

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000053802

Certified AMS: ACF5000 for O₂, CO, NO, NO₂, N₂O, SO₂, HCl, HF, NH₃, H₂O, CO₂, H₂CO, CH₄ and TOC

Manufacturer: ABB Automation GmbH
Stierstädter Str. 5
60488 Frankfurt
Germany

Test Institute: TÜV Rheinland Energy GmbH

This is to certify that the AMS has been tested and certified
according to 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 19 pages).



Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000053802

Publication in the German Federal Gazette
(BAnz.) of 15 March 2017

German Federal Environment Agency
Dessau, 25 April 2017



Dr. Marcel Langner
Head of Section II 4.1

This certificate will expire on:
14 March 2022

TÜV Rheinland Energy GmbH
Cologne, 24 April 2017



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Test institute accredited to EN ISO/IEC 17025:2005 by DAkkS (German Accreditation Body).
This accreditation is limited to the accreditation scope defined in the enclosure to the certificate D-PL-11120-02-00.

| | |
|-------------------------------|--|
| Test report: | 936/21219814/B dated 13 October 2016 |
| Initial certification: | 15 March 2017 |
| Expiry date: | 14 March 2022 |
| Publication: | BAnz AT 15.03.2017 B6, chapter I no. 3.1 |

Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13. BImSchV), at waste incineration plants according to Directive 2010/75/EU, chapter IV (17. BImSchV), the 27. BImSchV and other plants requiring official approval. The measured ranges have been selected considering the wide application range of the AMS.

The suitability of the AMS for this application was assessed on the basis of a laboratory test and a six month field test at a waste incineration plant.

The AMS is approved for an ambient temperature range of 5 °C to 30 °C (with fan) and with air conditioning system for 5 °C 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 valid at the time of performance testing. As changes in legal regulations are possible, any potential user should ensure that this AMS is suitable for monitoring the limit value relevant to the application.

Any potential user should ensure, in consultation with the manufacturer, that this AMS is suitable for the installation at which it will be installed.

Basis of the certification

This certification is based on:

- Test report 936/21219814/B dated 13 October 2016 of 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 15.03.2017 B6, chapter I no. 3.1,
Announcement by UBA from 22 February 2017:

AMS designation:

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

Manufacturer:

ABB Automation GmbH, Frankfurt am Main

Field of application:

For measurements at plants requiring official approval and plants according to 27th BImSchV

Measuring ranges during the performance test:

| Component | Certification range | Supplementary measurement ranges | | | Unit |
|------------------------------------|---------------------|----------------------------------|----------|---------|-------------------|
| CO | 0 – 75 | 0 – 300 | 0 – 4000 | – | mg/m ³ |
| NO | 0 – 150 | 0 – 400 | 0 – 2000 | – | mg/m ³ |
| NO ₂ | 0 – 80 | 0 – 600 | 0 – 1000 | – | mg/m ³ |
| N ₂ O | 0 – 50 | 0 – 1000 | – | – | mg/m ³ |
| SO ₂ | 0 – 75 | 0 – 300 | 0 – 5000 | – | mg/m ³ |
| HCl | 0 – 15 | 0 – 90 | 0 – 2000 | – | 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.-% |
| CH ₂ O | 0 – 20 | – | – | – | mg/m ³ |
| CH ₄ | 0 – 7,5 | 0 – 200 | – | – | mg/m ³ |
| TOC | 0 – 15 | 0 – 30 | 0 – 300 | 0 – 500 | mg/m ³ |
| O ₂ (ZrO ₂) | 0 – 25 | - | - | - | Vol.-% |

Software versions:

Syscon: 5.2.20
AMC: 3.6.2

Restrictions:

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 must be used for testing HF, HCl, NH₃ and H₂CO.
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, the measuring system may be used in an ambient temperature range of 5 to 45°C.

4. The maintenance interval is three 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 und TCP/IP).

Test report:

TÜV Rheinland Energy GmbH, Cologne
Report No.: 936/21219814/B dated 13 October 2016

Certified product

This certificate 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 waste gas from industrial combustion plants. The gas to be measured is extracted from the flue gas duct with a sampling probe and then transported to the heated analyser system via a heated sample gas line. A Fourier transform infrared spectrometer (FTIR spectrometer) is used for spectral detection. As an option a 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 an probe tube ABB Type 40 (the probe tube is screwed on and unheated) or Type 42 (the probe tube is flange-mounted and heated)
- Heated ABB TBL01-S sample gas line, inner diameter 6 mm, made of Teflon, max. 60 m length
- Analyser cabinet with:
 - Interferometer (incl. internal test device for validating spectrometer adjustment (validation unit))
 - FID (option)
 - 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 daily zero point adjustments of the FTIR using cleaned air. The FID undergoes automatic zero and span checks using test gas every 21 days and is adjusted when necessary; the oxygen sensor is tested 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.

The current software versions are:

Syscon: 5.2.20
AMC: 3.6.2.

The current version of the operation manual is 42/23-82 DE Rev.3 dated May 2016.

General notes

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 manufacture of 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 can be applied to the product or used in publicity material for the certified product.

This document as well as the certification mark remains property of TÜV Rheinland Energy GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energy GmbH this document shall be returned and the certificate mark must not be employed anymore.

The relevant version of this certificate and its expiration is also accessible on the internet: qal1.de.

Certification of ACF5000 is based on the documents listed below and the regular, continuous monitoring of the Quality Management System of the manufacturer:

Initial certification according to EN 15267

Certificate No. 0000053802: 25 April 2017
Expiry date of the certificate: 14 March 2022

Test report: 936/21219814/B dated 13 October 2016
TÜV Rheinland Energy GmbH, Cologne
Publication: BAnz AT 15.03.2017 B6, chapter I no. 3.1
Announcement by UBA dated 22 February 2017

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 | TÜV Rheinland |
| Date of report | 2016-10-13 |

Measured component

| | | |
|---------------------|----------------|---------------|
| Certification range | O ₂ | 0 - 25 Vol.-% |
|---------------------|----------------|---------------|

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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 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/B TÜV Rheinland |
| Date of report | 2016-10-13 |

Measured component

| | |
|---------------------|--------------------------------|
| Certification range | CO 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 | $u_{d,s}$ 0.520 mg/m ³ | | 0.270 (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_p -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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 1.07 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 2.10 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|-------------|
| Requirement of 2010/75/EU | U in % of the ELV 50 mg/m³ | 4.2 |
| Requirement of EN 15267-3 | U in % of the ELV 50 mg/m³ | 10.0 |
| | U in % of the ELV 50 mg/m³ | 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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|----|---------------------------|
| Certification range | NO | 0 - 150 mg/m ³ |
|---------------------|----|---------------------------|

Evaluation of the cross-sensitivity (CS)

(system with largest CS)

| | |
|------------------------------------|--------------------------------|
| Sum of positive CS at zero point | 0.90 mg/m ³ |
| Sum of negative CS at zero point | 0.00 mg/m ³ |
| Sum of positive CS at span point | 1.14 mg/m ³ |
| Sum of negative CS at span point | -2.51 mg/m ³ |
| Maximum sum of cross-sensitivities | -2.51 mg/m ³ |
| Uncertainty of cross-sensitivity | u_i -1.446 mg/m ³ |

Calculation of the combined standard uncertainty

Tested parameter

| | | | u^2 |
|--|-----------|--------------------------|---|
| Standard deviation from paired measurements under field conditions * | u_D | 0.253 mg/m ³ | 0.064 (mg/m ³) ² |
| Lack of fit | u_{lof} | -0.234 mg/m ³ | 0.055 (mg/m ³) ² |
| Zero drift from field test | $u_{d,z}$ | 0.173 mg/m ³ | 0.030 (mg/m ³) ² |
| Span drift from field test | $u_{d,s}$ | 1.126 mg/m ³ | 1.268 (mg/m ³) ² |
| Influence of ambient temperature at span | u_t | 0.400 mg/m ³ | 0.160 (mg/m ³) ² |
| Influence of supply voltage | u_v | 0.191 mg/m ³ | 0.036 (mg/m ³) ² |
| Cross-sensitivity (interference) | u_i | -1.446 mg/m ³ | 2.091 (mg/m ³) ² |
| Influence of sample gas flow | u_p | -0.808 mg/m ³ | 0.653 (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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 2.41 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 4.73 mg/m ³ |

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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-----------------|--------------------------|
| Certification range | NO ₂ | 0 - 80 mg/m ³ |
|---------------------|-----------------|--------------------------|

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_i | | 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 | $u_{d,z}$ 0.231 mg/m ³ | | 0.053 (mg/m ³) ² |
| Span drift from field test | $u_{d,s}$ 1.155 mg/m ³ | | 1.334 (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_p -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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 2.39 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 4.68 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|-------------|
| Requirement of 2010/75/EU | U in % of the ELV 50 mg/m³ | 9.4 |
| 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 |

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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|------------------|--------------------------|
| Certification range | N ₂ O | 0 - 50 mg/m ³ |
|---------------------|------------------|--------------------------|

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 _p | -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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-----------------|--------------------------|
| Certification range | SO ₂ | 0 - 75 mg/m ³ |
|---------------------|-----------------|--------------------------|

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 | U in % of the ELV 50 mg/m³ | 9.4 |
| 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 |

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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-----|--------------------------|
| Certification range | HCl | 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_i | | 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 | $u_{d,z}$ 0.061 mg/m ³ | | 0.004 (mg/m ³) ² |
| Span drift from field test | $u_{d,s}$ 0.217 mg/m ³ | | 0.047 (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_p 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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 0.43 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 0.85 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|-------------|
| Requirement of 2010/75/EU | U in % of the ELV 10 mg/m³ | 8.5 |
| 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 | 936/21219814/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|----|-------------------------|
| Certification range | HF | 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_i | | 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 | $u_{d,z}$ 0.017 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_p 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 | U in % of the ELV 1 mg/m³ | 17.9 |
| Requirement of EN 15267-3 | U in % of the ELV 1 mg/m³ | 40.0 |
| | U in % of the ELV 1 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 | 936/21219814/B TÜV Rheinland |
| Date of report | 2016-10-13 |

Measured component

| | |
|---------------------|--|
| Certification range | NH ₃ 0 - 5 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 | -0.09 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_b -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)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 0.18 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 0.35 \text{ mg/m}^3$$

Relative total expanded uncertainty

U in % of the ELV 2 mg/m³ 17.3

Requirement of 2010/75/EU

U in % of the ELV 2 mg/m³ 40.0 **

Requirement of EN 15267-3

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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|------------------|---------------|
| Certification range | H ₂ O | 0 - 40 Vol.-% |
|---------------------|------------------|---------------|

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_i | | 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 | $u_{d,s}$ | -0.277 Vol.-% | 0.077 (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_p | -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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 0.82 Vol.-% |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 1.61 Vol.-% |

Relative total expanded uncertainty

| | | |
|---------------------------|--------------------------------------|----------------|
| Requirement of 2010/75/EU | U in % of the range 40 Vol.-% | 4.0 |
| Requirement of EN 15267-3 | U in % of the range 40 Vol.-% | 10.0 ** |
| | U in % of the range 40 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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-----------------|---------------|
| Certification range | CO ₂ | 0 - 30 Vol.-% |
|---------------------|-----------------|---------------|

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 | $u_{d,s}$ | 0.104 | Vol.-% | 0.011 (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_p | -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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 0.48 | Vol.-% |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 0.93 | 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 ** |
| | U in % of the range 30 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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-------------------|--------------------------|
| Certification range | CH ₂ O | 0 - 20 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 | -0.09 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_i | | 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 | $u_{d,s}$ -0.185 mg/m ³ | | 0.034 (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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 0.39 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 0.76 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|----------------|
| Requirement of 2010/75/EU | U in % of the range 20 mg/m³ | 3.8 |
| Requirement of EN 15267-3 | U in % of the range 20 mg/m³ | 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/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-----------------|---------------------------|
| Certification range | CH ₄ | 0 - 7.5 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 | 0.09 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) | $u_c = \sqrt{\sum (u_{max, j})^2}$ | 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 range 7.5 mg/m³ | 3.5 |
| Requirement of EN 15267-3 | U in % of the range 7.5 mg/m³ | 30.0 ** |
| | U in % of the range 7.5 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 | 936/21219814/B |
| Date of report | TÜV Rheinland |
| | 2016-10-13 |

Measured component

| | | |
|---------------------|-----|--------------------------|
| Certification range | TOC | 0 - 15 mg/m ³ |
|---------------------|-----|--------------------------|

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 | $u_{d,z}$ | -0.069 mg/m ³ | 0.005 (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_p | -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) | $u_c = \sqrt{\sum (u_{max,j})^2}$ | 0.43 mg/m ³ |
| Total expanded uncertainty | $U = u_c * k = u_c * 1.96$ | 0.85 mg/m ³ |

Relative total expanded uncertainty

| | | |
|---------------------------|--|-------------|
| Requirement of 2010/75/EU | U in % of the ELV 10 mg/m³ | 8.5 |
| Requirement of EN 15267-3 | U in % of the ELV 10 mg/m³ | 30.0 |
| | U in % of the ELV 10 mg/m³ | 22.5 |