

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000053802_02

AMS designation: ACF 5000 for CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, CH₄, CH₂O, TOC, O₂, H₂O and CO₂

Manufacturer: ABB Automation GmbH
Stierstädter Str. 5
60488 Frankfurt/Main
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),
EN 12619 (2013) and EN 14181 (2014).**

Certification is awarded in respect of the conditions stated in this certificate
(this certificate contains 23 pages).
The present certificate replaces certificate 0000053802_01 of 08 September 2017.



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000053802

Publication in the German Federal Gazette
(BAnz) of 31 July 2017

German Federal Environment Agency
Dessau, 02 March 2022

This certificate will expire on:
14 March 2027

TÜV Rheinland Energy GmbH
Cologne, 01 March 2022

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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:	936/21219814/E of 10 March 2017
Initial certification:	25 April 2017
Expiry date:	14 March 2027
Certificate	Renewal (of previous certificate 0000053802_01 of 08 September 2017 valid until 14 March 2022)
Publication:	BAnz AT 31.07.2017 B12, chapter I number 2.1

Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13th BImSchV), chapter IV (17th BImSchV), 30th BImSchV, plants in compliance with TA Luft, plants according to the 27th BImSchV and other plants requiring official approval. 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 a field test of more than 12 months' duration at a waste incinerator.

The AMS is approved for the ambient temperature range of +5° to 30°C and with an air conditioning unit 5° to +45°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 936/21219814/E of 10 March 2017 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 31.07.2017 B12, chapter I number 2.1, UBA announcement dated 13 July 2017:

AMS designation:

ACF5000 for O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ und TOC

Manufacturer:

ABB Automation GmbH, Frankfurt am Main

Field of application:

For plants requiring official approval and for plants according to the 27th BImSchV

Measuring ranges during performance testing:

Component	Certification range	Supplementary measuring ranges			Unit
CO	0 – 75	0 – 300	0 – 4,000	–	mg/m ³
NO	0 – 150	0 – 400	0 – 2,000	–	mg/m ³
NO ₂	0 – 80	0 – 600	0 – 1,000	–	mg/m ³
N ₂ O	0 – 50	0 – 1,000	–	–	mg/m ³
SO ₂	0 – 75	0 – 300	0 – 5,000	–	mg/m ³
HCl	0 – 15	0 – 90	0 – 2,000	–	mg/m ³
HF	0 – 3	0 – 6	0 – 300	–	mg/m ³
NH ₃	0 – 5	0 – 15	0 – 230	–	mg/m ³
H ₂ O	0 – 40	–	–	–	Vol.-%
CO ₂	0 – 30	–	–	–	Vol.-%
H ₂ CO	0 – 20	–	–	–	mg/m ³
CH ₄	0 – 7.5	0 – 200	–	–	mg/m ³
TOC (FID)	0 – 15	0 – 30	0 – 300	0 – 500	mg/m ³
O ₂ (ZrO ₂)	0 – 25	–	–	–	Vol.-%

Software versions:

Syscon: 5.2.22
AMC: 3.6.2

Restriction:

If the measuring system is equipped with an active fan instead of an air-conditioning unit, the measuring system may only be operated in the ambient temperature range of 5 to 30 °C.

Notes:

1. Wet test gases should be used for testing HF, HCl, NH₃ and H₂O.
2. Instead of test gases, the internal automatic validation unit may be used for span point checks (QAL3) of components determined with the FTIR.
3. If the measuring system is equipped with an air conditioning unit, it may be used in ambient temperatures between 5 and 45°C.
4. The maintenance interval is six months.
5. The measuring system is equipped with a digital interface for data transfer in accordance with VDI guideline 4201 part 1 (General requirements), part 2 (Profibus) and part 3 (Modbus EIA485 and TCP/IP).
6. Supplementary testing (maintenance interval und software changes) as regards Federal Environment Agency (UBA) notice of 22 February 2017 (BAnz AT 15.03.2017 B6, chapter I number 3.1).

Test Report:

TÜV Rheinland Energy GmbH, Cologne
Report no.: 936/21219814/E of 10 March 2017

Publication in the German Federal Gazette: BAnz AT 26.03.2018 B8, chapter V
16th notification, UBA announcement dated 21 February 2018:

16 Notification as regards Federal Environment Agency (UBA) notice of 13 July 2017 (BAnz AT 31.07.2017 B12, chapter I number 2.1)

The current software versions of the ACF5000 measuring system for the components O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ and TOC manufactured by ABB Automation GmbH are:

AMC board: 3.6.2
Syscon: 5.2.24

The U-remote modules manufactured by Weidmüller or the KL series manufactured by Beckhoff may be used as analogue output signals.

In addition to the previously used laser from the Oclaro company, the laser from the Philipps company can also be used as the laser for determining the wave number of the spectrometer.

Statement issued by TÜV Rheinland Energy GmbH dated 7 December 2017

Publication in the German Federal Gazette: BAnz AT 17.07.2018 B9, chapter III
4th notification, UBA announcement dated 03 July 2018:

4 Notification as regards Federal Environment Agency (UBA) notices of 13 July 2017 (BAnz AT 31.07.2017 B12, chapter I number 2.1) and of 21 February 2018 (BAnz AT 26.03.2018 B8, chapter V 16th notification)

The current software versions of the ACF5000 measuring system for the components O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ und TOC manufactured by ABB Automation GmbH are:

AMC board: 3.6.4

Syscon: 5.2.30

The software version 5.2.28 for the Syscon is included here.

Statement issued by TÜV Rheinland Energy GmbH dated 2 May 2018

Publication in the German Federal Gazette: BAnz AT 26.03.2019 B7, chapter IV
78th notification, UBA announcement dated 27 February 2019:

78 Notification as regards Federal Environment Agency (UBA) notices of 13 July 2017 (BAnz AT 31.07.2017 B12, chapter I number 2.1) and of 03 July 2018 (BAnz AT 17.07.2018 B9, chapter III 4th notification)

The current software versions of the ACF5000 measuring system for the components O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ und TOC manufactured by ABB Automation GmbH are:

AMC board: 3.6.4, Syscon: 5.2.34

The software version 5.2.32 for the Syscon is included here.

Statement issued by TÜV Rheinland Energy GmbH dated 14 January 2019

Publication in the German Federal Gazette: BAnz AT 03.05.2021 B9, chapter III 2nd notification, UBA announcement dated 31 March 2021:

2 Notification as regards Federal Environment Agency (UBA) notices of 13 July 2017 (BAnz AT 31.07.2017 B12, chapter I number 2.1) and of 27 February 2019 (BAnz AT 26.03.2019 B7, chapter IV 78th notification)

The current software versions of the ACF5000 measuring system for the components O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ und TOC manufactured by ABB Automation GmbH are:

AMC board: 3.9.0, Syscon: 5.2.38

The software version 5.2.36 for the Syscon is included here.

Statement issued by TÜV Rheinland Energy GmbH dated 11 September 2020

Publication in the German Federal Gazette: BAnz AT 05.08.2021 B5, chapter IV 27th notification, UBA announcement dated 29 June 2021:

27 Notification as regards Federal Environment Agency (UBA) notices of 13 July 2017 (BAnz AT 31.07.2017 B12, chapter I number 2.1) and of 31 March 2021 (BAnz AT 03.05.2021 B9, chapter III 2nd notification)

The current software versions of the ACF5000 measuring system for the components O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ und TOC manufactured by ABB Automation GmbH are:

AMC board: 3.9.2, Syscon: 5.2.38

The zero air conditioner from LNI installed in the measuring system can also be used in version V04.

Statement issued by TÜV Rheinland Energy GmbH dated 3 May 2021

Certified product

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

The ACF5000 measuring system is a multi-component gas analyser for the continuous monitoring of releases from industrial combustion plants. The gas to be measured is extracted from the flue gas duct with a sampling probe and the transported to the analyser system via a heated sample gas line. A Fourier transform infrared spectrometer (FTIR spectrometer) is used for spectral detection. An optional flame ionisation detector (FID) serves to determine total organic carbon. Oxygen is determined with a zirconium dioxide probe. The measuring system comprises the following main components:

- Sampling probe with ABB PFE2 filter with a probe tube ABB Type 40 (screwed on and unheated) or Type 42 (flange-mounted and heated).
Heated sample gas line ABB TBL01-S, 6 mm inner diameter, made of Teflon, max. 60 m long
- Analyser cabinet with:
 - Interferometer (incl. internal test device for validating spectrometer adjustment (validation unit))
 - FID (optional)
 - O₂ sensor
 - Air processing
 - Air conditioning unit (for use at 5-45 °C, else fan for use at 5-30 °C)
 - Analogue interface
 - Digital profibus interface
 - Digital Modbus interface (EIA485 + TCP/IP)
 - Relay for the control of test gas valves for automatic test gas application

The measuring system performs an automatic zero point adjustment of the FTIR with instrument air on a daily basis. The FID is automatically checked every 21 days at the zero and span point with test gas and adjusted if necessary, the oxygen sensor every 14 days.

The measuring system may optionally be equipped with an automatic validation unit. This validation unit allows automatic, sequential insertion of gas-filled validation cells and specific validation foils (depending on the measured component) into the optical path of the FTIR spectrometer. The validation unit facilitates zero and span checks during the maintenance interval (QAL3) for those components determined with the FTIR.

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 ACF 5000 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. 0000053802_00: 25 April 2017
Expiry date of the certificate: 14 March 2022
Test report: 936/21219814/B of 13 October 2016
TÜV Rheinland Energy GmbH
Publication: BAnz AT 15.03.2017 B6, chapter I number 3.1
UBA announcement dated 22 February 2017

Supplementary testing according to EN 15267

Certificate no. 0000053802_01: 08 September 2017
Expiry date of the certificate: 14 March 2022
Test report: 936/21219814/E of 10 March 2017
TÜV Rheinland Energy GmbH
Publication: BAnz AT 31.07.2017 B12, chapter I number 2.1
UBA announcement dated 13 July 2017

Notifications according to EN 15267

Statement issued by TÜV Rheinland Energy GmbH dated 07 December 2017
Publication: BAnz AT 26.03.2018 B8, chapter V notification 16
UBA announcement dated 21 February 2018
(Design and software changes)

Statement issued by TÜV Rheinland Energy GmbH dated 02 May 2018
Publication: BAnz AT 17.07.2018 B9, chapter III notification 4
UBA announcement dated 03 July 2018
(Software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 14 January 2019
Publication: BAnz AT 26.03.2019 B7, chapter IV notification 78
UBA announcement dated 27 February 2019
(Software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 11 September 2020
Publication: BAnz AT 03.05.2021 B9, chapter III notification 2
UBA announcement dated 31 March 2021
(Software updates)

Statement issued by TÜV Rheinland Energy GmbH dated 03 May 2021
Publication: BAnz AT 05.08.2021 B5, chapter IV notification 27
UBA announcement dated 29 June 2021
(Software updates)

Renewal of the certificate

Certificate no. 0000053802_02: 02 March 2022
Expiry date of the certificate: 14 March 2027

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	Zirconium dioxide

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

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	0.37 Vol.-%
Sum of negative CS at span point	-0.18 Vol.-%
Maximum sum of cross-sensitivities	0.37 Vol.-%
Uncertainty of cross-sensitivity	u_i 0.214 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Standard deviation from paired measurements under field conditions *	u_D	0.057 Vol.-%		0.003 (Vol.-%) ²
Lack of fit	u_{lof}	0.040 Vol.-%		0.002 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	0.098 Vol.-%		0.010 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	-0.098 Vol.-%		0.010 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.105 Vol.-%		0.011 (Vol.-%) ²
Influence of supply voltage	u_v	0.029 Vol.-%		0.001 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.214 Vol.-%		0.046 (Vol.-%) ²
Influence of sample gas flow	u_p	-0.087 Vol.-%		0.008 (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)	$u_c = \sqrt{\sum (u_{max,i})^2}$	0.36 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.71 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 25 Vol.-%	2.8
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	10.0 **
	U in % of the range 25 Vol.-%	7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 10.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

Measured component

	CO
Certification range	0 - 75 mg/m ³

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	0.97 mg/m ³
Sum of negative CS at span point	-0.39 mg/m ³
Maximum sum of cross-sensitivities	0.97 mg/m ³
Uncertainty of cross-sensitivity	u_i 0.559 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.227 mg/m ³	0.052 (mg/m ³) ²
Lack of fit	u_{lof}	0.117 mg/m ³	0.014 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	-0.130 mg/m ³	0.017 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.563 mg/m ³	0.317 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.115 mg/m ³	0.013 (mg/m ³) ²
Influence of supply voltage	u_v	0.127 mg/m ³	0.016 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	0.559 mg/m ³	0.312 (mg/m ³) ²
Influence of sample gas flow	u_b	-0.289 mg/m ³	0.084 (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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	1.09 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	2.14 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	4.3
U in % of the ELV 50 mg/m³	10.0
U in % of the ELV 50 mg/m ³	7.5

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

Measured component

	NO
Certification range	0 - 150 mg/m³

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.90 mg/m³
Sum of negative CS at zero point	0.00 mg/m³
Sum of positive CS at span point	1.14 mg/m³
Sum of negative CS at span point	-2.51 mg/m³
Maximum sum of cross-sensitivities	-2.51 mg/m³
Uncertainty of cross-sensitivity	u_i -1.446 mg/m³

Calculation of the combined standard uncertainty

Tested parameter

			u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.253 mg/m³	0.064	(mg/m³)²
Lack of fit	u_{lof}	-0.234 mg/m³	0.055	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.173 mg/m³	0.030	(mg/m³)²
Span drift from field test	$u_{d,s}$	1.126 mg/m³	1.268	(mg/m³)²
Influence of ambient temperature at span	u_t	0.400 mg/m³	0.160	(mg/m³)²
Influence of supply voltage	u_v	0.191 mg/m³	0.036	(mg/m³)²
Cross-sensitivity (interference)	u_i	-1.446 mg/m³	2.091	(mg/m³)²
Influence of sample gas flow	u_p	-0.808 mg/m³	0.653	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.212 mg/m³	1.470	(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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.41 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.73 mg/m³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 98 mg/m³	4.8
Requirement of EN 15267-3	U in % of the ELV 98 mg/m³	20.0
	U in % of the ELV 98 mg/m³	15.0

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

Measured component

Certification range	NO ₂ 0 - 80 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.49 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	2.36 mg/m ³
Sum of negative CS at span point	-1.85 mg/m ³
Maximum sum of cross-sensitivities	2.36 mg/m ³
Uncertainty of cross-sensitivity	u_i 1.363 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2	
Repeatability standard deviation at set point *	u_r 0.557 mg/m ³	0.310	(mg/m ³) ²
Lack of fit	u_{lof} 0.462 mg/m ³	0.213	(mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 0.462 mg/m ³	0.213	(mg/m ³) ²
Span drift from field test	$u_{d,s}$ 1.201 mg/m ³	1.442	(mg/m ³) ²
Influence of ambient temperature at span	u_t 1.044 mg/m ³	1.090	(mg/m ³) ²
Influence of supply voltage	u_v 0.142 mg/m ³	0.020	(mg/m ³) ²
Cross-sensitivity (interference)	u_i 1.363 mg/m ³	1.857	(mg/m ³) ²
Influence of sample gas flow	u_b -0.640 mg/m ³	0.410	(mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.647 mg/m ³	0.418	(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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.44 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	4.79 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 50 mg/m³	9.6
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

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E
Date of report	TÜV Rheinland
	2017-03-10

Measured component

Certification range	N ₂ O	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	0.35 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.58 mg/m ³
Sum of negative CS at span point	-0.72 mg/m ³
Maximum sum of cross-sensitivities	-0.72 mg/m ³
Uncertainty of cross-sensitivity	u_i -0.416 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.055 mg/m ³	0.003 (mg/m ³) ²
Lack of fit	u_{lof}	0.098 mg/m ³	0.010 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	-0.115 mg/m ³	0.013 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.548 mg/m ³	0.300 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.300 mg/m ³	0.090 (mg/m ³) ²
Influence of supply voltage	u_v	0.101 mg/m ³	0.010 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-0.416 mg/m ³	0.173 (mg/m ³) ²
Influence of sample gas flow	u_b	-0.318 mg/m ³	0.101 (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)	$u_c = \sqrt{\sum (u_{max, i})^2}$	0.93 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.82 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 50 mg/m³	3.6
Requirement of EN 15267-3	U in % of the range 50 mg/m³	20.0 **
	U in % of the range 50 mg/m ³	15.0

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

A value of 20.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

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	0.97 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	2.91 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	2.91 mg/m ³
Uncertainty of cross-sensitivity	u _i 1.680 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D 0.701 mg/m ³	0.491 (mg/m ³) ²	
Lack of fit	u _{lof} 0.208 mg/m ³	0.043 (mg/m ³) ²	
Zero drift from field test	u _{d,z} -0.346 mg/m ³	0.120 (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 0.458 mg/m ³	0.210 (mg/m ³) ²	
Influence of supply voltage	u _v 0.528 mg/m ³	0.279 (mg/m ³) ²	
Cross-sensitivity (interference)	u _i 1.680 mg/m ³	2.823 (mg/m ³) ²	
Influence of sample gas flow	u _p -0.635 mg/m ³	0.403 (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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	2.39 mg/m ³
Total expanded uncertainty	U = u _c * k = u _c * 1.96	4.69 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	9.4
U in % of the ELV 50 mg/m³	20.0
U in % of the ELV 50 mg/m ³	15.0

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	TÜV Rheinland
Date of report	2017-03-10

Measured component

	HCl
Certification range	0 - 15 mg/m ³

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.14 mg/m ³
Sum of negative CS at zero point	-0.25 mg/m ³
Sum of positive CS at span point	0.36 mg/m ³
Sum of negative CS at span point	-0.56 mg/m ³
Maximum sum of cross-sensitivities	-0.56 mg/m ³
Uncertainty of cross-sensitivity	u_i -0.323 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2
Repeatability standard deviation at set point *	u_r 0.075 mg/m ³	0.006 (mg/m ³) ²
Lack of fit	u_{lof} -0.056 mg/m ³	0.003 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 0.078 mg/m ³	0.006 (mg/m ³) ²
Span drift from field test	$u_{d,s}$ 0.225 mg/m ³	0.051 (mg/m ³) ²
Influence of ambient temperature at span	u_t 0.072 mg/m ³	0.005 (mg/m ³) ²
Influence of supply voltage	u_v 0.056 mg/m ³	0.003 (mg/m ³) ²
Cross-sensitivity (interference)	u_i -0.323 mg/m ³	0.104 (mg/m ³) ²
Influence of sample gas flow	u_b 0.038 mg/m ³	0.001 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.121 mg/m ³	0.015 (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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.44 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.86 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 10 mg/m³	8.6
Requirement of EN 15267-3	U in % of the ELV 10 mg/m³	40.0
	U in % of the ELV 10 mg/m³	30.0

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	TÜV Rheinland
Date of report	2017-03-10

Measured component

	HF
Certification range	0 - 3 mg/m ³

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.02 mg/m ³
Sum of negative CS at zero point	-0.03 mg/m ³
Sum of positive CS at span point	0.10 mg/m ³
Sum of negative CS at span point	-0.03 mg/m ³
Maximum sum of cross-sensitivities	0.10 mg/m ³
Uncertainty of cross-sensitivity	u_i 0.060 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

		u^2	
Repeatability standard deviation at set point *	u_r 0.018 mg/m ³	0.000	(mg/m ³) ²
Lack of fit	u_{lof} 0.016 mg/m ³	0.000	(mg/m ³) ²
Zero drift from field test	$u_{d,z}$ 0.019 mg/m ³	0.000	(mg/m ³) ²
Span drift from field test	$u_{d,s}$ -0.036 mg/m ³	0.001	(mg/m ³) ²
Influence of ambient temperature at span	u_t 0.038 mg/m ³	0.001	(mg/m ³) ²
Influence of supply voltage	u_v 0.020 mg/m ³	0.000	(mg/m ³) ²
Cross-sensitivity (interference)	u_i 0.060 mg/m ³	0.004	(mg/m ³) ²
Influence of sample gas flow	u_b 0.014 mg/m ³	0.000	(mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.024 mg/m ³	0.001	(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)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.09 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.18 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 1 mg/m³	18.0
U in % of the ELV 1 mg/m³	40.0
U in % of the ELV 1 mg/m ³	30.0

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E
Date of report	TÜV Rheinland
	2017-03-10

Measured component

Certification range	NH ₃	0 - 5 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	-0.09 mg/m ³
Sum of positive CS at span point	0.00 mg/m ³
Sum of negative CS at span point	-0.19 mg/m ³
Maximum sum of cross-sensitivities	-0.19 mg/m ³
Uncertainty of cross-sensitivity	u _i -0.110 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Repeatability standard deviation at set point *	u _r	0.042 mg/m ³	0.002 (mg/m ³) ²
Lack of fit	u _{lof}	-0.029 mg/m ³	0.001 (mg/m ³) ²
Zero drift from field test	u _{d,z}	-0.066 mg/m ³	0.004 (mg/m ³) ²
Span drift from field test	u _{d,s}	-0.069 mg/m ³	0.005 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.062 mg/m ³	0.004 (mg/m ³) ²
Influence of supply voltage	u _v	0.040 mg/m ³	0.002 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	-0.110 mg/m ³	0.012 (mg/m ³) ²
Influence of sample gas flow	u _p	-0.019 mg/m ³	0.000 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.040 mg/m ³	0.002 (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)	$u_c = \sqrt{\sum (u_{max,i})^2}$	0.18 mg/m ³
Total expanded uncertainty	U = u _c * k = u _c * 1.96	0.35 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 2 mg/m³	17.3
Requirement of EN 15267-3	U in % of the ELV 2 mg/m³	40.0 **
	U in % of the ELV 2 mg/m³	30.0

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 40.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

Measured component

Certification range	H ₂ O 0 - 40 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	1.12 Vol.-%
Sum of negative CS at span point	-0.59 Vol.-%
Maximum sum of cross-sensitivities	1.12 Vol.-%
Uncertainty of cross-sensitivity	u_i 0.647 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Repeatability standard deviation at set point *	u_r 0.106 Vol.-%		0.011 (Vol.-%) ²
Lack of fit	u_{lof} -0.081 Vol.-%		0.007 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$ 0.000 Vol.-%		0.000 (Vol.-%) ²
Span drift from field test	$u_{d,s}$ -0.370 Vol.-%		0.137 (Vol.-%) ²
Influence of ambient temperature at span	u_t 0.115 Vol.-%		0.013 (Vol.-%) ²
Influence of supply voltage	u_v 0.040 Vol.-%		0.002 (Vol.-%) ²
Cross-sensitivity (interference)	u_i 0.647 Vol.-%		0.418 (Vol.-%) ²
Influence of sample gas flow	u_b -0.216 Vol.-%		0.047 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{rm} 0.323 Vol.-%		0.105 (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)	$u_c = \sqrt{\sum (u_{max,i})^2}$	0.86 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.68 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 40 Vol.-%	4.2
Requirement of EN 15267-3	U in % of the range 40 Vol.-%	10.0 **
		7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 10.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

Measured component

Certification range	CO ₂ 0 - 30 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	0.60 Vol.-%
Sum of negative CS at span point	-0.13 Vol.-%
Maximum sum of cross-sensitivities	0.60 Vol.-%
Uncertainty of cross-sensitivity	u_i 0.346 Vol.-%

Calculation of the combined standard uncertainty

Tested parameter

				u^2
Standard deviation from paired measurements under field conditions *	u_D	0.025 Vol.-%		0.001 (Vol.-%) ²
Lack of fit	u_{lof}	0.029 Vol.-%		0.001 (Vol.-%) ²
Zero drift from field test	$u_{d,z}$	-0.017 Vol.-%		0.000 (Vol.-%) ²
Span drift from field test	$u_{d,s}$	0.121 Vol.-%		0.015 (Vol.-%) ²
Influence of ambient temperature at span	u_t	0.083 Vol.-%		0.007 (Vol.-%) ²
Influence of supply voltage	u_v	0.025 Vol.-%		0.001 (Vol.-%) ²
Cross-sensitivity (interference)	u_i	0.346 Vol.-%		0.120 (Vol.-%) ²
Influence of sample gas flow	u_b	-0.164 Vol.-%		0.027 (Vol.-%) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.242 Vol.-%		0.059 (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)	$u_c = \sqrt{\sum (u_{max, i})^2}$	0.48 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.94 Vol.-%

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 30 Vol.-%	3.1
Requirement of EN 15267-3	U in % of the range 30 Vol.-%	10.0 **
		7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 10.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E
Date of report	TÜV Rheinland 2017-03-10

Measured component

Certification range	H2CO 0 - 20 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	-0.09 mg/m ³
Sum of positive CS at span point	0.39 mg/m ³
Sum of negative CS at span point	-0.21 mg/m ³
Maximum sum of cross-sensitivities	0.39 mg/m ³
Uncertainty of cross-sensitivity	u_i 0.225 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Repeatability standard deviation at set point *	u_r	0.061 mg/m ³	0.004 (mg/m ³) ²
Lack of fit	u_{lof}	0.057 mg/m ³	0.003 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	0.058 mg/m ³	0.003 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	-0.231 mg/m ³	0.053 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.116 mg/m ³	0.013 (mg/m ³) ²
Influence of supply voltage	u_v	0.072 mg/m ³	0.005 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	0.225 mg/m ³	0.051 (mg/m ³) ²
Influence of sample gas flow	u_p	-0.108 mg/m ³	0.012 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.162 mg/m ³	0.026 (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)	$u_c = \sqrt{\sum (u_{max, i})^2}$	0.41 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.81 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the range 20 mg/m³	4.1
Requirement of EN 15267-3	U in % of the range 20 mg/m ³	10.0 **
	U in % of the range 20 mg/m ³	7.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 10.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FTIR

Test report

Test laboratory	936/21219814/E TÜV Rheinland
Date of report	2017-03-10

Measured component

Certification range	CH ₄ 0 - 7.5 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	0.09 mg/m ³
Sum of negative CS at span point	0.00 mg/m ³
Maximum sum of cross-sensitivities	0.09 mg/m ³
Uncertainty of cross-sensitivity	u _i 0.052 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u ²
Standard deviation from paired measurements under field conditions *	u _D	0.016 mg/m ³	0.000 (mg/m ³) ²
Lack of fit	u _{lof}	-0.014 mg/m ³	0.000 (mg/m ³) ²
Zero drift from field test	u _{d,z}	0.048 mg/m ³	0.002 (mg/m ³) ²
Span drift from field test	u _{d,s}	0.082 mg/m ³	0.007 (mg/m ³) ²
Influence of ambient temperature at span	u _t	0.029 mg/m ³	0.001 (mg/m ³) ²
Influence of supply voltage	u _v	0.012 mg/m ³	0.000 (mg/m ³) ²
Cross-sensitivity (interference)	u _i	0.052 mg/m ³	0.003 (mg/m ³) ²
Influence of sample gas flow	u _p	-0.029 mg/m ³	0.001 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u _{rm}	0.061 mg/m ³	0.004 (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)	$u_c = \sqrt{\sum (u_{max,i})^2}$	0.13 mg/m ³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.26 mg/m ³

Relative total expanded uncertainty

Requirement of 2010/75/EU	U in % of the ELV 5 mg/m³	5.2
Requirement of EN 15267-3	U in % of the ELV 5 mg/m ³	30.0 **
	U in % of the ELV 5 mg/m ³	22.5

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
A value of 30.0 % was used for this.

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

Measuring system

Manufacturer	ABB Automation GmbH
AMS designation	ACF5000
Serial number of units under test	3.351922.3 / Beta2 / 3.351923.3 / Beta3
Measuring principle	FID

Test report

Test laboratory	TÜV Rheinland
Date of report	2017-03-10

Measured component

Certification range	TOC	0 - 15 mg/m ³
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Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	0.46 mg/m ³
Sum of negative CS at zero point	0.00 mg/m ³
Sum of positive CS at span point	0.24 mg/m ³
Sum of negative CS at span point	-0.54 mg/m ³
Maximum sum of cross-sensitivities	-0.54 mg/m ³
Uncertainty of cross-sensitivity	u_i -0.313 mg/m ³

Calculation of the combined standard uncertainty

Tested parameter

			u^2
Standard deviation from paired measurements under field conditions *	u_D	0.085 mg/m ³	0.007 (mg/m ³) ²
Lack of fit	u_{lof}	-0.041 mg/m ³	0.002 (mg/m ³) ²
Zero drift from field test	$u_{d,z}$	-0.165 mg/m ³	0.027 (mg/m ³) ²
Span drift from field test	$u_{d,s}$	0.199 mg/m ³	0.040 (mg/m ³) ²
Influence of ambient temperature at span	u_t	0.070 mg/m ³	0.005 (mg/m ³) ²
Influence of supply voltage	u_v	0.015 mg/m ³	0.000 (mg/m ³) ²
Cross-sensitivity (interference)	u_i	-0.313 mg/m ³	0.098 (mg/m ³) ²
Influence of sample gas flow	u_b	-0.129 mg/m ³	0.017 (mg/m ³) ²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.121 mg/m ³	0.015 (mg/m ³) ²
Variation of response factors (TOC)	u_{rf}	0.032 mg/m ³	0.001 (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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 0.46 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 0.90 \text{ mg/m}^3$$

Relative total expanded uncertainty

Requirement of 2010/75/EU

Requirement of EN 15267-3

U in % of the ELV 10 mg/m³ 9.0

U in % of the ELV 10 mg/m³ 30.0

U in % of the ELV 10 mg/m³ 22.5