Deutscher Akkreditierungs Rat

DAP-PL-3856.99

TÜV

TÜV Rheinland Group

# CERTIFICATE

## TÜV Rheinland Immissionsschutz und Energiesysteme GmbH

| | |
|---|---|
| **Manufacturer:** | Maihak AG |
| **Measuring System:** | Sidor |
| **Components:** | CO, NO, SO2 |
| **Test Report:** | TÜV Nord 04CU035 / 8000607710 2006-06-30 |

The measurement system fulfils
the requirements of
QAL 1
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.


attached: 3 page(s)

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# 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 | Sidor |
| Serial Number | 760 108, 760 109 |
| Measuring Principle | NDIR |
| **TÜV Data** | |
| Approval Report | TÜN Nord 04CU035 / 8000607710 2006-06-30 |
| Date | 2007-05-07 |
| Editor | Dipl.Chem. M. Kerpa |
| **Measurement Component** | CO 75 mg/m³ |

| **Evaluation of the cross sensitivity (CS)** | CS $X_{max,j}$ |
|---|---|
| to 3 Vol.-% Oxygen | 0,00 mg/m³ |
| to 21 Vol.-% Oxygen | 0,50 mg/m³ |
| to 30 Vol.-% Humidity | 0,36 mg/m³ |
| to 300 mg/m³ Carbon monoxide | 0,00 mg/m³ |
| to 15 Vol.-% Carbon dioxide | -1,50 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 monoxide | 0,90 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 | 1,76 mg/m³ |
| Sum of negative cross sensitivities | -1,50 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 | $u_L$ | 0,83 mg/m³ | 0,48 mg/m³ | 0,227 |
| Biggest interference (positiv or negativ) | $u_i$ | 1,76 mg/m³ | 1,02 mg/m³ | 1,035 |
| Span shift in the field test | $u_{d,s}$ | 1,41 mg/m³ | 0,81 mg/m³ | 0,663 |
| Zero shift in the field test | $u_{d,z}$ | 0,85 mg/m³ | 0,49 mg/m³ | 0,239 |
| Sensitivity to sample volume flow | $u_v$ | 0,53 mg/m³ | 0,30 mg/m³ | 0,092 |
| 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 | $u_t$ | -1,35 mg/m³ | -0,78 mg/m³ | 0,608 |
| Dependence on supply voltage | $u_{sv}$ | 0,45 mg/m³ | 0,26 mg/m³ | 0,068 |
| Repeatability at span | $u_s$ | 0,53 mg/m³ | 0,30 mg/m³ | 0,092 |
| Field reproducibility | $u_D$ | 0,28 mg/m³ | 0,16 mg/m³ | 0,026 |
| Uncertainty of the test gas at the reference point | $u_{tg}$ | 1,50 mg/m³ | 0,87 mg/m³ | 0,750 |
| Combined standard uncertainty ($u_C$) | $u_c$ | $u_c = \sqrt{\Sigma(u_{max,j})^2}$ | | 1,949 |
| Total expanded uncertainty | ($u_c$ * k) | $U_c = u_c * 1,96$ | | 3,820 |
| Relative total expanded uncertainty | | Uc in % of the limit 50 mg/m³ | | 7,6 |
| Requirement | | Uc in % of the limit 50 mg/m³ | | 10,0 |

**Result: Requirements keep to QAL 1 of EN 14181**

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## 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 | Sidor |
| Serial Number | 760 108, 760 109 |
| Measuring Principle | NDIR |
| **TÜV Data** | |
| Approval Report | TÜN Nord 04CU035 / 8000607710 2006-06-30 |
| Date | 2007-05-07 |
| Editor | Dipl.Chem. M. Kerpa |
| **Measurement Component** | NO 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 | 0,00 mg/m³ |
| to 30 Vol.-% Humidity | 0,00 mg/m³ |
| to 300 mg/m³ Carbon monoxide | 0,00 mg/m³ |
| to 15 Vol.-% Carbon dioxide | 2,80 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 monoxide | 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 | 0,60 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 | 3,40 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 | $u_L$ | 1,63 mg/m³ | 0,94 mg/m³ | 0,880 |
| Biggest interference (positiv or negativ) | $u_I$ | 3,40 mg/m³ | 1,96 mg/m³ | 3,853 |
| Span shift in the field test | $u_{d,s}$ | 2,50 mg/m³ | 1,44 mg/m³ | 2,083 |
| Zero shift in the field test | $u_{d,z}$ | 2,74 mg/m³ | 1,58 mg/m³ | 2,498 |
| Sensitivity to sample volume flow | $u_v$ | 1,00 mg/m³ | 0,58 mg/m³ | 0,333 |
| 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 | $u_t$ | -2,50 mg/m³ | -1,44 mg/m³ | 2,083 |
| Dependence on supply voltage | $u_{sv}$ | 0,88 mg/m³ | 0,51 mg/m³ | 0,255 |
| Repeatability at span | $u_s$ | 2,00 mg/m³ | 1,15 mg/m³ | 1,333 |
| Field reproducibility | $u_D$ | 0,61 mg/m³ | 0,35 mg/m³ | 0,123 |
| Uncertainty of the test gas at the reference point | $u_{tg}$ | 2,50 mg/m³ | 1,44 mg/m³ | 2,083 |
| Combined standard uncertainty ($u_C$) | $u_c$ | $u_c = \sqrt{\Sigma(u_{max,j})^2}$ | | 3,940 |
| Total expanded uncertainty | ($u_c$ * k) | $U_c = u_c * 1,96$ | | 7,723 |
| Relative total expanded uncertainty | | Uc in % of the limit 50 mg/m³ | | 15,4 |
| Requirement | | Uc in % of the limit 50 mg/m³ | | 20,0 |

**Result: Requirements keep to QAL 1 of EN 14181**

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## 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 | Sidor |
| Serial Number | 760 111, 760 118 |
| Measuring Principle | NDIR |
| **TÜV Data** | |
| Approval Report | TÜN Nord 04CU035 / 8000607710 2006-06-30 |
| Date | 2007-05-07 |
| Editor | Dipl.Chem. M. Kerpa |
| **Measurement Component** | SO2 100 mg/m³ |

| **Evaluation of the cross sensitivity (CS)** | CS $X_{max,j}$ |
|---|---|
| to 3 Vol.-% Oxygen | 0,00 mg/m³ |
| to 21 Vol.-% Oxygen | 0,40 mg/m³ |
| to 30 Vol.-% Humidity | 0,43 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 | 2,90 mg/m³ |
| to 20 mg/m³ Dinitrogen monoxide | -0,44 mg/m³ |
| to 100 mg/m³ Dinitrogen monoxide | -2,00 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 | 3,73 mg/m³ |
| Sum of negative cross sensitivities | -2,44 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 | $u_L$ | 1,30 mg/m³ | 0,75 mg/m³ | 0,563 |
| Biggest interference (positiv or negativ) | $u_i$ | 3,73 mg/m³ | 2,15 mg/m³ | 4,638 |
| Span shift in the field test | $u_{d,s}$ | 2,06 mg/m³ | 1,19 mg/m³ | 1,415 |
| Zero shift in the field test | $u_{d,z}$ | 1,69 mg/m³ | 0,98 mg/m³ | 0,952 |
| Sensitivity to sample volume flow | $u_v$ | 0,80 mg/m³ | 0,46 mg/m³ | 0,213 |
| 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 | $u_t$ | 3,00 mg/m³ | 1,73 mg/m³ | 3,000 |
| Dependence on supply voltage | $u_{sv}$ | 1,00 mg/m³ | 0,58 mg/m³ | 0,333 |
| Repeatability at span | $u_s$ | 1,65 mg/m³ | 0,95 mg/m³ | 0,908 |
| Field reproducibility | $u_D$ | 1,46 mg/m³ | 0,84 mg/m³ | 0,708 |
| Uncertainty of the test gas at the reference point | $u_{to}$ | 2,00 mg/m³ | 1,15 mg/m³ | 1,333 |
| Combined standard uncertainty ($u_C$) | $u_c$ | $u_c = \sqrt{\Sigma(u_{max,j})^2}$ | | 3,750 |
| Total expanded uncertainty | ($u_c$ * k) | $U_c = u_c * 1,96$ | | 7,350 |
| Relative total expanded uncertainty | | Uc in % of the limit 50 mg/m³ | | 14,7 |
| Requirement | | Uc in % of the limit 50 mg/m³ | | 20,0 |

**Result: Requirements keep to QAL 1 of EN 14181**