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**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 50271:2001**

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EUROPEAN STANDARD

**EN 50271**

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EUROPÄISCHE NORM

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ICS 13.320

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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# CENELEC

European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

### 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.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50271 on 2001-05-01.

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) 2002-06-01
  - latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2004-04-01
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## 1 Scope

This European Standard specifies requirements and tests for electrical apparatus for the detection and measurement of combustible gases, toxic<sup>1</sup> gases or oxygen using software and/or digital technologies. It is applicable to fixed, transportable and portable apparatus intended for use

- in domestic premises or
- in industrial applications where safety integrity levels 1 or 2 of IEC 61508 or safety categories 1 or 2 of EN 954-1 are required.

In industrial applications this standard is also applicable to apparatus which are intended for use in hazardous areas which may contain explosive or potentially explosive atmospheres.

This European standard supplements the requirements of the European Standards for the detection and measurement of combustible gases and vapours (e.g. EN 61779-1 to EN 61779-5, EN 50194), toxic gases (e.g. EN 45544, EN 50291) or oxygen (e.g. EN 50104).

## 2 Normative references

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places 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 of the publication referred to applies.

EN 954-1	Safety of machinery. Safety related parts of control systems - Part 1: General principles for design
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 50194	Electrical apparatus for the detection of combustible gases in domestic premises – Test methods and performance requirements
EN 50291	Electrical apparatus for the detection of carbon monoxide in domestic premises – Test methods and performance requirements
EN 61779-1	Electrical apparatus for the detection and measurement of flammable gases Part 1: General requirements and test methods

<sup>1</sup> For the purposes of this standard the word 'toxic' should be taken to include 'very toxic', 'toxic', 'harmful', 'corrosive', 'irritating', 'carcinogenic', 'mutagenic' and 'toxic to reproduction'.

EN 61779-2	Part 2: Performance requirements for group I apparatus indicating a volume fraction up to 5 % methane in air
EN 61779-3	Part 3: Performance requirements for group I apparatus indicating a volume fraction up to 100 % methane in air
EN 61779-4	Part 4: Performance requirements for group II apparatus indicating a volume fraction up to 100 % lower explosive limit
EN 61779-5	Part 5: Performance requirements for group II apparatus indicating a volume fraction up to 100 % gas
IEC 61508-1	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 1 : General requirements
IEC 61508-3	Functional safety of electrical/electronic/programmable electronic safety-related systems - Part 3 : Software requirements

### 3 Definitions

For the purposes of this European Standard, the definitions given in EN 61779-1 apply together with the following definitions:

#### 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, calibration mode 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

##### **safety-related software**

software that is used to implement safety functions

#### 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

### 4 Design principles

#### 4.1 General design requirements

In general the design of digital units has to follow good design practice. Requirements are listed in the following clauses.

#### 4.1.1 Analogue/digital interface

The relationship between corresponding analogue and digital values shall be unambiguous. The output range shall be capable of coping with the full range of input values within the instrument specification. A clear indication shall result if the conversion range has been exceeded. A/D- and D/A-converter quantisation steps shall be chosen so that the requirements in 4.1.2 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.

#### 4.1.2 Numerical errors

The resolution of data formats and precision to which values are computed shall be chosen so that any errors arising from the digital processing shall not be greater than the smallest deviation of indication required by the applicable European Standard. During data processing the digital unit shall control automatically the allowed input, output and internal data range and handle range violations. Estimation of deviations of measured values arising from quantisation, rounding and calculation errors shall take into account worst case conditions.

#### 4.1.3 Measuring operation

During measuring operation, the maximum overall time of four successive updates of the output value shall not exceed the response time  $t_{90}$ , as required by the applicable European Standard, or time to alarm for alarm only apparatus

#### 4.1.4 Special state indication

If a special state is entered by an apparatus this shall be indicated by a signal. The special state shall be also indicated on outputs provided for remote transmission of measuring values.

#### 4.1.5 Digital indication

If data for several indications are generated simultaneously by an apparatus it shall be possible to identify the indications. A combined signal shall be generated if all indications cannot be activated. In this case the indication with the highest safety priority at a given time shall be displayed or activated simultaneously. (Preferences of safety importance of indications shall be set suitably for each apparatus and documented in the instruction manual). It shall be possible to interrogate the indications that are not currently shown or activated.

If release of an indication encloses the automatic release of a second subsidiary indication (e. g. exceeding the 2nd limiting value includes exceeding the 1st limiting value) it is sufficient to show the indication of higher priority. After cancelling the higher order indication the subsidiary indication shall remain if the reason for its activation still exists.

#### 4.1.6 Digital reading (not applicable to alarm only apparatus)

For indicated 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.

### 4.2 Software

Software components shall comply with IEC 61508-3 safety integrity levels 1 and 2. In particular :

- a) It shall be possible for the user to identify the installed software version, for example by marking on the installed memory component, in (if accessible) or on the apparatus or by showing it on the display during power up or on user command.
- b) It shall not be possible for the user to modify the software function.
- c) Parameter settings shall be checked for validity. Invalid inputs shall be rejected. An access barrier shall be provided against parameter changing by unauthorised persons, e. g. it may be integrated by an authorisation code in the software or may be realised by a mechanical lock. Parameter settings shall be preserved after apparatus switch-off and while passing a special state. All user changeable parameters and their valid ranges shall be listed in the manual.



- d) Software shall have a structured and modular design to facilitate testing and maintenance. Program modules shall have a clearly defined interface to other modules.
- e) Software documentation shall be included in the technical file of the product. It shall include:
- the apparatus to which the software belongs;
  - unambiguous identification of program version;
  - type and version of software tools used;
  - source code of safety-related software modules;
  - functional description;
  - software structure (e. g. flow chart, Nassi-Schneidermann diagram);
  - software validation protocols;
  - any software modification provided with the date of change and new identification data.

NOTE The documentation is only for the use of the test laboratory. All information is confidential and is the property of the manufacturer.

- f) When third party approval includes safety related software, modifications of software functions by the manufacturer shall be notified to the third party. Modifications shall be fully documented and explained. Further testing may be necessary depending on the complexity of the modification.

#### 4.3 Hardware

Components shall only be used within their specifications or they shall be verified by individual testing. For interconnection between components, cabling and other interface specifications shall be adhered to.

It shall be impossible to change the program code under any operating conditions. Upgrades shall only be possible under the control of the manufacturer.

To store parameters and variables, which should be permanent even after switch-off or during a special state, storage parts shall be used in which the data content remains permanent when the supply voltage is removed. Where a battery is used for this purpose, the instruction manual shall indicate the life time of the data storage.

#### 4.4 Data transmission

Digital data transmission between spatially separated components of apparatus shall be reliable. Delays resulting from transmission errors shall not extend the response time  $t_{90}$  or time to alarm for alarm only apparatus by more than 1/3. If not the apparatus shall pass over to a defined special state. The defined special state shall be documented in the instruction manual.

#### 4.5 Test routines

Computerised digital units shall incorporate test routines. On failure detection, the apparatus shall pass over to a defined special state. The defined special state shall be documented in the instruction manual.

The following minimum tests shall be performed by the apparatus:

- a) power supply of digital units shall be monitored within time intervals of maximum ten times response time  $t_{90}$  or time to alarm for alarm only apparatus;
- b) all available visible and audible output functions shall be tested. The test shall be carried out automatically after starting operation or on user request. The result may need to be verified by the user;
- c) monitoring equipment with its own time base (e. g. watchdog) shall work independently and separately from the parts of the digital unit which perform the data processing. If a failure is detected by the monitoring equipment the apparatus shall enter into a special state;