



Explosion Protection

GAS DETECTION
SYSTEMS

ST 6037 2004

Explosion hazards mostly arise from flammable gases and vapours

Instead of avoiding their ignition by explosion protection measures it may be preferable to detect them before they become ignitable.

DANGER OF EXPLOSION IS LURKING EVERYWHERE

Wherever hazardous situations exist due to the presence of combustible gases and vapours e.g. in oil & gas exploration and storage, transportation and storage of flammable liquids and gases, in processes involving the use of solvents, or in the plastics processing industry, we will always encounter explosion protection measures, mostly regulated by law, to keep the personnel and plants safe.

Depending on the application different measuring principles for the detection of gases and vapours can be used: Catalytic bead sensors, point or open-path infrared sensors. When detectors are used in combination with a central controller such as Dräger Polytron or Dräger REGARD it is possible to detect flammable gases and vapours at an early stage, when concentrations are so low that a dangerous condition – a risk of explosion – can be reliably averted.

METHODOLOGY OF EXPLOSION PROTECTION

Flammable gases and vapours can only be ignited by an ignition source with sufficient high energy or sufficient high temperature if – under atmospheric conditions – they exist in a mixture with atmospheric oxygen in sufficiently high concentrations. This mixture's concentration is called LEL: Lower Explosion Limit.

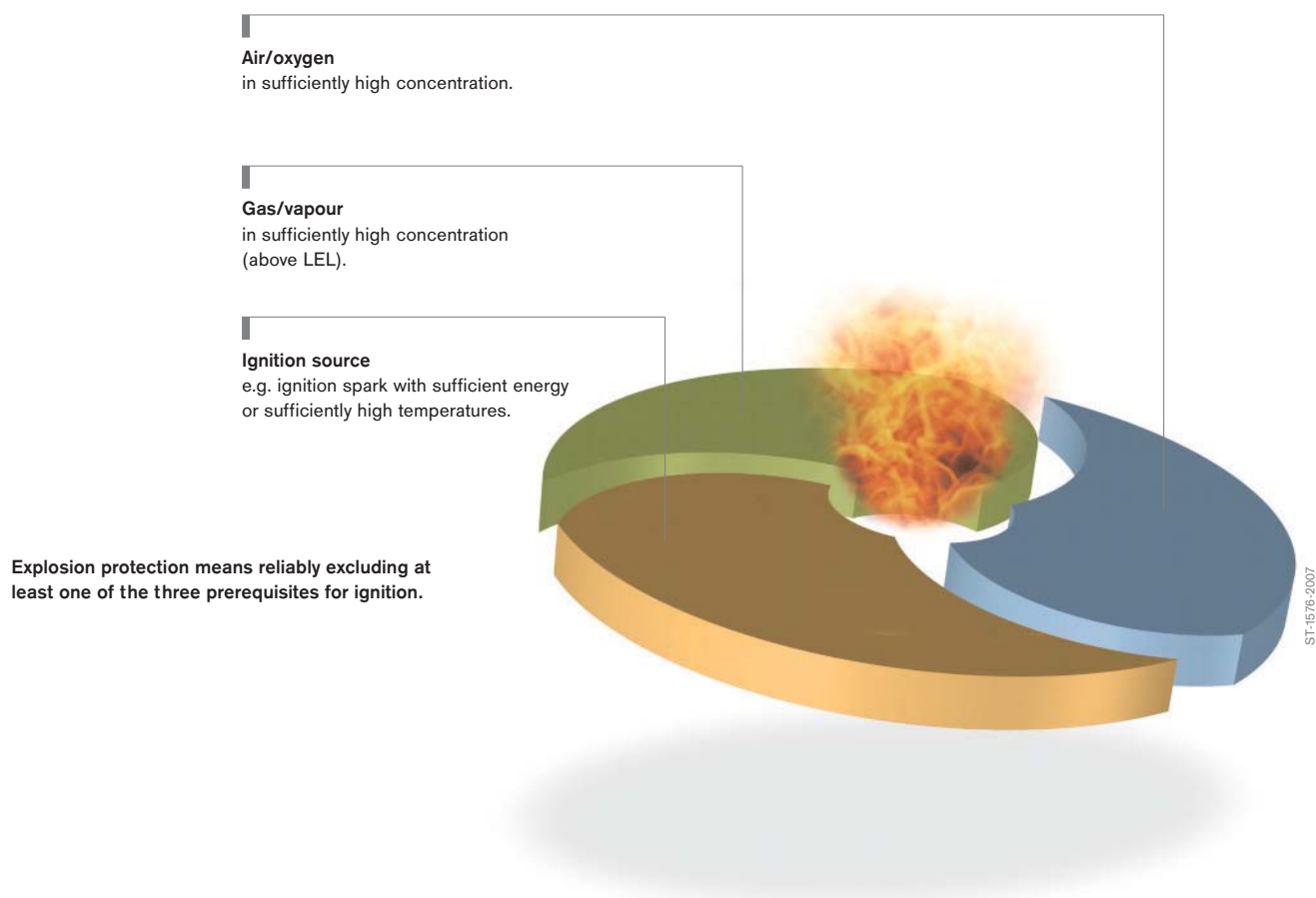
To have an ignition three conditions have to be met:

1. Concentration of flammable gas or vapour above the LEL
2. Sufficiently high oxygen concentration
3. Sufficiently high temperature or sufficient energy of the ignition source

Vice versa this rule reads: If one of the three conditions is not met it is reliably ensured that no ignition or explosion can take place.

So, measures of explosion protection can be the following:

1. Concentration limiting
2. Inertisation
3. Use of explosion protected apparatus

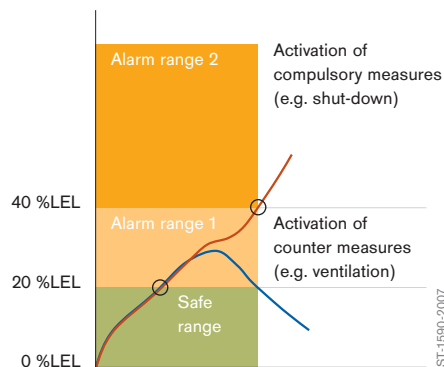


The safest way of concentration limiting is the removal of flammable gases and vapours from the process – this is not normally practical. Where flammable gases and vapours are used, it is normal for gas detection systems to be used to limit concentrations. When the process is closed and the level of flammable gases or vapours is allowed to exceed the LEL level, this is acceptable as long as the oxygen concentration is kept low enough to control the risk of explosion (inertisation).

If these measures however are not sufficient, all of the involved electrical devices have to be designed according to certain explosion protection standards so they will not act as a source of ignition if flammable gases or vapours are released.

Further advice concerning the methodology can be found in the harmonized standard EN 1127-1.

Hazardous Atmospheres

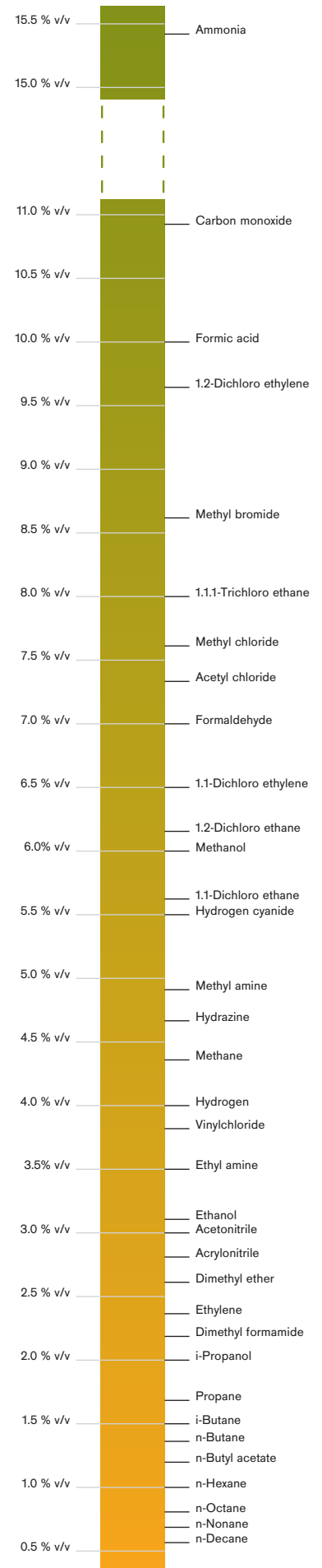


Alarm thresholds

If the gas concentration rises a counter measure is activated when reaching the alarm range 1. If the counter measure is effective the gas concentration will decrease (blue curve). If, however, the counter measure is not effective the concentration will keep on rising (red curve). When reaching the alarm range 2 compulsory measures are activated. Properly designed gas detection systems will rarely or never reach the alarm range 2.

LEL Scale

The lower the LEL the more dangerous is the substance, as ignitable concentrations can form more easily.



Preventing potentially explosive atmospheres – primary explosion protection.

BELOW THE LEL NO DANGER OF EXPLOSION

Concentration limiting (1) and inertisation (2) are also called primary measures because the formation of an ignitable concentration is averted. On the other hand when using explosion protected instruments (3) this is a secondary measure because not the formation of ignitable concentrations is averted, but only its ignition.

Concentration limiting means active dilution, e.g. by automatically ventilating fresh air into the hazardous area if concentrations have risen above the 20 %LEL threshold. If concentrations continue to rise because the counter measure is ineffective then it is necessary to automatically activate shut-down actions at 40 %LEL e.g. by switching off any non-explosion proof instrument or equipment. Gas detection systems used for this purpose must be type approved by a Notified Body in respect to their compliance with the European Standards (formerly acc. to EN 50054ff, now acc. to EN 61779 or EN 60079-29-1). This is true for the sensor and the transmitter as well as for the central controller unit.

As inertisation is also a preventive explosion protection measure, oxygen measuring instruments controlling the inertisation process at least in Europe also have to be type-approved for this purpose and shall comply with the relevant harmonised standards (e.g. EN 50 104).



Safety relevant data of flammable gases and vapours.

THE LOWER EXPLOSION LIMIT – LEL

For flammable substances there is a limit concentration necessary for ignition. Below this limit a mixture of the substance in air cannot be ignited because there is a deficiency of fuel. This limit is called the Lower Explosion Limit or LEL.

The LEL cannot be calculated but is an empirical characteristic figure which is established by standardized methods. With some exceptions the LEL lies between 0.5 and 15 % by volume.

GASES AND LEL

Matter above its boiling point commonly is called a gas. Thus the pressure of a pure liquefied gas is always higher than the atmospheric pressure so that released gases can very quickly form concentrations above the LEL causing dangerous ignitable gas-/air-mixtures.

VAPOURS OF FLAMMABLE LIQUIDS AND FLASHPOINT

Matter below its boiling point is not only gaseous but exists in an equilibrium with its liquid (and also solid) state which depends on the temperature.

The gaseous component of this matter is called vapour. A vapour's pressure is always lower than the atmospheric pressure, and, depending on the liquid's temperature, only certain maximum vapour concentrations can form. Especially the maximum vapour pressure of a flammable liquid can be so low that the LEL concentration can only be exceeded

at a certain temperature. Only above this certain temperature a flammable liquid's vapour becomes ignitable. This empirical temperature, established by standardized methods, is called the flashpoint which is a very important safety-relevant figure to assess the hazardous nature of flammable liquids. For example the flashpoint of pure Ethanol is 12 °C (so Ethanol is flammable at 20 °C), but for n-Butanol the flashpoint is 35 °C, so vapours of n-Butanol cannot be ignited at ambient temperatures of 20 °C, but above 35 °C they can.

And indeed: As long as the temperature of a flammable liquid is kept reliably some degrees below the flashpoint this is a primary explosion protection measure!

IGNITION TEMPERATURE AND MINIMUM IGNITION ENERGY

Sparks and arcs produced electrically (or mechanically) and hot surfaces are the best known ones of 13 different sources of ignition. To ignite mixtures of flammable gases or vapours in air the source of ignition must either have a temperature higher than the empirical ignition temperature or sparks must have an energy higher than the empirical minimum ignition energy. Both the ignition temperature and ignition energy characteristics are established by standardized methods and are relevant when designing or selecting explosion protected instruments for a certain application.



LIST OF SAFETY-RELEVANT FIGURES FOR A SELECTION OF FLAMMABLE GASES AND VAPOURS

Gas / Vapour	LEL % v/v	LEL g/m ³	Flashpoint*	Vapour pressure*	Ignition temperature
Acetone	2.5	60.5	< - 20 °C	246 mbar	535 °C
Acetylene	2.3	24.9	Gas	Gas	305 °C
Acrylonitrile	2.8	61.9	- 5 °C	117 mbar	480 °C
Ammonia	15.4	109.1	Gas	Gas	630 °C
Benzene	1.2	39.1	- 11 °C	100 mbar	555 °C
1.3-Butadiene	1.4	31.6	Gas	Gas	415 °C
i-Butane	1.5	36.3	Gas	Gas	460 °C
n-Butane	1.4	33.9	Gas	Gas	365 °C
n-Butanol	1.7	52.5	35 °C	7 mbar	325 °C
n-Butene	1.2	28.1	Gas	Gas	360 °C
n-Butyl acetate	1.2	58.1	27 °C	11 mbar	390 °C
Chlorobenzene	1.3	61.0	28 °C	12 mbar	590 °C
Cyclohexane	1.0	35.1	- 18 °C	104 mbar	260 °C
Cyclopentane	1.4	40.9	- 51 °C	346 mbar	320 °C
Diethylether	1.7	52.5	- 40 °C	586 mbar	175 °C
Dimethylether	2.7	51.9	Gas	Gas	240 °C
1.4-Dioxane	1.9	69.7	11 °C	38 mbar	375 °C
Epichlorohydrin	2.3	88.6	28 °C	16 mbar	385 °C
Ethanol	3.1	59.5	12 °C	58 mbar	400 °C
Ethylene	2.4	28.1	Gas	Gas	440 °C
Ethyl acetate	2.0	73.4	- 4 °C	98 mbar	470 °C
Ethyl benzene	1.0	44.3	23 °C	10 mbar	430 °C
Ethylene oxide	2.6	47.8	Gas	Gas	435 °C
n-Hexane	1.0	35.9	- 22 °C	160 mbar	240 °C
Hydrogen	4.0	3.3	Gas	Gas	560 °C
Methane	4.4	29.3	Gas	Gas	595 °C
Methanol	6.0	80.0	9 °C	129 mbar	440 °C
Methyl chloride	7.6	159.9	Gas	Gas	625 °C
Methylethyl ketone	1.5	45.1	- 10 °C	105 mbar	475 °C
Methyl methacrylate	1.7	70.9	10 °C	40 mbar	430 °C
n-Nonane	0.7	37.4	31 °C	5 mbar	205 °C
n-Octane	0.8	38.1	12 °C	14 mbar	205 °C
n-Pentane	1.4	42.1	- 40 °C	562 mbar	260 °C
Propane	1.7	31.2	Gas	Gas	470 °C
i-Propanol	2.0	50.1	12 °C	43 mbar	425 °C
Propylene	1.8	31.6	Gas	Gas	485 °C
Styrene	1.0	43.4	32 °C	7 mbar	490 °C
Toluene	1.1	42.2	6 °C	29 mbar	535 °C

Flashpoint (°C)	Substance
80	Nitrobenzene
70	Methyl pyrrolidone
60	Tetrahydro naphthalene
50	Dimethyl acetamide
40	Cyclohexanol
30	Dimethyl formamide
20	Trimethyl benzene
10	Ethylglycol
0	n-Butanol
-10	Nonane
-20	Chlorobenzene
-30	Ethyl benzene
-40	i-Butyl acetate
-50	Ethanol
-60	Methanol
-70	Toluene
-80	Acetonitrile
-90	Ethyl acetate
-100	Methylethyl ketone
-110	Cyclohexane
-120	Hexane
-130	Allyl amine

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Flashpoint Scale

The lower the flashpoint the more dangerous and easier to inflame is the liquid.

* Flashpoint is defined for liquids only, vapour pressure at 20 °C reasonable for liquids only



Avoiding effective ignition sources – secondary explosion protection

Without source of ignition no danger of explosion

If the formation of an ignitable atmosphere cannot safely be averted or cannot effectively be prevented (e.g. by using gas detection systems), electrical instruments being used in this area shall not act as a source of ignition: They need to be designed such that they cannot inflame these flammable atmospheres.

TYPES OF PROTECTION

Four of seven standardized types of protection are applied in the gas detection technology: Flameproof (d), intrinsic safety (i), encapsulation (m), and increased safety (e). By encapsulation hot surfaces and sparks are prevented mechanically whereas in intrinsically safe instruments this is practiced by electrical power limiting. Generally flameproof accepts internal explosions but is designed such that it withstands the internal explosion pressure and reliably avoids a flashback. Increased safety is limited to passive devices such as junction boxes, terminals and cable glands. These are designed such that the risk of forming hot surfaces or sparks is highly reduced. Explosion protected instruments have to be type approved and certified by a Notified Body.

EXPLOSION PROTECTION IS A LAW

In Europe explosion protection has become law by converting the EU-directives 94/9/EC and 99/92/EC, also known as ATEX 95 and ATEX 137,

into national ordinances. Manufacturers of explosion protected instruments have to mark these devices unitarily by a device category showing the permissible application range, whereas the user of these instruments is pledged to classify the potentially explosive atmosphere area into zones depending on the probability of occurrence of flammable atmospheres and the nature of flammable matter: gases or vapours (G) or dust (D).

For example II 2 GD is a typical device category for instruments which may be used in zone 1 and zone 2 as well as in zone 21 and 22, while instruments being used in zone 2 must have a marking of II 3 G at least.

In the USA explosion protection is regulated by the NEC 505, the relevant marking also implies application hints by terms like Class and Division.

In the USA instruments using either flameproof or intrinsically safe methods of protection are preferred. In most countries the European or American explosion protection standards are accepted. Recently there has been a drive towards the IEC-Ex protection standards, which is based on world-wide IEC explosion protection standards. Dräger gas detection instruments meet the explosion protection requirements of CENELEC (ATEX, Europe), UL (USA), CSA (Canada) and IEC-Ex (world-wide).



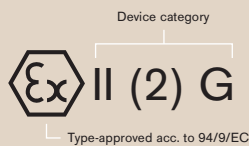
ASSIGNMENT OF TEMPERATURE CLASSES AND EXPLOSION GROUPS AND TYPICAL GASES AND VAPOURS

Temperature class and max. permissible surface temperature		Explosion group	IIB	IIC
		IIA	IIB	IIC
		ignition energy greater 0.18 mJ	ignition energy 0.06 to 0.18 mJ	ignition energy smaller 0.06 mJ
T1	450 °C	Acetone, Ammonia, Benzene, Ethyl acetate, Methane, Methanol, Propane, Toluene	Hydrogen cyanide, Town gas	Hydrogen
T2	300 °C	i-Amyl acetate, n-Butane, n-Butanol, 1-Butene, Propyl acetate, i-Propanol, Vinyl chloride	1.3-Butadiene, 1.4-Dioxane, Ethylene, Ethylene oxide	Acetylene
T3	200 °C	Amyl alcohol, Gasolines, Diesel fuel, Fuel oil, n-Hexane	Dimethylether, Ethyl glycol, Hydrogen sulfide	
T4	135 °C	Acetaldehyde	Diethylether	
T5	100 °C			
T6	85 °C			Carbon disulfide

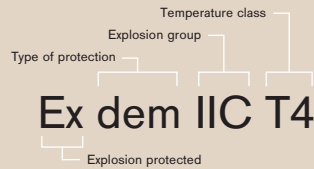
Example: If a potentially explosive atmosphere is caused by Carbon disulfide, an electrical apparatus is only suitable to be operated in this atmosphere if it is marked by IIC and T6, whereas for n-Hexane atmospheres electrical devices with the marking IIA T3 are sufficiently protected.



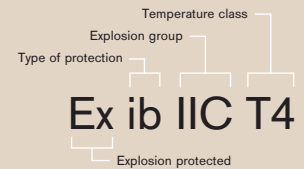
Typical marking of a gas detection transmitter acc. to 94/9/EC: Apparatus for zone 1, 2, 21 and 22.



Typical marking of a safety barrier or a performance approved central controller with electrical connections into the hazardous area (zone 1 or 2), but not to be operated in the hazardous area.



Typical explosion protection marking of an electrical apparatus (e.g. gas detection transmitter).



Marking of an apparatus acc. to IEC-Ex. Devices marked like this are only allowed to be operated in countries not belonging to the European Community.

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Warning sign mandatory
Warning sign mandatory for places where explosive atmospheres may occur (zones). Organizational measures have to be regarded.



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Hazardous Areas

By means of gas detection systems the probability of a formation of explosive atmospheres is reduced

The hazardous areas shrink: Zone 1 becomes zone 2.

According to the directive 99/92/EC (ATEX 137) the operator has to conduct a risk assessment of the hazardous area and to classify the area into zones depending on the probability of the occurrence of potentially explosive atmospheres. Also, he has to arrange organizational safety measures and provide evidence by means of an explosion protection document accordingly. Only suitable instruments may be used in certain zones.

Employing the use of gas detection systems which reliably prevent the occurrence of an ignitable atmosphere, by default reduces the probability that a flammable atmosphere can occur at all; it is not likely to occur in normal operation – and this is defined as zone 2. In other words: By means of a

suitable gas detection system a zone 1 area converts to a zone 2 area where less complex designed and mostly less expensive instruments may be used (e.g. lamps, machines, mobiles, fork lifters etc.)

An important requirement however is that the counter measures activated by the gas detection system are adequately preventing the formation of flammable concentrations. This might not be the case in the direct vicinity of a gas leak if the gas is more quickly released than removed or diluted by the ventilation. But although the proximal area around a leak keeps being zone 1, the zone 1 area shrinks drastically by using a gas detection system – a great advantage for the customer.

DEFINITION OF ZONES ACC. TO DIRECTIVE 99/92/EC

	Zone	Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere	Minimum requirement for device category
Gas	0	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously, or for long periods or frequently	II 1G
	1	A place in which an explosive atmosphere consisting of a mixture with air or flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally	II 2G
	2	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only	II 3G
Dust	20	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently	II 1D
	21	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally	II 2D
	22	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only	II 3D

Example: If an apparatus shall be operated in zone 21, the relevant marking must at least be device category II 2D

Using Gas Detection Systems

Proven in gas detection since decades: Pellistor sensors and Infrared sensors.

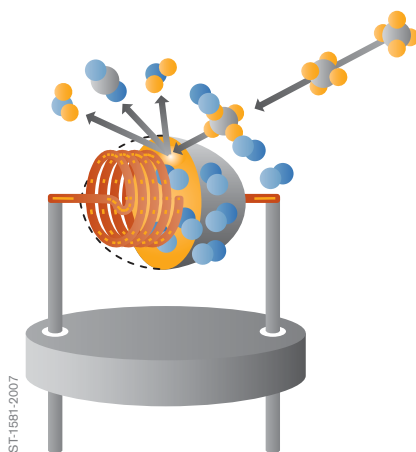
PELLISTOR SENSORS

The pellistor sensor (or catalytic bead sensor) is a relatively inexpensive flameproof sensor the measuring principle of which is based on a chemical reaction with oxygen and thus needs at least 12 % v/v. Without oxygen the pellistor sensor cannot give a reading, but also – because of oxygen deficiency – there is no danger of explosion. The pellistor sensor measures multiple gases and vapours, but with different sensitivity. If the sensitivity for a substance is too low the pellistor sensor may not be the correct measuring principle for a reliable gas detection system. Infrared sensors may be more applicable.

Catalytic bead principle

The heat-of-reaction measuring principle is based on the fact that flammable gases and vapours even below their LEL-concentration can undergo a flameless oxidation reaction with atmospheric oxygen, if only a suitable hot catalyst is present. The additional released heat of reaction is a measure for the gas concentration.

The pellistor sensor houses two small measuring beads called pellistors (artificial term coming from pellet and resistor), because they are used as precisely measuring temperature-dependent resistors. Both the pellistors are made of very porous ceramic material embedding a small platinum wire coil. The active pellistor additionally contains catalytic material. By means of an electrical current of approx. 270 mA on the one hand the platinum coil heats up the ceramic bead to ca. 450 °C, on the other hand the platinum coil acts as a measuring



Active pellistor (shown in half cut, schematic)

The penetrating methane molecule reacts by means of the heated catalytic bead material with atmospheric oxygen to form water vapour and carbon dioxide. The released heat of reaction causes a measurable resistance increase of the embedded platinum coil.



resistor dependent on the bead's temperature. When molecules of a flammable gas penetrate into a catalytic bead they react with the activated atmospheric oxygen which is absorbed in the porous ceramic and resultant heat of reaction increases the pellistor's temperature e.g. by about 2 °C for 10 %LEL octane. The resulting increase of the pellistor's resistance is in the magnitude of some milli-Ohms and is proportional to the gas concentration.

Environmental conditions

The increase of temperature, dependent of the gas concentration, however, can only be used as a measurement signal if changes of ambient temperature, which might be much greater, are compensated. This is realized by a second pellistor, which in opposite to the described one does not contain catalytic material and thus is measuring only the ambient temperature. As part of a Wheatstone bridge this passive pellistor compensates for environmental influences, especially for ambient temperature. For optimized behaviour both the pellistors must fit best concerning their measuring parameters, and they are accordingly matched to pairs during manufacturing.

Poison resistance

For many decades the pellistors manufactured by Dräger are of type PR, which means poison resistant. Based on their special construction the sensors have a longer lifetime compared to conventional sensors when being exposed to industrial atmospheres containing catalyst poisons such as sulphur-, phosphor-, lead- or silicone-compounds.

INFRARED SENSORS

In contrary to the catalytic bead sensors the infrared sensors, which are based on a pure physical measuring principle, are not prone to be poisoned and do not depend on oxygen content for measurement. By means of tight optical windows infrared sensors are separated from the gas to be detected. Infrared sensors, however, may have extremely different sensitivities to different gases and vapours, and some flammable substances such as vinyl chloride or acetonitrile are, against one's expectations, not detectable at all. The Dräger application laboratory is very experienced and has worked out sensitivity data for more than 300 gases and vapours for different IR transmitters.

The IR measuring principle is based on the fact that molecules of flammable gases and vapours except a few (e.g. H₂, NH₃, CO, CS₂, HCN, H₂S, and hydrides) are mostly hydrocarbons, the CH-bonding of which can be excited to vibration by certain wave-lengths (frequencies) of the IR-spectrum and thus absorb energy. If IR is radiated into an optical system filled with an IR-absorbing gas, an increase of IR-absorption might be detectable in a certain wavelength range, because normal air does not absorb IR.

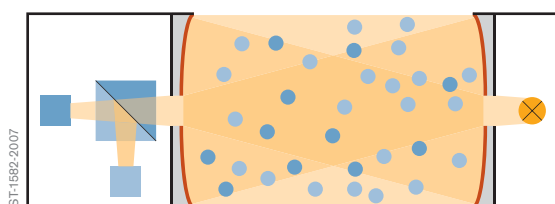
The generation of a stable spectrum of near infrared radiation is easily practiced by glow lamps operated by under-voltage, whereas the design of a wavelength-specific IR measuring detector is way more complex: Pyro-electric crystals, encapsulated behind an optical interference filter produce very



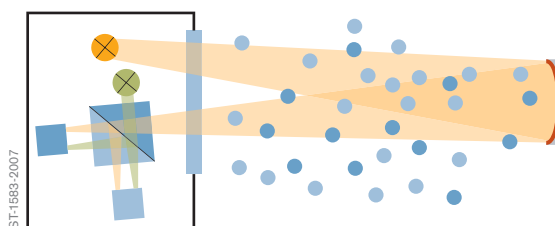
small intensity depending voltage changes when being exposed to pulsating radiation. These voltage changes are amplified, linearized and finally converted to a 4 to 20-mA-signal which is proportional to the gas concentration.

But not only gas reduces the measurable IR intensity, but also a contamination of the optical system by dust or mud causes intensity attenuation. This effect is compensated by a second IR measuring detector (reference detector), which gets the optical information by a beam splitter and detects the IR intensity in a wavelength range where flammable gases do not absorb IR. If both the measuring detector and the reference detector indicate an IR-absorption this is not caused by a gas but e.g. by dusty reflectors or else. By this way of compensation the sensor signal becomes contamination resistant, and at a certain degree of contamination additionally a beam block signal or maintenance signal can be generated. With the Dräger Polytron IR type 334 or 340 also possible alterations of the IR-detectors are compensated by a second IR source ("4-beam-compensation-method").

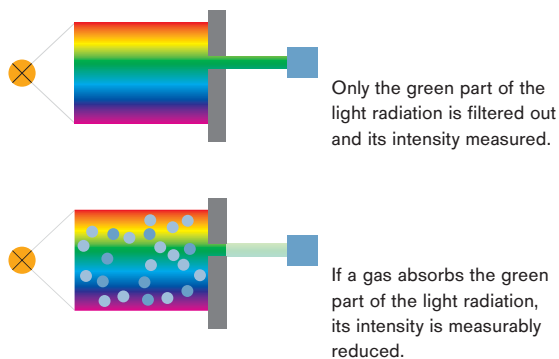
The greater the optical system, the more gas molecules are involved, and the higher is the IR-absorption. And by using greater optical systems lower measuring ranges such as e.g. 10 % of the LEL can be realized to detect leakages at a very early stage.



Dräger Polytron IR Ex
Schematic design (2-beam compensation method).



Dräger Polytron IR type 334
Schematic design (4-beam compensation method).



Only the green part of the light radiation is filtered out and its intensity measured.

If a gas absorbs the green part of the light radiation, its intensity is measurably reduced.

IR-transmitter

The fact that under normal conditions (no IR-absorbing gas) there is a high measuring signal, makes it possible to implement self diagnostic processes: The IR-transmitter is able to detect if e.g. the IR source fails or the optical system is blocked. The transmitter is fail-safe in the context of the IEC/EN 61508 standard and thus is suitable to be used in SIL2-rated safety chains.

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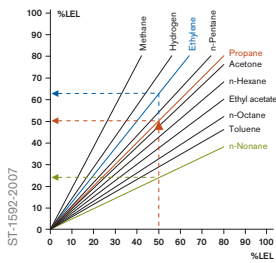
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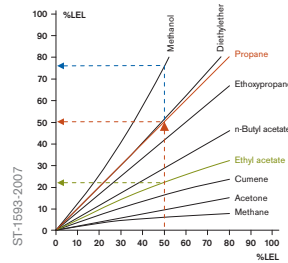
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Pellistor sensor
Different sensitivities of a Propane-calibrated pellistor sensor (schematic): 50 %LEL n-Nonane cause a measuring value of only 23 %LEL Propane while 50 %LEL Ethylene cause a measuring value of 62 %LEL.



Infrared sensor
Different sensitivities of a Propane-calibrated infrared sensor (Dräger Polytron IR Ex, schematic): 50 %LEL Ethyl acetate cause a measuring value of only 22 %LEL Propane while 50 %LEL Methanol cause a measuring value of 76 %LEL. A Propane-calibrated IR Ex is relative insensitive to Methane. Hydrogen cannot be detected at all by IR-technique.

Only by proper calibration and sensor positioning a gas detection system's reliability is ensured

CALIBRATION

Only by calibration with the target gas ("gas to be detected") the gas detection transmitter is enabled to give an individual gas concentration reading. If several gases or vapours are to be detected the transmitter has to be calibrated for the substance which it is least sensitive to. The properly performed calibration procedure is essential for the reliability of a gas detection system.

SENSOR POSITIONING

Please refer also to the IEC/EN 60079-29-2, chapter 8 – Criteria for the placement of sensors and sampling points.

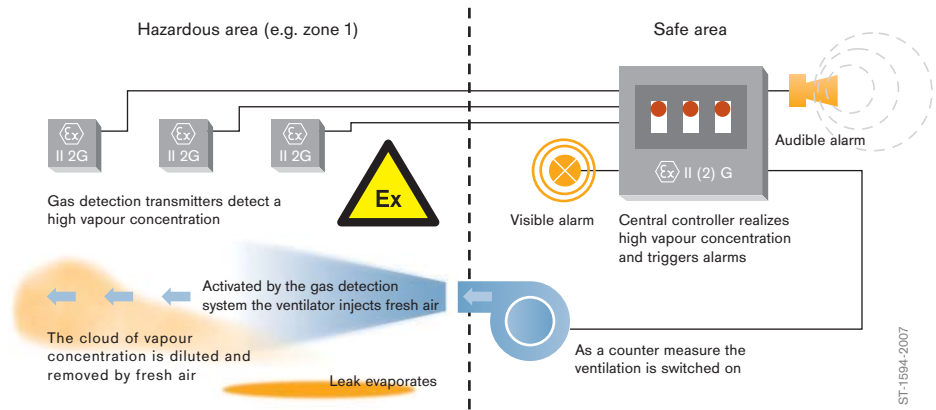
There are three different sensor placement strategies:

1. Spot monitoring: The potential sources of leak (e.g. valves, filling nozzles, flanges, bellows) are well-known and locatable. So sensors can be placed such that gas leaks can be detected very early and reliably.
2. Area monitoring: The potential sources of leak are spread across a large area and are not locatable (e.g. in hazardous goods stores). Thus the sensors should be positioned more or less equidistantly across the entire area.
3. Fence monitoring: The potential sources of leak are not locatable and there are no ignition sources in the area. Thus sensors are positioned at the outer limit to monitor for hazardous gas concentrations crossing into neighbouring areas.

Besides the operational experience of the local plant engineers concerning sensor positioning also the IEC/EN 60079-29-2 "Guide for selection, installation, use and maintenance of apparatus for the detection and measurement of combustible gases or oxygen" contains a lot of advices to place gas sensors properly.

It seems to be trivial, but one thing is essential to know when designing a gas detection system: A gas detector can only detect a gas which is in the direct vicinity and which can enter the sensor's elements. So it has to be considered that vapours of flammable liquids are always heavier than air and spread across the floor rather than rising up, and they even might condensate in other locations if the temperature decreases. Also, vapours of flammable liquids cannot form combustible concentrations if the ambient temperature is lower than the flash-point.

Gas detection transmitters for the detection of flammable vapours and heavy flammable gases (especially propane and butane belong to this group) should be placed where these substances might accumulate, as low as possible above the ground and/or below the leak. On the other hand three gases are well known which are very much lighter than air: Hydrogen, methane, and ammonia. Commonly these gases will rise under normal conditions, and sensors should be placed above the leak.



ST-1594-2007

Central Controllers – Centers for your Safety

Gas detection systems

Generally gas detection systems consist of explosion protected remote transmitters (gas detection transmitters), which are installed in the hazardous area, a central controller unit installed in the safe area to process the sensor signals and to trigger alarms and counter measures, and optical and audible alarm devices which also might be installed in the hazardous area.

CENTRAL CONTROLLER UNITS

Central controller units are installed in the non-hazardous area, and on the one hand they supply the connected gas detection transmitters with the necessary voltage, on the other hand they receive their measuring signals and status-information to process and indicate them. If pre-adjusted alarm thresholds are exceeded central controllers are to trigger alarms reliably. To have a high availability central controllers often are equipped also with an emergency power supply.

Central controllers might be small single-channel-units for the connection of only one transmitter as well as complete cabinets with built-in device racks for many plug-in modules (channel modules) connected to many transmitters, and with customized wired alarm circuits.

The channel modules mostly provide several relays with voltage-free contacts. Depending on whether the relays are energized in normal operation or in case of alarm, the voltage-free contacts can be configured as NO-contacts (normally open = closed in case of alarm) or NC-contacts (normally closed - open in case of alarm).

For primary protection systems at least one relay for device alarm must be energized in normal operation (fail-safe principle) so that a mains power breakdown can be detected. Furthermore, for relays having a safety function it is recommended that these relays are also fail-safe (de-energized in case of alarm or power-off).

The relay contacts – if necessary upgraded by additional relays to have redundant contacts – can be used to activate counter measures (ventilation on/off, ventilation flap open/close, gas supply on/off, shutdown activation, etc.) and for optical alarms, to keep the operator informed about the alarm condition even after having switched off the audible alarm. Switch-off means acknowledgement, and in parallel to the automatic measures the customer has to conduct organizational measures if necessary.

Furthermore a gas detection system often provides 4 to 20-mA-outputs ("signal repeaters"), e.g. to print-out or visualize the current gas concentrations for documentation purposes.

Especially the modular concept of the central controller Dräger REGARD offers numerous possibilities for customized design: Various combinations of Dräger REGARD Ex and 4 to 20-mA-modules, Master card for the acknowledgment of special alarm configurations and connections to PLCs, HART card as well as a ModBus-Gateway card for BUS-connection to process control systems and PCs with 32-bit operating systems for measurement display and data-logging.



Gas detectors

Based on catalytic bead sensor technology as well as infrared sensor technology Dräger offers a wide range of different gas detectors for the detection of flammable gases and vapours.

GAS DETECTORS

Dräger Polytron FX and Dräger Polytron 2 XP Ex
4 to 20-mA-transmitter with pellistor sensor or IR-sensor (optional), flameproof housing, with display and magnetic wand operation, ATEX- or UL-approved, to be connected to central controllers with 4 to 20-mA-inputs.



ST-1389-2006

Dräger PEX 3000
4 to 20-mA-transmitter with pellistor sensor, with built-in explosion protected 4 to 20-mA-converter, 7-segment-display and 2-key-operation (for calibration) to be connected to central controllers with 4 to 20-mA-inputs.



ST-5675-2004

Dräger Polytron SE Ex
Sensing head without electronics with pellistor sensor and mV-measuring signal to be connected to special central controllers, measuring range 0 to 100 or 0 to 10 %LEL, also as high temperature version for up to 150 °C.



ST-5669-2004

Dräger Polytron Ex
Explosion protected transmitter for pellistor sensor, with intrinsically safe current circuits (LC-display, sensor connection, operating facilities) to be connected to central controllers with 4 to 20-mA-inputs.



ST-3833-2003

DrägerSensor IR
Explosion protected transmitter with IR-sensor in flameproof housing, similar to Dräger PIR 3000, but with pellistor-sensor-emulation for replacement of pellistor sensors, with mV-output to be connected to special central controllers.



ST-8821-2005

Dräger PIR 7000
Explosion protected robust IR-transmitter with IR-sensor in flameproof stainless steel housing for central controllers with 4 to 20-mA-input, suitable for safety related systems acc. to SIL2, certified following IEC 61508, ATEX,- IECEx- and UL-approved.



ST-11659-2007

Dräger Polytron IR Ex
Explosion protected transmitter with IR-sensor, with intrinsically safe current circuits (LC-display, sensor connection, operating facilities) to be connected to central controllers with 4 to 20-mA-inputs, with open or closed optical system, different versions.



ST-5643-2004

Dräger Polytron IR type 334 and type 340
Explosion protected robust IR-transmitter with IR-sensor in flameproof stainless steel housing for central controllers with 4 to 20-mA-input, suitable for safety related systems acc. to SIL2, with HART and RS 485, ATEX- or UL-approved.



ST-5651-2004

Dräger PIR 3000
Explosion protected transmitter with IR-sensor in flameproof housing, to be connected to central controllers with 4 to 20-mA-input, ATEX-, IECEx- and UL-approved.



ST-8822-2005

Dräger Polytron Pulsar
Explosion protected Open Path gas detector for the detection of a gas concentration along a line of sight of up to 200 m.



ST-3932-2005



ST-748-2006



ST-478-2004

Central controllers

Based on different concepts, on the one hand device rack with channels modules or DIN-rail mounted controllers both to be installed in wall housings or cabinets, on the other hand stand-alone controller units in IP65-

protected ABS-enclosures, Dräger offers controllers with different properties, which – in combination with suitable gas detectors – are dedicated for the reliable gas detection in the field of explosion protection.

CENTRAL CONTROLLERS

Dräger Polytron Controller

Device racks for max. 2, 5, or 12 different channel modules and one acknowledgement module, to be installed in cabinets, panels or wall housings. Channel modules with bar graph display and LED status information, three configurable relays per module.



48658

Dräger REGARD System

Device rack to take up 16 different modules, to be installed in cabinets, panels, or wall housings. Channel modules with 4 digit matrix displays and operation push buttons for configuration.



ST-340-2004

Dräger REGARD 1

Stand-alone single channel controller with ABS-enclosure, with LC display and status LEDs, configurable for SE Ex sensing heads as well as 4 to 20-mA-transmitters, five relays, three alarm thresholds and battery back-up.



ST-335-2004

Dräger REGARD 3900

Stand-alone central controller with ABS-enclosure for 1 to 16 channels, with LC display and four status LEDs for each channel, fully configurable via laptop or PC to operate with 4 to 20-mA-transmitters.



ST-272-2004

Dräger REGARD 2400

Stand-alone central controller for wall mounting to be operated with four transmitters max.



ST-5647-2006

Dräger REGARD 2410

Central controller to be clipped on a DIN-rail for the connection of four transmitters max.



ST-5738-2006

Explosion Protection by Dräger Gas Detection Technology



ST-523-98

Dräger REGARD

A representative customized gas detection system.



ST-272-2004

Dräger REGARD 3900

Stand-alone central controller with ABS-enclosure for up to 16 channels.

EXPLOSION PROTECTION WITH DRÄGER

Dräger gas detection technology means sensors, transmitters, central controllers and competent support – our system engineers will design a specific gas detection system for your application.

The product portfolio of Dräger gas detection transmitters encompass numerous different types:

- catalytic bead or infrared sensor technology
- point- or open-path-detection
- increased safety, intrinsic safety, or flameproof
- analogue 4-20-mA-signal, mV signal
or digital HART or RS 485 signal
- with or without display at site
- with or without onboard relays
- low budget or high end equipment

Select between different central controllers for your special explosion protection application:

- for mV-signal or 4 to 20-mA-signal
- single-channel or multi-channel controllers
- device racks for cabinet installation or stand-alone type with ABS-housing
- with or without digital communication
- manually or PC-supported configuration

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