

BS EN 50291-1:2010+A1:2012



BSI Standards Publication

Electrical apparatus for the detection of carbon monoxide in domestic premises

Part 1: Test methods and performance requirements

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The start and finish of text introduced or altered by amendment is indicated in the text by tags. Tags indicating changes to CEN text carry the number of the CEN amendment. For example, text altered by CEN amendment A1 is indicated by A1 A1.

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A list of organizations represented on this subcommittee can be obtained on request to its secretary.

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Date	Text affected
31 July 2012	Implementation of CENELEC amendment A1:2012

**Electrical apparatus for the detection of carbon monoxide
in domestic premises -
Part 1: Test methods and performance requirements**

Appareils électriques pour la détection
de monoxyde de carbone dans les locaux
à usage domestique -
Partie 1: Méthodes d'essais
et prescriptions de performances

Elektrische Geräte für die Detektion
von Kohlenmonoxid in Wohnhäusern -
Teil 1: Prüfverfahren und Anforderungen
an das Betriebsverhalten

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

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CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

Foreword

This European Standard, prepared by the Technical Committee CENELEC TC 216, Gas detectors, was submitted to the formal vote and was approved by CENELEC as EN 50291-1 on 2010-04-15.

This European Standard supersedes EN 50291:2001.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN and CENELEC shall not be held responsible for identifying any or all such patent rights.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2011-04-15
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2013-04-15

Foreword to amendment A1

This document (EN 50291-1:2010/A1:2012) has been prepared by Technical Committee CLC/TC 216 “Gas detectors”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-05-07
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2015-05-07

This amendment includes the following changes with respect to EN 50291-1:2010:

- detailed provisions for end-of-life indication;
- a change in the degree of protection for battery operated apparatus;
- additional provisions for battery capacity; and
- editorial changes.

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1 Scope

This European Standard specifies general requirements for the construction, testing and performance of electrically operated carbon monoxide gas detection apparatus, designed for continuous operation in domestic premises. The apparatus may be mains or battery powered. Such apparatus is intended to warn of an accumulation of CO, enabling the occupant to react before being exposed to significant risk.

Additional requirements for apparatus to be used in recreational vehicles and similar premises are specified in EN 50291-2.

NOTE For caravan holiday homes EN 50291-1 applies.

This European Standard specifies two types of apparatus, these are





- type A – to provide a visual and audible alarm and an executive action in the form of an output signal that can be used to actuate directly or indirectly a ventilation or other ancillary device, and
- type B – to provide a visual and audible alarm only.

This European Standard excludes apparatus

- for the detection of combustible gases, other than carbon monoxide itself (see EN 50194-1),
- for the detection of CO in industrial installations (see EN 45544-1, EN 45544-2 and EN 45544-3) or commercial premises,
- for CO measurement for smoke and fire detection.

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 50270	2006	Electromagnetic compatibility – Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen
EN 50271	 2010 	Electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen – Requirements and tests for apparatus using software and/or digital technologies
EN 50292	2001	Electrical apparatus for the detection of carbon monoxide in domestic premises – Guide on the selection, installation, use and maintenance
EN 60335-1	2002	Household and similar electrical appliances – Safety – Part 1: General requirements (IEC 60335-1:2001, modified)
EN 60529	1991	Degrees of protection provided by enclosures (IP Code) (IEC 60529:1989)
EN 60704-1	 2010 	Household and similar electrical appliances – Test code for the determination of airborne acoustical noise – Part 1: General requirements (IEC 60407-1:1997)

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1

ambient air

normal atmosphere surrounding the apparatus

3.2

clean air

air which is free of carbon monoxide, interfering and contaminating substances

3.3

domestic premises

any house or building being a place of residence or home of a household, family or person

3.4

fixed installation

apparatus which is intended to have all parts except replaceable batteries permanently installed

3.5

sensor

assembly in which the sensing element is housed and which may contain associated circuit components

3.6

sensing element

device, the output of which will change in the presence of carbon monoxide

3.7

volume ratio (V/V)

ratio of the volume of a component to the volume of the gas mixture

3.8

output signal

signal characterised by a standby and an activation state by which action may be initiated, e.g. triggering a ventilation device

3.9

warm-up time

time interval between the time when the apparatus is switched on and the time when the apparatus is fully operational

3.10

alarm set point

fixed setting of the apparatus that determines the volume ratio and duration of exposure at which the apparatus will automatically initiate an alarm and, for type A apparatus an output signal

3.11

fault signal

visual and/or audible signal indicating a faulty or failed apparatus

3.12

mains-powered apparatus

apparatus designed to be powered by the normal domestic mains electrical supply, with or without an alternative power source

3.13

battery-powered apparatus

apparatus designed to be powered by batteries only

3.14

continuous operation

apparatus which is continuously powered with continuous or intermittent automatic sensing

3.15

recreational vehicle

recreational vehicles considered by this European Standard include recreational craft, caravans and motor caravans

NOTE Other motorised vehicles like trucks are known to have residential accommodation. They are not recreational vehicles but are considered as similar premises in respect of this European Standard.

3.16

caravan holiday home

transportable leisure accommodation vehicle that does not meet requirements for construction and use of road vehicles, that retains means for mobility and that is for temporary or seasonal occupation

[EN 13878:2003]

3.17

A1 apparatus

carbon monoxide detection device, which may also be generically termed "gas detector", comprising the sensor, remote sensor if applicable, alarm and any other circuit components, power supply and, for type A apparatus, a means of providing an output signal A1

A1 3.18

end-of-life

point in time where the apparatus should be replaced A1

4 General requirements

4.1 General

Unless otherwise stated, the requirements specified are applicable to both type A and type B apparatus.

The apparatus shall reliably detect the presence of carbon monoxide in domestic premises under the stated application conditions, shall produce an alarm, and in the case of type A apparatus, shall be able to initiate executive actions whenever the conditions (in terms of both level and duration) exceed pre-set alarm set points.

Apparatus which includes functionality additional to carbon monoxide detection shall perform according to the requirements of this European Standard and to the requirements of any standards relevant to the additional functionality.

The apparatus, electrical assemblies and components shall comply with the requirements of A1 4.4 A1 and the performance requirements of Clause 5. Apparatus shall be designed for continuous operation. The apparatus shall not be class 0 as defined in EN 60335-1:2002, 3.3.7.

When replaceable, the sensor as defined in 3.5 shall guarantee the same constructional characteristics and functions as the previous sensor without modifying the internal detector in such way to keep unchanged the compliance of the detector to all the requirements of this European Standard. The above condition shall be verified using the information and the documentation given by the manufacturer of the detector.

4.2 Construction

The apparatus shall comply with the appropriate requirements of EN 60335-1:2002 as listed in Table 1.

When the sensor is replaceable: Mechanical and/or electrical means shall guarantee the replacement of the sensor without errors. In the case of electrical recognition of the incorrect connection or absence of the sensor, the detector shall give an automatic signal of a fault and/or alarm. Moreover shall be impossible or recognized as an error the connection of a sensor designed for a certain type of gas to a detector designed for a different type of gas.

Table 1 – Construction requirements

Constructional requirement	EN 60335-1:2002 (Sub)clause
Protection against accessibility to live parts	8
Heating	Relevant parts of 11
Leakage current and electrical strength at operating temperature	13
Moisture resistance	15.1 and 15.3
Leakage current and electrical strength	16
Overload protection of transformers and associated circuits	17
Abnormal operation	19
Construction	22
Internal wiring	23
Components	24.1, 24.2, 24.4
Supply connection and external flexible cords	25.3
Terminals for external conductors	26
Provision for earthing	27
Screws and connections	28
Creepage distances, clearances and distances through insulation	29
Resistance to heat and fire	30
Resistance to rusting	31

4.3 Indicators and alarms

4.3.1 Visual indicators shall be fitted and coloured as follows:

- a) power supply indicators shall be coloured green;
- b) alarm indicators shall be coloured red.

Where fitted, the visual fault indication shall be yellow.

A1 Text deleted **A1**

The indicators shall be marked to show their function.

The indicators shall be visible when the apparatus is installed in its operating position according to the manufacturer's instructions.

4.3.2 The apparatus shall have an audible alarm, see 5.3.16.

4.3.3 Alarm indicators and audible alarms shall operate simultaneously at the set points as listed in Table 2.

Table 2 – Alarm conditions

CO concentration	Without alarm before	With alarm before
30 ppm	120 min	-
50 ppm	60 min	90 min
100 ppm	10 min	40 min
300 ppm	-	3 min

Once activated, the alarm shall remain in operation at carbon monoxide concentrations above 50 ppm.

4.3.4 All adjustment devices and tools intended for adjustment of, or access to, such adjustment devices shall be designed so as to discourage unauthorised interference with the apparatus.

4.4 **End-of-life**


4.4.1 General

Where incorporated, the end-of-life indicator shall be activated at a point that is determined either by prediction or inbuilt testing.

4.4.2 Prediction of end-of-life

The maximum length of time the manufacturer determines, either by prediction or lifetime tests, until the application of test gas C would fail the requirements of Table 3.



4.4.3 Inbuilt testing of end-of-life

The end-of-life is determined as the point in time when the application of test gas C or equivalent would fail the requirements of Table 3. 

4.5 Fault signals

The apparatus shall provide a fault signal in the event of loss of continuity or short circuit to the sensor.

The fault signal shall be clearly identified and different from a gas alarm.

 Where an end-of-life indication is incorporated, it can utilise the fault signal. Otherwise the end-of-life indication shall be clearly different from all other indications. 

4.6 Output signal (applicable for type A apparatus only)

The apparatus shall provide an output signal at each of the alarm conditions listed in Table 2.

4.7 Software-controlled apparatus

In the design of software-controlled apparatus, the risks arising from faults in the programme shall be taken into account.

The apparatus shall fulfil the requirements of EN 50271.

4.8 Labelling and instructions

4.8.1 General

All text on the apparatus, its packaging and in the instruction book shall be in accordance with national regulations.

4.8.2 Labelling

The apparatus shall carry durable label(s) carrying the following information:

- a) the manufacturer's or supplier's name, trademark or other means of identification;
- b) the name of apparatus, model number (if any) and the type of gas to be detected;
- c) the number of this European Standard;
- d) the type of apparatus, A or B;
- e) the serial number or manufacturing date code of the apparatus;
- f) for mains powered apparatus the electricity supply voltage and frequency and maximum power consumption;
- g) for battery powered apparatus the type and size of replacement batteries;
- h) indication of the maximum lifetime recommended for the apparatus.

A1 Text deleted **A1**

When the sensor is replaceable: The apparatus shall carry the next replacement date of the sensor that shall be clearly visible with the apparatus in a typical installed position. This data shall be updated in the apparatus at each revision or replacement of the sensor, with the new date given by the manufacturer. If the updating procedure provides the application of a pre-printed label, this shall be supplied with the new sensor with a warning to replace the previous label attached to the detector with the new one: Every sensor shall be provided with a marking which allows to trace the manufacturing and calibration information of each single sensor (e.g. serial number, manufacturing batch/production date, expected lifetime of the apparatus, etc.).

A1 The markings b) and h) shall be clearly visible with the apparatus in a typical installed position. **A1**

The markings shall be legible and shall comply with EN 60335-1:2002, 7.6 and 7.14.

4.8.3 Cautions

All gas detection apparatus shall carry a caution, on a label attached to the apparatus, for example:

CAUTION: READ THESE INSTRUCTIONS CAREFULLY
BEFORE OPERATING OR SERVICING.

4.8.4 Instruction booklet

The apparatus shall be provided with an instruction booklet or leaflet. The instruction book or leaflet shall give complete, clear and accurate instructions for the installation, safe and proper operation, and regular checking of the apparatus. It shall include at least the following information:

- a) for mains powered apparatus, the correct operating voltage, frequency, fuse-rating (if any) and method of connection to the mains supply system;
- b) for battery powered apparatus the type and size of replacement batteries, normal operating life, battery replacement instructions, and information on low battery conditions;

- c) guidance on siting and mounting of the apparatus and the warning that the apparatus should be installed by a competent person (see EN 50292);
- d) actions to take if the apparatus alarms (see EN 50292);
- e) an explanation of all warning (visual and audible) and other indicators, including re-setting facilities where relevant;
- f) a list of commonly occurring materials, vapours or gases, e.g. in cleaning fluids, polishes, paints, cooking operations, etc., which may affect the reliability of the apparatus in the short or long term;
- g) warning of the risk of electric shock or malfunction if the apparatus is tampered with;
- h) instructions on the use of any relevant test procedure supplied with the apparatus;
- i) the expected lifetime of the apparatus;
- j) for type A apparatus, instructions on the use and characteristics of the output signal;
- k) a note stating the working ranges of both temperature and humidity;
- l) the alarm conditions;
- m) a description of the effects of carbon monoxide on the human body, stating that the apparatus may not prevent the chronic effects of carbon monoxide exposure, and that the apparatus will not fully safeguard individuals at special risk (see EN 50292:2001, Annex A);
- n) warning that installation of the apparatus should not be used as a substitute for proper installation, use and maintenance of fuel burning appliances including appropriate ventilation and exhaust systems.

4.8.5 Packaging

A1 4.8.5.1 The apparatus packaging shall display

- a warning that the apparatus should be installed by a competent person,
- the relevant information regarding storage and transport,
- the expected lifetime of the sensor if it could be affected by storage time and if different to the lifetime of the apparatus.

4.8.5.2 The package shall clearly display the following message:

This apparatus is designed to protect individuals from the acute effects of carbon monoxide exposure. It will not fully safeguard individuals with specific medical conditions. If in doubt consult a medical practitioner.

4.8.5.3 Where incorporated, the apparatus packaging shall state that the apparatus includes an end-of-life indication. **A1**

5 Test and performance requirements

5.1 General requirements for tests

5.1.1 Test samples

For the purposes of type testing

- compliance with 4.2 and 5.3.15 to 5.3.18 shall be verified using samples as required. These samples should not be used for subsequent tests unless agreed by the manufacturer,

- three samples shall be subjected to the tests specified in 5.3.2 to 5.3.13 and for battery powered apparatus, Clause 6. All three samples shall pass the tests,
- three further samples may be used for the long term stability test 5.3.14 (at the manufacturer's discretion). All three samples shall pass the test.

5.1.2 Preparation of samples

The sample apparatus shall be prepared and mounted when applicable, in accordance with the manufacturer's instructions without modification.

The entire apparatus shall be subjected to the test conditions.

5.1.3 Use of mask for testing

The use of a mask is allowed for subjecting the apparatus to test gases. The design and operation of the mask used by the testing laboratory, in particular, the gas pressure and velocity inside the mask shall not influence the response of the apparatus or the results obtained. The manufacturer may provide a suitable mask with the apparatus.

5.1.4 Test chamber

The construction of the chamber shall be such as to ensure that the apparatus is exposed to a specific volume ratio of test gas in a reproducible manner.

5.2 Normal conditions for tests

5.2.1 General

The test conditions specified in 5.2.2 to 5.2.9 shall be used for all tests unless otherwise specified. Before commencing any test sequence, the apparatus shall be allowed to warm-up for a minimum period of 1 h except for 5.3.5.

5.2.2 Test gases for alarm testing

The following CO test gas volume ratios, see Table 3, shall be used for alarm testing as described in 5.3.1.

Table 3 – Alarm conditions with test gases

Test gas reference	CO volume ratio	Test gas volume ratio	Without alarm before	With alarm before
A	30 ppm	33 ppm ± 3 ppm	120 min	-
B	50 ppm	55 ppm ± 5 ppm	60 min	90 min
C	100 ppm	110 ppm ± 10 ppm	10 min	40 min
D	300 ppm	330 ppm ± 30 ppm	-	3 min

5.2.3 Test gases for specified tests

For the long-term stability test, 5.3.14, the mixture of CO in air shall have a volume ratio of 10 ppm ± 5 ppm.

For the high volume ratio test, 5.3.6, the mixture of CO in air shall have a volume ratio of 5 000 ppm ± 100 ppm.

5.2.4 Speed of test gas

The speed of air or test gas in the test chamber shall be between 0,1 m/s and 0,5 m/s. In the case of a mask, the requirements of 5.1.3 apply.

5.2.5 Power supply

For mains powered apparatus, the electricity supply shall be within $\pm 2\%$ of the nominal value declared by the manufacturer.

5.2.6 Temperature

The tests shall be performed using air and test gases of constant temperature $\pm 2\text{ }^{\circ}\text{C}$ within the range $15\text{ }^{\circ}\text{C}$ to $25\text{ }^{\circ}\text{C}$ throughout the duration of each test.

5.2.7 Humidity

The tests shall be performed using air and test gases of constant relative humidity (r.h.) $\pm 10\%$ r.h. within the range 30% r.h. to 70% r.h. throughout the duration of each test.

5.2.8 Pressure

The tests shall be performed using air and test gases at ambient pressure $\pm 2\text{ kPa}$ within the range of 86 kPa to 108 kPa throughout the duration of the test.

5.2.9 Removable parts

Optional filters, windshields, or diffusion devices supplied or recommended by the manufacturer shall be attached or removed according to which condition gives the most unfavourable result for the test being conducted.

5.3 Test methods and performance requirements

5.3.1 General

Prior to testing to this performance standard the mechanism of testing shall be agreed between the manufacturer and the persons undertaking the testing.

The apparatus shall comply with all the requirements under the specified test conditions. Unless otherwise stated, each test condition shall be separately varied while the others remain normal as defined in 5.2.

When the apparatus is switched on, a warm-up time during which the apparatus is not in an active monitoring mode, is acceptable.

Whilst the following sequence of tests is recommended the sequence of tests is not mandatory. They shall be carried out in clean air or the test air gas mixture as appropriate.

For all testing of alarm conditions, expose the apparatus sequentially to the following test gases as specified in Table 3 in a step change:

- to clean air for 15 min;
- to test gas A for 120 min or until the alarm activates if less than 120 min;
- to clean air for 15 min;
- to test gas B for 90 min or until the alarm activates if less than 90 min;
- to clean air for 15 min;
- to test gas C for 40 min or until the alarm activates if less than 40 min;
- to clean air for 15 min;
- to test gas D for 3 min or until the alarm activates if less than 3 min;
- to clean air for 15 min.

The exposure to test gas C and the subsequent exposure to clean air shall only be carried out for the alarm condition test in 5.3.4.

5.3.2 Unpowered storage

Expose the apparatus sequentially to the following conditions:

- a) a temperature of (-20 ± 2) °C for 24 h;
- b) ambient temperature for 24 h;
- c) a temperature of (50 ± 2) °C for 24 h;
- d) ambient temperature for 24 h.

Allow the apparatus to warm up for 1 h and then subject it to the tests given in 5.3.4 to 5.3.13.

5.3.3 Output signal

5.3.3.1 Test

For type A apparatus, verify, during every test, the state of the output signal according to the manufacturer's specification.

5.3.3.2 Performance requirement

The apparatus shall provide the output signal in accordance with the manufacturer's specification.

5.3.4 Alarm conditions

5.3.4.1 Test

Under the environmental conditions specified in 5.2.5 to 5.2.8, test the alarm conditions as described in 5.3.1.

5.3.4.2 Performance requirement

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

5.3.5 Alarm during warm-up time

5.3.5.1 Test

Mount the apparatus in clean air for 24 h in an unenergized condition. Introduce the test gas D and immediately switch-on.

5.3.5.2 Performance requirements

The apparatus shall alarm within 15 min of being switched-on.

5.3.6 Response and recovery to a high CO volume ratio

5.3.6.1 Test

Expose the apparatus sequentially to the following test gases in step change sequence:

- to clean air for 15 min;
- to 5 000 ppm CO as specified in 5.2.3 for 15 min;
- to clean air for 1 h;

- to test gas B for 90 min or until the alarm activates if less than 90 min;
- to clean air for 15 min.

5.3.6.2 Performance requirement

The apparatus shall not alarm during the initial exposure to clean air.

The apparatus shall alarm within 3 min when exposed to the high CO volume ratio.

After the exposure to the high CO volume ratio, the apparatus shall recover from the alarm state within 15 min, when exposed to clean air.

The apparatus shall alarm according to the conditions stated in Table 3 for test gas B.

After the exposure to test gas B, the apparatus shall recover from the alarm state within 6 min, when exposed to clean air.

5.3.7 Temperature effects

5.3.7.1 Test

Expose the apparatus and the test gas to a temperature of (-10 ± 1) °C for at least 6 h, followed by the ambient temperature for at least 6 h and finally to a temperature of (40 ± 1) °C for at least 6 h. At the end of each exposure interval and before conditions are changed, subject the apparatus to the test gas as described in 5.3.1.

5.3.7.2 Performance requirement

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

5.3.8 Humidity effects

5.3.8.1 Test

Expose the apparatus and the test gas to a humidity of (30 ± 5) % r.h. at (15 ± 2) °C for a period of 6 h followed by an exposure to (90 ± 5) % r.h. at (40 ± 2) °C for a period of 6 h. At the end of each exposure interval and before conditions are changed, subject the apparatus to the test gas as described in 5.3.1.

5.3.8.2 Performance requirement

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

5.3.9 Speed of test gas

5.3.9.1 Test

Expose the apparatus to the test gas A at an air speed of $(1,2 \pm 0,1)$ m/s for 2 h in a flow chamber with the apparatus in the normally mounted position.

5.3.9.2 Performance requirement

Throughout the test, the alarm shall not operate.

5.3.10 Supply voltage variations (mains powered apparatus only)**5.3.10.1 Test**

Set up the apparatus under normal conditions (5.2) at the rated supply voltage U_n and frequency. Subject the apparatus to test gas as described in 5.2.2 at a rated supply voltage of $U_n + 10\% U_n$. Repeat the test at a supply voltage of $U_n - 10\% U_n$.

5.3.10.2 Performance requirement

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

5.3.11 Electromagnetic compatibility**5.3.11.1 Test**

Test the apparatus, including the sensor and interconnecting wiring for electromagnetic compatibility in accordance with EN 50270.

5.3.11.2 Performance requirements

The apparatus shall meet the requirements of EN 50270.

5.3.12 Response to mixtures of carbon monoxide and other gases**5.3.12.1 General**

As it is not possible to obtain a stable, ready mixed, test gas mixture as required for this test, Table 4 describes three components which when mixed together in the relative proportions given, will produce a suitable test gas.

Table 4 – Composition of test gas mixture

Component	Test gas volume ratio	Balance gas	Relative proportion in total volume	Calculated volume ratio in the final mixture
1	(60 ± 6) ppm CO, (33 ± 3) ppm H ₂ , (5 500 ± 300) ppm CO ₂	Air	18	54 ppm CO, 30 ppm H ₂ , 4 950 ppm CO ₂
2	(100 ± 10) ppm NO	Nitrogen	1	5 ppm NO
3	(100 ± 10) ppm SO ₂	Air or nitrogen	1	5 ppm SO ₂

Component 1 shall be humidified prior to mixing with components 2 and 3.

NOTE NO and SO₂ volume ratios in the resulting test gas may be different from the calculated results because of the reaction between NO, SO₂, O₂, and water vapour.

5.3.12.2 Test

Expose the apparatus sequentially to

- clean air for 15 min,
- a mixture, the composition of which is described in Table 4, for 90 min or until the alarm activates if less than 90 min,
- clean air for 15 min.

5.3.12.3 Performance requirement

The apparatus shall not alarm during the initial exposure to clean air.

The apparatus shall alarm according to the conditions stated in Table 3 for test gas B.

After the exposure to the test gas mixture of composition described in Table 4, the apparatus shall recover from the alarm state within 6 min, when exposed to clean air.

5.3.13 Effects of other gases

5.3.13.1 Test

Subject the apparatus consecutively to the following gas mixtures under the conditions given below:

- ethanol at a volume ratio of $(2\ 000 \pm 200)$ ppm for 30 min;
- hexamethyldisiloxane at a volume ratio of (10 ± 3) ppm for 40 min.

The hexamethyldisiloxane test may be carried out with dry gas. After the test in dry gas, allow one hour for the apparatus to reach equilibrium under normal conditions. After exposure to each of these gases, subject the apparatus under normal conditions to the test gases as described in 5.3.1.

5.3.13.2 Performance requirement

The apparatus shall not alarm when exposed to ethanol and hexamethyldisiloxane.

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

5.3.14 Long term stability

5.3.14.1 Test

Mount the apparatus, expose it to a CO test gas mixture as specified in 5.2.3 and energize continuously for a period of 3 months. At the commencement of the test and every 30 days thereafter expose the apparatus to the test gases as specified in 5.3.1. During the test, the ambient conditions shall remain within the overall bands specified in 5.2.6, 5.2.7 and 5.2.8 disregarding tolerances.

5.3.14.2 Performance requirement

The apparatus shall not alarm when exposed to the test gas as specified in 5.2.3.

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

NOTE An additional extended stability test is recommended to be carried out by the manufacturer to receive statistical data according typical lifetime for the quality management of the product (see Annex A).

5.3.15 Drop test (applicable to apparatus not intended for fixed installation)

5.3.15.1 Test

The apparatus shall be dropped from a height of 1 m in each of three mutually perpendicular attitudes onto a concrete floor. Expose the apparatus to test gases as described in 5.3.1.

5.3.15.2 Performance requirements

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

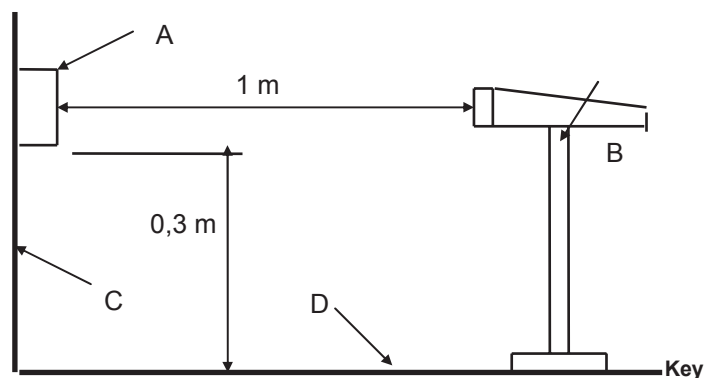
5.3.16 Alarm sound level

5.3.16.1 Test

The test shall be carried out in free-field conditions over reflecting planes, the horizontal plane simulating the floor or the ceiling and the vertical plane simulating the wall.

Position the apparatus in accordance with the manufacturer's instructions.

Position the microphone so that its axis corresponds to the geometric centre of the apparatus, see Figure 1.



Key

- A Apparatus
- B Microphone
- C Wall (vertical plane)
- D Floor or ceiling (horizontal plane)

Figure 1 – Sound level test

Test in accordance with EN 60704-1.

NOTE For apparatus which emit an intermittent or modulated sound it may be necessary to modify the circuit in order to obtain a continuous signal.

5.3.16.2 Performance requirement

The sound level shall be at least 85 dB (A) at 1 m.

5.3.17 Degree of protection

5.3.17.1 Test

[A₁] The enclosure of the apparatus shall provide a degree of protection of at least IPX2D with the exception of battery-powered apparatus. **[A₁]**

The apparatus shall be tested in accordance with EN 60529:1991, Clauses 12, 13 and 14.

5.3.17.2 Performance requirement

The apparatus shall meet the requirements specified in EN 60529:1991, Clauses 12, 13 and 14.

5.3.18 Mechanical strength

5.3.18.1 Test

The apparatus shall be tested in accordance with the test specified in EN 60335-1:2002, Clause 21, with the following modification to the third paragraph:

The apparatus is rigidly supported and three blows are applied to every point of the enclosure that is likely to be weak with an impact energy of $(1 \pm 0,2)$ J.

5.3.18.2 Performance requirement

The apparatus shall meet the requirements specified in EN 60335-1:2002, Clause 21.

6 Self-contained battery powered apparatus

6.1 Battery fault warning

6.1.1 General

Self-contained apparatus incorporating a battery shall give a visual or audible fault warning as specified in 6.2.3 before a decrease in the terminal voltage of the battery prevents correct operation.

6.1.2 Test

Connect the apparatus to a stabilized power supply set to the rated battery voltage. Decrease the supply voltage in steps of 0,1 V at intervals of at least 1 min, until the fault warning is given. Record the supply voltage at which the warning is given as U_E . At the voltage one step above the voltage at which the fault warning is given, subject the apparatus to the test gases as described in 5.3.1.

6.1.3 Performance requirements

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

6.2 Battery capacity

6.2.1 General

Batteries of self-contained apparatus shall be capable of supplying the quiescent load of the apparatus together with the additional load of routine testing, for a period as specified in 6.2.3 before the battery fault warning is given and, thereafter, of generating an alarm or, in the absence of an alarm, of operating for a further period as prescribed in 6.2.3.

6.2.2 Assessment

In the case of third party testing, the manufacturer shall supply details of the capacity of the recommended battery or batteries together with characteristic curves for voltage variation with time at (20 ± 10) °C for appropriate values of current drainage.

The current drawn by the apparatus in the quiescent and routine testing conditions shall be measured.

6.2.3 Performance requirements

The assessment of 6.2.2 shall indicate that the battery or batteries are capable of operating the apparatus as indicated in 6.2.1 for a period of 12 months $\overline{A_1}$ or longer if specified by the apparatus manufacturer $\overline{A_1}$. From the time when low battery voltage warning is indicated, the battery shall have sufficient capacity to give a low battery voltage warning for at least 7 days followed by an alarm signal as specified in 4.3 for at least 4 min.

The low battery voltage warning shall be indicated by either

- a suitable permanent visual indication for example a separate LED or a flashing of the fault indicator, or
- an acoustic indicator which may be intermittent but which shall energize for a minimum of 1 min per hour.

In the case of an alarm due to CO, the alarm sound shall to be as specified in 4.3.2.

6.3 Battery reversal

6.3.1 General

The battery reversal test shall be applied to apparatus incorporating replaceable batteries if there is any possibility of the apparatus being subjected to reversed polarity of the supply during normal battery replacement.

6.3.2 Test

- a) With a new battery fitted, subject the apparatus to the test gases as described in 5.3.1.
- b) Remove the battery and replace it in the apparatus with reverse polarity for 10 s to 15 s.
- c) Remove the battery and replace it in the apparatus with the correct polarity. Subject the apparatus to the test gases as defined in 5.3.1.
- d) Remove the battery and apply a voltage to the apparatus of between U_E and $0,95 U_E$ as determined in 6.1.2.

6.3.3 Performance requirements

When exposed to CO - air mixtures, the alarm shall operate according to the conditions in Table 3. Recovery from the alarm state shall take place within 6 min when exposed to clean air.

During stage b) the power supply indicator shall not be activated.

During stage d) the low battery voltage warning shall be given.

6.4 Battery connections

6.4.1 General

Where batteries are connected to a circuit board within the apparatus by flexible leads, strain relieving devices shall be fitted adjacent to both battery terminal connectors and the circuit board so that any pull on the leads shall not be transmitted to the battery terminals or circuit board.

6.4.2 Test

Leads shall be subjected to a pull of (20 ± 2) N without jerks for 1 min in any direction allowed by the design.

6.4.3 Performance requirements

The strain relieving devices shall be effective in ensuring that strain is not imparted to the battery terminals or circuit board during the test. This shall be checked by visual inspection.

Annex A (informative)

Extended stability test – Example protocol

A.1 General requirements

A sample of thirty carbon monoxide alarms, representative of the models being manufactured (particularly regarding the CO sensor) are to be selected at random. The apparatus is then subjected to the extended long-term stability test as specified below.

Continuous testing over the lifetime period claimed by the manufacturer should be carried out.

A.2 Test

Samples of the apparatus, numbered and with the date of installation, should be energized continuously for the claimed lifetime period. During the test, the ambient conditions shall remain within the overall bands specified in 5.2.6, 5.2.7 and 5.2.8 disregarding tolerances. At the commencement of the test and every three months (± 7 days) thereafter expose each apparatus to test gas C.

A.3 Performance requirement

At each application of test gas C the apparatus shall not alarm within 10 min and shall alarm within 40 min.

Annex B (informative)

A-deviations

A-deviation: National deviation due to regulations, the alteration of which is for the time being outside the competence of the CENELEC national member.

This European Standard does not fall under any Directive of the EC.

In the relevant CENELEC countries these A-deviations are valid instead of the provisions of the European Standard until they have been removed.

<u>Clause</u>	<u>Deviation</u>
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General	Italy (Italian Law 6/12/1971 n. 1083 and Ministerial Decree 26/04/1995)
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Clause 4, "Concetti di afficabilità" of the Italian standard UNI-CEI 70028:1994 " Rivelatori di gas naturale e rivelatori di GPL per uso domestico e similare" is maintained along with all the requirements of the present EN 50291-1.

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