



DrägerSensor® & Portable Instruments Handbook 6th Edition

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6th Edition

Dräger Safety AG & Co. KGaA
Lübeck, Germany
2022

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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1 Introduction

Dear Readers,

In times when the world around us is becoming more volatile, uncertain, complex, and ambiguous (VUCA), it is important to have a constant partner with high quality at one's side for upcoming measurement tasks, especially when it comes to Technology for Life. At Dräger, we are not only constantly working to improve our gas measurement systems and services, but also optimize our working methods and documents.

We are pleased to present you a revision of the DrägerSensor and Portable Instruments Handbook, now its sixth edition.

With Dräger Gas Detection Connect, our system solution for the Industrial Internet of Things is presented in this edition. Consisting of sensor, gas warning device, test station, gateway and cloud, an overall system is created for efficient fleet management and remotely live monitoring of the sensor values.

Also worth mentioning is our new 4-gas measuring device Dräger X-am 2800 with integrated Bluetooth interface. New added value is created by data analysis and alarm reporting within the Gas Detection Connect Cloud.

We are also pleased to introduce a new O₂ sensor and an improved catalytic Ex sensor, the CatEx SR in the X-am 2800. Both new sensors score with increased mechanical and chemical robustness.

To continue to keep track of the legal background in today's VUCA world, we have also updated the background to the measurement performance certificate (Type Examination Certification) according to IEC.

Many attentive readers have given us feedback on several corrections, which we have considered in this issue. Many thanks for the constructive criticism and the many, positive feedbacks on this compendium.

I hope you enjoy reading, browsing, and learning.

Yours,

Hauke Kastens

Head of Product Management Mobile Gas Measurements

PS: My sincere thanks go to everyone involved in this revision.

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 (H₂, fourteen times lighter than air), the heaviest gas (around ten times heavier than air) is tungsten hexafluoride (WF₆).

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 separated 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).

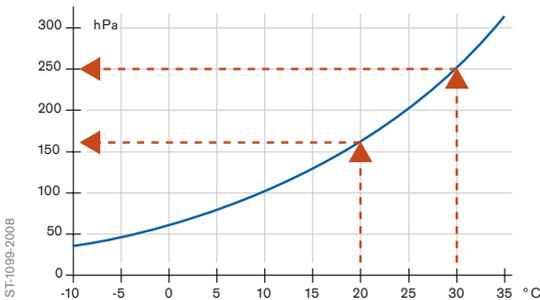
2.2 Vapors – aren't they gases, too?

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:

| Gas | Composition | |
|----------------------------------|------------------|------------------|
| | dry | humid |
| Principal gases | | |
| N ₂ – nitrogen | 780,840 | 768,543 |
| O ₂ – oxygen | 209,450 | 206,152 |
| H ₂ O – 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 ₂ O – 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} m². This creates an atmospheric pressure on the earth's surface of 10,325 kg/m², which corresponds to normal atmospheric pressure: 1,013 hPa (14.7 psi). Atmospheric pressure decreases with increasing altitude:

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

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

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

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

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

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

At what level does it become dangerous?

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

2.4 Ex, Ox, Tox – gas hazards!

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

There are basically three categories of risk:

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

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

For example, hydrogen sulfide can be detected in low concentrations because it smells of rotten eggs. However, the nose can no longer perceive the lethal, high concentrations of hydrogen sulfide. Many fatal accidents have occurred 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 LC₅₀ 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 LC₅₀ < 0.5 g/m³

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

T Toxic LC₅₀ = 0.5 ... 2.0 g/m³

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

LC₅₀ (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 temperature-dependent vapor pressure and its LEL.*

| Vapor | LEL Vol.-% | LEL g/m ³ | 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/m ³ | 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/m ³ | 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

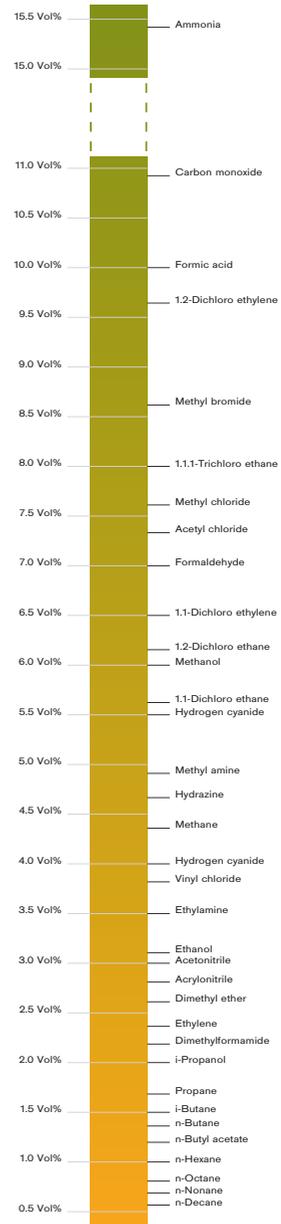
Flammable gases and vapors can form ignitable mixtures when combined with air, but the ratio of flammable gas to oxygen (or air) must lie within certain limits.

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 its LEL, then we can protect people against explosions by measuring the gas concentrations continuously and using appropriate measures to ensure that concentrations never exceed a level such as half the LEL (50% LEL).

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

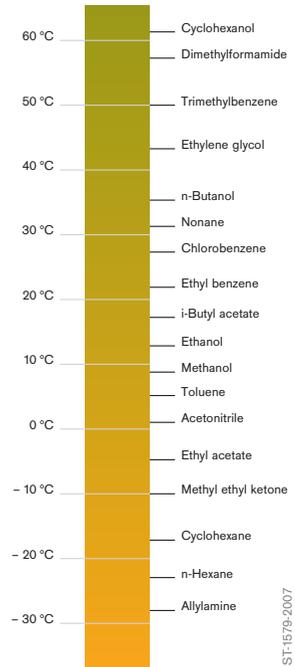


2.8 Flash point of flammable liquids

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

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

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



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

2.9 Concentration and their calculation

Concentration is defined as the content of a substance within a reference substance. When measuring harmful substances in the air, the quantity of that substance is defined in terms of a concentration in relation to the air. The right units must be chosen to produce useful figures for defining the concentration. High concentration is generally given as Vol.-% – in other words, one part of a substance to 100 parts of air. Air, for example, consists of 21% Vol.-% oxygen, which means that 100 parts of air contain 21 parts of oxygen. Lower concentration levels are measured in ppm = parts per million (mL/m^3), or ppb = parts per billion ($\mu\text{L}/\text{m}^3$). 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:

$$1 \text{ Vol.-%} = 10,000 \text{ ppm} = 10,000,000 \text{ ppb}$$

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

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

Converting mg/m^3 into ppm

$$C_{[\text{ppm}]} = \frac{\text{Molar volume}}{\text{Molar mass}} \cdot C$$

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

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

3 Introduction to portable instruments

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

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

3.1 Application areas for portable gas detection

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

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

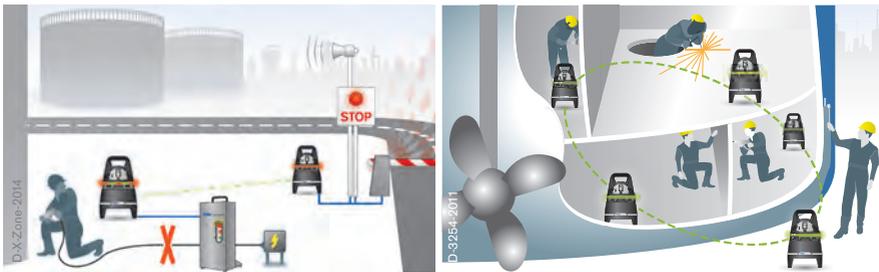
Personal monitoring

- 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.



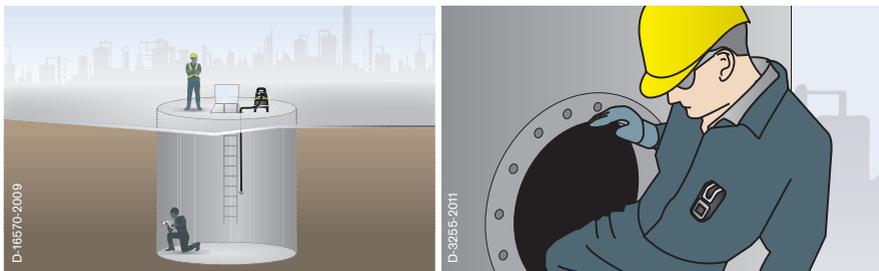
Area monitoring

- 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-16/08-2009

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 45 544-1/2/3 – for toxic gases and vapors

EN 50 104 – for oxygen

EN 60 079-29-1 – for flammable gases and vapors (for detailed information see also chapter 3.7 Measurement Performance Certificate according to IEC)

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/m ³ | 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/m ³ | 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 |

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 | EN 60079-11 | Intrinsic safety (also for dust) |
| Ex ib | | ia required for Zone 0 & 20 |
| Ex ic | | ib sufficient for Zone 1 & 21 ic sufficient for Zone 2 & 22 |
| Dust | | |
| Ex ta | EN 60079-31 | ta required for Zone 0 |
| Ex tb | | tb required for Zone 1 |
| Ex tc | | tc required for Zone 2 |

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

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

Explosion group

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

CATEGORIZATION OF GASES AND VAPORS

| Explosion group | Temperature category (max. permissible surface temperature) | | | | | |
|---|---|-----------------|----------------|------------------|------------|------------------|
| | T1 (450°C) | T2 (300°C) | T3 (200°C) | T4 (135°C) | T5 (100°C) | T6 (85°C) |
| Ignition temp. | > 450°C | 300–450°C | 200–300°C | 135–300°C | 100–135°C | 85–100°C |
| | > 842°F | 572–842°F | 392–572°F | 275–572°F | 212–275°F | 185–212°F |
| I | methane | | | | | |
| IIA | acetone | isoamyl acetate | amyl alcohol | acetaldehyde | | |
| Ignition energy more than 0.18 mJ | ammonia | n-butane | benzine | | | |
| | 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 | 1.3-butadiene | dimethyl ether | diethyl ether | | |
| Ignition energy 0.06 to 0.18 mJ | cyanide | | | | | |
| | coal gas | 1.4-dioxane | ethylglycol | | | |
| | | | ethylene | hydrogen sulfide | | |
| | ethylene oxide | | | | | |
| IIC | hydrogen | acetylene | | | | carbon disulfide |
| Ignition energy less than 0.06 mJ | | | | | | |

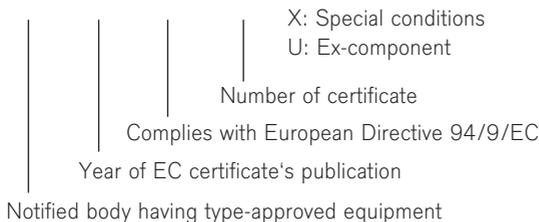
Temperature category

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

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

EC construction type certification:

BVS 10 ATEX E 080X



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.

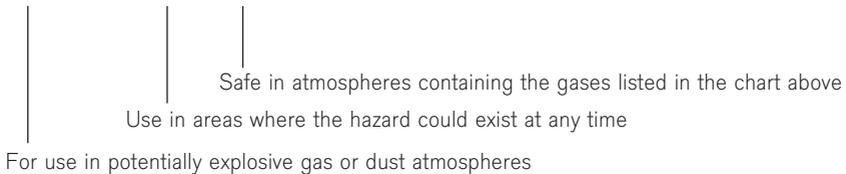
Notes

- 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



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 |
|---|---|
| <p>Division 1: Where ignitable concentrations of flammable gases, vapors or liquids:</p> <ul style="list-style-type: none"> – Are likely to exist under normal operating conditions – Exist frequently because of maintenance/ repair work or frequent equipment failure | <p>Zone 0: Where ignitable concentrations of flammable gases, vapors or liquids are present continuously or for long periods of time under normal operating conditions.</p> <hr/> <p>Zone 1: Where ignitable concentrations of flammable gases, vapors or liquids:</p> <ul style="list-style-type: none"> – Are likely to exist under normal operating conditions – May exist frequently because of repair, maintenance operations or leakage |
| <p>Division 2: Where ignitable concentrations of flammable gases, vapors or liquids:</p> <ul style="list-style-type: none"> – 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. | <p>Zone 2: Where ignitable concentrations of flammable gases, vapors or liquids:</p> <ul style="list-style-type: none"> – 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 Oficial 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 Measurement Performance Certificate according to IEC

What is a „Measurement Performance Certificate“?

A measurement performance certificate (Type Examination Certification) is a verification and certification of the measuring function of a gas detector. The certification is based on various legal regulations, such as the ATEX Directive (European Directive 2014/34/EU) or occupational health and safety regulations.

Occupational health and safety regulations are oriented to the “state of the art”. Example: In Germany the state of the art is described in occupational insurance association publications T021 and T023.

Standards are applied to ensure consistent certification. Based on the requirements of standards, test centers and approval agencies can test the suitability and classification of devices and issue certificates. The quality of measurements is tested under extreme environmental conditions (e.g., temperature, pressure, moisture, vibration, etc.).

Which standards are primarily applied for a measurement performance certificate?

The most relevant standards for gas warning devices are described below:

| | |
|----------------|---|
| EN 60079-29-1 | Explosive atmospheres – Part 29-1: Gas detectors - Performance requirements of detectors for flammable gases |
| EN 50104 | Electrical equipment for the detection and measurement of oxygen - Performance requirements and test methods |
| EN 50271 | Electrical apparatus for the detection of combustible gases, toxic gases, or oxygen – Requirements and tests for apparatus using software and/or digital technologies Notice: This standard is applicable for the operation and signaling of devices which are not considered in the „metrological standards“ but are necessary for safe operation of the devices. The standard is a supplement to the „metrological standard“ and can only be (meaningfully) applied in conjunction with them. The following are regulated, among others: Behavior in case of errors, special states, messages, calculation and rounding errors, test routines, requirements for the software development process, etc. |
| EN 45544-1/2/3 | Workplace atmospheres – Electrical apparatus used for the direct detection and direct concentration measurement of toxic gases and vapors – Part 1: General requirements and test methods Part 2: Performance requirements for apparatus used for exposure measurement Part 3: Performance requirements for apparatus used for general gas detection |

Notice: EN 45544 is not part of the regulated area of the ATEX Directive. However, it can be applied for metrological tests in the area of occupational health and safety by the manufacturer.

Also, to be mentioned:

IEC 60079-29-1 Explosive atmospheres – Part 29-1: Gas detectors - Performance requirements of detectors for **flammable gases**. This is the international standard (IEC = International Electrotechnical Commission), but in Europe the EN version must be used. This standard is also applied in North America and replaces (in the future) the previous local standards for gas detectors for the measurement of flammable gases. The IEC version contains only rudimentary requirements for the software and the software development process (this is regulated separately in Europe in EN 50271). The standard also contains requirements for electromagnetic compatibility.

These standards are regularly updated and adapted to the state of the art. The current version is valid, but a transition period applies when a new edition is published. The transition period is used to transfer European or international standards into local standards, for example a European EN standard into a German DIN EN standard. The manufacturers should also be given time to make any necessary adjustments to their products. During the transition period, manufacturers can use both the old and the new standard for testing.

When does a customer need a Measurement Performance Certificate (Type Examination Certification for metrology)?

A) Europe (legally regulated area of the European Union):

1. **ATEX Directive:** In addition to electrical safety, the ATEX Directive specifies requirements for the measuring function for primary protection against explosion (Ex and O₂): If a user wants to use gas detectors for the so-called "**primary explosion protection**", the detectors must have a Type Examination Certification for the measurement of flammable gases and oxygen (inertization). This includes tests in accordance with EN 60079-29-1, EN 50104 and EN 50271. Primary explosion protection is the prevention of potentially explosive atmospheres. Examples of measures for "primary explosion protection" include:
 - Inertization and associated measurements (measuring function for explosion protection: monitoring low/high concentrations of oxygen for explosion protection).
 - Clearance measurements in confined spaces (flammable gases). This is also explicitly stated in the EN 60079-29-2.
 - Measurements as part of a safety concept that switches automatic equipment (e.g., ventilation).

The operator of a plant in which there are potentially explosive atmospheres is obliged to prepare an explosion protection document with a hazard analysis and a safety concept to prevent the occurrence of explosive mixtures. The document specifies whether actions for primary, secondary, or tertiary explosion protection are required.

Devices for personal monitoring of an employee or workplace, which, in the event of an alarm, cause the user to escape, do not belong to the area of explosion protection, but are part of the occupational health and safety. A personal gas measuring device does not necessarily have to be metrologically tested since it is "only" used for monitoring and alarming.

However, associations or (private) companies may have their own regulations that require a Measurement Performance Certificate.

2. Shipping: The **Marine Equipment Directive (MED)** must be applied for shipping applications: The steering wheel marking (MED) is issued (only) with measurement performance certificate and is time limited. The MED Directive is also part of the legally regulated area.

3. Occupational health and safety: In addition, there is the area that is not regulated by law. In Germany, this is expressed via the recommendations (= state of the art) in the form of leaflets T021 and T023 of the Employer's Liability Insurance Association for Raw Materials and the Chemical Industry (BG RCI):

- T021 „Gas Detection Equipment for Toxic Gases/Vapors and Oxygen– Use and Operation“ (Ox/Tox)

- T023 „Gas Detection Equipment for Explosion Protection – Use and Operation“ (Ex)

Among other things, these documents regulate in detail the maintenance and servicing of gas detectors. This includes a graduated system of various checks to maintain the function of the devices. The documents represent the state of the art and were prepared with the participation of the manufacturers, operators, testing bodies and accident insurers. The leaflets represent a technical elaboration of the guidelines of the Industrial Safety Regulation ("Betriebssicherheitsverordnung", Germany) regarding the inspections to be carried out. Deviations from the documents should only be made based on a conscientious risk assessment (Germany).

B) Outside Europe:

Measurement Performance Certificates are also performed under other standards.

Examples of approvals with metrological testing include are:

- Canada/USA: UL/CSA approval

Some customer groups also have separate approval processes, for example:

- USA: Mine Approval (MSHA)

Outlook for the future:

The (European) EN 45544-1/2/3 series of standards is to be replaced in the future by the (international) ISO/IEC 62990-1 standard. EN 45544-4 is expected to be replaced by IEC 62990-2. It is expected that this standard will be based on the concept of EN 45544.

3.8 Single-gas measuring instruments



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



Dräger Pac 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 $+55^{\circ}\text{C}$ 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 / O₂ and the hydrogen compensated CO sensor (CO H₂-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



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 H₂S with CO or O₂ 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

Optional Bluetooth® module for Pac 6500, 8000, 8500 to connect to the GDC App for Android and iOS



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

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 H₂S 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.

With the new Bluetooth® enabled Pac, you can wirelessly transmit live readings to the Dräger Gas Detection Connect System. You can easily track the location of the employee and their Pac by connecting the device to the Gas Detection Connect Gateway app. Dräger Pac devices can be integrated into third-party applications via the OpenGATT protocol.

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

O₂ sensor: 10 months

Dual sensors (w/o O₂): 22 months

Ambient conditions:

Temperature

-30 to +55 / -22 to 131 °F

(Temperature depending on sensor)

-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 ₂ S LC, SO ₂ | CO LC, O ₂ , H ₂ S 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 ₂ S 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 |
| cCSA _{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 ₂ S LC, CO LC, SO ₂ | XXS EC Sensors: O ₂ , H ₂ S LC, CO LC, SO ₂ | XXS EC Sensors: O ₃ , Cl ₂ , CO ₂ , HCN, PH ₃ , NH ₃ , COCl ₂ , NO, NO ₂ LC, OV, OV-A | XXS EC Sensors: CO LC/O ₂ , H ₂ S LC/CO LC, CO H ₂ -CP |
| 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-50669-2017



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 response 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 ₂ O 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

Calibration accessories

Car charging connection cable 12V/24V

Communication accessories:

Dräger CC-Vision Basic, free of charge in the internet www.draeger.com, Calibration adapter.

D-2195-2011



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

3.9 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 2800 and Dräger 2500/5000/5600 (PAM) and Dräger X-am 3500/8000 (CSE/LEAK).

DRÄGER X-AM 8000 - THE ALLROUNDER



Dräger X-am 2800

D-34-12-2022



The X-am 2800 multi-gas detector measures up to four gases and is equipped with a particularly shock-resistant CatEx sensor. With the Dräger Gas Detection Connect software, it offers live data transmission and powerful fleet management. Designed for personal monitoring, the X-am 2800 offers the highest level of safety at a low cost of ownership. Small and lightweight: The X-am 2800 is comfortable to wear and easy to use even with gloves thanks to its large buttons. The display clearly shows important information such as gas readings, alarms, and time. The green D-light indicates that the unit is ready for use. All this and the language-free icon-based user interface make the use and familiarization pleasantly simple. An advantage is that existing accessories from the X-am 125 series can still be used for the unit.

OTHER BENEFITS

Robust thanks to water and dust protection according to IP 68

Important information such as gas readings, alarms, and time shown on the display

Catalytic bead sensor for measuring combustible gases and vapors: particularly robust and insensitive to shocks (drop test > 2 m) and sensor poisons

Powerful device management via smart software solution: Gas Detection Connect

Live data transmission via Bluetooth to a smartphone and from there to Dräger Gas Detection Connect

Sustainable: Long service life thanks to durable DrägerSensors, easily replaceable power supply, all components can be exchanged as spare parts and existing accessories can be reused



Personal Monitoring



Confined space entry*



Leak detection*



Live data transmission

* Please contact Dräger for availability of the Dräger X-am Pump for the X-am 2800.

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

| | |
|-------------------------------|--|
| Personal monitoring: | Approval for the use in Ex-Zone 0, protection class IP 68 Reusable accessories of the Dräger X-am 125 family |
| Confined space entry: | High flexibility with the help of the external pump* (with up to 45 m long hose), use of different probe types |
| Leak detection: | Fast response time of the catalytic bead sensors and the XXS sensors |
| Data management in the cloud: | Transmission of the gathered data directly and conveniently via Bluetooth to a smartphone and from there to the cloud software Dräger Gas Detection Connect. |

A Bluetooth® module in the X-am 2800 enables a connection to a smartphone using the Dräger Gas Detection Connect App and from there directly to the Gas Detection Connect cloud backend. Via the web application, the position and movement of persons can be viewed independent of time and location - based on GPS data of the smartphones used. Live data from Dräger devices with Bluetooth®, such as measured values and the device status, can also be checked via the web application. If an alarm occurs, information is provided immediately.

Both live events and past events that were transmitted via the smartphone app or the Dräger X-dock stations to the cloud backend and documented, can be viewed and exported at any time. All event and device data can be narrowed down using filters and search functions and thus made available for an Excel export.

Thanks to a well-thought-out role and rights management, the system can be easily adapted to the respective needs.

You decide whether your users can see the people on the map or not, whether they can see plain text names or just an ID, and whether they can access the X-dock station. Specified rights allow to create own roles and assign users individually.

TECHNICAL SPECIFICATIONS

| | |
|------------------------------------|---|
| Dimensions (W x H x D) (mm) | approx. 48 x 130 x 44 mm |
| Weight (g) | typical 220 to 250 g, depending on sensor selection |
| Ambient conditions: | |
| Temperature (°C) | -20 to +50 °C / -4 to +122 °F (measurement function and storage) -40 °C to +50 °C / -40 to +122 °F (use in potentially explosive areas) |
| Pressure (mbar) | 700 to 1,300 hPa (measurement function) 800 bis 1,100 hPa (use in potentially explosive areas) |
| Humidity (% RH) | 10 to 95 % 5 to 95 % RH, intermittent |
| Ingress protection | IP 68 |
| Display | High resolution matrix display |
| Alarms: | |
| Visual | 180° 3 LED "red" (gas alarms), 3 LED "yellow" (instrument alarms) |
| Acoustic (dB) | Multi-tone typical 90 dB (A) at a distance of 30 cm |
| Vibration | Yes |
| Power supply | rechargeable NiMH battery pack |
| Bluetooth® | Bluetooth 5.0, range approx. 95 m (line of sight) (Deactivated for some countries but can be retrofitted. Contact Dräger Service) |
| Operating time (h) | typical 12 h1) (Bluetooth active) typical 100 h* (w/o Ex sensor) |
| Charging time (h) | < 4 hours |
| Data logger | Use of an optimized data compression method with high accuracy and large storage capacity. (Typical data compression >90% compared to traditional data logger concept with adjustable interval) |
| Pump mode | Maximum hose length 45 m (Please contact Dräger for availability of this feature) |

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

FEATURES

| | |
|-------------------------------------|---|
| Possible sensor selection | Flexible 1 – 4 sensors (configurator version), One catalytic sensor and 3 XXS EC sensors |
| XXS EC sensors | O ₂ , O ₂ PR, CO LC, H ₂ S LC, NO ₂ and SO ₂ (incl. KX filter) |
| Catalytic sensors | |
| CatEx SR | 0 – 100 % LEL Special calibration for organic vapors and other gases possible |
| Approvals | |
| ATEX | I M1 Ex da ia I Ma II 1G Ex da ia IIC T4 Ga (applicable in Ex zone 0) |
| IECEX | Ex da ia I Ma Ex da ia IIC T4 Ga (applicable in Ex zone 0) |
| Measurement Performance Certificate | Please contact Dräger for availability |
| cCSAus (USA and Canada) | Please contact Dräger for availability |
| CE mark | ATEX (Directive 2014/34/EU) Electromagnetic compatibility (Directive 2014/30/EU) RoHS (Directive 2011/65/EU) |
| EAC Ex approval | Please contact Dräger for availability |

ACCESSORIES

| | |
|---------------------------|--|
| Charging accessories | Charging module Car charging connection cable 12V/24V / 230V |
| Calibration accessories | Dräger Bump Test Station Dräger X-dock Module Nonane tester (for function tests) |
| Communication accessories | Dräger CC-Vision Basic, free of charge on www.draeger.com/software USB Dira Dongle Cloud software Dräger Gas Detection Connect |
| Pump accessories | Dräger X-am Pump (please contact Dräger for availability) Hoses of various lengths Probes of various types |



BTS

Dräger Bump Test Station



D-47836-2012

Dräger X-dock



D-11864-2016

Dräger X-am Pump



ST-15024-2008

Nonane tester



D-0942-2020

Probe GP 600



D-1560-2021

Charging adapter



ST-14356-2008

Charging module

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 proven instrument generation of Dräger's gas detection technology. Its practical design, cell-phone size, low weight, and the long-life of the sensors make this family the perfect companion for personal monitoring. Combined with an optional external pump and hose or probe, they are perfect for confined space entry measurements. The Dräger X-zone 5500 extends the application of these instruments to innovative area monitoring instruments with various application possibilities (does not apply to X-am 2500).

OTHER BENEFITS

Robust: water and dust protection compliant with IP 67

Reliable gas inlets from both sides

Precise, vapor-sensitive Ex monitoring

Ideal solution for functional testing and calibration

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



ST-7317-2005

Personal monitoring



D-18765-2016

Confined space entry



D-18076-2016

Leak detection



D-27769-2009

Area Monitoring

ESPECIALLY SUITED FOR THE FOLLOWING APPLICATIONS

| | |
|-----------------------------|--|
| Personal monitoring | Durable, IP 67 |
| Confined space entry | High level of flexibility using external pump (with 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 connected to 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

| | Dräger X-am 2500 | Dräger X-am 5000 | Dräger X-am 5600 |
|-------------------------------------|---|--|---|
| Compatible sensors | 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 ₂ S, SO ₂ and NO ₂ | Amine, O ₂ , O ₂ PR, O ₂ 100, CO, CO LC, COCL ₂ , CO HC, H ₂ S, H ₂ S LC, H ₂ S 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 ₂ S/CO, CO H ₂ (compensated), H ₂ , H ₂ HC, Odorant, O ₃ , O ₂ /CO-LC, H ₂ S-LC/CO-LC, O ₂ /H ₂ S LC | Amine, O ₂ , O ₂ PR, O ₂ 100, CO, CO LC, COCL ₂ , CO HC, H ₂ S, H ₂ S LC, H ₂ S 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 ₂ S/CO, CO H ₂ (compensated), H ₂ , H ₂ HC, Odorant, O ₃ , O ₂ /CO-LC, H ₂ S-LC/CO-LC, O ₂ /H ₂ S 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.-% CH ₄ | 0–100% LEL 0–100 Vol.-% CH ₄ | |
| Infrared sensors | | | |
| IR Ex | | | 0–100% LEL 0–100 Vol.-% CH ₄ / C ₄ H ₁₀ /C ₂ H ₄ /LPG |
| IR CO ₂ | | | 0–5 Vol.-% CO ₂ |
| IR CO ₂ /Ex | | | 0–100% LEL 0–100 Vol.-% CH ₄ / C ₄ H ₁₀ /C ₂ H 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 ₂ S according to EN 45544/Methane to Nonane according to EN 60079 and EN 50271 | for O ₂ according to EN 50104/CO and H ₂ S according to EN 45544/Methane to Nonane according to EN 60079 and EN 50271 | for O ₂ according to EN 50104/CO and H ₂ S 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 to requirement „Title 30 Code of Federal Regulations, Part 22 for use in gassy underground mines“ | according to 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 da I X/ 1 Ex da ia IIC T4/T3 X | PO Ex ia I X / 0 Ex ia IIC T3 X oder PB Ex da I X/ 1 Ex da ia IIC T4/T3 X | PO Ex ia IX / 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 5500/5800

(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

Dräger X-Zone 5500/5800

D-234612-2009



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 frequency: 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



D-275892-2009



D-275801-2009

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 fence line. 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 fence line, 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-triggering 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) 915 MHz (USA, Canada, India, Australia), 922 MHz (Japan), 433 MHz (Russia, Malaysia) |
| 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, flexilibe power supply; External 100 - 240V charger (worldwide) or inductive wireless charging internal pump / hose length: max 45 m |
| Pump mode | |
| 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 length



D-29634-2009

Inductive charger
 Allowing easy charging



D-77506-2013

Set pump cover



D-14280-2017_1000

Cover plate
 With diffusion adapter



D-98766-2013

Set holder
 Dräger X-am 5100



D-21295-2011

Calibration and communication accessory
 USB DIRA with USB cable



D-27768-2009

Alarm damper
 For use within bump tests



D-77506-2013

Base for measurement of light gases



D-21276-2020

Power Supply Ex

Dräger X-am 7000

Sale discontinued

ST-7054-2005



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

OTHER BENEFITS

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



Area monitoring

ST-7058-2005



Confined space entry

ST-2770-2003



Leak detection

ST-6109-2004

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 meet 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 × 5.6 × 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-5651-2005

Dräger E-Cal



ST-499C-2005

Pump adapter



ST-499F-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

Optional Bluetooth® module for X-am 8000 to connect to the GDC App for Android and iOS



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 SPECIFICATIONS

| | |
|-------------------------------------|---|
| 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 800 to 1,100 hPa (use in potentially explosive areas) |
| 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 [®] (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 |

[®] 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 ₂ S LC, NO ₂ , SO ₂ | Amine, O ₂ , O ₂ PR, O ₂ 100, CO LC, CO HC, COCl ₂ , H ₂ S LC, H ₂ S 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 ₂ S/CO, CO H ₂ -CP (H ₂ compensated), H ₂ , H ₂ HC, Odorant, O ₂ /CO-LC, H ₂ S-LC/CO-LC, O ₂ /H ₂ S 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 ₂ H ₆ , C ₂ H ₄ , C ₂ H ₂ , C ₃ H ₈ , C ₃ H ₆ , C ₄ H 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 ₄ H ₁₀ / C ₂ H 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 ₄ H ₁₀ / C ₂ H ₄ /LPG 0 – 5 Vol.-% CO ₂ |
| IR Ex/CO ₂ HC | not possible | 0 – 100 % LEL 0 – 100 Vol.-% CH ₄ /C ₄ H ₁₀ / C ₂ H 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 ₂ S accord. EN 45544/Methane to Nonane* accord. EN 60079-29-1 and EN 50271:2010 | for O ₂ accord. EN 50104/ for CO and H ₂ S accord. EN 45544/Methane to Nonane* 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 |

* Nonane-suitable pump adapter required.

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 and nonane-specific 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



D-2117-2022

Nonane-specific pump adapter



D-2116-2022

Calibration adapter

3.10 Multi-gas Scanner



D-21-2020

The Dräger X-pid 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.



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 in a few seconds.

The »Analysis« measurement mode is comparable to gas chromatography laboratory analyses. For carcinogenic vapors such as benzene, compliance with the time-weighted average in the range from a few ppb to ppm is prescribed. The Dräger X-pid 9500 is optimized for measurements in this concentration range and can measure benzene from 50 ppb.

Dräger X-pid 9500

D-1202-2021



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

D-4439-2019

D-47-2020

ESPECIALLY 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 |

SOFTWARE CONNECTION

The GasVision 7 software is a Windows-based software which allows a professionally visualization and evaluation of Dräger X-pid's data logger. It is also possible to create an Excel-based export for further processing.

The Dräger CSE Connect software solution digitizes the exchange of information in the clearance measurement process. The data transfer between the smartphone app and the web application takes place via a cloud connection. The Dräger X-pid 9500 communicates directly with the app. This helps you to manage your measurement tasks safely and cost-effectively.

TECHNICAL DATA (refer exclusively to the Dräger X-pid® 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 9500 |
| PID | 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) |
| ATEX | II 1G Ex ia IIC T4 Ga (Sensoreinheit) II 2G Ex ib IIC T4 Gb (Bedieneinheit) Zone 0 (Sensoreinheit) Zone 1 (Bedieneinheit) |
| IECEX | Ex ia IIC T4 Ga (Sensoreinheit) Ex ib IIC T4 Gb (Bedieneinheit) |

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® 9500 bump test adapter
Test gas benzene or isobutylene-toluene

Hoses and probes

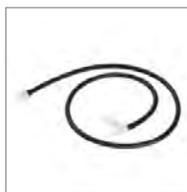
Float probe
Tygon hose with PTFE
Telescopic probe ES 150

D-13119-2018



Case with inlay for X-pid

D-2767-2018



Hose with bump test adapter

D-14331-2017



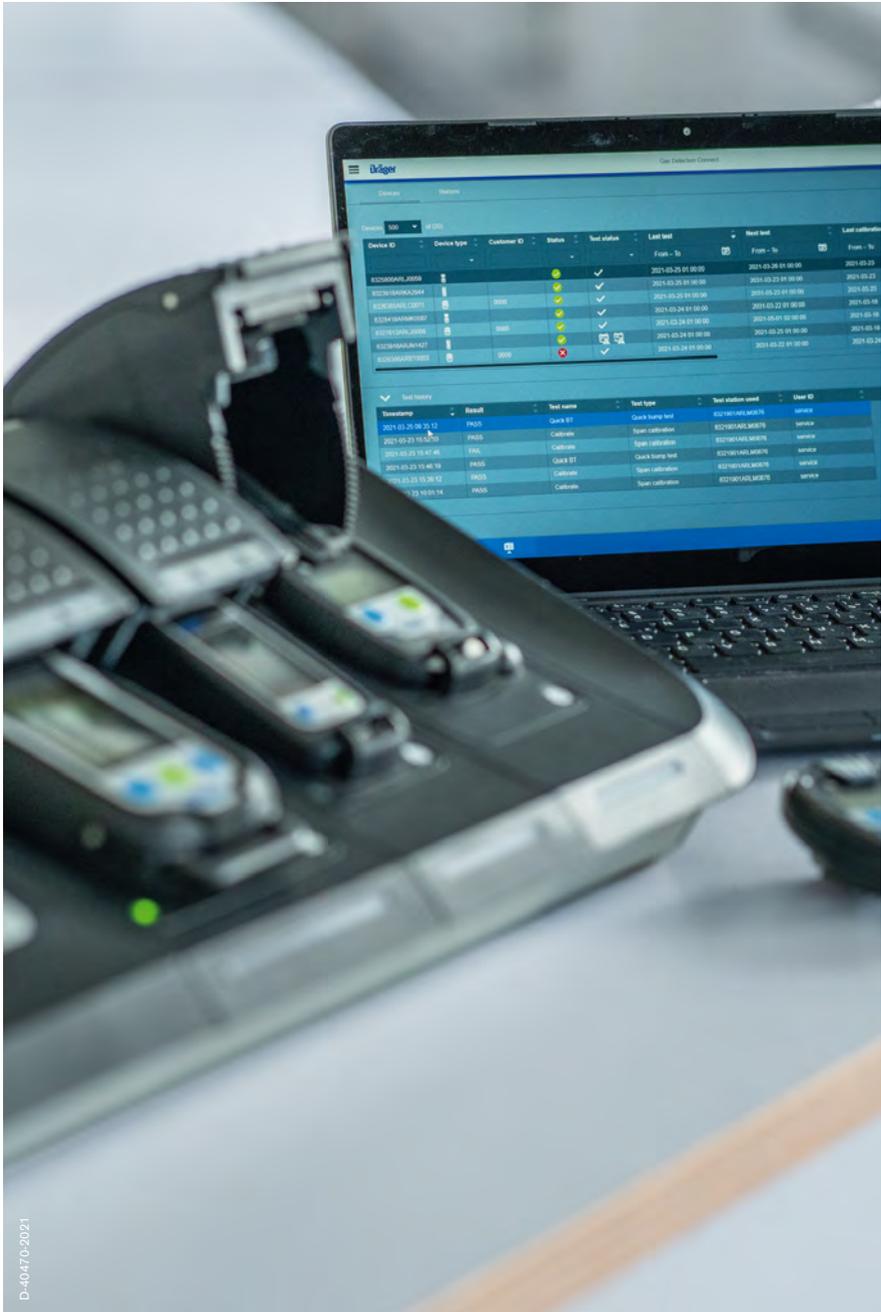
Float probe

D-0494-2018



Test gases

4 Software solutions



D-40470-2021

4.1 Dräger Gas Detection Connect



Gas Detection Connect - Live Monitoring

Gas Detection Connect (GDC for short) is an innovative cloud-based software solution that networks individual gas detection devices. As the future system of gas measurement technology, GDC aims to make the industrial world safer and more efficient.

In addition to live information about alarms directly from the field, certificates and status information from our X-dock test station as well as those of the gas detection devices can be viewed at any time. GDC consists of a cloud backend based on Microsoft Azure and is hosted in the EU. This cloud backend allows to centrally collect, store, and provide data from different locations. The data is then made available to the customer via the web application.

This means no installation and maintenance of the software at the customer's site - access is via a secure log-in to the GDC website in a browser. With a firmware update and in a few steps, the X-dock can be connected directly to GDC's cloud backend, thus automating the sending of all test data and information to the software solution. The path from GDC to the station and into the inserted devices was also realized with the first devices. This makes device management (asset management), such as tracking the test status or firmware updates, significantly easier and more efficient.

Sending live data such as alarms and displaying them on a map with location is also part of GDC (Live Monitoring). The Bluetooth-enabled Pac 6500, 8000 and 8500, as well as the X-am 2800 can connect to the GDC app via Bluetooth to send data to the cloud backend. Alarms are directly displayed, forwarded, and documented for future purposes such as analyzes or safety concepts. GDC's user-friendly interface allows a quick overview and easy compilation of reports, which can also be sent automatically.

GDC is a software solution that is continuously being developed step by step. Further devices of the mobile as well as stationary gas measurement technology will be integrated into GDC in the future.

4.2 Dräger CSE Connect



CSE Connect and X-am 8000

The Dräger CSE Connect software solution digitizes the exchange of information in the clearance measurement process (confined space entry). The data transfer between the smartphone app and the web application takes place via a cloud connection based on Microsoft Azure. The Dräger X-am® 8000 and the control unit of the Dräger X-pid communicate directly with the smartphone app. This helps our customers to plan, perform and document the measurement tasks more efficiently.

The cloud backend makes it possible to centrally collect the relevant data for the clearance measurement process from a wide variety of locations. These are then made available for evaluation directly in the web application by simply logging into the secure CSE Connect website. Thus, the data is not only made available faster in the clearance measurement process, but also more data is documented than in the paper-based process. In addition to the digital data from the X-am 8000 and X-pid such as measured values, measurement duration and device data, measured values can also be entered manually and QR codes can be scanned to clearly identify the measurement location.

4.3 Dräger X-dock Manager



X-am 2800 with X-dock Manager

The X-dock Manager is a PC-based (on-premises) fleet management software for the Dräger X-dock system. It provides information on the operational readiness of existing portable Dräger gas detectors, announces service intervals and documents the performance of the tests including test and calibration results.

By networking individual X-dock stations and centrally storing your data in the database provided by the X-dock Manager, all data is always available. In addition, the X-dock Manager provides supporting functions in device assignment and user management, as well as detailed reports on alarms and events that occurred during operation.

4.4 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 alarm thresholds, switch-off behaviour, or measuring and calibration gas, CC-Vision Basic helps you configure your gas detectors, even if you want to duplicate configurations and transfer them 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. CC-Vision Basic does not contradict this. 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



4.5 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.

4.6 New Datalogger concept (from 2021)

With the introduction of the “Dräger Gas Detection Connect” (GDC) a new data storage concept will also be introduced.

Dräger Gas Detection Connect is a Software as a Service (SaaS) solution for the digitalization and networking Dräger gas detection technology with a focus on fleet administration / fleet management and data transmission (“live monitoring” / visualization). Thanks to the cloud capability of the SaaS product, the customer's gas detection devices fleet can be managed independently of time and location. Measurement results and alarms can be displayed on a map via telemetry with the location of the gas detection devices, which allow direct networking, and provide current measurement values and alarms.

Why is there a new data storage concept?

There are several reasons why the new concept was developed. The main reasons are shown below:

| Option | Datalogger 2.0 „ALC“ / NEW | Datalogger 1.0 / Legacy |
|------------------------------------|---|---|
| Sampling interval | Dynamic For concentration changes of a certain size and max. every 10 seconds | Fixed Must be configured (e.g.: 1 s, 30 s, 1 min...) |
| Readout in X-dock | always (in GDC mode) | Only if option is active |
| Readout amount | X-dock: only new data Dräger CC-Vision/GasVision: entire logger | Always entire logger, therefore deletion necessary |
| Recording duration | Optimized for long recording time, but not calculable as it depends on the ambient conditions. Very long recording times, especially with low dynamics. | Depends on interval and number of channels and device type: Complicated to calculate |
| Smart events | Yes, e.g. peak information at „Alarm_off“ or additional information at bump test | No |
| Rolling | Yes, always | Configurable |
| Peak/average storage | Always peak value | Configurable, depends on device |
| Datalogger active/ inactive | Always active | ON/OFF configurable |
| Readability optimized for | Machine evaluation. GasVision, Excel export possible for human readability. | Human readability (text file). Not reliably evaluable by machine analysis. |
| Platform/Standard | Yes. Same event description across all devices. | No. Each device has its own specific memory implementation peculiarities. |

Previous method with intervals:

The previous method was developed with the focus on “readability” for the Dräger Pac and X-am 125 device series. The result is a text file that is readable even without the Dräger Gas-Vision PC software and thus enables a quick check by “humans” but is in no way optimized for machine analysis.

The data memory according to the old method must be set (configured) accordingly. Since different settings are possible, this also means: The user must know what he can set and what this means. For example, what was the difference between “Peak” (mean value) and “Average”?

Furthermore, he must also decide between

- short interval, i.e. a short storage period with high accuracy/resolution or
- long interval, i.e. long storage period with low accuracy/resolution

and must know what effect this will have. Is one minute enough? And what happens if an alarm occurs between intervals? For the user, configuring the logger means complexity. With this method, there is no possibility of achieving a high level of accuracy over a longer period by “smartly” backing up only relevant data. At a resolution of one second, for example, a measured value would currently be stored for each second even if it were continuously at zero. The result is large files that can only be read out very slowly via infrared.

A new concept was already introduced in the Dräger X-am 8000/3500: Data is recorded every second, but only if there have been value changes.

The new method

The new datalogger method is optimized for Dräger Gas Detection Connect and is used by this product. It represents a very good compromise between high data quality/resolution and low memory capacity requirements. In particular, the low memory requirement is an important prerequisite for “Dräger Gas Detection Connect”. The datalogger cannot be switched off and basically rolls. There is no “stop”.

The new method is (also) called “ALC”: Advanced Logging Compression (improved/intelligent compression of the datalogger).

The new ALC method is thus designed to record and store relevant changes and to filter “background noise”, it is therefore “smart”: It does not blindly store everything, but rather selectively stores what is also of interest. For the customer, this also means: No more options that he may hardly understand and whose impact he cannot estimate.

The data is no longer stored as a human-readable text file, but as a JSON file. This is a format

optimized for reading by machines/computers and is more difficult to understand by humans. A JSON file is optimized to be analyzed. With the Dräger CC-Vision, the datalogger can only be read out in the machine-optimized JSON format already mentioned.

With the PC software Dräger GasVision version > 7.3.9 the datalogger can be read out and the content can be displayed in the familiar graphical depiction. The depiction can also be exported as an Excel file via an export function. The Excel exports generates data that does not exist in the JSON format. This means that the compression is dissolved, and the structure is again purely chronological, so that this data becomes comprehensive. In Dräger Gas Detection Connect, a human-readable representation is of course also realized.

Possible uses:

1. Dräger X-dock networked with Dräger GDC:
the datalogger contents of the devices are downloaded from the device upon contact with the networked X-dock and transferred to the backend (cloud), for example during a bump test or an adjustment. Via the Dräger GDC frontend (browser) the data can then be viewed in the backend (cloud) and also analyzed and further processed as part of later planned functions. The new memory is thus read out in connection with Dräger GDC during every X-dock test. Only "new data" is read out, i.e. only what has been added since the last readout.
2. Dräger X-dock not networked with Dräger GDC:
The datalogger contents are downloaded from the device and stored - as usual - on the station or in the connected X-dock Manager.
3. Device connected to the Dräger Gas Detection Connect App via Bluetooth (Dräger Pac/X-am):
The App is also "online". The data is automatically transferred to the backend (cloud) directly during acquisition. The datalogger runs in parallel but marks the area that was transferred online.
4. „Live Monitoring“
If the live data transmission function of Dräger Gas Detection Connect (coupling with smartphone) is used, the data is transmitted to the backend when changes occur or at an interval (5 seconds). There is less "compression". However, the logger still stores the data, marked by the information that the device was operated online.

5. Datalogger readout via Dräger CC-Vision/Dräger GasVision:

The datalogger can always be read out via Dräger CC-Vision and Dräger GasVision, but only in the new format. Since the datalogger is rolling, a complete memory is always read out and readout takes longer. In the future, a human-readable export will only be possible with the Excel export in Dräger GasVision and of course in Dräger Gas Detection Connect.

Conclusion: The advantages of the new method ("ALC") for the customer are

- a more effective use of storage space despite larger data
- faster transfer of data, which also means faster access
- easier handling since options are no longer selectable.

5 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.



5.1 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 exposure 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

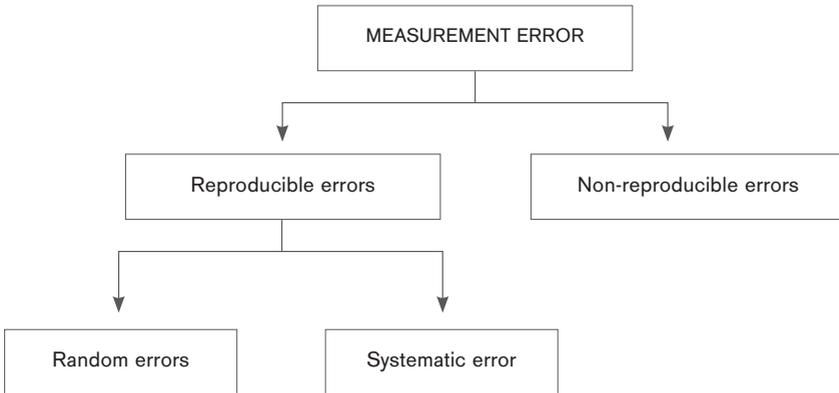
- Poisonous substances can occur anywhere – in industrial production and processing, in transport (rail, road, ship), in the case of incomplete combustion (CO), and also as a result of completely natural processes such as rotting and decomposition of biomass. Electrochemical and PID sensors are used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

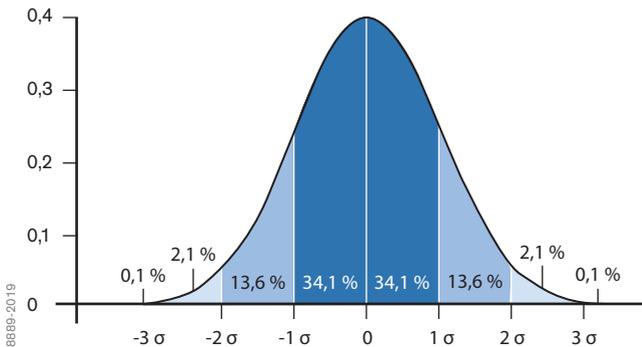
- What other hazardous material are present (cross-sensitivity)?
- Is it necessary to measure hazardous material selectively, or is it more sensible to measure a complete parameter?

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.



D-8889-2019

Standard deviation

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

Random Errors/Precision

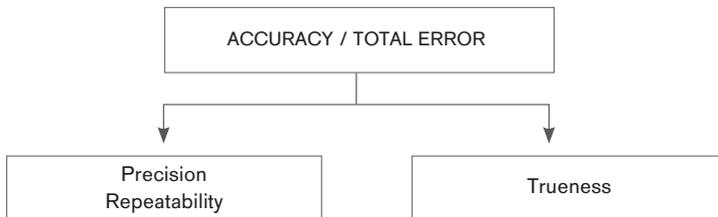
The precision or random errors of measuring instruments are determined by the fluctuation of the measured values around a mean value. This equation is also referred to as repeatability.

Systematic Errors/Trueness

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

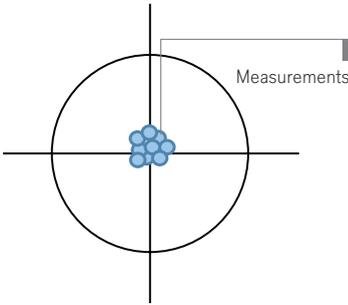
Accuracy/Total Error

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.



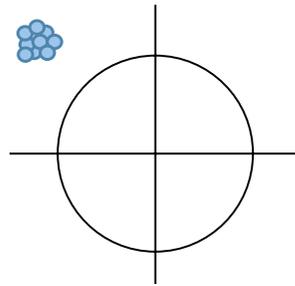
EN 60051 defines the accuracy of a measuring instrument as “the degree of compliance between a test result and the accepted reference value”. This means that the deviation between the displayed measured value and the true concentration is indicated.

D-8885-2019



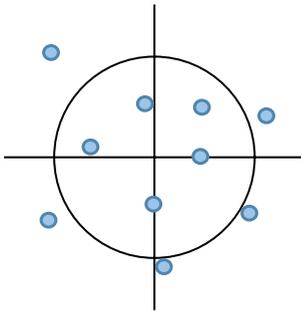
Precision good + trueness good → Accuracy good

D-8886-2019



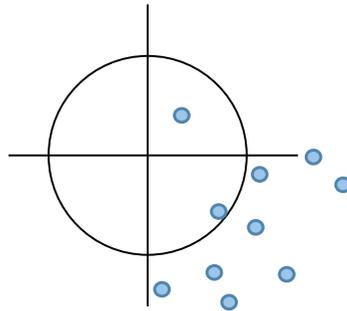
Precision good + trueness bad → Accuracy bad

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.

5.2 Overview of detectable vapors and gases

| CHEMICAL DESIGNATION | CAS-NO. | CAT EX | | | | | | | | | | | | IR | | | | PID | | | | EC | ORDER NO. | | | | |
|-------------------------------|-----------|---------------------|------------------|---------------------|---------------|------------------|----------|-------------|-------|-----------------------------|--------------------------|--------------------|-------------------------------|-------------------------------|-----------|--------|------------|---------------|--|--|--|----|-----------|--|----------|----------------------|-----------|
| | | SMART CATEX (HC PR) | SMART CATEX (PR) | SMART CATEX (FR PR) | CAT EX 125 PR | CATEX 125 PR GAS | CATEX SR | SMART IR-EX | IR-EX | SMART IR-CO ₂ HC | SMART IR-CO ₂ | IR-CO ₂ | DUAL IR-EX/CO ₂ ES | DUAL IR-EX/CO ₂ HC | SMART PID | PID HC | PID LC PPB | X-PID SENSORS | | | | | | | | | |
| Acetaldehyde | 75-07-0 | ■ | | | | | | | | | | | | | | | | ■ | | | | | | | XXS OV-A | 68 11 535 | |
| Acetic acid | 64-19-7 | ■ | ■ | * | ■ | | | | | | | | | | | | | | | | | | | | | XS EC Organic Vapors | 68 09 115 |
| Acetic anhydride | 108-24-7 | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Acetone | 67-64-1 | ■ | ■ | ■ | ■ | | | ■ | * | | | | | | | | | | | | | | | | ■ | | |
| Acetophenone | 98-86-2 | | | | | | | | | | | | | | | | | | | | | | | | ■ | | |
| Acetylene | 74-86-2 | ■ | ■ | * | ■ | | | | | | | | | | | | | | | | | | | | ■ | | |
| Acrolein | 107-02-8 | | | | | | | | | | | | | | | | | | | | | | | | ■ | | |
| Acrylonitrile | 107-13-1 | | | | | | | | | | | | | | | | | | | | | | | | ■ | | |
| Allyl alcohol (2-Propen-1-ol) | 107-18-6 | | | | | | | | | | | | | | | | | | | | | | | | ■ | | |
| Allyl chloride | 107-05-1 | | | | | | | | | | | | | | | | | | | | | | | | ■ | | |
| Ammonia | 7664-41-7 | ■ | ■ | * | ■ | | | | | | | | | | | | | | | | | | | | ■ | | |
| Aniline | 62-53-3 | | | | | | | | | | | | | | | | | | | | | | | | ■ | | |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

| CHEMICAL DESIGNATION | CAS-NO. | IR | | | | | | | | | | PID | | | EC | ORDER NO. | | | | | |
|--|------------|--------|----------------|------------------|---------------------|---------------|------------------|----------|-------------|-------|-----------------------------|--------------------------|--------------------|-------------------------------|----|-----------|-------------------------------|-----------|--------|------------------------|---------------|
| | | CAT EX | CAT EX (HC PR) | SMART CATEX (PR) | SMART CATEX (FR PR) | CAT EX 125 PR | CATEX 125 PR GAS | CATEX SR | SMART IR-EX | IR-EX | SMART IR-CO ₂ HC | SMART IR-CO ₂ | IR-CO ₂ | DUAL IR-EX/CO ₂ ES | | | DUAL IR-EX/CO ₂ HC | SMART PID | PID HC | PID LC PFB | X PID SENSORS |
| Chlorine dioxide | 10049-04-4 | | | | | | | | | | | | | | | * | | | | XXS EC Cl ₂ | 68 10 890 |
| Chloroacetone | 78-95-5 | | | | | | | | | | | | | | | * | | | | XS EC Cl ₂ | 68 09 165 |
| 4-Chloroaniline | 106-47-8 | | | | | | | | | | | | | | | * | | | | XS EC ClO ₂ | 68 11 360 |
| Chlorobenzene | 108-90-7 | | | | | | | | | | | | | | | ■ | ■ | ■ | * | | |
| 1-Chloro-2,3 epoxypropane (Epichlorohydrin) | 106-89-8 | | | | | | | | | | | | | | | * | | | | XXS OV | 68 11 530 |
| 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 | | | | | | | | | | | | | | | * | ■ | ■ | ■ | | |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

83 19 100
SMART PID
PID HC
PID LC PPB
X PID SENSORS
68 13 475
68 13 500

68 10 460
SMART IR-EX
IR-EX
SMART IR-CO₂ HC
68 10 599
SMART IR-CO₂
68 10 590
IR-CO₂
68 51 882
DUAL IR-EX/CO₂ ES
68 51 880
DUAL IR-EX/CO₂ HC
68 00 276

68 12 910
SMART CATEX (HC PR)
68 12 980
SMART CATEX (PR)
68 12 975
SMART CATEX (FR PR)
68 12 990
CAT EX 125 PR
68 13 980
CATEX 125 PR GAS
68 51 900
CATEX SR

CHEMICAL DESIGNATION **CAS-NO.** **CAT EX** **IR** **PID** **EC** **ORDER NO.**

| | | | | | | | |
|------------------------------|-----------------|-----|-----|---|---|--------------------------------------|------------------------|
| Cyclopentane | 287-92-3 | ■ * | ■ * | * | | | |
| n-Decane | 124-18-5 | | | * | | | |
| Diborane | 19287-45-7 | | | | | XXS PH ₃ XS EC Hydride | 68 10 886 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 XS EC Amine | 68 12 545 68 09 545 |
| N,N Diethylamine | 91-66-7 | | | | | | |
| Diethylcarbonat | 105-58-8 | | | | * | | |
| | | | | | | ■ | |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

| CHEMICAL DESIGNATION | CAS-NO. | IR | | | | | | | | | | PID | | | | EC | ORDER NO. | | | |
|-----------------------------|----------|---------------------|------------------|---------------------|---------------|------------------|----------|-------------|-------|-----------------------------|--------------------------|--------------------|-------------------------------|-------------------------------|-----------|----|-----------|--------|----------------------|---------------|
| | | SMART CATEX (HC PR) | SMART CATEX (PR) | SMART CATEX (FR PR) | CAT EX 125 PR | CATEX 125 PR GAS | CATEX SR | SMART IR-EX | IR-EX | SMART IR-CO ₂ HC | SMART IR-CO ₂ | IR-CO ₂ | DUAL IR-EX/CO ₂ ES | DUAL IR-EX/CO ₂ HC | SMART PID | | | PID HC | PID LC PPB | X PID SENSORS |
| Diethylether | 60-29-7 | ■ | ■ | * | ■ | | | * | | * | | * | | | * | ■ | | | XXS OV-A | 68 11 535 |
| 1,1-Difluorethylene | 75-38-7 | | | | | | | | | | | | | | * | | | | XS EC Organic Vapors | 68 09 115 |
| N,N-Dimethylacetamide | 127-19-5 | | | | | | | | | | | | | | * | | | | | |
| Dimethylamine | 124-40-3 | * | * | * | * | | | * | | | | | | | * | | | | XXS Amine | 68 12 545 |
| | | | | | | | | | | | | | | | | | | | XS EC Amine | 68 09 545 |
| Dimethyl carbonate | 616-38-6 | | | | | | | | | | | | | | | | | ■ | | |
| 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 | ■ | ■ | * | ■ | | | * | | | | | | | * | ■ | | | | |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

| CHEMICAL DESIGNATION | CAS-NO. | CAT EX | IR | IR-CO ₂ | IR-CO ₂ HC | SMART IR-EX | SMART IR-EX HC | SMART IR-CO ₂ | IR-CO ₂ | DUAL IR-EX/CO ₂ ES | DUAL IR-EX/CO ₂ HC | SMART PID | PID HC | PID LC PPB | X PID SENSORS | EC | ORDER NO. |
|----------------------|-----------|---|---|--------------------|-----------------------|-------------|----------------|--------------------------|--------------------|-------------------------------|-------------------------------|---------------------|--------|------------|---------------|----|--|
| Hydrogen cyanide | 74-90-8 | 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 12 990 CATEX 125 PR GAS 68 13 090 CATEX SR 68 51 900 | 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 68 19 100 | | | | | XXS HCN 68 10 887 XXS HCN PC 68 13 165 XS EC HCN 68 09 150 |
| Hydrogen fluoride | 7664-39-3 | | | | | | | | | | | | | | | | XS EC HF/HCl 68 09 140 |
| Hydrogen peroxide | 7722-84-1 | | | | | | | | | | | | | | | | XS EC H ₂ O ₂ 68 09 170 |
| Hydrogen selenide | 7783-07-5 | | | | | | | | | | | * | | | | | |
| Hydrogen sulfide | 7783-06-4 | | | | | | | | | | | * | | | | | XXS H ₂ S 68 10 883 XXS H ₂ S/CO 68 11 410 XXS H ₂ S LC 68 11 525 XXS H ₂ S LC/CO LC 68 13 280 XXS H ₂ S LC/O ₂ 68 14 137 XXS H ₂ S HC 68 12 015 XXS E H ₂ S 68 12 213 |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

SMART CATEX (HC PR) 68 12 910
 SMART CATEX (PR) 68 12 980
 SMART CATEX (FR PR) 68 12 975
 CAT EX 125 PR 68 12 990
 CATEX 125 PR GAS 68 13 090
 CATEX SR 68 51 900
 SMART IR-EX 68 10 460
 IR-EX 68 51 861
 SMART IR-CO₂ HC 68 10 599
 SMART IR-CO₂ 68 10 590
 IR-CO₂ 68 51 892
 DUAL IR-EX/CO₂ ES 68 51 890
 DUAL IR-EX/CO₂ HC 68 00 276
 SMART PID 68 19 100
 PID HC 68 13 475
 PID LC PPB 68 13 500
 X PID SENSORS 68 13 500

| CHEMICAL DESIGNATION | CAS-NO. | CAT EX | IR | SMART IR-EX | IR-EX | SMART IR-CO ₂ HC | SMART IR-CO ₂ | IR-CO ₂ | DUAL IR-EX/CO ₂ ES | DUAL IR-EX/CO ₂ HC | PID | EC | ORDER NO. |
|--|------------|--------|----|-------------|-------|-----------------------------|--------------------------|--------------------|-------------------------------|-------------------------------|-----|----------------------------|-----------|
| 4-Hydroxy-4-methyl-2-pentanone (acetone alcohol) | 123-42-2 | | | | | | | | | | | XS EC H ₂ S 100 | 68 09 110 |
| Iodomethane | 74-88-4 | | | | | | | | | | * | XS EC H ₂ S HC | 68 09 180 |
| Iron pentacarbonyl | 13463-40-6 | | | | | | | | | | * | XS 2 H ₂ S | 68 10 370 |
| Isoamyl acetate | 123-92-2 | | | | | | | | | | * | XS R H ₂ S 100 | 68 10 260 |
| Isobutanol | 78-83-1 | | | | | | | | | | | | |
| Isobutene | 115-11-7 | | | | | | | | | | | XXS OV-A | 68 11 535 |
| Isobutyle acetate | 110-19-0 | | | | | | | | | | | XS EC Organic Vapors | 68 09 522 |
| Isobutyraldehyde | 78-84-2 | | | | | | | | | | | | |
| Isopentane (2-Methylbutane) | 78-78-4 | | | | | | | | | | | | |
| Isoprene (2-Methyl-1,3-Butadiene) | 78-79-5 | | | | | | | | | | | | |
| Isopropyl acetate | 108-21-4 | | | | | | | | | | | | |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

SMART CATEX (HC PR) 68 12 910
 SMART CATEX (PR) 68 12 980
 SMART CATEX (FR PR) 68 12 975
 CAT EX 125 PR 68 12 990
 CATEX 125 PR GAS 68 13 080
 CATEX SR 68 51 900
 SMART IR-EX 68 10 460
 IR-EX 68 51 861
 SMART IR-CO₂ HC 68 10 599
 SMART IR-CO₂ 68 10 590
 IR-CO₂ 68 51 882
 DUAL IR-EX/CO₂ ES 68 51 880
 DUAL IR-EX/CO₂ HC 68 00 276
 SMART PID 68 19 100
 PID HC 68 13 475
 PID LC PFB 68 13 500
 X PID SENSORS 68 13 500

| CHEMICAL DESIGNATION | CAS-NO. | CAT EX | IR | PID | EC | ORDER NO. |
|-----------------------------------|-----------|--------|----|-----|----|---|
| 2-Methylbutyraldehyde | 96-17-3 | | | | | |
| 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 |
| Methylmethacrylate | 80-62-6 | | | | | XXS OV 68 11 530 XS EC Organic Vapors A68 09 522 |
| Methyl n-amy 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 |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

SMART CATEX (HC PR) 68 12 910
 SMART CATEX (PR) 68 12 980
 SMART CATEX (FR PR) 68 12 975
 CAT EX 125 PR 68 12 990
 CATEX 125 PR GAS 68 13 080
 CATEX SR 68 51 900
 SMART IR-EX 68 10 460
 IR-EX 68 51 861
 SMART IR-CO₂ HC 68 10 599
 SMART IR-CO₂ 68 10 590
 IR-CO₂ 68 51 882
 DUAL IR-EX/CO₂ ES 68 51 880
 DUAL IR-EX/CO₂ HC 68 00 276
 SMART PID 68 19 100
 PID HC 68 13 475
 PID LC PPB 68 13 500
 X PID SENSORS 68 13 500

| CHEMICAL DESIGNATION | CAS-NO. | CAT EX | IR | PID | EC | ORDER NO. |
|---------------------------|-----------|--------|----|-----|-----------------------|------------|
| 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 | A68 09 522 |
| Sulphur dioxide | 7446-09-5 | | | | XXS SO ₂ | 68 10 885 |
| | | | | | XS EC SO ₂ | 68 09 160 |
| Tetrachloroethylene (PCE) | 127-18-4 | | | | | |
| Tetraethyl lead | 78-00-2 | | | * | | |
| Tetrahydrofuran | 109-99-9 | | | * | XXS OV | 68 11 530 |
| 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 | | | * | | |

■ Sensitivity data known * Substance theoretically measurable, sensitivity not yet determined

5.3 Dräger CatEx sensors

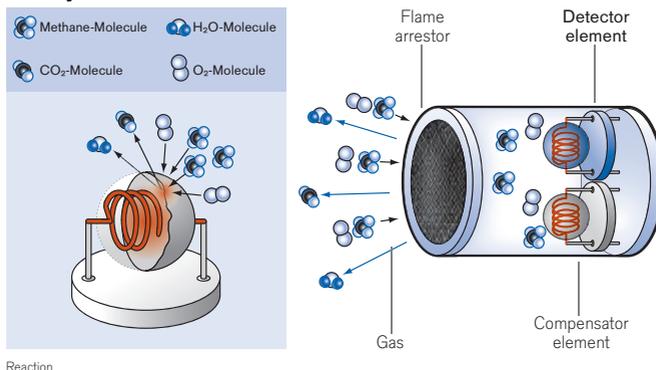


D-18520-2010

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



D-16400-2009

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 ₂ S 1000 ppmh ≤ ± 5 % of measured value Hexamethylidisiloxane HMDS 10 ppmh ≤ ± 5 % of measured value Hexamethylidisiloxane HMDS 30 ppmh ≤ ± 20 % of measured value After an exposure of 10 ppm HDMS for 5 hours, the sensitivity 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.-% CH₄:

| | |
|-------------------------------------|---|
| Response time: | ≤ 35 seconds at 0 to 5 Vol.-% (t_{90}) |
| Precision: | 1 Vol.-% CH ₄ |
| 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, siloxane 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 (CH₄) 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 ₃ COCH ₃ | 1.25 | 31 |
| Acetylene | C ₂ H ₂ | 1.15 | 34 |
| 1,3-butadiene | CH ₂ CHCHCH ₂ | 0.70 | 26 |
| Acetic acid | CH ₃ COOH | 3.00 | 23 |
| Ammonia | NH ₃ | 7.70 | 58 |
| Benzene | C ₆ H ₆ | 0.60 | 22 |
| Butane | C ₄ H ₁₀ | 0.70 | 27 |
| Butanone | CH ₃ COC ₂ H ₅ | 0.75 | 22 |
| Carbon monoxide | CO | 5.45 | 41 |
| Cyclohexane | C ₆ H ₁₂ | 0.50 | 21 |
| Cyclopentane | C ₅ H 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 | C_4H_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 | $C_6H_4(CH_3)_2$ | 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 ₂ S 1000 ppm ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 10 ppm ≤ ± 5 % of measured value Hexamethyldisiloxane HMDS 30 ppm ≤ ± 20 % of measured value After an exposure of 10 ppm HDMS for 5 hours, the sensitivity 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, siloxane 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 (CH₄) 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 ₃ COCH ₃ | 1.25 | 31 |
| Acetylene | C ₂ H ₂ | 1.15 | 34 |
| 1,3-butadiene | CH ₂ CHCHCH ₂ | 0.70 | 26 |
| Acetic acid | CH ₃ COOH | 3.00 | 23 |
| Ammonia | NH ₃ | 7.70 | 58 |
| Benzene | C ₆ H ₆ | 0.60 | 22 |
| Butane | C ₄ H ₁₀ | 0.70 | 27 |
| Butanone | CH ₃ COC ₂ H ₅ | 0.75 | 22 |
| Carbon monoxide | CO | 5.45 | 41 |
| Cyclohexane | C ₆ H ₁₂ | 0.50 | 21 |
| Cyclopentane | C ₅ H ₁₀ | 0.70 | 27 |
| Diethyl ether | (C ₂ H ₅) ₂ O | 0.85 | 24 |
| Diethylamine | (C ₂ H ₅) ₂ NH | 0.85 | 26 |
| Ethane | C ₂ H ₆ | 1.20 | 34 |
| Ethanol | C ₂ H ₅ OH | 1.55 | 31 |
| Ethene | C ₂ H ₄ | 1.20 | 36 |
| Ethyl acetate | CH ₃ COOC ₂ H ₅ | 1.00 | 24 |
| Heptane | C ₇ H ₁₆ | 0.40 | 18 |
| Hexane | C ₆ H ₁₄ | 0.50 | 21 |
| Hydrogen | H ₂ | 2.00 | 48 |
| 1-Methoxy-Propanol-2 | C ₄ H ₁₀ O ₂ | 0.90 | 22 |
| Methane | CH ₄ | 2.20 | 50 |
| Methanol | CH ₃ OH | 3.00 | 39 |
| Methyl tert-butyl ether (MTBE) | CH ₃ OC(CH ₃) ₃ | 0.80 | 27 |
| n-butanol | C ₄ H ₉ OH | 0.70 | 19 |

| Gas/vapor | Chem. symbol | Test gas concentration in Vol.-% | Displayed reading in % LEL |
|-----------------|---------------------------------------|----------------------------------|----------------------------|
| n-butyl acetate | $\text{CH}_3\text{COOC}_4\text{H}_9$ | 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 | $\text{C}_5\text{H}_{11}\text{OH}$ | 0.60 | 19 |
| Propane | C_3H_8 | 0.85 | 28 |
| Propanol | $\text{C}_3\text{H}_7\text{OH}$ | 1.00 | 26 |
| Propene | C_3H_6 | 1.00 | 32 |
| Propylene oxide | $\text{C}_3\text{H}_6\text{O}$ | 0.95 | 23 |
| Styrol | $\text{C}_6\text{H}_5\text{CHCH}_2$ | 0.50 | 15 |
| Toluene | $\text{C}_6\text{H}_5\text{CH}_3$ | 0.50 | 19 |
| o-Xylene | $\text{C}_6\text{H}_4(\text{CH}_3)_2$ | 0.55 | 19 |

The given values may fluctuate by $\pm 30\%$.

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 ₂ S 1000 ppm ≤ ± 10% of measured value Hexamethyldisiloxane HMDS 10 ppm ≤ ± 5% of measured value Hexamethyldisiloxane HMDS 30 ppm ≤ ± 20% of measured value After an exposure of 10 ppm HDMS for 5 hours, the sensitivity loss is less than 50%. Halogenated hydrocarbons or volatile silicon, sulphur, heavy metal compounds or substances that can polymerize → potential poisoning. |

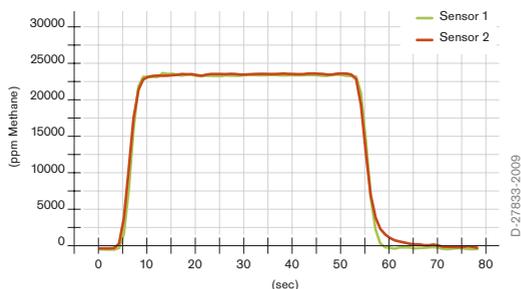
FOR THE MEASUREMENT RANGE 0 TO 100 VOL.-% CH₄:

| | |
|---------------------------------|---|
| 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, siloxane and other sensor poisons.

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



D-27835-2009

DrägerSensor® CatEx SR

Order no. 68 51 900

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|------------------|-------------|-------------|----------|----------------------|------------------|
| Dräger X-am 2800 | no | yes | 3 years | > 4 years | no |

MARKET SEGMENTS

Telecommunications, shipping, sewage, gas supply companies, refineries, fire services, chemical industry, mining, landfills, biogas plants, sewage treatment plants, tunneling, hydrogen production and storage

TECHNICAL SPECIFICATIONS

| | |
|---------------------------|--|
| Detection limit: | 2 % LEL (at calibration with methane) |
| Resolution: | 1 % LEL for measurement range 0 to 100 % LEL, 0.05 Vol.-% for measurement range 0 to 5 Vol.-% CH ₄ (methane) |
| Measurement range: | 0 to 100 % LEL / 0 to 5 Vol.-% CH ₄ (methane) |
| Ambient conditions | |
| Temperature*: | -20 to 55 °C (-4 to 131 °F) |
| Humidity: | 0 to 95 % RH |
| Pressure: | 700 to 1300 hPa |
| Warm-up time: | ≤ 1 minute |

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

| | |
|--|---|
| Response time: | Diffusion mode (t ₅₀) ≤ 6 seconds Diffusion mode (t ₉₀) ≤ 11 seconds Pump mode (t ₅₀) ≤ 6 seconds Pump mode (t ₉₀) ≤ 9 seconds |
| Precision: | |
| Zero point: | ≤ ± 1 % LEL |
| Sensitivity: | ≤ ± 1 % LEL at 50 % LEL |
| Linearity: | ≤ ± 10 % of measured value |
| 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 | |
| Zero point: | ≤ ± 0.05 % LEL/kPa |
| Sensitivity: | ≤ ± 0.10 % LEL/kPa at 50 % LEL |
| Long-term drift | |
| Zero point: | ≤ ± 1 % LEL/month |
| Sensitivity: | ≤ ± 1 % LEL/month at 50 % LEL |

* If the Dräger gas warning device is set to hydrogen, measurements are only possible at temperatures > -10 °C.

For further information, please refer to the instructions for use of the sensor!

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

| | | |
|--|---|-------------------|
| Response time: | Diffusion mode (t_{50}) | ≤ 6 seconds |
| | Diffusion mode (t_{90}) | ≤ 17 seconds |
| | Pump mode (t_{50}) | ≤ 7 seconds |
| | Pump mode (t_{90}) | ≤ 9 seconds |
| Precision: | | |
| Zero point: | $\leq \pm 1$ % LEL | |
| Sensitivity: | $\leq \pm 1$ % LEL at 50 % LEL | |
| Linearity: | $\leq \pm 10$ % of measured value | |
| Influence of temperature | | |
| Zero point: | $\leq \pm 0.05$ % LEL/K | |
| Sensitivity: | $\leq \pm 0.05$ % LEL/K at 50 % LEL | |
| Influence of humidity (at 40°C) | | |
| Zero point: | $\leq \pm 0.03$ % LEL/% RH | |
| Sensitivity: | $\leq \pm 0.03$ % LEL/% RH at 50 % LEL | |
| Influence of pressure | | |
| Zero point: | $\leq \pm 0.10$ % LEL/kPa | |
| Sensitivity: | $\leq \pm 0.10$ % LEL/kPa at 50 % LEL | |
| Long-term drift | | |
| Zero point: | $\leq \pm 1$ % LEL/month | |
| Sensitivity: | $\leq \pm 1$ % LEL/month at 50 % LEL | |
| Effect of sensor poisons: | | |
| | Halogenated hydrocarbons or volatile silicon, sulphur, heavy metal compounds may damage the CatEx Sensor. | |
| | Hydrogen sulfide H_2S 1000 ppmh $\leq \pm 2$ % of sensitivity | |
| | Hexamethyldisiloxane HMDS 10 ppmh $\leq \pm 5$ % sensitivity | |
| | Hexamethyldisiloxane HMDS 30 ppmh $\leq \pm 15$ % sensitivity | |
| | After an exposure to 10 ppm HMDS in air for 6 hours the loss of sensitivity is less than 50% | |
| Test gas: | | |
| | approx. 2.5 Vol.-% CH_4 | |
| | approx. 0.9 Vol.-% C_3H_8 | |

SPECIAL CHARACTERISTICS

Due to its special design, the DrägerSensor® CatEx SR (Shock Resistant) is particularly insensitive to shock loads. The shock resistance significantly exceeds the general standard requirements. In addition to this shock protection, it shows a good vapor measurement capability and is therefore suitable for the detection of combustible gases and vapors. It is ready for use very quickly, since a zero point and sensitivity adjustment for the %LEL measuring range can be carried out after approx. 60 seconds. In addition, the sensor has a very good long-term stability, low moisture influence and excellent poisoning resistance to sensor poisons such as siloxanes and hydrogen sulfide.

THE DETECTION OF OTHER GASES AND VAPORS THROUGH THE USE OF CROSS SENSITIVITIES FOR THE MEASUREMENT RANGE OF 0 TO 100 % LEL.

The specified values are typical values when adjusting with propane (C₃H₈) or methane (CH₄) and apply to new sensors with an accuracy of ±15%. Aging and sensor poisons can affect sensitivity ratios. The LEL according to ISO/IEC 80079-20-1:2017 were used. The table does not claim to be complete. The sensor can 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 when calibrated | |
|-----------|--------------------------------|-----------|----------------------------------|---|-------------------------------|
| | | | | CH ₄ | C ₃ H ₈ |
| n-Butane | C ₄ H ₁₀ | 106-97-8 | 0.70 | 21 | 48 |
| Ethane | C ₂ H ₆ | 74-84-0 | 1.20 | 31 | 62 |
| n-Heptane | C ₇ H ₁₆ | 142-82-5 | 0.43 | 17 | 34 |
| n-Hexane | C ₆ H ₁₄ | 110-54-3 | 0.50 | 19 | 39 |
| Hydrogen | H ₂ | 1333-74-0 | 2.00 | 44 | 85 |
| Methane | CH ₄ | 74-82-8 | 2.20 | 50 | 100 |
| n-Nonane | C ₉ H ₂₀ | 111-84-2 | 0.35 | 14 | 14 |
| n-Octane | C ₈ H ₁₈ | 111-65-9 | 0.40 | 16 | 31 |
| n-Pentane | C ₅ H ₁₂ | 109-66-0 | 0.55 | 18 | 37 |
| Propane | C ₃ H ₈ | 74-98-6 | 0.85 | 24 | 50 |
| Propene | C ₃ H ₆ | 115-07-1 | 1.00 | 27 | 55 |

NOTICE

Do not dispose of sensors in household waste. Sensors must be disposed of in accordance with local regulations. The product safety information sheet contains information on constituent substances (www.draeger.com).

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) | ≤ 7 seconds | ≤ 9 seconds |
| | Pump mode (t ₉₀) | ≤ 10 seconds | ≤ 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}) | ≤ 9 seconds | ≤ 11 seconds |
| | Pump mode (t_{90}) | ≤ 11 seconds | ≤ 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.-% CH₄:

| | | | |
|----------------------------------|---|--|--|
| 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 ₂ S 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 alkane from methane to nonane is certified for the use in the devices Dräger X-am 2500/5000 and Dräger X-am 3500/8000 (nonane-suitable pump adapter required) 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 (CH₄) and apply to new sensors. 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 ₃ H ₆ O | 67-64-1 | 1.25 | 31 |
| Acetic acid | C ₂ H ₄ O ₂ | 64-19-7 | 3.00 | 23 |
| Acetylene | C ₂ H ₂ | 74-86-2 | 1.15 | 36 |
| Ammonia | NH ₃ | 7664-41-7 | 7.70 | 57 |
| Benzene | C ₆ H ₆ | 71-43-2 | 0.60 | 25 |
| Butadiene -1,3 | C ₄ H ₆ | 106-99-0 | 0.70 | 27 |
| n-Butane | C ₄ H ₁₀ | 106-97-8 | 0.70 | 26 |
| n-Butanol | C ₄ H ₁₀ O | 71-36-3 | 0.70 | 20 |
| 2-Butanone | C ₄ H ₈ O | 78-93-3 | 0.75 | 22 |
| n-Butyl acetate | C ₈ H ₁₂ O ₂ | 123-86-4 | 0.60 | 17 |
| Carbon monoxide | CO | 630-08-0 | 5.45 | 32 |
| Cyclohexane | C ₆ H ₁₂ | 110-82-7 | 0.50 | 20 |
| Cyclopentane | C ₅ H ₁₀ | 287-92-3 | 0.70 | 27 |
| Diethylamine | C ₄ H ₁₁ N | 109-89-7 | 0.85 | 28 |
| Diethyl ether | (C ₂ H ₅) ₂ O | 60-29-7 | 0.85 | 27 |
| Ethane | C ₂ H ₆ | 74-84-0 | 1.20 | 35 |
| Ethanol | C ₂ H ₆ O | 64-17-5 | 1.55 | 33 |
| Ethene | C ₂ H ₄ | 74-85-1 | 1.20 | 36 |
| Ethyl acetate | C ₄ H ₈ O ₂ | 141-78-6 | 1.00 | 25 |
| n-Heptane | C ₇ H ₁₆ | 142-82-5 | 0.40 | 17 |
| n-Hexane | C ₆ H 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 ₄ O | 67-56-1 | 3.00 | 40 |
| 1-Methoxy-2-Propanol | C ₄ H ₁₀ O ₂ | 107-98-2 | 0.90 | 21 |
| Methyl tert-butyl ether (MTBE) | C ₅ H ₁₂ O | 1634-04-4 | 0.80 | 25 |
| n-Nonane | C ₉ H ₂₀ | 111-84-2 | 0.35 | 14 |
| n-Octane | C ₈ H ₁₈ | 111-65-9 | 0.40 | 17 |
| n-Pentane | C ₅ H ₁₂ | 109-66-0 | 0.55 | 21 |
| 3-Pentanol | C ₅ H ₁₂ O | 584-02-1 | 0.60 | 19 |
| Propane | C ₃ H ₈ | 74-98-6 | 0.85 | 29 |
| 2-Propanol | C ₃ H ₈ O | 67-63-0 | 1.00 | 27 |
| Propene | C ₃ H ₆ | 115-07-1 | 1.00 | 35 |
| Propylene oxide | C ₃ H ₆ O | 75-56-9 | 0.95 | 25 |
| Styrene | C ₈ H ₈ | 100-42-5 | 0.50 | 11 |
| Toluene | C ₇ H ₈ | 108-88-3 | 0.50 | 20 |
| o-Xylene | C ₈ H 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.

WEEE

Do not dispose the sensors in household waste. The sensors must be disposed in accordance with local regulations. Environmental and regulatory authorities and waste disposal companies provide information. Information on ingredients is included in the Product Safety Information Sheet (PSIS) available on www.draeger.com/sds.



DraegerSensor® 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) | ≤ 6 seconds | ≤ 8 seconds |
| Pump mode (t ₉₀) | ≤ 7 seconds | ≤ 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}) | ≤ 8 seconds | ≤ 10 seconds |
| | Pump mode (t_{90}) | ≤ 10 seconds | ≤ 13 seconds |
| Precision | | | |
| Zero point: | | $\leq \pm 1$ % LEL | |
| Sensitivity: | | $\leq \pm 1$ % LEL at 50 % LEL | |
| Linearity error: | | $\leq \pm 2$ % LEL at 70 % LEL | |
| Influence of temperature | | | |
| Zero point: | | $\leq \pm 0.15$ % LEL/K | |
| Sensitivity: | | $\leq \pm 0.15$ % LEL/K at 50 % LEL | |
| Influence of humidity (at 40°C) | | | |
| Zero point: | | $\leq \pm 0.03$ % LEL/% RH | |
| Sensitivity: | | $\leq \pm 0.03$ % LEL/% RH at 50 % LEL | |
| Influence of pressure | | X-am 2500/5000 | X-am 8000 |
| Zero point: | | $\leq \pm 0.50$ %LEL/kPa | $\leq \pm 0.10$ % UEG/kPa |
| Sensitivity: | | $\leq \pm 0.50$ % LEL/kPa at 50 % LEL | $\leq \pm 0.10$ % LEL/kPa at 50 % LEL |
| Long-term drift | | | |
| Zero point: | | $\leq \pm 3$ % LEL/month | |
| Sensitivity: | | $\leq \pm 3$ % 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.-% CH₄:

| | | |
|----------------------------------|--|--|
| Response time: | | ≤ 35 seconds (t_{90}) |
| Precision: | | $\leq \pm 1$ Vol.-% |
| Linearity error: | | $\leq \pm 5$ Vol.-% at 0 to 50 Vol.-% $\leq \pm 10$ % of measured value at 50 to 100 Vol.-% |
| Long-term drift | | |
| Zero point: | | $\leq \pm 3$ Vol.-%/month |
| Precision: | | $\leq \pm 3$ Vol.-%/month at 50 Vol.-% |
| Influence of temperature: | | $\leq \pm 0.3$ Vol.-%/K |
| Influence of humidity: | | $\leq \pm 0.2$ 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 ₂ S 1000 ppmh $\leq \pm 2$ % of measured value Hexamethyldisiloxane HMDS 10 ppmh $\leq \pm 10$ % of measured value Hexamethyldisiloxane HMDS 30 ppmh $\leq \pm 20$ % 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 (CH₄) 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 concentration in Vol.-% | Reading displayed in % LEL |
|------------------------|--------------------------------|-----------|----------------------------------|----------------------------|
| Acetylene (MTG) | C ₂ H ₂ | 74-86-2 | 1.15 | 32 |
| n-Butane (MTG) | C ₄ H ₁₀ | 106-97-8 | 0.70 | 22 |
| i-Butene (MTG) | C ₄ H ₈ | 115-11-7 | 0.80 | 23 |
| Ethane (MTG) | C ₂ H ₆ | 74-84-0 | 1.20 | 33 |
| Ethene (MTG) | C ₂ H 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 ₅ H ₁₂ | 109-66-0 | 0.75 | 22 |
| Propane (MTG) | C ₃ H ₈ | 74-98-6 | 0.85 | 28 |
| Propene (MTG) | C ₃ H 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 «ch₄L» provides a higher resolution and is used for leak detection. It is recommended to re-calibrate the zero point in fresh air at the operating site. The settings are optimized for the X-am 8000. With the unit [ppm], high gas concentrations cannot be shown on the X-am 5000s 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.

WEEE

Do not dispose the sensors in household waste. The sensors must be disposed in accordance with local regulations. Environmental and regulatory authorities and waste disposal companies provide information. Information on ingredients is included in the Product Safety Information Sheet (PSIS) available on www.draeger.com/sds.



D-27734-2017

DrägerSensor® CatEx 125 PR Gas

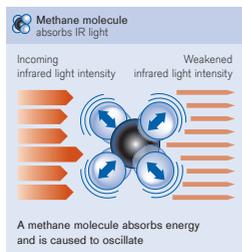
5.4 Dräger infrared sensors



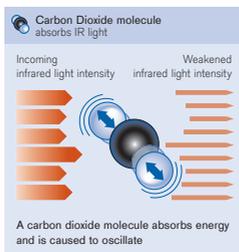
D-1949B-2010

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.

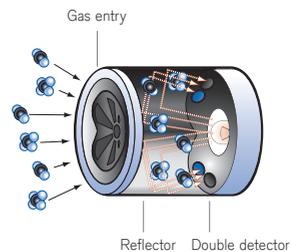
DUAL IR Ex/CO₂ Sensor



Reaction



Reaction



Hydrocarbons and carbon dioxide, on the other hand, absorb light in a certain wavelength range, (hydro carbons 3.3 to 3.5 μm ; CO₂ 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/CO₂ 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.-% CH₄ 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 |
| Influence 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.-% C₃H₈ WHEN CALIBRATED WITH PROPANE IN AIR:

| | |
|--|---|
| Precision: | $\leq \pm 1.0\%$ LEL propane at 50% LEL |
| Linearity error, typical: | $\leq \pm 4.0\%$ of measured value |
| Long-term drift | |
| Zero point: | $\leq \pm 1.0\%$ LEL propane/month |
| Sensitivity | $\leq \pm 2.0\%$ LEL propane/month at 50% LEL |
| Influence of temperature | |
| Zero point: | $\leq \pm 0.03\%$ LEL propane/K |
| Sensitivity | $\leq \pm 0.08\%$ LEL propane/K |
| Influence of humidity, at 40°C (104 °F) (0 to 95% RH, non-condensing) | |
| Zero point: | $\leq \pm 0.03\%$ LEL propane/% RH |
| Test gas: | 2 Vol.-% CH ₄ |
| | 0.9 Vol.-% C ₃ H 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.

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. ch₄ for 0 to 100% LEL and CH₄ 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 ₂ h ₄ | 0 to 100% LEL ²⁾ |
| ETHENE | C ₂ H 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 ₃ h ₈ | 0 to 100% LEL ²⁾ |
| PROPANE | C ₃ H 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 (C₃H₈, 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 ₃ COCH ₃ | 1.25 | 19 | 2.63 |
| Acetylene | C ₂ H ₂ | – | not possible | – |
| Benzene | C ₆ H ₆ | 0.6 | 11 | 4.44 |
| Butadiene -1,3 | CH ₂ CHCHCH ₂ | 0.7 | 13 | 3.85 |
| Cyclohexane | C ₆ H ₁₂ | – | on request | – |
| Cyclopentane | C ₅ H ₁₀ | 0.7 | 52 | 0.96 |
| Dimethyl ether | (C ₂ H ₅) ₂ O | 1.35 | 62 | 0.81 |
| Ethane | C ₂ H ₆ | 1.35 | 76 | 0.66 |
| Ethanol | C ₂ H ₅ OH | 1.75 | 64 | 0.78 |
| Ethene | C ₂ H ₄ | 1.15 | 9 | 5.56 |
| Ethyl acetate | CH ₃ COOC ₂ H ₅ | 1.05 | 35 | 1.43 |
| Ethyl acrylate | C ₅ H ₈ O ₂ | 0.85 | 23 | 2.17 |
| i-butane | C ₄ H ₁₀ | 0.9 | 49 | 1.02 |
| i-butene | C ₄ H ₈ | 0.8 | 32 | 1.56 |
| Methanol | CH ₄ O | 2.75 | 93 | 0.54 |
| Methyl chloride | CH ₃ Cl | 3.8 | 42 | 1.19 |
| Methylene chloride | CH ₂ Cl ₂ | 6.5 | 13 | 3.85 |
| Methyl ethyl ketone | C ₄ H ₈ O | 0.9 | 28 | 1.79 |
| n-heptane | C ₇ H ₁₆ | 0.55 | 45 | 1.11 |
| n-hexane | C ₆ H ₁₄ | 0.5 | 42 | 1.19 |
| n-nonane | C ₉ H ₂₀ | – | on request | – |
| n-octane | C ₈ H ₁₈ | 0.4 | 32 | 1.56 |
| n-pentane | C ₅ H ₁₂ | 0.7 | 54 | 0.93 |
| Propane | C ₃ H ₈ | 0.85 | 50 | 1.00 |
| n-propanol | C ₃ H ₇ OH | 0.6 | 40 | 1.25 |
| o-xylene | C ₆ H ₄ (CH ₃) ₂ | 0.5 | 13 | 3.85 |
| Toluene | C ₆ H ₅ CH 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.-% CH₄ 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 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: | ≤ ± 0.02% 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 measured 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 ₃ H 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/CO₂ ES or DrägerSensor IR Ex ES via cross-sensitivities used for technical measurements when calibrated with propane (C₃H₈, 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 ₃ H ₆ O | 67-64-1 | 1.25 | 18 | 2.78 |
| Acetylene | C ₂ H ₂ | 74-86-2 | – | not possible | – |
| Benzene | C ₆ H ₆ | 71-43-2 | 0.60 | 20 | 2.50 |
| Butadiene -1,3 | C ₄ H ₆ | 106-99-0 | 0.70 | 20 | 2.50 |
| i-Butane | (CH ₃) ₃ CH | 75-28-5 | 0.75 | 41 | 1.22 |
| n-Butane | C ₄ H ₁₀ | 106-97-8 | 0.70 | 42 | 1.19 |
| n-Butanol | C ₄ H ₁₀ O | 71-36-3 | 0.85 | 25 | 2.00 |
| 2-Butanon (MEK) | C ₄ H ₈ O | 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 ₄ H ₈ | 115-11-7 | 0.80 | 31 | 1.61 |
| n-Butyl acetate | C ₆ H ₁₂ O ₂ | 123-86-4 | 0.60 | 20 | 2.50 |
| Cyclohexane | C ₆ H ₁₂ | 110-82-7 | 0.50 | 15 | 3.33 |
| Cyclopentane | C ₅ H ₁₀ | 287-92-3 | 0.70 | 47 | 1.06 |
| Diethylamine | C ₄ H ₁₁ N | 109-89-7 | 0.85 | 44 | 1.14 |
| Diethyl ether | (C ₂ H ₅) ₂ O | 60-29-7 | 0.85 | 46 | 1.09 |
| Dimethyl ether | C ₂ H ₆ O | 115-10-6 | 1.35 | 51 | 0.98 |
| Ethane | C ₂ H ₆ | 74-84-0 | 1.20 | 65 | 0.77 |
| Ethanol | C ₂ H ₆ O | 64-17-5 | 1.55 | 41 | 1.22 |
| Ethene | C ₂ H ₄ | 74-85-1 | 1.20 | 15 | 3.33 |
| Ethyl acetate | C ₄ H ₈ O ₂ | 141-78-6 | 1.00 | 35 | 1.43 |
| Ethyl acrylate | C ₅ H ₈ O ₂ | 140-88-5 | 0.85 | 26 | 1.92 |
| n-Heptane | C ₇ H ₁₆ | 142-82-5 | 0.55 | 36 | 1.39 |
| n-Hexane | C ₆ H ₁₄ | 110-54-3 | 0.50 | 34 | 1.47 |
| Methane | CH ₄ | 74-82-8 | 2.20 | 37 | 1.35 |
| Methanol | CH ₄ O | 67-56-1 | 3.00 | 92 | 0.54 |
| n-Methoxy-2-Propanol | C ₄ H ₁₀ O ₂ | 107-98-2 | 0.90 | 26 | 1.92 |
| Methyl chloride | CH ₃ Cl | 74-87-3 | 3.80 | 47 | 1.06 |
| Methylene chloride | CH ₂ Cl ₂ | 75-09-2 | 6.50 | 20 | 2.50 |
| Methyl tert-butyl ether (MTBE) | C ₅ H ₁₂ O | 1634-04-4 | 0.80 | 59 | 0.85 |
| n-Nonane | C ₉ H ₂₀ | 111-84-2 | 0.35 | on request | – |
| n-Octane | C ₈ H ₁₈ | 111-65-9 | 0.40 | 20 | 2.50 |
| n-Pentane | C ₅ H ₁₂ | 109-66-0 | 0.55 | 36 | 1.39 |
| Propane | C ₃ H ₈ | 74-98-6 | 0.85 | 50 | 1.00 |
| n-Propanol | C ₃ H ₈ O | 71-23-8 | 1.05 | 40 | 1.25 |
| Propene | C ₃ H ₆ | 115-07-1 | 0.90 | 31 | 1.61 |
| Propylene oxide | C ₃ H ₆ O | 75-56-9 | 0.95 | 49 | 1.02 |
| Toluene | C ₇ H ₈ | 108-88-3 | 0.50 | 19 | 2.63 |
| o-Xylene | C ₈ H 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® IR Ex ES

DrägerSensor® Smart IR CO₂

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.-% CO₂

| | |
|--|--|
| 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 |
| Influence 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 CO₂ in the workplace. As with all other IR sensors, it requires little maintenance and has a high level of long-term stability.



D-10120-2009

DrägerSensor® Smart IR CO₂

DrägerSensor® Smart IR CO₂ 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.-% CO₂

| | |
|--|--|
| 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 |
| Influence 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 CO₂ in process gas, for example. CO₂ 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 CO₂ 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.-% CO₂ 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 CO₂ 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 CO₂ ES

DrägerSensor® Dual IR Ex/CO₂ 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.-% CH₄ WHEN CALIBRATED WITH 2.5 VOL.-% 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 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: | ≤ ± 0.02 % 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.% C₃H₈ 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 measured 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 | | |
| Zero point: | X-am 5600 ≤ ± 0.16 % (uncompensated) | X-am 8000 ≤ ± 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.-% CO₂ 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 | | |
| Zero point: | X-am 5600 ≤ ± 0.15 % (uncompensated) | X-am 8000 ≤ ± 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 ₃ H 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/CO₂ ES or DrägerSensor IR Ex ES via cross-sensitivities used for technical measurements when calibrated with propane (C₃H₈, 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 ₃ H ₆ O | 67-64-1 | 1.25 | 18 | 2.78 |
| Acetylene | C ₂ H ₂ | 74-86-2 | – | not possible | – |
| Benzene | C ₆ H ₆ | 71-43-2 | 0.60 | 20 | 2.50 |
| Butadiene -1,3 | C ₄ H ₆ | 106-99-0 | 0.70 | 20 | 2.50 |
| i-Butane | (CH ₃) ₃ CH | 75-28-5 | 0.75 | 41 | 1.22 |
| n-Butane | C ₄ H ₁₀ | 106-97-8 | 0.70 | 42 | 1.19 |
| n-Butanol | C ₄ H ₁₀ O | 71-36-3 | 0.85 | 25 | 2.00 |
| 2-Butanol (MEK) | C ₄ H ₈ O | 78-93-3 | 0.75 | 22 | 2.27 |
| i-Butene | C ₄ H ₈ | 115-11-7 | 0.80 | 31 | 1.61 |
| n-Butyl acetate | C ₆ H ₁₂ O ₂ | 123-86-4 | 0.60 | 20 | 2.50 |
| Cyclohexane | C ₆ H ₁₂ | 110-82-7 | 0.50 | 15 | 3.33 |
| Cyclopentane | C ₅ H ₁₀ | 287-92-3 | 0.70 | 51 | 1.06 |
| Diethylamine | C ₄ H ₁₁ N | 109-89-7 | 0.85 | 44 | 1.14 |
| Diethyl ether | (C ₂ H ₅) ₂ O | 60-29-7 | 0.85 | 46 | 1.09 |
| Dimethyl ether | C ₂ H ₆ O | 115-10-6 | 1.35 | 47 | 0.98 |
| Ethane | C ₂ H ₆ | 74-84-0 | 1.20 | 65 | 0.77 |
| Ethanol | C ₂ H ₆ O | 64-17-5 | 1.55 | 41 | 1.22 |
| Ethene | C ₂ H ₄ | 74-85-1 | 1.20 | 15 | 3.33 |
| Ethyl acetate | C ₄ H ₈ O ₂ | 141-78-6 | 1.00 | 35 | 1.43 |
| Ethyl acrylate | C ₅ H ₈ O ₂ | 140-88-5 | 0.85 | 26 | 1.92 |
| n-Heptane | C ₇ H ₁₆ | 142-82-5 | 0.55 | 36 | 1.39 |
| n-Hexane | C ₆ H ₁₄ | 110-54-3 | 0.50 | 34 | 1.47 |
| Methane | CH ₄ | 74-82-8 | 2.20 | 37 | 1.35 |
| Methanol | CH ₄ O | 67-56-1 | 3.00 | 92 | 0.54 |
| n-Methoxy-2-Propanol | C ₄ H ₁₀ O ₂ | 107-98-2 | 0.90 | 26 | 1.92 |
| Methyl chloride | CH ₃ Cl | 74-87-3 | 3.80 | 47 | 1.06 |
| Methylene chloride | CH ₂ Cl ₂ | 75-09-2 | 6.50 | 20 | 2.50 |
| Methyl tert-butyl ether (MTBE) | C ₅ H ₁₂ O | 1634-04-4 | 0.80 | 59 | 0.85 |
| n-Nonane | C ₉ H ₂₀ | 111-84-2 | 0.35 | on request | – |
| n-Octane | C ₈ H ₁₈ | 111-65-9 | 0.40 | 20 | 2.50 |
| n-Pentane | C ₅ H ₁₂ | 109-66-0 | 0.55 | 36 | 1.39 |
| Propane | C ₃ H ₈ | 74-98-6 | 0.85 | 50 | 1.00 |
| n-Propanol | C ₃ H ₈ O | 71-23-8 | 1.05 | 40 | 1.25 |
| Propene | C ₃ H ₆ | 115-07-1 | 0.90 | 31 | 1.61 |
| Propylene oxide | C ₃ H ₆ O | 75-56-9 | 0.95 | 49 | 1.02 |
| Toluene | C ₇ H ₈ | 108-88-3 | 0.50 | 19 | 2.63 |
| o-Xylene | C ₈ H 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/CO₂ 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.-% CH₄ WHEN CALIBRATED WITH 2.5 VOL.-% METHANE IN AIR:

| | |
|--|---|
| Response time: | 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 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: | ≤ ± 0.02 % 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 | |
| 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.% C₃H₈ WHEN CALIBRATED WITH 0.9 VOL.% PROPANE IN AIR:

| | | |
|--|--|--------------|
| Response time: | 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 measured 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 | | |
| 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.-% CO₂ WHEN CALIBRATED WITH MIT 50 VOL.-% CARBON DIOXIDE IN NITROGEN:

| | | |
|--|---|--------------|
| Response time: | 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 | | |
| 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.-% CH₄ for measurement range up to 100 %LEL
 50 Vol.-% CH₄ for measurement range up to Vol.-% CH₄
 0.9 Vol.-% C₃H₈ for measurement range up to 100 %LEL
 50 Vol.-% CO₂ for measurement range up to 100 Vol.-% CO₂
 Biogas 60 Vol.-% CH₄/40 Vol.-% CO₂

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. CO₂ 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/CO₂ HC via cross-sensitivities used for technical measurements when calibrated with propane (C₃H₈, 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 ₃ H ₆ O | 67-64-1 | 1.25 | 18 | 2.78 |
| Acetylene | C ₂ H ₂ | 74-86-2 | – | not possible | – |
| Benzene | C ₆ H ₆ | 71-43-2 | 0.60 | 20 | 2.50 |
| Butadiene -1,3 | C ₄ H ₆ | 106-99-0 | 0.70 | 20 | 2.50 |
| i-Butane | (CH ₃) ₃ CH | 75-28-5 | 0.75 | 41 | 1.22 |
| n-Butane | C ₄ H ₁₀ | 106-97-8 | 0.70 | 42 | 1.19 |
| n-Butanol | C ₄ H ₁₀ O | 71-36-3 | 0.85 | 25 | 2.00 |
| 2-Butanol (MEK) | C ₄ H ₈ O | 78-93-3 | 0.75 | 22 | 2.27 |
| i-Butene | C ₄ H ₈ | 115-11-7 | 0.80 | 31 | 1.61 |
| n-Butyl acetate | C ₆ H ₁₂ O ₂ | 123-86-4 | 0.60 | 20 | 2.50 |
| Cyclohexane | C ₆ H ₁₂ | 110-82-7 | 0.50 | 15 | 3.33 |
| Cyclopentane | C ₅ H ₁₀ | 287-92-3 | 0.70 | 47 | 1.06 |
| Diethylamine | C ₄ H ₁₁ N | 109-89-7 | 0.85 | 44 | 1.14 |
| Diethyl ether | (C ₂ H ₅) ₂ O | 60-29-7 | 0.85 | 46 | 1.09 |
| Dimethyl ether | C ₂ H ₆ O | 115-10-6 | 1.35 | 51 | 0.98 |
| Ethane | C ₂ H ₆ | 74-84-0 | 1.20 | 65 | 0.77 |
| Ethanol | C ₂ H ₆ O | 64-17-5 | 1.55 | 41 | 1.22 |
| Ethene | C ₂ H ₄ | 74-85-1 | 1.20 | 15 | 3.33 |
| Ethyl acetate | C ₄ H ₈ O ₂ | 141-78-6 | 1.00 | 35 | 1.43 |
| Ethyl acrylate | C ₅ H ₈ O ₂ | 140-88-5 | 0.85 | 26 | 1.92 |
| n-Heptane | C ₇ H ₁₆ | 142-82-5 | 0.55 | 36 | 1.39 |
| n-Hexane | C ₆ H ₁₄ | 110-54-3 | 0.50 | 34 | 1.47 |
| Methane | CH ₄ | 74-82-8 | 2.20 | 37 | 1.35 |
| Methanol | CH ₄ O | 67-56-1 | 3.00 | 92 | 0.54 |
| n-Methoxy-2-Propanol | C ₄ H ₁₀ O ₂ | 107-98-2 | 0.90 | 26 | 1.92 |
| Methyl chloride | CH ₃ Cl | 74-87-3 | 3.80 | 47 | 1.06 |
| Methylene chloride | CH ₂ Cl ₂ | 75-09-2 | 6.50 | 20 | 2.50 |
| Methyl tert-butyl ether (MTBE) | C ₅ H ₁₂ O | 1634-04-4 | 0.80 | 59 | 0.85 |
| n-Nonane | C ₉ H ₂₀ | 111-84-2 | 0.35 | on request | – |
| n-Octane | C ₈ H ₁₈ | 111-65-9 | 0.40 | 20 | 2.50 |
| n-Pentane | C ₅ H ₁₂ | 109-66-0 | 0.55 | 36 | 1.39 |
| Propane | C ₃ H ₈ | 74-98-6 | 0.85 | 50 | 1.00 |
| n-Propanol | C ₃ H ₈ O | 71-23-8 | 1.05 | 40 | 1.25 |
| Propene | C ₃ H ₆ | 115-07-1 | 0.90 | 31 | 1.61 |
| Propylene oxide | C ₃ H ₆ O | 75-56-9 | 0.95 | 49 | 1.02 |
| Toluene | C ₇ H ₈ | 108-88-3 | 0.50 | 19 | 2.63 |
| o-Xylene | C ₈ H ₁₀ | 95-47-6 | 0.50 | 11 | 4.55 |

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

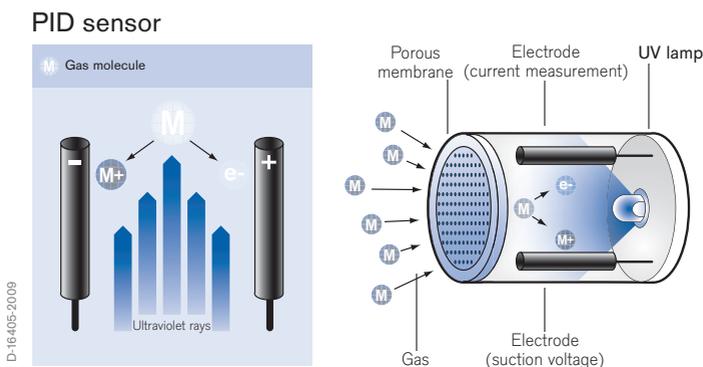
The table does not claim to be complete. The sensor may also be sensitive to other gases and vapors.

5.5 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.



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 (Krypton) |

MARKET SEGMENTS

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

TECHNICAL SPECIFICATIONS

| | |
|---|---|
| Detection limit:* | 0.3 ppm isobutylene |
| Resolution:* | 0-20 ppm 100 ppb |
| (valid for isobutylene) | > 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. |
| Influence of temperature (-20 to 50 °C) | |
| Zero point: | 0.02 ppm/K |
| Sensitivity: | 0.2 ppm/K |
| Influence of pressure | compensated |
| Influence 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 ₄ H ₈ (isobutylene) |

* Depends on the response factor of the measured gas

¹⁾ At a run time of max. 2,500 hours²⁾ 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 |
| Allyl alcohol | 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 | BDT1 | 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, VOC₁ to VOC₉. 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 (Krypton) |

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 benzene) | > 2-5 ppm 20 ppb |
| | > 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 PROPERTIES FOR 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. |
| Influence of pressure | compensated |
| Influence 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 ₄ H 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) |
| Allyl alcohol | 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 | 2BOH | 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, VOC₁ to VOC₉. 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

Dräger X-pid 9x00 Seeker PID

Order no. 68 50 012

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) |
| Precision¹ | < 2 % at 10.0 ppm isobutylene |
| (k = 1, ~68 %) | < 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 ₄ H ₈ (isobutylene) and 10 ppm C ₇ H 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 |
| Precision¹ | < 2 % at 10.0 ppm isobutylene |
| (k = 1, ~68 %) | < 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 ₄ H ₈ (isobutylene) and 10 ppm C ₇ H 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 analysis 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 |
| Diethylcarbonat | 105-58-8 | 48.4 | 4.33 | 13.0 | 1200 |
| Dimethylcarbonate | 616-38-6 | 14.6 | 1.67 | 5.00 | 500 |
| 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 |
| Ethylmethylcarbonat | 623-53-0 | 25.5 | 4.17 | 12.5 | 2000 |
| 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 acetate | 108-05-4 | 11.9 | 0.33 | 1.00 | 55.0 |
| 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 COMPOUNDS (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 | LOD¹⁾, ppm | LOQ²⁾, ppm | UR³⁾, 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 |
| Influence of pressure | ≤ ± 0.1% of measured value/hPa |
| Influence of humidity, at 40°C (104 °F) (0 to 95 % 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 ₄ H 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

5.6 Electrochemical sensors

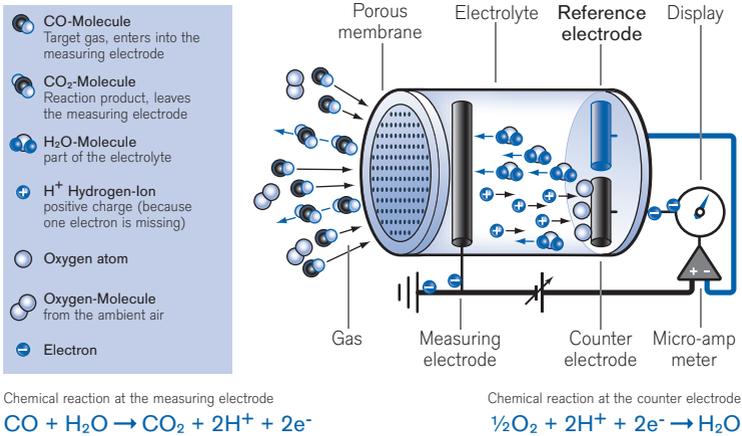


Many toxic gases are highly reactive and can change their chemical composition under certain conditions. An electrochemical sensor is a micro-reactor, which produces a very small but measurable current when reactive gases are present. As in a normal household battery, this involves an electrochemical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

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

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

Electrochemical sensor



D-16399-2009

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 PAM and Dräger X-am CSE. 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

XS, XS R and XS 2:

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

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 safety-relevant 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 O₂ 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% O₂ by vol. for N₂.

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. Dräger recommends using Dräger test gases for the adjustment and the function test. 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:

1. Remove filter with a peaked object.
2. Insert new filter.

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

The measurement response time may increase after the filter is installed.



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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.

For more information on handling, transport and disposal, please refer to the relevant Product Safety Information Sheets (PSIS) at www.draeger.com/sds.

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 ₂ S | 68 11 410 |
| XXS CO ₂ | 68 10 889 |
| XXS COCl ₂ | 68 12 005 |
| XXS H ₂ HC | 68 12 025 |
| XXS H ₂ S | 68 10 883 |
| XXS E H ₂ S | 68 12 213 |
| XXS H ₂ S HC | 68 12 015 |
| XXS H ₂ S 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 ₂ S LC | 68 14 137* |
| XXS H ₂ S-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 ₂ O ₂ | 68 09 170 |
| XS EC H ₂ S 100 | 68 09 110 |
| XS R H ₂ S | 68 10 260 |
| XS-2 H ₂ S | 68 10 370 |
| XS EC H ₂ S 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 N₂ possible

CONTENTS XS SENSORS

| XS Sensors | Chemical name (synonym) | |
|-------------------------------------|---|-----|
| XS EC Amine | amine like methylamine, ethylamine, dimethylamine etc. | 184 |
| XS EC Cl ₂ | chlorine | 186 |
| XS EC ClO ₂ | chlorine dioxide | 188 |
| XS EC CO | carbon monoxide | 190 |
| XS 2 CO | carbon monoxide | 190 |
| XS R CO | carbon monoxide | 190 |
| XS EC CO HC | carbon monoxide | 194 |
| XS EC CO ₂ | carbon dioxide | 196 |
| XS EC COCl ₂ | phosgene | 198 |
| XS EC H ₂ | hydrogen | 200 |
| XS EC H ₂ HC | hydrogen | 202 |
| XS EC HCN | hydrogen cyanide | 204 |
| XS EC HF/HCl | hydrogen chloride/hydrogen fluoride | 206 |
| XS EC H ₂ S | hydrogen sulfide | 208 |
| XS 2 H ₂ S | hydrogen sulfide | 208 |
| XS R H ₂ S | hydrogen sulfide | 208 |
| XS EC H ₂ S HC | hydrogen sulfide | 212 |
| XS EC H ₂ O ₂ | hydrogen peroxide | 214 |
| XS EC Hydrazine | hydrazine | 216 |
| XS EC Hydride | hydride like hydrogen phosphide, phosphine, arsine etc. | 218 |
| XS EC NH ₃ | ammonia | 220 |
| XS EC NO | nitrogen monoxide | 222 |
| XS EC NO ₂ | nitrogen dioxide | 224 |
| XS EC Odorant | sulfur compounds like tetrahydrothiophene, methylmercaptan, ethylmercaptan etc. | 226 |
| XS EC OV | organic gases and vapors like ethylene oxide, ethene, propene etc. | 228 |
| XS EC OV-A | organic gases and vapors like ethylene oxide, styrene isobutylene etc. | 230 |
| XS EC O ₂ -LS | oxygen | 232 |
| XS 2 O ₂ | oxygen | 232 |
| XS R O ₂ | oxygen | 232 |
| XS EC O ₂ 100 | oxygen | 236 |
| XS EC PH ₃ HC | hydrogen phosphide, phosphine | 238 |
| XS EC SO ₂ | sulfur dioxide | 240 |

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/ | 0 to 100 ppm CH ₃ NH ₂ (methylamine) | 0.70 |
| Relative sensitivity | 0 to 100 ppm (CH ₃) ₂ NH (dimethylamine) | 0.50 |
| | 0 to 100 ppm (CH ₃) ₃ N (trimethylamine) | 0.50 |
| | 0 to 100 ppm C ₂ H ₅ NH ₂ (ethylamine) | 0.70 |
| | 0 to 100 ppm (C ₂ H ₅) ₂ NH (diethylamine) | 0.50 |
| | 0 to 100 ppm (C ₂ H ₅) ₃ N (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 ₃ NH ₂ , (CH ₃) ₂ NH, (CH ₃) ₃ N, C ₂ H ₅ NH ₂ , (C ₂ H ₅) ₂ NH, (C ₂ H ₅) ₃ N | |

* 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 may fluctuate by $\pm 30\%$. 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 ₃ COCH ₃ | 1,000 ppm | No effect |
| Acetylene | C ₂ H 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 ₂ H ₄ | 1,000 ppm | ≤ 3 |
| Hydrogen | H ₂ | 1,000 ppm | ≤ 3 |
| Hydrogen cyanide | HCN | 25 ppm | ≤ 3 |
| Hydrogen sulfide | H ₂ S | 20 ppm | ≤ 50 |
| Methane | CH ₄ | 10 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 ₄ H ₈ S | 10 ppm | ≤ 10 |

(-) Indicates negative deviation

DrägerSensor® XS EC Cl₂

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/ | 0 to 20 ppm Cl ₂ (chlorine) 1.00 |
| Relative sensitivity | 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 may fluctuate by $\pm 30\%$. 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 ₂ H 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 ₂ H ₄ | 1,000 ppm | No effect |
| Hydrogen | H ₂ | 1,000 ppm | No effect |
| Hydrogen cyanide | HCN | 20 ppm | ≤ 0.1 |
| Hydrogen sulfide | H ₂ S | 20 ppm | ≤ 0.1 ⁽⁻⁾ |
| i-propanol | (CH ₃) ₂ CHOH | 1 Vol. % | No effect |
| Methane | CH ₄ | 4 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 ₄ H ₈ S | 1,000 ppm | No effect |

DrägerSensor® XS EC ClO₂

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

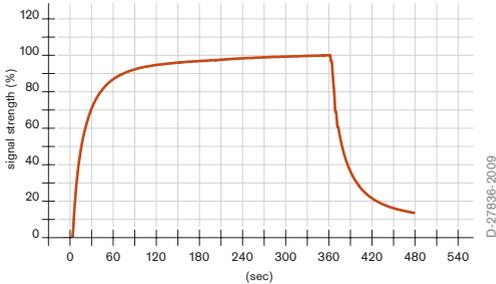
| | |
|--|---|
| Detection limit: | 0.02 ppm |
| Resolution: | 0.01 ppm |
| Measurement range: | 0 to 20 ppm ClO ₂ (chlorine dioxide) |
| Response time: | ≤ 20 seconds (t ₅₀) |
| Precision | |
| Sensitivity: | ≤ ± 5% of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | ≤ ± 0.03 ppm/year |
| 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 ClO₂ at 20 °C / 68 °F

Flow = 0.5 l/min, with 0.1 ppm ClO₂



The values given in the table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 ₂ S | 20 ppm | $\leq 0.5(-)$ |
| Methane | CH ₄ | 1 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 |
| | | | XS 2: 2 | > 3 years |
| | | | | = 5 years (limited operation time) |

Selective filter

D3T, 68 09 022 – replaceable for XS EC + XS R

A2T, 68 10 378 – replaceable for XS-2

Cross sensitivity of alcohols and acid gases (H₂S, SO₂) 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 H₂S 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 H₂S, SO₂.

The values shown in the following table are standard and apply to new sensors. The values may 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 ₃ COCH ₃ | 1,000 ppm | ≤ 20 | No effect |
| Acetylene | C ₂ H 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 ₂ Cl ₂ | 1,000 ppm | No effect | No effect |
| Ethane | C ₂ H ₆ | 0.2 Vol. % | No effect | No effect |
| Ethanol | C ₂ H ₅ OH | 200 ppm | ≤ 400 | No effect |
| Ethene | C ₂ H ₄ | 10 ppm | ≤ 25 | ≤ 25 |
| Ethyl acetate | CH ₂ COOC ₂ H 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 ₂ S | 30 ppm | ≤ 120 | No effect |
| Methane | CH ₄ | 5 Vol. % | No effect | No effect |
| Methanol | CH ₃ OH | 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 ₃ H 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 ₆ H ₅ CH ₃ | 1,000 ppm | No effect | No effect |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect | No effect |

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 ₃ COCH ₃ | 1,000 ppm | ≤ 20 | No effect |
| Acetylene | C ₂ H 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 ₂ Cl ₂ | 1,000 ppm | No effect | No effect |
| Ethane | C ₂ H ₆ | 0.2 Vol. % | No effect | No effect |
| Ethanol | C ₂ H ₆ OH | 200 ppm | ≤ 400 | No effect |
| Ethene | C ₂ H ₄ | 10 ppm | ≤ 25 | ≤ 25 |
| Ethyl acetate | CH ₃ COOC ₂ H ₅ | 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 ₂ S | 30 ppm | ≤ 120 | No effect |
| Methane | CH ₄ | 5 Vol. % | No effect | No effect |
| Methanol | CH ₃ OH | 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 ₃ H 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 ₆ H ₅ CH 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 ₃ COCH ₃ | 1,000 ppm | ≤ 20 | No effect |
| Acetylene | C ₂ H 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 ₂ Cl ₂ | 1,000 ppm | No effect | No effect |
| Ethane | C ₂ H ₆ | 0.2 Vol. % | No effect | No effect |
| Ethanol | C ₂ H ₅ OH | 200 ppm | ≤ 400 | No effect |
| Ethene | C ₂ H ₄ | 50 ppm | ≤ 25 | ≤ 10 |
| Ethyl acetate | CH ₃ COOC ₂ H ₅ | 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 ₂ S | 30 ppm | ≤ 120 | No effect |
| Methane | CH ₄ | 5 Vol. % | No effect | No effect |
| Methanol | CH ₃ OH | 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 ₃ H 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 ₄ H ₈ S | 5 ppm | No effect | No effect |
| Toluene | C ₂ H ₅ CH 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 $\pm 30\%$. 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 ₃ COCH ₃ | 1,000 ppm | ≤ 30 |
| Ammonia | NH ₃ | 200 ppm | No effect |
| Benzene | C ₆ H ₆ | 0.6 Vol. % | No effect |
| Carbon dioxide | CO ₂ | 10 Vol. % | No effect |
| Chlorine | Cl ₂ | 20 ppm | ≤ 8 ⁽⁻⁾ |
| Ethanol | C ₂ H ₅ OH | 200 ppm | ≤ 400 |
| Ethene | C ₂ H 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 ₂ S | 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 ₄ H ₈ S | 10 ppm | ≤ 4 |

DrägerSensor® XS EC CO₂

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 CO₂ concentrations in the ambient air.

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 | $\leq 0.1^{(-)}$ |
| Boron trichloride | BCl ₃ | 15 ppm | No effect |
| Carbon monoxide | CO | 100 ppm | No effect |
| Chlorine | Cl ₂ | 5 ppm | $\leq 0.1^{(-)}$ |
| Ethanol | C ₂ H ₅ OH | 130 ppm | $\leq 0.1^{(-)}$ |
| Ethene | C ₂ H ₄ | 50 ppm | $\leq 0.1^{(-)}$ |
| Hydrogen | H ₂ | 1,000 ppm | $\leq 0.1^{(-)}$ |
| Hydrogen chloride | HCl | 20 ppm | $\leq 0.1^{(-)}$ |
| Hydrogen phosphide | PH ₃ | 5 ppm | $\leq 0.1^{(-)}$ |
| Hydrogen sulfide | H ₂ S | 20 ppm | $\leq 0.1^{(-)}$ |
| Methane | CH ₄ | 30 Vol. % | No effect |
| Methanol | CH ₃ OH | 200 ppm | $\leq 0.1^{(-)}$ |
| Nitrogen dioxide | NO ₂ | 20 ppm | $\leq 0.1^{(-)}$ |
| Nitrogen monoxide | NO | 20 ppm | $\leq 0.1^{(-)}$ |
| Sulfur dioxide | SO ₂ | 20 ppm | $\leq 0.1^{(-)}$ |

DrägerSensor® XS EC COCl₂

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 may fluctuate by $\pm 30\%$. 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 | $\text{C}_2\text{H}_5\text{OH}$ | 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 | $\leq 0.1^{(-)}$ |
| Nitrogen monoxide | NO | 30 ppm | No effect |
| Ozone | O_3 | 0.3 ppm | $\leq 0.05^{(-)}$ |
| Propanol | $\text{C}_3\text{H}_7\text{OH}$ | 500 ppm | No effect |
| Sulfur dioxide | SO_2 | 2 ppm | No effect |

DrägerSensor® XS EC H₂

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 H₂ (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 may fluctuate by $\pm 30\%$. 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 H₂. 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 ₃ COCH ₃ | 1,000 ppm | ≤ 10 |
| Acetylene | C ₂ H 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 ₂ H 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 ₃ OH | 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 ₄ H ₈ S | 20 ppm | ≤ 10 |

DrägerSensor® XS EC H₂ 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. % H₂, 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 may fluctuate by $\pm 30\%$. 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 H₂. 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 ₂ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Ethylene | C ₂ H ₄ | 1,000 ppm | ≤ 0.1 |
| Hydrogen cyanide | HCN | 50 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 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 may fluctuate by $\pm 30\%$. 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 | $\leq 10^{(-)}$ |
| Ethene | C_2H_4 | 1,000 ppm | No effect |
| Ethylene oxide | $\text{C}_2\text{H}_4\text{O}$ | 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 | $(\text{CH}_3)_2\text{CHOH}$ | 500 ppm | No effect |
| Methane | CH_4 | 20 Vol. % | No effect |
| Methanol | CH_3OH | 175 ppm | No effect |
| Nitrogen dioxide | NO_2 | 10 ppm | $\leq 10^{(-)}$ |
| 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 | $\text{C}_4\text{H}_8\text{S}$ | 10 ppm | ≤ 0.5 |

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 (HNO₃), hydrogen bromide (HBr), phosphoryl trichloride (POCl₃), phosphorous trichloride (PCl₃) and HF (hydrogen fluoride) in the ambient air.

The values shown in the following table are standard and apply to new sensors. The values may 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

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 ₂ O ₂ | 20 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 30 ppm | ≤ 2 |
| i-propanol | (CH ₃) ₂ CHOH | 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 NH₃, amines) can impair the function of the sensor. If in doubt, perform a function test.

DrägerSensor® XS EC H₂S

DrägerSensor® XS 2 H₂S

DrägerSensor® XS R H₂S

Order no. 68 09 110

68 10 370

68 10 260

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|------------------|-------------|-------------|--|---|------------------|
| Dräger X-am 7000 | yes | yes | XS EC: 3 years 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 ₂ S (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 ₂ S 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 may fluctuate by $\pm 30\%$. 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 H₂S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS EC H₂S

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S |
|----------------------|---|---------------|---------------------------------|
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | ≤ 4 |
| Acetylene | C ₂ H ₂ | 0.6 Vol. % | ≤ 10 |
| Ammonia | NH ₃ | 500 ppm | No effect |
| Benzene | C ₆ H 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 ₃ SSCH ₃ | 20 ppm | ≤ 13 |
| Dimethylsulfide | (CH ₃) ₂ S | 20 ppm | ≤ 6 |
| Ethanol | C ₂ H ₅ OH | 200 ppm | ≤ 2 |
| Ethanethiol | C ₂ H ₅ SH | 20 ppm | ≤ 5 |
| Ethene | C ₂ H ₄ | 1,000 ppm | ≤ 10 |
| Gasoline | - | 0.55 Vol. % | No effect |
| Hexane | C ₆ H 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 ₃ OH | 200 ppm | ≤ 10 |
| Methylmercaptane | CH ₃ SH | 20 ppm | ≤ 15 |
| Nitrogen dioxide | NO ₂ | 20 ppm | No effect |
| Nitrogen monoxide | NO | 20 ppm | ≤ 10 |
| Octane | C ₈ H ₁₈ | 0.4 Vol. % | No effect |
| Phosphine | PH ₃ | 5 ppm | ≤ 5 |
| Propane | C ₃ H ₈ | 1 Vol. % | No effect |
| Propene | C ₃ H ₆ | 0.5 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | ≤ 4 |
| sec-Butylmercaptan | C ₄ H ₁₀ SH | 20 ppm | ≤ 7 |
| Tetrahydrothiophene | C ₄ H ₅ S | 20 ppm | ≤ 4 |
| Toluene | C ₂ H ₅ CH ₃ | 0.6 Vol. % | No effect |
| tert-Butylmercaptane | (CH ₃) ₃ CSH | 20 ppm | ≤ 10 |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect |
| Xylol | C ₆ H ₄ (CH ₃) ₂ | 0.5 Vol. % | ≤ 4 |

(-) Indicates negative deviation

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS 2 H₂S

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H₂S |
|---------------------|-----------------------------------|----------------------|--------------------------------------|
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | ≤4 |
| Acetylene | C ₂ H 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 ₂ H ₆ | 0.2 Vol. % | No effect |
| Ethanol | C ₂ H ₅ OH | 200 ppm | ≤2 |
| Ethanethiol | C ₂ H ₅ SH | 10 ppm | ≤5 |
| Ethene | C ₂ H ₄ | 1,000 ppm | ≤10 |
| Hexane | C ₆ H 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 ₃ OH | 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 ₃ H ₈ | 1 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | ≤4 |
| Tetrahydrothiophene | C ₄ H ₈ S | 10 ppm | ≤4 |
| Toluene | C ₇ H ₈ | 0.6 Vol. % | No effect |
| Xylene | C ₈ H ₁₀ | 0.5 Vol. % | ≤4 |

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS R H₂S

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S |
|---------------------|---|---------------|---------------------------------|
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | ≤ 4 |
| Acetylene | C ₂ H ₂ | 0.6 Vol. % | ≤ 10 |
| Ammonia | NH ₃ | 500 ppm | No effect |
| Benzene | C ₆ H 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 ₂ H ₅ OH | 200 ppm | ≤ 2 |
| Ethanethiol | C ₂ H ₅ SH | 10 ppm | ≤ 5 |
| Ethene | C ₂ H ₄ | 1,000 ppm | ≤ 10 |
| Gasoline | - | 0.55 Vol. % | No effect |
| Hexane | C ₆ H 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 ₃ OH | 200 ppm | ≤ 10 |
| Nitrogen dioxide | NO ₂ | 20 ppm | No effect |
| Nitrogen monoxide | NO | 20 ppm | ≤ 10 |
| Octane | C ₈ H ₁₈ | 0.4 Vol. % | No effect |
| Phosgene | COCl ₂ | 50 ppm | No effect |
| Phosphine | PH ₃ | 5 ppm | ≤ 5 |
| Propane | C ₃ H ₈ | 1 Vol. % | No effect |
| Propene | C ₃ H ₆ | 0.5 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | ≤ 4 |
| Tetrahydrothiophene | C ₄ H ₅ S | 10 ppm | ≤ 4 |
| Toluene | C ₂ H ₅ CH ₃ | 0.6 Vol. % | No effect |
| Xylene | C ₆ H ₄ (CH ₃) ₂ | 0.5 Vol. % | ≤ 4 |

DrägerSensor® XS EC H₂S 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 ₂ S (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 ₂ S 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 may fluctuate by $\pm 30\%$. 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 | $\leq 2^{(-)}$ |
| Ethanol | $\text{C}_2\text{H}_5\text{OH}$ | 200 ppm | ≤ 2 |
| Ethanethiol | $\text{C}_2\text{H}_5\text{SH}$ | 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 | $\text{C}_4\text{H}_8\text{S}$ | 10 ppm | ≤ 2 |
| Toluene | $\text{C}_6\text{H}_5\text{CH}_3$ | 0.6 Vol. % | No effect |
| Xylol | $\text{C}_6\text{H}_4(\text{CH}_3)_2$ | 0.5 Vol. % | ≤ 4 |

(–) Indicates negative deviation

DrägerSensor® XS EC H₂O₂

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 ₂ O 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: | <p>Alternatively, the sensor can be calibrated with 10 ppm SO₂. Such surrogate calibration with SO₂ can lead to an additional measuring error of up to 30 %.</p> <p>Following a surrogate calibration or sensor change, the following bump test must be performed (at 20 °C to 30 °C):</p> <p>Add 15 mL of a 3 % hydrogen peroxide solution into a 25-mL beaker. Hold the device above the container.</p> <p>Evaluation: After a maximum of 30 seconds, the reading must be greater than 1 ppm H₂O₂. If the value displayed is less than 1 ppm H₂O₂, a new H₂O₂ solution must be used or a calibration carried out.</p> |

SPECIAL CHARACTERISTICS

This sensor is used in the Dräger X-am 5100 to monitor the H₂O₂ (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 may fluctuate by $\pm 30\%$. 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 H₂O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ O ₂ |
|---------------------|-----------------------------------|---------------|--|
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | No effect |
| Acetylene | C ₂ H 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 ₂ H 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 ₂ S | 20 ppm | ≤ 80 |
| i-propanol | (CH ₃)CHOH | 500 ppm | No effect |
| Methane | CH ₄ | 5 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 ₄ H ₈ S | 10 ppm | ≤ 5 |

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 ₂ H ₄ (hydrazine) 1 |
| | 0 to 5 ppm CH ₃ NH-NH ₂ (methyl hydrazine) 0.6 |
| | 0 to 5 ppm (CH ₃) ₂ N-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 ₂ H ₄ , CH ₃ NH-NH ₂ , (CH ₃) ₂ N-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 ($\text{CH}_3\text{NH-NH}_2$), and dimethylhydrazine ($(\text{CH}_3)_2\text{N-NH}_2$).

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 | $\leq 0.1(-)$ |
| Ethanol | $\text{C}_2\text{H}_5\text{OH}$ | 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 | $(\text{CH}_3)_2\text{CHOH}$ | 1,000 ppm | No effect |
| Methane | CH_4 | 3 Vol. % | No effect |
| Nitrogen dioxide | NO_2 | 20 ppm | $\leq 0,05$ |
| 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 ₂ H 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 ₂ H 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 ₂ Se (hydrogen selenide)* 0.40 |
| Response time: | ≤ 10 seconds (t ₉₀) for PH ₃ , B ₂ H ₆ , SiH ₄ ≤ 20 seconds (t ₉₀) for AsH ₃ , GeH ₄ , H ₂ Se |
| 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 ₂ H ₆ , GeH ₄ , H ₂ Se |
| 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 ₂ Se |
| 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 ₂ Se 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 ₂ H ₆ |

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

SPECIAL CHARACTERISTICS

This sensor can be used to monitor the concentration of PH₃ (hydrogen phosphide), AsH₃ (arsine), B₂H₆ (diborane), GeH₄ (germanium tetrahydride) or SiH₄ (silane) in the ambient air. It is sufficient to calibrate the sensor using a PH₃ 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 may 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 ₃ COCH ₃ | 1,000 ppm | No effect |
| Acetylene | C ₂ H 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 ₂ H 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 ₂ S | 20 ppm | ≤ 20 |
| i-propanol | (CH ₃) ₂ CHOH | 1 Vol. % | No effect |
| Methane | CH ₄ | 4 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 |

DrägerSensor® XS EC NH₃

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 may fluctuate by $\pm 30\%$. 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. % | $\leq 5^{(-)}$ |
| Carbon monoxide | CO | 200 ppm | No effect |
| Chlorine | Cl_2 | 10 ppm | $\leq 20^{(-)}$ |
| 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 | $\leq 10^{(-)}$ |
| Nitrogen monoxide | NO | 20 ppm | ≤ 10 |
| Phosphine | PH_3 | 5 ppm | ≤ 8 |
| Sulfur dioxide | SO_2 | 20 ppm | No effect |
| Tetrahydrothiophene | $\text{C}_4\text{H}_8\text{S}$ | 10 ppm | ≤ 10 |

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 may fluctuate by $\pm 30\%$. 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 ₃ COCH ₃ | 1,000 ppm | No effect |
| Acetylene | C ₂ H ₂ | 0.8 Vol. % | ≤ 2 |
| Ammonia | NH ₃ | 500 ppm | No effect |
| Benzene | C ₆ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H 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 ₂ S | 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 ₃ H ₈ | 1 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 10 ppm | ≤ 2 |
| Tetrachloroethylene | CCl ₂ CCl ₂ | 1,000 ppm | No effect |
| Toluene | C ₆ H ₅ CH ₃ | 0.6 Vol. % | No effect |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect |

DrägerSensor® XS EC NO₂

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 may fluctuate by $\pm 30\%$. 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 | $\leq 60^{(-)}$ |
| 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 | $\leq 1^{(-)}$ |
| Formaldehyde | HCHO | 50 ppm | No effect |
| Hydrogen | H_2 | 1,000 ppm | $\leq 2^{(-)}$ |
| Hydrogen cyanide | HCN | 50 ppm | $\leq 10^{(-)}$ |
| Hydrogen sulfide | H_2S | 20 ppm | $\leq 100^{(-)}$ |
| 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 | $\leq 25^{(-)}$ |
| Sulfur dioxide | SO_2 | 50 ppm | $\leq 50^{(-)}$ |
| Tetrahydrothiophene | $\text{C}_4\text{H}_8\text{S}$ | 10 ppm | $\leq 5^{(-)}$ |

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 | 0 to 40 ppm C_4H_6S (tetrahydrothiophene) | 1.00 |
| relative sensitivity | 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 may fluctuate by $\pm 30\%$. 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 ₃ COCH 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 ₂ H 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 ₂ S | 10 ppm | ≤ 30 | No effect |
| Methane | CH ₄ | 100 Vol. % | No effect | No effect |
| Methanol | CH ₃ OH | 175 ppm | ≤ 8 | ≤ 8 |
| Nitrogen dioxide | NO ₂ | 20 ppm | ≤ 2 | ≤ 2 |
| Nitrogen monoxide | NO | 20 ppm | ≤ 30 | ≤ 30 |
| n-propyl mercaptan | C ₃ H ₇ SH | 6 ppm | ≤ 4 | ≤ 4 |
| Phosphine | PH ₃ | 5 ppm | ≤ 15 | ≤ 15 |
| Sulfur dioxide | SO ₂ | 20 ppm | ≤ 15 | No effect |

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 ₂ H ₄ O (ethylene oxide) 1.00 |
| | 0 to 200 ppm C ₃ H ₆ O (propylene oxide) 0.80 |
| | 0 to 100 ppm C ₂ H ₄ (ethene) 1.10 |
| | 0 to 100 ppm C ₃ H ₆ (propene) 0.70 |
| | 0 to 100 ppm C ₂ H ₃ Cl (vinyl chloride) 0.80 |
| | 0 to 200 ppm CH ₃ OH (methanol) 1.20 |
| | 0 to 300 ppm C ₂ H ₅ OH (ethanol) 0.60 |
| | 0 to 200 ppm CH ₃ CHO (acetaldehyde) 0.30 |
| | 0 to 100 ppm CH ₂ CHCHCH ₂ (butadiene) 1.20 |
| | 0 to 100 ppm HCHO (formaldehyde) 1.00 |
| | 0 to 100 ppm CH ₃ COOC ₂ H ₃ (vinyl acetate) 0.80 |
| 0 to 300 ppm (H ₃ C) ₂ CHOH (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 ₂ H ₄ , C ₃ H ₆ , C ₂ H ₃ Cl, CH ₂ CHCHCH ₂ , HCHO, CH ₃ COOC ₂ H ₃ |
| | 5 to 200 ppm C ₂ H ₄ O, C ₃ H ₆ O, CH ₃ OH |
| | 10 to 200 ppm CH ₃ CHO |
| | 20 to 300 ppm C ₂ H ₅ OH, (H ₃ C) ₂ CHOH |

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 may fluctuate by $\pm 30\%$. 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 ₂ H ₄ O |
|-----------------------------------|---|---------------|--|
| Acetic acid | CH ₃ COOH | 100 ppm | No effect |
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | ≤ 15 |
| Ammonia | NH ₃ | 100 ppm | No effect |
| Benzene | C ₆ H 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 ₆ H ₅ Cl | 200 ppm | No effect |
| Dichloromethane | CH ₂ Cl ₂ | 1,000 ppm | No effect |
| Dimethyl disulfide | (CH ₃) ₂ S ₂ | 50 ppm | ≤ 65 |
| Dimethyl sulfide | (CH ₃) ₂ S | 50 ppm | ≤ 40 |
| Dimethylformamide | HCON(CH ₃) ₂ | 100 ppm | No effect |
| Ethane | C ₂ H ₆ | 0.2 Vol. % | No effect |
| Ethyl acetate | CH ₃ COOC ₂ H 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 ₂ S | 10 ppm | ≤ 20 |
| Methane | CH ₄ | 2 Vol. % | No effect |
| Methanethiol | CH ₃ SH | 50 ppm | ≤ 75 |
| Methyl isobutyl ketone | (CH ₃) ₂ CHCH ₂ COCH ₃ | 500 ppm | No effect |
| Nitrogen dioxide | NO ₂ | 50 ppm | ≤ 5 |
| Nitrogen monoxide | NO | 25 ppm | ≤ 25 |
| Phenol | C ₆ H ₅ OH | 30 ppm | ≤ 6 |
| Phosgene | COCl ₂ | 50 ppm | No effect |
| Propane | C ₃ H ₈ | 1 Vol. % | ≤ 3 |
| Sulfur dioxide | SO ₂ | 10 ppm | ≤ 4 |
| Tetrachloroethylene | CCl ₂ CCl ₂ | 100 ppm | No effect |
| Toluene | C ₆ H ₅ CH ₃ | 1,000 ppm | No effect |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect |
| Xylol | C ₆ H 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 ₂ H ₄ O (ethylene oxide) 1.00 |
| | 0 to 100 ppm H ₂ CCHCN (acrylonitrile) 0.10 |
| | 0 to 100 ppm C ₆ H ₅ CHCH ₂ (styrene) 0.50 |
| | 0 to 100 ppm H ₂ CC(CH ₃)COOCH ₃ (methyl methacrylate) 0.30 |
| | 0 to 300 ppm (CH ₃) ₂ CCH ₂ (isobutylene) 0.70 |
| | 0 to 100 ppm C ₂ H ₃ OCH ₂ Cl (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 ₂ H ₄ O, C ₂ H ₃ OCH ₂ 10 to 100 ppm H ₂ CCHCN, C ₆ H ₅ CHCH ₂ , H ₂ CC(CH ₃)COOCH ₃ , 20 to 300 ppm (CH ₃) ₂ CCH ₂ |

SPECIAL CHARACTERISTICS

The DrägerSensor® XS OV-A has the same excellent insensitivity to moisture that the other Dräger-Sensor® XS OV's 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 may fluctuate by $\pm 30\%$. 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 ₂ H ₄ O |
|------------------------|---|---------------|--|
| Acetic acid | CH ₃ COOH | 100 ppm | No effect |
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | ≤ 15 |
| Ammonia | NH ₃ | 100 ppm | No effect |
| Benzene | C ₆ H 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 ₆ H ₅ Cl | 200 ppm | No effect |
| Dichloromethane | CH ₂ Cl ₂ | 1,000 ppm | No effect |
| Dimethyl disulfide | (CH ₃) ₂ S ₂ | 50 ppm | ≤ 65 |
| Dimethyl sulfide | (CH ₃) ₂ S | 50 ppm | ≤ 40 |
| Dimethylformamide | HCON(CH ₃) ₂ | 100 ppm | No effect |
| Ethyl acetate | CH ₃ COOC ₂ H 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 ₂ S | 10 ppm | ≤ 20 |
| Methane | CH ₄ | 2 Vol. % | No effect |
| Methanethiol | CH ₃ SH | 50 ppm | ≤ 75 |
| Methyl isobutyl ketone | (CH ₃) ₂ CHCH ₂ COCH ₃ | 500 ppm | No effect |
| Nitrogen dioxide | NO ₂ | 50 ppm | ≤ 5 |
| Nitrogen monoxide | NO | 25 ppm | ≤ 25 |
| Phenol | C ₆ H ₅ OH | 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 O₂-LS

DrägerSensor® XS 2 O₂

DrägerSensor® XS R O₂

Order no. 68 09 130

68 10 375

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 may fluctuate by $\pm 30\%$. 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 O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS EC O₂ LS

| Gas/vapor | Chem. symbol | Concentration | Display in Vol. % O ₂ |
|-------------------|----------------------------------|---------------|----------------------------------|
| Acetylene | C ₂ H 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 ₂ H ₆ | 5 Vol. % | No effect |
| Ethanol | C ₂ H ₅ OH | 1 Vol. % | ≤ 0.2 ⁽⁻⁾ |
| Ethene | C ₂ H ₄ | 2 Vol. % | ≤ 0.5 ⁽⁻⁾ |
| Hydrogen | H ₂ | 1 Vol. % | ≤ 1.6 ⁽⁻⁾ |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 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 ₃ H ₈ | 2 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 50 ppm | No effect |

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS 2 O₂

| Gas/vapor | Chem. symbol | Concentration | Display in Vol. % O₂ |
|-------------------|----------------------------------|----------------------|--|
| Acetylene | C ₂ H 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 ₂ H ₆ | 5 Vol. % | No effect |
| Ethanol | C ₂ H ₅ OH | 1 Vol. % | ≤ 0.2 ⁽⁻⁾ |
| Ethene | C ₂ H ₄ | 2 Vol. % | ≤ 0.5 ⁽⁻⁾ |
| Hydrogen | H ₂ | 1 Vol. % | ≤ 1.6 ⁽⁻⁾ |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 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 ₃ H ₈ | 2 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 50 ppm | No effect |

RELEVANT CROSS-SENSITIVITIES DrägerSensor® XS R O₂

| Gas/vapor | Chem. symbol | Concentration | Display in Vol. % O₂ |
|-------------------|----------------------------------|----------------------|--|
| Acetylene | C ₂ H 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 ₂ H ₆ | 5 Vol. % | No effect |
| Ethanol | C ₂ H ₅ OH | 1 Vol. % | ≤ 0.2 ⁽⁻⁾ |
| Ethene | C ₂ H ₄ | 2 Vol. % | ≤ 0.5 ⁽⁻⁾ |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 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 ₃ H ₈ | 2 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 50 ppm | No effect |

DrägerSensor® XS EC O₂ 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. % O₂ 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 may fluctuate by $\pm 30\%$. 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 O₂. 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 ₂ S | 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 ₃ H ₈ | 2 Vol. % | No effect |
| Sulfur dioxide | SO ₂ | 50 ppm | No effect |

DrägerSensor® XS EC PH₃ 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 $\pm 30\%$. 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 ₃ COCH 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 ₂ H ₆ | 5 ppm | ≤ 3 |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H 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 ₂ Se | 5 ppm | ≤ 2 |
| Hydrogen sulfide | H ₂ S | 20 ppm | ≤ 20 |
| i-propanol | (CH ₃)CHOH | 1 Vol. % | No effect |
| Methane | CH ₄ | 4 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 ₆ H ₅ CH ₃ | 1 Vol. % | No effect |
| Trimethylboron | B(CH ₃) ₃ | 1 ppm | No effect |

(-) Indicates negative deviation

DrägerSensor® XS EC SO₂

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

KIT, 68 09 163 – replaceable

Eliminates cross-sensitivity to hydrogen sulfide (H₂S).

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 H₂S 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 KIT selective filter (order no. 68 09 163) is an accessory for the DrägerSensor® XS EC SO₂ 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 may 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 SO₂. 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 ₃ CHO | 500 ppm | No effect |
| Acetone | CH ₃ COCH ₃ | 1,000 ppm | No effect |
| Acetylene | C ₂ H 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 ₂ H 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 ₂ S | 20 ppm | ≤ 100 |
| Methane | CH ₄ | 2 Vol. % | No effect |
| Methanol | CH ₃ OH | 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 ₄ H ₈ S | 10 ppm | ≤ 5 |

CONTENTS XXS SENSORS

| DrägerSensor® XXS | Chemical name (synonym) | |
|---|---|-----|
| XXS Amine | amine like methylamine, ethylamine, dimethylamine etc. | 244 |
| XXS Cl ₂ | chlorine | 246 |
| XXS CO | carbon monoxide | 248 |
| XXS E CO | carbon monoxide | 248 |
| XXS CO LC | carbon monoxide | 250 |
| XXS CO HC | carbon monoxide | 252 |
| XXS CO H ₂ -CP | carbon monoxide/hydrogen | 254 |
| XXS CO ₂ | carbon dioxide | 256 |
| XXS COCl ₂ | phosgene | 258 |
| XXS H ₂ | hydrogen | 260 |
| XXS H ₂ HC | hydrogen | 262 |
| XXS HCN | hydrogen cyanide | 264 |
| XXS HCN PC | hydrogen cyanide | 266 |
| XXS H ₂ S | hydrogen sulfide | 268 |
| XXS E H ₂ S | hydrogen sulfide | 268 |
| XXS H ₂ S HC | hydrogen sulfide | 270 |
| XXS H ₂ S LC | hydrogen sulfide | 272 |
| XXS H ₂ S/CO | hydrogen sulfide/carbon monoxide | 274 |
| XXS H ₂ S LC/CO LC | hydrogen sulfide/carbon monoxide | 276 |
| XXS NH ₃ | ammonia | 278 |
| XXX NO | nitrogen monoxide | 280 |
| XXS NO ₂ | nitrogen dioxide | 282 |
| XXS NO ₂ LC | nitrogen dioxide | 284 |
| XXS OV | organic vapors like ethylene oxide, ethene, propene, styrene etc. | 286 |
| XXS OV-A | organic vapors like acrylonitrile, vinyl acetate etc. | 290 |
| XXS O ₂ | oxygen | 294 |
| XXS E O ₂ | oxygen | 294 |
| XXS O ₂ PR | oxygen (Poison Resistant) | 296 |
| XXS O ₂ /CO LC | oxygen/carbon monoxide | 298 |
| XXS O ₂ /H ₂ S LC | oxygen/hydrogen sulfide | 300 |
| XXS O ₂ 100 | oxygen | 302 |
| XXS Odorant | sulfur compounds like THT, mercaptans | 304 |
| XXS Ozone | Ozone | 306 |
| XXS PH ₃ | hydrogen phosphide, arsine, diborane, silane | 308 |
| XXS PH ₃ HC | hydrogen phosphide | 310 |
| XXS SO ₂ | sulfur dioxide | 312 |

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

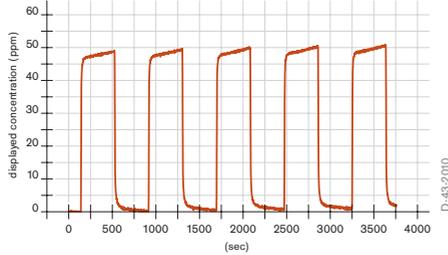
| | |
|--|---|
| Detection limit: | 2 ppm |
| Resolution: | 1 ppm |
| Measurement range/ relative sensitivity | 0 to 100 ppm CH ₃ NH ₂ (methylamine) 0.70 |
| | 0 to 100 ppm (CH ₃) ₂ NH (dimethylamine) 0.50 |
| | 0 to 100 ppm (CH ₃) ₃ N (trimethylamine) 0.50 |
| | 0 to 100 ppm C ₂ H ₅ NH ₂ (ethylamine) 0.70 |
| | 0 to 100 ppm (C ₂ H ₅) ₂ NH (diethylamine) 0.50 |
| | 0 to 100 ppm (C ₂ H ₅) ₃ N (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

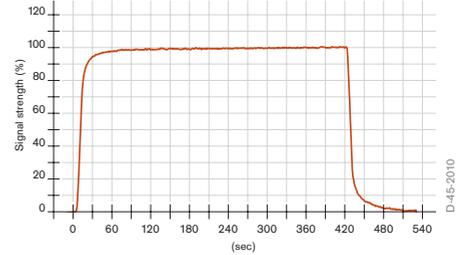
SPECIAL CHARACTERISTICS

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 may fluctuate by $\pm 30\%$. 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 | $\text{C}_4\text{H}_{11}\text{NO}_2$ | 10 ppm | 5 ppm |
| Ethene | C_2H_4 | 1000 ppm | ≤ 3 ppm |
| Ethylidimethylamine | $\text{C}_4\text{H}_{11}\text{N}$ | 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 | $(\text{CH}_3)_2\text{CCH}_2$ | 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 | $\text{C}_4\text{H}_8\text{S}$ | 10 ppm | ≤ 10 ppm |

(-) Indicates negative deviation

DrägerSensor® XXS Cl₂

Order no. 68 10 890

| 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 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.

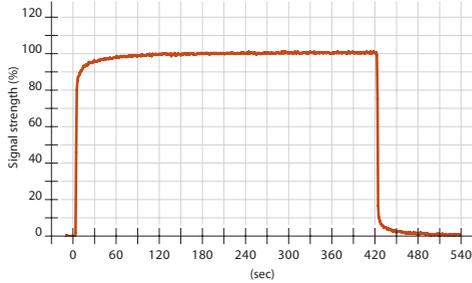
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| 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 |

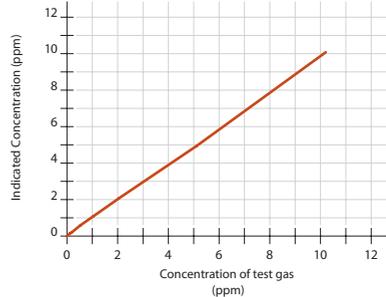
SPECIAL CHARACTERISTICS

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 may fluctuate by $\pm 30\%$. 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 | $\text{C}_2\text{H}_5\text{OH}$ | 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 | $\leq 0.6 (-)$ |
| Isobutylene | $(\text{CH}_3)_2\text{CCH}_2$ | 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 | $\leq 1 (-)$ |

(-) 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 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 (H₂S, SO₂) 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 H₂S 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.

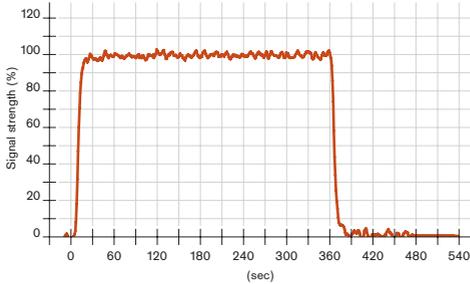
TECHNICAL SPECIFICATIONS

| | |
|--|-------------------------------------|
| 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 |

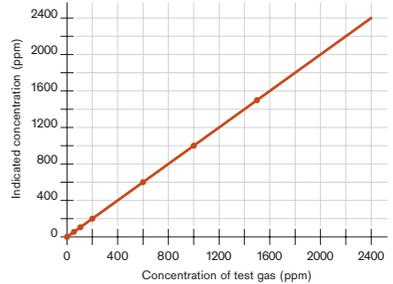
SPECIAL CHARACTERISTICS

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 H₂S, SO₂.

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



Linearity of CO sensor
calibrated with 50 ppm CO



D-27841-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 ₂ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H 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 ₂ S | 30 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H 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 6000/6500 | no | yes | 3 years | > 5 years |
| Dräger X-am 2500 | no | yes | 3 years | > 5 years |
| Dräger X-am 2800 | 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 - unexchangeable

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H₂S, SO₂) 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 H₂S will be: Service life = 10,000 ppm x hours / 10 ppm = 1,000 hours.

MARKET SEGMENTS

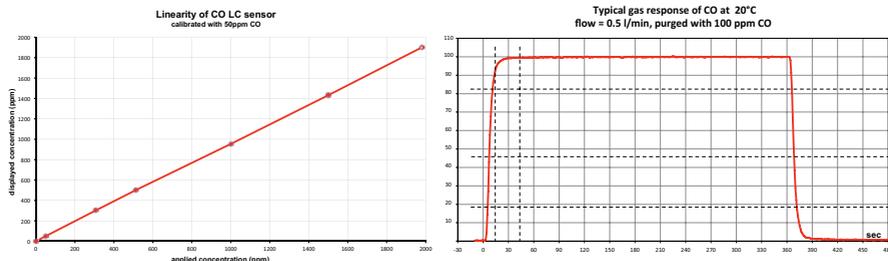
Waste disposal industry, metal processing, petrochemical, fertilizer production, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and gas, measuring dangerous substances, biogas.

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 H₂S, SO₂.



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 ₂ H 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 ₂ H ₄ | 100 ppm | ≤ 300 |
| Ethanol | C ₂ H ₅ OH | 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 ₂ S | 30 ppm | No effect* |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H 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 H₂S.

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 - unexchangeable

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H₂S, SO₂) 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 H₂S 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.

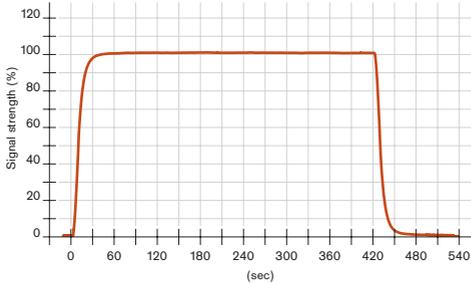
TECHNICAL SPECIFICATIONS

| | |
|--|--------------------------------------|
| 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 |

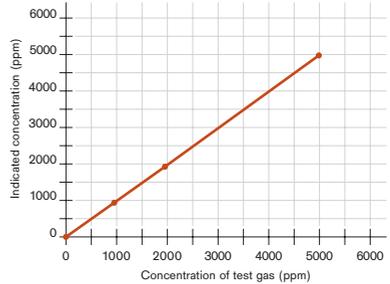
SPECIAL CHARACTERISTICS

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



D-27842-2009

The values shown in the following table are standard and apply to new sensors. The values may 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 ₂ H 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 ₂ H ₅ OH | 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 ₂ S | 30 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H ₈ | 1 Vol.-% | No effect |
| Sulfur dioxide | SO ₂ | 25 ppm | No effect |

DrägerSensor® XXS CO H₂-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 - unexchangeable

Internal selective filter.

Cross sensitivities to alcohol and acid gases (H₂S, SO₂) 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 H₂S will be: Service life = 25,000 ppm x hours / 10 ppm = 2,500 hours.

MARKET SEGMENTS

Steel industry, refineries, sewage treatment plants

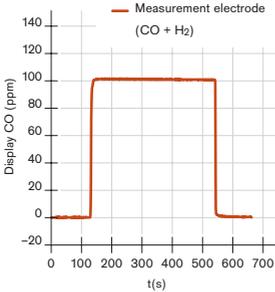
TECHNICAL SPECIFICATIONS

| | |
|--|---|
| 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 |

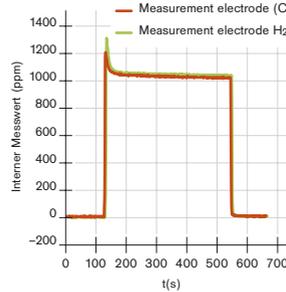
SPECIAL CHARACTERISTICS

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 H₂-CP uses two measuring electrodes – one of which measures CO and H₂, the other only H₂. 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.

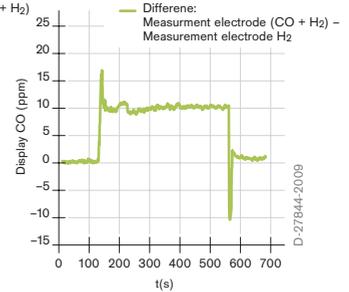
Sensor reaction 100 ppm CO



Internal H₂ signal
Sensor reaction 1022 ppm H₂



Calculated signal
Sensor reaction 1022 ppm H₂



The values shown in the following table are standard and apply to new sensors. The values may 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 ₂ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H 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 ₂ S | 30 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H ₈ | 1 Vol.-% | No effect |
| Sulfur dioxide | SO ₂ | 25 ppm | No effect |

¹⁾ after compensation

DrägerSensor® XXS CO₂

Order no. 68 10 889

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|------------------|-------------|-------------|----------|----------------------|------------------|
| 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.

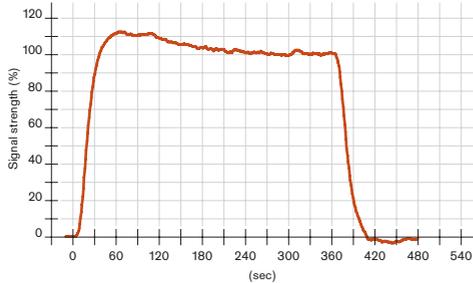
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| 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 |

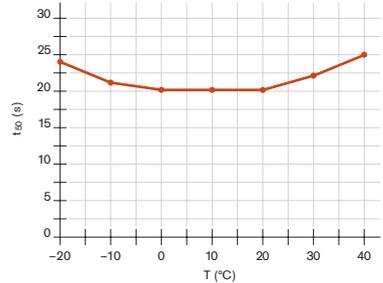
SPECIAL CHARACTERISTICS

This sensor is highly sensitive (see cross-sensitivity list) and offers an economical alternative to infrared sensors if you need to warn against CO₂ concentrations in the ambient air.

Sensor reaction to CO₂ at 20 °C/68 °F
Flow = 0.5 l/min, with 5000 ppm CO₂



Response time (t₅₀) vs. temperature
with 5000 ppm CO₂



D-27840-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 CO₂. 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 ₂ H 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 ₂ H ₅ OH | 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 ₂ S | 20 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 COCl₂

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

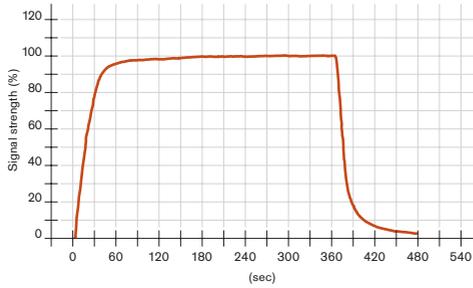
TECHNISCHE DATEN

| | |
|--|---|
| 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) When installing the sensor with CC-Vision, the supplied code number adopted the factory adjustment. A first adjustment not necessary. An inaccuracy of up to ± 30% must be expected. |

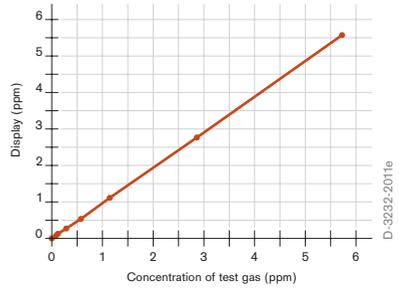
SPECIAL CHARACTERISTICS

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 COCl₂



Linearity of COCl₂ Sensors
calibrated with 0.28 ppm COCl₂



The values shown in the following table are standard and apply to new sensors. The values may 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 COCl₂. 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 ₂ H 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 ₂ H ₅ OH | 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 ₂ O ₂ | 1 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 1 ppm | ≤ 1 ¹⁾ |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H ₇ OH | 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 H₂

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 (H₂S, SO₂) 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 H₂S 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.

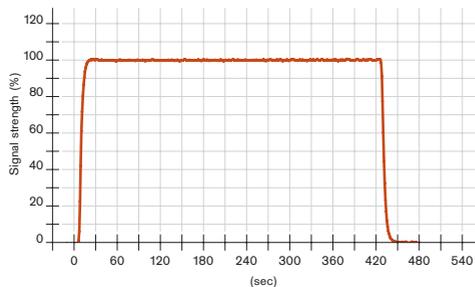
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| 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 |

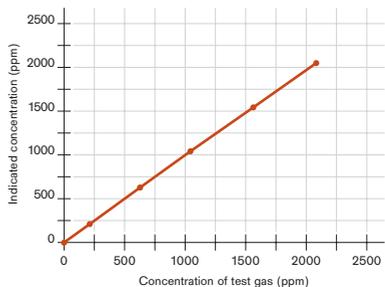
SPECIAL CHARACTERISTICS

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 H₂ at 20 °C/68 °F
Flow = 0.5 l/min, 1000 ppm H₂



Linearity of H₂ sensors
calibrated with 1045 ppm H₂



D-27856-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 H₂. 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 ₂ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen cyanide | HCN | 50 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 30 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H ₈ | 1 Vol.-% | No effect |
| Sulfur dioxide | SO ₂ | 25 ppm | No effect |

DrägerSensor® XXS H₂ 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 (H₂S) and sulfur dioxide (SO₂) 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 H₂S 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.

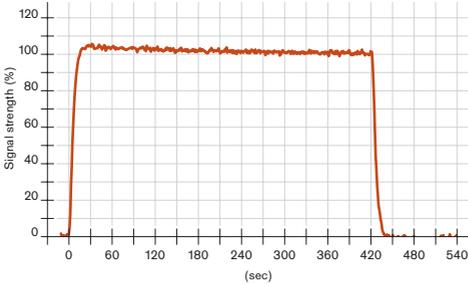
TECHNICAL SPECIFICATIONS

| | |
|--|---|
| 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 |

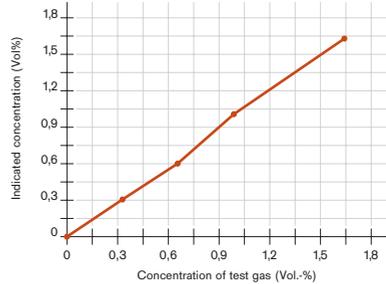
SPECIAL CHARACTERISTICS

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 H₂ HC at 20 °C/68 °F
Flow = 0.5 l/min, with 1,63 Vol% H₂



Linearity of XXS H₂ HC sensors
calibrated with 1.63 Vol% H₂



D-27857-2009

The values shown in the following table are standard and apply to new sensors. The values may 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 H₂. 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 ₂ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen cyanide | HCN | 50 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 30 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H 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 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 |

B2X (6812424) – optional and replaceable

Cross sensitivities to hydrogen sulfide (H₂S) and sulfur dioxide (SO₂) 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 H₂S 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).

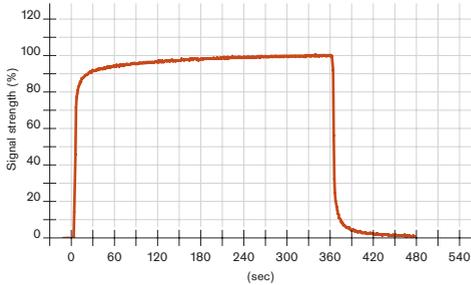
TECHNICAL SPECIFICATIONS

| | |
|--|------------------------------------|
| 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: | ≤ 35 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 |

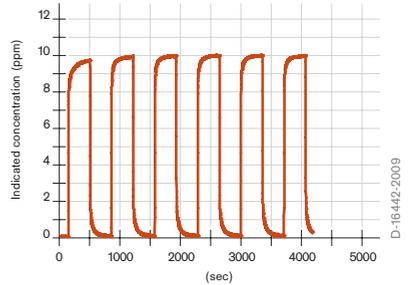
SPECIAL CHARACTERISTICS

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 may fluctuate by $\pm 30\%$. 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 |
| Phosgene | $COCl_2$ | 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 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 |

B2X (6812424) – optional and replaceable

Cross sensitivities to hydrogen sulfide (H₂S) and sulfur dioxide (SO₂) 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 H₂S 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

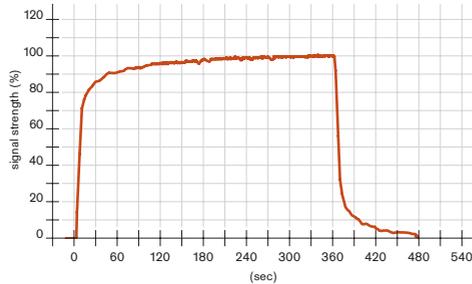
| | |
|--|------------------------------------|
| Detection limit: | 3 ppm |
| Resolution: | 0.5 ppm |
| Measurement range: | 0 to 50 ppm HCN (hydrogen cyanide) |
| Response time: | ≤ 10 seconds (t ₅₀) |
| Precision | |
| Sensitivity: | ≤ ± 5% of measured value |
| Long-term drift, at 20°C (68°F) | |
| 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

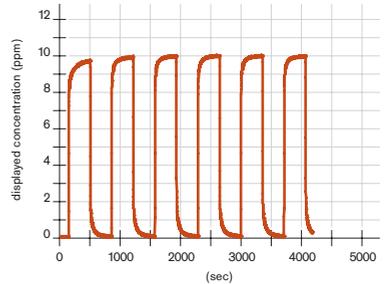
SPECIAL CHARACTERISTICS

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



D-16442-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 H₂S

DrägerSensor® XXS E H₂S

Order no. 68 10 883
68 12 213

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|------------------|-------------|-------------|-----------|----------------------|------------------|
| 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

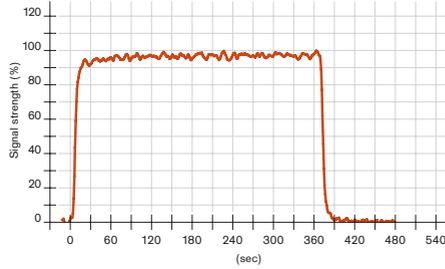
| | |
|--|--|
| Detection limit: | 2 ppm |
| Resolution: | 1 ppm |
| Measurement range: | 0 to 200 ppm H ₂ S (hydrogen sulfide) |
| Response time: | ≤ 15 seconds (t ₉₀) |
| Precision | |
| Sensitivity: | ≤ ± 2% of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | ≤ ± 1 ppm/year |
| 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 ₂ S |

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

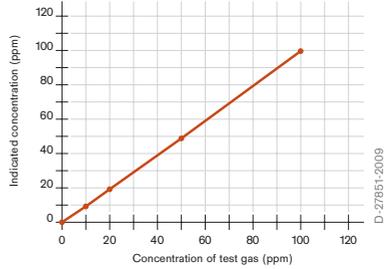
SPECIAL CHARACTERISTICS

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 SO₂ (with integrated selective filter) together with the DrägerSensor® XXS H₂S in a device such as a Dräger X-am 5000 or X-am 5600

Sensor reaction to H₂S at 20 °C/68 °F
Flow = 0.5 l/min, with 10 ppm H₂S



Linearity of H₂S sensor
calibrated with 20 ppm H₂S



The values shown in the following table are standard and apply to new sensors. The values may 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 H₂S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS H₂S AND XXS E H₂S

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S |
|----------------------|--|---------------|---------------------------------|
| Acetylene | C ₂ H 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 ₃ SSCH ₃ | 20 ppm | ≤ 5 |
| Dimethylsulfide | (CH ₃) ₂ S | 20 ppm | ≤ 5 |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H ₄ | 1000 ppm | ≤ 10 |
| Ethyl mercaptan | C ₂ H ₅ SH | 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) ₂ CCH ₂ | 100 ppm | No effect |
| Methane | CH ₄ | 5 Vol.-% | No effect |
| Methyl mercaptan | CH ₃ SH | 20 ppm | ≤ 15 |
| Nitrogen dioxide | NO ₂ | 20 ppm | ≤ 5 ⁽⁻⁾ |
| Nitrogen monoxide | NO | 30 ppm | No effect |
| Propane | C ₃ H ₈ | 1 Vol.-% | No effect |
| sec-Butyl mercaptan | C ₄ H ₁₀ S | 20 ppm | ≤ 5 |
| Sulphur dioxide | SO ₂ | 20 ppm | ≤ 2 |
| tert-Butyl mercaptan | (CH ₃) ₃ CSH | 20 ppm | ≤ 6 |
| Tetrahydrothiophene | C ₄ H ₈ S | 20 ppm | ≤ 3 |

(-) Indicates negative deviation

DrägerSensor® XXS H₂S 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

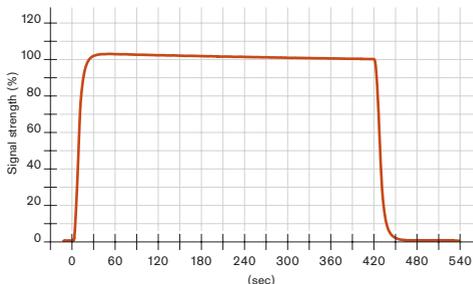
| | |
|--|--|
| Detection limit: | 4 ppm |
| Resolution: | 2 ppm |
| Measurement range: | 0 to 1,000 ppm H ₂ S (hydrogen sulfide) |
| Response time: | ≤ 15 seconds (t ₉₀) |
| Precision | |
| Sensitivity: | ≤ ± 2% of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | ≤ ± 2 ppm/year |
| 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 ₂ S |

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

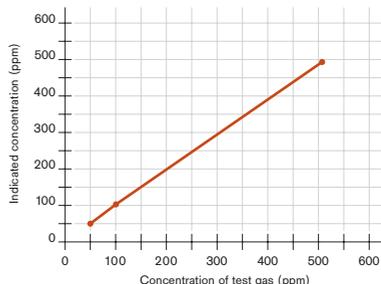
SPECIAL CHARACTERISTICS

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 H₂S HC at 20 °C/68 °F
Flow = 0.5 l/min, with 50 ppm H₂S



Linearity of H₂S HC sensor
calibrated with 50 ppm H₂S



D-27863-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 H₂S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S |
|--------------------|--|---------------|---------------------------------|
| Acetylene | C ₂ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H 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) ₂ CCH ₂ | 100 ppm | No effect |
| Methane | CH ₄ | 5 Vol.-% | No effect |
| Nitrogen dioxide | NO ₂ | 20 ppm | $\leq 5^{(-)}$ |
| Nitrogen monoxide | NO | 30 ppm | No effect |
| Propane | C ₃ H ₈ | 1 Vol.-% | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | ≤ 2 |

(-) Indicates negative deviation

DrägerSensor® XXS H₂S LC

Order no. 68 11 525

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|-----------------------|-------------|-------------|----------|----------------------|------------------|
| Dräger Pac 6000/6500 | no | yes | 3 years | > 5 years | no |
| Dräger X-am 2500 | no | yes | 3 years | > 5 years | no |
| Dräger X-am 2800 | 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

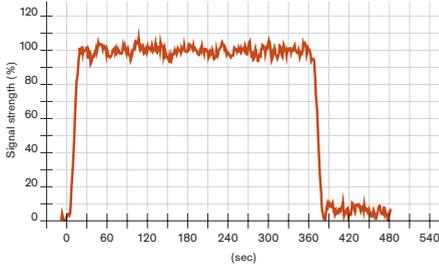
| | |
|--|--|
| Detection limit: | 0.4 ppm |
| Resolution: | 0.1 ppm |
| Measurement range: | 0 to 100 ppm H ₂ S (hydrogen sulfide) |
| Response time: | ≤ 15 seconds (t ₉₀) |
| Precision | |
| Sensitivity: | ≤ ± 5% of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | ≤ ± 0.2 ppm/year |
| 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 ₂ S |

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

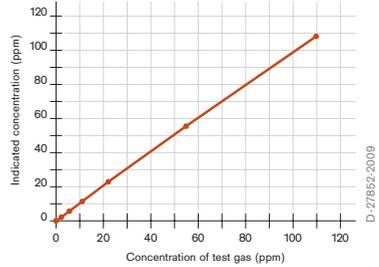
SPECIAL CHARACTERISTICS

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 H₂S at 20 °C/68 °F
Flow = 0.5 l/min, with 0,55 ppm H₂S



Linearity of H₂S LC sensor
calibrated with 22 ppm H₂S



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 H₂S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S |
|-----------------------|--|---------------|---------------------------------|
| Acetylene | C ₂ H 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 ₃ SSCH ₃ | 20 ppm | ≤ 5 |
| Dimethylsulfide | (CH ₃) ₂ S | 20 ppm | ≤ 5 |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H ₄ | 1000 ppm | ≤ 10 |
| Ethyl mercaptan | C ₂ H ₅ SH | 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) ₂ CCH ₂ | 100 ppm | No effect |
| Methane | CH ₄ | 5 Vol.-% | No effect |
| Methyl mercaptan | CH ₃ SH | 20 ppm | ≤ 16 ppm |
| Nitrogen dioxide | NO ₂ | 20 ppm | ≤ 4 ⁽⁻⁾ |
| Nitrogen monoxide | NO | 30 ppm | No effect |
| Propane | C ₃ H ₈ | 1 Vol.-% | No effect |
| sec-Butyl mercaptan | C ₄ H ₁₀ S | 20 ppm | ≤ 5 |
| Sulphur dioxide | SO ₂ | 20 ppm | ≤ 1.5 |
| tert- Butyl mercaptan | (CH ₃) ₃ CSH | 20 ppm | ≤ 4 |
| Tetrahydrothiophene | C ₄ H ₈ S | 20 ppm | ≤ 3 |

(-) Indicates negative deviation

DrägerSensor® XXS H₂S/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 |

Internal selective filter for CO - unexchangeable

Cross sensitivities to alcohol and acid gases (H₂S, SO₂) 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 H₂S 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.

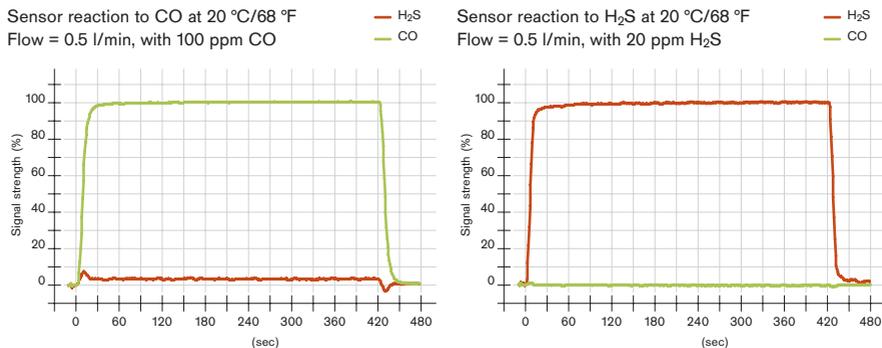
TECHNICAL SPECIFICATIONS

| | |
|--|---|
| Detection limit: | 2 ppm (H ₂ S)/6 ppm (CO) |
| Resolution: | 1 ppm (H ₂ S)/2 ppm (CO) |
| Measurement range: | 0 to 200 ppm H ₂ S (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 ₂ S) ≤ ± 5 ppm (CO) |
| Sensitivity: | ≤ ± 5% of measured value (H ₂ S) ≤ ± 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 ₂ S approx. 20 to 450 ppm CO |

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

SPECIAL CHARACTERISTICS

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



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 H₂S. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S | Display in ppm CO |
|-----------------------|--|---------------|---------------------------------|-------------------|
| Acetylene | C ₂ H 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 ₃ SSCH ₃ | 20 ppm | ≤ 11 | No effect |
| Dimethylsulfide | (CH ₃) ₂ S | 20 ppm | ≤ 5 | No effect |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect | No effect |
| Ethyl mercaptan | C ₂ H ₅ SH | 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 ₂ S | 20 ppm | 20 | No effect |
| Isobutylene | (CH ₃) ₂ CCH ₂ | 100 ppm | No effect | No effect |
| Methane | CH ₄ | 5 vol. % | No effect | No effect |
| Methyl mercaptan | CH ₃ SH | 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 ₃ H ₈ | 1 vol. % | No effect | No effect |
| sec-Butyl mercaptan | C ₄ H ₁₀ S | 20 ppm | ≤ 7 | No effect |
| Sulphur dioxide | SO ₂ | 25 ppm | ≤ 2 | No effect |
| tert- Butyl mercaptan | (CH ₃) ₃ CSH | 20 ppm | ≤ 8 | No effect |
| Tetrahydrothiophene | C ₄ H ₈ S | 20 ppm | ≤ 3 | No effect |

(-)¹⁾ negative reading

DrägerSensor® XXS H₂S 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 |

Internal selective filter for CO – unexchangeable

Cross sensitivities to alcohol and acid gases (H₂S, SO₂) 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 H₂S 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.

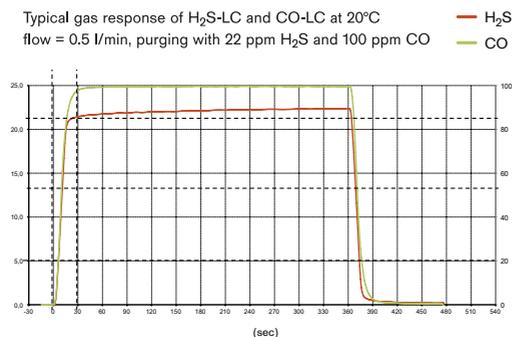
TECHNICAL SPECIFICATIONS

| | |
|--|---|
| Detection limit: | 0,4 ppm (H ₂ S)/1 ppm (CO) |
| Resolution: | 0.1 ppm (H ₂ S)/1 ppm (CO) |
| Measurement range: | 0 to 100 ppm H ₂ S (hydrogen sulfide) 0 to 2,000 ppm CO (carbon monoxide) |
| Response time: | ≤ 20 seconds (t ₉₀) |
| Precision | |
| Sensitivity: | H ₂ S: ≤ ± 5 % of measured value, CO: ≤ ± 2 % of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | H ₂ S: ≤ ± 0,2 ppm/year, CO: ≤ ± 2 ppm/year |
| Sensitivity: | H ₂ S: ≤ ± 5 % of measured value/year, CO: ≤ ± 3 % of measured value/year |
| Warm-up time: | H ₂ S: ≤ 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 ₂ S: no effect, CO: ≤ ± 5 ppm |
| Sensitivity: | H ₂ S: ≤ ± 5 % of measured value, CO: ≤ ± 0.3 % of measured value/K |
| Influence of humidity | |
| Zero point: | No effect |
| Sensitivity: | H ₂ S: ≤ ± 0.1 % of measured value/ %r.h., CO: ≤ ± 0.02 % of measured value/ %r.h. |
| Test gas: | approx. 5 to 90 ppm H ₂ S 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.



The values shown in the following table are standard and apply to new sensors. The values maybe fluctuate by $\pm 30\%$. 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 H₂S. To be sure, please check if gas mixtures are present. H₂S.

RELEVANT CROSS-SENSITIVITIES

| Gas/vapor | Chem. symbol | Concentration | Display in ppm H ₂ S | Display in ppm CO |
|-----------------------|--|---------------|---------------------------------|-------------------|
| Acetylene | C ₂ H 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 ₃ SSCH ₃ | 20 ppm | ≤ 5 | No effect |
| Dimethylsulfide | (CH ₃) ₂ S | 20 ppm | ≤ 5 | No effect |
| Ethene | C ₂ H ₄ | 100 ppm | ≤ 1 | ≤ 300 |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect | No effect |
| Ethyl mercaptan | C ₂ H ₅ SH | 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 ₂ S | 30 ppm | 30 | No effect |
| Isobutylene | (CH ₃) ₂ CCH ₂ | 100 ppm | No effect | No effect |
| Methane | CH ₄ | 5 Vol.-% | No effect | No effect |
| Methyl mercaptan | CH ₃ SH | 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 ₃ H ₈ | 1 Vol.-% | No effect | No effect |
| sec-Butyl mercaptan | C ₄ H ₁₀ S | 20 ppm | ≤ 5 | No effect |
| Sulphur dioxide | SO ₂ | 20 ppm | ≤ 1.5 | No effect |
| tert- Butyl mercaptan | (CH ₃) ₃ CSH | 20 ppm | ≤ 4 | No effect |
| Tetrahydrothiophene | C ₄ H ₈ S | 20 ppm | ≤ 3 | No effect |

(-) Indicates negative deviation

DrägerSensor® XXS NH₃

Order no. 68 10 888

| 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

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 |

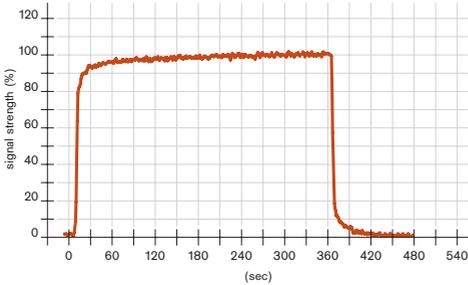
The sensor is not suitable for monitoring a permanent NH₃ concentration.

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

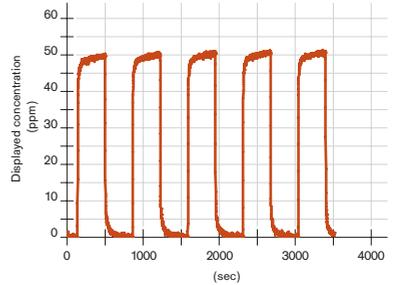
SPECIAL CHARACTERISTICS

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

Sensor reaction to NH₃ at 20 °C/68 °F
Flow = 0.5 l/min, 50 ppm NH₃



Repeatability of NH₃ Sensor with 50 ppm NH₃,
average from five sensors



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 NH₃. 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 ₂ H 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 ₄ H ₁₁ NO ₂ | 10 ppm | 5 ppm |
| Ethanol | C ₂ H ₅ OH | 250 ppm | ≤ 40 |
| Ethylidimethylamine | C ₄ H ₁₁ N | 50 ppm | 30 ppm |
| Hydrogen | H ₂ | 1,000 ppm | ≤ 4 |
| Hydrogen chloride | HCl | 20 ppm | ≤ 15 (-) |
| Hydrogen sulfide | H ₂ S | 20 ppm | ≤ 70 |
| Isobutylene | (CH ₃) ₂ CCH 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 8000 | no | yes | 1 year | > 2 years | no |
| Dräger X-am 2800 | 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.

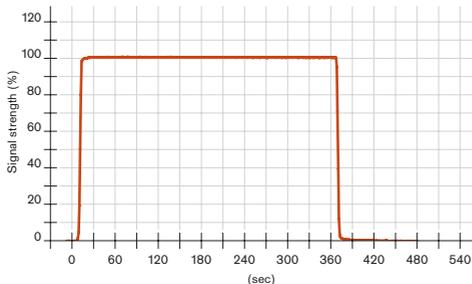
TECHNICAL SPECIFICATIONS

| | |
|--|-------------------------------------|
| 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 |

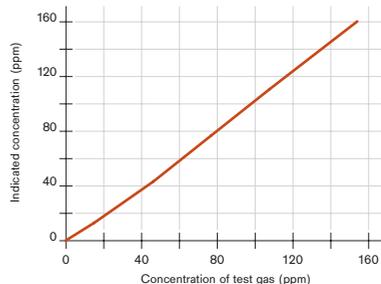
SPECIAL CHARACTERISTICS

This sensor enables a selective measurement of NO. NO₂ concentrations < 20 ppm have not effects. It also offers a very fast response time and excellent linearity across its entire measurement range.

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



Linearity of NO sensor calibrated with 76 ppm NO



D-27855-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 ₃ COCH ₃ | 1,000 ppm | No effect |
| Acetylene | C ₂ H ₂ | 0.8 Vol.-% | No effect |
| Ammonia | NH ₃ | 500 ppm | No effect |
| Benzene | C ₆ H 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 ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H 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 ₂ S | 5 ppm | 1 |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H 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 ₆ H ₅ CH ₃ | 0.6 Vol.-% | No effect |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect |

DrägerSensor® XXS NO₂

Order no. 68 10 884

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|--------------------------|-------------|-------------|----------|----------------------|------------------|
| Dräger X-am 2500 | no | yes | 1 year | > 2 years | no |
| Dräger X-am 2800 | 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.

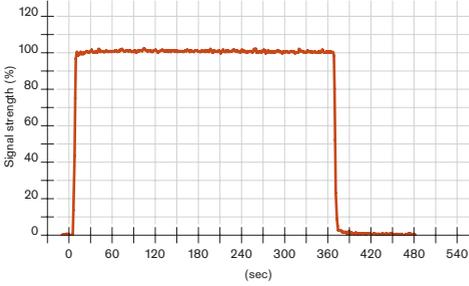
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| 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 |

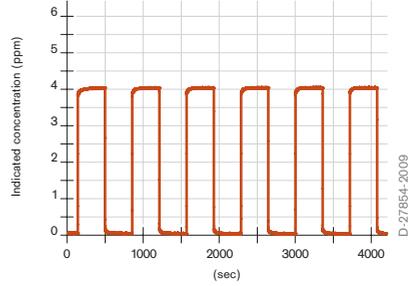
SPECIAL CHARACTERISTICS

This sensor's advantages include a fast response time and excellent repeatability. This sensor enables a selective measurement of NO₂. NO concentrations < 20 ppm do not influence the measurement results, thus a selective NO₂ measurement is possible.

Sensor reaction to NO₂ at 20 °C/68 °F
Flow = 0.5 l/min, 4 ppm NO₂



Repeatability of NO₂ sensors
with 4 ppm NO₂



The values shown in the following table are standard and apply to new sensors. The values may 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 NO₂. 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 ₂ H 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 ₂ H ₅ OH | 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 ₂ S | 20 ppm | ≤ 100 ⁽⁻⁾ |
| Isobutylene | (CH ₃) ₂ CCH 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 NO₂ 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

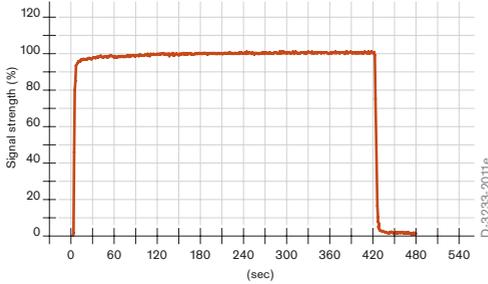
| | |
|--|--|
| Detection limit: | 0.04 ppm |
| Resolution: | 0.02 ppm |
| Measurement range: | 0 to 50 ppm NO ₂ (nitrogen dioxide) |
| Response time: | ≤ 15 seconds (t ₅₀) |
| Precision | |
| Sensitivity: | ≤ ± 3% of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | ≤ ± 0.04 ppm/year |
| 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 SO₂, H₂S, NO and CO), which allows a selective measurement of NO₂. 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 NO₂ LC at 20 °C
Flow = 0.5 l/min, 1 ppm NO₂



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 NO₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES

| Gas/vapor | Chem. symbol | Concentration | Display in ppm NO ₂ LC |
|-------------------|--|---------------|-----------------------------------|
| Acetylene | C ₂ H 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 ₂ H ₆ | 0.1 Vol.-% | No effect |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect |
| Hydrazine | N ₂ H 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 ₂ S | 1 ppm | ≤ 0.03 ⁽⁻⁾ |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H 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 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 | | Resolution/ Detection- limit | Relative sensitivity to EO ¹⁾ |
| | 0 bis 200 ppm C ₂ H ₄ O (ethylene oxide) | 0.5 | 1.00 |
| | 0 bis 200 ppm C ₃ H ₆ O (propylene oxide) | 0.5 | ≈ 0.85 |
| | 0 bis 100 ppm C ₂ H ₄ (ethene) | 0.5 | ≈ 0.60 |
| | 0 bis 100 ppm C ₃ H ₆ (propene) | 2 | ≈ 0.65 |
| | 0 bis 100 ppm C ₂ H ₃ Cl (vinyl chloride) | 0.5 | ≈ 0.60 |
| | 0 bis 800 ppm CH ₃ OH (methanol) | 0.5 | ≈ 0.50 |
| | 0 bis 100 ppm CH ₂ CHCHCH ₂ (butadiene) | 1 | ≈ 1.40 |
| | 0 bis 100 ppm HCHO (formaldehyde) | 2 | ≈ 0.80 |
| | 0 bis 300 ppm (H ₃ C) ₂ CHOH (isopropanol) | 2 | ≈ 0.35 |
| | 0 bis 200 ppm C ₄ H ₈ O (tetrahydrofuran) | 1 | ≈ 0.80 |
| | 0 bis 100 ppm C ₂ H ₃ OCH ₂ Cl (1-chloro-2,3 epoxypropane) | 1 | ≈ 0.35 |
| | 0 bis 100 ppm C ₆ H ₅ CHCH ₂ (styrene) | 1 | ≈ 0.70 |
| | 0 bis 100 ppm H ₂ CC(CH ₃)COOCH ₃ (methyl methacrylate) | 1 | ≈ 0.40 |
| Response time: | | | |
| Precision | ≤ 20 seconds (t ₅₀) | | |
| Sensitivity: | | | |
| Long-term drift, at 20°C (68°F) | ≤ ± 5% of measured value | | |
| Zero point: | | | |
| Sensitivity: | ≤ ± 5 ppm/year | | |
| Warm-up time: | ≤ ± 2% of measured value/month | | |
| Ambient conditions | ≤ 18 hours | | |
| Temperature: | | | |
| Humidity:²⁾ | (-20 to 50)°C (-4 to 122)°F | | |
| Pressure: | (30 to 90)% RH | | |
| Influence of temperature | (700 to 1,300) hPa | | |
| 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 | | |

TECHNICAL SPECIFICATIONS

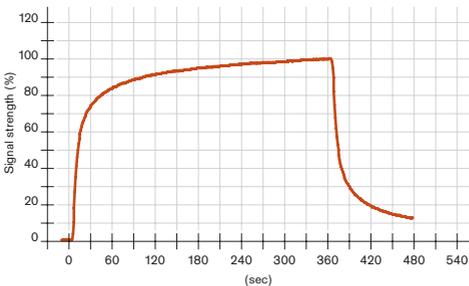
Influence of humidity

| | |
|--------------|--|
| Zero point: | No effect |
| Sensitivity: | $\leq \pm 0.5\%$ of measured value/% RH |
| Test gas: | approx. 3 to 12 ppm EO The DrägerSensor XXS OV has a defined cross-sensitivity to ethylene oxide (EO) and carbon monoxide (CO), see supplement 90 33 548. The sensor can be calibrated with EO or CO as an alternative for all target gases. Surrogate calibration can lead to an additional measurement error of up to 30 ‰ ³⁾ . Dräger recommends calibrating gas detection devices with the gas which has to be detected during operation. This method of target gas calibration is more accurate than calibration with a surrogate gas. A surrogate calibration and functional test with CO in consideration of the extended measurement tolerance must be given preference. Dräger also recommends using a test gas concentration in the range of the alarm thresholds to be monitored. |

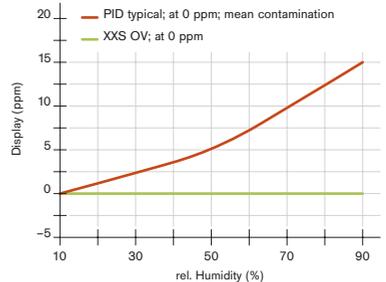
SPECIAL CHARACTERISTICS

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 C₂H₄O at 20 °C/68 °F
Flow = 0.5 l/min, with 20 ppm C₂H₄O



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 may fluctuate by $\pm 30\%$. 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 ₂ H ₄ O |
|------------------------|---|---------------|--|
| Acetaldehyde | CH ₃ CHO | 55 ppm | ≤ 15 |
| Acetic acid | CH ₃ COOH | 100 ppm | No effect |
| Acetylene | C ₂ H ₂ | 100 ppm | ≤ 150 |
| Acrylonitrile | H ₂ CCHCN | 80 ppm | ≤ 5 |
| Ammonia | NH ₃ | 100 ppm | No effect |
| Benzene | C ₆ H ₆ | 2,000 ppm | No effect |
| Butyraldehyd | C ₃ H ₇ CHO | 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 ₆ H ₅ Cl | 200 ppm | No effect |
| Dichloromethane | CH ₂ Cl ₂ | 1,000 ppm | No effect |
| Diethyl ether | (C ₂ H ₅) ₂ O | 100 ppm | ≤ 60 |
| Dimethylformamide | HCON(CH ₃) ₂ | 100 ppm | No effect |
| Ethane | C ₂ H ₆ | 0.2 Vol.-% | No effect |
| Ethanol | C ₂ H ₅ OH | 250 ppm | ≤ 150 |
| Ethyl acetate | CH ₃ COOC ₂ H ₅ | 100 ppm | No effect |
| Ethylene glycol | C ₂ H ₆ O 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 ₂ S | 20 ppm | ≤ 40 |
| Isobutylene | (CH ₃) ₂ CCH 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) ₂ CHCH ₂ COCH 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 ₆ H ₅ CH ₃ | 1,000 ppm | No effect |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect |
| Vinyl acetate | CH ₃ COOC ₂ H ₃ | 30 ppm | ≤ 30 |
| Xylene | C ₆ H ₄ (CH ₃) ₂ | 0.2 Vol.-% | No effect |

ST-1979-20.05



D-10165-2.009

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 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 | | Resolution/ Detection- limit | Relative sensitivity to EO ¹⁾ |
| | 0 bis 200 ppm C ₂ H ₄ O (ethylene oxide) | 1 | 1.00 |
| | 0 bis 100 ppm H ₂ CCHCN (acrylonitrile) | 1 | ≈ 0.15 |
| | 0 bis 300 ppm (CH ₃) ₂ CCH ₂ (isobutylene) | 2 | ≈ 0.90 |
| | 0 bis 100 ppm CH ₃ COOC ₂ H ₃ (vinyl acetate) | 1 | ≈ 0.85 |
| | 0 bis 300 ppm C ₂ H ₅ OH (ethanol) | 2 | ≈ 0.55 |
| | 0 bis 200 ppm CH ₃ CHO (acetaldehyde) | 1 | ≈ 0.35 |
| | 0 bis 200 ppm (C ₂ H ₅) ₂ O (diethyl ether) | 1 | ≈ 0.75 |
| | 0 bis 100 ppm C ₂ H ₂ (acetylene) | 1 | ≈ 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:

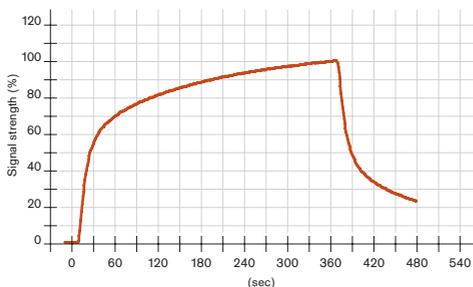
approx. 3 to 12 ppm EO

The DrägerSensor XXS OV-A has a defined cross-sensitivity to ethylene oxide (EO) and carbon monoxide (CO), see supplement 90 33 549. The sensor can be calibrated with EO or CO as an alternative for all target gases. Surrogate calibration can lead to an additional measurement error of up to 30 %³⁾. Dräger recommends calibrating gas detection devices with the gas which has to be detected during operation. This method of target gas calibration is more accurate than calibration with a surrogate gas. A surrogate calibration and functional test with CO in consideration of the extended measurement tolerance must be given preference. Dräger also recommends using a test gas concentration in the range of the alarm thresholds to be monitored.

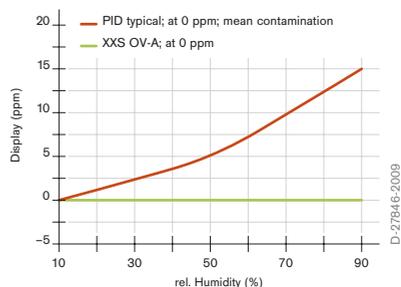
SPECIAL CHARACTERISTICS

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 C₂H₄O at 20 °C/68 °F
Flow = 0.5 l/min, with 20 ppm C₂H₄O



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.
- 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 may fluctuate by $\pm 30\%$. 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 ₂ H ₄ O |
|----------------------------|---|---------------|--|
| 1-chloro-2, 3 epoxypropane | C ₂ H ₃ OCH ₂ Cl | 25 ppm | ≤ 10 |
| Acetic acid | CH ₃ COOH | 100 ppm | No effect |
| Ammonia | NH ₃ | 100 ppm | No effect |
| Benzene | C ₆ H ₆ | 2,000 ppm | No effect |
| Butadiene | CH ₂ CHCHCH 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 ₆ H ₅ Cl | 200 ppm | No effect |
| Dichloromethane | CH ₂ Cl ₂ | 1,000 ppm | No effect |
| Dimethylformamide | HCON(CH ₃) ₂ | 100 ppm | No effect |
| Ethene | C ₂ H ₄ | 50 ppm | ≤ 45 |
| Ethyl acetate | CH ₃ COOC ₂ H 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 ₂ S | 20 ppm | ≤ 40 |
| Isobutylene | (CH ₃) ₂ CCH ₂ | 100 ppm | ≤ 75 |
| Isopropanol | (H ₃ C) ₂ CHOH | 250 ppm | ≤ 110 |
| Methane | CH ₄ | 2 Vol.-% | No effect |
| Methanol | CH ₃ OH | 100 ppm | ≤ 160 |
| Methyl methacrylate | H ₂ CC(CH ₃)COOCH ₃ | 60 ppm | ≤ 25 |
| Methyl isobutyl ketone | (CH ₃) ₂ CHCH ₂ COCH 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 ₃ H ₆ | 50 ppm | ≤ 35 |
| Propylene oxide | C ₃ H ₆ O | 50 ppm | ≤ 45 |
| Sulfur dioxide | SO ₂ | 20 ppm | ≤ 9 |
| Styrene | C ₆ H ₅ CHCH ₂ | 35 ppm | ≤ 35 |
| Tetrahydrofuran | C ₄ H ₈ O | 60 ppm | ≤ 55 |
| Trichloroethylene | CHClCCl ₂ | 1,000 ppm | No effect |
| Vinyl chloride | C ₂ H ₃ Cl | 50 ppm | ≤ 40 |

ST-1713-2005



D-10167-2009

DrägerSensor® XXS OV-A

DrägerSensor® XXS O₂

DrägerSensor® XXS E O₂

Order no. 68 10 881
68 12 211

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|--------------------------|-------------|-------------|-----------|----------------------|------------------|
| Dräger Pac 6000/ 6500 | no | yes | 3 years | > 5 years | no |
| Dräger X-am 2500 | no | yes | 3 years | > 5 years | no |
| Dräger X-am 2800* | 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 |

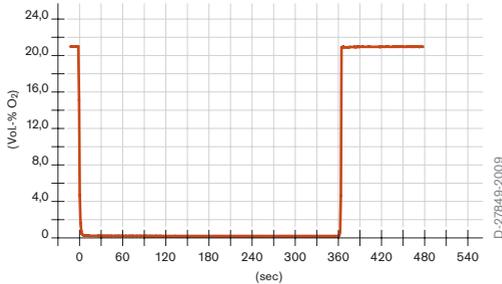
The sensor cannot be used to measure oxygen in the presence of helium. For oxygen monitoring during inerting processes, see DrägerSensor XXS O₂ 100 (SN 68 12 385).

* Dräger X-am 2800 does not support the DrägerSensor XXS E O₂ (6812211).

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 O₂ at 20 °C/68 °F
Flow = 0.5 l/min, with 100% N₂



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O₂ AND XXS E O₂

| Gas/vapor | Chem. symbol | Concentration | Display in Vol.-% O ₂ |
|-------------------|--|---------------|----------------------------------|
| Acetylene | C ₂ H ₂ | 1 Vol.-% | $\leq 0.5^{(-)}$ |
| Ammonia | NH ₃ | 500 ppm | No effect |
| Carbon dioxide | CO ₂ | 10 Vol.-% | $\leq 0.4^{(-)}$ |
| Carbon monoxide | CO | 0.5 Vol.-% | No effect |
| Chlorine | Cl ₂ | 10 ppm | No effect |
| Ethane | C ₂ H ₆ | 1.0 Vol.-% | $\leq 0.2^{(-)}$ |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H ₄ | 2 Vol.-% | $\leq 2^{(-)}$ |
| Helium | He | 20 Vol.-% | $\leq 3^*$ |
| Hydrogen | H ₂ | 1.6 Vol.-% | $\leq 2.5^{(-)}$ |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen cyanide | HCN | 50 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 100 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H ₈ | 2 Vol.-% | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | No effect |

(-) Indicates negative deviation

* non-linear false positive display value

DrägerSensor® XXS O₂ PR

Order no. 68 00 530

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|------------------------|-------------|-------------|----------|----------------------|------------------|
| Dräger X-am 2500/ 5000 | no | yes | 2 years | > 5 years | no |
| Dräger X-am 5000 | no | yes | 2 years | > 5 years | no |
| Dräger X-am 5600 | no | yes | 2 years | > 5 years | no |
| Dräger X-am 8000 | no | yes | 2 years | > 5 years | no |

Internal selective filter for CO – unexchangeable

Sewage, mining and tunneling, fumigation, biogas, hazmat and fire services, industrial gases

MARKET SEGMENTS

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

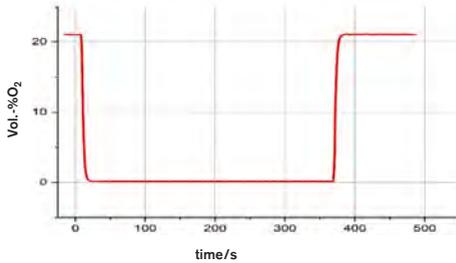
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| Detection limit: | 0.1 Vol.-% |
| Resolution: | 0.1 Vol.-% |
| Measurement range: | 0 to 30 Vol.-% O ₂ (oxygen) |
| Response time: | ≤ 13 seconds (t ₉₀) |
| Precision | |
| Sensitivity: | ≤ ± 1 % of measured value for 0 to 25 Vol.-% |
| 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) % r. h. |
| Pressure: | 700 to 1300 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/% r. h. |
| Test gas: | approx. 12 to 20 Vol.-% O ₂ |

BESONDERE EIGENSCHAFTEN

DrägerSensor® XXS oxygen sensors are lead-free, thus complying with Directive 2002/95/EG (RoHS). Due to the internal filter, this sensor is less sensitive to influences caused by outgassing of plastics. The extremely fast response time of less than 13 seconds provides a reliable warning of oxygen deficiency or excess.

Typical gas response O₂ at 20 °C
Flow = 0.5 l/min, purged with 100% N₂



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O₂ AND XXS E O₂

| Gas/vapor | Chem. symbol | Concentration | Display in Vol.-% O ₂ |
|-------------------|----------------------------------|---------------|----------------------------------|
| Acetylene | C ₂ H ₂ | 1.0 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 ₂ H ₆ | 1.0 Vol.-% | ≤ 2(-) |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect |
| Ethene | C ₂ H ₄ | 2.0 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 ₂ S | 100 ppm | No effect |
| Isobutylene | i-C ₄ H ₈ | 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 ₃ H ₈ | 2 Vol.-% | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | No effect |

(-) Indicates negative deviation

* non-linear false positive display value

DrägerSensor® XXS O₂/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 |

Internal selective filter for CO – unexchangeable

Cross sensitivities to alcohol and acid gases (H₂S, SO₂) 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 H₂S 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

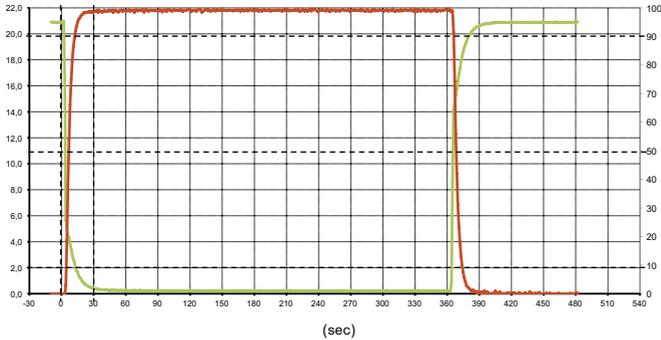
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| 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.

Typical gas response of O₂ and CO at 20°C
flow = 0.5 l/min, purged with 100 ppm CO in 100% N₂



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O₂ /CO LC

| Gas/vapor | Chem. symbol | Concentration | Display in Vol. % O ₂ | Display in ppm CO with selective filter |
|-------------------|----------------------------------|---------------|----------------------------------|---|
| Acetylene | C ₂ H ₂ | 1 Vol.-% | $\leq 0.5^{(-)}$ | ≤ 200 |
| Ammonia | NH ₃ | 100 ppm | No effect | No effect |
| Carbon dioxide | CO ₂ | 10 Vol.-% | $\leq 0.4^{(-)}$ | ≤ 2 |
| Carbon monoxide | CO | 0.2 Vol.-% | No effect | 2000 |
| Chlorine | Cl ₂ | 20 ppm | No effect | No effect |
| Ethane | C ₂ H ₆ | 1 Vol.-% | $\leq 0.2^{(-)}$ | No effect |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect | No effect |
| Ethene | C ₂ H ₄ | 2 Vol.-% | $\leq 2^{(-)}$ | ≤ 250 |
| Helium | He | 20 Vol.-% | $\leq 3^*$ | n.a. |
| Hydrogen | H ₂ | 0.5 | $\leq 0.8^{(-)}$ | ≤ 1000 |
| Hydrogen chloride | HCl | 40 ppm | No effect | No effect |
| Hydrogen cyanide | HCN | 50 ppm | No effect | No effect |
| Hydrogen sulfide | H ₂ S | 100 ppm | No effect | No effect |
| Isobutylene | i-C ₄ H 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 ₃ H ₈ | 2 Vol.-% | No effect | No effect |
| Sulfur dioxide | SO ₂ | 20 ppm | No effect | No effect |

(-) Indicates negative deviation

* non-linear false positive display value

DrägerSensor® XXS O₂/H₂S LC

Order no. 68 14 137

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|------------------|-------------|-------------|----------|----------------------|------------------|
| Dräger Pac 8500 | no | yes | 2 year | > 3 years | no |
| 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

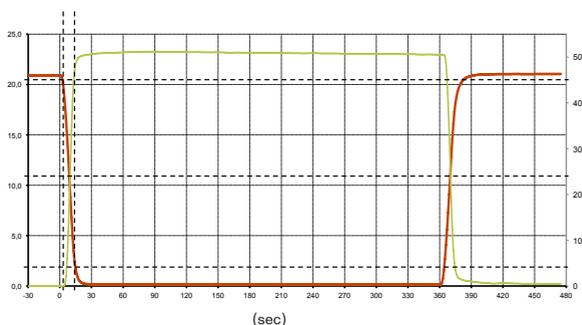
Gas suppliers, waste disposal, petrochemical industry, sewage, mining and tunneling, shipping, inorganic chemicals, steel, organic chemicals, oil and as

TECHNICAL SPECIFICATIONS

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

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 O₂ and H₂S at 20°C

— Vol% O₂

flow = 0,5 l/min, purged with
50.5 ppm H₂S in 100 Vol% N₂

— ppm H₂S

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O₂ /H₂S LC

| Gas/vapor | Chem. symbol | Concentration | Display in Vol.-% O ₂ | Display in ppm H ₂ S |
|----------------------|-------------------------------------|---------------|----------------------------------|---------------------------------|
| Acetylene | C ₂ H ₂ | 0,5 Vol.-% | $\leq 0,3^{(-)}$ | ≤ 10 |
| Ammonia | NH ₃ | 100 ppm | No effect | No effect |
| Carbon dioxide | CO ₂ | 10 Vol.-% | $\leq 0,4^{(-)}$ | 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 | $\leq 2^{(-)}$ |
| Dimethyl disulfide | CH ₃ SSCH ₃ | 20 ppm | No effect | ≤ 11 |
| Dimethyl sulfide | (CH ₃) ₂ S | 20 ppm | No effect | ≤ 5 |
| Ethane | C ₂ H ₆ | 1,0 Vol.-% | $\leq 0,2^{(-)}$ | No effect |
| Ethanol | C ₂ H ₅ OH | 250 ppm | No effect | No effect |
| Ethene | C ₂ H ₄ | 1000 ppm | No effect | ≤ 10 |
| Ethyl mercaptan | C ₂ H ₅ SH | 20 ppm | No effect | ≤ 13 |
| Helium | He | 20 Vol.-% | $\leq 3^*$ | n.a. |
| Hydrogen | H ₂ | 1,5 Vol.-% | $\leq 2,5^{(-)}$ | ≤ 5 |
| Hydrogen chloride | HCl | 40 ppm | No effect | No effect |
| Hydrogen cyanide | HCN | 50 ppm | No effect | No effect |
| Hydrogen sulfide | H ₂ S | 100 ppm | No effect | 100 |
| Isobutylene | i-C ₄ H ₈ | 100 ppm | No effect | No effect |
| Methane | CH ₄ | 5 Vol.-% | No effect | No effect |
| Methyl mercaptan | CH ₃ SH | 20 ppm | No effect | ≤ 16 |
| Nitrogen dioxide | NO ₂ | 20 ppm | No effect | $\leq 4^{(-)}$ |
| Nitrogen monoxide | NO | 30 ppm | No effect | No effect |
| Propane | C ₃ H ₈ | 1 Vol.-% | No effect | No effect |
| sec-Butyl mercaptan | C ₄ H ₁₀ S | 20 ppm | No effect | ≤ 7 |
| Sulfur dioxide | SO ₂ | 20 ppm | No effect | ≤ 3 |
| tert-Butyl mercaptan | (CH ₃) ₃ CSH | 20 ppm | No effect | ≤ 9 |
| Tetrahydrothiophene | C ₄ H ₈ S | 50 ppm | No effect | ≤ 5 |

(-) Indicates negative deviation

* non-linear false positive display value

DrägerSensor® XXS O₂ 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

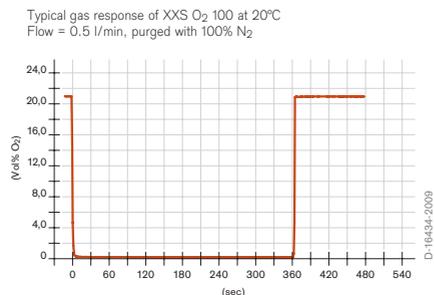
Gas suppliers, oxygen cylinders (diving), submarines, nuclear power plants

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 may fluctuate by $\pm 30\%$. 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 O₂. To be sure, please check if gas mixtures are present.

RELEVANT CROSS-SENSITIVITIES DRÄGERSENSOR® XXS O₂ 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.-% | $\leq 1^{(-)}$ |
| Hydrogen chloride | HCl | 40 ppm | No effect |
| Hydrogen sulfide | H ₂ S | 100 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH 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.-% | $\leq 1^{(-)}$ |
| Propane | C ₃ H 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 |

B2X (68 12 424) – as standard and exchangeable

Cross sensitivities to hydrogen sulfide (H₂S) and sulfur dioxide (SO₂) 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 H₂S 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 | 1.00 |
| Measurement range/ relative sensitivity | 0 - 40 ppm THT (tetrahydrothiophene) | 2.50 |
| | 0 - 40 ppm (CH ₃) ₃ CSH (tert.-butyl mercaptane) | 2.00 |
| | 0 - 40 ppm C ₂ H ₅ CH(CH ₃)SH (sec.-butyl mercaptane) | 4.00 |
| | 0 - 40 ppm CH ₃ SH (methyl mercaptane) | 3.00 |
| | 0 - 40 ppm C ₂ H ₅ SH (ethyl mercaptane) | 1.80 |
| | 0 - 100 ppm (CH ₃) ₂ S (dimethyl sulfide) | 4.00 |
| | 0 - 40 ppm CH ₃ SSCH ₃ (dimethyl disulfide) | |
| 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) ₃ CSH, C ₂ H ₅ CH(CH ₃)SH, CH ₃ SH, C ₂ H ₅ SH, (CH ₃) ₂ S, CH ₃ SSCH ₃ | |

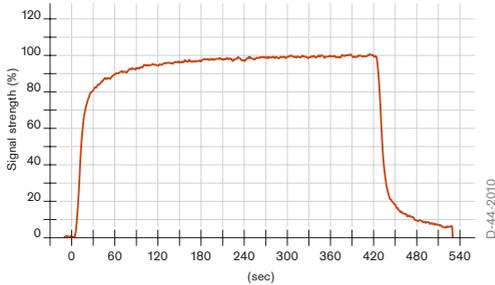
*Sudden temperature or humidity changes lead to dynamic effects (fluctuations).

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 H₂S and SO₂.

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 $\pm 30\%$. 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 NH₃. 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 ₂ H 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 ₂ S | 10 ppm | ≤ 30 ppm | No effect |
| Isobutylene | (CH ₃) ₂ CCH ₂ | 100 ppm | ≤ 3.5 ppm | ≤ 3.5 ppm |
| Methane | CH ₄ | 100 Vol.-% | No effect | No effect |
| Methanol | CH ₃ OH | 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 ₃ H ₇ SH | 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

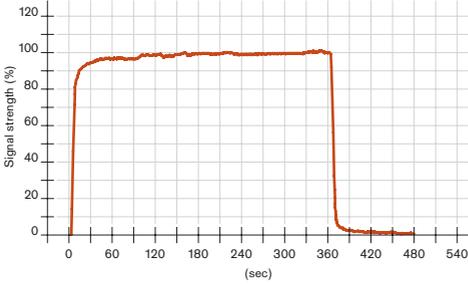
| | |
|--|--|
| Detection limit: | 0,02 ppm |
| Resolution: | 0,01 ppm |
| Measurement range: | 0 to 10 ppm O ₃ (ozone) |
| Response time: | ≤ 10 seconds (t ₉₀) |
| Precision | |
| Sensitivity: | ≤ ± 3 % of measured value |
| Long-term drift, at 20°C (68°F) | |
| Zero point: | ≤ ± 0.02 ppm/year |
| Sensitivity: | ≤ ± 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.

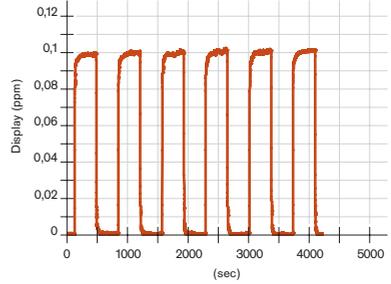
SPECIAL CHARACTERISTICS

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 O₃ at 20 °C
Flow = 0.5 l/min, 0.1 ppm O₃



Reproducibility of O₃ sensors
purged with 0.1 ppm O₃
average of five sensors



D-3235-2011e

The values shown in the following table are standard and apply to new sensors. The values may 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 ₂ H 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 ₂ H ₆ | 0,1 Vol.-% | no effect |
| Ethanol | C ₂ H ₅ OH | 250 ppm | no effect |
| Hydrazine | N ₂ H 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 ₂ S | 1 ppm | ≤ 0.02 ⁽⁻⁾ |
| Isobutylene | (CH ₃) ₂ CCH 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 ₃ H ₈ | 1 Vol.-% | no effect |
| Sulfur dioxide | SO ₂ | 1 ppm | ≤ 0.06 ⁽⁻⁾ |

(-) Indicates negative deviation

DrägerSensor® XXS PH₃

Order no. 68 10 886

| Used in | Plug & Play | Replaceable | Guaranty | Expected sensor life | Selective filter |
|-------------------------------|-------------|-------------|----------|----------------------|------------------|
| 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

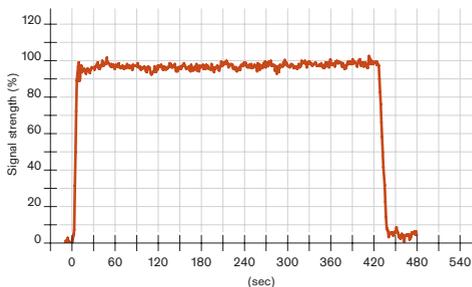
| | |
|--|--|
| Detection limit: | 0.02 ppm |
| Resolution: | 0.01 ppm |
| Measurement range/ relative Sensitivity | 0 to 20 ppm PH ₃ (phosphine) 1.00 |
| | 0 to 20 ppm AsH ₃ (arsine) 1.00 |
| | 0 to 20 ppm B ₂ H ₆ (diborane) 0.25 |
| | 0 bis 20 ppm GeH ₄ (Germanium hydride) 0.40 |
| | 0 to 20 ppm SiH ₄ (silane) 0.50 |
| | 0 to 20 ppm H ₂ Se (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 ₂ H ₆ : (0 to 50)°C (32 to 122)°F GeH ₄ : (15 - 35)°C (59 - 95)°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

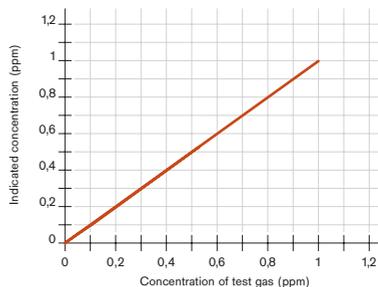
SPECIAL CHARACTERISTICS

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 PH₃ at 20 °C/68 °F
Flow = 0.5 l/min, with 0,1 ppm PH₃



Linearity of PH₃ sensor
calibrated with 1 ppm PH₃



D-27847-2009

The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 PH₃. 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 ₂ H 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 ₂ H ₅ OH | 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 ₂ S | 20 ppm | ≤ 20 |
| Isobutylene | (CH ₃) ₂ CCH 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 PH₃ 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.

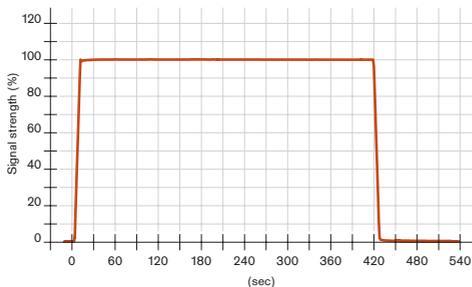
TECHNICAL SPECIFICATIONS

| | |
|--|--|
| 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 |

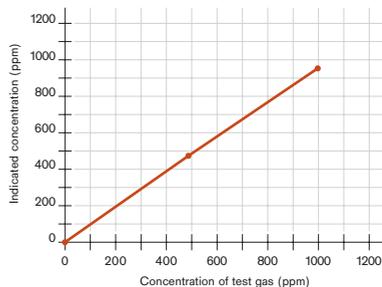
SPECIAL CHARACTERISTICS

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 PH₃ HC at 20 °C/68 °F
Flow = 0.5 l/min, with 1.050 ppm PH₃



Linearity of PH₃ HC sensor
calibrated with 15 ppm PH₃



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 PH₃. 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 ₂ H 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 ₂ H ₆ | 5 ppm | ≤ 3 |
| Ethanol | C ₂ H ₅ OH | 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 ₂ S | 20 ppm | ≤ 20 |
| Isobutylene | (CH ₃) ₂ CCH 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 SO₂

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 X-am 2500 | no | yes | 2 years | > 3 years |
| Dräger X-am 2800 | 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 |

KX (68 11 344) – optional and exchangeable

Cross sensitivities to hydrogen sulfide (H₂S) 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 H₂S 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.

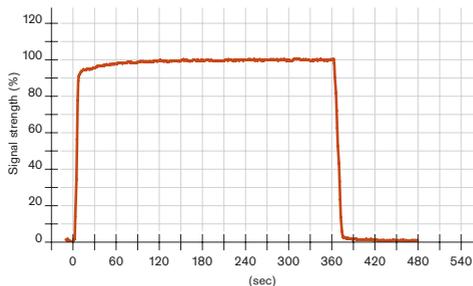
TECHNICAL SPECIFICATIONS

| | |
|--|---|
| 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 |

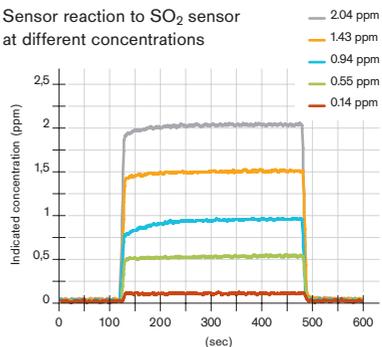
SPECIAL CHARACTERISTICS

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 SO₂ 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 SO₂ at 20 °C/68 °F
Flow = 0.5 l/min, with 2 ppm SO₂



Sensor reaction to SO₂ sensor
at different concentrations



The values shown in the following table are standard and apply to new sensors. The values may fluctuate by $\pm 30\%$. 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 SO₃. 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 ₂ H 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 ₂ H ₅ OH | 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 ₂ S | 20 ppm | ≤ 60 |
| Isobutylene | (CH ₃) ₂ CCH ₂ | 100 ppm | No effect |
| Methane | CH ₄ | 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

5.7 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 - note the use by date on the outer packaging). 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. Typically, the limit of detection of the sensors also corresponds to the limit of quantification. For selected sensors, the measuring range (incl. limit of quantification) is specified by a type examination certificate based on national/international/European standards through an examination by an approval body in the respective Notes on Approval of the Dräger gas detection devices. |
| 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 gas vapors with their ranges are indicated if a sensor can be used for different gases and vapors. |
| Relative Precision: | <p>Some sensors are suitable for the measurement of different target gases. The various cross sensitivities of these target gases are in general stated in the sensor information under the item measurement range. The sensitivity factor refers to a defined gas and is called relative sensitivity. With these sensitivity factors interferences (cross sensitivities) or calibration factors can be calculated.</p> <p>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.</p> <p>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.</p> |
| 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): | Criterion 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 $\leq \pm 0.2$ ppm year at 20° C (68°F) states that this sensor drifts max. $\leq \pm 2$ ppm per year. A value for the long-term drift of the sensitivity of $\leq \pm 2$ ppm/month, indicates that after two months with a display of 100 ppm, the gas concentration may be between 96 and 104 ppm at maximum.

Warm-up time:

The warm-up time indicates the amount of time needed before a newly installed sensor or a sensor, which was without electricity for a period of time and then is powered up again, can be calibrated. However, the sensor may be ready for use after only a few minutes. In this case, there may be a higher rate of measurement errors.

Ambient conditions:

Indicates the temperature, humidity and pressure range in which the sensor may be used. The indicated corrections do not apply with measurements outside of the permissible ambient conditions. Measurements outside of the specified range do not fall within the intended use and are therefore not part of the manufacturer's guarantee. However, if a sensor was short-term operated outside of the humidity specification, subsequent storage in a humidity range of 40 to 60% RH is recommended for at least double the time.

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 $\leq \pm 5$ % 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 $\leq \pm 5$ %. 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 $\leq \pm 0.5$ % 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: $10 \times 0.5\% = 5\%$ 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 $\leq \pm 0.5$ % of the measured value. This means, that a deviation of maximum $\leq \pm 5$ % 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 $\leq \pm 0.02$ % 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: $50 \times 0.02\% = 1\%$ 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 it is recommended to use an adjustment concentration in the range of the alarm thresholds to be monitored.

6 Accessories



6.1 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.

6.2 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 $\pm 30\%$ 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.

6.3 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 | ● | ●● |



6.4 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).

6.5 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.

6.6 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.

6.7 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 2800 | ■ | ■ | ■ | ■ |
| Dräger X-am 5100 | | | | ■ |
| Dräger X-am 7000 | ■ | ■ | ■ | ■ |
| Dräger X-am 3500/8000 | | ■ | ■ | ■ |

6.8 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. For this reason, Dräger recommends using test gases from Dräger for the adjustment and function test of Dräger products.

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.

Do not inhale the test gas. Risk to health!

Observe the hazard information given in the relevant safety data sheets. Make sure that the gas can be vented through an outlet or outside the building into the atmosphere.

6.9 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. Only pressure reducers made of stainless steel should be used for reactive gases. In addition, the pressure reducer should be used for the same reactive gas if possible. Switching between different reactive gases can affect the stability of the gas.

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

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-27716-2017



Variflow regulator

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-98769-2013



Regulator basic,
stainless steel

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-47929-2012



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.

D-4351-2014



Fixed pressure control
valve

6.10 Pumps



D-66522-2017

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 PAM (please contact Dräger for availability of the pump for the X-am 2800) 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.

6.11 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.

**FOR USE WITH
GAS DETECTION
DEVICES**

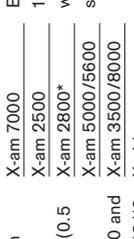
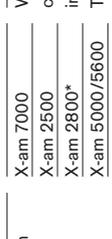
USES

LENGHT MATERIAL

**ORDER-
NUMBER NAME**

| | | | | | | |
|-----------|----------------------|---|-------|--|--|--|
| 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 2800* 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 2800* 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 2800* 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 2800* 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 2800* X-am 5000/5600 X-am 3500/8000 | Bis 1 m LENGHT flexibel ausziehbar. Geeignet für Ex-Bereiche. |

* Please contact Dräger for availability of the pump for the X-am 2800

| ORDER NUMBER | NAME | LENGHT MATERIAL | FOR USE WITH GAS DETECTION DEVICES | USES |
|--------------|-------------------------|------------------|--|---|
| 83 16 533 | Telescopic probe ES 150 | 1,5 m 4,9 ft. |  X-am 7000 X-am 2500 X-am 2800* X-am 5000/5600 X-am 3500/8000 X-pid | 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 | 1,5 m 4,9 ft. |  X-am 7000 X-am 2500 X-am 2800* 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 Kanalisationsbereichen, Lösemittelbeständig. |
| 83 18 371 | Float probe incl. hose | 5 m 6.6 ft. |  X-am 7000 X-am 2500 X-am 2800* X-am 5000/5600 X-am 3500/8000** | For measurements in drainage and sewage systems. Solvent-resistant. |
| 68 07 097 | Float probe incl. hose | 10 m 32.8ft. |  X-am 7000 X-am 2500 X-am 2800* X-am 5000/5600 X-am 3500/8000** | Electrically conductive. |

* Please contact Dräger for availability of the pump for the X-am 2800

** Probe not suitable for applications with PID sensors.

**FOR USE WITH
GAS DETECTION
DEVICES**

USES

LENGHT MATERIAL

**ORDER-
NUMBER NAME**

| | | | | | | |
|-----------|-------------------------------|--|------|--|---------------------------------------|---|
| 83 25 831 | Float probe EPP incl. hose |  D-14931-2017 | 3 m | Probe: EPP Hose: FKM with inner diameter of 3.2 mm and Luer male adapter | X-am 2800* X-am 3500/8000 X-pid | 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-14931-2017 | 10 m | Probe: EPP Hose: FKM with inner diameter of 3.2 mm and Luer male adapter | X-am 2800* X-am 3500/8000 X-pid | For measurements in drainage and sewage systems. Suitable for areas where there is a risk of explosion; solvent-resistant. |

* Please contact Dräger for availability of the pump for the X-am 2800

6.12 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.

6.13 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

| GAS | FORMULA | 10 m FKM hose | | | | 10 m Tygon E-3603 hose | | | | Antistatic (rubber) hose | | | | SE 200, PTFE lined Tygon hose 4594679 | | | |
|--|------------------------------------|---|-------|-------|---------|------------------------------------|-------|-------|---------|------------------------------------|-------|-------|---------|---------------------------------------|-------|-------|---------|
| | | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min |
| Carbon dioxide | CO ₂ | ■ | | | | ■ | | | | ■ | | | | ■ | | | |
| Carbon monoxide | CO | ■ | | | | ■ | | | | ■ | | | | ■ | | | |
| Oxygen | O ₂ | ■ | | | | ■ | | | | ■ | | | | ■ | | | |
| Nitrogen dioxide | NO ₂ | ■ | | | | ■ | | | | | | | ■ | ■ | | | |
| Chlorine | Cl ₂ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Hydrogen sulphide | H ₂ S | ■ | | | | ■ | | | | ■ | | | | ■ | | | |
| Phosgene | COCl ₂ | | ■ | | | | ■ | | | | | | ■ | | | | ■ |
| Hydrogen Cyanide | HCN | | | ■ | | | | ■ | | | | | ■ | | | ■ | |
| Phosphine | PH ₃ | | ■ | | | | | ■ | | | | | ■ | | | ■ | |
| Ammonia | NH ₃ | | | | ■ | | | ■ | | | | | ■ | | | ■ | |
| Nitric oxide | NO | | ■ | | | | | | | | | | ■ | | | ■ | |
| Sulphur dioxide | SO ₂ | | | ■ | | | | ■ | | | | | ■ | | | ■ | |
| Ozone | O ₃ | Due to its physical properties, ozone will be trapped in any hose (on the hose walls) | | | | | | | | | | | | | | | |
| Ethylene Oxide | EO | ■ | | | | ■ | | | | | | | | ■ | | | |
| Lightly volatile hydrocarbons or gases | Methane - Hexane | ■ | | | | | | | | ■ | | | | ■ | | | |
| Medium volatile hydrocarbons or gases | Acetic acid, Toulene, Octane | | | ■ | | | | ■ | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Low volatile hydrocarbons or vapors | n-Nonane Styrene | | | ■ | | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

■ suitable t₉₀ time ■ limited suitable, longer rinsing time, t₉₀ > 5 min. ■ not suitable

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

 Dräger X-am 3500/8000, Dräger X-am 2800 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 explosion-hazard area | Suitable | Suitable | Suitable |
| Further features | Solvent resistant | Flexible, no kinking | |

TEST RESULTS AND MEASUREMENT RECOMMENDATIONS

| GAS | FORMULA | 10 m FKM hose | | | | 10 m Tygon E-3603 hose | | | | Antistatic (rubber) hose | | | |
|--|---|---|-------|-------|---------|------------------------------------|-------|-------|---------|------------------------------------|-------|-------|---------|
| | | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min | 1 min Gassing/ floating time | 3 min | 5 min | > 5 min |
| Carbon dioxide | CO ₂ | ■ | | | | ■ | | | | ■ | | | |
| Carbon monoxide | CO | ■ | | | | ■ | | | | ■ | | | |
| Oxygen | O ₂ | ■ | | | | ■ | | | | ■ | | | |
| Nitrogen dioxide | NO ₂ | | ■ | | | | ■ | | | | ■ | | |
| Chlorine | Cl ₂ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| Hydrogen sulphide | H ₂ S | ■ | | | | ■ | | | | ■ | | | |
| Phosgene | COCl ₂ | Not yet measured | | | | | | | | | | | |
| Hydrogen Cyanide | HCN | | ■ | | | | ■ | | | | ■ | | ■ |
| Phosphine | PH ₃ | ■ | | | | ■ | | | | ■ | | | |
| Ammonia | NH ₃ | | | ■ | | | | | ■ | | | | ■ |
| Nitrogen monoxide | NO | ■ | | | | ■ | | | | ■ | | | |
| Sulphur dioxide | SO ₂ | | ■ | | | | | ■ | | 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 | ■ | | | | | | | ■ | ■ | | | |
| Lightly volatile hydrocarbons or gases | Methane - Hexane | ■ | | | | ■ | | | | ■ | | | |
| Medium volatile hydrocarbons or gases | Acetic acid, CH ₃ COOH | | ■ | | | ■ | ■ | ■ | ■ | | | | |
| | Toulene, C ₆ H ₅ CH ₃ | | ■ | | | ■ | ■ | ■ | ■ | | | ■ | |
| | Octane, C ₈ H ₁₈ | | ■ | | | ■ | ■ | ■ | ■ | | | ■ | |
| Low volatile hydrocarbons or vapors | n-Nonane, C ₉ H ₂₀ | | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |
| | Styrene, C ₆ H ₅ CH=CH ₂ | | ■ | | | ■ | ■ | ■ | ■ | ■ | ■ | ■ | ■ |

■ suitable t₉₀ time ■ limited suitable, longer rinsing time, t₉₀ > 5 min. ■ not suitable

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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