TÜV Rheinland Group

CERTIFICATE

the TÜV Rheinland Immissionsschutz and Energiesysteme GmbH TÜV Rheinland Group

The Measurement System

Manufacturer:	Fuji Electric Systems Co,. Ltd.
Emission Measuring System:	**Analytical systems ZKJ/ZFK7**
Test Report:	936/21202800/B from 30.12.2005

fulfils the requirements of the QAL 1

for the component:
carbon monoxide, nitrate monoxide, sulphur dioxide and oxygen

according to EN 14181 und EN ISO 14956.

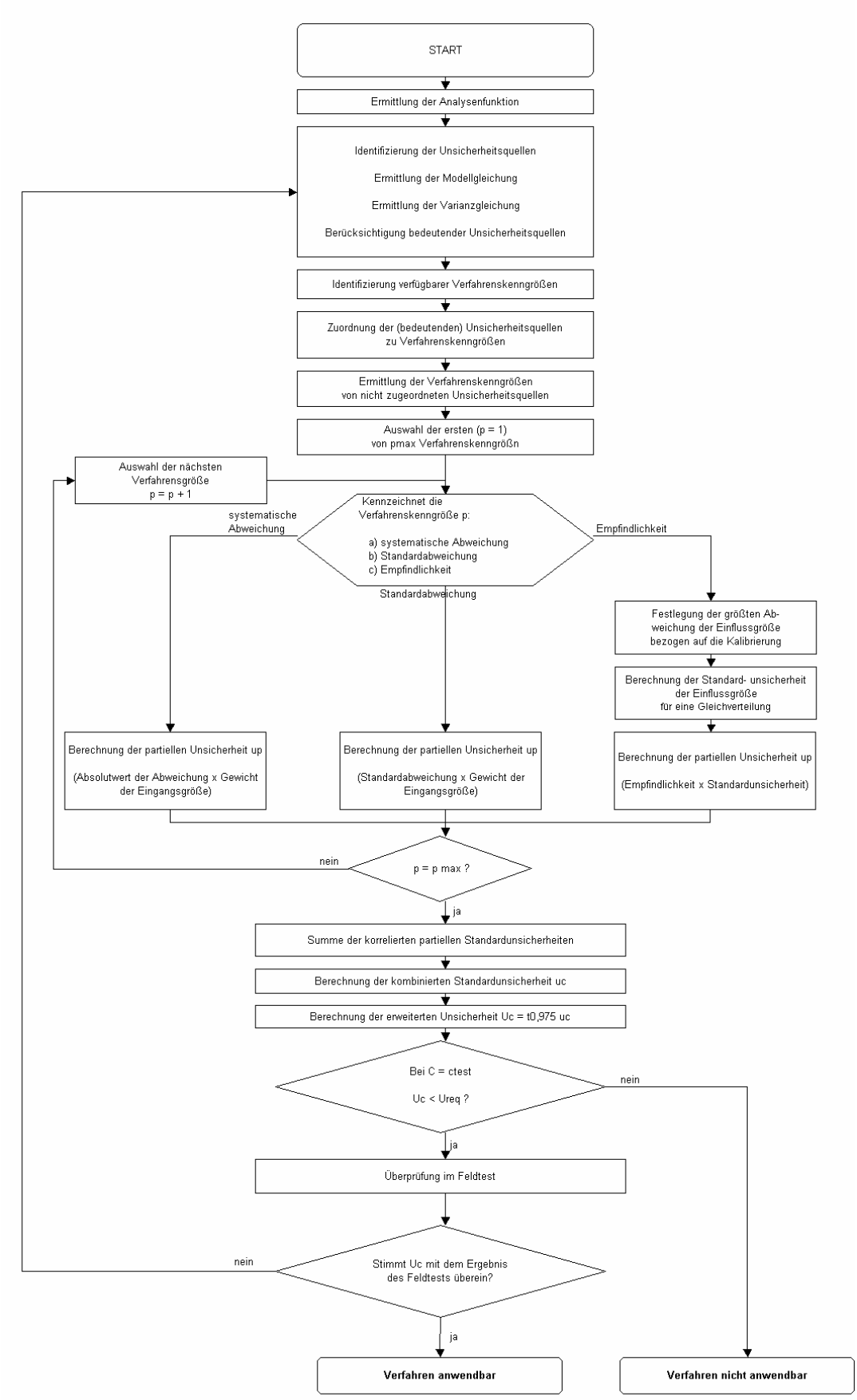
Dr. Peter Wilbring

Nicole Hamacher

TÜV Rheinland Immissionsschutz und
Energiesysteme GmbH
TÜV Rheinland Group
Am Grauen Stein, 51105 Köln
tie@umwelt-tuv.de

TIE-ID: 21202800_2

Deutscher Akkreditierungs Rat
DAR
DAP-PL-3856.99


START
Ermittlung der Analysenfunktion
Identifizierung der Unsicherheitsquellen
Ermittlung der Modellgleichung
Ermittlung der Varianzgleichung
Berücksichtigung bedeutender Unsicherheitsquellen
Identifizierung verfügbarer Verfahrenskenngrößen
Zuordnung der (bedeutenden) Unsicherheitsquellen zu Verfahrenskenngrößen
Ermittlung der Verfahrenskenngrößen von nicht zugeordneten Unsicherheitsquellen
Auswahl der ersten (p = 1) von pmax Verfahrenskenngrößn
Auswahl der nächsten Verfahrensgröße p = p + 1
Kennzeichnet die Verfahrenskenngröße p:
a) systematische Abweichung
b) Standardabweichung
c) Empfindlichkeit
systematische Abweichung
Standardabweichung
Empfindlichkeit
Festlegung der größten Abweichung der Einflussgröße bezogen auf die Kalibrierung
Berechnung der Standard- unsicherheit der Einflussgröße für eine Gleichverteilung
Berechnung der partiellen Unsicherheit up
(Absolutwert der Abweichung x Gewicht der Eingangsgröße)
Berechnung der partiellen Unsicherheit up
(Standardabweichung x Gewicht der Eingangsgröße)
Berechnung der partiellen Unsicherheit up
(Empfindlichkeit x Standardunsicherheit)
nein
p = p max ?
ja
Summe der korrelierten partiellen Standardunsicherheiten
Berechnung der kombinierten Standardunsicherheit uc
Berechnung der erweiterten Unsicherheit Uc = t0,975 uc
Bei C = ctest
Uc < Ureq ?
nein
ja
Überprüfung im Feldtest
Stimmt Uc mit dem Ergebnis des Feldtests überein?
nein
ja
Verfahren anwendbar
Verfahren nicht anwendbar

DIN EN ISO 14956 and prEN 15267-3 calculation for QAL 1 in DIN EN 14181

Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd.
Measurement System	Emissionsmesseinrichtung
Name	Analysensystem ZKJ/ZFK7
Serial Number	14/09
Measuring Principle	NDIR

TÜV Data

TÜV Report	936/21202800/B
Date	30.12.2005
Editor	Fr. Hamacher

Measurement Component CO 125 mg/m³

Evaluation of the cross sensitivity (CS)

	CS $X_{max,j}$
to 3 Vol.-% Oxygen	0,00 mg/m³
to 21 Vol.-% Oxygen	0,79 mg/m³
to 30 Vol.-% Humidity	-1,64 mg/m³
to 300 mg/m³ Carbon monoxide	0,00 mg/m³
to 15 Vol.-% Carbon dioxide	1,88 mg/m³
to 50 mg/m³ Methane	-0,63 mg/m³
to 20 mg/m³ Dinitrogen monoxide	0,00 mg/m³
to 100 mg/m³ Dinitrogen oxide	0,00 mg/m³
to 300 mg/m³ Nitrogen monoxide	0,00 mg/m³
to 30 mg/m³ Nitrogen dioxide	0,00 mg/m³
to 20 mg/m³ Ammonia	0,00 mg/m³
to 200 mg/m³ Sulphur dioxide	0,00 mg/m³
to 1000 mg/m³ Sulphur dioxide	0,00 mg/m³
to 50 mg/m³ Hydrogen chloride	0,00 mg/m³
to 200 mg/m³ Hydrogen chloride	0,00 mg/m³
Sum of positive cross sensitivities	2,66 mg/m³
Sum of negative cross sensitivities	-2,26 mg/m³

Calculation of the combined standard uncertainty

Test Value		$\Delta X_{max,j}$	$u(\Delta X_{max,j}) = \frac{\Delta X}{\sqrt{3}}$	$u(\Delta X_{max,j})^2$
Lack of fit	u_L	-2,00 mg/m³	-1,15 mg/m³	1,333
Biggest interference (positiv or negativ)	u_I	2,66 mg/m³	1,54 mg/m³	2,363
Span shift in the field test	$u_{d,s}$	2,75 mg/m³	1,59 mg/m³	2,521
Zero shift in the field test	$u_{d,z}$	-2,50 mg/m³	-1,44 mg/m³	2,083
Sensitivity to sample volume flow	u_v	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to sample pressure	u_{sp}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to ambient temperature	u_t	-1,54 mg/m³	-0,89 mg/m³	0,788
Dependence on supply voltage	u_{sv}	-0,29 mg/m³	-0,17 mg/m³	0,028
Repeatability at span	u_s	0,00 mg/m³	0,00 mg/m³	0,000
Field reproducibility	u_D	1,18 mg/m³	0,68 mg/m³	0,465
Uncertainty of the test gas at the reference point	u_{tg}	0,63 mg/m³	0,36 mg/m³	0,130
Combined standard uncertainty (u_C)	u_c	$u_c = \sqrt{\Sigma(u_{max,j})^2}$		3,116
Total expanded uncertainty	(u_c * k)	$U_c = u_c * 1,96$		6,108
Relative total expanded uncertainty		Uc in % of the limit 60 mg/m³		10
Requirement		Uc in % of the limit 60 mg/m³		10

Result: Requirements keep to QAL 1 of EN 14181

DIN EN ISO 14956 and prEN 15267-3 calculation for QAL 1 in DIN EN 14181

Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd.
Measurement System	Emissionsmesseinrichtung
Name	Analysensystem ZKJ/ZFK7
Serial Number	15/10
Measuring Principle	NDIR

TÜV Data

TÜV Report	936/21202800/B
Date	30.12.2005
Editor	Fr. Hamacher

Measurement Component CO 125 mg/m³

Evaluation of the cross sensitivity (CS)

	CS $X_{\max,j}$
to 3 Vol.-% Oxygen	1,64 mg/m³
to 21 Vol.-% Oxygen	0,70 mg/m³
to 30 Vol.-% Humidity	-1,88 mg/m³
to 300 mg/m³ Carbon monoxide	0,00 mg/m³
to 15 Vol.-% Carbon dioxide	1,56 mg/m³
to 50 mg/m³ Methane	0,00 mg/m³
to 20 mg/m³ Dinitrogen monoxide	0,00 mg/m³
to 100 mg/m³ Dinitrogen oxide	0,00 mg/m³
to 300 mg/m³ Nitrogen monoxide	0,00 mg/m³
to 30 mg/m³ Nitrogen dioxide	0,00 mg/m³
to 20 mg/m³ Ammonia	0,00 mg/m³
to 200 mg/m³ Sulphur dioxide	0,00 mg/m³
to 1000 mg/m³ Sulphur dioxide	0,00 mg/m³
to 50 mg/m³ Hydrogen chloride	0,00 mg/m³
to 200 mg/m³ Hydrogen chloride	0,00 mg/m³
Sum of positive cross sensitivities	3,90 mg/m³
Sum of negative cross sensitivities	-1,88 mg/m³

Calculation of the combined standard uncertainty

Test Value		$\Delta X_{\max,j}$	$u(\Delta X_{\max,j}) = \frac{\Delta X}{\sqrt{3}}$	$u(\Delta X_{\max,j})^2$
Lack of fit	u_L	-2,38 mg/m³	-1,37 mg/m³	1,880
Biggest interference (positiv or negativ)	u_I	3,90 mg/m³	2,25 mg/m³	5,070
Span shift in the field test	$u_{d,s}$	1,88 mg/m³	1,08 mg/m³	1,172
Zero shift in the field test	$u_{d,z}$	0,75 mg/m³	0,43 mg/m³	0,188
Sensitivity to sample volume flow	u_v	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to sample pressure	u_{sp}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to ambient temperature	u_t	-1,75 mg/m³	-1,01 mg/m³	1,021
Dependence on supply voltage	u_{sv}	-0,21 mg/m³	-0,12 mg/m³	0,015
Repeatability at span	u_s	0,00 mg/m³	0,00 mg/m³	0,000
Field reproducibility	u_D	1,18 mg/m³	0,68 mg/m³	0,465
Uncertainty of the test gas at the reference point	u_{tg}	0,63 mg/m³	0,36 mg/m³	0,130
Combined standard uncertainty (u_C)	u_c	$u_c = \sqrt{\Sigma(u_{\max,j})^2}$		3,153
Total expanded uncertainty	(u_c * k)	$U_c = u_c * 1,96$		6,180
Relative total expanded uncertainty		Uc in % of the limit 60 mg/m³		10
Requirement		Uc in % of the limit 60 mg/m³		10

Result: Requirements keep to QAL 1 of EN 14181

DIN EN ISO 14956 and prEN 15267-3 calculation for QAL 1 in DIN EN 14181

Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd.
Measurement System	Emissionsmesseinrichtung
Name	Analysensystem ZKJ/ZFK7
Serial Number	14/09 & 15/10
Measuring Principle	NDIR

TÜV Data

TÜV Report	936/21202800/B
Date	30.12.2005
Editor	Hr. Pletscher

Measurement Component NO 67 mg/m³

Evaluation of the cross sensitivity (CS)

	CS $X_{\max,j}$
to 3 Vol.-% Oxygen	0,42 mg/m³
to 21 Vol.-% Oxygen	0,50 mg/m³
to 30 Vol.-% Humidity	0,63 mg/m³
to 300 mg/m³ Carbon monoxide	0,00 mg/m³
to 15 Vol.-% Carbon dioxide	-1,47 mg/m³
to 50 mg/m³ Methane	0,00 mg/m³
to 20 mg/m³ Dinitrogen monoxide	0,00 mg/m³
to 100 mg/m³ Dinitrogen oxide	0,00 mg/m³
to 300 mg/m³ Nitrogen monoxide	0,00 mg/m³
to 30 mg/m³ Nitrogen dioxide	0,00 mg/m³
to 20 mg/m³ Ammonia	0,00 mg/m³
to 200 mg/m³ Sulphur dioxide	0,00 mg/m³
to 1000 mg/m³ Sulphur dioxide	0,00 mg/m³
to 50 mg/m³ Hydrogen chloride	0,00 mg/m³
to 200 mg/m³ Hydrogen chloride	0,38 mg/m³
to mg/m³	0,00 mg/m³
to mg/m³	0,00 mg/m³
to mg/m³	0,00 mg/m³
to mg/m³	0,00 mg/m³
Sum of positive cross sensitivities	1,92 mg/m³
Sum of negative cross sensitivities	-1,47 mg/m³

Calculation of the combined standard uncertainty

Test Value		$\Delta X_{\max,j}$	$u(\Delta X_{\max,j}) = \frac{\Delta X}{\sqrt{3}}$	$u(\Delta X_{\max,j})^2$
Lack of fit	u_L	1,01 mg/m³	0,58 mg/m³	0,337
Biggest interference (positiv or negativ)	u_I	1,92 mg/m³	1,11 mg/m³	1,233
Span shift in the field test	$u_{d,s}$	2,01 mg/m³	1,16 mg/m³	1,347
Zero shift in the field test	$u_{d,z}$	0,54 mg/m³	0,31 mg/m³	0,096
Sensitivity to sample volume flow	u_v	0,67 mg/m³	0,39 mg/m³	0,150
Sensitivity to sample pressure	u_{sp}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to ambient temperature	u_t	-0,94 mg/m³	-0,54 mg/m³	0,293
Dependence on supply voltage	u_{sv}	0,35 mg/m³	0,20 mg/m³	0,040
Repeatability at span	u_s	0,00 mg/m³	0,00 mg/m³	0,000
Field reproducibility	u_D	1,14 mg/m³	0,66 mg/m³	0,433
Uncertainty of the test gas at the reference point	u_{tg}	1,34 mg/m³	0,77 mg/m³	0,599
Variation of response factors (TOC)	$u_{R,TOC}$	0,00 mg/m³	0,00 mg/m³	0,000
Excursion of measurement beam	u_{mb}	0,00 mg/m³	0,00 mg/m³	0,000
Combined standard uncertainty (u_C)	u_c	$u_c = \sqrt{\Sigma(u_{\max,j})^2}$		2,128
Total expanded uncertainty	(u_c * k)	$U_c = u_c * 1,96$		4,170
Relative total expanded uncertainty		Uc in % of the limit 22 mg/m³		18,9
Requirement		Uc in % of the limit 22 mg/m³		20,0

Result: Requirements keep to QAL 1 of EN 14181

DIN EN ISO 14956 and prEN 15267-3 calculation for QAL 1 in DIN EN 14181

Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd.
Measurement System	Emissionsmesseinrichtung
Name	Analysensystem ZKJ/ZFK7
Serial Number	14/09 & 15/10
Measuring Principle	Zirkondioxid

TÜV Data

TÜV Report	936/21202800/B
Date	30.12.2005
Editor	Fr. Hamacher

Measurement Component O2 25 Vol.-%

Evaluation of the cross sensitivity (CS)	CS $X_{\max,j}$
to 3 Vol.-% Oxygen	0,00 Vol.-%
to 21 Vol.-% Oxygen	0,00 Vol.-%
to 30 Vol.-% Humidity	-0,03 Vol.-%
to 300 mg/m³ Carbon monoxide	-0,02 Vol.-%
to 15 Vol.-% Carbon dioxide	0,03 Vol.-%
to 50 mg/m³ Methane	-0,01 Vol.-%
to 20 mg/m³ Dinitrogen monoxide	0,00 Vol.-%
to 100 mg/m³ Dinitrogen oxide	0,00 Vol.-%
to 300 mg/m³ Nitrogen monoxide	0,00 Vol.-%
to 30 mg/m³ Nitrogen dioxide	0,00 Vol.-%
to 20 mg/m³ Ammonia	0,00 Vol.-%
to 200 mg/m³ Sulphur dioxide	0,00 Vol.-%
to 1000 mg/m³ Sulphur dioxide	0,00 Vol.-%
to 50 mg/m³ Hydrogen chloride	0,00 Vol.-%
to 200 mg/m³ Hydrogen chloride	0,02 Vol.-%
Sum of positive cross sensitivities	0,04 Vol.-%
Sum of negative cross sensitivities	-0,06 Vol.-%

Calculation of the combined standard uncertainty

Test Value		$\Delta X_{\max,j}$	$u(\Delta X_{\max,j}) = \frac{\Delta X}{\sqrt{3}}$	$u(\Delta X_{\max,j})^2$
Lack of fit	u_L	0,07 Vol.-%	0,04 Vol.-%	0,001
Biggest interference (positiv or negativ)	u_I	-0,06 Vol.-%	-0,03 Vol.-%	0,001
Span shift in the field test	$u_{d,s}$	-0,05 Vol.-%	-0,03 Vol.-%	0,001
Zero shift in the field test	$u_{d,z}$	0,01 Vol.-%	0,01 Vol.-%	0,000
Sensitivity to sample volume flow	u_v	0,00 Vol.-%	0,00 Vol.-%	0,000
Sensitivity to sample pressure	u_{sp}	0,00 Vol.-%	0,00 Vol.-%	0,000
Sensitivity to sample temperature	u_{st}	0,00 Vol.-%	0,00 Vol.-%	0,000
Sensitivity to ambient temperature	u_t	-0,02 Vol.-%	-0,01 Vol.-%	0,000
Dependence on supply voltage	u_{sv}	0,02 Vol.-%	0,01 Vol.-%	0,000
Repeatability at span	u_s	0,00 Vol.-%	0,00 Vol.-%	0,000
Field reproducibility	u_D	0,03 Vol.-%	0,02 Vol.-%	0,000
Uncertainty of the test gas at the reference point	u_{tg}	0,13 Vol.-%	0,07 Vol.-%	0,005
Combined standard uncertainty (u_C)	u_c	$u_c = \sqrt{\Sigma(u_{\max,j})^2}$		0,094
Total expanded uncertainty	(u_c * k)	$U_c = u_c * 1,96$		0,185
Relative total expanded uncertainty		Uc in % of the limit 2,5 Vol.-%		7
Requirement		Uc in % of the limit 2,5 Vol.-%		10

Result: Requirements keep to QAL 1 of EN 14181

DIN EN ISO 14956 and prEN 15267-3 calculation for QAL 1 in DIN EN 14181

Manufacturer data

Manufacturer	Fuji Electric Systems Co., Ltd.
Measurement System	Emissionsmesseinrichtung
Name	Analysensystem ZKJ/ZFK7
Serial Number	14/09 & 15/10
Measuring Principle	NDIR

TÜV Data

TÜV Report	936/21202800/B
Date	30.12.2005
Editor	Hr. Pletscher

Measurement Component SO2 286 mg/m³

Evaluation of the cross sensitivity (CS)

	CS $X_{max,\,j}$
to 3 Vol.-% Oxygen	0,00 mg/m³
to 21 Vol.-% Oxygen	0,00 mg/m³
to 30 Vol.-% Humidity	4,12 mg/m³
to 300 mg/m³ Carbon monoxide	0,00 mg/m³
to 15 Vol.-% Carbon dioxide	0,00 mg/m³
to 50 mg/m³ Methane	2,29 mg/m³
to 20 mg/m³ Dinitrogen monoxide	0,00 mg/m³
to 100 mg/m³ Dinitrogen oxide	0,00 mg/m³
to 300 mg/m³ Nitrogen monoxide	0,00 mg/m³
to 30 mg/m³ Nitrogen dioxide	0,00 mg/m³
to 20 mg/m³ Ammonia	0,00 mg/m³
to 200 mg/m³ Sulphur dioxide	0,00 mg/m³
to 1000 mg/m³ Sulphur dioxide	0,00 mg/m³
to 50 mg/m³ Hydrogen chloride	0,00 mg/m³
to 200 mg/m³ Hydrogen chloride	0,00 mg/m³
to mg/m³	0,00 mg/m³
to mg/m³	0,00 mg/m³
to mg/m³	0,00 mg/m³
to mg/m³	0,00 mg/m³
Sum of positive cross sensitivities	6,41 mg/m³
Sum of negative cross sensitivities	0,00 mg/m³

Calculation of the combined standard uncertainty

Test Value

		$\Delta X_{max,\,j}$	$u(\Delta X_{max,j}) = \frac{\Delta X}{\sqrt{3}}$	$u(\Delta X_{max,j})^2$
Lack of fit	u_L	5,72 mg/m³	3,30 mg/m³	10,906
Biggest interference (positiv or negativ)	u_I	6,41 mg/m³	3,70 mg/m³	13,681
Span shift in the field test	$u_{d,s}$	8,58 mg/m³	4,95 mg/m³	24,539
Zero shift in the field test	$u_{d,z}$	8,58 mg/m³	4,95 mg/m³	24,539
Sensitivity to sample volume flow	u_v	2,86 mg/m³	1,65 mg/m³	2,727
Sensitivity to sample pressure	u_{sp}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m³	0,00 mg/m³	0,000
Sensitivity to ambient temperature	u_t	-2,63 mg/m³	-1,52 mg/m³	2,308
Dependence on supply voltage	u_{sv}	1,00 mg/m³	0,58 mg/m³	0,334
Repeatability at span	u_s	0,00 mg/m³	0,00 mg/m³	0,000
Field reproducibility	u_D	1,42 mg/m³	0,82 mg/m³	0,669
Uncertainty of the test gas at the reference point	u_{tg}	5,72 mg/m³	3,30 mg/m³	10,906
NOx converter efficiency adjustment	u_{NOx}	0,00 mg/m³	0,00 mg/m³	0,000
Variation of response factors (TOC)	$u_{R,\,TOC}$	0,00 mg/m³	0,00 mg/m³	0,000
Excursion of measurement beam	u_{mb}	0,00 mg/m³	0,00 mg/m³	0,000
Combined standard uncertainty (u_C)	u_c	$u_c = \sqrt{\Sigma(u_{max,j})^2}$		9,519
Total expanded uncertainty	(u_c * k)	$U_c = u_c * 1,96$		18,657
Relative total expanded uncertainty		Uc in % of the limit 95 mg/m³		19,6
Requirement		Uc in % of the limit 95 mg/m³		20,0

Result: Requirements keep to QAL 1 of EN 14181