additional detection zone (ADZ)

zone where detection is possible but not certain (see Figures 1 and 2)

3.403

overall detection zone (ODZ)

sum of detection zone and additional detection zone (see Figures 1 and 2)

3.404

target

person or part of a person that is required to be detected when in the detection zone

3.405

background

objects, e.g. walls, floor, in the overall detection zone which are not intended to be detected

3.406

PIPD detection capability

function of the smallest effective area of the target and the thermal resolution of a PIPD that enables detection of this object when it is placed in, or moving within, the detection zone (see 4.2.12.1)

3.407

trip device

device with one or more OSSDs which go to the off state when a moving person or a moving part of a person is detected by the sensing function

3.408

presence sensing device

device with one or more OSSDs which go to the off state when a person or a part of a person enters or is in the detection zone

3.409

thermal resolution (R_{th})

minimum difference between target temperature and background temperature that can be detected in the detection zone with all other parameters fixed

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4 Functional and design requirements

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

4.1 Functional requirements

Replacement:

4.1.2 Sensing function

4.1.2.1 General

A person or part of a person (target) shall be detected by the contrast between its infra-red radiation in the range 6 μm to 14 μm , and the infra-red radiation of the background. The sensing function shall be effective over the detection zone or the defined signal range specified by the supplier.

The sensing device of a PIPD shall be actuated when a test piece in accordance with 4.2.13 is in the detection zone, either stationary or moving with specified speeds and directions in accordance with 4.2.12.3.

NOTE The main parameters that can affect the integrity of PIPD detection capability are

- target and background temperature (See 4.2.12.2),
- target and background emissivity,
- target size,
- target speed (See 4.2.12.3).

Combination of these parameters can significantly increase the complexity for the choice of the test piece. An example is given in 4.2.13. The test pieces defined in 4.2.13 use constant size and emissivity.

4.1.2.2 Configuration of the detection zone

No adjustment of the detection zone or the defined signal range shall be possible without the use of a key, key-word or tool.

If it is possible for the user to configure the detection zone(s), the necessary equipment and procedure shall be specified by the supplier.

If a PIPD has more than one detection zone, the means for the selection of which detection zone(s) is (are) valid shall meet this standard.

NOTE 1 One important measure is the confirmation of input parameters to the PIPD by re-transmitting these input parameters to the configuration unit and the subsequent confirmation by the user. The selection of detection zones is not a muting function as described in EN 61496-1, A.7.

NOTE 2 If the PIPD has the facility to configure the detection zone(s), the information shall be provided by the manufacturer to verify the configured detection zone. This can be done by penetrating all segments of the detection zone with the test piece (See Clause 7 of EN 61496-1).

4.1.2.3 Types of ESPE

Replacement:

In this Technical Specification, one type of ESPE is considered and it is the responsibility of the machine supplier and/or the user to prescribe if this type is suitable for a particular application. This type of ESPE is a type 2 ESPE.

The type 2 ESPE shall fulfil the fault detection requirements of 4.2.2.3 of this Technical Specification. In normal operation the output circuit of at least one OSSD shall go to the OFF state when the sensing device is actuated or when the power is removed from the device.

NOTE Other types of ESPE are under consideration and will be specified in future editions of IEC 61496

4.2 Design requirements

4.2.2 Fault detection requirements

4.2.2.2 Particular requirements for a type 1 ESPE

Not applicable

4.2.2.3 Particular requirements for a type 2 ESPE

Addition:

The test signal shall cause actuation of the sensing device.

NOTE 1 The sensing function depends upon the detection of the difference between the radiation emitted by the target (e.g. a person or part of a person) and the radiation emitted by the background. This can result in a failure to detect the target under unfavourable conditions. This needs to be taken into account when considering applying an ESPE using a PIPD to a machine.

Addition:

When the detection capability can be decreased below the limit stated by the supplier, as a result of a change of position of components, the fixing of those components shall not rely solely on friction.

NOTE 2 The use of oblong mounting holes without additional means could lead for example to a change of the position of the detection zone under mechanical interference such as bump.

Means shall be provided for the secure fixing of the enclosure(s).

4.2.2.4 Particular requirements for a type 3 ESPE

Not applicable

4.2.2.5 Particular requirements for a type 4 ESPE

Not applicable

Addition:

4.2.12 Integrity of PIPD detection capability

4.2.12.1 General requirements

The PIPD detection capability is determined by the formula $R_{es} \leq R_{th} \cdot S$ [$K^4 m^2$] where S is the smallest effective area of the target in square metres at the maximum specified distance. (Effective area is the area of a target, projected on a surface perpendicular to the optical axis, see Figure 1).

NOTE This information is provided by the supplier, see Clause 7.4

The PIPD detection capability shall be monitored throughout the detection zone.

The design of the PIPD shall ensure that the detection capability is not decreased below the limits specified by the supplier and in this standard by any of the following:

- component ageing;
- component tolerances (for example, spectral sensitivity of the receiver element);
- distance-dependent changes of sensitivity related for example to optics;
- limits of adjustment;
- insecure fixing of optical and mechanical components within the PIPD;
- environmental interference, especially:
 1. system noise;
 2. electrical interference according to 4.3.2 of EN 61496-1;
 3. pollution on the surface of the window of the housing;
 4. condensation on the surface of the window of the housing;
 5. ambient temperature;
 6. ambient light;
 7. background (for example contrast between object and background);
 8. vibration and bump;
 9. humidity;
 10. supply voltage variations and interruptions.

If a single fault (as specified in Annex B of EN 61496-1), which under normal operating conditions (see 5.1.2.1 of EN 61496-1) would not result in a loss of PIPD detection capability but, when occurring with a combination of the conditions specified above would result in such a loss, that fault together with the combination of conditions shall be considered as a single fault and the PIPD shall respond to such a single fault as required in 4.2.2.3.

4.2.12.2 Thermal resolution R_{th}

The minimum detectable $R_{th} = |\epsilon_T T_T^4 - \epsilon_B T_B^4| [K^4]$

where

ϵ_T is the target emissivity

T_T is the target temperature in Kelvins

ϵ_B is the background emissivity

T_B is the background temperature in Kelvins

The supplier shall specify the thermal resolution (at $\epsilon_T = \epsilon_B = 0,9$; $T_B = 300 K$) which shall be not greater than $R_{th} = 1,9 \times 10^9 K^4$.

4.2.12.3 Test piece speed and direction

The supplier shall state the range of speeds and directions according to a coordinate system relative to the PIPD within which the test piece is detected (for example, see Figure 3). The range of speeds shall be at least 0,2 m/s to 1,6 m/s for PIPDs suitable for use as trip devices only. For PIPDs suitable for use as presence sensing devices, the range of speeds shall be at least 0 m/s to 1,6 m/s.

NOTE If the PIPD is to be mounted on a moving machine the speed of the machine needs to be considered.

4.2.13 Test pieces for type testing

4.2.13.1 General

There are two types of test piece, which take into consideration different configurations of detection of a person. A cylindrical test piece is used to simulate a person in cases where the test piece impinges the detection zone at an angle $\alpha = 0^\circ$ to 80° (front view, side view). A flat test piece is used to simulate a person for values of the angle α from 80° to 90° (top view).

The surface of the test piece shall have a temperature value in accordance with 4.2.12.2. The temperature of the test piece shall be controlled in accordance with 5.1.2.2.