SLOVENSKI STANDARD
oSIST prEN 50402:2013

01-julij-2013

Električne naprave za odkrivanje in merjenje vnetljivih ali strupenih plinov, hlapov ali kisika - Zahteve za funkcionalno varnost vgrajenih sistemov za odkrivanje plina

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

Elektrische Geräte für die Detektion und Messung von brennbaren oder toxischen Gasen und Dämpfen oder Sauerstoff - Anforderungen an die funktionale Sicherheit von ortsfesten Gaswarnsystemen

Appareils électriques pour la détection et la mesure des gaz ou vapeurs combustibles ou toxiques ou de l'oxygène - Exigences relatives à la sécurité fonctionnelle des systèmes fixes de détection de gaz

Ta slovenski standard je istoveten z: **prEN 50402:2013**

ICS:

13.230	Varstvo pred eksplozijo	Explosion protection
13.320	Alarmni in opozorilni sistemi	Alarm and warning systems

oSIST prEN 50402:2013 **en**

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English version

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This draft European Standard is submitted to CENELEC members for CENELEC enquiry.
Deadline for CENELEC: 2013-10-18.

It has been drawn up by CLC/SC 31-9.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CENELEC 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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Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

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CENELEC

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Foreword

This document [prEN 50402:2013] 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".

This document is currently submitted to the Enquiry.

This document will supersede EN 50402:2005 and A1:2008.

Technical changes to the first edition:

- In General the standard is updated to consider the modifications in the second edition of EN 61508 for hardware and software. Route 2 of the second edition of EN 61508 will not be permitted for gas detection equipment.
- The standard is updated for the SIL 1 requirements to be in line with the second edition of EN 50271 specifying the minimum requirements for functional safety for performance approved gas detectors, gas detection apparatus and complete gas detection systems.
- The latest revisions of the metrological standards have been considered.
- SIL 4 has been deleted as being not appropriate to gas detection.
- The Clauses 4 and 5 have been updated for more detailed specification.
- Clause 6 for software is new.
- Clauses 7 to 11 are restructured for clarification of requirements and relation to EN 61508.
- Clause 10 is specifying more details for the customer information.
- The former normative Annex D is now Clause 12.
- The former informative Annex A has been deleted. Relevant text was moved to Clauses 7 to 9.
- The new informative Annex D is providing information on failure modes of sensing elements

Introduction

This European Standard specifies requirements for functional safety of gas detection systems and encompasses criteria for reliability, avoidance of faults and fault tolerance. Functional safety is that part of the overall safety related to the measures within the gas detection system to avoid or to handle failures in such a manner that the safety function will be assured. This includes not only design requirements of the gas detection system but also information requirements for planning, putting into operation, maintenance and repair.

This European standard is dedicated to the manufacturer. Information important for the safe use of the device (gas detection system) will be specified in the instruction manual.

Gas detection systems will fail to function if dangerous failures occur in the equipment used. Failure to function will also occur if such systems are not installed or maintained in an appropriate manner. In some applications failures of this type will dominate the functional safety achieved. This European Standard is only targeted at reducing equipment failures to levels appropriate to the application. Users of gas detection systems will therefore need to ensure installation and maintenance of such systems is carried out according to requirements. This European Standard does not specify the physical positioning of measuring points / locations.

Gas detection systems may differ strongly in structure, complexity and performance. They may not be handled in a uniform manner like low complexity devices. A general specification of requirements is not possible on that basis.

Gas detection systems therefore need to be divided into functional modules for validation to ensure that systems which have different structures are handled by appropriate procedures. A gas detection system will not normally include all modules covered by this European Standard. Requirements are specified for each of these modules in terms of hierarchical levels which represent one of the constituents of functional safety performance. The hierarchical levels are termed as SIL-capabilities, with SIL-capability 1 representing the minimum and SIL-capability 3 the maximum levels of performance to comply with this European Standard. The SIL-capability of a module is related to the maximum safety integrity level that may be claimed for a safety function which uses modules of that specified SIL-capability. Modules will be characterised in terms of the SIL-capability. Information is also required on failure rate characteristics of modules or related physical components to enable the overall performance of a gas detection system to be determined. In this way both random failures of hardware components and systematic failures in hardware and software are taken account of. This European standard also specifies the requirements that will enable determination of whether the gas detection system have a low enough failure rate when used in conjunction with other equipment necessary for functional safety.

This European Standard will enable the functional safety characteristics of the gas detection system to be determined from the characteristics of its modules and components (see Annex C). This will enable a gas detection system to be used as a part of an overall safety system.

The characterisation including the determination of a SIL-capability and failure rate data will only need to be carried out once for a particular design.

After characterisation of each module and component the properties of the whole gas detection system will be specified depending on the chosen safety function. The procedure for determining the SIL-capability of the safety function of a gas detection system will only need to be repeated for each new combination of modules and components. Different combination of equivalent modules may lead to gas detection systems which reach different SIL-capabilities.

A flexible adoption of the gas detection system to different applications will be possible without repeating all steps of the validation procedure for each new configuration.

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

1 Scope

This European Standard is applicable to fixed gas detection systems for the detection and measurement of flammable or toxic gases or vapours or oxygen.

NOTE 1 For the purpose of this standard the word ‘toxic’ covers ‘very toxic’, ‘toxic’, ‘harmful’, ‘corrosive‘, ‘irritating‘, ‘sensitising‘, ‘carcinogenic‘, ‘mutagenic‘ and ‘teratogenic‘.

NOTE 2 This European Standard is dedicated to fixed apparatus. For portable gas detectors claiming a SIL higher than 1, this European Standard may be applied.

This European Standard supplements the requirements of the European Standards for electrical apparatus for the detection and measurement of flammable gases, vapours (e.g. EN 60079–29–1 or EN 60079–29–4), toxic gases (e.g. EN 45544) or oxygen (e.g. EN 50104).

NOTE 3 These European Standards are mentioned in the text as "metrological standards".

NOTE 4 The examples above show the state of the standardisation for industrial applications at the time of publishing this European Standard. There may be other metrological standards covering other application fields, for which this European Standard is also applicable.

NOTE 5 This European Standard covers all SIL-capabilities (1, 2 and 3) however where SIL 1 capability is the only requirement then EN 50271 may be applied.

Applying the above-mentioned metrological standards will ensure the measuring performance is adequate in normal operation of a gas detection system. Additionally the requirements of this European Standard address the functional safety of gas detection systems and encompass criteria for reliability, fault tolerance and avoidance of systematic faults.

This European Standard will lead to the characterisation of the gas detection system by a SIL-capability and related hardware failure rate representing a hierarchical order of safety levels. This will allow the user to incorporate the gas detection system into an overall safety system according to the safety integrity levels of EN 61508 (all parts).

This European Standard is a product standard which is based on EN 61508 (all parts) and for gas detection systems covers SIL capabilities of 1, 2 or 3 only. It covers part of the phase 10 “realisation” of the overall safety lifecycle defined in Figure 2 of EN 61508-1:2010.

NOTE 6 Applications requiring a SIL capability of 4 for a gas detection system are unrealistic.

This European Standard is applicable for gas detection systems, which may consist of the following functional units:

- gas-sampling;
- sensor;
- signal transmission;
- input to control unit;
- signal processing in control unit;
- output from control unit.

This European Standard does not specify requirements for the installation and maintenance of gas detection systems. It also does not specify the physical positioning of measuring points / locations.

This European Standard does not specify which SIL-capability is sufficient for which application.

NOTE 7 The SIL-capability required for an application will be specified by the user (see Clause 9 and Annex A).

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 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, *Part 2: Performance requirements for apparatus used for measuring concentrations in the region of limit values*

EN 45544-3, *Part 3: Performance requirements for apparatus used for measuring concentrations well above limit values*

EN 45544-4, *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 50270, *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 60079–29–1:2007, *Explosive atmospheres – Part 29-1: Gas detectors – Performance requirements of detectors for flammable gases (IEC 60079-29-1, 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 60079–29–4, *Explosive atmospheres – Part 29-4: Gas detectors – Performance requirements of open path detectors for flammable gases (IEC 60079-29-4, mod.)*

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

EN 61508-2:2010, *Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2010)*

EN 61508-3:2010, *Part 3: Software requirements (IEC 61508-3:2010)*

EN 61508-4:2010, *Part 4: Definitions and abbreviations (IEC 61508-4:2010)*

EN 61508-5:2010, *Part 5: Examples of methods for the determination of safety integrity levels (IEC 61508-5:2010)*

EN 61508-6:2010, *Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 (IEC 61508-6:2010)*

EN 61508-7:2010, *Part 7: Overview of techniques and measures (IEC 61508-7:2010)*

3 Terms and definitions

For the purpose of this document, the terms and definitions given in EN 60079–29–1 and EN 61508-4:2010 apply.

Some definitions are repeated for convenience. Some definitions from EN 61508-4:2010 are adapted to gas detection.

3.1
functional safety
part of the overall safety relating to the equipment under control (EUC) and the EUC control system that depends on the correct functioning of the electrical/electronic/programmable electronic safety-related systems (E/E/PES) and other risk reduction measures

Note 1 to entry: The EUC is the equipment under control or the process that the gas detection system is assuring the safety of (EN 61508-4: 2010, 3.2.1 modified).

Note 2 to entry: The EUC control system responds to input signals from the process and generates output signals causing the EUC to operate in the desired manner (EN 61508-4:2010, 3.3.3 modified).

Note 3 to entry: The gas detection system is part of the E/E/PES.

[SOURCE: EN 61508-4:2010, 3.1.12]

3.2
safety function of a gas detection system
function (inclusive from gas sampling to output of the gas detection system) implemented by the gas detection system to enable the safety-related system to achieve a safe state of the EUC

3.3
safety related part
any part, e. g. module or element, which is necessary to implement the required safety function of a gas detection system

3.4
fault
abnormal condition that may cause a reduction in, or loss of, the capability of a functional unit to perform a required function

[SOURCE: EN 61508-4:2010, 3.6.1]

3.5
fault tolerance
ability of a functional unit to continue to perform a required function in the presence of faults or errors

[SOURCE: EN 61508-4:2010, 3.6.3]

3.6
SIL-capability
the SIL-capability is determined by the measures and techniques for avoidance and control of faults in both, hardware and software. The SIL-capability number is a property of an element, a module, a combination of modules or of one or several safety function(s) of a gas detection system. There are three different SIL-capability numbers existing from 1 to 3, with SIL-capability 3 representing the highest level of safety performance for a gas detection system. Each module or combination of modules will be allocated a SIL-capability from both class of safe failure fraction and failure rates (λ).

3.7
engineered for SIL-capability
The term is a specialised form of the above term SIL-capability. It specifies the classes of SFF without reference to failure rates.

The term is used for functional modules where the failure modes apply in general but the failure rates will depend on the applications and therefore cannot be determined in general by the manufacturer.

3.8
module
modules form the functional units of a gas detection system. A module executes a defined part of the functionality within the gas detection system. It consists of one or more elements

Note 1 to entry: Modules may be simple or complex (see 4.3).

3.9
element
functional sub-unit of a module

Note 1 to entry: The software or a part of it may be considered as an element.

3.10
component
the hardware of a gas detection system consists of components which are physically separable subassemblies

Note 1 to entry: Depending of the specific realisation an element of a functional module may belong to different hardware components.

3.11
periphery
components of the total system which do not belong to the gas detection system but are related with it

Note 1 to entry: See Figure 3.

Note 2 to entry: Periphery is not covered by this European Standard.

3.12
measuring point
location of a single sensor aspirated by diffusion or by a probe

Note 1 to entry: See Figure 1.

3.13
measuring group
redundant combination of two measuring points belonging to one measuring location

Note 1 to entry: See Figure 1.

3.14
measuring location
area containing one or more measuring points in which similar gas concentrations are expected

Note 1 to entry: See Figure 1.

Note 2 to entry: According to 3.12 to 3.14 it is possible that one sensor serves as a redundant partner for several other sensors.

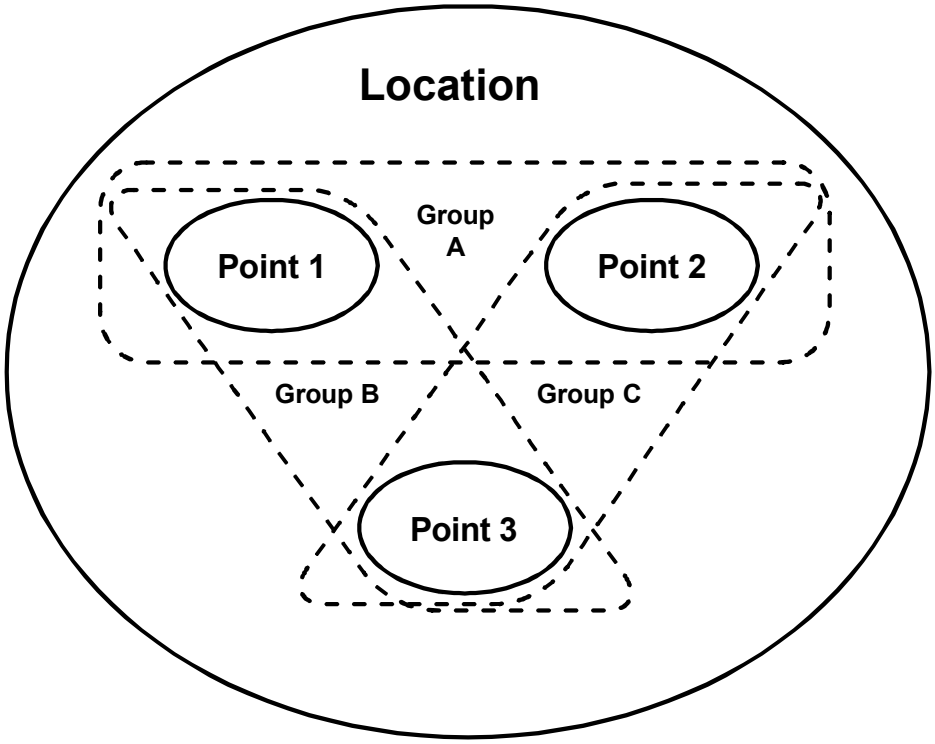

Figure 1 - Definitions of measuring point, measuring group and measuring location

3.15
measured signal
sensor signal in analogue or digital representation which may or may not be pre-amplified

3.16
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

3.17
status signal
electrical signal which indicates operational states, switching status of devices, adherence of general conditions (e. g. allowed temperature range or gas flow) within a module or to another module of the gas detection system

3.18
alarm signal
electrical signal which indicates the alarm state of one or more measurement points. The alarm signal will be processed either in the gas detection system (e. g. release of switching) or transmitted to the periphery

Note 1 to entry: Alarm signals are handled separately from other signals because they are generally handled with higher priority.

3.19
special state
every state of a measurement point, module, control unit or the total gas detection system in which the monitoring of gas concentration does not take place, e. g. put into operation, calibration mode or fault condition

3.20
parameter
setting by the manufacturer or user which affect the operation, e. g. changing of the alarm thresholds or measuring ranges. Parameter options are included in the software during design of the gas detection system. 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

3.21
minimum response time
value which is determined by the applicable metrological standards. In metrological standards the allowed response times during type testing are given. If there are different requirements for the response time in different applicable metrological standards the smallest value is the “minimum response time”

3.22
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”.

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

3.23
Self-testing facilities

test routines, e. g. memory check, which will be carried out within the gas detection system automatically and repeated cyclically. These facilities may be carried out within a single module or check the interconnection or co-operation between modules.

Self-testing facilities are cyclically repeated test routines, which do not interrupt the measuring mode. Test routines may also be carried out prior to operation, during start-up delay of a gas detection system before it starts the measuring mode, carried out on user request or in calibration mode of single measurement points or parts of the gas detection system

3.24
check
covers operational procedures, e. g. manual calibration, additional to self-test facilities on user request

3.25
verification
confirmation by examination and provision of objective evidence that the requirements have been fulfilled

[SOURCE: EN 61508-4:2010, 3.8.1]

3.26
redundancy
the existence of more than one means for performing a required function or for representing information

Note 1 to entry: Redundancy is used primarily to improve reliability (probability of functioning properly over a given period of time specified as T1) or availability (probability of functioning at given instant).

Note 2 to entry: Redundancy may be "hot" or "active" (all redundant item running at the same time), "cold" or "stand-by" (only one of the redundant item working at the same time), "mixed" (one or several items running and one or several items in stand-by at the same time).

[SOURCE: EN 61508-4:2010, 3.4.6, notes modified]