TECHNICAL SPECIFICATION **FINAL DRAFT**

SPECIFICATION TECHNIQUE **CLC/prTS 50131-2-5**

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ICS

English version

Alarm systems - Intrusion systems
Part 2-5: Requirements for combined passive infrared and ultrasonic detectors

Systèmes d'alarme - Systèmes de détection d'intrusion
Partie 2-5 : Exigences pour détecteurs combinés infrarouges passifs et ultrasoniques

Alarmanlagen - Einbruchmeldeanlagen
Teil 2-5 : Anforderungen an dualmelder Passiv-infrarot und ultraschall-melder

This draft Technical Specification is submitted to CENELEC members for formal vote.
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CENELEC
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Foreword

This draft Technical Specification was prepared by the Technical Committee CENELEC TC 79, Alarm systems. It is submitted to formal vote.

The following date is proposed:

- latest date by which the existence of the CLC/TS has to be announced at national level (doa) dav + 3 months

EN 50131 will consist of the following parts, under the general title “Alarm systems - Intrusion systems":

- Part 1 General requirements
- Part 2-1 Intrusion detectors - Common requirements
- Part 2-2 Requirements for passive infrared detectors
- Part 2-3 Requirements for microwave detectors
- Part 2-4 Requirements for combined passive infrared and microwave detectors
- Part 2-5 Requirements for combined passive infrared and ultrasonic detectors
- Part 2-6 Intrusion detectors - Opening contacts (magnetic)
- Part 2-7 Intrusion detectors - Glass break detectors acoustic or sismic
- Part 2-8 Intrusion detectors - Vibration detectors
- Part 2-9 Intrusion detectors - Active infrared detectors
- Part 2-10 Intrusion detectors - Proximity detectors
- Part 3 [1)] Control and indicating equipment
- Part 4 [2)] Warning devices
- Part 5-1 Requirements for interconnection equipments using dedicated wired links
- Part 5-2 Requirements for interconnection equipments using non-dedicated wired links
- Part 5-3 Requirements for intrusion alarm equipment using radio frequency techniques
- Part 6 Power supplies
- Part 7 [1)] Application guideline

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[1)] Respectively published as CLC/TS 50131-3:2003 and CLC/TS 50131-7:2003.
[2)] Under consideration as CLC/prTS 50131-4.

Contents

Introduction

This Technical Specification is a specification for combined passive infrared and ultrasonic detectors (to be referred to here as the combined 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 a combined detector is to detect the broad spectrum infrared radiation emitted by an intruder and, at the same time, to emit ultrasonic radiation over the area being protected, and analyse signals that are returned. An intrusion signal or message is only generated when both technologies register a positive indication of the presence of an intruder, thus reducing incorrect operation. The combined 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.

This specification is only concerned with the requirements and tests for the combined detector. Other types of detector are covered by other documents identified as drafts in the EN 50131-2 series.

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 (see 4.2.3) or by suitable system design.

1 Scope

This Technical Specification provides for security grades 1 - 4 (see EN 50131-1), specific or non-specific wired or wire-free combined passive infrared and ultrasonic detectors, and is covered by environmental classes 1 – 3 (see EN 50130-5).

A function designated in the specification as not required for a particular grade may be provided by themanufacturer. 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 + A1:1996	Alarm systems - Part 4: Electromagnetic compatibility - Product family standard: Immunity requirements for components of fire, intruder and social alarm systems
EN 50130-5:1996	Alarm systems - Part 5: Environmental test methods
EN 50131-1:1996	Alarm systems - Intrusion systems - Part 1: General requirements
EN 50131-6:1998	Alarm systems - Intrusion systems - Part 6: sower Supplies
EN 60068-1:1994	Environmental testing - Part 1: General and guidance (IEC 60068-1:1988 + corr. October 1988 + A2:1992)
EN 60068-2-52:1996	Environmental testing - Part 2-52: Tests - Test Kb: Salt mist, cyclic (sodium chloride solution) (IEC 60068-2-52:1996)

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 will generate an intrusion signal in response to stimulation by a human being or a standard target

3.2
basic detection target
heat source and/or ultrasonic 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
combined passive infrared and ultrasonic detector
detector of the broad-spectrum infrared emitted by a human being, with an active ultrasonic emitter and detector installed in the same casing

3.5
curtain detector
detector capable of sensing human movement through a continuous layer of detection zones

3.6
local memory
storage medium situated on board the detector, and having the capability to record signals or messages generated by the detector

3.7
long range detector
detector capable of sensing human movement in an extended field of view with horizontal angular coverage less than 10 degrees

3.8
masking
interference with the detector input capability by the introduction of a physical barrier such as metal, plastic, paper or sprayed paints or lacquers in close proximity to the detector

3.9
ultrasonic detector
detector having an active ultrasonic emitter and detector installed in the same casing

3.10
passive infrared detector
detector of the broad-spectrum infrared radiation emitted by a human being

3.11
simulated walk test target
non-human or synthetic heat source or ultrasonic reflector designed to simulate the standard walk test target

3.12
incorrect operation
physical condition that causes an inappropriate signal from a detector

3.13
standard walk test target
human being of standard weight and height clothed in close fitting clothing appropriate to the simulation of an intruder

3.14
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 ultrasonic emitter may be switched off.

3.15
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

3.16
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°

3.17
walk test
operational test during which a detector is stimulated by the standard walk test target in a controlled environment

3.18
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

3.19
walk test attitude, crawling
crawling attitude shall consist of the standard walk test target moving with hands and knees in contact with the floor

3.20
wire free detector
detector connected to the control and indicating equipment by non-physical means such as radio frequency signals

3.21
abbreviations

HDPE - high density polyethylene

PIR - passive infrared

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 combined detectors shall have an alert/set mode. Grades 3 and 4 shall also have an unset mode**.** If a combined 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 combined detector communicates. The combined 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 combined 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 [a]	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 [b]	Not required	Required [b]
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 [c]	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

[a] Not required in unset / standby mode - required in test mode.
[b] An independent masking signal or message may be provided instead.
[c] Not required for bus systems.

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

4.2 Detection

4.2.1 Detection performance

The combined detector shall generate an intrusion signal or message when the SWT or simulated walk test target moves within the boundary for a distance of 3 m or across the manufacturers claimed boundary of detection. An intrusion signal or message shall only be generated when both technologies register a positive indication of the presence of an intruder.

The variety of velocities and attitudes are as specified in Table 2.

Table 2 - General walk test velocity and attitude requirements

Test	**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 Distance (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 [a]	Not required	Not required	Required	Required
Velocity (m/s)	#	#	1,0	1,0
Attitude	#	#	Upright	Upright
Effect of control adjustments [b]	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 [c]	Not required [c]
Velocity (m/s)	#	#	1,0	1,0
Attitude	#	#	Upright	Upright

[a] The intermittent movement shall consist of the SWT moving a distance of 1 m by taking two 0,5 m steps (at 1,0 m/s), pausing for 5 s then continuing for a further 1 s.

[b] 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.

[c] The means to detect a significant reduction in range may be met either by detectors having the appropriate function (see 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 combined 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 combined 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 combined 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 (see EN 50131-1 for amendment)

4.3.2 Switch on delay

The combined 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 combined 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

Combined detectors of all grades shall signal complete power failure according to the provisions of Table 1.
Additionally, combined 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 combined 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 combined detector.

When a remote self-test is initiated a signal or message shall be generated between 1 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 combined detector shall resume it’s previous state within 5 s. Fault indication requirements appear in Table 1

Where normal operation of the combined 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 of the individual technologies to incorrect operation

The combined detector shall be considered to have sufficient immunity to incorrect operation if the following requirements have been met. No intrusion signal or message shall be generated during the tests.

4.4.1 Immunity to air flow

The PIR component of the combined detector shall not generate an intrusion signal or message when air is blown over the face of the combined detector.

4.4.2 Immunity to visible and near infrared radiation

The PIR component of the combined detector shall not generate an intrusion signal or message when visible and near infrared radiation from a light source such as a car headlamp is directed on to the front window or lens through a pane of glass.

4.4.3 Immunity to ultrasonic signal interference by extraneous sound sources

The ultrasonic component of the combined detector shall not generate an intrusion signal or message due to the operation of a sound source mounted nearby.

4.5 Tamper security

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

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

Access holes shall not allow interference with the operation of the combined 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 1 m with the combined 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 combined 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 combined 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 combined 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°.
If a combined 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 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 combined detector	Required	Required	Required	Required
Removal from the mounting surface	Not Required	Required [a]	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
[a] Required for wire free detectors only.				

4.6 Electrical requirements

These requirements do not apply to combined detectors having internal power supplies. For these detectors refer to EN 50131-6. For a combined 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 power 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 combined 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 rise and input voltage range limits

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

4.6.3 Input voltage ripple

The combined 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

Classification is laid down 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 combined detectors shall meet the requirements of the relevant environmental class and security grade as specified by the manufacturer.

Impact tests shall not be carried out on delicate combined detector components such as LEDs, optical Windows, lenses or ultrasonic transceivers.

For operational tests, the combined 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 combined detector shall continue to meet the requirements of this specification 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 combined 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 combined 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 combined detector's field of view with large objects such as furniture,

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

j) 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 combined 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, unobstructed and draught-free area at least 25 % larger in the three dimensions than the manufacturers claimed field of view, with the combined detector mounted in the as-used position on a wall or ceiling, or on a free-standing test rig.

To standardise the test area walls and floor for IR tests, they shall each be covered with uniform materials having an infrared emissivity of at least 80 % in the 8 to 14 micron wavelength band, at least directly behind the SWT, and in the FOV of the combined detector.

To standardise the test area walls and floor for ultrasonic tests, they shall not be constructed from materials having high ultrasonic reflection.

Volumetric, curtain, and long-range combined 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 combined 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 combined 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. Unless otherwise stated, both technologies shall operate together normally. The combined detector shall be allowed to stabilise 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.

The following SWT temperature conditions shall apply during the test and shall be recorded at intervals sufficient to ensure consistent measurement:

a) the temperature of the background surface immediately behind the target shall be in the range 15 °C to 25 °C, and shall be horizontally uniform over that area to +/- 2 °C during calibration of the SWT. Over the whole background area it shall be measured at ten points;

b) the averaged temperature difference between the background temperature and the SWT temperature shall be (3 +/- 10 %) °C. If it is greater, attenuation filters shall be placed directly over the combined detector lens or window to reduce the energy received by the combined detector. The procedure appears in Annex G.

6.2 Basic detection test

6.2.1 Basic detection targets

The manufacturer shall provide, for testing purposes only, methods for placing either technology permanently in a state where the other technology may cause an intrusion signal or message.

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

The passive infrared BDT consists of a heat source with equivalent heat emission to that of the human hand, that can be moved across the field of view of the combined detector.

The ultrasonic reflective BDT shall be a plate having equivalent ultrasonic reflectivity to that of the human hand, that can be moved across the field of view of the combined detector.

BDTs may be used separately or together. Informative descriptions appear in Annex E. The temperature of the heat source shall not be less than 3 °C above the background.

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

6.2.2 Basic test of passive infrared detection capability

Activate the ultrasonic technology; the unit shall not generate an intrusion signal or message. A stimulus that is similar to that produced by the SWT is applied to the combined detector using the PIR BDT. Move the BDT perpendicularly across the centre line of the detection field at a distance of not more than 1 m from the combined detector, and at a height where the manufacturer claims detection will occur.

Move the BDT a distance of 1 m at a velocity of 0,5 m/s to 1,0 m/s. The combined 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.

6.2.3 Basic test of ultrasonic detection capability

Activate the passive infrared technology; the unit shall not generate an intrusion signal or message. A stimulus that is similar to that produced by the SWT is applied to the combined detector using the ultrasonic 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 combined detector, at a height where the manufacturer claims detection will occur.

The BDT is to be moved a distance of 1 m at a velocity of 0,5 m/s to 1,0 m/s. The combined 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 across the field of view of the combined detector. The grade-dependent velocities and attitudes to be used by the SWTare 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.

GeneralPass/fail criteria for all walk tests: an intrusion signal or message shall be generated during 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 walk test targets

6.3.1.1 The standard walk test target

The SWT shall have the physical dimensions of 160 cm to 185 cm in height, shall weigh (70 +/- 10) kg and shall wear close fitting clothing having a heat emissivity of greater than 80 % in the 8 to 14 micron wavelength band. No objects having high ultrasonic reflectivity shall be worn or carried by the SWT, or incorrect ultrasonic reflection will result.

The averaged temperature difference between the SWT and the background shall be established.

Temperatures shall be measured at five points on the body of the SWT, on the surface facing perpendicularly to the axis of the combined detector, and the background temperature close to each point measured at the same time

1) head,
2) upper torso side,
3) hand at body side,
4) legs at knee,
5) feet.

Temperatures shall be measured using a non-contact thermometer, or equivalent equipment, which shall be verified against the calibration heat source (see 6.3.3.1).

The temperature differences with the background at each body point are calculated, weighted and averaged. The informative detail calculation of the SWT temperature difference is given in D.1.

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. It is known as the simulated target. In case of conflict, a human walk test shall be the primary reference.

6.3.2 Walk test target calibration

6.3.2.1 A calibration heat source

A heat source that has an absolutely constant temperature close to that of the human body is described in F1.

6.3.2.2 Standard walk test target temperature difference

The equivalent average temperature difference Dt_e between the background temperature and the SWT temperature shall be (3 +/- 10 %) °C.

Since the human target is variable in the amount of heat emitted in the 8 to 14 micron wavelength band, it may be necessary to adjust the signal received from the SWT to achieve the required equivalent average temperature difference.

The real average temperature difference Dt_r is measured, and it's value shall be greater than 2,7 °C, (3 - 10 %) °C. As is described in Annex G, attenuation filters shall be used to reduce the thermal radiation from the SWT by a factor Dt_e/Dt_r (+/- 10 %). If Dt_r is less than 3,3 °C, no filter will be required.

6.3.2.3 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 H.

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.

Combined PIR/ultrasonic detectors of all types shall be assessed in the specified test environment. If the dimensions of the detection pattern exceed the available test space, it may be tested in sections rather than as a whole.

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 reference line is drawn through the combined detector, at right angles to the combined detector axis.

The SWT or a suitable simulated target, with it's temperature difference with the background adjusted according to Annex D, 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

The diagram in 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 combined detector, and finishing with a final point where the boundary crosses the combined 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 combined detector by a radial line. At each test point, two alternative test directions are available, 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 $+45^{o}$ or -45^{o} to the radial line.

6.4.1.2. Verify detection within the boundary

The diagram in 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 combined detector, place the first test point at 4 m along the combined detector axis. Using the 2 m squared grid, place further test points at every alternate grid intersection, on both sides of the combined detector axis. No point shall be less than 1 m from, or lie outside, the claimed boundary. Each test point is connected to the combined 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.vm 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 combined detector axis mid-range point at 45°. The third walk test passes at right angles to the combined detector axis at a distance of 1 m in front of, and parallel to, the combined 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 combined detector axis mid-range point at 45^{o}.

The intermittent movement starts with the SWT standing with the feet together, moving 2 x 0,5 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 test begins outside the detection boundary at a distance (for grades 1 and 2) of (2,0 +/- 0,2) m, and (for grades 3 and 4) of (0,5 +/- 0,05) m from the combined detector reference line or the nearest claimed detection boundary.

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.

6.4.4 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, and within the manufacturers claimed detection boundary, as detailed in Figure C.2 and 6.4.1.2. Use only the manufacturers claimed values for maximum and minimum settings of control adjustments and the consequent range and angular coverage.

Each test point on the boundary is connected to the combined detector by a radial line. At each test point, two alternative test directions are available, 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 combined detector axis at a distance of 55 % 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 combined 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 combined 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 combined 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 combined 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 combined 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 combined 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.

Short one or both of the sensor signal leads to earth (or carry out an equivalent action as recommended by the manufacturer) during the period when the combined detector carries out it's own internal test, or during remote operation of the internal test if the combined detector is provided with this facility.
Repeat both self tests with one or both of the sensor leads in an open circuit condition (or carry out an equivalent action as recommended by the manufacturer).

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.

NOTE It will be necessary to consult the combined detector manufacturer regarding the most appropriate method for initiating the specified faults.

6.7 Immunity of individual technologies to incorrect operation

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

Pass/fail criteria: there shall be no intruder signal or message generated by the combined detector during each of the following tests

6.7.1 Immunity to airflow

Place the ultrasonic technology in a state where the PIR technology may cause an intrusion signal or message.

From a point 1,0 m from the combined detector, direct the airflow from a fan heater over the face of thecombined detector, raising the air temperature from ambient (20 ^{o}C) by 5 °C/min, to 40 °C within 4 min at the combined detector window. Do not allow the combined detector a direct view of the heating elements. Stabilise for 4 min at 40 ^{o}C.

Switch off the heat and allow the temperature to ramp down for 1 min, or until ambient is reached. Stabilise at ambient for 2 min. Repeat the cycle 5 times.

The warm air shall flow at a mean velocity of 0,7 ms^{-1} +/- 0,1 ms^{-1}, measured with an anemometer (0 to 1 ms^{-1}) at the combined detector window.

Place the PIR technology in a state where the ultrasonic technology may cause an intrusion signal or message, and repeat the test.

6.7.2 Immunity to visible and near infrared radiation

Place the ultrasonic technology in a state where the PIR technology may cause an intrusion signal or message.

A white light source (a 12 V halogen car headlamp bulb) capable of generating at least 2 000 lux at 3 m range is used to illuminate the combined detector. The light from the source shall fall on the combined detector through two clean 4 mm thick panes of glass, separated by a 10 mm air gap.

Measure the light intensity at the combined detector with a calibrated visible light meter. Calibration is described in Annex J.

Mount the combined detector in a darkened room, in the alert/set mode, on a stand at an initial range of 5 m
from the source. The source shall be mounted in the main axial detection zone of the combined detector that is sensitive to Infrared radiation in the 8 to 14 micron wavelength band.

Mount the visible light meter at the chosen position of the combined detector, and move the light source towards and away from it until a reading in the visible band of (2 000 +/- 10 %) lux is obtained.

The light source is scanned about a vertical axis such that the emitted light crosses the combined detector at a rate of 0,5 ms^{-1}, and clears the outer edge of the combined detector housing. A total of 10 scans shall be made across the front of the combined detector.

6.7.3 Immunity to extraneous sound sources

Place the passive infrared technology in a state where the ultrasonic technology may cause an intrusion signal or message.
A standard white noise generator operating between 20 Hz and 30 KHz shall be used. This shall be mounted at a distance such that it produces a nominal sound power at 26,3 KHz of 86 dB+/- 2dB at the detector.
Apply the white noise for a period of 60 s; remove the white noise for a period of 180 s; then re-apply and remove the white noise a total of five times at these time intervals.

6.8 Tamper security

The general test conditions of 6.1 apply.

Grade-dependent tamper requirements appear in Table 3.

6.8.1 Prevention of unauthorised access to the inside of the combined 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 L, or by distorting the housing without causing damage.

Pass/fail criteria: only the tool specified by the manufacturer shall open the access cover(s) to the inside of the combined 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 combined detector.

6.8.2 Detection of removal from the mounting surface

Confirm the operation of the back tamper device by removing the combined 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 combined 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 combined 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 combined 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 M.

Connect power to the combined detector and place it in the alert/set mode. Apply the required torque. Remove the torque. Measure the angle of twist of the combined 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 combined 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 combined detector housing in sequence whilst the BDT is moved in front of the combined detector. The magnet shall be applied in a manner that ensures that a single magnetic pole contacts the surface, to maximise flux penetration. Record the response of the combined 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 combined 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 combined detector masking

For each test, the combined detector shall be in the unset mode, and its signals or messages shall be monitored for changes of status. Monitor the anti-mask or tamper signal or message during the test.

Apply the spray materials specified in Table 5 from an aerosol can, using intermittent passes of the spray lasting no longer than 2 s each. Apply the brushed lacquer in single passes of the brush. After each application, place the detector in the set mode, and carry out the BDT. Repeat the applications until the detector no longer responds.

Apply each of the sheet material samples specified in Table 5 directly to the whole front of the detector, cutting them to fit the detector window where necessary. Then apply the samples again by sliding them across the face of the detector from one side, at distances of 0 and 50 mm. Perform two series of tests, one taking 1 s to cover the detector lens/ window, and the other 10 s. After each test, place the combined detector in the alert/set mode, and carry out the BDT to ensure that the combined detector no longer responds.

After each individual material application, wait 180 s for the system to stabilise. If more than one window is used, test each separately.

Pass/fail criteria: 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. Eighty percent of the materials tests shall be passed.

Table 5 – Range of materials for masking tests

Test No	Material
1	Black paper sheet
2	2 mm thick aluminium sheet
3	3 mm thick acrylic sheet
4	White polystyrene foam
5	Self adhesive clear vinyl [a]
6	Plastic skin - spray P U [a]
7	Clear lacquer, brush applied [a]
[a] Applied only from the front.	

All plate/sheet samples shall be a maximum of 150 mm square.

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 combined detector during the tests. Connect the combined detector to a variable, stabilised power supply and allow it to stabilise for at least 180 s.

Some of these tests can be applied to combined 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 Combined detector current consumption

Connect the combined 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 combined 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 power consumption shall not exceed the manufacturers stated values by more than 20 % in either mode.

6.9.2 Slow input voltage rise and input voltage range limits

These tests are not applicable to combined 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 combined detector to stabilise 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 combined detector to stabilise 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 combined detector to stabilise for 180 s, carry out the BDT, and monitor the intrusion and fault signals or messages.

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

Pass/fail criteria, slow power supply 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 combined detector shall generate an intrusion signal or message.

Pass/fail criteria, voltage below the range limits: for grade 3 and 4 combined detectors, the combined 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 combined detectors with internal power supplies.

Connect the combined detector to a signal generator with appropriate output impedance capable of generating a sinusoidal voltage of V +/- 10 % superimposed on the combined detector nominal voltage V at a frequency of 100 Hz. Allow at least 180 s for the combined detector to stabilise. 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 combined detector during the test apart from that generated by the BDT.

6.9.4 Input voltage step change

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

Connect the combined detector to a square wave generator limited to a maximum current of 1 amp 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 combined detector to stabilise. 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 combined detector during the test.

6.9.5 Total loss of power supply

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

6.10 Environmental classification and conditions

Unless stated otherwise the general test conditions of 6.1 apply.

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

Specific requirements for combined PIR/ultrasonic intrusion detectors are given in this specification (see Tables 6 and 7).

Combined detectors subjected to the operational tests are always powered. Combined detectors subjected to the endurance tests are always unpowered.

Special conditions:
During testing ensure that the combined detector is shielded from rapid changes of surface temperature or air movement or relative motion of the outside environment within the field of view due /to unwanted effects of the tests. This may be achieved by covering the receiving aperture of the combined detector with a material unable to pass infrared or ultrasonic 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.

Monitor the combined 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 combined 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 combined detector, and carry out the BDT. Warm air shall not be used for drying.
After the SO_2 test, combined detectors shall be washed and dried in accordance with the procedure prescribed in EN 60068-2-52:1984. The BDT shall be performed immediately after drying.
Carry out the access to interior test and the anti-masking test with black paper only (see 4.5.1 and 4.5.5).

Table 6 - Operational tests

Test	Class I	Class II	Class III
Dry heat	Required	Required	Required
Cold	Required	Required	Required
Damp heat (steady state)	Required	Not required	Not required
Damp heat (cyclic)	Not required	Required	Required
Water ingress	Not required	Not required	Required
Mechanical shock	Required	Required	Required
Vibration	Required	Required	Required
Impact	Required	Required	Required
Electromagnetic compatibility	Required	Required	Required

Pass/ fail criteria: no unintentional change of state shall occur during the tests. There shall be no signs of mechanical damage after the tests and the combined detector shall continue to meet the requirements of the BDT.

Table 7 - Endurance tests

Test	Class I	Class II	Class III
Damp heat (steady state)	Required	Required	Required
Damp heat (cyclic)	Not required	Not required	Required
SO2 corrosion	Not required	Required	Required
Vibration (sinusoidal)	Required	Required	Required

Pass/ fail criteria: there shall be no signs of mechanical damage after the tests and the combined detector shall continue to meet the requirements of the BDT.

6.11 Marking identification and documentation

6.11.1 Marking and/or identification

Examine the combined detector visually to confirm that it is marked either internally or externally with the required marking and/or identification (given in EN 50131-1).

Pass/ fail criteria: all specified markings shall be present.

6.11.2 Documentation

By visual inspection ensure the combined detector has been supplied with clear and concise installation instructions and maintenance functions, all information specified in this specification and in EN 50131-1, and the manufacturers claimed performance data.

Pass/ fail Criteria: all information specified shall be present.

Annex A
(normative)

Format of standard test magnets

A.1 Lower strength magnet
The required remanence is (0,15 ± 10 %) T.

A.2 Medium strength magnet
The required remanence is (0,30 ± 10 %) T.

A.3 Higher strength magnet
The required remanence is (1,2 ± 10 %) T.

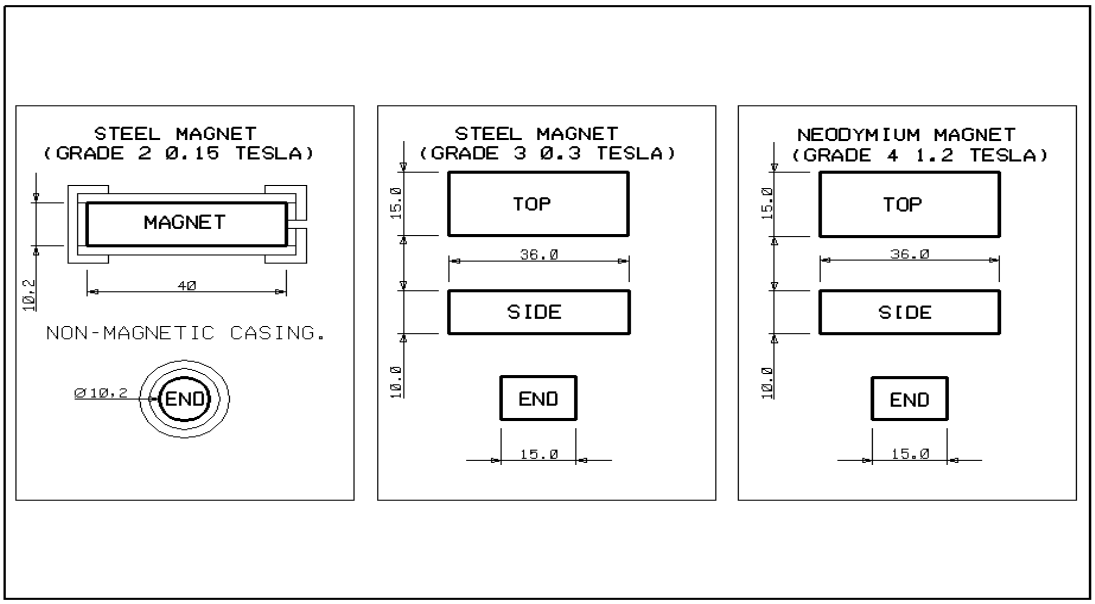

Figure A.1 – Format of standard test magnets

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 performance	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 airflow	6.2.2 + 6.2.3	Monitor	None	1
Immunity to visible & near infrared radiation	6.2.2 + 6.2.3	Monitor	None	1
Immunity to extraneous noise sources	6.2.2 + 6.2.3	6.7.3 + SWT	None	1
Tamper security				
Access through combined 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 combined detector masking	6.2.2 + BDT	Monitor	6.2.2 + 6.2.3	10
Electrical tests				
Combined detector power consumption	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	1
Slow input voltage rise and input voltage range limits	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	1
Input voltage ripple	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	1
Input voltage step change	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	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 + 6.2.3	6.2.2 + 6.2.3	6.2.2 + 6.2.3	3
Cold	6.2.2 + 6.2.3	6.2.2 + 6.2.3	6.2.2 + 6.2.3	3
Damp heat (steady state)	6.2.2 + 6.2.3	6.2.2 + 6.2.3	6.2.2 + 6.2.3	4
Damp heat (cyclic)	6.2.2 + 6.2.3	6.2.2 + 6.2.3	6.2.2 + 6.2.3	4
Water ingress	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	5
Mechanical shock	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	6
Vibration	6.2.2 + 6.2.3	6.2.2 + 6.2.3	6.2.2 + 6.2.3	7
Impact	6.2.2 + 6.2.3	None	6.2.2 + 6.2.3	6
EMC	6.2.2 + 6.2.3	Monitor	6.2.2 + 6.2.3	8
Environmental tests – Endurance				
Damp heat (steady state)	6.2.2 + 6.2.3	None	6.2.2 + 6.2.3	4
Damp heat (cyclic)	6.2.2 + 6.2.3	None	6.2.2 + 6.2.3	4
SO_2 corrosion	6.2.2 + 6.2.3	None	4.5.1+ 4.5.5 6.2.2 + 6.2.3	9 [a]
Vibration	6.2.2 + 6.2.3	None	6.2.2 + 6.2.3	7
Marking, identification and documentation				
Marking	None	None	None	1
Documentation	None	None	None	1

[a] For masking tests, more samples may be required.

Key to descriptions
None = No test or other operation is performed.
6.4.X + SWT = Verify the detection performance using the **S**tandard **W**alk **T**est **T**arget.
Monitor = Monitor the combined detector signals during the main test.
6.2.2 (or 6.2.3) + BDT = Basic test of detection capability using the **B**asic **D**etection **T**argets.
6.x + BDT = Verify the requirements using the **B**asic **D**etection **T**argets.
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.

Annex C
(informative)

Walk test diagrams

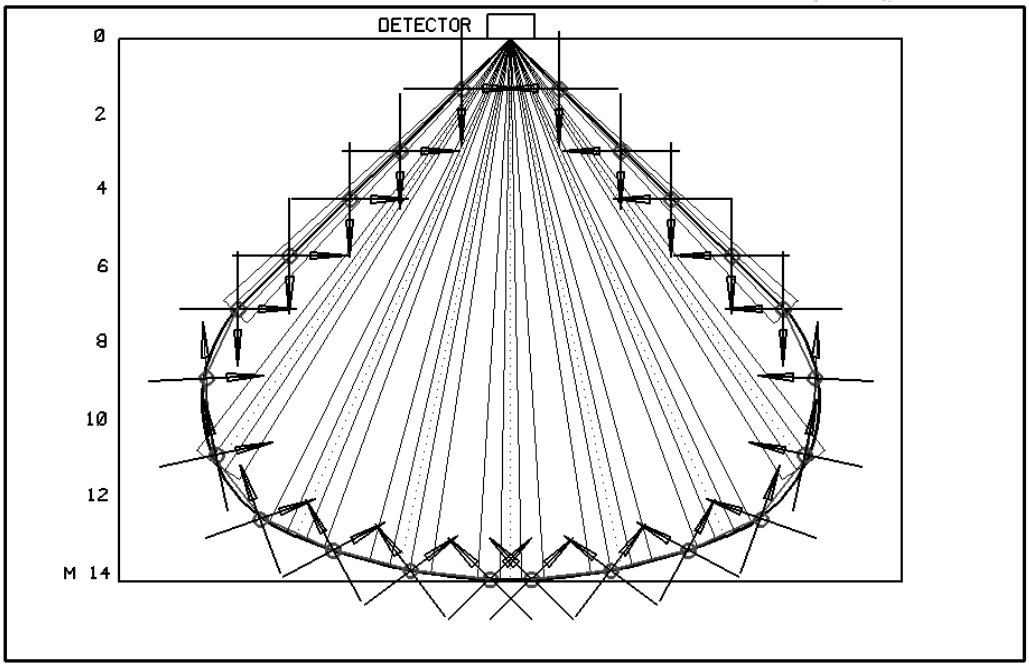

Figure C.1 - Detection across the boundary and effect of control adjustments

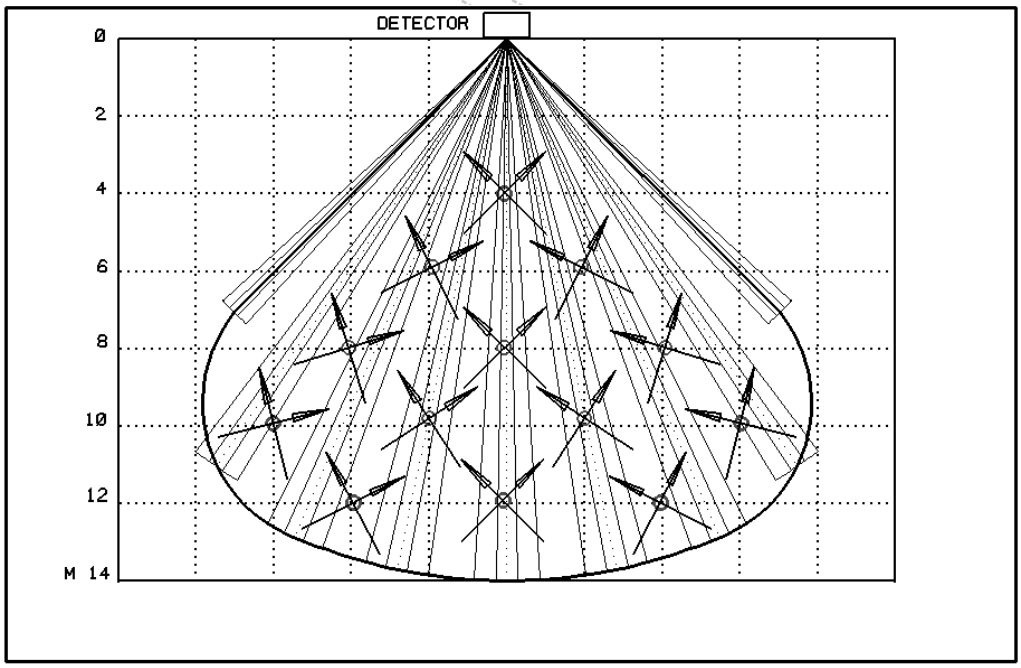

Figure C.2 - Detection within the boundary and effect of control adjustments

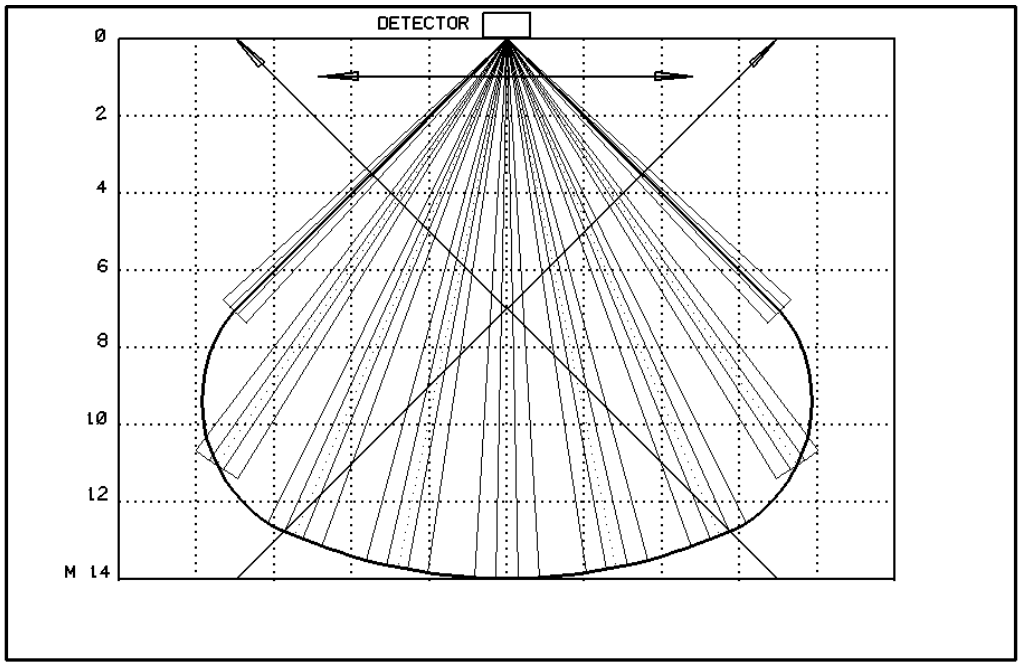

Figure C.3 - High velocity and intermittent movement

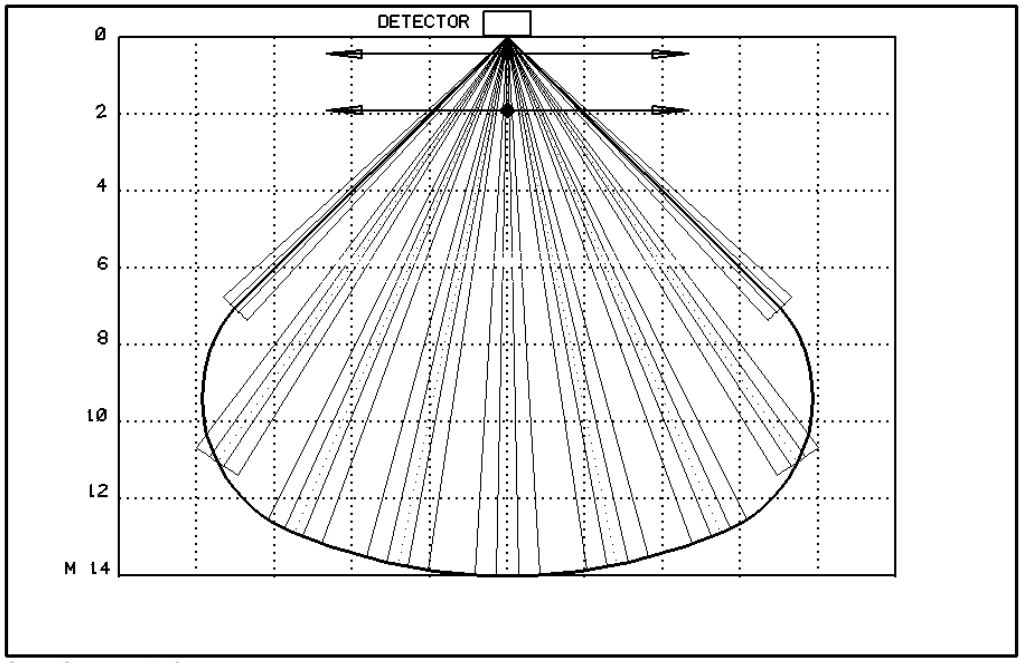

Figure C.4 - Close-in detection

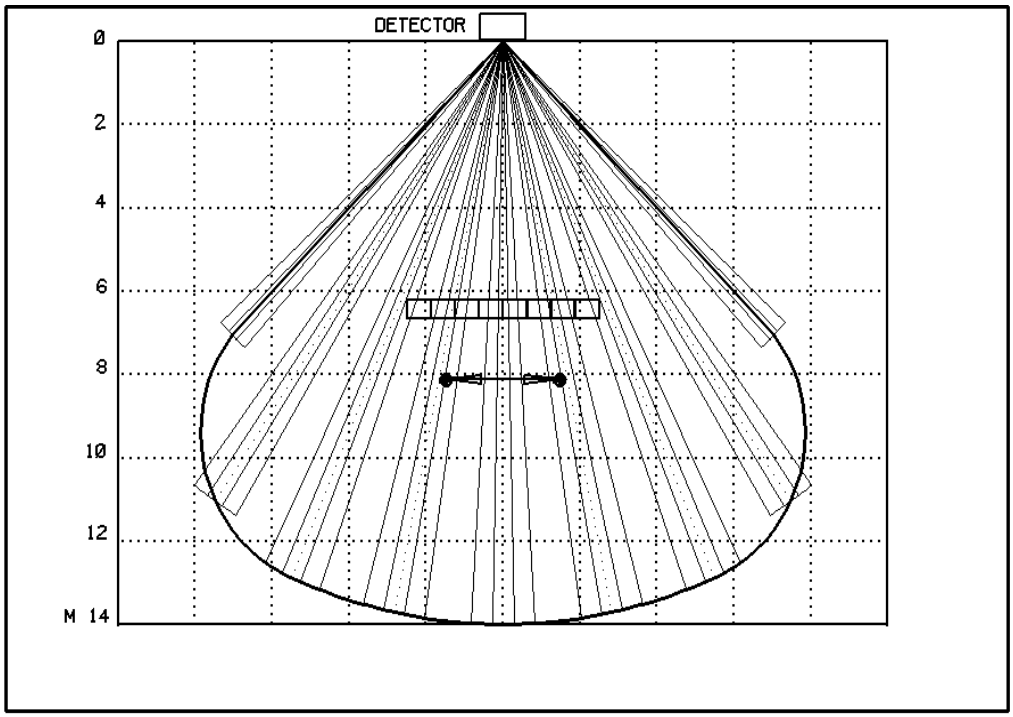

Figure C.5 - Significant range reduction

Annex D
(normative)

Procedure for calculation of the average temperature difference between the standard target and the background

D.1 Measurement and calculation of the real average temperature difference between the SWT and the background

The calculation of average temperature difference Dt_r of the selected SWT requires non-contact temperature measurement of the body and of the immediately adjacent background and averaging of the differences between these. The thermometer shall have a sensitivity range of 6 microns to 18 microns, a collection angle no larger than 3°, and it's emissivity setting shall be 95 %.
Five separate zones of the human form shall be measured for surface temperature, and the differences between the zone and the background weighted and summed to give Dt_r:

Body zone	Body – background temperature difference	Significance	Weighting factor
Head	Dt_{r1}	W_1	2
Upper torso side	Dt_{r2}	W_2	4
Hand at body side	Dt_{r3}	W_3	4
Legs at knee	Dt_{r4}	W_4	2
Feet	Dt_{r5}	W_5	1

$$Dt_r = \frac{\sum_{k=1}^{5} Dt_{rk} \times W_k}{\sum_{k=1}^{5} W_k}$$

D.2 Adjustment of equivalent average temperature difference between the SWT and the background

The equivalent average temperature difference between the SWT temperature and the immediately adjacent background temperature shall not be less than 2,7 °C (3 – 10 %) °C. If Dt_r is greater than 3,3 °C (3 + 10 %) °C, attenuation filters shall be placed directly over the combined detector lens or window to reduce the radiation received by the combined detector to within 10 % of that which would result from a temperature difference of 3 °C. The procedure is detailed in Annex G.

Alternatively, if Dt_r is greater than 3,3 °C (3 + 10 %) °C, the SWT may wear an extra layer or layers of close fitting clothing, or the general background temperature may be raised. If Dt_r is less than 2,7 °C (3 - 10 %) °C, the general background temperature will need to be lowered.

HDPE sheet shall be used as filter material for SWT signal adjustment. Two thicknesses of HDPE sheet have been identified as standard products. The available material thicknesses are 100 (A) microns and 200 (B) microns.

The percentage reduction in radiation received by the combined detector obtainable with these materials is best established with a suitable infrared spectrograph. A typical set of results is as follows:

Material combination	Received radiation reduced by
A	20 %
B	36 %
A + B	42 %
B + B	48 %
A + B + B	54 %

Annex E
(informative)

Basic detection target for the basic test of detection capability

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

A heat source is required to verify the passive infrared sensor, and it is required, after stabilisation, to have a surface temperature similar to that of an intruder.

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

A stack of 8 Ohm x 125 Ohm 0,25 watt resistors in series makes a 1 000 Ohm resistor of height 120 mm and width 30 mm. This may be mounted on a sheet of copper-clad PCB 150 mm x 150 mm which is a suitable ultrasonic reflector. The resistors, when run at 30 volts, will reach a stabilised surface temperature in the required range. This, when mounted on a hand-held rod provided with sufficient cable from the power supply, can be moved by hand across the field of view of the combined detector, and towards it. A suitabledistance of movement would be about 1,0 m at a range of about 1,0 m from the combined detector. This, seen from the combined detector is equivalent in size to the image of the SWT at 12 m range.Measure the surface temperature of the resistor stack with the calibrated non-contact thermometer. The temperature of the resistor stack should be at least 3 °C greater than that of the adjacent background. The applied voltage is altered to adjust the surface temperature.

Annex F
(informative)
Calibration heat source

This heat source will produce a constant output of broad-spectrum near-infrared radiation at a constant temperature for a period of at least 1 h, and is useful for calibrating non-contact thermometers.

A cylindrical metal container 250 mm in height and of diameter 150 mm with a closed bottom and removable lid, painted matt black, is filled with sodium sulphate decahydrate ($Na_2.SO_4.10\ H_2O$). The container is equipped with a thermocouple/ thermometer and is heated on an electric boiling ring so that all the contained salt can be melted and the melt temperature is at least 40 °C.

The heat is then removed, and the temperature allowed to decline by radiation. At the melting point of the salt, the emission of latent heat will keep the temperature exactly constant at 37 °C until all the latent heat has been emitted.

Annex G
(normative)

Calibration of the standard walk test target for passive infrared detectors

Calibration of the SWT shall be carried out for the infrared technology only.

The SWT is a human subject, and the difference in temperature between the target and the background is required to be (3 +/- 10 %) °C. However, a human target is variable in the amount of heat emitted in the 8 to 14 micron waveband.
The emission characteristics of a human target are very difficult to alter, but the background temperature may be adjusted, or the SWT may wear extra clothing.

The third option is to use filters. These can be sheets of High Density Polyethylene (HDPE) of different thickness, whose transmission can be measured with an infrared Spectrograph. If a prospective SWT has a temperature difference with the background over the combined detector window will reduce the radiation received by the combined detector. The filters are mounted in a flat frame, looking down at 45° to the detection axis, and at 0 mm and 50 mm from the combined detector window. The adjusted level of received radiation is measured through the HDPE film(s).

The range of signal adjustment available with HDPE films is detailed in Annex D.If the SWT has a temperature difference with the background that is less than (3 – 10 %) °C, and therefore does not produce a large enough signal, then the background temperature will have to be lowered or the SWT adjusted by altering the clothing. A measure of control over the test room temperature is therefore desirable.

For an absolute temperature calibration, the calibration heat source described in Annex F can be mounted on an adjustable stand and moved across the field of view at a height where detection is expected to provide a simulation source with an absolutely known temperature.

Throughout the tests it is desirable that the background temperature of the area immediately behind the SWT is measured.

Annex H
(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.

H.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.

H.2 Metronome

The metronome gives an audible timing sound that can be used, in conjunction with a 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 J
(informative)

Immunity to visible and near Infrared radiation: notes on calibration of the light source

A suitable illumination source is a round H4 type headlamp (VW Golf 1988: part no 192 941 753) with 12 V 60 W halogen bulb using only the main beam filament (see EN 60068).It has been found that intrusion signals or messages generated by such lamps are caused not by visible radiation but by wavelengths between 2 and 3 microns that are emitted in addition to the visible spectrum.

Not all headlamp and bulb combinations will emit the character of radiation needed.

A conventional photographic light meter may be used to measure the intensity of light in t he visible waveband generated by the headlamp, which will be set at a distance from the combined detector suchthat the intensity of light at the combined detector is (2 000 +/- 10 %) lux.

A conventional visible light meter will not measure the radiation emitted in the 2 to 3 micron waveband. The light meter should be calibrated against a standard light source. The headlamp is mounted at a distance which is adjusted so that the received visible radiation intensity is (2 000 +/- 10 %) lux, measured at the combined detector position with the light meter. Without moving the lamp, substitute a combined detector that operates in the 2 to 3 micron waveband (a PbS detector, for example), and note the reading. Consistent test conditions can now be ensured by measurement of the received radiation in the 2 to 3 micron wavelength band, rather than relying totally on the visible light meter reading, which is an indirect measurement and may be inaccurate.

Annex K
(informative)

List of small tools suitable for testing immunity of casing to unauthorised access

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

Annex L
(informative)

Test for resistance to re-orientation of adjustable mountings

Mount the combined detector on a substantial wood block with a metal backing (see Figure L.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 combined 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.

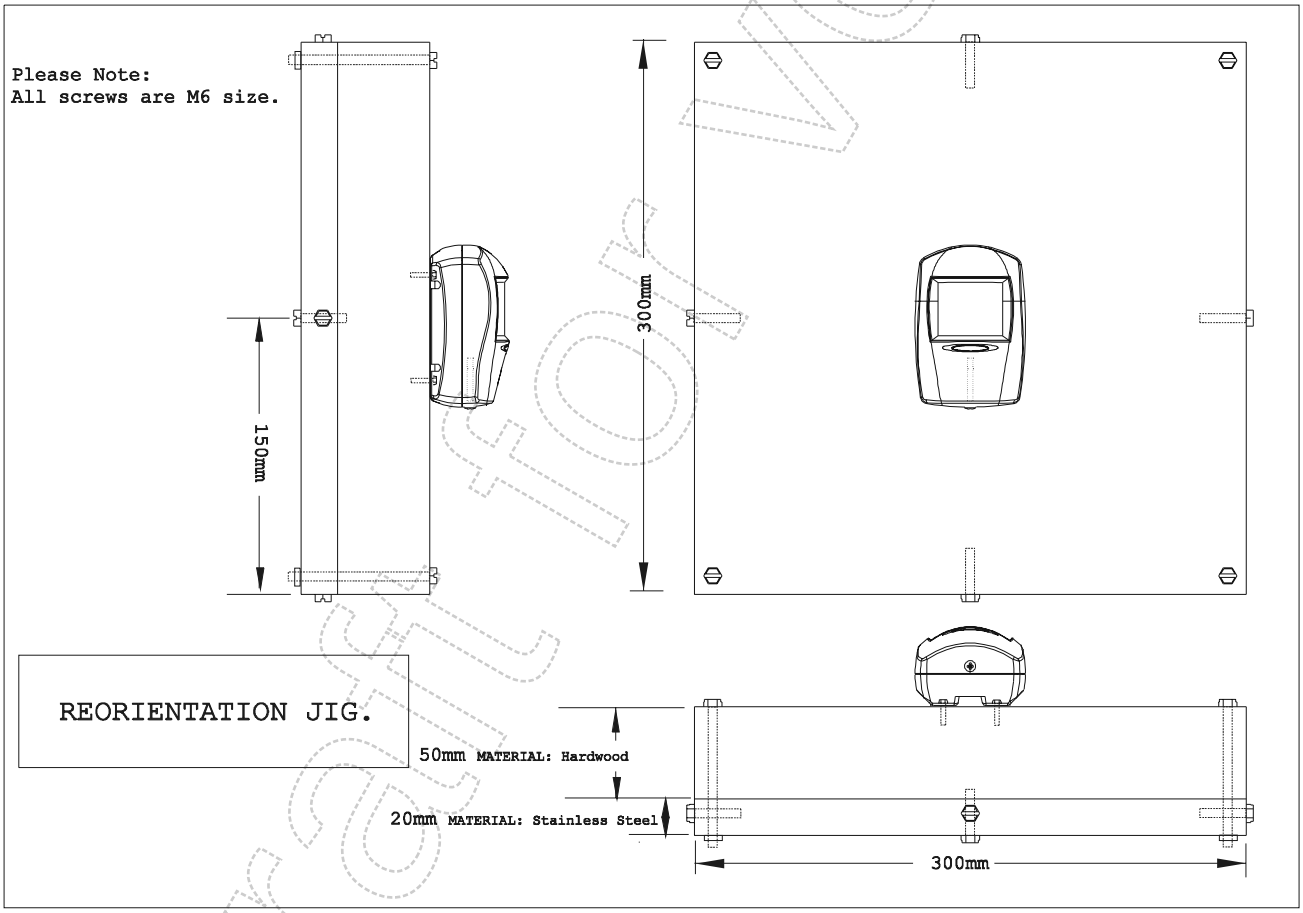

Figure L.1 - Re-orientation test