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Performance Overview calibration Laboratory

EP Instruments Messtechnik und Kalibrierung GmbH

D-K-15143-01-00

Services around the measurement technology in Germanys most accurate DAkkS laboratory*.

Whether in our laboratory or on-site in your company - our calibration service checks both individual measuring elements as well as complete test stands. In our DAkkS laboratory, we calibrate components for which we issue a DAkkS calibration certificate after calibration. Due to our accreditation according to DIN EN ISO / IEC 17025 for the quantities of volume and mass flow of flowing gases, our calibrations are based on national standards. For a calibration at your site, we will examine the complete test stands. This offers the advantage that not only one component, but the entire system is calibrated and the interaction of all sensors is controlled.
By the way, we also offer this service for test stands from other manufacturers.

Our services at a glance:

- **DAkkS accredited laboratory ***
  The high-precision calibration laboratory of our subsidiary EP Instruments measurement + calibration GmbH is accredited according to DIN EN ISO / IEC 17025 for the flow calibration of flowing gases.
- **On-site-calibration**
  We calibrate all measuring dimensions of the test bench directly with you. Our experienced technicians also control the harmonious interaction of all sensors, so that the whole system is perfectly matched
- **Traceability**
  to meet the requirements of the ISO 9001 standard.

* Calibration laboratory accredited by DAkkS according to DIN EN ISO / IEC 17025. The accreditation applies only to the one described in the certificate file D-K-15143-01-00 scope of accreditation.

DAkkS
Deutsche Akkreditierungsstelle
D-K-15143-01-00

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Explanations and notes

Calibration is the metrological determination of the deviation of a measuring device from a reference variable or the metrological determination of the characteristic measuring device to a reference variable.

Adjustment or parameterization is the setting of a measuring instrument so that this gives us a measurement result that is as exact as possible. The correct adjustment is always detected by a subsequent calibration. EP Instruments can carry out adjustments or parameter settings wherever the manufacturer of the measuring instrument has provided an adjustment: for example with coefficients in the data acquisition system or a control room, but partly also in the measuring instrument itself: for example, offset and slope.

Accredited calibration or DAkkS calibration, formerly also DKD calibration, is a calibration in a laboratory with a monitored quality management system according to ISO 17025. The monitoring takes place through the Deutsche Akkreditierungsstelle GmbH (DAkkS) and allows the customer a high degree of confidence in the correctness of the calibration result. The calibration guarantees a complete traceability chain to definition of SI units. Accreditation is always only valid for certain measured values in certain measuring ranges as well as with certain measuring methods.

Measurement uncertainty is the reliability of a measurement result. It corresponds approximately to the statement: With 100 repeats of the exactly same measurement, the result will deviate 95 times no more than the stated uncertainty of measurement upwards or downwards. The measurement uncertainties given in this table are available in our laboratory under the most favorable conditions. Due to special boundary conditions or restrictions on the references used, due to cross-influences between the test object and reference or due to instability which can not be predicted, the actual measurement uncertainty may also be somewhat higher.

✓ practicable

* Verification of feasibility on request

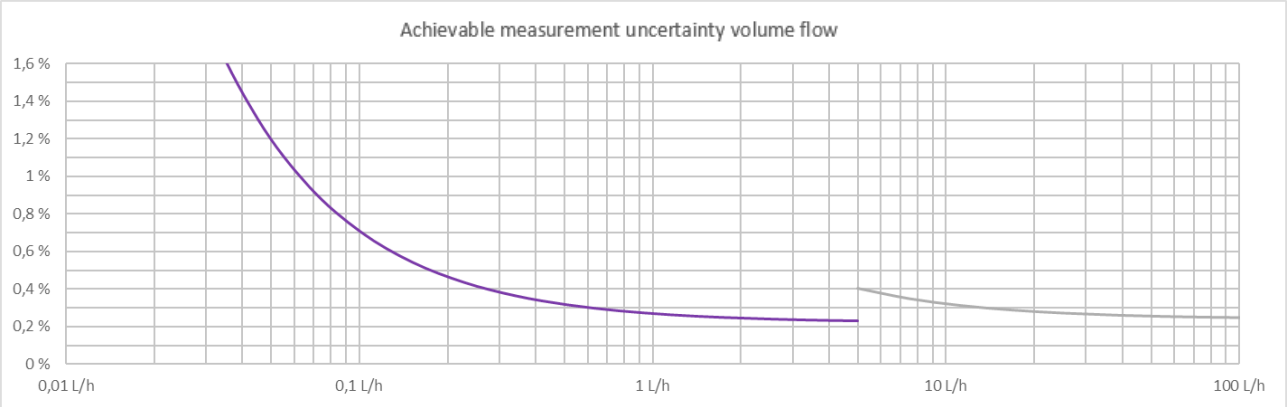
– unpractical

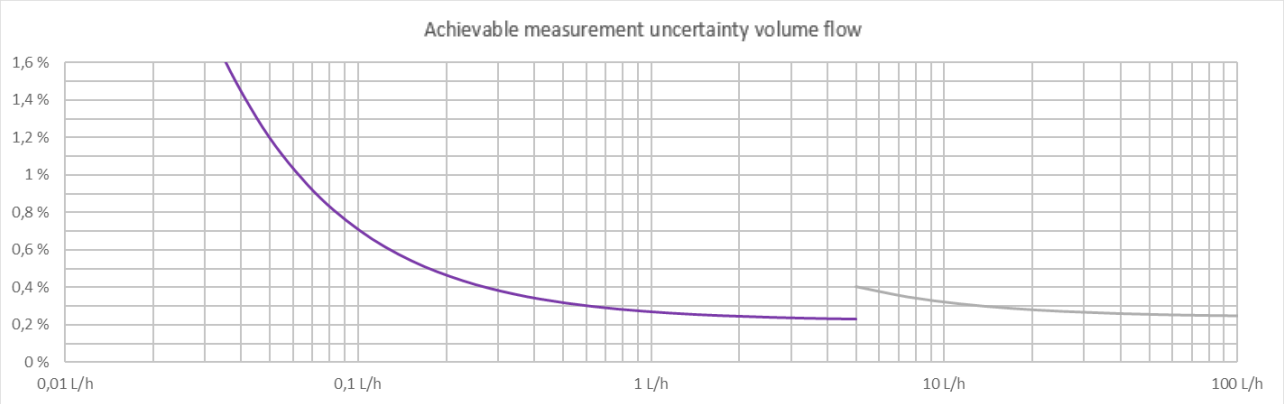
Flow rate: volume flow, mass flow, standard volume flow

Air (very small measuring ranges)

Volume flow rate:	0,020 ... 5,0 L/h
Mass flow:	0,022 ... 5,7 g/h
Standard volume flow:	0,018 ... 4,4 Standard-L/h

	in laboratory	on site
Factory-calibration:	✓	*
DAkkS-calibration:	✓	–





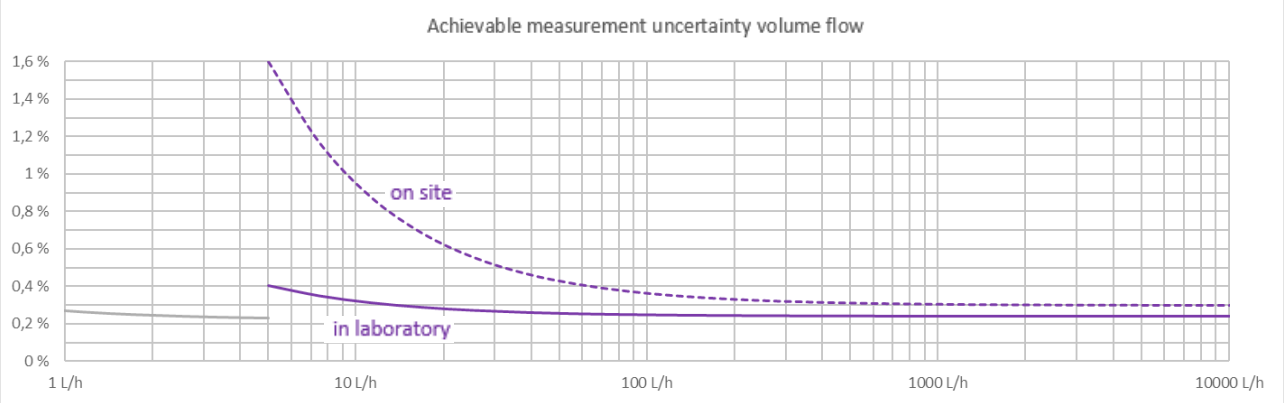
*Realizable with restrictions - Please formulate your requirements!

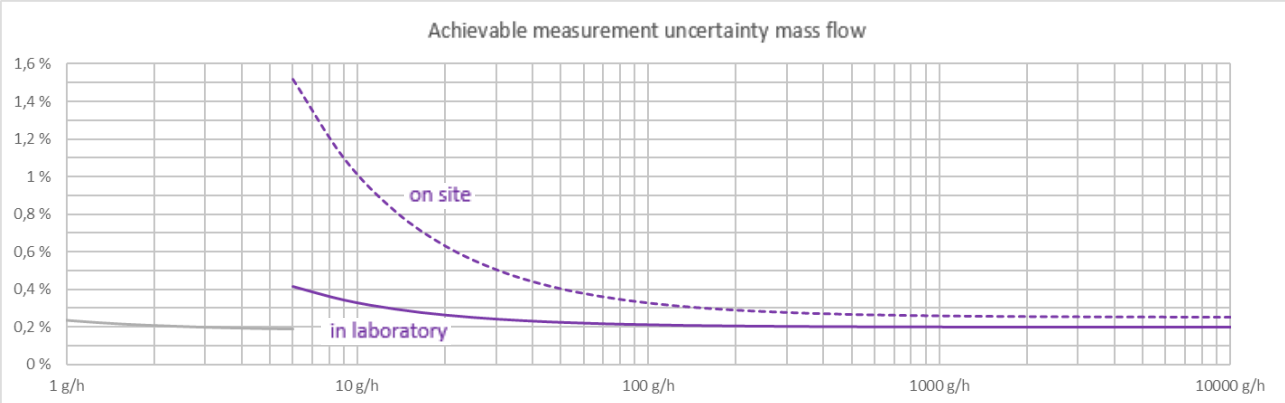
Flow rate: Volume flow, mass flow, standard volume flow

Air (small measuring ranges)

Volume flow rate:	5 … 5000 L/h
Mass flow:	6 … 6000 g/h
Standard volume flow:	4 … 4000 Standard-L/h

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	✓	✓



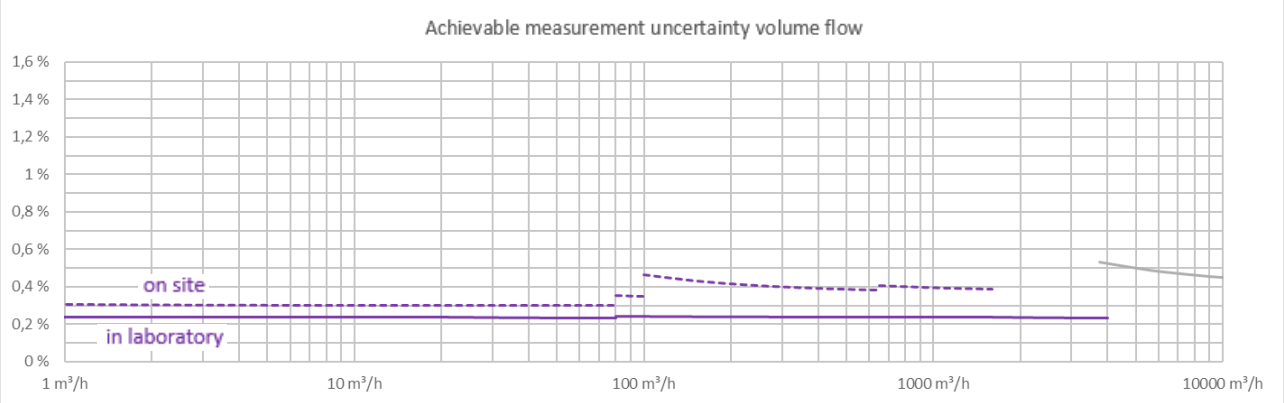


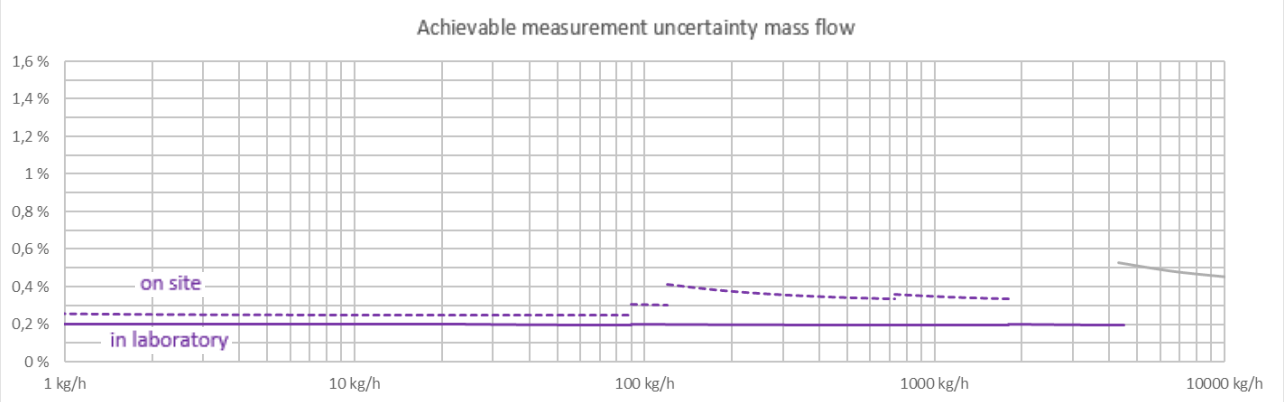
Flow rate: Volume flow, mass flow, standard volume flow

Air (medium measuring ranges)

Volume flow rate:	5 … 3750 m³/h
Mass flow:	6 … 4300 kg/h
Standard volume flow:	4 … 3300 Standard-m³/h

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	✓	✓



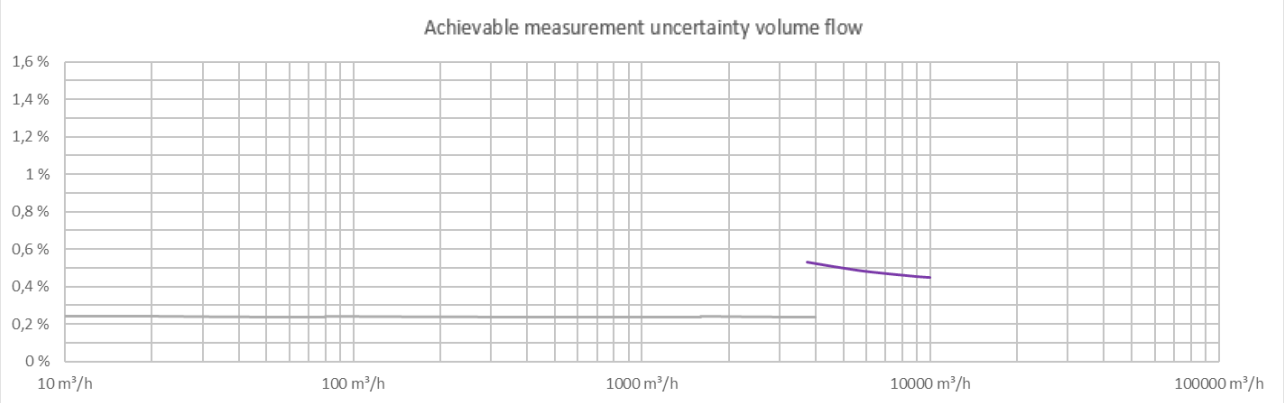


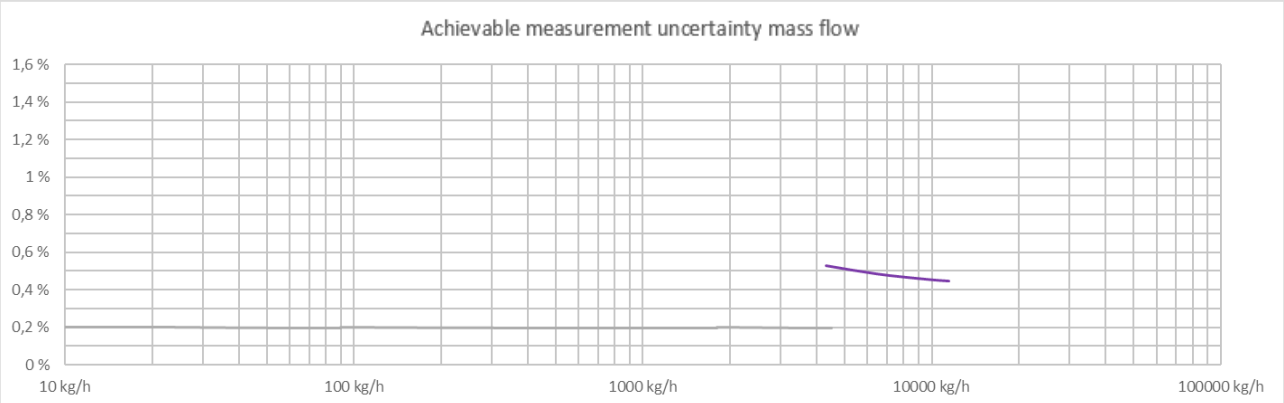
Flow rate: Volume flow, mass flow, standard volume flow

Air (high measuring ranges)

Volume flow rate:	3750 … 10 000 m³/h
Mass flow:	4300 … 11 500 kg/h
Standard volume flow:	3300 … 8 900 Standard-m³/h

	in laboratory	on site
Factory-calibration:	✓	*
DAkkS-calibration:	✓	–





*Realizable with restrictions - Please formulate your requirements!

Flow rate: Volume flow, mass flow, standard volume flow
Air

Technical limits in the calibration laboratory:

- Operation sucking with atmospheric air, at atmospheric pressure:
  - » below 4 m³/h maximum 800 mbar Pressure loss on the test specimen
  - » 4...4000 m³/h maximum 300 mbar Pressure loss on the test specimen
  - » 4000...10000 m³/h maximum 20 mbar Pressure loss on the test specimen
- Operation blowing with compressed air:
  - » up to a maximum of 800 kg / h at a maximum of 10 bar overpressure
- Carry out of measurements at room temperature
- Humidity in accordance with ambient conditions, or residual moisture in compressed air

Technical limits on site:

- According to blower achievements of the installations on site
- Available own mobile blowers:
  - » below 4 m³/h maximum 800 mbar Pressure loss on the test specimen
  - » 4...400 m³/h maximum 250 mbar Pressure loss on the test specimen
  - » 400...4000 kg/h maximum 20 mbar Pressure loss on the test specimen
- Carry out measurements at room temperature
  - » at other temperatures by arrangement
- Humidity according to the environment, or technical conditions on site

Flow rate: Volume flow, mass flow, standard volume flow

Other gases (safe gases)

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

- nitrogen, N_2
- argon, Ar
- helium, He
- carbon dioxide, CO_2
- krypton, Kr
- neon, Ne
- xenon, Xe
- sulphur hexafluoride, SF_6

Realizable measuring ranges are depending on the available size of the gas storage tank or the available gas cylinders.
Achievable measurement uncertainties as in air, but approx. plus 0.2%.

Other gases (Explosive, combustible and oxidising gases)

	in laboratory	on site
Factory-calibration:	*	*
DAkkS-calibration:	–	–

- oxygen, O_2
- hydrogen, H_2
- natural gas-L, natural gas-H, biogas
- methane, CH_4
- ethane C_2H_6, propane C_3H_8, butane C_4H_{10}
- ethylene, propylene
- nitrous oxide (laughing gas), N_2O
- dimethyl ether, C_2H_6O

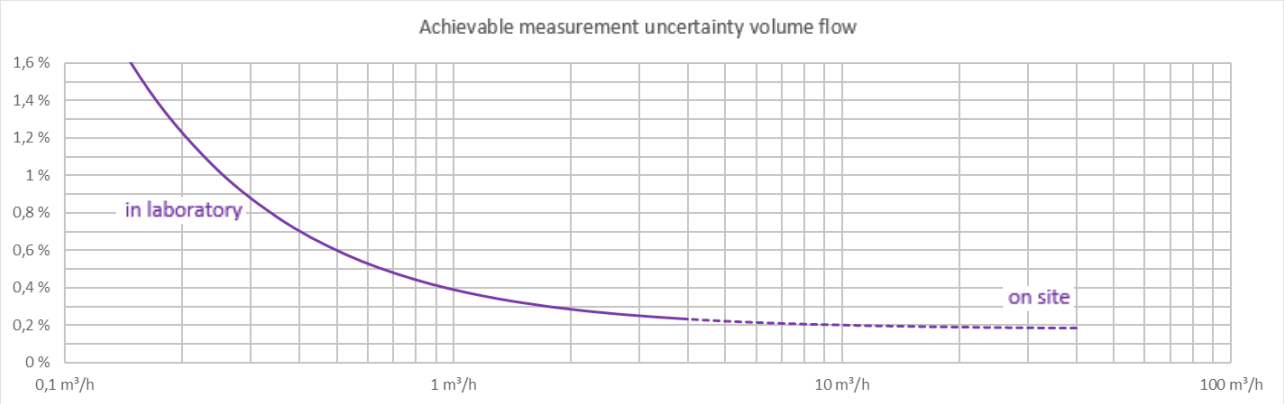
Individual check of feasibility at your request.

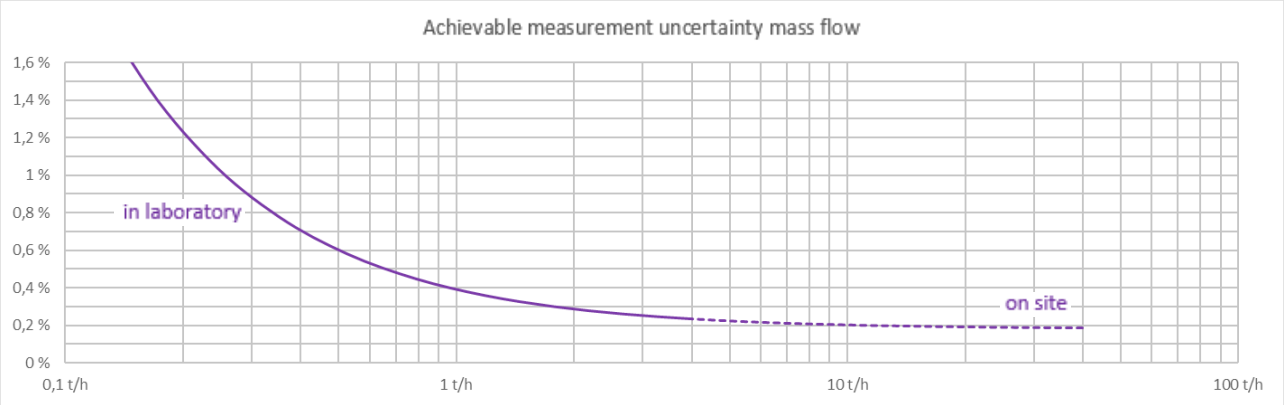
Toxic gases cannot be used for calibration.
* Realizable with restrictions - Please formulate your requirements!

Flow rate: Volume flow, mass flow
Liquids (water)

	in laboratory	on site
Factory-calibration:	*	✓
DAkkS-calibration:	–	–

	in laboratory	on site
Volume flow rate	(0) ... 2 m³/h	(0) ... 40 m³/h
Mass flow:	(0) ... 2 t/h	(0) ... 40 t/h





Individual check of feasibility at your request.

* Realizable with restrictions - Please formulate your requirements!

Flow rate: Summation volume, mass, standard volume

Air

	in laboratory	on site
Factory-calibration:	✓	*
DAkkS-calibration:	✓	*

Measuring ranges as a function of the flow and integration duration.
The measurement uncertainties depend very much on the type of synchronization of the start and stop times.

Other gases

	in laboratory	on site
Factory-calibration:	✓	*
DAkkS-calibration:	–	–

Individual check of feasibility at your request.

Water and other media

	in laboratory	on site
Factory-calibration:	*	*
DAkkS-calibration:	–	–

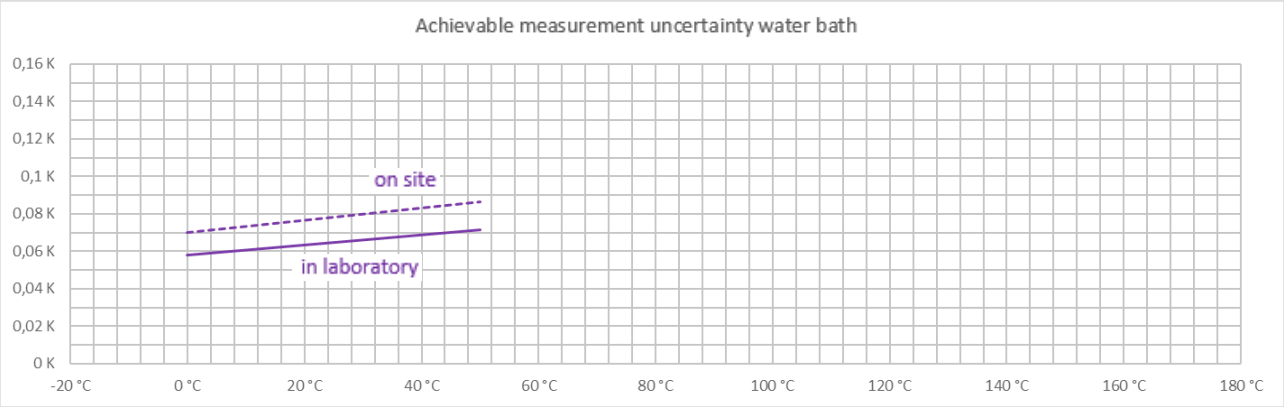
Individual check of feasibility at your request.

* Realizable with restrictions - Please formulate your requirements!

Measured temperature:
Calibration in water bath

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

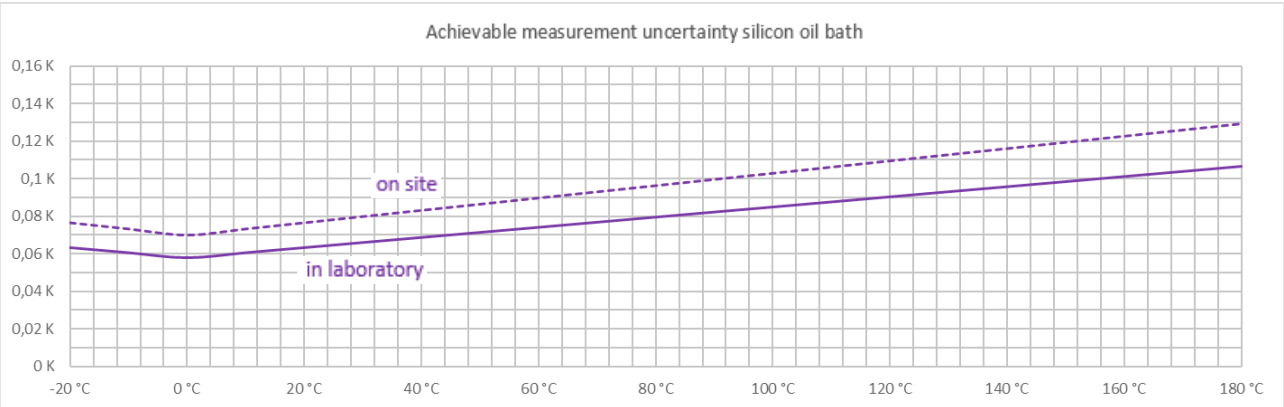
Measuring range: 1…50 °C



Calibration in silicon oil bath

	in laboratory	on site
Factory-calibration	✓	✓
DAkkS-calibration:	–	–

Measuring range: – 20 … + 180 °C



Measured pressure:
Absolute pressure and relative pressure
Test medium air or nitrogen

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

Measuring range: (0)…10 bar

Other test gases or liquids

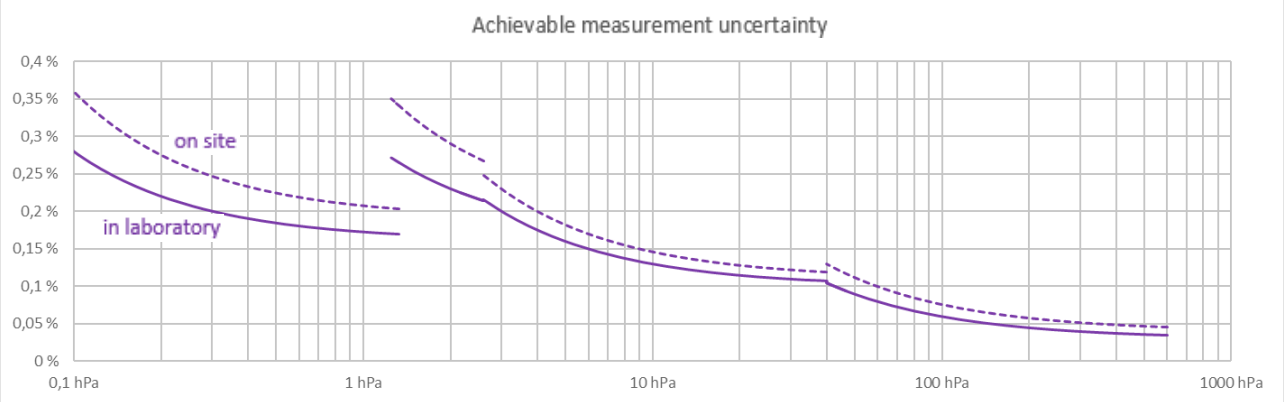
	in laboratory	on site
Factory-calibration:	*	*
DAkkS-calibration:	–	–

Measured pressure: Differential pressure
Test medium air or nitrogen

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

Measuring range: (0) … 600 hPa

Individual examination of the feasibility of higher pressures on your request.



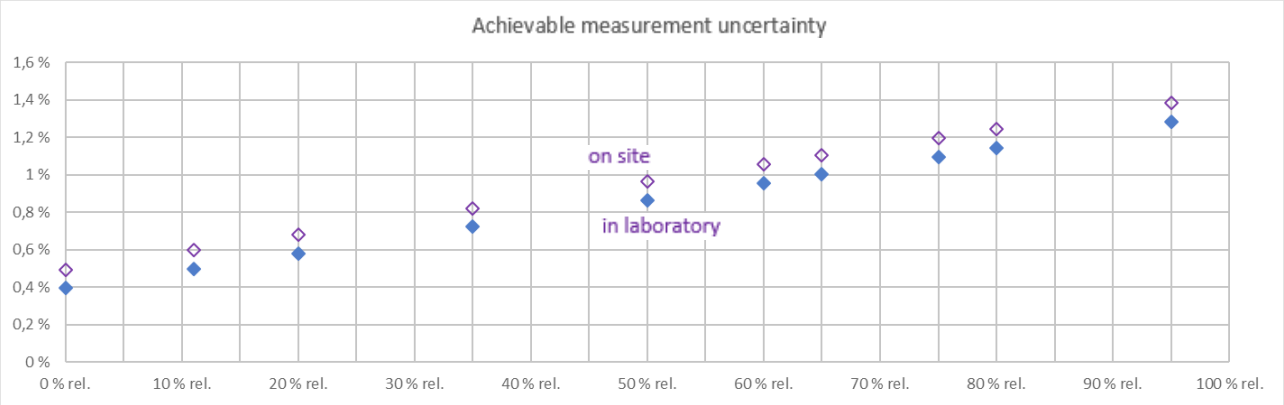
Other test gases or liquids

	in laboratory	on site
Factory-calibration:	*	*
DAkkS-calibration:	–	–

Measured humidity:
Humidity measuring devices

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

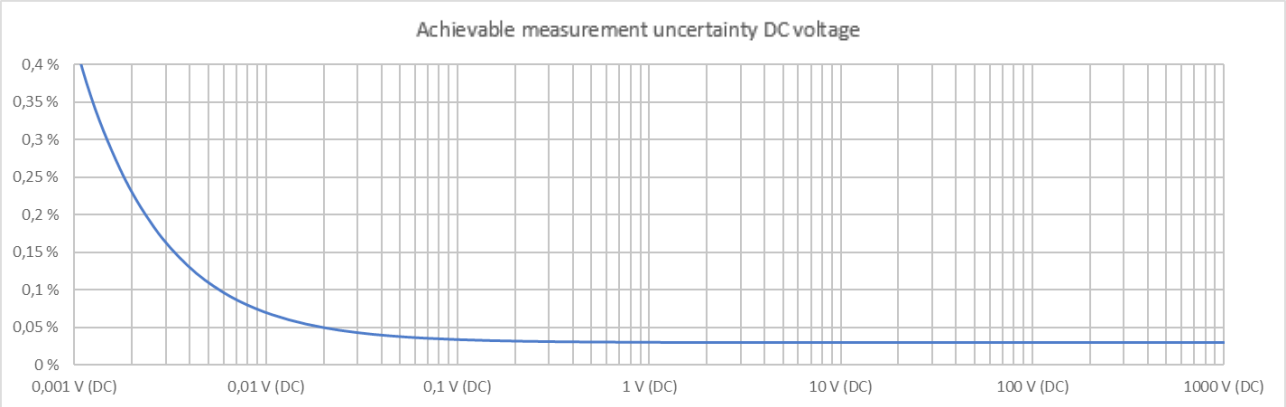
Ralizable measuring points: 0 // 11 // 20 // 35 // 50 // 60 // 65 // 75 // 80 // 95 % rel.



Electric measuring dimensions:
DC voltage

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

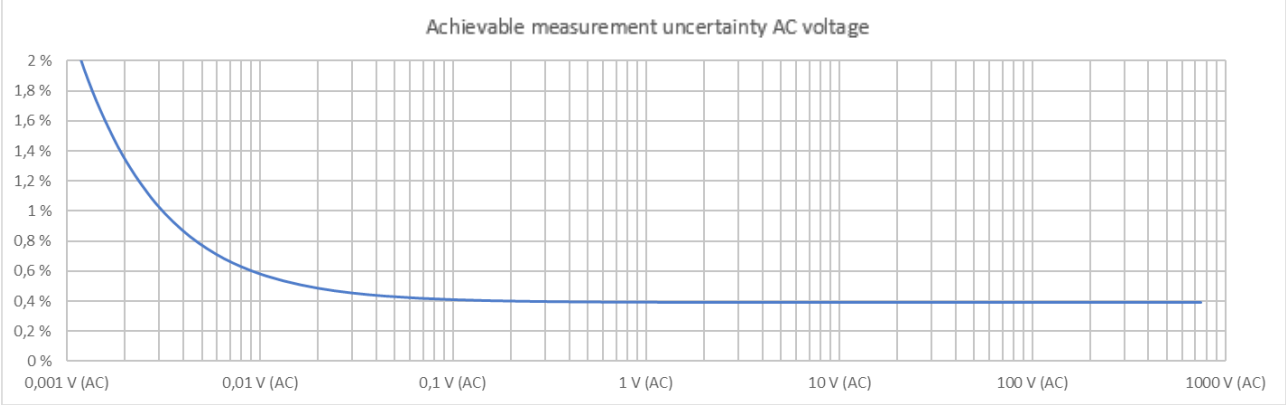
Measuring range: (0)...10 V; >10 V Check on request



AC voltage

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

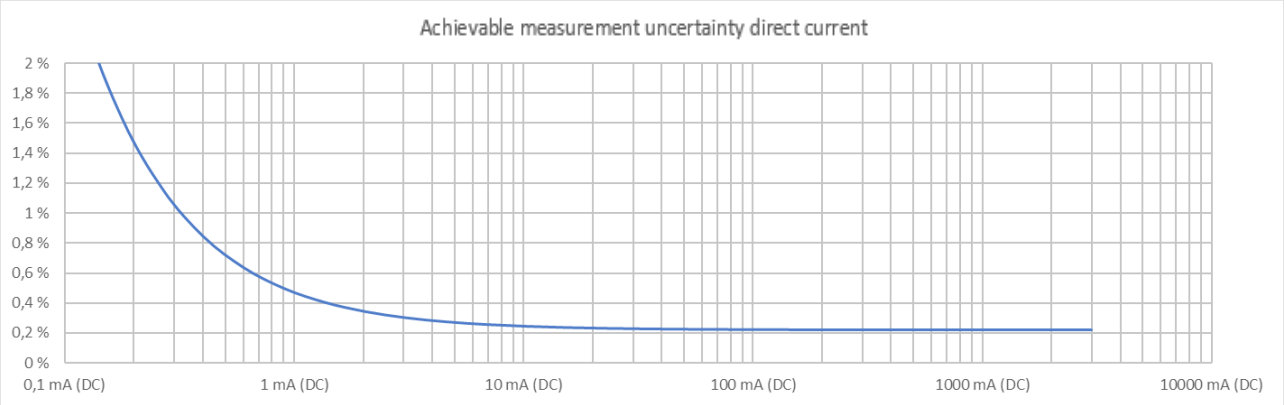
Measuring range: (0)...750 V (AC); >750 V Check on request



Electric measuring dimensions:
Direct current

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

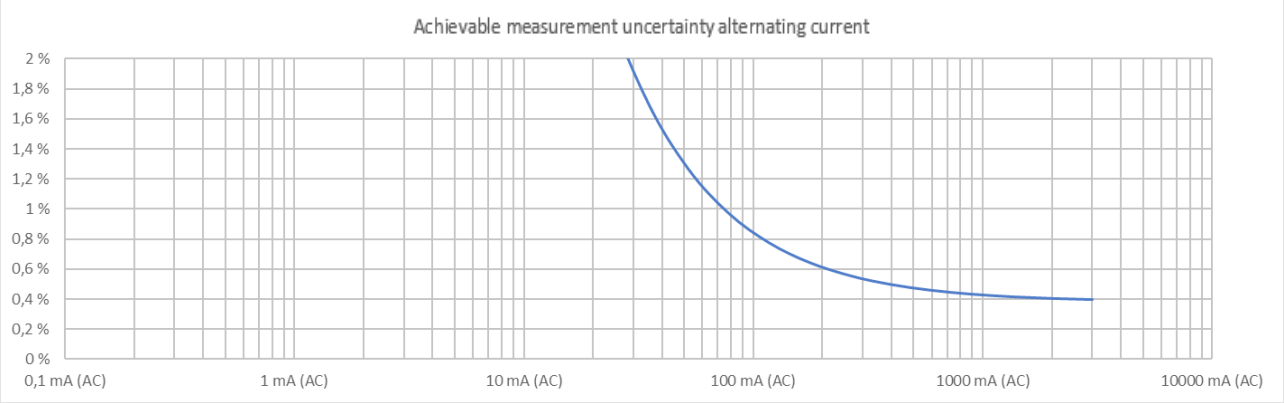
Measuring range: (0)…20 mA; >20 mA Check on request



Alternating current

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

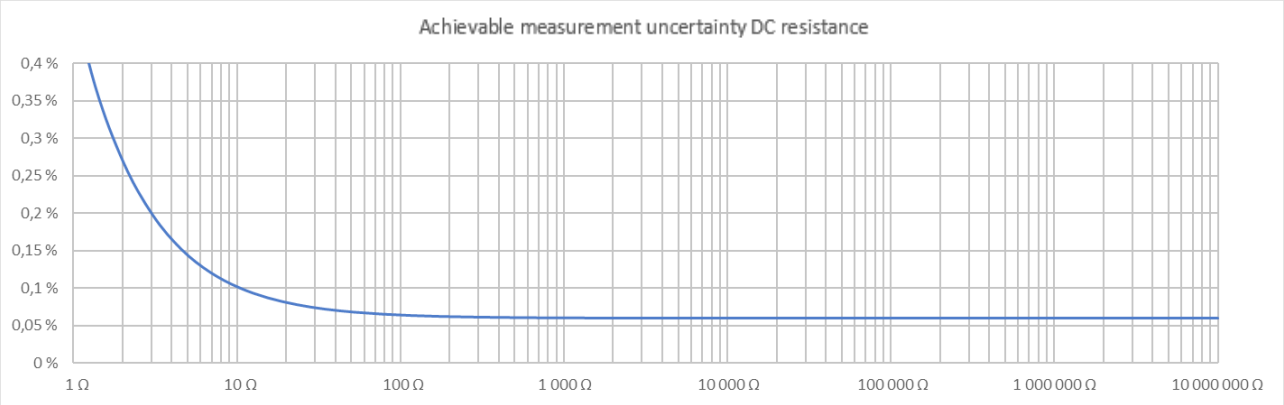
Measuring range: (0)…20 mA; >20 mA Check on request



Electric measuring dimensions:
DC resistance

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

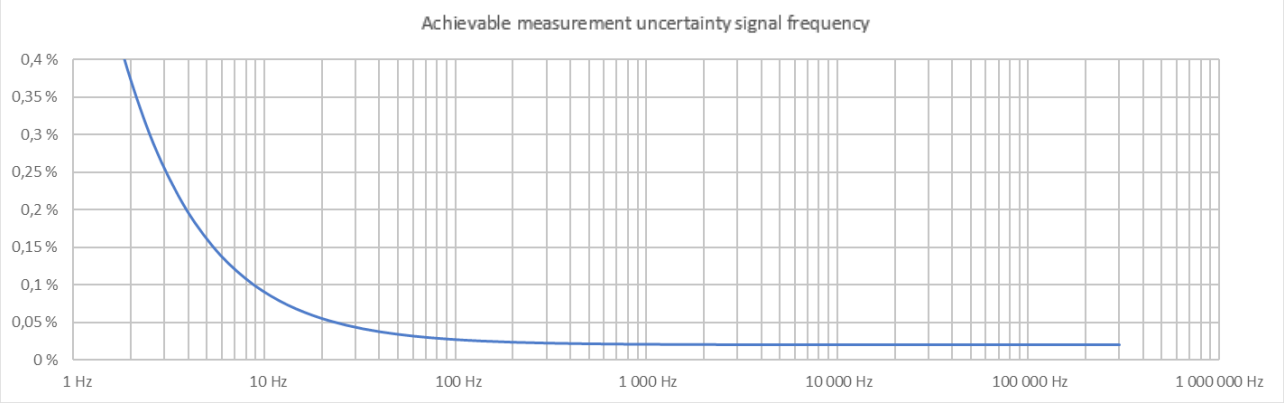
Measuring range: (0)…10 000 000 Ω



Signal frequency

	in laboratory	on site
Factory-calibration	✓	✓
DAkkS-calibration:	–	–

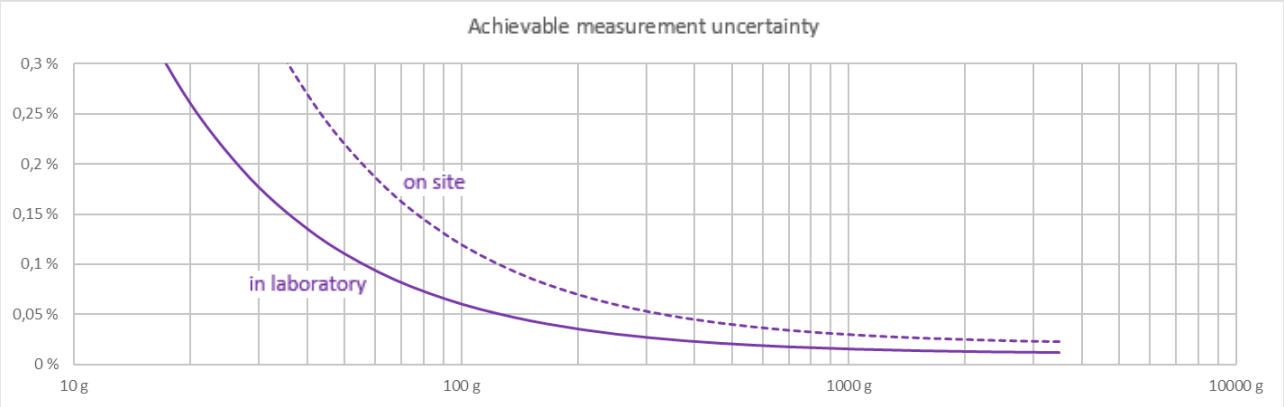
Measuring range: (0)…300 000 Hz



Measuring dimension mass

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

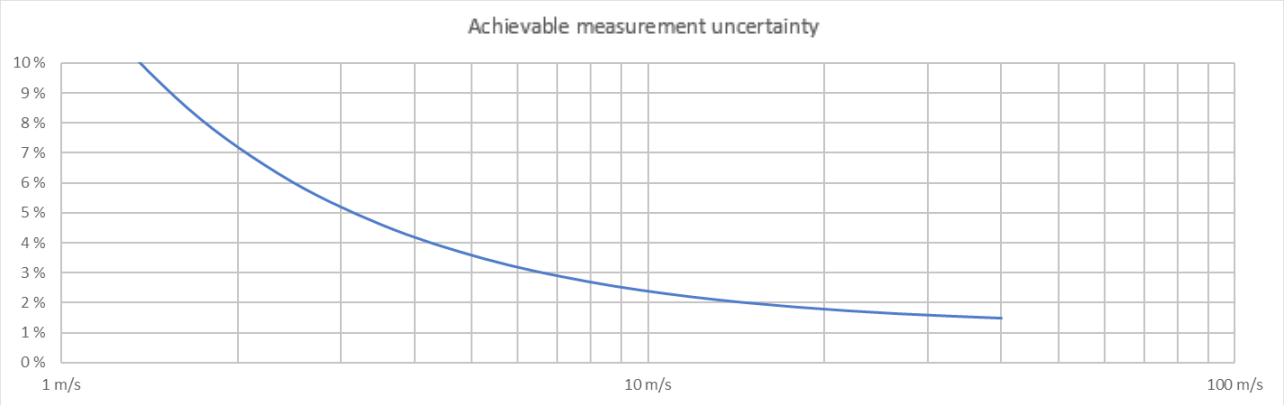
Measuring range: (0)…3500 g



Measuring dimension flow velocity: Flow medium air

	in laboratory	on site
Factory-calibration:	✓	✓
DAkkS-calibration:	–	–

Measuring range: (0)…40 m/s; Flow must be accessible for sensor use.



Unit conversion

Volume flow rate

[m³/h]	= [L/h] : 1000 = [L/min] : 1000 * 60 = [m³/s] * 3600 = [cf/m] * 1,699
[L/h]	= [m³/h] * 1000 = [L/min] * 60 = [m³/s] * 1000 * 3600 = [cf/m] * 1699
[L/min]	= [m³/h] * 1000 : 60 = [L/h] : 60 = [m³/s] * 1000 * 60 = [cf/m] * 1699 : 60
[m³/s]	= [m³/h] : 3600 = [L/h] : 1000 : 3600 = [L/min] : 1000 : 60 = [cf/m] * 1,699 : 3600
[cf/m]	= [m³/h] : 1,699 = [L/h] : 1699 = [L/min] : 1699 * 60 = [m³/s] : 1,699 * 3600

Mass flow rate

[kg/h]	= [g/h] : 1000 = [g/min] : 1000 * 60 = [kg/s] * 3600 = [lbs/h] * 0,4536
[g/h]	= [kg/h] * 1000 = [g/min] * 60 = [kg/s] * 1000 * 3600 = [lbs/h] * 453,6
[g/min]	= [kg/h] * 1000 : 60 = [g/h] : 60 = [kg/s] * 1000 * 60 = [lbs/h] * 453,6 : 60
[kg/s]	= [kg/h] : 3600 = [g/h] : 1000 : 3600 = [g/min] : 1000 : 60 = [lbs/h] * 0,4536 : 3600
[lbs/h]	= [kg/h] : 0,4536 = [g/h] : 453,6 = [g/min] : 453,6 * 60 = [kg/s] : 0,4536 * 3600

Temperature

[°C]	= [K] – 273,15 = ([°F] – 32) * 5 : 9	[°F]	= [K] * 9 : 5 – 459,67 = [°C] * 9 : 5 + 32

Pressure

[hPa]	= [mbar] = [psi] * 68,9476 = [inH2O] * 2,491 = [inHg] * 33,86	[psi]	= [hPa] * 0,0145 = [bar] * 0,0000145 = [inH2O] * 0,03613 = [inHg] * 0,49115
[bar]	= [hPa] : 1000 = [MPa] * 10 = [psi] * 0,0689476 = [inH2O] * 0,002491 = [inHg] * 0,03386	[inH2O]	= [psi] * 27,68 = [hPa] * 68,9476 = [bar] * 0,0689476 = [inHg] * 13,595

Mass

[kg]	= [lbs] * 0,4536 = [oz] * 0,02835	[lbs]	= [kg] : 0,4536
		[oz]	= [kg] : 0,02835

Velocity

[m/s]	= [ft/s] * 0,3048 = [km/h] / 3,6	[ft/s]	= [m/s] : 0,3048 = [ml/h] : 0,6818

Density of different gases

$$m = \rho \cdot V \qquad QM = \rho \cdot QV$$

$$V = \frac{m}{\rho} \qquad QV = \frac{QM}{\rho}$$

Estimation of the density of gases: $\boldsymbol{\rho \approx \frac{P}{T \cdot R_s}}$

P = absolute pressure in Pa
T = temperature in K
R_s = specific gas constant

gas	R_s [J/kg/K]
air	287,0
nitrogen	296,8
argon	208,1
helium	2077,3
carbon dioxide	188,9
krypton	99,2
neon	412,0
xenon	63,3
sulfur hexafluoride	56,9
oxygen	259,8
hydrogen	4124,5
natural gas-H	484,6
natural gas-L	440,8
biogas	329,0
methane	518,3
ethan	276,5
propane	188,6
butane	143,1