

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

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EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 50402:2005 sisaldab Euroopa standardi EN 50402:2005 ingliskeelset teksti. Käesolev dokument on jõustatud 27.09.2005 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 50402:2005 consists of the English text of the European standard EN 50402:2005. This document is endorsed on 27.09.2005 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.
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Käsitlusala: This European Standard is applicable to fixed gas detection systems for the detection and measurement of flammable or toxic¹) gases or vapours or oxygen.	Scope: This European Standard is applicable to fixed gas detection systems for the detection and measurement of flammable or toxic¹) gases or vapours or oxygen.
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ICS 13.320

Võtmesõnad:

**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**

Matériel électrique pour la détection et la
mesure des gaz ou vapeurs combustibles
ou toxiques, ou de l'oxygène –
Exigences relatives à la fonction
de sécurité des systèmes fixes
de détection de gaz

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

This European Standard was approved by CENELEC on 2005-07-01. 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
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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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 explosive atmospheres and by the Technical Committee CENELEC TC 216, Gas detectors.

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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.

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 sensors.

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 4 the maximum levels of performance to comply with this standard. The SIL-capability of a module is related to the maximum safety integrity level that can 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. The 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 toxic¹⁾ gases or vapours or oxygen.

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 61779 or EN 50241), toxic gases (e.g. EN 45544) or oxygen (e.g. EN 50104).

NOTE 1 These European Standards will be mentioned in the text as "metrological standards".

NOTE 2 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 standard is also applicable.

NOTE 3 For fixed apparatus used for safety applications with a SIL requirement up to 1 and for portable apparatus the European Standard EN 50271 may be applied instead of this European Standard.

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 or the categories of EN ISO 13849-1 (see Annex B).

This European Standard is a product standard which is based on EN 61508 and includes additional requirements of EN ISO 13849-1. It covers part of the phase 9 "realisation" of the overall safety lifecycle defined in EN 61508-1.

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 sensors..

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

NOTE 4 The SIL-capability required for an application will be specified by the user (see Annexes A and B).

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

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 ISO 13849-1 ²⁾		Safety of machinery – Safety related parts of control systems – Part 1: General principles of design (ISO 13849-1:1999)
EN 45544-1	1999	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	1999	Part 2: Performance requirements for apparatus used for measuring concentrations in the region of limit values
EN 45544-3	1999	Part 3: Performance requirements for apparatus used for measuring concentrations well above limit values
EN 45544-4	1999	Part 4: Guide for selection, installation, use and maintenance
EN 50073	1999	Guide for selection, installation, use and maintenance of apparatus for the detection and measurement of combustible gases or oxygen
EN 50104	2002	Electrical apparatus for the detection and measurement of oxygen - Performance requirements and test methods
EN 50241-1	1999	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	1999	Part 2: Performance requirements for apparatus for the detection of combustible gases
EN 61508-1	2001	Functional safety of electrical / electronic / programmable electronic safety-related systems Part 1: General requirements (IEC 61508-1:1998)
EN 61508-2	2001	Part 2: Requirements for electrical/electronic/programmable electronic safety-related systems (IEC 61508-2:2000)
EN 61508-3	2001	Part 3: Software requirements (IEC 61508-3:1998)
EN 61508-4	2001	Part 4: Definitions and abbreviations (IEC 61508-4:1998)
EN 61508-5	2001	Part 5: Examples of methods for the determination of safety integrity levels (IEC 61508-5:1998)
EN 61508-6	2001	Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3 (IEC 61508-6:2000)
EN 61508-7	2001	Part 7: Overview of techniques and measures (IEC 61508-7:2000)
EN 61511-1	2004	Functional safety – Safety instrumented systems for the process industry sector Part 1: Framework, definitions, system, hardware and software requirements (IEC 61511-1:2003)
EN 61779-1	2000	Electrical apparatus for the detection and measurement of flammable gases Part 1: General requirements and test methods (IEC 61779-1:1998, mod.)
EN 61779-2	2000	Part 2: Performance requirements for group I apparatus indicating a volume fraction up to 5 % methane in air (IEC 61779-2:1998, mod.)

²⁾ At draft stage.

EN 61779-4	2000	Part 4: Performance requirements for group II apparatus indicating a volume fraction up to 100 % lower explosive limit (IEC 61779-4:1998, mod.)
EN 61779-5	2000	Part 5: Performance requirement for group II apparatus indicating a volume fraction up to 100 % gas (IEC 61779-5:1998, mod.)

3 Definitions

For the purpose of this document the definitions given in EN 61779 and EN 61508-4 apply. Some definitions are repeated for convenience. Some definitions from EN 61508-4 are adapted to gas detection.

3.1

functional safety (EN 61508-4: 3.1.9)

part of the overall safety relating to the equipment under control (EUC) and the EUC control system which depends on the correct functioning of the electrical/electronic/programmable electronic safety-related systems (E/E/PES), other technology safety-related systems and external risk reduction facilities

NOTE 1 The EUC is the equipment under control or the process that the gas detection system is assuring the safety of (EN 61508-4: 3.2.3).

NOTE 2 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: 3.3.4).

NOTE 3 The gas detection system is part of the E/E/PES.

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 (EN 61508-4: 3.6.1)

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

3.5

fault tolerance (EN 61508-4: 3.6.3)

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

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 four different SIL-capability numbers existing from 1 to 4, with SIL-capability 4 representing the highest level of safety performance

3.7

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 Modules may be simple or complex (see 4.2).