Umwelt Bundesamt

TÜVRheinland®
Precisely Right.

CERTIFICATE

of Product Conformity (QAL1)

Certificate No.: 0000040210_02

Certified AMS:	Smart CEMS for CO, NO, NO_2, NOx, SO_2, CO_2 and O_2
Manufacturer:	Kontram Oy Tuupakantie 32 a 01740 Vantaa Finland
Test Institute:	TÜV Rheinland Energy 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 and EN 14181: 2004

Certification is awarded in respect of the conditions stated in this certificate (see also the following pages).
The present certificate replaces Certificate No. 0000040210_01 of 9 September 2014

TÜVRheinland® CERTIFIED

Suitability Tested
EN 15267
QAL1 Certified
Regular
Surveillance

www.tuv.com
ID 0000040210

Publication in the German Federal Gazette (BAnz.) of 5 August 2014

This certificate will expire on:
30 June 2020

German Federal Environment Agency
Dessau, 1 April 2019

TÜV Rheinland Energy GmbH
Cologne, 30 March 2019

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TÜV Rheinland Energie und Umwelt GmbH
Am Grauen Stein
51105 Cologne

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

10/221 2.08

Test report:	936/21218430/B of 2 April 2014
Initial certification:	1 April 2014
Expiry date:	30 June 2020
Publication:	BAnz AT 05.08.2014 B11, chapter I, no. 5.1

Approved application
The tested AMS is suitable for use at combustion plants according to Directive 2010/75/EU, chapter III.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 five-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/B of 2 April 2014 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 05.08.2014 B11, chapter I, no. 5.1 UBA announcement of 17 July 2014

AMS designation:
CEMS for CO, NO, NO_2, NOx, SO_2, CO_2 and O_2

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/m³
	NO	0 - 121	0 - 2680	mg/m³
	NO_2	0 - 185	0 - 1025	mg/m³
	NOx*	0 - 185	0 - 4097	mg/m³
	SO_2	0 - 486	0 - 5720	mg/m³
	CO_2	0 - 25	-	Vol.-%
	O_2	0 - 25	-	Vol.-%
CEMS S4900	CO	0 - 125	0 - 625	mg/m³
CEMS S4900	NO	0 - 121	0 - 1340	mg/m³
CEMS S4900	O_2	0 - 25	-	Vol.-%
CEMS S4900	SO_2	0 - 486	0 - 2860	mg/m³

*NOx = NO as NO_2 + NO_2

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 component CO as opposed to HCl at concentrations > 50 mg/m³.

Notes:

1. 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.
2. The functionality of a particular assembly of modules shall be checked in the context of verifying proper installation.
3. The measuring system Kontram CEMS is a modular system in which two analysers can be integrated.

CEMS a	T60i	CEMS c	S4900
CEMS b	T60i + S4900	CEMS d	S4900 + S4900

4. A type S4900 analyser can accommodate measuring cells for up to 3 different components.
5. The T60i analyser measures both NO and NO_2 and can also output NO_x as a calculated total.
6. Supplementary testing (extension to include the component O_2 for T60i and S4900 as well as an extension to include to a second type of gas sampling probe) as regards Federal Environmental Agency notices of 27 February 2014 (Federal Gazette (BAnz AT 01.04.2014 B12, chapter I, no. 4.1).

Test report:
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Report no.: 936/21218430/B of 2 April 2014

24 Notification as regards Federal Environment Agency (UBA) notices of 17 July 2014 (BAnz AT 05.08.2014 B11, Chapter I No. 5.1)

The CEMS measuring system for CO, NO, NO_2, NO_x, SO_2, CO_2 and O_2 manufactured by Kontram Oy was technically revised. For the new version, a steel door with an integrated control display has replaced the original transparent front door. This display serves as the central control unit for the temperature of gas conditioning and applying test gases.

A type 18112 pressure control manufactured by Fairchild has replaced the type 16232 by the same manufacturer which had previously been used. The ejector pump for the purge air of the permeation dryer was relocated to the SCU unit. If the CEMS T60i measurement unit is in-built, an external humidity sensor is not required. In that case the internal humidity sensor of the CEMS T60i module is used to protect the system from drops of water.

The new version of the measuring equipment has been renamed „Smart CEMS instead of CEMS.

The new software version of the analyser module CEMS T60i is: 02.02.08.

Statement issued by TÜV Rheinland Energie und Umwelt GmbH on 23 October 2015

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 with gas filter element (SiC 2 µm) or
  - Bühler TYP GAS 222.20 with gas filter element (ceramic 3 µm)

- 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 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).
For oxygen a paramagnetic oxygen measuring cell is used.

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.
For oxygen a paramagnetic oxygen measuring cell is used.

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**.

Document history
Certification of CEMS for CO, NO, NO_2, NOx, SO_2, CO_2 and O_2 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 01.04.2014 B12, chapter I, no. 4.1
UBA announcement of 27 February 2014

Supplementary testing according to EN 15267

Certificate no. 0000040210_01: 9 September 2014
Expiry date of the certificate: 31 March 2019

Test report: 936/21218430/B of 2 April 2014
TÜV Rheinland Energie und Umwelt GmbH, Cologne
Publication: BAnz AT 05.08.2014 B11, chapter I, no. 5.1
UBA announcement of 17 July 2014

Notifications

Statement issued by TÜV Rheinland Energie und Umwelt GmbH on 23 October 2015
Publication: BAnz AT 14.03.2016 B7, Chapter V Number 24
UBA announcement of18 February 2016
(changes to the hardware and software, new instrument name)

Renewal of the certificate

Certificate no. 0000040210_02: 1 April 2019
Validity of the certificate: 30 June 2020

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	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	CO		
Certification range	0 - 125	mg/m³	

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	1.10	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at span point	1.60	mg/m³
Sum of negative CS at span point	-2.70	mg/m³
Maximum sum of cross-sensitivities	-2.70	mg/m³
Uncertainty of cross-sensitivity	-1.559	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u²	
Standard deviation from paired measurements under field conditions *	u_D	0.613	mg/m³	0.376	(mg/m³)²
Lack of fit	u_{lof}	0.577	mg/m³	0.333	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.869	mg/m³	0.755	(mg/m³)²
Span drift from field test	$u_{d,s}$	2.983	mg/m³	8.898	(mg/m³)²
Influence of ambient temperature at span	u_t	1.274	mg/m³	1.623	(mg/m³)²
Influence of supply voltage	u_v	0.611	mg/m³	0.373	(mg/m³)²
Cross-sensitivity (interference)	u_i	-1.559	mg/m³	2.430	(mg/m³)²
Influence of sample gas flow	u_p	-0.150	mg/m³	0.023	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.010	mg/m³	1.021	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	3.98	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	7.80	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 110 mg/m³**	**7.1**
Requirement of 2010/75/EU	**U in % of the ELV 110 mg/m³**	**10.0**
Requirement of EN 15267-3	U in % of the ELV 110 mg/m³	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	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	NO		
Certification range	0 - 121	mg/m³	

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.00	mg/m³
Sum of negative CS at zero point	-1.45	mg/m³
Sum of postive CS at span point	0.80	mg/m³
Sum of negative CS at span point	-3.00	mg/m³
Maximum sum of cross-sensitivities	-3.00	mg/m³
Uncertainty of cross-sensitivity	-1.732	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u²	
Standard deviation from paired measurements under field conditions *	u_D	1.867	mg/m³	3.486	(mg/m³)²
Lack of fit	u_{lof}	-0.629	mg/m³	0.396	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-1.707	mg/m³	2.914	(mg/m³)²
Span drift from field test	$u_{d,s}$	-2.096	mg/m³	4.393	(mg/m³)²
Influence of ambient temperature at span	u_t	2.095	mg/m³	4.389	(mg/m³)²
Influence of supply voltage	u_v	0.407	mg/m³	0.166	(mg/m³)²
Cross-sensitivity (interference)	u_i	-1.732	mg/m³	3.000	(mg/m³)²
Influence of sample gas flow	u_p	-0.332	mg/m³	0.110	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.978	mg/m³	0.957	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	4.45	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	8.72	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 60 mg/m³**	**14.5**
Requirement of 2010/75/EU	**U in % of the ELV 60 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 60 mg/m³	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	Paramagnetic		
Test report	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	O_2		
Certification range	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 postive CS at span point	0.00	Vol.-%
Sum of negative CS at span point	-0.37	Vol.-%
Maximum sum of cross-sensitivities	-0.37	Vol.-%
Uncertainty of cross-sensitivity	-0.214	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.100	Vol.-%	0.010	(Vol.-%)²
Lack of fit	u_{lof}	0.058	Vol.-%	0.003	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	-0.081	Vol.-%	0.007	(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	0.118	Vol.-%	0.014	(Vol.-%)²
Influence of supply voltage	u_v	0.017	Vol.-%	0.000	(Vol.-%)²
Cross-sensitivity (interference)	u_i	-0.214	Vol.-%	0.046	(Vol.-%)²
Influence of sample gas flow	u_p	-0.057	Vol.-%	0.003	(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 span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.37	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.72	Vol.-%

Relative total expanded uncertainty	**U in % of the range 25 Vol.-%**	**2.9**
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

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
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_S4900		
Serial number of units under test	CEMS 1 / CEMS 2		
Measuring principle	IR-Spectroscopy		
Test report	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	SO_2		
Certification range	0 - 486	mg/m³	

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	2.29	mg/m³
Sum of negative CS at zero point	-2.99	mg/m³
Sum of postive CS at span point	12.50	mg/m³
Sum of negative CS at span point	-19.37	mg/m³
Maximum sum of cross-sensitivities	-19.37	mg/m³
Uncertainty of cross-sensitivity	-11.185	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	4.490	mg/m³	20.160	(mg/m³)²
Lack of fit	u_{lof}	2.296	mg/m³	5.272	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-4.186	mg/m³	17.523	(mg/m³)²
Span drift from field test	$u_{d,s}$	8.418	mg/m³	70.863	(mg/m³)²
Influence of ambient temperature at span	u_t	2.784	mg/m³	7.751	(mg/m³)²
Influence of supply voltage	u_v	2.750	mg/m³	7.563	(mg/m³)²
Cross-sensitivity (interference)	u_i	-11.185	mg/m³	125.104	(mg/m³)²
Influence of sample gas flow	u_p	-1.169	mg/m³	1.367	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	3.928	mg/m³	15.431	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	16.46	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	32.27	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 250 mg/m³**	**12.9**
Requirement of 2010/75/EU	**U in % of the ELV 250 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 250 mg/m³	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	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	CO		
Certification range	0 - 250	mg/m³	
Evaluation of the cross-sensitivity (CS)			
(system with largest CS)			
Sum of positive CS at zero point	1.20	mg/m³	
Sum of negative CS at zero point	0.00	mg/m³	
Sum of postive CS at span point	9.60	mg/m³	
Sum of negative CS at span point	-8.30	mg/m³	
Maximum sum of cross-sensitivities	9.60	mg/m³	
Uncertainty of cross-sensitivity	5.543	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	1.006	mg/m³	1.012	(mg/m³)²
Lack of fit	u_{lof}	1.155	mg/m³	1.334	(mg/m³)²
Zero drift from field test	$u_{d,z}$	0.239	mg/m³	0.057	(mg/m³)²
Span drift from field test	$u_{d,s}$	1.465	mg/m³	2.146	(mg/m³)²
Influence of ambient temperature at span	u_t	1.553	mg/m³	2.412	(mg/m³)²
Influence of supply voltage	u_v	1.189	mg/m³	1.414	(mg/m³)²
Cross-sensitivity (interference)	u_i	5.543	mg/m³	30.725	(mg/m³)²
Influence of sample gas flow	u_p	-1.293	mg/m³	1.672	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	2.021	mg/m³	4.083	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	6.70	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	13.13	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 175 mg/m³**	**7.5**
Requirement of 2010/75/EU	**U in % of the ELV 175 mg/m³**	**10.0**
Requirement of EN 15267-3	U in % of the ELV 175 mg/m³	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	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	CO_2		
Certification range	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 postive 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^2	
Standard deviation from paired measurements under field conditions *	u_D	0.182	Vol.-%	0.033	(Vol.-%)²
Lack of fit	u_{lof}	0.058	Vol.-%	0.003	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	-0.075	Vol.-%	0.006	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.294	Vol.-%	0.086	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.208	Vol.-%	0.043	(Vol.-%)²
Influence of supply voltage	u_v	0.051	Vol.-%	0.003	(Vol.-%)²
Cross-sensitivity (interference)	u_i	-0.462	Vol.-%	0.213	(Vol.-%)²
Influence of sample gas flow	u_p	0.078	Vol.-%	0.006	(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 span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.66	Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	1.29	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

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
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	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	NO		
Certification range	0 - 121	mg/m³	

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	0.64	mg/m³
Sum of negative CS at zero point	-2.11	mg/m³
Sum of postive CS at span point	2.90	mg/m³
Sum of negative CS at span point	-1.50	mg/m³
Maximum sum of cross-sensitivities	2.90	mg/m³
Uncertainty of cross-sensitivity	1.677	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	1.662	mg/m³	2.762	(mg/m³)²
Lack of fit	u_{lof}	-0.692	mg/m³	0.479	(mg/m³)²
Zero drift from field test	$u_{d,z}$	1.648	mg/m³	2.716	(mg/m³)²
Span drift from field test	$u_{d,s}$	2.096	mg/m³	4.393	(mg/m³)²
Influence of ambient temperature at span	u_t	1.234	mg/m³	1.523	(mg/m³)²
Influence of supply voltage	u_v	0.404	mg/m³	0.163	(mg/m³)²
Cross-sensitivity (interference)	u_i	1.677	mg/m³	2.812	(mg/m³)²
Influence of sample gas flow	u_p	0.568	mg/m³	0.323	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.978	mg/m³	0.957	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	4.02	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	7.87	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 55 mg/m³**	**14.3**
Requirement of 2010/75/EU	**U in % of the ELV 55 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 55 mg/m³	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			936/21218430/B		
Test laboratory			TÜV Rheinland		
Date of report			2014-04-02		
Measured component			NO_2		
Certification range			0 - 185	mg/m³	
Evaluation of the cross-sensitivity (CS)					
(system with largest CS)					
Sum of positive CS at zero point			2.06	mg/m³	
Sum of negative CS at zero point			0.00	mg/m³	
Sum of postive CS at span point			3.02	mg/m³	
Sum of negative CS at span point			-6.11	mg/m³	
Maximum sum of cross-sensitivities			-6.11	mg/m³	
Uncertainty of cross-sensitivity			-3.527	mg/m³	

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Repeatability standard deviation at set point *	u_r	0.766	mg/m³	0.587	(mg/m³)²
Lack of fit	u_{lof}	-1.186	mg/m³	1.407	(mg/m³)²
Zero drift from field test	$u_{d,z}$	2.601	mg/m³	6.765	(mg/m³)²
Span drift from field test	$u_{d,s}$	3.031	mg/m³	9.187	(mg/m³)²
Influence of ambient temperature at span	u_t	1.682	mg/m³	2.829	(mg/m³)²
Influence of supply voltage	u_v	0.981	mg/m³	0.962	(mg/m³)²
Cross-sensitivity (interference)	u_i	-3.527	mg/m³	12.440	(mg/m³)²
Influence of sample gas flow	u_p	1.743	mg/m³	3.038	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	1.495	mg/m³	2.236	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	6.28	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	12.31	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 85 mg/m³**	**14.5**
Requirement of 2010/75/EU	**U in % of the ELV 85 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 85 mg/m³	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		Paramagnetic	
Test report		936/21218430/B	
Test laboratory		TÜV Rheinland	
Date of report		2014-04-02	
Measured component		O_2	
Certification range		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 postive CS at span point		0.00	Vol.-%
Sum of negative CS at span point		-0.33	Vol.-%
Maximum sum of cross-sensitivities		-0.33	Vol.-%
Uncertainty of cross-sensitivity		-0.191	Vol.-%

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	0.101	Vol.-%	0.010	(Vol.-%)²
Lack of fit	u_{lof}	0.052	Vol.-%	0.003	(Vol.-%)²
Zero drift from field test	$u_{d,z}$	-0.087	Vol.-%	0.008	(Vol.-%)²
Span drift from field test	$u_{d,s}$	0.115	Vol.-%	0.013	(Vol.-%)²
Influence of ambient temperature at span	u_t	0.076	Vol.-%	0.006	(Vol.-%)²
Influence of supply voltage	u_v	0.021	Vol.-%	0.000	(Vol.-%)²
Cross-sensitivity (interference)	u_i	-0.191	Vol.-%	0.036	(Vol.-%)²
Influence of sample gas flow	u_p	0.021	Vol.-%	0.000	(Vol.-%)²
Uncertainty of reference material at 70% of certification range	u_{rm}	0.202	Vol.-%	0.041	(Vol.-%)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

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

Relative total expanded uncertainty	**U in % of the range 25 Vol.-%**	**2.7**
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

** The EU-directive 2010/75/EU on industrial emissions provides no requirements for this component.
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	936/21218430/B		
Test laboratory	TÜV Rheinland		
Date of report	2014-04-02		
Measured component	SO_2		
Certification range	0 - 486	mg/m³	

Evaluation of the cross-sensitivity (CS)
(system with largest CS)

Sum of positive CS at zero point	4.03	mg/m³
Sum of negative CS at zero point	0.00	mg/m³
Sum of postive CS at span point	0.00	mg/m³
Sum of negative CS at span point	-11.25	mg/m³
Maximum sum of cross-sensitivities	-11.25	mg/m³
Uncertainty of cross-sensitivity	-6.498	mg/m³

Calculation of the combined standard uncertainty

Tested parameter				u^2	
Standard deviation from paired measurements under field conditions *	u_D	3.173	mg/m³	10.068	(mg/m³)²
Lack of fit	u_{lof}	-2.296	mg/m³	5.272	(mg/m³)²
Zero drift from field test	$u_{d,z}$	-0.982	mg/m³	0.964	(mg/m³)²
Span drift from field test	$u_{d,s}$	8.418	mg/m³	70.863	(mg/m³)²
Influence of ambient temperature at span	u_t	1.353	mg/m³	1.831	(mg/m³)²
Influence of supply voltage	u_v	1.305	mg/m³	1.703	(mg/m³)²
Cross-sensitivity (interference)	u_i	-6.498	mg/m³	42.224	(mg/m³)²
Influence of sample gas flow	u_p	-1.052	mg/m³	1.107	(mg/m³)²
Uncertainty of reference material at 70% of certification range	u_{rm}	3.928	mg/m³	15.431	(mg/m³)²

* The larger value is used :
"Repeatability standard deviation at span" or
"Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u_C)	$u_c = \sqrt{\sum (u_{max,j})^2}$	12.23	mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	23.96	mg/m³

Relative total expanded uncertainty	**U in % of the ELV 160 mg/m³**	**15.0**
Requirement of 2010/75/EU	**U in % of the ELV 160 mg/m³**	**20.0**
Requirement of EN 15267-3	U in % of the ELV 160 mg/m³	15.0