

# CO<sub>2</sub> Gas Purity Measurement with a Suppressed Range of 98 – 100 %

## Process Overview

High-purity CO<sub>2</sub> is a key component in many industrial processes, scientific applications, incubation, beverage, safety and others. Depending on the industry, CO<sub>2</sub> purity is mandated by different regulations and standards that determine the purity criteria. The grade of purity of CO<sub>2</sub> can be influenced by elements such as oxygen, moisture content, total hydrocarbons, among others. That is why it is important to select the right gas analyzer for monitoring CO<sub>2</sub> purity.

## CO<sub>2</sub> Purity Monitoring

The Rosemount X-STREAM Enhanced Series of Continuous Gas Analyzers provide CO<sub>2</sub> gas purity measurement with a full range of 0 - 100 % CO<sub>2</sub> and a suppressed range of 98 - 100 % CO<sub>2</sub>. Some of the features of the Rosemount X-STREAM Enhanced Continuous Gas Analyzers include:

- Nitrogen purged thermostated photometer containment
- Barometric pressure compensation
- Internal pressure regulator, filter and capillary
- Sample flow measurement as option
- Table-top or rack-mountable analyzer
- 4 ranges per channel
- Autocalibration via internal or external valve block, controlled by digital I/O, serial interface, network, time-programmed
- Alternatively manual zero and span adjustment
- Analog, digital and serial I/Os
- Other suppressed ranges e. g. for O<sub>2</sub>, H<sub>2</sub> and N<sub>2</sub>O available.

Housed in a total 19-inch enclosure with thermostat control, the X-STREAM *Enhanced* Continuous Gas Analyzer for CO<sub>2</sub> gas purity can measure two ranges of CO<sub>2</sub> on a single bench: An absolute range of 0 – 100 % CO<sub>2</sub> and a suppressed range of 98 – 100 %.

The main advantage is that calibration can be done in the absolute range using pure nitrogen as zero gas and pure carbon dioxide as span gas thus avoiding zeroing with inaccurate and more expensive calibration gas (98 % ± x %) as zero gas for the suppressed range. Since suppressed ranges are depending much more on the influence of pressure, temperature and flow, special measures are necessary to keep those constant and run special compensation methods additionally (internal pressure regulator, capillary & pressure sensor; temperature & pressure compensation).

Therefore, the standard calibration interval has to be changed for the non-standard suppressed range. A daily calibration has to be carried out with 100 % N<sub>2</sub> and 100 % CO<sub>2</sub>. Due to the big change from 98 – 100 % CO<sub>2</sub> to 100 % N<sub>2</sub> (0 % CO<sub>2</sub>) a purge time of more than 240 seconds is required before running a zero adjustment. The same purge time is necessary to switch over to span gas or sample gas. To achieve the best results sample, zero and span gases need to be kept at constant temperature within the range of permissible ambient temperature.

## Calibration Procedure

Calibration is carried out within the absolute range:

- 0 – 100 % CO<sub>2</sub>

Run span gas calibration only after having carried out a zero calibration:

- zero gas: 100 % N<sub>2</sub>
- span gas: 100 % CO<sub>2</sub>

Zero and span calibration requires a certain purge time, after which the calibration routine with stability and averaging procedures takes place (calibration time). Purge time is also required after return from zero or span to sample gas.

Analyzer factory settings:

- purge time: >240 s (from sample to zero; from zero to span)
- calibration time: approximately 40 s
- purge time: >240 s (from zero to span or sample; span to zero)

Notes:

- The factory settings for calibration purge time covers the gas path from the X-STREAM gas inlet only, and does not include such times for an external sample handling system.
- All calibration gases have to be kept at the same temperature as sample gas. Sample gas has to be conditioned to the ambient temperature of the analyzer.

## Installation

Installation of the analytical equipment (gas analyzer, sample handling system and calibration gases) should be in an air conditioned room or at least in a well ventilated housing.



Rosemount X-STREAM Enhanced XEGP Continuous Gas Analyzer

0–100 % CO <sub>2</sub> Enhanced Performance Specifications		98–100 % CO <sub>2</sub> Performance Specifications	
Detection limit (4 $\sigma$ ) <sup>(1)(4)</sup>	≤ 0.5 %	Detection limit (4 $\sigma$ ) <sup>(1)(4)</sup>	≤ 2 %
Linearity <sup>(1)(4)</sup>	≤ 1 %	Linearity <sup>(1)(4)</sup>	≤ 1 %
Zero-point drift <sup>(1)(4)</sup>	≤ 1 % per week	Zero-point drift <sup>(1)(4)(5)</sup>	≤ 2 % per day
Span (sensitivity) drift <sup>(1)(4)</sup>	≤ 1 % per month	Span (sensitivity) drift <sup>(1)(4)(5)</sup>	≤ 2 % per day
Repeatability <sup>(1)(4)</sup>	≤ 0.5 %	Repeatability <sup>(1)(4)</sup>	≤ 2 %
Response time (t <sub>90</sub> ) <sup>(3)</sup>	4 s ≤ t <sub>90</sub> ≤ 7 s	Response time (t <sub>90</sub> ) <sup>(6)</sup>	≤ 30 s
Permissible gas flow	0.2–1.5 l/min	Permissible gas flow	defined by constant pressure at inlet
Influence of gas flow <sup>(1)(4)</sup>	≤ 0.5 %	Permissible gas pressure	1300 hPa (4.4 psig)–1700 hPa (10.1 psig)
Maximum gas pressure <sup>(8)</sup>	≤ 1500 hPa abs. (≤ 7 psig)	Permissible gas pressure variation	± 70 hPa (1 psig)
Influence of ambient pressure <sup>(2)</sup>		Influence of ambient pressure change from 800 to 1100 hPa at constant temperature with pressure compensation <sup>(1)(7)</sup>	
– At constant temperature	≤ 0.10 % per hPa		
– With pressure compensation <sup>(7)</sup>	≤ 0.01 % per hPa		≤ 2 %
Permissible ambient temperature	0 to +50 °C (32 to 122 °F)	Permissible ambient temperature	15 to 35 °C (59 to 95 °F)
Influence of temperature <sup>(1)(10)</sup> (at constant pressure)		Influence of temperature <sup>(1)(10)</sup> (at constant pressure)	
– On zero point	≤ 0.5 % per 10 K	– On zero point	≤ 0.5 % per 10 K
– On span (sensitivity) <sup>(11)</sup>	≤ 5 %	– On span (sensitivity) <sup>(11)</sup>	≤ 2 %
Thermostat control <sup>(9)</sup>	none / 60 °C (140 °F)	Thermostat control	60 °C (140 °F)
Warm up time	15 to 50 minutes	Warm up time	approx. 50 minutes
		Purge gas (N <sub>2</sub> ) flow	approx. 0.1–0.2 l/min

\*NOTE: 1psi = 68.95 hPa

(1) Related to f. s. (absolute range) or suppressed range (98–100 %)

(2) Related to measuring value

(3) From gas analyzer inlet at gas flow of 1.0 l/min (electronic damping = 0 s)

(4) Constant pressure and temperature

(5) Daily zero and span calibration requested

(6) Switching from absolute to suppressed range requires purge time of > 240 s

(7) Sample gas pressure sensor mandatory

(8) Limited to atmospheric if internal sample pump


(9) Optional thermostatically controlled box with temperature 60 °C (140 °F)

(10) Temperature variation: ≤ 10 K per hour


(11) Related to permissible ambient temp. range

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