

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040335_03

AMS designation: CEMSelect OEM for CO, NO, SO₂, CO₂, NO₂, NO_x and O₂

Manufacturer: Bühler Technologies GmbH
Harkortstraße 29
40880 Ratingen
Germany

Test Laboratory: TÜV Rheinland Energy GmbH

**This is to certify that the AMS has been tested
and found to comply with the standards
EN 15267-1 (2009), EN 15267-2 (2009), EN 15267-3 (2007)
and EN 14181 (2014).**

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 35 pages).
The present certificate replaces certificate 0000040335_02 of 04 June 2020.



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000040335

Publication in the German Federal Gazette
(BAnz) of 05 August 2021

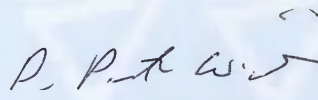
This certificate will expire on:
04 August 2026

German Federal Environment Agency
Dessau, 03 September 2021

TÜV Rheinland Energy GmbH
Cologne, 02 September 2021



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Test institute accredited to EN ISO/IEC 17025 by DAkkS (German Accreditation Body).
This accreditation is limited to the accreditation scope defined in the enclosure to certificate D-PL-11120-02-00.

Test Report:	936/21251815/A dated 03 May 2021
Initial certification:	09 September 2014
Expiry date:	04 August 2026
Publication:	BAnz AT 05.08.2021 B5, chapter I number 4.3

Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13th BImSchV), plants in compliance with TA Luft and plants according to the 27th BImSchV. When equipped with the module SIPROCESS UV600-7MB2621 for monitoring the components NO, NO₂ and SO₂ and when equipped with the module Ultramat 6, Ultramat 6-2K, Ultramat / Oxymat 6 for the components CO, NO and SO₂ as well as when equipped with the module Ultramat 23 / BA 5000-7MB2355-Z-T25 / T35, Ultramat 23 / BA 5000-7MB2357-Z-T25 / T35 and Ultramat 23 / BA 5000-7MB2358-Z-T35 for the component SO₂, the measuring system is fit for use at plants according to the 17th BImSchV. The measured ranges have been selected so as to ensure as broad a field of application as possible.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and several field tests test at various waste incineration plants.

The AMS is approved for an ambient temperature range of +5 °C to +40 °C.

The notification of suitability of the AMS, performance testing and the uncertainty calculation have been effected on the basis of the regulations applicable at the time of testing. As changes in legal provisions are possible, any potential user should ensure that this AMS is suitable for monitoring the limit values and oxygen concentrations relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the intended purpose.

Basis of the certification

This certification is based on:

- Test report 936/21251815/A dated 03 May 2021 issued by TÜV Rheinland Energy GmbH
- Suitability announced by the German Federal Environment Agency (UBA) as the relevant body
- The ongoing surveillance of the product and the manufacturing process

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, chapter I number 4.3 ,
UBA announcement dated 29 June 2021 :

AMS designation:

CEMSelect OEM for CO, NO, SO₂, CO₂, NO₂, NO_x and O₂

Manufacturer:

Bühler Technologies GmbH, Ratingen

Field of application:

Modular measuring system for plants requiring official approval and
for plants according to the 27th BImSchV

Measuring ranges in the performance test and maintenance intervals determined:

Component	Modul Type	Certification range	Additional ranges		Unit	Maintenance Intervall
CO	Ultramat 23 / BA 5000-7MB2355 - Z - T13 / T23 / T33	0 - 200	0 - 1250	-	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T13 / T23 / T33	0 - 200	0 - 1250	-	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2358 - Z - T13 / T23	0 - 375	0 - 1250	-	mg/m ³	6 Months
	Ultramat 23 / BA 5000-7MB2355 - Z - T14 / T24 / T34	0 - 1250	0 - 6000	-	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T14 / T24 / T34	0 - 1250	0 - 6000	-	mg/m ³	12 Months
	Ultramat 6 LR - Z + Y27	0 - 75	0 - 1250	0 - 3000	mg/m ³	6 Months
	Ultramat 6-2K LR - Z + Y27 + Y28	0 - 75	0 - 1250	0 - 3000	mg/m ³	6 Months
	Ultramat/Oxymat 6 LR - Z + Y27 + Y28	0 - 75	0 - 1250	0 - 3000	mg/m ³	6 Months
	Ultramat 6 HR - Z + Y27	0 - 1000	0 - 10000	-	mg/m ³	6 Months
	Ultramat 6-2K HR - Z + Y27 + Y28	0 - 1000	0 - 10000	-	mg/m ³	6 Months
	Ultramat/Oxymat 6 HR - Z + Y27 + Y28	0 - 1000	0 - 10000	-	mg/m ³	6 Months
NO _x	Ultramat 23 / BA 5000-7MB2355 - Z - T13 / T23 / T33	0 - 75 ³⁾ 0 - 1000 ⁴⁾	0 - 1250 ³⁾ 0 - 10000 ⁴⁾	-	mg/m ³	6 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T13 / T23 / T33	0 - 150 ¹⁾ 0 - 230 ²⁾	0 - 750 ¹⁾ 0 - 1150 ²⁾	0 - 2000 ¹⁾ 0 - 3067 ²⁾	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2358 - Z - T13 / T23	0 - 150 ¹⁾ 0 - 230 ²⁾	0 - 400 ¹⁾ 0 - 613 ²⁾	0 - 2000 ¹⁾ 0 - 3067 ²⁾	mg/m ³	12 Months
NO	Ultramat 23 / BA 5000-7MB2358 - Z - T13 / T23	0 - 400 ¹⁾ 0 - 613 ²⁾	0 - 2000 ¹⁾ 0 - 3067 ²⁾	-	mg/m ³	6 Months
	SIPROCESS UV600-7MB2621 - Z - Y17	0 - 50	0 - 200	0 - 2000	mg/m ³	2 Weeks
	Ultramat 23 / BA 5000-7MB2355 - Z - T14 / T24 / T34	0 - 600	0 - 3000	-	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T14 / T24 / T34	0 - 600	0 - 3000	-	mg/m ³	12 Months
	Ultramat 6 LR - Z + Y27	0 - 100	0 - 2000	-	mg/m ³	6 Months
	Ultramat 6-2K LR - Z + Y27 + Y28	0 - 100	0 - 2000	-	mg/m ³	6 Months
	Ultramat/Oxymat 6 LR - Z + Y27 + Y28	0 - 100	0 - 2000	-	mg/m ³	6 Months
	Ultramat 6 HR - Z + Y27	0 - 1000	0 - 10000	-	mg/m ³	6 Months
	Ultramat 6-2K HR - Z + Y27 + Y28	0 - 1000	0 - 10000	-	mg/m ³	6 Months
	Ultramat/Oxymat 6 HR - Z + Y27 + Y28	0 - 1000	0 - 10000	-	mg/m ³	6 Months
Ultramat 6-2K LR - HR - Z - Y27 + Y28	0 - 100 ³⁾ 0 - 1000 ⁴⁾	0 - 2000 ³⁾ 0 - 10000 ⁴⁾	-	mg/m ³	6 Months	

Component	Modul Type	Certification range	supplementary ranges		Unit	Maintenance Intervall
NO ₂	SIPROCESS UV600-7MB2621 - Z - Y17	0 - 50	0 - 500	-	mg/m ³	3 Months with a weekly adjustment with the calibration cell, otherwise 2 weeks
	Ultramat 23 / BA 5000-7MB2355 - Z - T25 / T35	0 - 50	0 - 1000	-	mg/m ³	4 Weeks
	Ultramat 23 / BA 5000-7MB2357 - Z - T25 / T35	0 - 50	0 - 1000	-	mg/m ³	4 Weeks
	Ultramat 23 / BA 5000-7MB2358 - Z - T35	0 - 50	0 - 1000	-	mg/m ³	4 Weeks
SO ₂	Ultramat 23 / BA 5000-7MB2355 - Z - T13 / T23 / T33	0 - 400	0 - 2000	0 - 7000	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T13 / T23 / T33	0 - 400	0 - 2000	0 - 7000	mg/m ³	12 Months
	Ultramat 23 / BA 5000-7MB2358 - Z - T13 / T23	0 - 400	0 - 2000	0 - 7000	mg/m ³	6 Months
	SIPROCESS UV600-7MB2621 - Z - Y17	0 - 75	0 - 130	0 - 2000	mg/m ³	3 Months with a weekly adjustment with the calibration cell, otherwise 2 weeks
	Ultramat 6 LR - Z + Y27	0 - 75	0 - 1500	-	mg/m ³	6 Months
	Ultramat 6-2K LR - Z + Y27 + Y28	0 - 75	0 - 1500	-	mg/m ³	6 Months
	Ultramat/Oxymat 6 LR - Z + Y27 + Y28	0 - 75	0 - 1500	-	mg/m ³	6 Months
	Ultramat 23 / BA 5000-7MB2355 - Z - T25 / T35	0 - 70	0 - 75	0 - 1250	mg/m ³	4 Weeks
	Ultramat 23 / BA 5000-7MB2357 - Z - T25 / T35	0 - 70	0 - 75	0 - 1250	mg/m ³	4 Weeks
	Ultramat 23 / BA 5000-7MB2358 - Z - T35	0 - 70	0 - 75	0 - 1250	mg/m ³	4 Weeks
CO ₂	Ultramat 23 / BA 5000-7MB2355 - Z - T13 / T23 / T33	0 - 25	-	-	Vol.-%	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T13 / T23 / T33	0 - 25	-	-	Vol.-%	12 Months
O ₂ (paramagnetic)	Ultramat 23 / BA 5000-7MB2355 - Z - T13 / T14	0 - 25	-	-	Vol.-%	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T13 / T14	0 - 25	-	-	Vol.-%	12 Months
	Ultramat 23 / BA 5000-7MB2358 - Z - T13 / T14	0 - 25	-	-	Vol.-%	6 Months
	Oxymat 6 - Z + Y27	0 - 25	0 - 5	-	Vol.-%	6 Months
	Ultramat / Oxymat 6 - Z + Y27 + Y28	0 - 25	0 - 5	-	Vol.-%	6 Months
O ₂ (electrochemical)	Ultramat 23 / BA 5000-7MB2355 - Z - T23 / T24 / T25	0 - 25	0 - 5	-	Vol.-%	12 Months
	Ultramat 23 / BA 5000-7MB2357 - Z - T23 / T24 / T25	0 - 25	0 - 5	-	Vol.-%	12 Months
	Ultramat 23 / BA 5000-7MB2358 - Z - T23 / T24 / T25	0 - 25	0 - 5	-	Vol.-%	6 Months

1 stated as NO
2) stated as NO2
3) low range (LR)
4) high range (HR)

- Z - T13 = O₂ paramagnetic Cell
- Z - T23 = O₂ electrochemical Cell
- Z - T24 = O₂ electrochemical Cell integrated

Software versions:

Ultramat 23-7MB2355 4.02.08
Ultramat 23-7MB2357 4.02.08
Ultramat 23-7MB2358 4.02.08

Ultramat 6 4.8.8
Ultramat 6-2K 4.8.8

Oxymat 6 4.8.8

Ultramat / Oxymat 6 4.8.8

SIEMENS SIMATIC Set CEM CERT 7MB1957 Rev. 1.0

SIPROCESS UV600-7MB2621
BCU: 9150883_3.003
Gas module: 9137582_3.002
UV Module: 9139736_3.005

Restriction:

When using the Ultramat 23-7MB2355, Ultramat 23-7MB2357 or Ultramat 23-7MB2358 and BA 5000-7MB2355, BA 5000-7MB2357 and BA 5000-7MB2358 modules respectively, the system cabinet must be equipped with an A/C unit.

Notes:

1. The CEMSelect OEM AMS, when equipped with the module SIPROCESS UV600-7MB2621 for monitoring the components NO, NO₂ and SO₂ and when equipped with the module Ultramat 6, Ultramat 6-2K, Ultramat / Oxymat 6 for the components CO, NO and SO₂ as well as when equipped with the module Ultramat 23 / BA 5000-7MB2355-Z-T25 / T35, Ultramat 23 / BA 5000-7MB2357-Z-T25 / T35 and Ultramat 23 / BA 5000-7MB2358-Z-T35 for the component SO, can also be used on installations according to the 17th BImSchV.
2. For automatic zero adjustments, the modules of the Ultramat 23/BA 5000 series must be operated at a 24h interval. The modules of the Ultramat 6 series must be operated at a one-week interval for automatic span point adjustments.
3. In order to optimise the cross-sensitivity of the CO measurement channel in relation to CO₂, the modules Ultramat 23 / BA 5000-7MB2355, Ultramat 23 / BA 5000-7MB2357 and Ultramat 23 / BA 5000-7MB2358 of the CEMSelect OEM measuring system will be distributed with a modified CO-receptor starting from the production month April 2014. A serial number starting with E4 in the central block will be used for identification purposes.
4. The modules Ultramat 23 / BA 5000-7MB2355, Ultramat 23 / BA 5000-7MB2357 and Ultramat 23 / BA 5000-7MB2358 must be operated with the Thermo-AUTOCAL function.
5. The modular CEMSelect OEM measuring system may alternatively be equipped with a sampling probe (SP2000H) manufactured by M&C TechGroup Germany GmbH and a sample gas cooler (EGK 2-19) manufactured by Bühler Technologies GmbH.
6. The sample gas cooler (EGK 2-19) manufactured by Bühler Technologies GmbH implemented in the modular CEMSelect OEM measuring system may be equipped with a PVDF or glass cooling element. In any case, a glass cooling element shall be used for the SIPROCESS UV600-7MB2621 module.
7. The modular CEMSelect OEM measuring system for determining NO_x is equipped with an NO_x type gas converter CG-2 manufactured by M&C Tech Group Germany GmbH.
8. When adding additional modules to the CEMSelect OEM measuring system, each combination of modules needs to be checked for functionality as part of testing proper installation and the maintenance interval has to be determined. Maintenance work must be spread over several days in order to comply with the requirements for outage times specified by the 13th and 17th BImSchV.
9. The Ultramat 6, Ultramat 6-2K, Ultramat/Oxymat 6 and Oxymat 6 modules need to be operated with weekly AUTO zero and AUTO span adjustments using test gases from pressurised gas bottles.
10. A system cabinet with a degree of protection of IP40 is part of the modular CEM-Select OEM measuring system. The system cabinet can be equipped with an air conditioning unit or a ventilator unit.
11. It is possible to integrate the central unit of the QAL1 certified LDS 6 7MB6121 NH₃ and LDS 6 7MB6121 HCl measuring systems from Siemens AG as measuring modules into the system cabinet of the CEMSelect OEM measuring system.
12. Supplementary test (approval of further measurement modules, integration of the system LDS6 7MB6121 of Siemens AG, re-evaluation of total uncertainty Ultramat 23 / BA 5000-7MB2358 for the component CO, update of the software version) as regards the notices of the Federal Environment Agency of 24 February 2020 (BAnz AT 24.03.2020 B7, chapter I number 3.2) and of 31 March 2021 (BAnz AT 03.05.2021 B9, chapter III 6th notification).

Test Report:

TÜV Rheinland Energy GmbH, Cologne
Report no.: 936/21251815/A dated 03 May 2021

Certified product

This certification applies to automated measurement systems conforming to the following description:

The complete modular CEMSelect OEM measuring system comprises a heated sampling probe, a heated sample gas line, a two-stage sample gas cooler, a delivery pump and a maximum of three multi-component analysers from the ULTRAMAT 6, ULTRAMAT 6 2-K, OXYMAT 6, ULTRAMAT/OXYMAT 6, ULTRAMAT 23 / BA 5000-7MB2355, ULTRAMAT 23 / BA 5000-7MB2357, ULTRAMAT 23 / BA 5000-7MB2358 or SIPROCESS UV600-7MB2621.

A system cabinet with housing protection class IP40 is part of the modular CEMSelect OEM measuring system. The system cabinet can be equipped with an air conditioning unit or a ventilator unit.

For the measurement of CO, NO and SO₂ in the ULTRAMAT 23 or BA 5000 analysers, the modular measuring system operates according to the principle of non-dispersive infrared absorption (NDIR method) or, for NO₂ and SO₂, alternatively according to the principle of UV absorption measurement. For measuring oxygen either an electrochemical or a paramagnetic oxygen measuring cell is used. The SIPROCESS UV600 analyser of the modular measuring system uses gas filter correlation (GFC) to measure NO and interference filter correlation (IFC) to measure NO₂ and SO₂.

A sample gas pump with integrated vapour recovery for the purpose of controlling sample gas flows is situated between the first and the second stage of cooling. A fine particle filter for dust separation is integrated in the cooler housing. Downstream of the sample gas cooler, the gas flow is divided into two to three partial flows to simultaneously supply analyser modules arranged in parallel with sample gas. Gas oversupply is led out via a bypass. A condensate filter is placed immediately upstream of each analyser modules which blocks the gas path in the event of moisture coming through in order to protect the analysers. In the ULTRAMAT 23 measuring modules, a (heated) converter is placed upstream of the condensate filter for measuring NO_x. A three-way valve is placed in front of the pump which serves to feed zero gas for automatic zero gas adjustment (AutoCal) and is controlled via the SIMATIC.

A second three-way valve is installed downstream of the pump which, controlled by SIMATIC, is able to time the supply of zero/test gases for automatic adjustments of zero and span points. Test gases may alternatively be fed manually via a third three-way valve.

The modular measuring system consists of the following components:

<u>Measuring cabinet</u>	CEMSelect OEM system cabinet	
<u>Probe</u>	Manufacturer	Bühler Technologies GmbH
	Type	Gas 222.20-Cal-twin incl. ceramic filter
<u>Alternative probe</u>	Manufacturer	M&C TechGroup Germany GmbH
	Type	SP2000-H incl. ceramic filter (length 100 cm), heated to 180 °C
<u>Heated sample gas line</u>	Temperature	180 °C
	Length:	50 m in the field, 10 m in the lab
	Diameter	(inner):4 mm
	Material	PTFE
<u>Compressor cooler</u>	Manufacturer	M&C TechGroup Germany GmbH
	Type	CSS V1-S
<u>Alternative cooler</u>	Manufacturer	Bühler Technologies GmbH
	Type	EGK 2-19, 2 stage, dew point 3 °C
<u>Sample gas pump</u>	Manufacturer	Bühler Technologies GmbH
	Type	P2.3:
<u>NO_x converter</u>	Manufacturer	M&C TechGroup Germany GmbH
	Type	Gas Konverter CG-2
<u>Analyser modules</u>	Manufacturer	Siemens AG / Bühler Technologies GmbH
	Type	ULTRAMAT 6 ULTRAMAT 6 2-K OXYMAT 6 ULTRAMAT / OXYMAT 6 ULTRAMAT 23 / BA 5000-7MB2355 ULTRAMAT 23 / BA 5000-7MB2357 ULTRAMAT 23 / BA 5000-7MB2358 SIPROCESS UV600

General remarks

This certificate is based upon the equipment tested. The manufacturer is responsible for ensuring that on-going production complies with the requirements of the EN 15267. The manufacturer is required to maintain an approved quality management system controlling the manufacturing process for the certified product. Both the product and the quality management systems shall be subject to regular surveillance.

If a product of the current production does not conform to the certified product, TÜV Rheinland Energy GmbH must be notified at the address given on page 1.

A certification mark with an ID-Number that is specific to the certified product is presented on page 1 of this certificate.

This document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. Upon revocation of the publication the certificate loses its validity. After the expiration of the certificate and on request of TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must no longer be used.

The relevant version of this certificate and its expiration date are also accessible on the internet at qal1.de.

Document history

Certification of the CEMSelect OEM measuring system is based on the documents listed below and the regular, continuous surveillance of the manufacturer's quality management system:

Initial certification according to EN 15267

Certificate no. 0000040335_00: 09 September 2014
Expiry date of the certificate: 04 August 2019
Test Report: 936/21224909/A of 03 April 2014
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 05.08.2014 B11, chapter I number 5.2
UBA announcement dated 17 July 2014

Supplementary testing according to EN 15267

Certificate no. 0000040335_01: 30 September 2015
Expiry date of the certificate: 04 August 2019
Test Report: 936/21224909/B of 26 March 2015
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 26.08.2015 B4, chapter I number 3.1
UBA announcement dated 22 July 2015

Notifications

Statement issued by TÜV Rheinland Energy GmbH dated 13 October 2016
Publication: BAnz AT 15 March 2017 B6, chapter IV correction 1
UBA announcement dated 22 February 2017
(Correction of a mistake in the public announcement)

Supplementary testing according to EN 15267

Statement issued by TÜV Rheinland Energy GmbH dated 07 March 2017
Test Report: 936/21239467/A of 07 March 2017
Publication: BAnz AT 31.07.2017 B12, chapter I number 3.2
UBA announcement dated 13 July 2017
(Supplementary testing)

Notifications

Statement issued by TÜV Rheinland Energy GmbH dated 06 October 2017
Test Report: 936/21239467/B of 05 October 2017
Publication: BAnz AT 02.02.2018 B5, chapter I notification 1
UBA announcement dated 17 January 2018
(Correction of the public announcement)

Statement issued by TÜV Rheinland Energy GmbH dated 08 December 2017
Publication: BAnz AT 26.03.2018 B8, chapter V notification 21
UBA announcement dated 21 February 2018
(Software updates)

Supplementary testing according to EN 15267

Certificate no. 0000040335_02: 04 June 2020
Expiry date of the certificate: 23 March 2025
Test Report: 936/21247820/A of 24 September 2019
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 24.03.2020 B7, chapter I number 3.2
UBA announcement dated 24 February 2020

Notifications

Statement issued by TÜV Rheinland Energy GmbH dated 14 July 2020
Publication: BAnz AT 03.05.2021 B9, chapter III number 6
UBA announcement dated 31 March 2021
(Software updates)

Supplementary testing according to EN 15267

Certificate no. 0000040335_03: 03 September 2021
Expiry date of the certificate: 04 August 2026
Test Report: 936/21251815/A dated 03 May 2021
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 05.08.2021 B5, chapter I number 4.3
UBA announcement dated 29 June 2021 :

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 6
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	CO	0 - 75 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.32 mg/m ³
Sum of negative CS at zero point	-0.33 mg/m ³
Sum of positive CS at span point	1.00 mg/m ³
Sum of negative CS at span point	-0.40 mg/m ³
Maximum sum of cross-sensitivities	1.00 mg/m ³
Uncertainty of cross-sensitivity	u_i 0.576 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D 0.614 mg/m ³		0.377 (mg/m ³) ²
Lack of fit	u_{of} 0.229 mg/m ³		0.052 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ -0.650 mg/m ³		0.423 (mg/m ³) ²
Span drift from field test	$u_{d,s}$ 0.606 mg/m ³		0.367 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.924 mg/m ³		0.854 (mg/m ³) ²
Influence of supply voltage	u_v 0.082 mg/m ³		0.007 (mg/m ³) ²
Cross-sensitivity (interference)	u_i 0.576 mg/m ³		0.332 (mg/m ³) ²
Influence of sample gas flow	u_n -0.079 mg/m ³		0.006 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_m 0.606 mg/m ³		0.368 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.67 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.27 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	6.5
Requirement of EN 15267-3	U in % of the ELV 50 mg/m ³	10.0
	U in % of the ELV 50 mg/m ³	7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 6
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	CO	0 - 1000 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	8.60 mg/m ³
Sum of negative CS at span point	-4.20 mg/m ³
Maximum sum of cross-sensitivities	8.60 mg/m ³
Uncertainty of cross-sensitivity	u_i 4.965 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	2.042 mg/m ³	4.170 (mg/m ³) ²
Lack of fit	u_{lof}	-1.732 mg/m ³	3.000 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	3.464 mg/m ³	11.999 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	-13.279 mg/m ³	176.332 (mg/m ³) ²
Influence of ambient temperature at span	u_t	5.700 mg/m ³	32.490 (mg/m ³) ²
Influence of supply voltage	u_v	3.549 mg/m ³	12.595 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	4.965 mg/m ³	24.651 (mg/m ³) ²
Influence of sample gas flow	u_p	0.842 mg/m ³	0.709 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	8.083 mg/m ³	65.333 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 18.20 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 35.67 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 500 mg/m³ 7.1

Requirement of 2010/75/EU

U in % of the ELV 500 mg/m³ 10.0

Requirement of EN 15267-3

U in % of the ELV 500 mg/m³ 7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	CO	0 - 1250 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	7.75 mg/m ³
Sum of negative CS at span point	-23.38 mg/m ³
Maximum sum of cross-sensitivities	-23.38 mg/m ³
Uncertainty of cross-sensitivity	u_i -13.496 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	2.228 mg/m ³	4.964 (mg/m ³) ²
Lack of fit	u_{lof}	3.464 mg/m ³	11.999 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	3.608 mg/m ³	13.018 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	7.939 mg/m ³	63.028 (mg/m ³) ²
Influence of ambient temperature at span	u_t	8.609 mg/m ³	74.115 (mg/m ³) ²
Influence of supply voltage	u_v	0.688 mg/m ³	0.473 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-13.496 mg/m ³	182.142 (mg/m ³) ²
Influence of sample gas flow	u_p	0.000 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	10.104 mg/m ³	102.083 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 21.26 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 41.66 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 600 mg/m³ 6.9

Requirement of 2010/75/EU

U in % of the ELV 600 mg/m³ 10.0

Requirement of EN 15267-3

U in % of the ELV 600 mg/m³ 7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 6
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	NO	0 - 100 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	3.06 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	3.20 mg/m ³
Sum of negative CS at span point	-0.50 mg/m ³
Maximum sum of cross-sensitivities	3.20 mg/m ³
Uncertainty of cross-sensitivity	u_i 1.848 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.628 mg/m ³	0.394 (mg/m ³) ²
Lack of fit	u_{lof}	-0.924 mg/m ³	0.854 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	1.386 mg/m ³	1.921 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.751 mg/m ³	0.564 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.896 mg/m ³	0.803 (mg/m ³) ²
Influence of supply voltage	u_v	0.582 mg/m ³	0.339 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	1.848 mg/m ³	3.415 (mg/m ³) ²
Influence of sample gas flow	u_p	-0.120 mg/m ³	0.014 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.808 mg/m ³	0.653 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,i})^2}$	2.99 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.87 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 40 mg/m³	14.7
Requirement of EN 15267-3	U in % of the ELV 40 mg/m ³	20.0
	U in % of the ELV 40 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 6
Serial number of units under test	System 1 / System 3 / System2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A TÜV Rheinland
Date of report	2019-09-24

Measured component

Certification range	NO 0 - 1000 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	-33.10 mg/m ³
Maximum sum of cross-sensitivities	-33.10 mg/m ³
Uncertainty of cross-sensitivity	u_i -19.110 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	5.941 mg/m ³	35.295 (mg/m ³) ²
Lack of fit	u_{lof}	4.041 mg/m ³	16.330 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	5.774 mg/m ³	33.339 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	10.970 mg/m ³	120.341 (mg/m ³) ²
Influence of ambient temperature at span	u_t	6.275 mg/m ³	39.376 (mg/m ³) ²
Influence of supply voltage	u_v	1.851 mg/m ³	3.426 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-19.110 mg/m ³	365.192 (mg/m ³) ²
Influence of sample gas flow	u_p	-0.722 mg/m ³	0.521 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	8.083 mg/m ³	65.333 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 26.06 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 51.08 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 500 mg/m³ 10.2

Requirement of 2010/75/EU

U in % of the ELV 500 mg/m³ 20.0

Requirement of EN 15267-3

U in % of the ELV 500 mg/m³ 15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	NO	0 - 600 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	-17.04 mg/m ³
Maximum sum of cross-sensitivities	-17.04 mg/m ³
Uncertainty of cross-sensitivity	u_i -9.838 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	2.338 mg/m ³	5.466 (mg/m ³) ²
Lack of fit	u_{lof}	1.732 mg/m ³	3.000 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	4.850 mg/m ³	23.523 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	6.582 mg/m ³	43.323 (mg/m ³) ²
Influence of ambient temperature at span	u_t	3.005 mg/m ³	9.030 (mg/m ³) ²
Influence of supply voltage	u_v	1.787 mg/m ³	3.193 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-9.838 mg/m ³	96.786 (mg/m ³) ²
Influence of sample gas flow	u_p	0.577 mg/m ³	0.333 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	4.850 mg/m ³	23.520 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	14.43 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	28.28 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 200 mg/m³	14.1
Requirement of EN 15267-3	U in % of the ELV 200 mg/m³	20.0
	U in % of the ELV 200 mg/m³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 6
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	TÜV Rheinland
Date of report	2019-09-24

Measured component

Certification range	SO ₂ 0 - 75 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	1.99 mg/m ³
Sum of negative CS at zero point	-0.84 mg/m ³
Sum of positive CS at span point	1.10 mg/m ³
Sum of negative CS at span point	-2.80 mg/m ³
Maximum sum of cross-sensitivities	-2.80 mg/m ³
Uncertainty of cross-sensitivity	u_i -1.615 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Standard deviation from paired measurements under field conditions *	u_D 1.066 mg/m ³	1.136 (mg/m ³) ²
Lack of fit	u_{inf} -0.637 mg/m ³	0.406 (mg/m ³) ²
Zero drift from field test	$u_{rt,z}$ 0.953 mg/m ³	0.908 (mg/m ³) ²
Span drift from field test	$u_{rt,s}$ 0.996 mg/m ³	0.992 (mg/m ³) ²
Influence of ambient temperature at span	u_t 1.277 mg/m ³	1.631 (mg/m ³) ²
Influence of supply voltage	u_v 0.448 mg/m ³	0.201 (mg/m ³) ²
Cross-sensitivity (interference)	u_i -1.615 mg/m ³	2.608 (mg/m ³) ²
Influence of sample gas flow	u_b -0.135 mg/m ³	0.018 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.606 mg/m ³	0.368 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 2.88 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 5.64 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 50 mg/m³ 11.3

Requirement of 2010/75/EU

U in % of the ELV 50 mg/m³ 20.0

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³ 15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	System1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	CO ₂	0 - 25 Vol.-%
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 Vol.-%
Sum of negative CS at zero point	0.00 Vol.-%
Sum of positive CS at span point	0.10 Vol.-%
Sum of negative CS at span point	-0.30 Vol.-%
Maximum sum of cross-sensitivities	-0.30 Vol.-%
Uncertainty of cross-sensitivity	u_i -0.173 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.740 Vol.-%	0.548 (Vol.-%) ²
Lack of fit	u_{of}	0.058 Vol.-%	0.003 (Vol.-%) ²
Zero drift from field test	$u_{t,z}$	-0.289 Vol.-%	0.084 (Vol.-%) ²
Span drift from field test	$u_{t,s}$	-0.260 Vol.-%	0.068 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.289 Vol.-%	0.084 (Vol.-%) ²
Influence of supply voltage	u_v	0.062 Vol.-%	0.004 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	-0.173 Vol.-%	0.030 (Vol.-%) ²
Influence of sample gas flow	u_b	0.000 Vol.-%	0.000 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.202 Vol.-%	0.041 (Vol.-%) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.93 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.82 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	7.3
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	10.0 **
	U in % of the range 25 Vol.-%	7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

** EU Directive 2010/75/EU on industrial emissions does not define requirements for this component.

A value of 10 % was used instead.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Oxyrat 6
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	Paramagnetic

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	O ₂	0 - 25 Vol.-%
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 Vol.-%
Sum of negative CS at zero point	0.00 Vol.-%
Sum of positive CS at span point	0.00 Vol.-%
Sum of negative CS at span point	0.00 Vol.-%
Maximum sum of cross-sensitivities	0.00 Vol.-%
Uncertainty of cross-sensitivity	u _i 0.000 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.083 Vol.-%	0.007 (Vol.-%) ²
Lack of fit	u _{of}	-0.012 Vol.-%	0.000 (Vol.-%) ²
Zero drift from field test	u _{tz}	-0.035 Vol.-%	0.001 (Vol.-%) ²
Span drift from field test	u _{ts}	-0.069 Vol.-%	0.005 (Vol.-%) ²
Influence of ambient temperature at span	u _t	0.081 Vol.-%	0.007 (Vol.-%) ²
Influence of supply voltage	u _v	0.055 Vol.-%	0.003 (Vol.-%) ²
Cross-sensitivity (interference)	u _i	0.000 Vol.-%	0.000 (Vol.-%) ²
Influence of sample gas flow	u _b	0.006 Vol.-%	0.000 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.202 Vol.-%	0.041 (Vol.-%) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.25 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.49 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	2.0
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	10.0 **
	U in % of the range 25 Vol.-%	7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

** EU Directive 2010/75/EU on industrial emissions does not define requirements for this component.

A value of 10 % was used instead.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	Electrochemical

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	O ₂	0 - 25 Vol.-%
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 Vol.-%
Sum of negative CS at zero point	0.00 Vol.-%
Sum of positive CS at span point	0.00 Vol.-%
Sum of negative CS at span point	0.00 Vol.-%
Maximum sum of cross-sensitivities	0.00 Vol.-%
Uncertainty of cross-sensitivity	u _i 0.000 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Repeatability standard deviation at set point *	u _r	0.050 Vol.-%	0.003 (Vol.-%) ²
Lack of fit	u _{lof}	0.058 Vol.-%	0.003 (Vol.-%) ²
Zero drift from field test	u _{tz}	-0.052 Vol.-%	0.003 (Vol.-%) ²
Span drift from field test	u _{ts}	0.081 Vol.-%	0.007 (Vol.-%) ²
Influence of ambient temperature at span	u _t	0.116 Vol.-%	0.013 (Vol.-%) ²
Influence of supply voltage	u _v	0.055 Vol.-%	0.003 (Vol.-%) ²
Cross-sensitivity (interference)	u _i	0.000 Vol.-%	0.000 (Vol.-%) ²
Influence of sample gas flow	u _b	0.006 Vol.-%	0.000 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.202 Vol.-%	0.041 (Vol.-%) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.27 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.53 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	2.1
Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	10.0 **
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

** EU Directive 2010/75/EU on industrial emissions does not define requirements for this component.

A value of 10 % was used instead.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelcet OEM
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	NDIR

Test report

Test laboratory	936/2127820/A
Date of report	TÜV Rheinland 2019-09-24

Measured component

Certification range	CO 0 - 200 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_i 1.998 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Standard deviation from paired measurements under field conditions *	u_D 0.588 mg/m ³	0.346 (mg/m ³) ²
Lack of fit	u_{of} -0.924 mg/m ³	0.854 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 1.848 mg/m ³	3.415 (mg/m ³) ²
Span drift from field test	$u_{r,s}$ -1.732 mg/m ³	3.000 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.493 mg/m ³	0.243 (mg/m ³) ²
Influence of supply voltage	u_v 0.484 mg/m ³	0.234 (mg/m ³) ²
Cross-sensitivity (interference)	u_i 1.998 mg/m ³	3.992 (mg/m ³) ²
Influence of sample gas flow	u_b -0.107 mg/m ³	0.011 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 1.617 mg/m ³	2.613 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	3.84 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	7.52 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 100 mg/m³	7.5
Requirement of EN 15267-3	U in % of the ELV 100 mg/m ³	10.0
	U in % of the ELV 100 mg/m ³	7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	NDIR

Test report

Test laboratory	936/21251815/A
Date of report	TÜV Rheinland 2021-02-22

Measured component

Certification range	CO 0 - 375 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_t 2.165 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Standard deviation from paired measurements under field conditions *	u_D 1.656 mg/m ³	2.742 (mg/m ³) ²
Lack of fit	u_{of} -1.155 mg/m ³	1.334 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 1.443 mg/m ³	2.082 (mg/m ³) ²
Span drift from field test	$u_{t,s}$ 1.443 mg/m ³	2.082 (mg/m ³) ²
Influence of ambient temperature at span	u_t 1.277 mg/m ³	1.631 (mg/m ³) ²
Influence of supply voltage	u_v 1.392 mg/m ³	1.938 (mg/m ³) ²
Cross-sensitivity (interference)	u_i 2.165 mg/m ³	4.687 (mg/m ³) ²
Influence of sample gas flow	u_b -0.217 mg/m ³	0.047 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 3.031 mg/m ³	9.188 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 5.07 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 9.94 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 150 mg/m³ 6.6

Requirement of 2010/75/EU

U in % of the ELV 150 mg/m³ 10.0

Requirement of EN 15267-3

U in % of the ELV 150 mg/m³ 7.5

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 3 / TÜV 4
Measuring principle	NDIR

Test report

Test laboratory	936/21251815/A
Date of report	TÜV Rheinland 2021-02-22

Measured component

Certification range	CO 0 - 375 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_t 2.165 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Standard deviation from paired measurements under field conditions *	u_D 1.656 mg/m ³	2.742 (mg/m ³) ²
Lack of fit	u_{of} -1.155 mg/m ³	1.334 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 1.443 mg/m ³	2.082 (mg/m ³) ²
Span drift from field test	$u_{t,s}$ 1.443 mg/m ³	2.082 (mg/m ³) ²
Influence of ambient temperature at span	u_t 1.277 mg/m ³	1.631 (mg/m ³) ²
Influence of supply voltage	u_v 1.568 mg/m ³	2.459 (mg/m ³) ²
Cross-sensitivity (interference)	u_i 2.165 mg/m ³	4.687 (mg/m ³) ²
Influence of sample gas flow	u_b -0.303 mg/m ³	0.092 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 3.031 mg/m ³	9.188 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	5.13 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	10.05 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 150 mg/m³	6.7
Requirement of EN 15267-3	U in % of the ELV 150 mg/m ³	10.0
	U in % of the ELV 150 mg/m ³	7.5

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland 2019-09-24

Measured component

Certification range	NO 0 - 150 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_i -3.464 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Standard deviation from paired measurements under field conditions *	u_D 0.619 mg/m ³	0.383 (mg/m ³) ²
Lack of fit	u_{of} 0.753 mg/m ³	0.567 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ -1.212 mg/m ³	1.469 (mg/m ³) ²
Span drift from field test	$u_{r,s}$ 2.252 mg/m ³	5.072 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.833 mg/m ³	0.694 (mg/m ³) ²
Influence of supply voltage	u_v 1.108 mg/m ³	1.228 (mg/m ³) ²
Cross-sensitivity (interference)	u_i -3.464 mg/m ³	11.999 (mg/m ³) ²
Influence of sample gas flow	u_b 0.381 mg/m ³	0.145 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 1.212 mg/m ³	1.470 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	4.80 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	9.41 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 65,2 mg/m³	14.4
Requirement of EN 15267-3	U in % of the ELV 65,2 mg/m ³	20.0
	U in % of the ELV 65,2 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	NDIR

Test report

Test laboratory	TÜV Rheinland
Date of report	2019-09-24

Measured component

Certification range	NO 0 - 400 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_i -6.928 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2	
Standard deviation from paired measurements under field conditions *	u_D 1.750 mg/m ³	3.063	(mg/m ³) ²
Lack of fit	u_{lof} -1.155 mg/m ³	1.334	(mg/m ³) ²
Zero drift from field test	$u_{z,0}$ 3.233 mg/m ³	10.452	(mg/m ³) ²
Span drift from field test	$u_{z,s}$ 3.695 mg/m ³	13.653	(mg/m ³) ²
Influence of ambient temperature at span	u_t 2.177 mg/m ³	4.739	(mg/m ³) ²
Influence of supply voltage	u_v 1.688 mg/m ³	2.849	(mg/m ³) ²
Cross-sensitivity (interference)	u_i -6.928 mg/m ³	47.997	(mg/m ³) ²
Influence of sample gas flow	u_b 0.277 mg/m ³	0.077	(mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 3.233 mg/m ³	10.453	(mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	9.73 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	19.07 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 130,4 mg/m³	14.6
Requirement of EN 15267-3	U in % of the ELV 130,4 mg/m³	20.0
	U in % of the ELV 130,4 mg/m³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	NDIR

Test report

Test laboratory	936/2127820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	NO
	0 - 400 mg/m³

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Uncertainty of cross-sensitivity	u_i	-6.928 mg/m³
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Calculation of the combined standard uncertainty

Tested parameter

			u^2	
Standard deviation from paired measurements under field conditions *	u_D	1.750 mg/m³	3.063	(mg/m³)²
Lack of fit	u_{lof}	-1.155 mg/m³	1.334	(mg/m³)²
Zero drift from field test	u_{dz}	3.233 mg/m³	10.452	(mg/m³)²
Span drift from field test	u_{ds}	3.695 mg/m³	13.653	(mg/m³)²
Influence of ambient temperature at span	u_t	2.117 mg/m³	4.482	(mg/m³)²
Influence of supply voltage	u_v	2.824 mg/m³	7.975	(mg/m³)²
Cross-sensitivity (interference)	u_i	-6.928 mg/m³	47.997	(mg/m³)²
Influence of sample gas flow	u_n	0.531 mg/m³	0.282	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	3.233 mg/m³	10.453	(mg/m³)²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 9.98 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 19.57 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 130.4 mg/m³ **15.0**

Requirement of 2010/75/EU

U in % of the ELV 130.4 mg/m³ **20.0**

Requirement of EN 15267-3

U in % of the ELV 130.4 mg/m³ **15.0**

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM SIPROCESS UV 600
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	UV-RAS

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	NO	0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_i 0.967 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D 0.350 mg/m ³	0.123 (mg/m ³) ²	
Lack of fit	u_{of} -0.289 mg/m ³	0.084 (mg/m ³) ²	
Zero drift from field test	$u_{d,z}$ 0.866 mg/m ³	0.750 (mg/m ³) ²	
Span drift from field test	$u_{r,s}$ -0.693 mg/m ³	0.480 (mg/m ³) ²	
Influence of ambient temperature at span	u_t 0.624 mg/m ³	0.389 (mg/m ³) ²	
Influence of supply voltage	u_v 0.096 mg/m ³	0.009 (mg/m ³) ²	
Cross-sensitivity (interference)	u_i 0.967 mg/m ³	0.935 (mg/m ³) ²	
Influence of sample gas flow	u_b -0.136 mg/m ³	0.018 (mg/m ³) ²	
Uncertainty of reference material at 70% of certification range	u_{rm} 0.404 mg/m ³	0.163 (mg/m ³) ²	

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.72 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.37 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 32,6 mg/m³	10.3
Requirement of EN 15267-3	U in % of the ELV 32,6 mg/m ³	20.0
	U in % of the ELV 32,6 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM SIPROCESS UV 600
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	UV-RAS

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland 2019-09-24

Measured component

Certification range	NO ₂ 0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u_i 1.065 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u	u^2
Standard deviation from paired measurements under field conditions *	u_D 0.372 mg/m ³	0.138	(mg/m ³) ²
Lack of fit	u_{of} 0.231 mg/m ³	0.053	(mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 0.606 mg/m ³	0.367	(mg/m ³) ²
Span drift from field test	$u_{d,s}$ -0.808 mg/m ³	0.653	(mg/m ³) ²
Influence of ambient temperature at span	u_t 0.643 mg/m ³	0.413	(mg/m ³) ²
Influence of supply voltage	u_v 0.200 mg/m ³	0.040	(mg/m ³) ²
Cross-sensitivity (interference)	u_i 1.065 mg/m ³	1.134	(mg/m ³) ²
Influence of sample gas flow	u_b -0.075 mg/m ³	0.006	(mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.404 mg/m ³	0.163	(mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.72 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.38 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	6.8
Requirement of EN 15267-3	U in % of the ELV 50 mg/m³	20.0
	U in % of the ELV 50 mg/m³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM SIPROCESS UV 600
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	UV-RAS

Test report

Test laboratory	TÜV Rheinland
Date of report	2019-09-24

Measured component

Certification range	SO ₂	0 - 75 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u _i 1.589 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u ²	
Standard deviation from paired measurements under field conditions *	u _D 0.586 mg/m ³	0.343 (mg/m ³) ²	
Lack of fit	u _{inf} 0.403 mg/m ³	0.162 (mg/m ³) ²	
Zero drift from field test	u _{tr,z} -1.212 mg/m ³	1.469 (mg/m ³) ²	
Span drift from field test	u _{tr,s} -1.256 mg/m ³	1.578 (mg/m ³) ²	
Influence of ambient temperature at span	u _t 0.872 mg/m ³	0.760 (mg/m ³) ²	
Influence of supply voltage	u _v 0.179 mg/m ³	0.032 (mg/m ³) ²	
Cross-sensitivity (interference)	u _i 1.589 mg/m ³	2.525 (mg/m ³) ²	
Influence of sample gas flow	u _n -0.264 mg/m ³	0.070 (mg/m ³) ²	
Uncertainty of reference material at 70% of certification range	u _{rm} 0.606 mg/m ³	0.368 (mg/m ³) ²	

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.70 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	5.30 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 50 mg/m³	10.6
U in % of the ELV 50 mg/m³	20.0
U in % of the ELV 50 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	SO ₂	0 - 400 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u _i -6.928 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	2.475 mg/m ³	6.126 (mg/m ³) ²
Lack of fit	u _{lof}	-2.309 mg/m ³	5.331 (mg/m ³) ²
Zero drift from field test	u _{dz}	6.235 mg/m ³	38.875 (mg/m ³) ²
Span drift from field test	u _{ds}	4.850 mg/m ³	23.523 (mg/m ³) ²
Influence of ambient temperature at span	u _t	4.414 mg/m ³	19.483 (mg/m ³) ²
Influence of supply voltage	u _v	2.217 mg/m ³	4.915 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	-6.928 mg/m ³	47.997 (mg/m ³) ²
Influence of sample gas flow	u _n	-2.215 mg/m ³	4.906 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	3.233 mg/m ³	10.453 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max, j})^2}$	12.71 mg/m ³
Total expanded uncertainty	U = u _c * k = u _c * 1.96	24.92 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 200 mg/m ³	12.5
Requirement of EN 15267-3	U in % of the ELV 200 mg/m ³	20.0
	U in % of the ELV 200 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 23
Serial number of units under test	TÜV 3 / TÜV 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland 2019-09-24

Measured component

Certification range	SO ₂ 0 - 400 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u _i -6.928 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u ²
Standard deviation from paired measurements under field conditions *	u _D 2.475 mg/m ³	6.126 (mg/m ³) ²
Lack of fit	u _{of} -2.309 mg/m ³	5.331 (mg/m ³) ²
Zero drift from field test	u _{d,z} 6.235 mg/m ³	38.875 (mg/m ³) ²
Span drift from field test	u _{d,s} 4.850 mg/m ³	23.523 (mg/m ³) ²
Influence of ambient temperature at span	u _t 4.414 mg/m ³	19.483 (mg/m ³) ²
Influence of supply voltage	u _v 2.564 mg/m ³	6.574 (mg/m ³) ²
Cross-sensitivity (interference)	u _i -6.928 mg/m ³	47.997 (mg/m ³) ²
Influence of sample gas flow	u _n -2.215 mg/m ³	4.906 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _m 3.233 mg/m ³	10.453 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	12.78 mg/m ³
Total expanded uncertainty	U = u _c * k = u _c * 1.96	25.04 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 200 mg/m ³	12.5
Requirement of EN 15267-3	U in % of the ELV 200 mg/m ³	20.0
	U in % of the ELV 200 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM Ultramat 6
Serial number of units under test	System 1 / System 3 / System 2 / System 4
Measuring principle	NDIR

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland 2019-09-24

Measured component

Certification range	SO ₂ 0 - 75 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	1.99 mg/m ³
Sum of negative CS at zero point	-0.84 mg/m ³
Sum of positive CS at span point	1.10 mg/m ³
Sum of negative CS at span point	-2.80 mg/m ³
Maximum sum of cross-sensitivities	-2.80 mg/m ³
Uncertainty of cross-sensitivity	u _i -1.615 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D 1.066 mg/m ³		1.136 (mg/m ³) ²
Lack of fit	u _{of} -0.637 mg/m ³		0.406 (mg/m ³) ²
Zero drift from field test	u _{d,z} 0.953 mg/m ³		0.908 (mg/m ³) ²
Span drift from field test	u _{d,s} 0.996 mg/m ³		0.992 (mg/m ³) ²
Influence of ambient temperature at span	u _t 1.277 mg/m ³		1.631 (mg/m ³) ²
Influence of supply voltage	u _v 0.448 mg/m ³		0.201 (mg/m ³) ²
Cross-sensitivity (interference)	u _i -1.615 mg/m ³		2.608 (mg/m ³) ²
Influence of sample gas flow	u _n -0.135 mg/m ³		0.018 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _m 0.606 mg/m ³		0.368 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.88 mg/m ³
Total expanded uncertainty	U = u _c * k = u _c * 1.96	5.64 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	11.3
Requirement of EN 15267-3	U in % of the ELV 50 mg/m ³	20.0
	U in % of the ELV 50 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM SIPROCESS UV 600
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	UV-RAS

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland 2019-09-24

Measured component

Certification range	NO ₂ 0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.00 mg/m ³
Uncertainty of cross-sensitivity	u _i 1.065 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.372 mg/m ³	0.138 (mg/m ³) ²
Lack of fit	u _{of}	0.231 mg/m ³	0.053 (mg/m ³) ²
Zero drift from field test	u _{d,z}	0.606 mg/m ³	0.367 (mg/m ³) ²
Span drift from field test	u _{d,s}	-0.808 mg/m ³	0.653 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.643 mg/m ³	0.413 (mg/m ³) ²
Influence of supply voltage	u _v	0.200 mg/m ³	0.040 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	1.065 mg/m ³	1.134 (mg/m ³) ²
Influence of sample gas flow	u _b	-0.075 mg/m ³	0.006 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.404 mg/m ³	0.163 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.72 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	3.38 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	6.8
Requirement of EN 15267-3	U in % of the ELV 50 mg/m ³	20.0
	U in % of the ELV 50 mg/m ³	15.0

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM
Serial number of units under test	TÜV 1 / TÜV 2
Measuring principle	Electrochemical

Test report

Test laboratory	936/21247820/A
Date of report	TÜV Rheinland
	2019-09-24

Measured component

Certification range	O ₂	0 - 25 Vol.-%
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.00	Vol.-%
Sum of negative CS at zero point	0.00	Vol.-%
Sum of positive CS at span point	0.00	Vol.-%
Sum of negative CS at span point	0.00	Vol.-%
Maximum sum of cross-sensitivities	0.00	Vol.-%
Uncertainty of cross-sensitivity	u _i	0.167 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				U ²
Standard deviation from paired measurements under field conditions *	u _D	0.056	Vol.-%	0.003 (Vol.-%) ²
Lack of fit	u _{lof}	0.058	Vol.-%	0.003 (Vol.-%) ²
Zero drift from field test	u _{dz}	0.167	Vol.-%	0.028 (Vol.-%) ²
Span drift from field test	u _{ds}	0.098	Vol.-%	0.010 (Vol.-%) ²
Influence of ambient temperature at span	u _t	0.040	Vol.-%	0.002 (Vol.-%) ²
Influence of supply voltage	u _v	0.009	Vol.-%	0.000 (Vol.-%) ²
Cross-sensitivity (interference)	u _i	0.167	Vol.-%	0.028 (Vol.-%) ²
Influence of sample gas flow	u _n	-0.029	Vol.-%	0.001 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.202	Vol.-%	0.041 (Vol.-%) ²

* The larger value is used :

"Repeatability standard deviation at set point" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u _c)	$u_c = \sqrt{\sum (u_{max, j})^2}$	0.34	Vol.-%
Total expanded uncertainty	U = u _c * k = u _c * 1.96	0.67	Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	2.7
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	25.0 **
	U in % of the range 25 Vol.-%	7.5

During performance testing, the tests were carried out with the Siemens Set CEM CERT 7MB1957 measuring system.

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.

A value of 25 % was used for this.

Test results from the test performed by TÜV Rheinland Energy GmbH and TÜV Süd Industrie Service GmbH account for the data of the uncertainty calculation.

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM (Ultramat 23)
Serial number of units under test	JN-820 / JN-821
Measuring principle	UV Absorption

Test report

Test laboratory	TÜV Rheinland
Date of report	2021-02-22

Measured component

Certification range	NO ₂ 0 - 50 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	1.61 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.30 mg/m ³
Sum of negative CS at span point	-0.70 mg/m ³
Maximum sum of cross-sensitivities	1.61 mg/m ³
Uncertainty of cross-sensitivity	u_i 0.930 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Standard deviation from paired measurements under field conditions *	u_D 0.096 mg/m ³	0.009 (mg/m ³) ²
Lack of fit	u_{lof} 0.346 mg/m ³	0.120 (mg/m ³) ²
Zero drift from field test	$u_{r,z}$ 0.173 mg/m ³	0.030 (mg/m ³) ²
Span drift from field test	$u_{d,s}$ -0.751 mg/m ³	0.564 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.473 mg/m ³	0.224 (mg/m ³) ²
Influence of supply voltage	u_v 0.031 mg/m ³	0.001 (mg/m ³) ²
Cross-sensitivity (interference)	u_i 0.930 mg/m ³	0.865 (mg/m ³) ²
Influence of sample gas flow	u_n 0.030 mg/m ³	0.001 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.404 mg/m ³	0.163 (mg/m ³) ²

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.41 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.76 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 33,3 mg/m³	8.3
Requirement of EN 15267-3	U in % of the ELV 33,3 mg/m³	20.0
	U in % of the ELV 33,3 mg/m³	15.0

Calculation of overall uncertainty according to EN 14181 and EN 15267-3

Measuring system

Manufacturer	Bühler Technologies GmbH
AMS designation	CEMSelect OEM (Ultramat 23)
Serial number of units under test	JN-820 / JN-821
Measuring principle	UV Absorption

Test report

Test laboratory	TÜV Rheinland
Date of report	2021-02-22

Measured component

Certification range	SO ₂ 0 - 70 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	2.29 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.60 mg/m ³
Sum of negative CS at span point	-1.90 mg/m ³
Maximum sum of cross-sensitivities	2.29 mg/m ³
Uncertainty of cross-sensitivity	u_i 1.322 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2	
Standard deviation from paired measurements under field conditions *	u_D 0.286 mg/m ³	0.082 (mg/m ³) ²	
Lack of fit	u_{lof} 0.230 mg/m ³	0.053 (mg/m ³) ²	
Zero drift from field test	$u_{r,z}$ 0.323 mg/m ³	0.104 (mg/m ³) ²	
Span drift from field test	$u_{d,s}$ -1.091 mg/m ³	1.190 (mg/m ³) ²	
Influence of ambient temperature at span	u_t 0.656 mg/m ³	0.430 (mg/m ³) ²	
Influence of supply voltage	u_v 0.162 mg/m ³	0.026 (mg/m ³) ²	
Cross-sensitivity (interference)	u_i 1.322 mg/m ³	1.748 (mg/m ³) ²	
Influence of sample gas flow	u_n 0.051 mg/m ³	0.003 (mg/m ³) ²	
Uncertainty of reference material at 70% of certification range	u_{rm} 0.566 mg/m ³	0.320 (mg/m ³) ²	

* The larger value is used :

"Repeatability standard deviation at set point" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_c)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 1.99 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 3.90 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 46,6 mg/m³ 8.4

Requirement of 2010/75/EU

U in % of the ELV 46,6 mg/m³ 20.0

Requirement of EN 15267-3

U in % of the ELV 46,6 mg/m³ 15.0