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DrägerSensor® & Portable Instruments Handbook

3.1st Edition

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DrägerSensor® & Portable Instruments Handbook

3.1st Edition

Dräger Safety AG & Co. KGaA
Lübeck, Germany
2016

This handbook is intended to be a reference for the users of portable gas detection. However, each individual case of application must be considered more closely. The information has been compiled to the best of our knowledge. However, the Dräger organization is not responsible for any consequence or accident which may occur as the result of misuse or misinterpretation of the information contained in this handbook.

The instructions for use may not always correspond to the data given in this book. For a full understanding of the performance characteristics of the measurement devices and for the use of Dräger products, only the instructions of use enclosed with the product shall apply and any inconsistencies between this handbook and the instructions for use shall be resolved in favour of the instructions for use. The user should carefully read and fully understand the instructions for use prior to the use of the measurement devices.

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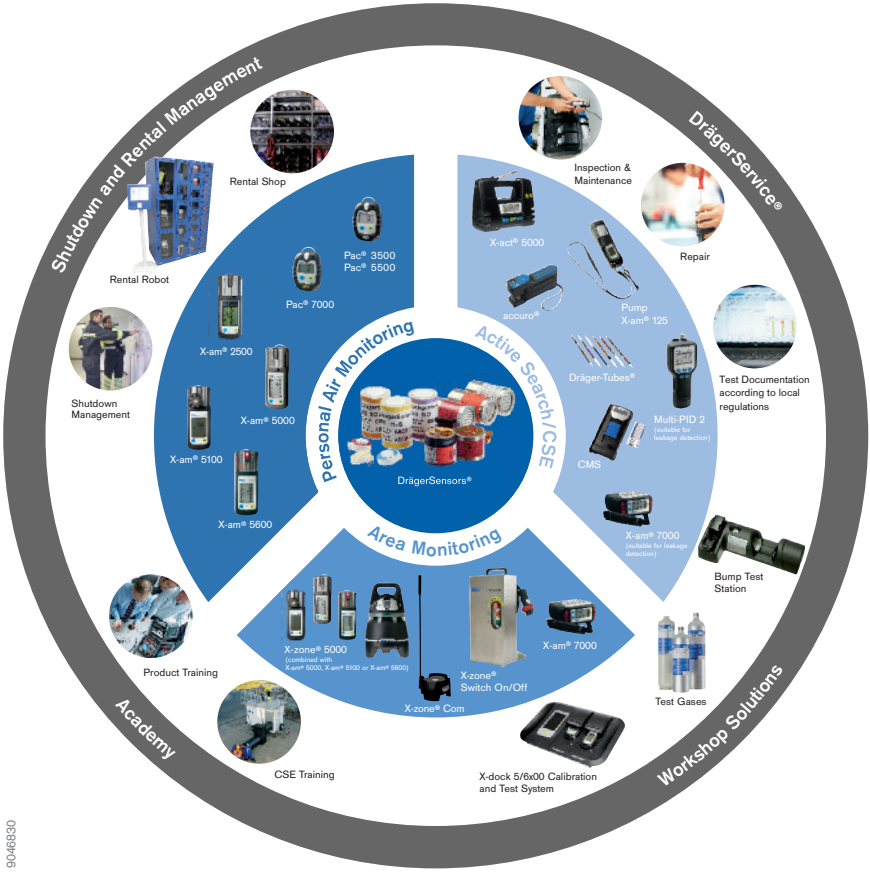
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1 Introduction

Dear readers,
This is the third edition of our DrägerSensor and gas detector manual. Since its first edition, for many of you this booklet has become an essential companion that provides valuable assistance in your everyday working life. We are very proud of the extensive positive feedback and always appreciate suggestions for improvement that we receive.

Integrated approaches based on the centrepiece of every gas detector, the sensor, have become necessary in the past few years. Our focus is on safety, reducing operating costs and customer benefits.

We believe that we need to offer you more than individual products – you expect an integrated and connected system. This does not just start with the measuring task, but when charging the device, daily testing, hand over, the actual measuring task using the right device and accessories as well as subsequent return and maintenance. The focus is also increasingly on assessing and managing entire groups of devices, especially the identification of risks, compliance with maintenance intervals, the maintenance itself as well as the evaluation of the useful life and readiness for operation. These are the challenges that we set ourselves.

We hope that you are happy with our new edition and look forward to receiving your ideas and suggestions for improvement – and naturally also positive feedback to our reference book.

Your Product Management for Portable Gas Detection

2 Properties of dangerous gases and vapors

Flammable and toxic gases and vapors occur in many areas. It is important to recognize the danger they pose – and that is the purpose of gas detection and warning devices. This handbook is meant to give a basic introduction to gas detection technology, measuring principles and safety concerns.

2.1 Gases – what is a gaseous matter?

Matter at a temperature above its boiling point is referred to as a gas. In terms of the normal human environment, this means that all those substances whose boiling points at normal atmospheric pressure are below 20°C (68° F), are gases. The lightest gas is hydrogen (H_2, fourteen times lighter than air), the heaviest gas (around ten times heavier than air) is tungsten hexafluoride (WF_6).

Under normal conditions, one cubic centimeter of gas contains thirty trillion molecules, whose average distance from one another is only around 3 nanometers. They move through space at between several hundred and several thousand meters per second but, at the same time, they collide with other molecules many billions of times each second. With the result that they only cover around 50–100 nanometers between impacts, and they continuously change their direction and transfer energy to the other molecules with which they collide.

The result is a completely random molecular motion which in macroscopic terms can be measured as temperature (average kinetic energy of all the molecules) and pressure (the average force exerted on a surface by all the molecules hitting it), as well as volume (spatial extent). Pressure, temperature, and volume are always in a fixed relationship to one another, which is governed by external conditions. In an ideal situation, they obey what is known as the "ideal gas law," namely:

- **At a constant pressure, their volume changes in proportion to their temperature** – their volume increases when heated;
- **If the volume remains the same (for example, in a closed container), then their pressure changes in proportion to their temperature** – for example, the pressure inside a container increases when heated;
- **At a constant temperature, pressure changes inversely proportion to volume** – for instance, the interior pressure rises when gas is compressed.

The extremely fast random movement of gas molecules is also the reason why they mix freely with other gases, never to become seperated again. This molecular behavior also explains the tendency of molecules to become less concentrated (diffusion), something which plays an important role in gas detection technology. Generally speaking, these processes become faster, the more quickly the molecules move (in other words, the hotter the gas is) and the lighter the molecules are (in other words, the lighter the gas is).

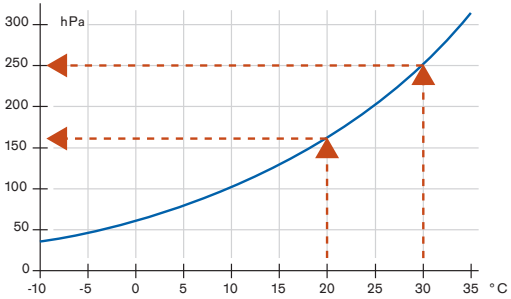
2.2 Vapors – aren't they gases, too?

Unlike gas – of which there are only perhaps between 200 to 300 – the word vapor is used to describe the gaseous state of a material below its boiling point. Vapor is always in equilibrium with its fluid (and sometimes solid) phase – it condenses and vaporizes according to the temperature. This is most familiar to us with water; when moist air near the ground cools down at night, ground mist forms (condensation) – but the warmth of the morning sun dissipates the mist (evaporation).

In a closed container, a maximum vapor concentration always exists above the surface of a liquid, and this concentration is dependent on the temperature of the liquid. On a microscopic level, the vapor is a result of the random movement of the liquid's molecules combined with their ability to overcome the surface tension and mix with the air molecules above the surface.

Every liquid has a certain characteristic vapor pressure, which depends on its temperature and reaches atmospheric pressure when the liquid reaches its boiling point. A graphic depiction of this relationship is known as a vapor pressure curve, and it shows the maximum possible vapor concentration at any given temperature.

Vapor pressure curve of liquid n-hexane



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If you divide the maximum possible vapor pressure by the ambient pressure, you are given the saturation concentration in Vol.-% (volume percent). Hexane gas at 20°C or 68° F (vapor pressure 162 hPa or 2.35 psi) and an ambient pressure of 1,000 hPa (14.5 psi) has a maximum possible concentration of 16.2 Vol.-%.

2.3 Our atmosphere

Our atmosphere extends far out into space, getting less dense the more it stretches. The blue color of the sky is caused by the scattering of the sun's rays on the air molecules in the atmosphere. The sky is actually already black by the time you reach a height of around 21 km (13 miles). If you were to subject the entire atmosphere to an even pressure of 1013 hPa (14.7 psi), then it would only be 8 km (5 miles) high, and the UV-absorbing stratospheric ozone layer would be a mere 3 mm (0.11 in.) high.

Typical composition of the earth's atmosphere in ppm:

	Composition	
Gas	dry	humid
Principal gases		
N_2 – nitrogen	780,840	768,543
O_2 – oxygen	209,450	206,152
H_2O – water vapor	0	15,748
Ar – argon	9,340	9,193
CO_2 – carbon dioxide	340	335
Trace gases		
Ne – neon	18	18
He – helium	5	5
CH_4 – methane	1.8	1.8
Kr – krypton	1.1	1.1
H_2 – hydrogen	0.5	0.5
N_2O – nitrous oxide	0.3	0.3
CO – carbon monoxide	0.09	0.09
Xe – xenon	0.09	0.09
O_3 – ozone	0.07	0.07
Other trace gases	3.05	3.0
Total	**1,000,000**	**1,000,000**

1 Vol.-% = 10,000 ppm; assumption for humid air: 68% r.h. at 20°C (68°F)

The earth's atmosphere has a mass of around 5 quadrillion metric tons (5.235×10^{18} kg), which weighs down on an area on the earth's surface of 0.507×10^{15} m^2. This creates an atmospheric pressure on the earth's surface of 10,325 kg/m^2, which corresponds to normal atmospheric pressure: 1,013 hPa (14.7 psi). Atmospheric pressure decreases with increasing altitude:

Altitude m/ft.	Atmospheric pressure hPa/psi	Altitude m/ft.	Atmospheric pressure hPa/psi
-1.000 (-3280.8)	1.148 (16.6)	2.000 (6.561,7)	795 (11.5)
-500 (-1640.4)	1.078 (15.6)	3.000 (9.842,5)	701 (10.2)
0 (0)	1.013 (14.7)	4.000 (13.123,3)	616 (8.9)
500 (1640.4)	952 (13.8)	5.000 (16.404,2)	540 (7.8)
1.000 (3280.8)	900 (13.1)	6.000 (19.685,0)	472 (6.8)
1.500 (4921.2)	840 (12.2)	8.000 (26.246,7)	356 (5.2)

The number of molecules in a given volume decreases with decreasing atmospheric pressure, which means that the results produced by partial pressure-measuring sensors are always dependent on the atmospheric pressure.

More than 78 Vol.-% of the earth's atmosphere is nitrogen, which is fully inert, and although available in excess, can not even be used as a much-needed fertilizer for plants. In contrast, highly reactive oxygen is fundamental to our breathing – more than that: it is the foundation of almost all life.

Just under 21 Vol.-% of the atmosphere is oxygen. A lack of oxygen is life-threatening – and cannot be perceived by the human senses.

Oxygen deficiency is generally caused by the release of an inert gas, which then in turn displace oxygen. Since the atmosphere is only around one fifth oxygen, the oxygen concentration is only reduced by around one fifth of the concentration of the inert gas. For example, if 10 Vol.-% of helium is released into the air then oxygen is reduced by 2 Vol.-% and the level of nitrogen by 8 Vol.-%. Because liquid nitrogen (–196°C or –321°F) is frequently used in industry, its evaporation can quickly cause a dangerous oxygen deficiency.

Oxygen enrichment (e.g. more than 25 Vol.-%) cannot be perceived by humans, but have severe consequences with respect to the flammability of materials, and may even cause autoignition. This is why explosion protection relates exclusively to atmospheric oxygen concentration.

At what level does it become dangerous?

Oxygen concentration in Vol.-%	Oxygen partial pressure in hPa/psi	Symptoms
Less than 17	Less than 170/2.5	Early stage of danger due to oxygen deficiency
11 to 14	110 to 140/1.6 to 2.0	Unnoticed decrease in physical and mental performance
8 to 11	80 to 110/1.2 to 2.0	Possible sudden loss of consciousness without warning after a certain period of exposure
6 to 8	60 to 80/0.9 to 1.2	Loss of consciousness within a few minutes – resuscitation possible if performed instantly
Less than 6	Less than 60/0.9	Immediate loss of consciousness

2.4 Ex, Ox, Tox – gas hazards!

Gases and vapors are almost always dangerous. If gases are not present in the atmospheric composition to which we are accustomed and which we can breathe, then safe breathing is threatened. Furthermore, all gases are potentially dangerous in their liquid, compressed, or normal state – the decisive factor is their concentration.

There are basically three categories of risk:

- **Risk of explosion (ex)** caused by flammable gases
- **Oxygen (ox)**
  Risk of suffocation through oxygen deficiency
  Risk of increased flammability due to oxygen enrichment
- **Risk of poisoning (tox)** by toxic gases

Without equipment to assist, mankind is not in a position to detect these risks early enough to enable preventative steps from being taken. And, with a few exceptions, our nose has proven an extremely unreliable warning instrument.

For example, hydrogen sulfide can be detected in low concentrations because it smells of rotten eggs. However, the nose can no longer perceive the lethal, high concentrations of hydrogen sulfide. Many fatal accidents have occured because people have fled into what they thought was the safe, odour-free area.

Even harmless gases such as argon, helium or nitrogen can also become dangerous if they are suddenly released, displacing the oxygen that is essential to life. Then there is risk of suffocation. An oxygen concentration of less than six Vol.-% is deadly. An excess of oxygen increases the risk of fire, and can even cause flammable materials to self-ignite. By igniting, flammable gases and vapors can not only cause considerable damage to industrial plants and equipment, they can also threaten people's lives.

Therefore, it is essential to be able to detect Ex, Ox and Tox risks reliably, and to protect human life, industrial plants and equipment, as well as the environment by taking the appropriate measures. Whether Dräger-Tubes® or portable gas detectors, Dräger offers you individual solutions that meet your needs and enable you to counter gas risks professionally.

2.5 Toxic gases and vapors

The toxicity of gases and vapors used in industrial processes is defined in laboratory experiments by determining the LC_{50} rate. On that basis, and together with other scientific tests and experiments relating to occupational health at the workplace, authorized commissions in several countries make recommendations of limit values, which are legally binding. In Germany, this is the Federal Institute for Occupational safety and Health (BAuA).

This maximum allowable concentration in the air means that workers will not suffer any detrimental affects to their health if they spend their entire working lives breathing in gas concentrations, which do not exceed that level. This, however, must be assured.

Limit value	Selected substances to which this limit value applies
5,000 ppm	carbon dioxide
1,000 ppm	propane, butane
500 ppm	acetone
200 ppm	methyl ethyl ketone (MEK)
100 ppm	butanol
50 ppm	n-hexane, toluene
20 ppm	acetonitrile
10 ppm	chlorobenzene
5 ppm	diethylamine
1 ppm	1.1.2.2-tetrachloroethane
500 ppb	chlorine
200 ppb	methyl chlorformate
100 ppb	chlorine dioxide
50 ppb	glutaraldehyde
10 ppb	methyl isocyanate

Status 2010, according to TRGS 900 (Germany)

T+ Very toxic $LC_{50} < 0.5$ g/m³

Arsine, boron trichloride, boron trifluoride, bromine, diborane, fluorine, hydrogen cyanide, hydrogen fluoride, hydrogen phosphide, hydrogen sulfide, nitrogen dioxide, nitrogen monoxide, ozone, phosgene, sulfur tetrafluoride, tungsten hexafluoride

T Toxic $LC_{50} = 0.5 \ldots 2.0$ g/m³

Acetonitrile, ammonia, benzene, carbon disulfide, carbon monoxide, chlorine, cyanogen, hydrogen chloride, methanol, methyl bromide, nitrogen trifluoride, sulfur dioxide

LC_{50} (LC stands for "lethal concentration") is the gas concentration in air, which – when inhaled over a given time period (usually four hours) – kills 50% of experimental animals (normally white laboratory rats).

2.6 Flammable gases and vapors

Flammable gases become more dangerous when they have a relatively low LEL (lower explosion limit) or flash point. The flash point is defined by the liquid's temerature-dependent vapor pressure and it's LEL.*

Vapor	LEL Vol.-%	LEL g/m³	Flash point in °C/°F	Vapor pressure at 20°C (68° F) in mbar	Ignition temp. in °C/°F
acetone	2.5	60.5	< –20/–4	246	535/995
acrylonitrile	2.8	61.9	–5/23	117	480/896
benzene	1.2	39.1	–11/12	100	555/1031
n-butanol	1.4	52.5	35/95	7	325/617
n-butyl acetate	1.2	58.1	27/81	11	390/734
n-butyl acrylate	1.2	64.1	37/99	5	275/527
chlorobenzene	1.3	61.0	28/82	12	590/1094
cyclohexane	1.0	35.1	–18/–0,4	104	260/500
cyclopentane	1.4	40.9	–37/–60	346	320/608
1.2-dichloroethane (EDC)	4.2	255.7	13/55	87	440/824
diethyl ether	1.7	52.5	–45/–40	586	175/374
1.4-dioxane	1.4	69.7	11/52	38	375/707
epichlorhydrin	2.3	88.6	28/82	16	385/725
ethanol	3.1	59.5	12/54	58	400/752
ethyl acetate	2.0	73.4	–4/25	98	470/878
ethylbenzene	1.0	44.3	23/73	10	430/806
n-hexane	1.0	35.9	–22/–8	160	230/464
methanol	6.0	80.0	9/48	129	440/824
1-methoxy-2-propanol	1.8	67.6	32/90	13	270/518
methyl ethyl ketone (MEK)	1.5	45.1	–10/14	105	475/887
methyl methacrylate	1.7	70.9	10/50	40	430/806
n-nonane	0.7	37.4	31/88	5	205/401
n-octane	0.8	38.1	12/54	14	205/401
n-pentane	1.1	42.1	–40/–40	562	260/500

* LEL values may differ regionally. The operator has to ensure to use the relevant value.

Vapor	LEL Vol.-%	LEL g/m³	Flash point in °C/°F	Vapor pressure at 20°C in mbar	Ignition temperature in °C/°F
i-propanol (IPA)	2.0	50.1	12/54	43	425/797
propylene oxide	1.9	46.0	–37/–35	588	430/806
styrol	1.0	43.4	32/90	7	490/914
tetrahydrofuran (THF)	1.5	45.1	–20/–4	173	230/446
toluene	1.1	42.2	6/43	29	535/995
xylene (isomer mixture)	1.0	44.3	30/77	7	465/869

Gas	LEL Vol.-%	LEL g/m³	Ignition temperature in °C/°F
acetylene	2.3	24.9	305/581
ammonia	15.4	109.1	630/1166
1,3-butadiene	1.4	31.6	415/779
i-butane	1.5	36.3	460/860
n-butane	1.4	33.9	365/689
n-butene (butylene)	1.5	28,1	360/680
dimethyl ether	2.7	51.9	240/464
ethene (ethylene)	2.4	28.1	440/824
ethylene oxide	2.6	47.8	435/815
hydrogen	4.0	3.3	560/1040
methane	4.4	29.3	595/1103
methyl chloride	7.6	159.9	625/1157
propane	1.7	31.2	470/878
propene (propylene)	1.8	31.6	485/905

Source: PTB list from the Physikalisch-Technische Bundesanstalt (PTB is the national metrology institute providing scientific and technical services). Values from NIOSH, IEC and others may differ. Please consider regional regulations.

Only flammable liquids have a flash point.

By definition, flammable gases do not have a flash point.

2.7 LEL and preventative explosion protection

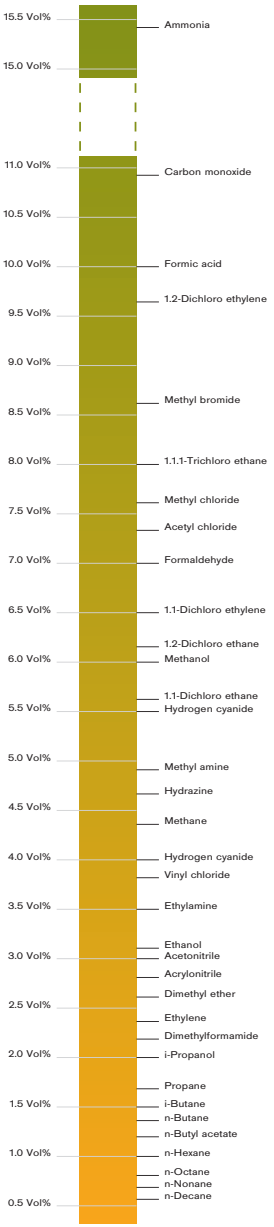
Flammable gases and vapors can form ignitable mixtures when combined with air, but the ratio of flammable gas to oxygen (or air) must lie within certain limits.

The lower explosion limit (LEL) is defined as the concentration of combustion gas (stated in Vol.-%) at which, under standardized conditions, the gas-air mixture can be ignited and will continue to burn on its own accord. The LEL of all known flammable gases and vapors lies in a range of approximately 0.5 to 15 Vol.-%. The LEL of hydrogen in air, for instance, is 4 Vol.-%. Accordingly, a gas sample containing 2 Vol.-% of hydrogen in air can definitely not be ignited.

Concentration limitation

This behavior of gases and vapors has important consequences for practical explosion protection. If a flammable gas cannot be ignited below it's LEL, then we can protect people against
explosions by measuring the gas concentrations continuously and using appropriate measures to ensure that concentrations never exceed a level such as half the LEL (50% LEL).

This method of preventative explosion protection is often referred to as a primary measure. What is prevented is not the ignition of the gas, but the very formation of an atmosphere which can explode. The preferred method of measuring these concentrations is to use infrared or catalytic bead sensors, which, when used for this purpose, must fulfill certain safety requirements.

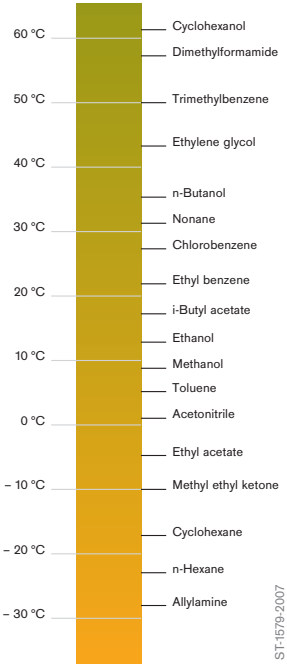


2.8 Flash point of flammable liquids

Although we speak of flammable liquids, in fact, the liquid state is not flammable. It is the vapor, which can form a flammable mixture together with the oxygen in the air. Both the volatility of this vapor and its lower explosion limit (LEL) comprise the measure of its potential danger. This is described by what is known as the flash point.

To be able to ignite at all, the concentration of vapor above the surface of the liquid must exceed the LEL. Whether it does so or not depends on how much vapor is produced. This, in turn, depends on what is known as the vapor pressure, which depends upon the temperature of the liquid. In safety terms, this is described by defining a flash point (F).The flash point is the temperature at which sufficient vapor forms to create a vapor-air mixture, which can be ignited in a standardized
apparatus. If a flammable liquid's flash point is above 50°C (122° F), then it definitely cannot be ignited at a temperature of 30°C (86° F).

Therefore, the lower the flash point of a flammable liquid, the more dangerous it is. Because the vapor of a flammable liquid is not ignitable below its flash point, preventative explosion protection can consist of using liquids whose flash points are significantly higher than the ambient temperature. This is often done in practice, but it does have the disadvantage – when using such liquids as solvents – that large amounts of energy are required to evaporate them. Gases by definition do not have a flash point, because under normal conditions they do not exist in liquid form.



You cannot ignite diesel (F > 55°C) using a match, but you can ignite gasoline with one (F < –20°C)!

2.9 Concentration and their calculation

Concentration is defined as the content of a substance within a reference substance. When measuring harmful substances in the air, the quantity of that substance is defined in terms of a concentration in relation to the air. The right units must be chosen to produce useful figures for defining the concentration. High concentration is generally given as Vol.-% – in other words, one part of a substance to 100 parts of air. Air, for example, consists of 21% Vol.-% oxygen, which means that 100 parts of air contain 21 parts of oxygen. Lower concentration levels are measured in ppm = parts per million (mL/m^3), or ppb = parts per billion ($\mu L/m^3$). A concentration of one ppm means there is one part of a substance in one million parts of air (the rough equivalent to one sugar cube inside a gasoline tanker). A concentration of one ppb refers to one part of a substance in one billion parts of air (equivalent to five people out of the entire population of the earth). Converting these very low concentrations into Vol.-% produces the following simple relationship:

1 Vol.-% = 10,000 ppm = 10,000,000 ppb

Alongside gaseous components, the air can also contain 'dissolved' solid or liquid substances, known as aerosols. The size of droplets or particles borne by the air is very small, which means that measuring them in terms of volume is not very useful. Aerosol concentrations are therefore measured in mg/m^3.

		Vol.-%	ppm	ppb
Vol.-% =	10 L/m^3 1 cL/L	1	10^4	10^7
ppm =	mL/m^3 $\mu L/L$	10^{-4}	1	10^3
ppb =	$\mu L/m^3$ nL/L	10^{-7}	10^{-3}	1

		g/L	mg/L	mg/m^3
g/L =	10 L/m^3 1 cL/L	1	10^3	10^6
mg/L =	mL/m^3 $\mu L/L$	10^{-3}	1	10^3
mg/m^3	$\mu L/m^3$ nL/L	10^{-6}	10^{-3}	1

Converting mg/m^3 into ppm

$$c_{[ppm]} = \frac{\text{Molar volume}}{\text{Molar mass}} \cdot c$$

$$c_{[mg/m^3]} = \frac{\text{Molar mass}}{\text{Molar volume}} \cdot c$$

The molar volume of any gas is 24.1 L/mol at 20°C (68° F) and 1,013 hPa (14.7 psi); the molar mass of a specific gas should be adapted dependent on that gas.

3 Introduction to portable instruments

In the beginning, there was the canary. These little finches would warn miners about dangerous gases underground: if they stopped singing, the miners had to get out quick. Crude and inaccurate methods of determining gas concentrations in the atmosphere like this one have long been consigned to history.

Nowadays, precise measuring instruments monitor the concentration of dangerous gases and flammable vapors. The latest of these are compact, small, robust and flexible single-gas and multi-gas units. Gases and vapors are not always necessarily harmful; after all, the earth's atmosphere is made of them. It is not until their concentration exceeds critical levels (risk of poisoning and explosion) or drops below certain levels (risk of suffocation through oxygen deficiency) that they can become a threat. This is why portable gas detection devices are used in all kinds of ways throughout many branches of industry. Scenarios range from individual employees and small groups of workers – all the way to large-scale operations such as the industrial shutdown of an entire petrochemical plant. Instruments measuring the various dangerous gases have to perform reliably under changing conditions. This can place great demands on reliability, durability, and flexibility, because in the end the detection equipment is directly responsible for the safety and health of workers. Not every unit may be used in every working environment. Before a device is used, you have to determine whether its specifications are sufficient. These requirements are all laid down in various standards and directives.

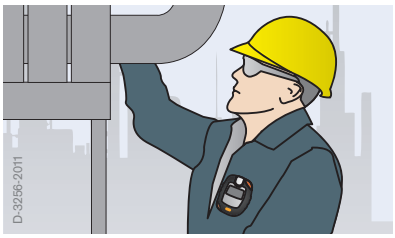
3.1 Application areas for portable gas detection

Portable gas detection instruments are subject to very diverse requirements. Different application areas require solutions tailored to the measurment task, which also take into account the respective ambient conditions.

It is generally possible to distinguish between the following application areas:

Personal monitoring

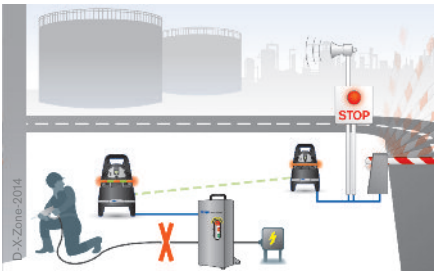
– These devices are designed to warn the wearer about gas risks in the immediate vicinity. For this reason, they are usually worn on work clothing. The basic requirements that these units therefore have to fulfill are wearing comfort, durability, and reliability. Continuously measuring single-gas and multi-gas instruments are suitable for this kind of work.

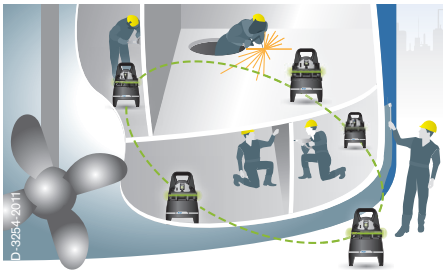


Area monitoring

– In contrast to the personal gas detector area monitors will be placed at central or critical locations to monitor workspaces optimally and independently from persons.

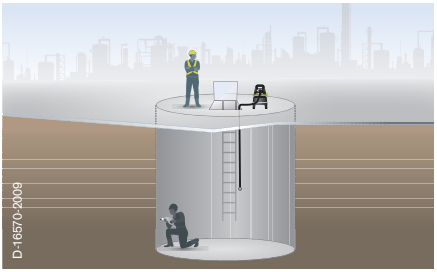
– For this, the basic requirements are robustness, stability and excellent alarm awareness (optical and acoustic) as well as a longest possible battery runtime. Increased security level can be achieved by connecting the area monitors to wireless alarm chains and by transferring the measurement values from instrument to instrument as well as to mobile terminals.





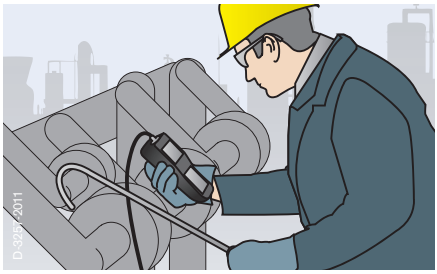
Confined space entry

– Maintenance and repair work often require people to climb into confined spaces. These areas of work can be especially dangerous because of the lack of space, the lack of ventilation, and the presense or development of hazardous substances. A clearance measurement is required before entry. Multi-gas instruments are used together with corresponding pumps and accessories such as hoses and probes. After a successful measurement where no hazards have been found, the same instruments can be used for continuous personal monitoring while working in the confined space.



Leak detection

– Leakages can occur wherever gases or liquids are stored or transported. It is important to identify leakages quickly so that the appropriate measures can be taken to avert harm to people, the environment, and the facility. Detection devices combined with corresponding pumps must be able to respond quickly so as to detect small changes in concentration. High levels of reliability are another minimum requirement for these measuring instruments.



3.2 Requirements for gas detection instruments

As safety products, gas detection devices for industrial use must fulfill the statutory requirements (explosion protection, electromagnetic compatibility), as well as other requirements, so that their quality and reliability remains assured even under tough conditions.

Explosion protection standards:
Design stipulations ensure that the gas measuring instrument does not become a source of ignition itself. Globally accepted standards include CENELEC (ATEX), CSA, UL, EAC, etc.

Protection ratings as defined by EN 60529 (IP Code)
The IP code provides information about the degree to which a casing provides protection against foreign objects and water.

IP = International Protection/Ingress Protection Extract based on DIN EN 60529:

First index number	Protection against solid foreign objects	Second index number	Protection against water
	5 Protection against contact. Protection against interior dust deposits		5 Protection against projected water from any angle
	6 Complete protection against touch. Protection against dust penetration		6 Protection against penetrating water during temporary flooding
			7 Protection against penetrating water during temporary immersion
			8 Protection against penetrating water during prolonged submersion

D-16408-2009

Protection class IP 67 provides a high degree of robustness, although this can have negative consequences in terms of vapor permeability. The MEWAGG research group ("Mess- und Warngeräte für gefährliche Gase") – part of BG Chemie (Germany's statutory employment accident insurance fund for the chemical industry) – therefore advises users who need to detect not only gases like methane and propane, but also higher hydrocarbons and solvents, to check the suitability of equipment with the manufacturer. This can, for example, involve a detection equipment assessment under ATEX.

Quality of measurement functions

Maintaining a predefined detection quality, even under extreme ambient conditions (temperature, pressure, wind, moisture, vibration, and so on)

EN 45 544 – for toxic gases and vapors
EN 50 104 – for oxygen
EN 60 079-29-1 – for flammable gases and vapors

Electromagnetic compatibility as defined by EN 50270

Electrical and electronic devices should not be influenced or interfered with by other electrical, magnetic, or electromagnetic fields – and vice versa. For instance, this means that using a mobile phone or a radio in the immediate vicinity of gas detection devices should not interfere with the instrument's detection signal, nor should the instrument interfere with the phone. EMC guidelines and standards define means of proving and confirming a device's insensitivity to interference and low level of interference output. Simply complying with the requirements of a standard or guideline may not be sufficient depending on the various

operating and ambient conditions. Rugged industrial applications require much more robust devices. Dräger pays special attention to these requirements, for example, with an additional in-house "robustness test."

RoHS and REACH

The requirements for materials and substances used must also be considered during the development and production of gas detection equipment. The European RoHS (Restriction of Hazardous Substances) Directive requires that six particularly dangerous substances may not be contained in electrical and electronic devices. The REACH Regulation (Registration, Evaluation, Authorization, and Restriction of Chemicals) requires that the presence of particularly hazardous materials in products must be disclosed. Dräger seeks to avoid such substances as far as possible within the scope of technical conditions and meets the relevant directives and regulations in this regard.

3.3 Explosion protection

Industrial processes very often involve flammable substances, including sometimes flammable particles. In these areas, flammable gases and vapors can sometimes be released on a process-related basis (such as relief valves) or by unforeseen incidents (breakdowns). As a means of prevention, areas such as these are designated EX areas ("zones") in which only equipment which is reliably protected against ignition may be used.

Explosion protection is standardized worldwide; IEC (international), CENELEC (European) and NEC 505 North American standards are similar, and based on the three-zone concept which is rapidly gaining acceptance in the USA.

Zone in IEC, NEC 505 and CENELEC	Dangerous, explosive atmosphere exists ...
Zone 0	constantly, regularly or long-term
Zone 1	occasionally
Zone 2	rarely and for short periods

American explosion protection compliant with NEC 500 is still typically based on the dual division concept:

Division in NEC 500	Dangerous explosive atmosphere exists ...
Division 1	constantly or occasionally
Division 2	rarely and for short periods

3.4 ATEX 137 – directive 1999/92/EC

ATEX stands for **AT**mospheres **EX**plosibles. This directive has been binding on all systems since July 30, 2006, and is addressed to employers. It describes minimum requirements for the protection of employees' health and safety in areas at risk of explosion.

The directive pursues the following targets:

- Prevent the formation of explosive atmospheres; if this is not possible
- Prevent the ignition of explosive atmospheres; if this is not possible
- Reduce the harmful effects of an explosion to a tolerable minimum.

Employers are obliged to assess the risk of explosion in the relevant areas. Zone categories are defined by answering the question: how likely is it that an explosive atmosphere (gas, vapor, dust) will form in the areas concerned?

ZONE DEFINITIONS IN ATEX 137, ANNEX I, 2

	Areas at risk of explosion are divided into the following zones according to the likelihood of an explosive atmosphere forming there:
Zone 0	Area in which explosive atmospheres comprising mixtures of air and flammable gases, vapors, and aerosols are present constantly, frequently, or over long periods of time.
Zone 1	Area in which, under normal operation, an explosive atmosphere can occasionally form as a mixture of air and flammable gases, vapors, or aerosols.
Zone 2	Area in which, under normal operation, an explosive atmosphere consisting of a mixture of air and flammable gases, vapors, or aerosols normally does not form – or, if so, only briefly.
Zone 20	Area in which explosive atmospheres in the form of clouds of combustible dust in the air are present constantly, frequently, or over long periods of time.
Zone 21	Area in which, under normal operation, an explosive atmosphere can occasionally form as clouds of combustible dust in the air.
Zone 22	Area in which, under normal operation, an explosive atmosphere in the form of a cloud of combustible dust in the air normally does not form – or, if so, only briefly.

Depending on the zone identified, only certain gas measuring instruments may be used there (this table links the categories of ATEX 95 with the zones in ATEX 137):

Permitted use	Gas, vapor (G)	Dust (D)
Instruments in category 1	Zone 0, 1, 2	Zone 20, 21, 22
Instruments in category 2	Zone 1, 2	Zone 21, 22
Instruments in category 3	Zone 2	Zone 22

(For instrument categories, see section 3.5 ATEX 95)

The instrument group and temperature category requirements are then determined by defining the flammable gases, vapors, aerosols, and dusts used, along with their ignition temperatures.

Extract from section 2.6 “Flammable gases and vapors”

Gas	LEL Vol.-%	LEL g/m³	Ignition temperature in °C/°F
acetylene	2.3	24.9	305/581
ammonia	15.4	109.1	630/1166
1,3-butadiene	1.4	31.6	415/779
dimethyl ether	2.7	51.9	240/464
ethene (ethylene)	2.4	28.1	440/824
ethylene oxide	2.6	47.8	435/815
hydrogen	4.0	3.3	560/1040
i-butane	1.5	36.3	460/860
methane	4.4	29.3	595/1103
methyl chloride	7.6	159.9	625/1157
n-butane	1.4	33.9	365/689
n-butene (butylene)	1.2	28,1	360/680
propane	1.7	31.2	470/878
propene (propylene)	1.8	31.6	485/905

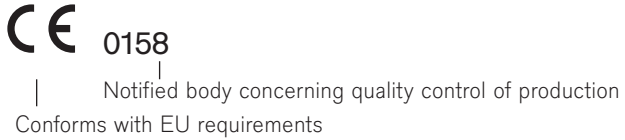
Vapor	LEL Vol.-%	LEL g/m³	Flash point in °C/°F	Vapor pressure at 20°C (68°F) in mbar	Ignition temperature in °C/°F
isopropyl alcohol (IPA)	2.0	50.1	12/54	43	425/797
propylene oxide	1.9	46.0	–37/–35	588	430/806
styrol	1,0	43.4	32/90	7	490/914
tetrahydrofuran (THF)	1.5	45.1	–20/–4	200	230/446
toluene	1.1	42.2	6/43	29	535/995
xylol (isomer mixture)	1.0	44.3	25/77	7	465/869

3.5 ATEX 95 – directive 2014/34/EU

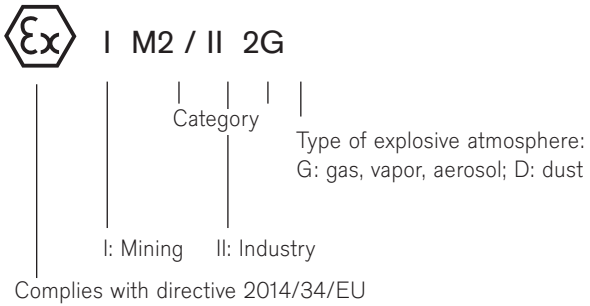
This directive applies to, among others, the manufacturers of gas detection and warning instruments. It describes the requirements that must be fulfilled by gas detection devices used in areas at risk of explosion, and which incorporate their own potential ignition sources.

The CE symbol of conformity – coupled with information about the equipment category (described the zones of the area at risk of explosion in which the gas warning instrument may be used as an electrical device) may look like this:

Markings as defined by 2014/34/EU (ATEX 95)



Markings (as defined by ATEX):



Equipment groups I and II indicate in which area the device may be used:

I = Mining

II = Industry

Information then follows about which equipment category the gas detection device satisfies:

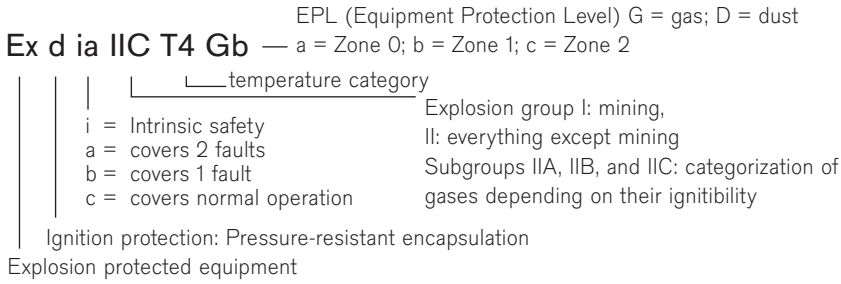
Category 1	Very high level of safety, sufficient safety provided by two protective measures or in the event of two faults
Category 2	Sufficient safety in the event of frequent equipment faults or one breakdown
Category 3	Sufficient safety if operation is fault-free

Finally, the atmosphere is indicated (G: gas, vapor, aerosol or D: conductive and non-conductive combustible dusts).

The designation indicates the zones in which the instrument may be used (example for industry).

Ex area:	Zone 0	Zone 1	Zone 2	Zone 20	Zone 21	Zone 22
Ex atmosphere:	constantly, long-term or frequently	occasionally	normally not or only short-term	constantly, long-term or frequently	occasionally	normally not or only short-term
II 1 G	yes	yes	yes	no	no	no
II 2 G	no	yes	yes	no	no	no
II 3 G	no	no	yes	no	no	no
II 1 D	no	no	no	yes	yes	yes
II 2 D	no	no	no	no	yes	yes
II 3 D	no	no	no	no	no	yes

Explosion protection marking in EN 60079



The requirements for electrical equipment to be used in hazardous areas are outlined in the standard series EN 60079. In addition to the requirements, markings are defined as well. A marking according to ATEX as well as a marking to indicate the equipment protection level (EPL = Equipment Protection Level) is required. With the introduction of the EPL, it is now possible to allocate which device may be used in which explosive atmosphere or area outside of Europe as well.

Ignition protection types provide information about the protective measures incorporated into a device:

Ignition protection types and CENELEC standards

Abbreviation	CENELEC standard	Ignition protection type
Gas		
	EN 60079-0	General requirements
Ex o	EN 60079-6	Oil immersion
Ex p	EN 60079-2	Pressurized encapsulation
Ex m	EN 60079-18	Encapsulation
Ex q	EN 60079-5	Powder / Sand filling
Ex d	EN 60079-1	Explosion/Flame-proof encapsulation
Ex e	EN 60079-7	Increased safety
Ex ia Ex ib Ec ic	EN 60079-11	Intrinsic safety (also for dust) ia required for Zone 0 & 20 ib sufficient for Zone 1 & 21 ic sufficient for Zone 2 & 22
Dust		
Ex ta	EN 60079-31	ta required for Zone 0
Ex tb		tb required for Zone 1
Ex tc		tc required for Zone 2

Comparison: Designation according to IEC (2007) / CENELEC (2009) and EU directive 2014/34/EU (ATEX)

EPL (Equipment Protection Level)		
according to IEC / CENELEC	according to EU directive 2014/34/EU	Area
Ma	M1	Mining
Mb	M2	
Ga	1G	explosive gas atmosheres
Gb	2G	
Gc	3G	
Da	1D	area with combustible dust
Db	2D	
Dc	3D	

Explosion group

Explosion group I encompasses equipment used for mining (coal dust and methane atmospheres). Explosion group II applies to all other areas (all other gases). For the ignition types “explosion/flame-proof encapsulation” and “intrinsic safety,” explosion group II is subdivided into IIA, IIB, and IIC. This subdivision relates to the different levels of ignitability in terms of ignition penetration and electrical sparks. Explosion group IIC covers all gases and vapors. In the future, we will also see explosion group III for flammable dusts, and this in turn will be subdivided in three other groups (IIIA: flammable fibers, IIIB: non-conductive dust, IIIC: conductive dust).

CATEGORIZATION OF GASES AND VAPORS

Explosion group	Temperature category (max. permissible surface temperature)					
	T1 (450°C)	T2 (300°C)	T3 (200°C)	T4 (135°C)	T5 (100°C)	T6 (85°C)
Ignition temp.	> 450°C	300–450°C	200–300°C	135–300°C	100–135°C	85–100°C
	> 842°F	572–842°F	392–572°F	275–572°F	212–275°F	185–212°F
I	methane					
IIA	acetone	isoamyl acetate	amyl alcohol	acetaldehyde		
Ignition energy	ammonia	n-butane	benzine			
more than	benzene	n-butanol	diesel fuel			
0.18 mJ	ethyl acetate	1-butene	heating oil			
	methane	propyl acetate	n-hexane			
	methanol	i-propanol				
	propane	vinyl chloride				
	toluene					
IIB	hydrogen cyanide	1.3-butadiene	dimethyl ether	diethyl ether		
Ignition energy	coal gas	1.4-dioxane	ethylglycol			
0.06 to 0.18 mJ		ethylene	hydrogen sulfide			
		ethylene oxide				
IIC	hydrogen	acetylene				carbon disulfide
Ignition energy less than 0.06 mJ						

Temperature category

Electrical equipment in group II is categorized according to the maximum surface temperatures that are allowed to come into contact with explosive atmospheres. The ignition temperature of the gas must be greater than the maximum surface temperature. T6 covers all gases and vapors. For dust explosion protection, the maximum surface temperature is specified in °C, e.g. T130 °C (266 °F).

The last part of the designation, the EC construction type certificate, shows among other things which testing station tested the equipment and when the first time.

EC construction type certification:

BVS 10 ATEX E 080X

- E 080X
  - X: Special conditions
  - U: Ex-component
- Number of certificate
- 10 ATEX
  - Complies with Europea Directive 2014/34/EU
- Year of EC certificate's publication
- BVS
  - Notified body having type-approved equipment

3.6 Laws and regulations in USA, Canada, and Mexico

Laws and regulations in most municipalities, states, and provinces in North America require certain products to be tested to a specific standard or group of standards by a Nationally Recognized Testing Laboratory (NRTL). There are a number of third party approval agencies in the US – UL, FM, ETL and many others. They all provide listings or classifications for explosion protection and provide some performance testing. They do not have any regulatory or legal status. They are primarily a certification to verify the safety of a product for insurance purposes and to minimize liability. Most of the NRTL are also recognized for certifications for Canada.

Underwriters Laboratories Inc. (UL)
is a private third party product safety certification organization. UL develops standards and test procedures for products, materials, components, assemblies, tools and equipment, chiefly dealing with product safety. UL is one of several companies approved for such testing by the U.S. federal agency OSHA (Occupational Safety and Health Administration). OSHA maintains a list of approved NRTL's.

UL develops standards for safety, often based on American National Standards (ANSI) and evaluates many types of products. A typical standard for electronic products includes not only requirements for electrical safety, but also risk of fire and mechanical hazards. UL evaluates products for compliance with specific safety requirements. UL develops its Standards to correlate with the requirements of installation codes, such as the National Electrical Code (NEC).

As one method of protection, UL evaluates instruments for Intrinsic Safety (IS) for use in hazardous areas. The IS rating means that the instrument will not be the source of ignition in a potentially explosive environment. The areas are defined by the type of hazard that may exist (Class), the possibility of a hazard being present in the area (Division) and the specific hazards that may be encountered (Group). UL 913 is the applicable Standard for Safety for Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

Hazardous Location:

An area where the possibility of explosion and fire is created by the presence of flammable gases, vapors, dusts, fibers or filings.

Class I	Those areas in which flammable gases or vapors may be present in the air in sufficient quantities to be explosive or ignitable.
Class II	Those areas made hazardous by the presence of combustible dust.
Class III	Those areas in which there are easily ignitable fibers or filings present, due to type of material being handled, stored or processed.

Division 1	In which ignitable concentrations of hazards exists under normal operation conditions and/or where hazard is caused by frequent maintenance or repair work or frequent equipment failure.
Division 2	In which ignitable concentrations of hazards are handled, processed or used, but which are normally in closed containers or closed systems from which they can only escape through accidental rupture or breakdown of such containers or systems.

Groups

The gases and vapors of Class I locations are broken into four groups by the codes A, B, C and D. These materials are grouped according to the ignition temperature of the substance, its explosion pressure and other flammable characteristics.

Class II – dust locations – groups E, F & G. These groups are classified according to the ignition temperature and the conductivity of the hazardous substance.

The gases and vapors of Class I locations are broken into four groups by the codes A, B, C and D. These materials are grouped according to the ignition temperature of the substance, its explosion pressure and other flammable characteristics.	**Group A**	Acetylene
	Group B	Hydrogen
	Group C	Ethyl-Ether, Ethylene, Cycle Propane
	Group D	Gasoline, Hexane, Naptha, Benzene, Butane, Propane, Alcohol, Laquer Solvent Vapors, Natural Gas
Class II – dust locations – groups E, F & G. These groups are classified according to the ignition temperature and the conductivity of the hazardous substance.	**Group E**	Metal Dust
	Group F	Carbon Black, Coal, Coke Dust
	Group G	Flour, Starch, Grain Dust

Operating Temperature Codes

Maximum Temperature		NEC 500 CSA/UL Codes	IEC, ATEX NEC 505 Codes
Degrees C Codes	Degrees F	Temperature Codes	Temperature
450	842	T1	T1
300	572	T2	T2
280	536	T2A	
260	500	T2B	
230	446	T2C	
215	419	T2D	
200	392	T3	T3
180	356	T3A	
165	329	T3B	
160	320	T3C	
135	275	T4	T4
120	248	T4A	
100	212	T5	T5
85	185	T6	T6

These are simplified definitions – refer to National Electrical Code (NEC), Article 500 for complete definitions.

Notes

1) T1 through T2D not applicable to Class II location.
2) T2A through T2D, Class I Group D only.

A typical UL classification would look like this:
Only as to intrinsic safety for use in hazardous locations

Class I&II, Div.1, Grps A,B,C,D,E,F,G

Safe in atmospheres containing the gases listed in the chart above

Use in areas where the hazard could exist at any time

For use in potentially explosive gas or dust atmospheres

As part of a global harmonization effort, the Zone classification system can be used in North America on a voluntary basis (refer to article 505 of the NEC).

NEC 500 CSA/UL Codes	IEC, ATEX NEC 505 Codes
Division 1: Where ignitable concentrations of flammable gases, vapors or liquids: – Are likely to exist under normal operating conditions – Exist frequently because of maintenance/repair work or frequent equipment failure	**Zone 0:** Where ignitable concentrations of flammable gases, vapors or liquids are present continuously or for long periods of time under normal operating conditions.
	Zone 1: Where ignitable concentrations of flammable gases, vapors or liquids: – Are likely to exist under normal operating conditions – May exist frequently because of repair, maintenance operations or leakage
Division 2: Where ignitable concentrations of flammable gases, vapors or liquids: – Are not likely to exist under normal operation conditions – Are normally in closed containers where the hazard can only escape through accidental rupture or breakdown of such containers or in case of abnormal operation of equipment.	**Zone 2:** Where ignitable concentrations of flammable gases, vapors or liquids: – Are not likely to exist under normal operation conditions – Occur for only a short period of time – Become hazardous only in case of an accident or some unusual operating condition

US Mine Safety Health Administration (MSHA)

In the United States, equipment for use in mines must be approved by the US Mine Safety Health Administration (MSHA). MSHA maintains its own test facilities and has specific standards for electrical equipment being used in mines. MSHA defines and enforces safety regulations for all types of mining operations as legislated by the US Congress. This includes both underground and above ground coal mines, metal/nonmetal mines and large tunneling operations. The MSHA approval process is a legal requirement for use of equipment in a mine. MSHA considers all underground operations as hazardous locations. An MSHA approval reads a bit differently than a UL approval label:

Permissible Gas Monitor

Tested for intrinsic safety in Methane-Air mixtures only

The Canadian Standards Association (CSA)

The Canadian Standards Association (CSA) is a not-for-profit association composed of representatives from government, industry, and consumer groups. They are involved with many diverse areas of specialization such as climate change, business management and safety and performance standards, including those for electrical and electronic equipment, industrial equipment, boilers and pressure vessels, compressed gas handling appliances, environmental protection, and construction materials. CSA also provides advisory services, training materials and print and electronic published standard documents. Currently forty percent of all the standards issued by CSA are referenced in Canadian legislation.

CSA developed the CAN/CSA Z299 series of quality assurance standards still in use today. They are an alternative to the ISO 9000 series of quality standards.

They do all of the review and testing for Intrinsic Safety and conduct performance testing. They propose standards which are often codified into law or become de facto standards in Canada. CSA is a recognized NRTL for testing and safety, not only for Canada but also for the US.

Mexican Safety and Health

Mexican Safety and Health is controlled by the Norma Official Mexicana (NOM) regulations. Nom -005-STPS-1998 is very comparable to 29 CFR 1910.1200, the basic OSHA regulation in the US. While using US OSHA regulations as a basis, the Mexican government has implemented local requirements. They accept the testing and standards of any of the Nationally Recognized Testing Labs.

HAZARDOUS LOCATIONS CLASSIFICATIONS

Classification Material Presence	IEC, ATEX NEC 505 Codes	NEC 500 CSA/UL Codes
Gas & Vapors		
Acetylene	Group IIC	Class I/ Group A
Hydrogen	Group IIB	Class I/ Group B
Ethylene	Group IIB	Class I/ Group C
Propane	Group IIA	Class I/ Group D
Methane	Group I	Class I/ Group D
Dust		
Metal	N/A	Class II/ Group E
Coal	N/A	Class II/ Group F
Grain	N/A	Class II/ Group G
Fibers (All)	N/A	Class III

3.7 Single-gas measuring instruments

If the danger of toxic gases or vapors can be narrowed down to a single gas or condustive component, then single-gas measuring and warning devices are the ideal solution for personal monitoring in the workplace. They are small, robust, and ergonomic. These devices are usually attached to the work clothing near the breathing area, but do not limit the movement of workers. They monitor the ambient air continuously and produce an alarm (visual, acoustic, and by vibration) if the gas concentration exceeds an alarm limit preset in the device. This enables employees to respond immediately to dangers if accidents occur during normal operation, or if unforeseen events occur during maintenance and repair work.

Dräger Pac 3500–7000

The Pac 3500–7000 family is equipped with XXS sensors. These miniaturized electrochemical sensors enable a small, ergonomic instrument design. The sensor sits right behind a replaceable dust and water filter which protects it from outside influences, and yet has a negligible effect on response times. Like accuracy and reliability, response time is a crucial factor. The t_{90} to t_{20} times provide information about how quickly the sensor responds to changes in gas concentration. Their fast response times and very small diffusion paths enable these sensors to react extremely quickly, immediately indicating any danger that arises. The electrical signal produced by the sensor is converted into a concentration reading on the display by the unit's electronics and software. Alarm thresholds are stored in the unit (A1 = pre-alarm/A2 = main alarm). If gas concentrations exceed these alarm thresholds, then the unit produces an acoustic, visual, and vibration alarm. Durability and explosion protection are two other important factors when choosing the right gas detection device.

Dräger X-am 5100

The Dräger X-am 5100 is designed for the measurement of the gases / vapors hydrazine, hydrogen peroxide, hydrogen chloride and hydrogen fluoride. These special gas hazards are difficult to detect because they adsorb to different surfaces. The open gas inlet projecting from the device prevents that adsorbing surfaces are between the gas and the gas sensor. A rapid response of the proven XS sensors is thus also ensured for these special gases.

Dräger Pac 3500/5500/7000

ST-15139-2008

Small and robust, economical and powerful. The compact Dräger Pac family is equipped with the latest sensor technology and a multitude of features, and is tailor-made for the diverse demands of industry.

D-537-2009

ST-1743-2005

OTHER BENEFITS

Robust: water- and dust-protection compliant with IP 68
Ideal solution for functional testing and adjustment
Flexible alarm and warning features
Long sensor and device life time at Dräger Pac 5500 and 7000
Reliable gas entry from both sides

ST-6066-2004

Personal monitoring

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Personal monitoring	Robust, IP 68
	Reliable gas inlets from both sides
	Response time of 10 seconds

The impact-resistant housing is covered with protective rubber, which makes it resistant to corrosive chemicals. A strong, rotating crocodile clip made from stainless steel allows the unit to be fixed securely to clothing or belt.

TECHNICAL SPECIFICATIONS

Dimensions (W × H × D)	84 × 64 × 25 mm; 3.3 x 2.5 x 1.0 in.
Weight	120 g; 3.8 oz.
Ambient conditions:	
Temperature	–30 to +50°C; -20 to +120°F
Pressure	700 to 1,300 hPa
Humidity	10 to 90% r.h.
Ingress protection	IP 68
Alarms:	
Visual	360°
Acoustic	Multi-tone alarm > 90 dB in 30 cm (1 ft.)
Vibration	yes
Power supply	Replaceable lithium battery

Dräger Pac 3500/5500/7000

FEATURES COMPARISON

	Dräger Pac 3500	Dräger Pac 5500	Dräger Pac 7000
Compatible sensors:			
XXS EC sensors	O_2, CO, H_2S-LC	O_2, CO, H_2S-LC	O_2, CO, CO-LC, H_2S-LC, CO_2, Cl_2, HCN, HCN PC, NH_3, NO, NO_2, PH_3, SO_2, H_2S, OV; OV-A
Operation time	2 years	Unlimited	Unlimited
Data logger:	Events saved with date and time (up to 60 events)	Events saved with date and time (up to 60 events)	Concentrations and events saved together with date and time (up to 120 hours at 1 data set per minute).
Battery life CO, H_2S	8 hours/day, 2 years (1 minute alarm per day)	8 hours/day, 2 years (1 minute alarm per day)	24 hours/day > 5,500 hours (1 minute alarm per day)
Battery life O_2	8 hours/day, 1 year (1 minute alarm per day)	8 hours/day, 1 year (1 minute alarm per day)	24 hours/day > 2,700 hours (1 minute alarm per day)
Bump test	Pushing the OK-button 3 times	Pushing the OK-button 3 times	Automatic
Approvals:			
ATEX	ATEX I M1 / II 1G Ex ia I/IIC T4	ATEX I M1 / II 1G Ex ia I/IIC T4	ATEX I M1 / II 1G Ex ia I/IIC T4
Measurement performance certificate	–	–	XXS EC Sensoren: O_2, H_2S, CO
UL	Class I, II Div. 1 Group A, B, C, D, E, F, G Temp. Code T4	Class I, II Div. 1 Group A, B, C, D, E, F, G Temp. Code T4	Class I, II Div. 1 Group A, B, C, D, E, F, G Temp. Code T4
CSA	Class I, II Div. 1 Gruppe A, B, C, D, E, F, G Temp.-Code T4	Class I, II Div. 1 Gruppe A, B, C, D, E, F, G Temp.-Code T4	Class I, II Div. 1 Gruppe A, B, C, D, E, F, G Temp.-Code T4
IECEx	Ex ia II CT4	Ex ia II CT4	Ex ia II CT4
GOST/ EAC	PO Ex ia I X 0 Ex ia IIC T4 X	PO Ex ia I X 0 Ex ia IIC T4 X	PO Ex ia I X 0 Ex ia IIC T4 X
RUS – Pattern Approval Certificate of measuring instruments	XXS EC sensors: O_2, H_2S, CO	XXS EC sensors: O_2, H_2S, CO	XXS EC sensors: O_2, H_2S, CO, CO LC, H_2S LC, Cl_2, CO_2, HCN, HCN PC, PH_3, NH_3, NO_2, SO_2, OV, OV-A
MED	–	–	96/98/EC
CE mark	Electromagnetic compatibility (Directive 2004/108/EC)	Electromagnetic compatibility (Directive 2004/180/EC)	Electromagnetic compatibility (Directive 2004/108/EC)

ACCESSORIES

Calibration accessories	Dräger Bump Test Station Dräger X-dock Communication accessories: Dräger CC-Vision Basic, free of charge in the internet www.draeger.com

ST-4701-2005

Dräger Bump Test Station

D-47820-2012

Dräger X-dock Pac 5300

D-77451-2013

Communication cradle

Dräger X-am 5100

D-11213-2011

The Dräger X-am 5100 is designed for the measurement of the gases / vapors hydrazine, hydrogen peroxide, hydrogen chloride and hydrogen fluoride. These special gas hazards are difficult to detect because they adsorb to different surfaces. The open gas inlet projecting from the device prevents that adsorbing surfaces are between the gas and the gas sensor. A rapid response of the proven XS sensors is thus also ensured for these special gases. Dräger X-am 5100 can only be operated in diffusion mode.

OTHER BENEFITS

Usage in industrial area – Ex approved

Measurement performance of the sensors are independent of the device

ST-7317-2005

Personal monitoring

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Personal monitoring	small and light rapid respond time of the Dräger XS Sensors Battery life > 200 hours

TECHNICAL SPECIFICATIONS

Dimensions (W × H × D)	47 x 129 x 55 mm; 1.85 x 5.08 x 2.17 in.
Weight	ca. 220 g; 7 oz.
Ambient conditions:	
Temperature	-20 to +50; -4 to +120°F
Pressure	700 to 1300
Humidity	10 to 95 % r.H.
Ingress protection	IP 54
Alarms:	
Visual	180°
Acoustic	Multi-tone alarm > 90 dB in 30 cm (1 ft.)
Vibration	yes
Power supply	Alkaline, rechargeable NiMH for Alkaline Pack, T4 Akku Pack
Battery life (h)	> 200
Charging time (h)	< 4
Compatible sensors	XS Sensors XS H_2O_2, XS Hydrazine, XS HF/HCL
Operation time	unlimited
Data logger	can be read out via IR > 1000 h at a recording interval of 1 value per minute
Approvals:	
ATEX	I M1 Ex ia I Ma II 1G Ex ia IIC T4/T3 Ga
IECEx	Ex ia I Ma Ex ia IIC T4/T3 Ga
c CSA us	Class I, Div. 1, Groups A,B,C,D TC T4/T3 Class I, Zone 0, A/Ex ia IIC T4/T3 /Ga
EAC Ex	PO Ex ia I X O Ex ia IIC T4/T3 X
CE mark	Electromagnetic compatibility (Directive 2004/108/EC)

ACCESSORIES

General accessories	Charging module Car charging connection cable 12V/24V
Calibration accessories	Communication accessories: Dräger CC-Vision Calibration adapter

D-2125-2011

USB DIRA with USB cable

D-12284-2009

Charging accessories

ST-14351-2008

Car charging connecting cable

D-98760-2013

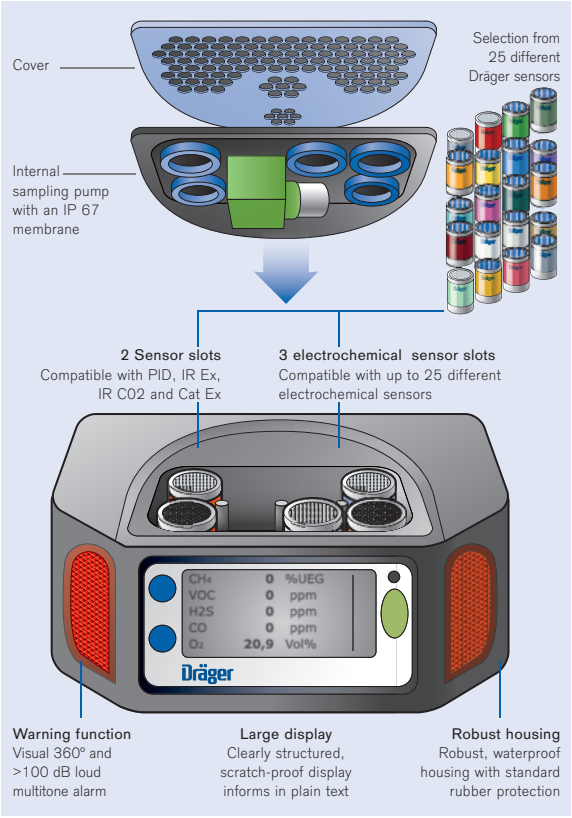
Dräger X-zone with Dräger X-am 5100 holder

3.8 Multi-gas measuring instruments

If hazardous substances (Ex-Ox-Tox) occur in the work place, then it is advisable to use continuous multi-gas measuring instruments. These enable different measuring approaches be used (infrared, catalytic bead, PID, and electrochemical sensors) in one device, thus drawing on the strengths of the measurement principles.

The constellation of the sensors depends on the application. Up to 6 gases can be detected in real-time and continuously. As well as being used for personal monitoring and area monitoring, multi-gas measuring instruments can also be used for clearance monitorings and leak detection with the help of optional accessories. Multi-gas measuring instruments include the Dräger X-am 2500, X-am 5000, X-am 5600, and X-am 7000.

Gas measurement technology (example: Dräger X-am 7000)



D-16407-2009

Dräger X-am 2500/5000/5600


D-77497-2013


ST-9468-2007


D-27784-2009

Dräger offers a complete product series for the simultaneous measurement of different gases. The Dräger X-am 2500/5000/5600 family is a new generation of gas detection equipment. Its practical design, cell-phone size, low weight, and the long-life of the electrochemical XXS sensors make this family the perfect companion for personal monitoring. Combined with an optional external pump and hose or probe, they are perfect for confined space entry measurements. The Dräger X-zone 5500 extends the application of these instruments to innovative area monitoring instruments with various application possibilities (does not apply to X-am 2500).

OTHER BENEFITS

Robust: water and dust protection compliant with IP 67

Reliable gas inlets from both sides

Precise, vapor-sensitive Ex monitoring

Ideal solution for functional testing and calibration
(automatic testing and calibration station – Dräger X-dock & Dräger Bump Test Station)


ST-7317-2005

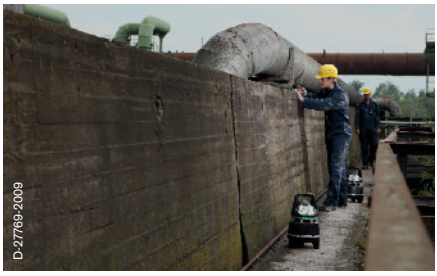
Personal monitoring


ST-9555-2007

Confined space entry


ST-9618-2007

Leak detection


D-27769-2009

Area Monitoring

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Personal monitoring	Durable, IP 67
Confined space entry	High level of flexibility using external pump (with 20 m or 66 ft. tube), adaptable to various probes
Leak detection	Catalytic sensors and XXS sensors respond quickly
Area Monitoring	Wireless fenceline, available for use in Zone 0

An optional external pump, which can be operated using a hose of up to 20 meters (66 ft.) long, is an ideal solution for applications involving the confined space entry measurements in tanks, pipelines, etc. When the instrument is placed in the cradle, the pump automatically starts.
The daily bump test of the instruments is easier and more comfortable than ever before: With the Dräger Bump Test Station no power is necessary and the instruments can be tested fast and easily.
The Dräger X-dock offers complete comfort, easy operation and central documentation and all with reduced gas consumption. Thus, Dräger's test stations support safety on the highest level and this is time and cost-effectively.

TECHNICAL SPECIFICATIONS

Dimensions (W × H × D)	47 × 129 × 31 mm; 1.8 x 5.1 x 1.2 in.
Weight	220 g; 8.8 oz.
Ambient conditions:	
Temperature	–20 to +50°C; -4 to +122°F
Pressure	700 to 1,300 hPa
Humidity	10 to 95% r.h.
Ingress protection	IP 67
Alarms:	
Visual	180°
Acoustic	Multi-tone > 90 dB in 30 cm (1 ft.)
Vibration	yes
Power supply	Alkaline, rechargeable NiMH for alkaline pack, T4 rechargeable battery pack
Operating period (h)	approx. 10
Charging time (h)	< 4
Pump mode (Dräger X-am 1/2/5000 external pump)	Maximum hose length 20 m; 66 ft.

Dräger X-am 2500/5000/5600

FEATURES COMPARISON

	Dräger X-am 2500	Dräger X-am 5000	Dräger X-am 5600
Compatible sensors	Flexible 1 - 4 sensors. One catalytic sensor and XXS EC sensors (see XXS EC sensors)	Flexible from 1 to 4 sensors. One catalytic sensor and 3 XXS EC sensors (see XXS EC sensors)	Flexible from 1 to 4 sensors One IR sensor and 3 XXS EC sensors (see XXS EC sensors)
XXS EC sensors	O_2, CO, H_2S, SO_2 and NO_2	Amine, O_2, CO, CO LC, $COCL_2$, CO HC, H_2S, H_2S LC, H_2S HC, HCN PC, CO_2, Cl_2, HCN, NH_3, NO, NO_2, NO_2 LC, PH_3, PH_3 HC, SO_2, OV, OV-A, H_2S/CO, CO H_2 (compensated), H_2, H_2 HC, Odorant, O_3	Amine, O_2, CO, CO LC, $COCL_2$, CO HC, H_2S, H_2S LC, H_2S HC, CO_2, Cl_2, HCN, HCN PC, NH_3, NO, NO_2, NO_2 LC, PH_3, PH_3 HC, SO_2, OV, OV-A, H_2S/CO, CO H_2 (compensated), H_2, H_2 HC, Odorant, O_3
Catalytic sensors			
Cat Ex 125 PR	0–100% LEL 0–5 Vol.-% CH_4	0–100% LEL 0–100 Vol.-% CH_4 Special calibration for organic vapors is possible	
Cat Ex 125 PR-Gas	0–100% LEL 0–100 Vol.-% CH4	0–100% LEL 0–100 Vol.-% CH_4	
Infrared sensors			
IR Ex			0–100% LEL 0–100 Vol.-% CH_4 / C_4H_{10} / C_2H_4 / LPG
IR CO_2			0–5 Vol.-% CO_2
IR CO_2/Ex			0–100% LEL 0–100 Vol.-% CH_4 / C_4H_{10} / C_2H_4 / LPG 0–5 Vol.-% CO_2
Data logger	Can be read out via Infrared > 1000 hours with 4 gases and a recording interval of 1 value per minute	Can be read out via Infrared > 1000 hours with 5 gases and a recording interval of 1 value per minute	Can be read out via Infrared > 1000 hours with 6 gases and a recording interval of 1 value per minute
Approvals:			
ATEX	I M1/II 2G Ex ia d IIC T4/T3 I M2 EEx ia d I	I M1/II 1G Ex ia I/IIC T3 I M2/II 2G Ex d ia I/IIC T4/T3	I M1/II 1G Ex ia I/IIC T4/T3
Measurement performance certificate	for O_2 according to EN 50104/CO and H_2S according to EN 45544/Methane to Nonane according to EN 60079 and EN 50271	for O_2 according to EN 50104/CO and H_2S according to EN 45544/Methane to Nonane according to EN 60079 and EN 50271	for O_2 according to EN 50104/CO and H_2S according to EN 45544/Methane to Nonane according to EN 60079 and EN 50271
c CSA us	Div.1, Class I, Groups A,B,C,D T4/T3 A/Ex ia IIC T3 /Ga A/Ex d ia IIC T4/T3 /Gb Canada: Ex ia IIC T3 Ex d ia IIC T4/T3 USA: AEx ia IIC T3 Ga AEx d ia IIC T4/T3 Gb	Div.1, Class I, Groups A,B,C,D T4/T3 A/Ex ia IIC T3 /Ga A/Ex d ia IIC T4/T3 /Gb Canada: Ex ia IIC T3 Ex d ia IIC T4/T3 USA: AEx ia IIC T3 Ga AEx d ia IIC T4/T3 Gb	Div.1, Class I, Groups A,B,C,D T4/T3 A/Ex ia IIC T4/T3 /Ga Canada: Ex ia IIC T4/T3 USA: AEx ia IIC T4/T3 Ga

FEATURES COMPARISON

	Dräger X-am 2500	Dräger X-am 5000	Dräger X-am 5600
IECEx	Ex ia I Ex ia IIC T3 Ex d ia I Ex d ia IIC T4/T3	Ex ia I Ma Ex ia IIC T3 Da Ex d ia I Mb Ex d ia IIC T4/T3 Db	Ex ia I Ma Ex ia IIC T4/T3 Ga
CE mark	Electromagnetic compatibility (Directive 2004/108/EC) ATEX (Directive 2014/34/EU)	Electromagnetic compatibility (Directive 2004/108/EC) ATEX (Directive 2014/34/EU)	Electromagnetic compatibility (Directive 2004/108/EC) ATEX (Directive 2014/34/EU)
MED	MED 96/98/EG	MED 96/98/EG	MED 96/98/EG
MSHA	according the requirement "Title 30 Code of Federal Regulations, Part 22 for use in gassy underground mines"	according the requirement "Title 30 Code of Federal Regulations, Part 22 for use in gassy underground mines"	–
EAC Ex	PO Ex ia I X / 0 Ex ia IIC T3 X or PB Ex d ia I X/ 1 Ex d ia IIC T4/T3 X	PO Ex ia I X / 0 Ex ia IIC T3 X or PB Ex d ia I X/ 1 Ex d ia IIC T4/T3 X	PO Ex ia 1X / 0 Ex ia IIC T4/T3 X

ACCESSORIES

General accessories	Charging module
	Car charging connection cable 12V/24V
Calibration accessories	Dräger Bump Test Station
	Dräger X-dock
	Dräger CC-Vision
	Basic, free of charge on www.draeger.com
	Nonane tester (for function tests)
Pump accessories	Dräger X-am 1/2/5000 external pump
	Hoses of various lengths
	Probes
Area Monitoring	Dräger X-zone 5500 (for Dräger X-am 5000/5100/5600)

BTS X-am 1-2-5000.swf

Dräger Bump Test Station

D-47836-2012

Dräger X-dock 5300
Dräger X-am 125

ST-9476-2007

External pump

ST-16024-2008

Nonane tester

D-22594-2009

Dräger X-zone 55500

D-3042-2014

Dräger X-zone Com

Dräger X-Zone 5500

D-23612-2009

State-of-the-art area monitoring – in combination with the gas detectors Dräger X-am 5000, 5100 and 5600 the Dräger X-zone 5500 is suitable for the measurement of one to six gases. The easy transportable, robust and waterproof X-zone expands the mobile gas detection to a unique system with various different application possibilities.

OTHER BENEFITS

IP 67 and Zone 0 approval for industrial applications
Wireless communication of X-zone's for frequencie: 868 MHz, 915 MHz, 433 Mhz and 430 MHz
Robust and trouble-free connection up to 100m between two X-zone
Robust and simple to be used induction wireless charging technology available
PowerOff-function: via the potential-free alarm contact external equipment can be switched off during an alarm occur.

D-27692-2009

D-27691-2009

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Area Monitoring	Up to 25 Dräger X-zone 5500 can be automatically interconnected to form a wireless fenceline. This allows a continuous monitoring of larger areas, e.g. pipelines or industrial tanks during industrial shut downs, up to 120 hours.
Confined space entry	An optional intergrated pump allows the continuous monitoring of confined space entry or locations which are difficult to access, for a distance of up to 45 m.

The Dräger X-zone 5500 transforms the Dräger personal gas detection instruments Dräger X-am 5100/5000/5600 into innovative area monitoring devices for a wide range of application. This gas measurement system is patented. With the flexible sensor equipping of the Dräger X-am 5000 and X-am 5600 the fields of application of the Dräger X-zone 5500 are manifold. Just insert a different Dräger X-am 5000 or X-am 5600, which are equipped with other sensors, and the Dräger X-zone 5500 can be used for a different application. With the 360°alarm amplifier, the acoustic warning is heard with the same volume from all sides. X-zone 5500 affords a new portable safety concept. Up to 25 Dräger X-zones can be automatically interconnected to form a wireless fenceline. In the event of a gas alarm, the device transmits the alarm signal to all units that are part of the fenceline which then signal a daughter alarm. The daughter alarm is, in contrast to the red master alarm, displayed geen/red by the illuminated LED ring, thus allowing and providing for a fast and easy recognitions of the alarm itself as well as of the alarm-trigging devices. This ensures an easy and clear evacuation alarm and alerting. Via the potential-free alarm contact, the Dräger X-zone 5500 device can also interconnect and operate external equipment such as alarm horns, lamps or traffic lights. Furthermore, the signal of the alarm chain including the maximum gas concentrations can be transferred to the control room or mobile terminals via Modbus interface and communication modules like the X-zone Com. Dräger X-zone 5500 as an area monitoring devices often stay located well within an explosion hazard area, even during a gas alarm. It is therefore all the more important the devices are approved for use in explosion hazard areas, zone 0. The modern induction charger, is simple to use, comfortable and has no issues with dirty charging contacts, so it is maintenance friendly.

TECHNICAL SPECIFICATIONS

Dimensions (W × H × D)	480 x 300 x 300 mm; 19 x 12 x 12 in
Weight	10 kg; 353 oz. (24 Ah battery)
Ambient conditions:	
Temperature	-20 to +50; -4 to +122°F
Pressure	700 to 1,300 hPa
Humidity	10 to 95 % r.h.
Ingress protection	IP 67
Alarms:	
Visual	360° LED (illuminated ring)
Acoustic	multi-tone: > 108 in 1m (3.3 ft.) > 120 in 30 cm (1 ft.)

Alarm output	Potential-free alarm contact for intrinsically safe circuits (6 pole); < 20 V to 0.25 A (0.15 A constant current); resistive load
Radio transmission	Worldwide licencse-free ISM frequencies Digital radio, robust and interference-free transmission up to 100 m.
RF approval	868 MHz (EU, Norway, Switzerland, Turkey, South Africa, Singapore) 915 MHz (USA, Canada, India, Australia, Japan) 433 MHz (Russia)
Power supply	Pb-Akku
Operation period	Up to 120 h with a fully equipped Dräger X-am 5000/5600, up to 400 h with tox sensors and 30 minutes alarm per day
Charging period	< 10 h, flexilbe power supply; External 100 - 240V charger (worldwide) or inductive wireless charging
Pump mode	internal pump / hose length: max 45 m
Approval	
ATEX	I M1 Ex ia I Ma II 1G Ex ia IIC T3 Ga II 2G Ex ia d IIC T4 Gb
c CSA us	Class I, Zone 0, AEx ia IIC T3 Ga Class I, Zone 1, AEx ia d IIC T4 Gb
IECEx	Ex ia I Ma Ex ia IIC T3 Ga Ex ia d IIC T4 Gb
CE-mark	Electromagnetic compatibility (Directive 2004/108/EC) / R&TTE (Directive 99/005/EG) ATEX (Directive 2014/34/EU)

ACCESSORIES

General accessories	Inductive charger Plug-in charger Pb-battery (24 Ah) Socket, 30 cm high; for measurement of light gases Alarm damper, for use within bump tests X-zone Com, Holder X-am 5100, X-zone Switch Off Box, X-zone Switch On Box
Calibration accessories	Bump Test adapter for function tests Cover plate with diffusion adapter Communication accessories: Dräger CC-Vision Basic, free of charge on www.draeger.com USB DIRA with USB cable
Pump accessories	cover plate with pump adapter different measuring probe extension hose, different lenght

D-23634-2009

Inductive charger
Allowing easy charging

D-23631-2009

Socket
For measurements of light gases

D-23627-2009

Cover plate
With diffusion adapter

D-98766-2013

Set holder
Dräger X-am 5100

D-2125-2011

Calibration and communication accessory
USB DIRA with USB cable

D-27768-2009

Alarm damper
For use within bump tests

D-6704-2011

X-zone Switch Off
Switching station

D-6741-2011

X-zone Switch On
Switching station

D-3042-2014

X-zone Com®

D-52751-2012

RVP 5000

Dräger X-am 7000

ST-7054-2005

Multi-purpose: the Dräger X-am 7000 is the innovative solution for the simultaneous and continuous measurement of up to five gases. A combination of more than 25 sensors allows flexible solutions to individual monitoring tasks. The X-am 7000 can be equipped with three electrochemical and two infrared, catalytic bead sensors or photo ionization sensors. It is the ideal companion in a variety of applications where the reliable detection of oxygen, toxic and combustible gases and vapors is necessary.

OTHER BENEFITS

- Integrated water- and dust-filter, and immersion-proof, as defined in IP 67
- Clearly structured, scratch-resistant display
- Very loud acoustic multi-tone alarm and 360° all-round visual alarm
- Intelligent charge management
- Intuitive software functions

ST-7058-2005

Area monitoring

ST-2770-2003

Confined space entry

ST-6109-2004

Leak detection

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Area monitoring	Durable, IP 67
Confined space entry	Built-in high-performance pump makes it possible to sample gas using a hose up to 45 m/150 ft. long.
Leak detection	Extensive portfolio of over 25 different DrägerSensors enables the detection of more than 100 gases and vapors.

Smart CatEx PR sensors enable the detection of flammable gases and vapors, and can be calibrated to as many as five different sensitivity levels. The unit can be switched automatically from % LEL to 100 Vol.-% in full-range mode. Leakages are reliably detected, visually in bar-graph mode and audibly in tracking mode.

The PID sensor detects organic vapors in very low concentrations. An integrated library of 20 substances, three user-adaptable channels, and an easy switch to leak detection mode makes the instrument flexible enough to met your specific needs.

With the help of Dräger CC-Vision Basic software, up to 5 different detection applications can be saved within the instrument. By doing so, the use of different instrument configurations can be set for that specific application. During operation, a simple change between these set parameters can be done via the instrument's menu.

In addition to the electrochemical sensors, the catalytic and infrared sensors are automatically recognized by the instrument upon insertion. All sensors are pre-calibrated, and therefore a reconfiguration of the Dräger X-am 7000 can be done by simply changing the sensor. No additional service or maintenance is necessary.

TECHNICAL SPECIFICATIONS

Dimensions (W × H × D)	150 × 140 × 75 mm; 5.9 x 5.6 x 3 in.
Weight	600 g; 21 oz. (basic unit) 490 g; 17 oz. (rechargeable battery 3.0 Ah) 730 g; 26 oz. (rechargeable battery 6.0 Ah)
Ambient conditions:	
Temperature	–20 to +55 °C, short-term, –40 to +60 °C, –5 to + 130 °F, short-term –40 to +140 °F
Pressure	700 to 1,300 hPa
Humidity	10 to 95% r.h.
Ingress protection	IP 67
Alarms:	
Visual	360°
Acoustic	Multi-tone > 100 dB in 30 cm (1 ft.)
Vibration	no
Power supply	Alkaline, rechargeable NiMH
Battery life (h)	Alkaline: > 20 NiMH: > 9 (4.8 V/3.0 Ah) > 20 (4.8 V/6.0 Ah) (complete with all sensors and 20 % of the time in pumped mode)
Charging time (h)	3.5 to 7, dependent on battery type
Data logger	100 h
Pump mode	Maximum hose length of 45 m (150 ft.)
Approvals:	
ATEX	II 2G Ex d ia IIC T4 Gb; -20 ≤ Ta ≤ + 60 °C I M2 Ex d ia I Mb
Measurement performance certificate	for Methane, Propane and Nonane according to EN 60079-29-1
UL	Class I Div. 1 Group A, B, C, D, Temp. Code T4 –20 ≤ Ta ≤ + 60 °C (NiMH); –20 ≤ Ta ≤ +40 °C (Alkaline)
CSA	Class I Div. 1 Group A, B, C, D, Temp. Code T4 –20 ≤ Ta ≤ + 60 °C (NiMH); –20 ≤ Ta ≤ +40 °C (Alkaline)
IECEx	Ex d ia I/IIC T4; -20 ≤ Ta ≤ + 60 °C
MED	MED 96/98/EC
CE mark	Electromagnetic compatibility (Directive 2004/108/EC) ATEX (Directive 2014/34/EU)

ACCESSORIES

General accessories	Charging module
	Power supply for charging module
	Power supply for vehicles
	Car mounting kit
Calibration accessories	Dräger Bump Test Station
	Dräger E-Cal
	Communication accessories:
	Dräger CC-Vision Basic/Gas-Vision,
	free of charge on www.draeger.com
	Printer Set for Dräger Bump Test Station
Pump accessories	Pump adapter
	Pump membrane set
	Probes
	Hoses

ST-7491-2005

Dräger Bump Test Station

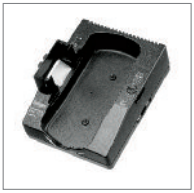
ST-551-2005

Dräger E-Cal

ST-4990-2005

Pump adapter

ST-14991-2008



Charging module

4 Introduction to sensor technology

The heart of every measuring instrument is its sensor. The sensor is crucial in determining the quality of measurements, and therefore it has a fundamental influence on the safety of the user. The development and production of sensors is part of Dräger's core competence.

4.1 Selecting the proper measurement method

Selecting the correct measuring principle is essential when detecting dangerous gases. Every measuring principle has its own strengths and limits, and each is better for particular groups of gases (flammable/toxic gases and oxygen). For this reason, it is important to ask which gases/vapors occur in the workplace Generally speaking, we differentiate between the following gas risks:

Risk of explosion

– Wherever flammable gases and vapors occur, there is an increased risk of explosion. Typical areas for this include mining, refineries, the chemical industry, and many others. Infrared and catalytic bead sensors are used to detect this type of risk. These sensors usually detect gas concentrations in the LEL (lower explosure level) range, but some of them can also be used for the 100 Vol.-% range.

Lack or excess of oxygen

– A lack of oxygen is life-threatening. An excess of oxygen can affect the flammability of materials and can even cause auto-ignition. Electrochemical sensors are used to measure oxygen. Their measuring range is from between 0 and 25 Vol.-% all the way up to 100 Vol.-%.

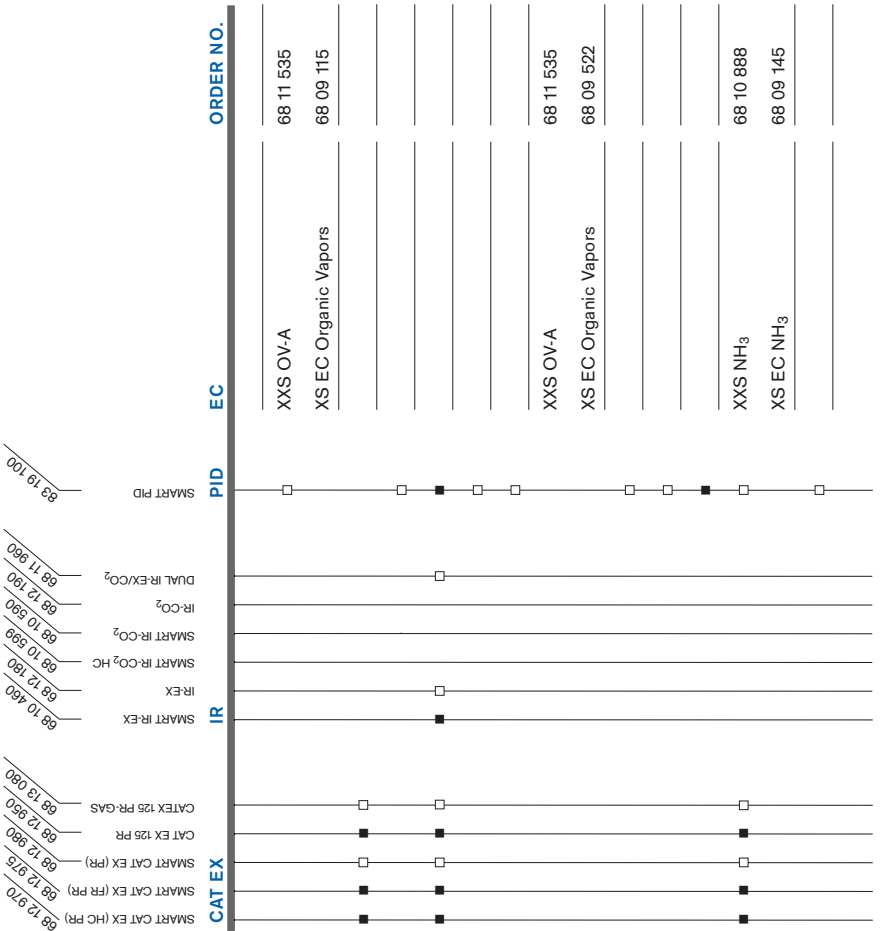
Toxicity

– Poisonous substances can occur anywhere – in industrial production and processing, in transport (rail, road, ship), in the case of incomplete combustion (CO), and also as a result of completely naturally processes such as rotting and decomposition of biomass. Electrochemical and PID sensors are used to detect toxic gases.

The decision about which sensor type is the right one for a particular application also depends on other factors such as:

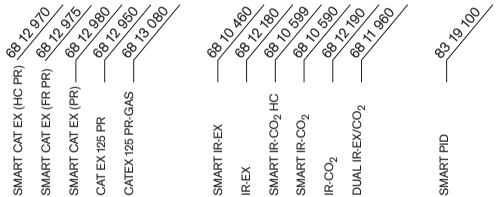
– What other hazardous material are present (cross-sensitivity)?
– Is it necessary to measure hazardous material selectively, or is it more sensible to measure a complete parameter?

4.2 Overview of detectable vapors and gases



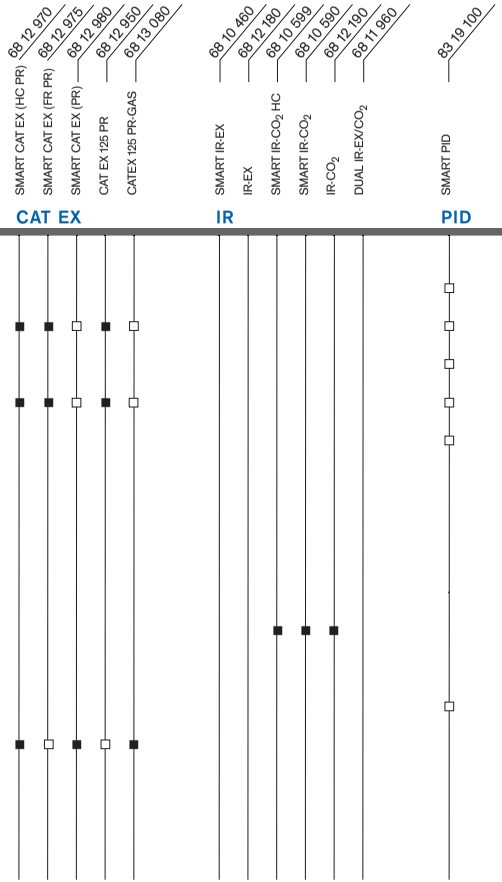
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Acetaldehyde	75-07-0	■	■	□	XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 115
Acetic acid	64-19-7	□	□	□		
Acetic anhydride	108-24-7	■	□	□		
Acetone	67-64-1	□	■	■		
Acetophenone	98-86-2	■	□	□		
Acrolein	107-02-8	■	□	□		
Acrylonitrile	107-13-1	■	□	□	XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 522
Allyl chloride	107-05-1	■	□	□		
Allylalcohol	107-18-6	■	□	□		
Alpha-pinene	7785-26-4	■	□	■		
Ammonia	7664-41-7	□	□	□	XXS NH_3	68 10 888
					XS EC NH_3	68 09 145
Aniline	62-53-3	■	□	□		

■ Sensitivity data known □ Sensitivity not yet determined



CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Arsine	7784-42-1				XS EC Hydride	68 09 135
					XXS PH_3	68 10 886
Benzene	71-43-2	■ ■ □ ■ □	■ □			
Benzonitrile	100-47-0			□		
Benzylalcohol	100-51-6			□		
Biphenyl	92-52-4			□		
Bromine	7726-95-6				XXS Cl_2	68 10 890
					XS EC Cl_2	68 09 165
1-Bromopropane	106-94-5			□		
Bromoform (Tribromomethane)	75-25-2			□		
n-Butane	106-97-8	■ ■ □ ■ □	■ ■			
i-Butane	75-28-5	□ □ □ □ □	■ □			
i-Butene	115-11-7	□ □ □ □ □	■ □			
1,3-Butadiene	106-99-0	■ ■ □ ■ □	■ □	□	XXS OV	6811530
					XS EC Organic Vapors	6809115
Butanone	78-93-3	■ ■ □ ■ □				

■ Sensitivity data known □ Sensitivity not yet determined

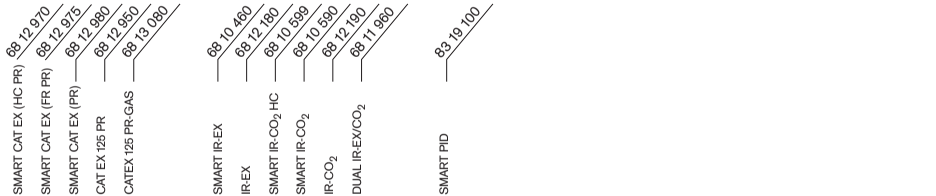


CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
2-Butoxyethyl acetate	112-07-2			□		
n-Butyl acetate	123-86-4	■ ■ □ ■ □		□		
n-Butyl acrylate	141-32-2			□		
n-Butylalcohol	71-36-3	■ ■ □ ■ □		□		
n-Butyl mercaptan (Butanethiol)	109-79-5			□		
tert. Butyl mercaptane	75-66-1				XS EC Odorant	68 09 200
					XXS Odorant	68 12 535
sec. Butyl mercaptane	513-53-1				XS EC Odorant	68 09 200
					XXS Odorant	68 12 535
Carbon dioxide	124-38-9		■ ■ ■		XXS CO_2	68 10 889
					XS EC CO_2	68 09 175
Carbon disulfide	75-15-0			□		
Carbon monoxide	630-08-0	■ □ ■ □ ■			XXS CO	68 10 882
					XXS H_2S/CO	68 11 410
					XXS CO H_2-CP	68 11 950
					XXS CO LC	68 13 210
					XXS CO HC	68 12 010

■ Sensitivity data known □ Sensitivity not yet determined

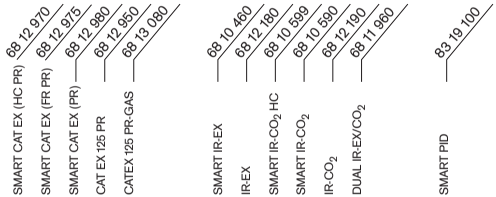
CHEMICAL DESIGNATION	CAS NO.	CAT EX					IR						PID	EC	ORDER NO.
		68 12 970 SMART CAT EX (HC PR)	68 12 975 SMART CAT EX (FR PR)	68 12 980 SMART CAT EX (PR)	68 12 950 CAT EX 125 PR	68 13 080 CATEX 125 PR-GAS	68 10 460 SMART IR-EX	68 12 180 IR-EX	68 10 599 SMART IR-CO_2 HC	68 10 590 SMART IR-CO_2	68 12 190 IR-CO_2	68 11 960 DUAL IR-EX/CO_2	83 19 100 SMART PID		
Carbon monoxide														XXS E CO	68 12 212
														XS EC CO	68 09 105
														XS EC CO HC	68 09 120
														XS 2 CO	68 10 365
														XS R CO	68 10 258
Chlorine	7782-50-5													XXS Cl_2	68 10 890
														XS EC Cl_2	68 09 165
1-Chlorine-2,3 epoxypropane	106-89-8												□	XXS OV	68 11 530
(Epichlorohydrin)														XS EC Organic Vapors - A	68 09 522
4-Chloroaniline	106-47-8												□		
Chlorine dioxide	10049-04-4												□	XS EC Cl_2	68 09 165
														XXS EC Cl_2	68 10 890
														XS EC ClO_2	68 11 360
Chloroacetone	78-95-5												□		
Chlorobenzene	108-90-7												■		

■ Sensitivity data known □ Sensitivity not yet determined



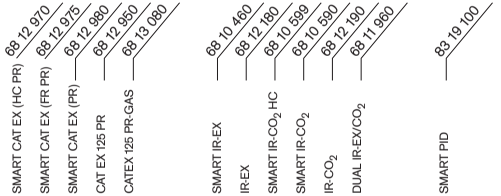
CHEMICAL DESIGNATION	CAS NO.	CAT EX					IR						PID	EC	ORDER NO.
p-Cresol	106-44-5												□		
m-Cresol	108-39-4												□		
o-Cresol	95-48-7												□		
Crotonaldehyde (2-Butenal)	4170-30-3												□		
Cumene (Isopropylbenzene)	98-82-8												□		
Cyclohexane	110-82-7	■	■	□	■	□	■	□				□	■		
Cyclohexanone	108-94-1												□		
Cyclohexylamine	108-91-8												□		
Cyclopentane	287-92-3	■	■	□	■	□	■	□				□	□		
n-Decane	124-18-5												□		
Diborane	19287-45-7													XXS PH_3	68 10 886
														XS EC Hydride	68 09 135
Dibutylamine	111-92-2												□		
Dibutylether	142-96-1	□	□	□		□							□		
1,2-Dichlorobenzene	95-50-1												□		
1,3 Dichloropropene	542-75-6												□		

■ Sensitivity data known □ Sensitivity not yet determined



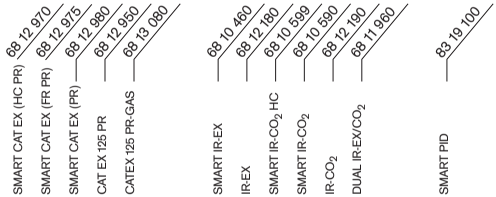
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
1,2-Dichloroethylene (trans)	156-60-5			□		
Diesel fuel		□ □ □ □ □		■		
Diethylamine	109-89-7	■ ■ □ ■ □			XS EC Amine	68 09 545
					XXS Amine	68 12 545
Diethylether	60-29-7	■ ■ □ ■ □		□	XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 115
1,1-Difluorethylene	75-38-7			□		
Dimethylamine	124-40-3	□ □ □ □ □		□	XS EC Amine	68 09 545
					XXS Amine	68 12 545
1,4-Dioxane	123-91-1			□		
Dimethyldisulfide	624-92-0			□	XXS Odorant	68 12 535
Dimethyl ether	115-10-6	□ □ □ □ □	■ □	□		
Dimethyl hydrazine	540-73-8				XS EC Hydrazine	68 09 190
					XS EC Hydrazine D	68 10 295
Dimethylsulfide	75-18-3			□	XS EC Odorant	68 09 200
					XXS Odorant	68 12 535

■ Sensitivity data known □ Sensitivity not yet determined



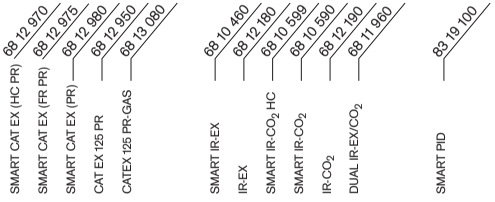
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
N,N Diethylanilin	91-66-7			■		
N,N-Dimethylacetamide	127-19-5			■		
N,N-Dimethylformamide (DMF)	68-12-2			■		
Epichlorohydrin (1-Chloro-2,3 Epoxypropane)	106-89-8			■		
Ethane	74-84-0	■ ■ □ ■ □	■ ■	□		
Ethanol	64-17-5	■ ■ □ ■ □	■ ■	□	XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 115
Ethene	74-85-1	■ ■ □ ■ □	■ ■	□	XXS OV	68 11 530
					XS EC Organic Vapors	68 09 115
Ethine	74-86-2	■ ■ ■			XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 115
Ethylacetate	141-78-6	■ ■ □ ■ □	■ ■	■		
Ethyl acrylate	140-88-5		■ ■	□		
Ethyl amine	75-04-7	□ □ □ □ □		□	XS EC Amine	68 09 545
					XXS Amine	68 12 545
Ethylbenzene	100-41-4			■		

■ Sensitivity data known □ Sensitivity not yet determined



CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Ethylbromide	74-96-4			□		
Ethyl cellosolve (2-Ethoxyethanol)	110-80-5			□		
Ethylenediamine (1,2-Diaminoethane)	107-15-3			□		
Ethylene oxide	75-21-8			□	XXS OV	68 11 530
					XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 115
					XS EC Organic Vapors A	68 09 522
2-Ethylhexylacrylate	103-11-7			□		
Ethyl mercaptan (Ethanethiol)	75-08-1			□	XS EC Odorant	68 09 200
					XXS Odorant	68 12 535
Ethyl tert butyl ether (ETBE)	637-92-3			□		
4-Ethyltoluene	622-96-8			□		
Fluorine	7782-41-4				XXS Cl_2	68 10 890
					XS EC Cl_2	68 09 165
Formaldehyde	50-00-0				XXS OV	68 11 530
					XS EC Organic Vapors	68 09 115

■ Sensitivity data known □ Sensitivity not yet determined

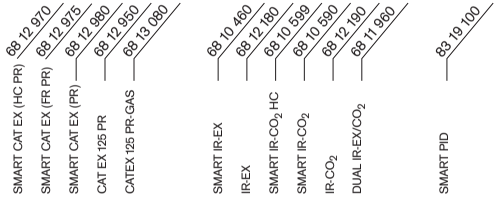


CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Furfural	98-01-1			□		
Germanium hydride	7782-65-2				XS EC Hydride	68 09 135
Hydrazine	302-01-2			□	XS EC Hydrazine	68 09 190
					XS EC Hydrazine D	68 10 295
1-Hexene	592-41-6			□		
n-Heptane	142-82-5	■ ■ □ ■ □	■ □ □ □ □	□		
i-Hexane	107-83-5			□		
n-Hexane	110-54-3	■ ■ □ ■ □	■ □ □ □ □	□		
Hydrogen	1333-74-0	■ ■ □ ■ □			XXS H_2 HC	68 12 025
					XXS H_2	68 12 370
					XS EC H_2	68 09 185
					XS H_2 HC	68 11 365
Hydrogen bromide	10035-10-6				XS EC HF/ HCl	68 09 140
Hydrogen chloride	7647-01-0				XS EC HF/ HCl	68 09 140

■ Sensitivity data known □ Sensitivity not yet determined

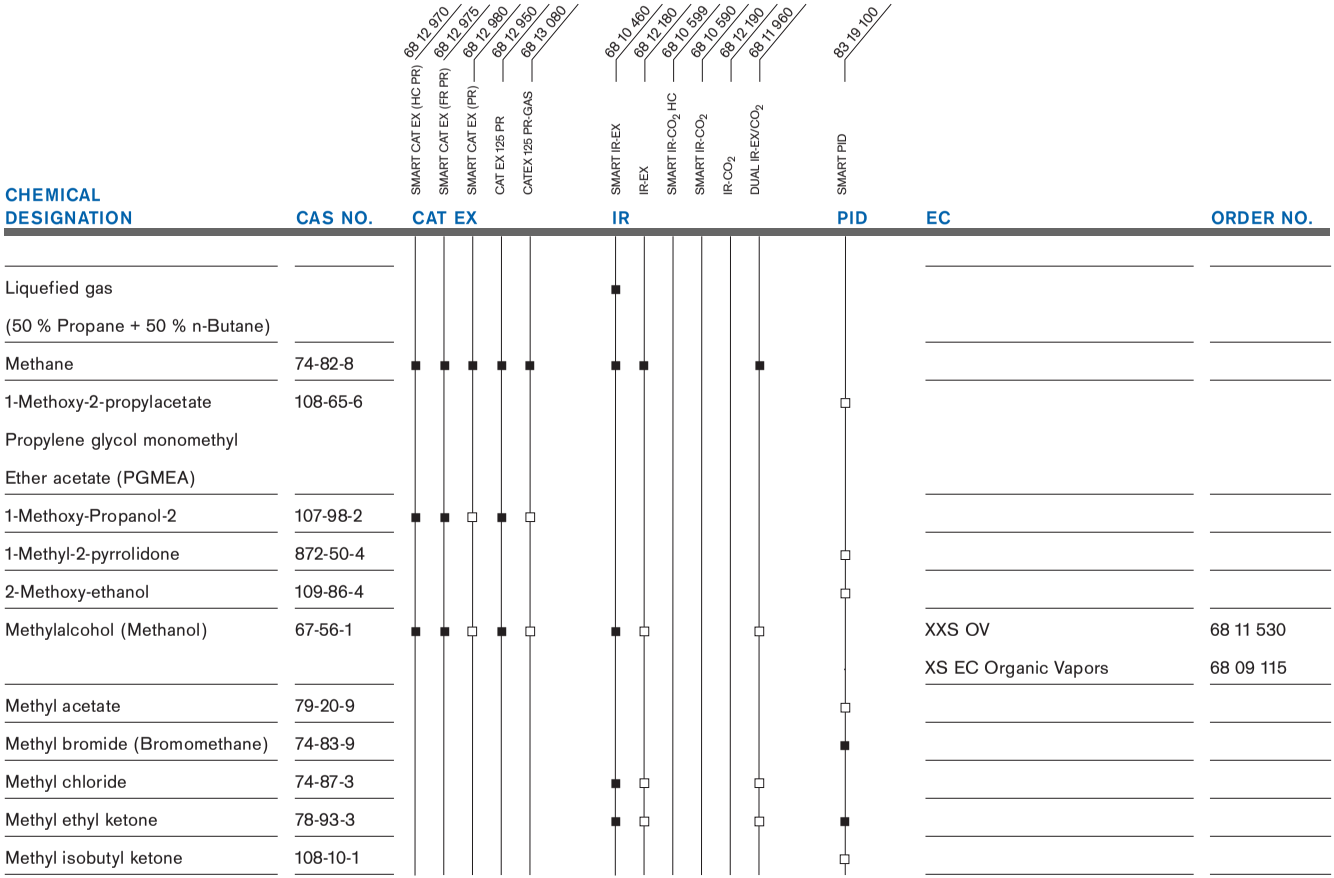
CHEMICAL DESIGNATION	CAS NO.	68 12 970 SMART CAT EX (HC PR)	68 12 975 SMART CAT EX (FR PR)	68 12 980 SMART CAT EX (PR)	68 12 950 CAT EX 125 PR	68 13 080 CATEX 125 PR-GAS	68 10 460 SMART IR-EX	68 12 180 IR-EX	68 10 599 SMART IR-CO_2 HC	68 10 590 SMART IR-CO_2	68 12 190 IR-CO_2	68 11 960 DUAL IR-EX/CO_2	83 19 100 SMART PID	EC	ORDER NO.
		CAT EX					IR						PID		
Hydrogen cyanide	74-90-8													XXS HCN	68 10 887
														XXS HCN PC	68 13 165
														XS EC HCN	68 09 150
Hydrogen fluoride	7664-39-3													XS EC HF/ HCl	68 09 140
Hydrogen peroxide	7722-84-1													XS EC H_2O_2	68 09 170
Hydrogen sulfide	7783-06-4												□	XXS H_2S	68 10 883
														XXS H_2S/CO	68 11 410
														XXS H_2S LC	68 11 525
														XXS H_2S HC	68 12 015
														XXS E H_2S	68 12 213
														XS EC H_2S	68 09 110
														XS EC H_2S HC	68 09 180
														XS 2 H_2S	68 10 370
														XS R H_2S	68 10 260
Hydrogen selenide	7783-07-5												□		

■ Sensitivity data known □ Sensitivity not yet determined



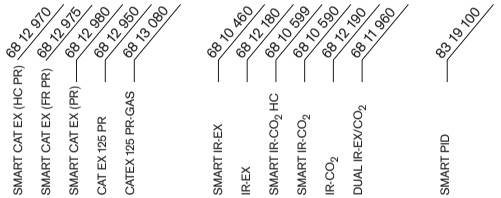
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
4-Hydroxy-4-methyl-2-pentanone (Diaceton alcohol)	123-42-2			□		
Iodomethane	74-88-4			□		
Iron pentacarbonyl	13463-40-6			□		
Isoamyl acetate	123-92-2			□		
Isobutene	115-11-7			■	XXS OV-A	68 11 535
					XS EC Organic Vapors	68 09 522
Isobutyl acetate	110-19-0			□		
Isobutyraldehyde	78-84-2			□		
Isopentane	78-78-4			□		
Isoprene (2-Methyl-1,3-Butadiene)	78-79-5			□		
Isopropyl acetate	108-21-4			■		
Isopropyl cellosolve	109-59-1			□		
Isopropyl ether	108-20-3			□		
Jet Fuel		□	■ ■	■		

■ Sensitivity data known □ Sensitivity not yet determined



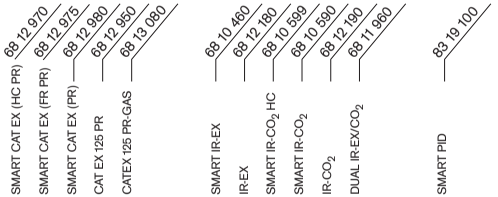
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Liquefied gas (50 % Propane + 50 % n-Butane)			■			
Methane	74-82-8	■ ■ ■ ■ ■	■ ■	■		
1-Methoxy-2-propylacetate	108-65-6			□		
Propylene glycol monomethyl Ether acetate (PGMEA)						
1-Methoxy-Propanol-2	107-98-2	■ ■ □ ■ □				
1-Methyl-2-pyrrolidone	872-50-4			□		
2-Methoxy-ethanol	109-86-4			□		
Methylalcohol (Methanol)	67-56-1	■ ■ □ ■ □	■ □	□	XXS OV	68 11 530
					XS EC Organic Vapors	68 09 115
Methyl acetate	79-20-9			□		
Methyl bromide (Bromomethane)	74-83-9			■		
Methyl chloride	74-87-3		■ □	□		
Methyl ethyl ketone	78-93-3		■ □	■		
Methyl isobutyl ketone	108-10-1			□		

■ Sensitivity data known □ Sensitivity not yet determined



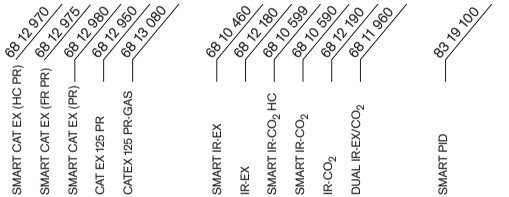
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Methyl mercaptan (Methanethiol)	74-93-1			□	XS EC Odorant	68 09 200
					XXS Odorant	68 12 535
Methyl n-amyl ketone (2-Heptanone)	110-43-0			□		
Methyl tert-butyl ether (MTBE)	1634-04-4	■ ■ □ ■ □		■		
Methylen chloride	75-09-2		■ □ □			
Methylmethacrylate	80-62-6				XXS OV	68 11 530
					XS EC Organic Vapors A	68 09 522
Monomethylamine	74-89-5			□	XS EC Amine	68 09 545
					XXS Amine	68 12 545
Monomethylhydrazine	60-34-4				XS EC Hydrazine	68 09 190
					XS EC Hydrazine D	68 10 295
Napthalene	91-20-3			□		
Nitric acid	7697-37-2				XS EC HF/ HCl	68 09 140
2-Nitrotoluene	88-72-2			□		
3-Nitrotoluene	99-08-1			□		
Nitrobenzene	98-95-3			□		

■ Sensitivity data known □ Sensitivity not yet determined



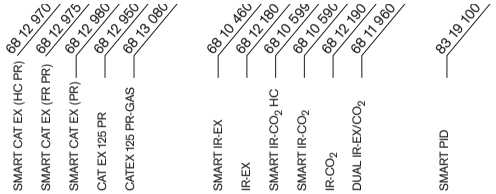
CHEMICAL DESIGNATION	CAS NO.	CAT EX					IR						PID	EC	ORDER NO.
Nitrogen dioxide	10102-44-0													XXS NO_2	68 10 884
														XS EC NO_2	68 09 155
														XXS NO_2 LC	68 12 600
Nitrogen monoxide	10102-43-9													XXS NO	68 11 545
														XS EC NO	68 09 125
n-Nonane	111-84-2	■	■	□	■	□	■	□				■	■		
n-Octane	111-65-9	■	■	□	■	□	□	□				□	■		
iso-Octane	540-84-1												□		
(2,2,4-Trimethylpentane)															
Oxygen	7782-44-7													XXS O_2	68 10 881
														XXS E O_2	68 12 211
														XS EC O_2 LS	68 09 130
														XS EC O_2 100	68 09 550
														XS 2 O_2	68 10 375
														XS R O_2 LS	68 10 262
Ozon	10028-15-6													XXS Ozon	68 11 540

■ Sensitivity data known □ Sensitivity not yet determined



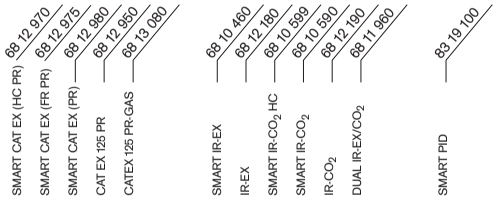
CHEMICAL DESIGNATION	CAS NO.	CAT EX					IR						PID	EC	ORDER NO.
n-Pentane	109-66-0	■	■	□	■	□	■	■				■	□		
Pentylalcohol	71-41-0	■	■	□	■	□	■	□				□			
Petrol (Gasoline)	8030-31-7	■	■	□	■	□	□	□				□	■		
Phenol	108-95-2												□		
Phenyl hydrazine	100-63-0												□		
Phosgene	75-44-5													XS EC $COCl_2$	68 08 582
														XXS $COCl_2$	68 12 005
Phosphine	7803-51-2												□	XS EC Hydride	68 09 135
														XS EC PH_3	68 09 535
														XXS PH_3	68 10 886
														XXS PH_3 HC	68 12 020
Phosphorous trichloride	7719-12-2													XS EC HF/ HCl	68 09 140
Phosphorous trichlorideoxide	10025-87-3													XS EC HF/ HCl	68 09 140
Propane	74-98-6	■	■	□	■	□	■	■				■			
i-Propanol (Isopropanol)	67-63-0	□	□	□	□	□							□	XXS OV	68 11 530
														XS EC Organic Vapors	68 09 115

■ Sensitivity data known □ Sensitivity not yet determined



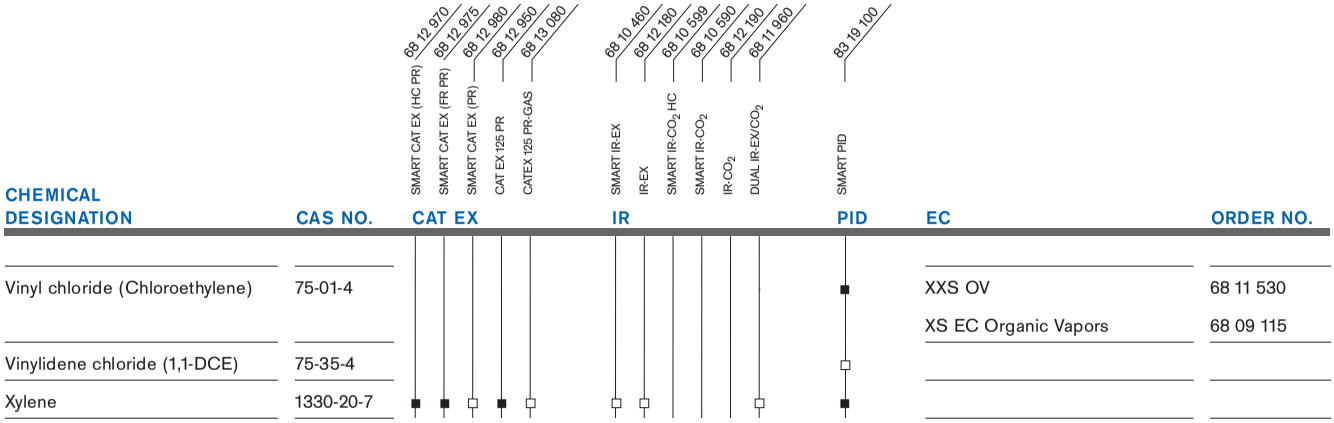
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
n-Propanol	71-23-8	■ ■ □ ■ □	■ □ □ □ □	□		
Propene	115-07-1	■ ■ □ ■ □	■ □ □ □ □	□	XXS OV	68 11 530
					XS EC Organic Vapors	68 09 115
Propionaldehyde (Propanal)	123-38-6			□		
n-Propyl acetate	109-60-4			□		
Propylene Oxide (1,2 Epoxy propane)	75-56-9	■ ■ □ ■ □	■ □ □ □ □	□	XXS OV	68 11 530
					XS EC Organic Vapors	68 09 115
Silane	7803-62-5				XXS PH_3	68 10 886
					XS EC Hydride	68 09 135
Styrene	100-42-5	■ ■ □ ■ □	■ □ □ □ □	■	XXS OV	68 11 530
					XS EC Organic Vapors A	68 09 522
Sulphur dioxide	7446-09-5				XXS SO_2	68 10 885
					XS EC SO_2	68 09 160
Tetrachloroethylene (PCE)	127-18-4			□		
Tetraethyl lead	78-00-2			□		
Tetrahydrofuran	109-99-9			□	XXS OV	68 11 530

■ Sensitivity data known □ Sensitivity not yet determined



CHEMICAL DESIGNATION	CAS NO.	CAT EX					IR						PID	EC	ORDER NO.
Tetrahydrothiophene	110-01-0												□	XS EC Odorant	68 09 200
														XXS Odorant	68 12 535
Thiophene	110-02-1												□		
Toluene	108-88-3	■	■	□	■	□	■	■				■	■		
o-Toluidine	95-53-4												□		
2,4-Toluene diisocyanate	584-84-9												□		
Trichloroethylene	79-01-6												■		
Triethylamine	121-44-8	□	□	□	□	□							□	XS EC Amine	68 09 545
														XXS Amine	68 12 545
Trimethylamine	75-50-3												□	XS EC Amine	68 09 545
														XXS Amine	68 12 545
1,3,5-Trimethylbenzene	108-67-8												□		
Vinyl acetate	108-05-4												□	XXS OV-A	68 11 535
														XS EC Organic Vapors	68 09 115
Vinyl bromide	593-60-2												□		

■ Sensitivity data known □ Sensitivity not yet determined



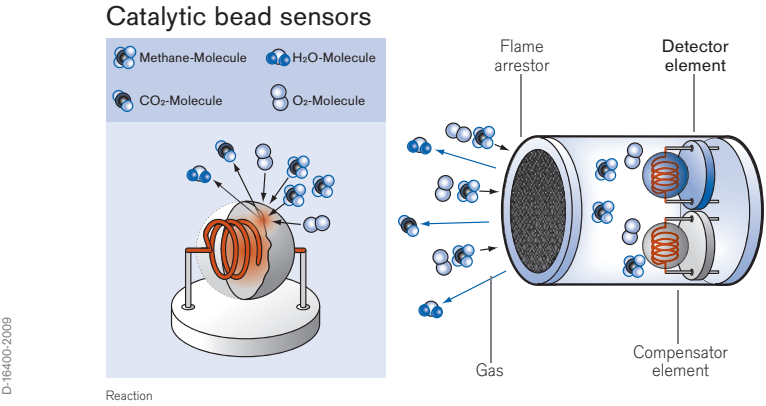
CHEMICAL DESIGNATION	CAS NO.	CAT EX	IR	PID	EC	ORDER NO.
Vinyl chloride (Chloroethylene)	75-01-4			■	XXS OV	68 11 530
					XS EC Organic Vapors	68 09 115
Vinylidene chloride (1,1-DCE)	75-35-4			□		
Xylene	1330-20-7	■ ■ □ ■ □	□ □	■		

■ Sensitivity data known □ Sensitivity not yet determined

4.3 Dräger CatEx sensors

Under certain circumstances, flammable gases and vapors can be oxidized using the oxygen in the ambient air, causing heat of the reaction to be released. Typically, this is achieved through the use of special and suitably heated catalyst material, which slightly increases its temperature through the resulting heat of reaction. This slight increase in temperature is a measure of the gas concentration.

A small platinum coil is embedded in a porous ceramic bead with a diameter of less than 1 mm (0.04 in.). A current flows through the platinum coil, heating the pellistor to several hundred degrees. If the pellistor contains a suitable catalytic material, then its temperature will increase in the presence of flammable gases, which in turn causes the resistance of the platinum coil to increase. This change in resistance can then be evaluated electronically. The oxygen required for the combustion comes from the ambient air. This sensor works on the basis of the catalytic bead principle.



In order to eliminate changes in the ambient temperature, a second pellistor is used with almost the same structure, but which does not react to gas (it may, for example, contain no catalytic material). Coupled by a Wheatstone bridge, the two pellistors then form a sensor circuit, which is largely independent of the ambient temperature, and which can detect the presence of flammable gases and vapors. Because a catalytic bead sensor contains hot pellistors, it can – if the lower exposure level (LEL) is exceeded – become a source of ignition in its own right. This is prevented using a metal flame arrester. If an ignition occurs in the interior of the catalytic bead sensor, then the sensor's housing withstands the explosion pressure and the flame is cooled to below the ignition temperature of the gas by the flame arrester disk. This ensures that the flame does not penetrate through to the outside of the sensor. If the device is adjusted and calibrated accordingly, then the thermal conduction signal can be used to determine the gas concentration of methane between 0 and 100 Vol.-%.

DrägerSensor® Smart CatEx (HC PR)

Order no. 68 12 970

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	2 years	> 3 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	2% LEL
Resolution:	1.0% LEL for the measuring range 0 to 100% LEL 0.02 Vol.-% for the measuring range 0 to 5 Vol.-% CH_4 (methane) 1 Vol.-% for the measuring range 5 to 100 Vol.-% CH_4 (methane)
Measurement range:	0 to 100% LEL or 0 to 100 Vol.-% CH_4 (methane)
General technical specifications	
Ambient conditions	
Temperature:	(–20 to 55)°C (–4 to 131)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	≤ 15 seconds (T_{50}) ≤ 25 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.5% of measured value
Linearity error	≤ ± 2% LEL (0–40% LEL) ≤ ± 5% of measured value (40–100% LEL)
Long-term drift	
Zero point:	≤ ± 1% LEL/month
Sensitivity:	≤ ± 2% LEL/month typ. values for X-am 7000 ≤ ± 1% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.03% LEL/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH
Effect of sensor poisons:	Hydrogen sulphide H_2S 1000 ppmh ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ± 20 % of measured value After an exposure of 10 ppm HDMS for 5 hours, the sensivity loss is less than 50 %. Halogenated hydrocarbons, heavy metals, substances containing silicone or sulfur, or substances that can polymerize → potential poisoning.
Test gas:	approx. 2 Vol.-% or 50 Vol.-% CH_4 test gas

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH PROPANE IN AIR:

Response time:	≤ 20 seconds (T_{50})
	≤ 40 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.5% of measured value
Linearity error:	≤ ± 4% LEL (0–40% LEL)
	≤ ± 10% of measured value (40–100% LEL)
Long-term drift	
Zero point:	≤ ± 4% LEL/month
Sensitivity:	≤ ± 1% LEL/month
	typ. values for X-am 7000 ≤ ± 1% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.04% LEL/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH

FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CH_4:

Response time:	≤ 35 seconds at 0 to 5 Vol.-% (T_{90})
Measurement accuracy	1 Vol.-% CH4
Linearity error:	
0 to 50 Vol.-%	≤ ± 5 Vol.-%
50 to 100 Vol.-%	≤ ± 10% of measured value
Long-term drift	
Zero point:	≤ ± 3 Vol.-%/month
Sensitivity:	≤ ± 3 Vol.-%/month
Influence of temperature	
Sensitivity 0 to 50 Vol.-%	≤ ± 0.2 Vol.-%/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity 50 to 100 Vol.-%	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Sensitivity 0 to 50 Vol.-%	≤ ± 0.15 Vol.-%/% RH
Sensitivity 50 to 100 Vol.-%	≤ ± 0.2% of measured value/% RH

TECHNICAL SPECIFICATIONS

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH NONANE IN AIR:

Response time, rising:	≤ 60 seconds (T_{50})
	≤ 320 seconds (T_{90})
Response time, declining:	≤ 130 seconds (T_{50})
	≤ 1000 seconds (T_{90})

SPECIAL CHARACTERISTICS

The DrägerSensor® Smart CatEx (HC PR) is used to detect flammable gases and vapors in the ambient air: LEL monitoring or, in the case of methane, also Vol.-% monitoring. It has an excellent poison resistance against hydrogen sulphide, siloxiane and other sensor poisons. These sensors have been tested according to EN 61779-1 and EN 61779-4 for methane, propane, and nonane for 0–100% LEL, and for 0–100 Vol.-% for methane in accordance with EN 61779-1 and EN 61779-5. Substance-specific data is stored in the data memory for 35 different gases and vapors.

DETECTING OTHER GASES AND VAPORS

Through the use of cross sensitivities for the measurement range of 0 to 100% LEL. The figures given are typical readings when calibrated with methane (CH_4) and apply to new sensors without additional diffusion barriers. A LEL of 4.4 Vol.-% was used for methane. If an LEL of 5.0 Vol.-% is used, then the figures in the table must be multiplied by a factor of 0.88. The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
Acetone	CH_3COCH_3	1.25	31
1,3-butadiene	$CH_2CHCHCH_2$	0.70	26
Acetic acid	CH_3COOH	3.00	23
Ammonia	NH_3	7.70	58
Benzene	C_6H_6	0.60	22
Butane	C_4H_{10}	0.70	27
Butanone	$CH_3COC_2H_5$	0.75	22
Carbon monoxide	CO	5.45	41
Cyclohexane	C_6H_{12}	0.50	21
Cyclopentane	C_5H_{10}	0.70	27

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
Diethyl ether	$(C_2H_5)_2O$	0.85	24
Diethylamine	$(C_2H_5)_2NH$	0.85	26
Ethane	C_2H_6	1.20	34
Ethanol	C_2H_5OH	1.55	31
Ethene	C_2H_4	1.20	36
Ethyl acetate	$CH_3COOC_2H_5$	1.00	24
Ethine	C_2H_2	1.15	34
Heptane	C_7H_{16}	0.40	18
Hexane	C_6H_{14}	0.50	21
Hydrogen	H_2	2.00	48
1-Methoxy-Propanol-2	$C_4H_{10}O_2$	0.90	22
Methane	CH_4	2.20	50
Methanol	CH_3OH	3.00	39
Methyl tert-butyl ether (MTBE)	$CH_3OC(CH_3)_3$	0.80	27
n-butanol	$C4H_9OH$	0.70	19
n-butyl acetate	$CH_3COOC_4H_9$	0.60	17
Nonane	C_9H_{20}	0.35	13
Octane	C_8H_{18}	0.40	17
Pentane	C_5H_{12}	0.55	21
Pentanol	$C_5H_{11}OH$	0.60	19
Propane	C_3H_8	0.85	28
Propanol	C_3H_7OH	0.60	19
Propene	C_3H_6	1.00	32
Propylene oxide	C_3H_6O	0.95	23
Styrol	$C_6H_5CHCH_2$	0.50	15
Toluene	$C_6H_5CH_3$	0.50	19
Xylene	$C_6H4(CH_3)_2$	0.55	19

DrägerSensor® Smart CatEx (PR)

Order no. 68 12 980

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	2 years	> 3 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	2% LEL
Resolution:	1.0% LEL for the measuring range 0 to 100% LEL, 0.02 Vol.-% for the measuring range 0 to 5 Vol.-% CH_4 (methane)
Measurement range:	0 to 100% LEL
General technical specifications	
Ambient conditions	
Temperature:	(–20 to 55)°C (–4 to 131)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	≤ 15 seconds (T_{50}) ≤ 25 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.5% of measured value
Linearity error:	≤ ± 2% LEL (0–40% LEL) ≤ ± 5% of measured value (40–100% LEL)
Long-term drift	
Zero point:	≤ ± 1% LEL/month
Sensitivity:	≤ ± 2% LEL/month typ. values for X-am 7000 ≤ ± 1% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.03% LEL/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH
Effect of sensor poisons:	Hydrogen sulphide H_2S 1000 ppmh ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ± 20 % of measured value After an exposure of 10 ppm HDMS for 5 hours, the sensivity loss is less than 50 %. Halogenated hydrocarbons, heavy metals, substances containing silicone or sulfur, or substances that can polymerize → potential poisoning.
Test gas:	approx. 2 Vol.-% CH_4 test gas

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH PROPANE IN AIR:

Response time:	≤ 20 seconds (T_{50})
	≤ 40 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.5% of measured value
Linearity error:	≤ ± 4% LEL (0–40% LEL)
	≤ ± 10% of measured value (40–100% LEL)
Long-term drift	
Zero point:	≤ ± 4% LEL/month
Sensitivity:	≤ ± 1% LEL/month
	typ. values for X-am 7000 ≤ ± 1% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.04% LEL/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH NONANE IN AIR:

Response time, rising:	≤ 60 seconds (T_{50})
	≤ 320 seconds (T_{90})
Response time, declining:	≤ 130 seconds (T_{50})
	≤ 1000 seconds (T_{90})

SPECIAL CHARACTERISTICS

The DrägerSensor® Smart CatEx (PR) is used to detect flammable gases and vapors around the LEL in the ambient air. It has an excellent poison resistance against hydrogen sulphide, siloxiane and other sensor poisons. These sensors have been tested according to EN 61779-1 and EN 61779-4 for methane, propane, and nonane for a range of 0–100% LEL. Substance-specific data is stored in the data memory for 35 different gases and vapors.

DETECTING OTHER GASES AND VAPORS

Through the use of cross sensitivities for the measurement range of 0 to 100% LEL. The figures given are typical readings when calibrated with methane (CH_4) and apply to new sensors without additional diffusion barriers. A LEL of 4.4 Vol.-% was used for methane. If a LEL of 5.0 Vol.-% is used, then the figures in the table must be multiplied by a factor of 0.88. The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
Acetone	CH_3COCH_3	1.25	31
1,3-butadiene	$CH_2CHCHCH_2$	0.70	26
Acetic acid	CH_3COOH	3.00	23
Ammonia	NH_3	7.70	58
Benzene	C_6H_6	0.60	22
Butane	C_4H_{10}	0.70	27
Butanone	$CH_3COC_2H_5$	0.75	22
Carbon monoxide	CO	5.45	41
Cyclohexane	C_6H_{12}	0.50	21
Cyclopentane	C_5H_{10}	0.70	27
Diethyl ether	$(C_2H_5)_2O$	0.85	24
Diethylamine	$(C_2H_5)_2NH$	0.85	26
Ethane	C_2H_6	1.20	34
Ethanol	C_2H_5OH	1.55	31
Ethene	C_2H_4	1.20	36
Ethyl acetate	$CH_3COOC_2H_5$	1.00	24
Ethine	C_2H_2	1.15	34
Heptane	C_7H_{16}	0.40	18
Hexane	C_6H_{14}	0.50	21
Hydrogen	H_2	2.00	48
1-Methoxy-Propanol-2	$C_4H_{10}O_2$	0.90	22
Methane	CH_4	2.20	50
Methanol	CH_3OH	3.00	39
Methyl tert-butyl ether (MTBE)	$CH_3OC(CH_3)_3$	0.80	27
n-butanol	$C4H_9OH$	0.70	19

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
n-butyl acetate	$CH_3COOC_4H_9$	0.60	17
Nonane	C_9H_{20}	0.35	13
Octane	C_8H_{18}	0.40	17
Pentane	C_5H_{12}	0.55	21
Pentanol	$C_5H_{11}OH$	0.60	19
Propane	C_3H_8	0.85	28
Propanol	C_3H_7OH	0.60	19
Propene	C_3H_6	1.00	32
Propylene oxide	C_3H_6O	0.95	23
Styrol	$C_6H_5CHCH_2$	0.50	15
Toluene	$C_6H_5CH_3$	0.50	19
Xylene	$C_6H4(CH_3)_2$	0.55	19

DrägerSensor® Smart CatEx (FR PR)

Order no. 68 12 975

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	2 years	> 3 years	–

MARKET SEGMENTS

Gas supply companies (methane leak detection), telecommunications, shipping, sewage, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	2% LEL
Resolution:	1.0% LEL for the measuring range 0 to 100% LEL 0.02 Vol.-% for the measuring range 0 to 5 Vol.-% CH_4 (methane) 1 Vol.-% for the measuring range 5 to 100 Vol.-% CH_4 (methane)
Measurement range:	0 to 100% LEL or 0 to 100 Vol.-% CH_4 (methane)
General technical specifications	
Ambient conditions	
Temperature:	(–20 to 55)°C (–4 to 131)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	≤ 7 seconds (T_{50}) ≤ 9 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.5% of measured value
Linearity error:	≤ ± 4% LEL (0–40% LEL) ≤ ± 10% of measured value (40–100% LEL)
Long-term drift	
Zero point:	≤ ± 3% LEL/month typ. values for X-am 7000 ≤ ± 1% LEL/month
Sensitivity:	≤ ± 3% LEL/month typ. values for X-am 7000 ≤ ± 1% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.2% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.05% LEL/% RH
Sensitivity:	≤ ± 0.3% of measured value/% RH
Effect of sensor poisons:	Hydrogen sulphide H_2S 1000 ppmh ≤ ± 10% of measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ± 5% of measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ± 20% of measured value After an exposure of 10 ppm HDMS for 5 hours, the sensivity loss is less than 50%. Halogenated hydrocarbons, heavy metals, substances containing silicone or sulfur, or substances that can polymerize → potential poisoning.

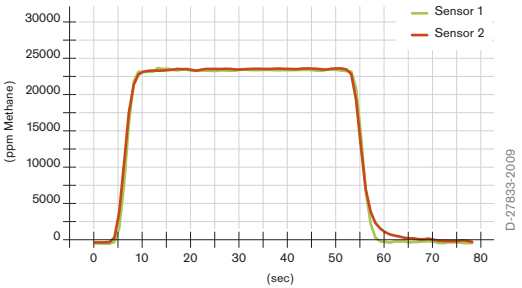
FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CH_4:

Response time:	≤ 18 seconds (T_{90}) at 0 to 5 Vol.-%
Measurement accuracy	
Sensitivity:	≤ ± 2.5% of measured value
Linearity error	
0 to 50 Vol.-%	≤ ± 5 Vol.-%
50 to 100 Vol.-%	≤ ± 10% of measured value
Long-term drift	
Zero point:	≤ ± 0.3 Vol.-%/month
Sensitivity	≤ ± 3 Vol.-%/month
Influence of temperature	
Sensitivity 0 to 50 Vol.-%	≤ ± 0.2 Vol.-%/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity 50 to 100 Vol.-%	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Sensitivity 0 to 50 Vol.-%	≤ ± 5 Vol.-%/% RH
Sensitivity 50 to 100 Vol.-%	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 2 Vol.-% or 50 Vol.-% CH_4 test gas

SPECIAL CHARACTERISTICS

The DrägerSensor® Smart CatEx (FR PR) is especially suitable for detecting leaks on account of its fast response time (T_{90}) of less than 9 seconds for methane. It has an excellent poison resistance against hydrogen sulphide, siloxiane and other sensor poisons.

Response time of DrägerSensor® Smart CatEx (FR PR)
in X-am 7000



DrägerSensor® CatEx 125 PR

Order no. 68 12 950

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 1/2/5000	–	yes	3 years	> 4 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, sewage treatment plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	2% LEL
Resolution:	1.0% LEL for measuring range 0 to 100% LEL, 1.0 Vol.-% for measuring range 0 to 100 Vol.-% CH_4 (methane)
Measurement range:	0 to 100% LEL in Dräger X-am 2500/5000 or 0 to 100 Vol.% CH_4 (methane) in Dräger X-am 5000
General technical specifications	
Ambient conditions	
Temperature:	(–20 to 55)°C (–4 to 131)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 3 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	≤ 17 seconds (T_{90}) ≤ 7 seconds (T_{50}) typical values for X-am 2500 T_{90} at 25 °C (77 °F) ≤ 12 seconds typical values for X-am 5000 T_{90} at 25 °C (77 °F) ≤ 10 seconds
Measurement accuracy:	≤ ± 1% LEL
Long-term drift	
Zero point:	≤ ± 2% LEL/month typical value in X-am 2500/5000 ≤ 1 % LEL/month
Sensitivity:	≤ ± 2% LEL/month typical value in X-am 2500/5000 ≤ 1 % LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.1% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 1% LEL
Sensitivity:	≤ ± 2% LEL (test gas 50% LEL), effect of humidity when calibrating at 0% relative humidity in the range of 10–90 % at 40°C
Effect of sensor poisons:	Hydrogen sulphide H_2S, 1000 ppmh ≤ ±2% of the measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ±5 % of the measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ±20 % of the measured value. After an exposure to HMDS of 10 ppm for 5 hours, the loss of sensitivity is less than 50%. Halogenated hydrocarbons, volatile substances containing sulphur, heavy metals and silicon, or substances capable of polymerisation: poisoning possible.

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH PROPANE IN AIR:

Response time:	≤ 10 seconds (T_{50}) ≤ 32 seconds (T_{90}) typical values for X-am 2500 T_{90} at 25 °C (77 °F) ≤ 24 seconds typical values for X-am 5000 T_{90} at 25 °C (77 °F) ≤ 14 seconds
Measurement accuracy:	1 % LEL
Long-term drift	
Zero point:	≤ ± 2% LEL/month
Sensitivity:	≤ ± 2% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K at (–20 to 40)°C (–4 to 104)°F
Sensitivity:	≤ ± 0.1% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 1% LEL
Sensitivity:	≤ ± 2% LEL

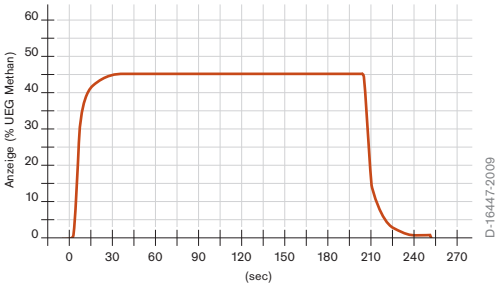
FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CH_4:

Response time:	≤ 30 seconds at 5 to 100 Vol.-%
Measurement accuracy	≤ ± 1 % LEL
Linearity error:	
0 to 50 Vol.-%	≤ ± 5 Vol.-%
50 to 100 Vol.-%	≤ ± 10% of measured value
Long-term drift	
Zero point:	≤ ± 3 Vol.-%/month
Sensitivity:	≤ ± 3 Vol.-%/month
Influence of temperature:	≤ ± 0.15 Vol.-%/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity:	≤ ± 0.15 Vol.-%/ %RH at 40°C / 104°F
Test gas:	approx. 2 Vol.-% or 50 Vol.-% CH_4 test gas

SPECIAL CHARACTERISTICS

The DrägerSensor® CatEx 125 PR (Poison Resistant) is used to detect flammable gases and vapors. The detection of hydrocarbons from methane to nonane is certified by a measurement performance certificates for use in the Dräger X-am 1/2/5000 series in accordance with EN 60079-29-1 and EN 50271. It also has a small long-term drift, few influence of humidity and excellent poison resistance against hydrogen sulphide, siloxiane and other sensor poisons.

Ansprechzeit des DrägerSensor CatEx 125 PR
im X-am 5000 bei 45% UEG Methan



DETECTING OTHER GASES AND VAPORS

Through the use of cross sensitivities for the measurement range of 0 to 100% LEL. The figures given are typical readings when calibrated with methane (CH_4) and apply to new sensors without additional diffusion barriers. A LEL of 4.4 Vol.-% was used for methane. If a LEL of 5.0 Vol.-% is used, then the figures in the table must be multiplied by a factor of 0.88. The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
Acetone	CH_3COCH_3	1.25	31
Acetic acid	CH_3COOH	7.7	57
Ammonia	NH_3	6.16	48
Benzene	C_6H_6	0.6	25
Butadiene -1,3	$CH_2CHCHCH_2$	0.7	27
Butane	C_4H_{10}	0.7	26
n-butanol	C_4H_9OH	0.7	20
Butanone	$CH_3COC_2H_5$	0.75	22
n-butyl acetate	$CH_3COOC_4H_9$	0.6	18
Carbon monoxide	CO	5.45	32
Cyclohexane	C_6H_{12}	0.5	21
Cyclopentane	C_5H_{10}	0.7	27
Diethylamine	$(C_2H_5)_2NH$	0.85	28

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
Diethyl ether	$(C_2H_5)_2O$	0.85	27
Ethane	C_2H_6	1.2	35
Ethanol	C_2H_5OH	1.55	33
Ethene	C_2H_4	1.2	36
Ethine	C_2H_2	1.15	36
Ethyl acetate	$CH_3COOC_2H_5$	1.0	25
Heptane	C_7H_{16}	0.4	17
Hexane	C_6H_{14}	0.5	21
Hydrogen	H_2	2.0	49
Methane	CH_4	2.2	50
Methanol	CH_3OH	3.0	42
Methyl tert-butyl ether (MTBE)	$CH_3OC(CH_3)_3$	0.8	27
Nonane	C_9H_{20}	0.35	15
1-Methoxy-Propanol-2-	$C_4H_{10}O_2$	0.9	23
Octane	C_8H_{18}	0.4	18
Pentane	C_5H_{12}	0.55	22
Pentanol	C_5H11OH	0.6	19
Propane	C_3H_8	0.85	29
Propanol	C_3H_7OH	1.00	27
Propene	C_3H_6	1.00	35
Propylene oxide	C_3H_6O	0.95	25
Styrene	$C_6H_5CHCH_2$	0.5	11
Toluene	$C_6H_5CH_3$	0.5	21
Xylene	$C_6H_4(CH_3)_2$	0.55	22

DrägerSensor® CatEx 125 PR-Gas

Order no. 68 13 080

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 2500	–	yes	2 years	> 3 years	–
Dräger X-am 5000	–	yes	2 years	> 3 years	–

MARKET SEGMENTS

Mining, telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, landfills, biogas plants, sewage treatment plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	2% LEL
Resolution:	1.0% LEL for measuring range 0 to 100% LEL or 1.0 Vol.-% for measuring range 0 to 100 Vol.-% CH_4 (methane)
Measurement range:	0 to 100% LEL or 0 to 100 Vol.-% CH_4 (methane)
General technical specifications	
Ambient conditions	
Temperature:	(–20 to 55)°C (–4 to 131)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	≤ 7 seconds (T_{50}) ≤ 10 seconds (T_{90})
Measurement accuracy:	≤ ± 1% LEL
Long-term drift	
Zero point:	≤ ± 3% LEL/month
Sensitivity:	≤ ± 3% LEL/month
Influence of temperature	
Zero point:	≤ ± 0.1% LEL/K
Sensitivity:	≤ ± 0.2% of measured value/K
Influence of humidity	
Zero point:	≤ ± 1% LEL
Sensitivity:	≤ ± 2% LEL

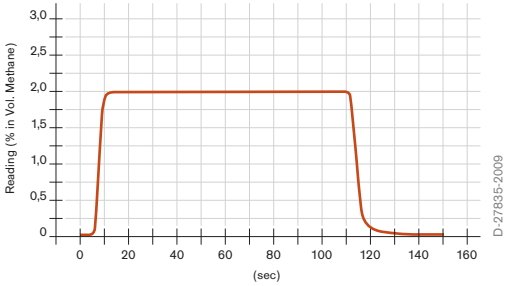
FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CH_4:

Response time:	≤ 35 seconds (T_{90}) at 0 to 100 Vol.-%
Measurement accuracy:	≤ ± 1 Vol.-%
Linearity error:	
0 to 50 Vol.-%	≤ ± 5 Vol.-%
50 to 100 Vol.-%	≤ ± 10% of measured value
Long-term drift	
Zero point:	≤ ± 3 Vol.-%/month
Sensitivity:	≤ ± 3 Vol.-%/month
Influence of temperature	
0 to 50 Vol.-%	≤ ± 0.15 Vol.-%/K at (–20 to 40)°C (–4 to 104)°F
50 to 100 Vol.-%	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
0 to 50 Vol.-%	≤ ± 0.1 Vol.-%/RH.
50 to 100 Vol.-%	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 2 Vol.-% or 50 Vol.-% CH_4 test gas
Effect of sensor contaminants:	Hydrogen sulphide H_2S, 1000 ppmh ≤ ±2% of the measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ±5% of the measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ±20% of the measured value After an exposure to HMDS of 10 ppm for 5 hours, the loss of sensitivity is less than 50%. Halogenated hydrocarbons, volatile substances containing sulphur, heavy metals and silicon, or substances capable of polymerisation: poisoning possible

SPECIAL CHARACTERISTICS

This sensor is optimized for the detection of methane. It has a response time (T_{90}) of less than 10 seconds. The pellistors are impact-protected, which makes the sensor especially shock-proof. In conjunction with this sensor, the Dräger X-am 5000 is approved for Zone 0/T4 worldwide. The LEL and the Vol.-% measuring range can be used in the Dräger X-am 5000.

Response time of DrägerSensor CatEx 125 PR-Gas
in X-am 5000



DETECTING OTHER GASES AND VAPORS

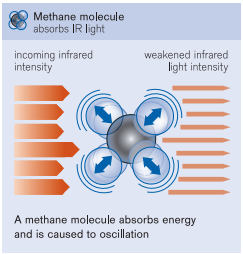
Through the use of cross sensitivities for the measurement range of 0 to 100% LEL. The figures given are typical readings when calibrated with methane (CH_4) and apply to new sensors without additional diffusion barriers. A LEL of 4.4 Vol.-% was used for methane. If a LEL of 5.0 Vol.-% is used, then the figures in the table must be multiplied by a factor of 0.88. The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

Gas/vapor	Chem. symbol	Test gas concentration in Vol.-%	Displayed reading in % LEL
Butane	C_4H_{10}	0.70	30
Butene	C_4H_8	0.75	30
Ethane	C_2H_6	1.20	35
Ethene	C_2H_4	1.20	30
Ethine	C_2H_2	1.15	31
Hydrogen	H_2	2.00	51
Methane	CH_4	2.20	50
Propane	C_3H_8	0.85	35
Propene	C_3H_6	1.00	33

4.4 Dräger infrared sensors

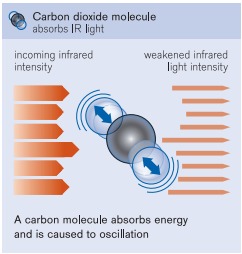
Every gas absorbs light in a particular way; some even absorb visible light (wavelength of 0.4 to 0.8 micrometers), which is why chlorine is yellowish green, bromine and nitrogen dioxide are brown, iodine vapor is violet, and so on – but unfortunately they are only visible in high (deadly) concentrations.

DUAL IR Ex/CO_2 Sensor



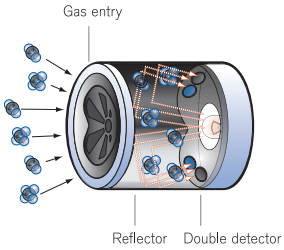
Reaction

CH_4 + energy → CH_4 (charged)



Reaction

CH_4 + energy → CH_4 (charged)



Hydrocarbons and carbon dioxide, on the other hand, absorb light in a certain wavelength range, (hydro carbons 3.3 to 3.5 µm; CO_2 approx. 4 µm) – and that can be utilized for detection purposes, since the main components of air (oxygen, nitrogen, and argon) do not absorb radiation in that range. In a container containing gaseous hydrocarbons such as methane or propane or carbon dioxide, the intensity of an incoming infrared light will be weakened, and the degree of this weakening is dependent on the concentration of gas. With the DrägerSensor Dual IR Ex / CO_2 a simultaneous measurement is possible.

Air: infrared light passes through without weakening – intensity remains the same
Gas (e.g. methane): infrared light becomes weaker as it passes through – intensity drops in relation to the concentration of methane. This is the principle of an infrared measuring instrument that utilizes Dräger IR sensors. Flammable gases and vapors are mostly hydrocarbons, and hydrocarbons are almost always detectable by means of their typical IR absorption levels.

Functional principle: the ambient air to be monitored passes into the measuring cuvette by means of diffusion or through the use of a pump. The infrared transmitter produces broad-band radiation that passes through a window into the cuvette, where it is reflected off the mirrored walls and passes through another window, falling onto the double detector. This double detector consists of a measurement and a reference detector. If the gas mixture contains a percentage of e.g. hydrocarbons, then some of the radiation is absorbed and the measurement detector produces a reduced electrical signal. The signal from the reference detector remains unchanged. Fluctuations in the performance of the infrared transmitter, dirt on the mirror and windows, and interference from dust or aerosols in the ambient air have the same effect on both sensors, and are fully compensated.

DrägerSensor® Smart IR Ex

Order no. 68 10 460

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	5 years	> 5 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	3% LEL/0.1 Vol.-%
Resolution:	0.5% LEL
Measurement range:	0 to 100% LEL/0 to 100 Vol.-% depending on the gas being measured
Ambient conditions	
Temperature:	(–20 to 60)°C (–4 to 140)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 4 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL OR 0 TO 4.4 VOL.-% CH_4 WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	Diffusion mode ≤ 20 seconds (T_{50}) Diffusion mode ≤ 50 seconds (T_{90}) Pump mode ≤ 20 seconds (T_{50}) Pump mode ≤ 41 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.0% LEL methane at 50% LEL
Linearity error, typical:	≤ ± 5% of measured value
Long-term drift	
Zero point:	≤ ± 2.5% LEL methane/month
Sensitivity:	≤ ± 8% LEL methane/month at 50% LEL
Influence of temperature	
Zero point:	≤ ± 0.05% LEL methane/K at (–20 to 60)°C (–4 to 140)°F
Sensitivity:	≤ ± 0.15% LEL methane/K at 50% LEL and (–20 to 60)°C (–4 to 140)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.05% LEL methane/% RH

FOR THE MEASUREMENT RANGE 0 TO 100% LEL OR 0 TO 1.7 VOL.-% C_3H_8 WHEN CALIBRATED WITH PROPANE IN AIR:

Measurement accuracy	
Sensitivity	≤ ± 1.0% LEL propane at 50% LEL
Linearity error, typical:	≤ ± 4.0% of measured value
Long-term drift	
Zero point:	≤ ± 1.0% LEL propane/month
Sensitivity	≤ ± 2.0% LEL propane/month at 50% LEL
Influence of temperature	
Zero point:	≤ ± 0.03% LEL propane/K
Sensitivity	≤ ± 0.08% LEL propane/K
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.03% LEL propane/% RH
Test gas:	2 Vol.-% CH_4 0.9 Vol.-% C_3H_8

SPECIAL CHARACTERISTICS

This sensor can be used for LEL monitoring and Vol.-% monitoring for some gases. The sensor's database can contain up to 50 different gases. It is also the ideal sensor for measuring hydrocarbons in an inert atmosphere, since its measuring method does not depend on the presence of oxygen. This sensor also has a very long life time, and there is no risk of poisoning from sulfurous or silicone compounds.

LEL figures depend on country-specific standards.

COMPATIBLE GASES AND MEASUREMENT RANGES:

Sensor precalibration

The sensor can be delivered with all the necessary calibration data available. The sensor's database can contain up to 50 different gases. The zero point and sensitivity are precalibrated in the sensor for methane (0 to 100% LEL) and propane (0 to 100% LEL). The Vol.-% and % LEL readings are differentiated by displaying the measured gas in upper- and lower-case letters (e.g. ch_4 for 0 to 100% LEL and CH_4 for 0 to 100 Vol.-%).

Gas	Data set name	Measurement range
n-butane	buta	0 to 100% LEL [2]
n-BUTANE	BUTA	0 to 100 Vol.-%
Ethene	c_2h_4	0 to 100% LEL [2]
ETHENE	C_2H_4	0 to 100 Vol.-%
Ethanol	EtOH	0 to 100% LEL [2]
Ex	Ex	0 to 100% LEL
Liquid petroleum gas	LPG (50% propane + 50% butane)[3]	0 to 100% LEL [2] / 0 to 100 Vol.-%
JetFuel	JetF	0 to 100% LEL [2]
Methane	ch_4	0 to 100% LEL [2]
METHANE	CH_4	0 to 100 Vol.-%
n-nonane	Nona	0 to 100% LEL [2]
n-pentane	Pent	0 to 100% LEL [2]
Propane	c_3h_8	0 to 100% LEL [2]
PROPANE	C_3H_8	0 to 100 Vol.-%
Toluene	Tolu	0 to 100% LEL [2]

[2] LEL figures depend on country-specific standards.

[3] The figures in the table assume a composition of 50% propane and 50% butane.
In practice, the composition of LPG fluctuates, which can lead to increased measurement errors.

DETECTION OF OTHER GASES AND VAPORS FOR THE MEASUREMENT RANGE 0 TO 100% LEL:

Through the use of cross sensitivities when calibrated with propane (C_3H_8, 100% LEL = 1.7 Vol.-%). The sensor can be used to detect the gases and vapors listed in the following table. The sensor must be configured to "Ex" measurement gas in the instrument. For example: if the instrument is subjected to 1.25 Vol.-% acetone (50% LEL), the instrument will show a reading of 19% LEL if configured to "Ex" measurement gas (calibration using 50% LEL / = 0.85 Vol.-% propane). Calibration using the target gas is preferable to calibration using a replacement gas.

Gas/vapor gas	Chemical symbol	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol.-% propane)	Cross-sensitivity factor
Acetone	CH_3COCH_3	1.25	19	2.63
Acetylene	C_2H_2	–	not possible	–
Benzene	C_6H_6	0.6	11	4.44
Butadiene -1,3	$CH_2CHCHCH_2$	0.7	13	3.85
Cyclohexane	C_6H_{12}	–	on request	–
Cyclopentane	C_5H_{10}	0.7	52	0.96
Dimethyl ether	$(C_2H_5)_2O$	1.35	62	0.81
Ethane	C_2H_6	1.35	76	0.66
Ethanol	C_2H_5OH	1.75	64	0.78
Ethene	C_2H_4	1.15	9	5.56
Ethyl acetate	$CH_3COOC_2H_5$	1.05	35	1.43
Ethyl acrylate	$C_5H_8O_2$	0.85	23	2.17
i-butane	C_4H_{10}	0.9	49	1.02
i-butene	C_4H_8	0.8	32	1.56
Methanol	CH_4O	2.75	93	0.54
Methyl chloride	CH_3Cl	3.8	42	1.19
Methylene chloride	CH_2Cl_2	6.5	13	3.85
Methyl ethyl ketone	C_4H_8O	0.9	28	1.79
n-heptane	C_7H_{16}	0.55	45	1.11
n-hexane	C_6H_{14}	0.5	42	1.19
n-nonane	C_9H_{20}	–	on request	–
n-octane	C_8H_{18}	0.4	32	1.56
n-pentane	C_5H_{12}	0.7	54	0.93
Propane	C_3H_8	0.85	50	1.00
n-propanol	C_3H_7OH	0.6	40	1.25
o-xylene	$C_6H_4(CH_3)_2$	0.5	13	3.85
Toluene	$C_6H_5CH_3$	0.6	19	2.63

DrägerSensor® IR EX

Order no. 68 12 180

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5600	–	yes	5 years	> 5 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	1% LEL/0.2 Vol.-%
Resolution:	1% LEL/0.1 Vol.-% (dependent on measuring range)
Measurement range:	0 to 100% LEL/0 to 100 Vol.-% depending on the gas being measured
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 120)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL OR 0 TO 4.4 VOL.-% CH_4 WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	Diffusion mode ≤ 10 seconds (T_{50}) Diffusion mode ≤ 20 seconds (T_{90}) Pump mode ≤ 10 seconds (T_{50}) Pump mode ≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1.5% LEL methane at 50% LEL
Linearity error, typical:	≤ ± 3.5% of measured value or ≤ ± 1.5% of the highest figure in the set measuring (whichever is higher)
Long-term drift	
Zero point:	≤ ± 1% LEL methane/month
Sensitivity:	≤ ± 3% LEL methane/month at 50% LEL
Influence of temperature	
Zero point:	≤ ± 0.02% LEL methane/K at (–20 to 50)°C (–4 to 120)°F
Sensitivity:	≤ ± 0.1% LEL methane/K at 50% LEL and (–20 to 50)°C (–4 to 120)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.01% LEL methane/% RH

FOR THE MEASUREMENT RANGE 0 TO 100% LEL OR 0 TO 1.7 VOL.-% C_3H_8 WHEN CALIBRATED WITH PROPANE IN AIR:

Response time:	Diffusion mode ≤ 12 seconds (T_{50}) Diffusion mode ≤ 40 seconds (T_{90}) Pump mode ≤ 15 seconds (T_{50}) Pump mode ≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity	≤ ± 1.25% LEL propane at 50% LEL
Linearity error, typical:	≤ ± 3.0% of measured value or ≤ ± 1.0% of the highest figure in the set measuring (whichever is higher)
Long-term drift	
Zero point:	≤ ± 3% LEL propane/month
Sensitivity	≤ ± 4% LEL propane/month at 50% LEL
Influence of temperature	
Zero point:	≤ ± 0.06% LEL propane/K
Sensitivity	≤ ± 0.13% LEL propane/K at 50% LEL
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.01% LEL propane/% RH
Test gas:	2 Vol.-% CH_4 or 50 Vol.-% CH_4 0.9 Vol.-% C_3H_8

SPECIAL CHARACTERISTICS

This sensor can be used for LEL monitoring, and Vol.-% monitoring for some gases. It is also the ideal sensor for measuring hydrocarbons in an inert atmosphere, since its measuring method does not depend on the presence of oxygen. This sensor also has a very long life time, and there is no risk of poisoning from sulfurous or silicone compounds.

COMPATIBLE GASES AND MEASURING RANGES:

Gas	Data set name	Measurement range
n-butane	buta	0 to 100% LEL [2)]
n-BUTANE	BUTA	0 to 100 Vol.-%
Ethene	c_2h_4	0 to 100% LEL [2)]
ETHENE	C_2H_4	0 to 100 Vol.-%
Ethanol	EtOH	0 to 100% LEL [2)]
Ex	Ex	0 to 100% LEL
JetFuel	JetF	0 to 100% LEL [2)]
Methane	ch_4	0 to 100% LEL [2)]
METHANE	CH_4	0 to 100 Vol.-%
n-nonane	Nona	0 to 100% LEL [2)]
n-pentane	Pent	0 to 100% LEL [2)]
Propane	c_3h_4	0 to 100% LEL [2)]
PROPANE	C_3H_8	0 to 100 Vol.-%
Toluene	Tolu	0 to 100% LEL [2)]

[2)] LEL figures depend on country-specific standards.

DETECTION OF OTHER GASES AND VAPORS FOR THE MEASURING RANGE 0 TO 100% LEL

Gas/vapor gas	Chemical symbol	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol.-% propane)	Cross-sensitivity factor
Acetone	C_3H_6O	1.25	18	2.78
Acetylene	C_2H_2	–	not possible	–
Benzene	C_6H_6	0.6	20	2.50
Butadiene -1,3	C_4H_6	0.7	20	2.50
i-Butane	$(CH_3)_3CH$	0.75	41	1.22
n-Butane	C_4H_{10}	0.7	42	1.19
i-Butene	$(CH_3)_2C=CH_2$	0.8	31	1.61
n-Butanol	$C_4H_{10}O$	0.85	25	2.0
2-Butanone (MEK)	C_4H_8O	0.75	22	2.27
Butyl Acetate	$C_6H_{12}O_2$	0.60	20	2.5
Cyclohexane	C_6H_{12}	0.50	15	3.33
Cyclopentane	$C5H_{10}$	0.7	47	1.06
Dimethyl Aether	C_2H_6O	1.35	51	0.98
Diethylamine	$C_4H_{11}N$	0.85	44	1.14
Diethyl Aether	$(C_2H_5)_2O$	0.85	46	1.09
Ethane	C_2H_6	1.2	65	0.77
Ethylalcohol	C_2H_6O	1.55	41	1.22
Ethene	C_2H_4	1.2	15	3.33
Ethylacetate	$C_4H_8O_2$	1.0	35	1.43
Ethyl acetate	$C_5H_8O_2$	0.85	26	1.92
n-Heptane	C_7H_{16}	0.55	36	1.39
n-Hexane	C_6H_{14}	0.5	34	1.47
Methane	CH_4	2.2	37	1.35
Methanol	CH_4O	3,0	92	0,54
n-Methoxy-2-Propanol	$C_4H_{10}O_2$	0.9	26	1.92
Methyl-tert-butyl aether	$C_5H_{12}O$	0.80	59	0.85
Methyl chloride	CH_3Cl	3.8	47	1.06
Methylen chlorid	CH_2Cl_2	6.5	on request	–
Methyl ethyl ketone	C_4H_8O	0.75	22	2.27
n-Nonane	$C9H_{20}$	0.35	on request	–
n-Octane	$C8H_{18}$	0.40	20	2.50
n-Pentane	$C5H_{12}$	0.55	36	1.39
Propane	C_3H_8	0.85	50	1.00
n-Propylalcohol	C_3H_7OH	1.05	40	1.25
Propene	C_3H_6	0.90	31	1.61
Propylene oxide	C_3H_6O	0.95	49	1.02
Toluene	$C_6H_5CH_3$	0.50	19	2.63
o-Xylene	$C_6H_4(CH_3)_2$	0.5	11	4.55

D-2111-2011

DrägerSensor® IR Ex

DrägerSensor® Smart IR CO_2

Order no. 68 10 590

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	5 years	> 5 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	0.01 Vol.-%
Resolution:	0.01 Vol.-% CO_2
Measurement range:	0 to 5 Vol.-% CO_2
Ambient conditions	
Temperature:	(–20 to 60)°C (–4 to 140)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 4 minutes

FOR THE MEASUREMENT RANGE 0 TO 5 VOL.-% CO_2

Response time	Diffusion mode ≤ 20 seconds (T_{50}) Diffusion mode ≤ 45 seconds (T_{90}/T_{10}) Pump mode ≤ 20 seconds (T_{50}) Pump mode ≤ 50 seconds (T_{90}/T_{10})
Measurement accuracy	
Sensitivity:	≤ ± 0.06 Vol.-% CO_2 at 2.5 Vol.-%
Linearity error, typical:	> 0 to ≤ 1 Vol.-% CO_2 <± 1 % of the full scale value > 1 to ≤ 4 Vol.-% CO_2 <± 5 % of the measured value > 4 to ≤ 5 Vol.-% CO_2 <± 10 % of the full scale value
Long-term drift	
Zero point:	≤ ± 0.004 Vol.-% CO_2/month
Sensitivity:	≤ ± 3% of measured value/month at 2.5 Vol.-%
Influence of temperature	
Zero point:	≤ ± 0.002 Vol.-% CO_2/K at (–20 to 60)°C (–4 to 140)°F
Sensitivity:	≤ ± 0.4% of measured value/K at 2.5 Vol.-% and (–20 to 60)°C (–4 to 140)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.02 Vol.-% CO_2
Test gas:	2.5 Vol.-% CO_2

SPECIAL CHARACTERISTICS

With its extremely low drift and low detection limit, this sensor is ideal for measuring carbon dioxide inside closed spaces, and for monitoring CO_2 in the workplace. As with all other IR sensors, it requires little maintenance and has a high level of long-term stability.

D-10120-2009

DrägerSensor® Smart IR CO_2

DrägerSensor® Smart IR CO_2 HC

Order no. 68 10 599

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	5 years	> 5 years	–

MARKET SEGMENTS

Biogas, process gas

TECHNICAL SPECIFICATIONS

Detection limit:	0.4 Vol.-%
Resolution:	0.2 Vol.-% CO_2
Measurement range:	0 to 100 Vol.-% CO_2
Ambient conditions	
Temperature:	(–20 to 60)°C (–4 to 140)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 4 minutes

FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CO_2

Response time:	Diffusion mode ≤ 20 seconds (T_{50}) Diffusion mode ≤ 65 seconds (T_{90}) Pump mode ≤ 20 seconds (T_{50}) Pump mode ≤ 65 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2.0 Vol.-% CO_2 at 50 Vol.-%
Linearity error, typical:	≤ ± 1 Vol.-% CO_2 or ≤ ± 5% of measured value (whichever is higher)
Long-term drift	
Zero point:	≤ ± 0.2 Vol.-% CO_2/month
Sensitivity:	≤ ± 3% of measured value/month at 50 Vol.-%
Influence of temperature	
Zero point:	≤ ± 0.004 Vol.-% CO_2/K at (–20 to 60)°C (–4 to 140)°F
Sensitivity:	≤ ± 0.4% of measured value/K at 50 Vol.-% and (–20 to 60)°C (–4 to 140)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.5 Vol.-% CO_2
Test gas:	50 Vol.-% CO_2

SPECIAL CHARACTERISTICS

This sensor is especially suitable if you need to measure high concentrations of CO_2 in process gas, for example. CO_2 concentrations of up to 100 Vol.-% can be detected reliably with this sensor. Other qualities that distinguish this sensor are low cross-sensitivities, long-term stability, and minimal maintenance.

DrägerSensor® IR CO_2

Order no. 68 12 190

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5600	–	yes	5 years	> 5 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	0.01 Vol.-% CO_2
Resolution:	0.01 Vol.-% CO_2 or 50 ppm CO_2 (dependent on measuring range)
Measurement range:	0 to 5 Vol.-% CO_2
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 120)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 5 VOL.-% CO_2

Response time:	Diffusion mode ≤ 15 seconds (T_{50}) Diffusion mode ≤ 31 seconds (T_{90}) Pump mode ≤ 10 seconds (T_{50}) Pump mode ≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 0.08 Vol.-% CO_2 at 2.5 Vol.-%
Linearity error, typical:	≤ ± 10% of measured value or ≤ ± 1.5% of the highest figure in the set measuring range (whichever is higher)
Long-term drift	
Zero point:	≤ ± 0.005 Vol.-% CO_2/month
Sensitivity:	≤ ± 0.1 Vol.-% CO_2 /6 months
Influence of temperature	
Zero point:	≤ ± 0.0002 Vol.-% CO_2/K at (–20 to 50)°C (–4 to 120)°F
Sensitivity:	≤ ± 0.0015 Vol.-% CO_2/K at 2.5 Vol.-% and (–20 to 50)°C (–4 to 120)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.0001 Vol.-% CO_2/% RH
Test gas:	2.5 Vol.-% CO_2

SPECIAL CHARACTERISTICS

With its extremely low drift and low detection limit, this sensor is ideal for measuring carbon dioxide inside closed spaces, and for monitoring CO_2 in the workplace. As with all other IR sensors, it requires little maintenance and has a high level of long-term stability.

D-2108-2011

DrägerSensor® IR CO_2

DrägerSensor® DUAL IR Ex/CO_2

Order no. 68 11 960

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5600	–	yes	5 years	> 5 years	–

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, chemical industry, mining, landfills, biogas plants, tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	1% LEL/0.2 Vol.-% for IR Ex 0.01 Vol.-% CO_2 for IR CO_2
Resolution:	1% LEL/0.1 Vol.-% for IR Ex (dependent on measuring range) 0.01 Vol.-% CO_2 or 50 ppm CO_2 for IR CO_2 (dependent on measuring range)
Measurement range:	0 to 100% LEL/0–100 Vol.-% CH_4 0 to 5 Vol.-% CO_2
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 120)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	≤ 5 minutes

FOR THE MEASUREMENT RANGE 0 TO 100% LEL OR 0 TO 4.4 VOL.-% CH_4 WHEN CALIBRATED WITH METHANE IN AIR:

Response time:	Diffusion mode ≤ 10 seconds (T_{50}) Diffusion mode ≤ 20 seconds (T_{90}) Pump mode ≤ 10 seconds (T_{50}) Pump mode ≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1.5% LEL methane at 50% LEL
Linearity error, typical:	≤ ± 3.5% of measured value or ≤ ± 1.5% of the highest figure in the set measuring range (whichever is higher)
Long-term drift	
Zero point:	≤ ± 1% LEL methane/month
Sensitivity:	≤ ± 3% LEL methane/month at 50% LEL
Influence of temperature	
Zero point:	≤ ± 0.02% LEL methane/K at (–20 to 50)°C (–4 to 120)°F
Sensitivity:	≤ ± 0.1% LEL methane/K at 50% LEL and (–20 to 50)°C (–4 to 120)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.01% LEL methane/% RH

FOR THE MEASUREMENT RANGE 0 TO 100% LEL OR 0 TO 1.7 VOL.-% C_3H_8 WHEN CALIBRATED WITH PROPANE IN AIR

Response time:	Diffusion mode ≤ 12 seconds (T_{50}) Diffusion mode ≤ 40 seconds (T_{90}) Pump mode ≤ 15 seconds (T_{50}) Pump mode ≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1.25% LEL propane at 50% LEL
Linearity error, typical:	≤ ± 3.0% of measured value or ≤ ± 1.0% of highest measuring range figure (whichever is higher)
Long-term drift	
Zero point:	≤ ± 3.0% LEL propane/month
Sensitivity:	≤ ± 4.0% LEL propane/month at 50% LEL
Influence of temperature	
Zero point:	≤ ± 0.06% LEL propane/K
Sensitivity:	≤ ± 0.13% LEL propane/K at 50% LEL
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.01% LEL propane/% RH

FOR THE MEASUREMENT RANGE 0 TO 5 VOL.-% CO_2

Response time:	Diffusion mode ≤ 15 seconds (T_{50}) Diffusion mode ≤ 31 seconds (T_{90}) Pump mode ≤ 10 seconds (T_{50}) Pump mode ≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 0.08 Vol.-% CO_2 at 2.5 Vol.-%
Linearity error, typical:	≤ ± 10% of measured value or ≤ ± 1.5% of highest measuring range figure (whichever is higher)
Long-term drift	
Zero point:	≤ ± 0.005 Vol.-% CO_2/month
Sensitivity:	≤ ± 0.1 Vol.-% CO_2/6 months at 2.5% CO_2
Influence of temperature	
Zero point:	≤ ± 0.0002 Vol.-% CO_2/K at (–20 to 50)°C (–4 to 120)°F
Sensitivity:	≤ ± 0.0015% Vol.-% CO_2/K at 2.5 Vol.-% and (–20 to 50)°C (–4 to 120)°F
Effect of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing)	
Zero point:	≤ ± 0.0001 Vol.-% CO_2/% RH
Test gas:	2 Vol.-% CH_4 or 50 Vol.-% CH_4 2.5 Vol.-% CO_2

SPECIAL CHARACTERISTICS

This sensor enables flammable gases and carbon dioxide to be measured simultaneously with just one sensor. As with all other IR sensors, it requires little maintenance, has a high level of long-term stability, and is highly resistant to poisoning.

COMPATIBLE GASES AND MEASURING RANGES:

Gas	Data set name	Measurement range
Ethene	c_2h_4	0 to 100% LEL [2)]
ETHENE	C_2H_4	0 to 100 Vol.-%
Ethanol	EtOH	0 to 100% LEL [2)]
Ex	Ex	0 to 100% LEL
JetFuel	JetF	0 to 100% LEL [2)]
Methane	ch_4	0 to 100% LEL [2)]
METHANE	CH_4	0 to 100 Vol.-%
n-butane	buta	0 to 100% LEL [2)]
n-BUTANE	BUTA	0 to 100 Vol.-%
n-nonane	Nona	0 to 100% LEL [2)]
n-pentane	Pent	0 to 100% LEL [2)]
Propane	c_3h_4	0 to 100% LEL [2)]
PROPANE	C_3H_8	0 to 100 Vol.-%
Toluene	Tolu	0 to 100% LEL [2)]

DETECTION OF OTHER GASES AND VAPORS FOR THE MEASUREMENT RANGE 0 TO 100% LEL:

Through the use of cross sensitivities when calibrated with propane (C_3H_8, 100% LEL = 1.7 Vol.-%). The sensor can be used to detect the gases and vapors listed in the following table. The sensor must be configured to "Ex" measurement gas in the instrument. The sensor may also be sensitive to other gases.

DETECTION OF OTHER GASES AND VAPORS FOR THE MEASURING RANGE 0 TO 100% LEL

Gas/vapor gas	Chemical symbol	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol.-% propane)	Cross-sensitivity factor
Acetone	C_3H_6O	1.25	18	2.78
Acetylene	C_2H_2	–	not possible	–
Benzene	C_6H_6	0.6	20	2.50
Butadiene -1,3	C_4H_6	0.7	20	2.50
i-Butane	$(CH_3)_3CH$	0.75	41	1.22
n-Butane	C_4H_{10}	0.7	42	1.19
i-Butene	$(CH_3)_2C=CH_2$	0.8	31	1.61

[2)] LEL figures depend on country-specific standards.

DETECTION OF OTHER GASES AND VAPORS FOR THE MEASURING RANGE 0 TO 100% LEL

Gas/vapor gas	Chemical symbol	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol.-% propane)	Cross-sensitivity factor
n-Butanol	$C_4H_{10}O$	0.85	25	2.0
2-Butanone (MEK)	C_4H_8O	0.75	22	2.27
Butyl Acetate	$C_6H_{12}O_2$	0.60	20	2.5
Cyclohexane	C_6H_{12}	0.50	15	3.33
Cyclopentane	$C5H_{10}$	0.7	47	1.06
Dimethyl Aether	C_2H_6O	1.35	51	0.98
Diethylamine	$C_4H_{11}N$	0.85	44	1.14
Diethyl Aether	$(C_2H_5)_2O$	0.85	46	1.09
Ethane	C_2H_6	1.2	65	0.77
Ethylalcohol	C_2H_6O	1.55	41	1.22
Ethene	C_2H_4	1.2	15	3.33
Ethylacetate	$C_4H_8O_2$	1.0	35	1.43
Ethyl acetate	$C_5H_8O_2$	0.85	26	1.92
n-Heptane	C_7H_{16}	0.55	36	1.39
n-Hexane	C_6H_{14}	0.5	34	1.47
Methane	CH_4	2.2	37	1.35
Methanol	CH_4O	3,0	92	0,54
n-Methoxy-2-Propanol	$C_4H_{10}O_2$	0.9	26	1.92
Methyl-tert-butyl aether	$C_5H_{12}O$	0.80	59	0.85
Methyl chloride	CH_3Cl	3.8	47	1.06
Methylen chlorid	CH_2Cl_2	6.5	on request	–
Methyl ethyl ketone	C_4H_8O	0.75	22	2.27
n-Nonane	$C9H_{20}$	0.35	on request	–
n-Octane	$C8H_{18}$	0.40	20	2.50
n-Pentane	$C5H_{12}$	0.55	36	1.39
Propane	C_3H_8	0.85	50	1.00
n-Propylalcohol	C_3H_7OH	1.05	40	1.25
Propene	C_3H_6	0.90	31	1.61
Propylene oxide	C_3H_6O	0.95	49	1.02
Toluene	$C_6H_5CH_3$	0.50	19	2.63
o-Xylene	$C_6H_4(CH_3)_2$	0.5	11	4.55

D-1602-2010

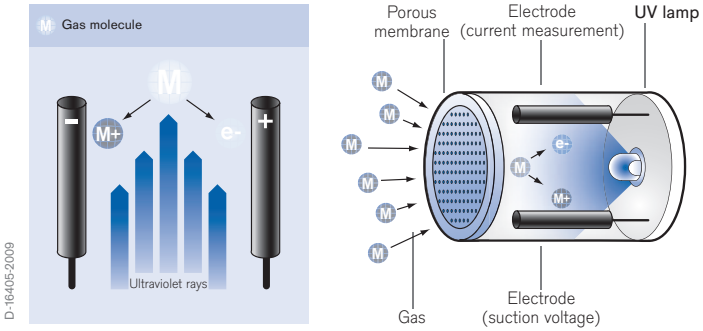
DrägerSensor® Dual IR EX/CO_2

4.5 Dräger PID sensors

Many flammable gases and vapors are toxic to humans long before they reach the lower explosion limit (LEL). For this reason, personal protection in the workplace ideally includes the additional measurement of ppm levels of volatile organic substances using a PID sensor.

The air is drawn into the measuring chamber through the gas inlet. In the chamber, a UV lamp produces photons, which ionize certain molecules within the flow of gas. A relatively high amount of energy is required to ionize the air's permanent gases such as noble gases, nitrogen, oxygen, carbon dioxide, and water vapor. For this reason, these gases do not interfere with the measurement of the harmful substances. Most of the organic substances recognized as dangerous (such as hydrocarbons) are ionized and subjected to the electrical field between the electrodes in the measuring chamber. The strength of the resulting current is directly proportional to the concentration of ionized molecules inside the chamber. This makes it possible to determine the concentration of harmful substance in the air.

PID sensor



Ionization energy and UV lamps

Ionization energy is measured in electron volts (eV) and defines the amount of energy required to bring a molecule into the ionized (charged) state. Ionization energy is something specific to each material, like the boiling point and vapor pressure. For a substance to be ionized, its ionization energy must be lower than the photon energy from the lamp used in the PID. Common is the lamp type 10.6 eV lamp. This enables a PID to detect whole groups of harmful substances, while it can also be used to measure single substances if calibrated accordingly.

Calibration and response factors

Isobutylene is used to calibrate a PID, unless the actual substance being measured can be used. The relative sensitivity to other substances is then expressed in terms of response factors. If a substance is detected with greater sensitivity than isobutylene, then its response factor is less than one. Substances that are detected with less sensitivity than isobutylene have a response factor greater than one.

FOR EXAMPLE:

Substance	Ionization energy	Response factor
Benzene	9.25 eV	0.5
Cyclohexane	9.98 eV	1.3

DrägerSensor® Smart PID

Order no. 83 19 100

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	UV lamp
Dräger X-am 7000	yes	yes	1 years	> 1 year	10.6 eV

MARKET SEGMENTS

Chemical industry, painters, storage and use of fuels (e.g. gas stations)

TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm isobutylene
Resolution:	1 ppm up to 100 ppm
	2 ppm from 100 to 250 ppm
	5 ppm from 250 ppm upwards
Measurement range:	0 to 2,000 ppm isobutylene
General technical specifications	
Ambient conditions	
Temperature:	(–20 to 60)°C (–4 to 140)°F
Humidity:	(10 to 95)% RH
Pressure:	(700 to 1,300) hPa
Warm-up time:	4 minutes

FOR THE MEASUREMENT RANGE 1 TO 2,000 PPM WHEN CALIBRATED WITH ISOBUTYLENE IN AIR:

Response time:	Diffusion mode ≤ 15 seconds (T_{20})
	Diffusion mode ≤ 50 seconds (T_{90})
	Pump mode ≤ 10 seconds (T_{20})
	Pump mode ≤ 25 seconds (T_{90})
Repeatability	
at 100 ppm isobutylene:	≤ ± 2 ppm isobutylene
Linearity error, typical:	≤ ± 5% of measured value
Pressure effect	≤ ± 0.1% of measured value/hPa
Effect of humidity, at 40°C (104 °F) (0 to 90% RH, non-condensing)	
Zero point:	≤ ± 0.06 ppm isobutylene/% RH
at 100 ppm isobutylene:	≤ ± 0.15 ppm isobutylene/% RH
Test gas:	approx. 100 ppm i-C_4H_8 (isobutylene)

SPECIAL CHARACTERISTICS

The PID can be used to detect numerous volatile organic compounds (VOCs). More than 20 of the VOCs most commonly used in industry are stored in its data memory. Other gases can be added to the memory on the customer's request.

GASES STORED IN THE MEMORY

Gas/vapor	CAS no.	Data set name	Measurement range
Acetone	67-64-1	ACTO	0–2,000 ppm
(-)-alpha-pinene	7785-26-4	aPIN	0–1,000 ppm
Benzene	71-43-2	BENZ	0–1,000 ppm
Chlorobenzene	108-90-7	CLBZ	0–1,500 ppm
Cyclohexane	110-82-7	CYHE	0–3,000 ppm
Ethyl acetate	141-78-6	ETAC	0–7,000 ppm
Ethylbenzene	100-41-4	ETBZ	0–1,500 ppm
Isobutylene	115-11-7	IBUT	0–2,000 ppm
Methyl bromide	74-83-9	MEBR	0–4,000 ppm
Methyl ethyl ketone	78-93-3	MEK	0–1,000 ppm
Methyl tert-butyl ether (MTBE)	1634-04-4	MTBE	0–2,000 ppm
n-nonane	111-84-2	NONA	0–3,000 ppm
n-octane	111-65-9	OCTA	0–5,000 ppm
Styrene	100-42-5	STYR	0–1,500 ppm
Toluene	108-88-3	TOLU	0–1,500 ppm
Trichloroethylene	79-01-6	TCE	0–1,500 ppm
Vinyl chloride	75-01-4	VC	0–3,000 ppm
Xylene	1330-20-7	XYLE	0–1,500 ppm
Diesel		DESL	0–2,000 ppm
Gasoline		GASO	0–2,000 ppm
Jet fuel		JP8	0–2,000 ppm

The standard gas is: Isobutylene – 0 to 2,000 ppm.

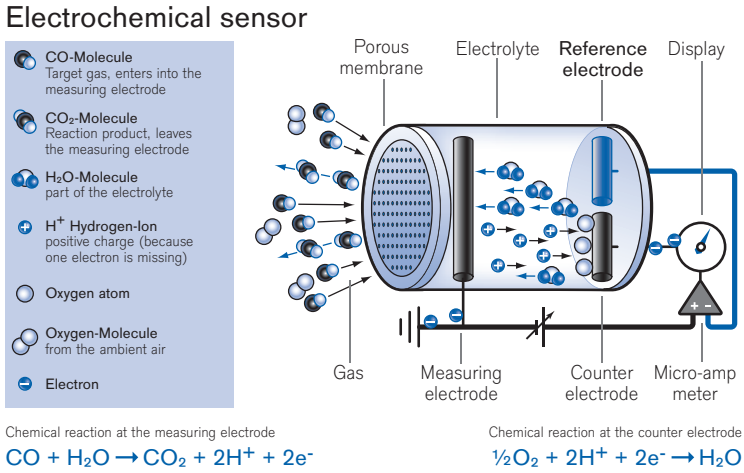
Other gases can be added to the memory on the customer's request.

4.6 Electrochemical sensors

Many toxic gases are highly reactive and can change their chemical composition under certain conditions. An electrochemical sensor is a micro-reactor, which produces a very small but measurable current when reactive gases are present. As in a normal household battery, this involves an electrochemical process, since the chemical transformation produces electrons.

The basic principle behind an electrochemical sensor involves at least two electrodes (a measuring electrode and a counter-electrode), which have contact with each other in two ways: first, through an electrically conductive medium (electrolyte, meaning a fluid that conducts ions) and, second, through an external electrical circuit (electron conductor). The electrodes are made of a special material that also has catalytic characteristics so that certain chemical reactions take place at what is known as the three-phase zone where gas, solid catalyzer, and liquid electrolyte meet. A dual-electrode sensor (measuring and counter-electrode) does, however, have many drawbacks. For instance, if high concentrations of gas occur, this leads to higher currents in the sensor and, therefore, to a drop in voltage. The drop in voltage, in turn, changes the preset sensor voltage. This can lead to unusable readings or, in the worst case, it can cause the chemical reaction inside the sensor to come to a halt during the measurement process.

For this reason, the Dräger XS and XXS sensors contain a third electrode known as the reference electrode, which does not have a current passing through it, and whose potential therefore remains constant. It continuously measures the sensor voltage at the measuring electrode, which can be corrected using the sensor's control enhancement. This produces a considerably improved measuring quality (e.g. in terms of linearity and selectivity) and a longer life time.



The Dräger XS sensors are known as "smart" sensors and contain their own EEPROM. This memory module contains all of the sensor's relevant data, which, when plugged into Dräger X-am 7000 is retrieved. The device then automatically adjusts itself to these figures (e.g. calibration figures, alarm level). This "plug & play" function enables sensors to be swapped between devices without performing operations such as a re-calibration. XXS sensors are used in the following devices: Dräger Pac 3500 to 7000 and Dräger X-am 2500/5000 and to 5600. In this case, the sensor-relevant data is stored in the device. When a sensor is changed, this information is transferred using a software application.

General Instructions for DrägerSensors® XS, XS R, XS 2 and XXS

1 Intended Use

For use in Dräger gas monitors in accordance with the Instructions for Use of the individual sensor.

2 Readiness for Operation of a new Sensor

The sensor has an internal data memory (EEPROM) which is evaluated by an appropriate Dräger gas monitor.

XS, XS R and XS 2:

New sensors are supplied with calibration data and certain default settings already stored in the data memory. The default settings, such as measuring range, alarm thresholds and calibration intervals can be adjusted by the user in some of the Dräger gas monitors. If a sensor is replaced by another of the same type (with the same order number), the new settings entered by the user are retained.

XXS:

Calibration should be carried out before using the sensor for the first time and when replacing the sensor.

3 Sensor Calibration / Adjustment

Calibration / adjustment interval:

Recommended interval see Instructions for Use of the sensor in use. For critical applications: perform a test of zero point and sensitivity with the sensor fitted in the Dräger gas monitor in accordance with local regulations.

Calibration / adjustment of zero point:

Apply zero gas (nitrogen or synthetic air) with a flow of 0.5 litres per minute to the sensor.
Waiting time for measured value to stabilize = up to 3 minutes.

Checking zero point for O_2 sensors:

For test gas use pure nitrogen.
In order to prevent return diffusion: fit the second outlet socket of the calibration adapter with a piece of tubing of at least 10 cm length. 3 minutes following commencement of exposure, the measured value display must be lower than 0.6% O_2 by vol. for N_2.

Calibration / adjustment of sensitivity:

Only use hoses made of polytetrafluoroethylene (PTFE) and fluoroelastomer (FKM). Keep tubing as short as possible, calibration gas may partly be adsorbed in the tubing. Regardless of the chosen measuring range use commercial calibration gas (see Instructions for Use of the respective sensor) with a concentration between 40% of the set full scale value and up to 100% of the highest adjustable full scale value. Calibration gas is available from gas suppliers. Apply calibration gas with a flow of 0.5 litres per minute to the sensor. Waiting time for measured value to stabilize = up to 5 minutes.

Calibration of sensitivity with test gas ampoules

The use of test gas ampoules can lead to an additional calibration error of up to ±35%. Observe the "Instructions for Use" of the calibration bottle (order no. 68 03 407) and the respective test gas ampoules (see sensor data sheet). Approx. 3 minutes after shattering the ampoule: calibrate instrument.

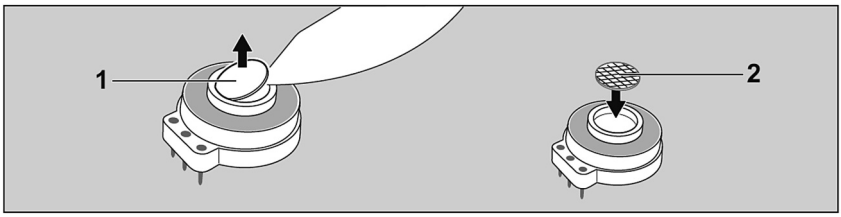
4 Measurements with hose probe (pump operation)

Follow the information contained in the Dräger gas monitor instructions for use. Some gases may be adsorbed on surfaces. Only use approved hoses. For more information, please contact your local Dräger offices or e-mail: mmt.applic@draeger.com.

5 Replacing Selective Filter

To increase the selectivity of the sensors, some sensors are provided with a replaceable selective filter as standard (see Instructions for Use of the sensor in use). The following points should be observed when using the filter:

- Remove filter with a peaked object.



- Insert new filter.
- Due to changed sensitivity, the instrument must be calibrated whenever the selective filter is replaced.

All other properties of the sensor remain unaffected by the use of the filter. For service life of the filter see Instructions for Use of the respective sensor. How often the selective filter needs to be replaced depends on the amount and type of hazardous substances it is exposed to.

Source: General Instructions for DrägerSensors® XS, XS R, XS 2 and XXS Part no. 9023657

CONTENTS XS SENSORS

CONTENTS XS SENSORS

DrägerSensor® XS EC Amine

Order no. 68 09 545

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 1.5 years	–

MARKET SEGMENTS

Foundries, refineries, power plants

TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm	
Resolution:	1 ppm	
Measurement range/ Relative sensitivity	0 to 100 ppm CH_3NH_2 (methylamine)	0.70
	0 to 100 ppm $(CH_3)_2NH$ (dimethylamine)	0.50
	0 to 100 ppm $(CH_3)_3N$ (trimethylamine)	0.50
	0 to 100 ppm $C_2H_5NH_2$ (ethylamine)	0.70
	0 to 100 ppm $(C_2H_5)_2NH$ (diethylamine)	0.50
	0 to 100 ppm $(C_2H_5)_3N$ (triethylamine)	0.50
	0 to 100 ppm NH_3 (ammonia)*	1.00
Response time:	≤ 30 seconds (T_{50})	
Measurement accuracy		
Sensitivity:	≤ ± 3% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 2 ppm/month	
Sensitivity:	≤ ± 3% of measured value/month	
Warm-up time:	≤ 12 hours	
Ambient conditions		
Temperature:	(–40 to 50)°C (–40 to 122)°F	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 5 ppm	
Sensitivity:	≤ ± 5% of measured value	
Influence of humidity		
Zero point:	≤ ± 0.1 ppm/% RH	
Sensitivity:	≤ ± 0.2% of measured value/% RH	
Test gas:	approx. 5 to 100 ppm NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$, $C_2H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$	

* lead compound

SPECIAL CHARACTERISTICS

Six different amines can be detected using this sensor. It is sufficient to calibrate it using an ammonia test gas. By doing so, all of the other amines are then automatically calibrated.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of amine. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NH_3
Acetone	CH_3COCH_3	1,000 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	≤ 5(–)
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 20(–)
Ethene	C_2H_4	1,000 ppm	≤ 3
Ethine	C_2H_2	200 ppm	No effect
Hydrogen	H_2	1,000 ppm	≤ 3
Hydrogen cyanide	HCN	25 ppm	≤ 3
Hydrogen sulfide	H_2S	20 ppm	≤ 50
Methane	CH_4	10 Vol. %	No effect
Methanol	CH_3OH	200 ppm	≤ 3
Nitrogen dioxide	NO_2	20 ppm	≤ 10(–)
Nitrogen monoxide	NO	20 ppm	≤ 10
Phosphine	PH_3	5 ppm	≤ 8
Sulfur dioxide	SO_2	20 ppm	No effect
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 10

(–) Indicates negative deviation

DrägerSensor® XS EC Cl_2

Order no. 68 09 165

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 1.5 years	–

MARKET SEGMENTS

Food and beverage, inorganic chemicals, manufacture of plastics, measuring hazardous material, pulp and paper, power generation, sewage plants water treatment.

TECHNICAL SPECIFICATIONS

Detection limit:	0.1 ppm	
Resolution:	0.05 ppm	
Measurement range/ Relative sensitivity	0 to 20 ppm Cl_2 (chlorine)	1.00
	0 to 20 ppm F_2 (fluorine)	1.00
	0 to 20 ppm Br_2 (bromine)	1.00
	0 to 20 ppm ClO_2 (chlorine dioxide)	0.60
Response time:	≤ 30 seconds (T_{90})	
Measurement accuracy		
Zero point:	≤ ± 0.05 ppm	
Sensitivity:	≤ ± 2% of measured value	
Long-term drift, at 20°C (68°F)		
Sensitivity:	≤ ± 2% of measured value/month	
Warm-up time:	≤ 1 hour	
Ambient conditions		
Temperature:	(–40 to 50)°C (–40 to 122)°F	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.1 ppm	
Sensitivity:	≤ ± 5% of measured value	
Influence of humidity		
Zero point:	No effect	
Sensitivity:	≤ ± 0.4% of measured value/% RH	
Test gas:	approx. 2 to 20 ppm Cl_2 or one of the other target gases: F_2, Br_2, ClO_2	

SPECIAL CHARACTERISTICS

This sensor is suitable for monitoring concentrations of chlorine, bromine, fluorine, and chlorine dioxide in the ambient air. It is sufficient to calibrate the sensor using a chlorine test gas; by doing so, all of the other target gases are then automatically calibrated.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of chlorine. To be sure, please check if gas mixtures are present. .

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm Cl_2
Ammonia	NH_3	50 ppm	≤ 0.5(–)
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	100 ppm	No effect
Ethene	C_2H_4	1,000 ppm	No effect
Ethine	C_2H_2	200 ppm	No effect
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen cyanide	HCN	20 ppm	≤ 0.1
Hydrogen sulfide	H_2S	20 ppm	≤ 0.1(–)
i-propanol	$(CH_3)_2CHOH$	1 Vol. %	No effect
Methane	CH_4	4 Vol. %	No effect
Methanol	CH_3OH	500 ppm	≤ 0.3(–)
Nitrogen dioxide	NO_2	20 ppm	≤ 0.2
Nitrogen monoxide	NO	25 ppm	No effect
Phosphine	PH_3	10 ppm	No effect
Sulfur dioxide	SO_2	10 ppm	≤ 0.2
Tetrahydrothiophene	C_4H_8S	1,000 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC ClO_2

Order no. 68 11 360

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	1 year	–

MARKET SEGMENTS

Food and beverage, breweries, waste water treatment, swimming pools, industrial gases, pulp and paper.

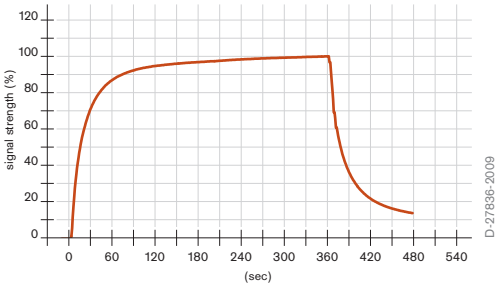
TECHNICAL SPECIFICATIONS

Detection limit:	0.02 ppm
Resolution:	0.01 ppm
Measurement range:	0 to 20 ppm ClO_2 (chlorine dioxide)
Response time:	≤ 20 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.03 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.02 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	test gas 1 to 20 ppm ClO_2

SPECIAL CHARACTERISTICS

The chlorine dioxide sensor is especially selective (see cross sensitivity table) and has a particularly low cross sensitivity to chlorine.

Sensor reaction to ClO_2 at 20 °C / 68 °F
Flow = 0.5 l/min, with 0.1 ppm ClO_2



The values given in the table are standard an apply to new sensors, The values maybe fluctuate be ± 30%. The sensor may also be sensitive to other gases (for information contact Dräger).
Gas mixtures can be displayed as the sum of all components. Gases with negative sensitivity may displace a positive display of chlorine dioxide. A check should be carried out to see if mixtures of gases are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm ClO_2
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	10 Vol. %	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	1 ppm	≤ 0.1
Hydrogen	H_2	1,000 ppm	≤ 0.02
Hydrogen cyanide	HCN	10 ppm	No effect
Hydrogen sulfide	H_2S	20 ppm	≤ 0.5(–)
Methane	CH_4	1 Vol. %	No effect
Methanol	CH_3OH	500 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 1
Nitrogen monoxide	NO	20 ppm	≤ 0.05
Ozone	O_3	0.5 ppm	≤ 0.05
Sulfur dioxide	SO_2	20 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC CO
DrägerSensor® XS 2 CO
DrägerSensor® XS R CO

Order no. 68 09 105
68 10 365
68 10 258

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 7000	yes	yes	XS EC: 3 years	> 5 years
			XS 2: 2 years	> 3 years
			XS R: 5 years	= 5 years (limited operation time)

Selective filter
D3T, 68 09 022 – replaceable for XS EC + XS R
A2T, 68 10 378 – replaceable for XS-2
Cross sensitivity of alcohols and acid gases (H_2S, SO_2) are eleminated. The filter's service life can be calculated as follows: 5,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 5,000 ppm x hours / 10 ppm = 500 hours. The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Waste disposal, metal processing, petrochemicals, fertilizer production, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and gas, hazmat, biogas.

TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm for XS EC / XS 2 / XS R
Resolution:	1 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 35 seconds T_{90}) – XS EC
	≤ 20 seconds (T_{90}) – XS 2
	≤ 30 seconds (T_{90}) – XS R
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value – XS EC / XS 2 / XS R
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/month – XS EC / XS 2
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 12 hours – XS EC / XS 2 / XS R
Ambient conditions	
Temperature:	(–20 to 50) °C (–4 to 122) °F – XS EC
	(–40 to 50) °C (–40 to 122) °F – XS 2 / XS R
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 0.4% of measured value/K
Influence of humidity	
Zero point:	≤ ± 0.02 ppm/% RH – XS EC
	No effect – XS 2 / XS R
Sensitivity:	≤ ± 0.1% of measured value/% RH – XS EC / XS 2
	≤ ± 0.05% of measured value/% RH – XS R
Test gas:	approx. 10 to 2,000 ppm CO test gas

SPECIAL CHARACTERISTICS

In addition to an outstanding linearity and a quick response time, these CO sensors are highly selective. Internal selective filters, some of which are replaceable, filter out the majority of accompanying gases such as alcohol and acidic gases like H_2S, SO_2.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of carbon monoxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS EC CO – 68 09 105

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO without selective filter	Display in ppm CO with selective filter
Acetone	CH_3COCH_3	1,000 ppm	≤ 20	≤ 1
Ammonia	NH_3	200 ppm	≤ 1	≤ 1
Carbon dioxide	CO_2	30 Vol. %	≤ 35	≤ 35
Chlorine	Cl2	20 ppm	≤ 1(–)	≤ 1
Dichloromethane	CH_2CL_2	1,000 ppm	≤ 1	≤ 1
Ethane	C_2H_6	0.2 Vol. %	≤ 1	≤ 1
Ethanol	C_2H_5OH	200 ppm	≤ 400	≤ 1
Ethene	C_2H_4	10 ppm	≤ 25	≤ 25
Ethyl acetate	$CH_2COOC_2H_4$	1,000 ppm	≤ 150	≤ 1
Ethine	C_2H2	200 ppm	≤ 500	≤ 300
Formaldehyde	HCHO	20 ppm	≤ 30	≤ 1
Hydrogen	H_2	0.1 Vol. %	≤ 90	≤ 90
Hydrogen chloride	HCl	40 ppm	≤ 6	≤ 1
Hydrogen cyanide	HCN	50 ppm	≤ 10	≤ 1(–)
Hydrogen sulfide	H_2S	30 ppm	≤ 120	≤ 1
Methane	CH_4	5 Vol. %	≤ 1	≤ 1
Methanol	CH_3OH	175 ppm	≤ 150	≤ 2
Nitrogen dioxide	NO_2	20 ppm	≤ 1	≤ 1
Nitrogen monoxide	NO	25 ppm	≤ 50	≤ 12
Phosgene	$COCL_2$	50 ppm	≤ 1	≤ 1
Phosphine	PH_3	5 ppm	≤ 20	≤ 3
Propane	C_3H_8	1 Vol. %	≤ 1	≤ 1
Sulfur dioxide	SO_2	25 ppm	≤ 25	≤ 1
Tetrachloroethylene	CCl_2 CCl_2	1,000 ppm	≤ 1	≤ 1
Toluene	$C_6H_5CH_3$	1,000 ppm	≤ 1	≤ 1
Trichloroethylene	$CHClCCl_2$	1,000 ppm	≤ 1	≤ 1

(–) Indicates negative deviation

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS R CO – 68 10 258

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO without selective filter	Display in ppm CO with selective filter
Acetone	CH_3COCH_3	1,000 ppm	≤ 20	No effect
Ammonia	NH_3	200 ppm	No effect	No effect
Carbon dioxide	CO_2	30 Vol. %	No effect	No effect
Chlorine	Cl_2	20 ppm	No effect	No effect
Dichloromethane	CH_2CL_2	1,000 ppm	No effect	No effect
Ethane	C_2H_6	0.2 Vol. %	No effect	No effect
Ethanol	C_2H_6OH	200 ppm	≤ 400	No effect
Ethene	C_2H_4	10 ppm	≤ 25	≤ 25
Ethyl acetate	$CH_2COOC_2H_4$	1,000 ppm	≤ 150	No effect
Ethyne	C_2H_2	200 ppm	≤ 500	≤ 300
Formaldehyde	HCHO	20 ppm	≤ 30	No effect
Hydrogen	H_2	0.1 Vol. %	≤ 90	≤ 90
Hydrogen chloride	HCl	40 ppm	≤ 6	No effect
Hydrogen cyanide	HCN	50 ppm	≤ 10	No effect
Hydrogen sulfide	H_2S	30 ppm	≤ 120	No effect
Methane	CH_4	5 Vol. %	No effect	No effect
Methanol	CH_3OH	175 ppm	≤ 150	≤ 2
Nitrogen dioxide	NO_2	20 ppm	No effect	No effect
Nitrogen monoxide	NO	25 ppm	≤ 50	≤ 6
Phosgene	$COCL_2$	50 ppm	No effect	No effect
Phosphine	PH_3	5 ppm	≤ 20	≤ 3
Propane	C_3H_8	1 Vol. %	No effect	No effect
Sulfur dioxide	SO_2	25 ppm	≤ 25	No effect
Tetrachloroethylene	CCl_2 CCl_2	1,000 ppm	No effect	No effect
Toluene	$C_2H_5CH_3$	1,000 ppm	No effect	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect	No effect

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS 2 CO – 68 10 365

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO without selective filter	Display in ppm CO with selective filter
Acetone	CH_3COCH_3	1,000 ppm	≤ 20	No effect
Ammonia	NH_3	200 ppm	No effect	No effect
Carbon dioxide	CO_2	30 Vol. %	No effect	No effect
Chlorine	Cl_2	20 ppm	No effect	No effect
Dichloromethane	CH_2CL_2	1,000 ppm	No effect	No effect
Ethane	C_2H6	0.2 Vol. %	No effect	No effect
Ethanol	C_2H_5OH	200 ppm	≤ 400	No effect
Ethene	C_2H_4	50 ppm	≤ 25	≤ 10
Ethyl acetate	$CH_2COOC_2H_4$	1,000 ppm	≤ 150	No effect
Ethine	C_2H_2	200 ppm	≤ 500	≤ 50
Formaldehyde	HCHO	20 ppm	≤ 30	No effect
Hydrogen	H_2	0.1 Vol. %	≤ 90	≤ 90
Hydrogen chloride	HCl	40 ppm	≤ 6	No effect
Hydrogen cyanide	HCN	50 ppm	≤10	No effect
Hydrogen sulfide	H_2S	30 ppm	≤ 120	No effect
Methane	CH_4	5 Vol. %	No effect	No effect
Methanol	CH_3OH	175 ppm	≤ 150	≤ 2
Nitrogen dioxide	NO_2	20 ppm	No effect	No effect
Nitrogen monoxide	NO	25 ppm	≤ 50	No effect
Phosgene	$COCL_2$	50 ppm	No effect	No effect
Phosphine	PH_3	5 ppm	≤ 20	No effect
Propane	C_3H_8	1 Vol. %	No effect	No effect
Sulfur dioxide	SO_2	25 ppm	≤ 25	No effect
Tetrachloroethylene	CCl_2 CCl_2	1,000 ppm	No effect	No effect
Tetrahydrothiophene	C_4H_8S	5 ppm	No effect	No effect
Toluene	$C_2H_5CH_3$	1,000 ppm	No effect	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect	No effect

DrägerSensor® XS EC CO HC

Order no. 68 09 120

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 3 years	–

MARKET SEGMENTS

Waste disposal, metal processing, petrochemicals, fertilizer production, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and gas, hazmat, biogas.

TECHNICAL SPECIFICATIONS

Detection limit:	10 ppm
Resolution:	5 ppm
Measurement range:	0 to 10,000 ppm CO (carbon monoxide)
Response time:	≤ 10 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/month
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 10 ppm
Sensitivity:	≤ ± 0.3% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	50 to 10,000 ppm CO test gas

SPECIAL CHARACTERISTICS

Because of its excellent linearity, this sensor (measurement range 10,000 ppm) can be calibrated at the lower levels of its measurement range. It also offers very stable measurements, even at high concentrations and over long periods of time.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of carbon monoxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO
Acetone	CH_3COCH_3	1,000 ppm	≤ 30
Ammonia	NH_3	200 ppm	No effect
Benzene	C_6H_6	0.6 Vol. %	No effect
Carbon dioxide	CO_2	10 Vol. %	No effect
Chlorine	Cl_2	20 ppm	≤ 8(–)
Ethanol	C_2H_5OH	200 ppm	≤ 400
Ethene	C_2H_4	20 ppm	≤ 50
Hydrogen	H_2	0.1 Vol. %	≤ 400
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	≤ 10
Hydrogen sulfide	H_2S	20 ppm	≤ 80
Methane	CH_4	5 Vol. %	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 40
Phosgene	$COCl_2$	50 ppm	No effect
Phosphine	PH_3	5 ppm	≤ 20
Sulfur dioxide	SO_2	20 ppm	≤ 20
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 4

(–) Indicates negative deviation

DrägerSensor® XS EC CO_2

Order no. 68 09 175

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 1.25 years	–

MARKET SEGMENTS

Waste disposal, Food and beverage, breweries, metal processing, petrochemicals, fertilizer production, sewage, police, customs and rescue services, mining and tunneling, shipping and transport, power generation.

TECHNICAL SPECIFICATIONS

Detection limit:	0.2 Vol. %
Resolution:	0.1 Vol. %
Measurement range:	0 to 5 Vol. % CO_2 (carbon dioxide)
Response time:	≤ 45 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 20% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.1 Vol. %/month
Sensitivity:	≤ ± 15% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature:	(–20 to 40)°C (–4 to 104)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.01 Vol. %/K
Sensitivity:	≤ ± 2% of measured value/K
Influence of humidity	
Zero point:	≤ ± 0.005 Vol. %/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 0.5 to 4 Vol. % CO_2 test gas

SPECIAL CHARACTERISTICS

This sensor is highly sensitive (see cross-sensitivity list) and offers an economical alternative to infrared sensors, if you need to warn against CO_2 concentrations in the ambient air.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of dioxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display
Ammonia	NH_3	50 ppm	≤ 0.1(–)
Boron trichloride	BCl_3	15 ppm	No effect
Carbon monoxide	CO	100 ppm	No effect
Chlorine	Cl_2	5 ppm	≤ 0.1(–)
Ethanol	C_2H_5OH	130 ppm	≤ 0.1(–)
Ethene	C_2H_4	50 ppm	≤ 0.1(–)
Hydrogen	H_2	1,000 ppm	≤ 0.1(–)
Hydrogen chloride	HCl	20 ppm	≤ 0.1(–)
Hydrogen phosphide	PH_3	5 ppm	≤ 0.1(–)
Hydrogen sulfide	H_2S	20 ppm	≤ 0.1(–)
Methane	CH_4	30 Vol. %	No effect
Methanol	CH_3OH	200 ppm	≤ 0.1(–)
Nitrogen dioxide	NO_2	20 ppm	≤ 0.1(–)
Nitrogen monoxide	NO	20 ppm	≤ 0.1(–)
Sulfur dioxide	SO_2	20 ppm	≤ 0.1(–)

(–) Indicates negative deviation

DrägerSensor® XS EC $COCl_2$

Order no. 68 08 582

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	6 months	> 1 year	–

MARKET SEGMENTS

Production of plastics, insecticides production, dyes.

TECHNICAL SPECIFICATIONS

Detection limit:	0.01 ppm
Resolution:	0.01 ppm
Measurement range:	0 to 10 ppm $COCl_2$ (phosgene)
Response time:	≤ 20 seconds (T_{20})
	≤ 40 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 10% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.01 ppm/month
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 40)°C (–4 to 104)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.001 ppm/K
Sensitivity:	≤ ± 1% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	3 to 10 ppm $COCl_2$

SPECIAL CHARACTERISTICS

The XS Phosgene sensor is highly selective, especially against hydrogen chloride (HCl).

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of phosgene. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm $COCl_2$
Ammonia	NH_3	20 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Chlorine	Cl_2	0.5 ppm	≤ 0.2
Ethanol	C_2H_5OH	260 ppm	No effect
Ethine	C_2H_2	20 ppm	No effect
Hydrogen	H_2	8,000 ppm	No effect
Hydrogen chloride	HCl	0.5 ppm	≤ 0.7
Hydrogen peroxide	H_2O_2	1 ppm	No effect
Hydrogen sulfide	H_2S	1 ppm	≤ 1
Nitrogen dioxide	NO_2	1 ppm	≤ 0.1(–)
Nitrogen monoxide	NO	30 ppm	No effect
Ozone	O_3	0.3 ppm	≤ 0.05(–)
Propanol	C_3H_7OH	500 ppm	No effect
Sulfur dioxide	SO_2	2 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC H_2

Order no. 68 09 185

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Chemical, petrochemical, rocket fuel, leakages, production of plastics, metal processing, industrial gases, fertilizer production

TECHNICAL SPECIFICATIONS

Detection limit:	10 ppm
Resolution:	5 ppm
Measurement range:	0 to 2,000 ppm H_2 (hydrogen)
Response time:	≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 4 ppm/month
Sensitivity:	≤ ± 4% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 10 ppm
Sensitivity:	≤ ± 1 ppm/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.15% of measured value/% RH
Test gas:	approx. 200 to 1,800 ppm H_2 test gas

SPECIAL CHARACTERISTICS

This sensor enables ppm concentrations of H_2 (hydrogen) to be measured in the ambient air. It has a very fast response time and is therefore especially suited to detect leakages.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2
Acetone	CH_3COCH_3	1,000 ppm	≤ 10
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	100 ppm	≤ 130
Chlorine	Cl_2	5 ppm	≤ 5(–)
Ethene	C_2H_4	1,000 ppm	≤ 1800
Ethine	C_2H_2	200 ppm	≤ 700
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	20 ppm	≤ 20
Methane	CH_4	50 Vol. %	No effect
Methanol	CH_3OH	500 ppm	≤ 750
Nitrogen dioxide	NO_2	20 ppm	≤ 15(–)
Nitrogen monoxide	NO	20 ppm	≤ 10
Phosgene	$COCl_2$	50 ppm	No effect
Phosphine	PH_3	10 ppm	≤ 40
Sulfur dioxide	SO_2	20 ppm	≤ 15
Tetrahydrothiophene	C_4H_8S	20 ppm	≤ 10

(–) Indicates negative deviation

DrägerSensor® XS EC H_2 HC

Order no. 68 11 365

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Ammonia synthesis, fuel refinement (hydrocracking), sulfur elimination, chemical, rocket fuel, leakage inspection, metal processing, industrial gases, fertilizer production, battery chargers, fuel cells.

TECHNICAL SPECIFICATIONS

Detection limit:	0.02 Vol. %
Resolution:	0.01 Vol. %
Measurement range:	0 to 4 Vol. % H_2 (hydrogen)
Response time:	≤ 20 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.05 Vol. %/year
Sensitivity:	≤ ± 3% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.05 Vol. %
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	0.2 to 4 Vol. % H_2 test gas

SPECIAL CHARACTERISTICS

This sensor covers the entire range of LELs up to 4 Vol. % H_2, and is therefore the ideal addition when using IR technology in the Dräger X-am 7000 to measure for explosion risks. The sensor also offers high selectivity (see cross-sensitivity specifications) and linearity.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in Vol. % H_2
Ammonia	NH_3	500 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	1,000 ppm	≤ 0.1
Chlorine	Cl_2	50 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethylene	C_2H_4	1,000 ppm	≤ 0.1
Ethine	C_2H_2	200 ppm	≤ 0.02
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	20 ppm	≤ 0.1
Methane	CH_4	1 Vol. %	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 0.05
Phosphine	PH_3	5 ppm	≤ 0.02
Sulfur dioxide	SO_2	20 ppm	No effect

DrägerSensor® XS EC HCN

Order no. 68 09 150

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 1.5 years	–

MARKET SEGMENTS

Metal processing, mining, fumigation and pest control, chemical war agent (blood agents).

TECHNICAL SPECIFICATIONS

Detection limit:	0.5 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 50 ppm HCN (hydrogen cyanide)
Response time:	≤ 10 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/month
Sensitivity:	≤ ± 5% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	3 to 50 ppm HCN After long periods of exposure > 10 ppm HCN/hour, the sensor should be recalibrated.

SPECIAL CHARACTERISTICS

The extremely quick response time of this sensor provides a fast and reliable warning against prussic acid (hydrogen cyanide).

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of hydrogen cyanide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm HCN
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	200 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	1,000 ppm	≤ 0.5
Chlorine	Cl_2	10 ppm	≤ 10(–)
Ethene	C_2H_4	1,000 ppm	No effect
Ethylene oxide	C_2H_4O	30 ppm	No effect
Ethine	C_2H_2	200 ppm	≤ 20
Formaldehyde	HCHO	50 ppm	≤ 2
Hydrogen	H_2	1.6 Vol. %	≤ 10
Hydrogen sulfide	H_2S	20 ppm	≤ 5
i-propanol	$(CH_3)_2CHOH$	500 ppm	No effect
Methane	CH_4	20 Vol. %	No effect
Methanol	CH_3OH	175 ppm	No effect
Nitrogen dioxide	NO_2	10 ppm	≤ 10(–)
Nitrogen monoxide	NO	20 ppm	≤ 0.5
Phosphine	PH_3	5 ppm	≤ 25
Propane	C_3H_8	1 Vol. %	No effect
Sulfur dioxide	SO_2	20 ppm	≤ 10
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 0.5

(–) Indicates negative deviation

DrägerSensor® XS EC HF/HCl

Order no. 68 09 140

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 1.5 years	–

MARKET SEGMENTS

Semiconductor, chemical

TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm	
Resolution:	0.1 ppm	
Measurement range/ relative sensitivity	0 to 30 ppm HCl (hydrogen chloride)	1.00
	0 to 30 ppm HNO_3 (nitric acid)	1.00
	0 to 30 ppm HBr (hydrogen bromide)	1.00
	0 to 30 ppm $POCl_3$ (phosphoryl trichloride)	1.00
	0 to 30 ppm PCl_3 (phosphorous trichloride)	3.00
	0 to 30 ppm HF (hydrogen fluoride)	0.66
Response time:	≤ 60 seconds (T_{50})	
Measurement accuracy		
Sensitivity:	≤ ± 15% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 0.5 ppm/month	
Sensitivity:	≤ ± 5% of measured value/month	
Warm-up time:	≤ 1 hour	
Ambient conditions		
Temperature:	(–20 to 40)°C (–4 to 104)°F	
Humidity:	(30 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.5 ppm	
Sensitivity:	≤ ± 10% of measured value	
Influence of humidity		
Zero point:	No effect	
Sensitivity:	≤ ± 2% of measured value/% RH	
Test gas:	HCl test gas between 3 to 30 ppm; or one of the other target gases HNO_3, HBr, $POCl_3$,PCl_3, HF. Every time the sensor is used, the following function test should be performed beforehand. Procedure: hold the unit over a container containing a (9 ± 0.5) mol of acetic acid, at room temperature. Evaluation: after 30 seconds, the figure displayed should be greater than 0.5 ppm HCl. If the figure is less than 0.5 ppm, then the sensitivity must be calibrated. A function test can also be performed using the test gas.	

SPECIAL CHARACTERISTICS

This sensor is used exclusively in the Dräger X-am 5100. This sensor can be used to monitor concentrations of hydrogen chloride (HCl), nitric acid (HNO_3), hydrogen bromide (HBr), phosphoryl trichloride ($POCl_3$), phosphorous trichloride (PCl_3) and HF (hydrogen fluoride) in the ambient air.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of HCl/HF. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm HCl
Ammonia*	NH_3	500 ppm	No effect
Carbon dioxide	CO_2	10 Vol. %	No effect
Carbon monoxide	CO	150 ppm	No effect
Chlorine	Cl_2	5 ppm	≤ 22
Hydrogen	H_2	1.5 Vol. %	No effect
Hydrogen cyanide	HCN	20 ppm	≤ 9
Hydrogen peroxide	H_2O_2	20 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	≤ 2
i-propanol	$(CH_3)_2CHOH$	500 ppm	No effect
Methane	CH_4	2 Vol. %	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 0.8
Nitrogen monoxide	NO	20 ppm	≤ 5
Sulfur dioxide	SO_2	20 ppm	≤ 20

* Volatile alkaline substances (such as NH_3, amines) can impair the function of the sensor. If in doubt, perform a function test.

DrägerSensor® XS EC H_2S
DrägerSensor® XS 2 H_2S
DrägerSensor® XS R H_2S

Order no. 68 09 110
68 10 370
68 10 260

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	XS EC: 3 years	> 5 years	–
			XS 2: 2 years	> 3 years	
			XS R: 5 years	= 5 years (limited operation time)	

MARKET SEGMENTS

Waste disposal, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, steel industry, pulp and paper, organic chemicals, oil and gas, hazmat, biogas.

TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm for XS EC / XS 2 / XS R
Resolution:	0.1 ppm for XS EC / XS 2 / XS R
Measurement range:	0 to 100 ppm H_2S (hydrogen sulfide)
Response time:	≤ 20 seconds (T_{90}) - XS R
	≤ 25 seconds (T_{90}) - XS EC
	≤ 30 seconds (T_{90}) - XS 2
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value - XS EC / XS R
	≤ ± 1% of measured value - XS 2
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/year - XS EC / XS R
	≤ ± 1 ppm/month - XS 2
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 12 hours - XS EC / XS 2 / XS R
Ambient conditions	
Temperature*:	(–20 to 50)°C (–4 to 122)°F - XS EC
	(–40 to 50)°C (–40 to 122)°F - XS 2 / XS R
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm - XS EC / ≤ ± 2 ppm - XS 2 / XS R
Sensitivity:	≤ ± 5% of measured value - XS EC / XS 2 / XS R
Influence of humidity	
Zero point:	≤ ± 0.02 ppm/% RH - XS EC / XS 2, no effect - XS R
Sensitivity:	≤ ± 0.05% of measured value/% RH - XS EC / XS 2 / XS R
Test gas:	approx. 5 to 100 ppm H_2S test gas

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

These sensor's advantages include fast response times and excellent linearity. At concentrations up to 20 ppm, sulfur dioxide only has a minor effect on hydrogen sulfide readings. This, therefore, enables the selective measurement of hydrogen sulfide alongside sulfur dioxide.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS EC H_2S

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetone	CH_3COCH_3	1,000 ppm	≤ 4
Ammonia	NH_3	500 ppm	≤ 1
Benzene	C_6H_6	0.6 Vol. %	≤ 1
Carbon dioxide	CO_2	1.5 Vol. %	≤ 1(–)
Carbon disulfide	CS_2	15 ppm	≤ 1
Carbon monoxide	CO	125 ppm	≤ 3
Chlorine	Cl_2	20 ppm	≤ 2(–)
Dimethyldisulfide	CH_3SSCH_3	20 ppm	≤ 13
Dimethylsulfide	$(CH_3)_2S$	20 ppm	≤ 6
Ethanol	C_2H_5OH	200 ppm	≤ 2
Ethanethiol	C_2H_5SH	20 ppm	≤ 5
Ethene	C_2H_4	1,000 ppm	≤ 10
Ethine	C_2H_2	0.6 Vol. %	≤ 10
FAM regular gasoline (DIN 51635, DIN 51557)	–	0.55 Vol. %	≤ 1
Hexane	C_6H_{14}	0.6 Vol. %	≤ 1
Hydrogen	H_2	1 Vol. %	≤ 10
Hydrogen chloride	HCl	40 ppm	≤ 1
Hydrogen cyanide	HCN	50 ppm	≤ 1
Methane	CH_4	5 Vol. %	≤ 1
Methanol	CH_3OH	200 ppm	≤ 10
Methylmercaptane	CH_3SH	20 ppm	≤ 15
Nitrogen dioxide	NO_2	20 ppm	≤ 1
Nitrogen monoxide	NO	20 ppm	≤ 10
Octane	C_8H_{18}	0.4 Vol. %	≤ 1
Phosphine	PH_3	5 ppm	≤ 5
Propane	C_3H_8	1 Vol. %	≤ 1
Propene	C_3H_6	0.5 Vol. %	≤ 1
Sulfur dioxide	SO_2	20 ppm	≤ 4
sec-Butylmercaptan	$C_4H_{10}SH$	20 ppm	≤ 7 ppm
Tetrahydrothiophene	C_4H_5S	20 ppm	≤ 4
Toluene	$C_2H_5CH_3$	0.6 Vol. %	≤ 1
tert-Butylmercaptane	$(CH_3)_3CSH$	20 ppm	≤ 10 ppm
Trichloroethylene	$CHClCCl_2$	1,000 ppm	≤ 1
Xylol	$C_6H_4(CH_3)_2$	0.5 Vol. %	≤ 4

(–) Indicates negative deviation

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS 2 H_2S

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetone	CH_3COCH_3	1,000 ppm	≤4
Ammonia	NH_3	500 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon disulfide	CS_2	15 ppm	No effect
Carbon monoxide	CO	125 ppm	≤3
Chlorine	Cl_2	20 ppm	≤2(–)
Ethane	C_2H_6	0.2 Vol. %	No effect
Ethanol	C_2H_5OH	200 ppm	≤2
Ethanethiol	C_2H_5SH	10 ppm	≤5
Ethene	C_2H_4	1,000 ppm	≤10
Ethine	C_2H_2	0.6 Vol. %	≤10
Hexane	C_6H_{14}	0.6 Vol. %	No effect
Hydrogen	H_2	1 Vol. %	≤10
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Methane	CH_4	5 Vol. %	No effect
Methanol	CH_3OH	200 ppm	≤10
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤10
Phosgene	$COCL_2$	50 ppm	No effect
Phosphine	PH_3	5 ppm	≤5
Propane	C_3H_8	1 Vol. %	No effect
Sulfur dioxide	SO_2	20 ppm	≤4
Tetrahydrothiophene	C_4H_5S	10 ppm	≤4
Toluene	$C_2H_5CH_3$	0.6 Vol. %	No effect
Xylene	$C_6H_4(CH_3)_2$	0.5 Vol. %	≤4

(–) Indicates negative deviation

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS R H_2S

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetone	CH_3COCH_3	1,000 ppm	≤ 4
Ammonia	NH_3	500 ppm	No effect
Benzene	C_6H_6	0.6 Vol. %	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon disulfide	CS_2	15 ppm	No effect
Carbon monoxide	CO	125 ppm	No effect
Chlorine	Cl_2	8 ppm	≤ 2(–)
Ethanol	C_2H_5OH	200 ppm	≤ 2
Ethanethiol	C_2H_5SH	10 ppm	≤ 5
Ethene	C_2H_4	1,000 ppm	≤ 10
Ethine	C_2H_2	0.6 Vol. %	≤ 10
FAM regular gasoline (DIN 51635, DIN 51557)	–	0.55 Vol. %	No effect
Hexane	C_6H_{14}	0.6 Vol. %	No effect
Hydrogen	H_2	1 Vol. %	≤ 10
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Methane	CH_4	5 Vol. %	No effect
Methanol	CH_3OH	200 ppm	≤ 10
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 10
Octane	C_8H_{18}	0.4 Vol. %	No effect
Phosgene	$COCl_2$	50 ppm	No effect
Phosphine	PH_3	5 ppm	≤ 5
Propane	C_3H_8	1 Vol. %	No effect
Propene	C_3H_6	0.5 Vol. %	No effect
Sulfur dioxide	SO_2	20 ppm	≤ 4
Tetrahydrothiophene	C_4H_5S	10 ppm	≤ 4
Toluene	$C_2H_5CH_3$	0.6 Vol. %	No effect
Xylene	$C_6H_4(CH_3)_2$	0.5 Vol. %	≤ 4

(–) Indicates negative deviation

DrägerSensor® XS EC H_2S HC

Order no. 68 09 180

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 3 years	–

MARKET SEGMENTS

Waste disposal, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, steel industry, pulp and paper, organic chemicals, oil and gas, hazmat, biogas.

TECHNICAL SPECIFICATIONS

Detection limit:	5 ppm
Resolution:	1 ppm
Measurement range:	0 to 1,000 ppm H_2S (hydrogen sulfide)
Response time:	≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 3 ppm/month
Sensitivity:	≤ ± 3% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	≤ ± 0.1 ppm/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	20 to 1,000 ppm H_2S test gas

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

Because of its excellent linearity, this sensor can be calibrated in its lower measurement range using a hydrogen sulfide test gas without compromising on accuracy in its upper measurement range. It also offers a fast response time and good selectivity.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetone	CH_3COCH_3	1,000 ppm	≤ 4
Ammonia	NH_3	500 ppm	No effect
Benzene	C_6H_6	0.6 Vol. %	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon disulfide	CS_2	15 ppm	No effect
Carbon monoxide	CO	125 ppm	≤ 3
Chlorine	Cl_2	8 ppm	≤ 2(–)
Ethanol	C_2H_5OH	200 ppm	≤ 2
Ethanethiol	C_2H_5SH	10 ppm	≤ 5
Ethene	C_2H_4	1,000 ppm	≤ 10
Ethine	C_2H_2	0.6 Vol. %	≤ 10
FAM regular gasoline (DIN 51635, DIN 51557)	–	0.55 Vol. %	No effect
Hexane	C_6H_{14}	0.6 Vol. %	No effect
Hydrogen	H_2	0.1 Vol. %	≤ 10
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Methane	CH_4	5 Vol. %	No effect
Methanol	CH_3OH	500 ppm	≤ 20
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 10
Octane	C_8H_{18}	0.4 Vol. %	No effect
Phosgene	$COCl_2$	50 ppm	No effect
Phosphine	PH_3	5 ppm	≤ 5
Propane	C_3H_8	1 Vol. %	No effect
Propene	C_3H_6	0.5 Vol. %	No effect
Sulfur dioxide	SO_2	20 ppm	≤ 4
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 2
Toluene	$C_6H_5CH_3$	0.6 Vol. %	No effect
Xylol	$C_6H_4(CH_3)_2$	0.5 Vol. %	≤ 4

(–) Indicates negative deviation

DrägerSensor® XS EC H_2O_2

Order no. 68 09 170

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5100	no	yes	1 year	> 2 years	–

MARKET SEGMENTS

Disinfection and sterilization, bleaching, decontaminating interior spaces.

TECHNICAL SPECIFICATIONS

Detection limit:	0.1 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 20 ppm H_2O_2 (hydrogen peroxide)
Response time:	≤ 60 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 10% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature:	(0 to 50)°C (32 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 0.5% of measured value/K
Influence of humidity	
Zero point:	≤ ± 0.01 ppm/% RH
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	H_2O_2 test gas between 1 to 10 ppm Alternatively, the sensor can be calibrated using SO_2 test gas (10 ppm). But a higher measurement uncertainty must be expected.

SPECIAL CHARACTERISTICS

This sensor is used in the Dräger X-am 5100 to monitor the H_2O_2 (hydrogen peroxide) concentration in the ambient air. It offers high sensitivity (see cross-sensitivity table).

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2O_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2O_2
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	125 ppm	No effect
Chlorine	Cl_2	5 ppm	≤ 1(–)
Ethene	C_2H_4	50 ppm	No effect
Ethine	C_2H_2	200 ppm	≤ 35
Hydrogen	H_2	1.5 Vol. %	≤ 5
Hydrogen chloride	HCl	15 ppm	≤ 3
Hydrogen cyanide	HCN	25 ppm	≤ 7
Hydrogen sulfide	H_2S	20 ppm	≤ 80
i-propanol	$(CH_3)CHOH$	500 ppm	No effect
Methane	CH_4	5 Vol. %	No effect
Methanol	CH_3OH	200 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 15(–)
Nitrogen monoxide	NO	20 ppm	No effect
Phosphine	PH_3	5 ppm	≤ 15
Sulfur dioxide	SO_2	20 ppm	≤ 12
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 5

(–) Indicates negative deviation

DrägerSensor® XS EC Hydrazine

Order no. 68 09 190

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5100	no	yes	1 year	> 1 year	–

MARKET SEGMENTS

Rocket fuel, aircraft fuel (e.g. F-16), fuel for emergency power generators, for electrochemical power generation in secondary cells or in alkaline fuel cells, especially in space travel, submarines, and other military equipment.

TECHNICAL SPECIFICATIONS

Detection limit:	0.01 ppm
Resolution:	0.01 ppm
Measurement range:	0 to 5 ppm N_2H_4 (hydrazine)
	0 to 5 ppm $CH_3NH\text{-}NH_2$ (methyl hydrazine)
	0 to 5 ppm $(CH_3)_2N\text{-}NH_2$ (dimethylhydrazine)
Response time:	≤ 180 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.01 ppm/month
Sensitivity:	≤ ± 5% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(15 to 95)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	0.1 to 3 ppm N_2H_4, $CH_3NH\text{-}NH_2$, $(CH_3)_2N\text{-}NH_2$

SPECIAL CHARACTERISTICS

This sensor is used exclusively in the Dräger X-am 5100 for monitoring concentrations of hydrazine (N_2H_4), methyl hydrazine ($CH_3NH\text{-}NH_2$), and dimethylhydrazine ($(CH_3)_2N\text{-}NH_2$).

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of hydrazine. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm N_2H_4
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	250 ppm	≤ 2.5
Carbon dioxide	CO_2	100 Vol. %	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 0.1(–)
Ethanol	C_2H_5OH	130 ppm	No effect
Ethene	C_2H_4	20 ppm	No effect
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen sulfide	H_2S	20 ppm	≤ 0.25
i-propanol	$(CH_3)_2CHOH$	1,000 ppm	No effect
Methane	CH_4	3 Vol. %	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 0,05
Nitrogen monoxide	NO	25 ppm	≤ 0.05
Propane	C_3H_8	1.5 Vol. %	No effect
Sulfur dioxide	SO_2	10 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC Hydrazine D

Order no. 68 10 295

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Pac III S / E*	yes	yes	6 months	6 months	–

MARKET SEGMENTS

Rocket fuel, aircraft fuel (e.g. F-16), fuel for emergency power generators, for electrochemical power generation in secondary cells or in alkaline fuel cells, especially in space travel, submarines, and other military equipment.

TECHNICAL SPECIFICATIONS

Detection limit:	0.01 ppm
Resolution:	0.01 ppm
Measurement range:	0 to 5 ppm N_2H_4 (hydrazine)
	0 to 5 ppm $CH_3NH\text{-}NH_2$ (methyl hydrazine)
	0 to 5 ppm $(CH_3)_2N\text{-}NH_2$ (dimethylhydrazine)
Response time:	≤ 180 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 20% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.01 ppm/month
Sensitivity:	≤ ± 20% of measured value/6 months
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(15 to 95)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	0.1 to 3 ppm N_2H_4, $CH_3NH\text{-}NH_2$, $(CH_3)_2N\text{-}NH_2$

*The DrägerSensor XS EC Hydrazine D can be ordered as a replacement sensor for the Dräger Pac III S/E. The Dräger Pac III will no longer be sold at the end of 2011. The DrägerSensor XS EC Hydrazine used in combination with the Dräger X-am 5100 can then be used to monitor hydrazine concentrations.

SPECIAL CHARACTERISTICS

This sensor is used exclusively in the Dräger Pac III for monitoring concentrations of hydrazine (N_2H_4), methyl hydrazine ($CH_3NH\text{-}NH_2$), and dimethylhydrazine ($(CH_3)_2N\text{-}NH_2$). Hydrazines tend to be adsorbed by surfaces, which means a special sensor cap should be used (order no. 68 09 541). This sensor does not have to be recalibrated during its limited life span.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of hydrazine. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm N_2H_4
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	250 ppm	≤ 2.5
Carbon dioxide	CO_2	100 Vol. %	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 0.1(–)
Ethanol	C_2H_5OH	130 ppm	No effect
Ethene	C_2H_4	20 ppm	No effect
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen sulfide	H_2S	20 ppm	≤ 0.25
i-propanol	$(CH_3)_2CHOH$	1,000 ppm	No effect
Methane	CH_4	3 Vol. %	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 0.05
Nitrogen monoxide	NO	25 ppm	≤ 0.05
Propane	C_3H_8	1.5 Vol. %	No effect
Sulfur dioxide	SO_2	10 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC Hydride

Order no. 68 09 135

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 3 years > 1 year for B_2H_6 and GeH_4	–

MARKET SEGMENTS

Inorganic chemicals, industry, fumigation, pre entry measurement.

TECHNICAL SPECIFICATIONS

Detection limit:	0.02 ppm	
Resolution:	0.01 ppm	
Measurement range:	0 to 20 ppm PH_3 (hydrogen phosphide)	1.00
	0 to 20 ppm AsH_3 (arsine)	0.85
	0 to 1 ppm B_2H_6 (diborane)	0.40
	0 to 20 ppm GeH_4 (germanium tetrahydride)	0.95
	0 to 50 ppm SiH_4 (silane)	0.95
	0 to 50 ppm H_2Se (hydrogen selenide)*	0.40
Response time:	≤ 10 seconds (T_{90}) for PH_3, B_2H_6, SiH_4	
	≤ 20 seconds (T_{90}) for AsH_3, GeH_4	
Measurement accuracy		
Sensitivity:	≤ ± 2% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 0.02 ppm/month	
Sensitivity:	≤ ± 2% of measured value/month for PH_3, AsH_3	
	≤ ± 3% of measured value/month for SiH_4	
	≤ ± 5% of measured value/month for B_2H_6, GeH_4	
Warm-up time:	≤ 15 minutes	
Ambient conditions		
Temperature:	(–20 to 50)°C (–4 to 122)°F	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.02 ppm	
Sensitivity:	≤ ± 5% of measured value	
Influence of humidity		
Zero point:	≤ ± 0.02 ppm	
Sensitivity:	≤ ± 0.05% of measured value/% RH	
Test gas:	0.2 to 20 ppm PH_3, AsH_3 or GeH_4	
	0.2 to 50 ppm SiH_4	
	0.1 to 1 ppm B_2H_6	

*with limited temperature range: 0 to 40°C dry test gas

SPECIAL CHARACTERISTICS

This sensor can be used to monitor the concentration of PH_3 (hydrogen phosphide), AsH_3 (arsine), B_2H_6 (diborane), GeH_4 (germanium tetrahydride) or SiH_4 (silane) in the ambient air. It is sufficient to calibrate the sensor using a PH_3 test gas; by doing so all of the other target gases are then automatically calibrated.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of hydride. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm PH_3
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	250 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect
Carbon monoxide	CO	150 ppm	≤ 0.1
Chlorine	Cl_2	10 ppm	≤ 2(–)
Ethene	C_2H_4	1,000 ppm	≤ 0,2
Ethine	C_2H_2	200 ppm	≤ 12
Formaldehyde	HCHO	50 ppm	≤ 0.15
Hydrogen	H_2	1,000 ppm	≤ 0.25
Hydrogen cyanide	HCN	50 ppm	≤ 2
Hydrogen sulfide	H_2S	20 ppm	≤ 20
i-propanol	$(CH_3)_2CHOH$	1 Vol. %	No effect
Methane	CH_4	4 Vol. %	No effect
Methanol	CH_3OH	200 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 5(–)
Nitrogen monoxide	NO	20 ppm	No effect
Sulfur dioxide	SO_2	10 ppm	≤ 2

(–) Indicates negative deviation

DrägerSensor® XS EC NH_3

Order no. 68 09 145

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Food and beverage, poultry farming, power generation, inorganic chemicals, fertilizer production, analysis of chemical war agents, hazmat, fumigation, metal processing, petrochemicals, pulp and paper.

TECHNICAL SPECIFICATIONS

Detection limit:	3 ppm
Resolution:	1 ppm
Measurement range:	0 to 300 ppm NH_3 (ammonia)
Response time:	≤ 20 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/month
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	≤ ± 0.1 ppm/% RH
Sensitivity:	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 10 to 150 ppm NH_3

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

The quick response time of this sensor provides a fast and reliable warning against ammonia.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NH_3. To be sure, please check if gas mixtures are present. .

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NH_3
Acetone	CH_3COCH_3	1,000 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol. %	≤ 5(–)
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 20(–)
Ethene	C_2H_4	1,000 ppm	≤ 3
Ethine	C_2H_2	200 ppm	No effect
Hydrogen	H_2	1,000 ppm	≤ 3
Hydrogen cyanide	HCN	25 ppm	≤ 3
Hydrogen sulfide	H_2S	20 ppm	≤ 50
Methane	CH_4	10 Vol. %	No effect
Methanol	CH_3OH	200 ppm	≤ 3
Nitrogen dioxide	NO_2	20 ppm	≤ 10(–)
Nitrogen monoxide	NO	20 ppm	≤ 10
Phosphine	PH_3	5 ppm	≤ 8
Sulfur dioxide	SO_2	20 ppm	No effect
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 10

(–) Indicates negative deviation

DrägerSensor® XS EC NO

Order no. 68 09 125

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Power plants, district heating plants

TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm
Resolution:	0.5 ppm
Measurement range:	0 to 200 ppm NO (nitrogen monoxide)
Response time:	≤ 30 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/month
Sensitivity:	≤ ± 3% of measured value/month
Warm-up time:	≤ 18 hours
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.01 ppm/K
Sensitivity:	≤ ± 0.2% of measured value/K
Influence of humidity	
Zero point:	≤ ± 0.01 ppm/% RH
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	approx. 1 to 200 ppm NO test gas

SPECIAL CHARACTERISTICS

This sensor enables a selective measurement of NO. It also offers a very fast response time and excellent linearity across its entire measurement range.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NO. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NO
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	500 ppm	No effect
Benzene	C_6H_6	0.6 Vol. %	No effect
Carbon dioxide	CO_2	5 Vol. %	No effect
Carbon monoxide	CO	2,000 ppm	No effect
Chlorine	Cl_2	5 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	0.1 Vol. %	No effect
Ethine	C_2H_2	0.8 Vol. %	≤ 2
Hydrogen	H_2	5 Vol. %	≤ 2
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	5 ppm	≤ 5
Methane	CH_4	2 Vol. %	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Phosphine	PH_3	2 ppm	≤ 2
Propane	C_3H_8	1 Vol. %	No effect
Sulfur dioxide	SO_2	10 ppm	≤ 2
Tetrachloroethylene	CCl_2 CCl_2	1,000 ppm	No effect
Toluene	$C_6H_5CH_3$	0.6 Vol. %	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect

DrägerSensor® XS EC NO_2

Order no. 68 09 155

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Inorganic chemicals, metal processing, oil and gas, petrochemicals, steel, shipping, rocket engineering, mining and tunneling.

TECHNICAL SPECIFICATIONS

Detection limit:	0.5 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 50 ppm NO_2 (nitrogen dioxide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/month
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 1 to 50 ppm NO_2 test gas

SPECIAL CHARACTERISTICS

This sensor offers a fast response time and stable readings, even after experiencing high concentrations of nitrogen dioxide.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NO_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NO_2
Acetaldehyde	CH_3CHO	500 ppm	No effect
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	200 ppm	No effect
Carbon dioxide	CO_2	2.5 Vol. %	No effect
Carbon monoxide	CO	125 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 10
Ethene	C_2H_4	1,000 ppm	≤ 1(–)
Ethine	C_2H_2	200 ppm	≤ 60(–)
Formaldehyde	HCHO	50 ppm	No effect
Hydrogen	H_2	1,000 ppm	≤ 2(–)
Hydrogen cyanide	HCN	50 ppm	≤ 10(–)
Hydrogen sulfide	H_2S	20 ppm	≤ 100(–)
Methane	CH_4	5 Vol. %	No effect
Methanol	CH_3OH	175 ppm	No effect
Nitrogen monoxide	NO	20 ppm	No effect
Phosphine	PH_3	5 ppm	≤ 25(–)
Sulfur dioxide	SO_2	50 ppm	≤ 50(–)
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 5(–)

(–) Indicates negative deviation

DrägerSensor® XS EC Odorant

Order no. 68 09 200

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 7000	yes	yes	1 year	> 2 years

Selective filter

B2T, 68 09 198 – replaceable

Cross sensitivities from acidic gases (H_2S, SO_2) are largely eliminated.

The filter's service life can be calculated as follows: 40 ppm x hours of contaminant gas. Example: Given constant concentration of 1 ppm H_2S will be: Service life = 40 ppm x hours / 1 ppm = 40 hours. The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Gas supply companies

TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm	
Resolution:	0.5 ppm	
Measurement range relative sensitivity	0 to 40 ppm C_4H_8S (tetrahydrothiophene)	1.00
	0 to 40 ppm $(CH_3)_3CSH$ (t-butyl mercaptan)	1.60
	0 to 40 ppm $C_2H_5CH(CH_3)SH$ (sec-butyl mercaptan)	1.60
	0 to 40 ppm CH_3SH (methyl mercaptan)	2.00
	0 to 40 ppm C_2H_5SH (ethyl mercaptan)	1.50
	0 to 100 ppm $(CH_3)_2S$ (dimethyl sulfide)	1.20
	0 to 40 ppm CH_3SSCH_3 (dimethyl disulfide)	0.33
Response time:	≤ 90 seconds (T_{90})	
Measurement accuracy		
Sensitivity:	≤ ± 5% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 1 ppm/month	
Sensitivity:	≤ ± 3% of measured value/month	
Warm-up time:	≤ 12 hours	
Ambient conditions		
Temperature*:	(–20 to 50)°C (–4 to 122)°F for THT, TBM, SBM	
	(5 to 40)°C (32 to 104)°F for MeM, EtM, DMS, DMDS	
Humidity*:	(0 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 1 ppm	
Sensitivity:	≤ ± 5% of measured value	
Influence of humidity		
Zero point:	≤ ± 0.01 ppm/% RH	
Sensitivity:	≤ ± 0.1% of measured value/% RH	
Test gas:	2 to 20 ppm THT or of one of the other target gases: $(CH_3)_3CSH$, $C_2H_5CH(CH_3)SH$, CH_3SH, C_2H_5SH, $(CH_3)_2S$, CH_3SSCH_3	

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

This sensor can be used to monitor seven different odorants in the ambient air or (for short periods) in natural gas. It is sufficient to calibrate the sensor using a THT test gas. By doing so, all of the other target gases are then automatically calibrated.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of THT. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm THT without selective filter	Display in ppm THT with selective filter
Acetone	CH_3COCH_3	1,000 ppm	≤ 3	≤ 3
Ammonia	NH_3	200 ppm	No effect	No effect
Carbon dioxide	CO_2	1.5 Vol. %	No effect	No effect
Carbon monoxide	CO	125 ppm	≤ 3	≤ 3
Chlorine	Cl_2	8 ppm	≤ 3(–)	No effect
Ethene	C_2H_4	50 ppm	No effect	No effect
Hydrogen	H_2	1,000 ppm	≤ 2	≤ 2
Hydrogen cyanide	HCN	50 ppm	No effect	No effect
Hydrogen sulfide	H_2S	10 ppm	≤ 30	No effect
Methane	CH_4	100 Vol. %	No effect	No effect
Methanol	CH_3OH	175 ppm	≤ 8	≤ 8
Nitrogen dioxide	NO_2	20 ppm	≤ 2	≤ 2
Nitrogen monoxide	NO	20 ppm	≤ 30	≤ 30
n-propyl mercaptan	C_3H_7SH	6 ppm	≤ 4	≤ 4
Phosphine	PH_3	5 ppm	≤ 15	≤ 15
Sulfur dioxide	SO_2	20 ppm	≤ 15	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC OV

Order no. 68 09 115

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Production of plastics, painter, chemical industry, disinfection, pest control.

TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm	
Resolution:	0.5 ppm	
Measurement range/ relative sensitivity	0 to 200 ppm C_2H_4O (ethylene oxide)	1.00
	0 to 200 ppm C_3H_6O (propylene oxide)	0.80
	0 to 100 ppm C_2H_4 (ethene)	1.10
	0 to 100 ppm C_3H_6 (propene)	0.70
	0 to 100 ppm C_2H_3Cl (vinyl chloride)	0.80
	0 to 200 ppm CH_3OH (methanol)	1.20
	0 to 300 ppm C_2H_5OH (ethanol)	0.60
	0 to 200 ppm CH_3CHO (acetaldehyde)	0.30
	0 to 100 ppm $CH_2CHCHCH_2$ (butadiene)	1.20
	0 to 100 ppm HCHO (formaldehyde)	1.00
	0 to 100 ppm $CH_3COOC_2H_3$ (vinyl acetate)	0.80
	0 to 300 ppm $(H_3C)_2CHOH$ (isopropanol)	0.30
Response time:	≤ 90 seconds (T_{50})	
Measurement accuracy		
Sensitivity:	≤ ± 5% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 2 ppm/month	
Sensitivity:	≤ ± 5% of measured value/month	
Warm-up time:	≤ 18 hours	
Ambient conditions		
Temperature:	(–20 to 50)°C (–4 to 122)°F	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.1 ppm/K at (–20 to 40)°C (–4 to 104)°F	
Zero point:	≤ ± 1 ppm/K at (40 to 50)°C (104 to 122)°F	
Sensitivity:	≤ ± 1% of measured value/K	
Influence of humidity		
Zero point:	No effect	
Sensitivity:	≤ ± 0.2% of measured value/% RH	
Test gas:	5 to 100 ppm C_2H_4, C_3H6, C_2H_3Cl, $CH_2CHCHCH_2$, HCHO, $CH_3COOC_2H_3$	
	5 to 200 ppm C_2H_4O, C_3H_6O, CH_3OH	
	10 to 200 ppm CH_3CHO	
	20 to 300 ppm C_2H_5OH, $(H_3C)_2CHOH$	

SPECIAL CHARACTERISTICS

This sensor is especially suited to detect leakages of numerous organic gases and vapors. Although it does not detect as broad a spectrum of gases as a PID, it has the key advantage of being almost completely insensitive to moisture. It also does not need to be calibrated every day, having instead a six-month calibration interval typical of electrochemical sensors. Furthermore, for the majority of gases it is enough to calibrate it using ethylene oxide, whereby all other gases are automatically calibrated as well. The exceptions are ethyne, tetrahydrofuran, and diethyl ether, which have to be calibrated using the target gas.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of ethylene oxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm C_2H_4O
Acetic acid	CH_3COOH	100 ppm	No effect
Acetone	CH_3COCH_3	1,000 ppm	≤ 15
Ammonia	NH_3	100 ppm	No effect
Benzene	C_6H_6	2,000 ppm	No effect
Carbon dioxide	CO_2	30 Vol. %	No effect
Carbon monoxide	CO	100 ppm	≤ 56
Chlorine	Cl_2	10 ppm	No effect
Chlorobenzene	C_6H_5Cl	200 ppm	No effect
Dichloromethane	CH_2Cl_2	1,000 ppm	No effect
Dimethyl disulfide	$(CH_3)_2S_2$	50 ppm	≤ 65
Dimethyl sulfide	$(CH_3)_2S$	50 ppm	≤ 40
Dimethylformamide	$HCON(CH_3)_2$	100 ppm	No effect
Ethane	C_2H_6	0.2 Vol. %	No effect
Ethyl acetate	$CH_3COOC_2H_5$	100 ppm	No effect
Gasoline, F 50	–	700 ppm	≤ 20
Gasoline, FAM regular gasoline	–	0.5 Vol. %	≤ 3
Gasoline, premium unleaded	–	700 ppm	≤ 70
Hydrogen	H_2	5,000 ppm	≤ 50
Hydrogen chloride	HCl	40 ppm	≤ 10
Hydrogen cyanide	HCN	20 ppm	≤ 20
Hydrogen sulfide	H_2S	10 ppm	≤ 20
Methane	CH_4	2 Vol. %	No effect
Methanethiol	CH_3SH	50 ppm	≤ 75
Methyl isobutyl ketone	$(CH_3)_2CHCH_2COCH_3$	500 ppm	No effect
Nitrogen dioxide	NO_2	50 ppm	≤ 5
Nitrogen monoxide	NO	25 ppm	≤ 25
Phenol	C_6H_5OH	30 ppm	≤ 6
Phosgene	$COCl_2$	50 ppm	No effect
Propane	C_3H_8	1 Vol. %	≤ 3
Sulfur dioxide	SO_2	10 ppm	≤ 4
Tetrachloroethylene	CCl_2 CCl_2	100 ppm	No effect
Toluene	$C_6H_5CH_3$	1,000 ppm	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect
Xylol	$C_6H_4(CH_3)_2$	0.2 Vol. %	No effect

This sensor is not suitable for monitoring the limit values of ethylene oxide, propylene oxide, butadiene, formaldehyde, vinyl acetate or vinyl chloride.

DrägerSensor® XS EC OV-A

Order no. 68 09 522

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	> 2 years	–

MARKET SEGMENTS

Production of plastics, disinfection, painter, chemical industry.

TECHNICAL SPECIFICATIONS

Detection limit:	5 ppm	
Resolution:	0.5 ppm	
Measurement range/ relative sensitivity	0 to 100 ppm C_2H_4O (ethylene oxide)	1.00
	0 to 100 ppm H_2CCHCN (acrylonitrile)	0.10
	0 to 100 ppm $C_6H_5CHCH_2$ (styrene)	0.50
	0 to 100 ppm $H_2CC(CH_3)COOCH_3$ (methyl methacrylate)	0.30
	0 to 300 ppm $(CH_3)_2CCH_2$ (isobutylene)	0.70
	0 to 100 ppm $C_2H_3OCH_2Cl$ (epichlorohydrin)	0.45
Response time:	≤ 90 seconds (T_{50}) for EO, But, ClPO	
	≤ 300 seconds (T_{50}) for ACN, MMA, Styr	
Measurement accuracy		
Sensitivity:	≤ ± 20% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 2 ppm/month	
Sensitivity:	≤ ± 10% of measured value/month	
Warm-up time:	≤ 18 hours	
Ambient conditions		
Temperature:	(–20 to 55)°C (–4 to 131)°F for EO, But, Styr, ClPO	
	(5 to 40)°C (41 to 104)°F for ACN, MMA	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.2 ppm/K	
Sensitivity:	≤ ± 1% of measured value/K	
Influence of humidity		
Zero point:	≤ ± 0.1 ppm/% RH	
Sensitivity:	≤ ± 0.2% of measured value/% RH	
Test gas:	10 to 100 ppm H_2CCHCN, $C_6H_5CHCH_2$, $H_2CC(CH_3)COOCH_3$, $C_2H_3OCH_2$	
	20 to 300 ppm $(CH_3)_2CCH_2$	

SPECIAL CHARACTERISTICS

The DrägerSensor® XS OV-A has the same excellent insensitivity to moisture that the other DrägerSensor® XS OVs have, but it has also been optimized for other organic gases and vapors. Target gas calibration is required for all gases. Because of the absorption effects of the gases it measures, dust filters cannot be used.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of ethylene oxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm C_2H_4O
Acetic acid	CH_3COOH	100 ppm	No effect
Acetone	CH_3COCH_3	1,000 ppm	≤ 15
Ammonia	NH_3	100 ppm	No effect
Benzene	C_6H_6	2,000 ppm	No effect
Carbon dioxide	CO_2	30 Vol. %	No effect
Carbon monoxide	CO	30 ppm	≤ 15
Chlorine	Cl_2	10 ppm	No effect
Chlorobenzene	C_6H_5Cl	200 ppm	No effect
Dichloromethane	CH_2Cl_2	1,000 ppm	No effect
Dimethyl disulfide	$(CH_3)_2S_2$	50 ppm	≤ 65
Dimethyl sulfide	$(CH_3)_2S$	50 ppm	≤ 40
Dimethylformamide	$HCON(CH_3)_2$	100 ppm	No effect
Ethyl acetate	$CH_3COOC_2H_5$	100 ppm	No effect
Gasoline, F 50	–	700 ppm	≤ 20
Hydrogen	H_2	5,000 ppm	≤ 50
Hydrogen chloride	HCl	40 ppm	≤ 10
Hydrogen cyanide	HCN	20 ppm	≤ 20
Hydrogen sulfide	H_2S	10 ppm	≤ 20
Methane	CH_4	2 Vol. %	No effect
Methanethiol	CH_3SH	50 ppm	≤ 75
Methyl isobutyl ketone	$(CH_3)_2CHCH_2COCH_3$	500 ppm	No effect
Nitrogen dioxide	NO_2	50 ppm	≤ 5
Nitrogen monoxide	NO	25 ppm	≤ 25
Phenol	C_6H_5OH	30 ppm	≤ 6
Phosgene	$COCl_2$	50 ppm	No effect
Sulfur dioxide	SO_2	10 ppm	≤ 4
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect

DrägerSensor® XS EC O_2-LS — Order no. 68 09 130
DrägerSensor® XS 2 O_2 — 68 10 375
DrägerSensor® XS R O_2 — 68 10 262

Used in	Plug & Play	Replaceable	Guaranty*	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	XS EC: 3 years	> 5 years	–
			XS 2: 2 years	> 3 years	
			XS R: 5 years	= 5 years (limited operation time)	

MARKET SEGMENTS

Sewage, mining and tunneling, fumigation, biogas, measuring hazmat, industrial gases.

TECHNICAL SPECIFICATIONS

Detection limit:	0.1 Vol. %
Resolution:	0.1 Vol. %
Measurement range:	0 to 25 Vol. % O_2 (oxygen)
Response time:	≤ 25 seconds (T_{90}) – XS EC
	≤ 20 seconds (T_{90}) – XS 2 / XS R
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.5 Vol. %/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.4 Vol. % XS EC
	≤ ± 0.2 Vol. % XS 2 / XS R
Sensitivity:	≤ ± 2% of measured value XS EC
	≤ ± 1% of measured value XS R / XS 2
Influence of humidity	
Zero point:	≤ ± 0.002 Vol. %/% RH – XS EC
	No effect – XS 2 / XS R
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	N_2 (zero gas)
	11.5 to 23.0 Vol. % O_2

SPECIAL CHARACTERISTICS

DrägerSensor® XS oxygen sensors are lead-free, thus complying with Directive 2002/95/EC (RoHS). Because they are non-consuming sensors, they have a much longer life spans than sensors that are consuming.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of O_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS EC O_2 LS

Gas/vapor	Chem. symbol	Concentration	Display in Vol. % O_2
Chlorine	Cl_2	20 ppm	No effect
Carbon dioxide	CO_2	5 Vol. %	No effect
Carbon monoxide	CO	0.5 Vol. %	≤ 0.3(–)
Ethane	C_2H_6	5 Vol. %	No effect
Ethanol	C_2H_5OH	1 Vol. %	≤ 0.2(–)
Ethene	C_2H_4	2 Vol. %	≤ 0.5(–)
Ethine	C_2H_2	0.5 Vol. %	≤ 0.2(–)
Hydrogen	H_2	1 Vol. %	≤ 1.6(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect
Methane	CH_4	10 Vol. %	No effect
Nitrogen dioxide	NO_2	50 ppm	No effect
Nitrogen monoxide	NO	100 ppm	No effect
Propane	C_3H_8	2 Vol. %	No effect
Sulfur dioxide	SO_2	50 ppm	No effect

(–) Indicates negative deviation

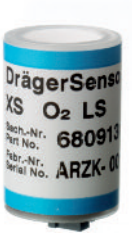
RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS 2 O_2

Gas/vapor	Chem. symbol	Concentration	Display in Vol. % O_2
Chlorine	Cl_2	20 ppm	No effect
Carbon dioxide	CO_2	5 Vol. %	No effect
Carbon monoxide	CO	0.5 Vol. %	≤ 0.3(–)
Ethane	C_2H_6	5 Vol. %	No effect
Ethanol	C_2H_5OH	1 Vol. %	≤ 0.2(–)
Ethene	C_2H_4	2 Vol. %	≤ 0.5(–)
Ethyne	C_2H_2	0.5 Vol. %	≤ 0.2(–)
Hydrogen	H_2	1 Vol. %	≤ 1.6(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect
Methane	CH_4	10 Vol. %	No effect
Nitrogen dioxide	NO_2	50 ppm	No effect
Nitrogen monoxide	NO	100 ppm	No effect
Propane	C_3H_8	2 Vol. %	No effect
Sulfur dioxide	SO_2	50 ppm	No effect

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS R O_2

Gas/vapor	Chem. symbol	Concentration	Display in Vol. % O_2
Chlorine	Cl_2	20 ppm	No effect
Carbon dioxide	CO_2	5 Vol. %	No effect
Carbon monoxide	CO	0.5 Vol. %	≤ 0.3(–)
Ethane	C_2H_6	5 Vol. %	No effect
Ethanol	C_2H_5OH	1 Vol. %	≤ 0.2(–)
Ethene	C_2H_4	2 Vol. %	≤ 0.5(–)
Ethyne	C_2H_2	0.5 Vol. %	≤ 0.2(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect
Methane	CH_4	10 Vol. %	No effect
Nitrogen dioxide	NO_2	50 ppm	No effect
Nitrogen monoxide	NO	100 ppm	No effect
Propane	C_3H_8	2 Vol. %	No effect
Sulfur dioxide	SO_2	50 ppm	No effect

(–) Indicates negative deviation



DrägerSensor® XS O_2

DrägerSensor® XS EC O_2 100

Order no. 68 09 550

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	3 years	–

MARKET SEGMENTS

Sewage, mining and tunneling, fumigation, biogas, hazmat, industrial gases.

TECHNICAL SPECIFICATIONS

Detection limit:	0.5 Vol. %
Resolution:	0.5 Vol. %
Measurement range:	0 to 100 Vol. % O_2 (oxygen)
Response time:	≤ 5 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.5 Vol. %/year
Sensitivity:	≤ ± 3% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(0 to 45)°C (32 to 133)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,100) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.01% of measured value/% RH
Test gas:	N_2 (zero gas)
	10 to 100 Vol. % O_2

SPECIAL CHARACTERISTICS

This sensor can be used for measuring oxygen concentrations of up to 100 Vol. % O_2 in the ambient air. The principle upon which the sensor is based is the measurement of the partial oxygen pressure, which means it can also measure oxygen in inert gases like nitrogen, argon, and helium.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of O_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in Vol. %O_2
Carbon dioxide	CO_2	5 Vol. %	≤ 1(–)
Chlorine	Cl_2	20 ppm	No effect
Helium	He	50 Vol. %	≤ 1(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect
Methane	CH_4	10 Vol. %	No effect
Nitrogen dioxide	NO_2	50 ppm	No effect
Nitrogen monoxide	NO	0.05 Vol. %	≤ 1(–)
Propane	C_3H_8	2 Vol. %	No effect
Sulfur dioxide	SO_2	50 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC PH_3 HC

Order no. 68 09 535

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	1 year	3 years	–

MARKET SEGMENTS

Inorganic chemicals, industry, fumigation, pre entry measurements.

TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm
Resolution:	1 ppm
Measurement range:	0 to 1,000 ppm PH_3 (phosphine)
Response time:	≤ 10 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/month
Sensitivity:	≤ ± 3% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	approx. 4 to 1,000 ppm PH_3

SPECIAL CHARACTERISTICS

This sensor demonstrates excellent linearity across the whole measurement range even if calibrated in the lower levels of that range, and it also provides a stable reading even at high concentrations over long periods of time.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of phosphine. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm PH_3
Acetone	CH_3COCH_3	1.25 Vol. %	No effect
Ammonia	NH_3	50 ppm	No effect
Arsine	AsH_3	5 ppm	≤ 4
Carbon dioxide	CO_2	10 Vol. %	No effect
Carbon monoxide	CO	300 ppm	No effect
Chlorine	Cl_2	5 ppm	No effect
Diborane	B_2H_6	5 ppm	≤ 3
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	200 ppm	No effect
Germanium tetrahydride	GeH_4	5 ppm	≤ 5
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen chloride	HCl	20 ppm	No effect
Hydrogen cyanide	HCN	25 ppm	≤ 2
Hydrogen selenide	H_2Se	5 ppm	≤ 2
Hydrogen sulfide	H_2S	20 ppm	≤ 20
i-propanol	$(CH_3)CHOH$	1 Vol. %	No effect
Methane	CH_4	4 Vol. %	No effect
Methanol	CH_3OH	200 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 5(–)
Nitrogen monoxide	NO	20 ppm	No effect
Silane	SiH_4	5 ppm	≤ 5
Sulfur dioxide	SO_2	10 ppm	≤ 2
Toluene	$C_6H_5CH_3$	1 Vol. %	No effect
Trimethylboron	$B(CH_3)_3$	1 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XS EC SO_2

Order no. 68 09 160

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 7000	yes	yes	1 year	> 2 years

Selective filter

K1T, 68 09 163 – replaceable

Eliminates cross-sensitivity to hydrogen sulfide (H_2S).

The filter's service life can be calculated as follows: 2,000 ppm x hours of contaminant gas. Example: Given constant concentration of 1 ppm H_2S will be: Service life = 2,000 ppm x hours / 1 ppm = 2,000 hours.

The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Food industry, pest control, mining, oil and gas, petrochemicals, pulp and paper, shipping, steel

TECHNICAL SPECIFICATIONS

Detection limit:	0.5 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 100 ppm SO_2 (sulfur dioxide)
Response time:	≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/month
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	≤ ± 0.002 ppm/% RH
Sensitivity:	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 1 to 100 ppm SO_2 test gas

SPECIAL CHARACTERISTICS

In addition to a fast response time and excellent linearity, this sensor is highly selective if the selective filter is used. The K1T selective filter (order no. 68 09 163) is an accessory for the DrägerSensor® XS EC SO_2 and eliminates the sensor's cross-sensitivity to hydrogen sulfide. The filter has a lifetime of 2,000 ppm × hours, which means that at a hydrogen sulfide concentration of 1 ppm it can be used for 2,000 hours.

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of SO_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm SO_2 without selective filter
Acetaldehyde	CH_3CHO	500 ppm	No effect
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	200 ppm	No effect
Carbon dioxide	CO_2	30 Vol. %	No effect
Carbon monoxide	CO	125 ppm	No effect
Chlorine	Cl_2	5 ppm	≤ 5(–)
Ethene	C_2H_4	50 ppm	No effect
Ethine	C_2H_2	200 ppm	≤ 60
Formaldehyde	HCHO	50 ppm	≤ 1
Hydrogen cyanide	HCN	20 ppm	≤ 10
Hydrogen	H_2	1,000 ppm	≤ 2
Hydrogen sulfide	H_2S	20 ppm	≤ 100
Methane	CH_4	2 Vol. %	No effect
Methanol	CH_3OH	175 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 20(–)
Nitrogen monoxide	NO	20 ppm	No effect
Phosphine	PH_3	5 ppm	≤ 50
Tetrahydrothiophene	C_4H_8S	10 ppm	≤ 5

(–) Indicates negative deviation

CONTENTS XXS SENSORS

DrägerSensor® XXS Amine

Order no. 68 12 545

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	no	yes	1 year	> 1.5 years	no
Dräger X-am 5600	no	yes	1 year	> 1.5 years	no

MARKET SEGMENTS

Foundries, refineries, power plants

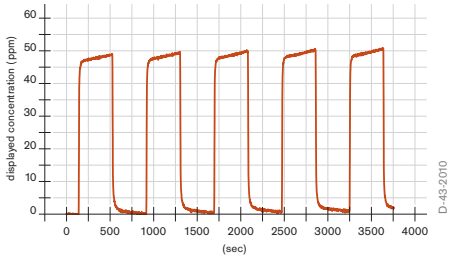
TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm	
Resolution:	1 ppm	
Measurement range/ relative sensitivity	0 - 100 ppm CH_3NH_2 (methylamine)	0.70
	0 - 100 ppm $(CH_3)_2NH$ (dimethylamine)	0.50
	0 - 100 ppm $(CH_3)_3N$ (trimethylamine)	0.50
	0 - 100 ppm $C_2H_5NH_2$ (ethylamine)	0.70
	0 - 100 ppm $(C_2H_5)_2NH$ (diethylamine)	0.50
	0 - 100 ppm $(C_2H_5)_3N$ (triethylamine)	0.50
	0 – 100 ppm NH_3 (ammonia)	1.00
Response time:	≤ 30 seconds (T_{90})	
Measurement accuracy		
Sensitivity:	≤ ± 5 % of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 2 ppm/month	
Sensitivity:	≤ ± 3 % of measured value/month	
Warm-up time:	≤ 12 hours	
Ambient conditions		
Temperature:	(-40 to 50)°C (-40 to 122)°F	
Humidity:	(10 to 90) % RH.	
Pressure:	(700 to 1300) hPa	
Influence of temperature		
Zero point:	≤ ± 5 ppm	
Sensitivity:	≤ ± 5 % of measured value	
Influence of humidity		
Zero point:	≤ ± 0.1 ppm / % RH	
Sensitivity:	≤ ± 0.2 % of measured value/% RH	
Test gas:	approx. 5 to 90 ppm NH_3	

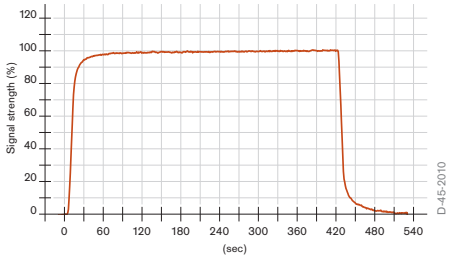
SPECIAL CHARACTERISTICS

This sensor is suitable for monitoring concentration of six different amines in ambient air. A fast response time and excellent repeatability are just two examples of this sensor's special characteristics.

Reproducibility of Amine sensors
purged with 48 ppm methyl amine average of five sensors



Typical gas response of Amine at 20 °C
flow = 0,5 l/min, purged with 48 ppm methyl amine



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NH_3. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NH_3
Acetone	CH_3COCH_3	1000 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol.-%	≤5 ppm (–)
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤20 ppm (–)
Ethene	C_2H_4	1000 ppm	≤3 ppm
Ethine	C_2H_2	200 ppm	No effect
Hydrogen	H_2	1000 ppm	≤3 ppm
Hydrogen cyanide	HCN	25 ppm	≤3 ppm
Hydrogen sulfide	H_2S	20 ppm	≤50 ppm
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	≤4 ppm
Methane	CH_4	10 Vol.-%	No effect
Methanol	CH_3OH	200 ppm	≤10 ppm
Nitrogen dioxide	NO_2	20 ppm	≤10 ppm (–)
Nitrogen monoxide	NO	20 ppm	≤10 ppm
Phosphine	PH_3	5 ppm	≤8 ppm
Sulfur dioxide	SO_2	20 ppm	No effect
Tetrahydrothiophene	C_4H_8S	10 ppm	≤10 ppm

(–) Indicates negative deviation

DrägerSensor® XXS Cl_2

Order no. 68 10 890

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Food and beverage, inorganic chemicals, manufacture of plastics, measuring dangerous substances, pulp and paper, power generation, sewage plants, water treatment.

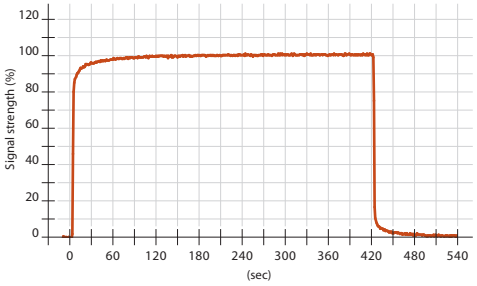
TECHNICAL SPECIFICATIONS

Detection limit:	0.05 ppm	
Resolution:	0.05 ppm	
Measurement range/ relative sensitivity	0 to 20 ppm Cl_2 (chlorine)	1.00
	0 to 20 ppm F_2 (fluorine)	1.00
	0 to 20 ppm Br_2 (bromine)	1.00
	0 to 20 ppm ClO_2 (chlorine dioxide)	0.60
Response time:	≤ 30 seconds (T_{90})	
Measurement accuracy		
Sensitivity:	≤ ± 2% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 0.2 ppm/year	
Sensitivity:	≤ ± 2% of measured value/month	
Warm-up time:	≤ 30 minutes	
Ambient conditions		
Temperature:	(–40 to 50)°C (–40 to 122)°F	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.05 ppm	
Sensitivity:	≤ ± 5% of measured value	
Influence of humidity		
Zero point:	No effect	
Sensitivity:	≤ ± 0.4% of measured value/% RH	
Test gas:	approx. 1 to 18 ppm Cl_2	

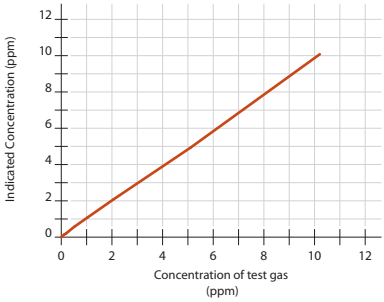
SPECIAL CHARACTERISTICS

This sensor is suitable for monitoring concentrations of chlorine, bromine, fluorine, and chlorine dioxide in the ambient air. These sensors' advantages include excellent linearity and fast response times.

Sensor reaction Cl_2 at 20 °C/68°F
Flow = 0.5 l/min, with 0,5 ppm Cl_2



Linearity of Cl_2 Sensors
calibrated with 10.2 ppm Cl_2



D-27838-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of chlorine. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm Cl_2
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	No effect
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen chloride	HCl	20 ppm	≤ 0.6
Hydrogen cyanide	HCN	60 ppm	No effect
Hydrogen sulfide	H_2S	10 ppm	≤ 0.6 (–)
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	0.9 Vol.-%	No effect
Nitrogen dioxide	NO_2	10 ppm	No effect
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	1 ppm	No effect
Phosphine	PH_3	1 ppm	No effect
Sulfur dioxide	SO_2	10 ppm	≤ 1 (–)

(–) Indicates negative deviation

DrägerSensor® XXS CO
DrägerSensor® XXS E CO

Order no. 68 10 882
68 12 212

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 3500	no	yes	3 years	> 5 years
Dräger Pac 5500	no	yes	3 years	> 5 years
Dräger Pac 7000	no	yes	3 years	> 5 years
Dräger Pac 7000 5Y	no	yes	5 years	> 5 years
Dräger X-am 2500	no	yes	3 years	> 5 years
Dräger X-am 5000	no	yes	3/5 years	> 5 years
Dräger X-am 5600	no	yes	3/5 years	> 5 years

Selective filter

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 25,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 25,000 ppm x hours / 10 ppm = 2,500 hours.

MARKET SEGMENTS

Waste disposal industry, metal processing, petrochemical, fertilizer production, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and gas, measuring dangerous substances, biogas.

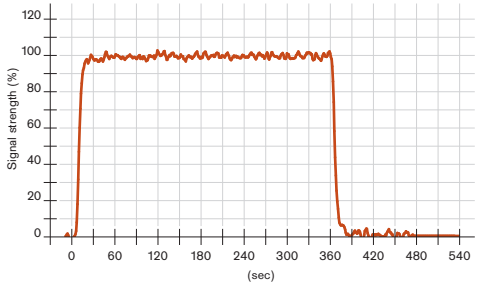
TECHNICAL SPECIFICATIONS

Detection limit:	6 ppm
Resolution:	2 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 3% of measured value/year
Warm-up time:	≤ 5 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 0.3% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.02% of measured value/% RH
Test gas:	approx. 20 to 1800 ppm CO

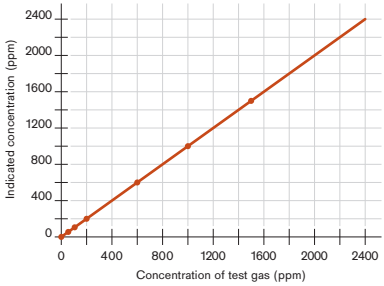
SPECIAL CHARACTERISTICS

In addition to an outstanding linearity and a quick response time, these CO sensors are highly selective. An internal selective filter, which is fitted to the sensor as standard, filters out most associated gases such as alcohol and acid gases H_2S, SO_2.

Sensor reaction to CO at 20 °C/68 °F
Flow = 0.5 l/min, with 30 ppm CO



Linearity of CO sensor
calibrated with 50 ppm CO



D-27841-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS CO

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	≤ 2
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 200
Hydrogen	H_2	0.1 Vol.-%	≤ 350
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	≤ 5
Methane	CH_4	5 Vol.-%	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS E CO

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	≤ 2
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 200
Hydrogen	H_2	0.1 Vol.-%	≤ 350
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	≤ 5
Methane	CH_4	5 Vol.-%	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

D-10161-2009

DrägerSensor® XXS CO

DrägerSensor® XXS CO LC

Order no. 68 13 210

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 7000	no	yes	2 years	> 5 years
Dräger X-am 5000	no	yes	2 years	> 5 years
Dräger X-am 5000	no	yes	2 years	> 5 years

Selective filter

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 10,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 10,000 ppm x hours / 10 ppm = 1,000 hours.

MARKET SEGMENTS

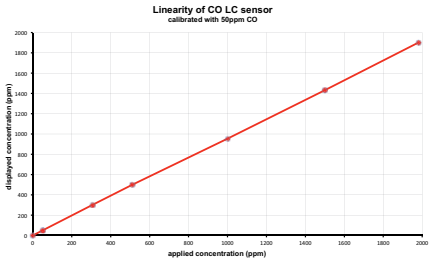
Waste disposal industry, metal processing, petrochemical, fertilizer production, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and gas, measuring dangerous substances, biogas.

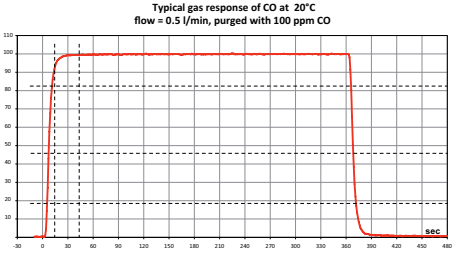
TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm
Resolution:	1 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 3% of measured value/year
Warm-up time:	≤ 30 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 0.3% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.02% of measured value/% RH
Test gas:	approx. 20 to 1800 ppm CO

SPECIAL CHARACTERISTICS

In addition to an outstanding linearity and a quick response time, these CO sensors are highly selective. An internal selective filter, which is fitted to the sensor as standard, filters out most associated gases such as alcohol and acid gases H_2S, SO_2.





The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	≤ 2
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 200
Hydrogen	H_2	0.1 Vol.-%	≤ 200
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	≤ 5
Methane	CH_4	5 Vol.-%	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

DrägerSensor® XXS CO HC

Order no. 68 12 010

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	1 year	> 3 years
Dräger X-am 5600	no	yes	1 year	> 3 years

Selective filter

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 5,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 5,000 ppm x hours / 10 ppm = 500 hours.

MARKET SEGMENTS

Waste disposal industry, metal processing, petrochemical, fertilizer production, mining and tunneling (in particular monitoring high CO concentrations during rescue operations), shipping, inorganic chemicals, biogas, hazmat, steel industry, oil and gas, organic chemicals.

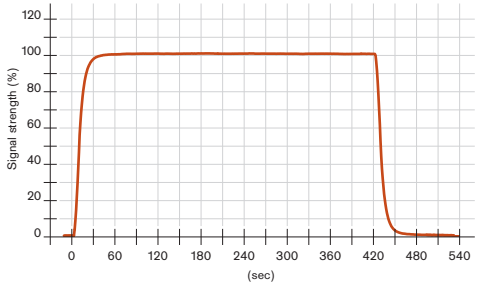
TECHNICAL SPECIFICATIONS

Detection limit:	10 ppm
Resolution:	5 ppm
Measurement range:	0 to 10,000 ppm CO (carbon monoxide)
Response time:	≤ 25 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 5 ppm/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 5 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 0.3% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.02% of measured value/% RH
Test gas:	approx. 100 to 9,000 ppm CO

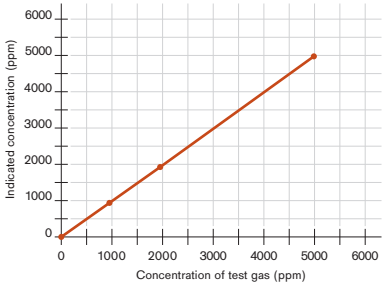
SPECIAL CHARACTERISTICS

This sensor demonstrates excellent linearity across the whole measurement range even if calibrated in the lower reaches of that range, and it also provides a stable reading even at high concentrations over long periods of time.

Typical Sensor reaction to CO HC at 20 °C/68 °F
Flow = 0.5 l/min, with 5.000 ppm CO



Linearity of CO HC sensor
calibrated with 100 ppm CO



D-27842-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	No effect
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 200
Hydrogen	H_2	0.1 Vol.-%	≤ 350
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	≤ 5
Methane	CH_4	5 Vol.-%	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

DrägerSensor® XXS CO H_2-CP

Order no. 68 11 950

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	1 year	> 3 years
Dräger X-am 5600	no	yes	1 year	> 3 years

Selective filter

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 25,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 25,000 ppm x hours / 10 ppm = 2,500 hours.

MARKET SEGMENTS

Steel industry, refineries, sewage treatment plants

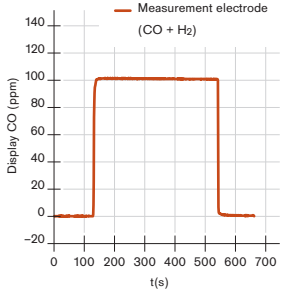
TECHNICAL SPECIFICATIONS

Detection limit:	6 ppm
Resolution:	2 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 25 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature:	(–40 to 50) °C (–40 to 122) °F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 0.3% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.02% of measured value/% RH
Test gas:	approx. 20 to 1,800 ppm CO and 1,000 ppm H_2

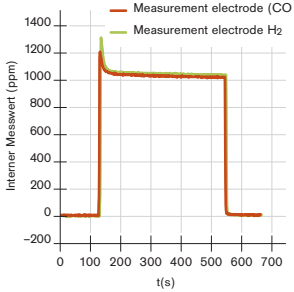
SPECIAL CHARACTERISTICS

Carbon monoxide and hydrogen can occur simultaneously in many areas of work such as in the steel industry, refineries, and sewage treatment plants. Hydrogen affects the CO signal in conventional sensors, which leads to many false alarms. The DrägerSensor® XXS CO H_2-CP uses two measuring electrodes – one of which measures CO and H_2, the other only H_2. The CO level is calculated and displayed on the basis of the difference between the two signals. A hydrogen concentration of 1,000 ppm (2.5% LEL) causes a maximum displayed concentration of only 15 ppm CO, which does not activate the CO alarm.

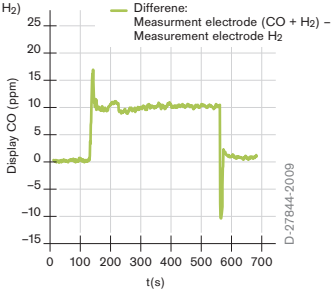
Sensor reaction 100 ppm CO



Internal H_2 signal
Sensor reaction 1022 ppm H_2



Calculated signal
Sensor reaction 1022 ppm H_2



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	No effect
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 200
Hydrogen	H_2	0.1 Vol.-%	< = ±15 [1)]
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	5 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	≤ 5
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

[1)] after compensation

DrägerSensor® XXS CO_2

Order no. 68 10 889

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 1.25 years	no
Dräger X-am 5000	no	yes	1 year	> 1.25 years	no
Dräger X-am 5000	no	yes	1 year	> 1.25 years	no

MARKET SEGMENTS

Waste disposal, Food and beverage (breweries), metal processing, petrochemical, fertilizer production, sewage, police, customs and rescue services, mining and tunneling, shipping and transport, power generation.

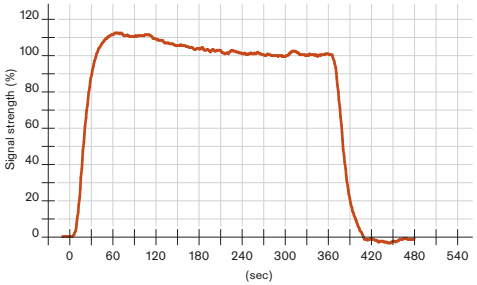
TECHNICAL SPECIFICATIONS

Detection limit:	0.3 Vol.-%
Resolution:	0.1 Vol.-%
Measurement range:	0 to 5 Vol.-% CO_2 (carbon dioxide)
Response time:	≤ 30 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 20% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.2 Vol.-%/year
Sensitivity:	≤ ± 15% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature:	(–20 to 40)°C (–4 to 104)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.01 Vol.-%/K
Sensitivity:	≤ ± 2% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	1 to 4 Vol.-% CO_2

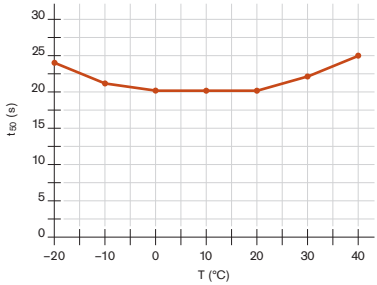
SPECIAL CHARACTERISTICS

This sensor is highly sensitive (see cross-sensitivity list) and offers an economical alternative to infrared sensors if you need to warn against CO_2 concentrations in the ambient air.

Sensor reaction to CO_2 at 20 °C/68 °F
Flow = 0.5 l/min, with 5000 ppm CO_2



Response time (t_{50}) vs. temperature
with 5000 ppm CO_2



D-27840-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm CO_2
Ammonia	NH_3	50 ppm	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Chlorine	Cl_2	10 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	No effect
Hydrogen	H_2	1.6 Vol.-%	No effect
Hydrogen chloride	HCl	20 ppm	No effect
Hydrogen cyanide	HCN	60 ppm	No effect
Hydrogen sulfide	H_2S	20 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	No effect
Methane	CH_4	0.9 Vol.-%	No effect
Ozone	O_3	1.5 ppm	No effect
Phosphine	PH_3	5 ppm	No effect
Sulfur dioxide	SO_2	20 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XXS $COCl_2$

Order no. 68 12 005

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	0.5 years	> 1 year at below 25°C	no
Dräger X-am 5600	no	yes	0.5 years	> 6 months at 35°C	

MARKTSEGMENTE

Manufacture of plastics, chemical industry, insecticides production, dyes, military

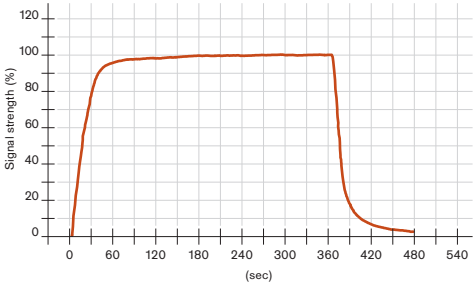
TECHNISCHE DATEN

Detection limit:	0,01 ppm
Resolution:	0,01 ppm
Measurement range:	0 bis 10 ppm $COCl_2$ (Phosgene)
Response time:	≤ 20 seconds (T_{20})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0,01 ppm/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(-20 to 35) °C (-4 to 99) °F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1300) hPa
Influence of temperature	
Zero point:	no effect
Sensitivity:	≤ ± 0.2% of measured value/K
Influence of humidity	
Zero point:	no effect
Sensitivity:	≤ ± 0.05% of measured value/RH
Test gas:	$COCl_2$ test gas between 3.8 to 9 ppm (not in Dräger's portfolio)

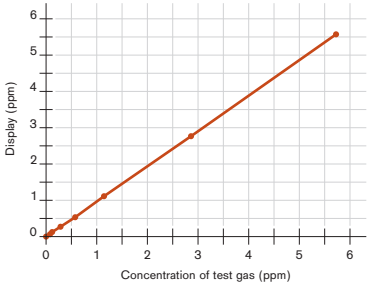
SPECIAL CHARACTERISTICS

This sensor's advantages include a very low detection limit, excellent linearity and high signal stability.

Sensor reaction at 20 °C
Flow = 0.5 l/min, 0.115 ppm $COCl_2$



Linearity of $COCl_2$ Sensors
calibrated with 0.28 ppm $COCl_2$



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of $COCl_2$. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. Symbol	Concentration	Reading in ppm $COCl_2$
Ammonia	NH_3	20 ppm	No effect
Carbon dioxide	CO_2	1,5 Vol.-%	No effect
Carbon monoxide	CO	1000 ppm	No effect
Chlorine	Cl_2	0,5 ppm	≤ 0.2
Ethanol	C_2H_5OH	260 ppm	No effect
Ethine	C_2H_2	20 ppm	No effect
Hydrogen	H_2	8000 ppm	No effect
Hydrogen chloride	HCl	0,5 ppm	≤ 0.7
Hydrogen fluoride	HF	0,4 ppm	≤ 0.1 ppm
Hydrogen peroxide	H_2O_2	1 ppm	No effect
Hydrogen sulfide	H_2S	1 ppm	≤ 1[1)]
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Nitrogen dioxide	NO_2	1 ppm	≤ 0.1(–)
Nitrogen monoxide	NO	30 ppm	No effect
Ozone	O_3	0,3 ppm	≤ 0.05(–)
Phosphine	PH_3	0,5 ppm	≤ 0.1 ppm
Propanol	C_3H_7OH	500 ppm	No effect
Sulfur dioxide	SO_2	2 ppm	No effect

(–) Indicates negative deviation

1) Permanent exposure to H2S can result in a reduction of sensitivity.

DrägerSensor® XXS H_2

Order no. 68 12 370

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	1 year	> 2 years
Dräger X-am 5600	no	yes	1 year	> 2 years

Selective filter

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 5,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 5,000 ppm x hours / 10 ppm = 500 hours.

MARKET SEGMENTS

Leak detection, chemical, petrochemical, rocket fuel, production of plastics, steel production, industrial gases, fertilizer, battery charging stations, fuel cells.

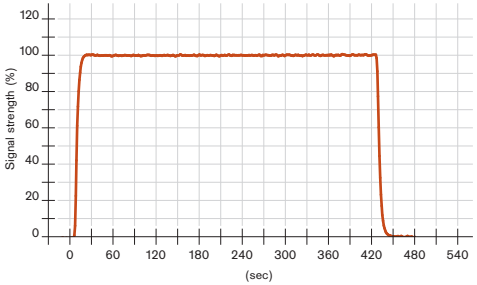
TECHNICAL SPECIFICATIONS

Detection limit:	10 ppm
Resolution:	5 ppm
Measurement range:	0 to 2,000 ppm H_2 (hydrogen)
Response time:	≤ 10 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 4 ppm/year
Sensitivity:	≤ ± 4% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 10 ppm
Sensitivity:	≤ ± 1 ppm/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.15% of measured value/% RH
Test gas:	approx. 20 to 2,000 ppm H_2

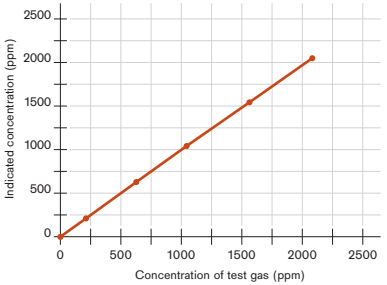
SPECIAL CHARACTERISTICS

This sensor enables the detection of hydrogen concentrations in ppm. Its very fast response time makes it especially suitable for detecting leaks.

Sensor reaction to H_2 at 20 °C/68 °F
Flow = 0.5 l/min, 1000 ppm H_2



Linearity of H_2 sensors
calibrated with 1045 ppm H_2



D-27856-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	≤ 2
Carbon monoxide	CO	100 ppm	≤ 200
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 200
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH4	5 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 51
Propane	C_3H8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

DrägerSensor® XXS H_2 HC

Order no. 68 12 025

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	1 year	> 2 years
Dräger X-am 5600	no	yes	1 year	> 2 years

Selective filter

Internal selective filter.

Cross sensitivities to hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) are eliminated.

The filter's service life can be calculated as follows: 5,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 5,000 ppm x hours / 10 ppm = 500 hours.

MARKET SEGMENTS

Chemical industry, petrochemical industry, rocket fuel, leak detection, production of plastics, metal processing, industrial gases, fertilizer manufacturing, battery charging stations, fuel cells.

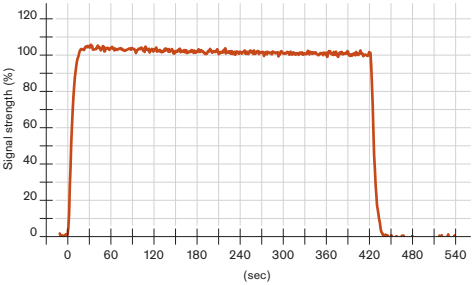
TECHNICAL SPECIFICATIONS

Detection limit:	0.02 Vol.-%
Resolution:	0.01 Vol.-%
Measurement range:	0 to 4 Vol.-% H_2 (hydrogen)
Response time:	≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.05 Vol.-%/year
Sensitivity:	≤ ± 3% of measured value/month
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.05 Vol.-%
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.01% of measured value/% RH
Test gas:	approx. 0.2 to 3.99 Vol.-% H_2

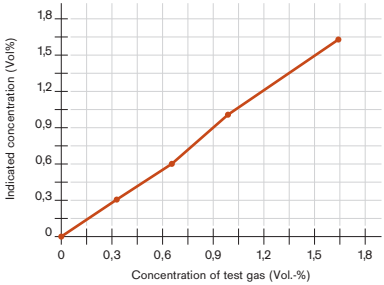
SPECIAL CHARACTERISTICS

This sensor is suitable for measuring hydrogen across the entire LEL range. If a Dräger X-am 5600 is fitted with an IR-Ex sensor, then this sensor is the ideal addition for detecting any risk of explosion caused by hydrogen. Like all Dräger sensors, this one offers very fast response times and excellent linearity.

Sensor reaction to XXS H_2 HC at 20 °C/68 °F
Flow = 0.5 l/min, with 1,63 Vol% H_2



Linearity of XXS H_2 HC sensors
calibrated with 1.63 Vol% H_2



D-27857-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% H_2
Ammonia	NH_3	100 ppm	No effect
Carbon monoxide	CO	1,000 ppm	≤ 0.1
Carbon dioxide	CO_2	30 Vol.-%	No effect
Chlorine	Cl_2	20 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 0.02
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	30 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH4	5 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 0.05
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	25 ppm	No effect

DrägerSensor® XXS HCN

Order no. 68 10 887

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 7000	no	yes	1 year	> 1.5 years
Dräger X-am 5000	no	yes	1 year	> 1.5 years
Dräger X-am 5600	no	yes	1 year	> 1.5 years

Selective filter

B2X (6812424) – replaceable.

Cross sensitivities to hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) are eliminated.

The filter's service life can be calculated as follows: 1,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 1,000 ppm x hours / 10 ppm = 100 hours. The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Metal processing, mining, fumigation and pest control, chemical warfare agent (blood agents).

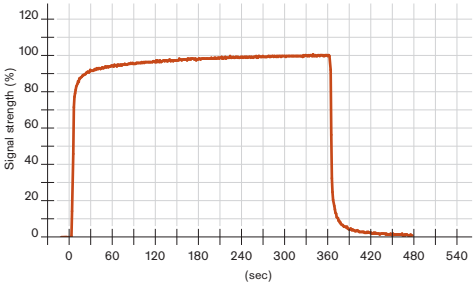
TECHNICAL SPECIFICATIONS

Detection limit:	0.5 ppm
Resolution:	0.1 ppm
Measurement range/ relative sensitivity	0 to 50 ppm HCN (hydrogen cyanide)
Response time:	≤ 10 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 5% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 1 to 45 ppm HCN

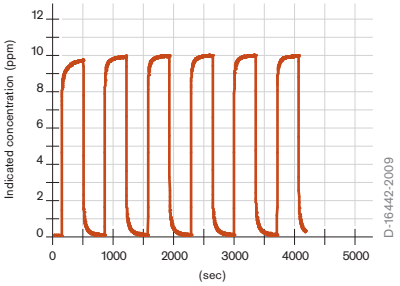
SPECIAL CHARACTERISTICS

This sensor's extremely quick response time and excellent repeatability provides a fast and reliable warning against Prussic acid (hydrogen cyanide).

Sensor reaction to HCN at 20 °C/68 °F
Flow = 0.5 l/min, 20 ppm HCN



Repeatability of HCN sensors with mit 10 ppm HCN



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of HCN To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm HCN
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 20 (–)
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 10
Hydrogen	H_2	1.5 Vol.-%	≤ 10
Hydrogen chloride	HCl	20 ppm	≤ 1
Hydrogen sulfide	H_2S	20 ppm	≤ 50
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	≤1.5
Methane	CH_4	1 Vol.-%	No effect
Nitrogen dioxide	NO_2	10 ppm	≤ 20 (–)
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	No effect
Phosphine	PH_3	1 ppm	≤ 8
Sulfur dioxide	SO_2	20 ppm	≤ 10

(–) Indicates negative deviation

DrägerSensor® XXS HCN PC

Order no. 68 13 165

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 7000	no	yes	1 year	> 1.5 years
Dräger X-am 5000	no	yes	1 year	> 1.5 years
Dräger X-am 5600	no	yes	1 year	> 1.5 years

Selective filter

B2X (6812424) – replaceable.

Cross sensitivities to hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) are eliminated.

The filter's service life can be calculated as follows: 1,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 1,000 ppm x hours / 10 ppm = 100 hours.

The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Metal processing, mining, fumigation and pest control, chemical warfare agent (blood agents).

TECHNICAL SPECIFICATIONS

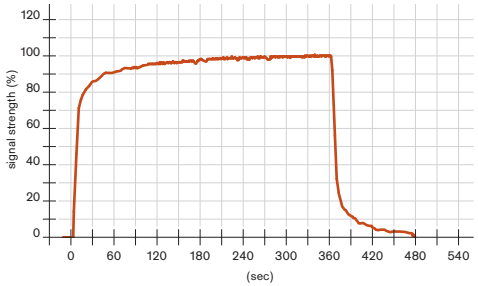
Detection limit:	3 ppm
Resolution:	0.5 ppm
Measurement range:	0 to 50 ppm HCN (hydrogen cyanide) 0 to 100 ppm C_2N_2 (cyanogen)*
Response time:	≤ 10 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 3 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 3 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 7 to 45 ppm HCN

*with limited temperature range: 0 to 40°C dry test gas

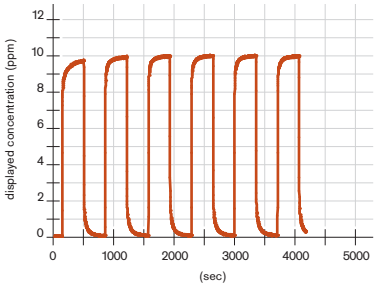
SPECIAL CHARACTERISTICS

This sensor's extremely quick response time and excellent repeatability provides a fast and reliable warning against Prussic acid (hydrogen cyanide).

Sensor reaction to HCN at 20°C
Flow = 0.5 l/min, 20 ppm HCN



reproducibility of HCN PC sensors
purged with 10 ppm HCN



D-16442-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of HCN To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm HCN
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	1 ppm	2 (–)
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 10
Hydrogen	H_2	0.5 Vol.-%	≤ 3
Hydrogen chloride	HCl	20 ppm	≤ 1
Hydrogen sulfide	H_2S	1 ppm	≤ 3
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	1 Vol.-%	No effect
Nitrogen dioxide	NO_2	1 ppm	≤ 1 (–)
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	No effect
Phosphine	PH_3	0.1 ppm	≤ 1
Sulfur dioxide	SO_2	1 ppm	≤ 2

(–) Indicates negative deviation

DrägerSensor® XXS H_2S
DrägerSensor® XXS E H_2S

Order no. 68 10 883
68 12 213

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	3 years	> 5 years	no
Dräger Pac 7000 5Y	no	yes	5 years	> 5 years	no
Dräger X-am 5000	no	yes	3/5 years	> 5 years	no
Dräger X-am 5600	no	yes	3/5 years	> 5 years	no

MARKET SEGMENTS

Waste disposal, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, steel, pulp and paper, organic chemicals, oil and gas, hazmat, biogas.

TECHNICAL SPECIFICATIONS

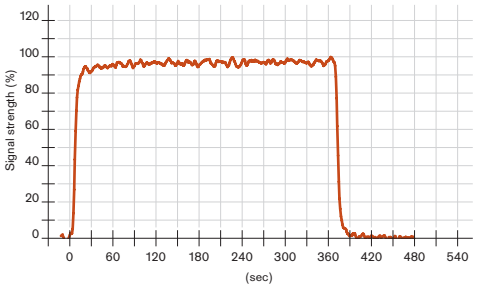
Detection limit:	2 ppm
Resolution:	1 ppm
Measurement range:	0 to 200 ppm H_2S (hydrogen sulfide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/year
Sensitivity:	≤ ± 3% of measured value/year
Warm-up time:	≤ 5 minutes
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.03% of measured value/% RH
Test gas:	approx. 5 to 180 ppm H_2S

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

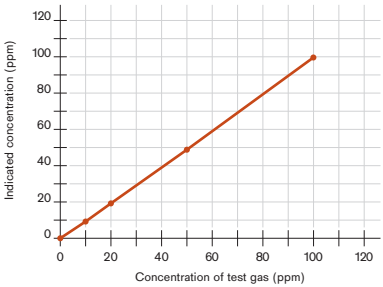
SPECIAL CHARACTERISTICS

This sensor's advantages include fast response times and excellent linearity. At concentrations up to 20 ppm, sulfur dioxide has hardly any effect on hydrogen sulfide readings. This enables the selective measurement of the gas concentration using the DrägerSensor® XXS SO_2 (with integrated selective filter) together with the DrägerSensor® XXS H_2S in a device such as a Dräger X-am 5000 or X-am 5600

Sensor reaction to H_2S at 20 °C/68 °F
Flow = 0.5 l/min, with 10 ppm H_2S



Linearity of H_2S sensor
calibrated with 20 ppm H_2S



D-27851-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS H_2S

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetylene	C_2H_2	100 ppm	No effect
Ammonia	NH_3	200 ppm	No effect
Carbon dioxide	CO_2	5 Vol.-%	No effect
Carbon monoxide	CO	500 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 2(–)
Dimethyl disulphide	CH_3SSCH_3	20 ppm	≤ 5
Dimethylsulphide	$(CH_3)_2S$	20 ppm	≤ 5
Ethanol	C_2H_5OH	250 ppm	no effect
Ethyl mercaptan	C_2H_5SH	20 ppm	≤ 12
Hydrogen	H_2	2 Vol.-%	≤ 18
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	5 Vol.-%	No effect
Methyl mercaptan	CH_3SH	20 ppm	≤ 15
Nitrogen dioxide	NO_2	20 ppm	≤ 5(–)

(–) Indicates negative deviation

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS H_2S

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Nitrogen monoxide	NO	30 ppm	No effect
Propane	C_3H_8	1 Vol.-%	No effect
sec-Butyl mercaptan	$C_4H_{10}S$	20 ppm	≤ 5
Sulphur dioxide	SO_2	20 ppm	≤ 2
tert- Butyl mercaptan	$(CH_3)_3CSH$	20 ppm	≤ 6
Tetrahydrothiophene	C_4H_8S	20 ppm	≤ 3

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS E H_2S

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetylene	C_2H_2	100 ppm	no effect
Ammonia	NH_3	200 ppm	no effect
Carbon dioxide	CO_2	5 Vol.-%	no effect
Carbon monoxide	CO	500 ppm	no effect
Chlorine	Cl_2	10 ppm	≤2(–)
Ethanol	C_2H_5OH	250 ppm	no effect
Hydrogen	H_2	0.1 Vol.-%	no effect
Hydrogen chloride	HCl	40 ppm	no effect
Hydrogen cyanide	HCN	50 ppm	no effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	5 Vol.-%	no effect
Nitrogen dioxide	NO_2	20 ppm	≤5(–)
Nitrogen monoxide	NO	30 ppm	no effect
Propane	C_3H_8	1 Vol.-%	no effect
Sulphur dioxide	SO_2	20 ppm	≤ 2

(–) Indicates negative deviation

ST-1973-2005

D-10162-2009

DrägerSensor® XXS H_2S

DrägerSensor® XXS H_2S HC

Order no. 68 12 015

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	1 year	> 3 years	no
Dräger X-am 5600	no	yes	1 year	> 3 years	no

MARKET SEGMENTS

Waste disposal industry, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, steel industry, pulp and paper, organic chemicals, oil and gas, measuring hazardous material, biogas.

TECHNICAL SPECIFICATIONS

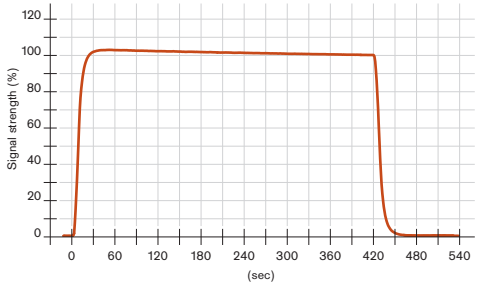
Detection limit:	4 ppm
Resolution:	2 ppm
Measurement range:	0 to 1,000 ppm H_2S (hydrogen sulfide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 5 minutes
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.03% of measured value/% RH
Test gas:	approx. 40 to 900 ppm H_2S

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

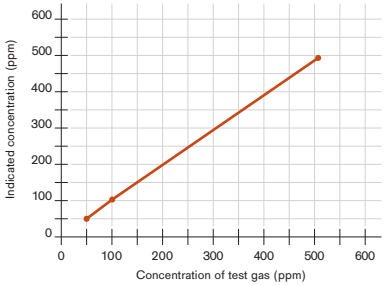
SPECIAL CHARACTERISTICS

Because of its excellent linearity, this sensor can be calibrated in its lower measurement range using a hydrogen sulfide test gas without compromising on accuracy in its upper measurement range. It also offers a fast response time and good selectivity.

Sensor reaction to H_2S HC at 20 °C/68 °F
Flow = 0.5 l/min, with 505 ppm H_2S



Linearity of H_2S HC sensor
calibrated with 50 ppm H_2S



D-27853-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Ammonia	NH_3	200 ppm	No effect
Carbon dioxide	CO_2	5 Vol.-%	No effect
Carbon monoxide	CO	500 ppm	No effect
Chlorine	Cl_2	10 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	No effect
Hydrogen	H_2	0.1 Vol.-%	No effect
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen phosphide	PH_3	5 ppm	≤ 4
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	5 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ $5^{(-)}$
Nitrogen monoxide	NO	30 ppm	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	20 ppm	≤ 2

(–) Indicates negative deviation

DrägerSensor® XXS H_2S LC

Order no. 68 11 525

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 3500	no	yes	3 years	> 5 years	no
Dräger Pac 5500	no	yes	3 years	> 5 years	no
Dräger Pac 7000	no	yes	3 years	> 5 years	no
Dräger X-am 2500	no	yes	3 years	> 5 years	no
Dräger X-am 5000	no	yes	3 years	> 5 years	no
Dräger X-am 5600	no	yes	3 years	> 5 years	no

MARKET SEGMENTS

Waste disposal, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, steel industry, pulp and paper, organic chemicals, oil and gas, hazmat, biogas.

TECHNICAL SPECIFICATIONS

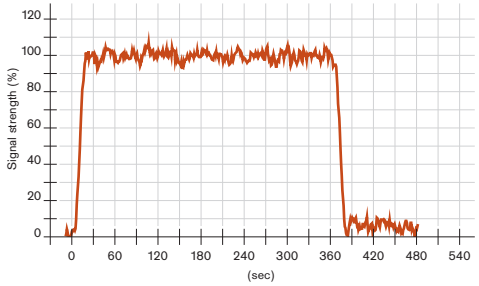
Detection limit:	0.4 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 100 ppm H_2S (hydrogen sulfide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.2 ppm/year
Sensitivity:	≤ ± 5% of measured value/year
Warm-up time:	≤ 5 minutes
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 5 to 90 ppm H_2S

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

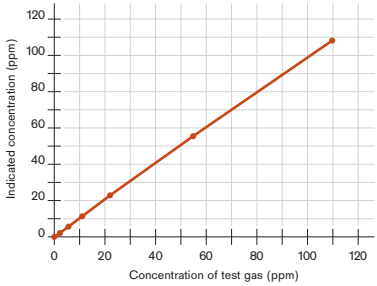
SPECIAL CHARACTERISTICS

Combined with an excellent linearity and a fast response time, this sensor enables the selective measurement of hydrogen sulfide at below 1 ppm.

Sensor reaction to H_2S at 20 °C/68 °F
Flow = 0.5 l/min, with 0,55 ppm H_2S



Linearity of H_2S LC sensor
calibrated with 22 ppm H_2S



D-27852-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S
Acetylene	C_2H_2	100 ppm	No effect
Ammonia	NH_3	200 ppm	No effect
Carbon dioxide	CO_2	5 Vol.-%	No effect
Carbon monoxide	CO	500 ppm	≤ 1
Chlorine	Cl_2	10 ppm	≤ 1(–)
Dimethyl disulphide	CH_3SSCH_3	20 ppm	≤ 5
Dimethylsulphide	$(CH_3)_2S$	20 ppm	≤ 5
Ethanol	C_2H_5OH	250 ppm	No effect
Ethyl mercaptan	C_2H_5SH	20 ppm	≤ 13
Hydrogen	H_2	0.1 Vol.-%	≤ 0.5
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	5 Vol.-%	No effect
Methyl mercaptan	CH_3SH	20 ppm	≤ 16 ppm
Nitrogen dioxide	NO_2	20 ppm	≤ 4(–)
Nitrogen monoxide	NO	30 ppm	No effect
Propane	C_3H_8	1 Vol.-%	No effect
sec-Butyl mercaptan	$C_4H_{10}S$	20 ppm	≤ 5
Sulphur dioxide	SO_2	20 ppm	≤ 1.5
tert- Butyl mercaptan	$(CH_3)_3CSH$	20 ppm	≤ 4
Tetrahydrothiophene	C_4H_8S	20 ppm	≤ 3

(–) Indicates negative deviation

DrägerSensor® XXS H_2S/CO

Order no. 68 11 410

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	2 years	> 3 years
Dräger X-am 5600	no	yes	2 years	> 3 years

Selective filter

Internal selective filter for CO.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 25,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 25,000 ppm x hours / 10 ppm = 2,500 hours.

MARKET SEGMENTS

Waste disposal, metal processing, biogas, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, paper industry, hazmat, steel industry, oil and gas, organic chemicals.

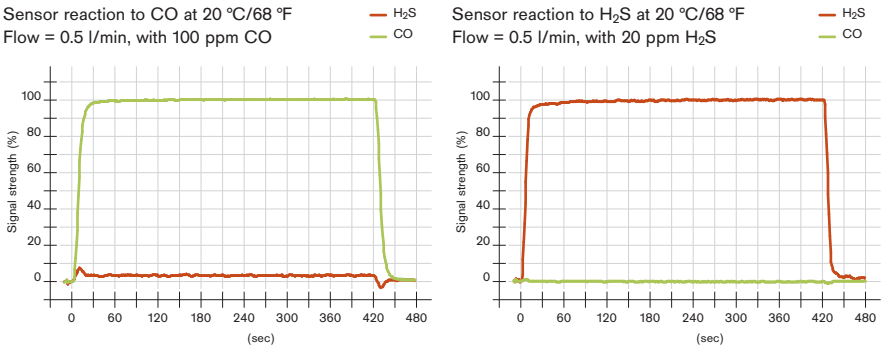
TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm (H_2S)/6 ppm (CO)
Resolution:	1 ppm (H_2S)/2 ppm (CO)
Measurement range:	0 to 200 ppm H_2S (hydrogen sulfide)
	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 5 minutes
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 2 ppm (H_2S) ≤ ± 5 ppm (CO)
Sensitivity:	≤ ± 5% of measured value (H_2S) ≤ ± 0.3% of measured value/K (CO)
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	approx. 5 to 90 ppm H_2S
	approx. 20 to 450 ppm CO

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

Carbon monoxide and hydrogen sulfide occur together in many areas of work. This sensor can monitor both gases simultaneously.



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO or H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S	Display in ppm CO
Ammonia	NH_3	100 ppm	No effect	No effect
Carbon dioxide	CO_2	30 vol. %	No effect	No effect
Carbon monoxide	CO	100 ppm	No effect	100
Chlorine	Cl_2	20 ppm	≤ 2 (–) [1]	No effect
Dimethyl disulphide	CH_3SSCH_3	20 ppm	≤ 11	No effectt
Dimethylsulphide	$(CH_3)_2S$	20 ppm	≤ 5	No effect
Ethine	C_2H_2	100 ppm	No effect	≤ 200
Ethyl alcohol	C_2H_5OH	250 ppm	No effect	No effect
Ethyl mercaptan	C_2H_5SH	20 ppm	≤ 13	no effect
Hydrogen	H_2	0.1 vol. %	No effect	≤ 350
Hydrogen chloride	HCl	40 ppm	No effect	No effect
Hydrogen cyanide	HCN	50 ppm	No effect	No effect
Hydrogen sulphide	H_2S	20 ppm	20	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect	No effect
Methane	CH_4	5 vol. %	No effect	No effect
Methyl mercaptan	CH_3SH	20 ppm	≤ 16 ppm	≤ 16 ppm
Nitrogen dioxide	NO_2	20 ppm	≤ 5 (–) [1]	No effect
Nitrogen monoxide	NO	30 ppm	No effect	≤ 5
Propane	C_3H_8	1 vol. %	No effect	No effect
sec-Butyl mercaptan	$C_4H_{10}S$	20 ppm	≤ 7	No effect
Sulphur dioxide	SO_2	25 ppm	≤ 2	No effect
tert- Butyl mercaptan	$(CH_3)_3CSH$	20 ppm	≤ 8	No effect
Tetrahydrothiophene	C_4H_8S	20 ppm	≤ 3	No effect

(–) [1] negative reading

DrägerSensor® XXS H_2S LC/CO LC

Order no. 68 13 280

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	2 years	> 3 years
Dräger X-am 5600	no	yes	2 years	> 3 years

Selective filter

Internal selective filter for CO.

Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.

The filter's service life can be calculated as follows: 25,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 25,000 ppm x hours / 10 ppm = 2,500 hours.

MARKET SEGMENTS

Waste disposal, metal processing, biogas, petrochemical, fertilizer production, sewage, mining and tunneling, shipping, inorganic chemicals, paper industry, hazmat, steel industry, oil and gas, organic chemicals.

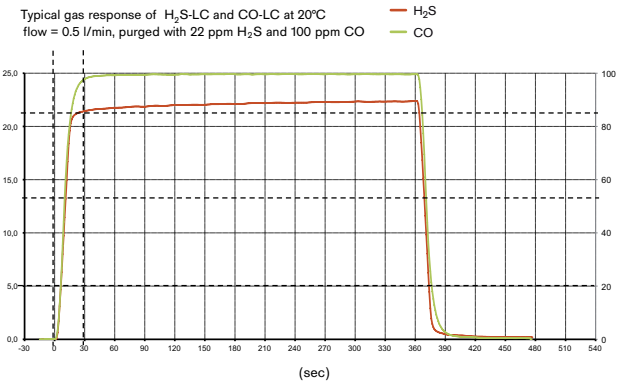
TECHNICAL SPECIFICATIONS

Detection limit:	0,4 ppm (H_2S)/2 ppm (CO)
Resolution:	0.1 ppm (H_2S)/1 ppm (CO)
Measurement range:	0 to 100 ppm H_2S (hydrogen sulfide)
	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 20 seconds (T_{90})
Measurement accuracy	
Sensitivity:	H_2S: ≤ ± 5 % of measured value, CO: ≤ ± 2 % of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	H_2S: ≤ ± 0,2 ppm/year, CO: ≤ ± 2 ppm/year
Sensitivity:	H_2S: ≤ ± 5 % of measured value/year, CO: ≤ ± 3 % of measured value/year
Warm-up time:	H_2S: ≤ 5 Minuten, CO: ≤ 30 Mintuen
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	H_2S: no effect, CO: ≤ ± 5 ppm
Sensitivity:	H_2S: ≤ ± 0.1 % of measured value, CO: ≤ ± 0.3 % of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	H_2S: ≤ ± 0.1 % of measured value/ %r.h., CO: ≤ ± 0.02 % of measured value/ %r.h.
Test gas:	approx. 5 to 90 ppm H_2S
	approx. 20 to 1800 ppm CO

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

Carbon monoxide and hydrogen sulfide occur together in many areas of work. This sensor can monitor both gases simultaneously. Because of the low detection limits, this sensor is suitable for the limit value monitoring.



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of CO or H_2S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S	Display in ppm CO with selektive filter
Acetylene	C_2H_2	100 ppm	No effect	≤ 200
Ammonia	NH_3	100 ppm	No effect	No effect
Carbon dioxide	CO_2	10 Vol.-%	No effect	No effect
Carbon monoxide	CO	500 ppm	≤ 1	
Chlorine	Cl_2	10 ppm	≤ 1 (–)	No effect
Dimethyl disulphide	CH_3SSCH_3	20 ppm	≤ 5	No effect
Dimethyl sulfide	$(CH_3)_2S$	20 ppm	≤ 5	No effect
Ethyl Alcohol	C_2H_5OH	250 ppm	No effect	No effect
Ethyl mercaptan	C_2H_5SH	20 ppm	≤ 13	No effect
Hydrogen	H_2	0.1 Vol.-%	≤ 0.5	≤ 200
Hydrogen chloride	HCl	40 ppm	No effect	No effect
Hydrogen cyanide	HCN	50 ppm	No effect	No effect
Hydrogen sulphide	H_2S			No effect
Isobutylene	i-C_4H_8	100 ppm	No effect	No effect
Methane	CH_4	5 Vol.-%	No effect	No effect
Methyl mercaptan	CH_3SH	20 ppm	≤ 16	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 4 (–)	No effect
Nitrogen monoxide	NO	30 ppm	No effect	≤ 5
Propane	C_3H_8	1 Vol.-%	No effect	No effect
sec. Butyl mercaptan	$C_4H_{10}S$	20 ppm	≤ 5	No effect
Sulfur dioxide	SO_2	20 ppm	≤ 1.5	No effect
tert. Butyl mercaptan	$(CH_3)_3CSH$	20 ppm	≤ 4	No effect
Tetrahydrothiopene	C_4H_8S	20 ppm	≤ 3	No effect

(–) Indicates negative deviation

DrägerSensor® XXS NH_3

Order no. 68 10 888

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Food and beverage, poultry farming, power generation, inorganic chemicals, fertilizer production, hazmat, fumigation, metal processing, petrochemical, pulp and paper.

TECHNICAL SPECIFICATIONS

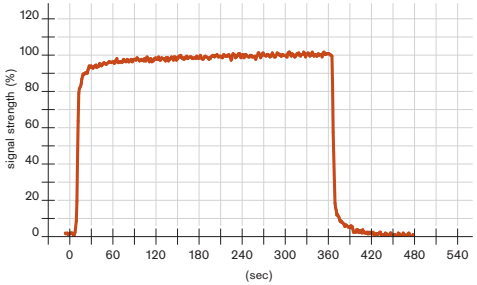
Detection limit:	4 ppm
Resolution:	1 ppm
Measurement range:	0–300 ppm NH_3 (ammonia)
Response time:	≤ 10 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 5 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 12 hours
Ambient conditions	
Temperature*:	(–40 to 50)°C (–40 to 122)°F
Humidity*:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 5 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	≤ ± 0.1 ppm/% RH
Sensitivity:	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 10 to 150 ppm NH_3

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

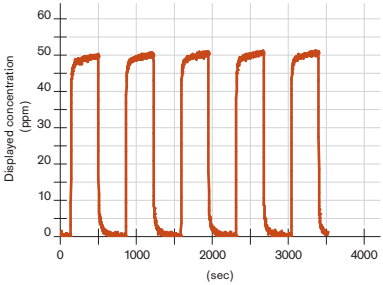
SPECIAL CHARACTERISTICS

A fast response time and excellent repeatability are just two examples of this sensor's special characteristics.

Sensor reaction to NH_3 at 20 °C/68 °F
Flow = 0.5 l/min, 50 ppm NH_3



Repeatability of NH_3 Sensor with 50 ppm NH_3, average from five sensors



D-27837-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NH_3. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NH_3
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 30 (–)
Ethanol	C_2H_5OH	250 ppm	≤ 40
Ethine	C_2H_2	100 ppm	No effect
Hydrogen	H_2	1,000 ppm	≤ 4
Hydrogen chloride	HCl	20 ppm	≤ 15 (–)
Hydrogen sulfide	H_2S	20 ppm	≤ 70
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	0.9 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 10 (–)
Nitrogen monoxide	NO	20 ppm	≤ 10
Ozone	O_3	0.5 ppm	No effect
Phosphine	PH_3	1 ppm	≤ 2
Sulfur dioxide	SO_2	20 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XXS NO

Order no. 68 11 545

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Power and district heating plants, chemical industry.

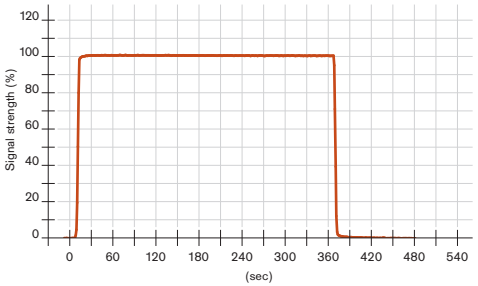
TECHNICAL SPECIFICATIONS

Detection limit:	0.3 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 200 ppm NO (nitrogen monoxide)
Response time:	≤ 10 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.3 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 20 hours
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.02 ppm/K
Sensitivity:	≤ ± 0.3% of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	approx. 3 to 175 ppm NO

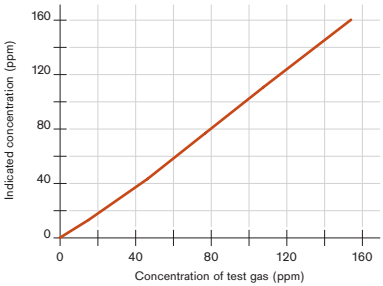
SPECIAL CHARACTERISTICS

This sensor enables a selective measurement of NO. NO_2 concentrations < 20 ppm have not effects. It also offers a very fast response time and excellent linearity across its entire measurement range.

Typical gas response of XXS NO at 20°C flow = 0.5 l/min, purging with 20 ppm NO



Linearity of NO sensor calibrated with 76 ppm NO



D-27865-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NO. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NO
Acetone	CH_3COCH_3	1,000 ppm	No effect
Ammonia	NH_3	500 ppm	No effect
Benzene	C_6H_6	0.6 Vol.-%	No effect
Carbon dioxide	CO_2	5 Vol.-%	No effect
Carbon monoxide	CO	2,000 ppm	No effect
Chlorine	Cl_2	5 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	0.1 Vol.-%	No effect
Ethine	C_2H_2	0.8 Vol.-%	No effect
Hydrogen	H_2	1.5 Vol.-%	No effect
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	5 ppm	1
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	2 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Phosphine	PH_3	2 ppm	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulphur dioxide	SO_2	10 ppm	No effect
Tetrachloroethylene	CCl_2 CCl_2	1,000 ppm	No effect
Toluene	$C_6H_5CH_3$	0.6 Vol.-%	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect

DrägerSensor® XXS NO_2

Order no. 68 10 884

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 2 years	no
Dräger X-am 2500	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Inorganic chemicals, metal processing, oil and gas, petrochemical, steel industry, shipping, rocket engineering, mining and tunneling.

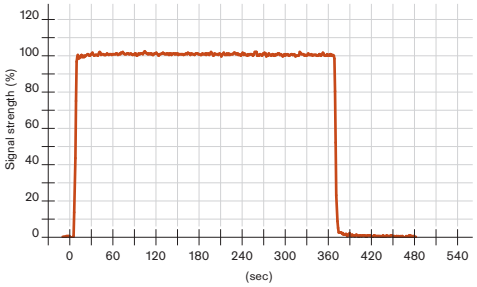
TECHNICAL SPECIFICATIONS

Detection limit:	0.2 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 50 ppm NO_2 (nitrogen dioxide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–30 to 50)°C (–22 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.2% of measured value/% RH
Test gas:	approx. 1 to 45 ppm NO_2

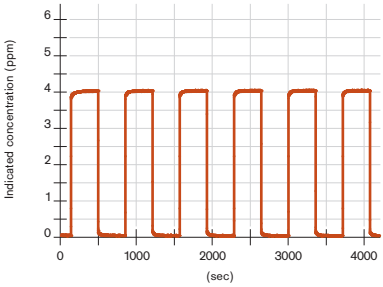
SPECIAL CHARACTERISTICS

This sensor's advantages include a fast response time and excellent repeatability. This sensor enables a selective measurement of NO_2. NO concentrations < 20 ppm do not influence the measurement results, thus a selective NO_2 measurement is possilbe.

Sensor reaction to NO_2 at 20 °C/68 °F
Flow = 0.5 l/min, 4 ppm NO_2



Repeatability of NO_2 sensors
with 4 ppm NO_2



D-27854-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NO_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NO_2
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol.-%	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 5
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 10(–)
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen chloride	HCl	20 ppm	≤ 10(–)
Hydrogen cyanide	HCN	60 ppm	≤ 10(–)
Hydrogen sulfide	H_2S	20 ppm	≤ 100(–)
Isobutylene	$(CH_3)_2CCH_2$	10 ppm	≤ 0.8(–)
Methane	CH4	1 Vol.-%	No effect
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	No effect
Phosphine	PH_3	1 ppm	≤ 4(–)
Sulphur dioxide	SO_2	20 ppm	≤ 20(–)

(–) Indicates negative deviation

DrägerSensor® XXS NO_2 LC

Order no. 68 12 600

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Mining and tunnelling (emissions from diesel-engined vehicles), inorganic chemistry, metal processing, oil & gas, petrochemical industry, shipping, rocket technology

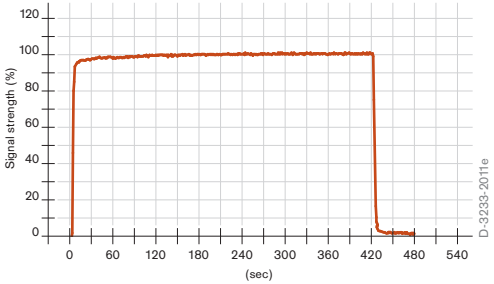
TECHNICAL SPECIFICATIONS

Detection limit:	0.04 ppm
Resolution:	0.02 ppm
Measurement range:	0 to 50 ppm NO_2 (nitrogen dioxide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F), 50% RH	
Zero point:	≤ ± 0.04 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 120 minutes
Ambient conditions	
Temperature:	(–30 to 50)°C (–22 to 122)°F
Humidity:	(15 to 80)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 0.5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 0.5 to 45 ppm NO_2

SPECIAL CHARACTERISTICS

Low cross sensitivities (e.g against SO_2, H_2S, NO and CO), which allows a selective measurement of NO_2. With a detection limit of 0.04 ppm and a quick response time this sensor is excellent to measure around the limit values.

Typical gas response of XXS NO_2 LC at 20 °C
Flow = 0.5 l/min, 1 ppm NO_2



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NO_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm NO_2LC
Acetylene	C_2H_2	100 ppm	No effect
Ammonia	NH_3	30 ppm	No effect
Arsine	AsH_3	0.5 ppm	No effect
Carbon dioxide	CO_2	5 Vol.-%	No effect
Carbon monoxide	CO	2,000 ppm	No effect
Chlorine	Cl_2	1 ppm	≤ 1.5
Chlorine dioxide	ClO_2	1 ppm	≤ 1.5
Ethane	C_2H_6	0.1 Vol.-%	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Hydrazine	N_2H_4	1 ppm	No effect
Hydrogen	H_2	0.1 Vol.-%	No effect
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	1 ppm	≤ 0.03(–)
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	5 Vol.-%	No effect
Nitrogen monoxide	NO	30 ppm	No effect
Ozone	O_3	0,5 ppm	≤ 1
Phosphine	PH_3	0,5 ppm	No effect
Propane	C_3H_8	1 Vol.-%	No effect
Sulfur dioxide	SO_2	1 ppm	≤ 0.12(–)

(–) Indicates negative deviation

DrägerSensor® XXS OV

Order no. 68 11 530

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Production of plastics, disinfection, painter, chemical industry, pest control.

TECHNICAL SPECIFICATIONS

Detection limit:	0.5 ppm		
Resolution:	0.5 ppm		
Measurement range/			C_2H_4O / CO
relative sensitivity	0 to 200 ppm C_2H_4O (ethylene oxide)	1.00	0.33
	0 to 200 ppm C_3H_6O (propylene oxide)	0.85	0.40
	0 to 100 ppm C_2H_4 (ethene)	0.75	0.45
	0 to 100 ppm C_3H_6 (propene)	0.65	0.50
	0 to 100 ppm C_2H_3Cl (vinyl chloride)	0.60	0.55
	0 to 200 ppm CH_3OH (methanol)	0.75	0.45
	0 to 100 ppm $CH_2CHCHCH_2$ (butadiene)	1.40	0.25
	0 to 100 ppm HCHO (formaldehyde)	1.50	0.20
	0 to 300 ppm $(H_3C)_2CHOH$ (isopropanol)	0.35	0.95
	0 to 200 ppm C_4H_8O (tetrahydrofuran)	0.80	0.40
	0 to 100 ppm $C_2H_3OCH_2Cl$ (1-chloro-2,3 epoxypropane)	0.35	0.95
	0 to 100 ppm $C_6H_5CHCH_2$ (styrene)	0.80	0.40
	0 to 100 ppm $H_2CC(CH_3)COOCH_3$ (methyl methacrylate)	0.35	0.95
Response time:	≤ 20 seconds (T_{50})		
Measurement accuracy			
Sensitivity:	≤ ± 5% of measured value		
Long-term drift, at 20°C (68°F)			
Zero point:	≤ ± 5 ppm/year		
Sensitivity:	≤ ± 2% of measured value/month		
Warm-up time:	≤ 18 hours		
Ambient conditions			
Temperature:	(–20 to 50)°C (–4 to 122)°F		
Humidity:	(10 to 90)% RH		
Pressure:	(700 to 1,300) hPa		
Influence of temperature			
Zero point:	± 2 ppm at (–20 to 40)°C (–4 to 104)°F		
Zero point:	± 0.5 ppm/K at (40 to 50)°C (104 to 122)°F		
Sensitivity:	≤ ± 1% of measured value/K		
Influence of humidity			
Zero point:	No effect		
Sensitivity:	≤ ± 0.2% of measured value/% RH		

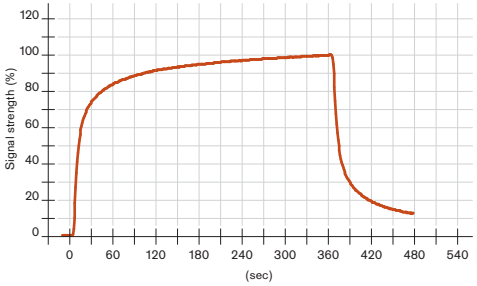
TECHNICAL SPECIFICATIONS

Test gas:	approx. 3 to 50 ppm C_2H_4O The Dräger Sensor XXS OV has a defined cross-sensitivity to carbon monoxide (CO). It can be calibrated with CO as a replacement for all of its target gases. This replacement calibration using CO can produce an additional measuring error of up to 20%. We recommend that devices are calibrated with the gas you intend to detect in actual operation. Calibration using the target gas is more accurate than replacement gas calibration. Using mixed gas please ensure the test gas does not contain NO, SO_2 or H_2S. This causes a reading on the instrument's display due to cross sensitivities.

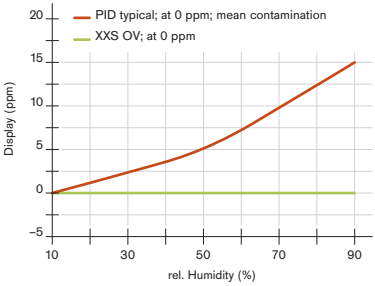
SPECIAL CHARACTERISTICS

This sensor is especially suited for detecting leakages of numerous organic gases and vapors. Although it does not detect as broad a spectrum of gases as a PID sensor, it has the key advantage of being almost completely insensitive to moisture. It also does not need to be calibrated every day, having instead a six-month calibration interval typical of electrochemical sensors.

Sensor reaction to C_2H_4O at 20 °C/68 °F
Flow = 0.5 l/min, with 20 ppm C_2H_4O



Influence of humidity on XXS OV sensors and PID sensors



D-27845-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of ethylene oxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm C_2H_4O
Acetaldehyde	CH_3CHO	55 ppm	≤ 15
Acetic acid	CH_3COOH	100 ppm	No effect
Acrylonitrile	H_2CCHCN	80 ppm	≤ 5
Ammonia	NH_3	100 ppm	No effect
Benzene	C_6H_6	2,000 ppm	No effect
Butyraldehyd	C_3H_7CHO	50 ppm	≤ 17 ppm
Carbon dioxide	CO_2	30 Vol.-%	No effect
Carbon monoxide	CO	100 ppm	≤ 33
Chlorine	Cl_2	10 ppm	No effect
Chlorobenzene	C_6H_5Cl	200 ppm	No effect
Dichloromethane	CH_2Cl_2	1,000 ppm	No effect
Diethyl ether	$(C_2H_5)_2O$	100 ppm	≤ 60
Dimethylformamide	$HCON(CH3_3)_2$	100 ppm	No effect
Ethane	C_2H_6	0.2 Vol.-%	No effect
Ethanol	C_2H_5OH	250 ppm	≤ 150
Ethine	C_2H_2	100 ppm	≤ 150
Ethyl acetate	$CH_3COOC_2H_5$	100 ppm	No effect
Hydrogen	H_2	1,000 ppm	≤ 5
Hydrogen chloride	HCl	20 ppm	≤ 5
Hydrogen cyanide	HCN	20 ppm	≤ 10
Hydrogen sulfide	H_2S	20 ppm	≤ 40
Isobutylene	$(CH_3)_2CCH_2$	50 ppm	≤ 45
Nitrogen dioxide	NO_2	20 ppm	≤ 2
Nitrogen monoxide	NO	20 ppm	≤ 20
Methane	CH_4	2 Vol.-%	No effect
Methyl isobutyl ketone	$(CH_3)_2CHCH_2COCH_3$	500 ppm	No effect
Phosgene	$COCl_2$	50 ppm	No effect
Sulfur dioxide	SO_2	20 ppm	≤ 10
Tetrachloroethylene	CCl_2 CCl_2	100 ppm	No effect
Toluene	$C_6H_5CH_3$	1,000 ppm	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect
Vinyl acetate	$CH_3COOC_2H_3$	30 ppm	≤ 30
Xylene	$C_6H_4(CH_3)_2$	0.2 Vol.-%	No effect

ST-1979-2005

D-10155-2009

DrägerSensor® XXS OV

DrägerSensor® XXS OV-A

Order no. 68 11 535

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000	no	yes	1 year	> 2 years	no
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Production of plastics, disinfection, paintshops, chemical industry.

TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm		
Resolution:	1 ppm		
Measurement range/ relative sensitivity		C_2H_4O / CO	
	0 to 200 ppm C_2H_4O (ethylene oxide)	1.00	0.33
	0 to 100 ppm H_2CCHCN (acrylonitrile)	0.15	2.20
	0 to 300 ppm $(CH_3)_2CCH_2$ (isobutylene)	0.90	0.35
	0 to 100 ppm $CH_3COOC_2H_3$ (vinyl acetate)	1.10	0.30
	0 to 300 ppm C_2H_5OH (ethanol)	0.55	0.60
	0 to 200 ppm CH_3CHO (acetaldehyde)	0.35	0.95
	0 to 200 ppm $(C_2H_5)_2O$ (diethyl ether)	0.75	0.45
	0 to 100 ppm C_2H_2 (ethine)	1.40	0.25
Response time:	≤ 40 seconds (T_{50})		
Measurement accuracy			
Sensitivity:	≤ ± 20% of measured value		
Long-term drift, at 20°C (68°F)			
Zero point:	≤ ± 5 ppm/year		
Sensitivity:	≤ ± 3% of measured value/month		
Warm-up time:	≤ 18 hours		
Ambient conditions			
Temperature:	(–20 to 50)°C (–4 to 122)°F		
Humidity:	(10 to 90)% RH		
Pressure:	(700 to 1,300) hPa		
Influence of temperature			
Zero point:	(–20 to 40)°C (–4 to 104)°F = ± 2 ppm		
Zero point:	(40 to 60)°C (104 to 140)°F = ± 0.5 ppm/K		
Sensitivity:	≤ ± 1% of measured value/K		
Influence of humidity			
Zero point:	No effect		
Sensitivity:	≤ ± 0.2% of measured value/% RH		

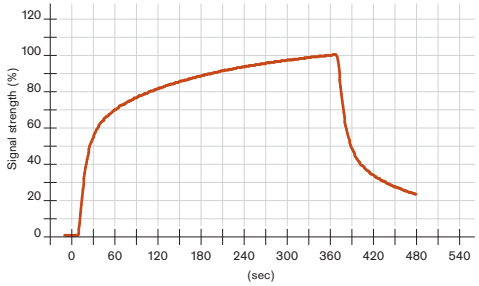
TECHNICAL SPECIFICATIONS

Test gas:	approx. 3 to 50 ppm C_2H_4O The Dräger Sensor XXS OV-A has a defined cross-sensitivity to carbon monoxide (CO). It can be calibrated with CO as a replacement for all of its target gases. This replacement calibration using CO can produce an additional measuring error of up to 20%. We recommend that devices are calibrated with the gas you intend to detect in actual operation. Calibration using the target gas is more accurate than replacement gas calibration. Using mixed gas please ensure the test gas does not contain NO, SO_2 or H_2S. This causes a reading on the instrument's display due to cross sensitivities.

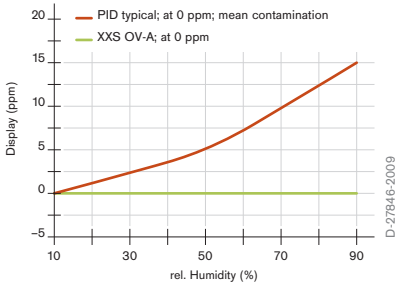
SPECIAL CHARACTERISTICS

The DrägerSensor® XXS OV-A has the same excellent characteristics as the DrägerSensor® XXS OV, but it has also been optimized for other organic gases and vapors. Just like the DrägerSensor® XXS OV, the DrägerSensor® XXS OV-A can be calibrated with CO as a replacement, although this may produce an additional measuring error of 20%. For more accurate measurements, we recommend calibrating using the target gas – i.e. the gas that you intend to detect in actual operation.

Sensor reaction to C_2H_4O at 20 °C/68 °F
Flow = 0.5 l/min, with 20 ppm C_2H_4O



Influence of humidity on XXS OV-A sensors and PID sensors



D-27846-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of ethylene oxide. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm C_2H_4O
1-chloro-2, 3 epoxypropane	$C_2H_3OCH_2Cl$	25 ppm	≤ 10
Acetic acid	CH_3COOH	100 ppm	No effect
Ammonia	NH_3	100 ppm	No effect
Benzene	C_6H_6	2,000 ppm	No effect
Butadiene	$CH_2CHCHCH_2$	50 ppm	≤ 75
Carbon dioxide	CO_2	30 Vol.-%	No effect
Carbon monoxide	CO	100 ppm	≤ 33
Chlorine	Cl_2	10 ppm	No effect
Chlorobenzene	C_6H_5Cl	200 ppm	No effect
Dichloromethane	CH_2Cl_2	1,000 ppm	No effect
Dimethylformamide	$HCON(CH_3)_2$	100 ppm	No effect
Ethene	C_2H_4	50 ppm	≤ 45
Ethyl acetate	$CH_3COOC_2H_5$	100 ppm	No effect
Formaldehyde	HCOH	40 ppm	≤ 25
Hydrogen	H_2	1,000 ppm	≤ 5
Hydrogen chloride	HCl	20 ppm	≤ 3
Hydrogen cyanide	HCN	20 ppm	≤ 8
Hydrogen sulfide	H_2S	20 ppm	≤ 40
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	≤75
Isopropanol	$(H_3C)_2CHOH$	250 ppm	≤ 110
Methane	CH_4	2 Vol.-%	No effect
Methanol	CH_3OH	100 ppm	≤ 160
Methyl methacrylate	$H_2CC(CH_3)COOCH_3$	60 ppm	≤ 25
Methyl isobutyl ketone	$(CH_3)_2CHCH_2COCH_3$	500 ppm	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 1
Nitrogen monoxide	NO	20 ppm	≤ 15
Phosgene	$COCl_2$	50 ppm	No effect
Propene	C_3H_6	50 ppm	≤ 35
Propylene oxide	C_3H_6O	50 ppm	≤ 45
Sulfur dioxide	SO_2	20 ppm	≤ 9
Styrene	$C_6H_5CHCH_2$	35 ppm	≤ 35
Tetrahydrofuran	C_4H8O	60 ppm	≤ 55
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect
Vinyl chloride	C_2H_3Cl	50 ppm	≤ 40

ST-1713-2005

D-10157-2009

DrägerSensor® XXS OV-A

DrägerSensor® XXS O_2
DrägerSensor® XXS E O_2

Order no. 68 10 881
68 12 211

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 3500	no	yes	3 years	> 5 years	no
Dräger Pac 5500	no	yes	3 years	> 5 years	no
Dräger Pac 7000	no	yes	3 years	> 5 years	no
Dräger Pac 7000 5Y	no	yes	5 years	> 5 years	no
Dräger X-am 2500	no	yes	3 years	> 5 years	no
Dräger X-am 5000	no	yes	3/5 years	> 5 years	no
Dräger X-am 5600	no	yes	3/5 years	> 5 years	no

MARKET SEGMENTS

Sewage, mining and tunneling, fumigation, biogas, hazmat, industrial gases.

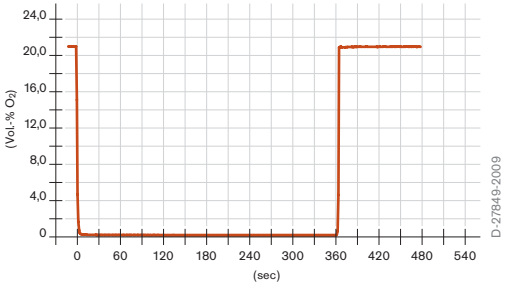
TECHNICAL SPECIFICATIONS

Detection limit:	0.1 Vol.-%
Resolution:	0.1 Vol.-%
Measurement range:	0 to 25 Vol.-% O_2 (oxygen)
Response time:	≤ 10 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.5 Vol.-%/year
Sensitivity:	≤ ± 1% of measured value/year
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–40 to 50)°C (–40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 0.2 Vol.-%
Sensitivity:	≤ ± 2% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 12 to 20 Vol.-% O_2 in N_2

SPECIAL CHARACTERISTICS

DrägerSensor® XXS oxygen sensors are lead-free, thus complying with Directive 2002/95/EC (RoHS). Because they are non-consuming sensors, they have much longer life times than sensors that are consuming. An extremely fast response time of less than ten seconds produces a reliable warning of any lack or excess of oxygen.

Sensor reaction to O_2 at 20 °C/68 °F
Flow = 0.5 l/min, with 100% N_2



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RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O_2

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% O_2
Ammonia	NH_3	500 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	≤ 0.4(–)
Carbon monoxide	CO	0.5 Vol.-%	No effect
Chlorine	Cl_2	10 ppm	No effect
Ethane	C_2H_6	1.0 Vol.-%	≤ 0.2(–)
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	2 Vol.-%	≤ 2(–)
Ethine	C_2H_2	1 Vol.-%	≤ 0.5(–)
Hydrogen	H_2	1.6 Vol.-%	≤ 2.5(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	10 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	No effect
Propane	C_3H_8	2 Vol.-%	No effect
Sulfur dioxide	SO_2	20 ppm	No effect

(–) Indicates negative deviation

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS E O_2

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% O_2
Ammonia	NH_3	500 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	≤ 0.4(–)
Carbon monoxide	CO	0.5 Vol.-%	No effect
Chlorine	Cl_2	10 ppm	No effect
Ethane	C_2H_6	1.0 Vol.-%	≤ 0.2(–)
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	2 Vol.-%	≤ 2(–)
Ethine	C_2H_2	1 Vol.-%	≤ 0.5(–)
Hydrogen	H_2	1.6 Vol.-%	≤ 2.5(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen cyanide	HCN	50 ppm	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	10 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	30 ppm	No effect
Propane	C_3H_8	2 Vol.-%	No effect
Sulfur dioxide	SO_2	20 ppm	No effect

(–) negative reading

ST-1977-2005

ST-14975-2008

DrägerSensor® XXS O2

DrägerSensor® XXS O_2 / CO LC

Order no. 68 13 275

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	1 year	> 3 years
Dräger X-am 5600	no	yes	1 year	> 3 years

Selective filter
Internal selective filter for CO.
Cross sensitivities to alcohol and acid gases (H_2S, SO_2) are eliminated.
The filter's service life can be calculated as follows: 25,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 25,000 ppm x hours / 10 ppm = 2,500 hours.

MARKET SEGMENTS

Gas suppliers, oxygen cylinders (diving), submarines, nuclear power plants

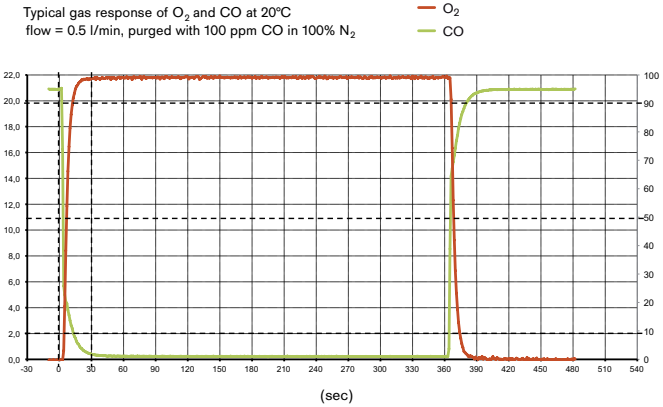
TECHNICAL SPECIFICATIONS

Detection limit:	1 Vol.-% O_2, 2 ppm CO
Resolution:	1 Vol.-% O_2, 1 ppm CO
Measurement range:	0 to 25 Vol.-% O_2 (oxygen), 0 to 2000 ppm CO
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	O_2: ≤ ± 1 % of measured value, CO: ≤ ± 2 % of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	O_2: ≤ ± 0.5 Vol.-% /year, CO: ≤ ± 2 ppm/year
Sensitivity:	O_2: ≤ ± 1 % of measured value/year, CO: ≤ ± 3 % of measured value/year
Warm-up time:	O_2: ≤ 15 minutes, CO: ≤ 30 minutes
Ambient conditions	
Temperature:	(-40 to 50)°C (-40 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	O_2 : ≤ ± 0.2 Vol.-% CO: ≤ ± 5 ppm
Sensitivity:	O_2 : ≤ ± 2 % of measured value CO: ≤ ± 0.3 % of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	O_2 : ≤ ± 0.1 % of measured value/%r.h. CO: ≤ ± 0.02 % of measured value/%r.h.
Test gas:	approx. 12 to 20 Vol.-% O_2 20 to 1800 ppm CO

SPECIAL CHARACTERISTICS

DrägerSensor® XXS oxygen sensors are lead-free, thus complying with Directive 2002/95/EC (RoHS). Because they are non-consuming sensors, they have much longer life times than sensors that are consuming. An extremely fast response time of less than ten seconds produces a reliable warning of any lack or excess of oxygen. The prominent feature of this sensor is the simultaneous measurement of % by vol. oxygen and ppm carbon monoxide in **one** sensor.

Typical gas response of O_2 and CO at 20°C
flow = 0.5 l/min, purged with 100 ppm CO in 100% N_2



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of O_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O_2 100

Gas/vapor	Chem. symbol	Concentration	Display in ppm O_2	Display in ppm CO with selektive filter
Acetylene	C_2H_2	1 Vol.-%	≤ 0.5(–)	≤ 200
Ammonia	NH_3	100 ppm	No effect	No effect
Carbon dioxide	CO_2	10 Vol.-%	≤ 0.4(–)	≤ 2
Carbon monoxide	CO	0.5 Vol.-%	No effect	
Chlorine	Cl_2	20 ppm	No effect	No effect
Ethane	C_2H_6	1 Vol.-%	≤ 0.2(–)	No effect
Ethanol	C_2H_5OH	250 ppm	No effect	No effect
Ethene	C_2H_4	2 Vol.-%	≤ 2(–)	≤ 250
Hydrogen	H_2	1.6 Vol.-%	≤ 2.5(–)	≤ 200
Hydrogen chloride	HCl	40 ppm	No effect	No effect
Hydrogen cyanide	HCN	50 ppm	No effect	No effect
Hydrogen sulfide	H_2S	100 ppm	No effect	No effect
Isobutylene	i-C_4H_8	100 ppm	No effect	No effect
Methane	CH_4	10 Vol.-%	No effect	No effect
Nitrogen dioxide	NO_2	20 ppm	No effect	No effect
Nitrogen monoxide	NO	30 ppm	No effect	≤ 5
Propane	C_3H_8	2 Vol.-%	No effect	No effect
Sufur dioxide	SO_2	20 ppm	No effect	No effect

(–) Indicates negative deviation

DrägerSensor® XXS O_2 100

Order no. 68 12 385

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	1 year	> 3 years	no
Dräger X-am 5600	no	yes	1 year	> 3 years	no

MARKET SEGMENTS

Gas suppliers, oxygen cylinders (diving), submarines, nuclear power plants

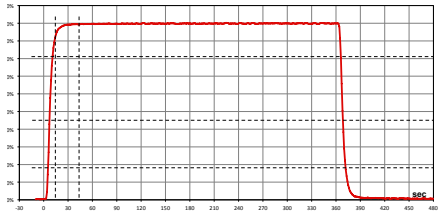
TECHNICAL SPECIFICATIONS

Detection limit:	0.5 Vol.-%
Resolution:	0.5 Vol.-%
Measurement range:	0 to 100 Vol.-% O_2 (oxygen)
Response time:	≤ 5 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.5 Vol.-%/year
Sensitivity:	≤ ± 3% of measured value/year
Warm-up time:	≤ 1 hour
Ambient conditions	
Temperature:	(0 to 45)°C (32 to 113)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,100) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.01% of measured value/% RH
Test gas:	approx. 10 to 100 Vol.-% O_2 in N_2

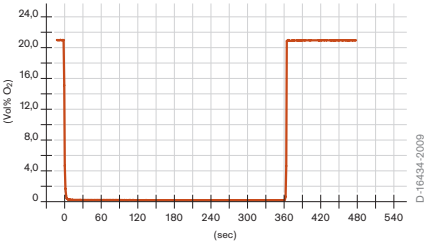
SPECIAL CHARACTERISTICS

DrägerSensor® XXS oxygen sensors are lead-free, thus complying with Directive 2002/95/EC (RoHS). Because they are non-consuming sensors, they have much longer life times than sensors that are consuming. An extremely fast response time of less than ten seconds produces a reliable warning of any lack or excess of oxygen.

Typical gas response of XXS O_2 100 at 20°C
Flow = 0.5 l/min, purged with 100% O_2



Typical gas response of O_2 100 at 20°C
Flow = 0.5 l/min, purged with 100% N_2



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of O_2. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O_2 100

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% O_2
Carbon dioxide	CO_2	5 vol.-%	≤ 1(–)
Chlorine	Cl_2	20 ppm	No effect
Helium	He	50 vol.-%	≤ 1(–)
Hydrogen chloride	HCl	40 ppm	No effect
Hydrogen sulphide	H_2S	100 ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	10 vol.-%	No effect
Nitrogen dioxide	NO_2	50 ppm	No effect
Nitrogen monoxide	NO	0.05 vol.-%	≤ 1(–)
Propane	C_3H_8	2 vol.-%	No effect
Sulphur dioxide	SO_2	50 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XXS Odorant

Order no. 68 12 535

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5000	no	yes	1 year	> 2 years
Dräger X-am 5600	no	yes	1 year	> 2 years

Selective filter

B2X (68 12 424) – replaceable.

Cross sensitivities to hydrogen sulfide (H_2S) and sulfur dioxide (SO_2) are eliminated.

The filter's service life can be calculated as follows: 1,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 1,000 ppm x hours / 10 ppm = 100 hours. The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Gas supply companies

TECHNICAL SPECIFICATIONS

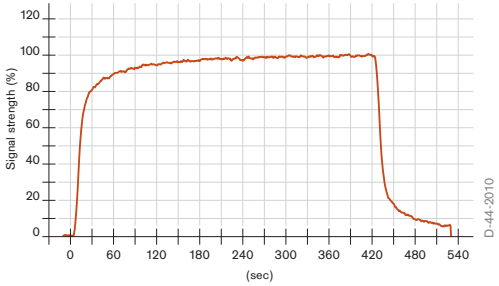
Detection limit:	1 ppm	
Resolution:	0.5 ppm	
Measurement range/	0 - 40 ppm THT (tetrahydrothiophene)	1.00
relative sentitivity	0 - 40 ppm $(CH_3)_3CSH$ (tert.-butyl mercaptane)	2.50
	0 - 40 ppm $C_2H_5CH(CH_3)SH$ (sec.-butyl mercaptane)	2.00
	0 - 40 ppm CH_3SH (methyl mercaptane)	4.00
	0 - 40 ppm C_2H_5SH (ethyl mercaptane)	3.00
	0 - 100 ppm $(CH_3)_2S$ (dimethyl sulfide)	1.80
	0 - 40 ppm CH_3SSCH_3 (dimethyl disulfide)	4.00
Response time:	≤ 90 seconds (T_{90})	
Measurement accuracy		
Sensitivity:	≤ ± 3 % measured value/month	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 2 ppm/year	
Sensitivity:	≤ ± 2% measured value/month	
Warm-up time:	≤ 12 hours	
Ambient conditions		
Temperature*:	(-20 to 50)°C (-4 to 122) °F for THT, TBM, SBM (5 to 40)°C (32 to 104) °F for MeM, EtM, DMS, DMDS	
Humidity*:	(10 to 90) % RH	
Pressure:	(700 to 1300) hPa	
Influence of temperature		
Zero point:	≤ ± 2 ppm	
Sensitivity:	≤ ± 10 % of measured value	
Influence of humidity		
Zero point:	≤ ± 0,1 ppm / % RH	
Sensitivity:	≤ ± 0,2 % of measured value/ RH	
Test gas:	THT test gas of approx. 2 to 18 ppm or an other of the target gases: $(CH_3)_3CSH$, $C_2H_5CH(CH_3)SH$, CH_3SH, C_2H_5SH, $(CH_3)_2S$, CH_3SSCH_3	

*Sudden temperature or humidity changes lead to dynamic effects (fluctuations). These dynamic effects decrease within 2 to 3 minutes.

SPECIAL CHARACTERISTICS

This sensor can be used to monitor seven different odorants in the ambient air or (for short periods) in natural gas. It is sufficient to calibrate the sensor using a THT test gas. By doing so, all of the other target gases are then automatically calibrated. In addition to a quick response time this Odorant sensor are highly selective. An internal, replaceable selective filter filters out most associated gases in natural gases like H_2S and SO_2.

Typical gas response of Odorant at 20 °C
flow = 0,5 l/min, purged with 10 ppm THT



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of NH_3. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm THT without selective filter	Display in ppm THT with selective filter
Ammonia	NH_3	200 ppm	No effect	No effect
Carbon dioxide	CO_2	1.5 Vol.-%	No effect	No effect
Carbon monoxide	CO	125 ppm	No effect	No effect
Chlorine	Cl_2	8 ppm	≤3 ppm(–)	No effect
Ethene	C_2H_4	50 ppm	No effect	No effect
Hydrogen	H_2	1000 ppm	No effect	No effect
Hydrogen cyanide	HCN	50 ppm	No effect	No effect
Hydrogen sulfide	H_2S	10 ppm	≤30ppm	No effect
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	≤3.5 ppm	≤3.5 ppm
Methane	CH_4	100 Vol.-%	No effect	No effect
Methanol	CH_3OH	200 ppm	≤5 ppm	≤5 ppm
Nitrogen dioxide	NO_2	10 ppm	No effect	No effect
Nitrogen monoxide	NO	20 ppm	≤30 ppm	≤30 ppm
n-propyl mercaptan	C_3H_7SH	6 ppm	≤4 ppm	≤4 ppm
Phosphine	PH_3	5 ppm	≤15 ppm	≤15 ppm
Sulfur dioxide	SO_2	20 ppm	≤15 ppm	No effect

(–) Indicates negative deviation

DrägerSensor® XXS Ozone

Order no. 68 11 540

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	1 year	> 2 years	no
Dräger X-am 5600	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Ozone generator manufacturer, coal-fired power plants, water treatment (drinking and industrial water), food and beverage industry, swimming pools, pulp and paper industry, pharmaceutical and cosmetics industry

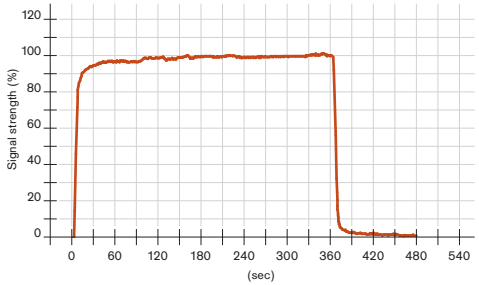
TECHNICAL SPECIFICATIONS

Detection limit:	0,02 ppm
Resolution:	0,01 ppm
Measurement range:	0 to 10 ppm O_3 (Ozon)
Response time:	≤ 10 seconds (T_{50})
Measurement accuracy	
Sensitivity:	≤ ± 3 % of measured value
Long-term drift, at 20°C (68°F)/ 50 % RH	
Zero point:	≤ ± 0.02 ppm/year
Sensitivity:	≤ ± 2 % of measured value/month
Warm-up time:	≤ 120 minutes
Ambient conditions	
Temperature:	(-20 to 50) °C (-4 to 122) °F
Humidity:	(15 to 80) % RH
Pressure:	(700 to 1300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 0.5 % of measured value/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1 % of measured value/% RH
Test gas:	approx. 0.5 to 9 ppm O_3 5 ppm NO_2 The calibration and function test can be conducted both with the target gas O_3, as well as with the replacement test gas NO_2. Surrogate calibration with NO_2 can lead to an additional measuring error of up to ± 30 %. When conducting a function test with 5 ppm NO_2 an indication of 2.8 ±0.8 ppm O_3 is expected.

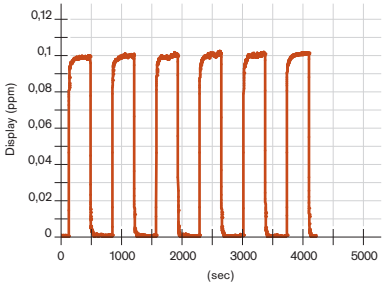
SPECIAL CHARACTERISTICS

A fast response time and excellent repeatability are just two examples of this sensor's special characteristics. With a detection limit of 0.02 ppm and a resolution of 0.01 ppm, it is also optimally suited for limit value monitoring.

Sensor reaction to O_3 at 20 °C
Flow = 0.5 l/min, 0.1 ppm O_3



Reproducibility of O_3 sensors
purged with 0.1 ppm O_3
average of five sensors



D-3235-2011e

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of Ozone. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm Ozone
Ammonia	NH_3	30 ppm	no effect
Arsine	AsH_3	0,5 ppm	no effect
Carbon dioxide	CO_2	5 Vol.-%	no effect
Carbon monoxide	CO	2000 ppm	no effect
Chlorine	Cl_2	1 ppm	≤ 0.8
Chlorine dioxide	ClO_2	1 ppm	≤ 0.8
Ethane	C_3H_6	0,1 Vol.-%	no effect
Ethanol	C_2H_5OH	250 ppm	no effect
Ethine	C_2H_2	100 ppm	no effect
Hydrazine	N_2H_4	1 ppm	no effect
Hydrogen	H_2	0,1 Vol.-%	no effect
Hydrogen chloride	HCl	40 ppm	no effect
Hydrogen cyanide	HCN	50 ppm	no effect
Hydrogen sulfide	H_2S	1 ppm	≤ 0.02 (–)
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	≤ 0.04
Methane	CH_4	5 Vol.-%	no effect
Nitrogen dioxide	NO_2	1 ppm	≈ 0.55
Nitrogen monoxide	NO	30 ppm	no effect
Phosphine	PH_3	0,5 ppm	no effect
Propane	C_3H_8	1 Vol.-%	no effect
Sulfur dioxide	SO_2	1 ppm	≤ 0.06 (–)

(–) Indicates negative deviation

DrägerSensor® XXS PH_3

Order no. 68 10 886

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger Pac 7000[1)]	no	yes	1 year	> 3 years	no
Dräger X-am 5000	no	yes	1 year	> 3 years	no
Dräger X-am 5600	no	yes	1 year	> 3 years	no

1) Selection of measuring gas in Pac 7000 not possible, only phosphine

MARKET SEGMENTS

Inorganic chemicals, fumigation, clearance measurements.

TECHNICAL SPECIFICATIONS

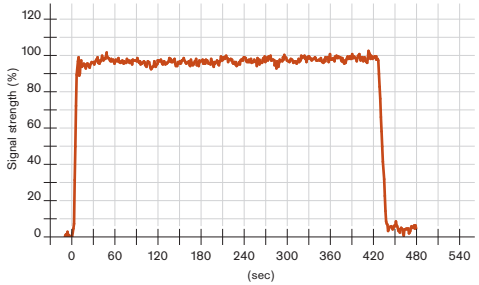
Detection limit:	0.02 ppm	
Resolution:	0.01 ppm	
Measurement range/	0 to 20 ppm PH_3 (phosphine)	1.00
relative Sensitivity	0 to 20 ppm AsH_3 (arsine)	0.90
	0 to 20 ppm B_2H_6 (diborane)	0.35
	0 to 20 ppm SiH_4 (silane)	0.85
	0 to 20 ppmH_2Se (selenium hydrogen)*	0.50
Response time:	≤ 10 seconds (T_{90})	
Measurement accuracy		
Sensitivity:	≤ ± 2% of measured value	
Long-term drift, at 20°C (68°F)		
Zero point:	≤ ± 0.05 ppm/year	
Sensitivity:	≤ ± 2% of measured value/month	
Warm-up time:	≤ 15 minutes	
Ambient conditions		
Temperature:	PH_3, AsH_3, SiH_4: (–20 to 50)°C (–4 to 122)°F	
	B_2H_6: (0 to 50)°C (32 to 122)°F	
Humidity:	(10 to 90)% RH	
Pressure:	(700 to 1,300) hPa	
Influence of temperature		
Zero point:	≤ ± 0.02 ppm	
Sensitivity:	≤ ± 5% of measured value	
Influence of humidity		
Zero point:	No effect	
Sensitivity:	≤ ± 0.05% of measured value/% RH	
Test gas:	approx. 0.05 to 18 ppm PH_3	

*With limited temperature range: 0 to 40°C dry test gas

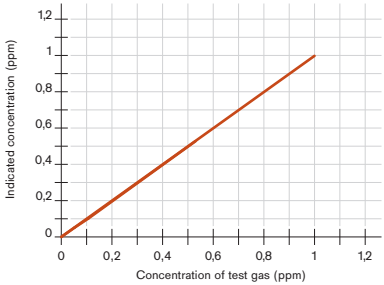
SPECIAL CHARACTERISTICS

This sensor's advantages include an extreme fast response time of less than 10 seconds for 90% of the measured signal, and its excellent linearity. It is suitable for monitoring concentrations of common hydrides such as phosphine, arsine, diborane, and silane in the ambient air.

Sensor reaction to PH_3 at 20 °C/68 °F
Flow = 0.5 l/min, with 0,1 ppm PH_3



Linearity of PH_3 sensor
calibrated with 1 ppm PH_3



D-27847-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of PH_3. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm PH_3
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 2 (–)
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	No effect
Hydrogen	H_2	1,000 ppm	≤ 0.3
Hydrogen chloride	HCl	20 ppm	≤ 1
Hydrogen cyanide	HCN	60 ppm	≤ 5
Hydrogen sulfide	H_2S	20 ppm	≤ 20
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	0.9 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 5 (–)
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	No effect
Sulfur dioxide	SO_2	10 ppm	≤ 1

(–) Indicates negative deviation

DrägerSensor® XXS PH_3 HC

Order no. 68 12 020

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	1 year	> 3 years	no
Dräger X-am 5600	no	yes	1 year	> 3 years	no

MARKET SEGMENTS

Inorganic chemicals, industry, fumigation.

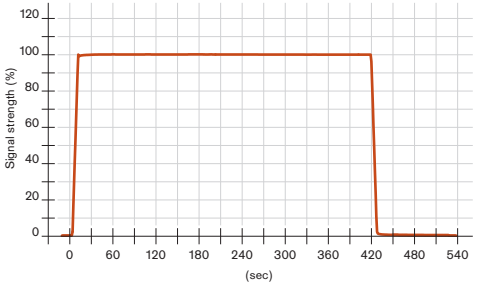
TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm
Resolution:	1 ppm
Measurement range:	0 to 2,000 ppm PH_3 (phosphine)
Response time:	≤ 10 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	No effect
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.05% of measured value/% RH
Test gas:	approx. 4 to 1,800 ppm PH_3

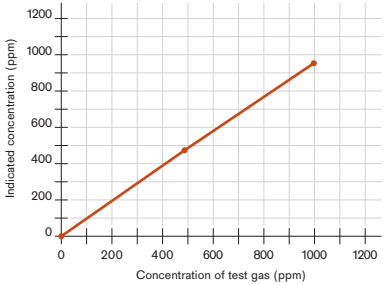
SPECIAL CHARACTERISTICS

This sensor demonstrates excellent linearity across the whole measurement range even if calibrated in the lower reaches of that range, and it also provides a stable reading even at high concentrations over long periods of time.

Sensor reaction to PH_3 HC at 20 °C/68 °F
Flow = 0.5 l/min, with 1.050 ppm PH_3



Linearity of PH_3 HC sensor
calibrated with 15 ppm PH_3



D-27848-2009

The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of PH_3. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm PH_3
Ammonia	NH_3	50 ppm	No effect
Arsine	AsH_3	5 ppm	≤ 5
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	No effect
Diborane	B_2H_6	5 ppm	≤ 3
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	No effect
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen chloride	HCl	20 ppm	No effect
Hydrogen cyanide	HCN	60 ppm	≤ 5
Hydrogen sulfide	H_2S	20 ppm	≤ 20
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH_4	0.9 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 5 (–)
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	No effect
Sulfur dioxide	SO_2	10 ppm	No effect
Silane	SiH_4	5 ppm	≤ 5

(–) Indicates negative deviation

DrägerSensor® XXS SO_2

Order no. 68 10 885

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 7000	no	yes	1 year	> 2 years
Dräger X-am 2500	no	yes	1 year	> 2 years
Dräger X-am 5000	no	yes	1 year	> 2 years
Dräger X-am 5600	no	yes	1 year	> 2 years

Selective filter

KX (68 11 344) replaceable.

Cross sensitivities to hydrogen sulfide (H_2S) are eliminated.

The filter's service life can be calculated as follows: 1,000 ppm x hours of contaminant gas. Example: Given constant concentration of 10 ppm H_2S will be: Service life = 1,000 ppm x hours / 10 ppm = 100 hours. The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Food industry, pest control, mining, oil and gas, petrochemical, paper manufacture, shipping, steel industry.

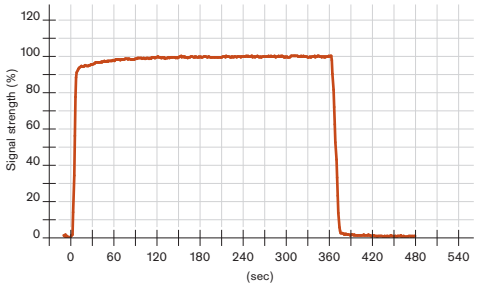
TECHNICAL SPECIFICATIONS

Detection limit:	0.1 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 100 ppm SO_2 (sulfur dioxide)
Response time:	≤ 15 seconds (T_{90})
Measurement accuracy	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 15 minutes
Ambient conditions	
Temperature:	(–30 to 50)°C (–22 to 122)°F
Humidity:	(10 to 90)% RH
Pressure:	(700 to 1,300) hPa
Influence of temperature	
Zero point:	≤ ± 1 ppm
Sensitivity:	≤ ± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 2 to 90 ppm SO_2

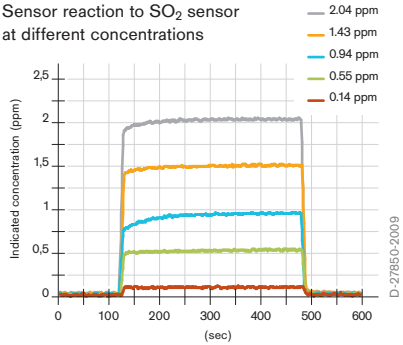
SPECIAL CHARACTERISTICS

As well as a fast response time and excellent linearity, this sensor is highly selective if the selective filter is used. The KX selective filter (order no. 68 11 344) is an accessory for the DrägerSensor® XXS EC SO_2 and eliminates the sensor's cross-sensitivity to hydrogen sulfide. The filter has a lifetime of 1,000 ppm × hours, which means that at a hydrogen sulfide concentration of 1 ppm, it can be used for 1,000 hours.

Sensor reaction to SO_2 at 20 °C/68 °F
Flow = 0.5 l/min, with 2 ppm SO_2



Sensor reaction to SO_2 sensor
at different concentrations



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by ± 30%. The sensor may also be sensitive to additional gases (for more information, please contact Dräger). Gas mixtures may be displayed as the sum of all components. Gases with a negative cross sensitivity may displace an existing concentration of SO_3. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm SO_2 without selective filter
Ammonia	NH_3	50 ppm	No effect
Carbon dioxide	CO_2	1.5 Vol.-%	No effect
Carbon monoxide	CO	200 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 5 (-)
Ethanol	C_2H_5OH	250 ppm	No effect
Ethine	C_2H_2	100 ppm	≤ 140
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen chloride	HCl	20 ppm	≤ 5
Hydrogen cyanide	HCN	20 ppm	≤ 10
Hydrogen sulfide	H_2S	20 ppm	≤ 60
Isobutylene	$(CH_3)_2CCH_2$	100 ppm	No effect
Methane	CH4	1 Vol.-%	No effect
Nitrogen dioxide	NO_2	20 ppm	≤ 30 (-)
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	No effect
Phosphine	PH_3	1 ppm	≤ 6

(–) Indicates negative deviation

4.7 Explanatory notes – sensor data

DRÄGERSENSOR

Name and type of the sensor as well as the order number

Used as follows:	Indicates the devices suitable for use with this sensor
Plug & Play:	Indicates whether this sensor has plug & play functionality
Replaceable:	Indicates whether the sensor in the device can be replaced
Warranty:	Indicates the warranty period for the sensor

Limited manufacturer guarantee

Dräger grants a limited manufacturer guarantee for products in this handbook within the specified guarantee period under the following conditions. Dräger guarantees to the End Customer a product life time for the guarantee period indicated in this handbook, beginning with the first use of the product, but not longer than the guarantee period indicated plus one year after manufacture of the product. End Customer is the person or legal entity that acquired the new and unused product for its own use and not for resale.

Dräger's obligations and End Customer's sole and exclusive remedy under the Limited Manufacturer Guarantee is limited to the replacement of the defective product with a new product. For any valid claim hereunder (as determined by Dräger in its sole discretion), Dräger will replace the product free of charge with a new unit of the same type and properties.

The End Customer must provide written notice of any claim under the Limited Manufacturer Guarantee within thirty (30) days of when the claim becomes known or should have been known and in any event within the stated guarantee period. Such notice must be provided to either Dräger or the dealer where he acquired the product.

The Limited Manufacturer Guarantee is valid only if the End Customer (i) performed all maintenance measures recommended by the manufacturer (in the published Product Specifications or instructions for use) or required by applicable law and (ii) did not use the product in any manner which is outside its intended use as provided in the Product Specifications or instructions for use. This Limited Manufacturer Guarantee excludes any damage caused to the product (a) due to any act or omission of End Customer or any other third party, or (b) caused by transport, installation, modifications to, or improper use of the product.

DRÄGER MAKES NO GUARANTEE FOR THE PRODUCT OTHER THAN THE ONE SET FORTH HEREIN OR THAT WHICH MAY BE PROVIDED IN A SEPARATE WARRANTY OR GUARANTEE COVERING THE PRODUCT. THIS GUARANTEE DOES NOT LIMIT ANY STATUTORY OR OTHER MANDATORY RIGHTS THE END CUSTOMER MAY BE ENTITLED TO.

The Limited Manufacturer Guarantee and its enforcement are subject to German substantive law to the exclusion of the UN Convention on the International Sale of Goods (CISG) and the conflict of laws rules. Place of performance is Lübeck, Germany. The courts of Lübeck, Germany shall have exclusive jurisdiction.

Selective filter:	Indicates whether this sensor has a selective filter, which could be a replaceable one. The filters eliminate the cross sensitivities of the indicated gases. Each filter has a specified service life calculated based on exposed ppm and duration.

MARKET SEGMENTS

A list of typical market segments in which this sensor is used. This list does not claim to be complete.

TECHNICAL DATA

Indicates the technical data for this sensor.

SPECIAL FEATURES

Description of the features that characterize this sensor and thus make it particularly interesting for various applications.

RELEVANT CROSS-SENSITIVITIES

Selection of gases, which may affect the sensor in typical applications. The effect of the filter is depicted in a separate column for sensors with selective filter.

TECHNICAL DATA

Detection limit:	Indicates the smallest concentration other than zero depicted in the display. For example: At a detection limit of 2 ppm, the value 2 ppm is depicted in the display as the first concentration. Concentrations lower than 2 ppm are depicted as 0 ppm.
Resolution:	Indicates the concentration increments of the display. For example: With a detection limit of 2 ppm and a resolution of 1 ppm, the concentrations are depicted in the following increments: 2 ppm / 3 ppm / 4 ppm ...
Measurement Range:	Indicates the maximum measuring ranges of the sensor. All gases/ vapors with their ranges are indicated if a sensor can be used for different gases and vapors.
Relative sensitivity:	Some sensors are suitable for the measurement of different target gases. The various cross sensitivities of these target gases are in general stated in the sensor information under the item measurement range. The sensitivity factor refers to a defined gas and is called relative sensitivity. With these sensitivity factors interferences (cross sensitivities) or calibration factors can be calculated. **Example XXS OV:** The defined gas for an XXS OV sensor is ethylene oxide (EO). The relative sensitivity of carbon monoxide (CO) related to EO is 0.33. Meaning, an XXS OV sensor calibrated to EO will give a reading of 33 ppm when exposed to 100 ppm CO. The given values are guiding values and apply to new sensors. Gas mixtures may be displayed as the sum. Therefore, it should be examined whether gas mixtures are present. Gases with a negative sensitivity may offset the positive display of the calibration gas.
Response time:	Typically, the times listed here are T_{50} or T_{90} at 20°C (68°F), 50% r.h., 1013 mbar. These times indicate when 50 % or 90 % of the final signal has been reached.
Measurement accuracy:	The data presented here relate to the sensitivity: For example, if a measuring accuracy of ≤ ± 3 ppm of the measured value is indicated for the sensitivity, then the following can be said about the measuring accuracy: The concentration is between 97 and 103 ppm if 100 ppm is displayed.
Long-term drift:	This information indicates the typical drift of the sensor in the zero point and in the sensitivity across a longer period. This data may refer to a month or a year. The long-term drift data of ≤ ± 0.2 ppm/year at 20° C (68°F) states that this sensor drifts max. ≤ ±2 ppm per year. A value for the long-term drift of the sensitivity of ≤ ± 2 ppm/month, indicates that after two months with a display of 100 ppm, the gas concentration may be between 96 and 104 ppm at maximum.
Warm-up time:	The warm-up time indicates the amount of time needed before a newly installed sensor or a sensor, which was without electricity for a period of time and then is powered up again, can be calibrated. However, the sensor may be ready for use after only a few minutes. In this case, there may be a higher rate of measurement errors.

Ambient conditions:	Indicates the temperature, humidity and pressure range in which the sensor may be used. The indicated corrections do not apply with measurements outside of the permissible ambient conditions. Dräger is pleased to offer you additional advice on how to meet your specific requirements. Please contact the respective branch office if you require assistance. The addresses are listed on the rear cover page of this manual.
Influence of temperature:	The effect of temperature must be considered when the measurement temperature deviates from the temperature during the calibration. **Example 1:** Temperature effect on the sensitivity amounts to ≤ ± 5 % of the measured value. This means that the max. deviation across the entire temperature range of the sensor (typically - 40 to 50°C or - 40 to 122°F) is expected to be ≤ ± 5 %. At an ambient temperature of, for example, - 10° C (14°F) and a displayed value of 100 ppm, the gas concentration may be between 95 and 105 ppm at maximum. The temperature difference between the temperature of the measurement and the temperature of the calibration must be taken into account with some sensors. **Example 2:** The effect of temperature on the sensitivity is ≤ ± 0.5 % of the measured value / K. The sensor was calibrated at 25°C (77°F), the measurement is taken at an ambient temperature of 35°C (95°F). The temperature difference is then 10°C (14°F) or 10 K. This yields the following calculation: 10 x 0.5% = 5% With an ambient temperature of 35°C (95°F) and a displayed value of 100 ppm, the gas concentration is between 95 and 105 ppm at maximum.
Influence of humidity:	The effects of humidity must be considered if the humidity during measurement deviates from the calibration humidity. **Example 1:** The effect of humidity on the sensitivity is ≤ ± 0.5 % of the measured value. This means, that a deviation of maximum ≤ ± 5 % over the entire humidity operating range (typically (10 to 90)% RH) must be taken into account. With an ambient humidity of 50 %, for example, and a displayed value of 100 ppm, the gas concentration may be between 95 and 105 ppm at maximum. The humidity difference between the humidity of the measurement and the humidity of the calibration must be taken into account with some sensors. **Example 2:** The effect of humidity on the sensitivity is ≤ ± 0.02 % of the measured value / % rel. humidity. The sensor was calibrated at 0% rel. humidity, the measurement is taken at an ambient rel. humidity of 50 %. The difference of the rel. humidity is then 50 %. This yields the following calculation: 50 x 0.02 % = 1 % With an ambient humidity of 50 % and a displayed value of 100 ppm, the gas concentration is between 99 and 101 ppm at maximum.
Test gas:	Recommended test gas concentration for calibrating the sensor.

5 Accessories

5.1 Introduction

Dräger offers a range of accessories to ensure that you can make optimal use of your gas detector for your specific application. We also help you maintain your device and make sure that it is kept ready for operation.

Safety

Measuring devices that are not operating correctly do not provide protection and can lead to accidents. Testing these devices (bump test) is the only way to guarantee reliable and correct measurement of and warning against gas hazards.

Enhanced functionality

Using the correct accessories can enhance the functionality of gas detectors. For example, a personal detection device can be converted into a leak detection or clearance measurement device in confined spaces by using an external pump, probe or an extension hose. It is important that you choose the accessory that is best suited for your application.

Configuration/Documentation/Archiving

Setting the parameters of the gas detectors always becomes important when limit values change or if the gas detector is used for another application. This is where we provide after-sales support: and the PC software helps you with the configuration. The documentation is also extremely important: Who performed which test and what was the result? Where have the calibration certificates been filed?
Our solutions also provide support in this area.

Evaluation

A data logger collects numerous measured values and results – but the data remains idle until it is evaluated. That's why we help you prepare the data: this includes graphic displays and easy navigation in the data logger – as well as automatic reports, e.g. if an alarm is triggered or a calibration interval is exceeded.
Solutions to make sure that you always stay on top of your process.

5.2 The bump test

Anyone looking for a definition of the bump test will struggle to find a clear and straightforward explanation. This important test is performed in a variety of different ways in practice. When designing the test system you need to ask: what significance do "I" expect from the bump test?

a) Does the device need to show that it works in principle and that "gas" is reaching the sensors to be checked (qualitative finding)?
b) Or do I need a quantitative finding, i.e. whether the device is still providing measurements that are "accurate enough"?

Dräger provides two different categories of the bump test:

The quick bump test

The quick bump test checks whether the relevant sensor exceeds the first alarm threshold after applying an "appropriate" test gas. Additional safety measures are available (e.g. the sensor may need to be above the alarm threshold for a certain amount of time) but, in principle, the test threshold is the alarm threshold configured in the device.
A test gas is "appropriate" if it is not "too far" above the first alarm threshold, as this would otherwise mean that the gas test would only fail after a dramatic loss of sensitivity. A limit must also be maintained in the event of a more qualitative test. Dräger provides recommended limits for these tests.

The extended bump test

The advanced bump test checks whether the tested sensor complies with the test gas concentration within a tolerance window after an "appropriate" test gas is applied. This test includes a quantitative finding and increases safety.
The sensor also has an impact on whether the test gas is "appropriate". A test close to the alarm thresholds is often advisable, but many sensors are also linear so that the permitted range is much larger than for the quick test, as the "test threshold" is always adjusted. This allows the accuracy to be determined at almost any point within the measuring range. However, the selection of a range that corresponds to the measuring task is advisable. Dräger also provides recommended ranges for the permitted test gas concentrations.
The CC-Vision software lists the permitted calibration ranges for every individual sensor (and every selected test gas) for both the quick and the extended bump test. In many cases the gas detector – or even the Dräger X-dock – does not accept concentrations outside this range.

The following table helps you select the appropriate bump test for you:

	Quick bump test	Extended bump test
Test duration	●●	●
Gas consumption	●●	●
Behaviour for "special gases" (high adsorption)	●	●
Check for accuracy / residual sensitivity	●	●●
Behaviour when applying the incorrect gas (e.g. incorrect concentration set or undefined cross-sensitivity, as the incorrect test gas cylinder is connected; residual gas in the hose, etc.)	●	●●
Permitted test gas concentration range (minimum and maximum accepted concentration)	●	●●
Testing below A1 possible	●	●●

5.3 Devices for calibration and functional testing

Portable gas detectors are used for continuous measurement and support you in every application. As a result, it is important to check the devices for operational readiness by applying test gas and evaluating the result. This not only ensures that the sensors themselves are ready for measurement, but that the access to the sensor is not blocked by dust or dirt. An calibration should also take place at regular intervals, as factors such as environmental influences or ageing can have an impact on the sensor sensitivity.

National guidelines also prescribe bump tests and calibrations, such as information sheet T021 (gas warning devices for toxic gases/vapours) or T023 (gas warning devices for explosion protection) by the "Rohstoffe und chemische Industrie" (raw materials and chemicals industry) liability insurance association (BG RCI) in Germany. The applicable standard for the member states of the European Union, EN 60079-29-2 "Gas detectors – Selection, installation, use and maintenance of detectors for flammable gases and oxygen", also prescribes the implementation of a sensitivity test directly prior to use (international: IEC 60079-29-2).

5.4 Manual bump test

ST-5006-2005

The simplest and most cost-effective option for testing the function of a portable gas detector is to perform a manual bump test with test gas. This only requires an appropriate test gas cylinder, a corresponding pressure reducer and a calibration adapter for the specific device. Briefly applying the test gas to the sensors triggers the instrument alarm. Make sure that an adequate test gas concentration is applied! Depending on the type of device, it can be calibrated – in the same arrangement – using the device software or a PC with the Dräger CC-Vision software. This software allows the user to configure and calibrate the devices in line with their individual requirements.

5.5 The Dräger Bump Test Station

ST-4700-2005

The Dräger Bump Test Station facilitates the performance of an everyday bump test, as the test is evaluated by the devices themselves and the test gas is automatically applied on insertion. In addition, most devices are able to automatically identify the station and switch to bump test mode without having to perform any manual activities.

Dräger devices Dräger Pac 3500, 5500 and 7000, Dräger X-am 2500, 5000 and 5600 as well as the X-am 7000 are supported. The Dräger Bump Test Station does not require a power supply – the evaluation itself is performed by the gas detector. The documentation also takes place in the gas detector, within the data logger. The device must be configured for the type of bump test and the required test gas concentration.

The sensors' rapid response time ensures a quick test in under 12 seconds in some cases. The lower gas consumption and time saving reduce the operating costs.

5.6 Dräger X-dock – more than just a test station

D-47870-2012

The Dräger X-dock automatic test and calibration station is the modular solution for the daily bump test as well as a workshop and fleet management solution.

The X-dock can be operated independently as an individual station – a PC is not required. This gives you the benefit of a range of options at every location: the X-dock can perform quick or advanced bump tests or even perform calibrations, readout the data logger and check the gas detector's alarm elements or the sensors' response times. These individual test steps can be configured – and the three most important objectives are always ensured:

1. Ease of use:
   The simplest test: insert and close the lid – the rest takes place automatically.
2. Short test time:
   An advanced pneumatics system provides extremely short test times.
3. Low gas consumption:
   The short test time as well as the gas flow, which has been reduced to 300ml/min, reduces the gas consumption significantly, which also helps to reduce costs. In addition, the X-dock immediately switches off valves once a test gas is no longer required for a certain test step and the device has completed the test.

This system combines ease of use with low operating costs – but with full documentation. Everything that the X-dock performs is stored in the internal database. If the station is used as an individual station, the results can be exported as a PDF or printed on any conventional postscript-enabled printer.
This means that the system is scalable: whether you use one or ten modules on a master is up to you.
The Dräger X-dock independently detects the test gases that are required. The touchscreen can be used to program the connected gas cylinders – the X-dock station performs everything else automatically. Up to six test gas cylinders can be connected to a master and these test gases can themselves consist of gas mixtures. This covers almost every application.
However, the highlight is a possible expansion: X-dock stations can be connected to a network. The data is synchronised and stored on a server.

The X-dock Manager PC software makes data evaluation as easy as pie:

Which calibrations are coming up or are even overdue? Has a device not been checked? Has an alarm been triggered in operation and when are the X-dock stations engaged? Questions that the X-dock Manager conveniently answers.
If you still need more, the X-dock also provides a range of special functions for your application: for example, the X-dock can be used as a charging station for X-am 125 devices – this function is ideally supplemented by the test planner function, which performs the set test on a predetermined schedule (e.g. daily).

Take the time to find out what the Dräger X-dock can do for you!

Geräte	Dräger Bump Test Station	Dräger X-dock Station	Basic test with gas	Dräger CC-Vision software
Dräger Pac 3500/5500/7000	■	■	■	■
Dräger X-am 2500/5000/5600	■	■	■	■
Dräger X-am 5100				■
Dräger X-am 7000	■		■	■

5.7 Test gases and accessories

D-37353-2015

Test gases are an essential part of the bump test. Only an **appropriate** test gas can verify a gas detector's functionality and it is just as important for calibration.
A high standard of quality is required as test gases are a key element of the safety chain. Dräger test gases are produced pursuant to ISO 9001 and guarantee a globally valid quality standard. Single as well as mixed gases are available.

Once the test gas cylinders are completely empty they can be transported to a scrap metal facility and disposed of in an environmentally friendly manner, which means that customers do not have to pay any rental or transport costs.

5.8 Pressure reducer

The history of Dräger started with a patent for a pressure reducer – and every system that needs a test gas cylinder also needs a pressure reducer. Gases are pressurised so that the cylinder can hold more than its actual volume. This pressure now needs to be reduced for the application (e.g. the bump test) – this requires a pressure reducer.

Some pressure reducers reduce the pressure to a set level (e.g. 0.5 bar). The flow rate is then determined by the line resistances or any flow control valves.

There are also pressure reducers that regulate a fixed volume flow – e.g. 0.5 l/min. In this case, the pressure is adapted according to the resistance in order to ensure a constant volume flow.

The correct pressure reducer for the system needs to be selected. Pressure reducers can naturally also be reused. They have a screw thread and can be adapted from one test gas cylinder to the next at any time.

ST-4809-2005

Trigger control valve

APPLICATION

For the quick functional test before devices are used

Manually pressing the trigger briefly applies test gas to the gas detector's sensors. Raising the trigger fixes the control valve in the open position and provides a continuous gas flow of 0.5 l/min.

ST-4806-2005

Basic valve

For devices without an internal pump

Standard pressure reducer with thumbwheel to manually open and close the gas outlet. Volume flow: 0.5 l/min.

ST-4804-2005

On-demand control valve

For devices with an internal pump

The pump's suction automatically opens the valve and can be used with devices with internal pumps. Volume flow: 0.5 l/min.


D-98769-2013

Stainless steel valve

APPLICATION

Special stainless steel valve for aggressive gases
This stainless steel valve is ideal for reactive gases, such as chlorine or ammonia. The valve is opened and closed using a thumbwheel.


D-47929-2012

Fixed pressure control valve

Constant pressure control valve for Dräger X-dock
With a pre-set pressure of 0.5 bar, specifically designed for the use with the Dräger X-dock Station. Available as a nickel-plated version or in stainless steel for reactive gases, such as chlorine or ammonia.


D-43511-2014

Fixed pressure control valve

Constant pressure control valve with flowstop for Dräger X-dock
With a pre-set pressure of 0.5 bar, specifically designed for the use with the Dräger X-dock Station. The installed flowstop prevents gas from accidentally escaping from the cylinder.

5.9 Pumps


ST-4990-2005

Dräger X-am 7000 with pump adapter

In certain situations confined spaces need to be checked and cleared before they can be accessed. In this case, the ambient air from the room needs to be fed into the measuring device while ensuring that the person using the device does not have to access the space. Pumps equipped with a hose and probe are ideal for performing a measurement from a safe distance.
A pump is also required for leak detection, in order to connect the corresponding probe to the gas detector.

The Dräger X-am 7000 can be equipped with an integrated high-performance pump.

ST-9477-2007

Dräger X-am 1/2/5000 pump

In both cases, a corresponding adapter ensures that the device can be used as either a diffusion unit or a pump unit. I.e. you can use the device in diffusion mode (pump-free), even if you decide on an internal pump.

The external Dräger X-am 1/2/5x00 pump is available for the Dräger X-am 2500/5000 and 5600 product family. When the detector is inserted the pumping function starts automatically and initiates a flow test. The pump is immediately ready for operation following a successful flow test and is able to be operated with a hose up to 30 m long. Performing a flow test prior to every commissioning ensures the safe and reliable use of the pump. An easily replaceable dust and water filter protects the pump and the device sensors from contamination – because, as a general rule: anyone working with a pump and hose should use a water filter!

5.10 Probes

Pump-supporting measurements without probes are almost unimaginable as various tasks need to be fulfilled depending on the application.
Is selective suction required or does it need to be within a certain area? Is a rigid connection adequate or does the probe need to have a flexible neck? Is a telescopic probe required? How big is the opening available for the measurement?

We have the right probe in all of these cases.

ORDER NUMBER	NAME		LENGTH	MATERIAL	FOR USE WITH GAS DETECTION DEVICES	USES
83 17 188	Bar probe 400	 D-25398-2009	40 cm 1.3 ft.	Stainless-steel probe with an external diameter of 10 mm (0.4 in.).	X-am 7000 X-am 2500 X-am 5000/5600	This probe is particularly durable. It is used for applications such as pre entry measurements in gas-filled containers, where it is necessary to obtain air samples through closed seals.
64 08 160	GL probe (German Lloyd probe)	 D-25393-2009	50 cm 1.6 ft.	Stainless-steel probe with an external diameter of 6 mm (0.24 in.).	X-am 7000 X-am 2500 X-am 5000/5600	Measurements in hatchways on ships.
83 16 531	Leakage probe 70	 ST-14995-2008	70 cm 2.3 ft.	Flexible metal tube with an integrated Viton hose. External diameter of 10 mm (0.4 in.) Tested for gases of the group IIC in the areas Zone 0 and Zone 1, test report BVS PB 18/13 (DEKRA/Exam).	X-am 7000 X-am 2500 X-am 5000/5600	This flexible probe can measure “round corners,” making it especially useful for difficult to reach places where there is a risk of explosion.
83 16 532	Bar probe 90	 D-25396-2009	90 cm 3.0 ft.	Probe made from carbon-fiber reinforced plastic with an external diameter of 8 mm (0.3 in.).	X-am 7000 X-am 2500 X-am 5000/5600	With its fixed length, this probe can be used for any applications involving distances of 90 cm (2.9 ft.) such as confined space entry.
83 16 530	Telescopic probe 100	 ST-14992-2008	1 m 3.3 ft.	Metal probe with an integrated Viton hose. External diameter of 12 mm (0.47 in.). Tested for gases of the group IIC in the areas Zone 0 and Zone 1, test report BVS PB 18/13 (DEKRA/Exam).	X-am 7000 X-am 2500 X-am 5000/5600	Extendable to lengths of up to 1 m (3.3 ft.). Suitable for areas where there is a risk of explosion.

ORDER NUMBER	NAME		LENGTH	MATERIAL	FOR USE WITH GAS DETECTION DEVICES	USES
83 16 533	Telescopic probe ES 150	 ST-14997-2008	1.5 m 4.9 ft.	Stainless-steel probe with an integrated Viton hose. External diameter of 12 mm (0.5 in.). Tested for gases of the group IIC in the areas Zone 0 and Zone 1, test report BVS PB 18/13 (DEKRA/Exam).	X-am 7000 X-am 2500 X-am 5000/5600	Extendable to lengths of up to 1.5 m (4.9 ft.). Suitable for areas where there is a risk of explosion; solvent-resistant.
64 08 239	Measurement probe	 D-25392-2009	1.5 m 4.9 ft.	Aluminum probe with with an integrated PVC hose. External diameter of 10 mm (0.4 in.).	X-am 7000 X-am 2500 X-am 5000/5600	With its fixed length, this probe can be used for any applications involving distances of 1.5 m (4.9 ft.). The tip of the probe is perforated for the last 15 cm (0.5 ft), enabling sampling in media such as grain sacks and dry bulk solids.
68 01 954	Plugable telescopic probe	 ST-14968-2008	2 m 6.6 ft.	Plastic probe with an integrated rubber hose. External diameter of 13 mm (0.5 in.).	X-am 7000 X-am 2500 X-am 5000/5600	A probe 2 m (6.6 ft.) in length whose plug-in system makes it compact and easy to carry. Universal usage.
83 18 371	Float probe incl. hose	 D-10391-2009	5 m 16.4 ft.	Probe: Polycarbonate. Viton hose with external diameter of 8 mm (0.3 in.) + water and dust filter.	X-am 7000 X-am 2500 X-am 5000/5600	For measurements in drainage and sewage systems. Solvent-resistant.
68 07 097	Float probe incl. hose	 D-10391-2009	10 m 32.8 ft.	Probe: Polycarbonate. Tube: CR-NR [polychloroprene (CR) with natural rubber (NR)] with an external diameter of 9 mm (0.35 in.).	X-am 7000 X-am 2500 X-am 5000/5600	Electrically conductive.

5.11 Hoses

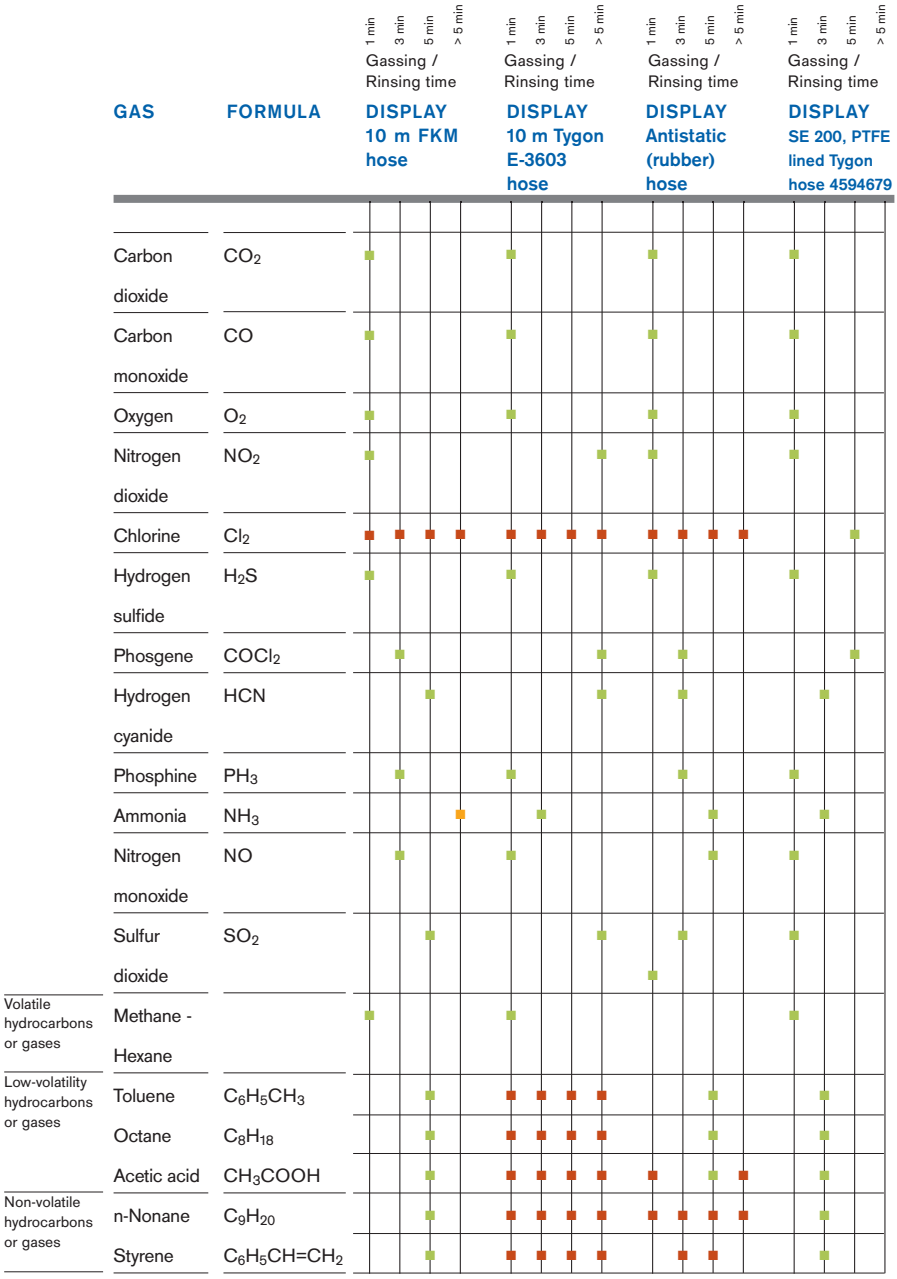
An extension hose, together with pumps, is always required if the air quality has to be assessed from distant measuring points, such as at the base of a silo, a cargo chamber on a ship, or a sewer. Two points must be considered: the hose length and the hose material. The pumping capacity is critical when determining the length of the hose. The pumping capacity of the Dräger X-am 1/2/5x00 pump is designed for 30 m and for 45 m for the X-am 7000.

The adsorption behaviour of the gases to be measured on the surface of the hose must be considered when selecting the hose material.
Three different hose materials have proven themselves in practice and are suitable for certain gas families. The following table will help you choose the hose that is right for you.

PROPERTIES

	Fluororubber 1203150	**Tygon 8320766 E-3603**	**Rubber 1180681**	**Tygon with internal PTFE coating 4594679**
Material	FKM	PVC	CR-NR DWN 2715	PVC with PTFE
Chemical name	Fluororubber	Polyvinyl chloride	Polychloroprene (CR) with natural rubber (NR)	Tygon shell and interior polytetra-fluoroethylene (PTFE) coating
Inner Ø	5 mm	5 mm	5 mm	5 mm
Outer Ø	8 mm	8 mm	9 mm	8 mm
Hardness	75 Shore A	55 Shore A	60 Shore A	
Colour	Black	Transparent	Black	Transparent
Benefit	Suitable for vapours	Transparent	Conducts electricity	Specifically for aggressive gases such as chlorine
Operating range	-15 °C to + 200 °C	-46°C to + 74 °C	-30°C to +134°C	-36°C to 74°C
Use in explosion-hazard area	Suitable		Suitable	

TEST RESULTS AND MEASUREMENT RECOMMENDATIONS



5.12 Dräger CC-Vision Basic

CC stands for calibration and configuration. It describes the two main functions of this PC software. This software ensures the professional configuration and calibration of Dräger gas detectors as well as the documentation of the results.
Whether it be alarm thresholds, turn off behaviour, or measured and calibration gas, CC-Vision Basic helps you configure your gas detectors – even if you want to duplicate configurations and transfer these to other devices.
The device functions are clearly displayed on the screen in a tree structure and allow to set the device parameters quickly and individually and to calibrate the sensors.
Anyone who has purchased a Dräger X-dock and the X-dock Manager will naturally want to use them to manage all of their devices. However, the CC-Vision Basic is not a contradiction in terms. The CC-Vision Basic sets the parameters of individual devices, while the X-dock sets the parameters of entire groups of devices based on the specifications provided by the CC-Vision Basic.
The Dräger X-dock and the Dräger CC-Vision Basic work in perfect symbiosis to provide even better support for your processes.

Test it for yourself and download CC-Vision Basic free of charge from:
www.draeger.com/software

5.13 Dräger GasVision

The gas detector's data logger provides a wealth of information – but the trick is to find the relevant information and process the data accordingly.
This is where the Dräger GasVision software provides support. The data logger provides both a graphic AND tabular display to conveniently navigate through the data.

- Zoom into certain areas to look at these in detail
- Display the TWA, average value, MAX and MIN values for marked areas
- Export data to Excel
- Directly display the measured data of a connected device

This visualisation of the data allows hazardous situations to be detected and appropriate measures to be introduced.

Concluding remark

This chapter only covers part of the extensive accessories available. In addition to pump, calibration and communication accessories, a large range of pockets and cases (with or without equipment) and various power packs complement the group of accessories that can be adapted to the relevant application. The services, such as maintenance contracts, full service maintenance contracts and the all-inclusive worry-free package or training, such as service technician training, round out the gas detector technology area. Our branch employees are more than happy to provide advice on these products and services.

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