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TECHNICAL SPECIFICATION

colour inside

Safety of machinery – Electro-sensitive protective equipment – Part 5: Particular requirements for radar-based protective devices

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Safety of machinery – Electro-sensitive protective equipment – Part 5: Particular requirements for radar-based protective devices

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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SAFETY OF MACHINERY – ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT –

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FOREWORD

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IEC TS 61496-5 has been prepared by IEC technical committee 44: Safety of machinery – Electrotechnical aspects. It is a Technical Specification.

The text of this Technical Specification is based on the following documents:

Draft	Report on voting
44/986/DTS	44/1007/RVDTS

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 Technical Specification 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 www.iec.ch/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 radar protective devices (RPDs) responsive to diffuse reflection 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 3.501. Additional annexes are lettered from AA onwards and additional tables are numbered with prefix 5.

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 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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

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.

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. In this context, attention is drawn to the relevant guidance established internationally, for example, IEC 62046 and ISO 12100.

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 recommended.

Differences between worldwide frequency allocation can affect some tests due to national regulations.

SAFETY OF MACHINERY – ELECTRO-SENSITIVE PROTECTIVE EQUIPMENT –

Part 5: Particular requirements for radar-based protective devices

1 Scope

Replacement:

This part of IEC 61496 provides particular requirements for the design, construction and testing of non-contact electro-sensitive protective equipment (ESPE) designed specifically to provide whole-body detection of a person or persons as part of a safety-related system, employing radar protective devices (RPDs) responsive to diffuse reflection of radar signals for the sensing function using frequency-modulated continuous-wave (FMCW) technique. Special attention is directed to features which ensure that an appropriate safety-related performance is achieved. An ESPE can include optional safety-related functions, the requirements for which are given in Annex A of IEC 61496-1:2020 and Annex A of this document.

The requirements given in this document are related to the detection of adult persons being present in an industrial manufacturing environment.

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.

This document does not consider the aspects of a moving RPD application. Additional consideration can be necessary, if the RPD supplier specifies the RPD for use on moving application.

Additional requirements and tests can apply if setup of the RPD differs from Figure 2 and Figure 4.

NOTE The Radar cross-section stated in this document is based on measurements using horizontal arrangements.

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

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

Excluded from this document are RPDs that employ electromagnetic radiation outside the range 9 GHz to 81 GHz (identified as subset of band 10 and band 11 in accordance with ITU Radio Regulations). For sensing devices that employ electromagnetic radiation outside this range, this document can be used as a guide. National regulations can limit the available frequencies.

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 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).

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, IEC 62046, IEC 62061, and ISO 13849-1).

This document does not deal with EMC emission requirements.

2 Normative references

Clause 2 of IEC 61496-1:2020 applies, except as follows.

Addition:

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

3 Terms and definitions

Clause 3 of IEC 61496-1:2020 applies, except as follows.

Replacement of 3.3 and 3.4:

3.3
detection capability
sensing function parameter limit(s) specified by the supplier that will cause actuation of the RPD

Note 1 to entry: Detection capability of RPD is often described by the minimum detectable object radar cross section, which refers to its size, the angle and the object properties (e.g. reflectivity, geometry, distance, velocity, approaching angle).

Note 2 to entry: A list of influences which can affect the RPD detection capability is given in 4.2.12.1.

3.4
detection zone
zone within which the specified test target(s) is detected by the RPD with a minimum required probability of detection

Addition:

3.501
radar protective device
RPD
device whose sensing function is performed by radio wave emitting and receiving elements that detect the diffuse reflection of an object present in a detection zone

3.502
radar cross section
RCS
equivalent echoing area which is 4π times the ratio of the power per unit solid angle scattered in a specified direction to the power per unit area in a plane wave incident on the scatterer from a specified direction

Note 1 to entry: See Bibliography [1] chapter 2.

[SOURCE: ISO 8729-2:2009, 3.3, modified – Note 1 to entry has been replaced.]

3.503
FMCW
frequency-modulated continuous-wave

3.504
static residual movement
micro movement associated with a non-moving person (e.g. chest displacement during breathing)

Note 1 to entry: For additional information, see Bibliography [2].

3.505
basic test distance
BTD
radial distance from the supplier-specified origin of distance measurement on an RPD to the test target during the test performed

3.506
basic test angle
BTA
angle from the RPD's centre axis, specified by the supplier, at which the test target is placed during the tests performed

3.507
tolerance zone
zone outside of and adjacent to the detection zone and the zone with limited position accuracy within which the specified test target(s) is detected with a probability of detection lower than the required probability within the detection zone

Note 1 to entry: The tolerance zone is necessary to achieve the required probability of detection of the specified test target(s) within the detection zone.

Note 2 to entry: For explanation of the concept of probability of detection and the tolerance zone, see Annex BB.

Note 3 to entry: Test targets are specified in 4.2.13.

3.508
zone with limited position accuracy
zone, between the surface of RPD and the beginning of the detection zone, where the stated position accuracy is not ensured

[SOURCE: IEC 61496-3:2018, 3.310, modified – In the term, "detection capability" has been replaced with "position accuracy". In the definition, "optical windows" has been replaced with "surface of RPD", "detection capability" has been replaced with "stated position accuracy", and "achieved" has been replaced with "ensured".]

3.509
centre axis
line through the origin of distance measurement and the centre of the maximum detection zone stated by the supplier

[SOURCE: IEC 61496-3:2018, 3.305]

4 Functional, design and environmental requirements

Clause 4 of IEC 61496-1:2020 applies, except as follows.

4.1 Functional requirements

4.1.1 Normal operation

Replacement:

Normal operation is the state of an RPD where no faults are detected and where the OSSD(s) are allowed to be in the ON-state or the OFF-state depending on the state of the sensing function and operating mode.

In normal operation, the RPD shall respond by giving (an) appropriate output signal(s) when a test target representing the detection capability enters or is in the detection zone.

The RPD response time shall not exceed that stated by the supplier. No means of adjustment of the response time shall be possible without the use of a key, keyword or tool.

4.1.3 Types of ESPE

Replacement:

In this document only a Type 3 ESPE is considered.

A Type 3 ESPE shall fulfil the fault detection requirements of 4.2.2.4 of this document. In normal operation, the output circuit of each of at least two output signal switching devices (OSSD(s)) of the type 3 ESPE shall go to the OFF-state when the sensing function is actuated, or when the power is removed from the device.

It is the responsibility of the machine supplier and/or the user to specify which type is required for a particular application.

When a single safety-related data interface is used to perform the functions of the OSSD(s), then the data interface and associated safety-related communication interface shall meet the requirements of 4.2.4.4 of IEC 61496-1:2020. In this case, a single safety-related data interface can substitute for two OSSD(s) in a Type 3 ESPE.

Addition:

4.1.6 Zone with limited position accuracy

The RPD may have a zone where the detection is ensured but the position accuracy is not ensured. This zone starts at the RPD front surface and ends at the minimum detection zone stated by the supplier.

Dimensions of the zone with limited position accuracy and appropriate information for use shall be provided by the supplier.

The supplier shall ensure that the specified targets are detected in the zone with limited position accuracy and that the zone with limited position accuracy shall not vary over time.

These requirements shall be verified by analysis and by tests in 5.4.7.2.1

4.2 Design requirements

4.2.2 Fault detection requirements

Replacement:

4.2.2.2 Particular requirements for a type 1 ESPE

4.2.2.2 of IEC 61496-1:2020 does not apply.

4.2.2.3 Particular requirements for a type 2 ESPE

4.2.2.3 of IEC 61496-1:2020 does not apply.

4.2.2.4 Particular requirements for a type 3 ESPE

Replacement:

A single fault in the sensing device resulting in a complete loss of the stated ESPE detection capability shall cause the ESPE to go to a lock-out condition within the specified response time.

A single fault resulting in a deterioration of the stated ESPE detection capability shall cause the ESPE to go to a lock-out condition within a time period of 5 s following the occurrence of that fault.

NOTE Examples of deterioration of the ESPE detection capability can include:

– the increase of the minimum detectable radar cross section (RCS);
– the decrease of the signal-to-noise ratio (S/N);
– the decrease of position accuracy.

A single fault resulting in an increase in response time beyond the specified value or preventing at least one OSSD going to the OFF-state shall cause the ESPE to go to a lock-out condition within the response time, or immediately upon any of the following demand events where fault detection requires a change in state:

– on actuation of the sensing function;
– on power off/on;
– on reset of the start interlock or the restart interlock, if available (see Clauses A.5 and A.6 of IEC 61496-1:2020);
– on the application of an external test signal, if available.

In cases where a single fault which in itself does not cause a failure to danger is not detected, the occurrence of one additional fault shall not cause a failure to danger. For verification of this requirement, see 5.3.4.

An external test signal can be required if, for example, in a particular application, the frequency of actuation of the sensing function is foreseeably low and the OSSD(s) are monitored only at the change of state.

The occurrence of single faults shall be considered by analysis and/or test with each of the following conditions and throughout the entire detection zone:

– environmental conditions specified in 4.3;
– at the limits of alignment and/or adjustment if applicable.

4.2.2.5 Particular requirements for a type 4 ESPE

4.2.2.5 of IEC 61496-1:2020 does not apply.

Replacement:

4.2.12 Integrity of the RPD detection capability

4.2.12.1 General

The design of the RPD shall ensure that the detection capability as specified by the supplier is not degraded by any of, but not limited to, the following influences:

a) Interference with objects in the detection zone;
b) Interference with objects outside the detection zone;
c) Velocity of test target movement;
d) Size and shape of the detection zone;
e) Calibration (where applicable);
f) Properties and/or limitations of the emitting/receiving element, and signal processing, for example the following:
    1) Signal noise;
    2) Dynamic range;
    3) Sensitivity and uniformity;
    4) Antenna pattern;
    5) Change of characteristics;
g) Coexistence of several RPDs where the detection capability could be influenced by other RPDs;
h) Component ageing;
i) Environmental factors, for example the following:
    1) Humidity/condensation;
    2) Moisture;
    3) Dust;
    4) Floor material;
    5) Temperature;
j) Production wastes in the environment of use of the RPDs, for example the following:
    1) Wood chips;
    2) Metal chips;
    3) Debris;
    4) Smoke;
    5) Steam;
    6) Water;
k) Influence on detection capability of a single RPD due to multiple test targets inside the configured detection zone(s).

4.2.12.2 Detection zone(s) and tolerance zone(s)

The supplier shall take into account worst-case conditions including, for example, signal-to-noise ratio S/N and standard deviation σ considering all influences listed in this document and any additional influences specified by the supplier (environmental influence, component faults, multi-path reflections, etc.).

The supplier shall specify the relevant parameters of the detection zone(s), including operating distance and angles (azimuth and elevation). The geometry shall be sufficient to ensure that a test target is detected at the maximum operating distance.

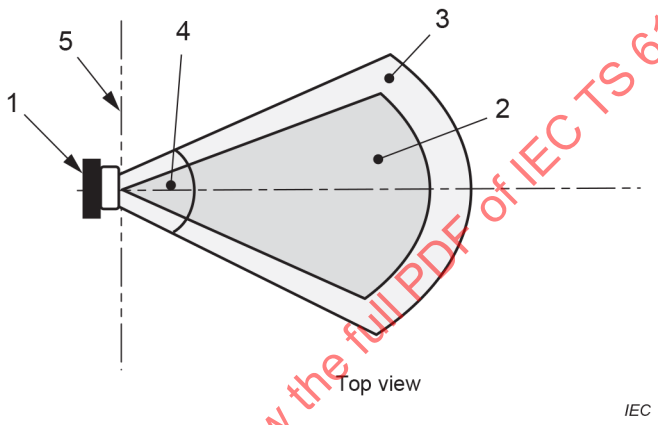
All points on a path projected from any point on the border of the detection zone(s) to the receiving element(s) of the RPD shall be within the detection zone or the zone with limited position accuracy (see 4.1.6).

The supplier shall specify the position and dimension of the tolerance zone(s).

The tolerance zone depends on systematic influences, measurement faults, resolution of the measurement values, etc. and is necessary to ensure the required detection probability within the detection zone.

The test target (see 4.2.13) shall be detected with a minimum probability of detection of 1×10^{-7} to $2{,}9 \times 10^{-7}$ throughout the detection zone(s).

To achieve this minimum probability of detection, the tolerance zones are added to the detection zone and to the zone with limited position accuracy (see Figure 1).



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – origin of distance measurement

Figure 1 – Definition of zones inside field of view of an RPD

NOTE Information on probability of detection calculation methodology is available in Annex BB.

4.2.12.3 Influence of detection

Targets of minimum detectable RCS that are either stationary or moving within the detection zone at any speed of up to 1,6 m/s shall be detected by the RPD within the specified response time.

This requirement is verified by the test 5.2.3.3 for moving targets and by the test 5.2.3.5 for stationary targets.

NOTE 1 A stationary person still has static residual movement.

The response time shall be determined by the supplier, taking into account worst-case conditions and the movement of the target. Where the supplier states that an RPD can be used to detect the target moving at speeds greater than 1,6 m/s, the requirements shall be met at any speed up to and including the stated maximum speed.

NOTE 2 The speed range up to 1,6 m/s is considered as being representative for a walking person.

4.2.12.4 Minimum detection zone(s)

The supplier shall specify the minimum detection zone(s), taking into account the conditions as described in 4.2.12.3.

4.2.12.5 Sensitivity

To verify the sensitivity, the RPD shall pass the test described in 5.2.11.

4.2.12.6 Position accuracy

The supplier shall determine the position accuracy and shall identify influences to be taken into account; for example, algorithms; antenna design; calibration of the RPD; number of transmitting and receiving channels; environmental conditions.

Replacement:

4.2.13 Test targets for type testing

4.2.13.1 General

The test targets are part of the RPD and shall therefore be provided by the supplier for use in the type tests of Clause 5. They shall be marked with a type reference and identification of the RPD with which they are intended to be used.

Other test targets may be used, providing they give equivalent results for testing detection capability and integrity of detection.

Where the term “test piece” is referenced in IEC 61496-1:2020, a test target in accordance with this document shall be used.

4.2.13.2 Corner reflector test target

The corner reflector test target shall be a trihedral corner reflector with an effective radar cross-section of 0,17 m^2 and shall be used for type testing in accordance with Clause 5.

NOTE 1 See Annex CC for more information about the manufacturing of a corner reflector.

NOTE 2 The RCS of 0,17 m^2 is considered as being representative for the 99 percentile value of an adult human being in accordance with ISO 7250-1 [3]. See Bibliography [4][1].

4.2.13.3 Articulated pedestrian test target

The pedestrian test target shall approximate the radar cross section of an adult person with dimensions based on ISO 7250-1 [3] and shall be used for type testing in accordance with Clause 5.

NOTE See Bibliography [5] for more information about the characteristics of the articulated pedestrian test target. The sizes represent a 50 % RAMSIS Bodybuilder based on the RAMSIS version 3.8.30 with a height of 1 800 mm.

4.2.13.4 Interfering test target

The interfering test target shall be a trihedral corner reflector with an effective radar cross-section of, at least, 40 m^2, and shall be used for type testing in accordance with Clause 5.

NOTE 1 See Annex CC for more information about the manufacturing of a corner reflector.

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1 Numbers in square brackets refer to the Bibliography.

NOTE 2 The RCS of 40 m^2 is considered as being representative of large metallic objects (e.g. forklift) or multiple targets moving close together.

Addition:

4.2.14 Radiation frequencies

RPDs shall operate in the frequency range included between 9 GHz and 81 GHz.

4.2.15 Radiation intensity

The radiation intensity generated and emitted by the RPD shall at no time exceed the power or energy levels corresponding to maximum human exposure to non-ionizing radiation.

NOTE 1 It is the responsibility of the user to be aware of the applicable national and local regulations concerning the power or energy levels corresponding to maximum human exposure to non-ionizing radiation.

NOTE 2 Examples are given in IEC 62479:2010 [6] and EN 50364:2018 [7].

4.2.16 Mechanical construction

When the detection capability can be degraded 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 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 influence such as shock.

4.3 Environmental requirements

4.3 of IEC 61496-1:2020 applies, except as follows.

Replacement:

4.3.5 Radio interference

4.3.5.1 Interference from other radio sources

The RPD shall not fail to danger when subject to electromagnetic disturbances in the same frequency band.

The RPD shall not fail to danger when subject to electromagnetic disturbances in the frequency bands of 9 GHz to 81 GHz that are shown to be critical as a result of the analysis of the design and these frequency bands are relevant for the application.

NOTE Examples of electromagnetic disturbances in the same frequency band include:

– disturbances from other radio sources (e.g. door access points, radio link);
– interference from a continuous wave (CW) emitting source;
– interference from radar devices operating in the same occupied bandwidth but with different modulation parameters (e.g. different chirp parameters);
– intermodulation or image frequency.

These requirements shall be verified by the tests in 5.4.6.1.

4.3.5.2 Interference from RPD of identical design

The RPD shall not fail to danger when subject to radiation from other RPDs of identical design.

NOTE This can also be referred to as coexistence of similar RPDs.

These requirements shall be verified by analysis and/or by the tests in 5.4.6.2 taking into account mounting restrictions specified by the supplier.

Addition:

4.3.6 Pollution interference

Requirement and relative test for pollution is under consideration.

4.3.7 Interference by surrounding objects

4.3.7.1 Interference by object(s) outside the detection zone

Static or moving target(s) or object(s) outside the detection zone shall not degrade the detection capability. This requirement shall be verified by analysis and by tests in 5.4.7.1.

NOTE The background is considered as an object.

4.3.7.2 Interference by object(s) inside the detection zone

Objects in the zone with limited position accuracy of the RPD or occlusion by objects in the detection zone of an RPD shall not degrade the detection capability. This shall be verified by analysis and by tests in accordance with 5.4.7.2. The analysis shall include examination of any software filtering algorithms provided.

4.3.8 Manual interference

It shall not be possible to degrade the stated detection capability by covering the housing of the RPD or other parts (if applicable). If the detection capability is degraded, the OSSD(s) shall go to the OFF-state within a time period of 5 s and the OSSD(s) shall remain in the OFF-state until the manual interference is removed.

These requirements shall be verified by the tests of 5.4.8.

4.3.9 Drift and ageing of components

For a type 3 RPD drift or ageing of components that would degrade the detection capability from the value stated shall not cause a failure to danger of the RPD and shall be detected within a time period of 5 s and shall lead to an OFF-state.

If a reference means is used to monitor ageing and drift of components, variations in its properties (for example reflectivity) shall not cause a failure to danger of the RPD. If a reference means is used to monitor ageing and drift of components, it shall be considered to be part of the RPD and shall be provided by the supplier of the RPD.

5 Testing

Clause 5 of IEC 61496-1:2020 is applicable except as follows:

5.1.1.2 Operating condition

Replace from fifth paragraph of 5.1.1.2 of IEC 61496-1:2020 with the following:

As a result of the analysis of the design and the integrity of the detection capability of the RPD, a test plan shall be established considering the test conditions and parameters outlined in this document. In the following tests, it shall be verified that when the OSSD(s) go to the OFF-state, they remain in the OFF-state as long as the test target has a static residual movement in the detection zone. The minimum test conditions shall be as specified in this document or by the supplier, whichever is more stringent.

Tests can be omitted if an analysis can demonstrate that:

– limited intended use in application justifies omission of test (e.g. only for top-down overhead, for use only in non-condensing environment), or
– a less stringent test is replaced by a more stringent test (e.g. test of equal detection capability at minimum operating distance versus maximum operating distance), or
– detection capability is not affected by the environmental condition (e.g. condensation). The analysis shall be documented in the test plan.

For some RPDs, the tests specified in 5.4.2, 5.4.3 and 5.4.4 can have limitations with respect to test equipment and test setups. Any deviation from the test requirements given in these clauses shall be accompanied by a full description and technical justification in the test report.

Unless otherwise stated in this document, and if the facility is provided to set the detection zone, the zone used for the tests shall be set as follows:

– radius (range) of the detection zone of 1,0 m (BTD);
– azimuth and elevation (angles) of the detection zone set to the maximum.

This radius value includes the specified zone with limited position accuracy (if present).

NOTE For example, a zone with limited position accuracy of 0,5 m and a detection zone of 1,0 m results in a zone useable for the tests of 1,0 m.

For an RPD with a stated maximum detection distance of less than 1,0 m, that stated maximum distance shall be used as BTD.

Unless otherwise specified, the BTA is 0° for both the azimuth and the elevation.

For an RPD without the facility to set the detection zone, the fixed detection zone shall be used for all tests.

All tests shall be performed with the test target symmetry axes aligned along the centre axis and pointing towards the RPD (i.e. the test target is aligned in bore-sight with the RPD, see Annex CC). The test target shall also be positioned at the boundary (in all directions, i.e. range, azimuth and elevation) of the detection zone(s). Test at other orientations, position and velocity of the test target and different types of test target, can be required depending on analysis of the design and worst-case considerations. The test conditions shall be defined from the limits of detection capability specified in this document or by the supplier, whatever is more stringent. Within these limits, the RPD shall operate as specified by the supplier; outside these limits the RPD shall not fail to danger.

5.1.2 Test conditions

5.1.2.2 Measurement accuracy

5.1.2.2 of IEC 61496-1:2020 applies except as follows:

Additions:

– for measurement of other timings: ±10 %;

NOTE The value of ±10 % is based on experience.

EXAMPLE Intrusion time in limited test D, integration time.

– for radio intensity measurement: ±3 dB;
– for speed measurement: 10 %.

Replacement for linear and angular measurement items:

– for distance/position: 10 % of the stated distance/position;

– for angular measurements: 10 % of the stated angular accuracy;

All measurements shall be made after stable temperature conditions have been achieved. This is considered to be fulfilled when the rate of temperature rise or fall is less than 2 K/h.

5.2 Functional tests

5.2.1 Sensing function

Replacement:

5.2.1.1 General

The sensing function and the integrity of the detection capability shall be tested as specified, taking into account the following.

a) The systematic analysis required in 5.2.1.2.

b) The tests shall verify that the specified test targets are detected when the test target is moving within the configured detection zone at a speed of up to 1,6 m/s, including 0 m/s with static residual movement. Where the supplier states that targets can be detected moving at higher speeds, the requirements shall be met at all speeds up to the stated maximum speeds.

NOTE The RPD can detect a test target moving at any speed from 0 m/s to 1,6 m/s only when it remains inside the configured detection zone for at least the minimum response time. The detection zone can be adjusted to the minimum detection zone for testing.

c) Where the supplier states that RPD can be installed in top-down overhead setup, the test target shall enter the detection zone moving perpendicularly to the centre-axis.

d) The tests shall verify the detection capability in the stated detection zone(s).

e) The tests shall verify the dimension(s) of the zone with limited position accuracy stated by the supplier.

f) The number, selection and conditions of the individual tests shall be such as to verify the requirements of 4.2.12.1.

g) Additional test setups can be required, for example:

- different orientations of the pedestrian test target (PT) towards the centre axis (e.g. 360° rotation in vertical axis of the PT with 45° increments);
- different postures of the PT (e.g. sitting, squatting, kneeling, crawling, supine, prone).

It shall be verified that the sensing function is continuously actuated and, where appropriate, that the OSSD(s) go to the OFF-state as described in the tests below, taking into account the operating principle of the RPD and, in particular, the techniques used to provide tolerance to environmental interference.

Table 51 shows an overview of the minimum tests required for the verification of detection capability requirements.

Table 51 – Minimum tests required for the verification of detection capability requirements (see also 4.2.12)

Sub-clause	Test	Test target for horizontal mounting	Test target for top-down overhead	Position of the test target with respect to the RPD			
				Range			
				Minimum detection distance	BTD	Every 2,0 m	Maximum detection distance
5.2.1.2	Detection capability	CR	PT	X	X	X	X
5.2.2.1	Response time	CR	CR				X
5.2.2.2	Response time	PT	PT				X
5.2.10	Position accuracy	CR	PT	X	X	X	X
5.2.11	Sensitivity and stability	CR	PT	X	X	X	X
5.4.2.2	Temperature variation and humidity test	CR	CR		X		
5.4.2.3	Condensing test	CR	CR		X		
5.4.3.1 5.4.3.2	Supply voltage variations and supply voltage interruptions	CR	CR				X
5.4.3.3 to 5.4.3.7	Electrical disturbances except supply voltage variations and supply voltage interruptions	CR	CR		X		
5.4.4.1	Vibration	CR	CR		X		
5.4.4.2	Shock	CR	CR		X		
5.4.6.1	Interference from other radio sources	CR	PT				X
5.4.6.2	Coexistence of several RPDs	CR	PT				X
5.4.7.1	Interference by object(s) outside the detection zone	CR and IT	PT and IT		X		X
5.4.7.2	Interference by object(s) inside the detection zone	PT and IT	PT and IT				X
5.4.7.3	Detection of target with high RCS	IT	IT		X		X
5.4.8	Manual interference	PT	PT				X

CR = Corner reflector test target (in accordance with 4.2.13.2)

PT = Pedestrian test target (in accordance with 4.2.13.3)

IT = Interfering test target (in accordance with 4.2.13.4)

5.2.1.2 Integrity of the detection capability

It shall be verified that the stated RPD detection capability is maintained or the RPD does not fail to danger, by systematic analysis of the design of the RPD, using testing where appropriate and/or required, taking into account the conditions specified in 4.2.12.1 and the faults specified in 5.3.4.

NOTE For details of fault combinations, see 5.3.

The conditions and the number of measurements required to determine the integrity of the detection capability shall take into account the objectives of 5.2.1.1. As a minimum, the series of measurements listed in Table 51 shall be carried out performing a B test at each position (considering distance, azimuth, elevation and approaching direction) necessary to verify the integrity of detection capability within the detection zone. When measurement values are required for verification, each test result shall be based on a minimum of 1 000 single measurements at each position of the test target.

The use of special tools supplied by the supplier can be necessary to perform certain tests involving the recording and analysis of measurement values.

5.2.2 Response time

Addition:

5.2.2.1 Response time test with corner reflector test target

The response time test shall be carried out as follows:

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– The detection zone shall be set to maximum, when applicable.

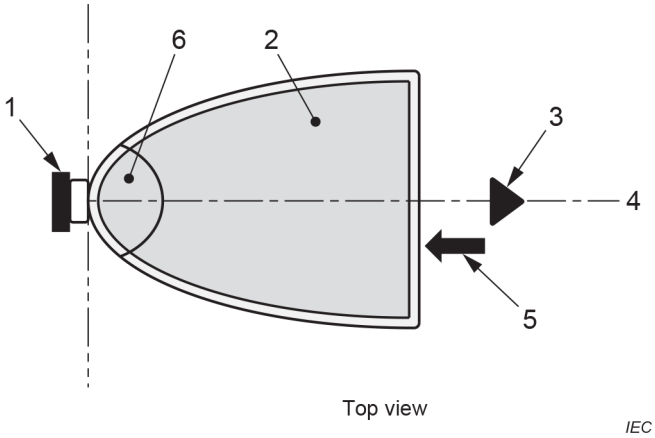
– A test target in accordance with Table 51 shall be placed with its symmetry axes always aligned along the centre axis towards the RPD, outside of the detection zone and tolerance zone.

– With no intrusion in the detection zone, it shall be verified, for a period of at least 5 s, unless otherwise specified, that the OSSD(s) is(are) in the ON-state and that it(they) does(do) not go to the OFF-state.

– The test target shall then enter the detection zone moving along the centre axis (see Figure 2) with the maximum constant speed stated by the supplier.

– When the surface of the test target enters entirely into the detection zone:

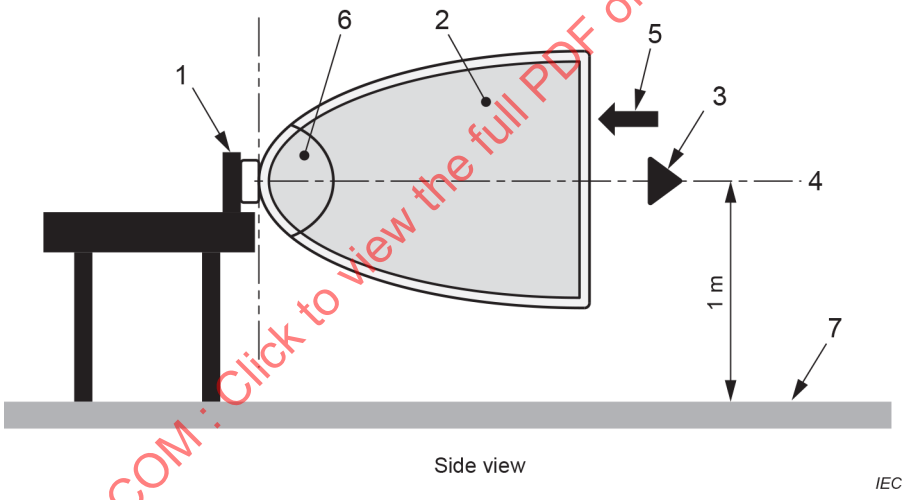
  - it shall be verified that the OSSD(s) of the RPD goes(go) from the ON state to the OFF state;
  - the time shall be recorded between the entrance of the target and the change of status of the OSSD(s) from ON to OFF;
  - it shall be verified that the recorded time is lower than the response time declared by the supplier.



Key

1 – RPD
2 – detection zone
3 – corner reflector test target
4 – centre axis
5 – direction of approach
6 – zone with limited position accuracy

a) Picture illustrating a radial approach, top view



Key

1 – RPD
2 – detection zone
3 – corner reflector test target
4 – centre axis
5 – direction of approach
6 – zone with limited position accuracy
7 – floor

b) Picture illustrating a radial approach, side view

Figure 2 – Radial approaches

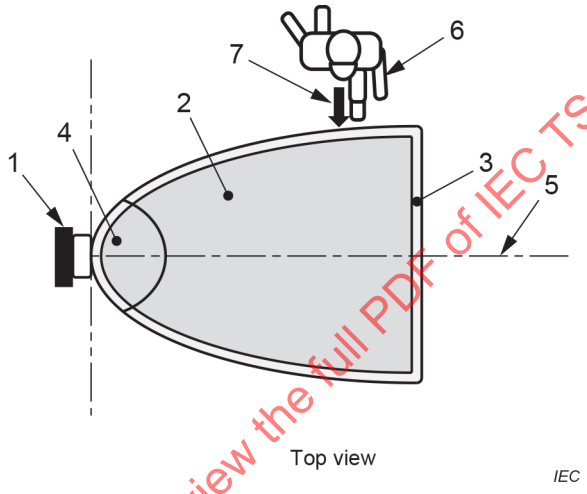
5.2.2.2 Response time test with pedestrian test target

The response time test shall be carried out as follows.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– The detection zone shall be set to maximum, when applicable.

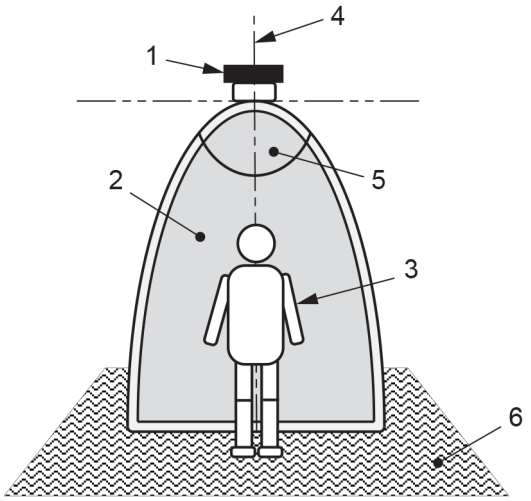
– A test target in accordance with Table 51 shall be placed outside of the detection zone.
– With no intrusion in the detection zone, it shall be verified, for a period of at least 5 s, unless otherwise specified, that the OSSD(s) shall be in the ON-state and shall not go to the OFF-state.
– The test target shall then enter the detection zone moving perpendicularly to the centre-axis (see Figure 3 or Figure 4) with the minimum constant speed of 0,1 m/s and with the maximum constant speed stated by the supplier.
– When the pedestrian test target enters entirely into the detection zone:
  • it shall be verified that the OSSD(s) of the RPD goes from the ON state to the OFF state;
  • the time shall be recorded between the entrance of the target and the change of status of the OSSD(s) from ON to OFF;
  • it shall be verified that the recorded time is lower than the response time declared by the supplier.



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – pedestrian test target
7 – direction of approach

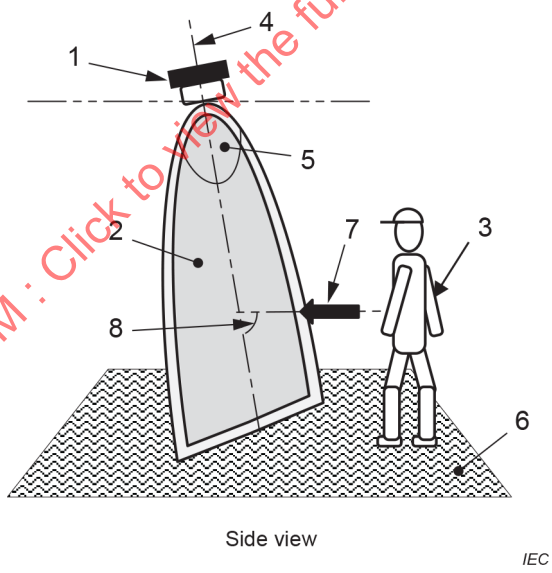
Figure 3 – Picture illustrating a perpendicular approach (top view)



Key

1 – RPD
2 – detection zone
3 – pedestrian test target
4 – centre axis
5 – zone with limited position accuracy
6 – floor

a) Picture illustrating top-down overhead setup (front view)



Key

1 – RPD
2 – detection zone
3 – pedestrian test target
4 – centre axis
5 – zone with limited position accuracy
6 – floor
7 – direction of approach
8 – angle of approach

b) Picture illustrating top-down overhead setup (side view)

Figure 4 – Overhead setup

NOTE In accordance with ISO 13855:2010 [8], 6.4, foreseeable angles of approach greater than 30° is considered orthogonal approach and foreseeable angles of approach less than 30° is considered parallel approach.

5.2.3 Limited functional tests

5.2.3.1 General

Addition:

Unless otherwise stated in this document, a test target in accordance with 4.2.13 shall be used for the limited functional tests. The limited functional test D (D Test) simulates a static residual movement.

5.2.3.3 Limited functional test B (B test)

Replacement:

With no intrusion in the detection zone, it shall be verified, for a period of at least 5 s, unless otherwise specified, that the OSSD(s) shall be in the ON-state and shall not go to the OFF-state.

The test target shall be placed into the detection zone and shall move in the direction of the RPD, with a linear speed of 0,1 m/s. The OSSD(s) shall respond by going from the ON-state to the OFF-state.

NOTE The 0,1 m/s speed is the lowest speed detectable as referenced in EN 50131-2-3:2021 [9].

The test target shall be removed from the detection zone. The OSSD(s) shall respond by going from the OFF-state to the ON-state. It shall be verified that, for a period of at least 5 s unless otherwise specified, the OSSD(s) remain(s) in the ON-state with the test target not being present in the detection zone.

5.2.3.4 Limited functional test C (C test)

Replacement:

This test is the same as the limited functional test B but, where the OSSD(s) should be in the ON-state, the OSSD(s) is(are) allowed to be in the OFF-state. No failure to danger shall occur. At the end of each of the relevant tests in 5.4, the RPD shall continue to operate normally or shall resume normal operation following recovery from a lock-out condition.

If the RPD cannot resume normal operation due to a permanent component failure, it is acceptable if it is verified that the OSSD(s) remains in the OFF-state.

Addition:

5.2.3.5 Limited functional test D (D test)

The OSSD(s) of the device shall be in the OFF-state (triggered by a test target or by different means).

The test target shall be introduced in the detection zone and shall move 2 mm forward and 2 mm backward, with a linear speed of 0,002 m/s. It shall be verified that for a period of at least 30 s the OSSD(s) remain(s) in the OFF-state with the test target moving at the specified speed.

The test target shall be removed from the detection zone. The OSSD(s) shall respond by going from the OFF-state to the ON-state within the time specified by the supplier. It shall be verified that, for a period of at least 5 s unless otherwise specified, the OSSD(s) remain(s) in the ON-state with the test target not being present in the detection zone.

NOTE 1 Additional information on static residual movement speed can be found in Bibliography [2].

NOTE 2 A stationary person can be detected by monitoring its static residual movement.

Addition:

5.2.9 Test target for type testing

The stated RCS values of the test target(s) shall be verified by inspection of the supplier's declaration (based on test results) or by measurement. Other test targets may be used, providing they meet the relevant requirements of this document.

5.2.10 Position accuracy

The supplier's calculation of the detection zone(s) shall include appropriately the position accuracy. It shall be verified for correctness and validity by comparison with result of measurement of the detection capability in accordance with 5.2.1.2.

5.2.11 Sensitivity

The sensitivity and stability test shall be carried out according to the following:

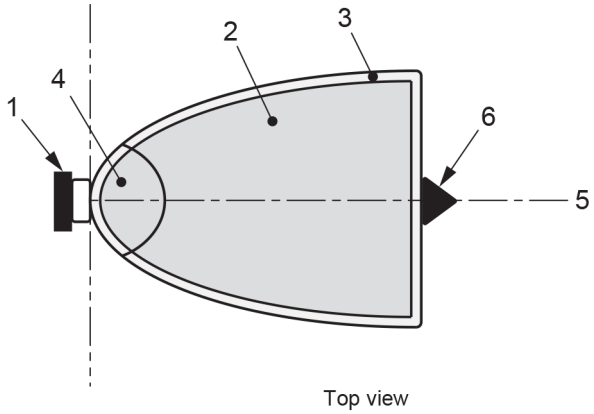
– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– A test target in accordance with Table 51 shall be placed with its symmetry axes always aligned along the centre axis towards the RPD.

– The detection zone shall be set to maximum, when applicable.

– A limited functional test D (D test) shall be performed.

A possible configuration for this test is shown in Figure 5a) and Figure 5b).



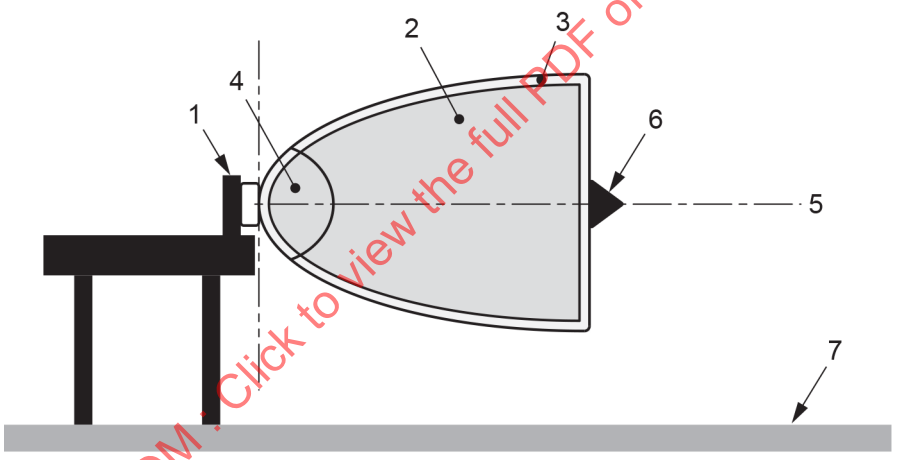
Top view

IEC

Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target

a) Example of sensitivity test setup (top view)



Side view

IEC

Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – floor

b) Example of sensitivity test setup (side view)

Figure 5 – Sensitivity test setup

5.2.12 Influences on detection

The requirements of 4.2.12.3 shall be verified by analysis and/or measurement.

NOTE The supplier's documentation related to the RCS and the geometrical size of the test target(s) and the calculations used can be verified by inspection.

5.2.13 Radiation frequencies

The frequency of operation as specified in 4.2.14 shall be verified either by inspection of the device data sheet or by measurement.

5.2.14 Radiation intensity

The radiation intensity as specified in 4.2.15 shall be verified by measurement and by inspection of the technical documentation provided by the supplier.

NOTE National and local regulations can exist with respect to measurement of radiation intensity.

5.2.15 Mechanical construction

The requirements of 4.2.16 shall be verified by inspection.

5.3 Performance testing under fault conditions

5.3.2 Type 1 ESPE

5.3.2 of IEC 61496-1:2020 does not apply.

5.3.3 Type 2 ESPE

5.3.3 of IEC 61496-1:2020 does not apply.

5.3.4 Type 3 ESPE

5.3.4 of IEC 61496-1:2020 applies, except as follows:

Addition:

It shall be verified that the drift or ageing of components that influence the detection capability will lead to an OFF-state of the OSSD(s) within a time period of 5 s in accordance with 4.3.9.

A combination of one or more of the following is sufficient to verify the requirement to combine single faults with operating conditions/ influences as required by 4.2.2.4:

– analysis;
– simulation;
– tests carried out in the presence of a single fault, where relevant.

5.3.5 Type 4 ESPE

5.3.5 of IEC 61496-1:2020 does not apply.

5.4 Environmental tests

5.4 of IEC 61496-1:2020 applies, except Table 6, Table 7 and Table 9 because ground vehicle installations are not included in the scope of this document.

Replacement:

5.4.6 Radio frequency interference

5.4.6.1 Interference from other radio sources

5.4.6.1.1 Continuous wave

The test shall be performed in the following sequence.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– A test target in accordance with Table 51 shall be placed with its symmetry axis always aligned along the centre axis towards the RPD, outside the detection zone and tolerance zone.

– A continuous wave transmitter in the same frequency band as the one of the RPD and with the maximum effective isotropic radiated power (EIRP) to be expected in accordance with the analysis in 4.3.5.1, shall be placed close to the test target but outside the detection zone and tolerance zone, pointing towards the RPD under test.

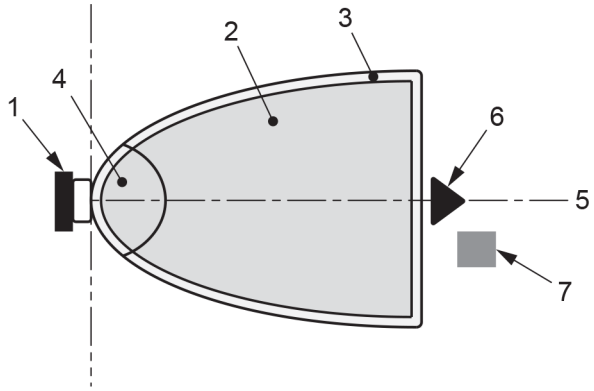
NOTE National and local regulations can exist for maximum effective isotropic radiated power (EIRP) for emitting sources.

– The transmitter device disturbance shall be maintained for at least 5 min.

– The transmitter device duty cycle shall be 100 %.

– The RPD shall pass a C test, so that the test target is inserted into the detection zone at the beginning of the test, is static during the test (with static residual movement) and is removed at the end of the test.

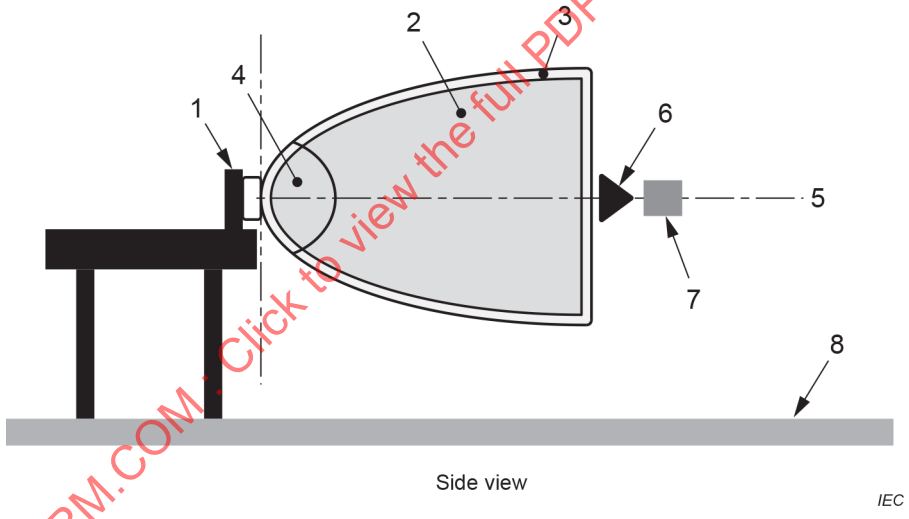
A possible configuration for this test is shown in Figure 6 a) and Figure 6 b).



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – continuous wave transmitter

a) Example of test setup (top view)



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – continuous wave transmitter
8 – floor

b) Example of test setup (side view)

Figure 6 – Test setup for continuous wave interference

5.4.6.1.2 Different FMCW sweep parameters

The test shall be performed in the following sequence.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– A test target in accordance with Table 51 shall be placed with its symmetry axes always aligned along the centre axis towards the RPD, outside the detection zone and tolerance zone.

– A radar device operating in the same frequency band with the same occupied bandwidth as the one of the RPD, and with a comparable emitting power but with different chirp parameters, shall be placed close to the test target but outside the detection zone and at the border of the tolerance zone, pointing towards the RPD under test.

– The additional radar device disturbance shall be maintained for at least 5 min.

– The additional radar device duty cycle shall be 100 %.

– The RPD shall pass a C test, so that the test target is inserted into the detection zone at the beginning of the test, is static during the test (with static residual movement) and is removed at the end of the test.

5.4.6.2 Coexistence of several RPDs

The test shall be performed in the following sequence.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

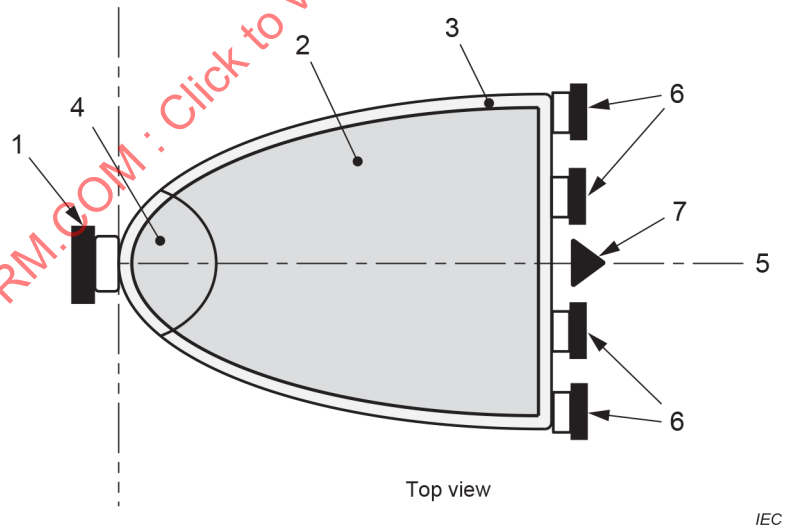
– A test target in accordance with Table 51 shall be placed with its symmetry axes always aligned along the centre axis towards the RPD, outside the tolerance zone.

– Four RPDs shall be placed at the outer border of the tolerance zone pointing towards the RPD under test in accordance with Figure 7.

– The additional RPDs' disturbance shall be maintained for at least 2 h.

– The additional RPDs shall be turned off and on at least 10 times during the test.

The RPD shall pass a C test, so that the test target is inserted into the detection zone at the beginning of the test, is static during the test (with static residual movement) and is removed at the end of the test.



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – additional RPD (for disturbance)
7 – corner reflector test target

Figure 7 – Example of placement of several additional RPDs

Additions:

5.4.7 Interference by surrounding objects

5.4.7.1 Interference by object(s) outside the detection zone

5.4.7.1.1 Interference by moving object

The test shall be performed in the following sequence.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– A test target in accordance with Table 51 shall be placed with its symmetry axis always aligned along the centre axis towards the RPD.

– A B test shall be conducted.

– An interfering test target in accordance with 4.2.13.4 with its symmetry axis aligned along the radial direction and pointing towards the RPD, shall be placed as shown in Figure 8 a).

– The distance (d in Figure 8) between the interfering test target and the outer border of the tolerance zone shall be set to the minimum that does not cause the OSSD(s) to go to OFF-state by the presence of the interfering test target.

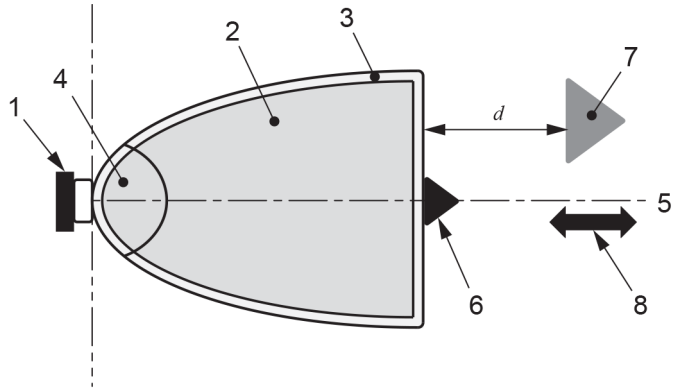
– The interfering test target shall continuously move back and forth (e.g. 0,1 m displacement) with a maximum speed of 0,1 m/s.

– The interfering test target shall not be in the shadow of the test target, as shown in Figure 8 a).

– The OSSD(s) shall remain in the ON-state for a period of 5 s.

– A D test shall be conducted.

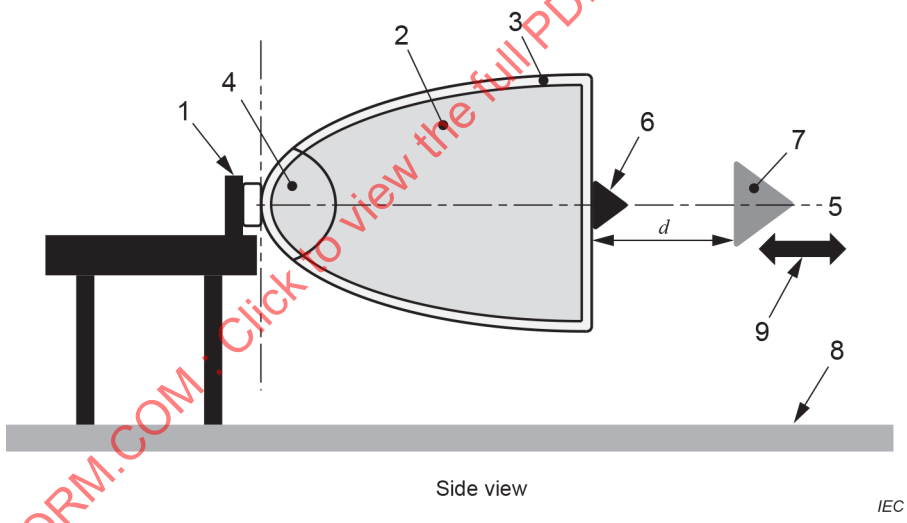
A possible configuration for this test is shown in Figure 8.



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – interfering test target
8 – allowed movement direction

a) Interfering by moving object setup (top view)



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – interfering test target
8 – floor
9 – allowed movement direction

b) Interfering by moving object setup (side view)

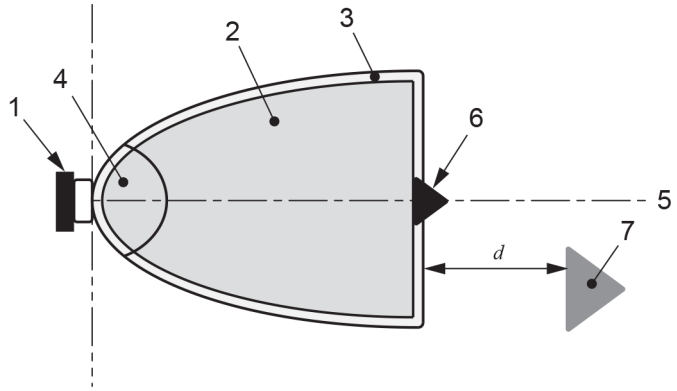
Figure 8 – Examples of interfering by moving object setup

5.4.7.1.2 Interference by static object

The test shall be performed in the following sequence.

- The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.
- A test target in accordance with Table 51 shall be placed with its symmetry axis always aligned along the centre axis towards the RPD.
- A B test shall be conducted.
- An interfering test target in accordance with 4.2.13.4 with its symmetry axis aligned along the radial direction and pointing towards the RPD, shall be placed as shown in Figure 9 a). The distance (d in Figure 9) between the interfering test target and the outer border of the tolerance zone shall be set to the minimum that does not cause the OSSD(s) to go to the OFF-state by the presence of the interfering test target.
- The interfering test target shall not be in the shadow of the test target as shown in Figure 9 a).
- The OSSD(s) shall remain in the ON-state for a period of 5 s.
- A D test shall be conducted.

A possible configuration for this test is shown in Figure 9.

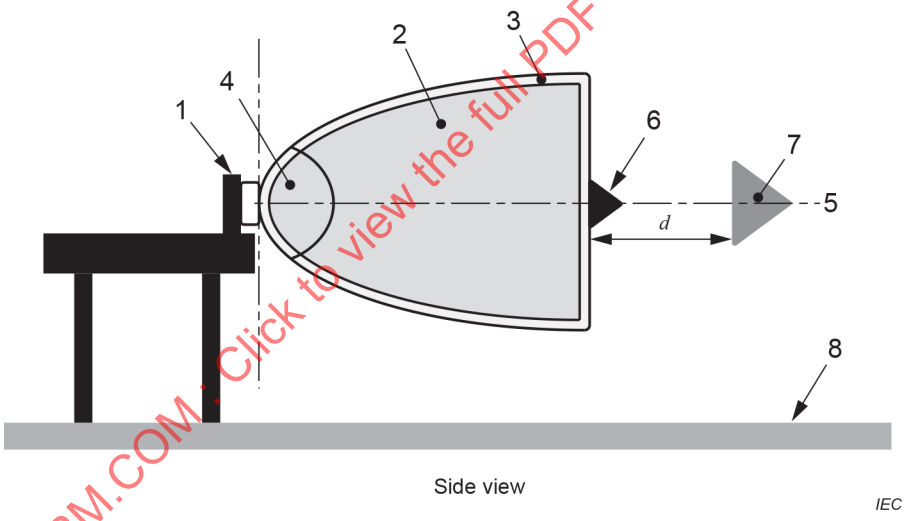


Top view

Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – interfering test target

a) Typical installation for the static object interference test (top view)



Side view

Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – corner reflector test target
7 – interfering test target
8 – floor

b) Typical installation for the static object interference test (side view)

Figure 9 – Typical installation for the static object interference test

5.4.7.2 Interference by object(s) inside the detection zone

5.4.7.2.1 Interference in the zone with limited position accuracy

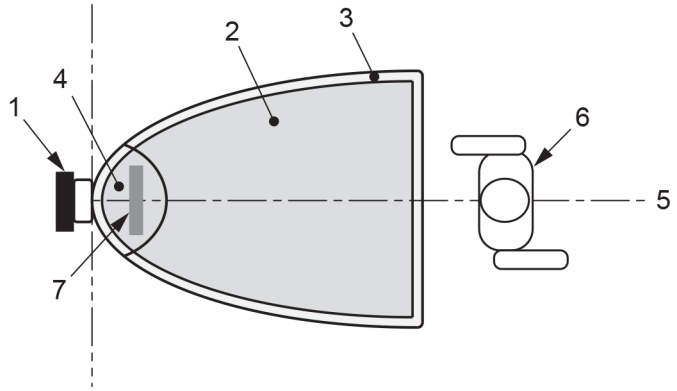
The object used for simulating interference shall be a metallic plate 1 cm square (analysis shall show if other dimensions are more appropriate) with its symmetry axis aligned along the centre axis and pointing towards the RPD.

Analysis shall identify the worst-case placement for the interfering object inside the zone with limited position accuracy.

Immunity against interference in the zone with limited position accuracy shall be tested as follows.

– The detection zone shall be set to maximum, when applicable.
– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.
– The OSSD(s) shall be in the ON-state for at least 5 s.
– A test target in accordance with 4.2.13.3 shall be placed towards the RPD.
– The test shall be carried out by placing the interfering object in the zone with limited position accuracy at the BTA.
– The RPD shall pass a C test.

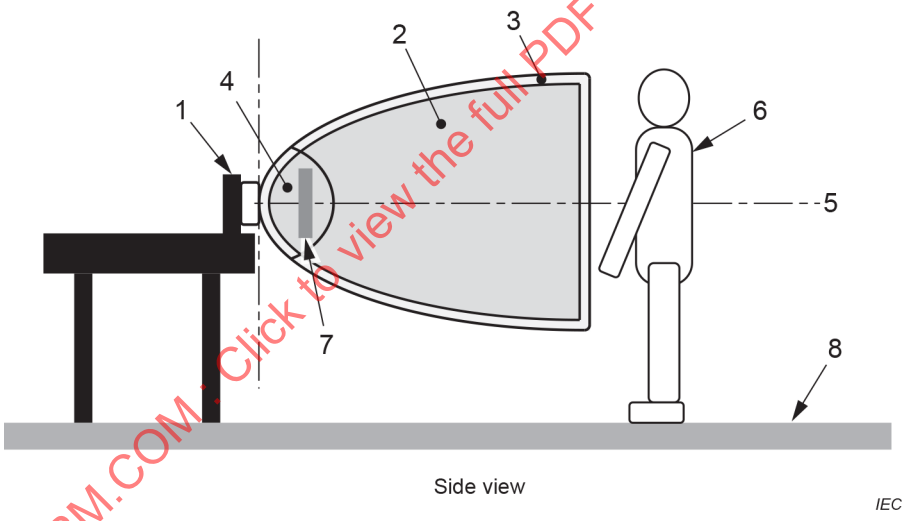
A possible configuration for this test is shown in Figure 10.



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – pedestrian test target
7 – interfering object

a) Example of setup for interference in the zone with limited position accuracy (top view)



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – pedestrian test target
7 – interfering object
8 – floor

b) Example of setup for interference in the zone with limited position accuracy (side view)

Figure 10 – Example of setup for interference in the zone with limited position accuracy

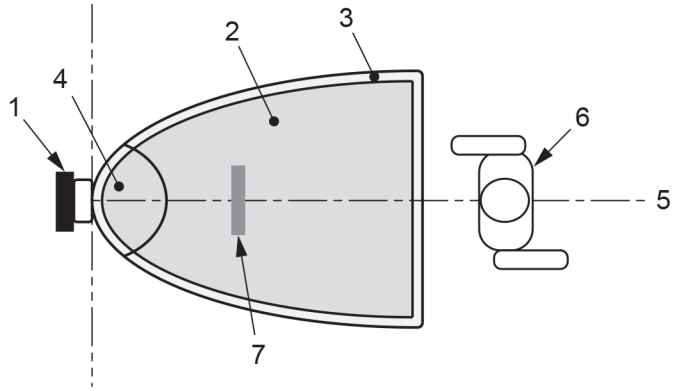
5.4.7.2.2 Occlusion

Immunity against occlusion within the detection zone shall be tested as follows.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– The detection zone shall be set to maximum, when applicable.
– The OSSD(s) shall be in the ON-state for at least 5 s.
– The metallic object shall be able to obscure 50 % (geometrical dimension) of the test target.
– The test shall be carried out by placing the occluding object stationary in the detection zone at the BTD and BTA.
– The OSSD(s) are allowed to go to the OFF-state.
– If the OSSDs are in the ON-state, or after a time defined by the supplier the OSSDs can go to the ON-state, then the RPD shall pass a C test with the test target at the BTA.

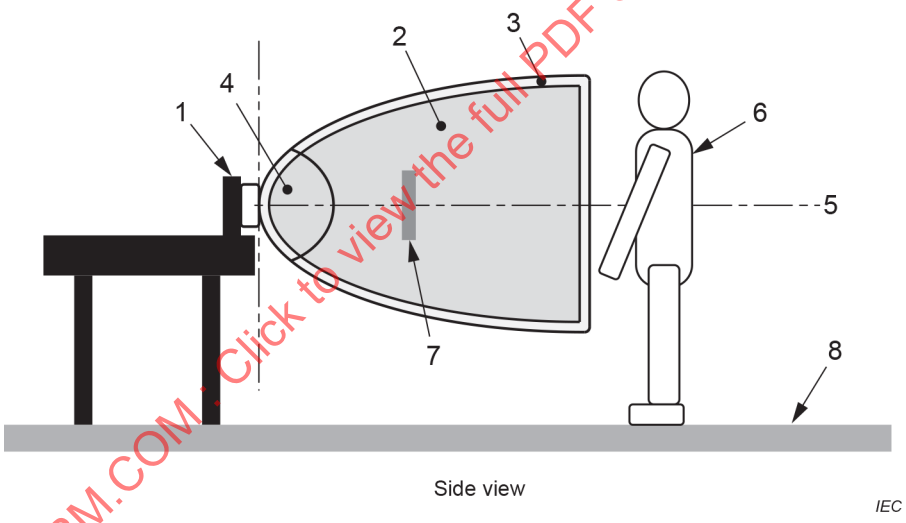
A possible configuration for this test is shown in Figure 11.



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – pedestrian test target
7 – occluding object

a) Example of setup for occlusion (top view)



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – pedestrian test target
7 – occluding object
8 – floor

b) Example of setup for occlusion (side view)

Figure 11 – Example of setup for occlusion

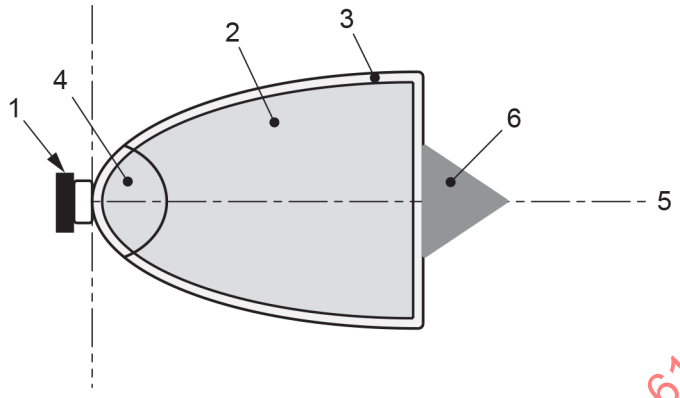
5.4.7.3 Detection of target with high RCS

The test shall be performed in the following sequence.

– The RPD shall be placed at 1 m height, horizontally; for top-down overhead setup the RPD shall be installed at the maximum height in accordance with the supplier's instructions.

– An interfering test target in accordance with 4.2.13.4 shall be placed at 1 m height, with its symmetry axis always aligned along the radial direction towards the RPD.
– The RPD shall pass a B test with the interfering test target.

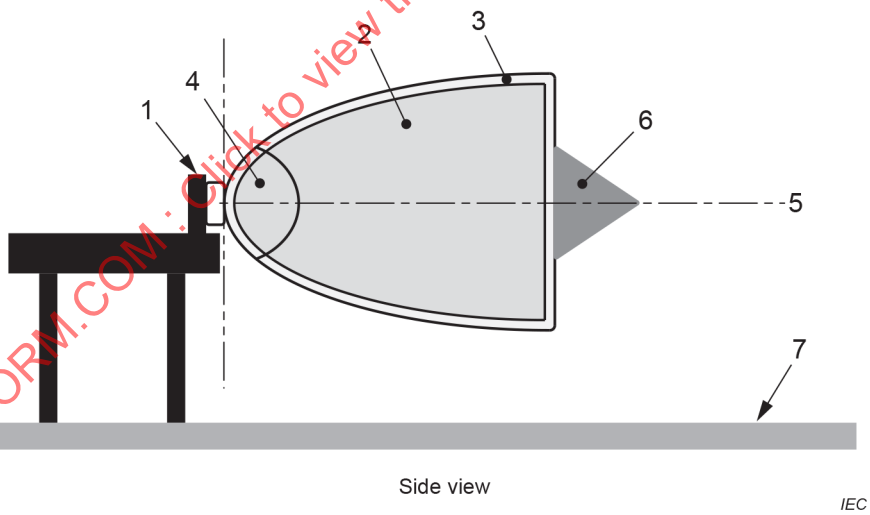
A possible configuration for this test is shown in Figure 12.



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – interfering test target

a) Example of detection with high RCS target test setup (top view)



Key

1 – RPD
2 – detection zone
3 – tolerance zone
4 – zone with limited position accuracy
5 – centre axis
6 – interfering test target
7 – floor

b) Example of detection with high RCS target test setup (side view)

Figure 12 – Example of detection with high RCS target test setup

5.4.8 Manual interference

Tests for immunity against coverage shall be performed as follows.

– The material used for coverage shall be an aluminium foil.
– The test shall be performed using the material defined above by covering 50 % of the area of the emitting element (i.e. antenna(s)) of the RPD at any relevant location.

The test shall be performed in the following sequence.

a) RPD in normal operation.
b) Switch off the RPD. Introduce the material used for the coverage. Restore power.
c) The OSSD(s) shall stay in the OFF-state at least until the coverage is removed or, in case the OSSDs are in the ON-state or after a time defined by the supplier, the OSSDs can go to the ON-state, then the RPD shall pass a B test with the test target, in accordance with Table 51, at the BTA.
d) Remove the coverage.
e) Introduce the material used for the coverage.
f) Verify again step c).

Additional tests by covering greater areas than those defined above shall be carried out if it is likely that such coverage will not be detected.

6 Marking for identification and for safe use

Clause 6 of IEC 61496-1:2020 applies, except as follows.

6.1 General

Replacement:

In accordance with ISO 12100, all parts of the ESPE shall bear all markings which are necessary:

– for its unambiguous identification;
– for its safe use,

and supplementary information shall be given, as appropriate:

– permanently on the ESPE;
– in accompanying documents such as instruction handbooks;
– on the packaging.

The following exemplary permanent markings should be present on the RPD or easily available:

a) identification of the product, including name and address of the supplier, designation of series or type, serial number and year of construction;
b) parameters, for example dimensions, of the detection zone;
c) detection capability;
d) response time;
e) rated voltage(s) including number of phases and frequency where relevant;
f) rated input power (if greater than 25 W) or rated current;
g) designation of IP code;
h) type of ESPE in accordance with 4.1.3;

i) PL and/or SIL in accordance with 4.1.4;

j) indication of the origin of distance measurement.

7 Accompanying documents

Clause 7 of IEC 61496-1:2020 applies, except as follows.

Addition:

nn) dimensions of maximum and minimum detection zone(s), tolerance zone(s) together with information about the origin of distance measurement (see also Figure 1) for the determination of the detection range;

oo) information about the minimum required distance between the border of a detection zone and the surrounding environment without detecting, for example, walls or parts of machines in order to ensure availability in operation;

pp) instructions for setting the detection zone(s) including consideration of the tolerance zone(s) and details on other optional functions of the RPD, described in Annex A of this document if these options are available. A clear statement shall be given when a zone(s) is described, whether its description is related to the detection zone(s) and the tolerance zone(s) as defined in 3.4; and 3.507

qq) instructions to prevent an undetected passage of a person towards the hazard;

rr) information on how the detection capability may be affected if the RPD is used within an additional housing. For example, additional housings may have an influence on the detection capability and the detection zone;

ss) if appropriate for the application(s), an indication on the floor of the detection zone should be included;

tt) instructions on how to document the setting of the detection zone(s) together with date, serial number of the RPD and identification of the person responsible;

uu) mounting restrictions in accordance with 4.3.5, if the RPD can be influenced during normal operation by an RPD of identical design;

vv) information concerning external influences which may not be covered by this document and which may degrade the stated detection capability. Examples may include radio communication devices, snow, rain, ice, pollution;

ww) information concerning the need to check periodically the housing for damage (depending on the application);

xx) information concerning the need to check periodically the mounting of the RPD for correctness and to check for possible misalignment of the detection zone(s) (depending on the application);

yy) information regarding the measures to be taken to avoid possible effects from radiation exposure, if applicable;

zz) information as required by 4.1.6 if the RPD possesses a zone(s) with limited position accuracy;

aaa) information regarding the maximum speed in the worst-case direction within the detection zone of the RPD of an object having the minimum detectable object size (see 4.2.12.3);

bbb) instructions that only qualified persons should perform settings of the detection zone and/or other safety-related parameters;

ccc) radio frequency and radio power indication.