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## Explosion Protection

GAS DETECTION  
SYSTEMS

## Explosion hazards due to flammable gases and vapours

### THE DANGER OF EXPLOSION IS LURKING EVERYWHERE

Detecting flammable gases and vapours before they become a hazard takes priority over mechanical and electrical explosion-protection measures. In any situation where flammable gases and vapours can lead to dangerous conditions – whether in exploratory drilling and production of crude oil and natural gas, in the chemical and petrochemical industry, during storage and transport of flammable liquids and gases, during processing of plastics, or when using solvents – explosion protection is legally required for personnel as well as facilities.

Depending on the application, different measuring principles can be deployed to detect such flammable gases and vapours: catalytic bead sensors, infrared sensors or open-path detectors, in combination with central units, like Dräger REGARD, can provide an early warning when flammable gases and vapours are present while concentrations are still safely below the flash point. In this way, dangerous situations can be prevented before they even happen through enacting effective countermeasures.

### METHODOLOGY OF EXPLOSION PROTECTION

Flammable gases and vapours can only be ignited by an ignition source with sufficiently high ignition energy and/or temperature if they exist – under atmospheric conditions – in combination with sufficiently high concentrations of oxygen in the air. These concentrations are referred to as the Lower Explosion Limit (LEL).

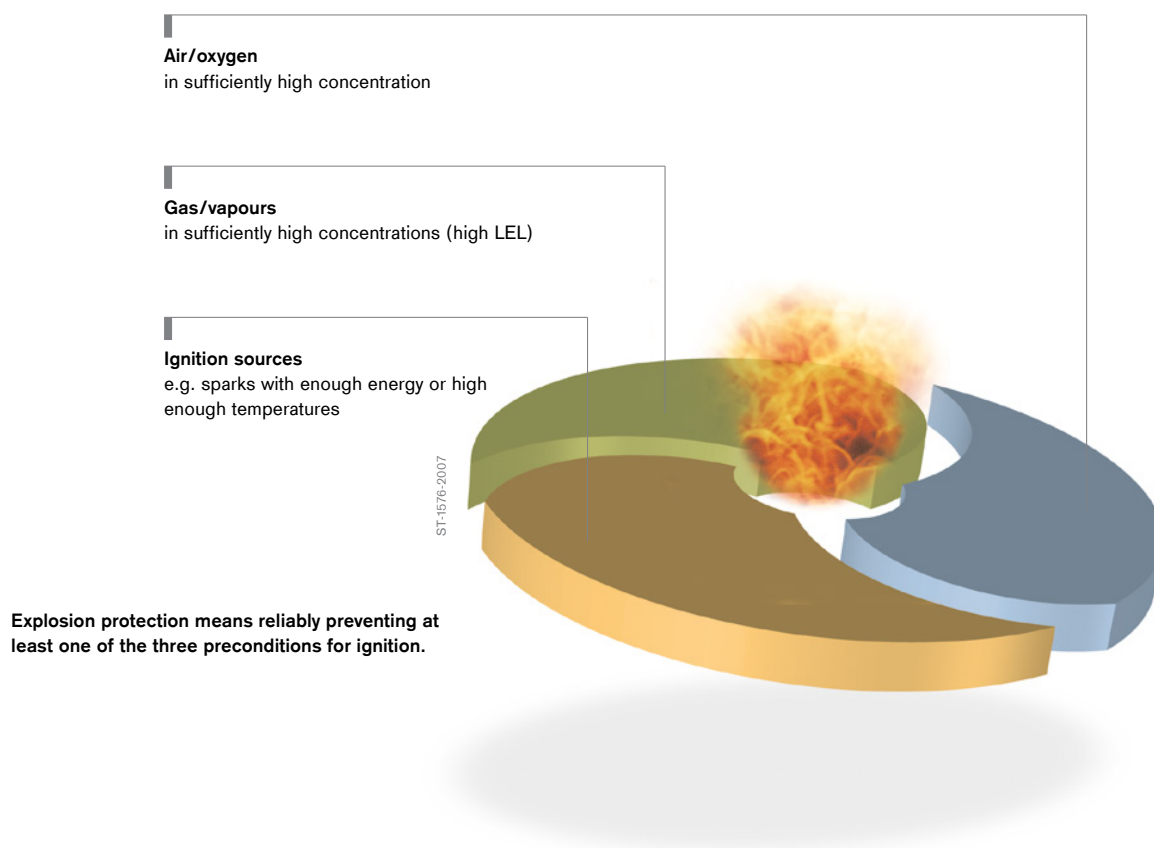
In other words, ignition can only take place if three conditions are met:

1. Concentration of the flammable gas or vapour above the LEL
2. There is a sufficiently high concentration of oxygen/atmospheric oxygen
3. There is a sufficiently high temperature or level of energy from an ignition source

The same applies in reverse: If any of these three conditions is not met, there is no way ignition or explosion can occur.

Explosion protection measures can therefore be:

1. Limiting concentrations
2. Inertisation
3. The use of explosion-protective operating equipment

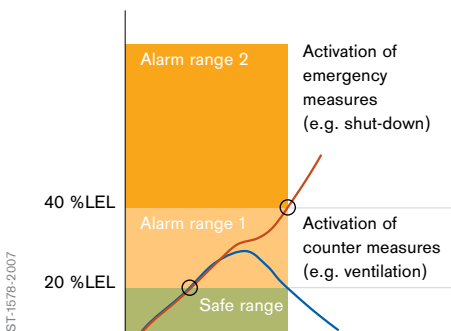


The most certain way to limit concentrations is, of course, to completely avoid using flammable gases/vapours. However, this is rarely feasible. Therefore, gas detection equipment is used to limit concentrations, while, in closed processes, concentrations are in fact allowed to reach well above the LEL, yet the oxygen level is reduced to such an extent that no ignitable mixture can form (inertisation).

If such measures are insufficient or not fully adequate, then ultimately only (standardised) ignition-protected types of operating equipment must be used, so the equipment does not become an ignition source in the event of a gas leak.

For further information on explosion protection methods, please review the harmonised standard EN 1127-1.

# Hazardous Atmospheres



## Alarm thresholds

If the LEL concentration begins to increase, then, as soon as it reaches the alarm range 1, countermeasures are activated. If these measures are successful, the concentration will decrease (blue curve). However, if the measures fail, the concentration continues to rise (red curve). Once the second alarm range is reached, emergency measures are activated. Properly designed industrial plants only reach the alarm range 2 in very rare instances, if ever.



**LEL scales**

The lower the LEL, the more dangerous the substance, because it is easier for ignitable concentrations to form. For example, the LEL of hydrogen is 4% vol. A testing gas with 2% vol. hydrogen in air is not ignitable.

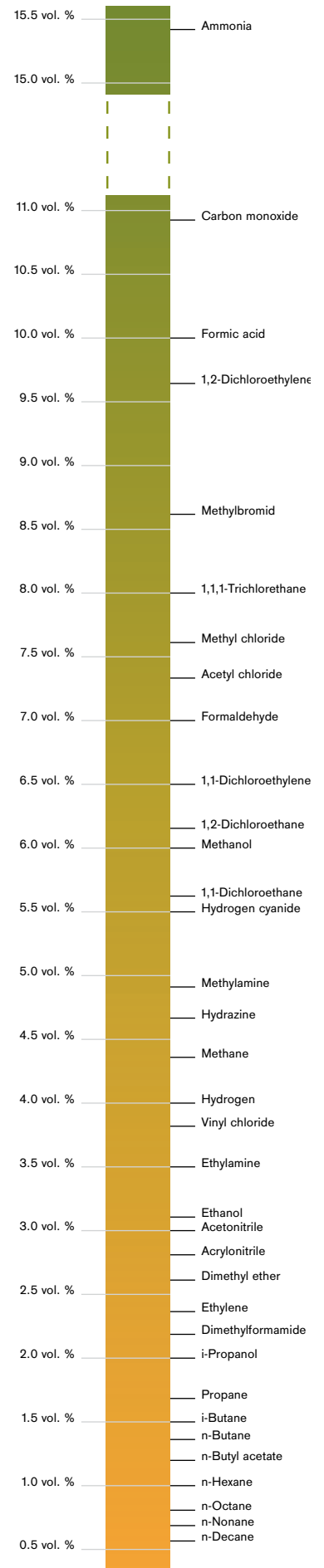
# Preventing potentially explosive atmospheres – Primary explosion protection

**BELOW THE LEL, NO DANGER OF EXPLOSION**

Limiting concentrations (1) and inertisation (2) are known as primary measures, because they prevent the formation of ignitable concentrations. In contrast, the use of explosion-protective types of operating equipment (3) is known as a secondary measure because it does not prevent the formation of ignitable concentrations, but keeps them from igniting.

Limiting concentrations means actively diluting them; e.g., by automatically injecting fresh air into hazardous areas whenever concentrations reach just 20% of the LEL. Only when the concentration still continues to increase (i.e. the countermeasure was not sufficient) should emergency measures be activated. For example, at 40% of LEL, all non-explosion-protective types of electrical operating equipment are shut down. Gas detection devices are used to detect such concentrations. In Europe, these devices must be submitted to type-specific testing for their intended purpose by a 'notified body', in accordance with EN 60079-29-1, previously EN 50054ff or EN 61779). This applies to the sensor as well as the transmitter and central unit.

Because inertisation is also a preventive explosion-protection measure, oxygen detection is subject to specific requirements, at least in Europe: O<sub>2</sub> detection devices must also be submitted to type-specific testing for this purpose (e.g. acc. EN 50104).



ST-1577-2007



## Safety relevant key figures of flammable gases and vapours

### THE LOWER EXPLOSION LIMIT (LEL)

Each flammable substance has a concentration limit below which it cannot be ignited when mixed with air because not enough fuel is present. The LEL is an incalculable empirical property of flammable substances which is determined based on specific standards and – with a few exceptions – lies in the range of 0.5 to 15% vol.

### GASES AND LEL

In general, substances above their boiling points are known as gases. Therefore, the pressure of a gas is always higher than the atmospheric pressure, which means that, when they are released, gases can quickly exceed their LEL concentrations and form ignitable mixtures of gas and air.

### VAPOURS OF FLAMMABLE LIQUIDS AND FLASHPOINT

Substances below their boiling point not only occur in gaseous forms, but also in a temperature-specific equilibrium with their liquid (or even solid) state.

The gaseous component in such cases is known as a vapour. The vapour's pressure is always lower than atmospheric pressure, and – depending on the temperature – only certain maximal concentrations of vapours can form. In particular, the maximum possible vapour pressure of a flammable liquid

can be so low that the LEL is only reached when a certain temperature is exceeded; i.e. the vapour only becomes ignitable above this temperature. This empirically determined temperature is known as the flashpoint – a very important safety relevant figure for assessing the hazard posed by flammable liquids. For example, the flashpoint of pure ethanol is 12 °C. This means it is combustible at temperatures as low as 20 °C. In contrast, N-butanol vapours with a flashpoint of 35 °C still cannot be ignited at a temperature of 20 °C.

And, in fact, if the temperature of a flammable liquid remains significantly below the flashpoint, primary explosion protection is already in progress.

### IGNITION TEMPERATURE AND MINIMUM IGNITION ENERGY

Electrically (or mechanically) produced sparks and hot surfaces are the best known of the 13 different types of ignition sources. To ignite gas-air mixtures or vapour-air mixtures, the ignition source must either have a temperature above the ignition temperature, or a spark's energy must exceed the mixture's minimum ignition energy level. Both levels (ignition point and minimum ignition energy) are substance-specific, safety relevant figures which are defined by specific safety standards and play a major role in the development and selection of explosion-protected equipment.

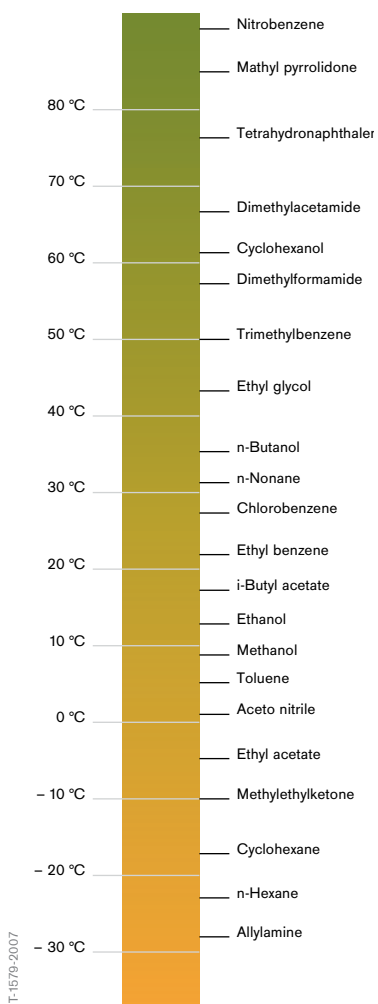


### SELECTION OF SAFETY RELEVANT FIGURES FOR FLAMMABLE GASES AND VAPOURS

Gas/vapour	LEL % vol*	LEL g/m <sup>3</sup> *	Flash-point**	Vapour pressure**	Ignition temperature
Acetone	2.5	61	< -20 °C	246 hPa	535 °C
Acetylene	2.3	25	Gas	Gas	305 °C
Acrylonitrile	2.8	62	-5 °C	117 hPa	480 °C
Ammonia	15.4	109	Gas	Gas	630 °C
Benzene	1.2	39	-11 °C	100 hPa	555 °C
1.3-Butadiene	1.4	32	Gas	Gas	415 °C
i-Butane	1.5	36	Gas	Gas	460 °C
n-Butane	1.4	34	Gas	Gas	365 °C
n-Butanol	1.4	43	35 °C	7 hPa	325 °C
n-Butyl acetate	1.2	58	27 °C	11 hPa	390 °C
Chlorobenzene	1.3	61	28 °C	12 hPa	590 °C
Cyclohexane	1.0	35	-18 °C	104 hPa	260 °C
Cyclopentane	1.4	41	-51 °C	346 hPa	320 °C
Diethyl ether	1.7	52	-40 °C	586 hPa	175 °C
Dimethyl ether	2.7	52	Gas	Gas	240 °C
1.4-Dioxan	1.4	51	11 °C	38 hPa	375 °C
Epichlorohydrin	2.3	89	28 °C	16 hPa	385 °C
Ethanol	3.1	60	12 °C	58 hPa	400 °C
Ethylene	2.4	28	Gas	Gas	440 °C
Ethyl acetate	2.0	73	-4 °C	98 hPa	470 °C
Ethyl benzene	1.0	44	23 °C	10 hPa	430 °C
Ethyl acetate	1.0	44	23 °C	10 hPa	430 °C
Ethylene oxide	2.6	48	Gas	Gas	435 °C
n-Hexane	1.0	36	-22 °C	162 hPa	230 °C
Methane	4.4	29	Gas	Gas	595 °C
Methanol	6.0	80	9 °C	129 hPa	440 °C
Methanol	6.0	80	9 °C	129 hPa	440 °C
Methyl chloride	7.6	160	Gas	Gas	625 °C
Methylethylketone	1.5	45	-10 °C	105 hPa	475 °C
Methyl methacrylate	1.7	71	10 °C	40 hPa	430 °C
n-Nonane	0.7	37	31 °C	5 hPa	205 °C
n-Octane	0.8	38	12 °C	14 hPa	205 °C
n-Pentane	1.1	33	-40 °C	562 hPa	260 °C
Propane	1.7	31	Gas	Gas	470 °C
i-Propanol	2.0	50	12 °C	43 hPa	425 °C
Propylene	2.0	35	Gas	Gas	485 °C
Styrene	1.0	43	32 °C	7 hPa	490 °C
Toluene	1.0	38	6 °C	29 hPa	535 °C
Hydrogen	4.0	3	Gas	Gas	560 °C

\* acc. PTB Standard

\*\* Flashpoint only defined for liquids; Indicating vapour pressure (at 20 °C) is also only useful for liquids



#### Flashpoint scale

The lower the flashpoint, the more dangerous; i.e., the easier it is to ignite the liquid. For example, the flashpoint of trimethylbenzene is 50 °C. That means trimethylbenzene vapours are not ignitable at 20 °C.



## No hazard of explosion without ignition source – Secondary explosion protection

If it is not possible to sufficiently prevent the formation of an ignitable atmosphere through primary measures (e.g. using gas detection systems), then electrical operating equipment must be designed in such a way that it is guaranteed not to act as an ignition source.

### IGNITION PROTECTION TYPES

Four of the seven standardised ignition protection types are relevant for detectors and gas detection technologies: flameproof (d), intrinsic safety (i), encapsulation (m) and increased-safety (e). Hot surfaces and sparks are 'mechanically' prevented by encapsulation, whereas intrinsically safe equipment prevents these by limiting electrical power. Flameproof, in principle, allows an internal ignition, yet resists explosion pressure and reliably avoids a flashback. Lastly, increased-safety equipment reduces the risk of formation of hot surfaces and sparks through its specific type of construction, but it is limited to certain types of equipment (cable glands, junction boxes, lamps, engines, etc.). Explosion-proof operating equipment must be tested and certified by a 'notified body'.

### EXPLOSION PROTECTION IS THE LAW

In Europe, explosion protection is enshrined in law by the EU Directive ATEX 2014/34/EU and

99/92/EC, also known as articles 114 and 137. Manufacturers of explosion-proof equipment must apply standard labelling to such devices, and define the approved area of application by indicating an equipment category. The user must categorise explosive atmosphere areas depending on their type (D: dust, G: gas) and the presence of flammable agents.

For example, II 2 GD is a typical equipment category which can be used in zone 1 and 2 or in zone 21 and 22, whereas equipment for zone 2 must have at least a II 3 G label.

In the USA, explosion protection is regulated through NEC 505. Explosion protection labelling in the USA also contains information about the use in terms of 'Class' and 'Division'. In the USA, however, only flameproof and intrinsic safety are recognised as ignition protection types. In most countries, the European and American explosion protection standards are accepted, although the so-called IECEx, a product based on globally accepted IEC explosion protection standards, is the preferred system today. Dräger gas detection devices generally fulfil the explosion-protection requirements of CENELEC (ATEX, Europe), UL (USA), CSA (Canada) and IECEx (worldwide).

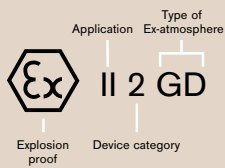




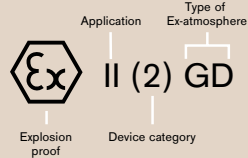
**ASSIGNMENT OF TEMPERATURE CLASSES AND EXPLOSION GROUPS AND TYPICAL GASES AND VAPOURS**

Temperature class and max. permissible surface temperature		Explosion group		
		<b>IIA</b> Ignition energy above 0.18 mJ	<b>IIB</b> Ignition energy 0.06 to 0.18 mJ	<b>IIC</b> Ignition energy below 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, ethylglycol Hydrogen sulfide	
T4	135 °C	Acetaldehyde	Diethylether	
T5	100 °C			
T6	85 °C			Carbon disulphide

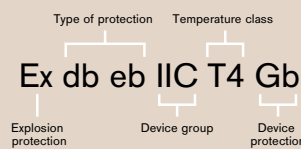
For example, if a potentially explosive atmosphere is caused by carbon disulphide, electrical equipment must have a IIC and T6 label, whereas, for n-hexane, equipment with IIA and T3 labels is adequate.



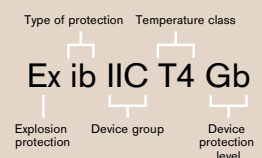
Typical marking of a gas detection transmitter acc. to 2014/34/EU: Equipment for zone 1, 2, 21 and 22.



Typical marking of a related electrical device, like a safety barrier that is not allowed for use in an explosion-hazard area, but may be electrically connected with a corresponding device inside the explosion-hazard area.



Typical marking for the ignition protection type of a piece of electrical equipment (e.g. gas detection transmitter).



ST-1580-2007



**Mandatory warning sign**

Mandatory warning sign for marking and delimiting explosion-hazard areas (zones). There are organisational measures that must be attended.



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# Hazardous areas

## Through gas detection systems, the probability of an ignitable atmosphere forming is reduced

In Europe, the operator must conduct a risk assessment in accordance with Directive 99/92/EC (ATEX 137), and categorise its explosion-hazard areas according to their level of danger (i.e. the probability of an explosive atmosphere occurring), implement organisational safety measures, and verify these with an explosion protection document. Only certain pieces of equipment may be used in the indicated zones.

Through the use of gas detection systems that reliably prevent the occurrence of an ignitable atmosphere, the probability of an ignitable atmosphere occurring in the first place is significantly reduced. Normally, it will not occur at all (definition of zone 2). In other words, a zone 1 can be made into

a zone 2 through the use of a verified gas detection system. In this zone, equipment can be used that is simpler in construction as far as explosion safety is concerned (and generally also less expensive), such as lamps, machines, fork lifters, etc.

However, it is still necessary for the countermeasures initiated by the gas detection system to sufficiently prevent the formation of ignitable concentrations. This is possibly not the case directly surrounding a gas leak, if the gas is released more quickly than it can be extracted by the countermeasure of ventilation. The vicinity remains zone 1, but the zone 1 area is considerably reduced by the use of gas detection systems – very much to the operator's benefit.

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

Hazardous areas are classified based on the probability of an explosive atmosphere forming in the following zone			Minimum requirement for device category
	Zone		
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 a long period or frequently	II 1G
	1	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 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 a piece of equipment is to be used in zone 21, its marking must correspond at least with equipment category II 2D.

# Use of gas detection systems

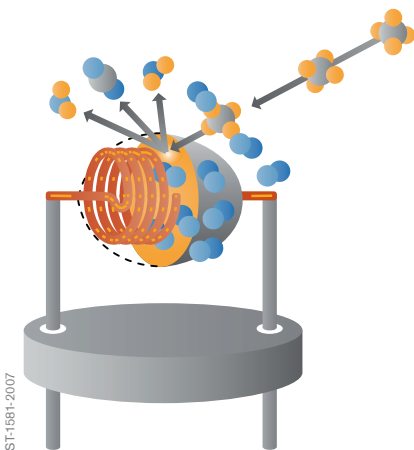
## Proven in gas detection over decades: catalytic bead and infrared sensors

### CATALYTIC BEAD SENSORS

The catalytic bead sensor is a flameproof sensor for measuring flammable gases and vapours, with a flame arrestor housing it. It is used to warn against explosion hazards. The measuring principle is based on a chemical reaction between the measuring substance and oxygen. This requires at least 12% vol. oxygen in the ambient air. If oxygen concentrations are too low, the catalytic bead sensor transmits no detection signal – but there is no risk of explosion in that case. The catalytic bead sensor has different levels of sensitivity to different flammable gases and vapours. For some substances, the sensitivity is so low that the sensor is unable to reliably indicate them.

The heat of reaction measuring principle is based on the fact that flammable gases and vapours undergo an oxidation reaction with atmospheric oxygen, even at concentrations below their LEL. The prerequisite is a suitable hot catalyst. The heat of reaction released during oxidation is a measure of the gas's concentration.

The catalytic bead sensor houses two small detection beads known as 'pellistors' (a combination of 'pellet' and 'resistor'). Pellistors are made from porous ceramic which embeds a fine, platinum-wire coil. An electrical current of approximately 250 mA heats the platinum coil to approximately 450 °C. At the same time, the platinum coil also serves as a measuring resistor for temperature changes. If molecules of flammable gases penetrate the pellistor, they are catalytically oxidised by the activated ambient oxygen that is bound inside the porous ceramic. The heat of



#### The active pellistor (cross section, schematic)

Upon entry, the methane molecule is oxidised into water vapour and carbon dioxide by the activated ambient oxygen situated inside the heated bead. The heat of reaction released causes a detectable change in the resistance of the embedded platinum coil.





reaction that is released results in an increase in temperature (for example, ca. 2 °C for 10% LEL octane). The temperature increase results in a change in resistance of only thousandths of an ohm, which is proportional to the gas concentration.

The temperature increase based on the gas concentration can, however, only be used as a measuring signal if the possibly much stronger fluctuations in ambient temperature are metrologically compensated for. For this, the second pellistor, referred to as the compensator, is used. In contrast to the active pellistor, in the compensator, the catalytic reaction is physically or chemically suppressed so that it is only exposed to the ambient temperature. Interconnected inside a Wheatstone bridge, it thus compensates for environmental influences, especially the influence of the ambient temperature. For optimal performance, both pellistors must always match one another as closely as possible in terms of their technical parameters. For that reason, they are paired accordingly during manufacturing.

The activity of catalysts decreases over time, and can also be greatly reduced by catalytic poisoning. For decades, Dräger has produced its own type of PR ('poison resistant') pellistors. Because of their construction and the materials used, they last longer than conventional pellistors in industrial atmospheres which can contain catalytic poisons like sulphur, phosphor, lead and silicone compounds.

#### INFRARED SENSORS

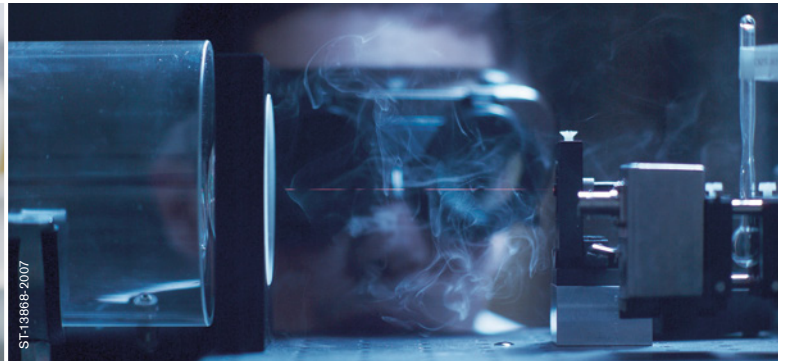
In contrast to catalytic bead sensors, there is no

risk of catalytic poisoning with infrared sensors, which rely on a purely physical measuring principle, and also do not require any oxygen.

The gas is separated by the IR detectors through optical windows. However, infrared sensors measure flammable gases and vapours with extremely different levels of sensitivity, at times, and certain substances, like vinyl chloride or acetonitrile, are not at all detectable, contrary to expectations. The Dräger applications laboratory has indexed just under 300 gases and vapours as detectable using IR gas detection transmitters.

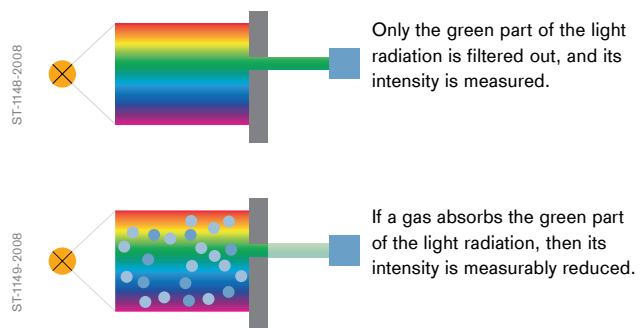
The IR detection principle is based on the understanding that the molecules or flammable gases and vapours (with a very few exceptions, such as H<sub>2</sub>, NH<sub>3</sub>, CO, CS<sub>2</sub>, HCN, H<sub>2</sub>S and hydride) are hydrocarbons. Certain wavelengths of the IR spectrum cause their CH bonds to vibrate, and, in this way, they absorb energy. When infrared light is radiated into an optical system that is filled with an infrared-active gas, an increase in IR absorption can be seen in a certain range of wavelengths that are optically filtered out, because normal air does not absorb IR light.

Whereas the production of near-infrared is relatively simple using low-voltage-operated lightbulbs, the construction of a wavelength-specific IR measuring detector is much more complicated. These are pyroelectric crystals situated behind an interference filter that produce very small changes in voltage when exposed to pulses of IR light. After intensive electronic amplification and linearisation, they finally produce a 4-20 mA signal that is proportionate to the concentration.



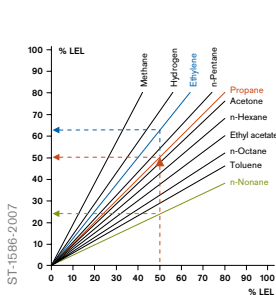
Yet, not only gas, but also a reduction in radiant power or contamination of the optical system lead to a weakening of the IR signal. Such effects are compensated for using a second IR measurement detector (reference detector) which receives the IR radiation via a beam splitter and measures in a wavelength range in which gases are not IR active. Therefore, if both measurement detectors indicate significant IR absorption, it is usually not related to gas, but to some other cause, such as contamination of the optical system. Due to the compensation, the detection signal from the IR sensor is tolerant of contamination and can even generate a maintenance request signal starting at a certain degree of contamination. In the Dräger PIR 7000, possible changes in the IR detectors are even compensated for using a second radiator ('four-beam compensation process').

The more gas molecules there are inside the optical system (cuvette), the greater the absorption, and thus also the possibility of achieving lower full-scale deflection; for example, only 10% of LEL, which allows for very early detection of any leaks.

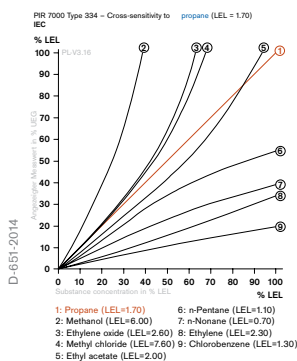


#### IR transmitters

The fact that there must always be a high measurement signal available in the absence of IR-absorbent gases has cleared the path for self-diagnostics procedures. If, for example, the IR source fails or the optical system is blocked, then the IR transmitter can detect this. It is 'fail-safe' as defined by IEC/EN 61508, which is a precondition for use in plants in acc. with, e.g., SIL2.



**Catalytic bead sensors**  
 Different sensitivities of a catalytic bead sensor calibrated to propane (schematic): 50% LEL n-nonane results in a measuring value of only 23% LEL propane, whereas 50% LEL ethylene causes a measured value of 62% LEL.



**Infrared sensor**  
 Different sensitivities of an infrared sensor calibrated to propane (Dräger PIR 7000, Type 334, typical cross sensitivities). 50% LEL n-nonane results in a measured value of only about 23% LEL propane, whereas 50% LEL ethylene oxide causes a measured value of about 64% LEL. The propane-configured sensor reacts with significantly less sensitivity to chlorobenzene and ethylene. It does not measure hydrogen, ammonia or other flammable substances at all.

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

### CALIBRATION

Only calibration with the target gas, the gas detection transmitter is individually adjusted to a specific gas. If several gases or vapours are to be reliably detected, then the transmitter must be set to the substance to which it reacts with the least sensitivity. Properly conducted calibration is essential to the reliability of the gas detection system.

### SENSOR PLACEMENT

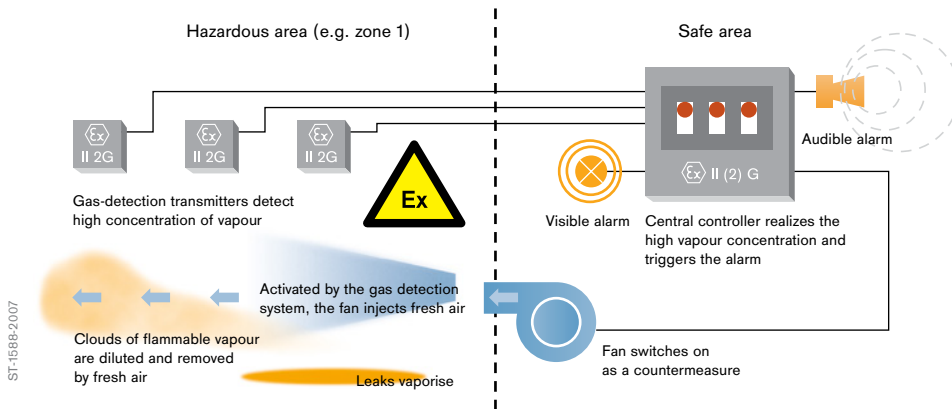
See also IEC/EN 60079-29-2, section 8 for criteria on the arrangement of sensors and measuring points. There are three different sensor placement strategies:

1. Spot monitoring: Potential leakage sources (e.g. valves, filling nozzles, flanges, bellows) are known and localisable. Therefore, the sensors can be positioned in such a way that allows gas leaks to be detected reliably and very early.
2. Area monitoring: The potential sources of leakage are not localisable and are situated somewhere inside a large area (e.g. a hazardous materials depot). Therefore, the sensors are distributed at equal distances throughout the entire area.
3. Fence monitoring: The potential sources of leakage are not localisable. Therefore, the outer limit of the facility is monitored to detect in case hazardous substances leak into nearby areas.

In addition to the operational experience of local safety engineers, which is necessary for the placement of gas detection transmitters, there is also IEC/EN 60079-29-2, the 'Guide for selection, installation, use and maintenance of apparatus for the detection and measurement of combustible gases or oxygen', which contains a lot of information on the proper positioning of such sensors.

It is important when properly laying out a gas detection system that a sensor can, of course, only detect the gas concentration in its direct vicinity. Vapours from flammable liquids are heavier than air. They spread out near the ground and condense or evaporate again, depending on the temperature. In any case, they are not ignitable at temperatures below their flashpoint. This is because 100% LEL can only be exceeded at temperatures above the flashpoint.

Gas detection transmitters for detecting flammable vapours and heavy gases (e.g. propane and butane) must be installed as near to the ground as possible, because these substances can accumulate here. Hydrogen, methane and ammonia, on the other hand, are much lighter than air, so they rise. Therefore, in these cases, the sensors should be placed above possible leakage spots.



## Central controllers – centres for your safety

In general, gas detection systems consist of remote transmitters (gas detection transmitters), central controller units and optical and acoustic alarm devices. The transmitters are explosion protected and are installed inside the hazardous area. The central controller units are located inside the non-hazardous area. They administer the detection signals and enact countermeasures in case of an emergency. The alarm devices can be positioned in both areas. Ensure that alarm devices placed in the hazard area are sufficiently explosion protected.

### CENTRAL UNITS

Central units are control units. They are located outside the non-hazardous area, and supply power to the connected gas detection transmitters. Plus, they receive the transmitters' detection signals and status information, and administer these. If preset alarm thresholds are exceeded, the control units alert the operator and send reliable output signals to the alarms. For added security, central units are often equipped with emergency power supplies.

Central units can range from small, single-channel devices for connecting just one transmitter, to complete control cabinets with built-in racks for many plug-in modules (input and output modules) designed to implement the operator's specific alarm strategy. Generally, the output modules contain 4 or 8 relays with potential-free contacts.

The relay contacts can control countermeasures (switching ventilators on/off, opening/closing ventilation valves, switching gas supply on/off, emergency shutdown, etc.). For this, contacts must be wired redundantly, as necessary.





## Transmitters







The product range of Dräger gas detection transmitters includes a number of various types. A selection of their features can be

found here. Details about transmitters and their features can also be found in the Product Information sheets.

	Dräger PEX 3000	Dräger PIR 3000	Dräger PIR 7000	Dräger Polytron® 5100
				
Sensor type	Catalytic bead	Infrared	Infrared	Electrochemical
Hazard	ex	ex	ex	ox, tox
Explosion protection	'd', 'e'	'd', 'e'	'd', 'e'	'd', 'e'
Output signal	4-20 mA	4-20 mA	4-20 mA, HART®	4-20 mA
Ex approvals	-	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA
				
Sensor type	Catalytic bead	Infrared	Infrared	Electrochemical
Hazard	ex	ex	ex	ox, tox
Explosion protection	'd', 'e'	'd', 'e'	'd', 'e'	'i'
Output signal	4-20 mA	4-20 mA	4-20 mA	4-20 mA, HART®, LON, FF, PB
Ex approvals	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA

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	<b>Dräger Polytron® 8100</b>	<b>Dräger Polytron® 8200</b>	<b>Dräger Polytron® 8310</b>	<b>Dräger Polytron® 8700</b>
	 D-52604-2012	 D-15042-2010	 D-14983-2010	 D-14983-2010
Sensor type	Electrochemical	Catalytic bead	Infrared	Infrared
Hazard	ox, tox	ex	ex	ex
Explosion protection	'd', 'e' (optional junction box)	'd', 'e' (optional junction box)	'd', 'e' (optional junction box)	'd', 'e' (optional junction box)
Output signal	4-20 mA, HART®, Modbus, FF, PB	4-20 mA, HART®, Modbus, FF, PB	4-20 mA, HART®, Modbus, FF, PB	4-20 mA, HART®, Modbus, FF, PB
Ex approvals	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA	ATEX, IECEx, UL, CSA
	<b>Dräger Polytron® SE Ex</b>	<b>Dräger Pulsar 7000 Series</b>		
	 D-13660-2010	 D-7357-2016		
Sensor type	Catalytic bead	Open-path (IR)		
Hazard	ex	ex		
Explosion protection	'd', 'e' (junction box)	'd', 'e' (junction box)		
Output signal	mV	4-20 mA, HART®		
Ex approvals	ATEX, IECEx	ATEX, IECEx		





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## Central units

Here, you will find a selection of central units and information about their features. Details about the

central units and their features can be found in the Product Information sheets.

	<b>Dräger REGARD 2400/2410</b>	<b>Dräger REGARD 3900 Series</b>	<b>Dräger REGARD 7000</b>	<b>Dräger REGARD-1</b>
	 ST-88330-2007	 D-1129-2010	 D-6806-2016	 ST-335-2004
Input signal	4-20 mA, mV (SE Ex)	4-20 mA	4-20 mA, HART®, Modbus RTU, mV (SE Ex)	4-20 mA, mV (SE Ex)
Output signal	4-20 mA, Modbus, PB	4-20 mA, Modbus, PB	4-20 mA, Modbus, PB, PN	4-20 mA
Channels	4	16	1536 (logical channels)	1
Mounting	Wall-mounted casing, top-hat rail	Wall-mounted casing	Docking station	Wall-mounted casing
Configuration	PC	Manual, PC	Dashboard, PC	Manual

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