SLOVENSKI STANDARD
SIST EN 50271:2018

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Nadomešča:
SIST EN 50271:2010

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 50271:2018**

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EUROPEAN STANDARD
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English Version

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre 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 CEN-CENELEC Management Centre has the same status as the official versions.

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Contents

European foreword

This document (EN 50271:2018) has been prepared by CLC/SC 31-9, “Electrical apparatus for the detection and measurement of combustible gases to be used in industrial and commercial potentially explosive atmospheres”, of CLC/TC 31, “Electrical apparatus for potentially explosive atmospheres”, and by 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) 2018-12-15
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2021-06-15

This document supersedes EN 50271:2010.

The State of the Art is included in Annex ZY “*Significant changes between this European Standard and* EN 50271:2010” which lists all changes to EN 50271:2010.

This document has been prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and covers essential requirements of EU Directive 2014/34/EU.

For the relationship with EU Directive see informative Annex ZZ, which is an integral part of this document.

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 ensured.

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.

This European standard also specifies additional optional requirements for compliance with SIL 1 in low demand mode operation. The following apparatus or gas detection systems are not fully covered by this standard:

– apparatus at SIL 1 when the apparatus or gas detection system contains functionality not covered by EN 50271

– apparatus at SIL 1 high demand mode operation

– apparatus at SIL 2 and SIL 3;

For such apparatus or gas detection systems the European standard EN 50402 should be used instead of EN 50271. EN 50402 includes all requirements of EN 50271.

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.

This European Standard is applicable to fixed, transportable and portable apparatus intended for use in domestic premises as well as commercial and industrial applications and their software-controlled safety related accessories.

This European Standard does not apply to external sampling systems which are not accessories, 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 60079-29-4, 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 1 These European Standards will be mentioned in this European Standard as “metrological standards”.

NOTE 2 The examples above show the state of the standardization 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 the EN 61508 series. It covers part of the phase 10 “realisation” of the overall safety life cycle defined in EN 61508-1.

Additional requirements are specified if compliance with safety integrity level 1 (SIL 1) according to the EN 61508 series is claimed for fixed or transportable apparatus for low demand mode of operation. They can also be applied to portable apparatus which are able to perform an automatic executive action.

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

2 Normative references

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

EN 50402:2017, *Electrical apparatus for the detection and measurement of combustible or toxic gases or vapours or of oxygen - Requirements on the functional safety of gas detection systems*

EN 60079-29-1:2016, *Explosive atmospheres - Part 29-1: Gas detectors - Performance requirements of detectors for flammable gases*

EN 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1: General requirements*

EN 61508-2:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems*

EN 61508-3:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3: Software requirements*

EN 61508-4:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 4: Definitions and abbreviations*

EN 61508-5:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 5: Examples of methods for the determination of safety integrity levels*

EN 61508-6:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3*

EN 61508-7:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 7: Overview of techniques and measures*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 60079-29-1:2016 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 and/or alarming is intended, for example the special states of warm-up, calibration mode or fault condition

[SOURCE: EN 60079-29-1:2016, 3.5.4]

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

[SOURCE: EN 61508-4:2010, 3.6.4, mod.]

3.5
parameters
settings by the manufacturer or user which affect the operation of the apparatus, e.g. changing of the alarm set points or measuring ranges. Parameter options are included in the hardware and/or software during design of the apparatus. Changes of parameter settings are not modifications of the software. In the software several different levels of permission to read or to change parameters may exist

3.6
specified range of input values
range of analogue input values corresponding to the digital output range of an A/D-converter or range of digital input values corresponding to the analogue output range of a D/A-converter. The minimum and maximum digital values of the converter are not to be considered to be within the specified range because minima and maxima correspond to stuck-at faults which have to be detected by the apparatus (see 4.1.4)

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 a sub-range 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 1 to entry: 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 measured 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 “smallest deviation of indication”

Note 1 to entry: The smallest 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

[SOURCE: EN 50402:2017, 3.22]

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

3.15
safety function of a gas detection apparatus
any function (inclusive from gas sampling to output of the gas detection apparatus) implemented by the gas detection apparatus which is related to safety as defined by the manufacturer

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 need not include environmental interferences to the A/D- or D/A-converters, e.g. temperature variation, since environmental testing is covered by the metrological standards.

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, nonlinear behaviour of the sensor signal with gas concentration, 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 automatically control the specified input data range and handle range violations. The minimum and maximum digital values 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 automatically control the allowed data ranges and handle range violations.

During measuring operation, the maximum overall time of four successive updates of the measured value and all safety relevant 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 General

It shall not be possible for any interface to an external device to adversely affect a safety function of the apparatus without the apparatus entering a special state.

NOTE This includes both hardware and software interfaces.

4.1.5.2 Fixed and transportable apparatus

a) Control units

While a special state is present within the entire gas detection apparatus (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 indicating that the entire gas detection apparatus is in the special state “fault” shall be such that they de-energize when the special state occurs and also on power loss. In the case of deactivation of alarm devices, e.g. for calibration purposes, it is not required to indicate a special state by a transmittable signal if the alarm devices are automatically re-enabled within 15 min.

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

The special state “calibration” shall be transmitted to the control unit continuously or the measured value shall be transmitted during calibration. All other special states shall be transmitted to the control unit continuously. The test routine according to 4.6 c) is excluded.

c) All other apparatus

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 indicating that the apparatus is in the special state “fault” shall be such that they de-energize when the special state occurs and also on power loss. In the case of deactivation of alarm devices, e.g. for calibration purposes, it is not required to indicate a special state by a transmittable signal if the alarm devices are automatically re-enabled within 15 min.

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).

4.1.5.3 Portable apparatus

The special state “fault” shall be continuously indicated by an optical and audible signal. It is permitted that the audible signal can be silenced.

If it is not possible to show an indication in all possible fault situations the normal operation of the apparatus shall be confirmed by a periodic optical and audible output signal (commonly called alive signal or confidence signal). The time interval between two signals shall not exceed 60 s.

EXAMPLE: A sudden breakdown of battery voltage cannot be indicated without implementing a second independent power supply.

The special state “warm-up” shall be indicated by an optical and/or audible signal.

The special states “calibration mode” and “parameterization 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.

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 according to the requirements of the metrological standards.

4.3 Software

4.3.1 General

This clause specifies 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. Compliance through “proven in use” (Route 2s of EN 61508-3) shall not be used.

NOTE This standard specifies minimum requirements and does not give additional recommendations (in the tables of EN 61508-3 and in EN 50402:2017 marked as “R”).

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.

Bought or re-used software modules which were previously developed according to 4.3.3 to 4.3.5 or commercial libraries which are only available as object code shall be qualified (see 4.3.5.3.2).

Bought or re-used software modules which are relevant for the basic gas detection functionality (signal chain from sensor to safety relevant output(s)) or the effectiveness of the test routines (according to 4.6) which were not developed according to 4.3.3 to 4.3.5 shall be treated as new code (Route 3s according to EN 61508-3, 7.4.2.13). All other bought or re-used software modules shall be qualified (see 4.3.5.3.2).

Only the requirements of 4.3.3, 4.3.4 a)-e), g), h) and 4.7 shall be applied 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.