SLOVENSKI STANDARD
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Zrak na delovnem mestu - 2. del: Plinski detektorji - Izbira, vgraditev, uporaba in vzdrževanje detektorjev strupenih plinov, hlapov in kisika

Workplace atmospheres - Part 2: Gas detectors - Selection, installation, use and maintenance of detectors for toxic gases and vapours and oxygen

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13.320	Alarmni in opozorilni sistemi	Alarm and warning systems

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COMMITTEE DRAFT FOR VOTE (CDV)

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IEC TC 31 : EQUIPMENT FOR EXPLOSIVE ATMOSPHERES	
SECRETARIAT: United Kingdom	SECRETARY: Mr Mick Maghar
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CDV to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT	☐ QUALITY ASSURANCE ☐ SAFETY
☒ SUBMITTED FOR CENELEC PARALLEL VOTING **Attention IEC-CENELEC parallel voting** The attention of IEC National Committees, members of CENELEC, is drawn to the fact that this Committee Draft for Vote (CDV) is submitted for parallel voting. The CENELEC members are invited to vote through the CENELEC online voting system.	☐ NOT SUBMITTED FOR CENELEC PARALLEL VOTING

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TITLE:

Workplace atmospheres – Part 2: Gas detectors – Selection, installation, use and maintenance of detectors for toxic gases and vapours and oxygen

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NOTE FROM TC/SC OFFICERS:

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WORKPLACE ATMOSPHERES –
Part 2: Gas detectors –
Selection, installation, use and maintenance of detectors for toxic gases and vapours

FOREWORD

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International Standard ISO/IEC 62990-2 has been prepared by Joint Working Group (JWG) 45 of IEC technical committee 31: Equipment for explosive atmospheres and ISO technical committee 146: Air quality, sub-committee 2: Workplace atmospheres.

The text of this standard is based on the following documents:

FDIS	Report on voting
31/XX/FDIS	31/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,

- replaced by a revised edition, or
- amended.

The National Committees are requested to note that for this publication the stability date is ....
THIS TEXT IS INCLUDED FOR THE INFORMATION OF THE NATIONAL COMMITTEES AND WILL BE DELETED AT THE PUBLICATION STAGE.

INTRODUCTION

Toxic gas detection equipment may be used whenever there is the possibility of a hazard to life or adverse health effects caused by the accumulation of a toxic gas or vapour. Such equipment can provide a means of reducing the exposure to the hazard by detecting the presence of a toxic gas or vapour and issuing suitable audible or visual warnings. Gas detectors may also be used to initiate precautionary steps (e.g. plant shutdown and evacuation).

Performance requirements for gas detection equipment for workplace atmospheres are set out in ISO/IEC 62990-1 and ISO/IEC 62990-3.

However performance capability alone cannot ensure that the use of such equipment will properly safeguard life and health where toxic gases and vapours may be present. The level of safety obtained depends heavily upon correct selection, installation, calibration and periodic maintenance of the equipment, combined with knowledge of the limitations of the detection technique required. This cannot be achieved without responsible informed management.

This standard has been specifically written to cover all the functions necessary from selection to ongoing maintenance for a successful gas detection operation.

WORKPLACE ATMOSPHERES –
Part 2: Gas detectors –
Selection, installation, use and maintenance of detectors for toxic gases and vapours

1 Scope

This document gives guidance on the selection, installation, use and maintenance of electrical equipment used for the direct detection and direct concentration measurement of toxic gases and vapours in workplace atmospheres. The primary purpose of such equipment is to ensure safety of personnel and property by providing an indication of the concentration of a toxic gas or vapour and warning of its presence.

This document is applicable to equipment whose purpose is to provide an indication, alarm and/or other output function to give a warning of the presence of a toxic gas or vapour in the atmosphere and in some cases to initiate automatic or manual protective actions. It is applicable to equipment in which the sensor automatically generates an electrical signal when gas is present.

For the purposes of this document, equipment includes

a) fixed equipment;

b) transportable equipment, and

c) portable equipment.

This document is intended to cover equipment defined within ISO/IEC 62990-1, but may provide useful information for equipment not covered by that document.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 62990-1, *Workplace atmospheres – Part 1: Gas detectors – Performance requirements of detectors for toxic gases*

IEC 60079-10-1, *Explosive atmospheres – Part 10-1: Classification of area – Explosive gas atmospheres*

IEC 60079-29-2, *Explosive atmospheres – Part 29-2: Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen*

IEC 60079-0, *Explosive atmospheres – Part 0: Equipment – General requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 62990-1, as well as the following apply. In addition, since this is intended as a stand-alone standard, certain definitions within ISO/IEC 62990-1 are repeated below for the convenience of the reader.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

NOTE Additional definitions applicable to explosive atmospheres can be found in Chapter 426 of the International Electrotechnical Vocabulary (IEV) IEC 60050 (426).

3.1
toxic gas
gas or vapour that can be harmful to human health and/or the performance of persons due to its physical or physico-chemical properties

Note 1 to entry: For the purpose of this document, the term "toxic gas" includes "toxic vapours".

3.2
interfering gas
any gas other than the gas to be detected, including water vapour, which affects the indication

3.3
clean air
air that is free of gases or vapours which the sensor is sensitive to or which influence the performance of the sensor

3.4
zero gas
gas recommended by the manufacturer, which is free of toxic gases and interfering and contaminating substances, the purpose of which is calibration or adjustment of the equipment zero

3.5
volume fraction
quotient of the volume of a specified component and the sum of the volumes of all components of a gas mixture before mixing, all volumes referring to the pressure and the temperature of the gas mixture

Note 1 to entry: The volume fraction and volume concentration take the same value if, at the same state conditions, the sum of the component volumes before mixing and the volume of the mixture are equal. However, because the mixing of two or more gases at the same state conditions is usually accompanied by a slight contraction or, less frequently, a slight expansion, this is not generally the case.

3.6
occupational exposure limit value
OELV
limit of the time-weighted average of the concentration of a chemical agent in the air within the breathing zone of a worker in relation to a specified reference period

Note 1 to entry: The term "limit value" is often used as a synonym for "occupational exposure limit value", but the term "occupational exposure limit value" is preferred because there is more than one limit value (e.g., biological limit value and occupational exposure limit value).

Note 2 to entry: Occupational exposure limit values (OELVs) are often set for reference periods of 8 h, but can also be set for shorter periods or concentration excursions.

[SOURCE: ISO 18158:2016, 2.1.5.4, modified (Note 2 to entry is shortened)]

3.7
exposure (by inhalation)
situation in which a chemical agent is present in air that is inhaled by a person

3.8
time weighted average concentration
TWA concentration
concentration of gas in air averaged over a reference period

3.9
fixed equipment
equipment fastened to a support, or otherwise secured in a specific location when energized

3.10
transportable equipment
equipment not intended to be carried by a person during operation, nor intended for fixed installation

3.11
portable equipment
equipment intended to be carried by a person during its operation

Note 1 to entry: Portable equipment is battery powered and includes, but is not limited to;

a) hand-held equipment, typically less than 1 kg, which requires use of only one hand to operate,

b) personal monitors, similar in size and mass to the hand-held equipment, that are continuously operating while they are attached to the user, and,

c) larger equipment that can be operated by the user while it is carried either by hand, by a shoulder strap or carrying harness and which may or may not have a hand directed probe.

3.12
personal equipment
portable equipment attached to a person that monitors the atmosphere in their breathing zone so that their exposure to toxic gases can be determined

Note 1 to entry: Also known as a personal monitor.

3.13
aspirated equipment
equipment that samples the atmosphere by drawing it to the sensor

Note 1 to entry: A hand operated or electric pump is often used to draw gas to the sensor.

3.14
alarm-only equipment
equipment with an alarm but not having an indication of measured value

3.15
sensing element
part of the sensor which is sensitive to the gas/vapour to be measured

3.16
sensor
assembly in which the sensing element is housed and that may also contain associated circuit components

3.17
remote sensor
sensor which is installed separately, but is connected to a gas detection control unit, gas detection transmitter, or to transportable or portable equipment

3.18
gas detection transmitter
fixed gas detection equipment that provides a conditioned electronic signal or output indication to a generally accepted industry standard (such as 4-20 mA), intended to be utilized with separate gas detection control units or signal processing data acquisition, central monitoring and similar systems, which typically process information from various locations and sources including, but not limited to gas detection equipment

3.19
gas detection control unit
equipment intended to provide display indication, alarm functions, output contacts or alarm signal outputs or any combination when operated with remote sensor(s)

3.20
alarm set point
setting of the equipment at which the measured concentration will cause the equipment to initiate an indication, alarm or other output function

3.21
fault signal
audible, visible or other type of output, different from the alarm signal, permitting, directly or indirectly, a warning or indication that the equipment is not working satisfactorily

3.22
sample line
means by which the gas being sampled is conveyed to the sensor

Note 1 to entry: Accessories such as filter or water trap are often included in the sample line.

3.23
sampling probe
separate accessory sample line which is optionally attached to the equipment

Note 1 to entry: It is usually short (e.g. of the order of 1 m) and rigid, although it can be telescopic. In some cases it is connected by a flexible tube to the equipment.

3.24
field calibration kit
means of presenting test gas to the equipment for the purpose of calibrating, adjusting or verifying the operation of the equipment

Note 1 to entry: The field calibration kit can be used for verifying the operation of the alarms if the concentration of the test gas is above the alarm set-point.

Note 2 to entry: A mask for calibration and test is an example of a field calibration kit.

3.25
zero indication
indication given by an equipment when exposed to zero gas in normal operating conditions

3.26
indication range
range of measured values of gas concentration over which the equipment is capable of indicating (see Figure 1)

3.27
lower limit of indication
smallest measured value within the indication range (see Figure 2)

3.28
upper limit of indication
largest measured value within the indication range (see Figure 2)

3.29
measuring range
range of measured values of gas concentration over which the accuracy of the equipment lies within specified limits (see Figure 2)

3.30
lower limit of measurement
smallest measured value within the measuring range (see Figure 2)

3.31
upper limit of measurement
largest measured value within the measuring range (see Figure 2)

3.32
expanded uncertainty
U
quantity defining an interval about a result of a measurement, expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurand

[SOURCE: ISO 18158:2016, 2.4.2.5]

3.33
zero uncertainty
quantity defining an interval about zero expected to encompass a large fraction of the distribution of values that could reasonably be attributed to the measurement in clean air

Note 1 to entry: In Figure 2, the mean value of the measured values in clean air is not equal to zero to illustrate that there can be an offset due to drift. The mean value can be above or below zero.

3.34
selectivity
degree of independence from interfering gases

3.35
averaging time
period of time for which the measuring procedure yields an averaged value

3.36
drift
variation in the equipment indication over time at any fixed gas volume fraction (including clean air) under constant ambient conditions

3.37
time of recovery
t(x)
time interval, with the equipment in a warmed-up condition, between the time when an instantaneous change from standard test gas to clean air is produced at the equipment inlet and the time when the indication reaches a stated percentage (x) of the initial indication

Note 1 to entry: For alarm only equipment the stated indication can be represented by the de-activation of the alarm set at a stated value.

3.38
time of response
t(x)
time interval, with the equipment in a warmed-up condition, between the time when an instantaneous change between clean air and the standard test gas is produced at the equipment inlet, and the time when the indication reaches a stated percentage (*x*) of the final indication

Note 1 to entry: For alarm only equipment the stated indication can be represented by the activation of the alarm set at a stated value.

3.39
warm-up time
time interval, with the equipment in a stated atmosphere, between the time when the equipment is switched on and the time when the indication reaches and remains within the stated tolerances

Note 1 to entry: See Figure 1.

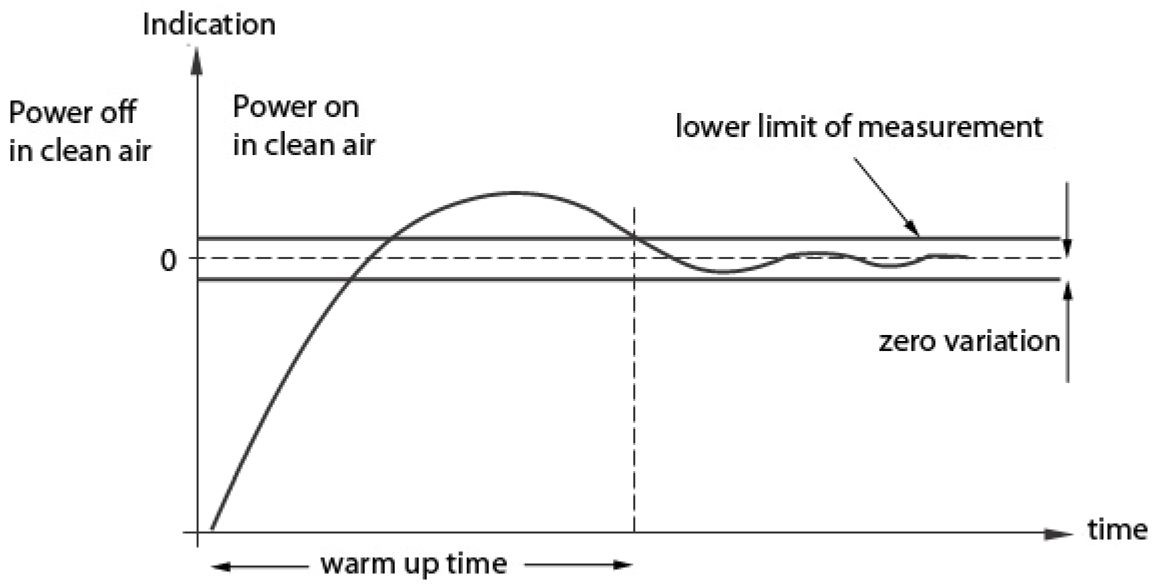

Figure 1 – Example of warm-up time in clean air

3.40
calibration
procedure which establishes the relationship between a measured value and the concentration of a test gas

Note 1 to entry: If the deviation at calibration is too high, usually an adjustment will be carried out subsequently.

3.41
adjustment
procedure carried out to minimize the deviation of the measured value from the test gas concentration

Note 1 to entry: When the equipment is adjusted to give an indication of zero in clean air, the procedure is called 'zero adjustment'.

3.42
special state
any state of the equipment other than those in which monitoring of gas concentration and/or alarming is the intent

Note 1 to entry: Special state includes warm-up, calibration mode or fault condition.

3.43
ventilation
movement of air and its replacement with fresh air due to the effects of wind, temperature gradients, or artificial means (for example, fans or extractors)

4 Properties and detection of toxic gases and vapours

4.1 Properties and detection

A distinction is drawn between gases, which remain gaseous at typical ambient pressures and temperatures, and vapours where liquid can also exist at any relevant pressure or temperature. The following properties and behaviours of gases should be taken into account, in particular when locating detectors or deciding on a sampling strategy, in order to obtain representative indications. Failure to take proper consideration of these gas properties and behaviours may lead to failure to alarm and failure to take appropriate action or false alarms and incorrect action. It may also lead to false estimates of exposure.

Toxic gases typically become harmful at low concentrations (occupational exposure limit values typically range from ppb to 1 % v/v levels). At distances far from the source of toxic gas release, the relative density of such a gas mixture is not significantly different from that of air. However, close to the source, the relative density can be significantly different, although consideration should be given to influences by the thermal effect of pressurised gas.

Gases and mixtures with relative densities between 0,8 and 1,2 should generally be considered to behave like air at ambient temperatures and are therefore capable of propagating in all directions.

High pressure leaks can generate gas clouds that propagate over significant distances from the source before mixing. This can occur for sources where the gas can be of any density.

In stagnant environments low pressure leaks can build up local high concentration pockets due to insufficient passive air movement.

Spillage of liquids can result in toxic vapour clouds that can disperse over long distances and duration and can accumulate in trenches, drains, tunnels etc. This is a result of liquid and vapour flow under gravity, cooling due to evaporation, and densities greater than air. The vapour cloud tends to stay close to the ground until well mixed with air. Nevertheless, concentrations in the breathing zone can approach harmful levels.

Gases and vapours fully mix with each other by diffusion over time or if stirred (e.g. by convection or mechanical ventilation). Once they have been mixed, they will remain mixed, unless a component is removed chemically or is absorbed, for instance on a charcoal filter. Additionally, in the case of vapours, the concentration can be lowered by condensation due to increased pressure or reduced temperature. Some gases can react chemically with each other on mixing, e.g. nitric oxide and oxygen.

The toxic component within a gas mixture follows the characteristics of the mixture, irrespective of the physical characteristics of the toxic component in pure form. The detection of H_2S for sour gas applications should be based on consideration of the characteristics of the sour gas mixture as a whole – typically dominated by methane, i.e. a “lighter than air” mixture, irrespective of the properties of pure H_2S.

Air movement by convection, mechanical ventilation or wind can have a marked effect on gas distribution. A heat source in an enclosed space, for example, can create a circular flow where the heated gas rises, runs along the ceiling and falls as it cools, then runs along the floor back to the heat source.

Flow patterns can become very complicated and voids may well exist in which the gas may accumulate. Consequently, each workplace scenario could be different. The use of smoke tubes, mathematical modelling or scale models placed in wind tunnels may help to optimize the location of fixed detectors.

Some gases tend to stick (sorb) on surfaces, which leads to a decrease of their concentration in air. This behaviour can be significant, especially with low gas concentrations and for reactive gases. Sorbed gases can desorb and produce a response even when there is no gas present in the monitored air. The sorption/desorption properties of each gas should be considered before the measurement task is undertaken. This is particularly important where sampling probes or sample lines are used to convey the gas to the equipment. The gas flow rate, temperature, length, diameter and material from which the probe or line is made are important factors.

Hygroscopic gases can form aerosols, which could be hazardous. A detector, which is only capable of measuring gas phase concentrations, will underestimate the true hazard.

4.2 The difference between detecting gases and vapours

4.2.1 Gases

4.2.1.1 Characteristics of gases

Substances that remain gaseous under the range of temperatures and pressures relevant to the gas detection application will closely follow the Gas Laws and behave predictably.