

# **Measurement of CO<sub>2</sub> concentrations in temperature changes**

Comparison of temperature characteristics between Senseair's CO<sub>2</sub> sensor and competitors' products

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## Introduction

In recent years, attention has been focused on improving indoor air quality (IAQ) by measuring  $CO_2$  concentrations and providing appropriate ventilation to provide safe and comfortable living environments. Efficient control of air conditioning and ventilation systems requires high accuracy and temperatureindependent  $CO_2$  sensors. Also, the Green Building Certification Program LEED [1] recommends the use of a  $CO_2$  sensor with a measurement accuracy of  $\pm 75$ ppm [2].

In this evaluation of a  $CO_2$  sensor used in air conditioning and ventilation systems, we set the measurement accuracy of  $CO_2$  concentrations recommended by LEED to ±75ppm, and compared the temperature characteristics of Senseair's  $CO_2$  sensor and competitors' products.

The  $CO_2$  sensor in the HVAC (Heating, Ventilation, and Air-Conditioning) system is also an important component. In order to evaluate, it is necessary to build an evaluation system that maintains a stable  $CO_2$ concentration and constant  $CO_2$  temperature, so it is not easy to evaluate the sample. We hope that this temperature characteristic evaluation will also serve as reference as the results of the basic characterization of the  $CO_2$  sensor.

<sup>[1]</sup> LEED is an environmental performance assessment system for building environments (buildings and urban environments) developed and operated by USGBC (U.S. Green Building Council), a non-profit organization, with certification audits conducted by GBCI (Green Business Certification Inc.).

<sup>[2]</sup> https://www.usgbc.org/credits/eq12

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# **Evaluation system**

#### **Evaluation conditions**

**Reference concentration CO<sub>2</sub> cylinder** [1] 395ppn

395ppm, 994ppm (Measured with gas analyzer)

[1] Reasons to choose between two CO<sub>2</sub> concentrations
Approximately 400ppm : Equivalent to atmospheric CO<sub>2</sub> concentration
Approximately 1000ppm : Equivalent to the standard CO<sub>2</sub> concentration for building air conditioning management

Temperature

0°C, 15°C, 25°C, 35°C, 45°C, and 50°C (6 points in total)



Note : In order to make the evaluation conditions of each  $CO_2$  sensor equal, the calibration recommended by each manufacturer is performed. The evaluation box is supplied with a standard concentration of  $CO_2$  gas at a constant flow rate.

# **Evaluation results**



Note) The **red dashed line** shows the measurement value of the reference  $CO_2$  concentration  $\pm 75$  ppm [1].

[1] LEED recommended  $CO_2$  sensor accuracy.

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- The graphs above show the measurement results using 2 reference concentrations of CO<sub>2</sub> gas (395ppm, 994ppm) after performing the calibrations recommended by the manufacturers for each CO<sub>2</sub> sensor.
- Only the Senseair  $CO_2$  sensor has an accuracy of less than  $\pm 75$  ppm of the reference  $CO_2$  concentration between 0 and 50°C.

# Senseair

#### CO<sub>2</sub> concentration: 395ppm



#### CO<sub>2</sub> concentration: 994ppm



### Target specification

Accuracy (CO<sub>2</sub> concentration output) :  $\pm$ 75ppm Measurement temperature range: 0°C ~ 50°C

#### Measurement results

The  $CO_2$  concentration that meets the target specifications was output in the measurement temperature range.

### If installed in an HVAC system

Appropriate ventilation control is possible.

# Manufacturer A

#### CO<sub>2</sub> concentration: 395ppm



#### CO<sub>2</sub> concentration: 994ppm



### Target specification

Accuracy (CO<sub>2</sub> concentration output) :  $\pm$ 75ppm Measurement temperature range: 0°C ~ 50°C

#### Measurement results

In the 994ppm environment, a higher CO<sub>2</sub> concentration was output around 25°C or above, which deviated from the target specifications.

### If installed in an HVAC system

In the 994ppm environment, a higher  $CO_2$  concentration was output around 25°C or above. In this case, overventilation can cause energy loss.

# **Manufacturer B**

#### CO<sub>2</sub> concentration: 395ppm



#### CO<sub>2</sub> concentration: 994ppm



### Target specification

Accuracy (CO<sub>2</sub> concentration output) :  $\pm$ 75ppm Measurement temperature range: 0°C ~ 50°C

#### Measurement results

A higher  $CO_2$  concentration was output around 10°C or below, while lower output was seen around 40°C or above, which deviated from the target specifications.

### If installed in an HVAC system

A CO<sub>2</sub> concentration that was higher than the actual value was output around 10°C or below. In this case, overventilation can cause energy loss. However, a CO<sub>2</sub> concentration that was lower than the actual value was output around 40°C or above. In this case, ventilation will be insufficient and will not provide the expected ventilation control.

# **Manufacturer C**

#### CO<sub>2</sub> concentration: 395ppm



#### CO<sub>2</sub> concentration: 994ppm



### Target specification

Accuracy (CO<sub>2</sub> concentration output) :  $\pm$ 75ppm

Measurement temperature range: 0°C ~ 50°C

### Measurement results

A higher  $CO_2$  concentration was output around 20°C or below, which deviated from the target specifications.

### If installed in an HVAC system

A higher  $CO_2$  concentration was output around 20°C or below. In this case, overventilation can cause energy loss.

## Conclusion

- The Green Building Certification Program LEED (Leadership in Energy & Environmental Design) recommends the use of CO<sub>2</sub> sensors with a measurement accuracy of ±75ppm or less.
- In this measurement, only Senseair's CO<sub>2</sub> sensor achieved the required accuracy recommended by LEED (±75ppm).
- Senseair's CO<sub>2</sub> sensor is ideal for efficient control of HVAC systems.

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