Press article

Monitoring of Room Overflow

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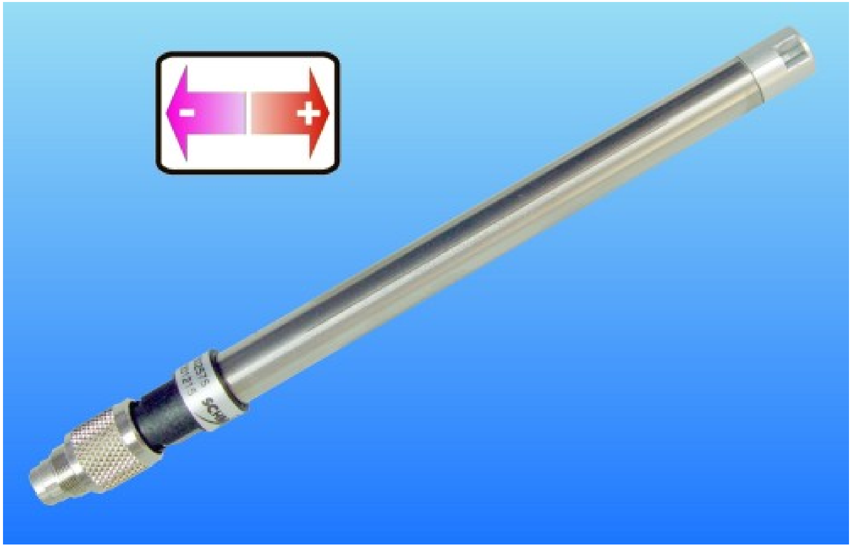


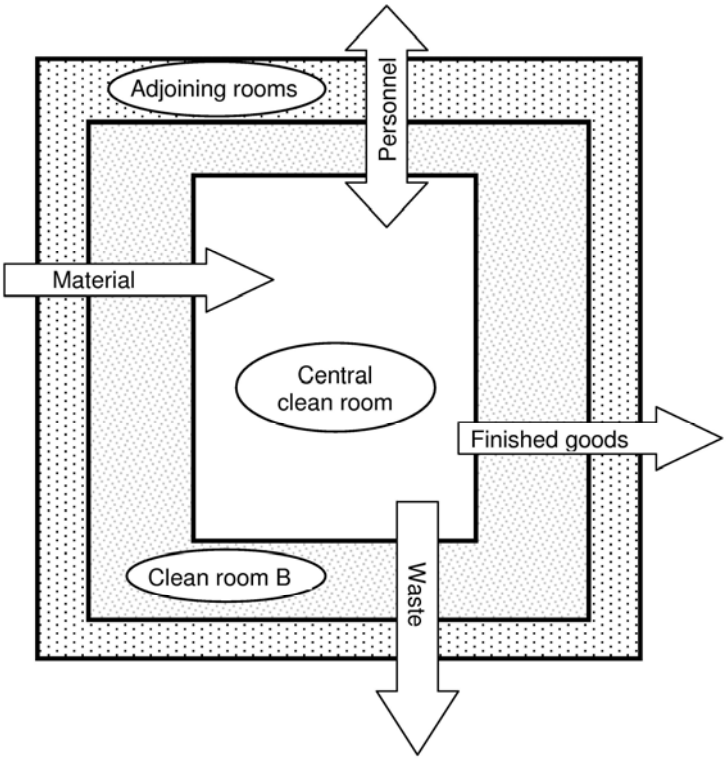
Picture 1: SCHMIDT® Flow Sensor SS 20.400

Introduction

SCHMIDT Technology offers a flow sensors which incorporates completely new features in a slim high quality metal housing. First time an insertion type thermal flow sensor can measure flow velocity as well as direction. The sensor has been designed especially in mind for low velocity measurements in clean room environment. Overflow measurements as well as air exchange between rooms can be improved substantially using the features descriped below.

Room overflow – some basic comments

Production processes in clean room require that no contaminated air either from the outside or the adjacent room intrudes affecting the production process, resulting in harmfull substances for instance in medical product or in the worst case causing direct harm to human beings in the room. Solution to avoid this is either a hermetically sealed room or a forced overflow generated by an overpressure in the area to be protected. The air with possible contamination will flow to the outside and possible contamination from the outside will not intrude. Common practice nowadays is to monitor the overflow by measuring the differential pressure between adjoining areas and keep it controlled. The values should be according to EN ISO 14644 within 5 to 20 Pascal. EN ISO 14644 also recommends the air flow velocity to be > 0.2 m/s equivalent to 0.024 Pascal m/s and with little turbulences. At rooms were doors or larger openings in walls such as production lines or frquently opening doors have to be installed an overpressure is difficult to maintain. In cases of cascaded rooms this target becomes even more dificult. for the central area. Measuring of the overflow is there
fore a good alternative being able to work with much lower overpressure and as can be seen from the example above it becomes almost impossible to get a stable differential pressure sensing for 0.024 Pascal which would be the equivalence to 0.2 m/s. Another advantage is the easiness of mounting of a flow sensor as no tubes are required and existing at already existing lead-throughs.



Picture 2: Concept of cascaded clean rooms

How are differential pressure and air flow velocity linked

In order to transform pressure difference in to overflow velocity as a first approximation „Torricelli's law" can be applied when a whole of sufficient diameter and length is used.

$$w = \sqrt{\frac{2 \cdot \Delta p}{\rho}}$$

Where:
w = Flow velocity in m/s
Δp = Differential pressure [Pa]
ρ = Fluid density [kg/m^3]

At air conditions of 20°C and 1013.25 hPas the following relations are given:

Differential pressure Δp [Pa]	Flow velocity w [m/s]
0,01	0.13
0.024	0.2
0,1	0.41
1	1.29
5	2.89
10	4.08
15	5.00
20	5.77
30	7.07

Based on this calculation it can be seen that the sensor mounted at the overflow opening can measure even at smallest differential pressures right down to 0.01 Pa.

Present solutions

The safest way to avoid backflow between two rooms is – as mentioned already- by applying a high overpressure. In pharmaceutical applications differential pressures of 15 … 30 Pascal are widely used. If however cascaded rooms are necessary the central rooms overpressure has to be increased to make sure that the outside rooms are still safe. At the approval the required overflow is visualized with the help of fume. For permanent monitoring and control of the overflow differential pressure sensors are widely used. The week point of this principle is that differential pressure sensors are not stable at low pressures so a relative high differential pressure has to be maintained which results in an unnecessary energy loss and unwanted turbulences.

Functional principle of the new sensor

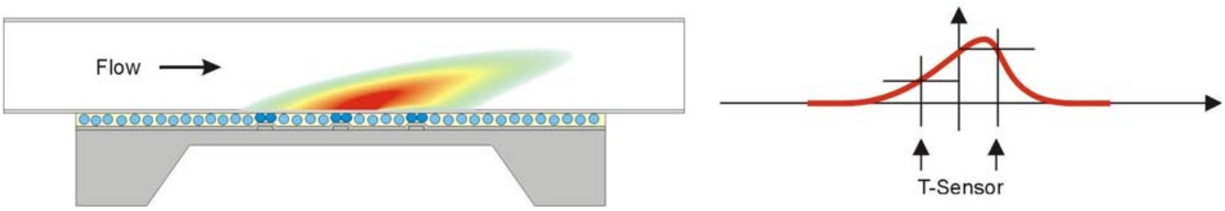
The flow sensor SS 20.400 from SCHMIDT Technology can measure the flow velocity and direction. The sensor is based on the thermal principle also known as hot wire anemometer. The SS 20.400 offers the following advantages for air velocity measurement:

- Measuring of lowest air velocity (starting with 0.05 m/s)
- No moving parts reducing resulting in long term stable performance
- Designed for very low very low air flow resistance with smallest pressure drop

Furthermore the SS 20.400 stand out due to more advantages

Principle of operation

The new sensing element is build symmetrical. Adjacent to a central heater two temperature sensors are placed.



Picture 3: Schematics of sensor principle

When air flows across the element one temperature-element will see a higher and the other element a lower temperature. The temperature difference represents now a value for calculating the airflow velocity. At the same time the direction of the airflow can be determined. Due to the microstructure of those elements the reaction time is as low as 10 ms, which is factors better than most of other thermal sensors used nowadays.

Miniaturized sensing elements and electronics

For protection purposes the sensor element is build in an air flow optimized sensor tip which results in good measuring results even if the tip is not mounted perfectly in line with the air flow (i.e. slightly tilted or twisted). The necessary electronics is mounted in the tube following the tip so no separate or voluminous electronic or transducer is needed. The microprocessor based electronics contains various connection possibilities such as: analogue output 0 (4) … 20 mA / 0 … 10 V, directions indication, two level switching (both as open collector), as well as an RS 232 interface. The analogue output delivers a linear output signal for forward or backward flow. Via the RSS 232 interface the user can program certain features in the field. For this SCHMIDT Technology can supply a separate programming kit connected to a PC.

Summarizing the advantages

- Well-defined direction sensing
- Measuring of forward and backflow velocity with one sensor
- Fast response time within ms-range
- Integrated programmable flow level switching output therefore usable also as alarm unit
- Small dimensions
- Parameterization via programming kit/PC
- Built in contamination sensing of measuring tip
- Material in line with GMP requirements

Technical data

Design:	Insertion type sensor (Ø 9 x 150 mm incl. plug), Transducer integrated
Application area::	Laminar flow measuring in rooms or tubes
Measuring range:	0.05 to 1 / 2.5 / 10 / 20 m/s (in two directions)
Ambient pressure:	atmospheric, 700 .. 1300 hPa
Mounting:	Mobile, wall or ceiling with special mounting kits
Supply voltage:	12 … 24 VDC
Signal outputs:	0 / 4 ... 20 mA , 0 .. 2 /5/10 V 2 open collector outputs for direction and switching level RS 232 for parameterization

Applications of the sensor

The SCHMIDT Flow sensor SS 20.400 is ideally for application in overflow measuring as described above. For mounting flanges for wall mounting (see below) or compression fitting are available. The diameter for the overflow channel depends on the required air volume exchange rate. As the sensor measures already from 0.05 m/s (i.e. <<0,01Pa) an overflow is still detectable whereas the differential pressure cannot be applied any more. This enables clean rooms to be designed much better energy efficiency. At the same time reverse flow can be detected which in cases were polluted air or aggressive content exist sensing is a must to either protect people or avoid damage of sensitive products.

Picture 4: Clean Room wall with hole for overflow (arrow)

Picture 5: Flow sensor SS 20.400 in front of an overflow opening

The following diagram show the results of the analogue output (blue) and the switching output “OC1” (green) for the monitoring of a clean room in a pharmaceutical production.

Picture 6: Signal characteristics at overflow monitoring

The peak in the output voltage results from opening doors. A short opening does not lead to an alarm whereas longer openings will cause the pressure and thus the overflow to drop below a specified value and the switching output will react.
With the SCHMIDT® Programming kit the user can adjust the signal delay time as well as the switching threshold to its needs.

Picture 7: SS 20.400 in a version for laminar down flow

The sensor is available in different versions suitable for a variety of applications in the clean room area such as:

Laminar flow monitoring
Flow supervision of inlet and/or exhaust air volume
Supervision of cooling air
Flow control for shielding gas

Summary

The flow sensor SS 20.400 opens totally new possibilities in the clean room area with the following advantages:

- Stable long term measuring signal even at lowest differential pressures
- No false alarm due to sensor drifting
- Simple mounting (no additional pipes needed)
- Cleaning when installed possible (for instance with H_2O_2)
- Fast installation and dismounting (i.e. in case of calibration)

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