SLOVENSKI STANDARD
SIST EN 50271:2010

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Nadomešča:
SIST EN 50271:2002

Električne naprave za odkrivanje in merjenje vnetljivih plinov, strupenih plinov ali kisika - Zahteve in preskusi za naprave s programsko opremo in/ali digitalno tehnologijo

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

Elektrische Geräte für die Detektion und Messung von brennbaren Gasen, giftigen Gasen oder Sauerstoff - Anforderungen und Prüfungen für Warngeräte, die Software und/oder Digitaltechnik nutzen

Appareils électriques de détection et de mesure des gaz combustibles, des gaz toxiques ou de l'oxygène - Exigences et essais pour les appareils utilisant un logiciel et/ou des technologies numériques

Ta slovenski standard je istoveten z: **EN 50271:2010**

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English version

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

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This European Standard was approved by CENELEC on 2010-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

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
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Foreword

This 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 potentially explosive atmospheres. It was submitted to the formal vote and approved by CENELEC as EN 50271 on 2010-06-01.

This document supersedes EN 50271:2001.

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 State of the Art is included in Annex ZY "*Significant changes between this European Standard and EN 50271:2001*".

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)	2011-06-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-06-01

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

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Introduction

This European Standard specifies minimum requirements for functional safety of gas detection apparatus using software and/or digital technologies and defines criteria for reliability and avoidance of faults. Functional safety is that part of the overall safety which is related to the measures within the gas detection apparatus to avoid or to handle failures in such a manner that the safety function will be assured.

Gas detection apparatus will fail to function if dangerous failures occur. The aim of this European Standard is to reduce the risk of dangerous equipment failures to levels appropriate to typical applications of such apparatus.

Failure to function will also occur if such apparatus are not selected, installed or maintained in an appropriate manner. In some applications failures of this type will dominate the functional safety achieved. Users of gas detection apparatus will therefore need to ensure that selection, installation and maintenance of such apparatus are carried out appropriately. Guidance for the selection, installation, use and maintenance of gas detection apparatus are set out in EN 60079-29-2 and EN 45544-4, respectively.

This European Standard does not include requirements for operational availability which will need to be considered separately.

Regarding the requirements for the software development process, this European Standard specifies a practical approach to comply with the requirements of EN 61508-3 for SIL 1 without using this generic standard.

It is recommended to apply this European Standard for apparatus used for safety applications with SIL-requirement 1 instead of EN 50402 because EN 50402 is designed for the assessment of more complex gas detection systems with SIL-requirements greater than 1. However, the technical requirements of EN 50271 and EN 50402 are the same for SIL 1.

1 Scope

This European Standard specifies minimum requirements and tests for electrical apparatus for the detection and measurement of combustible gases, toxic gases or oxygen using software and/or digital technologies. Additional requirements are specified if compliance with safety integrity level 1 (SIL 1) according to EN 61508 series is required for low demand mode of operation.

NOTE 1 It is recommended to apply this European Standard for apparatus used for safety applications with SIL-requirement 1 instead of EN 50402. However, the technical requirements of EN 50271 and EN 50402 are the same for SIL 1.

NOTE 2 For fixed apparatus used for safety applications with SIL-requirements higher than 1 EN 50402 is applicable.

This European Standard is applicable to fixed, transportable and portable apparatus intended for use in domestic premises as well as commercial and industrial applications.

This European Standard does not apply to external sampling systems, or to apparatus of laboratory or scientific type, or to apparatus used only for process control purposes.

This European Standard supplements the requirements of the European Standards for the detection and measurement of flammable gases and vapours (e.g. EN 60079-29-1, EN 50241-1, EN 50241-2, EN 50194-1, EN 50194-2), toxic gases (e.g. EN 45544 series, EN 50291-1, EN 50291-2) or oxygen (e.g. EN 50104).

NOTE 3 These European Standards will be mentioned in this European Standard as "metrological standards".

NOTE 4 The examples above show the state of the standardisation for gas detection apparatus at the time of publishing this European Standard. There may be other metrological standards for which this European Standard is also applicable.

This European Standard is a product standard which is based on EN 61508 series. It covers part of the phase 9 "realisation" of the overall safety life cycle defined in EN 61508-1.

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 45544-1	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 1: General requirements and test methods
EN 45544-2	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 2: Performance requirements for apparatus used for measuring concentrations in the region of limit values
EN 45544-3	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 3: Performance requirements for apparatus used for measuring concentrations well above limit values
EN 45544-4	Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapours – Part 4: Guide for selection, installation, use and maintenance
EN 50104	Electrical apparatus for the detection and measurement of oxygen – Performance requirements and test methods

EN 50194-1	Electrical apparatus for the detection of combustible gases in domestic premises – Part 1: Test methods and performance requirements
EN 50194-2	Electrical apparatus for the detection of combustible gases in domestic premises – Part 2: Electrical apparatus for continuous operation in a fixed installation in recreational vehicles and similar premises – Additional test methods and performance requirements
EN 50241-1	Specification for open path apparatus for the detection of combustible or toxic gases and vapours – Part 1: General requirements and test methods
EN 50241-2	Specification for open path apparatus for the detection of combustible or toxic gases and vapours – Part 2: Performance requirements for apparatus for the detection of combustible gases
EN 50291-1	Electrical apparatus for the detection of carbon monoxide in domestic premises – Part 1: Test methods and performance requirements
EN 50291-2	Electrical apparatus for the detection of carbon monoxide in domestic premises – Part 2: Electrical apparatus for continuous operation in a fixed installation in recreational vehicles and similar premises including recreational craft – Additional test methods and performance requirements
EN 50402:2005 + A1:2008	Electrical apparatus for the detection and measurement of combustible or toxic gases or vapours or of oxygen – Requirements on the functional safety of fixed gas detection systems
EN 60079-29-1:2007	Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases (IEC 60079-29-1:2007, mod.)
EN 60079-29-2	Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen (IEC 60079-29-2)
EN 61508-1:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements (IEC 61508-1:1998 + corr. May 1999)
EN 61508-2:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2000)
EN 61508-3:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 3: Software requirements (IEC 61508-3:1998 + corr. Apr. 1999)
EN 61508-4:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 4: Definitions and abbreviations (IEC 61508-4:1998 + corr. Apr. 1999)
EN 61508-5:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 5: Examples of methods for the determination of safety integrity levels (IEC 61508-5:1998 + corr. Apr. 1999)
EN 61508-6:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 (IEC 61508-6:2000)
EN 61508-7:2001	Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 7: Overview of techniques and measures (IEC 61508-7:2000)

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 60079-29-1:2007 and the following apply.

3.1
digital unit
part of an electrical apparatus in which data is processed digitally. Analogue-digital(A/D)-converters and digital-analogue(D/A)-converters as interfaces to analogue units of the apparatus belong to the digital unit

3.2
special state
all states of the apparatus other than those in which monitoring of gas concentration take place, for example warm-up, maintenance mode (configuration, calibration, etc) or fault condition

3.3
software
intellectual creation comprising the programs, procedures, rules and associated documentation pertaining to the operation of the digital unit

3.4
failure
termination of the ability of a functional unit to provide a required function or operation of a functional unit in any way other than as required

[EN 61508-4:2001, 3.6.4, mod.]

3.5
parameters
settings by the manufacturer or user which effect the operation of the software, e.g. changing of alarm thresholds or measurement units. Parameter options are included in the software during design of the apparatus. Changes of parameter settings are not modifications of the software

3.6
specified range of input values
range of input values corresponding to the conversion range of the A/D- or D/A-converter

3.7
defined range of input values
range of input values defined by the manufacturer of the apparatus to be valid; the defined range is part of the specified range of input values

3.8
output data
result of the digital data processing, which is used for driving the output interfaces

NOTE Output interfaces may be analogue or digital displays, analogue or digital outputs and/or alarm indicators or relays.

3.9
output signal
analogue or digital signal which is available at an output interface

3.10
measured value
processed measured signal including physical unit (e.g. % LEL). A measured value may be formed from a single signal or a combination of several measurement signals. The combined measured signals may represent different physical units, e.g. gas concentration and temperature

3.11
smallest deviation of indication
value which is determined by the applicable metrological standards. In metrological standards the allowed tolerances for deviation of indication during type testing are given. If there are different requirements for the tolerances in different applicable metrological standards the smallest tolerance is the “minimum deviation of indication”.

The minimum deviation of indication is basis for the required resolution of measured signals which use digital transmission and data processing to meet the requirements of the metrological standards when using digital technologies

[EN 50402:2005, 3.21, mod.]

3.12
message
indication on a display which gives an information about the status of the apparatus (e.g. alarm, special state, warning)

3.13
software component
part of the program that consists of one or several software modules and that can also interact with other such constructs

3.14
software module
construct that consists of subroutines and/or data declarations and that can also interact with other such constructs

4 Design principles

4.1 Basic requirements

4.1.1 General

The metrological standards define performance requirements for gas detection apparatus which have direct implications on the digital units and software which may be used in such apparatus. This subclause specifies basic requirements to digital units and software to fulfil the metrological standards.

4.1.2 Analogue/digital interface

The relationship between corresponding analogue and digital values shall be unambiguous. The output range shall be capable of coping with the defined range of input values. Input values outside the specified range of the converter shall not result in a valid measured value. A/D- and D/A-converter quantisation steps shall be chosen so that the requirements in 4.1.3 for the accuracy of data representation will be fulfilled. The design shall take into account the maximum possible A/D- and D/A-converter errors.

NOTE This assessment may not include environmental interferences to the A/D- or D/A-converters, e.g. temperature variation.

Outputs at the limits of the specified range of D/A-converters shall result in output signals which are described as fault signal by the manufacturer.

4.1.3 Numerical errors

Deviations of measured values arising from quantisation, rounding and calculation errors shall be estimated assuming worst case conditions.

These worst case conditions shall be evaluated in detail. For example, the influence of the sensing principle such as non-linear behaviour of the signal or ageing of sensors, varying sensitivities for different gases and signal variation with temperature, pressure or humidity shall be taken into consideration.

The estimated deviation of measured values shall not be greater than 50 % of the smallest deviation of indication.

NOTE The deviation of measured values arising from the digital unit will be typically much lower than 50 % of the smallest deviation of indication. Deviations arising from other sources (e.g. sensor) are expected to be dominant.

4.1.4 Measuring operation

During data processing the digital unit shall control automatically the specified input data range and handle range violations. Zero and full scale of the converter shall not be considered to be within the specified range in order to detect stuck-at faults.

The software design and verification shall guarantee that range violations for internal and output data do not occur. Otherwise the digital unit shall control automatically the allowed data ranges and handle range violations.

During measuring operation, the maximum overall time of four successive updates of the output signals shall not exceed the response time t_{90} of the apparatus or, for alarm only apparatus, the minimum time to alarm.

NOTE This timing requirement may not be applied to output signals which are explicitly claimed by the manufacturer to be not safety-relevant.

4.1.5 Special state indication

4.1.5.1 Fixed and transportable apparatus

a) Control units

While a special state is present within the gas detection system (i.e. control unit and external sensors or transmitters) this shall be continuously indicated by a signal. This signal shall be transmittable except when the apparatus is intended to be used in domestic premises only. Signals provided for signalling that the entire gas detection system is in the special state "fault" shall use the idle current principle.

b) Gas detection apparatus (transmitters) intended to be used with control units

A special state of the gas detection apparatus shall be transmitted to the control unit continuously.

c) Apparatus having self-contained sensors

A special state shall be continuously indicated by a signal. This signal shall be transmittable except when the apparatus is intended to be used in domestic premises only. Signals provided for signalling that the entire apparatus is in the special state "fault" shall use the idle current principle.

NOTE In the case of digital data transmission, the term "continuously" is used with the meaning: continually, at the rate at which the output signal is updated (see 4.1.4).

4.1.5.2 Portable apparatus

The special state "fault" shall be continuously indicated by an optical and acoustic signal.

NOTE 1 It may be possible to silence the acoustic signal.

NOTE 2 It will not be possible to show an indication in all possible fault situations without implementing an emergency path, e.g. to detect sudden breakdown of battery voltage without second independent power supply. However it is possible to indicate the normal operation of the apparatus by a periodic optical and acoustical output signal (commonly called alive signal or confidence signal).

The special state "warm-up" shall be indicated by an optical and/or acoustic signal.

The special states "calibration mode" and "parametrisation mode" shall be indicated by an optical signal.

4.2 Displays

4.2.1 General

If a display is provided the requirements of 4.2.2 and 4.2.3 apply.

4.2.2 Indication of messages

If it is intended to indicate messages on a display:

a) it shall be possible to display all active messages simultaneously or a consolidated signal shall be generated (e.g. indicating lights for alarms or fault) and a consolidated message shall be displayed. It shall be possible to interrogate all active messages;

b) a unique message shall be provided for each individual gas alarm;

c) if no special state is activated, it shall be possible to interrogate the measured values of all gas sensors.

If a message includes another subsidiary message (e.g. exceeding the 2nd alarm threshold includes exceeding the 1st alarm threshold) it is sufficient to show the message of higher priority. After cancelling the higher order message the subsidiary message shall remain if the reason for its activation still exists.

NOTE It is recommended that the manufacturer defines an appropriate set of messages in order to enable the user an easy identification of alarms, special states, etc.

4.2.3 Indication of measured values

For measured values the displayed unit of measurement and any related sign shall be unambiguous. Any under-range or over-range measurements shall be clearly indicated.

4.3 Software

4.3.1 General

This clause defines minimum requirements for the software development process which are based on EN 61508-3. Alternative procedures are permitted provided that the applicable requirements of EN 61508-3 are fulfilled.

In general, software will consist of device software and, if applicable, an operating system and libraries (e.g. mathematical functions).

The requirements of this clause shall be applied to the entire software. A distinction between safety-related and non safety-related software is not made.

New operating systems shall be developed according to 4.3.3 to 4.3.5. Re-used or commercial operating systems shall comply with 4.3.2.

New device software and libraries shall be developed according to 4.3.3 to 4.3.5. Re-used or commercial software modules (e.g. libraries) shall be qualified (see 4.3.5.3.2).

To software for parameterization of the gas detection device, which is running on external devices (e.g. PC) on request and under control of an authorized user for a short period of time, only the requirements of 4.3.3, 4.3.4 a)-h) and 4.7 shall be applied.