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Electrical apparatus for the detection and measurement of oxygen - Performance requirements and test methods

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Elektrische Geräte für die Detektion und die Messung von Sauerstoff - Anforderungen an das Betriebsverhalten und Prüfmethoden

Appareils électriques de détection et de mesure d'oxygène - Règles de fonctionnement et méthodes d'essais

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English version

Electrical apparatus for the detection and measurement of oxygen Performance requirements and test methods

Appareils électriques de détection et de mesure d'oxygène
Règles de fonctionnement et méthodes d'essais

Elektrische Geräte für das Aufspüren und die Messung von Sauerstoff
Anforderungen an das Betriebsverhalten und Prüfmethoden

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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.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

This second edition of the European Standard was prepared by SC 31-9, Electrical apparatus for the detection and measurement of combustible gases to be used in industrial and commercial potentially explosive atmospheres, of Technical Committee CENELEC TC 31, Electrical apparatus for explosive atmospheres, on the basis of EN 50104:1995 and an amendment thereto.

This amendment was approved by CENELEC on 1996-12-09 for incorporation into a new edition of EN 50104.

This European Standard replaces EN 50104:1995.

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) 1999-01-01

- latest date which the national standards conflicting with the EN have to be withdrawn (dow) 1999-01-01

This European Standard has been prepared under a mandate given to CENELEC by the European Commission and covers essential requirements of EC Directive 94/9/EC.

Annexes designated "informative" are given for information only.
In this standard, annexes A and B are informative.

Contents

Annexes

Figures

1 Scope

This European Standard specifies performance requirements and test methods for portable, transportable and fixed electrical apparatus for the measurement of the oxygen concentration in gas mixtures indicating up to 25 % (v/v).

This European Standard applies to apparatus intended for commercial and industrial safety applications, including integral sampling systems of aspirated apparatus. In the case of inert gas purging, this European Standard applies also to apparatus with an oxygen measuring function for explosion protection. It does not apply to external sampling systems, nor laboratory, scientific or medical equipment nor those which are used exclusively for process control.

NOTE: The most commonly used oxygen sensors in commercial equipment for industrial application are:
a) paramagnetic sensors;
b) electrochemical sensors (aqueous and solid electrolytes).

2 Normative references

This European Standard incorporates by dated or undated references, provisions from other publications. These normative references are cited at the appropriate place in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

EN 50081-1	1992	Electromagnetic compatibility - Generic emission standard Part 1: Residential, commercial and light industry
EN 50081-2	1993	Electromagnetic compatibility - Generic emission standard Part 2: Industrial environment
EN 50082-1	1997	Electromagnetic compatibility - Generic immunity standard Part 1: Residential, commercial and light industry
EN 50082-2	1995	Electromagnetic compatibility - Generic immunity standard Part 2: Industrial environment
EN 60068-2-6	1995	Environmental testing -- Part 2: Tests - Test Fc : Vibration (sinusoidal)

3 Definitions

For the purposes of this standard, the following definitions apply.

3.1 oxygen alarm apparatus: Portable, transportable or fixed apparatus to monitor the oxygen concentration in gas mixtures, which measures autonomously and continuously or cyclically, warns and optionally switches, indicates, registers and stores.

3.2 fixed apparatus: An apparatus which is intended to have all of its parts permanently installed.

3.3 transportable apparatus: An apparatus that is not intended to be portable, but which can readily be moved from one place to another.

3.4 portable apparatus: Apparatus that has been designed to be readily carried from place to place and to be used while being carried.

The portable apparatus is battery powered. Portable apparatus includes the following apparatus, but is not limited only to them:

- small hand-held apparatus, typically weighing less than 1 kg, suitable for single-handed operation;
- personal monitors, similar in size and weight to the hand-held apparatus, which are continuously ready to be operated but not necessarily continuously sensing) while attached to the user; and
- larger apparatus up to 5 kg that can be operated by the user while suspended by hand, by a shoulder strap or by a carrying case; it may or may not have a hand-directed probe.

3.5 continuous-duty apparatus: An apparatus which is continuously powered and that continuously senses the oxygen concentration at every measuring point.

3.6 cyclically operated apparatus: An apparatus that senses several measuring points at time intervals.

3.7 alarm-only apparatus: An apparatus having an alarm but not having a meter or other indicating device.

3.8 measuring principle: Type of physical or physico-chemical detection principle and the measurement procedure to determine the measured value.

3.9 measuring signal: Signal of the sensor that is either not amplified or amplified with a constant factor.

3.10 sensor: An assembly in which the sensing element is housed and which may contain associated circuit components.

3.11 sensing element: Part of the sensor which directly picks up the quantity to be measured and which is sensitive to that quantity.

3.12 remote sensor: A sensor which is not an integral part of the main body of the apparatus.

3.13 diffusion apparatus: An apparatus in which the transfer of gas from the atmosphere to the gas sensor takes place by diffusion, i.e. there is not aspirated flow.

3.14 aspirated apparatus: An apparatus in which the sensor obtains the gas by means of a pump.

3.15 sample line: The pipeline by means of which the gas being sampled is conveyed to the sensor.

3.16 sampling probe: A separate sample line that may or may not be supplied together with the apparatus, and which is attached to the apparatus when required. It is usually short (e.g. approximately 1 m) and rigid (e.g. it can be telescopic), but can be connected by a flexible tube to the apparatus.

3.17 fault signal: An audible, visible or other type of output different from an alarm signal, conveying, directly or indirectly, a warning or indication that the apparatus is not working satisfactorily.

3.18 latching alarm: An alarm which, once activated, requires deliberate action to deactivate it.

3.19 zero test gas: A gas, such as nitrogen, containing neither oxygen nor other gases that may activate the sensor.

3.20 standard test gas: Test gas with a composition specified for each apparatus to be used for all tests unless otherwise stated (see 5.2).

3.21 reference air: Air, under normal ambient conditions, with an oxygen concentration of (21 $\pm$ 0,4) % (v/v).

3.22 alarm set point: A fixed or adjustable setting of the apparatus that is intended to preset the level of concentration at which the apparatus automatically initiates an indication, alarm or other output function.

3.23 stabilized apparatus: An apparatus which, when three successive indications are taken at 5 min intervals, indicates no changes greater than ± 1 % of the measuring range.

3.24 warm-up time (not applicable to spot-reading apparatus): The time interval, with the apparatus in a stated atmosphere, between the time when the apparatus is switched on and the time when the indication reaches and remains within the stated tolerances (see figures 1 and 2).

3.25 repeatability: The closeness of agreement between the results of successive measurements of the same value of the same quantity carried out by the same method, with the same measuring instruments, by the same observer, in the same laboratory at quite short intervals of time in unchanged conditions.

3.26 response error: The difference between the arithmetical average of n consecutive measurements carried out with a test gas under reference conditions and the actual value of its concentration.

3.27 time of response t_x (not applicable to spot-reading apparatus): The time interval, with the apparatus in a warmed-up condition, between the time when an instantaneous variation in volume ratio is produced at the apparatus inlet and the time when the response reaches a stated percentage (X) of the final indication.

3.28 drift: The variation in apparatus indication with time at any gas level (including clean air).

4 General requirements

4.1 Function

The apparatus shall reliably measure the oxygen concentration under the stated application conditions, shall produce an alarm or signal and, if applicable, shall be able to initiate external alarm and protective actions, whenever the level exceeds or falls below a preselected alarm concentration.

4.2 Use in potentially explosive atmospheres

Portable and transportable apparatus, as well as parts of fixed apparatus, that are used in potentialy explosive atmospheres shall conform to the appropriate regulations for explosive_protection.

Apparatus intended for use in potentially explosive atmospheres shall not be used in oxygen enriched atmospheres.

4.3 Mechanical construction

All apparatus parts shall be able to withstand the stresses during proper use due to vibration, dust, corrosive media and climatic influences. Materials that come into contact with the measuring gas shall not affect the measured value.

Gas detection apparatus or parts thereof (e.g. remote sensors) specifically intended for use in the presence of corrosive vapours or gases, or which may produce corrosive byproducts as a result of the detection process (e.g. catalytic oxidation or other chemical process), shall be constructed of materials known to be resistant to corrosion by such substances.

All apparatus shall be so constructed as to facilitate regular accuracy checks.

The design of a gas detection apparatus shall be such that all materials used in the construction and all components, including electrical and electronic components, employed in the apparatus shall be used within the manufacturer's ratings, or limits specified by the material or component manufacturer, unless otherwise specified by appropriate safety standards taking into account the limits of specified operating conditions.

Zero-point and gain adjustments shall not influence each other.

The adjustment devices of the apparatus shall be easily accessible, but secured against unauthorized adjustment.

Every apparatus shall be constructed in such a manner that it is easily accessible for regular function checks and that it can be equipped with suitable devices for application of test gas (calibration and test masks). The gas path of the apparatus, including any necessary filter and sampling device, shall be gastight (see 6.4).

If alarm devices, output contacts or signal outputs are built in, they are latching.

4.4 Indicating devices

An indication shall be provided to show that the apparatus is switched on.

When the apparatus is intended for the measurement of volume ratios of gases, the indicating or recording device shall permit measurement of the permitted deviations specified by this European Standard.

For alarm-only apparatus, the manufacturer shall identify suitable points for connecting indicating or recording devices for the purpose of testing the conformity of the apparatus to this European Standard.

If the apparatus has more than one measuring range, the range selected shall be clearly identified.

If individual indicating lights are fitted, they shall be coloured as follows.

a) Alarms indicating the presence of gas at potentially dangerous levels shall be coloured RED.

b) Equipment fault indicators shall be coloured YELLOW.

c) Power supply indicators shall be coloured GREEN.

Each indicating light shall be labelled to show its function.

4.5 Fault signal

Fixed and transportable apparatus shall provide a fault signal in the event of failure of power to the apparatus, loss of continuity or short circuit (i.e. loop failure) in one or more of the wires to any remote sensor, or loss of electrical continuity of any sensor.

Automatically aspirated apparatus shall be provided with an integral flow proving device which produces a fault signal in the event of flow failure.

4.6 Software controlled apparatus

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

5 Normal conditions of test

5.1 General

The test conditions specified in 5.2 to 5.10 shall be used for all tests unless otherwise stated.

5.2 Test gases

The gas mixture may be made by any suitable method. The volume concentration of oxygen in the standard test gas shall fall in the middle of the measuring range.

When the apparatus is intended for measuring oxygen deficiency, all tests shall be made with reference air and standard test gas, considering a measuring range of x % to 21 % (v/v) (where x shall be defined by the manufacturer).

When the apparatus is intended for measuring oxygen enrichment, all tests shall be made with reference air and standard test gas, considering a measuring range of 21 % to x % (v/v) (where x shall be defined by the manufacturer but shall be not greater than 25 % (v/v)).

When the apparatus is intended for measuring inertization, all tests shall be made with zero test gas and standard test gas, considering a measuring range of 0 % to x % (v/v) (where x shall be defined by the manufacturer, but shall be not greater than 21 % (v/v)). For apparatus with a suppressed zero point, a test gas with the oxygen concentration of the beginning of the measuring range shall be used instead of zero gas.

When the apparatus is intended for more than one application, it shall be tested for each application.

The actual value of the concentration of the test gases shall be known within ± 2 % relative.

5.3 Flow rate for test gases

The flow rate of the test gases shall conform to the specifications of the manufacturer. Either a calibration mask or a test chamber shall be used for a diffusion apparatus.

5.4 Supply voltage

Any mains-powered apparatus shall be operated in accordance with the voltage and frequency specified by the manufacturer (± 2 %). All battery-powered apparatus shall be equipped with new or fully charged batteries for short term measurements. For long term tests, the unit shall either be re-equipped with new or fully charged batteries as necessary, or be energized from a stabilized power supply.

5.5 Ambient temperature

The ambient air and the test gas shall be kept at a constant temperature (± 2 °C) within the range 15 °C to 25 °C for the entire duration of each individual test.

5.6 Pressure

The individual tests shall be carried out at an ambient pressure within the range 86 kPa to 108 kPa[1)]. If the apparatus is sensitive to changes in barometric pressure, the pressure shall be recorded to within ± 1 kPa and the results corrected as appropriate.

5.7 Humidity

The relative humidity of the ambient air and the standard test gas used during the drift test (see 6.8), shall be constant to ± 10 % r.h. within the range 40 % to 80 % r.h. for the entire duration of the each individual test.

5.8 Stabilization time

Each time that the apparatus is subjected to a different test condition, the apparatus shall be allowed to stabilized under these new conditions before measurements are taken for comparison purposes, unless otherwise indicated.

5.9 Apparatus which can be switched to different measuring ranges

For apparatus with more than one measuring range, each measuring range shall be tested.

5.10 Orientation

The apparatus shall be tested in the orientation recommended by the manufacturer.

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1) 1 kPa = 1000 N/m² = 10 mbar.