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Part 29-0: Gas detectors – General requirements and test methods, and possible supplementary parts

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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UK Vote

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



31/1711/CD

COMMITTEE DRAFT (CD)

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31/1635/NP, 31/1664A/RVN

IEC TC 31 : EQUIPMENT FOR EXPLOSIVE ATMOSPHERES	
SECRETARIAT: United Kingdom	SECRETARY: Mr Tom Stack
OF INTEREST TO THE FOLLOWING COMMITTEES:	PROPOSED HORIZONTAL STANDARD: ☐ Other TC/SCs are requested to indicate their interest, if any, in this CD to the secretary.
FUNCTIONS CONCERNED: ☐ EMC ☐ ENVIRONMENT ☐ QUALITY ASSURANCE ☒ SAFETY	

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TITLE:

Explosive atmospheres - Part 29-0: Gas detectors – General requirements and test methods, and possible supplementary parts.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**EXPLOSIVE ATMOSPHERES - Part 29-0: Gas detectors –
General requirements and test methods****FOREWORD**

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International Standard IEC 60079-29-0 has been prepared by the IEC technical committee 31: Equipment for explosive atmospheres.

The text of this International Standard is based on the following documents:

FDIS	Report on voting

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

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

A list of all parts in the IEC 60079-29 series can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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176

INTRODUCTION

177 This part of IEC 60079-29 specifies general requirements for the design and describes the test
178 methods that apply to portable, transportable and fixed equipment intended to measure the
179 concentration of gases and vapours in industrial and commercial applications including workplace
180 atmospheres. Performance requirements are defined in supplementing parts of IEC 60079-29.
181 They are intended to apply under environmental conditions present at the site of operation.
182 However, because a wide range of environmental conditions are encountered in practice, these
183 supplementing parts specify requirements that have to be fulfilled by equipment when tested
184 under prescribed laboratory conditions.

185 Electrical equipment used for the direct detection and direct concentration measurement of toxic
186 gases and vapours generate readings in clean air (nominally zero), which vary with
187 environmental conditions and time. This document therefore includes test methods and
188 requirements for acceptable variations in measured values at application of zero gas and of
189 defined test gases.

190 Consideration should also be given to the following relevant standards:

191 General requirements for construction, testing and performance of open path detectors for
192 flammable gases are set out in IEC 60079-29-4, *Explosive atmospheres – Part 29-4: Gas*
193 *detectors – Performance requirements of open path detectors for flammable gases*.

194 Guidance for the selection, installation, use and maintenance of gas detecting equipment is set
195 out in IEC 60079-29-2: *Explosive atmospheres – Part 29-2, Gas detectors – Selection,*
196 *installation, use and maintenance of detectors for flammable gases and oxygen*.

197 Guidance for functional safety of fixed gas detection systems is set out in IEC 60079-29-3:
198 *Explosive atmospheres – Part 29-3, Gas detectors – Guidance on functional safety of fixed gas*
199 *detection systems*.

200

201

Part 29-0: Gas detectors – General requirements and test methods

1 Scope

This part of IEC 60079-29 specifies general requirements for the design and describes the test methods as well as performance requirements that apply to portable, transportable and fixed equipment intended to measure the concentration of gases and vapours in industrial and commercial applications including explosive atmospheres, mines susceptible to firedamp, and workplace atmospheres.

This document is applicable to gas detection equipment whose primary purpose is to provide an indication, alarm or other output function. It is applicable to equipment in which the sensor generates an electrical/electronic signal correlating with the target gas concentration.

This document applies to the following gas detection equipment:

- Type Group I Flammable gas detection equipment:
Equipment intended for the detection of flammable gases in mines susceptible to fire damp.
- Type Group II Flammable gas detection equipment:
Equipment intended for the detection of flammable gases in explosive atmosphere other than mines susceptible to fire damp.
- Type DE oxygen detection equipment:
Equipment intended for monitoring oxygen deficiency or oxygen enrichment.
- Type IN oxygen detection equipment:
Equipment for monitoring inertisation as measuring function for explosion protection.
NOTE: Inertisation is an explosion protection technique where an explosive atmosphere is purged with inert gas.
- Type SM (Safety Monitoring) toxic gas detection equipment:
Equipment for general gas detection applications (e.g. safety warning, leak detection), and typically using alarm signalling.
NOTE: Toxic gas detection equipment for Health Monitoring (Type HM) performance requirements reside in IEC 62990-1.
- Type OF (Open Path Flammable) and Type OT (Open Path Toxic) gas detection equipment:
Equipment for the detection and measuring of gases or vapours in ambient air by measuring the spectral absorption by the gases or vapours over an open area or cross-duct optical path.

For Type OF and Type OT, this document specifies performance requirements for portable, transportable and fixed equipment for the detection and measuring of gases or vapours in ambient air by measuring the spectral absorption by the gases or vapours over optical paths typically ranging from less than one metre up to several hundred metres.

Such equipment measures the integral concentration of the absorbing gas over the optical path in units such as LFL metre for flammable gases or ppm metre for toxic gases.

NOTE 1 Actual values of concentration in units such as %LFL or ppm can be deduced only where it can be assumed that the concentration is uniform over the optical path. See Appendix X for additional guidance.

247 NOTE 2 The 'integral concentration' of the absorbing gas is sometimes termed the 'column density' of the absorbing
248 gas.

249 NOTE 3 This standard is based upon absorption techniques using infrared radiation. Other techniques and
250 applications may require additional test considerations to address the particular characteristics of those approaches.

251 Equipment falling within the scope of this standard is classified by the following configurations:

252 a) separate optical transmitter and receiver, located at respective ends of the path through the
253 atmosphere to be monitored.

254 b) an optical transceiver (i.e. combined transmitter and receiver) and a dedicated reflector
255 located at respective ends of the path through the atmosphere to be monitored.

256 c) an optical transceiver that utilizes topographical features in the environment instead of a
257 dedicated reflector at the end of a path through the atmosphere to be monitored.

258

259 Additionally, open path gas detectors are characterised by the following features:

260 a) The optical transmitter and receiver, or transceiver and reflector, are mechanically
261 decoupled.

262 b) The optical path length may vary according to particular applications and installations (i.e.
263 it is not fixed).

264 c) There is no single mechanical enclosure of any type across the optical path (e.g.
265 environmental cover).

266 d) It is assumed the gas concentration across the optical path is not uniform.

267 The particular technical challenges experienced by open path gas detectors that are not
268 experienced by single point detectors include:

269 a) The maintenance of proper alignment between transmitter and receiver or transceiver and
270 reflector.

271 b) The detection and resolution of obstructions in the optical path.

272 c) Ensuring immunity from interfering light sources.

273 .This standard is also applicable when an equipment manufacturer makes any claims regarding
274 any special features of construction or performance that exceed the minimum requirements of
275 this standard or when the equipment is used in applications where a uniform gas concentration
276 is assumed to be present. All such claims shall be verified and the test procedures should be
277 extended or supplemented, where necessary, to verify the claimed performance. The additional
278 tests shall be agreed between the manufacturer and the test laboratory and identified and
279 described in the test report.

280 This standard does not apply to any of following:

281 a) equipment consisting of a passive optical receiver without a dedicated optical source;

282 b) equipment intended for the detection of dusts or mists in air;

283 c) equipment intended for the detection of explosives; and

284 This standard is applicable to equipment which is intended for use in hazardous or non-
285 hazardous areas, or both. Equipment for use in hazardous areas is also required to have
286 explosion protection in accordance with the 60079 series of standards.

287 NOTE This standard is intended to provide for the supply of equipment giving a level of performance suitable for
288 general purpose applications. However, for specific applications a prospective purchaser or an appropriate authority
289 may additionally require equipment to be submitted for particular tests or approval. Such tests or approval are
290 regarded as additional to and separate from the provisions of the standards referred to above.

291

292 This document is not applicable to equipment:

- 293 – used for medical applications
- 294 – used only in laboratories for analysis or measurement;
- 295 – used only for process monitoring or control purposes (such as a gas analyser);
- 296 – used in the domestic environment;
- 297 – used in environmental air pollution monitoring;
- 298 – used for flue gas analysis
- 299 – used for sampling systems external from the gas detection equipment.

300

301 2 Normative references

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

306 IEC 60068-2-6, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

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

308 IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

309 IEC 61000-4-29, *Electromagnetic compatibility (EMC) – Part 4-29: Testing and measurement
310 techniques – Voltage dips, short interruptions and voltage variations on d.c. input power port
311 immunity tests*

312 IEC 61000-6-3, *Electromagnetic compatibility (EMC) – Part 6-3: Generic standards – Emission
313 standard for residential, commercial and light-industrial environments*

314 IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission
315 standard for industrial environments*

316 IEC 61326-1, *Electrical equipment for measurement, control and laboratory use – EMC
317 requirements – Part 1: General requirements*

318 3 Terms and definitions

319 For the purposes of this document, the following terms and definitions apply.

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

- 322 • IEC Electropedia: available at <http://www.electropedia.org/>
- 323 • ISO Online browsing platform: available at <http://www.iso.org/obp>

324 3.1 325 gas properties

326 3.1.1
327 ambient air, [<gas detection>](#)
328 normal atmosphere surrounding the equipment

3.1.2**clean air, <gas detection>**

air that is free of ~~flammable or toxic~~ gases or vapours ~~or substances~~ to which the sensor is sensitive or which influence the performance of the sensor

3.1.3**reference air, <gas detection>**

air with an oxygen concentration of $(21 \pm 0,4) \%$ ~~(v/v)~~

3.1.4**zero test gas, <gas detection>**

gas, which is free of the gas(es) to be measured and interfering and contaminating substances, the purpose of which is calibration/adjustment of the equipment zero

3.1.5**standard test gas, <gas detection>**

test gas ~~with a composition specified for each item of equipment and gas or vapour to be used for all tests unless otherwise stated~~ to be used for all tests unless otherwise stated

3.1.6**flammable gas, <gas detection>**

ADMITTED: flammable gases

DEPRECATED: combustible gas

gas or vapour which, when mixed with air in a certain proportion, will form an explosive atmosphere

Note 1 to entry: For the purposes of this part of IEC 60079-29, the term "flammable gas" includes flammable vapours.

Note 2 to entry: For the purposes of this part of IEC 60079-29, the terms "combustible gas" and "flammable gas" are equivalent.

[SOURCE: IEC 60070-10-1:2020 with "or vapour" dropped from term and two notes to entry added. Admitted and deprecated terms also added]

3.1.7**toxic gas, <gas detection>**

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".~~

3.1.8**poisons, <gas detection>**

<for sensing elements> substances that lead to temporary or permanent change of performance, particularly loss of sensitivity of the sensing element

3.1.9**volume fraction (v/v)**

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.

~~**3.1.10**~~~~**reference period**~~

~~specified period of time for which the occupational exposure limit value of a chemical agent applies~~

~~Note 1 to entry: The reference period is usually 8 h for long-term measurements and 15 min for short-term measurements.~~

~~[SOURCE: ISO 18158:2016, 2.1.5.7, modified (term “biological agent” deleted as not relevant to the current document)]~~

3.2

~~component of~~ gas detection equipment

3.2.1

alarm-only equipment, <gas detection>

equipment with an alarm but not having an indication of measured value

3.2.2

aspirated equipment, <gas detection>

equipment that samples the gas by drawing it to the gas sensor

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

3.2.3

automatically aspirated equipment, <gas detection>

aspirated equipment with an integral pump or separate pump, which is connected directly to the equipment

3.2.4

diffusion equipment, <gas detection>

equipment in which the transfer of gas from the atmosphere to the sensor takes place without aspirated flow

3.2.5

fixed equipment

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

[SOURCE: IEC 60070-0:2017]

3.2.6

portable equipment, <gas detection>

equipment intended to be carried by a person during its operation

Note 1 to entry: Portable equipment carried by a person during its operation is sometimes referred to as hand-held equipment.

Note 2 to entry: Hand-held gas detection equipment, typically less than 1 kg, requires use of only one hand to operate. Larger equipment that can be operated by the user while it is carried either by hand, by a shoulder strap or carrying harness, can be equipped with or without a hand directed probe. 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.~~

[SOURCE: IEC 60070-0:2017 with addition of Note 2 to entry]

3.2.7

transportable equipment

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

[SOURCE: IEC 60070-0:2017]

3.2.8**gas detection transmitter**

fixed gas detection equipment that provide 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

3.2.9**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)

3.2.10**separate gas detection control unit**

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

3.2.11**equipment with integral sensor(s), <gas detection>**

equipment that provides display indication, alarm functions, output contacts or alarm signal outputs using a sensor which is within or directly assembled to the equipment housing

3.2.12**accessory, <gas detection>**

component which can be fitted to the equipment for special purpose

EXAMPLE: External gas pump, sampling probe, hoses, collecting cone, weather protection device.

3.3**sensors****3.3.1****sensing element, <gas detection>**

part of the sensor ~~which~~ that is sensitive to the gas or /vapour to be measured

3.3.2**measuring principle, <gas detection>**

~~type of physical or physico-chemical detection principle and the measurement procedure to determine the measured value~~ principle that makes the sensing element or the sensor sensitive to the gas or vapour to be measured

3.3.3**sensor, <gas detection>**

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

3.3.4**integral sensor, <gas detection>**

sensor ~~which~~ that is within or directly assembled to the equipment housing

3.3.5**remote sensor, <gas detection>**

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

3.4 supply of gas to equipment

3.4.1 sample line, [<gas detection>](#)

means by which the gas being sampled is conveyed to the sensor

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

3.4.2 sampling probe, [<gas detection>](#)

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.~~

3.4.3 Adjustment, [<gas detection>](#)

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/zero test gas](#), the procedure is called 'zero adjustment'.

3.4.4 calibration, [<gas detection>](#)

procedure which establishes the relationship between an [indication-measured value](#) and the concentration of a test gas

3.4.5 ~~field~~ calibration kit, [<gas detection>](#)

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 beyond the alarm set-point.

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

3.4.6 mask for calibration and test, [<gas detection>](#)

device that can be attached to the equipment to present a test gas to the sensor in a reproducible manner

3.5 signals and alarms

3.5.1 measured value, [<gas detection>](#)

calculated concentration of gas or vapour that results from processing the sensor signal

Note 1 to entry: The measured value may be further processed before indication on output or display (e.g. filtering, averaging, suppression of indication).

3.5.2 indication, [<gas detection>](#)

representation of the measured value on an output or display

3.5.3 indication range, [<gas detection>](#)

range of indications of gas concentration over which the equipment is capable of indicating

SEE Figure 1.

3.5.4**lower limit of indication, <gas detection>**

smallest indication within the indication range

SEE Figure 1.

3.5.5**upper limit of indication, <gas detection>**

largest indication within the indication range

SEE Figure 1.

3.5.6**measuring range, <gas detection>**

range of measured values of gas concentration over which the accuracy of the equipment lies within specified limits

SEE Figure 1.

3.5.7**lower limit of measurement, <gas detection>**

smallest measured value within the measuring range

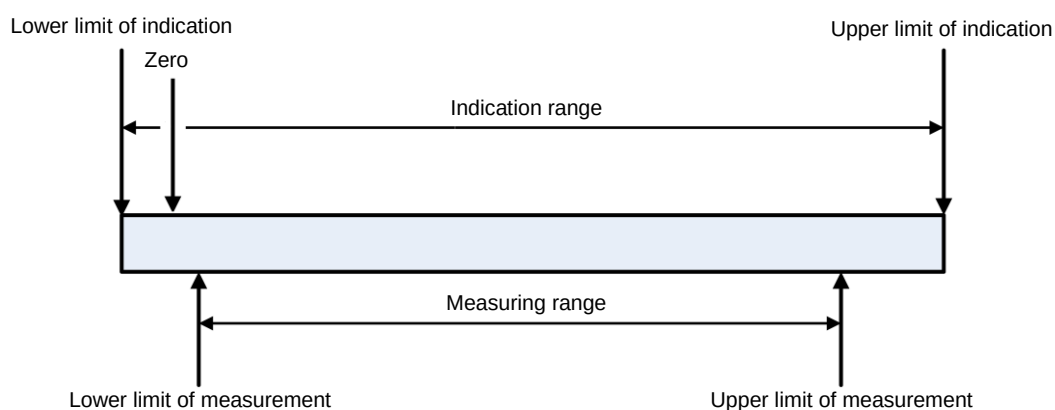
SEE Figure 1.

3.5.8**upper limit of measurement, <gas detection>**

largest measured value within the measuring range

SEE Figure 1.

Note 1 to entry: Indications below the lower limit of measurement or above the upper limit of measurement will not necessarily meet the requirements of this document.



IEC

Figure 1 – Relationship between indication range and measuring range

3.5.9**alarm set point, <gas detection>**

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

3.5.10**latching alarm, <gas detection>**

alarm that, once activated, requires deliberate action to be deactivated

3.5.11**fault signal, <gas detection>**

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

3.5.12**special state, <gas detection>**

~~any~~ state of the equipment other than those in which monitoring of gas concentration or alarming is the intent

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

3.6**times****3.6.1****drift, <gas detection>**

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

3.6.2**final indication, <gas detection>**

indication given by the equipment after stabilization

stabilization

~~when the indication reaches and remains within the stated tolerances~~

3.6.3**time of response, <gas detection>**

$t(x)$

time interval, with the equipment in a warmed-up condition, between the time when an instantaneous rising concentration between two test gases is produced at the equipment inlet, and the time when the indication reaches a stated percentage (x) of the differences of the two indications~~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.

3.6.4**time of recovery, <gas detection>**

$t(x)$

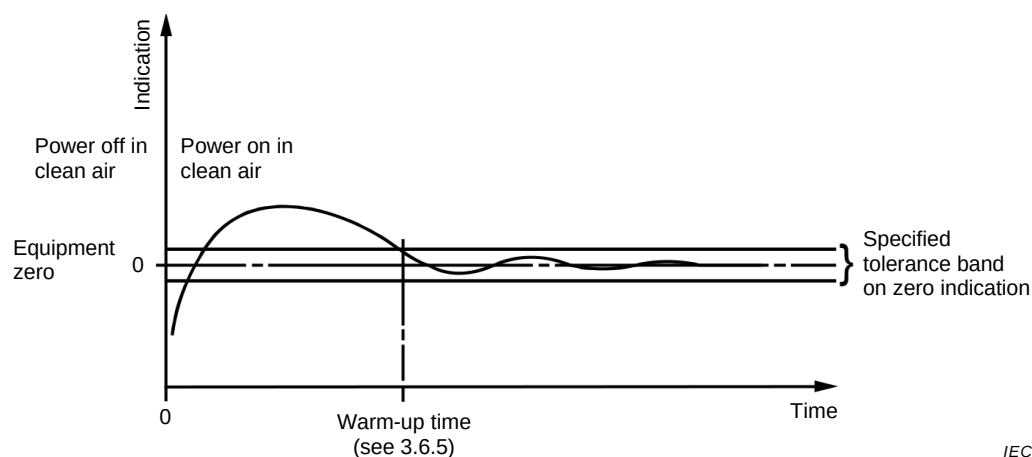
time interval, with the equipment in a warmed-up condition, between the time when an instantaneous falling concentration between two test gases is produced at the equipment inlet, and the time when the indication reaches a stated percentage (x) of the differences of the two indications~~change from standard 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.

3.6.5**warm-up time, <gas detection>**

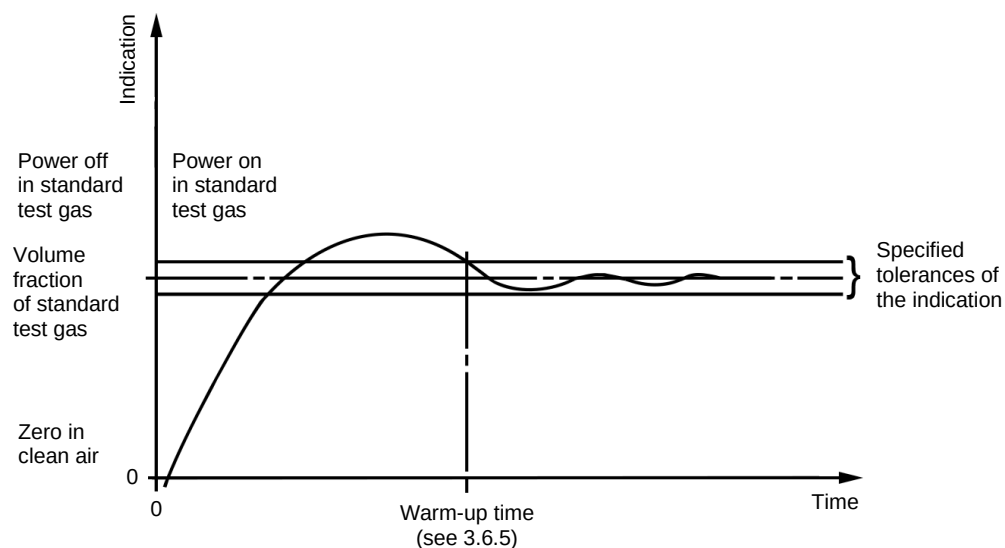
time interval, with the equipment in a stated atmosphere, between the time when the equipment is switched on and the time when the indication reaches and remains within the stated tolerances

Note 1 to entry: See equipment warm-up time in Figures 2 and 3.



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Figure 2 – Warm-up time in clean air (typical)



IEC

Figure 3 – Warm-up time in standard test gas (typical)

3.7**Miscellaneous open path****3.7.1****special tool beam block signal, <gas detection>**

audible, visual or other type of output which provides, directly or indirectly, a warning or indication that the optical path is obscured or that the signal detected is too weak to enable the equipment to function normally tool required to gain access to, or to adjust the equipment controls

Note 1 to entry: The design of the tool is intended to discourage unauthorised interference with the equipment.

3.7.2**inhibition signal, <gas detection>**

audible, visual, or other type of output which provides, directly or indirectly, a warning or indication that normal operation has been suspended

3.7.3**integral concentration, <gas detection>**

mathematical integral of the gas concentration along the optical path.

Note 1 to entry: It is expressed in units of concentration multiplied by distance, e.g. LFL.metre for flammable gases or ppm.metre for toxic gases

Note 2 to entry: 100 % LFL x 1 metre = 1 LFL.metre; 10 % LFL x 10 metre = 1 LFL.metre.

3.7.4

open path, <gas detection>

distance in space which traverses the area (or part of the area) in which the atmosphere is being monitored and through which gases in the atmosphere are free to move

3.7.5

optical axis, <gas detection>

median line of the optical path

3.7.6

optical path, <gas detection>

path traversed by optical radiation from an optical transmitter to an optical receiver.

Note 1 to entry: The radiation can traverse the open path once, twice or many times depending on the form taken by the instrument

3.7.7

open path transmitter, <gas detection>

assembly in which the optical transmitting element(s) are housed and which may contain associated optical and electrical components

3.7.8

open path transceiver, <gas detection>

assembly in which the optical detecting element(s) and optical transmitting element(s) are housed and which may contain associated optical and electrical components

3.7.9

open path receiver, <gas detection>

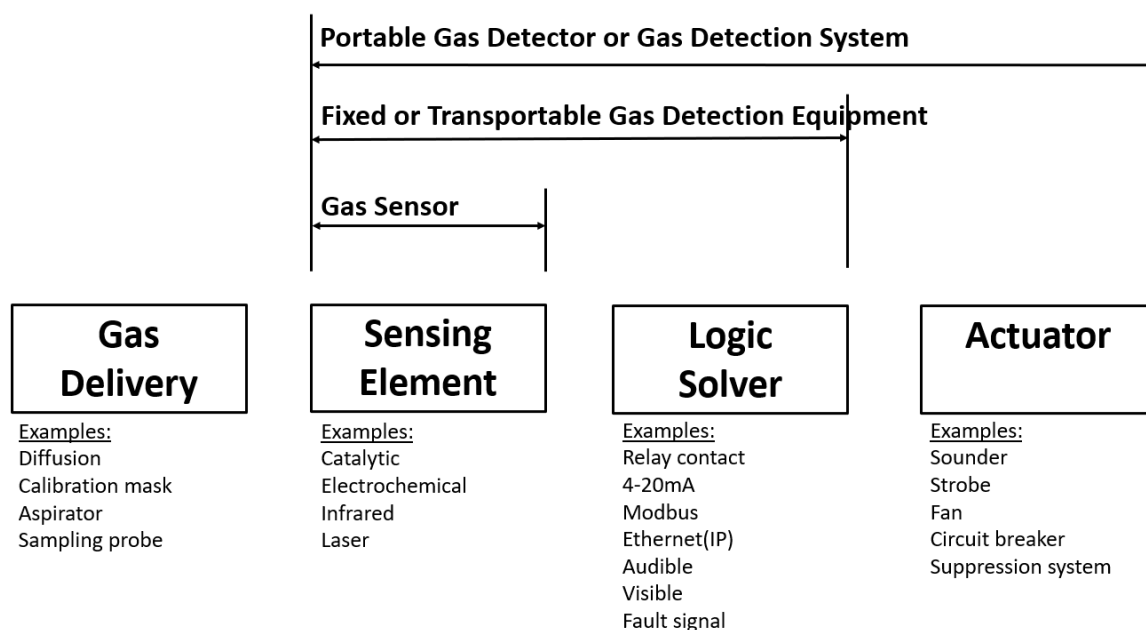
assembly in which the optical detecting element(s) are housed and which may contain associated optical and electrical components

4 General requirements

4.1 Introduction

In addition to the requirements of this document, gas detection equipment intended for use in explosive atmospheres shall comply with the relevant requirements of IEC 60079-0 and the Type(s) of Protection standards. The ambient temperature and pressure ranges of such equipment conforming to this document shall not exceed the ambient temperature and pressure ranges of the Type(s) of Protection.

The following figure provides the general concept of the gas detection equipment and gas detection system:



4.2 Design

4.2.1 General

The equipment shall be constructed in such a manner that regular functional checks can be undertaken by the user and that it can be equipped with a field calibration kit for application of test gas.

Gas detection equipment shall be constructed of materials known to be resistant to degradation by the environment in which they are intended to be used. Equipment specifically intended for use in the presence of corrosive vapours or gases, or which can produce corrosive by-products as a result of the detection process (e.g. catalytic oxidation or other chemical process) shall be constructed of materials known to be resistant to corrosion by such substances.

Materials and components used in the construction of the equipment which are relevant to performance of the equipment shall be used within the material and component manufacturer's ratings or limitations unless otherwise specified by appropriate safety standards. If such material and component ratings are not available, demonstrated functionality of the equipment may be used. All materials along the gas path shall not cause an inaccurate reading due to adsorption and absorption effects of materials in contact with the gas(es) to be detected.

For aspirated equipment and automatically aspirated equipment, inlet and outlet ports shall be unambiguously marked to ensure the correct connection of any sample and exhaust lines.

Any failure of the gas detection equipment that is not relevant to safety or health shall not adversely affect those functions of the equipment that are related to safety.

EXAMPLE: Equipment with 4 to 20 mA safety related output and with Highway Addressable Remote Transducer (HART) non safety related communication. Any failure of HART shall not affect the 4 to 20 mA output.

4.2.2 Indicators and means of indication of measured values

4.2.2.1 Indicators

Distinguishable indicators shall be provided as shown in Table 1:

State	Equipment Type		
	Portable	Transportable	Fixed
Power	Visual	Visual	Visual
Alarm	Visual and Audible	Visual	Visual
Fault	Visual and Audible	Visual	Visual
Warm-up	Visual or Audible	Visual	Visual
Calibration	Visual	Visual	Visual
Other special state	Visual	Visual	Visual

Table 1 – Indicators

It is permitted that the indications related to gas detection transmitters and remote sensors are shown only at the separate gas detection control unit or gas detection control unit.

If audible indicators are provided for transportable or fixed equipment, they shall indicate alarms, and may indicate special states.

4.2.2.2 Colours of visual indicators

If only one visual indicator is provided for signalling alarms, special states and other indications, it shall be coloured red.

If separate visual indicators are used or if a multi-coloured visual indicator is provided, the colours shall be used in the following order of priority ((a) being highest priority):

- a) alarm indicators shall be coloured RED;
- b) special state indicators shall be coloured YELLOW;
- c) power supply indicators shall be coloured GREEN;
- d) normal operation indicators, if fitted, shall be coloured GREEN.

If a multi-coloured visual indicator is provided, the equipment shall provide an additional indication by means other than colour.

If there is more than one visual indicator of the same colour with different functions, the function of each indicator shall be provided adjacent to each indicator.

NOTE This may be achieved by printed labels, text, marks or icons on a display.

4.2.2.3 Display and other outputs for indication of measured values

For equipment with a display for indication of measured values, the gas name, measured value and unit of measurement shall be indicated. It is permissible to mark the gas name and unit of measurement adjacent to the display. It is permissible to provide abbreviations.

Within the measuring range, the resolution of the display and all other outputs for indication of the measured value shall be less than or equal to 1 % of the upper limit of measurement. For oxygen detection equipment, the resolution shall be less than or equal to 0,1 % (v/v) of oxygen;

Within the measuring range, all outputs shall present the same value within the resolution of each output.

Any measurements above the upper limit of indication shall be clearly indicated.

If the equipment has more than one indication range, the range selected shall be clearly identified.

The manufacturer shall identify suitable methods for connecting, indicating or recording devices for the purpose of testing the compliance of the equipment with this document. The indication on the display and all other outputs for indication of the measured value shall not contradict the results obtained by the indicating or recording devices.

NOTE Such suitable methods will be necessary for alarm-only equipment.

4.2.2.4 Suppression of indications

Suppression of indication is only permitted according to the following rules:

1. For Type DE equipment: Measured values within an interval of $\pm 0,5$ % (v/v) oxygen around the nominal indication in ambient air may be indicated as the nominal indication in ambient air.

2. For all other types of equipment:

a) Measured values within the measuring range (i.e. between the lower limit of measurement and the upper limit of measurement) shall be indicated;

b) Measured values below the suppression threshold value (values below zero included) specified in the applicable performance standard shall be indicated as:

– zero; or

– the measured value; or

– another indication that the measured value is below the lower limit of measurement;

c) Below minus 2 times the suppression threshold value the equipment shall indicate the measured value or provide a fault signal.

NOTE Under-range faults are defined in 4.2.4.

3. In calibration mode any kind of suppression of the measured value shall be automatically disabled.

NOTE The deviation of the zero indication may be beneficial for maintenance purpose.

4. It shall be possible to configure the equipment such that in measuring mode any kind of suppression of indication is disabled.

4.2.3 Alarm signal(s)

Alarm and TWA alarm set points shall not be adjustable outside the measuring range.

For equipment with multiple configurable alarm setpoints, there shall be a documented order for the alarms from most sensitive to the least sensitive. The more sensitive setpoint shall always produce an alarm response prior to the less sensitive setpoint.

It is permitted that alarms are configurable to be latching or non-latching.

If alarms are not configurable to be latching or non-latching, at least one alarm shall be latching.

If alarms are configurable to be latching or non-latching, at least one alarm shall be configured latching as a factory default setting. The factory setting at delivery may deviate from the factory default setting on user request.

For Type DE oxygen detection equipment, the latching properties of alarms at increasing or decreasing oxygen concentration shall be considered separately.

Alarms shall remain in operation while the alarm condition is present. Audible alarms may be silenced by the user if other alarms remain active.

If it is possible to de-activate alarm indicators or alarm signal outputs, this deactivation shall be indicated by a signal. For fixed equipment, this deactivation shall include a transmittable output signal if the alarm indicators or alarm signal outputs are automatically re-enabled within 15 min.

EXAMPLE It might be necessary to de-activate alarm indicators or alarm signal outputs during calibration/adjustment and maintenance procedures.

4.2.3.1 Group I portable equipment indicating up to 5 % (v/v)

Alarm devices shall not be adjustable above 3 % (v/v). An additional over-range alarm, which indicates when full scale has been exceeded, may be provided.

4.2.3.2 Group II portable equipment indicating up to 100 % LFL

Alarm devices shall not be adjustable above 60 % LFL. An additional over-range alarm, which indicates when full scale has been exceeded, may be provided.

4.2.4 Fault signals

Externally powered equipment shall provide a fault signal in the event of failure of power to the equipment.

Externally powered equipment shall provide a fault signal when the supply voltage falls below the lower supply voltage fault limit specified by the manufacturer.

A short-circuit or open-circuit in any field wiring connections shall be indicated by a fault signal. It is permitted for the equipment to enter the "calibration" special state under the short-circuit or open-circuit condition if this calibration activation procedure is specified in the instruction manual.

Under the above conditions the equipment may also indicate alarm.

Measured values below zero (e.g. caused by drift) shall be indicated by an under-range fault signal at -10 % of the upper limit of measurement at the latest. Equipment with a measuring range up to 20 % LFL shall provide a fault signal at no greater than -20 % of the upper limit of the measuring range. This requirement is not applicable for Type DE oxygen detection equipment.

Equipment where the sensor or sensing element can be replaced without opening the housing shall provide a fault signal if the sensor or sensing element is not re-connected within 15 min.

Automatically aspirated equipment shall be provided with an integral flow-indicating device that produces a fault signal in the event of low flow.

4.2.5 Adjustments

All adjustment functions shall be designed so as to discourage unauthorized or inadvertent interference with the equipment.