

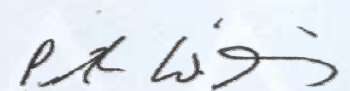
CERTIFICATE


TÜV Rheinland Immissionsschutz und Energiesysteme GmbH

Manufacturer:	Maihak AG
Measuring System:	S 700 - Multor 710 E / 715 E / 720 E
Components:	NO, SO ₂ , CO
Test Report:	RW TÜV 16/1190/94 - 203 75 784 2001-02-02

The measurement system fulfils
the requirements of QAL 1
for NO and SO₂ for ELV $\geq 100 \text{ mg/m}^3$
and for CO for ELV $\geq 150 \text{ mg/m}^3$
according to EN 14181 and EN ISO 14956.

Köln, 2007-05-07


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The company is accredited to DIN EN ISO/IEC 17025.

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

Manufacturer data

Manufacturer	Maihak AG
Measurement System	Multi Component Measuring Device
Name	S 700 Multor
Serial Number	710 , 715
Measuring Principle	NDIR

TÜV Data

Approval Report	RW TÜV 16/01190/1994 - 203 75 784 - 2001-02-02
Date	2007-05-02
Editor	Dipl.Chem. M. Kerpa

Measurement Component NO 250 mg/m³

Evaluation of the cross sensitivity (CS)

	CS	X max, j
to 3 Vol.-% Oxygen	-0,22	mg/m ³
to 21 Vol.-% Oxygen	-0,76	mg/m ³
to 30 Vol.-% Humidity	-0,95	mg/m ³
to 300 mg/m ³ Carbon monoxide	0,91	mg/m ³
to 15 Vol.-% Carbon dioxide	3,04	mg/m ³
to 50 mg/m ³ Methane	0,00	mg/m ³
to 20 mg/m ³ Dinitrogen monoxide	-0,68	mg/m ³
to 300 mg/m ³ Nitrogen monoxide	0,00	mg/m ³
to 30 mg/m ³ Nitrogen dioxide	0,71	mg/m ³
to 20 mg/m ³ Ammonia	0,00	mg/m ³
to 1000 mg/m ³ Sulphur dioxide	0,82	mg/m ³
to 200 mg/m ³ Hydrogen chloride	-1,22	mg/m ³
Sum of positive cross sensitivities	5,48	mg/m ³
Sum of negative cross sensitivities	-3,83	mg/m ³

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	1,25 mg/m ³	0,72 mg/m ³	0,521
Biggest interference (positiv or negativ)	u_I	5,48 mg/m ³	3,16 mg/m ³	10,002
Span shift in the field test	$u_{d,s}$	9,75 mg/m ³	5,63 mg/m ³	31,688
Zero shift in the field test	$u_{d,z}$	8,75 mg/m ³	5,05 mg/m ³	25,521
Sensitivity to sample volume flow	u_v	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to sample pressure	u_{sp}	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to ambient temperature	u_t	4,50 mg/m ³	2,60 mg/m ³	6,750
Dependence on supply voltage	u_{sv}	0,00 mg/m ³	0,00 mg/m ³	0,000
Repeatability at span	u_s	0,50 mg/m ³	0,29 mg/m ³	0,083
Field reproducibility	u_D	1,37 mg/m ³	0,79 mg/m ³	0,627
Uncertainty of the test gas at the reference point	u_{ta}	7,50 mg/m ³	4,33 mg/m ³	18,750
Combined standard uncertainty (u_c)	u_c	$u_c = \sqrt{\sum(u_{max, j})^2}$		9,692
Total expanded uncertainty	$(u_c * k)$	$U_c = u_c * 1,96$		18,997
Relative total expanded uncertainty		Uc in % of the limit 100 mg/m ³		18,9
Requirement		Uc in % of the limit 100 mg/m ³		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	Maihak AG
Measurement System	Multi Component Measuring Device
Name	S 700 Multor
Serial Number	710 , 715
Measuring Principle	NDIR

TÜV Data

Approval Report	RW TÜV 16/01190/1994 - 203 75 784 - 2001-02-02
Date	2007-05-02
Editor	Dipl.Chem. M. Kerpa

Measurement Component SO2 250 mg/m³

Evaluation of the cross sensitivity (CS)

	CS $X_{max,j}$
to 3 Vol.-% Oxygen	-0,22 mg/m ³
to 21 Vol.-% Oxygen	-0,25 mg/m ³
to 30 Vol.-% Humidity	0,48 mg/m ³
to 300 mg/m ³ Carbon monoxide	0,68 mg/m ³
to 15 Vol.-% Carbon dioxide	-0,76 mg/m ³
to 50 mg/m ³ Methane	3,21 mg/m ³
to 20 mg/m ³ Dinitrogen monoxide	0,90 mg/m ³
to 300 mg/m ³ Nitrogen monoxide	-0,97 mg/m ³
to 30 mg/m ³ Nitrogen dioxide	1,42 mg/m ³
to 20 mg/m ³ Ammonia	-0,93 mg/m ³
to 1000 mg/m ³ Sulphur dioxide	0,00 mg/m ³
to 200 mg/m ³ Hydrogen chloride	-2,44 mg/m ³
Sum of positive cross sensitivities	6,69 mg/m ³
Sum of negative cross sensitivities	-5,58 mg/m ³

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	1,75 mg/m ³	1,01 mg/m ³	1,021
Biggest interference (positiv or negativ)	u_I	6,69 mg/m ³	3,86 mg/m ³	14,924
Span shift in the field test	$u_{d,s}$	9,75 mg/m ³	5,63 mg/m ³	31,688
Zero shift in the field test	$u_{d,z}$	8,00 mg/m ³	4,62 mg/m ³	21,333
Sensitivity to sample volume flow	u_v	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to sample pressure	u_{sp}	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to ambient temperature	u_t	2,25 mg/m ³	1,30 mg/m ³	1,688
Dependence on supply voltage	u_{sv}	0,50 mg/m ³	0,29 mg/m ³	0,083
Repeatability at span	u_s	1,00 mg/m ³	0,58 mg/m ³	0,333
Field reproducibility	u_D	1,80 mg/m ³	1,04 mg/m ³	1,076
Uncertainty of the test gas at the reference point	u_{ta}	7,50 mg/m ³	4,33 mg/m ³	18,750
Combined standard uncertainty (u_c)	u_c	$u_c = \sqrt{\sum(u_{max,j})^2}$		9,534
Total expanded uncertainty	$(u_c * k)$	$U_c = u_c * 1,96$		18,686
Relative total expanded uncertainty		Uc in % of the limit 100 mg/m ³		18,6
Requirement		Uc in % of the limit 100 mg/m ³		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	Maihak AG
Measurement System	Multi Component Measuring Device
Name	S 700 Multor
Serial Number	710 , 715
Measuring Principle	NDIR

TÜV Data

Approval Report	RW TÜV 16/01190/1994 - 203 75 784 - 2001-02-02
Date	2007-05-02
Editor	Dipl.Chem. M. Kerpa

Measurement Component CO 200 mg/m³

Evaluation of the cross sensitivity (CS)

	CS $X_{max,j}$
to 3 Vol.-% Oxygen	-0,18 mg/m ³
to 21 Vol.-% Oxygen	-0,40 mg/m ³
to 30 Vol.-% Humidity	0,38 mg/m ³
to 300 mg/m ³ Carbon monoxide	0,00 mg/m ³
to 15 Vol.-% Carbon dioxide	-3,85 mg/m ³
to 50 mg/m ³ Methane	0,00 mg/m ³
to 20 mg/m ³ Dinitrogen monoxide	-0,36 mg/m ³
to 300 mg/m ³ Nitrogen monoxide	0,58 mg/m ³
to 30 mg/m ³ Nitrogen dioxide	-0,75 mg/m ³
to 20 mg/m ³ Ammonia	0,00 mg/m ³
to 1000 mg/m ³ Sulphur dioxide	0,00 mg/m ³
to 200 mg/m ³ Hydrogen chloride	-0,59 mg/m ³
Sum of positive cross sensitivities	0,96 mg/m ³
Sum of negative cross sensitivities	-6,13 mg/m ³

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	1,80 mg/m ³	1,04 mg/m ³	1,080
Biggest interference (positiv or negativ)	u_I	-6,13 mg/m ³	-3,54 mg/m ³	12,534
Span shift in the field test	$u_{d,s}$	6,00 mg/m ³	3,46 mg/m ³	12,000
Zero shift in the field test	$u_{d,z}$	3,60 mg/m ³	2,08 mg/m ³	4,320
Sensitivity to sample volume flow	u_v	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to sample pressure	u_{sp}	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to sample temperature	u_{st}	0,00 mg/m ³	0,00 mg/m ³	0,000
Sensitivity to ambient temperature	u_t	1,60 mg/m ³	0,92 mg/m ³	0,853
Dependence on supply voltage	u_{sv}	0,40 mg/m ³	0,23 mg/m ³	0,053
Repeatability at span	u_s	0,60 mg/m ³	0,35 mg/m ³	0,120
Field reproducibility	u_D	0,86 mg/m ³	0,50 mg/m ³	0,245
Uncertainty of the test gas at the reference point	u_{ta}	4,00 mg/m ³	2,31 mg/m ³	5,333
Combined standard uncertainty (u_c)	u_c	$u_c = \sqrt{\sum(u_{max,j})^2}$		6,045
Total expanded uncertainty	$(u_c * k)$	$U_c = u_c * 1,96$		11,848
Relative total expanded uncertainty		Uc in % of the limit 150 mg/m ³		7,8
Requirement		Uc in % of the limit 150 mg/m ³		10,0

Result: Requirements keep to QAL 1 of EN 14181