

# CERTIFICATE

## of Product Conformity (QAL1)

Certificate No.: 0000072196\_01

**Certified AMS:** MGAprime Q for CO, NO, O<sub>2</sub>, CO<sub>2</sub>, NO<sub>2</sub>, N<sub>2</sub>O and SO<sub>2</sub>

**Manufacturer:** MRU GmbH  
Fuchshalde 8  
74172 Neckarsulm  
Deutschland

**Test Institute:** 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 15267-4 (2017),  
EN 14793 (2017) and EN 14181 (2014).**

Certification is awarded in respect of the conditions stated in this certificate  
(this certificate contains 12 pages).

The present certificate replaces certificate 0000072196 dated 07 September 2020.



Suitability Tested  
EN 15267  
QAL1 Certified  
Regular  
Surveillance


www.tuv.com  
ID 0000072196

Publication in the German Federal Gazette  
(BAnz.) of 03 May 2021

German Federal Environment Agency  
Dessau, 02 June 2021

This certificate will expire on:  
02 May 2026

TÜV Rheinland Energy GmbH  
Cologne, 01 June 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 the certificate D-PL-11120-02-00.

**Test report:** 936/21245785/C of 07 September 2020  
**Initial certification:** 31 Juli 2020  
**Expiry date:** 02 May 2026  
**Publication:** BAnz AT 03.05.2021 B9, chapter I number 4.1

### Approved application

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III (13<sup>th</sup> BImSchV), 44<sup>th</sup> BImSchV and TA Luft. As well it is suitable as an alternative method for the standard reference method for calibrating and validating stationary AMS in the context of QAL2 and AST in accordance with EN 14181. The measured ranges have been selected so as to ensure as broad a field of application as possible.

The suitability of the P-AMS for this application was assessed on the basis of a laboratory test and seven field tests at different industrial plants. The plants were two municipal waste incinerators, a lignite-fired power plant, a sewage incinerator, a biomass heating plant, a hot water burner test stand and an engine test stand.

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 installation at which it will be installed.

### Basis of the certification

This certification is based on:

- Test report 936/21245785/C of 07 September 2020 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 03.05.2021 B9, chapter I number 4.1  
Announcement by UBA dated 31 March 2021:

**AMS designation:**

MGAprime Q for CO, NO, O<sub>2</sub>, CO<sub>2</sub>, NO<sub>2</sub>, N<sub>2</sub>O and SO<sub>2</sub>

**Manufacturer:**

MRU GmbH, Neckarsulm

**Field of application:**

Portable AMS for periodic measurements of emissions from stationary sources in accordance with the 13<sup>th</sup> and 44<sup>th</sup> BImSchV, TA Luft and as an alternative method for the standard reference method for calibrating and validating stationary AMS in the context of QAL2 and AST in accordance with EN 14181.

**Measuring ranges during performance testing:**

Component	Certification range	Supplementary range	Unit
CO	0–220	0–3,750	mg/m <sup>3</sup>
NO	0–270	0–2,680	mg/m <sup>3</sup>
NO <sub>2</sub>	0–308	0–1,025	mg/m <sup>3</sup>
CO <sub>2</sub>	0–20	-	Vol.-%
N <sub>2</sub> O	0–196	0–490	mg/m <sup>3</sup>
SO <sub>2</sub>	0–429	0–8,571	mg/m <sup>3</sup>
O <sub>2</sub>	0–25	-	Vol.-%

**Software version:**

V1.001.029

**Restrictions:**

None

**Notes:**

1. Operation of the P-AMS requires that the pump provided by the manufacturer injects a 10 % phosphoric acid into the instrument's cooler.
2. In the event of temperature changes of more than 6°C, it must be checked on-site whether the measurement uncertainty is still within the permissible limits.
3. Supplementary testing (additional components NO<sub>2</sub>, SO<sub>2</sub> and N<sub>2</sub>O) as regards Federal Environment Agency (UBA) notice of 27 May 2020 (BAnz AT 31.07.2020 B10, chapter I number 4.2).

**Test report:**

TÜV Rheinland Energy GmbH, Cologne  
Report No.: 936/21245785/C of 07 September 2020

**Certified product**

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

The *MGAprime Q* measuring system tested consists of:

- HPI sampling probe (length: 0.5 m) and heating hose (length: 3 m),
- the *MGAprime Q* analyser itself,
- and the additional APE unit for injecting phosphoric acid into the analyser.

The gas sampling probe has a heated probe handle incl. a dust filter and allows connection to a heated sampling line. The *MGAprime Q* controls the heaters, the probe handle and the sampling probe.

The measuring system has two different kinds of sensors.

- a paramagnetic sensor to measure O<sub>2</sub>;
- non-dispersive infrared absorption measurement for measuring CO, NO, NO<sub>2</sub>, N<sub>2</sub>O, SO<sub>2</sub> und CO<sub>2</sub>.

The measuring system is operated via a touch-sensitive display. The outer casing of the instrument is a compact and robust metal housing with shock-absorbing plastic corners, housed in a water-repellent bag. The P-AMS can be operated from within this bag. The AMS has a degree of protection of IP42.

All electrical and pneumatic connections are located on the front of the unit.

An APE acid dosing unit is used to inject phosphoric acid (10 %) into the instrument's cooler. Correct measurement requires the injection of phosphoric acid (10 %).

- This injection ensures constant conditions of the gas cooler.
- The use of phosphoric acid reduces losses of SO<sub>2</sub> and NO<sub>2</sub> on the wet surfaces of the gas cooler.

The injection takes place via two pumps. The total quantity of phosphorous acid during operation is 24 ml per hour.

**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 certification mark may be applied to the product or used in advertising materials 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: [gal1.de](http://gal1.de).

### **History of documents**

Certification of MGAprime Q 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. 0000072196: 07 September 2020  
Expiry date of the certificate: 30 July 2025  
Test report 936/21245785/B dated 11 May 2020  
TÜV Rheinland Energy GmbH, Cologne  
Publication: BAnz AT 31.07.2020, chapter I number 4.2  
Announcement by UBA dated 27 May 2020

#### **Supplementary testing according to EN 15267**

Certificate No. 0000072196\_01: 02 June 2021  
Expiry date of the certificate: 02 May 2026  
Test report 936/21245785/C of 07 September 2020  
TÜV Rheinland Energy GmbH, Cologne  
Publication: BAnz AT 03.05.2021 B9, chapter I number 4.1  
Announcement by UBA dated 31 March 2021

The following pages present the uncertainty calculations for the individual components. Since separate uncertainty calculations are required for each field test, this certificate indicates the highest uncertainty result determined for each field test. All other uncertainty calculations are summarised in the mentioned performance test.

### Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both systems during field test 1

#### Measuring system

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	63108 / 63107
Measuring principle	IR

#### Test report

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

#### Measured component

Certification range	CO 0 - 220 mg/m <sup>3</sup>
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#### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	0.69 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	$u_i$ 0.40 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Test parameter

		$u^2$
Standard deviation laboratory test	$u_r$ 0.690 mg/m <sup>3</sup>	0.476 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	$u_{lof}$ 0.572 mg/m <sup>3</sup>	0.327 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	$u_{d,z}$ 0.650 mg/m <sup>3</sup>	0.423 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	$u_{d,s}$ 1.299 mg/m <sup>3</sup>	1.687 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature from field	$u_t$ 0.837 mg/m <sup>3</sup>	0.700 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage field test specific	$u_v$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity field test specific	$u_i$ 0.399 mg/m <sup>3</sup>	0.159 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow field test specific	$u_p$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_{rm}$ 1.778 mg/m <sup>3</sup>	3.162 (mg/m <sup>3</sup> ) <sup>2</sup>

Combined standard uncertainty ( $u_c$ )

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 2.63 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1,96 \quad 5.16 \text{ mg/m}^3$$

#### Relative total expanded uncertainty

Requirement of 2010/75/EU	<b>U in % of the range 88 mg/m<sup>3</sup></b>	<b>5.9</b>
Requirement of EN 15267-3	<b>U in % of the range 88 mg/m<sup>3</sup></b>	<b>10.0</b>
Requirement for standard reference methods	<b>U in % of the range 88 mg/m<sup>3</sup></b>	<b>7.5</b>
	<b>U in % of the range 88 mg/m<sup>3</sup></b>	<b>6.0</b>

**Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both systems during field test 3**

**Measuring system**

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	63108 / 63107
Measuring principle	IR

**Test report**

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

**Measured component**

Certification range	NO 0 - 270 mg/m <sup>3</sup>
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	7.44 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	$u_i$ 4.30 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test parameter**

		$u^2$
Standard deviation laboratory test	$u_r$ 1.300 mg/m <sup>3</sup>	1.690 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	$u_{lof}$ 1.154 mg/m <sup>3</sup>	1.332 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	$u_{d,z}$ 0.462 mg/m <sup>3</sup>	0.213 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	$u_{d,s}$ -1.386 mg/m <sup>3</sup>	1.921 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature from field	$u_t$ 1.155 mg/m <sup>3</sup>	1.333 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage field test specific	$u_v$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity field test specific	$u_i$ 4.297 mg/m <sup>3</sup>	18.464 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow field test specific	$u_b$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_{rm}$ 2.182 mg/m <sup>3</sup>	4.763 (mg/m <sup>3</sup> ) <sup>2</sup>

Combined standard uncertainty ( $u_c$ )

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 5.46 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c \cdot k = u_c \cdot 1,96 \quad 10.70 \text{ mg/m}^3$$

**Relative total expanded uncertainty**

**U in % of the range 108 mg/m<sup>3</sup> 9.9**

**Requirement of 2010/75/EU**

**U in % of the range 108 mg/m<sup>3</sup> 20.0**

Requirement of EN 15267-3

U in % of the range 108 mg/m<sup>3</sup> 15.0

Requirement for standard reference methods

U in % of the range 108 mg/m<sup>3</sup> 10.0

**Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both systems during field test 5**

**Measuring system**

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	63108 / 63107
Measuring principle	IR

**Test report**

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

**Measured component**

Certification range	CO <sub>2</sub> 0 - 20 Vol.-%
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	0.16 Vol.-%
Uncertainty of cross-sensitivity	u <sub>i</sub> 0.09 Vol.-%

**Calculation of the combined standard uncertainty**

**Test parameter**

				u <sup>2</sup>
Standard deviation laboratory test	u <sub>r</sub>	0.020 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	0.115 Vol.-%		0.013 (Vol.-%) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	-0.012 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	-0.115 Vol.-%		0.013 (Vol.-%) <sup>2</sup>
Influence of ambient temperature from field	u <sub>t</sub>	0.245 Vol.-%		0.060 (Vol.-%) <sup>2</sup>
Influence of supply voltage field test specific	u <sub>v</sub>	0.000 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Cross-sensitivity field test specific	u <sub>i</sub>	0.093 Vol.-%		0.009 (Vol.-%) <sup>2</sup>
Influence of sample gas flow field test specific	u <sub>b</sub>	0.000 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	0.162 Vol.-%		0.026 (Vol.-%) <sup>2</sup>

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,i})^2}$	0.35 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	0.68 Vol.-%

**Relative total expanded uncertainty**

<b>Requirement of 2010/75/EU</b>	<b>U in % of the range 20 Vol.-%</b>	<b>3.4</b>
Requirement of EN 15267-3	U in % of the range 20 Vol.-%	7.5
Requirement for standard reference methods	U in % of the range 20 Vol.-%	6.0

\*\* There are no requirements for this component in the EU Directive 2010/75/EU on industrial emissions. A value of 10 % was used.



### Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both systems during field test 1

#### Measuring system

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	63108 / 63107
Measuring principle	Paramagnetic

#### Test report

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

#### Measured component

	O <sub>2</sub>
Certification range	0 - 25 Vol.-%

#### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	0.05 Vol.-%
Uncertainty of cross-sensitivity	$u_i$ 0.03 Vol.-%

#### Calculation of the combined standard uncertainty

##### Test parameter

				$U^2$
Standard deviation laboratory test	$u_r$	0.010 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Lack of fit	$u_{lof}$	0.003 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Zero drift from field test	$u_{d,z}$	0.017 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Span drift from field test	$u_{d,s}$	-0.110 Vol.-%		0.012 (Vol.-%) <sup>2</sup>
Influence of ambient temperature from field	$u_t$	0.245 Vol.-%		0.060 (Vol.-%) <sup>2</sup>
Influence of supply voltage field test specific	$u_v$	0.000 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Cross-sensitivity field test specific	$u_i$	0.030 Vol.-%		0.001 (Vol.-%) <sup>2</sup>
Influence of sample gas flow field test specific	$u_n$	0.000 Vol.-%		0.000 (Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_{rm}$	0.202 Vol.-%		0.041 (Vol.-%) <sup>2</sup>

Combined standard uncertainty ( $u_c$ )	$u_c = \sqrt{\sum (u_{max, j})^2}$	0.34 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	0.66 Vol.-%

#### Relative total expanded uncertainty

<b>Requirement of 2010/75/EU</b>	<b>U in % of the range 25 Vol.-%</b>	<b>2.6</b>
Requirement of EN 15267-3	U in % of the range 25 Vol.-%	7.5
Requirement for standard reference methods	U in % of the range 25 Vol.-%	6.0
	<b>U in % of the range 25 Vol.-%</b>	<b>10.0 **</b>

\*\* There are no requirements for this component in the EU Directive 2010/75/EU on industrial emissions.  
A value of 10.0 % was used.

**Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both system during field test 3**

**Measuring system**

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	63108 / 63107
Measuring principle	IR

**Test report**

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

**Measured component**

Certification range	NO <sub>2</sub> 0 - 308 mg/m <sup>3</sup>
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	7.51 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	$u_i$ 4.337 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test parameter**

		$u^2$
Standard deviation laboratory test	$u_r$ 0.540 mg/m <sup>3</sup>	0.292 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	$u_{lof}$ -1.099 mg/m <sup>3</sup>	1.208 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	$u_{d,z}$ -0.178 mg/m <sup>3</sup>	0.032 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	$u_{d,s}$ 1.598 mg/m <sup>3</sup>	2.553 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature from field	$u_t$ 1.102 mg/m <sup>3</sup>	1.213 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage field test specific	$u_v$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity field test specific	$u_i$ 4.337 mg/m <sup>3</sup>	18.810 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_b$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Unsicherheit des Referenzmaterials bei 70% des ZB	$u_{rm}$ 2.490 mg/m <sup>3</sup>	6.198 (mg/m <sup>3</sup> ) <sup>2</sup>

Combined standard uncertainty ( $u_c$ )

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 5.50 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1,96 \quad 10.79 \text{ mg/m}^3$$

**Relative total expanded uncertainty**

**U in % of the range 8.8**

**Requirement of 2010/75/EU**

**U in % of the range 20.0**

Requirement of EN 15267-3

U in % of the range 15.0

Requirement for standard reference methods

10.0

**Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both systems during field test 3**

**Measuring system**

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	68109 / 68107
Measuring principle	IR

**Test report**

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

**Measured component**

Certification range	SO <sub>2</sub> 0 - 429 mg/m <sup>3</sup>
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	12.66 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	$u_i$ 7.310 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test parameter**

		$u^2$
Standard deviation laboratory test	$u_r$ 1.270 mg/m <sup>3</sup>	1.613 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	$u_{lof}$ -1.907 mg/m <sup>3</sup>	3.637 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	$u_{d,z}$ 0.248 mg/m <sup>3</sup>	0.061 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	$u_{d,s}$ -1.981 mg/m <sup>3</sup>	3.926 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature from field	$u_t$ 1.281 mg/m <sup>3</sup>	1.640 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage field test specific	$u_v$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity field test specific	$u_i$ 7.310 mg/m <sup>3</sup>	53.436 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas pressure field test specific	$u_p$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow field test specific	$u_n$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_m$ 3.468 mg/m <sup>3</sup>	12.024 (mg/m <sup>3</sup> ) <sup>2</sup>

Combined standard uncertainty ( $u_c$ )

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 8.74 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1,96 \quad 17.12 \text{ mg/m}^3$$

**Relative total expanded uncertainty**

**Requirement of 2010/75/EU**

Requirement of EN 15267-3

Requirement for standard reference methods

**U in % of the range 10.0**

**U in % of the range 20.0**

U in % of the range 15.0

U in % of the range 10.0

**Calculation of overall uncertainty according to EN 14181 and EN 15267-4 for both systems during field test 7**

**Measuring system**

Manufacturer	MRU GmbH
AMS designation	MGAprime Q
Serial number of units under test	68108 / 68107
Measuring principle	IR

**Test report**

Test laboratory	936/21245785/C TÜV Rheinland
Date of report	07 September 2020

**Measured component**

Certification range	N <sub>2</sub> O 0 - 196 mg/m <sup>3</sup>
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

The cross-sensitivities were calculated site-specifically as a function of the exhaust gas matrix at the respective field test facility, taking into account the cross-sensitivity influences determined in the laboratory.

Maximum sum of cross-sensitivities	3.27 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	$u_i$ 1.887 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Test parameter**

		$u^2$
Standard deviation laboratory test	$u_r$ 0.470 mg/m <sup>3</sup>	0.221 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	$u_{lof}$ -0.577 mg/m <sup>3</sup>	0.333 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	$u_{d,z}$ 0.339 mg/m <sup>3</sup>	0.115 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	$u_{d,s}$ 1.584 mg/m <sup>3</sup>	2.509 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature from field	$u_t$ 0.374 mg/m <sup>3</sup>	0.140 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage field test specific	$u_v$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity field test specific	$u_i$ 1.887 mg/m <sup>3</sup>	3.561 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas pressure field test specific	$u_p$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow field test specific	$u_n$ 0.000 mg/m <sup>3</sup>	0.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_{rm}$ 1.584 mg/m <sup>3</sup>	2.510 (mg/m <sup>3</sup> ) <sup>2</sup>

Combined standard uncertainty ( $u_c$ )	$u_c = \sqrt{\sum (u_{max,j})^2}$	3.06 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1,96$	6.01 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

<b>Requirement of 2010/75/EU</b>	<b>U in % of the range</b>	<b>3.1</b>
Requirement of EN 15267-3	<b>U in % of the range</b>	<b>20.0</b>
Requirement for standard reference methods	U in % of the range	15.0
	U in % of the range	10.0