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Alarm systems - Intrusion systems
Part 2-3: Requirements for microwave detectors

Systèmes d'alarme -
Systèmes de détection intrusion
Partie 2-3: Exigences pour détecteurs micro-ondes

Alarmanlagen -
Einbruchmeldeanlagen
Teil 2-3: Anforderungen an Mikrowellenmelder

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CENELEC

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Foreword

This Technical Specification was prepared by the Technical Committee CENELEC TC 79, Alarm systems.

The text of the draft was submitted to the vote at the meeting of TC 79 in Madrid and was approved by CENELEC as CLC/TS 50131-2-3 on 2004-05-04. Standstill is maintained.

The following date was fixed:

- latest date by which the existence of the TS has to be announced at national level (doa) 2004-11-04

NOTE Latest date by which the TS has to be voted as EN: 2 years maximum after dav of TS.

Contents

Introduction

This Technical Specification is a specification for microwave detectors (to be referred to as the detector) used as part of intrusion detection systems installed in buildings. It includes four security grades and the first three environmental classes.

The purpose of the detector is to detect an intruder. It emits microwave radiation over the area being protected, and analyses signals that are returned. An intrusion signal or message is generated when the detector registers a positive indication of the presence of an intruder. The detector shall provide the necessary range of signals or messages to be used by the rest of the intrusion detection system.

The number and scope of these signals or messages will be more comprehensive for systems that are specified at the higher grades.

All detectors shall meet the requirements of the telecommunications standards for short-range devices (SRDs).

This specification is only concerned with the requirements and tests for the microwave detector. Other types of detector are covered by other documents identified as CLC/TS 50131-2-x.

The requirement in EN 50131-1 that detectors in grade 3 and 4 systems shall include a means to detect a significant reduction in range may be met either by detectors having the appropriate function (4.2.3) or by suitable system design.

1 Scope

This Technical Specification provides for security grades 1 to 4 (see EN 50131-1) specific or non-specific wired or wire-free microwave detectors and is covered by environmental classes I to III (see EN 50130-5).

A function designated in the specification as not required for a particular grade may be provided by the manufacturer. If provided, it will be tested, and shall meet all relevant requirements of any higher grade. If it passes, the manufacturer may claim it as an extra feature, which does not alter the overall grading of the detector.

The specification does not apply to system interconnections.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 50130-4:1995	Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder and social alarm systems
EN 50130-5:1998	Alarm systems - Part 5: Environmental test methods
EN 50131-1:1997	Alarm Systems - Intrusion systems - Part 1: General requirements
EN 50131-6:1997	Alarm systems - Intrusion systems - Part 6: Power supplies
EN 60529:1991	Degree of protection provided by enclosures (IP code)

3 Definitions and abbreviations

For the purpose of this specification**,** the following definitions and abbreviations apply in addition to those given in EN 50131-1:

3.1
alert/set mode
state of operation in which a detector shall generate an intrusion signal in response to stimulation by a human being or a standard target

3.2
basic detection target
microwave reflector designed to verify the operation of a detector

3.3
ceiling mount detector
detector capable of sensing human movement from a mounting position on the ceiling

3.4
incorrect operation
physical condition that causes an inappropriate signal from a detector

3.5
local memory
storage medium situated on board the detector, and having the capability to record signals or messages generated by the detector

3.6
long range detector
detector capable of sensing human movement in an extended field of view with horizontal angular coverage less than 10°

3.7
masking
interference with the detector input capability by the introduction of a physical barrier

3.8
microwave detector
detector with an active microwave emitter and detector installed in the same casing

3.9
simulated walk test target
non-human or synthetic microwave reflector designed to simulate the standard walk test target

3.10
standard walk test target
human being of specified weight and height clothed in close fitting clothing appropriate to the simulation of an intruder

3.11
standby/unset mode
state of operation in which a detector is not required to generate an intrusion signal or message in response to stimulation by a human being or a standard target

NOTE For environmental reasons, the microwave emitter may be switched off.

3.12
test mode
state of operation in which a detector will activate an intrusion indicator in response to stimulation by a human being or a standard walk test target

3.13
volumetric detector
detector capable of sensing human movement in a volume such as a room with a field of view with horizontal angular coverage greater than 45°

3.14
walk test
operational test during which a detector is stimulated by the standard walk test target in a controlled environment

3.15
walk test attitude, crawling
crawling attitude shall consist of the standard walk test target moving with hands and knees in contact with the floor

3.16
walk test attitude, upright
upright attitude shall consist of the standard walk test target standing and walking with arms held at the sides of the body. The standard walk test target begins and ends a traverse with feet together

3.17
wire free detector
detector connected to the control & indicating equipment by non-physical means such as radio frequency signals

3.18 Abbreviations

EMC	electromagnetic compatibility
SWT	standard walk test target
BDT	basic detection target
FOV	field of view

4 Functional requirements

4.1 Indication signals or messages

All detectors shall have an alert/set mode. Grades 3 & 4 shall also have an unset mode. If a detector has only one mode of operation, then it shall always be in the alert/set mode. Tamper detection shall be active in all modes.

Each possible mode of operation is determined by the status of the intrusion detection system with which the detector communicates. The detector signals or messages in these modes of operation shall function in accordance with Table 1. All signals or messages apply to all modes of operation unless stated otherwise. Where a memory display is provided on board the detector, it shall not function in the alert/set mode.

Table 1 – Indication signals or messages

Event	Grades	Intrusion signal or message	Tamper signal or message	Fault signal or message
Intrusion	1 – 4	Required *	Not permitted	Not permitted
No stimulus	1 – 4	Not permitted	Not permitted	Not permitted
Masking	1 – 2	Not required	Not required	Not required
	3 – 4	Required **	Not required	Required **
Tamper	1 – 4	Not required	Required	Not required
Low supply voltage (external)	1 – 2	Not required	Not required	Not required
	3 – 4	Not required	Not required	Required
Total loss of external power supply	1	Not required	Not required	Not required
	2 – 4 ***	Required	Not required	Not required
Local self test pass	1 – 4	Not permitted	Not permitted	Not permitted
Local self test fail	1 – 2	Not permitted	Not permitted	Not required
	3 – 4	Not permitted	Not permitted	Required
Remote self test pass	1 – 2	Not required	Not permitted	Not permitted
	3 – 4	Required	Not permitted	Not permitted
Remote self test fail	1 – 2	Not permitted	Not permitted	Not required
	3 – 4	Not permitted	Not permitted	Required

* Not required in unset / standby mode: required in test mode.

** An independent masking signal or message may be provided instead.

*** Not required for bus systems.

NOTE For internal power supplies, see EN 50131-6.

4.2 Detection

4.2.1 Detection performance

The detector shall generate an intrusion signal or message when the SWT or simulated walk test target moves within and across the manufacturers claimed boundary of detection for a distance of 3 m.
The detector shall also generate an intrusion signal or message when the standard or simulated walk test target moves at velocities and attitudes according to the requirements specified in Table 2.

The effect of minimum control settings (if provided) shall also be tested. The minimum setting for such controls shall not reduce the range of the detector below 25 % of the claimed maximum value.

Table 2 – General walk test velocity and attitude requirements

Requirement	Grade 1	Grade 2	Grade 3	Grade 4
Detection at the boundary	Required	Required	Required	Required
Velocity (m/s)	1,0	1,0	1,0	1,0
Attitude	Upright	Upright	Upright	Upright
Detection within the boundary	Required	Required	Required	Required
Velocity (m/s)	0,3	0,3	0,2	0,1
Attitude:	Upright	Upright	Upright	Upright
Detection at high velocity	Not required	Required	Required	Required
Velocity (m/s)	#	2,0	2,5	3,0
Attitude	#	Upright	Upright	Upright
Close-in detection performance (dist, m)	2,0	2,0	0,5	0,5
Velocity (m/s)	0,5	0,4	0,3	0,2
Attitude	Upright	Upright	Crawling	Crawling
Intermittent movement detection performance *	Not required	Not required	Required	Required
Velocity (m/s)	#	#	0,2 (1,0)	0,1 (1,0)
Attitude	#	#	Upright	Upright
Effect of control adjustments **	Not required	Required	Required	Required
Velocity (m/s)	#	0,3	0,2	0,1
Attitude	#	Upright	Upright	Crawling
Significant reduction of specified range	Not required	Not required	Not required ***	Not required ***
Velocity (m/s)	#	#	# (1,0)	1,0
Attitude	#	#	# (Upright)	Upright

* The intermittent movement shall consist of the SWT moving a distance of 1 m by taking two 0,2 (5) m steps (at 1,0 m/s), pausing for 5 s then continuing until the SWT has left the area for a further 1 s.

** If means for continuous adjustment of detection sensitivity is provided, the effect of any setting shall be indicated with a tolerance of less than 25 % of the maximum reading.

*** The means to detect a significant reduction in range may be met either by detectors having the appropriate function (4.2.3) or by suitable system design.

To test features that are not required in a particular grade, parameters from a higher grade shall be specified.

4.2.2 Indication of detection

An indicator shall be provided at the detector to indicate when detection causes an intrusion signal or message. This indicator shall only have this function, shall not function in the event of power failure, and be capable of being enabled/disabled. This operation shall only be performed locally after removal of the cover or remotely at the control and indicating equipment.

4.2.3 Significant reduction of specified range

If the facility to detect reduction in specified range is provided, then range reduction along the principal axis of detection of more than 50 % shall generate an alarm or fault signal or message within a maximum period of 180 s, according to the requirements given in Table 2. The requirements of 4.3.5 (self test) and 4.5.5 (resistance to masking) can provide range reduction detection.

If additional equipment is required to detect significant reduction in range, reference shall be made to the manufacturers documentation.

4.3 Operational requirements

4.3.1 Time interval between intrusion signals or messages

Wired detectors shall be able to provide an intrusion signal or message not more than 15 s after the end of the preceding intrusion signal or message. Wire free detectors shall perform the same function in a time as follows:

Grade 1: 300 s
Grade 2: 300 s
Grade 3: 30 s
Grade 4: 15 s

NOTE See EN 50131-1 for amendment.

4.3.2 Switch on delay

The detector shall meet all functional requirements within 180 s of the power supply reaching its nominal voltage.

4.3.3 Fault condition signals

When a detector suffers a fault, a fault signal or message shall be generated in accordance with the manufacturer's specification, and the provisions of Table 1.

4.3.4 Power supply faults

Detectors of all grades shall signal complete power failure according to the provisions of Table 1. Additionally, detectors of grades 3 and 4 shall signal when the supply voltage moves below the manufacturers specified range according to the provisions of Table 1.

4.3.5 Self tests

Grade 3 and Grade 4 detectors shall monitor the function of the sensor and associated on-board signal processing circuitry. A self-test shall be performed under the control of the detector.
When a remote self-test is initiated a signal or message shall be generated between 1 s and 5 s later, and shall be signalled within 5 s of that initiation. The test duration shall not exceed 10 s. After the test is completed, the detector shall resume it’s previous state within 5 s. Fault indication requirements appear in Table 1

Where normal operation of the detector is inhibited during a local test of function monitoring the inhibition time shall be limited to a maximum of 15 s in a period of 1 h.

4.4 Immunity to microwave signal interference by fluorescent lights

The detector shall not generate an intrusion signal or message due to the operation of a fluorescent light source mounted nearby.

4.5 Tamper security

Tamper security requirements for each grade of detector are shown in Table 3.

4.5.1 Prevention of unauthorized access to the inside of the detector through covers and existing holes

Access holes shall not allow interference with the operation of the detector by probing with commonly available tools. Damage must not be caused that would be visible to a person with normal eyesight viewing from a distance of 1m with the detector illuminated at a level of 2 000 lux.

A tool shall be required to open the unit. All covers giving access to components which could affect adversely the operation of the detector shall be fitted with a tamper detection device in accordance with Table 3. A tamper signal or message shall be generated before access is gained with any tool.

4.5.2 Detection of removal from the mounting surface

A tamper detection device shall be fitted which signals a tamper if the detector is removed from the mounting surface in accordance with Table 3. Mounting screws shall only be accessible from within the unit. Operation of the device shall not be preventable by external means. This device shall activate before access can be gained to it.

4.5.3 Resistance to re-orientation of adjustable mountings

Where the orientation of a detector can be adjusted, resistance to re-orientation of the mounting shall be provided in accordance with Table 3.

The alignment of the boundary of detection shall not have changed by more than 5° due to a grade dependent applied torque. Alternatively a tamper detection device shall signal before the alignment of the boundary of detection has moved by 5°. One test arrangement is described in Annex H.

If a detector provides a means to adjust the orientation of its coverage pattern, the access to this means shall be protected by a tamper detection device.

4.5.4 Immunity to magnetic field interference

It shall not be possible to inhibit any signalling devices with a magnet of grade dependent remanence, according to Table 3. The form of standard magnets is described in Annex A.

4.5.5 Resistance to masking

Means shall be provided to detect inhibition of the operation of the detector by covering its sensing area and sensor, in the unset mode. The maximum response time for the masking detection device shall be 180 s. Intrusion and fault signals or messages or a dedicated anti-masking signal or message shall be generated.

The signals or messages shall remain latched until restored. Grade dependency appears in Table 3.

No anti-masking signal or message shall be generated by normal human movement at 1 m/s at a distance greater than 1 m in the unset condition.

Table 3 – Tamper security requirements

Requirement	Grade 1	Grade 2	Grade 3	Grade 4
Resistance to access to the inside of the detector	Required	Required	Required	Required
Removal from the mounting surface *	Not required	Required *	Required	Required
Resistance to reorientation **Applied torque** (Nm)	Not required	Required 2	Required 5	Required 10
Magnetic field **Immunity** (T)	Not required	Required 0,15	Required: 0,3	Required 1,2
Anti-masking capability	Not required	Not required	Required	Required
* Required for wire free detectors only.				

4.6 Electrical requirements

These requirements do not apply to detectors having internal power supplies. For these detectors refer to EN 50131-6. For a detector having an external power supply, the requirements appear in Table 4.

Table 4 –Electrical requirements

Test	Grade 1	Grade 2	Grade 3	Grade 4
Detector current consumption	Required	Required	Required	Required
Input voltage range and slow input voltage rise	Not required	Required	Required	Required
Input voltage ripple	Not required	Required	Required	Required
Input voltage step change	Not required	Required	Required	Required
Total loss of supply	Not required	Required	Required	Required

4.6.1 Detector current consumption

The detector's quiescent and maximum current consumption shall not exceed the figures claimed by the manufacturer at the nominal input voltage.

4.6.2 Slow input voltage change (rise) and input voltage range limits

The detector shall meet all functional requirements when the input voltage lies between +/- 25 % of the nominal value, or between the manufacturer's stated values (range limits if greater). When the supply voltage is raised slowly, the detector shall function normally at the specified range limits.

4.6.3 Input voltage ripple

The detector shall meet all functional requirements during the sinusoidal variation of the Input voltage by +/- 10 % of nominal, at a frequency of 100 Hz .

4.6.4 Input voltage step change

No signals or messages shall be caused by a step in the input voltage between the maximum and minimum values of the input voltage.

4.6.5 Total loss of supply

An intrusion signal or message shall be caused by the total loss of the supply voltage.

4.7 Environmental classification and conditions

4.7.1 Environmental classification

The environmental classification is described in EN 50131-1. All the relevant environmental tests shall be carried out at the appropriate level for all security grades, as detailed in EN 50130-5.

4.7.2 Immunity to environmental conditions

All detectors shall meet the requirements of the relevant environmental (class) and equipment class as specified by the manufacturer.

For operational tests, the detector shall not generate unintentional intrusion, tamper, fault or other signals or messages when subjected to the specified range of environmental conditions.

For endurance tests, the detector shall continue to meet the requirements of this standard after being subjected to the specified range of environmental conditions.

5 Marking, identification and documentation

5.1 Marking and/or identification

Marking and/or identification shall be applied to the product in accordance with the requirements of EN 50131-1.

5.2 Documentation

The product shall be accompanied with clear and concise documentation conforming to the main systems document EN 50131-1.The documentation shall additionally state

a) a list of all options, functions (including any from higher grades), inputs, signals or messages, indications and their relevant characteristics;

b) the manufacturer's diagram of the detector and its claimed detection boundary showing top and side elevations superimposed upon a scaled 2 m squared grid. The size of the grid shall be directly related to the size of the claimed detection boundary;

c) the recommended mounting height, and the effect of changes to it on the claimed detection boundary;

d) the effect of adjustable controls on the detector's performance or on the claimed detection boundary;

e) any disallowed field adjustable control settings or combinations of these;

f) where alignment adjustments are provided, these shall be labelled as to their function;

g) a warning to the user not to obscure partially or completely the detector's field of view with large objects such as furniture;

h) the manufacturers quoted nominal operating voltage, and the maximum and quiescent detector current consumption at that voltage;

i) the method of detecting a 50 % reduction in range, where provided.

6 Testing

The tests are intended to be primarily concerned with verifying the correct operation of the detector to the specification provided by the manufacturer. All the test parameters specified shall carry a general tolerance of +/- 10 % unless otherwise stated. A list of tests appears as a general test matrix in Annex B.

6.1 General test conditions

6.1.1 Standard laboratory conditions for testing

The general atmospheric conditions in the measurement and tests laboratory shall be those specified in EN 60068-1, subclause 5.3.1, unless stated otherwise.

Temperature	15 °C - 35 °C
Relative humidity	25% RH - 75% RH
Air pressure	86 kPa - 106 kPa

6.1.2 General detection testing environment and procedures

Manufacturers documented Instructions regarding mounting and operation shall be read and applied to all tests.

6.1.2.1 Testing environment

The detection tests require an enclosed, and unobstructed area at least 25 % larger in the three dimensions than the manufacturers claimed field of view, with the detector mounted in the as-used position on a wall or ceiling, or on a freestanding test rig.

Volumetric and long-range detectors shall be mounted on the centre line of the vertical surface constituting the back wall of the test area, or on a free-standing test rig, at a height of 2,0 m unless otherwise specified by the manufacturer. Ceiling mounted detectors shall be mounted in an appropriate orientation permitting at least half the field of view to be verified.

Annex C provides example diagrams for the range of walk tests for one format of detection pattern. Many others are possible.

6.1.2.2 Testing procedures

The detector shall be connected to the nominal supply voltage, placed in the alert/set mode, and connected to the monitoring system that is appropriate to the test. The detector shall be allowed to stabilize for 180 s. The intrusion signal or message output shall be monitored. If multiple sensitivity modes such as pulse counting are available, any non-compliant modes shall be identified by the manufacturer. All compliant modes shall be tested.

After the stabilisation period, the detector shall be left in the alert/set mode for 300 s during which period no movement in the protected area shall take place. If incorrect signals or messages are produced, the source of interference shall be traced and eliminated before testing can proceed.

6.2 Basic detection test

6.2.1 Basic detection target

The purpose of the BDT is to verify that a detector is still operational after a test or tests has been carried out. The BDT verifies only the qualitative performance of a detector.

The BDT shall be a metal plate having equivalent microwave reflectivity to that of the human hand, that can be moved across the field of view of the detector. An informative description appear in Annex D.

A close-in walk test may be carried out as an alternative to using the BDT.

6.2.2 Basic test of detection capability

A stimulus that is similar to that produced by the SWT is applied to the detector using the BDT. Move the BDT along the centre line of the detection field from a distance of 2 m to a distance of 1 m from the detector, at a height where the manufacturer claims detection will occur.

The BDT is to be moved at a velocity of 0,5 to 1,0 m/s. The detector shall produce an intrusion signal or message when exposed to the stimulus both before and after being subjected to any test that may adversely affect its performance.

6.3 Walk testing

Walk testing is accomplished by the controlled movement of a SWT in the field of view of the detector. The grade dependent velocities and attitudes to be used by the SWT are specified in Table 2. Walk tests shall not be repeated before a time interval of at least 20 s (or greater if specified by the manufacturer) has elapsed.

General pass/fail criteria for all walk tests: An intrusion signal or message shall be generated during a (each) walk test to register a pass. If an individual walk test is failed, it shall be repeated twice more. Two passes out of the three tests shall constitute a passed test. For a complete test series, 95 % or more of the tests shall be passed.

6.3.1 The standard walk test target

The SWT shall have the physical dimensions of 160 cm to 185 cm in height, shall weigh 70 kg +/-10 kg and shall wear close fitting clothing. No metallic objects shall be worn or carried by the SWT or incorrect microwave reflection will result.

There shall be a means of calibration and control of the desired velocity at which the SWT is required to move.

NOTE The use of a simulator / robot in place of the SWT is permitted, provided that it meets the specification of the SWT with regard to signal. It is known as the simulated target. In case of conflict, a human walk test shall be the primary reference.

6.3.2 Control of the standard walk test target velocity

This equipment provides a means whereby the SWT can move at a desired velocity. The system produces an apparent movement or audible signal, which may be matched by the SWT. The SWT begins and ends a traverse with feet together, matching movement with the velocity control system. The system can employ any desired means provided that the SWT velocity can be monitored to a tolerance of better than +/- 10 %.

The informative description of two such systems appears in Annex E.

6.4 Verification of detection performance

The general test conditions of 6.1.2 apply to all tests in this series.

Detection performance shall be tested against the manufacturers documented claims. Any variable controls shall be set to the values recommended by the manufacturer to achieve the claimed performance. Microwave detectors of all types shall be assessed in the specified test environment. Lay out the test area according to the provisions of the diagrams in Annex C, and the manufacturers performance claims.

The diagrams in Annex C show an example of the detection boundary. A detector reference line is drawn through the detector, at right angles to the detector axis.

The SWT or a suitable simulated target shall be used. Grade dependent velocities and attitudes are specified in Table 2.

6.4.1 Detection within and across the detection boundary

The tests assess detection of intruders moving within and across the boundaries of the detection area. The diagrams in Annex C show an example of the detection boundary, superimposed where appropriate on a scaled 2 m squared grid. A variety of boundary formats are possible and can be tested.

6.4.1.1 Verify detection across the boundary

Figure C.1 shows an example of a manufacturers claimed detection boundary.

Select test points on the boundary, as detailed in Figure C.1:

Place test points at 2 m intervals around the entire boundary of the detection pattern, starting from the detector, and finishing with a final point where the boundary crosses the detector axis, if omission of this point would leave a gap greater than 2 m wide. Repeat for the opposite side of the detection pattern.

Each test point is connected to the detector by a radial line. At each test point, two test directions are used, beginning at a distance of 1,5 m from the test point and finishing 1,5 m after it. The SWT shall move at either +45° or -45° to the radial line.

6.4.1.2 Verify detection within the boundary

Figure C.2 shows an example of a manufacturers claimed detection boundary superimposed on a 2 m squared grid.

Select test points within the boundary, as detailed in Figure C.2:

Starting at the detector, place the first test point at 4 m along the detector axis. Using the 2 m squared grid, place further test points at every alternate grid intersection, filling the protected area on both sides of the detector axis. No point shall be less than 1 m from, or lie outside, the claimed boundary.

Each test point is connected to the detector by a radial line. At each test point, two test directions are defined at +45° or -45° to that line. The SWT shall start at a distance of 1,5 m from the test point and finish 1,5 m after it.

6.4.2 Detection at high velocity and with intermittent movement

The tests assess detection of intruders moving at high velocity, and moving intermittently across the protected area.

6.4.2.1 Verify the high-velocity detection performance

Three walk tests are performed, crossing the entire detection area as detailed in Figure C.3. Two walk tests begin outside the boundary of the area, from opposite sides, and pass through the detector axis mid-range point at 45° to that axis. The third walk test passes at right angles to the detector axis at a distance of 1 m in front of, and parallel to, the detector reference line.

The SWT shall cross all of the specified detection area, coming to rest after clearing the other detection boundary. At the end of each path, the SWT shall pause for at least 20 s, then return to the starting point.

6.4.2.2 Verify the intermittent movement detection performance

Two walk tests are performed, crossing the entire detection area as detailed in Figure C.3.

The tests begin outside the boundary of the area, from opposite sides, and pass through the detector axis mid-range point at 45°.

The intermittent movement starts with the SWT standing with the feet together, moving 2 x 0,2 (5) m steps and stopping with the feet together. After 5 s at rest the cycle is repeated until the SWT has left the area.

The SWT shall cross all of the specified detection area, coming to rest after clearing the other detection boundary. At the end of each path, the SWT shall pause for at least 20 s, then return to the starting point.

6.4.3 Verify the close-in detection performance

Two walk tests are performed, beginning and ending outside the boundary of the detection area as detailed in Figure C.4. The SWT starts from outside the detection boundary, and moves with grade dependent attitude and velocity across the specified detection area.

The SWT shall cross all of the specified detection area, coming to rest after clearing the other detection boundary. At the end of each path, the SWT shall pause for at least 20 s, then return to the starting point. Table 2 specifies velocities, attitudes and distances.

6.4.4 Verify the effect of control adjustments on detection

Select test points on the manufacturers claimed detection boundary, as detailed in Figure C.1 and 6.4.1.1. Use only the manufacturers claimed values for minimum settings of control adjustments and the consequent range and angular coverage.

Each test point on the boundary is connected to the detector by a radial line. At each test point, two test directions are used, beginning at a distance of 1,5 m from the test point and finishing 1,5 m after it. The SWT shall move at either +45° or -45° to the radial line.

The SWT shall move along each path from start to finish. At the end of each path, the SWT shall pause for at least 20 s, then return to the starting point.

6.4.5 Verify the significant reduction of specified range

Select a test point on the detector axis at a distance of 5 % of the manufacturer's claimed detection range. Erect a barrier of cardboard boxes across the axis and perpendicular to it, at a distance of 45 % of the manufacturer's claimed detection range, covering a horizontal distance of +/- 2,5 m on either side of the detector axis, and a vertical height of 3 m as detailed in Figure C.5.

At the test point, two test directions are used, beginning at a distance of 1,5 m before the test point, and finishing 1,5 m after it, moving perpendicularly to the detector axis.

The SWT shall move along each path from start to finish. At the end of each walk test, the SWT shall pause for at least 20 s before carrying out any further test.

Pass/fail criteria: An alarm or fault signal or message shall be generated when the barrier is present.

6.5 Switch-on delay, time interval between signals and indication of detection

The general test conditions of 6.1 apply.

Switch on the detector power with the indicator enabled (if provided), and allow 180 s for stabilisation. Carry out the BDT. Note the response. Carry out the BDT again, after the specified time interval between signals. Note the response again. Disable the intrusion indicator (if provided). Repeat the BDT.

Pass/fail criteria: The detector shall generate an intrusion signal or message in response to the BDT. The intrusion signal or message and the intrusion indicator shall respond at the same time, and shall do so after 180 s have elapsed. A second intrusion signal or message shall be generated after the specified time interval has elapsed. With the indicator disabled the detector shall still generate an intrusion signal or message.

6.6 Fault condition signals or messages: self tests

The general test conditions of 6.1 apply.

Verify that the detector is operating with the BDT by monitoring the intrusion and fault signals or messages. Remove the BDT and verify that no intrusion or fault signal or message is generated.

Remove the power from the microwave emitter (or carry out an equivalent action as recommended by the manufacturer) during the period when the detector carries out it's own internal test, or during remote operation of the internal test if the detector is provided with this facility.

Pass/fail criteria, local self test: When a fault is initiated during the self-test period specified by the manufacturer, a fault signal or message shall be generated for grades 3 and 4 only, and no intrusion signal or message. The local memory shall not be set.

Pass/fail criteria, remote self test: When a fault is initiated during the self-test period specified by the manufacturer, an intrusion signal or message shall be generated for grades 3 and 4 only, and no fault signal or message. The local memory shall not be set.

6.7 Immunity to microwave signal attenuation by fluorescent lights

The general test conditions of 6.1 apply to all tests in this series.

Carry out the BDT. Note the response. Carry out the following tests:

A pair of 1,20 m x 25 mm diameter 36 W / 40 W fluorescent tubes of between 100 h and 1 000 h usage having no metal reflectors or extraneous decoration is mounted on the ceiling 0,5 m above, 2,0 m in front of, and parallel to the detector axis. For ceiling mounted detectors, the tube shall be mounted 1,0 m below the detector and 0,5 m in front of it (see Annex F).

Carry out the close-in detection test (6.4.3) with the light off. Monitor for an intrusion signal or message. The light shall be switched on for 60 s and off for 30 s five times.

Monitor for incorrect operation. Repeat the close-in detection test with the light on, and check the intrusion signal again. Repeat the test with the fluorescent tube rotated through 90° relative to the detector axis.

Pass/fail criteria: There shall be no incorrect change of status of the detector during the test.

6.8 Tamper security

The general test conditions of 6.1 apply.

Grade dependent tamper requirements appear in Table 2.

6.8.1 Prevention of unauthorized access to the inside of the detector through covers and existing holes

Attempt to overcome the tamper detection device without the use of the tool specified by the manufacturer, by deliberate attack with normally available objects (of minimum thickness 0,5 mm) as listed in Annex G, or by distorting the housing without causing damage.

Pass/fail criteria: Only the tool specified by the manufacturer for servicing purposes shall open the accesscover(s) to the inside of the detector. The tamper detection device shall operate before access is gained to any circuit connection or control that can adjust performance or alignment of the detector.

6.8.2 Detection of removal from the mounting surface

Confirm the operation of the back tamper device by removing the detector from the mounting surface. Replace the unit on the mounting surface without the fixing screws, unless they form a part of the tamper detection device.

Slowly prise the detector away from the mounting surface and attempt to prevent the tamper device from operating by inserting a strip of steel between 100 mm and 200 mm long by 10 mm to 20 mm wide, and 1 mm thick between the rear of the detector and its mounting surface.

Pass/fail criteria: A tamper signal or message shall be generated before the tamper device can be inhibited.

6.8.3 Resistance to re-orientation of adjustable mountings

Mount the detector so that it may be turned on the adjustable mount by a measured torque, and the resultant angular displacement assessed both during and after the test, as shown in Annex H.

Connect power to the detector and place it in the alert/set mode. Apply the required torque. Remove the torque. Measure the angle of twist of the detector relative to the mounting.

Pass/fail criteria: If the angle of re-orientation at the required torque level is less than 5°, the test is passed.

If a tamper device is provided, it shall activate before the angular displacement of 5° is reached.

6.8.4 Resistance to magnetic field interference

Connect power to the detector and place it in the alert/set mode. A magnet of nominal remanence in accordance with Table 3 shall be placed on each surface of the detector housing in sequence whilst the BDT is moved in front of the detector. The magnet shall be applied in a manner that ensures that a single magnetic pole contacts the surface, to maximize flux penetration. Record the response of the detector. Then interrogate each tamper detection device and record any change of state, including the state of the relay. The magnets shall be as specified in Annex A.

Pass/fail criteria: For grade 4, a tamper signal or message shall be produced, or the detector shall continue to work normally without a signal or message being generated. The presence of the magnet shall not prevent correct generation of any signal or message.

6.8.5 Resistance to detector masking

For each test, the detector shall be in the unset mode, and its signals or messages shall be monitored for changes of status.

Apply a sheet of 2 mm thick aluminium, large enough to inhibit detection**,** directly to the whole front of the detector. Apply the sheet again, by sliding it across the emitting surface of the detector from one side. Perform two series of tests, one taking 1 s to cover the detector emitting surface, and the other 10 s.

After each individual material application, wait 180 s for the system to stabilize.

Monitor the anti-mask or tamper signal or message during the test.

Pass/fail criteria: Either an intrusion and a fault signal or message OR an independent anti-masking signal or message (an anti-masking and / or tamper signal or message) shall be generated within 180 s of the masking material being applied, and shall continue to be generated as long as the material is in place. Alternatively, the detector shall continue to operate normally.

If an individual test is failed, it shall be repeated twice more. Two passes out of the three tests shall constitute a passed test.

General pass/fail criteria for all tests: For a complete test series, 95 % or more of the tests shall be passed.

6.9 Electrical tests

The BDT given in 6.2 shall be used where appropriate for verification. Ensure that there is no human movement in the FOV of the detector during the tests. Connect the detector to a variable, stabilized power supply and allow it to stabilize for at least 180 s.

Some of these tests can be applied to detectors with internal power supplies, and shall be performed by substituting a DC power supply for the internal battery. Table 4 specifies grade dependency.

6.9.1 Detector current consumption

Connect the detector in series with a current measuring meter and connect a voltmeter across the power input terminals. Set the voltage to the nominal value. Place the detector in the unset/standby mode, if provided, and enable the intrusion indicator. Measure current and voltage. Repeat the measurement in the alert/set mode.

Pass/fail criteria: The current consumption shall not exceed the manufacturers stated values by more than 20 % in either mode.

6.9.2 Slow input voltage change (rise) and input voltage range limits

These tests are not applicable to detectors with internal power supplies.

Raise the supply voltage from zero by 100 mV every 1 s until the nominal voltage V – 25 % is reached, or the minimum level specified by the manufacturer, whichever is less. Allow the detector to stabilize for 180 s, carry out the BDT, and monitor the intrusion and fault signals or messages.

Reset the supply voltage to the nominal V. Raise the voltage from V by 100 mV every 1 s until the nominal voltage V + 25 % is reached, or the maximum level specified by the manufacturer, whichever is greater. Allow the detector to stabilize for 180 s, carry out the BDT, and monitor the intrusion and fault signals or messages.

Reset the supply voltage to the nominal V. Lower the voltage by 100 mV every 1 s until the nominal voltage V – 25 % is reached, or the minimum level specified by the manufacturer, whichever is less. Allow the detector to stabilize for 180 s, carry out the BDT, and monitor the intrusion and fault signals or messages.

For grade 3 and 4 detectors, lower the voltage by 100 mV every 1 s from V - 25% until a fault signal is generated.

Pass/fail criteria, slow power supply change (rise): There shall be no intrusion signal or message when a fault signal is generated, and there shall be no fault signal or message when an intrusion signal or message is generated.

Pass/fail criteria, voltage at the range limits: The detector shall generate an intrusion signal or message.

Pass/fail criteria, voltage below the range limits: For grade 3 and 4 detectors, the detector shall signal a fault prior to the situation where no intrusion signal or message is generated when the BDT is carried out.

6.9.3 Input voltage ripple

This test is not applicable to detectors with internal power supplies.

Connect the detector to a signal generator with appropriate output impedance capable of generating a sinusoidal voltage of V +/- 10% superimposed on the detector nominal voltage V at a frequency of 100 Hz. Allow at least 180 s for the detector to stabilize. Apply the sinusoidal voltage for 180 s at 100 Hz.

Carry out the BDT. Observe whether any intrusion or fault signals or messages are generated.

Pass/fail criteria: There shall be no signals or messages generated by the detector during the test apart from that generated by the BDT.

6.9.4 Input voltage step change

This test is not applicable to detectors with internal power supplies.

Connect the detector to a square wave generator limited to a maximum current of 1 A capable of switching from the nominal supply voltage V to the nominal voltage V +/- 25 % in 1 ms.

Begin the test at the nominal voltage, and allow at least 180 s for the detector to stabilize. Carry out the BDT. Monitor intrusion and fault signals or messages. Apply ten successive square wave pulses from nominal supply voltage V to V + 25 %, of duration 5 s at intervals of 10 s. Observe whether any intrusion or fault signals or messages are generated. Repeat the BDT. Repeat the step change test for the voltage range V to V – 25 %.

Pass/fail criteria: There shall be no signals or messages generated by the detector during the test.

6.9.5 Total loss of power supply

This test is not applicable to detectors with internal power supplies or detectors in bus systems.

Disconnect the detector from the power supply. Observe whether any intrusion or other signals or messages are generated.

Pass/fail criteria: An intrusion signal or message shall be generated by the detector.

6.10 Environmental classification and conditions

Unless stated otherwise the general test conditions of 6.1 apply.

Detectors shall be subjected to the environmental conditioning described in EN 50130-5 and the EMC product family standard EN 50131-4.

Specific requirements for combined PIR/microwave intrusion detectors are given in this specification. See Tables 6 and 7.

Detectors subjected to the operational tests are always powered and set, and tests shall be performed at maximum settings.

Detectors subjected to the endurance tests are always unpowered. Detectors which have more than one recommended mounting position shall be separately tested in each position for mechanical shock and impact.

Special conditions:

During testing ensure that the detector is shielded from any possible sources of microwave reflection. This may be achieved by covering the receiving aperture of the detector with a material unable to pass microwave energy, which shall not interfere with the intended conditioning. It is necessary to consider the effect on any anti-masking sensors when selecting a suitable material or method. It may be necessary to consult the manufacturer. After the tests, any shielding material added for test purposes shall be removed before carrying out the BDT.

Monitor the detector for unintentional intrusion and (where applicable) tamper signals or messages. No functional test is required during the tests.

After the tests and any recovery period prescribed by the environmental test standard, carry out the BDT, and visually inspect the detector both internally and externally for signs of mechanical damage.

After the water ingress test, wipe any water droplets from the exterior of the enclosure, dry the detector and carry out the BDT.

Annex A
(normative)

Format of standard test magnets

A.1 Lower strength magnet

The required remanence is 0,15 T ± 10 %.

A.2 Medium strength magnet

The required remanence is 0,30 T ± 10 %.

A.3 Higher strength magnet

The required remanence is 1,2 T ± 10 %.

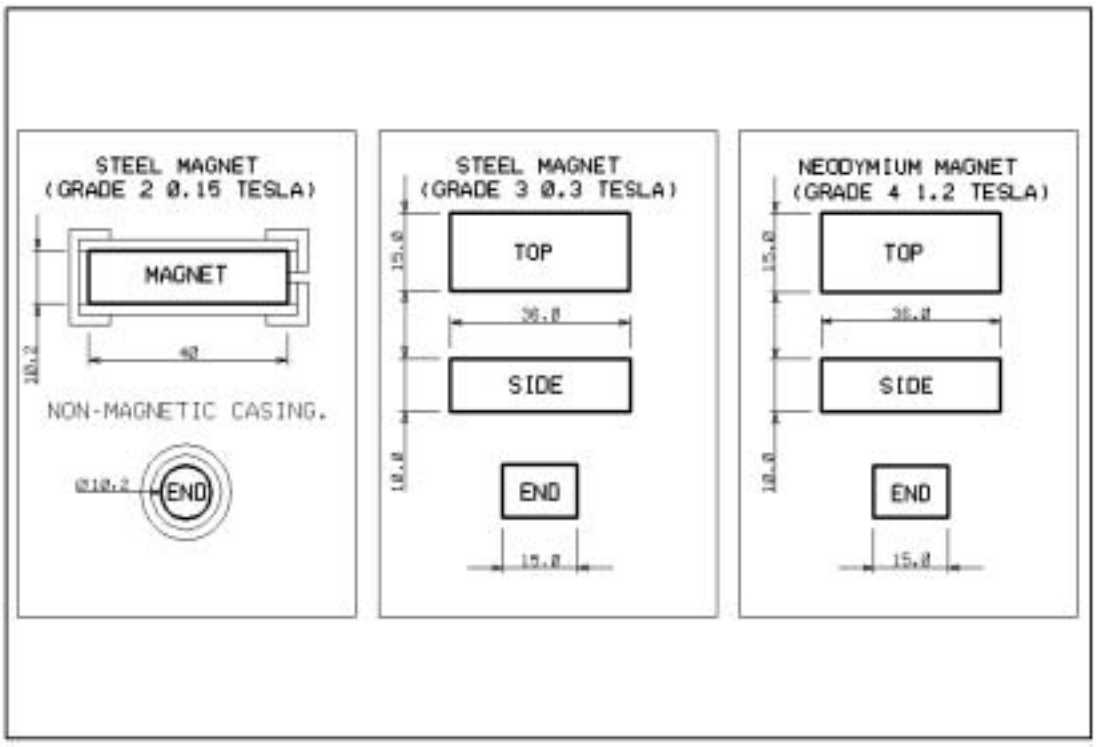

Figure A.1 - Format of standard test magnets

NOTE The names and addresses of suppliers of the magnets are held by the Certification Body and are available on request.

Annex B
(normative)

General testing matrix

Main test title	Task to be performed in conjunction with main test			Sample No.
	Before main test	**During main test**	**After main test**	
Verification of detection performance				
Detection within and across the boundary				
Verify detection across the boundary.	None	6.4.1.1 + SWT	None	1
Verify detection within the boundary	None	6.4.1.2 + SWT	None	1
Effects of control adjustments on detection	None	6.4.4 + SWT	None	1
Verify significant reduction in range	None	6.4.5 + SWT	None	1
Detection at high velocity and with intermittent movement				
Verify the high velocity detection performance	None	6.4.2.1 + SWT	None	1
Verify the response to intermittent movement	None	6.4.2.2 + SWT	None	1
Detection close-in				
Verify the close-in detection performance	None	6.4.3 + SWT	None	1
Switch-on delay, time interval between signals and indication of detection	None	6.5 + BDT	None	1
Fault condition signals or messages				
Self tests	None	6.6 + BDT	None	2
Immunity of each technology to incorrect operation				
Immunity to microwave signal attenuation by fluorescent lights	None	6.7.3 + SWT	None	1
Tamper security				
Access through detector interior through covers & holes	None	Monitor	None	10
Detection of removal from the mounting surface	None	Monitor	None	10
Resistance to re-orientation	None	Monitor	None	10
Resistance to magnetic field interference	None	6.8.4 + BDT	None	10
Resistance to detector masking	6.2.2 + BDT	Monitor	6.2.2 + BDT	10
Electrical tests				
Detector power consumption	6.2.2 + BDT	Monitor	6.2.2 + BDT	1
Slow input voltage rise and input voltage range limits	6.2.2 + BDT	Monitor	6.2.2 + BDT	1
Input voltage ripple	6.2.2 + BDT	Monitor	6.2.2 + BDT	1
Input voltage step change	6.2.2 + BDT	Monitor	6.2.2 + BDT	1

Main test title	Task to be performed in conjunction with main test			Sample No.
	Before main test	**During main test**	**After main test**	
Environmental tests – Operational				
Dry heat	6.2.2 + BDT	6.2.2 + BDT	6.2.2 + BDT	3
Cold	6.2.2 + BDT	6.2.2 + BDT	6.2.2 + BDT	3
Damp heat (steady state)	6.2.2 + BDT	6.2.2 + BDT	6.2.2 + BDT	4
Damp heat (cyclic)	6.2.2 + BDT	6.2.2 + BDT	6.2.2 + BDT	4
Water ingress	6.2.2 + BDT	Monitor	6.2.2 + BDT	5
Mechanical shock	6.2.2 + BDT	Monitor	6.2.2 + BDT	6
Vibration	6.2.2 + BDT	6.2.2 + BDT	6.2.2 + BDT	7
Impact	6.2.2 + BDT	None	6.2.2 + BDT	6
EMC	6.2.2 + BDT	Monitor	6.2.2 + BDT	8
Environmental tests – Endurance				
Damp heat (steady state)	6.2.2 + BDT	None	6.2.2 + BDT	4
Damp heat (cyclic)	6.2.2 + BDT	None	6.2.2 + BDT	4
SO_2 corrosion	6.2.2 + BDT	None	4.5.1 + 4.5.5 6.2.2 + BDT	9 *
Vibration	6.2.2 + BDT	None	6.2.2 + BDT	7
Marking, identification and documentation				
Marking	None	None	None	1
Documentation	None	None	None	1

Key to descriptions:

None = no test or other operation is performed.

6.4.x + SWT = verify the detection performance using the standard walk test target.

Monitor = monitor the detector signals during the main test.

6.2.2 + BDT = basic test of detection capability using the basic detection targets.

6.x + BDT = verify the requirements using the basic detection targets.

NOTE The numbered samples are a recommendation for sequential testing where no failure occurs. If a sample fails a test it may be substituted with a new one.

* For masking tests, more samples may be required.

Annex C
(normative)

Walk test diagrams

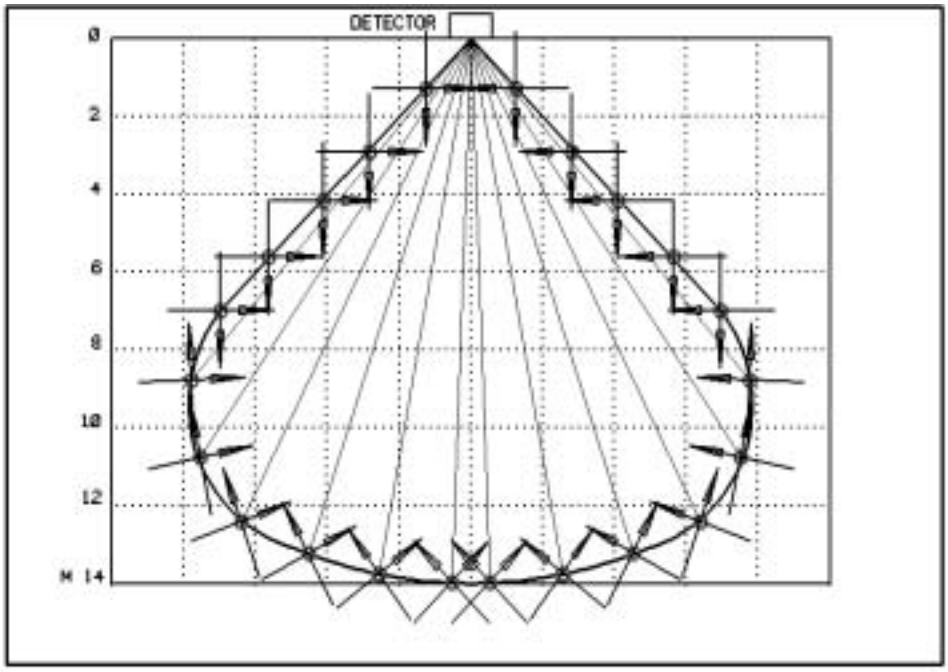

Figure C.1 – Detection across the boundary, & effect of control adjustments

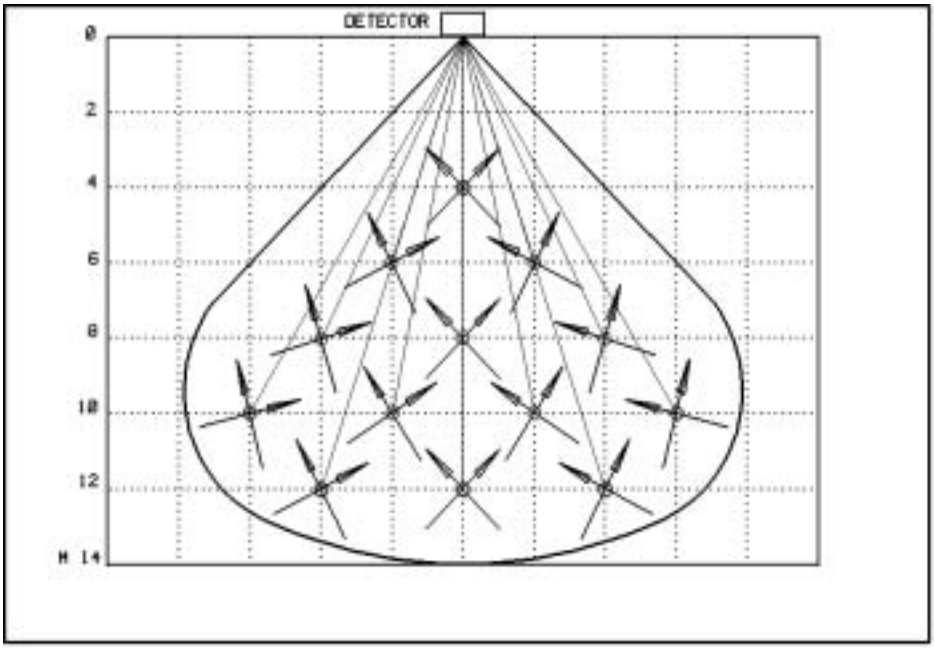

Figure C.2 – Detection within the boundary, & effect of control adjustments

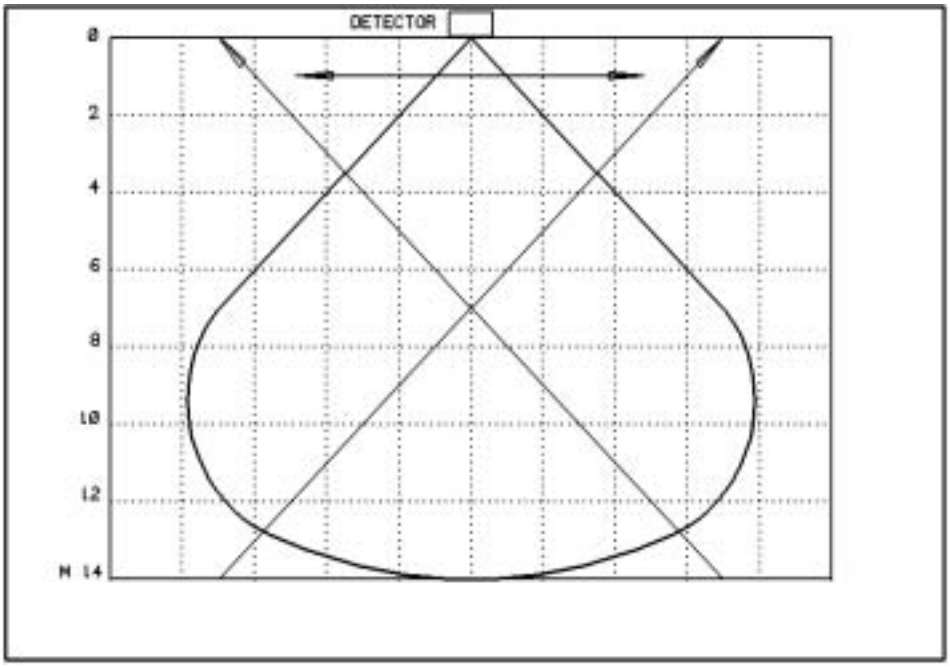

Figure C.3 – High velocity and intermittent movement

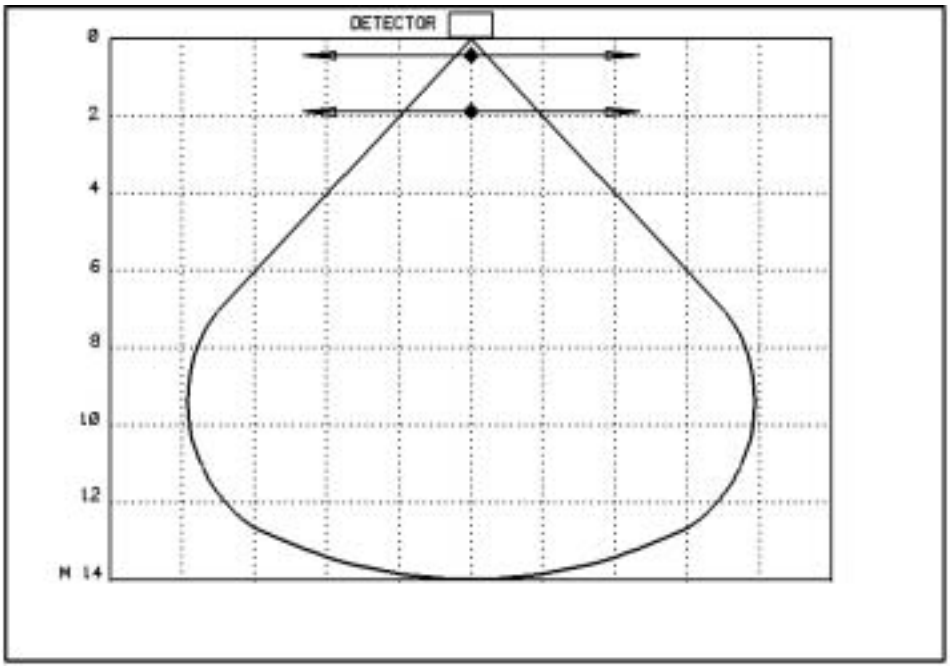

Figure C.4 – Close-in detection

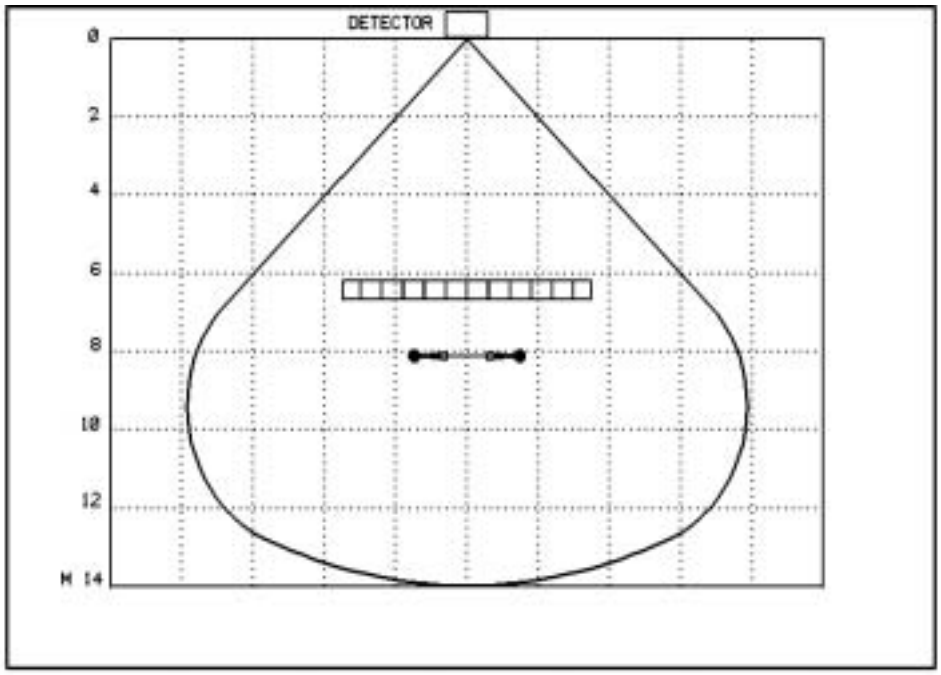

Figure C.5 – **Significant range reduction**

Annex D
(informative)

Basic detection target for the basic test of detection capability

The purpose of this equipment is to verify that a detector is still operational after a test has been carried out.

A microwave reflective surface is required to verify the microwave sensor, and it is required to be able to generate a Doppler signal sufficient to verify the operation of the sensor.

A sheet of copper of dimensions 150 mm x 150 mm is a suitable microwave reflector. This, when mounted on a hand-held rod, can be moved by hand across the field of view of the detector, and towards it. A suitable distance of movement would be about 1,0 m at a range of about 1,0 m from the detector.

Annex E
(informative)

Equipment for walk test velocity control

The SWT is required to move at a variety of velocities during walk tests as specified in Table 2. The required velocities range from 0,1 m/s to 3,0 m/s +/- 10 %. A means of controlling these velocities is desirable.

E.1 Moving light source guiding system

This equipment consists of a series of diodes mounted along the floor in the direction that the controlled walk test subject is desired to follow. They are driven by a variable time switch so that they flash in sequence across the floor, producing an apparent movement, which can be followed by the SWT.

E.2 Metronome

The metronome gives an audible timing sound that can be used, in conjunction with marked distance scale on the floor to instruct a human target to move from one mark to the next as each beat from the metronome sounds.

Annex F
(normative)

Immunity to microwave signal attenuation by fluorescent lights

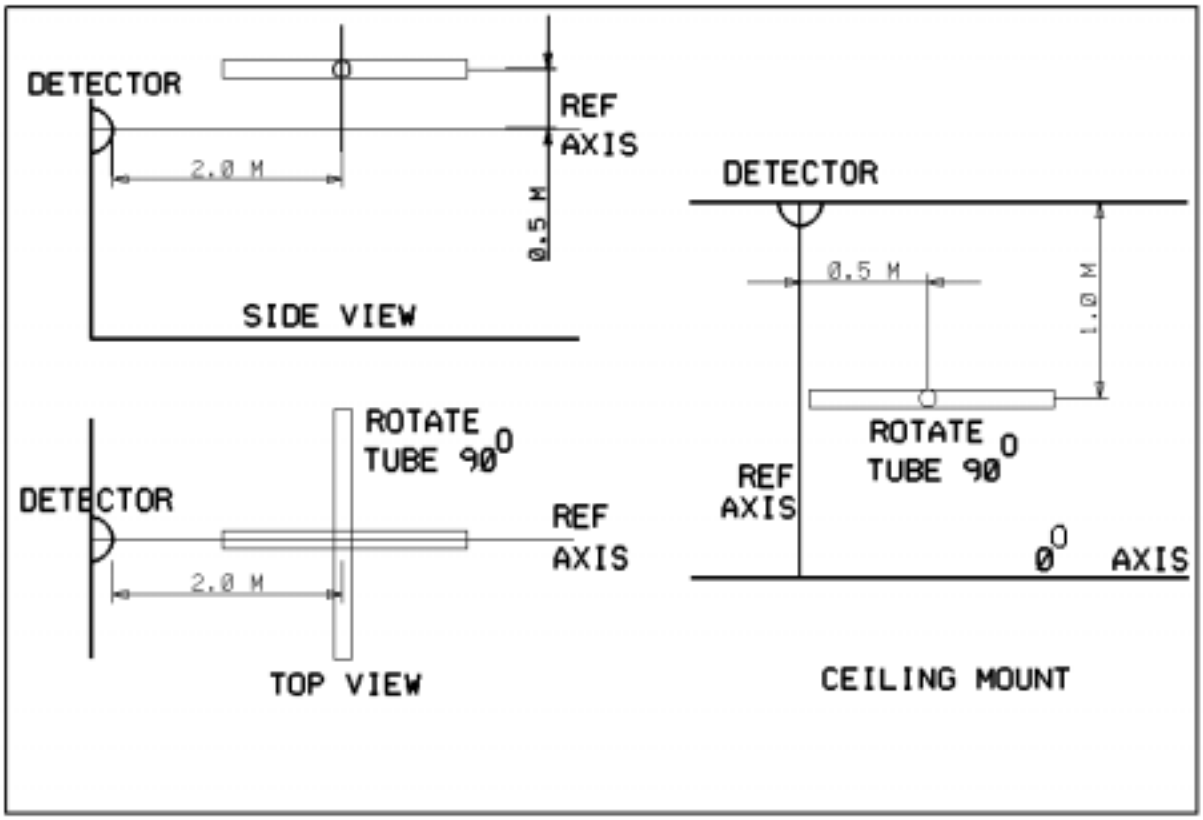

Figure F.1 – Immunity to fluorescent lamp interference

Annex G
(informative)

Example list of small tools suitable for testing immunity of casing to attack

Penknife	
Steel ruler	Magnets
Wire	Paper
Matches	Pliers
Paper clip	Small screwdriver set
Pen	Stiff wire (1 mm +/- 0,05 mm as EN 60529, IP4X)

Annex H
(informative)

Test for resistance to re-orientation of adjustable mountings

Mount the detector on a substantial wood block with a metal backing (see Figure H.1). Steel nuts fitted to the metal base are used to apply a torque wrench so a measured torque may be applied to the housing at the appropriate level for the measurement of re–orientation.

The test is performed by gripping the detector casing in a substantial soft-jawed vice and turning the metal base with the torque wrench. A line and protractor attached to the metal base allows assessment of the turning angle caused by the applied torque.

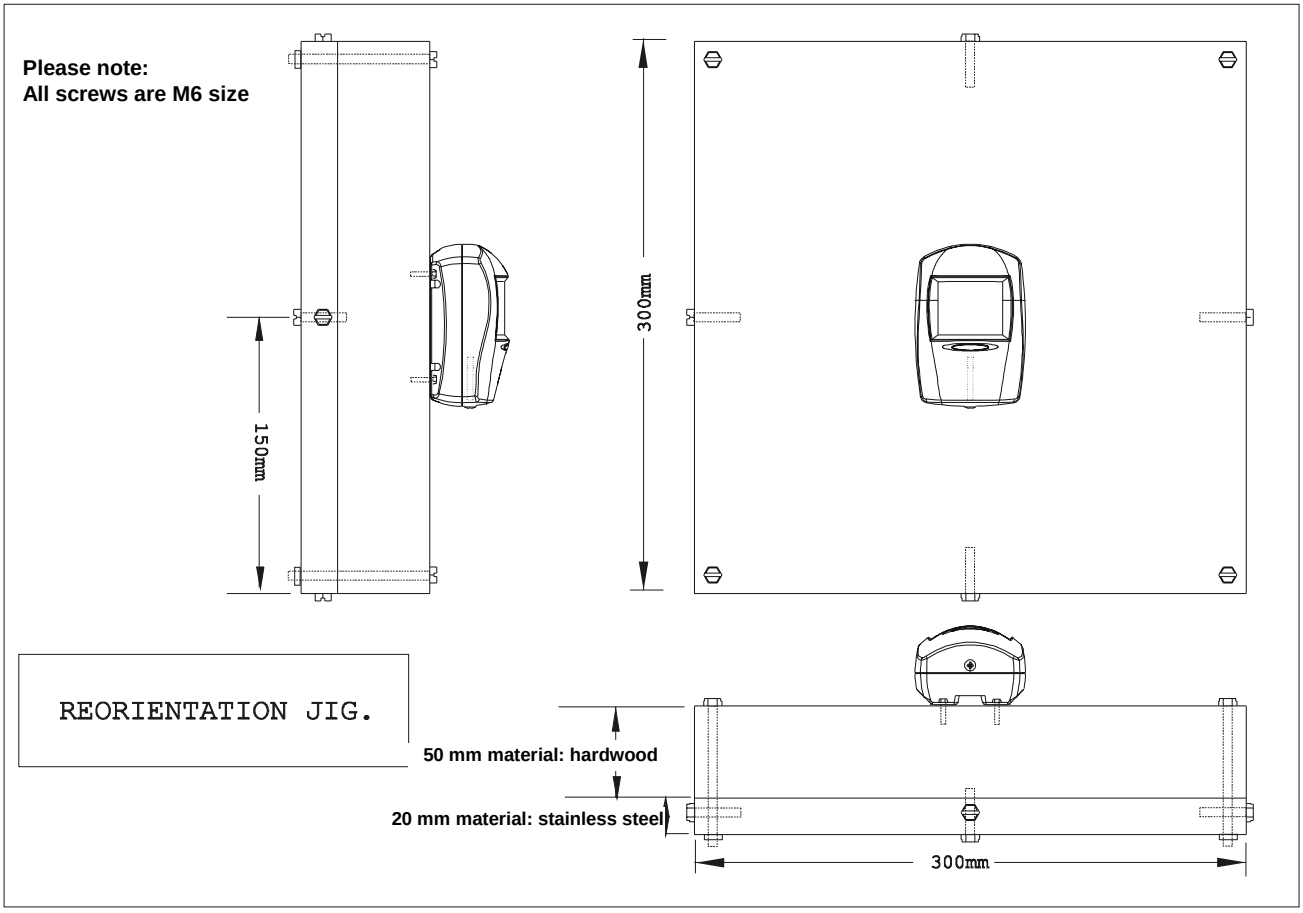

Figure H.1 – Re-orientation test