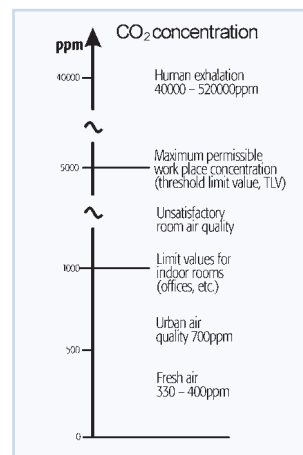


# GAS CONCENTRATION IN AIR

## Why is the Measurement of Room Air Quality So Important?

An unsatisfactory room air quality of indoor rooms (e.g. in offices) can easily cause tiredness, poor powers of concentration and even diseases to people. Indicator for the room air quality is the concentration of specific gases in air. The most important ones include:

- ▶ Carbon dioxide (CO<sub>2</sub>)
- ▶ Carbon monoxide (CO)
- ▶ Oxygen (O<sub>2</sub>)
- ▶ Ozone (O<sub>3</sub>)



### CO<sub>2</sub> Concentration

An important criterion for the evaluation of the room air quality is the CO<sub>2</sub> concentration. A CO<sub>2</sub> concentration, which is too high due to insufficient ventilation, is experienced as stale or stagnant air. The illustration above shows the range of CO<sub>2</sub> concentrations that are relevant to a human.

### CO Concentration

CO is produced when carbon is only partially combusted (fuel). CO is very dangerous for humans because it is at the same time highly toxic - and invisible and odorless. Reasons for the production of CO in various combustion processes :

- ▶ deficiency of air
- ▶ too high excess of air
- ▶ too early cooling down of flame

### Effects of CO in the ambient air on the human body

CO concentration		Inhalation period and consequences
30 ppm	0.0003%	Maximum concentration in the workplace per 8-hour shift (German MAK value)
200 ppm	0.02%	Slight headache within 2 to 3 hours
400 ppm	0.04%	Headache within 1 to 2 hours, first in the forehead and temples, then spreading to the whole head
800 ppm	0.08%	Dizziness, nausea, and twitching limbs within 45 minutes, unconsciousness within 2 hours
1600 ppm	0.16%	Headache, dizziness, nausea within 20 minutes, death within 2 hours
3200 ppm	0.32%	Headache, dizziness, nausea within 5 to 10 minutes, death within 30 minutes
6400 ppm	0.64%	Headache and dizziness within 1 to 2 minutes, death within 10 to 15 minutes
12800 ppm	1.28%	Death within 1 to 3 minutes

### Applications

- ▶ measurement, control, and warning system in garages,
- ▶ monitoring of room air quality with respect to maximum permissible workplace concentration (MAK value)
- ▶ monitoring of outside air or of protected air systems in domestic and large public shelters

## O<sub>2</sub> Concentration

The inhaled air consists of vital oxygen at a ratio of 1:5. Oxygen is required for all oxidation processes; for combustion processes, as well as for silent oxidations. Examples include the rusting of iron, oxidations, which occur in living processes, or the decomposition of organic material. Additionally, all combustion processes that release energy require this gas, for example, heating systems or aircraft engines. However, oxygen is also bound with any type of noxious fires such as forest and heath fires. Due to the permanent cycle of assimilation and photosynthesis in green plants when they are subject to sunshine, oxygen is continuously re-formed from carbon dioxide. The balance between oxygen consumption and oxygen production is disturbed by the continuously increasing combustion of fossil combustibles. Therefore, many areas require control measurements of the oxygen content in the air, e.g. in air condition systems, air purifiers, oxygen rectifiers, greenhouses and oxygen incubators, as well as for exhaust emission tests, e.g. in the automotive industry.

## O<sub>3</sub> Concentration

The ozone contained in the earth's atmosphere forms at altitudes of approximately 30km. It provides a protective shield around the earth and filters out approximately 50% of the solar UV radiation, particularly the short-wave range, which is dangerous for living organisms. However, ozone is toxic and an extremely aggressive trace gas that can cause major burns in human mucous membranes when breathed in high concentrations. Therefore, control measurements for the ozone content in air must be performed in many areas, e.g. leakage tests in industry, protection of health and safety standards at work, mobile-based air quality measurements or for providing environmental data on advertising displays etc.

## Calculation Formulae

The following formulae are used for converting the O<sub>3</sub> measured value from ppb to µg/m<sup>3</sup>, depending on the current atm. pressure and the temperature.

$$\text{Ozone (g/m}^3\text{)} = \frac{0,57 \times \text{Atm. Press [hPa]}}{\text{Temperature [K]}} \times \text{Ozone (ppb)}$$

Example: 20°C and 1013 hPa = factor 2

Ozone (µg/m<sup>3</sup>) = 2 x Ozone (ppb)

This is the nominal value for conversion from ppb to µg/m<sup>3</sup>.

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# GAS CONCENTRATION IN AIR

## Carbon Dioxide Sensor, hand-held FYA 600 CO2H



- Compact sensor for mobile and stationary applications.
- High display resolution (1 ppm).

**+** Operation with the device in SLEEP mode is not possible! When operating more than one CO<sub>2</sub> probe on a single ALMEMO® device, these CO<sub>2</sub> probes will need their own external power supply ! On request we can offer a wide variety of power supply options to suit your particular measuring setup.

### Types (including manufacturer's test certificate)

Carbon dioxide sensor,  
hand-held including connecting cable,  
1.5 m long for measuring CO<sub>2</sub> in air

**Order no. FYA600CO2H**

### Technical Data:

Sensor:	2-channel infra-red absorption principle
Measuring range:	0 to 10 000 ppm (0 to 1 vol% CO <sub>2</sub> )
Accuracy: (under nominal conditions)	0 to 5000 ppm± (50 ppm+ 2% of measured value) 5000 to 10000 ppm ±(100 ppm +3% of meas. value)
Resolution:	1 ppm or 0,0001 vol %
Nominal conditions:	22°C ±2 °C / 50 % rF ± 10 % rF
Ambient temperaturer:	0 to +50 °C
Storage temperature:	-20 to +50 °C
Ambient atmospheric humidity:	0 to 90 % rF (non-condensing)
Temperature coefficient	0,4% of measured value / °C
Voltage supply:	6.5 to 12 V DC, from the ALMEMO® device Operation with mains supply unit recommended !
Current consumption:	effective approx. 40 mA; max. approx. 80 mA
Connection cable:	1,5 m

## Carbon Dioxide Probe FYA 600 CO2



- Since the gas is supplied by means of free convection, this is especially suitable for climatology measurements.
- Various measuring ranges up to 25%.

**+** Operation with the device in SLEEP mode is not possible! When operating more than one CO<sub>2</sub> probe on a single ALMEMO® device, these CO<sub>2</sub> probes will need their own external power supply ! On request we can offer a wide variety of power supply options to suit your particular measuring setup.

### Type:

Carbon dioxide sensor  
including connecting cable 1.5m long  
for CO<sub>2</sub> measurements in air  
(Please specify measuring range !)

**Order no. FYA600CO2**

### Technical Data:

Gas:	CO <sub>2</sub>
Measuring principle:	IR optics
Measuring ranges:	nominal (% CO <sub>2</sub> ): 0 ... 0.5%, 0 ... 2.5%, 0 ... 10%, 0 ... 25%
Accuracy:	±2% of fin. val.
Reproducibility:	±1% of final value
Resolution:	(depending on measuring range) 50 ... 100ppm at 5000ppm <200ppm at 2.5%
Voltage output:	0 ... 2V for the selected measuring range
Current output:	referred to GND max. burden (load resist.): 400Ω
Power supply:	6.5 to 12VDC from the ALMEMO® device Operation with mains supply unit recommended !
Current consumpt.	eff. 50mA/ max. 70mA
Settling time t <sub>90</sub> :	< 60s
Temperature coefficient:	typical -0.4% signal/K
Temperature range:	5 to +40°C
Relative humidity:	0 to 95%
Dimensions:	W 96mm x H 36mm x D 64mm
Weight:	241g
Connecting cable:	1.5m long, ALMEMO® connector

## Carbon Monoxide Probe FYA 600 CO



- Applications:  
For measurement, control and warnings in garages, for monitoring the air quality with respect to the maximum allowable concentration at work places (MAC value, e.g. in laboratories and engine test benches)
- + Operation with the device in SLEEP mode is not possible!

### Types (including factory test certificate)

Carbon monoxide sensor including connecting cable 1.5m long for CO measurements in air

range: 0 ... 150 ppm

**Order no. FYA600COB1**

range: 0 ... 300 ppm

**Order no. FYA600COB2**

range: 0 ... 5000 ppm

**Order no. FYA600COB3**

range: 0 ... 5 vol.%

**Order no. FYA600COB4**

### Technical Data:

Gas:	CO
Measuring principle:	electrochemical reaction
Measuring range:	see types
Zero point error:	< 10 ppm CO
Gauge reading balance:	< 3 ppm CO
Error of meas. value:	±3% of full scale value
Zero point drift:	< 2% (1 year)
Reproducibility:	< 2% (1 year)
Linearity:	< 2% of full scale value
Settling time $t_{90}$ :	< 60s
Transverse sensitivity:	< 2% by integrated filter
Output:	4 ... 20 mA on ALMEMO® connector
Supply voltage:	from the ALMEMO® measuring instrument
Ambient temperature:	-10 to +40°C, sensor temperature compensated in range
Air humidity:	0 to 90% non-condensing
Life span of the meas. cell:	approx. 2 years typical
Dimensions of meas. head:	Ø 80mm, height 80mm
Weight:	600g
Connecting cable:	1.5m, with ALMEMO® connector

## Oxygen Probe FYA 600 O2



- Examples from the range of applications:  
Measurements in air conditioning systems, air purifiers, oxygen rectifiers, greenhouses and oxygen incubators.
- Approved by PTB and approved for exhaust emission measurements in the automotive industry.



A correction value can be stored in the ALMEMO® connector plug to compensate for the natural ageing of the probes, so optimum output characteristics can be ensured for the whole operating life.

### Type:

Oxygen sensor  
including connecting cable 1.5m long  
for O<sub>2</sub> measurements in air

**Order no. FYA600O2**

### For Reordering:

Oxygen sensor  
ALMEMO® connecting cable

**Order no. FY9600O2**  
**Order no. ZA9600AKO2**

### Technical Data:

Gas:	O <sub>2</sub>
Measuring principle:	electrochemical cell
Measuring range:	1 ... 100% O <sub>2</sub> , linear
Accuracy :	1% O <sub>2</sub>
Resolution :	0.01% O <sub>2</sub>
Response time:	< 40s
Signal drift:	< 2% signal/month (typ. < 5% over operating life)
Offset voltage at 20°C:	< 20µV
Operating life:	2 years, if operated in 20.9% O <sub>2</sub>
Nominal conditions:	20°C, 50% rH, 1013mbar
Temperature range:	-20 to +50°C
Temperature compensation:	effective in range -10 to +40°C
Pressure range:	atm. pressure ±10%
Relative humidity:	0 to 99% non-condensing
Connecting cable:	adapter cable 1.5m long
Dimensions:	H 43mm x Ø 29.3mm

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# GAS CONCENTRATION IN AIR

## Ozone Measuring Transducer FYA 600 O3



- Suitable for many measuring tasks where ozone measurements for control purposes were too expensive to date, e.g. for leakage tests in industry, for protection of health and safety standards at work, for mobile air quality measurements etc.
- Each ozone sensor is supplied with a manufacturer's test certificate.
- As a result of the high long-term stability, only small maintenance costs.

### Technical Data:

Gas:	O <sub>3</sub> (ozone)
Measuring principle:	electrochemical three-electrode sensor
Measuring range:	0 ... 300 ppb
Detection limit	20 ppb
Accuracy:	typically 5% of final value under nominal conditions (for intermittent operation)
Long term accuracy:	after 12 months under nominal conditions typically 5% of final value (for intermittent operation)
Exposure period :	until specification is reached, at least 2 hours (at 200 ppb); for a prolonged period the device was in an ozone-free environment
Meas. interval:	pump on: 5min pump off: 10min
Pump flow rate:	500ml/min
Signal output:	0 ... 2V, load resistance > 100kΩ
Power supply:	6 to 14V, stable
Current consumption:	pump on : 50 mA, typical pump off : 25 mA, typical pump blocked : 180 mA, typical
Overload capacity:	1 ppm
Expected useful life :	Sensor, typically 24 months (at 20 °C) pump, typically 6000 hours
Nominal conditions:	20°C, 30% r.H., 1013 mbar, no contaminations of the contact surfaces
Operating range :	-20 to +40 °C / 30 to 80 % RH
Storage temperature:	0 to 20°C, at 30 to 80% RH non-condensing
Dimensions:	L 180mm x W 125mm x H 90mm
Connecting cable:	1.5m long with ALMEMO® connector programmed in ppb

#### Type (including manufacturer's test certificate)

Ozone sensor  
including connecting cable 1.5m long  
for O<sub>3</sub> measurements in air

**Order no. FYA600O3**

#### Option:

Pump in continuous operation  
(fixed factory setting)

**Order no. OY9600O3D**

Maintenance set :  
new electro-chemical measuring cell,  
pump replacement,  
readjustment, including calibration certificate

**Order no. ZB9600O3S**



# GAS CONCENTRATION IN AIR

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## Gas probe for various gases FYA 600 A



**new!**

- Applications:
  - For measuring and warning systems
  - For monitoring room air quality, e.g. maximum admissible concentrations of toxic gases in the workplace

+ Operation with the device in SLEEP mode is not possible!

### Technical Data:

Gas:	see model variants
Measuring principle:	electrochemical reaction
Measuring range:	see model variants
Error of meas. value:	±3% of full scale value
Zero point drift:	< 2% (1 year)
Reproducibility:	< 2% (1 year)
Linearity:	< 2% of full scale value
Settling time $t_{90}$ :	< 60s
Transverse sensitivity:	< 2% by integrated filter
Output:	4 ... 20 mA on ALMEMO® connector
Supply voltage:	from the ALMEMO® measuring instrument
Ambient temperature:	-10 to +40°C, sensor temperature compensated in range
Air humidity:	0 to 90% non-condensing
Life span of the meas. cell:	approx. 2 years typical
Dimensions of meas. head:	Ø 80mm, height 80mm
Weight:	600g
Connecting cable:	1.5m, with ALMEMO® connector

### Model variants (including factory test certificate)

Gas probe, including connecting cable, 1.5 meters, for measuring gas in air

#### Ammonia $\text{NH}_3$

Range 0 to 250 ppm

**Order no. FYA600ANH3**

#### Nitrogen dioxide $\text{NO}_2$

Range 0 to 30 ppm

**Order no. FYA600ANO2**

#### Nitrogen oxide $\text{NO}$

Range 0 to 50 ppm

**Order no. FYA600ANO**

#### Chlorine gas $\text{Cl}_2$

Range 0 to 50 ppm

**Order no. FYA600ACL2**

#### Sulfur dioxide $\text{SO}_2$

Range 0 to 20 ppm

**Order no. FYA600ASO2B1**

Range 0 to 50 ppm

**Order no. FYA600ASO2B2**

Range 0 to 250 ppm

**Order no. FYA600ASO2B3**

#### Hydrogen sulfide $\text{H}_2\text{S}$

Range 0 to 50 ppm

**Order no. FYA600AH2SB2**

Range 0 to 250 ppm

**Order no. FYA600AH2SB3**

#### Ethylene oxide $\text{C}_2\text{H}_4\text{O}$

Range 0 to 20 ppm

**Order no. FYA600AC2H4OB1**

Range 0 to 50 ppm

**Order no. FYA600AC2H4OB2**

Range 0 to 100 ppm

**Order no. FYA600AC2H4OB4**

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