

# CERTIFICATE

## of Product Conformity (QAL1)

Certificate No.: 0000040210

**Certified AMS:** CEMS for CO, NO, NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub> and CO<sub>2</sub>

**Manufacturer:** Kontram Oy  
Tuupakantie 32 a  
01740 Vantaa  
Finland

**Test Institute:** TÜV Rheinland Energie und Umwelt GmbH

**This is to certify that the AMS has been tested  
and found to comply with:**

**EN 15267-1: 2009, EN 15267-2: 2009, EN 15267-3: 2007,  
EN ISO 16911-2 : 2013 and EN 14181: 2004**

Certification is awarded in respect of the conditions stated in this certificate  
(see also the following pages).



Suitability Tested  
EN 15267  
QAL1 Certified  
Regular  
Surveillance

www.tuv.com  
ID 0000040210

Publication in the German Federal Gazette  
(BAnz.) of 01 April 2014

German Federal Environment Agency  
Dessau, 29 April 2014



i. A. Dr. Marcel Langner

This certificate will expire on:  
31 March 2019

TÜV Rheinland Energie und Umwelt GmbH  
Cologne, 28 April 2014



ppa. Dr. Peter Wilbring

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Accreditation according to EN ISO/IEC 17025 and certified according to ISO 9001:2008.

<b>Test report:</b>	936/21218430/A of 08 October 2013
<b>Initial certification:</b>	01 April 2014
<b>Expiry date:</b>	31 March 2019
<b>Publication:</b>	BAnz AT 01 April 2014 B12, chapter I, No. 4.1

### **Approved application**

The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III. The tested ranges have been chosen with respect to 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 three-month field test at a municipal waste incinerator.

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

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 936/21218430/A of 08 October 2013 of TÜV Rheinland Energie und Umwelt 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 01 April 2014 B12, chapter I, No. 4.1, Announcement by UBA from 27 February 2014)

**AMS designation:**

CEMS for CO, NO, NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub> and CO<sub>2</sub>

**Manufacturer:**

Kontram Oy, Helsinki, Finland

**Field of application:** For measurements at plants according to (Directive 2010/75/EU, chapter III combustion plants)

**Measuring ranges during the performance test:**

Module	Components	Certification range	Supplementary ranges	Unit
CEMS - T60i	CO	0 - 250	0 - 3125	mg/m <sup>3</sup>
	NO	0 - 121	0 - 2680	mg/m <sup>3</sup>
	NO <sub>2</sub>	0 - 185	0 - 1025	mg/m <sup>3</sup>
	NO <sub>x</sub> *	0 - 185	0 - 4097	mg/m <sup>3</sup>
	SO <sub>2</sub>	0 - 486	0 - 5720	mg/m <sup>3</sup>
	CO <sub>2</sub>	0 - 25	-	Vol.-%
CEMS - S4900	CO	0 - 125	0 - 625	mg/m <sup>3</sup>
CEMS - S4900	NO	0 - 121	0 - 1340	mg/m <sup>3</sup>
CEMS - S4900	SO <sub>2</sub>	0 - 486	0 - 2860	mg/m <sup>3</sup>

\* NO<sub>x</sub> = NO as NO<sub>2</sub> + NO

**Software versions:**

S4900: 4000/653 rev3

T60i: 01.10.04.329, fw 11.19.119, detector fw 02.03.014

**Restriction:**

The CEMS-T60i module did not fulfil the performance criterion in accordance with EN 15267-3 as related to cross-sensitivities for the components CO and NO as opposed to HCl at concentrations >50 mg/m<sup>3</sup> and for the component CO as opposed to SO<sub>2</sub> at concentrations >200 mg/m<sup>3</sup>.

**Notes:**

- The maintenance interval is four weeks. In the event of extending the CEMS measuring system by additional modules/components, the maintenance interval shall be determined upon proper installation.
- The functionality of a particular assembly of modules shall be checked in the context of verifying proper installation.
- The measuring system Kontram CEMS is a modular system in which two analysers can be integrated.  

CEMS a	T60i
CEMS b	T60i + S4900
CEMS c	S4900
CEMS d	S4900 + S4900
- A type S4900 analyser can accommodate measuring cells for up to 3 different components.
- The T60i analyser measures both NO and NO<sub>2</sub> and can also output NO<sub>x</sub> as a calculated total.

**Test report:**

TÜV Rheinland Energie und Umwelt GmbH, Cologne

Report No.: 936/21218430/A of 8 October 2013

### **Certified product**

This certificate applies to automated measurement systems conforming to the following description: The measuring system is a modular system comprising up to two different analysers of type T60i and/or S4900.

The tested measuring system comprises:

- Heated sample gas probe JCT, type JES301 and  
50 m heated sampling hose in the field test, 180 °C, 6 mm PTFE gas tubing  
(a heated 5 m sampling hose was used in the laboratory)
- Measuring cabinet CEMS with sample gas pump (ejection pump)  
Permeation dryer (PD-100T-24MSS, Permapure)  
Flow volume regulator
- Up to two analyser modules (T60i, T60i + S4900, S4900 or 2 x S4900)

#### *Analyser module T60i*

The T60i module measures exhaust gas components using a non-dispersive infra-red analyser (NDIR) (this means that the measuring system uses optical band-pass filters as opposed to diffraction gratings or prisms).

#### *Analyser module S4900*

A separate measuring cell with single-beam measurement with gas filter correlation is used for carbon monoxide, nitrogen monoxide and sulphur dioxide.

### **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 Energie und Umwelt 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 Energie und Umwelt GmbH. With revocation of the publication the certificate loses its validity. After the expiration of the certificate and on requests of the TÜV Rheinland Energie und Umwelt 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 CEMS for CO, NO, NO<sub>2</sub>, NO<sub>x</sub>, SO<sub>2</sub> and CO<sub>2</sub> 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. 0000040210: 29 April 2014

Expiry date of the certificate: 31 March 2019

Test report: 936/21218430/A of 8 October 2013  
TÜV Rheinland Energie und Umwelt GmbH, Cologne

Publication: BAnz AT 01 April 2014 B12, chapter I, No. 4.1  
Announcement by UBA from 27 February 2014

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

**Measuring system**

Manufacturer	Kontram Oy
AMS designation	CEMS_S4900
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

**Test report**

Test laboratory	936/21218430/A TÜV Rheinland
Date of report	2013-10-08

**Measured component**

Certification range	CO 0 - 125 mg/m <sup>3</sup>
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

Sum of positive CS at zero point	1.10 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at span point	1.60 mg/m <sup>3</sup>
Sum of negative CS at span point	-2.70 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	-2.70 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	-1.559 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Tested parameter**

			u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub>	0.613 mg/m <sup>3</sup>	0.376 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	0.577 mg/m <sup>3</sup>	0.333 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	-0.869 mg/m <sup>3</sup>	0.755 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	2.983 mg/m <sup>3</sup>	8.898 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	1.274 mg/m <sup>3</sup>	1.623 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	0.611 mg/m <sup>3</sup>	0.373 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	-1.559 mg/m <sup>3</sup>	2.430 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub>	-0.150 mg/m <sup>3</sup>	0.023 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	1.010 mg/m <sup>3</sup>	1.021 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	3.98 mg/m <sup>3</sup>
Total expanded uncertainty	U = u <sub>c</sub> * k = u <sub>c</sub> * 1.96	7.80 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

**Requirement of 2010/75/EU**

Requirement of EN 15267-3

<b>U in % of the ELV 110 mg/m<sup>3</sup></b>	<b>7.1</b>
<b>U in % of the ELV 110 mg/m<sup>3</sup></b>	<b>10.0</b>
U in % of the ELV 110 mg/m <sup>3</sup>	7.5

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

#### Measuring system

Manufacturer	Kontram Oy
AMS designation	CEMS_S4900
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

#### Test report

Test laboratory	936/21218430/A TÜV Rheinland
Date of report	2013-10-08

#### Measured component

	NO
Certification range	0 - 121 mg/m <sup>3</sup>

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

(system with largest CS)

Sum of positive CS at zero point	0.00 mg/m <sup>3</sup>
Sum of negative CS at zero point	-1.45 mg/m <sup>3</sup>
Sum of positive CS at span point	0.80 mg/m <sup>3</sup>
Sum of negative CS at span point	-3.00 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	-3.00 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	-1.732 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Tested parameter

			u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub>	1.867 mg/m <sup>3</sup>	3.486 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	-0.629 mg/m <sup>3</sup>	0.396 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	-1.707 mg/m <sup>3</sup>	2.914 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	-2.096 mg/m <sup>3</sup>	4.393 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	2.095 mg/m <sup>3</sup>	4.389 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	0.407 mg/m <sup>3</sup>	0.166 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	-1.732 mg/m <sup>3</sup>	3.000 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub>	-0.332 mg/m <sup>3</sup>	0.110 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	0.978 mg/m <sup>3</sup>	0.957 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	4.45 mg/m <sup>3</sup>
Total expanded uncertainty	U = u <sub>c</sub> * k = u <sub>c</sub> * 1.96	8.72 mg/m <sup>3</sup>

#### Relative total expanded uncertainty

##### Requirement of 2010/75/EU

Requirement of EN 15267-3

<b>U in % of the ELV 60 mg/m<sup>3</sup></b>	<b>14.5</b>
<b>U in % of the ELV 60 mg/m<sup>3</sup></b>	<b>20.0</b>
U in % of the ELV 60 mg/m <sup>3</sup>	15.0

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

**Measuring system**

Manufacturer	Kontram Oy
AMS designation	CEMS_S4900
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

**Test report**

Test laboratory	936/21218430/A TÜV Rheinland
Date of report	2013-10-08

**Measured component**

Certification range	SO <sub>2</sub> 0 - 486 mg/m <sup>3</sup>
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**Evaluation of the cross-sensitivity (CS)**

(system with largest CS)

Sum of positive CS at zero point	2.29 mg/m <sup>3</sup>
Sum of negative CS at zero point	-2.99 mg/m <sup>3</sup>
Sum of positive CS at span point	12.50 mg/m <sup>3</sup>
Sum of negative CS at span point	-19.37 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	-19.37 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	-11.185 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Tested parameter**

			u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub>	4.490 mg/m <sup>3</sup>	20.160 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	2.296 mg/m <sup>3</sup>	5.272 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	-4.186 mg/m <sup>3</sup>	17.523 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	8.418 mg/m <sup>3</sup>	70.863 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	2.784 mg/m <sup>3</sup>	7.751 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	2.750 mg/m <sup>3</sup>	7.563 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	-11.185 mg/m <sup>3</sup>	125.104 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>b</sub>	-1.169 mg/m <sup>3</sup>	1.367 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	3.928 mg/m <sup>3</sup>	15.431 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u<sub>c</sub>)

$$u_c = \sqrt{\sum (u_{\max, j})^2} \quad 16.46 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 32.27 \text{ mg/m}^3$$

**Relative total expanded uncertainty**

**U in % of the ELV 250 mg/m<sup>3</sup> 12.9**

**Requirement of 2010/75/EU**

**U in % of the ELV 250 mg/m<sup>3</sup> 20.0**

**Requirement of EN 15267-3**

**U in % of the ELV 250 mg/m<sup>3</sup> 15,0**



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

**Measuring system**

Manufacturer	Kontram Oy
AMS designation	CEMS_T60i
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

**Test report**

Test laboratory	936/21218430/A
Date of report	TÜV Rheinland
	2013-10-08

**Measured component**

Certification range	CO
	0 - 250 mg/m <sup>3</sup>

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

(system with largest CS)

Sum of positive CS at zero point	1.20 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at span point	8.40 mg/m <sup>3</sup>
Sum of negative CS at span point	-8.30 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	8.40 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	4.850 mg/m <sup>3</sup>

**Calculation of the combined standard uncertainty**

**Tested parameter**

			u <sup>2</sup>
Repeatability standard deviation at set point *	u <sub>r</sub>	1.006 mg/m <sup>3</sup>	1.012 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	1.155 mg/m <sup>3</sup>	1.334 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	0.239 mg/m <sup>3</sup>	0.057 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	1.465 mg/m <sup>3</sup>	2.146 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	1.553 mg/m <sup>3</sup>	2.412 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	1.189 mg/m <sup>3</sup>	1.414 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	4.850 mg/m <sup>3</sup>	23.523 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub>	-1.293 mg/m <sup>3</sup>	1.672 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	2.021 mg/m <sup>3</sup>	4.083 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	6.14 mg/m <sup>3</sup>
Total expanded uncertainty	U = u <sub>c</sub> * k = u <sub>c</sub> * 1.96	12.03 mg/m <sup>3</sup>

**Relative total expanded uncertainty**

**Requirement of 2010/75/EU**

Requirement of EN 15267-3

<b>U in % of the ELV 160 mg/m<sup>3</sup></b>	<b>7.5</b>
<b>U in % of the ELV 160 mg/m<sup>3</sup></b>	<b>10.0</b>
U in % of the ELV 160 mg/m <sup>3</sup>	7.5

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

**Measuring system**

Manufacturer	Kontram Oy
AMS designation	CEMS_T60i
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

**Test report**

Test laboratory	936/21218430/A
Date of report	TÜV Rheinland
	2013-10-08

**Measured component**

Certification range	CO <sub>2</sub>
	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	0.20	Vol.-%
Sum of negative CS at span point	-0.80	Vol.-%
Maximum sum of cross-sensitivities	-0.80	Vol.-%
Uncertainty of cross-sensitivity	-0.462	Vol.-%

**Calculation of the combined standard uncertainty**

**Tested parameter**

				u <sup>2</sup>	
Standard deviation from paired measurements under field conditions *	u <sub>D</sub>	0.182	Vol.-%	0.033	(Vol.-%) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	0.058	Vol.-%	0.003	(Vol.-%) <sup>2</sup>
Zero drift from field test	u <sub>d.z</sub>	-0.075	Vol.-%	0.006	(Vol.-%) <sup>2</sup>
Span drift from field test	u <sub>d.s</sub>	0.294	Vol.-%	0.086	(Vol.-%) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	0.208	Vol.-%	0.043	(Vol.-%) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	0.051	Vol.-%	0.003	(Vol.-%) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	-0.462	Vol.-%	0.213	(Vol.-%) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub>	0.078	Vol.-%	0.006	(Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	0.202	Vol.-%	0.041	(Vol.-%) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u<sub>c</sub>)

$$u_c = \sqrt{\sum (u_{\max j})^2} \quad 0.66 \text{ Vol.-%}$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 1.29 \text{ Vol.-%}$$

**Relative total expanded uncertainty**

**U in % of the range 25 Vol.-% 5.2**

Requirement of 2010/75/EU

**U in % of the range 25 Vol.-% 10.0 \*\***

Requirement of EN 15267-3

U in % of the range 25 Vol.-% 7.5

\*\* For this component no requirements in the EC-directives 2010/75/EU on industrial emissions are given.

The chosen value is recommended by the certification body.

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

#### Measuring system

Manufacturer	Kontram Oy
AMS designation	CEMS_T60i
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

#### Test report

Test laboratory	936/21218430/A TÜV Rheinland
Date of report	2013-10-08

#### Measured component

	NO
Certification range	0 - 121 mg/m <sup>3</sup>

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

(system with largest CS)

Sum of positive CS at zero point	0.64 mg/m <sup>3</sup>
Sum of negative CS at zero point	-3.13 mg/m <sup>3</sup>
Sum of positive CS at span point	2.90 mg/m <sup>3</sup>
Sum of negative CS at span point	-2.40 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	-3.13 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	-1.808 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Tested parameter

			u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub>	1.662 mg/m <sup>3</sup>	2.762 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	-0.692 mg/m <sup>3</sup>	0.479 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	1.648 mg/m <sup>3</sup>	2.716 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	2.096 mg/m <sup>3</sup>	4.393 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	1.234 mg/m <sup>3</sup>	1.523 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	0.404 mg/m <sup>3</sup>	0.163 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	-1.808 mg/m <sup>3</sup>	3.269 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub>	0.568 mg/m <sup>3</sup>	0.323 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	0.978 mg/m <sup>3</sup>	0.957 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u<sub>c</sub>)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 4.07 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 7.98 \text{ mg/m}^3$$

#### Relative total expanded uncertainty

##### Requirement of 2010/75/EU

Requirement of EN 15267-3

**U in % of the ELV 55 mg/m<sup>3</sup> 14.5**

**U in % of the ELV 55 mg/m<sup>3</sup> 20.0**

U in % of the ELV 55 mg/m<sup>3</sup> 15.0

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

#### Measuring system

Manufacturer	Kontram Oy
AMS designation	CEMS_T60i
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

#### Test report

Test laboratory	936/21218430/A TÜV Rheinland
Date of report	2013-10-08

#### Measured component

	NO <sub>2</sub>
Certification range	0 - 185 mg/m <sup>3</sup>

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

(system with largest CS)

Sum of positive CS at zero point	2.06 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at span point	3.02 mg/m <sup>3</sup>
Sum of negative CS at span point	-6.11 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	-6.11 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	-3.527 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Tested parameter

		u <sup>2</sup>
Repeatability standard deviation at set point *	u <sub>r</sub> 0.766 mg/m <sup>3</sup>	0.587 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> -1.186 mg/m <sup>3</sup>	1.407 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> 2.601 mg/m <sup>3</sup>	6.765 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> 3.031 mg/m <sup>3</sup>	9.187 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 1.682 mg/m <sup>3</sup>	2.829 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.981 mg/m <sup>3</sup>	0.962 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub> -3.527 mg/m <sup>3</sup>	12.440 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>b</sub> 1.743 mg/m <sup>3</sup>	3.038 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub> 1.495 mg/m <sup>3</sup>	2.236 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	6.28 mg/m <sup>3</sup>
Total expanded uncertainty	U = u <sub>c</sub> * k = u <sub>c</sub> * 1.96	12.31 mg/m <sup>3</sup>

#### Relative total expanded uncertainty

##### Requirement of 2010/75/EU

Requirement of EN 15267-3

<b>U in % of the ELV 85 mg/m<sup>3</sup></b>	<b>14.5</b>
<b>U in % of the ELV 85 mg/m<sup>3</sup></b>	<b>20.0</b>
U in % of the ELV 85 mg/m <sup>3</sup>	15.0

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

#### Measuring system

Manufacturer	Kontram Oy
AMS designation	CEMS_T60i
Serial number of units under test	CEMS 1 / CEMS 2
Measuring principle	IR-Spectroscopy

#### Test report

Test laboratory	936/21218430/A TÜV Rheinland
Date of report	2013-10-08

#### Measured component

Certification range	SO <sub>2</sub> 0 - 486 mg/m <sup>3</sup>
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#### Evaluation of the cross-sensitivity (CS)

(system with largest CS)

Sum of positive CS at zero point	4.03 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at span point	0.00 mg/m <sup>3</sup>
Sum of negative CS at span point	-11.25 mg/m <sup>3</sup>
Maximum sum of cross-sensitivities	-11.25 mg/m <sup>3</sup>
Uncertainty of cross-sensitivity	-6.498 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Tested parameter

			u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub>	3.173 mg/m <sup>3</sup>	10.068 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub>	-2.296 mg/m <sup>3</sup>	5.272 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub>	-0.982 mg/m <sup>3</sup>	0.964 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub>	8.418 mg/m <sup>3</sup>	70.863 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub>	1.353 mg/m <sup>3</sup>	1.831 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub>	1.305 mg/m <sup>3</sup>	1.703 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross-sensitivity (interference)	u <sub>i</sub>	-6.498 mg/m <sup>3</sup>	42.224 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub>	-1.052 mg/m <sup>3</sup>	1.107 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub>	3.928 mg/m <sup>3</sup>	15.431 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The larger value is used :

"Repeatability standard deviation at span" or

"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u<sub>c</sub>)

$$u_c = \sqrt{\sum (u_{max,j})^2} \quad 12.23 \text{ mg/m}^3$$

Total expanded uncertainty

$$U = u_c * k = u_c * 1.96 \quad 23.96 \text{ mg/m}^3$$

#### Relative total expanded uncertainty

##### Requirement of 2010/75/EU

Requirement of EN 15267-3

**U in % of the ELV 160 mg/m<sup>3</sup> 15.0**

**U in % of the ELV 160 mg/m<sup>3</sup> 20.0**

U in % of the ELV 160 mg/m<sup>3</sup> 15.0