DrägerSensor® & Portable Instruments Handbook

5th Edition

Dräger. Technology for Life®

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Dräger Safety AG & Co. KGaA
Lübeck, Germany
2021

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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CONTENTS

Dräger Services
Product Service
Rental Service
On-site Safety Service
Shutdown Safety Service
Training
Pac® 8000
Pac® 6000
Pac® 8500
Pac® 6500
X-am® 2500
X-am® 5000
X-am® 5100
X-am® 5600
X-act® 5000 Basic
Dräger-Tubes®
accuro®
MicroTubes
X-act® 7000
X-pid® 9000/9500
X-am® Pump
X-am® 3500
X-am® 8000
Personal Air Monitoring
Active Search/CSE
Area Monitoring
Dräger Sensors®
X-zone® 5500
X-zone® Com
X-am® 8000
Bump Test Station
Test Gases
X-dock® 5/6x00 Calibration and Test System
Workshop Solutions
Software Solutions
Gas Detection Trainings App
Tubes App
CSE Connect
X-dock® Manager
CC-Vision Gas Vision

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1 Introduction

Dear readers,
The world keeps turning and new challenges await us. As a result of this constant change, we, Dräger Safety AG & Co. KGaA, are constantly working to further develop the known quality and to adapt it to new requirements. We are pleased to present already the fifth edition of our DrägerSensor® & Portable Instruments Handbook.

The additional requirements of today are, among others, the topic „Connectivity“ or also the „measurability of carcinogenic concentrations of hazardous substances“. With the information on the following pages, we therefore provide you new solutions to have an answer to this challenge.

Among other things, you will find information on

– our portable gas chromatograph „Dräger X-pid“ with the corresponding PID sensors e.g. for selective measurements of BTEX mixtures (benzene, toluene, ethylbenzene and xylenes) in an explosive atmosphere.

As in the past, this handbook is intended to support you in your daily tasks with the information you need about DrägerSensors and Dräger portable gas detection technology. The experiences you share also help us to continuously develop the handbook. Suggestions, correction notes and criticism from you were also implemented in this issue. As we all know, the devil is in the details. We would therefore like to thank everyone involved in the creation.

We are pleased to present the fifth edition of our DrägerSensor® & Portable Instruments Handbook, with which we would like to pass on to you our experience and application notes in dealing with the sensors used in the mobile gas detection technology.
We hope to support you in the assessment of your individual challenges.

In this spirit, we wish you every success in your daily challenges and hope you find the information you need for your daily work.

Your Product Management Team 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).

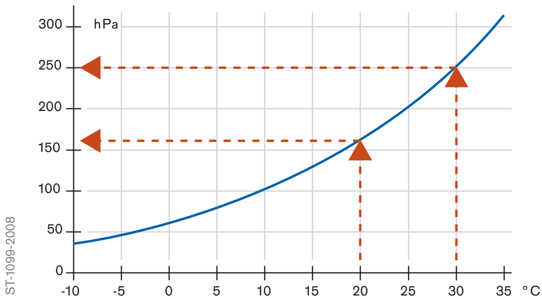
2.2 Vapors – aren't they gases, too?

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



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
-1.000 (-3280.8)	1.148 (16.6)
-500 (-1640.4)	1.078 (15.6)
0 (0)	1.013 (14.7)
500 (1640.4)	952 (13.8)
1.000 (3280.8)	900 (13.1)
1.500 (4921.2)	840 (12.2)

Altitude m/ft.	Atmospheric pressure hPa/psi
2.000 (6.561,7)	795 (11.5)
3.000 (9.842,5)	701 (10.2)
4.000 (13.123,3)	616 (8.9)
5.000 (16.404,2)	540 (7.8)
6.000 (19.685,0)	472 (6.8)
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 $LC_{50} < 0.5\ g/m^3$

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 $LC_{50} = 0.5 \ldots 2.0\ g/m^3$

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).

Carcinogenic substances

However, many substances do not develop their lethal effect until years after exposure. A still frequently underestimated risk for workers - and an enormous challenge for occupational safety - are carcinogenic substances such as formaldehyde or benzene. Basically, carcinogens are defined as substances that can cause cancer or promote the development of cancer. They can enter the body through inhalation of the ambient air, through food, but also through the skin. For carcinogenic hazardous substances in the workplace, the exposure time is decisive, i.e. the period during which workers are exposed to such a substance.

Most carcinogens do not exert their carcinogenic effects during short-term exposure. Thus, a long-term exposure to carcinogens in the workplace increases the risk of causing cancer. In this respect, even small amounts can have a damaging effect. The risk of developing cancer from exposure to a carcinogen remains for life, as some cellular damage does not have an effect until years after exposure. This includes the way in which one is exposed to the carcinogen, the length and intensity of the contact, and any genetic predisposition.

Carcinogenic substances are therefore the ‚time bombs‘ among hazardous substances in the workplace.

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	1.0	38.3	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)	2.0	35.0	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

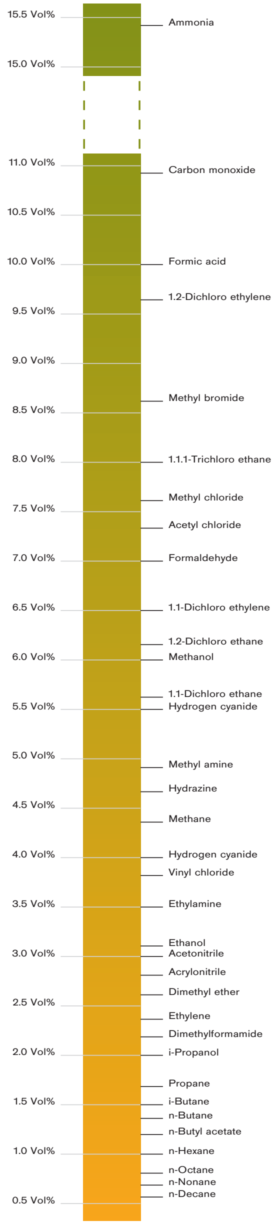
Flammable gases and vapors can form ignitable mixtures when combined with air, but the ratio of flammable gas to oxygen (or air) must lie within certain limits.

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.



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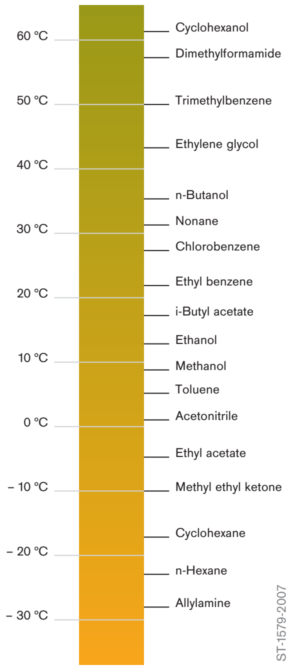
2.8 Flash point of flammable liquids

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 (μL/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/m3 1 cL/L	1	10^4	10^7
ppm =	mL/m3 μL/L	10^{-4}	1	10^3
ppb =	μL/m3 nL/L	10^{-7}	10^{-3}	1

		g/L	mg/L	mg/m^3
g/L =	10 L/m3 1 cL/L	1	10^3	10^6
mg/L =	mL/m3 μL/L	10^{-3}	1	10^3
mg/m3	μL/m3 nL/L	10^{-6}	10^{-3}	1

Converting mg/m^3 into ppm

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

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.

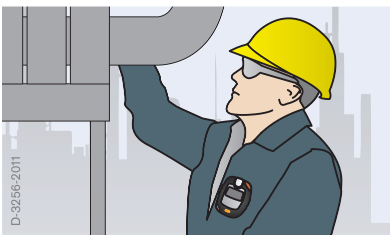
3.1 Application areas for portable gas detection

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

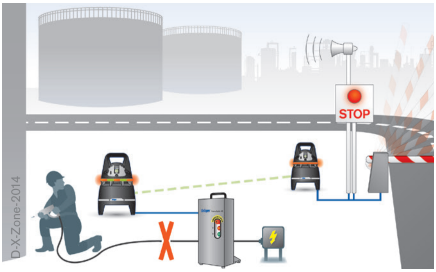
– These devices are designed to warn the wearer about gas risks in the immediate vicinity. For this reason, they are usually worn on work clothing. The basic requirements that these units therefore have to fulfill are wearing comfort, durability, and reliability. Continuously measuring single-gas and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

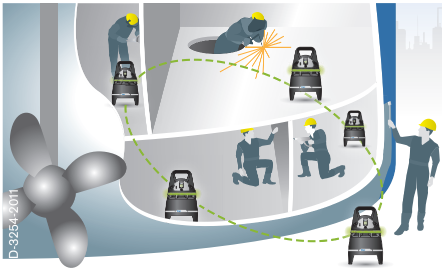


Area monitoring

– 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.

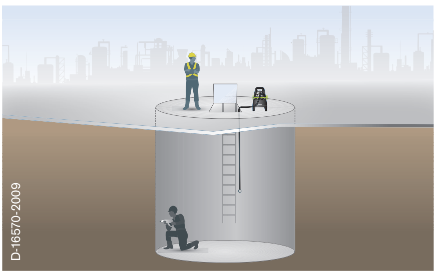
– For this, the basic requirements are robustness, stability and excellent alarm awareness (optical and acoustic) as well as a longest possible battery runtime. Increased security level can be achieved by connecting the area monitors to wireless alarm chains and by transferring the measurement values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





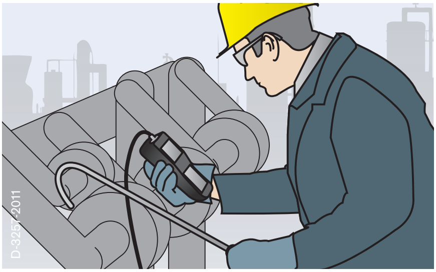
Confined space entry

– 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.

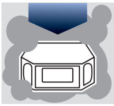
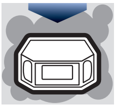
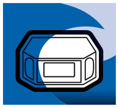
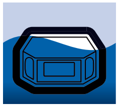
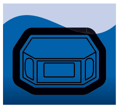
Explosion protection standards:

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, 2003, 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)	2.0	35.0	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	1.0	38.3	6/43	29	535/995
xylol (isomer mixture)	1.0	44.3	25/77	7	465/869

3.5 ATEX 95 – directive 94/9/EC

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 94/9/EC (ATEX 95)

CE 0158

Notified body concerning quality control of production

Conforms with EU requirements

Markings (as defined by ATEX):

Ex I M2 / II 2G

Category

Type of explosive atmosphere:
G: gas, vapor, aerosol; D: dust

I: Mining II: Industry

Complies with directive 94/9/EC

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

MINING

Instrument category	Safety
I M1	Very high level of safety, may remain in operation at high methane concentrations
I M2	High level of safety, must be switched off at high methane concentrations

Explosion protection marking in EN 60079

EPL (Equipment Protection Level) G = gas; D = dust

Ex d ia IIC T4 Gb — a = Zone 0; b = Zone 1; c = Zone 2

temperature category

Explosion group I: mining,
II: everything except mining
Subgroups IIA, IIB, and IIC: categorization of gases depending on their ignitibility

i = Intrinsic safety
a = covers 2 faults
b = covers 1 fault
c = covers normal operation

Ignition protection: Pressure-resistant encapsulation

Explosion protected equipment

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 Ex tb Ex tc	EN 60079-31	ta required for Zone 0 tb required for Zone 1 tc required for Zone 2

Comparison: Designation according to IEC (2007) / CENELEC (2009) and EU directive 94/9/EG (ATEX)

EPL (Equipment Protection Level)		
according to IEC / CENELEC	**according to EU directive 94/9/EG**	**Area**
Ma Mb	M1 M2	Mining
Ga Gb Gc	1G 2G 3G	explosive gas atmosheres
Da Db Dc	1D 2D 3D	area with combustible dust

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 0.06 to 0.18 mJ	coal gas	1.4-dioxane	ethylglycol			
		ethylene	hydrogen sulfide			
		ethylene oxide				
IIC Ignition energy less than 0.06 mJ	hydrogen	acetylene				carbon disulfide

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

X: Special conditions
U: Ex-component

Number of certificate

Complies with European Directive 94/9/EC

Year of EC certificate's publication

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, Naphtha, Benzene, Butane, Propane, Alcohol, Lacquer 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 or IIA	Class I/ Group D
Dust		
Metal	Group IIIC	Class II/ Group E
Coal	Group I or IIIC	Class II/ Group F
Grain	Group IIIB	Class II/ Group G
Fibers (All)	Group IIIA	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.

Easy fastening with tightly closing crocodile clip

Illuminating D-Light shows device is tested and ready for use

Robust housing with handy design for tough conditions

Clear colour coding prevents mistakes

D-4996-2017

Easily replaceable filter membrane protects the sensor

Large display shows all important information

360° alarm signal can be easily seen from all sides

Dräger Pac Family

Each instrument of the Pac family is equipped with one XXS sensor. 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. A powerful battery and the extended application range from -40°C to + 55°C for the Pac 6x00/8x00 series provide more safety even in extreme environments. Additional sensors, like ozone and phosgene, or the use of dual sensors, like CO LC / O_2 and the hydrogen compensated CO sensor (CO H_2-CP), extend the range of application of the handy single gas detectors. The green illuminating D-Light shows the device is tested and ready. Alarm thresholds are stored in the instrument (A1 = pre-alarm/A2 = main alarm). Instruments with an oxygen sensor provide the possibility of alarming with a pre- and a main alarm for both rising and falling concentrations. If the gas concentrations exceed or fall below these alarm thresholds, the instrument sets off an audible, visual, and vibrating alarm. A large non-verbal display indicates important information such as the respective gas concentration or remaining operating time and battery capacity. Durability and explosion protection are two other important factors when choosing the right gas detection device. Accessories like the Bump Test Station or X-dock Module can be easily used for the entire instrument family.

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 6000/6500 and Dräger Pac 8000/8500

D-4977-2017

D-4987-2017

D-4989-2017

D-4996-2017

Reliable and precise even in harsh conditions. Quick sensor response times and a powerful battery ensure additional safety. With the broad measurement spectrum the Pac family can be used in a variety of applications including in applications with special gases such as ozone and phosgene. The instrument can be equipped with a hydrogen-compensated CO sensor or with a Dräger dual sensor. This enables the detection of two gases in one measurement, either H_2S with CO or O_2 with CO.

OTHER BENEFITS

Compliance-Signal (D-Light) for more safety
Extended application range due to a wide temperature range and additional sensors
Cost-efficient because of durable sensors and powerful battery
Clear reading due to white backlight
Optimal monitoring of oxygen concentrations (saturation or deficiency) with respective pre and main alarms
Ready for use again quickly, due to easy changeable dust filter in case of pollution


D-16219-2016


D-17169-2016


D-2581-2018

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Personal monitoring	Clear sensor identification by colored instrument marking
	Alarm display is configurable as “not acknowledgeable”
	More applications because of extended sensor portfolio including dual XXS sensors
	Increased resilience to environmental influences, for example usage up to -40°C
	Third alarm threshold for CO monitoring
	Same accessories as for Pac 3500-7000 family

The Pac 6x00/8x00 is protected against water, dust and other foreign bodies by a special membrane filter. When the filter becomes heavily soiled in use, you quickly and easily can replace it yourself. The device is then ready to use again right away. Thanks to the powerful battery, Pac instruments with H_2S or CO sensors can be used for two years at a 24/7 usage and one alarm minute per day without having to change the battery.

TECHNICAL SPECIFICATIONS

Dimensions (B x H x T) (mm)	64 x 84 x 20 without clip
Weight (g)	approx. 106 (113 with clip)
Typ. battery life: **(under standard conditions):**	24 months at 24 h usage/day, 1 min alarm/day O_2 sensor: 10 months Dual sensors (w/o O_2): 22 months
Ambient conditions:	
Temperature (Temperature depending on sensor)	-30 to +55 / -22 to 131 °F -40 °C / -40°F short-term up to 1h
Pressure (hPa)	700 to 1300
Humidity (% r. h. non-condensing)	10 to 90
Ingress protection	IP 68
Alarms:	
Visual	360°
Acoustic (dB)	Multi-tone > 90 in 30 cm (1ft.)
Vibration	yes
Power supply	Replaceable lithium thionyl chloride battery

FEATURES COMPARISON

	Dräger Pac 6000	Dräger Pac 6500	Dräger Pac 8000	Dräger Pac 8500
Compatible sensors				
XXS EC Sensors	CO LC, O_2, H_2S LC, SO_2	CO LC, O_2, H_2S LC, SO_2	NO, CO_2, Cl_2, HCN, NH_3, PH_3, OV, OV-A, NO_2 LC, Ozone, Phosgene	CO H_2-CP, CO LC/H_2S LC, CO LC/O_2
Operation time	2 Years	Unlimited	Unlimited	Unlimited
Event logger/Data logger:	Storage of peak or average values and events with date and time	Storage of peak or average values and events with date and time TWA, STEL	Storage of peak or average values and events with date and time TWA, STEL	Storage of peak or average values and events with date and time TWA, STEL
Battery life (under standard conditions) 24 h usage/day, 1 min alarm/day	24 months O_2 sensor: 10 months	24 months O_2 sensor: 10 months	24 months	24 months O_2 sensor: 10 months
Approvals:				
ATEX	I M1 Ex ia I Ma II 1G Ex ia IIC T4 Ga	I M1 Ex ia I Ma II 1G Ex ia IIC T4 Ga	I M1 Ex ia I Ma II 1G Ex ia IIC T4 Ga	I M1 Ex ia I Ma II 1G Ex ia IIC T4 Ga
$_{C}CSA_{US}$	Class I, Zone 0, A/Ex ia IIC T4 Ga Class II, Division 1, Groups E, F, G	Class I, Zone 0, A/Ex ia IIC T4 Ga Class II, Division 1, Groups E, F, G	Class I, Zone 0, A/Ex ia IIC T4 Ga Class II, Division 1, Groups E, F, G	Class I, Zone 0, A/Ex ia IIC T4 Ga Class II, Division 1, Groups E, F, G
IECEx	Ex ia I Ma Ex ia IIC T4 Ga	Ex ia I Ma Ex ia IIC T4 Ga	Ex ia I Ma Ex ia IIC T4 Ga	Ex ia I Ma Ex ia IIC T4 Ga
EAC – Ex-approval	PO Ex ia I Ma X 0Ex ia IIC T4 Ga X	PO Ex ia I Ma X 0Ex ia IIC T4 Ga X	PO Ex ia I Ma X 0Ex ia IIC T4 Ga X	PO Ex ia I Ma X 0Ex ia IIC T4 Ga X
RUS – Pattern Approval Certificate of measuring instruments	XXS EC Sensors: O_2, H_2S LC, CO LC, SO_2	XXS EC Sensors: O_2, H_2S LC, CO LC, SO_2	XXS EC Sensors: O_3, Cl_2, CO_2, HCN, PH3, NH_3, $COCl_2$, NO, NO_2 LC, OV, OV-A	XXS EC Sensors: CO LC/O_2, H_2S LC/CO LC, CO H_2-CP
MED – Marine Equipment Directive		2014/90/EU (Pac 6500 O_2)		
CE mark	Electromagnetic compatibility (Direction 2014/30/EU)	Electromagnetic compatibility (Direction 2014/30/EU)	Electromagnetic compatibility (Direction 2014/30/EU)	Electromagnetic compatibility (Direction 2014/30/EU)

ACCESSORIES

Calibration accessories	Dräger Bump Test Station Dräger X-dock 5300 Pac Series
Communication accessories	Dräger CC-Vision Basic, free of charge in the internet www.draeger.com

D-5069-2017

Dräger
Bump Test Station

D-47820-2012

Dräger
X-dock Pac 5300

D-12273-2016

Communication-
cradle

D-12284-2016

Sensor grid black

D-12277-2016

Sensor grid silver

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

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
CE mark	Electromagnetic compatibility (Directive 2014/30/EU)

ACCESSORIES

General accessories	Charging module Car charging connection cable 12V/24V
Calibration accessories	Communication accessories: Dräger CC-Vision Basic, free of charge in the internet www.draeger.com, 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 7 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 2500/5000/5600 and X-am 3500/8000 as well as X-am 7000.

DRÄGER X-AM 8000 - THE ALLROUNDER

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 the latest instrument generation of Dräger‘s gas detection technology. 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

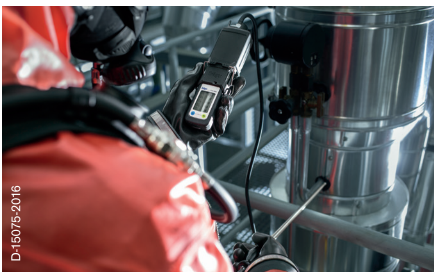
Reliable gas inlets from both sides

Precise, vapor-sensitive Ex monitoring

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

Personal monitoring

Confined space entry



Leak detection

Area Monitoring

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Personal monitoring	Durable, IP 67
Confined space entry	High level of flexibility using external pump (with 45 m or 148 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 45 meters (148 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 15 minutes to -40°C; -40°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 Pump)	Maximum hose length 45 m; 148 ft.

Dräger X-am 2500/5000/5600

FEATURES COMPARISON

Compatible sensors	Dräger X-am 2500	Dräger X-am 5000	Dräger X-am 5600
	Flexible 1 to 4 sensors. One catalytic sensor and XXS EC sensors (see XXS EC sensors)	Flexible 1 to 4 sensors. One catalytic sensor and 3 XXS EC sensors (see XXS EC sensors)	Flexible 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, O_2 100, 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, O_2/CO-LC, H_2S-LC/CO-LC, O_2/H_2S LC	Amine, O_2, O_2 100, 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, O_2/CO-LC, H_2S-LC/CO-LC, O_2/H_2S LC
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 Mining PR	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	II 1G Ex da ia IIC T4/T3 Ga I M1 Ex da ia I Ma	II 1G Ex da ia IIC T4/T3 Ga I M1 Ex da ia I Ma	II 1G Ex ia IIC T4/T3 Ga I M1 Ex ia I Ma
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, Propane, Nonane and H_2 (mit XXS H_2 HC) and also CO_2 according to EN 60079 and EN 50271
c CSA u	Div.1, Class I, Groups A,B,C,D T4/T3 Class II, Groups E,F,G A/Ex da ia IIC T4/T3/Gb	Div.1, Class I, Groups A,B,C,D T4/T3 Class II, Groups E,F,G A/Ex da ia IIC T4/T3/Gb	Div.1, Class I, Groups A,B,C,D T4/T3 Class II, Groups E,F,G A/Ex ia IIC T4/T3/Ga

FEATURES COMPARISON

	Dräger X-am 2500	**Dräger X-am 5000**	**Dräger X-am 5600**
IECEx	Ex da ia I Ma Ex da ia IIC T4/T3 Ga	Ex da ia I Ma Ex da ia IIC T4/T3	Ex ia I Ma Ex ia IIC T4/T3 Ga
CE mark	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 94/9 EC)	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 94/9 EC)	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 94/9 EC)
MED	2014/90/EU	2014/90/EU	2014/90/EU
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 oder 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 oder 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 Pump Hoses of various lengths Probes
Area Monitoring	Dräger X-zone 5500 (for Dräger X-am 5000/5100/5600)


BTS

Dräger Bump Test Station


D-47836-2012

Dräger X-dock 5300
Dräger X-am 125


D-11864-2016

Dräger X-am Pump


ST-15024-2008

Nonane tester


D-23594-2009

Dräger X-zone 5500


D-3042-2014

Dräger X-zone Com

Dräger X-Zone 5500/5800

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 and X-zone 5800 are 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.
- Permanent power supply of the X-zone 5800 in explosion-proof areas by means of Power Supply Ex

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Area Monitoring	Up to 25 Dräger X-zone 5500/5800 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 5500/5800 transforms the Dräger personal gas detection instruments Dräger X-am 5000/5100/5600 into innovative area monitoring devices for a wide range of applications. A patented solution for more safety.
With the flexible sensor equipping of the Dräger X-am 5000, X-am 5100 and X-am 5600 the fields of application of the Dräger X-zone 5500/5800 are manifold. Just insert a different Dräger X-am 5x00, which is equipped with an alternative sensor setup, and the Dräger X-zone 5500/5800 is ready for a different application. The modern induction charger is simple to use, comfortable and has no issues with dirty charging contacts, so the device is easy to maintain.
The Dräger X-zone 5500/5800 affords a new portable safety concept. Up to 25 Dräger X-zones can be automatically interconnected to form a wireless fenceline. This interconnection of the area monitoring devices allows the rapid safeguarding of larger areas, e.g. of pipelines or industrial tanks during industrial shutdowns. 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 green/red by the illuminated LED ring, thus allowing and providing a fast and easy recognition of the alarm itself as well as of the alarm-trigging devices. With the 360° alarm signalization, the acoustic and optical alarm can be recognized from all sides. This ensures an easy and clear evacuation alarm and alerting.
With the help of a potential-free alarm contact on the Dräger X-zone 5500/5800 external devices such as horns, lamps or traffic lights can be switched. Alternatively, the signal from the alarm chain can be forwarded to a variety of evaluation devices via the Modbus interface.
The X-zone Com enables wireless access to the data of the Dräger X-zone 5500/5800 via the GSM network. Status queries and alarms via SMS, periodical sending of data via e-mail or presentation in a cloud service - the X-zone Com sends all relevant data such as gas name, gas type, gas concentration, alarms and faults directly to the device of your choice.
The X-zone Com is designed to be easily commissioned with minimal installation effort.
As an alternative to these solutions, it is also possible to pass the Modbus signals of the Dräger X-zone 5500/5800 directly to a control room. By this a direct connection to a PLC can be realized.

TECHNICAL SPECIFICATIONS

Dimensions (W × H × D)	490 x 300 x 300 mm; 20 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) 868.1 MHz (Malaysia) 915 MHz (USA, Canada, India, Australia), 922 MHz (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	< 14 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 2014/30/EU) / R&TTE (Directive 99/005/EG) ATEX (Directive 94/9 EC)

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, Power Supply Ex, Holder X-am 5100
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 probes extension hose, different lenght


D-23634-2009

Inductive charger
Allowing easy charging


D-23631-2009

Socket
For measurements of light gases


D-14280-2017_1000

Cover plate
With diffusion adapter


D-98766-2013

Set holder
Dräger X-am 5100


D-2125-2011

Calibration and com-mu-nication accessory
USB DIRA with USB cable


D-27768-2009

Alarm damper
For use within bump tests


D-3042-2014

X-zone Com


D-21278-2020

Power Supply Ex

Dräger X-am 7000

Sale discontinued

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

Area monitoring

Confined space entry

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 2014/30/EU) ATEX (Directive 94/9EC)

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, 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

Dräger X-am 3500/8000


D-6521-2017


D-410-2018

The Dräger X-am 3500/8000 family are advanced gas detection devices with an integrated, powerful pump for simultaneous and continuous monitoring of up to four gases in the Dräger X-am 3500 and up to seven gases in the X-am 8000. The devices are optimized for professional clearance measurements before entry and work in confined spaces and containers, as well as for the search of gas leaks. The X-am 8000's five sensor slots and an extensive number of different sensors (including various dual sensors for measuring two gases with just one slot) ensure a flexible adaptation to individual measurement tasks. An infrared sensor or photoionization detector can be plugged in one slot in the X-am 8000, and an infrared sensor or catalytic heat tone sensor in another slot. Both instruments have three slots for electrochemical sensors in XXS format for the measurement of oxygen and toxic gases. Despite the diverse performance capabilities of the devices, their operation is very simple and sets new standards. In particular, the color display, the operation with three large buttons and the flexible switching between diffusion and pump operation during use contribute to this.

OTHER BENEFITS

Built-in high performance pump allowing a measurement with a hose up to 45 m
Inductive charging of the power supply
Use in Ex Zone 0, temperature class T4 in every assembly version
High performance catalytic bead and infrared sensors and photoionization sensors (only in Dräger X-am 8000) with low detection limits
Wizards for different measurement tasks: – Confined space entry measurements: Calculation of the necessary hose flooding time depending on the probe length, set measurement gas and temperature limit – Leak search: visual and audible display of the gas concentration – Use of pre-tubes with the PID sensor: benzene-selective measurement
Event report including impact detection


D-16791-2016

Confined space entry


D-16357-2016

Leak detection

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

Confined space entry:	Wizard for confined space entry measurements, build-in, high performance pump, extensive probe portfolio
Leak detection:	Wizard for leak detection, extensive assortment of DrägerSensors for the measurement of > 100 different gases
Area monitoring:	IP68, accessory: base for placing the instrument upright, particularly loud horn (100 dB @ 30 cm/1 ft.)

A Bluetooth® module enables the x-am 8000 to communicate with other systems and exchange data. This saves time and helps to manage the measurement tasks more efficiently.

An additional useful tool is the **Mobile Solution (Android App and Cloud)**, specially designed for the X-am 8000. It allows, for example, the readout of measurement values away from the point of sampling on the smartphone and thus support particularly confined space entry measurements. You also can easily and conveniently use the app to create and administrate measurement reports.

To measure hard-to-detect hydrocarbons, you can fit the Dräger X-am 8000 with one of two high-performance PID sensors. Two different types are available: The PID HC covers a measurement range of 0 to 2,000 ppm (isobutylene). The PID LC ppb is particularly suited for a measurement range of 0 to 10 ppm (isobutylene) with a low resolution in the range below 1 ppm.

For benzene-specific measurements, the X-am 8000 can be used with a pre-tube. The advantage: you only need one measuring device for this application, which significantly reduces the costs of purchasing, maintaining and transporting devices in use. A built-in assistant supports the use of the pre-tubes.

TECHNICAL DATA

Dimension (W x H x D) (mm)	Approx. 179 x 77 x 42 mm; 70 x 30 x 16 in.
Weight (g)	Approx.495 g, depending on sensor selection, without transport belt, without pump Approx. 550 g, depending on sensor selection, without transport belt, with pump
Ambient conditions:	
Temperature	-20 to +50 °C; -4 to +122 °F
Pressure (hPa)	700 to 1300
Humidity (% r.h.)	10 to 90 % (to 95 % intermittent)
Ingress protection	IP68
Display	High-contrast colour display
Alarms:	
Visual	3 LEDs >red< (gas alarms) 3 LEDs >yellow< (instrument alarms)
Acoustic (dB)	Multi-tone typical 100 dB (A) at a distance of 30 cm (1 ft.)
Vibration	Yes
Power supply	Lithium ion battery pack, inductively rechargeable
Operation time (h) diffusion	Typical 24 h[1] (equipped with CatEx and 3 EC sensors)
Charging time (h)	Typical 4 h after use for one shift, maximum 10 h
Data logger	12 MB, e.g. 10 minutes per hour gas exposition with changing measurement values every second on all 7 channels = 210 h
Pump mode	Maximum hose length 45 m

1) Nominal runtime of the gas detector at ambient conditions 20 to 25 °C, 1013 hPa, less than 1 % of the time alarming, display energy save mode activated. The actual runtime varies by the ambient temperature and pressure, battery and alarm conditions.

FEATURES

	Dräger X-am 3500	**Dräger X-am 8000**
Possible sensor selection	1 – 4 sensors, Slot 1: not used Slot 2: CatEx sensor Slot 3 – 5: electrochemical sensors XXS design	Flexible 1 – 5 sensors, Slot 1: PID or IR sensor Slot 2: IR or CatEx sensor Slot 3 – 5: electrochemical sensors XXS design
XXS EC Sensoren	O_2, CO LC, H_2S LC, NO_2, SO_2	Amine, O_2, O_2 100, CO LC, CO HC, $COCl_2$, H_2S LC, H_2S HC, CO_2, Cl_2, HCN, HCN PC, NH_3, NO, NO_2, NO_2 LC, Ozon, PH_3, PH_3 HC, SO_2, OV, OV-A, H_2S/CO, CO H_2-CP (H_2 compensated), H_2, H_2 HC, Odorant, O_2/CO-LC, H_2S-LC/CO-LC, O_2/H_2S LC

FEATURES

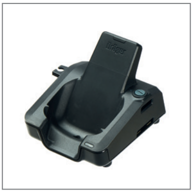
	Dräger X-am 3500	Dräger X-am 8000
Catalytic bead sensors		
CatEx 125 PR	0 – 100 % LEL 0 – 100 Vol.-% CH_4: Special calibration for organic vapours possible	0 – 100 % LEL 0 – 100 Vol.-% CH_4: optional automatic measurement range switch, Special calibration for organic vapours possible
CatEx 125 PR Gas	not possible	0 – 100 % UEG für CH_4, C_2H_6, C_2H_4, C_2H_2, C_3H_8, C_3H_6, C_4H_{10}, H_2 0 – 100 Vol.-% CH_4: optional automatic measurement range switch
Infrared sensors		
IR Ex ES	not possible	0 – 100 % LEL 0 – 100 Vol.-% $CH_4/C_4H_{10}/C_2H_4$/LPG
IR CO_2 ES	not possible	0 – 5 Vol.-% CO_2
IR Ex/CO_2 ES	not possible	0 – 100 % LEL 0 – 100 Vol.-% CH_4/C_4H10/C_2H_4/LPG 0 – 5 Vol.-% CO_2
IR Ex/CO_2 HC	not possible	0 – 100 % LEL 0 – 100 Vol.-% CH_4/C_4H10/C_2H_4/LPG 0 – 100 Vol.-% CO_2
PID Sensoren		
PID HC	not possible	0 – 2,000 ppm Isobutylene
PID LC ppb	not possible	0.03 – 10 ppm Isobutylene
Approvals		
CE mark	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 2014/34/EU)	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 2014/34/EU)
ATEX/IEC Ex	I M1, II 1G Ex da ia I Ma, Ex da ia IIC T4 Ga Zone 0, T4	I M1, II 1G Ex da ia I Ma, Ex da ia IIC T4 Ga Zone 0, T4
Measurement performance certificate	for O_2 accord. EN 50104/ for CO and H_2S accord. EN 45544/Methane to Octane accord. EN 60079-29-1 and EN 50271:2010	for O_2 accord. EN 50104/ for CO and H_2S accord. EN 45544/Methane to Octane accord. EN 60079-29-1 and EN 50271:2010
Marine Approval	DNV GL accord. Directive 2014/90/EU (MED)	DNV GL accord. Directive 2014/90/EU (MED)
c CSA us	Class I, Zone 0, A/Ex da ia IIC T4 Ga Class II, Div. 1, Groups E, F and G	Class I, Zone 0, A/Ex da ia IIC T4 Ga Class II, Div. 1, Groups E, F and G
EAC Ex	PO Ex da ia I Ma X 0Ex da ia IIC T4 Ga X	PO Ex da ia I Ma X 0Ex da ia IIC T4 Ga X

ACCESSORIES

Charging accessories	Charging module for inductive charging of the instrument Power supply for vehicles 12V/24V
Calibration accessories	Dräger X-dock, Nonane tester
Communication accessories	Dräger CC-Vision Basic, free of charge on www.draeger.com
Pump accessories	Pump adapter
Area monitoring	Base to place the instrument upright for the area monitoring
Benzene-specific measurement	PID benzene pre-tube

D-6545-2017

Dräger X-am 8000 with base



D-6560-2017

Inductive power supply

D-6558-2017

Holder for labels

D-14319-2017

Pump adapter

3.9 Multigas Scanner

D-21-2020

The Dräger X-pid 9000/ 9500 detects volatile organic substances such as benzene even at the lowest concentrations. To determine the concentration of certain hazardous substances, the device combines two measuring modes and thus optimally supports measuring strategies for clearing hazardous areas or confined spaces. The “Seeker” measuring mode determines the total concentration of volatile organic hydrocarbons in the ambient air in a broadband measurement. In “Analysis” mode, the instrument selectively and precisely measures target substances that the user selects in advance.

Sensor unit
compiles measurenment values them via Bluetooth to the control unit

Integrated photoionisation detector (PID)
for measuring in the low ppb range

Control unit
with large touch screen and connectivity via Wi-Fi and 4G/LTE

D-806-2018

Integrated gas chromatography (GC)
to separate compounds in gas-vapour-mixtures

Integrated pump
for attaching a hose of up to 10 m lenght

Mobile App
allows intuitivee handling and control

Seeker mode: Broadband measurement for pre-tests and localization of measuring points

The Seeker mode is used to continuously measure the total concentration of several volatile organic compounds in the ambient air at the workplace and in potentially explosive atmosphere. The measurement mode Seeker displays a VOC sum signal and is comparable to single gas PID measuring devices.

Analysis mode: Selective measurement for monitoring carcinogenic substances

The analysis mode is used to measure the concentration of individual preset hazardous substances, so-called target substances, in the ambient air at the workplace and in potentially explosive atmospheres. Individual response factors of the target substances are considered and thus an exact concentration is determined.

Dräger X-pid 9000/9500

D-810-2018

The selective PID gas measurement device is ideal for users who frequently test for hazardous toxic substances. Benzene, butadiene and other volatile organic compounds (VOCs) are carcinogenic even in the smallest concentrations. Selective measurement is necessary because other gases and vapors are often also present. The gas measurement device allows for short test times and laboratory-quality results.

OTHER BENEFITS

Target substance database expandable by the customer

Lower operating costs by dispensing with consumables

High selectivity and low detection limits for more safety by separating gas mixtures into individual substances

Robust behavior under all conditions due to reduction of environmental influences

Easy operation via ex-protected smartphone via mobile app

Measurement results in laboratory quality

Simple function test and easy calibration

Use in explosion-proof areas

Entry into confined spaces/clearance measuring

Exposition measurement

ESPCIALLY SUITED FOR THE FOLLOWING APPLICATIONS AND THEIR USP'S

Confined space entry:	Selective detection of benzene or butadiene
Exposition measurements:	Precise monitoring of e.g. benzene loads without cross-sensitivities
Emission measurements:	Detection of known hazards in the vicinity of chemical plants or factories
Exploratory measurements:	Detection of over 40 substances in short measuring times and without consumables

The measuring mode »Seeker« is a broadband measurement for pre-testing and localization of measuring points. The Seeker allows a continuous, direct-reading measurement of the total concentration of all volatile organic compounds (VOC) present. Thus, the measurement mode Seeker displays the VOC sum concentration and is comparable to single PID measuring devices.

The measuring mode »Analysis« allows a selective measurement of hazardous substances for monitoring. In this way, pre-selected substances, so-called target compounds, can be measured accurately in just a few seconds. The measurement mode »Analysis« is comparable to laboratory gas chromatographs.

For carcinogenic vapors such as benzene, a compliance with the shift average values in the range of a few ppb to ppm is mandatory. The Dräger X-pid 9000/9500 is optimized for measurements in this concentration range and can measure benzene > 50 ppb.

TECHNICAL DATA (refer exclusively to the Dräger X-pid® 9000/9500 sensor unit)

Dimensions (W x H x D) (mm)	approx. 132 x 281 x 56 mm
Weight (g)	approx. 880 g
Ambient conditions:	
Temperature (°C)	-10 to +35
Pressure (mbar)	700 to 1.300
Humidity (% r.h.)	10 to 95 %
Ingress protection	IP54 (sensor unit) IP64 (control unit - ecom Smart-Ex)
Warm-up phase	approx. 10 min May extend at low ambient temperatures.
Operation time	Typical 8 h Decreases at low ambient temperatures.
Sensor	10.6 eV PID (Analysis-PID) after separation by a gas chromatograph Sensitive for all substances with < 10.6 eV ionization energy and a boiling temperature < 150 °C

	X-pid 9000/9500	X-pid 8500 (only USA)
PID	0 – 100 ppm isobutylene	0 – 100 ppm isobutylene
Approvals		
CE mark	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 2014/34/EU) Funk (Directive 2014/53/EU) RoHS 3 (Directive 2015/863/EU)	Electromagnetic compatibility (Directive 2014/30/EU) ATEX (Directive 2014/34/EU) Funk (Directive 2014/53/EU) RoHS 3 (Directive 2015/863/EU)
ATEX	II 1G Ex ia IIC T4 Ga (Sensoreinheit) II 2G Ex ib IIC T4 Gb (Bedieneinheit) Zone 0 (Sensoreinheit) Zone 1 (Bedieneinheit)	II 1G Ex ia IIC T4 Ga / Ex ia IIC T4 Ga Zone 0 (sensor unit) Zone 1 (control unit)
IECEx	Ex ia IIC T4 Ga (Sensoreinheit) Ex ib IIC T4 Gb (Bedieneinheit)	Ex ia IIC T4 Ga (sensor unit) Ex ib IIC T4 Gb (control unit)
cULus		Class I, Div 1 Groups A-D T4 (sensor unit) Class I, Div 1 Groups A-G T4 (control unit)

ACCESSORIES

Cases	Sturdy case with an inlay specially tailored to the X-pid with space for the control and sensor unit with respective chargers as well as for a test gas cylinder and other accessories.
Calibration accessories	Dräger X-pid® 9000 / 9500 bump test adapter Test gas benzene or isobutylene-toluene
Hoses and probes	Float probe Tygon hose with PTFE Telescopic probe ES 150

D-13119-2018

Case with inlay for X-pid

D-2767-2018

Hose with bump test adapter

D-14331-2017

Float probe

D-0494-2018

Test gases

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

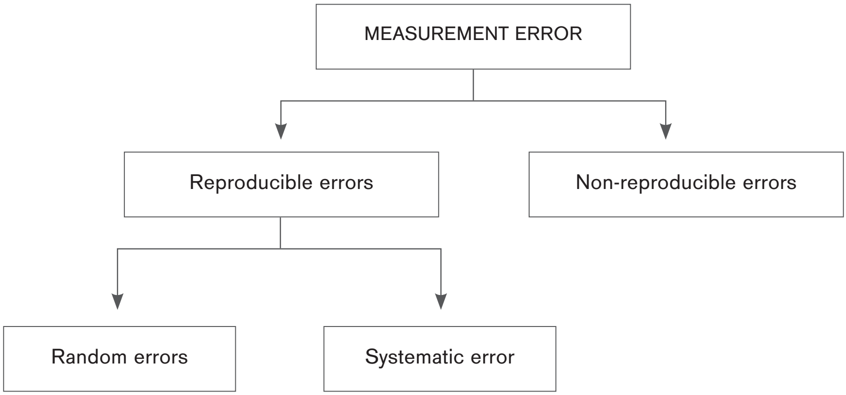
– Poisonous substances can occur anywhere – in industrial production and processing, in transport (rail, road, ship), in the case of incomplete combustion (CO), and also as a result of completely naturally processes such as rotting and decomposition of biomass. Electrochemical and PID sensors are used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

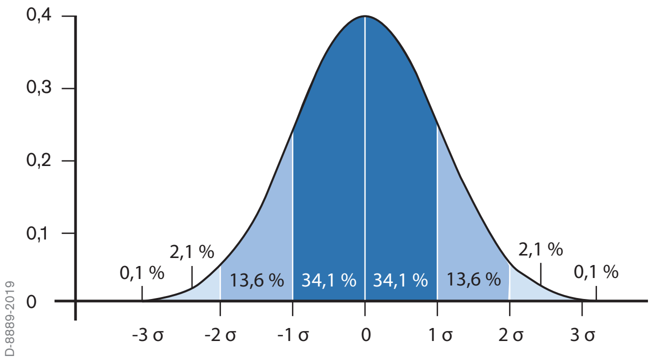
– What other hazardous material are present (cross-sensitivity)?
– Is it necessary to measure hazardous material selectively, or is it more sensible to measure a complete parameter?

Measurement Deviations

The difference between the displayed value by a gas detector and the true value is described as the measurement deviation. There is no measurement system, which always displays the correct value. The aim of every measurement system is to eliminate or at least minimise measurement deviations.



There are many potential causes of measurement errors, which are divided into reproducible and non-reproducible errors. Technically, the latter should never arise during analysis, but in fact they are time and again the cause of false assessments of the situation. Typical examples include the use of measurement equipment that is not suitable for the application, or measurements taken in the wrong place. The cause of the reproducible errors lies in the measuring device. These are divided into random errors and systematic errors.



Standard deviation
Normal distribution of test results and their propabillity of incidence as a function of their deviation from the mean value

Random Errors/Precision

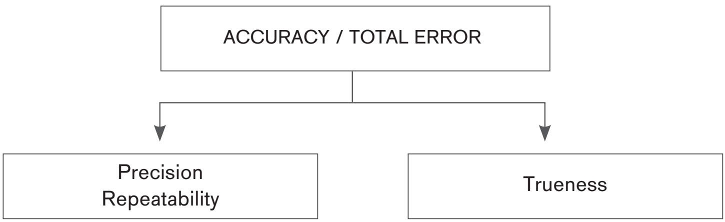
The precision or random errors of measuring instruments are determined by the fluctuation of the measured values around a mean value. This equation is also referred to as repeatability.

Systematic Errors/Trueness

Trueness / systematic error describes the deviation of the mean value of several measurements from the true concentration.

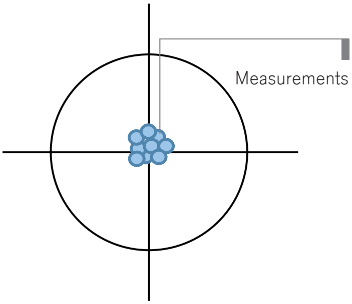
Accuracy/Total Error

Accuracy is a generic term that is used in measurement technology and quality assurance. It is a parameter to quantify the reproducible errors. A measuring instrument is accurate when it combines both high precision and a high degree of trueness, i.e. when it yields minimal random and systematic errors.



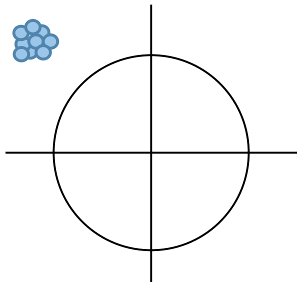
EN 60051 defines the accuracy of a measuring instrument as "the degree of compliance between a test result and the accepted reference value". This means that the deviation between the displayed measured value and the true concentration is indicated.

D-8885-2019



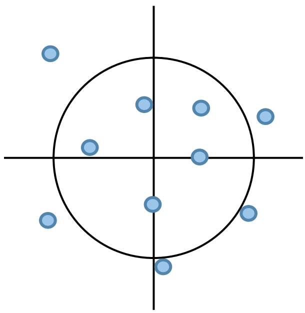
Precision good + trueness good ⟶
Accuracy good

D-8886-2019



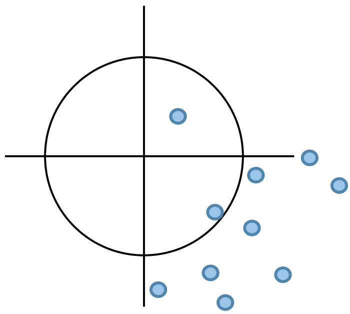
Precision good + trueness bad ⟶
Accuracy bad

D-8887-2019



Precision bad + trueness good ⟶
Accuracy bad

D-8888-2019



Precision bad + trueness bad ⟶
Accuracy very bad

Detection Limit / Quantitation Limit

Analytics differentiates between the detection limit and the quantitation limit. The detection limit (limit of detection, LoD, or lower detection limit, LDL) is the lowest measured value at which the presence of a substance can be proven qualitatively. The quantitation limit (limit of quantitation, LoQ) is the smallest concentration of an analyte that can be quantitatively determined with a defined level of accuracy. The quantitation limit always has a degree of accuracy that is at least equal to or greater than that of the detection limit.

Measurement accuracy of gas detectors

The measurement accuracy of gas detectors is determined by their systematic errors (trueness) and less by the precision of the sensors. The following factors should particularly be considered:

- Trueness depending on linearity errors,
- Trueness depending on temperature,
- Trueness depending on humidity,
- Trueness depending on pressure.

The mentioned factors result from the physical properties of the used sensor technology and must basically be considered for all sensors. Some measurement properties, such as sensitivity, may change over the sensor lifetime. The systematic errors and precision also change accordingly. The numeric values given in the specifications apply to sensors in mint condition.

A calibration under the conditions prevailing during the measurement (e.g. temperature) improves the trueness of the measured values. For example, especially the linearity near the adjustment concentration is significantly better. To achieve the greatest possible accuracy, a target gas calibration is recommended. In addition, the trueness of the measured value is also particularly determined by the uncertainty (tolerance) of the test gas concentration.

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4.2 Overview of detectable vapors and gases

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	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													✱	■	■			
Acetylene	74-86-2	■	■	✱	■	■												XXS OV-A	68 11 535
																		XS EC Organic Vapors	68 09 115
Acrolein	107-02-8													✱	■		■		
Acrylonitrile	107-13-1																	XXS OV-A	68 11 535
																		XS EC Organic Vapors	68 09 115
Allyl alcohol (2-Propen-1-ol)	107-18-6													✱	■	■			
Allyl chloride	107-05-1													✱	■	■			
Ammonia	7664-41-7	■	■	✱	■									✱	■			XXS NH_3	68 10 888
																		XS EC NH_3	68 09 145
Aniline	62-53-3													✱					

■ Empfindlichkeitsdaten bekannt ✱ Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
Arsine	7784-42-1																	XXS PH_3	68 10 886
																		XS EC Hydride	68 09 135
Benzene	71-43-2	■	■	*	■		■	*				*	*	■	■	■	■		
Benzonitrile	100-47-0													*					
Benzyl alcohol	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													*					
1,3-Butadiene	106-99-0	■	■	*	■	*	■	*				*	*	*	■	■	■	XXS OV	68 11 530
																		XS EC Organic Vapors	68 09 115
i-Butane	75-28-5	*	*	*	*	*	■	*				*	*						
n-Butane	106-97-8	■	■	*	■	■	■	■				■	■						
2-Butanol	78-92-2														■	■			
2-Butanone	78-93-3	■	■	*	■									■	■	■	*		

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
1-Butene	106-98-9														■	■			
i-Butene	115-11-7	*	*	*	*	■	■	*				*	*	■	■	■	■		
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													*					
sec.Butylmercaptan	513-53-1																	XXS Odorant XS EC Odorant	68 12 535 68 09 200
tert. Butylmercaptan	75-66-1																	XXS Odorant XS EC Odorant	68 12 535 68 09 200
Butyraldehyde	123-72-8																■		
Carbon dioxide	124-38-9								■	■	■	■	■					XXS CO_2 XS EC CO_2	68 10 889 68 09 175
Carbon disulfide	75-15-0													*	■	■	■		

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
Carbon monoxide	630-08-0	■	✱	■	■	✱												XXS CO	68 10 882
																		XXS H_2S/CO	68 11 410
																		XXS H_2S LC/CO LC	68 13 280
																		XXS CO H_2-CP	68 11 950
																		XXS CO LC	68 13 210
																		XXS CO LC/O_2	68 13 275
																		XXS CO HC	68 12 010
																		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

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
Chlorine dioxide	10049-04-4													*				XXS EC Cl_2	68 10 890
																		XS EC Cl_2	68 09 165
																		XS EC ClO_2	68 11 360
Chloroacetone	78-95-5													*					
4-Chloroaniline	106-47-8													*					
Chlorobenzene	108-90-7													■	■	■	*		
1-Chloro-2,3 epoxypropane	106-89-8													*				XXS OV	68 11 530
(Epichlorohydrin)																		XS EC Organic Vapors-A	68 09 522
m-cresol	108-39-4													*					
o-cresol	95-48-7													*					
p-cresol	106-44-5													*					
Crotonaldehyde (2-Butenal)	4170-30-3													*					
Cumene (Isopropylbenzene)	98-82-8													*	■	■			
Cyclohexane	110-82-7	■	■	*	■		■	*				*	*	■	■	■	■		
Cyclohexanone	108-94-1													*	■	■			
Cyclohexylamine	108-91-8													*					

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
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
Dibutylether	142-96-1	✱	✱	✱	✱									✱					
Di-n-butylamine	111-92-2													✱					
1,2-Dichlorobenzene	95-50-1													✱	■	■			
1,2-Dichloroethylene (cis)	156-59-2																■		
1,2-Dichloroethylene (trans)	156-60-5													✱	■	■	■		
1,3 Dichloropropene	542-75-6													✱					
Diesel fuel	e.g. 68476-34-6	✱	✱	✱	✱									■	■	■			
Diethylamine	109-89-7	■	■	✱	■			✱				✱	✱	✱				XXS Amine	68 12 545
																		XS EC Amine	68 09 545
N,N Diethylaniline	91-66-7													✱					
Diethylether	60-29-7	■	■	✱	■			✱				✱	✱	✱	■	■		XXS OV-A	68 11 535
																		XS EC Organic Vapors	68 09 115

■ Empfindlichkeitsdaten bekannt ✱ Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
1,1-Difluorethylene	75-38-7													*					
N,N-Dimethylacetamide	127-19-5													*					
Dimethylamine	124-40-3	*	*	*	*									*				XXS Amine	68 12 545
																		XS EC Amine	68 09 545
Dimethyldisulfide	624-92-0													*				XXS Odorant	68 12 535
																		XS EC Odorant	68 09 200
Dimethyl ether	115-10-6	*	*	*	*		■	*				*	*	*	■	■			
N,N-Dimethylformamide (DMF)	68-12-2													*	■				
Dimethylhydrazine	540-73-8																	XS EC Hydrazin	68 09 190
Dimethylsulfide	75-18-3													*				XXS Odorant	68 12 535
																		XS EC Odorant	68 09 200
1,4-Dioxane	123-91-1													*	■	■			
1,2-Epoxypropane	75-56-9	■	■	*	■	*								*					
Ethane	74-84-0	■	■	*	■	■	■	*				*	*						
Ethanol	64-17-5	■	■	*	■		■	■				■	■		■		■	XXS OV-A	68 11 535
																		XS EC Organic Vapors	68 09 115

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
Ethene	74-85-1	■	■	✱	■	■	■	■				■	■		■			XXS OV	68 11 530
																		XS EC Organic Vapors	68 09 115
Ethylacetate	141-78-6	■	■	✱	■		■	✱				✱	✱	■	■	■	✱		
Ethyl acrylate	140-88-5						■	✱				✱	✱	✱			✱		
Ethyl amine	75-04-7	✱	✱	✱	✱									✱				XXS Amine	68 12 545
																		XS EC Amine	68 09 545
Ethylbenzene	100-41-4													■	■	■	■		
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													✱					

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
Ethyl mercaptan (Ethanethiol)	75-08-1													✱	■	■		XXS Odorant	68 12 535
																		XS EC Odorant	68 09 200
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
Furan	110-00-9													✱					
Furfural	98-01-1													✱	■	■			
Germanium hydride	7782-65-2																	XXS PH_3	68 10 886
																		XS EC Hydride	68 09 135
n-Heptane	142-82-5	■	■	✱	■		■	✱				✱	✱	✱	■	■	■		
1,1,1,3,3,3-Hexamethyldisilazane	999-97-3														■	■			
i-Hexane (2-Methylpentane)	107-83-5													✱					
n-Hexane	110-54-3	■	■	✱	■		■	✱				✱	✱	✱	■	■	■		

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX					IR							PID				EC	ORDER NO.
		SMART CATEX (HC PR) 68 12 970	SMART CATEX (PR) 68 12 980	SMART CATEX (FR PR) 68 12 975	CAT EX 125 PR 68 12 950	CATEX 125 PR GAS 68 13 080	SMART IR-EX 68 10 460	IR-EX 68 51 881	SMART IR-CO_2 HC 68 10 599	SMART IR-CO_2 68 10 590	IR-CO_2 68 51 882	DUAL IR-EX/CO_2 ES 68 51 880	DUAL IR-EX/CO_2 HC 68 00 276	SMART PID 83 19 100	PID HC 68 13 475	PID LC PPB 68 13 500	X-PID SENSORS		
1-Hexene	592-41-6													*	■	■			
Hydrazine	302-01-2													*				XS EC Hydrazin	68 09 190
Hydrogen	1333-74-0	■	■	*	■	■												XXS H_2	68 12 370
																		XXS H_2 HC	68 12 025
																		XS EC H_2	68 09 185
																		XS H_2 HC	68 11 365
Hydrogen bromide	10035-10-6																	XS EC HF/HCI	68 09 140
Hydrogen chloride	7647-01-0																	XS EC HF/HCI	68 09 140
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/HCI	68 09 140
Hydrogen peroxide	7722-84-1																	XS EC H_2O_2	68 09 170
Hydrogen selenide	7783-07-5													*					

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
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 LC/CO LC	68 13 280
																		XXS H_2S LC/O_2	68 14 137
																		XXS H_2S HC	68 12 015
																		XXS E H_2S	68 12 213
																		XS EC H_2S 100	68 09 110
																		XS EC H_2S HC	68 09 180
																		XS 2 H_2S	68 10 370
																		XS R H_2S 100	68 10 260
4-Hydroxy-4-methyl-2-pentanone (aceton alcohol)	123-42-2													✱					
Iodomethane	74-88-4													✱					
Iron pentacarbonyl	13463-40-6													✱					
Isoamyl acetate	123-92-2													✱					

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	SMART CATEX (PR) 68 12 980	SMART CATEX (FR PR) 68 12 975	CAT EX 125 PR 68 12 950	CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR-EX 68 51 881	SMART IR-CO_2 HC 68 10 599	SMART IR-CO_2 68 10 590	IR-CO_2 68 51 882	DUAL IR-EX/CO_2 ES 68 51 880	DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID HC 68 13 475	PID LC PPB 68 13 500	X-PID SENSORS	EC	ORDER NO.
Isobutanol	78-83-1														■	■			
Isobutene	115-11-7													■	■	■	■	XXS OV-A	68 11 535
																		XS EC Organic Vapors	68 09 522
Isobutyle acetate	110-19-0													*	■	■			
Isobutyraldehyde	78-84-2													*					
Isopentane (2-Methylbutane)	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	e.g. 8008-20-6	*	*	*	*		■	■				■	■	■	■	■			
Liquefied gas (50 % Propane + 50 % n-Butane)	e.g. 68476-85-7	*	*	*	■	■	■	■				■	■						
Methane	74-82-8	■	■	■	■	■	■	■				■	■						
2-Methoxy-ethanol	109-86-4													*	■	■			
1-Methoxy-Propanol-2	107-98-2	■	■	*	■			*				*	*						

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX					IR							PID				EC	ORDER NO.
		SMART CATEX (HC PR) 68 12 970	SMART CATEX (PR) 68 12 980	SMART CATEX (FR PR) 68 12 975	CAT EX 125 PR 68 12 950	CATEX 125 PR GAS 68 13 080	SMART IR-EX 68 10 460	IR-EX 68 51 881	SMART IR-CO_2 HC 68 10 599	SMART IR-CO_2 68 10 590	IR-CO_2 68 51 882	DUAL IR-EX/CO_2 ES 68 51 880	DUAL IR-EX/CO_2 HC 68 00 276	SMART PID 83 19 100	PID HC 68 13 475	PID LC PPB 68 13 500	X-PID SENSORS		
1-Methoxy-2-propylacetate Propylene glycol monomethyl Ether acetate (PGMEA)	108-65-6													*					
Methyl acetate	79-20-9													*	■				
Methyl acrylate	96-33-3																■		
Methyl alcohol (Methanol)	67-56-1	■	■	*	■		■	*				*	*					XXS OV	68 11 530
																		XS EC Organic Vapors	68 09 115
Methyl bromide (Bromomethane)	74-83-9													■	■	■	■		
Methyl chloride	74-87-3						■	*				*	*						
Methylcyclohexane	108-87-2													*	■	■			
Methylen chloride	75-09-2						■	*				*	*						
Methyl ethyl ketone MEK)	78-93-3						■	*				*	*	■	■	■			
Methyl isobutyl carbinol	108-11-2														■	■			
Methyl isobutyl ketone	108-10-1													*	■	■			
Methyl mercaptan (Methanethiol)	74-93-1													*	■	■		XXS Odorant	68 12 535
																		XS EC Odorant	68 09 200

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	SMART CATEX (PR) 68 12 980	SMART CATEX (FR PR) 68 12 975	CAT EX 125 PR 68 12 950	CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR-EX 68 51 881	SMART IR-CO_2 HC 68 10 599	SMART IR-CO_2 68 10 590	IR-CO_2 68 51 882	DUAL IR-EX/CO_2 ES 68 51 880	DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID HC 68 13 475	PID LC PPB 68 13 500	X-PID SENSORS	EC	ORDER NO.
Methylmethacrylate	80-62-6																■	XXS OV	68 11 530
																		XS EC Organic Vapors A	68 09 522
Methyl n-amyl ketone (2-Heptanone)	110-43-0													✱					
1-Methyl-2-pyrrolidone	872-50-4													✱					
Methyl tert-butyl ether (MTBE)	1634-04-4				■			✱				✱	✱	■	■	■			
Monomethylamine	74-89-5													✱				XXS Amine	68 12 545
																		XS EC Amine	68 09 545
Monomethylhydrazine	60-34-4																	XS EC Hydrazin	68 09 190
Napthalene	91-20-3													✱					
Nitric acid	7697-37-2																	XS EC HF/HCl	68 09 140
Nitrobenzene	98-95-3													✱					
Nitrogen dioxide	10102-44-0																	XXS NO_2	68 10 884
																		XXS NO_2 LC	68 12 600
																		XS EC NO_2	68 09 155
Nitrogen monoxide	10102-43-9																	XXS NO	68 11 545
																		XS EC NO	68 09 125

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CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
o-Nitrotoluene	88-72-2													*					
3-Nitrotoluene	99-08-1													*					
n-Nonane	111-84-2	■	■	*	■		■	■				■	■	■	■	■			
Iso-Octane (2,2,4-Trimethylpentane)	540-84-1													*	■	■			
n-Octane	111-65-9	■	■	*	■		*	*				*	*	■	■	■			
Oxygen	7782-44-7																	XXS O_2	68 10 881
																		XXS O_2/CO LC	68 13 275
																		XXS O_2/H_2S LC	67 14 137
																		XXS E O_2	68 12 211
																		XXS O_2 100	68 12 385
																		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
Ozone	10028-15-6																	XXS Ozone	68 11 540
n-Pentane	109-66-0	■	■	*	■	■	■	■				■	■	*	■				

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
Pentylalcohol	71-41-0	■	■	*	*		■	*				*	*		■	■			
3-Pentylalcohol	584-02-1				■														
Petrol (Gasoline)	e.g. 8006-61-9	■	■	*	■		*	*				*	*	■	■	■			
Phenol	108-95-2													*					
Phenyl hydrazine	100-63-0													*					
Phosgene	75-44-5																	XXS $COCl_2$	68 12 005
																		XS EC $COCl_2$	68 08 582
Phosphine	7803-51-2													*	■	■	■	XXS PH_3	68 10 886
																		XXS PH_3 HC	68 12 020
																		XS EC Hydride	68 09 135
																		XS EC PH_3 HC	68 09 535
Phosphorous trichloride	7719-12-2																	XS EC HF/HCl	68 09 140
Phosphorous trichloride oxide	10025-87-3																	XS EC HF/HCl	68 09 140
alpha-Pinene	2437-95-8													■	■	■			
Propane	74-98-6	*	■	*	■	■	■	■				■	■						

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX					IR							PID				EC	ORDER NO.
		SMART CATEX (HC PR) 68 12 970	SMART CATEX (PR) 68 12 980	SMART CATEX (FR PR) 68 12 975	CAT EX 125 PR 68 12 950	CATEX 125 PR GAS 68 13 080	SMART IR-EX 68 10 460	IR-EX 68 51 881	SMART IR-CO_2 HC 68 10 599	SMART IR-CO_2 68 10 590	IR-CO_2 68 51 882	DUAL IR-EX/CO_2 ES 68 51 880	DUAL IR-EX/CO_2 HC 68 00 276	SMART PID 83 19 100	PID HC 68 13 475	PID LC PPB 68 13 500	X-PID SENSORS		
i-Propanol	67-63-0		*	*	■									*	■		■	XXS OV	68 11 530
																		XS EC Organic Vapors	68 09 115
n-Propanol	71-23-8	■	■	*	*		■	*				*	*	*	■		■		
Propene (Propylene)	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	75-56-9							*				*	*	*	■		■	XXS OV	68 11 530
(1,2 Epoxy propane)																		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														■	■	■		

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	SMART CATEX (PR) 68 12 980	SMART CATEX (FR PR) 68 12 975	CAT EX 125 PR 68 12 950	CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR-EX 68 51 881	SMART IR-CO_2 HC 68 10 599	SMART IR-CO_2 68 10 590	IR-CO_2 68 51 882	DUAL IR-EX/CO_2 ES 68 51 880	DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID HC 68 13 475	PID LC PPB 68 13 500	X-PID SENSORS	EC	ORDER NO.
Tetraethyl lead	78-00-2													*					
Tetrahydrofuran	109-99-9													*	■	■	■	XXS OV	68 11 530
Tetrahydrothiophene	110-01-0													*				XXS Odorant	68 12 535
																		XS EC Odorant	68 09 200
Thiophene	110-02-1													*	■	■			
Toluene	108-88-3	■	■	*	■		■	■				■	■	■	■	■	■		
2,4-Toluene diisocyanate	584-84-9													*					
o-Toluidine	95-53-4													*					
Trichloroethylene	79-01-6													■	■	■	■		
Trichloro methane (Chloroform)	67-66-3													*					
Triethylamine	121-44-8	*	*	*	*									*				XXS Amine	68 12 545
																		XS EC Amine	68 09 545
Trimethylamine	75-50-3													*				XXS Amine	68 12 545
																		XS EC Amine	68 09 545
1,2,4-Trimethylbenzene (Pseudocumene)	95-63-6														■				

■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

CHEMICAL DESIGNATION	CAS-NO.	CAT EX: SMART CATEX (HC PR) 68 12 970	CAT EX: SMART CATEX (PR) 68 12 980	CAT EX: SMART CATEX (FR PR) 68 12 975	CAT EX: CAT EX 125 PR 68 12 950	CAT EX: CATEX 125 PR GAS 68 13 080	IR: SMART IR-EX 68 10 460	IR: IR-EX 68 51 881	IR: SMART IR-CO_2 HC 68 10 599	IR: SMART IR-CO_2 68 10 590	IR: IR-CO_2 68 51 882	IR: DUAL IR-EX/CO_2 ES 68 51 880	IR: DUAL IR-EX/CO_2 HC 68 00 276	PID: SMART PID 83 19 100	PID: PID HC 68 13 475	PID: PID LC PPB 68 13 500	PID: X-PID SENSORS	EC	ORDER NO.
1,3,5 Trimethylbenzene (Mesitylene)	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													*					
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													*	■	■	■		
m-Xylene	108-38-3														■	■	■		
o-Xylene	95-47-6	■	■	*	■		■	■				■	■		■	■	■		
p-Xylene	106-42-3														■	■	■		

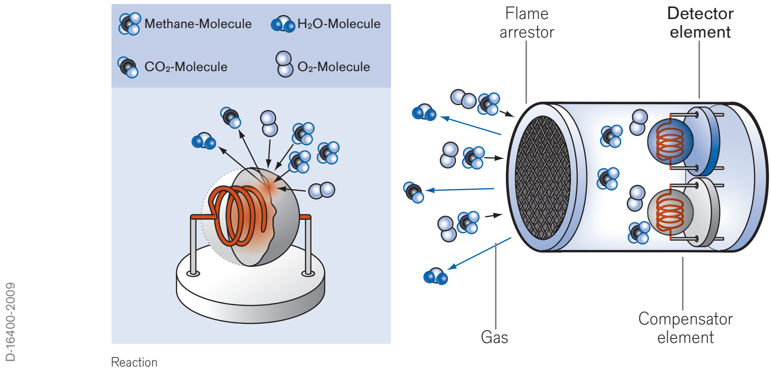
■ Empfindlichkeitsdaten bekannt * Substanz theoretisch messbar, Empfindlichkeit noch nicht ermittelt

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.

Catalytic bead sensors



Reaction

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})
Precision:	≤ ± 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
Precision:	≤ ± 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
Precision:	≤ ± 0.3% of measured value/K at (−20 to 40)°C (−4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.03% LEL/% RH
Precision:	≤ ± 0.1% of measured value/% RH
Effect of sensor poisons:	Hydrogen sulfide 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 or volatile silicon, sulphur, heavy metal compounds or substances that can polymerize → potential poisoning.
Test gas:	approx. 2 Vol.-% or 50 Vol.-% CH_4

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

Response time:	≤ 20 seconds (t_{50}) ≤ 40 seconds (t_{90})
Precision:	≤ ± 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
Precision:	≤ ± 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
Precision:	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.04% LEL/% RH
Precision:	≤ ± 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})
Precision:	1 Vol.-% CH4
Linearity error:	
5 to 50 Vol.-%	≤ ± 5 Vol.-%
50 to 100 Vol.-%	≤ ± 10% of measured value
Long-term drift	
Zero point:	≤ ± 3 Vol.-%/month
Precision:	≤ ± 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 sulfide, siloxiane and other sensor poisons. 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
Acetylene	C_2H_2	1.15	34
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
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	1.00	26
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
o-Xylene	$C_6H4(CH_3)_2$	0.55	19

The given values may fluctuate by ±30 %.

The table does not claim to be complete. The sensor may also be sensitive to other gases and vapours. Poisoning of the sensor may also alter the relative sensitivities for certain gases and vapours. The specified test gas concentrations correspond to 50 % of the lower explosion limit of each test gas (source: E. Brandes, W. Möller: Sicherheitstechnische Kenngrößen, PTB, ISBN 978-3-86509-811-5, edition 2008).

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})
Precision:	≤ ± 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
Precision:	≤ ± 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
Precision:	≤ ± 0.3% of measured value/K at (−20 to 40)°C (−4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.03% LEL/% RH
Precision:	≤ ± 0.1% of measured value/% RH
Effect of sensor poisons:	Hydrogen sulfide 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 or volatile silicon, sulphur, heavy metal compounds or substances that can polymerize → potential poisoning.
Test gas:	approx. 2 Vol.-% CH_4

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

Response time:	≤ 20 seconds (t_{50}) ≤ 40 seconds (t_{90})
Precision:	≤ ± 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
Precision:	≤ ± 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
Precision:	≤ ± 0.3% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.04% LEL/% RH
Precision:	≤ ± 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 sulfide, siloxiane and other sensor poisons. 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
Acetylene	C_2H_2	1.15	34
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
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	1.00	26
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
o-Xylene	$C_6H4(CH_3)_2$	0.55	19

The given values may fluctuate by ±30 %.

The table does not claim to be complete. The sensor may also be sensitive to other gases and vapours. Poisoning of the sensor may also alter the relative sensitivities for certain gases and vapours. The specified test gas concentrations correspond to 50 % of the lower explosion limit of each test gas (source: E. Brandes, W. Möller: Sicherheitstechnische Kenngrößen, PTB, ISBN 978-3-86509-811-5, edition 2008).

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})
Precision:	≤ ± 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
Precision:	≤ ± 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
Precision:	≤ ± 0.2% of measured value/K at (–20 to 40)°C (–4 to 104)°F
Influence of humidity	
Zero point:	≤ ± 0.05% LEL/% RH
Precision:	≤ ± 0.3% of measured value/% RH
Effect of sensor poisons:	Hydrogen sulfide 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 or volatile silicon, sulphur, heavy metal compounds or substances that can polymerize → potential poisoning.

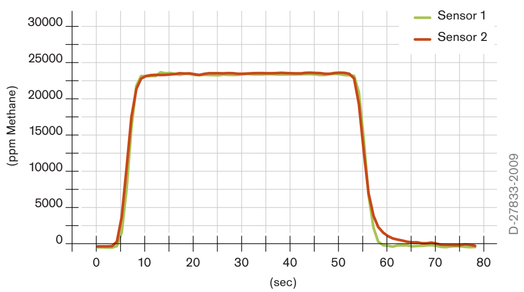
FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CH_4:

Response time:	≤ 18 seconds (t_{90}) at 0 to 5 Vol.-%
Precision:	≤ ± 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:	≤ ± 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

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 sulfide, 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 2500/5000	no	yes	3 years	> 4 years	–
Dräger X-am 3500/8000	no	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 (at calibration with methane)
Resolution:	1 % LEL for measurement range 0 to 100 % LEL, 1 Vol.-% for measurement range 0 to 100 Vol.-% CH_4 (methane)
Measurement range:	0 to 100 % LEL 0 to 100 Vol.-% CH_4 (methane) in Dräger X-am 5000, X-am 8000
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

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

Response time:		X-am 2500/5000	X-am 3500/8000
	Diffusion mode (t_{50})	≤ 7 seconds	≤ 9 seconds
	Diffusion mode (t_{90})	≤ 17 seconds	≤ 20 seconds
	Pump mode (t_{50})		≤ 9 seconds
	Pump mode (t_{90})		≤ 12 seconds

Precision		
Zero point:	≤ ± 1 % LEL	
Sensitivity:	≤ ± 1 % LEL at 50 % LEL	
Linearity error:	≤ ± 2 % LEL at 70 % LEL	
Influence of temperature		
Zero point:	≤ ± 0.03 % LEL/K	
Sensitivity:	≤ ± 0.05 % LEL/K at 50 % LEL	
Influence of humidity (at 40°C)		
Zero point:	≤ ± 0.01 % LEL/% RH	
Sensitivity:	≤ ± 0.03 % LEL/% RH at 50 % LEL	
Influence of pressure	X-am 2500/5000	X-am 3500/8000
Zero point:	≤ ± 0.30 %LEL/kPa	≤ ± 0.03 % LEL/kPa
Sensitivity:	≤ ± 0.30 % LEL/kPa at 50 % LEL	≤ ± 0.10 % LEL/kPa at 50 % LEL
Long-term drift		
Zero point:	≤ ± 1 % LEL/month	
Sensitivity:	≤ ± 2 % LEL/month at 50 % LEL	

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

Response time:		X-am 2500/5000	X-am 3500/8000
	Diffusion mode (t_{50})	≤ 10 seconds	≤ 12 seconds
	Diffusion mode (t_{90})	≤ 25 seconds	≤ 30 seconds
	Pump mode (t_{50})		≤ 11 seconds
	Pump mode (t_{90})		≤ 15 seconds

Precision		
Zero point:	≤ ± 1 % LEL	
Sensitivity:	≤ ± 1 % LEL at 50 % LEL	
Linearity error:	≤ ± 3 % LEL at 70 % LEL	
Influence of temperature		
Zero point:	≤ ± 0.05 % LEL/K	
Sensitivity:	≤ ± 0.05 % LEL/K at 50 % LEL	
Influence of humidity (at 40°C)		
Zero point:	≤ ± 0.03 % LEL/% RH	
Sensitivity:	≤ ± 0.03 % LEL/% RH at 50 % LEL	
Influence of pressure	X-am 2500/5000	X-am 3500/8000
Zero point:	≤ ± 0.30 %LEL/kPa	≤ ± 0.03 % UEG/kPa
Sensitivity:	≤ ± 0.30 % LEL/kPa at 50 % LEL	≤ ± 0.10 % LEL/kPa at 50 % LEL
Long-term drift		
Zero point:	≤ ± 2 % LEL/month	
Sensitivity:	≤ ± 3 % LEL/month at 50 % LEL	

* s. a. Notes on Approval 9033890 (X-am 2500/5000), 9033655 (X-am 3500/8000)

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

Response time:	≤ 30 seconds (t_{90})
Precision:	≤ ± 1 Vol.-%
Linearity error:	≤ ± 5 Vol.-% at 0 to 50 Vol.-% ≤ ± 10% of measured value at 50 to 100 Vol.-%
Long-term drift	
Zero point:	≤ ± 3 Vol.-%/month
Precision:	≤ ± 3 Vol.-%/month at 50 Vol.-%
Influence of temperature:	≤ ± 0.15 Vol.-%/K
Influence of humidity:	≤ ± 0.15 Vol.-%/% RH at 40 °C

NOTICE: Monitoring explosive mixtures in the range from 0 to 100% LEL in the measuring range up to 100 Vol% is only possible for devices that have an automatic range switchover. Heat conduction measurements are possible in the absence of oxygen, but the accuracy specifications in the range 0 to 5 Vol% here do not apply in this case.
This setting is not suitable for the monitoring of explosive mixtures in the measuring range of 0 to 100% LEL.

Test gas:	approx. 2 Vol.-% CH_4 or 50 Vol.-% CH_4
Effect of sensor poisons:	Halogenated hydrocarbons or volatile silicon, sulphur, heavy metal compounds may damage the CatEx Sensor. Hydrogen sulphide H_2S 1000 ppmh ≤ ± 2 % of measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ± 25 % of measured value After an exposure to 10 ppm HMDS in air for 5 hours the loss of sensitivity is less than 50%.

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 for the use in the devices Dräger X-am 2500/5000 and from methane to octance for the devices Dräger X-am 3500/8000 in accordance with EN 60079-29-1 and EN 50271. In addition, the sensor has very good long-term stability, hardly any influence of humidity and an excellent poisoning resistance to sensor poisons such as hydrogen sulfide and siloxanes.

DETECTING OTHER GASES AND VAPORS

The detection of other gases and vapors through the use of cross sensitivities for the measurement range of 0 to 100 % LEL. The values given are typical values when calibrated with methane (CH_4) and apply to new sensors without additional diffusion barriers. For methane, the LEL according to ISO/IEC 80079-20-1:2017 was used. The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chemical symbol	CAS No.	Test gas concentration in Vol.-%	Reading displayed in % LEL
Acetone	C_3H_6O	67-64-1	1.25	31
Acetic acid	$C_2H_4O_2$	64-19-7	3.00	23
Acetylene	C_2H_2	74-86-2	1.15	36
Ammonia	NH_3	7664-41-7	7.70	57
Benzene	C_6H_6	71-43-2	0.60	25
Butadiene -1,3	C_4H_6	106-99-0	0.70	27
n-Butane	C_4H_{10}	106-97-8	0.70	26
n-Butanol	$C_4H_{10}O$	71-36-3	0.70	20
2-Butanone	C_4H_8O	78-93-3	0.75	22
n-Butyl acetate	$C_6H_{12}O_2$	123-86-4	0.60	17
Carbon monoxide	CO	630-08-0	5.45	32
Cyclohexane	C_6H_{12}	110-82-7	0.50	20
Cyclopentane	C_5H_{10}	287-92-3	0.70	27
Diethylamine	$C_4H_{11}N$	109-89-7	0.85	28
Diethyl ether	$(C_2H_5)_2O$	60-29-7	0.85	27
Ethane	C_2H_6	74-84-0	1.20	35
Ethanol	C_2H_6O	64-17-5	1.55	33
Ethene	C_2H_4	74-85-1	1.20	36
Ethyl acetate	$C_4H_8O_2$	141-78-6	1.00	25
n-Heptane	C_7H_{16}	142-82-5	0.40	17
n-Hexane	C_6H_{14}	110-54-3	0.50	20
Hydrogen	H_2	1333-74-0	2.00	49
Liquid petroleum gas**	LPG		0.70	22
Methane	CH_4	74-82-8	2.20	50

Gas/vapor	Chemical symbol	CAS No.	Test gas concentration in Vol.-%	Reading displayed in % LEL
Methanol	CH_4O	67-56-1	3.00	40
1-Methoxy-2-Propanol	$C_4H_{10}O_2$	107-98-2	0.90	21
Methyl tert-butyl ether (MTBE)	$C_5H_{12}O$	1634-04-4	0.80	25
n-Nonane	C_9H_{20}	111-84-2	0.35	14
n-Octane	C_8H_{18}	111-65-9	0.40	17
n-Pentane	C_5H_{12}	109-66-0	0.55	21
3-Pentanol	$C_5H_{12}O$	584-02-1	0.60	19
Propane	C_3H_8	74-98-6	0.85	29
2-Propanol	C_3H_8O	67-63-0	1.00	27
Propene	C_3H_6	115-07-1	1.00	35
Propylene oxide	C_3H_6O	75-56-9	0.95	25
Styrene	C_8H_8	100-42-5	0.50	11
Toluene	C_7H_8	108-88-3	0.50	20
o-Xylene	C_8H_{10}	95-47-6	0.55	19

** The values in the table are based on 50% propane and 50% butane. In practice, the composition of LPG can fluctuate, which may lead to increased measuring errors.

The given values may fluctuate by ±30 %.

The table does not claim to be complete. The sensor may also be sensitive to other gases and vapours. Poisoning of the sensor may also alter the relative sensitivities for certain gases and vapours. After overstepping the measuring range there could be increased readings in the measuring range 0 to 100 %LEL. Calibrate the sensor, if necessary. The given test gas concentrations correspond to 50% of the lower explosion limit of each test gas (source: E. Brandes, W. Möller:Technical safety data, PTB, ISBN 978-3-86509-811-5, edition 2008).

D-27736-2017

DrägerSensor® CatEx 125 PR

DrägerSensor® CatEx 125 PR-Gas

Order no. 68 13 080

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 2500/5000	no	yes	3 years	> 4 years
Dräger X-am 8000	no	yes	3 years	> 4 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 (at calibration with methane)
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 or 0 to 100 Vol.-% CH_4 (methane) in Dräger X-am 5000, x-am 8000
Ambient conditions	
Temperature:	–20 to 55 °C (-4 to 131 °F)
Humidity:	10 to 95 % RH
Pressure:	700 to 1300 hPa
Warm-up time:	≤ 3 minutes

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

Response time:		X-am 2500/5000	X-am 8000
	Diffusion mode (t_{50})	≤ 6 seconds	≤ 8 seconds
	Diffusion mode (t_{90})	≤ 8 seconds	≤ 15 seconds
	Pump mode (t_{50})		≤ 8 seconds
	Pump mode (t_{90})		≤ 10 seconds

Precision		
Zero point:	≤ ± 1 % LEL	
Sensitivity:	≤ ± 1 % LEL at 50 % LEL	
Linearity error:	≤ ± 2 % LEL at 70 % LEL	
Influence of temperature		
Zero point:	≤ ± 0.05 % LEL/K	
Sensitivity:	≤ ± 0.05 % LEL/K at 50 % LEL	
Influence of humidity (at 40°C)		
Zero point:	≤ ± 0.03 % LEL/% RH	
Sensitivity:	≤ ± 0.03 % LEL/% RH at 50 % LEL	
Influence of pressure	X-am 2500/5000	X-am 8000
Zero point:	≤ ± 0.30 %LEL/kPa	≤ ± 0.03 % LEL/kPa
Sensitivity:	≤ ± 0.30 % LEL/kPa at 50 % LEL	≤ ± 0.10 % LEL/kPa at 50 % LEL
Long-term drift		
Zero point:	≤ ± 1 % LEL/month	
Sensitivity:	≤ ± 1 % LEL/month at 50 % LEL	

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

Response time:		X-am 2500/5000	X-am 8000
	Diffusion mode (t_{50})	≤ 9 seconds	≤ 12 seconds
	Diffusion mode (t_{90})	≤ 18 seconds	≤ 29 seconds
	Pump mode (t_{50})		≤ 10 seconds
	Pump mode (t_{90})		≤ 13 seconds
Precision			
Zero point:	≤ ± 1 % LEL		
Sensitivity:	≤ ± 1 % LEL at 50 % LEL		
Linearity error:	≤ ± 2 % LEL at 70 % LEL		
Influence of temperature			
Zero point:	≤ ± 0.15 % LEL/K		
Sensitivity:	≤ ± 0.15 % LEL/K at 50 % LEL		
Influence of humidity (at 40°C)			
Zero point:	≤ ± 0.03 % LEL/% RH		
Sensitivity:	≤ ± 0.03 % LEL/% RH at 50 % LEL		
Influence of pressure	X-am 2500/5000	X-am 8000	
Zero point:	≤ ± 0.50 %LEL/kPa	≤ ± 0.10 % UEG/kPa	
Sensitivity:	≤ ± 0.50 % LEL/kPa at 50 % LEL	≤ ± 0.10 % LEL/kPa at 50 % LEL	
Long-term drift			
Zero point:	≤ ± 3 % LEL/month		
Sensitivity:	≤ ± 3 % LEL/month at 50 % LEL		

* s. a. Notes on Approval 9033890 (X-am 2500/5000), 9033655 (X-am 8000)

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

Response time:	≤ 35 seconds (t_{90})
Precision:	≤ ± 1 Vol.-%
Linearity error:	≤ ± 5 Vol.-% at 0 to 50 Vol.-% ≤ ± 10% of measured value at 50 to 100 Vol.-%
Long-term drift	
Zero point:	≤ ± 3 Vol.-%/month
Precision:	≤ ± 3 Vol.-%/month at 50 Vol.-%
Influence of temperature:	≤ ± 0.3 Vol.-%/K
Influence of humidity:	≤ ± 0.2 Vol.-%/% RH at 40 °C

NOTICE: Monitoring explosive mixtures in the range from 0 to 100% LEL in the measuring range up to 100 Vol% is only possible for devices that have an automatic range switchover. Heat conduction measurements are possible in the absence of oxygen, but the accuracy specifications in the range 0 to 5 Vol% here do not apply in this case.
This setting is not suitable for the monitoring of explosive mixtures in the measuring range of 0 to 100% LEL.

Test gas:	approx. 2 Vol.-% CH_4 or 50 Vol.-% CH_4
Effect of sensor poisons:	Halogenated hydrocarbons or volatile silicon, sulphur, heavy metal compounds may damage the CatEx Sensor. Hydrogen sulphide H_2S 1000 ppmh ≤ ± 2 % of measured value Hexamethyldisiloxane HMDS 10 ppmh ≤ ± 10 % of measured value Hexamethyldisiloxane HMDS 30 ppmh ≤ ± 20 % of measured value After an exposure to 10 ppm HMDS in air for 3 hours the loss of sensitivity is less than 40%.

SPECIAL CHARACTERISTICS

This sensor is optimized for the detection of methane. It has a response time (t_{90}) of less than 10 seconds. Due to the additional shock absorption of the pellistors, it is particularly resistant to shock. Provided with all the necessary approvals, this is a very robust sensor that can be used in both industrial and mining applications.

DETECTING OTHER GASES AND VAPORS

The detection of other gasea through the use of cross sensitivities for the measurement range of 0 to 100 % LEL. The values given are typical values when calibrated with methane (CH_4) and apply to new sensors without additional diffusion barriers. For methane, the LEL according to ISO/IEC 80079-20-1:2017 was used. The table does not claim to be complete. The sensor may also be sensitive to other gases.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chemical symbol	CAS No.	Test gas concen-tration in Vol.-%	Reading displayed in % LEL
Acetylene (MTG)	C_2H_2	74-86-2	1.15	32
n-Butane (MTG)	C_4H_{10}	106-97-8	0.70	22
i-Butene (MTG)	C_4H_8	115-11-7	0.80	23
Ethane (MTG)	C_2H_6	74-84-0	1.20	33
Ethene (MTG)	C_2H_4	74-85-1	1.20	30
Hydrogen (MTG)	H_2	1333-74-0	2.00	44
Liquid petroleum gas**	LPG		0.70	22
Methane (MTG)	CH_4	74-82-8	2.20	50
Methane***	CH_4	74-82-8	2.20	50
n-Pentane	C_5H_{12}	109-66-0	0.75	22
Propane (MTG)	C_3H_8	74-98-6	0.85	28
Propene (MTG)	C_3H_6	115-07-1	1.00	32

** The values in the table are based on 50% propane and 50% butane. In practice, the composition of LPG can fluctuate, which may lead to increased measuring errors.

*** The measuring gas «ch_4L» provides a higher resolution and is used for leak detection. It is recommended to re-calibrate the zero point in fresh air at the oeprating site. The settings are optimized for the X-am 8000. With the unit [ppm], high gas concentrations cannot be shown on the X-am 5000›s display; the unit should be changed to [Vol%] or [%UEG].

MTG = German abbreviation for measurement performance certificate.
A metrological report is a verification and certification of the measuring function of a gas measuring device.

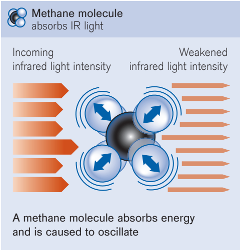
D-27734-2017

DrägerSensor® CatEx 125 PR Gas

4.4 Dräger infrared sensors

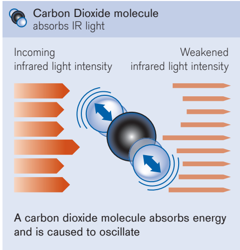
Every gas absorbs light in a particular way; some even absorb visible light (wavelength of 0.4 to 0.8 micrometers), which is why chlorine is yellowish green, bromine and nitrogen dioxide are brown, iodine vapor is violet, and so on – but unfortunately they are only visible in high (deadly) concentrations.

DUAL IR Ex/CO_2 Sensor



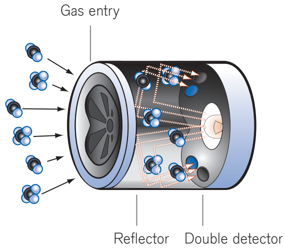
Reaction

CH_4 + Energy → CH_4(excited)



Reaction

CO_2 + Energy → CO_2(excited)



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})
Precision:	≤ ± 2.0% LEL methane at 50% LEL
Linearity error, typical:	≤ ± 5% of measured value
Long-term drift	
Zero point:	≤ ± 2.5% LEL methane/month
Precision:	≤ ± 2.5% 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
Precision:	≤ ± 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:

Precision:	≤ ± 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

The specified values may deviate by up to ±30 %.

Calibration for a gas or vapor may result in increased linearity errors. The specified test-gas concentration corresponds to approximately 50 % of the lower explosion limit for the test gas in question. (Source: E. Brandes, W. Möller: Sicherheitstechnische Kenngrößen, PTB, ISBN 3-89701-745-8, Edition 2003)

DrägerSensor® IR EX

Order no. 68 51 881

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5600	no	yes	5 years	> 5 years
Dräger X-am 8000	no	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 (when calibrated with CH_4)
Resolution:	1% LEL
Measurement range:	0 to 100 % LEL/ 0 to 100 Vol.-% (depending on the respective target gas)
Ambient conditions	
Temperature:	(–20 to 50)°C (–4 to 122)°F
Humidity:	(0 to 95)% RH
Pressure:	(800 to 1100) hPa (in potentially explosive atmospheres) (700 to 1300) hPa
Warm-up time:	≤ 3 minutes

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

Response time:		X-am 5600	X-am 8000
	Diffusion mode (t_{50})	≤ 10 seconds	≤ 10 seconds
	Diffusion mode (t_{90})	≤ 15 seconds	≤ 21 seconds
	Pump mode (t_{50})	≤ 7 seconds	≤ 9 seconds
	Pump mode (t_{90})	≤ 10 seconds	≤ 11 seconds

Precision		
Zero point:	≤ ± 1.0% LEL	
Sensitivity:	≤ ± 2% LEL at 50% LEL	
Linearity error:	≤ ± 4 % of mesaured value or ≤ ± 1.5 % of the end of measurement range (the larger value applies in each case)	
Influence of temperature (-20 to 50 °C)		
Zero point:	≤ ± 0.02% LE/K	
Sensitivity:	≤ ± 0.1% LEL/K at 50% LEL	
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)		
Zero point:	≤ ± 0.01% LEL/% RH	
Influence off pressure of the respective measured value/hPa		
	X-am 5600	X-am 8000
Zero point:	≤±0.16 % (uncompensated)	≤±0.06 % (compensated)
Long-term drift		
Zero point:	≤ ± 1% LEL/month	
Sensitivity:	≤ ± 3% LEL/month at 50 % LEL	

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

Response time:		X-am 5600	X-am 8000
	Diffusion mode (t_{50})	≤ 12 seconds	≤ 14 seconds
	Diffusion mode (t_{90})	≤ 40 seconds	≤ 57 seconds
	Pump mode (t_{50})	≤ 8 seconds	≤ 10 seconds
	Pump mode (t_{90})	≤ 13 seconds	≤ 15 seconds
Precision			
Zero point:	≤ ± 1.0 % LEL		
Sensitivity:	≤ ± 2 % LEL at 50 % LEL		
Linearity error:	≤ ± 3.0 % of mesaured value or ≤ ± 1.0 % of the end of measurement range (the larger value applies in each case)		
Influence of temperature (-20 to 50 °C)			
Zero point:	≤ ± 0.06 % LEL/K		
Sensitivity:	≤ ± 0.13 % LEL/K at 50 % LEL		
Influence of humidity at 40 °C (104 °F) (0 to 95 % RH, non-condensing)			
Zero point:	≤ ± 0.01 % LEL/% RH		
Influence of pressure of the respective measured value/hPa			
	X-am 5600	X-am 8000	
Zero point:	≤±0.16 % (uncompensated)	≤±0.06 % (compensated)	
Long-term drift			
Zero point:	≤ ± 3% LEL/month		
Sensitivity:	≤ ± 4% LEL/month at 50 % LEL		

* s. a. Notes on Approval 9033890 (X-am 5600), 9033655 (X-am 8000)

Test gas:	2,5 Vol.-% CH_4 for measurement range up to 100 %LEL 50 Vol.-% CH_4 for measurement range up to 100 Vol.% CH_4 0,9 Vol.-% C_3H_8 for measurement range up to 100 %LEL

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
n-BUTANE	BUTA	0 to 100 Vol.-%
Ethene	c2h4	0 to 100% LEL
ETHENE	C2H4	0 to 100 Vol.-%
Ethanol	EtOH	0 to 100% LEL
Ex	Ex	0 to 100% LEL
JetFuel	JetF	0 to 100% LEL
Liquid Petroleum Gas ***	LPG	0 to 100 Vol.-%
Methane	ch4	0 to 100% LEL
METHANE	CH4	0 to 100 Vol.-%
n-nonane	Nona	0 to 100% LEL
n-pentane	Pent	0 to 100% LEL
Propane	c3h8	0 to 100% LEL
PROPANE	C3H8	0 to 100 Vol.-%
Toluene	Tolu	0 to 100% LEL

** The LEL information is dependent on the applicable country-specific standards.

*** The values in the table are based on 50% propane and 50% butane. In practice, the composition of LPG can fluctuate, which may lead to increased measuring errors.

DETECTING OTHER GASES AND VAPORS

Detection of other gases and vapors for the measuring range 0% to 100% LEL with the DrägerSensor Dual IR Ex/CO_2 ES or DrägerSensor IR Ex ES via cross-sensitivities used for technical measurements when calibrated with propane (C_3H_8, 100 % LEL = 1.7 Vol.%. Always observe these values for this application). The sensor can be used to detect the gases and vapors mentioned in the table. For this purpose, the sensor in the device must be configured to the target gas „Ex“. The specified values apply to 20 °C and may vary by ± 30 %. Calibration to the gas or the vapor can cause increased linearity errors.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chemical symbol	CAS No.	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol% = 50 % LEL propane)	Cross-sensitivity factor f
Acetone	C_3H_6O	67-64-1	1.25	18	2.78
Acetylene	C_2H_2	74-86-2	–	not possible	–
Benzene	C_6H_6	71-43-2	0.60	20	2.50
Butadiene -1,3	C_4H_6	106-99-0	0.70	20	2.50
i-Butane	$(CH_3)_3CH$	75-28-5	0.75	41	1.22
n-Butane	C_4H_{10}	106-97-8	0.70	42	1.19
n-Butanol	$C_4H_{10}O$	71-36-3	0.85	25	2.00
2-Butanon (MEK)	C_4H_8O	78-93-3	0.75	22	2.27

Gas/vapor	Chemical symbol	CAS No.	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol% = 50 % LEL propane)	Cross-sensitivity factor f
i-Butene	C_4H_8	115-11-7	0.80	31	1.61
n-Butyl acetate	$C_6H_{12}O_2$	123-86-4	0.60	20	2.50
Cyclohexane	C_6H_{12}	110-82-7	0.50	15	3.33
Cyclopentane	C_5H_{10}	287-92-3	0.70	47	1.06
Diethylamine	$C_4H_{11}N$	109-89-7	0.85	44	1.14
Diethyl ether	$(C_2H_5)_2O$	60-29-7	0.85	46	1.09
Dimethyl ether	C_2H_6O	115-10-6	1.35	51	0.98
Ethane	C_2H_6	74-84-0	1.20	65	0.77
Ethanol	C_2H_6O	64-17-5	1.55	41	1.22
Ethene	C_2H_4	74-85-1	1.20	15	3.33
Ethyl acetate	$C_4H_8O_2$	141-78-6	1.00	35	1.43
Ethyl acrylate	$C_5H_8O_2$	140-88-5	0.85	26	1.92
n-Heptane	C_7H_{16}	142-82-5	0.55	36	1.39
n-Hexane	C_6H_{14}	110-54-3	0.50	34	1.47
Methane	CH_4	74-82-8	2.20	37	1.35
Methanol	CH_4O	67-56-1	3.00	92	0.54
n-Methoxy-2-Propanol	$C_4H_{10}O_2$	107-98-2	0.90	26	1.92
Methyl choride	CH_3Cl	74-87-3	3.80	47	1.06
Methylene chloride	CH_2Cl_2	75-09-2	6.50	20	2.50
Methyl tert-butyl ether (MTBE)	$C_5H_{12}O$	1634-04-4	0.80	59	0.85
n-Nonane	C_9H_{20}	111-84-2	0.35	on request	–
n-Octane	C_8H_{18}	111-65-9	0.40	20	2.50
n-Pentane	C_5H_{12}	109-66-0	0.55	36	1.39
Propane	C_3H_8	74-98-6	0.85	50	1.00
n-Propanol	C_3H_8O	71-23-8	1.05	40	1.25
Propene	C_3H_6	115-07-1	0.90	31	1.61
Propylene oxide	C_3H_6O	75-56-9	0.95	49	1.02
Toluene	C_7H_8	108-88-3	0.50	19	2.63
o-Xylene	C_8H_{10}	95-47-6	0.50	11	4.55

f = Specifications relate to the respective test gas concentration and the corresponding LEL.
The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

D-0951-2020

DrägerSensor® IR Ex ES

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})
Precision:	≤ ± 0.06 Vol.-% CO_2 at 2.5 Vol.-%
Linearity error, typical:	> 0 to ≤ 1 Vol.-% CO_2 <± 1 % of end of measuring range > 1 to ≤ 4 Vol.-% CO_2 <± 5 % of the measured value > 4 to ≤ 5 Vol.-% CO_2 <± 10 % of end of measuring range
Long-term drift	
Zero point:	≤ ± 0.004 Vol.-% CO_2/month
Precision:	≤ ± 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
Precision:	≤ ± 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:	0 to 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.

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})
Precision:	≤ ± 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
Precision:	≤ ± 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
Precision:	≤ ± 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 ES

Order no. 68 51 882

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5600	no	yes	5 years	> 5 years
Dräger X-am 8000	no	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.-% or 50 ppm (depending on set unit)
Measurement range:	0 to 5 Vol.-%
Ambient conditions	
Temperature:	(-20 to 50) °C (-4 to 122) °F
Humidity:	(0 to 95) % r. F.
Pressure:	(700 to 1300) hPa
Warm-up time:	≤ 3 minutes

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 5 VOL.-% CO_2 WHEN CALIBRATED WITH 2.0 VOL.-% CARBON DIOXIDE IN AIR*:

Response time:		X-am 5600	X-am 8000
	Diffusion mode (t_{50})	≤ 15 seconds	≤ 14 seconds
	Diffusion mode (t_{90})	≤ 31 seconds	≤ 48 seconds
	Pump mode (t_{50})	≤ 8 seconds	≤ 10 seconds
	Pump mode (t_{90})	≤ 11 seconds	≤ 14 seconds

Precision		
Zero point:	≤ ± 0.01 Vol.-%	
Sensitivity:	≤ ± 0.08 Vol.-% at 2.5 Vol.-%	
Linearity error:	≤ ± 10 % of measured value or ≤ ± 1.5 % of the end of measurement range (the larger value applies in each case)	
Influence of temperature (-20 to 50 °C)		
Zero point:	≤ ± 0.0002 Vol.-%/K	
Sensitivity:	≤ ± 0.015 % Vol.-%/K at 2.5 Vol.-%	
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)		
Zero point:	≤ ± 0.0001 Vol.-%/ % RH	
Influence of pressure of the respective measured value/hPa		
	X-am 5600	X-am 8000
Zero point:	≤ ± 0.15 % (uncompensated)	≤ ± 0.09 % (compensated)
Long-term drift		
Zero point:	± 0.005 Vol.-%/month	
Sensitivity:	± 0.1 Vol.-%/6 months at 2.5 Vol.-%	
Test gas	2 Vol.-% CO_2	

* s. a. Notes on Approval 9033890 (X-am 5600), 9033655 (X-am 8000)

SPECIAL CHARACTERISTICS

With its extremely low drift and low detection limit, this sensor is ideal for measuring carbon dioxide in indoor areas, 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-0966-2020

DrägerSensor® IR CO_2 ES

DrägerSensor® Dual IR Ex/CO_2 ES

Order no. 68 51 880

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 5600	no	yes	5 years	> 5 years
Dräger X-am 8000	no	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 for IR Ex (when calibrated with CH_4) 0.01 Vol.-% CO_2 for IR CO_2
Resolution:	1 % LEL for IR Ex 0.01 Vol.-% CO_2 or 50 ppm CO_2 (depending on set unit)
Measurement range:	0 to 100 % LEL/ 0 to 100 Vol.-% (depending on the respective target gas) 0 to 5 Vol.-% CO_2
Ambient conditions	
Temperature:	(-20 to 50) °C (-4 to 122) °F
Humidity:	(0 to 95) % RH
Pressure:	(800 to 1100) hPa (in potentially explosive atmospheres) (700 to 1300) hPa
Warm-up time:	≤ 3 minutes

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 100 % LEL OR 0 TO 4.4 VOL.% CH_4 WHEN CALIBRATED WITH 2.5 VOL.% METHANE IN AIR*:

		X-am 5600	X-am 8000
Response time:	Diffusion mode (t_{50})	≤ 10 seconds	≤ 10 seconds
	Diffusion mode (t_{90})	≤ 15 seconds	≤ 21 seconds
	Pump mode (t_{50})	≤ 7 seconds	≤ 9 seconds
	Pump mode (t_{90})	≤ 10 seconds	≤ 11 seconds

Precision	
Zero point:	≤ ± 1.0 % LEL
Sensitivity:	≤ ± 2 % LEL at 50 % LEL
Linearity error:	≤ ± 4 % of mesaured value or ≤ ± 1.5 % of the end of measurement range (the larger value applies in each case)
Influence of temperature (-20 to 50 °C)	
Zero point:	≤ ± 0.02 % LEL/K
Sensitivity:	≤ ± 0.1 % LEL/K at 50 % LEL
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)	
Zero point:	≤ ± 0.01 % LEL/% RH

Influence of pressure of the respective measured value/hPa	X-am 5600	X-am 8000
Zero point:	≤ ± 0.16 % (uncompensated)	≤ ± 0.06 % (compensated)

Long-term drift	
Zero point:	≤ ± 1 % LEL/month
Sensitivity:	≤ ± 3 % LEL/month at 50 % LEL

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 100 % LEL OR 0 TO 1.7 VOL.% C_3H_8 WHEN CALIBRATED WITH 0.9 VOL.% PROPANE IN AIR*:

Response time:		X-am 5600	X-am 8000
	Diffusion mode (t_{50})	≤ 12 seconds	≤ 14 seconds
	Diffusion mode (t_{90})	≤ 40 seconds	≤ 57 seconds
	Pump mode (t_{50})	≤ 8 seconds	≤ 10 seconds
	Pump mode (t_{90})	≤ 13 seconds	≤ 15 seconds
Precision			
Zero point:	≤ ± 1.0 % LEL		
Sensitivity:	≤ ± 2 % LEL at 50 % LEL		
Linearity error:	≤ ± 3.0 % of mesaured value or ≤ ± 1.0 % of the end of measurement range (the larger value applies in each case)		
Influence of temperature (-20 to 50 °C)			
Zero point:	≤ ± 0.06 % LEL/K		
Sensitivity:	≤ ± 0.13 % LEL/K at 50 % LEL		
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)			
Zero point:	≤ ± 0.01 % LEL/% RH		
Influence of pressure of the respective measured value/hPa			
	X-am 5600	X-am 8000	
Zero point:	≤ ± 0.16 % (uncompensated)	≤ ± 0.06 % (compensated)	
Long-term drift			
Zero point:	≤ ± 3 % LEL/month		
Sensitivity:	≤ ± 4 % LEL/month at 50 % LEL		

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 5 VOL.-% CO_2 WHEN CALIBRATED WITH 2.0 VOL.-% CARBON DIOXIDE IN AIR*:

Response time:		X-am 5600	X-am 8000
	Diffusion mode (t_{50})	≤ 15 seconds	≤ 14 seconds
	Diffusion mode (t_{90})	≤ 31 seconds	≤ 48 seconds
	Pump mode (t_{50})	≤ 8 seconds	≤ 10 seconds
	Pump mode (t_{90})	≤ 11 seconds	≤ 14 seconds
Precision			
Zero point:	≤ ± 0.01 Vol.-%		
Sensitivity:	≤ ± 0.08 Vol.-% at 2.5 Vol.-%		
Linearity error:	≤ ± 10 % of measured value or ≤ ± 1.5 % of the end of measurement range (the larger value applies in each case)		
Influence of temperature (-20 to 50 °C)			
Zero point:	≤ ± 0.0002 Vol.-%/K		
Sensitivity:	≤ ± 0.015 % Vol.-%/K at 2.5 Vol.-%		
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)			
Zero point:	≤±0.0001 Vol.-%/ % RH		
Influence of pressure of the respective measured value/hPa			
	X-am 5600	X-am 8000	
Zero point:	≤ ± 0.15 % (uncompensated)	≤ ± 0.09 % (compensated)	

Long-term drift	
Zero point:	± 0.005 Vol.-%/month
Sensitivity:	± 0.1 Vol.-%/6 months at 2.5 Vol.-%

* s. a. Notes on Approval 9033890 (X-am 5600), 9033655 (X-am 8000)

Test gases	2.5 Vol.-% CH_4 for measurement range up to 100 %LEL 50 Vol.-% CH_4 for measurement range up to 100 Vol.-% CH_4 0.9 Vol.-% C_3H_8 for measurement range up to 100 %LEL 2 Vol.-% CO_2 for measurement range up to 5 Vol.-% CO_2

SPECIAL CHARACTERISTICS

This sensor allows a measurement of hydrocarbons (gases and vapors) and carbon dioxide 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 MEASUREING RANGES

Gas	Data set name	Measurement range **
n-Butane	buta	0 to 100 % LEL
n-BUTANE	BUTA	0 to 100 Vol.-%
Ethene	c2h4	0 to 100 % LEL
ETHENE	C2H4	0 to 100 Vol.-%
Ethanol	EtOH	0 to 100 % LEL
Ex	Ex	0 to 100 % LEL
JetFuel	JetF	0 to 100 % LEL
Liquid Petroleum Gas ***	LPG	0 to 100 Vol.-%
Methane	ch4	0 to 100 % LEL
METHANE	CH4	0 to 100 Vol.-%
n-Nonane	Nona	0 to 100 % LEL
n-Pentane	Pent	0 to 100 % LEL
Propane	c3h8	0 to 100 % LEL
PROPANE	C3H8	0 to 100 Vol.-%
Toluene	Tolu	0 to 100 % LEL

** The LEL information is dependent on the applicable country-specific standards.

*** The values in the table are based on 50% propane and 50% butane. In practice, the composition of LPG can fluctuate, which may lead to increased measuring errors.

DETECTING OTHER GASES AND VAPORS

Detection of other gases and vapors for the measuring range 0% to 100% LEL with the DrägerSensor Dual IR Ex/CO_2 ES or DrägerSensor IR Ex ES via cross-sensitivities used for technical measurements when calibrated with propane (C_3H_8, 100 % LEL = 1.7 Vol.%. Always observe these values for this application). The sensor can be used to detect the gases and vapors mentioned in the table. For this purpose, the sensor in the device must be configured to the target gas „Ex".The specified values apply to 20 °C and may vary by ± 30 %. Calibration to the gas or the vapor can cause increased linearity errors.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chemical symbol	CAS No.	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol% = 50 % LEL propane)	Cross-sensitivity factor f
Acetone	C_3H_6O	67-64-1	1.25	18	2.78
Acetylene	C_2H_2	74-86-2	–	not possible	–
Benzene	C_6H_6	71-43-2	0.60	20	2.50
Butadiene -1,3	C_4H_6	106-99-0	0.70	20	2.50
i-Butane	$(CH_3)_3CH$	75-28-5	0.75	41	1.22
n-Butane	C_4H_{10}	106-97-8	0.70	42	1.19
n-Butanol	$C_4H_{10}O$	71-36-3	0.85	25	2.00
2-Butanon (MEK)	C_4H_8O	78-93-3	0.75	22	2.27
i-Butene	C_4H_8	115-11-7	0.80	31	1.61
n-Butyl acetate	$C_6H_{12}O_2$	123-86-4	0.60	20	2.50
Cyclohexane	C_6H_{12}	110-82-7	0.50	15	3.33
Cyclopentane	C_5H_{10}	287-92-3	0.70	51	1.06
Diethylamine	$C_4H_{11}N$	109-89-7	0.85	44	1.14
Diethyl ether	$(C_2H_5)_2O$	60-29-7	0.85	46	1.09
Dimethyl ether	C_2H_6O	115-10-6	1.35	47	0.98
Ethane	C_2H_6	74-84-0	1.20	65	0.77
Ethanol	C_2H_6O	64-17-5	1.55	41	1.22
Ethene	C_2H_4	74-85-1	1.20	15	3.33
Ethyl acetate	$C_4H_8O_2$	141-78-6	1.00	35	1.43
Ethyl acrylate	$C_5H_8O_2$	140-88-5	0.85	26	1.92
n-Heptane	C_7H_{16}	142-82-5	0.55	36	1.39
n-Hexane	C_6H_{14}	110-54-3	0.50	34	1.47
Methane	CH_4	74-82-8	2.20	37	1.35
Methanol	CH_4O	67-56-1	3.00	92	0.54
n-Methoxy-2-Propanol	$C_4H_{10}O_2$	107-98-2	0.90	26	1.92
Methyl choride	CH_3Cl	74-87-3	3.80	47	1.06
Methylene chloride	CH_2Cl_2	75-09-2	6.50	20	2.50
Methyl tert-butyl ether (MTBE)	$C_5H_{12}O$	1634-04-4	0.80	59	0.85
n-Nonane	C_9H_{20}	111-84-2	0.35	on request	–
n-Octane	C_8H_{18}	111-65-9	0.40	20	2.50
n-Pentane	C_5H_{12}	109-66-0	0.55	36	1.39
Propane	C_3H_8	74-98-6	0.85	50	1.00
n-Propanol	C_3H_8O	71-23-8	1.05	40	1.25
Propene	C_3H_6	115-07-1	0.90	31	1.61
Propylene oxide	C_3H_6O	75-56-9	0.95	49	1.02
Toluene	C_7H_8	108-88-3	0.50	19	2.63
o-Xylene	C_8H_{10}	95-47-6	0.50	11	4.55

f = Specifications relate to the respective test gas concentration and the corresponding LEL.

The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

DrägerSensor® Dual IR Ex/CO_2 HC

Order no. 68 00 276

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger X-am 8000	no	yes	5 years	> 5 years

MARKET SEGMENTS

Mining, landfills, biogas plants

TECHNICAL SPECIFICATIONS

Detection limit:	1 % LEL for IR Ex (when calibrated with CH_4) 0.2 Vol.-% CO_2 for IR CO_2
Resolution:	1 % UEG for Ex 0.1 Vol.-% CO_2
Measurement range:	0 to 100 % UEG/ 0 to 100 Vol.-% (depending on the respective target gas) 0 to 100 Vol.-% CO_2
Ambient conditions	
Temperature:	(-20 to 50 °C (-4 to 122 °F)
Humidity:	0 to 90 % RH
Pressure:	(800 to 1100) hPa (in potentially explosive atmospheres) (700 to 1300) hPa
Warm-up time:	≤ 3 minutes

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 100 % LEL OR 0 TO 4.4 VOL.% CH_4 WHEN CALIBRATED WITH 2.5 VOL.% METHANE IN AIR:

Response time:		X-am 8000
	Diffusion mode (t_{50})	≤ 10 seconds
	Diffusion mode (t_{90})	≤ 21 seconds
	Pump mode (t_{50})	≤ 9 seconds
	Pump mode (t_{90})	≤ 11 seconds

Precision	
Zero point:	≤ ± 1.0 % LEL
Sensitivity:	≤ ± 2 % LEL at 50 % LEL
Linearity error:	≤ ± 4 % of mesaured value or ≤ ± 1.5 % of the end of measurement range (the larger value applies in each case)
Influence of temperature (-20 to 50 °C)	
Zero point:	≤ ± 0.02 % LEL/K
Sensitivity:	≤ ± 0.1 % LEL/K at 50 % LEL
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)	
Zero point:	≤ ± 0.01 % LEL/% RH
Influence of pressure of the respective measured value/hPa	
	X-am 8000
Zero point:	≤ ± 0.06 % (compensated)
Long-term drift	
Zero point:	≤ ± 1 % LEL/month
Sensitivity:	≤ ± 3 % LEL/month at 50 % LEL

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 100 % LEL OR 0 TO 1.7 VOL.% C_3H_8 WHEN CALIBRATED WITH 0.9 VOL.% PROPANE IN AIR:

Response time:		X-am 8000
	Diffusion mode (t_{50})	≤ 14 seconds
	Diffusion mode (t_{90})	≤ 57 seconds
	Pump mode (t_{50})	≤ 10 seconds
	Pump mode (t_{90})	≤ 15 seconds

Precision	
Zero point:	≤ ± 1.0 % LEL
Sensitivity:	≤ ± 2 % LEL at 50 % LEL
Linearity error:	≤ ± 3.0 % of mesaured value or ≤ ± 1.0 % of the end of measurement range (the larger value applies in each case)
Influence of temperature (-20 to 50 °C)	
Zero point:	≤ ± 0.06 % LEL/K
Sensitivity:	≤ ± 0.13 % LEL/K at 50 % LEL
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)	
Zero point:	≤ ± 0.01 % LEL/% RH
Influence of pressure of the respective measured value/hPa	
	X-am 8000
Zero point:	≤ ± 0.06 % (compensated)
Long-term drift	
Zero point:	≤ ± 3 % LEL/month
Sensitivity:	≤ ± 4 % LEL/month at 50 % LEL

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CO_2 WHEN CALIBRATED WITH MIT 50 VOL.-% CARBON DIOXIDE IN NITROGEN:

Response time:		X-am 8000
	Diffusion mode (t_{50})	≤ 15 seconds
	Diffusion mode (t_{90})	≤ 55 seconds
	Pump mode (t_{50})	≤ 13 seconds
	Pump mode (t_{90})	≤ 20 seconds

Precision	
Zero point:	≤ ± 0.05 Vol.-%
Sensitivity:	≤ ± 0.5 Vol.-% at 50 Vol.-%
Linearity error:	≤ ± 1.0 Vol.-% or ≤ ± 5 % of the end of measurement range (the larger value applies in each case)
Influence of temperature (-20 to 50 °C)	
Zero point:	≤ ± 0.008 Vol.-%/K
Sensitivity:	≤ ± 0.4 % Vol.-%/K at 50 Vol.-%
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)	
Zero point:	≤ ± 0.001 Vol.-%/ % RH
Influence of pressure of the respective measured value/hPa	
	X-am 8000
Zero point:	≤ ± 0.09 % (compensated)
Long-term drift	
Zero point:	≤ ± 0.05 Vol.-%/month
Sensitivity:	≤ ± 2 Vol.-%/month at 50 Vol.-%

Test gases	2.5 Vol.-% CH_4 for measurement range up to 100 %LEL 50 Vol.-% CH_4 for measurement range up to Vol.-% CH_4 0.9 Vol.-% C_3H_8 for measurement range up to 100 %LEL 50 Vol.-% CO_2 for measurement range up to 100 Vol.-% CO_2 Biogas 60 Vol.-% CH_4/40 Vol.-% CO_2

SPECIAL CHARACTERISTICS

This sensor allows a measurement of hydrocarbons (gases and vapors) and carbon dioxide 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. CO_2 concentrations of up to 100% by volume can be reliably detected with this 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.

Gas	Data set name	Measurement range **
n-Butane	buta	0 to 100 % LEL 1)
n-BUTANE	BUTA	0 to 100 Vol.-%
Ethene	c2h4	0 to 100 % LEL 1)
ETHENE	C2H4	0 to 100 Vol.-%
Ethanol	EtOH	0 to 100 % LEL 1)
Ex	Ex	0 to 100 % LEL
JetFuel	JetF	0 to 100 % LEL 1)
Liquid Petroleum Gas ***	LPG	0 to 100 Vol.-%
Methane	ch4	0 to 100 % LEL 1)
METHANE	CH4	0 to 100 Vol.-%
n-Nonane	Nona	0 to 100 % LEL 1)
n-Pentane	Pent	0 to 100 % LEL 1)
Propane	c3h8	0 to 100 % LEL 1)
PROPANE	C3H8	0 to 100 Vol.-%
Toluene	Tolu	0 to 100 % LEL 1)

** The LEL information is dependent on the applicable country-specific standards.

*** The values in the table are based on 50% propane and 50% butane. In practice, the composition of LPG can fluctuate, which may lead to increased measuring errors.

DETECTING OTHER GASES AND VAPORS

Detection of other gases and vapors for the measuring range 0% to 100% LEL with the DrägerSensor Dual IR Ex/CO_2 HC via cross-sensitivities used for technical measurements when calibrated with propane (C_3H_8, 100 % LEL = 1.7 Vol.%. Always observe these values for this application). The sensor can be used to detect the gases and vapors mentioned in the table. For this purpose, the sensor in the device must be configured to the target gas „Ex". The specified values apply to 20 °C and may vary by ± 30 %. Calibration to the gas or the vapor can cause increased linearity errors.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chemical symbol	CAS No.	Test gas concentration in Vol.-%	Reading displayed in % LEL (if calibrated to 0.85 Vol% = 50 % LEL propane)	Cross-sensitivity factor f
Acetone	C_3H_6O	67-64-1	1.25	18	2.78
Acetylene	C_2H_2	74-86-2	–	not possible	–
Benzene	C_6H_6	71-43-2	0.60	20	2.50
Butadiene -1,3	C_4H_6	106-99-0	0.70	20	2.50
i-Butane	$(CH_3)_3CH$	75-28-5	0.75	41	1.22
n-Butane	C_4H_{10}	106-97-8	0.70	42	1.19
n-Butanol	$C_4H_{10}O$	71-36-3	0.85	25	2.00
2-Butanon (MEK)	C_4H_8O	78-93-3	0.75	22	2.27
i-Butene	C_4H_8	115-11-7	0.80	31	1.61
n-Butyl acetate	$C_6H_{12}O_2$	123-86-4	0.60	20	2.50
Cyclohexane	C_6H_{12}	110-82-7	0.50	15	3.33
Cyclopentane	C_5H_{10}	287-92-3	0.70	47	1.06
Diethylamine	$C_4H_{11}N$	109-89-7	0.85	44	1.14
Diethyl ether	$(C_2H_5)_2O$	60-29-7	0.85	46	1.09
Dimethyl ether	C_2H_6O	115-10-6	1.35	51	0.98
Ethane	C_2H_6	74-84-0	1.20	65	0.77
Ethanol	C_2H_6O	64-17-5	1.55	41	1.22
Ethene	C_2H_4	74-85-1	1.20	15	3.33
Ethyl acetate	$C_4H_8O_2$	141-78-6	1.00	35	1.43
Ethyl acrylate	$C_5H_8O_2$	140-88-5	0.85	26	1.92
n-Heptane	C_7H_{16}	142-82-5	0.55	36	1.39
n-Hexane	C_6H_{14}	110-54-3	0.50	34	1.47
Methane	CH_4	74-82-8	2.20	37	1.35
Methanol	CH_4O	67-56-1	3.00	92	0.54
n-Methoxy-2-Propanol	$C_4H_{10}O_2$	107-98-2	0.90	26	1.92
Methyl choride	CH_3Cl	74-87-3	3.80	47	1.06
Methylene chloride	CH_2Cl_2	75-09-2	6.50	20	2.50
Methyl tert-butyl ether (MTBE)	$C_5H_{12}O$	1634-04-4	0.80	59	0.85
n-Nonane	C_9H_{20}	111-84-2	0.35	on request	–
n-Octane	C_8H_{18}	111-65-9	0.40	20	2.50
n-Pentane	C_5H1_2	109-66-0	0.55	36	1.39
Propane	C_3H_8	74-98-6	0.85	50	1.00
n-Propanol	C_3H_8O	71-23-8	1.05	40	1.25
Propene	C_3H_6	115-07-1	0.90	31	1.61
Propylene oxide	C_3H_6O	75-56-9	0.95	49	1.02
Toluene	C_7H_8	108-88-3	0.50	19	2.63
o-Xylene	C_8H_{10}	95-47-6	0.50	11	4.55

f = Specifications relate to the respective test gas concentration and the corresponding LEL.

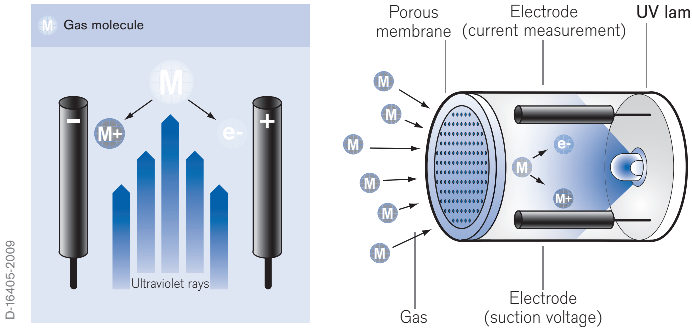
The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

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® PID HC

Order no. 68 13 475

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	UV lamp
Dräger X-am 8000	no	yes	1 year[1)]	2 years	10.6 eV

MARKET SEGMENTS

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

TECHNICAL SPECIFICATIONS

Detection limit:*	0.3 ppm isobutylene	
Resolution:* **(valid for isobutylene)**	0-20 ppm	100 ppb
	> 20-50 ppm	200 ppb
	> 50-100 ppm	500 ppb
	> 100-200 ppm	1 ppm
	> 200-500 ppm	2 ppm
	> 500-1.000 ppm	5 ppm
	> 1,000-2,000 ppm	10 ppm
Measurement range:	0 to 2,000 ppm isobutylene	
General technical specifications		
Ambient conditions		
Temperature:[2)]	(−20 to 60)°C (−4 to 140)°F	
Humidity:[2)]	(10 to 95)% RH	
Pressure:	(700 to 1,300) hPa	
Warm-up time:	2 minutes ready for measurement (warm-up 1)	
	2 minutes ready for calibration (warm-up 2)	

TYPICAL MEASURING PROPERTIES FOR THE MEASUREMENT RANGE 0 TO 2,000 PPM WHEN CALIBRATED WITH ISOBUTYLENE IN AIR:

Response time:	Diffusion mode ≤ 5 seconds (t_{20})
	Diffusion mode ≤ 10 seconds (t_{90})
	Pump mode ≤ 5 seconds (t_{20})
	Pump mode ≤ 10 seconds (t_{90})
Precision	
at 100 ppm isobutylene:	≤ ± 2% of measured value; at zero point ≤ ±0.3 ppm isobutylene
Linearity error:	≤ ± 5% of measured value; A calibration in the range of the expected concentration will give a higher accuracy at the measuring point.
Pressure effect	compensated
Effect of humidity, at 20 °C (68 °F) (0 to 90% RH, non-condensing)	
Zero point:	≤ ± 0.05 ppm isobutylene/% RH
at 100 ppm isobutylene:	≤ ± 0.15 ppm isobutylene/% RH
Test gas:	approx. 100 ppm i-C_4H_8 (isobutylene)

* Depends on the response factor of the measured gas

1) At a run time of max. 2,500 hours

2) Sudden temperature and humidity changes influence the measurement signal. When sudden temperature and humidity changes are expected, it is recommended to use a humidity pre-tube (81 03 531) for the measurement.

SPECIAL CHARACTERISTICS

The PID can be used to detect numerous volatile organic compounds (VOCs). More than 80 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.	Code	Measurement range
Acetaldehyde	75-07-0	Aald	0 - 10000 ppm
Acetone	67-64-1	Acet	0 - 2000 ppm
Acetophenone	98-86-2	AcPh	0 - 2000 ppm
Acrolein	107-02-8	Acro	0 - 8000 ppm
Allylalcohol	107-18-6	AlOH	0 - 4500 ppm
Allyl chloride	107-05-1	AlCl	0 - 8000 ppm
alpha-Pinen	2437-95-8	aPIN	0 - 800 ppm
Ammonia	7664-41-7	NH3	0 - 10000 ppm
Benzene	71-43-2	C6H6	0 - 1000 ppm
1-Bromopropane	106-94-5	BrPr	0 - 3000 ppm
1,3-Butadiene	106-99-0	BTD1	0 - 1500 ppm
1-Butanol	71-36-3	BuOH	0 - 9500 ppm
2-Butanol	78-92-2	2BOH	0 - 6500 ppm
1-Butene	106-98-9	Bute	0 - 2000 ppm
n-Butyl acetate	123-86-4	Bace	0 - 5500 ppm
Carbon disulfide	75-15-0	CS2	0 - 2000 ppm
Chlorobenzene	108-90-7	ClBz	0 - 1000 ppm
Cumene	98-82-8	Cume	0 - 1500 ppm
Cyclohexane	110-82-7	Chex	0 - 2500 ppm
Cyclohexanone	108-94-1	CyHo	0 - 2000 ppm
1,2-Dichlorobenzene (ortho-)	95-50-1	BeDi	0 - 1500 ppm
trans-1,2-Dichloroethylene	156-60-5	DiCl	0 - 900 ppm
Diesel fuel	68476-34-6	Desl	0 - 2000 ppm
Dimethyl ether	115-10-6	DME	0 - 5000 ppm
N,N-Dimethylformamide	68-12-2	DMF	0 - 2000 ppm
1,4-Dioxane	123-91-1	Diox	0 - 2500 ppm
Ethanol	64-17-5	EtOH	0 - 10000 ppm
Ethyl acetate	141-78-6	Etat	0 - 8000 ppm
Ethylbenzene	100-41-4	EtBz	0 - 1000 ppm
Ethylene	74-85-1	C2H4	0 - 10000 ppm
Ethylene oxide	75-21-8	EO	0 - 10000 ppm
Ethyl ether	60-29-7	DETH	0 - 2000 ppm
Ethyl mercaptan	75-08-1	EtM	0 - 5000 ppm
Ethyl tert-butyl ether	637-92-3	ETBE	0 - 2000 ppm
4-Ethyltoluene	622-96-8	EtTo	0 - 1000 ppm
Furfural	98-01-1	Furf	0 - 3000 ppm
Gasoline	8006-61-9	Gaso	0 - 2000 ppm
n-Heptane	142-82-5	Hept	0 - 6500 ppm

GASES STORED IN THE MEMORY

Gas/Vapor	CAS no.	Code	Measurement range
1,1,1,3,3,3-Hexamethyldisilazane	999-97-3	HMDS	0 - 500 ppm
n-Hexane	110-54-3	Hexa	0 - 8000 ppm
1-Hexene	592-41-6	Hex1	0 - 2000 ppm
Hydrogen sulfide	7783-06-4	H2S	0 - 8000 ppm
Isobutanol	78-83-1	iBto	0 - 10000 ppm
Isobutyl acetate	110-19-0	iBAc	0 - 6500 ppm
Isobutylene	115-11-7	iBut	0 - 2000 ppm
Iso-octane	540-84-1	iOct	0 - 2000 ppm
Isoprene	78-79-5	iPre	0 - 1500 ppm
Isopropanol (IPA)	67-63-0	PrOH	0 - 10000 ppm
Isopropyl acetate	108-21-4	iPAc	0 - 6000 ppm
Isopropyl ether	108-20-3	iPEt	0 - 2000 ppm
Jet fuel	8008-20-6	JetF	0 - 2000 ppm
2-Methoxyethanol	109-86-4	EGME	0 - 6500 ppm
Methyl acetate	79-20-9	MeAc	0 - 10000 ppm
Methyl bromide	74-83-9	MeBr	0 - 4000 ppm
2-Methylbutane (Isopentane)	78-78-4	iPen	0 - 10000 ppm
Methylcyclohexane	108-87-2	Mche	0 - 2000 ppm
Methyl ethyl ketone	78-93-3	MEK	0 - 2000 ppm
Methyl isobutyl carbinol	108-11-2	MIBC	0 - 4000 ppm
Methyl isobutyl ketone	108-10-1	MiBK	0 - 2000 ppm
Methyl mercaptane	74-93-1	MeM	0 - 1500 ppm
Methyl tert-butyl ether	1634-04-4	MTBE	0 - 2000 ppm
n-Nonane	111-84-2	Nona	0 - 3000 ppm
n-Octane	111-65-9	Octa	0 - 4000 ppm
n-Pentane	109-66-0	Pent	0 - 10000 ppm
1-Pentanol	71-41-0	PeOH	0 - 9500 ppm
Phosphine	7803-51-2	PH3	0 - 8000 ppm
n-Propanol	71-23-8	nPOH	0 - 10000 ppm
Propyl acetate	109-60-4	PrAc	0 - 9000 ppm
Propylene	115-07-1	C3H6	0 - 2500 ppm
Styrene	100-42-5	Styr	0 - 800 ppm
Tetrachloroethylene	127-18-4	PCE	0 - 1500 ppm
Tetrahydrofuran	109-99-9	THF	0 - 4000 ppm
Thiophene	110-02-1	ThPh	0 - 700 ppm
Toluene	108-88-3	Tolu	0 - 1000 ppm
Trichloroethylene	79-01-6	TCE	0 - 1000 ppm
1,2,4-Trimethylbenzene (Pseudocumene)	95-63-6	PsDo	0 - 1000 ppm
1,3,5-Trimethylbenzene	108-67-8	Mesi	0 - 1000 ppm
Vinyl acetate	108-05-4	Vac	0 - 2500 ppm
Vinyl chloride	75-01-4	VC	0 - 4000 ppm
Vinylidene Chloride	75-35-4	DCE	0 - 2000 ppm
meta-Xylene	108-38-3	mXyl	0 - 800 ppm
ortho-Xylene	95-47-6	Xyol	0 - 1000 ppm
para-Xylene	106-42-3	pXyl	0 - 1000 ppm

The standard gas is: Isobutylene

The response factors of the library gases are predefined and cannot be changed. For gases not included in the library, use the designated user gases VOC, VOC_1 to VOC_9. These can be configured accordingly on a customer-specific basis.

For additional information on the gases stored in the library see data sheet 9300316 at www.draeger.com at the Dräger X-am 8000 or the PID sensors (instructions for use).

DrägerSensor® PID LC ppb

Order no. 68 13 500

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	UV lamp
Dräger X-am 8000	no	yes	1 year[1]	2 years	10.6 eV

MARKET SEGMENTS

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

TECHNICAL SPECIFICATIONS

Detection limit:*	0.03 ppm / benzene	
Resolution:*	0-2 ppm	10 ppb
(valid for isobutylene and	> 2-5 ppm	20 ppb
benzene)	> 5-10 ppm	50 ppb
Measurement range:	0 to 10 ppm isobutylene/0 to 5 ppm benzene	
General technical specifications		
Ambient conditions		
Temperature:[2]	(–20 to 60)°C (–4 to 140)°F	
Humidity:[2]	(10 to 95)% RH	
Pressure:	(700 to 1,300) hPa	
Warm-up time:	1 minute ready for measurement (warm-up 1) 5 minutes ready for calibration (warm-up 2)	

TYPICAL MEASURING PROPERTIESFOR THE MEASUREMENT RANGE 0 TO 10 PPM WHEN CALIBRATED WITH ISOBUTYLENE IN AIR:

Response time:	Diffusion mode ≤ 5 seconds (t_{20}) Diffusion mode ≤ 15 seconds (t_{90}) Pump mode ≤ 5 seconds (t_{20}) Pump mode ≤ 15 seconds (t_{90})
Precision	
at 5 ppm isobutylene:	≤ ± 2% of measured value; at zero point ≤ ± 0.05 ppm isobutylene
Linearity error:	≤ ± 5% of measured value; A calibration in the range of the expected concentration will give a higher accuracy at the measuring point.
Pressure effect	compensated
Effect of humidity, at 20 °C (68 °F) (0 to 90% RH, non-condensing)	
Zero point:	≤ ± 0.005 ppm isobutylene/% RH
at 5 ppm isobutylene:	≤ ± 0.02 ppm isobutylene/% RH
Test gas:	approx. 5 ppm i-C_4H_8 (isobutylene)

* Depends on the response factor of the measured gas

[1] At a run time of max. 2,500 hours

[2] Sudden temperature and humidity changes influence the measurement signal. When sudden temperature and humidity changes are expected, it is recommended to use a humidity pre-tube (81 03 531) for the measurement.

SPECIAL CHARACTERISTICS

Apart from the detection of a variety of volatile organic compounds (VOC) this sensor is suitable for a benzene specific measurement in the ppb range. Using the prefilter benzene (81 03 511) tube concurrent hydrocarbons will be filtered.

GASES STORED IN THE MEMORY

Gas/Vapor	CAS no.	Code	Measurement range
Acetaldehyde	75-07-0	Aald	---1)
Acetone	67-64-1	Acet	0 - 18 ppm
Acetophenone	98-86-2	AcPh	0 - 15 ppm
Acrolein	107-02-8	Acro	---1)
Allylalcohol	107-18-6	AlOH	0 - 35 ppm
Allyl chloride	107-05-1	AlCl	0 - 80 ppm
alpha-Pinen	80-56-8	aPIN	0 - 8 ppm
Ammonia	7664-41-7	NH3	---1)
Benzene	71-43-2	C6H6	0 - 8 ppm
1-Bromopropane	106-94-5	BrPr	0 - 30 ppm
1,3-Butadiene	106-99-0	BTD1	0 - 10 ppm
1-Butanol	71-36-3	BuOH	0 - 80 ppm
2-Butanol	78-92-2	$_2$BOH	0 - 40 ppm
1-Butene	106-98-9	Bute	0 - 20 ppm
n-Butyl acetate	123-86-4	Bace	0 - 40 ppm
Carbon disulfide	75-15-0	CS2	0 - 15 ppm
Chlorobenzene	108-90-7	ClBz	0 - 12 ppm
Cumene	98-82-8	Cume	0 - 12 ppm
Cyclohexane	110-82-7	Chex	0 - 24 ppm
Cyclohexanone	108-94-1	CyHo	0 - 15 ppm
1,2-Dichlorobenzene (ortho-)	95-50-1	BeDi	0 - 10 ppm
trans-1,2-Dichloroethylene	156-60-5	DiCl	0 - 8 ppm
Diesel fuel	68476-34-6	Desl	0 - 15 ppm
Dimethyl ether	115-10-6	DME	0 - 45 ppm
N,N-Dimethylformamide	68-12-2	DMF	---1)
1,4-Dioxane	123-91-1	Diox	0 - 25 ppm
Ethanol	64-17-5	EtOH	---1)
Ethyl acetate	141-78-6	Etat	0 - 75 ppm
Ethylbenzene	100-41-4	EtBz	0 - 14 ppm
Ethylene	74-85-1	C2H4	---1)
Ethylene oxide	75-21-8	EO	---1)
Ethyl ether	60-29-7	DETH	0 - 20 ppm
Ethyl mercaptan	75-08-1	EtM	0 - 35 ppm
Ethyl tert-butyl ether	637-92-3	ETBE	0 - 16 ppm
4-Ethyltoluene	622-96-8	EtTo	0 - 8 ppm
Furfural	98-01-1	Furf	0 - 20 ppm
Gasoline	8006-61-9	Gaso	0 - 15 ppm
n-Heptane	142-82-5	Hept	0 - 45 ppm

GASES STORED IN THE MEMORY

Gas/Vapor	CAS no.	Code	Measurement range
1,1,1,3,3,3-Hexamethyldisilazane	999-97-3	HMDS	0 - 6 ppm
n-Hexane	110-54-3	Hexa	0 - 70 ppm
1-Hexene	592-41-6	HEX1	0 - 20 ppm
Hydrogen sulfide	7783-06-4	H2S	0 - 60 ppm
Isobutanol	78-83-1	iBto	0 - 65 ppm
Isobutyl acetate	110-19-0	iBAc	0 - 45 ppm
Isobutylene	115-11-7	iBut	0 - 15 ppm
Iso-octane	540-84-1	iOct	0 - 20 ppm
Isoprene	78-79-5	iPre	0 - 10 ppm
Isopropanol (IPA)	67-63-0	PrOH	---1)
Isopropyl acetate	108-21-4	iPAc	0 - 50 ppm
Isopropyl ether	108-20-3	iPEt	0 - 20 ppm
Jet fuel	8008-20-6	JetF	0 - 15 ppm
2-Methoxyethanol	109-86-4	EGME	0 - 50 ppm
Methyl acetate	79-20-9	MeAc	---1)
Methyl bromide	74-83-9	MeBr	0 - 32 ppm
2-Methylbutane (Isopentane)	78-78-4	iPen	---1)
Methylcyclohexane	108-87-2	Mche	0 - 20 ppm
Methyl ethyl ketone	78-93-3	MEK	0 - 16 ppm
Methyl isobutyl carbinol	108-11-2	MIBC	0 - 25 ppm
Methyl isobutyl ketone	108-10-1	MiBK	0 - 18 ppm
Methyl mercaptane	74-93-1	MeM	0 - 10 ppm
Methyl tert-butyl ether	1634-04-4	MTBE	0 - 16 ppm
n-Nonane	111-84-2	Nona	0 - 32 ppm
n-Octane	111-65-9	Octa	0 - 32 ppm
n-Pentane	109-66-0	Pent	---1)
1-Pentanol	71-41-0	PeOH	0 - 65 ppm
Phosphine	7803-51-2	PH3	0 - 50 ppm
n-Propanol	71-23-8	nPOH	---1)
Propyl acetate	109-60-4	PrAc	0 - 65 ppm
Propylene	115-07-1	C3H6	0 - 19 ppm
Styrene	100-42-5	Styr	0 - 12 ppm
Tetrachloroethylene	127-18-4	PCE	0 - 15 ppm
Tetrahydrofuran	109-99-9	THF	0 - 25 ppm
Thiophene	110-02-1	ThPh	0 - 8 ppm
Toluene	108-88-3	Tolu	0 - 15 ppm
Trichloroethylene	79-01-6	TCE	0 - 14 ppm
1,2,4-Trimethylbenzene (Pseudocumene)	95-63-6	PsDo	---1)
1,3,5-Trimethylbenzene	108-67-8	Mesi	0 - 8 ppm
Vinyl acetate	108-05-4	Vac	0 - 30 ppm
Vinyl chloride	75-01-4	VC	0 - 32 ppm
Vinylidene Chloride	75-35-4	DCE	0 - 12 ppm
meta-Xylene	108-38-3	mXyl	0 - 10 ppm
ortho-Xylene	95-47-6	Xyol	0 - 12 ppm
para-Xylene	106-42-3	pXyl	0 - 8 ppm

The standard gas is: Isobutylene

---1) The measuring capability of the sensor type is not sufficient for this substance.

The response factors of the library gases are predefined and cannot be changed. For gases not included in the library, use the designated user gases VOC, VOC_1 to VOC_9. These can be configured accordingly on a customer-specific basis.

For additional information on the gases stored in the library see data sheet 9300316 at www.draeger.com at the Dräger X-am 8000 or the PID sensors (instructions for use).

Dräger X-pid 9x00 Analysis PID
Order no. 68 50 012

Dräger X-pid 9x00 Seeker PID
Order no. 68 50 013

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	UV lamp
Dräger X-pid 9000/9500	no	yes	1 year	> 5 years (10,000 h)	10.6 eV

MARKET SEGMENTS

Chemical industry, painters, storage and use of fuels (e.g. gas stations), selective measurements of e.g. benzene or 1,3-Butadiene

TECHNICAL SPECIFICATIONS (IN SYSTEM)

Resolution:*	0 – 9.99 ppm	0.01 ppm
	> 10 – 99.9 ppm	0.1 ppm
	> 100 ppm	1 ppm
General technical data		
Ambient conditions		
Temperature:	(-10 to 35)°C (14 to 95)°F	
Humidity:	10 to 90 % RH (to 95 % RH intermittent)	
Pressure:	700 to 1300 hPa	
Warm-up time:	10 minutes	

FOR THE MEASUREMENT MODE SEEKER:

Response time:	approx. 45 seconds (isobutylene, w/o hose)
Detection limit:	0.01 ppm isobutylene (isobutylene response)
Measurement range:	0 to 60 ppm isobutylene (isobutylene response)
Precision[1] (k = 1, ~68 %)	< 2 % at 10.0 ppm isobutylene < 2 % at 5.00 ppm Benzene
Linearity error:	not specified
Influence of pressure:	not specified
Influence of humidity, at 40 °C (104 °F) (0 to 95 % RH, non-condensing)	
Zero point:	not specified
Sensitivity:	not specified
Test gas:	Mixture of 10 ppm i-C_4H_8 (isobutylene) and 10 ppm C_7H_8 (Toluene)

* depends on the response factor of the sample gas

FOR THE MEASUREMENT MODE ANALYSIS:

Response time:	none (provided that substance concentration is present at the device at the start of the analysis)
Detection limit:	Substance-dependent, see table with target substances
Measurement range:	Substance-dependent, see table with target substances
Precision[1] **(k = 1, ~68 %)**	< 2 % at 10.0 ppm isobutylene < 2 % at 5.00 ppm Benzene
Analyse time	Substance-dependent, due to the most non-volatile compound 20 s isobutylene analysis program 30 s benzene analysis program 30 s isobutylene & benzene analysis program
Influence of pressure:	No effect
Influence of humidity:	No effect
Test gas:	Mixture of 10 ppm i-C_4H_8 (isobutylene) and 10 ppm C_7H_8 (Toluene)

SPECIAL CHARACTERISTICS

The selective PID gas detector is ideally suited for users with large measurement volumes for toxic hazardous substances. Benzene, butadiene and other VOCs have a carcinogenic effect even in the lowest concentrations. A selective measurement is necessary, because other gases and vapors are often present. The gas measuring device enables short measuring times and results in laboratory quality.

FOR THE MEASUREMENT MODE ANALYSIS QUALIFIED AND QUANTIFIED TARGET COMPOUNDS

Response time:	No t_{90}, provided that substance concentration is present at the device at the start of the analysis. Analysis time depends on the substance, due to the most non-volatile compound. 30 s benzene analysis program 10 s butadiene analyis program 30 s benzene & butadiene analysis program

Target compounds	CAS no.	Retention time, s	LOD[1], ppm	LOQ[2], ppm	UR[3], ppm
Acetone	67-64-1	8.10	0.17	0.50	50
Acroleine	107-02-8	7.80	0.33	1.00	100
Benzene	71-43-2	19.30	0.02	0.05	25
Butadiene, 1,3-	106-99-0	6.40	0.07	0.20	25
Butyl acetate	123-86-4	64.30	0.67	2.00	220
Butyraldehyde	123-72-8	12.23	4.00	12.00	210
Carbon disulfide	75-15-0	9.80	0.33	1.00	110
Cyclohexane	110-82-7	20.30	0.67	2.00	200
Dichloroethene, 1,1-	75-35-4	8.90	0,07	0.20	50
Dichloroethene, cis-1,2-	156-59-2	13.40	0,07	0.20	50
Dichloroethene, trans-1,2-	156-60-5	10.90	0,07	0.20	50
Ethanol	64-17-5	7.52	10.00	30.00	935
Ethylbenzene	100-41-4	88.70	1.00	3.00	300
Ethylene oxide	75-21-8	6.80	0.33	1.00	100
Heptane, n-	142-82-5	27.10	5.00	15.00	500
Hexane, n-	110-54-3	13.70	0.33	1.00	100
Isobutylene	115-11-7	6.30	0.07	0.20	100
Isopropyl alcohol	67-63-0	9.10	1.00	3.00	200
Methyl acrylate	96-33-3	14.40	0.67	2.00	200
Methyl bromide	74-83-9	6.80	0.17	0.50	100
Methyl Methacrylate	80-62-6	27.66	2.50	7.50	275
Phosphine	7803-51-2	5.30	0.67	2.00	100
Propanol, 1-	71-23-8	11.56	5.00	15.00	550
Propylene oxide	75-56-9	8.20	0.17	0.50	25
Styrene	100-42-5	111.30	1.00	3.00	300
Tetrachloroethylene	127-18-4	58.90	0.67	2.00	150
Tetrahydrofuran	109-99-9	16.50	1.00	3.00	200
Toluene	108-88-3	41.60	0.33	1.00	100
Trichloroethylene	79-01-6	24.90	0.33	1.00	100
Vinyl chloride	75-01-4	6.30	0.33	1.00	100
Xylene, m-	108-38-3	95.70	1.00	3.00	300
Xylene, o-	95-47-6	114.50	1.00	3.00	300
Xylene, p-	106-42-3	96.60	1.00	3.00	300

FOR THE MEASUREMENT MODE QUALIFIED TARGET COUMPOUNDS (BUT NOT QUANTIFIED)

Other target substances are qualified but not quantified for the Dräger X-pid® 9500. The measuring range has not always been determined experimentally; instead, no specification is possible in these cases. Qualified target substances can be added to analysis programs and assigned in analyses by their retention time. The concentration calculation is done via simplified assumptions without claiming high accuracy.

Target compounds	CAS no.	Retention time, s	LOD[1], ppm	LOQ[2], ppm	UR[3], ppm
Butanone, 2-	78-93-3	12.9	1	3	300
Butyl acrylate	141-32-2	125.5	-	-	-
Chlorobenzene	108-90-7	75.6	1	3	200
Epichlorohydrin	106-89-8	27.3	0.67	2	200
Ethyl acetate	141-78-6	14.6	1	3	300
Ethyl acrylate	140-88-5	24.9	1	3	200

[1] Limit of detection
[2] Limit of quantification
[3] Upper range

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})
Precision	
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	2437-95-8	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
o-Xylene	95-47-6	XYLE	0–1,500 ppm
Diesel		DESL	0–2,000 ppm
Gasoline		GASO	0–2,000 ppm
Jet fuel		JP_8	0–2,000 ppm

The standard gas is: Isobutylene

4.6 Electrochemical sensors

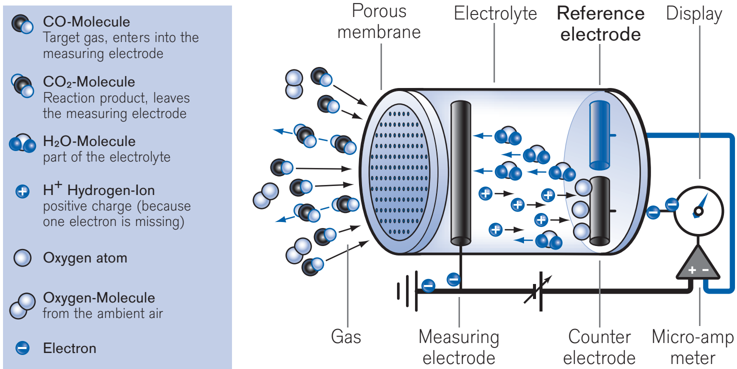

ST-1125-2004

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.

Electrochemical sensor



D-16399-2009

Chemical reaction at the measuring electrode

$CO + H_2O \rightarrow CO_2 + 2H^+ + 2e^-$

Chemical reaction at the counter electrode

$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$

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 family and Dräger X-am 2500/5000/5600 and Dräger X-am 3500/8000. 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 (optional test):

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 Precision:

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 typical concentration between 40% of the set full scale value and up to 80% of the highest adjustable full scale value. Test gas specifications may differ per sensor and must be taken into account. 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.

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

Usage of electrochemical sensors in inert atmospheres

Generally, it is no problem to use an electrochemical sensor in inert atmospheres (atmosphere with < 8 % by volume oxygen). A maximum usage time of 10 hours should not be exceeded. Additionally, the sensor should be stored when not used (e.g. overnight) in a normal ambient conditions (20.9 % by volume oxygen).

APPLICABLE SENSORS

DrägerSensors XXS:	
XXS Amine	68 12 545
XXS Cl_2	68 10 890
XXS CO	68 10 882
XXS CO LC	68 13 210
XXS E CO	68 12 212
XXS CO H_2-CP	68 11 950
XXS CO HC	68 12 010
XXS CO/H_2S	68 11 410
XXS CO_2	68 10 889
XXS $COCl_2$	68 12 005
XXS H_2 HC	68 12 025
XXS H_2S	68 10 883
XXS E H_2S	68 12 213
XXS H_2S HC	68 12 015
XXS H_2S LC	68 11 525
XXS HCN	68 10 887
XXS HCN PC	68 13 165
XXS NH_3	68 10 888
XXS NO	68 11 545
XXS NO_2	68 10 884
XXS NO_2 LC	68 12 600
XXS O_2	68 10 881
XXS E O_2	68 12 211
XXS O_2 100	68 12 385
XXS Odorant	68 12 535
XXS OV	68 11 530
XXS OV-A	68 11 535
XXS O_3	68 11 540
XXS PH_3	68 10 886
XXS PH_3 HC	68 12 020
XXS SO_2	68 10 885
XXS O_2/CO LC	68 13 275*
XXS O_2/H_2S LC	68 14 137*
XXS H_2S-LC/CO LC	68 13 280*

DrägerSensors XS EC:	
XS EC Amine	68 09 545
XS EC Cl_2	68 09 165
XS EC ClO_2	68 11 360
XS EC CO	68 09 105
XS R CO	68 10 258
XS-$_2$ CO	68 10 365
XS EC CO HC	68 09 120
XS EC CO_2	68 09 175
XS EC $COCl_2$	68 08 582
XS EC H_2 HC	68 11 365
XS EC H_2O_2	68 09 170
XS EC H_2S 100	68 09 110
XS R H_2S	68 10 260
XS-2 H_2S	68 10 370
XS EC H_2S HC	68 09 180
XS EC HCN	68 09 150
XS EC HF/HCl	68 09 140
XS EC Hydrazine	68 09 190
XS EC Hydride	68 09 135
XS EC NH_3	68 09 145
XS EC NO	68 09 125
XS EC NO_2	68 09 155
XS EC O_2	68 09 130
XS R O_2	68 10 262
XS-2 O_2	68 10 375
XS EC O_2 100	68 09 550
XS EC Odorant	68 09 200
XS EC OV	68 09 115
XS EC OV-A	68 09 522
XS EC PH_3 HC	68 09 535
XS EC SO_2	68 09 160

*for these sensors only N_2 possible

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})	
Precision		
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, or one of the other target gases: C H_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
Acetylene	C_2H_2	200 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
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})	
Precision		
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:	≤ 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
Acetylene	C_2H_2	200 ppm	No effect
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
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.

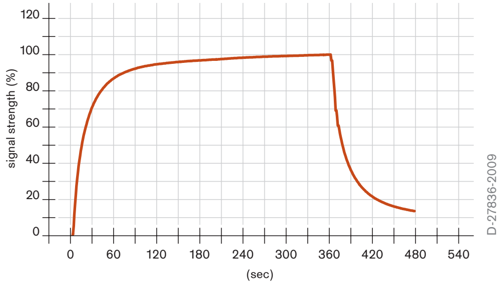
TECHNICAL SPECIFICATIONS

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})
Precision	
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	> 5 years
				> 3 years
			XS 2: 2	= 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
Precision	
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	No effect
Acetylene	C_2H_2	200 ppm	≤ 500	≤ 300
Ammonia	NH_3	200 ppm	No effect	No effect
Carbon dioxide	CO_2	30 Vol. %	≤ 35	≤ 35
Chlorine	Cl_2	20 ppm	≤ 1(–)	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_5OH	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
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	≤ 1(–)
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	≤ 12
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	$C_6H_5CH_3$	1,000 ppm	No effect	No effect
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect	No effect

(–) 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
Acetylene	C_2H_2	200 ppm	≤ 500	≤ 300
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
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
Acetylene	C_2H_2	200 ppm	≤ 500	≤ 50
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
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})
Precision	
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})
Precision	
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 in Vol. % CO_2
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})
Precision	
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 $COCl_2$
Acetylene	C_2H_2	20 ppm	No effect
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
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})
Precision	
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
Acetylene	C_2H_2	200 ppm	≤ 700
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
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})
Precision	
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
Acetylene	C_2H_2	200 ppm	≤ 0.02
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
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})
Precision	
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
Acetylene	C_2H_2	200 ppm	≤ 20
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
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 5100	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})	
Precision		
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 5 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 — Order no. 68 09 110
DrägerSensor® XS 2 H_2S — 68 10 370
DrägerSensor® XS R H_2S — 68 10 260

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 7000	yes	yes	XS EC: 3 years XS 2: 2 years XS R: 5 years	> 5 years > 3 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 /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
Precision	
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/XS microPac, ≤ ± 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
Acetylene	C_2H_2	0.6 Vol. %	≤ 10
Ammonia	NH_3	500 ppm	No effect
Benzene	C_6H_6	0.6 Vol. %	No effect
Carbon dioxide	CO_2	1.5 Vol. %	≤ 1(–)
Carbon disulfide	CS_2	15 ppm	No effect
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
Gasoline	–	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
Methylmercaptane	CH_3SH	20 ppm	≤ 15
Nitrogen dioxide	NO_2	20 ppm	No effect
Nitrogen monoxide	NO	20 ppm	≤ 10
Octane	C_8H_{18}	0.4 Vol. %	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
sec-Butylmercaptan	$C_4H_{10}SH$	20 ppm	≤ 7
Tetrahydrothiophene	C_4H_5S	20 ppm	≤ 4
Toluene	$C_2H_5CH_3$	0.6 Vol. %	No effect
tert-Butylmercaptane	$(CH_3)_3CSH$	20 ppm	≤ 10
Trichloroethylene	$CHClCCl_2$	1,000 ppm	No effect
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
Acetylene	C_2H_2	0.6 Vol. %	≤10
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
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
Acetylene	C_2H_2	0.6 Vol. %	≤ 10
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
Gasoline	–	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})
Precision	
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
Acetylene	C_2H_2	0.6 Vol. %	≤ 10
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
Gasoline	–	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})
Precision	
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:	Alternatively, the sensor can be calibrated with 10 ppm SO_2. Such surrogate calibration with SO_2 can lead to an additional measuring error of up to 30 %. Following a surrogate calibration or sensor change, the following bump test must be performed (at 20 °C to 30 °C): Add 15 mL of a 3 % hydrogen peroxide solution into a 25-mL beaker. Hold the device above the container. Evaluation: After a maximum of 30 seconds, the reading must be greater than 1 ppm H_22O_2. If the value displayed is less than 1 ppm H_2O_2, a new H_2O_2 solution must be used or a calibration carried out.

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
Acetylene	C_2H_2	200 ppm	≤ 35
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
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	≤ 7
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:	0.02 ppm	
Resolution:	0.01 ppm	
Measurement range:	0 to 5 ppm N_2H_4 (hydrazine)	1
	0 to 5 ppm $CH_3NH\text{-}NH_2$ (methyl hydrazine)	0.6
	0 to 5 ppm $(CH_3)_2N\text{-}NH_2$ (dimethylhydrazine)	0.6
Response time:	≤ 180 seconds (t_{90})	
Precision		
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

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 10 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, H_2Se	
Precision		
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, H_2Se	
Warm-up time:	≤ 15 minutes	
Ambient conditions		
Temperature:	(–20 to 50)°C (–4 to 122)°F (0 to 40)°C (32 to 104)°F for H_2Se	
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 10 ppm H_2Se 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
Acetylene	C_2H_2	200 ppm	≤ 12
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
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})
Precision	
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
Acetylene	C_2H_2	200 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
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})
Precision	
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
Acetylene	C_2H_2	0.8 Vol. %	≤ 2
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
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})
Precision	
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
Acetylene	C_2H_2	200 ppm	≤ 60(–)
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(–)
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})	
Precision		
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})	
Precision		
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_3H_6, 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, iBut, ClPO ≤ 300 seconds (t_{50}) for ACN, MMA, Styr	
Precision		
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, iBut, 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:	5 to 200 ppm C_2H_4O, $C_2H_3OCH_2$ 10 to 100 ppm H_2CCHCN, $C_6H_5CHCH_2$, $H_2CC(CH_3)COOCH_3$, 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 Dräger-Sensor® XS OVs have, but it has also been optimized for other organic gases and vapors. Target gas calibration is required for all gases.

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 XS 2: 2 years XS R: 5 years	> 5 years > 3 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
Precision	
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**
Acetylene	C_2H_2	0.5 Vol. %	≤ 0.2$^{(-)}$
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$^{(-)}$
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
Acetylene	C_2H_2	0.5 Vol. %	≤ 0.2(–)
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(–)
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
Acetylene	C_2H_2	0.5 Vol. %	≤ 0.2(–)
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(–)
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})
Precision	
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})
Precision	
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})
Precision	
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
Acetylene	C_2H_2	200 ppm	≤ 60
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
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
Dräger X-am 8000	no	yes	1 year	> 1.5 years	no

MARKET SEGMENTS

Foundries, refineries, power plants

TECHNICAL SPECIFICATIONS

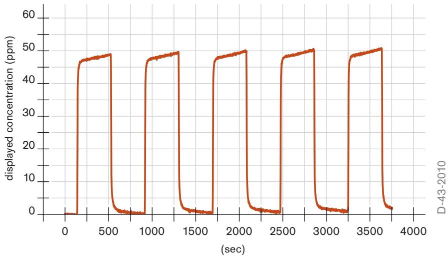
Detection limit:	2 ppm	
Resolution:	1 ppm	
Measurement range/ relative sensitivity	0 to 100 ppm CH_3NH_2 (methylamine)	0.70
	0 to 100 ppm $(CH_3)_2NH$ (dimethylamine)	0.50
	0 to 100 ppm $(CH_3)_3N$ (trimethylamine)	0.50
	0 to 100 ppm $C_2H_5NH_2$ (ethylamine)	0.70
	0 to 100 ppm $(C_2H_5)_2NH$ (diethylamine)	0.50
	0 to 100 ppm $(C_2H_5)_3N$ (triethylamine)	0.50
	NH_3 (ammonia)*	1.00
Response time:	≤ 30 seconds (t_{90})	
Precision		
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	

+ lead compound

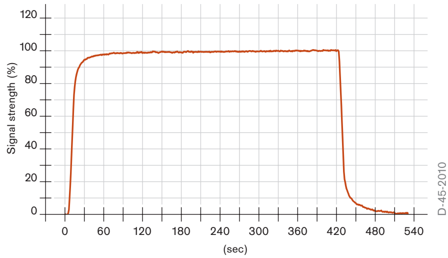
SPECIAL CHARACTERISTICS

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
Acetylene	C_2H_2	200 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 (–)
Diethanolamine	$C_4H_{11}NO_2$	10 ppm	5 ppm
Ethene	C_2H_4	1000 ppm	≤3 ppm
Ethyldimethylamine	$C4H_{11}N$	50 ppm	45 ppm
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 Pac 8000	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
Dräger X-am 8000	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.

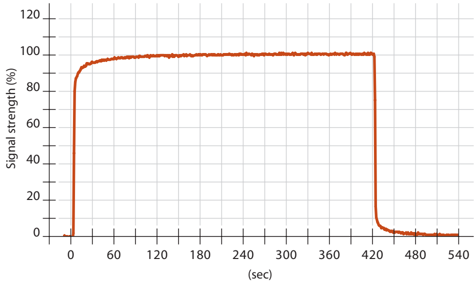
TECHNICAL SPECIFICATIONS

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})	
Precision		
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	

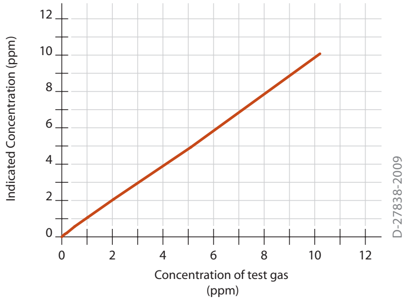
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	No effect
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
Hydrogen	H_2	1,000 ppm	No effect
Hydrogen chloride	HCl	20 ppm	≤ 0.5
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 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
Dräger X-am 8000	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.

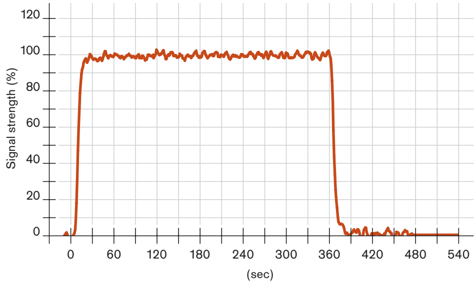
TECHNICAL SPECIFICATIONS

Detection limit:	6 ppm
Resolution:	2 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 15 seconds (t_{90})
Precision	
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

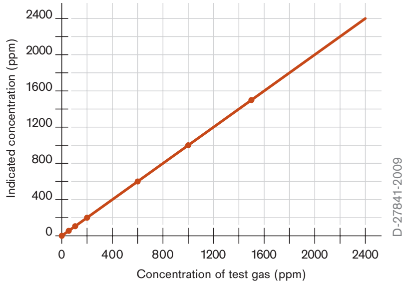
SPECIAL CHARACTERISTICS

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



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 AND XXS E CO

Gas/vapor	**Chem. symbol**	**Concentration**	**Display in ppm** CO
Acetylene	C_2H_2	100 ppm	≤ 200
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
Ethene	C_2H_4	100 ppm	≤ 300
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 LC

Order no. 68 13 210

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 3500/5500	no	yes	3 years	> 5 years
Dräger Pac 6000/6500	no	yes	3 years	> 5 years
Dräger Pac 7000	no	yes	3 years	> 5 years
Dräger X-am 2500	no	yes	3 years	> 5 years
Dräger X-am 5000	no	yes	3 years	> 5 years
Dräger X-am 5600	no	yes	3 years	> 5 years
Dräger X-am 8000	no	yes	3 years	> 5 years
X-am 3500	no	yes	3 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

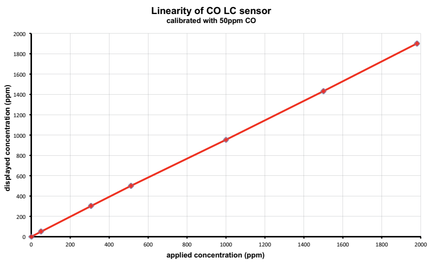
Waste disposal industry, metal processing, petrochemical, fertilizer production, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and gas, measuring dangerous substances, biogas.

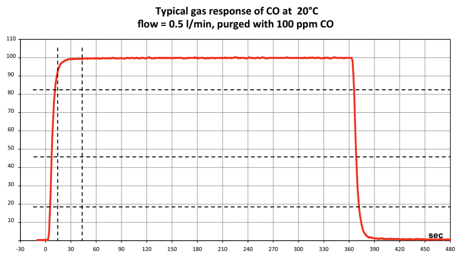
TECHNICAL SPECIFICATIONS

Detection limit:	1 ppm
Resolution:	1 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 15 seconds (t_{90})
Precision	
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:	≤ 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:	≤ ± 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
Acetylene	C_2H_2	100 ppm	≤ 200
Ammonia	NH_3	100 ppm	No effect
Carbon dioxide	CO_2	30 Vol.-%	≤ 2
Chlorine	Cl_2	20 ppm	No effect
Ethene	C_2H_4	100 ppm	≤ 300
Ethanol	C_2H_5OH	250 ppm	No effect
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

* Concentrations significantly above 200 ppm H2S can lead to an influence (filter breakthrough) on the sensor in case of continuous exposure to H_2S.

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
Dräger X-am 8000	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.

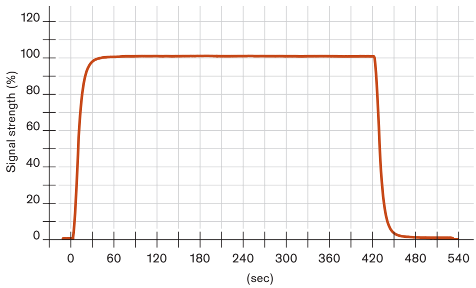
TECHNICAL SPECIFICATIONS

Detection limit:	10 ppm
Resolution:	5 ppm
Measurement range:	0 to 10,000 ppm CO (carbon monoxide)
Response time:	≤ 25 seconds (t_{90})
Precision	
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

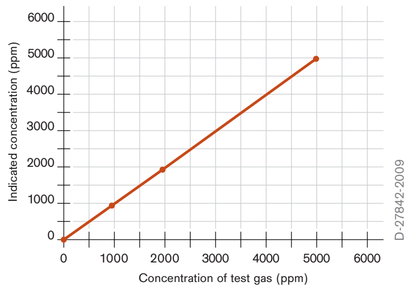
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	≤ 200
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
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 Pac 8500	no	yes	1 year	> 3 years
Dräger X-am 5000	no	yes	1 year	> 3 years
Dräger X-am 5600	no	yes	1 year	> 3 years
Dräger X-am 8000	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

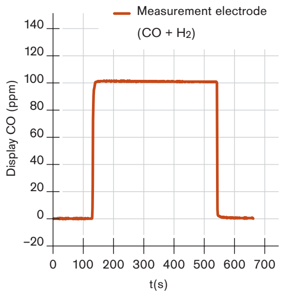
TECHNICAL SPECIFICATIONS

Detection limit:	6 ppm
Resolution:	2 ppm
Measurement range:	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 25 seconds (t_{90})
Precision	
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:	(−20 to 50) °C (−4 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

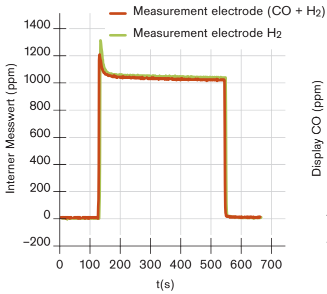
SPECIAL CHARACTERISTICS

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.

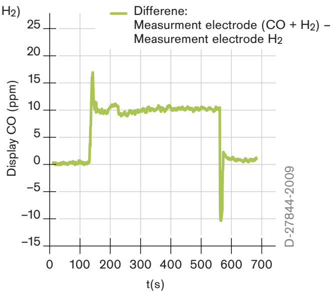
Sensor reaction 100 ppm CO



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
Acetylene	C_2H_2	100 ppm	≤ 200
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
Ethene	C_2H_4	100 ppm	≤ 300
Hydrogen	H_2	0.1 Vol.-%	≤ 15 (–)
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 Pac 8000	no	yes	1 year	> 1.25 years	no
Dräger X-am 5000	no	yes	1 year	> 1.25 years	no
Dräger X-am 5600	no	yes	1 year	> 1.25 years	no
Dräger X-am 8000	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.

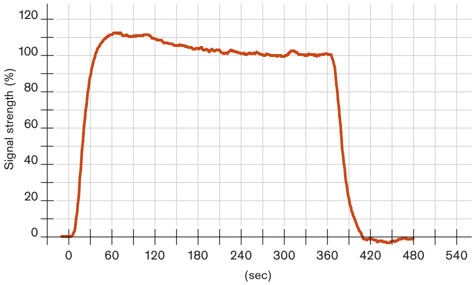
TECHNICAL SPECIFICATIONS

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})
Precision	
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/K
Influence of humidity	
Zero point:	No effect
Sensitivity:	≤ ± 0.1% of measured value/% RH
Test gas:	1 to 4 Vol.-% CO_2

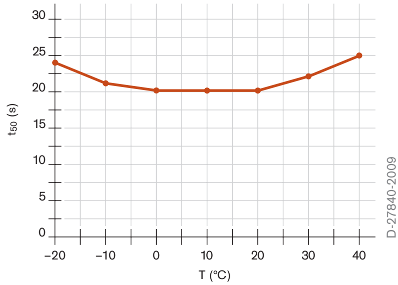
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	No effect
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
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 Pac 8000	no	yes	0.5 years	> 1 year at below 25°C	no
Dräger X-am 5000	no	yes	0.5 years	> 6 months at 35°C	no
Dräger X-am 5600	no	yes	0.5 years		no
Dräger X-am 8000	no	yes	0.5 years		no

MARKTSEGMENTE

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

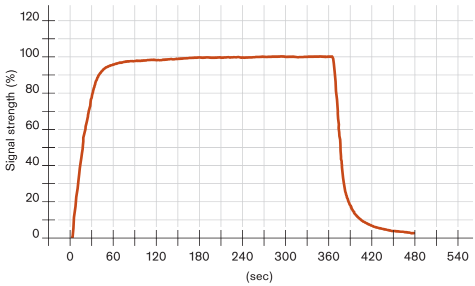
TECHNISCHE DATEN

Detection limit:	0,01 ppm
Resolution:	0,01 ppm
Measurement range:	0 bis 10 ppm $COCl_2$ (Phosgene)
Response time:	≤ 20 seconds (t_{20})
Precision	
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
Storage:	(+4 ... +8)°C (39 ... 46) °F
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)

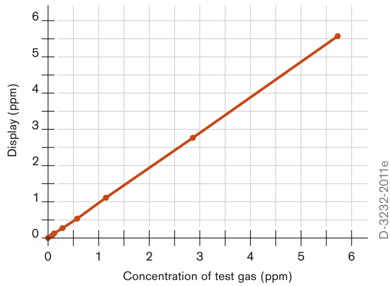
SPECIAL CHARACTERISTICS

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 $COCl_2$
Acetylene	C_2H_2	20 ppm	No effect
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
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
Dräger X-am 8000	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.

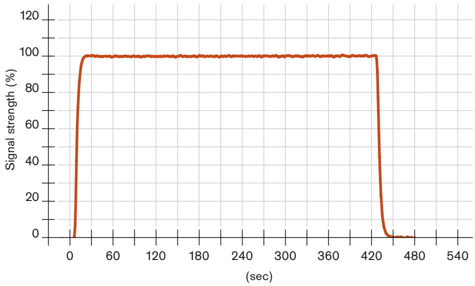
TECHNICAL SPECIFICATIONS

Detection limit:	10 ppm
Resolution:	5 ppm
Measurement range:	0 to 2,000 ppm H_2 (hydrogen)
Response time:	≤ 10 seconds (t_{90})
Precision	
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

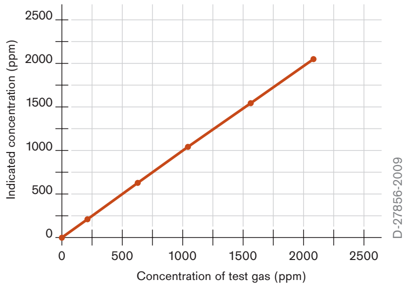
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	≤ 200
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
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	20 ppm	≤ 51
Propane	C_3H_8	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
Dräger X-am 8000	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.

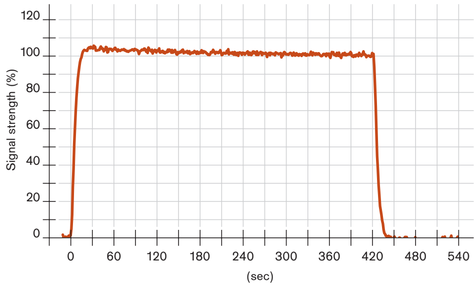
TECHNICAL SPECIFICATIONS

Detection limit:	0.02 Vol.-%
Resolution:	0.01 Vol.-%
Measurement range:	0 to 4 Vol.-% H_2 (hydrogen)
Response time:	≤ 20 seconds (t_{90})
Precision	
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

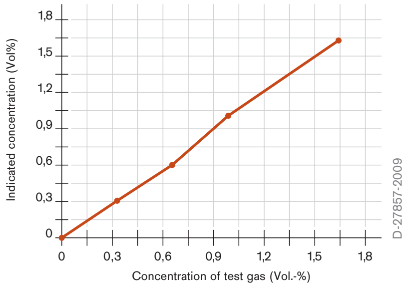
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	≤ 0.02
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
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	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 Pac 8000	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
Dräger X-am 8000	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. Due to the change of sensitivity, a calibration is necessary after installation. 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).

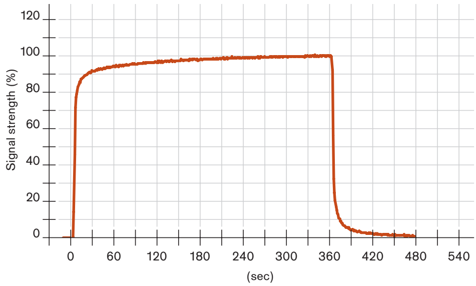
TECHNICAL SPECIFICATIONS

Detection limit:	0.5 ppm
Resolution:	0.1 ppm
Measurement range	0 to 50 ppm HCN (hydrogen cyanide)
Response time:	≤ 10 seconds (t_{50})
Precision	
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

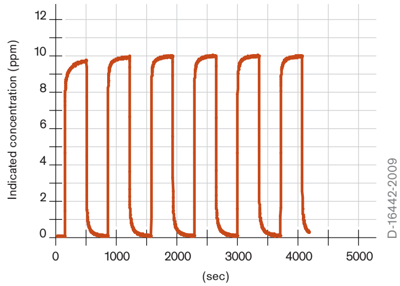
SPECIAL CHARACTERISTICS

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
Acetylene	C_2H_2	100 ppm	≤ 10
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
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
Dräger X-am 8000	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. Due to the change of sensitivity, a calibration is necessary after installation. 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

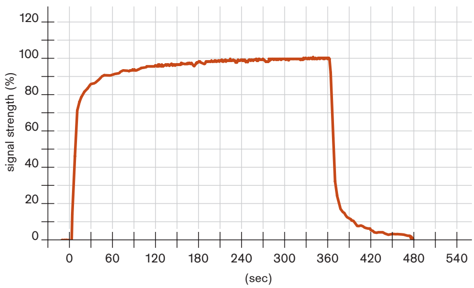
Detection limit:	3 ppm
Resolution:	0.5 ppm
Measurement range:	0 to 50 ppm HCN (hydrogen cyanide)
Response time:	≤ 10 seconds (t_{50})
Precision	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 3 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 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

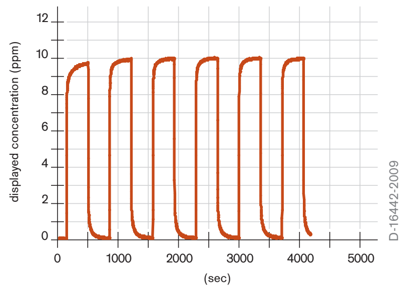
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	≤ 10
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
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
Dräger X-am 8000	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

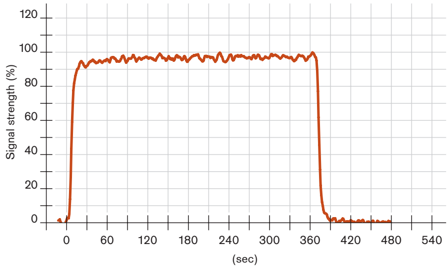
Detection limit:	2 ppm
Resolution:	1 ppm
Measurement range:	0 to 200 ppm H_2S (hydrogen sulfide)
Response time:	≤ 15 seconds (t_{90})
Precision	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 1 ppm/year
Sensitivity:	≤ ± 3% of measured value/year
Warm-up time:	≤ 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.

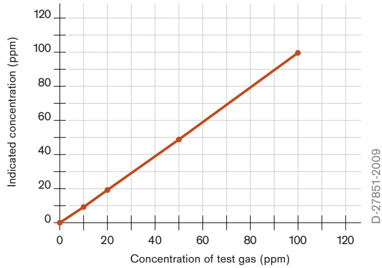
SPECIAL CHARACTERISTICS

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



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 AND 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 disulfide	CS_2	50 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 disulfide	CH_3SSCH_3	20 ppm	≤ 5
Dimethylsulfide	$(CH_3)_2S$	20 ppm	≤ 5
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	1000 ppm	≤ 10
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(–)
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

(–) Indicates negative deviation

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
Dräger X-am 8000	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

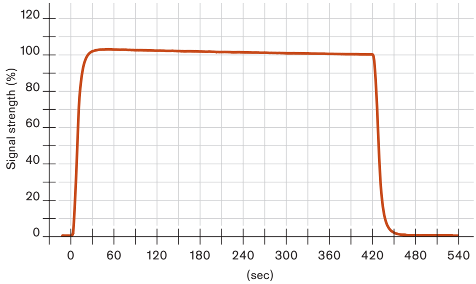
Detection limit:	4 ppm
Resolution:	2 ppm
Measurement range:	0 to 1,000 ppm H_2S (hydrogen sulfide)
Response time:	≤ 15 seconds (t_{90})
Precision	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 2 ppm/year
Sensitivity:	≤ ± 1% of measured value/month
Warm-up time:	≤ 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.

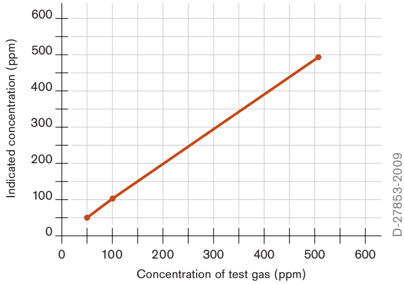
SPECIAL CHARACTERISTICS

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 50 ppm H_2S



Linearity of H_2S HC sensor
calibrated with 50 ppm H_2S



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 disulfide	CS_2	50 ppm	No effect
Carbon monoxide	CO	500 ppm	No effect
Chlorine	Cl_2	10 ppm	No effect
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	1000 ppm	≤ 10
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 /5500	no	yes	3 years	> 5 years	no
Dräger Pac 6000/ 6500	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
Dräger X-am 3500/8000	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

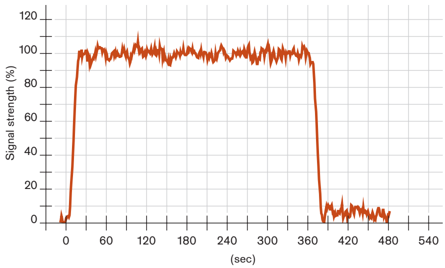
Detection limit:	0.4 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 100 ppm H_2S (hydrogen sulfide)
Response time:	≤ 15 seconds (t_{90})
Precision	
Sensitivity:	≤ ± 5% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.2 ppm/year
Sensitivity:	≤ ± 5% of measured value/year
Warm-up time:	≤ 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.

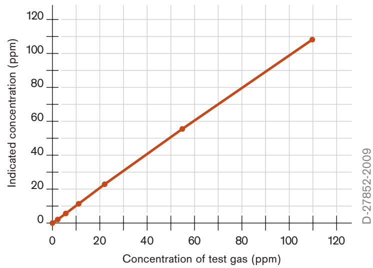
SPECIAL CHARACTERISTICS

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



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
Carbon disulfide	CS_2	50 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 1(–)
Dimethyl disulfide	CH_3SSCH_3	20 ppm	≤ 5
Dimethylsulfide	$(CH_3)_2S$	20 ppm	≤ 5
Ethanol	C_2H_5OH	250 ppm	No effect
Ethene	C_2H_4	1000 ppm	≤ 10
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
Dräger X-am 8000	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

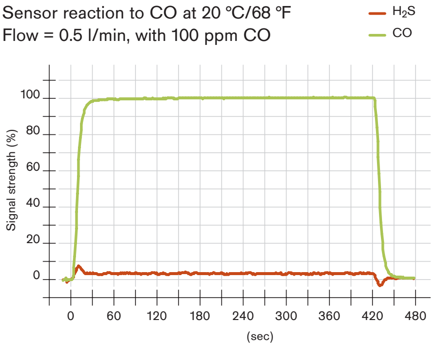
Detection limit:	2 ppm (H_2S)/6 ppm (CO)
Resolution:	1 ppm (H_2S)/2 ppm (CO)
Measurement range:	0 to 200 ppm H_2S (hydrogen sulfide)
	0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 20 seconds (t_{90})
Precision	
Sensitivity:	≤ ± 2% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 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.

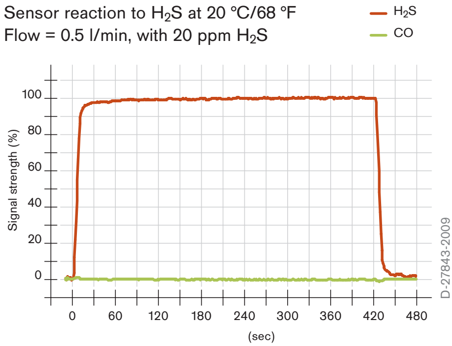
SPECIAL CHARACTERISTICS

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

Sensor reaction to CO at 20 °C/68 °F
Flow = 0.5 l/min, with 100 ppm CO



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



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
Acetylene	C_2H_2	100 ppm	No effect	≤ 200
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 disulfide	CH_3SSCH_3	20 ppm	≤ 11	No effectt
Dimethylsulfide	$(CH_3)_2S$	20 ppm	≤ 5	No effect
Ethanol	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 sulfide	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 Pac 8500	no	yes	2 years	> 3 years
Dräger X-am 5000	no	yes	2 years	> 3 years
Dräger X-am 5600	no	yes	2 years	> 3 years
Dräger X-am 8000	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

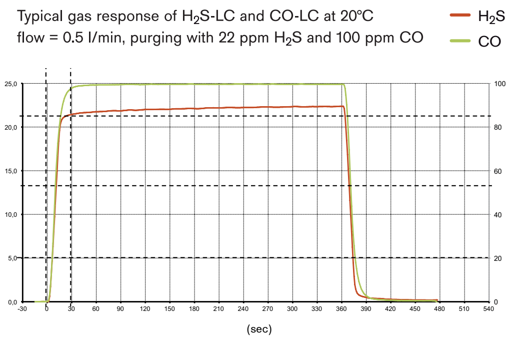
Detection limit:	0,4 ppm (H_2S)/1 ppm (CO)
Resolution:	0.1 ppm (H_2S)/1 ppm (CO)
Measurement range:	0 to 100 ppm H_2S (hydrogen sulfide) 0 to 2,000 ppm CO (carbon monoxide)
Response time:	≤ 20 seconds (t_{90})
Precision	
Sensitivity:	H_2S: ≤ ± 5 % of measured value, CO: ≤ ± 2 % of measured value
Long-term 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 minutes, CO: ≤ 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:	$H_{2ä}S$: no effect, CO: ≤ ± 5 ppm
Sensitivity:	H_2S: ≤ ± 5 % 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

Very fast temperature changes lead to temporary displays on the CO channel. After approx. 10 minutes, the signal stabilizes again.

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 limitvalue monitoring.

Typical gas response of H_2S-LC and CO-LC at 20°C
flow = 0.5 l/min, purging with 22 ppm H_2S and 100 ppm CO



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. H_2S.

RELEVANT CROSS-SENSITIVITIES

Gas/vapor	Chem. symbol	Concentration	Display in ppm H_2S	Display in ppm CO
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 disulfide	CS_2	50 ppm	No effect	n.a.
Carbon monoxide	CO	500 ppm	≤ 1	500
Chlorine	Cl_2	10 ppm	≤ 1 (–)	No effect
Dimethyl disulfide	CH_3SSCH_3	20 ppm	≤ 5	No effectt
Dimethylsulfide	$(CH_3)_2S$	20 ppm	≤ 5	No effect
Ethene	C_2H_4	100 ppm	≤ 1	≤ 300
Ethanol	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	≤ 200
Hydrogen chloride	HCl	40 ppm	No effect	No effect
Hydrogen cyanide	HCN	50 ppm	30	No effect
Hydrogen sulfide	H_2S	30 ppm	30	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	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
Sulphur dioxide	SO_2	20 ppm	≤ 1.5	No effect
tert- Butyl mercaptan	$(CH_3)_3CSH$	20 ppm	≤ 4	No effect
Tetrahydrothiophene	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 Pac 8000	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
Dräger X-am 8000	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

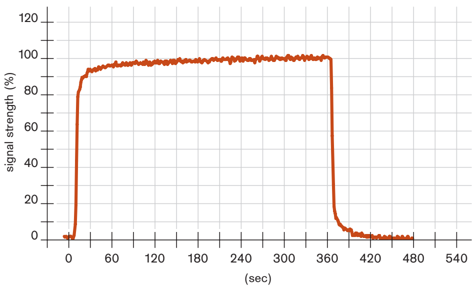
Detection limit:	4 ppm
Resolution:	1 ppm
Measurement range:	0–300 ppm NH_3 (ammonia)
Response time:	≤ 10 seconds (t_{50})
Precision	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 5 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up time:	≤ 12 hours
Ambient 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 75 ppm NH_3

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

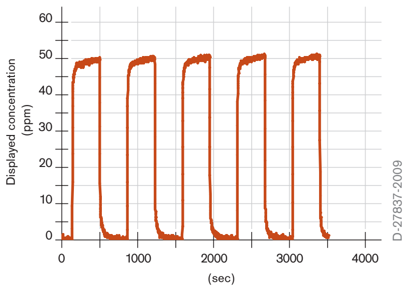
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	No effect
Carbon dioxide	CO_2	10 Vol.-%	No effect
Carbon monoxide	CO	1,000 ppm	No effect
Chlorine	Cl_2	10 ppm	≤ 30 (–)
Diethanolamine	$C_4H_{11}NO_2$	10 ppm	5 ppm
Ethanol	C_2H_5OH	250 ppm	≤ 40
Ethyldimethylamine	$C_4H_{11}N$	50 ppm	30 ppm
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 Pac 8000	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
Dräger X-am 8000	no	yes	1 year	> 2 years	no

MARKET SEGMENTS

Power and district heating plants, chemical industry.

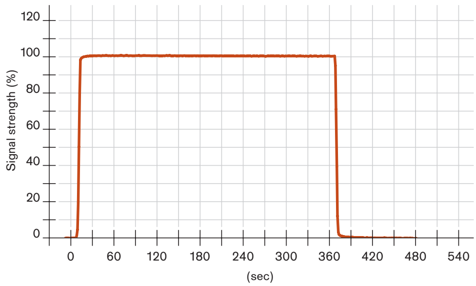
TECHNICAL SPECIFICATIONS

Detection limit:	0.3 ppm
Resolution:	0.1 ppm
Measurement range:	0 to 200 ppm NO (nitrogen monoxide)
Response time:	≤ 10 seconds (t_{90})
Precision	
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

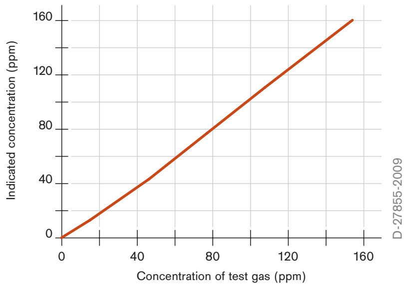
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	0.8 Vol.-%	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
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
Dräger X-am 3500/8000	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.

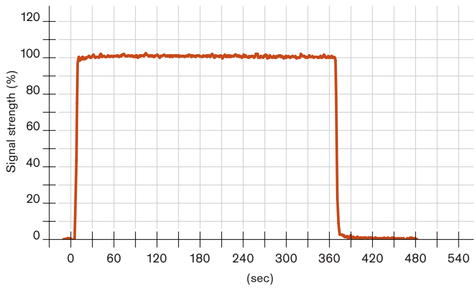
TECHNICAL SPECIFICATIONS

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})
Precision	
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

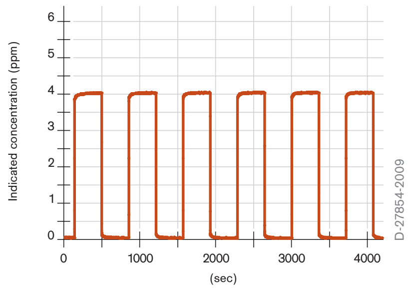
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	≤ 10(–)
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
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	$(CH_3)_2CCH_2$	100 ppm	≤ 0.8(–)
Methane	CH_4	1 Vol.-%	No effect
Nitrogen monoxide	NO	20 ppm	No effect
Ozone	O_3	0.5 ppm	0.5
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 Pac 8000	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
Dräger X-am 8000	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

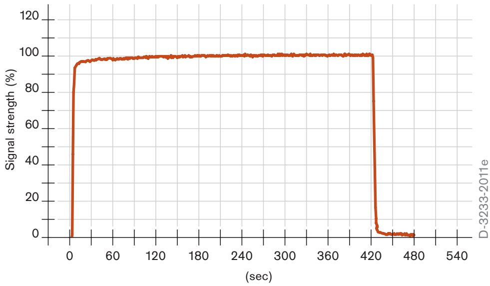
Detection limit:	0.04 ppm
Resolution:	0.02 ppm
Measurement range:	0 to 50 ppm NO_2 (nitrogen dioxide)
Response time:	≤ 15 seconds (t_{90})
Precision	
Sensitivity:	≤ ± 3% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.04 ppm/year
Sensitivity:	≤ ± 2% of measured value/month
Warm-up 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

*A use or storage over a longer period below the specified relative humidity may cause a change of sensor sensitivity due to dehydration. This effect is reversible once the relative humidity increases. Please consider the storage conditions stated on the packaging or in the instruction for use.

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 Pac 8000	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
Dräger X-am 8000	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/ relative sensitivity		C_2H_4O 1)
	0 to 200 ppm C_2H_4O (ethylene oxide)	≈ 1.00
	0 to 200 ppm C_3H_6O (propylene oxide)	≈ 0.85
	0 to 100 ppm C_2H_4 (ethene)	≈ 0.60
	0 to 100 ppm C_3H_6 (propene)	≈ 0.65
	0 to 100 ppm C_2H_3Cl (vinyl chloride)	≈ 0.60
	0 to 200 ppm CH_3OH (methanol)	≈ 0.50
	0 to 100 ppm $CH_2CHCHCH_2$ (butadiene)	≈ 1.40
	0 to 100 ppm HCHO (formaldehyde)	≈ 0.80
	0 to 300 ppm $(H_3C)_2CHOH$ (isopropanol)	≈ 0.35
	0 to 200 ppm C_4H_8O (tetrahydrofuran)	≈ 0.80
	0 to 100 ppm $C_2H_3OCH_2Cl$ (1-chloro-2,3 epoxypropane)	≈ 0.35
	0 to 100 ppm $C_6H_5CHCH_2$ (styrene)	≈ 0.70
	0 to 100 ppm $H_2CC(CH_3)COOCH_3$ (methyl methacrylate)	≈ 0.40
Response time:	≤ 20 seconds (t_{50})	
Precision		
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: 2)	(30 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:	≤ ± 0.5% of measured value/% RH	

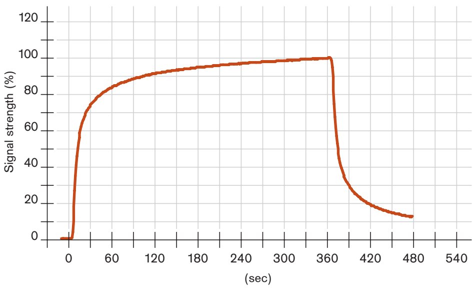
TECHNICAL SPECIFICATIONS

Test gas:	approx. 3 to 50 ppm C_2H_4O The Dräger Sensor XXS OV has a defined cross-sensitivity to ethylene oxide (EO). It can be calibrated with EO as a replacement for all of its target gases. This replacement calibration using EO can produce an additional measuring error of up to 30%[3] . 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.

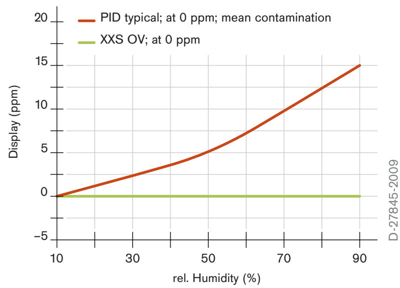
SPECIAL CHARACTERISTICS

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



1) Factors depend on serial numbers and are mentioned in the supplement to the sensor instructions for use (90 33 548).
2) A use or storage over a longer period below the specified relative humidity may cause a change of sensor sensitivity due to dehydration. This effect is reversible once the relative humidity increases. Please consider the storage conditions stated on the packaging or in the instruction for use.
3) only valid for use and storage in > 30 % r.h.

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
Acetylene	C_2H_2	100 ppm	≤ 150
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	≤ 44
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
Ethyl acetate	$CH_3COOC_2H_5$	100 ppm	No effect
Ethylene glycol	$C_2H_6O_2$	50 ppm	≤ 35
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 Pac 8000	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
Dräger X-am 8000	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[1]
	0 to 200 ppm C_2H_4O (ethylene oxide)	≈ 1.00
	0 to 100 ppm H_2CCHCN (acrylonitrile)	≈ 0.15
	0 to 300 ppm $(CH_3)_2CCH_2$ (isobutylene)	≈ 0.90
	0 to 100 ppm $CH_3COOC_2H_3$ (vinyl acetate)	≈ 0.85
	0 to 300 ppm C_2H_5OH (ethanol)	≈ 0.55
	0 to 200 ppm CH_3CHO (acetaldehyde)	≈ 0.35
	0 to 200 ppm $(C_2H_5)_2O$ (diethyl ether)	≈ 0.75
	0 to 100 ppm C_2H_2 (acetylene)	≈ 1.40
Response time:	≤ 40 seconds (t_{50})	
Precision		
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:[2]	(30 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:	≤ ± 0.5% of measured value/% RH	

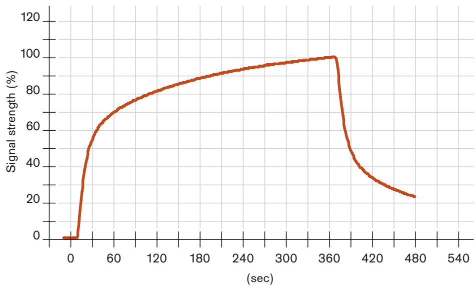
TECHNICAL SPECIFICATIONS

Test gas:	approx. 3 to 50 ppm C_2H_4O The Dräger Sensor XXS OV-A has a defined cross-sensitivity to ethylene oxide (EO). It can be calibrated with EO as a replacement for all of its target gases. This replacement calibration using EO can produce an additional measuring error of up to 30%. 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.

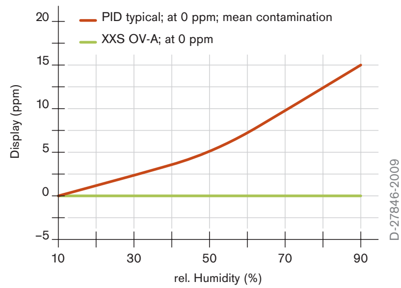
SPECIAL CHARACTERISTICS

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 EO as a replacement, this may produce an additional measuring error of 30%. 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



1) Factors depend on serial numbers and are mentioned in the supplement to the sensor instructions for use (90 33 549).

2) A use or storage over a longer period below the specified relative humidity may cause a change of sensor sensitivity due to dehydration. This effect is reversible once the relative humidity increases. Please consider the storage conditions stated on the packaging or in the instruction for use.

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	≤ 45
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_4H_8O	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/ 5500	no	yes	3 years	> 5 years	no
Dräger Pac 6000/ 6500	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
Dräger X-am 8000	no	yes	3/5 years	> 5 years	no

MARKET SEGMENTS

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

TECHNICAL SPECIFICATIONS

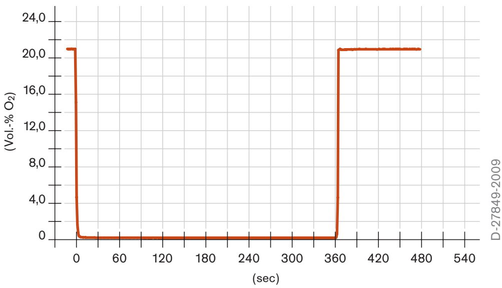
Detection limit:	0.1 Vol.-%
Resolution:	0.1 Vol.-%
Measurement range:	0 to 25 Vol.-% O_2 (oxygen)
Response time:	≤ 10 seconds (t_{90})
Precision	
Sensitivity:	≤ ± 1% of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.5 Vol.-%/year
Sensitivity:	≤ ± 1% of measured value/year
Warm-up time:	≤ 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

The sensor cannot be used to measure oxygen in the presence of helium. For oxygen monitoring during inerting processes, see DrägerSensor XXS O2 100 (SN 68 12 385).

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



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 AND XXS E O_2

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% O_2
Acetylene	C_2H_2	1 Vol.-%	≤ 0.5$^{(-)}$
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$^{(-)}$
Helium	He	20 Vol.-%	≤ 3*
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

* non-linear false positive display value

DrägerSensor® XXS O_2/CO LC

Order no. 68 13 275

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life
Dräger Pac 8500	no	yes	2 years	> 3 years
Dräger X-am 5000	no	yes	2 years	> 3 years
Dräger X-am 5600	no	yes	2 years	> 3 years
Dräger X-am 8000	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

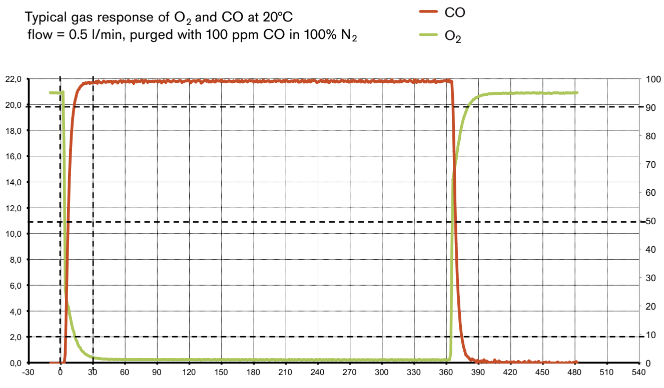
Gas suppliers, waste management, petrochemical industry, sewage, mining and tunneling, shipping, inorganic chemistry, steel industry, organic chemistry, oil & gas

TECHNICAL SPECIFICATIONS

Detection limit:	0.1 Vol.-% O_2, 1 ppm CO
Resolution:	0.1 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})
Precision	
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: ≤ 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:	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.



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 /CO LC

Gas/vapor	Chem. symbol	Concentration	Display in Vol. % O_2	Display in ppm CO with selective 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	0.2 Vol.-%	No effect	2000
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
Helium	He	20 Vol.-%	≤ 3*	n.a.
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

* non-linear false positive dispaly value

DrägerSensor® XXS O_2/H_2S LC

Order no. 68 14 137

Used in	Plug & Play	Replaceable	Guaranty	Expected sensor life	Selective filter
Dräger X-am 5000	no	yes	2 years	> 3 years	no
Dräger X-am 5600	no	yes	2 years	> 3 years	no
Dräger X-am 8000	no	yes	2 years	> 3 years	no

MARKET SEGMENTS

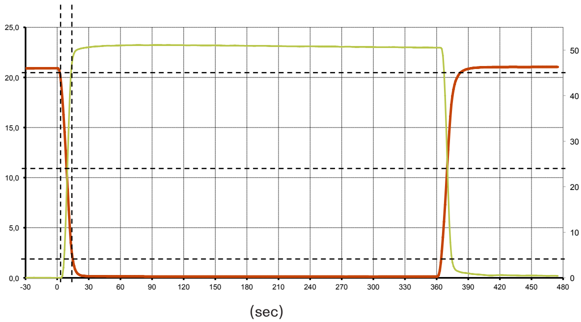
Gas suppliers, waste disposal, petrochemical industry, sewage, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and as

TECHNICAL SPECIFICATIONS

Detection limit:	0.1 Vol.-% O_2, 0.4 ppm H_2S
Resolution:	0.1 Vol.-% O_2, 0.1 ppm H_2S
Measurement range:	0 to 25 Vol.-% O_2 (oxygen), 0 to 100 ppm H_2S (hydrogen sulfide)
Response time:	O2: ≤ 15 seconds, H_2S: ≤ 20 seconds (t_{90})
Precision	
Sensitivity:	O_2: ≤ ± 1 % of measured value, H_2S: ≤ ± 5 % of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	O_2: ≤ ± 0.5 Vol.-% /year, H_2S: ≤ ± 0.2 ppm/year
Sensitivity:	O_2: ≤ ± 1 % of measured value/year, H_2S: ≤ ± 5 % of measured value/ year
Warm-up time:	O_2: ≤ 15 minutes, H_2S: ≤ 10 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.-% H_2S: No effect
Sensitivity:	O_2 : ≤ ± 2 % of measured value H_2S: ≤± 5% of measured value
Influence of humidity	
Zero point:	No effect
Sensitivity:	O_2 : ≤ ± 0.1 % of measured value/%r.h. H_2S: ≤ ± 0.1 % of measured value/ %r.h.
Test gas:	approx. 12 to 20 Vol.-% O_2 approx. 5 to 90 ppm H_2S

SPECIAL CHARACTERISTICS

DrägerSensor® XXS oxygen sensors are lead-free, thus complying with Directive 2002/95/EC (RoHS). The prominent feature of this sensor is the simultaneous measurement of % by vol. oxygen and ppm hydrogen sulfide in **one** sensor.



Typical gas response of O_2 and H_2S at 20°C

Vol% O_2

flow = 0,5 l/min, purged with 50.5 ppm H_2S in 100 Vol% N_2

ppm H_2S

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 /H_2S LC

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% O_2	Display in ppm H_2S
Acetylene	C_2H_2	0,5 Vol.-%	≤ 0,3$^{(-)}$	≤ 10
Ammonia	NH_3	100 ppm	No effect	No effect
Carbon dioxide	CO_2	10 Vol.-%	≤ 0,4$^{(-)}$	No effect
Gas	chem.symbol	Conc.	display O2	display H2S
Carbon disulfide	CS_2	50 ppm	n.a.	No effect
Carbon monoxide	CO	500 ppm	No effect	≤ 2
Chlorine	Cl_2	10 ppm	No effect	≤ 2$^{(-)}$
Dimethyl disulfide	CH_3SSCH_3	20 ppm	No effect	≤ 11
Dimethyl sulfide	$(CH_3)_2S$	20 ppm	No effect	≤ 5
Ethane	C_2H_6	1,0 Vol.-%	≤ 0,2$^{(-)}$	No effect
Ethanol	C_2H_5OH	250 ppm	No effect	No effect
Ethene	C_2H_4	1000 ppm	No effect	≤ 10
Ethyl mercaptan	C_2H_5SH	20 ppm	No effect	≤ 13
Helium	He	20 Vol.-%	≤ 3*	n.a.
Hydrogen	H_2	1,5 Vol.-%	≤ 2,5$^{(-)}$	≤ 5
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	100
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	No effect	≤ 16
Nitrogen dioxide	NO_2	20 ppm	No effect	≤ 4$^{(-)}$
Nitrogen monoxide	NO	30 ppm	No effect	No effect
Propane	C_3H_8	1 Vol.-%	No effect	No effect
sec-Butyl mercaptan	$C_4H_{10}S$	20 ppm	No effect	≤ 7
Sulfur dioxide	SO_2	20 ppm	No effect	≤ 3
tert-Butyl mercaptan	$(CH_3)_3CSH$	20 ppm	No effect	≤ 9
Tetrahydrothiophene	C_4H_8S	50 ppm	No effect	≤ 5

(–) Indicates negative deviation

* non-linear false positive dispaly value

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
Dräger X-am 8000	no	yes	1 year	> 3 years	no

MARKET SEGMENTS

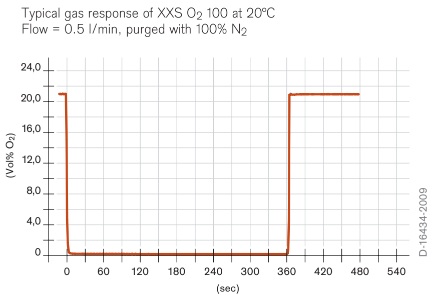
Gas suppliers, oxygen cylinders (diving), submarines, nuclear power plants

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})
Precision	
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:	≤ 15 minutes
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). The sensor's measurement principle is based on the partial pressure measurement of oxygen. Therefore, this sensor is suitable for the oxygen monitoring during inertisation processes. The inert gas can be nitrogen, carbon dioxide, argon or 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 DRÄGERSENSOR® XXS O_2 100

Gas/vapor	Chem. symbol	Concentration	Display in Vol.-% O_2
Carbon dioxide	CO_2	5 vol.-%	No effect
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
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
Dräger X-am 8000	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. Due to the change of sensitivity, a calibration is necessary after installation. The measurement value response time increases after the installation of the filter.

MARKET SEGMENTS

Gas supply companies

TECHNICAL SPECIFICATIONS

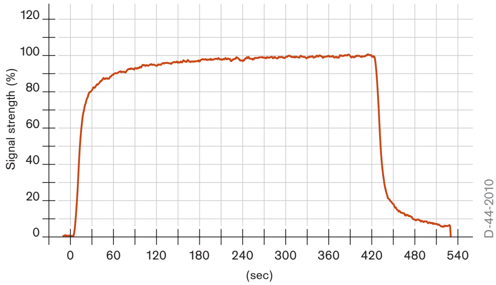
Detection limit:	1 ppm	
Resolution:	0.5 ppm	
Measurement range/ relative sentitivity	0 - 40 ppm THT (tetrahydrothiophene)	1.00
	0 - 40 ppm $(CH_3)_3CSH$ (tert.-butyl mercaptane)	2.50
	0 - 40 ppm $C_2H_5CH(CH_3)SH$ (sec.-butyl mercaptane)	2.00
	0 - 40 ppm CH_3SH (methyl mercaptane)	4.00
	0 - 40 ppm C_2H_5SH (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})	
Precision		
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	≤30 ppm	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 Pac 8000	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
Dräger X-am 8000	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

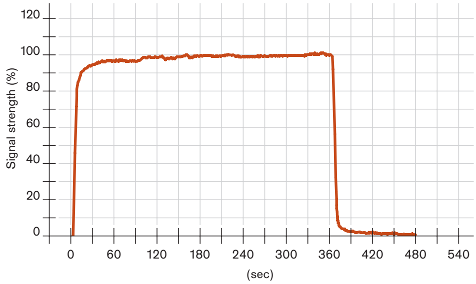
Detection limit:	0,02 ppm
Resolution:	0,01 ppm
Measurement range:	0 to 10 ppm O_3 (ozone)
Response time:	≤ 10 seconds (t_{50})
Precision	
Sensitivity:	≤ ± 3 % of measured value
Long-term drift, at 20°C (68°F)	
Zero point:	≤ ± 0.02 ppm/year
Sensitivity:	≤ ± 2 % of measured value/month
Warm-up time:	≤ 120 minutes
Ambient conditions	
Temperature:	(-20 to 50) °C (-4 to 122) °F
Humidity:*	(10 to 90) % 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 3.5 ±1 ppm O_3 is expected.

*A use or storage over a longer period below the specified relative humidity may cause a change of sensor sensitivity due to dehydration. This effect is reversible once the relative humidity increases. Please consider the storage conditions stated on the packaging or in the instruction for use.

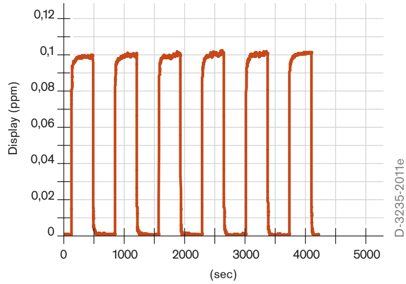
SPECIAL CHARACTERISTICS

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



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
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	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
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	≤ 0.71
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 Pac 8000[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
Dräger X-am 8000	no	yes	1 year	> 3 years	no

1) Selection of measuring gas in Pac 7000/8000 not possible, only phosphine

MARKET SEGMENTS

Inorganic chemicals, fumigation, clearance measurements.

TECHNICAL SPECIFICATIONS

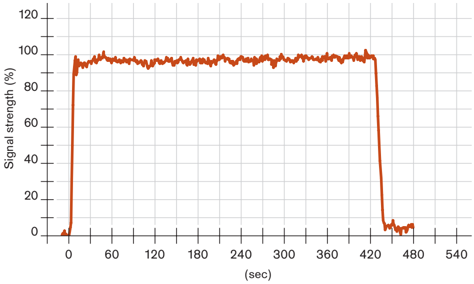
Detection limit:	0.02 ppm	
Resolution:	0.01 ppm	
Measurement range/ relative Sensitivity	0 to 20 ppm PH_3 (phosphine)	1.00
	0 to 20 ppm AsH_3 (arsine)	1.00
	0 to 20 ppm B_2H_6 (diborane)	0.25
	0 bis 20 ppm GeH_4 (Germanium hydride)	0.40
	0 to 20 ppm SiH_4 (silane)	0.50
	0 to 20 ppm H_2Se (selenium hydrogen)*	0.50
Response time:	≤ 10 seconds (t_{90})	
Precision		
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. 0.5 to 18 ppm PH_3	

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

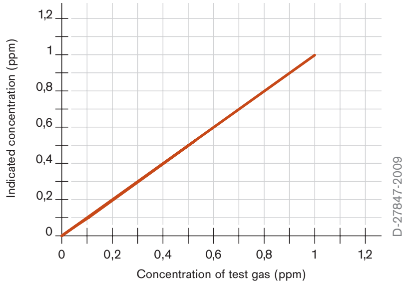
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	No effect
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
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
Dräger X-am 8000	no	yes	1 year	> 3 years	no

MARKET SEGMENTS

Inorganic chemicals, industry, fumigation.

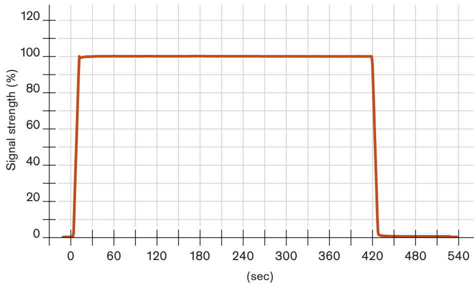
TECHNICAL SPECIFICATIONS

Detection limit:	2 ppm
Resolution:	1 ppm
Measurement range:	0 to 2,000 ppm PH_3 (phosphine)
Response time:	≤ 10 seconds (t_{90})
Precision	
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

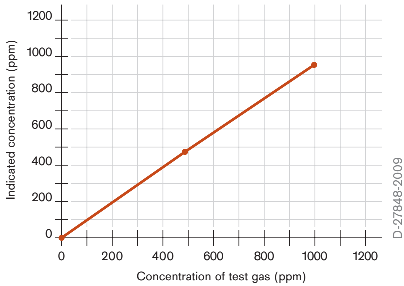
SPECIAL CHARACTERISTICS

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



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
Acetylene	C_2H_2	100 ppm	No effect
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
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 6000/ 6500	no	yes	2 years	> 3 years
Dräger Pac 7000	no	yes	2 years	> 3 years
Dräger X-am 2500	no	yes	2 years	> 3 years
Dräger X-am 5000	no	yes	2 years	> 3 years
Dräger X-am 5600	no	yes	2 years	> 3 years
Dräger X-am 3500/8000	no	yes	2 years	> 3 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. Due to the change of sensitivity, a calibration is necessary after installation. 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.

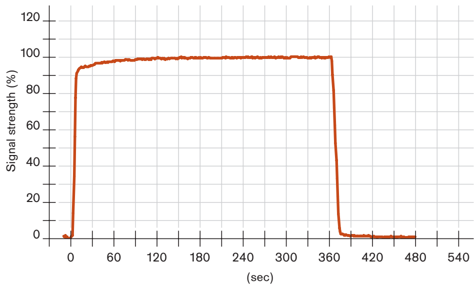
TECHNICAL SPECIFICATIONS

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})
Precision	
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:	(−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:	≤ ± 0.1% of measured value/% RH
Test gas:	approx. 2 to 90 ppm SO_2

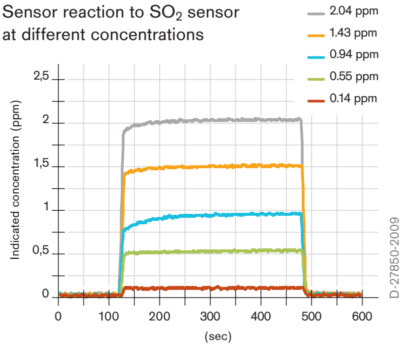
SPECIAL CHARACTERISTICS

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**
Acetylene	C_2H_2	100 ppm	≤ 140
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
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
Guaranty:	Indicates the Manufacturer's guaranty 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.

Expected sensor life:	Indicates the typical lifespan of a sensor under normal operation conditions at 20°C (68°F), 50 %r.h., 1013 hPa. This applies for the operation of the sensor (the date from which the sensor is plugged into the instrument). The values are based on laboratory and field experience and may deviate in individual cases. The decisive factor is the adjustment capability of the sensor. If it is not possible any more to adjust a sensor it must be replaced.
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 (Limit of Detection - LOD):	Specifies the smallest non-zero concentration at which a sensor gives a signal, and which is shown in the display. Example electrochemical sensor: With a detection limit of 2 ppm, 2 ppm is therefore visible in the display as the first concentration. Concentrations below 2 ppm are depicted as 0 ppm.
Limit of quantification (LOQ):	Specification for X-pid: In analytics, a distinction is made between the limit of detection and the limit of determination. The detection limit is the lowest measured value at which the presence of a substance is qualitatively detected. The limit of quantification is the smallest concentration of an analyte that can be determined quantitatively with a specified accuracy. The limit of quantification always has at least an equivalent or higher specification than the detection limit of the identical sensor.
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 ...
Upper range:	Specification for X-pid: Concentration up to which a substance can be measured, i.e. the sensor (PID) gives a signal, that is within the specification of the measuring device. The upper limit varies and depends on the substance.
Measurement Range:	Indicates the maximum measuring ranges of the sensor. All gase vapors with their ranges are indicated if a sensor can be used for different gases and vapors.
Relative Precision:	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 measurment 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 0.4. Meaning, an XXS OV sensor calibrated to EO will give a reading of 40 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. Typical values measured for the metrological report with a gas warning device can be found in the respective Notes on Approval supplied with each device.
Precision (repeatability):	Criterium for the repeatability of measurement results under the same conditions (1-sigma at 20 °C, 50 %RH). If a precision of, for example, ≤ ± 3 ppm of the measured value is specified, the following statement is applicable for 1-sigma: At a concentration of 100 ppm, the displayed value can be between 97 and 103 ppm.
Linearity error:	In measurement technology, a linearity error is a deviation of the actual characteristic curve from the nominal characteristic curve, which is a straight line or, if necessary, is approximated as such. The displayed measured value (actual characteristic curve) is ideally linearly dependent on the measurement parameter (gas concentration = nominal characteristic curve). Deviations from this linear relationship that occur in reality are referred to as linearity errors. The linearity error is greater the more the gas concentration to be measured deviates from the calibration gas concentration used. Example: With a linearity error of ± 5 %LEL, values between 95 %LEL and 105 %LEL can be displayed for a gas concentration of 100 %LEL to be measured.
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 mesurements 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. Commercially available test gas in cylinders is dry. If the instrument is subsequently used in practice at ambient conditions of e.g. 20 °C and 50 %RH, this may have an effect on the zero point and the measurement result, depending on the sensor type (for example with the PID sensor). In addition, for EC sensors applies: it is recommended to use an adjustment concentration in the range of the alarm thresholds to be monitored.

5 Accessories

D-53038-2012

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 Adjustment or calibration?

The terms “calibration” and “adjustment” are often used synonymously. However, there are important differences between the two terms. The term “calibration” is often used although technically an “adjustment” is meant - namely a test with subsequent correction. In this section, however, the technically correct term is used, even if in practice both terms are mostly used synonymously.

Adjustment

During an adjustment, the displayed value, the so-called actual value, is corrected to the correct value, the so-called nominal value (e.g. the test gas concentration) as closely as possible with the constraints of the display. The aim is to obtain more accurate displayed measurements. This applies to both the zero point and the sensitivity of the sensor. Depending on the sensor, either a zero gas (e.g. synthetic air or nitrogen) or fresh air is used to adjust the zero point, while the appropriate test gas is required for the sensitivity adjustment.

Target gas adjustment or surrogate? gas adjustment (cross calibration)?

In a target gas adjustment, the gas detector is adjusted with the gas that it will be measuring. This type of adjustment is the most accurate and is therefore recommended by Dräger where ever possible.

With some sensors, however, a target gas adjustment is not possible or only possible to a limited extent. Some substances may require extensive expertise and a careful approach to avoid mistakes during adjustments. Sometimes several (combustible) substances are to be measured in one application, to which the sensor reacts at different sensitivities. In such cases, a surrogate gas adjustment is recommended. Thus, a surrogate test gas is a gas mixture used to replace a test gas that is difficult to handle.

Reasons for a surrogate gas adjustment can be among others:

- Target gas is hazardous or critical to the health of the tester:
  Example: The standard test gas for the OV sensors is ethylene oxide. This gas is toxic and carcinogenic. Therefore, the OV sensors can be adjusted with the substitute gas carbon monoxide (CO). This is less dangerous and easier to handle.
- The sensor detects several different gases:
  A PID sensor can detect all substances ionized by the UV lamp in the sensor. For simplicity, the sensor is typically adjusted with isobutylene. The relative sensitivity of other substances is then expressed using so-called response factors, which must then be considered for the measured value display. This conversion takes place automatically in Dräger gas detectors.
- Purposely selecting a more sensitive setting for a measurement with increased safety:

A CatEx sensor is less sensitive to nonane. If the CatEx sensor is set to nonane, all the other gases such as methane or propane are displayed with increased sensitivity. This provides increased safety during the measurement.

- If different combustible gases are measured with a CatEx sensor, including methane, then it is recommended to perform an adjustment and function bump test with methane in order to compensate the effect of a selective methane insensitivity by this sensor technology. Also, in this application, the conversion between the gases is automatically done in Dräger instruments. General note: In principle, a deviation of up to ± 30% of the measured value must be considered for the displayed concentration when performing a surrogate gas adjustment.

Calibration

During calibration, **a gas detector is checked** and the deviation (incl. measurement tolerances) from a reference gas (e.g. the test gas concentration) is determined and logged. Actions beyond logging do **not** take place during a calibration. The aim of the calibration is a protocol, the so-called calibration certificate. Under no circumstances **may** changes be made to the device after a calibration, as otherwise the calibration (= protocol/documentation) is then void.

Every gas detector is subject to changes due to wear, contamination or environmental influences (temperature, humidity, pressure, ...). Consequently, measured values can change and should be checked regularly. The recommended daily function test with a suitable test gas (also called bump test) fulfills this requirement.

5.3 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	🔴	🟢🟢

🔴🔴 🔴 ⚫ 🟢 🟢🟢

Inadequate → Above-average

5.4 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).

5.5 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.

5.6 The Dräger Bump Test Station

D-5068-2017

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 family, 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.

5.7 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 pre-determined 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 family	■	■	■	■
Dräger X-am 2500/5000/5600	■	■	■	■
Dräger X-am 5100				■
Dräger X-am 7000	■	■	■	■
Dräger X-am 3500/8000		■	■	■

5.8 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.

5.9 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. The cylinders contain compressed gas. The 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 used for various test gas cylinders.

APPLICATION


ST-4809-2005
Trigger control valve

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
Control valve basic

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.

APPLICATION

D-27716-2017

Variflow regulator

Regulator with adjustable volume flow

Can be set to a number of fixed flow specific settings between 0 - 5 l/min (0 l/min; 0.5 l/min; 0.75 l/min; 1.0 l/min; 1.5 l/min; 2.0 l/min up to 5 l/min).

D-98769-2013

Regulator basic, stainless steel

Special stainless steel valve for aggressive gases

This stainless steel valve is ideal for reactive gases, such as chlorine or ammonia. It is recommended to use a regulator for each single gas type. 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. It is recommended to use one regulator for each single gas type.

D-4351-2014

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.

5.10 Pumps

D-6522-2017

Dräger X-am 8000
with pump adapter

In certain situations confined spaces and areas 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 3500/8000 can be equipped with an integrated high-performance pump.

D-11864-2016

Dräger X-am Pump

In both cases, a corresponding adapter ensures that the device can be used as either a diffusion unit or a pump unit. You can use the device in diffusion mode (pump-free), even if you decide on an internal pump.

The external Dräger X-am Pump is available for the Dräger X-am 2500/5000 and 5600 product family. When the detector is inserted the pumping function starts automatically. The period of pump operation, flow test and the measurement results are stored in the X-am's data logger. Like the X-am instrument family, the X-am Pump is approved for Ex Zone 0. The pump can be used with hoses up to 45 m (148 ft.) and is optimized for a hose diameter of 3 mm for short purging times. Via a Micro USB socket the pump's battery pack can be charged with the charging cable of any mobile phone.

5.11 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		LENGHT	MATERIAL	FOR USE WITH GAS DETECTION DEVICES	USES
83 17 188	Bar probe 400		40 cm	Stainless-steel probe with an external diameter of 10 mm (0.4 in.).	X-am 7000 X-am 2500 X-am 5000/5600 X-am 3500/8000	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.
83 28 667	Bar probe GP 600		48 cm	Polypropylene probe male hose connection 1.5m hose 3.2 x 1.6 FKM 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 X-am 3500/8000	Low-cost basic model Suitable for areas where there is a risk of explosion.
83 16 531	Leakage probe 70		70 cm	Flexible metal tube with an integrated FKM 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 X-am 3500/8000	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		90 cm	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 X-am 3500/8000	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		1 m	Metal probe with an integrated FKM 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 X-am 3500/8000	Bis 1 m LENGHT flexibel ausziehbar. Geeignet für Ex-Bereiche.

ORDER-NUMBER	NAME		LENGHT	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 FKM 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 X-am 3500/8000	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	Measuremen 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 X-am 3500/8000	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. Für Messungen in Abwasser- und Kanalisationsbreichen, Lösemittel-beständig.
83 18 371	Float probe incl. hose	 D-10391-2009	5 m 6.6 ft.	Probe: Polycarbonate. FKM hose with external diameter of 8 mm (0.3 in.) + water and dust filter.	X-am 7000 X-am 2500 X-am 5000/5600 X-am 3500/8000	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 X-am 3500/8000	Electrically conductive.

ORDER-NUMBER	NAME		LENGHT	MATERIAL	FOR USE WITH GAS DETECTION DEVICES	USES
83 25 831	Float probe EPP incl. hose	 D-14331-2017	3 m	Probe: EPP Hose: FKM with inner diameter of 3.2 mm and Luer male adapter	X-am 3500/8000	For measurements in drainage and sewage systems. Suitable for areas where there is a risk of explosion; solvent-resistant.
83 25 832	Float probe EPP incl. hose	 D-14331-2017	10 m	Probe: EPP Hose: FKM with inner diameter of 3.2 mm and Luer male adapter	X-am 3500/8000	For measurements in drainage and sewage systems. Suitable for areas where there is a risk of explosion; solvent-resistant.

5.12 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 3500/8000, X-zone 5500/5800 and X-am Pump is designed for 45 m.

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.

5.13 Usage of Hoses

HOSES WITH 5 MM INNER DIAMETER FOR THE USE WITH INSTRUMENTS:

Dräger X-am 2500, 5000 and 5600 with the Dräger X-am 1/2/5000 external pump (p/n 83 19 400)

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	Fluorinated rubber	Polyvinyl chloride	Polychloroprene (CR) with natural rubber (NR)	Tygon shell and interior polytetrafluoroethylene (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	56 Shore A	60 Shore A	
Colour	Black	Transparent	Black	Transparent
Benefit	Suitable for vapours	Phthalate-free (plasticizer)	Conducts electricity	Specifically for aggressive gases such as chlorine
Temperature range	-15 °C to + 200 °C	-46°C to + 74 °C	-30°C to +134°C	-36°C to 74°C
Antistatic	no	no	yes	no
Use in explosion-hazard area	Suitable	Suitable	Suitable	Suitable
Further features	solvent resistant	flexible, no kinking		

TEST RESULTS AND MEASUREMENT RECOMMENDATIONS

Gassing/floating time

	GAS	FORMULA	DISPLAY 10 m FKM hose: 1 min	3 min	5 min	> 5 min	DISPLAY 10 m Tygon E-3603 hose: 1 min	3 min	5 min	> 5 min	DISPLAY Antistatic (rubber) hose: 1 min	3 min	5 min	> 5 min	DISPLAY SE 200, PTFE lined Tygon hose 4594679: 1 min	3 min	5 min	> 5 min
	Carbon dioxide	CO_2	suitable				suitable				suitable				suitable			
	Carbon monoxide	CO	suitable				suitable				suitable				suitable			
	Oxygen	O_2	suitable				suitable				suitable				suitable			
	Nitrogen dioxide	NO_2	suitable				suitable							suitable	suitable			
	Chlorine	Cl_2	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable			suitable	
	Hydrogen sulphiede	H_2S	suitable				suitable				suitable				suitable			
	Phosgene	$COCl_2$		suitable				suitable						suitable			suitable	
	Hydrogen Cyandie	HCN			suitable			suitable						suitable		suitable		
	Phosphine	PH_3		suitable				suitable			suitable				suitable			
	Ammonia	NH_3				limited suitable			suitable			suitable				suitable		
	Nitric oxide	NO		suitable					suitable		suitable				suitable			
	Sulphur dioxide	SO_2			suitable			suitable						suitable	suitable			
	Ozone	O_3	Due to its physical properties, ozone will be trapped in any hose (on the hose walls)															
	Ethylene Oxide	EO	suitable				suitable							limited suitable	suitable			
Lightly volatile hydrocarbons or gases	Methane - Hexane		suitable		suitable						suitable				suitable			
Medium volatile hydrocarbons or gases	Acetic acid,	CH_3COOH			suitable				suitable		not suitable	not suitable	not suitable	not suitable		suitable		
	Toulene,	$C_6H_5CH_3$			suitable				suitable		not suitable	not suitable	not suitable	not suitable		suitable		
	Octane	C_8H_{18}			suitable				suitable		not suitable	not suitable	not suitable	not suitable		suitable		
Low volatile hydrocarbons or vapors	n-Nonane	C_9H_{20}			suitable		not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable		suitable		
	Styrene	$C_6H_5CH{=}CH_2$			suitable		not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable		suitable		

suitable t_{90} time

limited suitable, longer rinsing time, t_{90} > 5 min.

not suitable

HOSES WITH 3 MM INNER DIAMETER FOR THE USE WITH THE INSTRUMENTS:

Dräger X-am 3500/8000 or
Dräger X-am 2500, 5000 and 5600 with Dräger X-am Pump (p/n 83 27 100)

PROPERTIES

	Fluorinated rubber 8325837	**Tygon E-3603 8325838**	**Rubber** 8325839
Material	FKM	PVC	CR-NR
Chemical name	Fluorinated rubber	Polyvinyl chloride	Chloroprene rubber / Natural rubber
Inner Ø	3.2 mm	3.2 mm	3.2 mm
Outer Ø	6.4 mm	6.4 mm	6.4 mm
Hardness		56 Shore A	60 Shore A
Colour	Black	Transparent	Black
Benefit	Suitable for vapours	Phthalate-free (plasticizer)	Conducts electricity
Temperature range	-15 °C to + 200 °C	-55 °C to 74 °C	-30°C to 134°C
Antistatic	No	No	Yes
Use in explosi-on-hazard area	Suitable	Suitable	Suitable
Further features	Solvent resistant	Flexible, no kinking	

TEST RESULTS AND MEASUREMENT RECOMMENDATIONS

	GAS	FORMULA	DISPLAY 10 m FKM hose – Gassing/floating time 1 min	3 min	5 min	> 5 min	DISPLAY 10 m Tygon E-3603 hose – Gassing/floating time 1 min	3 min	5 min	> 5 min	DISPLAY Antistatic (rubber) hose – Gassing/floating time 1 min	3 min	5 min	> 5 min
	Carbon dioxide	CO_2	suitable				suitable				suitable			
	Carbon monoxide	CO	suitable				suitable				suitable			
	Oxygen	O_2	suitable				suitable				suitable			
	Nitrogen dioxide	NO_2		suitable				suitable				suitable		
	Chlorine	Cl_2	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable
	Hydrogen sulphiede	H_2S	suitable				suitable				suitable			
	Phosgene	$COCl_2$	Not yet measured											
	Hydrogen Cyandie	HCN		suitable				suitable			suitable			suitable
	Phosphine	PH_3	suitable				suitable				suitable			
	Ammonia	NH_3			suitable					suitable				suitable
	Nitrogen monoxide	NO	suitable				suitable				suitable			
	Sulphur dioxide	SO_2		suitable					suitable		Not yet measured			
	Ozone	O_3	Due to its physical properties, ozone will be trapped in any hose (on the hose walls)											
	Ethylene Oxide	EO	suitable							limited suitable	suitable			
Lightly volatile hydrocarbons or gases	Methane -		suitable				suitable				suitable			
	Hexane				suitable									
Medium volatile hydrocarbons or gases	Acetic acid,	CH_3COOH			suitable		not suitable	not suitable	not suitable	not suitable				
	Toulene,	$C_6H_5CH_3$			suitable		not suitable	not suitable	not suitable	not suitable			suitable	
	Octane	C_8H_{18}			suitable		not suitable	not suitable	not suitable	not suitable			suitable	
Low volatile hydrocarbons or vapors	n-Nonane	C_9H_{20}			suitable		not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable
	Styrene	$C_6H_5CH{=}CH_2$			suitable		not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable	not suitable

suitable t_{90} time

limited suitable, longer rinsing time, t_{90} > 5 min.

not suitable

5.14 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

5.15 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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