

# CERTIFICATE

## of Product Conformity (QAL1)

Certificate No: 0000025931\_03

**Certified AMS:** ZRE and ZRE/ZFK 7 for CO, NO, SO<sub>2</sub> and O<sub>2</sub>

**Manufacturer:** Fuji Electric Co., Ltd.  
No. 1, Fuji-machi,  
Hino-city, Tokyo 191-8502,  
Japan

**Test Institute:** TÜV Rheinland Energy & Environment 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 (2023), EN 15267-3 (2007)  
as well as EN 14181 (2004).**

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

The present certificate replaces certificate 0000025931\_02 dated 12 February 2020.



Suitability Tested  
EN 15267  
QAL1 Certified  
Regular  
Surveillance


www.tuv.com  
ID 0000025931

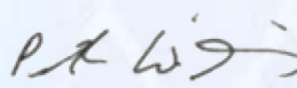
Publication in the German Federal Gazette  
(BAnz) of 12 February 2010

This certificate will expire on:  
11 February 2030

German Environment Agency  
Dessau, 10 February 2025

TÜV Rheinland Energy & Environment GmbH  
Cologne, 9 February 2025

  
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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.

<b>Test report:</b>	936/21210059/A dated 21 October 2009
<b>Initial certification:</b>	12 February 2010
<b>Expiry date:</b>	11 February 2030
<b>Certificate:</b>	Renewal (of previous certificate 0000025931_02 of 12 February 2020 valid until 11 February 2025)
<b>Publication:</b>	BAnz. 12 February 2010, No. 24, p. 553, chapter I No. 1.1

### Approved application

The tested AMS is suitable for use at plants according to Directive 2010/75/EC, chapter III (combustion plants / 13th BImSchV:2009), Directive 2015/2193/EC (44th BImSchV:2022), and TA Luft:2002 as long as the daily mean values for carbon monoxide, sulphur dioxide and nitrogen oxide that shall be monitored do not fall below 120 / 230 / 125 mg/m<sup>3</sup>. The instrument cannot be used at plants where N<sub>2</sub>O concentrations higher than 30 mg/m<sup>3</sup> are to be expected.

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 waste incineration.

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 emission limit values and oxygen concentration 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.

### Note

The legal regulations mentioned correspond to the current state of legislation during certification. Each user should, if necessary, in consultation with the competent authority, ensure that this AMS meets the legal requirements for the intended use. In addition, it cannot be ruled out that legal regulations governing the use of a measuring device for emission monitoring may change during the lifetime of the certificate.

### Basis of the certification

This certification is based on:

- Test report 936/21210059/A dated 21 October 2009 of TÜV Rheinland Immissionsschutz und Energiesysteme 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. 12 February 2010, No. 24, p. 553, chapter I No. 1.1, Announcement by UBA dated 25 January 2010:

**AMS designation:**

ZRE and ZRE/ZFK7 for NO, SO<sub>2</sub>, CO and O<sub>2</sub>

**Manufacturer:** Fuji Electric Systems Co., Ltd., Tokyo, Japan

**Field of application:** For plants according to 13. BImSchV and TA Luft

**Measuring ranges during the performance test:**

Component	Certification-range	Supplementary range	Unit
CO	0 - 125	0 - 1.250	mg/m <sup>3</sup>
NO	0 - 268	0 - 2.680	mg/m <sup>3</sup>
SO <sub>2</sub>	0 - 571	0 - 5.710	mg/m <sup>3</sup>
O <sub>2</sub> (Pa.)*	0 - 25	0 - 10	Vol.-%
O <sub>2</sub> (Zi.)**	0 - 25	0 - 10	Vol.-%

\* Pa. = paramagnetic \*\* Zi. = zirconium oxide

**Software version:**

1.02

**Restrictions:**

1. The requirements with regard to measurement uncertainty in accordance with EN 15267-3 are fulfilled for a daily average limit value of 120 mg/m<sup>3</sup> for CO.
2. The requirements with regard to measurement uncertainty in accordance with EN 15267-3 are fulfilled for a daily average limit value of 230 mg/m<sup>3</sup> for SO<sub>2</sub>.
3. The requirements with regard to measurement uncertainty in accordance with EN 15267-3 are fulfilled for a daily average limit value of 125 mg/m<sup>3</sup> for NO.
4. The measuring system is not suitable for plants where N<sub>2</sub>O concentrations in the stack gas exceed 30 mg/m<sup>3</sup>.

**Notes:**

1. Either the paramagnetic or the zirconia oxygen sensor may be used for measuring O<sub>2</sub>:  
Version ZRE: NO, SO<sub>2</sub>, CO and O<sub>2</sub> (Pa),  
Version ZRE/ZFK7: NO, SO<sub>2</sub>, CO and O<sub>2</sub> (Zi)
2. The maintenance interval is four weeks.
3. An automatic zero point calibration must be carried out at least once every 24 h.
4. Test gases shall be fed via the dynamic injector at least once every three months (control of the gas line and gas processing).
5. An AMS of identical design is also distributed by the company ETA, Rue Einstein, BP60129, 62220 Carvin, France.

**Test Institute:**

TÜV Rheinland Immissionsschutz und Energiesysteme GmbH, Cologne

Report No.: 936/21210059/A dated 21 October 2009

Publication in the German Federal Gazette: BAnz. 29 July 2011, no. 113, p. 2725, chapter III notification 9, Announcement by UBA dated 15 July 2011:

**9 Notification as regards Federal Environment Agency notices of 25 January 2010 (BAnz. p. 552, chapter I, No. 1.1)**

The current software version of the measuring system ZRE und ZRE/ZFK7 manufactured by Fuji Electric Systems Co., Ltd. is:

1.03

Statement of TÜV Rheinland Energie und Umwelt GmbH of 24 March 2011

Publication in the German Federal Gazette: BAnz. 02 March 2012, no. 36, p. 920, chapter V notification 7, Announcement by UBA dated 23 February 2012:

**7 Notification as regards Federal Environment Agency notices of 25 January 2010 (BAnz. p. 552, chapter I, No. 1.1) and of 15 July 2011 (BAnz. p. 2725, chapter III, notification 9)**

The company Fuji Electric Systems Co., Ltd., manufacturer of the ZRE and ZRE/ZFK7 measuring system for NO, SO<sub>2</sub>, CO and O<sub>2</sub>, was renamed.

The new company name is:  
Fuji Electric Co., Ltd.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 26 September 2011

Publication in the German Federal Gazette: BAnz AT 05.08.2014 B11, Chap. V notification 7, Announcement by UBA dated 17 July 2014:

**7 Notification as regards Federal Environmental Agency notices of 25 January 2010 (Federal Gazette (BAnz.) p. 552, chapter I, No. 1.1) and of 23 February 2012 (Federal Gazette (BAnz.) p. 920, chapter V, notification 7)**

The ZRE and ZRE/ZFK7 measuring systems for monitoring CO, NO, SO<sub>2</sub> and O<sub>2</sub> manufactured by Fuji Electric Co., Ltd. will hereafter be distributed with the P1.1E pump manufactured by Bühler Technologies GmbH.

Statement of TÜV Rheinland Energie und Umwelt GmbH of 12 March 2014



Publication in the German Federal Gazette: BAnz AT 22.07.2019 B8, Chap. V notification 5, Announcement by UBA dated 28 June 2019:

**5 Notification as regards Federal Environment Agency (UBA) notices of 25 January 2010 (BAnz. p. 552, chapter I number 1.1 and of 7 July 2014 (BAnz AT 05.08.2014 B11, chapter V notification 7)**

A new display has been introduced to the multi-component ZRE/ZFK7 measuring system manufactured by Fuji Electric. The software of the AMS has been changed accordingly.

The latest software version of the ZRE/ZFK7 measuring system is

3.00.

In addition, software version 2.00 is also up-to-date.

Statement issued by TÜV Rheinland Energy GmbH dated 6 March 2019

### **Certified product**

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

The AMS is a non-dispersive infrared gas analyser (NDIR analyser) based on the single-beam principle for the determination of CO, SO<sub>2</sub> and NO. A paramagnetic sensor or, alternatively, a zirconia cell (ZFK7) may be installed for the determination of O<sub>2</sub>.

The ZRE option consists of a NDIR analyser and a paramagnetic O<sub>2</sub> analyser. The sample gas is divided into three partial flows: one flow passes through the converters and the optical bench for NO detection, another partial flow passes the optical bench for CO and SO<sub>2</sub> detection, and the third partial flow passes through the paramagnetic sensor.

The ZRE/ZFK7 option consists of the NDIR analyser and a zirconium sensor for detecting O<sub>2</sub>. Here, the measuring gas is divided into two partial gas flows: one flow passes through the converters and the optical bench for NO detection and the other one passes through the optical bench for CO and SO<sub>2</sub> detection, followed by the zirconium oxygen sensor.

The ZFK7 analyser is connected to the ZRE analyser in a way that allows operation, parameterisation and output of all measured values via the ZRE analyser.

The systems are equipped with a probe manufactured by TECNOVA HT PERO-MI (type AGP04), a cooler manufactured by M&C, type ECM-2 G/SR 25.2, ZDL021 converters manufactured by Fuji Electric Systems Co., Ltd., Japan, and, as an option if the measuring gas contains NH<sub>3</sub>, with a scrubber of the AS-series manufactured by Permapure. The cabinet is equipped with a cooling unit.

### 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 & Environment 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 & Environment 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 & Environment 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](http://qal1.de).



### **History of documents**

Certification of ZRE und ZRE/ZFK 7 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. 0000025931\_00: 10 March 2010  
Expiry date of the certificate: 11 February 2015  
Test report: 936/21210059/A dated 21 October 2009  
TÜV Rheinland Immissionsschutz und Energiesysteme GmbH  
Publication: BAnz. 12 February 2010, No. 24, p. 553, chapter I number 1.1  
UBA announcement dated 25 January 2010

#### **Notifications**

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 24 March 2011  
Publication: BAnz. 29 July 2011, No. 113, p. 2725, chapter III notification 9  
UBA announcement dated 15 July 2011  
(Software changes)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 26 September 2011  
Publication: BAnz. 02 March 2012, No. 36, p. 920, chapter V notification 7  
UBA announcement dated 23 February 2012  
(New manufacturer name)

Statement issued by TÜV Rheinland Energie und Umwelt GmbH dated 12 March 2014  
Publication: BAnz AT 05.08.2014 B11, chapter V notification 7  
UBA announcement dated 17 July 2014  
(Hardware changes)

#### **Renewal of certificates**

Certificate No. 0000025931\_01: 2 February 2015  
Expiry date of the certificate: 11 February 2020

#### **Notifications**

Statement issued by TÜV Rheinland Energy GmbH dated 6 March 2019  
Publication: BAnz AT 22.07.2019 B8, chapter V notification 5  
UBA announcement dated 28 June 2019  
(Soft- and hardware changes)

#### **Renewal of certificates**

Certificate No. 0000025931\_02: 12 February 2020  
Expiry date of the certificate: 11 February 2025

#### **Renewal of certificates**

Certificate No. 0000025931\_03: 12 February 2025  
Expiry date of the certificate: 11 February 2030

### Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

#### Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd
Name of measuring system	ZRE
Serial Number	100AC01 / 100AC02
Measuring Principle	NDIR

#### TÜV Data

Approval Report	936/21210059/A / 2009-10-21
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Editor	Steinhagen
Date	2009-10-19

#### Measurement Component

Certificated range	SO <sub>2</sub> 571 mg/m <sup>3</sup>
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#### Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	3.60 mg/m <sup>3</sup>
Sum of negative CS at zero point	0.00 mg/m <sup>3</sup>
Sum of positive CS at reference point	19.87 mg/m <sup>3</sup>
Sum of negative CS at reference point	-2.97 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	19.87 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	11.47 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Test Value

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 2.108 mg/m <sup>3</sup>	4.444 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	u <sub>lof</sub> 0.635 mg/m <sup>3</sup>	0.403 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	u <sub>d,z</sub> -2.670 mg/m <sup>3</sup>	7.129 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	u <sub>d,s</sub> -7.810 mg/m <sup>3</sup>	60.996 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	u <sub>t</sub> 8.307 mg/m <sup>3</sup>	69.006 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	u <sub>v</sub> 0.500 mg/m <sup>3</sup>	0.250 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	u <sub>i</sub> 11.472 mg/m <sup>3</sup>	131.616 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	u <sub>p</sub> -1.717 mg/m <sup>3</sup>	2.948 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub> 4.615 mg/m <sup>3</sup>	21.301 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max,j})^2}$	17.27 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	33.84 mg/m <sup>3</sup>

#### Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC	U in % of the ELV 230 mg/m <sup>3</sup>	14.7
Requirement of EN 15267-3	U in % of the ELV 230 mg/m <sup>3</sup>	20.0
	U in % of the ELV 230 mg/m <sup>3</sup>	15.0



**Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3**

**Manufacturer data**

Manufacturer	Fuji Electric Systems Co., Ltd
Name of measuring system	ZRE
Serial Number	100AC01 / 100AC02
Measuring Principle	NDIR

**TÜV Data**

Approval Report	936/21210059/A / 2009-10-21
Editor	Steinhagen
Date	2009-10-19

**Measurement Component**

Certificated range	CO	125 mg/m³
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**Evaluation of the cross sensitivity (CS)**

Sum of positive CS at zero point	2.15 mg/m³
Sum of negative CS at zero point	0.00 mg/m³
Sum of positive CS at reference point	3.86 mg/m³
Sum of negative CS at reference point	-0.63 mg/m³
Maximum sum of cross sensitivities	3.86 mg/m³
Uncertainty of cross sensitivity	2.23 mg/m³

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u²
Standard deviation from paired measurements under field conditions *	u <sub>D</sub> 1.604 mg/m³	2.573 (mg/m³)²
Lack of fit	u <sub>lof</sub> 0.289 mg/m³	0.084 (mg/m³)²
Zero drift from field test	u <sub>d,z</sub> -0.274 mg/m³	0.075 (mg/m³)²
Span drift from field test	u <sub>d,s</sub> -1.667 mg/m³	2.779 (mg/m³)²
Influence of ambient temperature at span	u <sub>t</sub> 2.498 mg/m³	6.240 (mg/m³)²
Influence of supply voltage	u <sub>v</sub> 0.346 mg/m³	0.120 (mg/m³)²
Cross sensitivity (interference)	u <sub>i</sub> 2.230 mg/m³	4.973 (mg/m³)²
Influence of sample gas flow	u <sub>p</sub> -0.361 mg/m³	0.130 (mg/m³)²
Uncertainty of reference material at 70% of certification range	u <sub>rm</sub> 1.010 mg/m³	1.021 (mg/m³)²

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty (u <sub>c</sub> )	$u_c = \sqrt{\sum (u_{max j})^2}$	4.24 mg/m³
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	8.31 mg/m³

**Relative total expanded uncertainty**

Requirement of 2000/76/EC and 2001/80/EC	<b>U in % of the ELV 120 mg/m³</b>	<b>6.9</b>
Requirement of EN 15267-3	<b>U in % of the ELV 120 mg/m³</b>	<b>10.0</b>
	<b>U in % of the ELV 120 mg/m³</b>	<b>7.5</b>

### Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3

#### Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd
Name of measuring system	ZRE
Serial Number	100AC01 / 100AC02
Measuring Principle	NDIR

#### TÜV Data

Approval Report	936/21210059/A / 2009-10-21
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Editor	Steinhagen
Date	2009-10-19

#### Measurement Component

Certificated range	NO	268 mg/m <sup>3</sup>
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#### Evaluation of the cross sensitivity (CS)

Sum of positive CS at zero point	3.59 mg/m <sup>3</sup>
Sum of negative CS at zero point	-1.96 mg/m <sup>3</sup>
Sum of positive CS at reference point	2.17 mg/m <sup>3</sup>
Sum of negative CS at reference point	-2.06 mg/m <sup>3</sup>
Maximum sum of cross sensitivities	3.59 mg/m <sup>3</sup>
Uncertainty of cross sensitivity	2.07 mg/m <sup>3</sup>

#### Calculation of the combined standard uncertainty

##### Test Value

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions *	$u_D$ 1.324 mg/m <sup>3</sup>	1.753 (mg/m <sup>3</sup> ) <sup>2</sup>
Lack of fit	$u_{lof}$ -0.242 mg/m <sup>3</sup>	0.059 (mg/m <sup>3</sup> ) <sup>2</sup>
Zero drift from field test	$u_{d,z}$ 1.070 mg/m <sup>3</sup>	1.145 (mg/m <sup>3</sup> ) <sup>2</sup>
Span drift from field test	$u_{d,s}$ 4.350 mg/m <sup>3</sup>	18.923 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of ambient temperature at span	$u_t$ 5.689 mg/m <sup>3</sup>	32.365 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of supply voltage	$u_v$ 0.462 mg/m <sup>3</sup>	0.213 (mg/m <sup>3</sup> ) <sup>2</sup>
Cross sensitivity (interference)	$u_i$ 2.073 mg/m <sup>3</sup>	4.299 (mg/m <sup>3</sup> ) <sup>2</sup>
Influence of sample gas flow	$u_p$ 0.097 mg/m <sup>3</sup>	0.009 (mg/m <sup>3</sup> ) <sup>2</sup>
Uncertainty of reference material at 70% of certification range	$u_m$ 2.166 mg/m <sup>3</sup>	4.693 (mg/m <sup>3</sup> ) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty ( $u_c$ )	$u_c = \sqrt{\sum (u_{max,j})^2}$	7.97 mg/m <sup>3</sup>
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	15.61 mg/m <sup>3</sup>

#### Relative total expanded uncertainty

Requirement of 2000/76/EC and 2001/80/EC	U in % of the ELV 125 mg/m <sup>3</sup>	12.5
Requirement of EN 15267-3	U in % of the ELV 125 mg/m <sup>3</sup>	20.0
	U in % of the ELV 125 mg/m <sup>3</sup>	15.0



**Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3**

**Manufacturer data**

Manufacturer	Fuji Electric Systems Co., Ltd
Name of measuring system	ZRE
Serial Number	100AC01 / 100AC02
Measuring Principle	Paramagnetism

**TÜV Data**

Approval Report	936/21210059/A / 2009-10-21
Editor	Steinhagen
Date	2009-10-19

**Measurement Component**

Certificated range	O <sub>2</sub>	25 Vol.-%
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**Evaluation of the cross sensitivity (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 reference point	0.14 Vol.-%
Sum of negative CS at reference point	0.00 Vol.-%
Maximum sum of cross sensitivities	0.14 Vol.-%
Uncertainty of cross sensitivity	0.08 Vol.-%

**Calculation of the combined standard uncertainty**

**Test Value**

	<b>u</b>	<b>u<sup>2</sup></b>
Standard deviation from paired measurements under field conditions * $u_D$	0.058 Vol.-%	0.003 (Vol.-%) <sup>2</sup>
Lack of fit $u_{lof}$	0.040 Vol.-%	0.002 (Vol.-%) <sup>2</sup>
Zero drift from field test $u_{d,z}$	-0.064 Vol.-%	0.004 (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 at span $u_t$	0.184 Vol.-%	0.034 (Vol.-%) <sup>2</sup>
Influence of supply voltage $u_v$	0.020 Vol.-%	0.000 (Vol.-%) <sup>2</sup>
Cross sensitivity (interference) $u_i$	0.081 Vol.-%	0.007 (Vol.-%) <sup>2</sup>
Influence of sample gas flow $u_p$	0.075 Vol.-%	0.006 (Vol.-%) <sup>2</sup>
Uncertainty of reference material at 70% of certification range $u_{rm}$	0.202 Vol.-%	0.041 (Vol.-%) <sup>2</sup>

\* The bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

Combined standard uncertainty ( $u_c$ )	$u_c = \sqrt{\sum (u_{max,j})^2}$	0.33 Vol.-%
Total expanded uncertainty	$U = u_c * k = u_c * 1.96$	0.65 Vol.-%

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC</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.-%	10.0 **
		7.5

\*\* For this component no requirements in the EC-directives 2001/80/EC und 2000/76/EC are given. A value of 10 % was used for this.

**Calculation of overall uncertainty for QAL1 in EN 14181 and EN 15267-3**

**Manufacturer data**

Manufacturer	Fuji Electric Systems Co., Ltd
Name of measuring system	ZFK7
Serial Number	100AC01 / 100AC02
Measuring Principle	zirconia

**TÜV Data**

Approval Report	936/21210059/A / 2009-10-21
Editor	Steinhagen
Date	2009-10-19

**Measurement Component**

Certificated range	O <sub>2</sub>	25 Vol.-%
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**Evaluation of the cross sensitivity (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 reference point	0.25 Vol.-%
Sum of negative CS at reference point	0.00 Vol.-%
Maximum sum of cross sensitivities	0.25 Vol.-%
Uncertainty of cross sensitivity	0.14 Vol.-%

**Calculation of the combined standard uncertainty**

**Test Value**

	u	u <sup>2</sup>
Standard deviation from paired measurements under field conditions * u <sub>D</sub>	0.051 Vol.-%	0.003 (Vol.-%) <sup>2</sup>
Lack of fit u <sub>lof</sub>	-0.040 Vol.-%	0.002 (Vol.-%) <sup>2</sup>
Zero drift from field test u <sub>d,z</sub>	-0.052 Vol.-%	0.003 (Vol.-%) <sup>2</sup>
Span drift from field test u <sub>d,s</sub>	0.098 Vol.-%	0.010 (Vol.-%) <sup>2</sup>
Influence of ambient temperature at span u <sub>t</sub>	0.231 Vol.-%	0.053 (Vol.-%) <sup>2</sup>
Influence of supply voltage u <sub>v</sub>	0.023 Vol.-%	0.001 (Vol.-%) <sup>2</sup>
Cross sensitivity (interference) u <sub>i</sub>	0.144 Vol.-%	0.021 (Vol.-%) <sup>2</sup>
Influence of sample gas flow u <sub>p</sub>	0.063 Vol.-%	0.004 (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 bigger value of: "Repeatability standard deviation at span" or "Standard deviation from paired measurements under field conditions"

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

**Relative total expanded uncertainty**

<b>Requirement of 2000/76/EC and 2001/80/EC</b>	<b>U in % of the range 25 Vol.-%</b>	<b>2.9</b>
<b>Requirement of EN 15267-3</b>	<b>U in % of the range 25 Vol.-%</b>	<b>10.0 **</b>
	<b>U in % of the range 25 Vol.-%</b>	<b>7.5</b>

\*\* For this component no requirements in the EC-directives 2001/80/EC und 2000/76/EC are given.  
A value of 10 % was used for this.