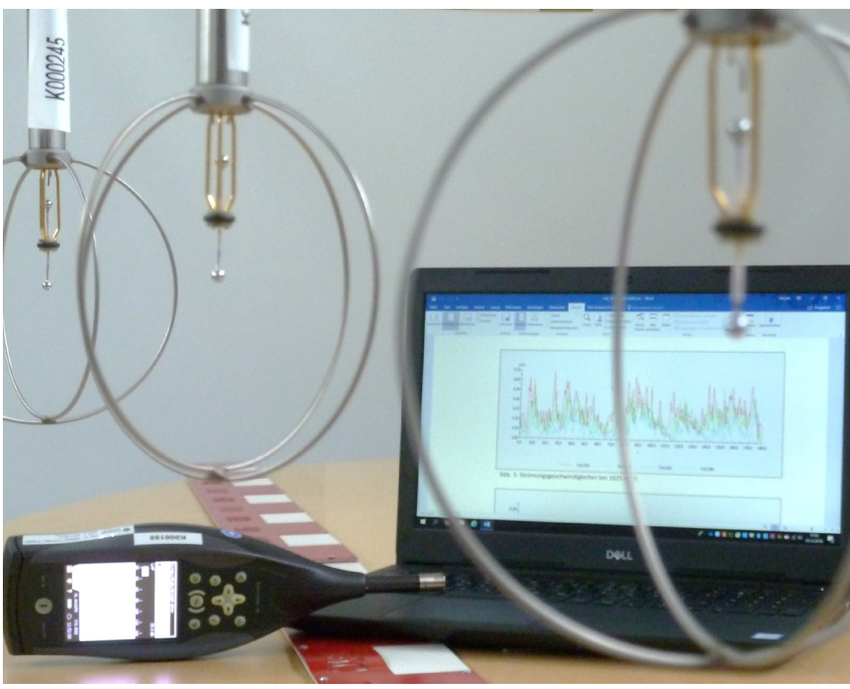
Pure competence in air.



THE LAS LABORATORY FOR ACOUSTICS & FLOW ENGINEERING

LAS - SERVICE SPECIFICATION

Our SCHAKO laboratories offer comprehensive engineering and technical services to our customers, enabling them to test their own and individualized air-conditioning concepts based on air and air/water systems before successfully implementing them in the corresponding project.

Customer testing can be simulated at scale in the component area of the flow laboratory.

Service specification of the
LAS Laboratory for Acoustics & Flow Engineering
of SCHAKO KG

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SERVICE SPECIFICATION

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Technical data

***Sound measurement laboratory dimensions: 8.7 x 4.2 x 2.3 m ***Enveloping surface measuring area: hemisphere with r=1.5 m ***Max. size of measured object: must fit into hemisphere with r=1.35 m ***Max. supply air flow rate: 0 to 2,500 m^3/h ***Max. exhaust air flow rate: 0 to 2,500 m^3/h ***Max. pressure loss: 500 Pa ***Measuring system: Norsonic Nor850[1)] sound measuring system ***Halstrup Walcher REG 21 digital pressure gauge[1)] ***Measuring range 0 to 10 kPa

[1)] Measuring equipment is subject to regular and monitored calibration interval.

Fig. 1: Volume and pressure drop measurement acc. to DIN EN ISO 3744

Volume and pressure drop measurement acc. to DIN EN ISO 3744

We measure the flow noise and pressure drop of our products in our in-house sound measurement room. We use the enveloping surface method with ten microphones arranged in specific measurement positions around the object being measured. This serves the purpose of recording the physical sound pressure level and calculating the corresponding sound power level.

The measuring procedure complies with the DIN EN 3744 standard, with the sound measurement room being categorized as accuracy class 2 with a reflecting plane.

Technical data

***Measuring channel dimensions: 7.0 x 1.2 x 1.2 m ***Max. inflow channel cross-section: 0.8 x 0.5 m ***Measuring system: Norsonic Nor850 sound measuring system[1)]

Insertion loss acc. to DIN EN ISO 7235

A substitution process is used to determine the attenuation behaviour of absorbers or silencers across the frequency range. The process involves a comparison of test duct sound measurements with and without attenuating elements.

Fig. 2: Insertion loss acc. to DIN EN ISO 7235

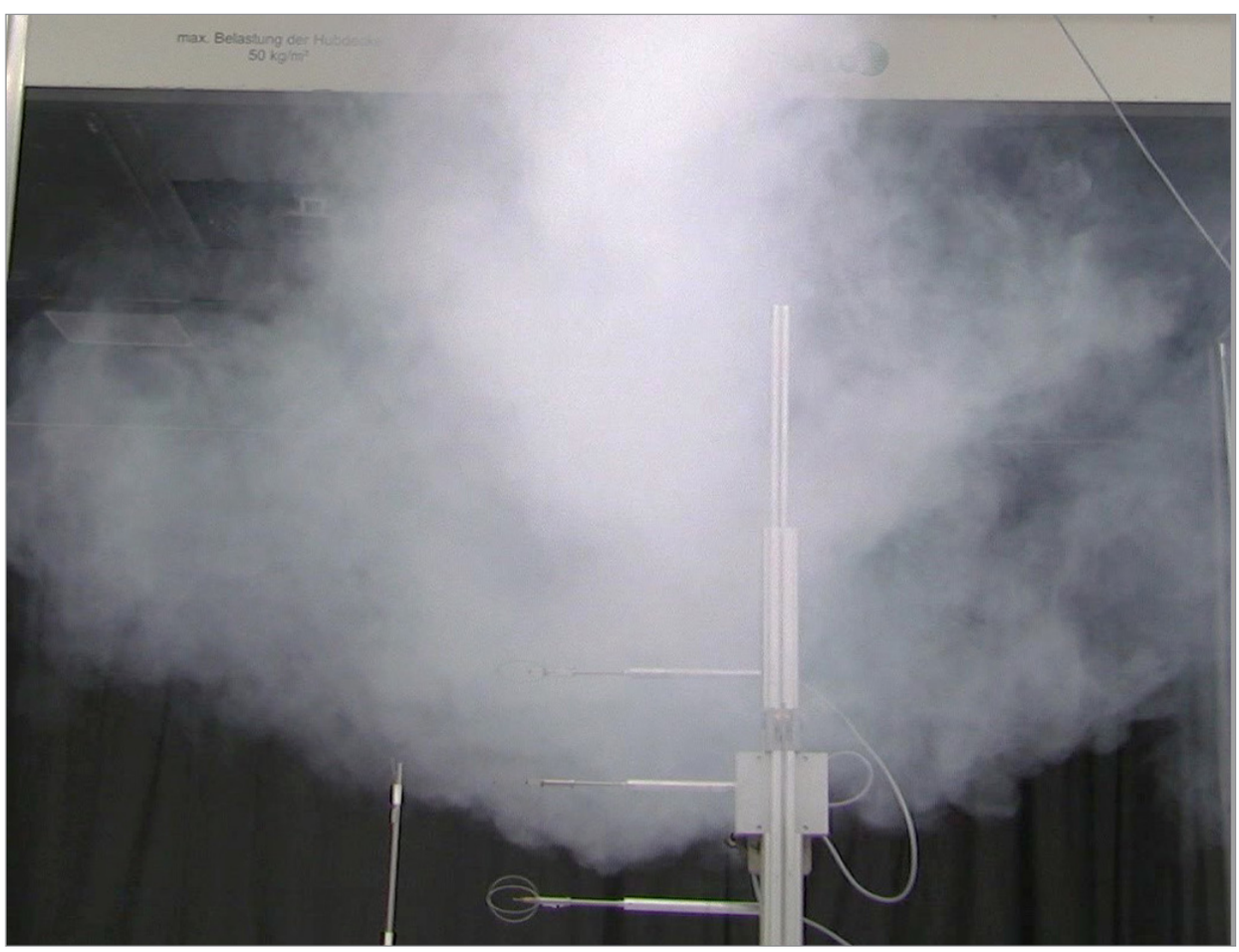
Technical data

***Laboratory dimensions: max. installation height 5.5 m ***Max. room length 13 m ***Dimensions for installation flush with ceiling: 8 x 5.8 m ***Max. amount of supplied air 8,000 m^3/h ***Measuring system: DANTEC DYNAMICS ComfortSense[1)] ***for room air velocities acc. to EN 13182, ISO 7726, ISO 7730, and ASHRAE 55 and ASHRAE 113 standards ***Measuring range: 0.01 to 1 m/s, and 1 to 10 m/s between 0 and 45 °C

Comfort measurement acc. to DIN EN 7730

Measurement of the behaviour of one or more object(s) in different rooms and climatic conditions with supply and/or exhaust air during a defined period of time. The average velocity, minimum velocity, maximum velocity, turbulence intensity, temperature or temperature deviation, and draft risk are measured simultaneously.

Fig. 3: Comfort measurement acc. to DIN EN 7730



Flow measurement acc. to DIN EN 15251, DIN EN 12599, DIN EN 12238

Measurement of the critical throw from objects installed flush with the ceiling (Coanda effect in case of cooling), the maximum penetration, the maximum throw distance as well as the temperature ratio and the resulting induction ratio.

Leakage measurement acc. to DIN EN 1751

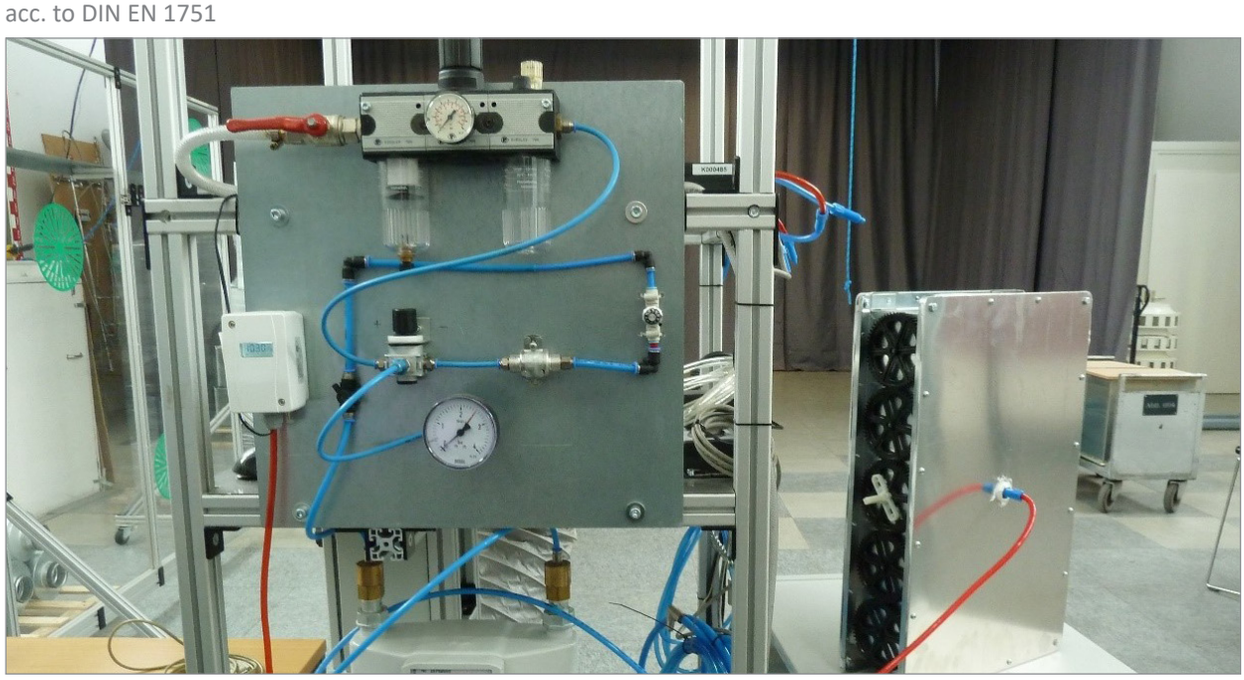
ENCLOSURE LEAKAGE - The tightness, i.e. the air flow rate attributable to air leakage under pressure, of a closed object to be measured is measured using a flow meter and a pressure gauge.

SHUT-OFF/THROTTLE DAMPER LEAKAGE - The tightness, i.e. the air flow rate attributable to air leakage under pressure, of an object to be measured, which is closed by shut-off/throttle dampers, is measured using a flow meter and a pressure gauge.

Technical data

***Measuring system: ITRON G1,6RF1C
***Gas flow counter[1)]
***Qmin: 0.016 m^3/h ***Qmax: 2.5 m^3/h
***Pmax: 0.5 bar ***Class 1.5 ***Halstrup Walcher REG 21 digital pressure gauge[1)]
***Measuring range 0 to 10 kPa

Fig. 4: Leakage measurement acc. to DIN EN 1751



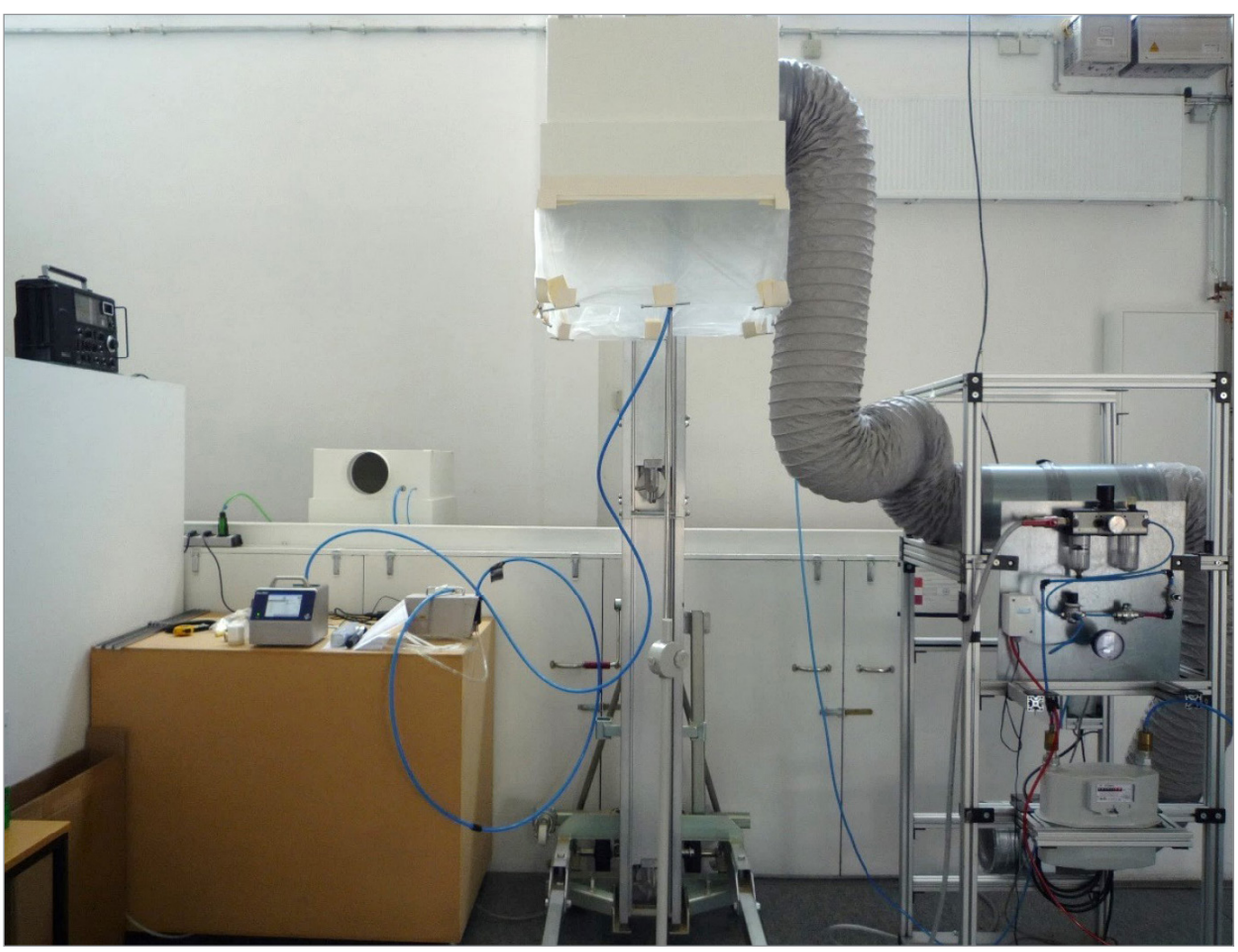
Technical data

***Measuring system: AEROTRAK 9310 scattered light individual particle counter[1)] ***Particle size range 0.3 to 25 µm ***Maximum concentration 400,000 particles/ft3 at 5 % coincidence error ***Volumetric flow rate 28.3 l/min at ± 5 % accuracy ***Measuring duration: 1 second to 99 hours

Leak testing acc. to DIN EN ISO 14644-3

Determination of the tightness between filter enclosure and filters under test, i.e. their sealing surfaces, by measuring the escaping particle concentration according to the requirements for clean room technology.

Fig. 5: Leak testing acc. to DIN EN ISO 14644-3



Volumetric flow controller testing & heat capacity determination

Technical data

***Test setup 1: EP LMF - LaminarFlow[1)] ***Measuring section 1: 20 to 500 m^3/h; ***Measuring section 2: 400 to 2,000 m^3/h ***Measuring channels: Ø 80 mm to Ø 315 mm ***Test setup 2: ER VMF - VenturiMasterFlow[1)] ***Measuring range: 257 to 18,000 m^3/h ***Measuring channels: Ø 315 mm to Ø 500 mm, or 500 x 500 mm.

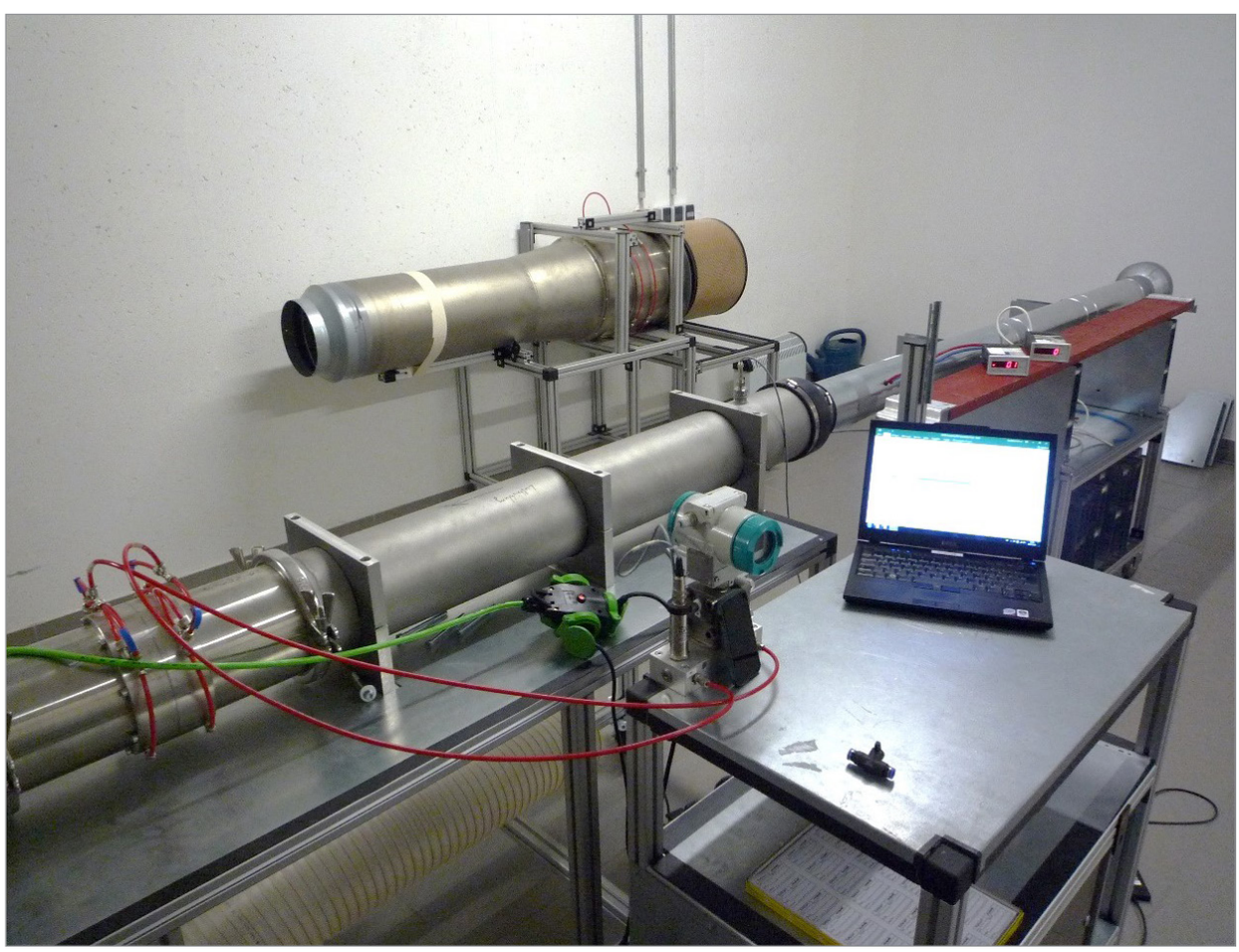
MEASURING LINE AND CONTROLLER CALIBRATION

Calibration of controllers and measuring lines with volumetric flow measuring cross, Venturi nozzles, or verification of the flow rate coefficient (heat capacity value).

CONTROLLER FUNCTIONALITY TEST

Control behaviour testing of mechanical and electrical flow rate controllers. Determination of the flow rate coefficient (heat capacity value).

Fig. 6: Volumetric flow controller testing & heat capacity determination



Technical data

***Lifting platform dimensions: 8 x 5.8 m; max. lift: 5.5 m ***Max. air quantity: 10,000 m^3/h ***Air temperature range: 5 °C to 60 °C ***WDV water heat meter[1)] ***Water temperature range: 5 °C to 60 °C ***Max water quantity 900 l/h

Experimental setup of air systems and air/water systems

A multitude of different rooms and their interior can be reproduced in the flow laboratory at full scale using an adjustable lifting platform to determine or verify the ventilation needs of customers. This enables visualizations of supply and exhaust air behaviour by adding artificial fog, and the application of the measurement procedures mentioned above.

Fig. 7: Experimental setup of air systems and air/water systems

Mobile metrology

AIR VELOCITY[1)]

Testo 9340 904	Measuring range: from 0.1 to 15 m/s
Testo 400	Measuring range: from 0 to 5 m/s

TEMPERATURE[1)]

Testo 400	Measuring range: from-40 °C to 150 °C
Globe thermometer	Measuring range: from 0 °C to 120 °C

AIR PRESSURE MEASUREMENT[1)]

Halstrup Walcher REG 21	Measuring ranges: from 0 to 50 Pa, from 0 to 100 Pa, 0 to 250 Pa, from 0 to 500 Pa, and from 10 to 9.99 KPa
Testo 400	Measuring range: from-100 hPa to +200 hPa

AIR FLOW MEASUREMENT[1)]

AHLBORN FV A605 TA1	Measuring range: from 0.01 to 1 m/s; from 0 to 40 °C
Testo 0636 9740	Measuring range: from 0 to 5 m/s; from 0 to 50 °C

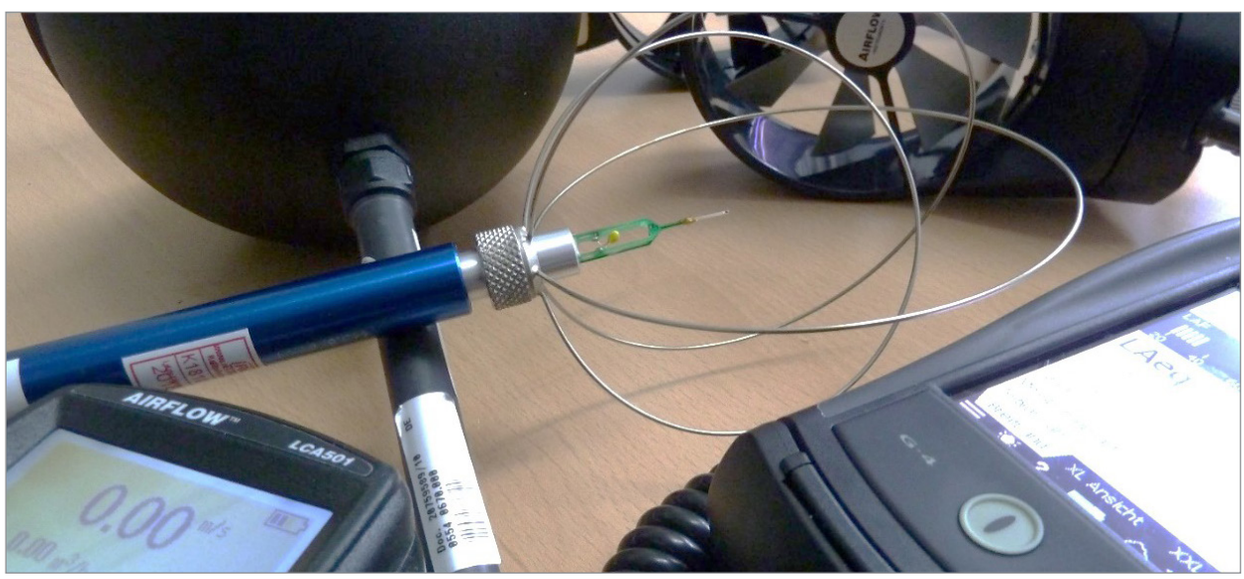
HUMIDITY MEASUREMENT[1)]

Testo 0636 9740	Measuring range: from 0 to 100 % r.H.;-20 to 70 °C
Testo 400	Measuring range: from 5 to 95 % r.H

SOUND MEASUREMENT[1)]

NORSONIC Nor850, Mic. type GRAS40HL	Measuring range: from 6 Hz to 20 kHz and from 6.5 to 110 dB

[1)] The measuring equipment is subject to a regular monitored calibration interval



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