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Measuring Air Velocity - Basics

Operating Principle

The E+E air velocity sensor is an hot film anemometer. An electrical current is increasing the temperature of a resistor on the substrate. The flowing air causes a reduction of this temperature. The cooling effect is directly proportional to the mass flow and consequently to the air velocity and inversely proportional to the air temperature. At equilibrium, the temperature of the sensor's surface is the measure for mass flow.
For temperature compensation a second temperature sensor shall be placed in the same air flow. In the new E+E design both sensors are on the same substrate.

The sensitivity of the air velocity sensor is strongly related to the difference between the temperature of the heated element and of the flowing air.

$$\Delta T = T_{Sensor} - T_{Air}$$

The higher the **ΔT**, the higher the sensitivity.

On the other hand, the electrical power consumption P_{sensor} should be as low as possible.

The designer's target is to maximize the ratio temperature difference **ΔT** to power consumption P_{sensor}.

$$R_{Th-L} = \frac{T_{Sensor} - T_{Air}}{P_{Sensor}}$$

R_{Th-L} is the sensor's characteristic number „Thermal Loss Resistance", also called „Natural Thermal Coefficient".

R_{Th-L} depends on the design of the sensor, as well as on its practical installation.

Sensor Design

The most important negative phenomenon is the thermal loss through the sensor's terminals. Appropriate sensor geometry and careful selection of material are reducing this source of errors to a great extent.

Substrate Material

A substrate material with very low thermal conductivity allows for higher temperature difference ΔT.

Substrate Thickness

The electrical power consumption of the sensor is directly proportional to the thickness of the substrate.

Electrical terminals

The electrical power consumption is inversely proportional to the distance between the heating element and the terminals

The design of E+E air velocity sensors:

Substrate material : glass
Substrate thickness : 0.15mm
Stripe form, typical 2 x 10mm, with a terminal at each end
(see also 'Air Velocity Sensor Elements')

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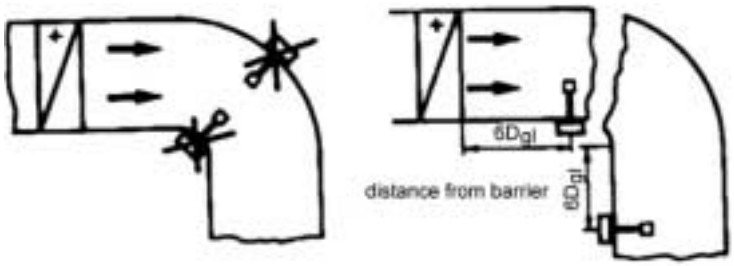
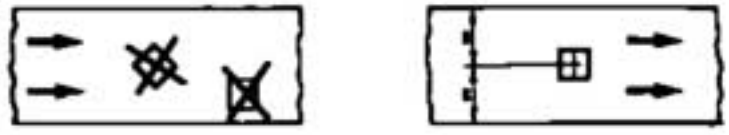
Positioning The Air Velocity Probe

The correct position of the sensing probe is the main condition for reliable and accurate measurement of the air velocity.
Turbulence appears after fans as well as after turns, junctions or section changes in the duct. Reliable measurements are only possible if the probe is placed far enough from such places. The minimum distance is a function of the duct's diameter. The equivalent diameter of a rectangular duct a x b is

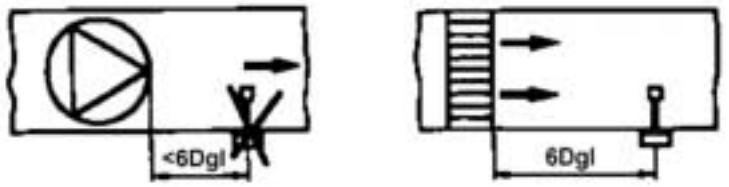
$$D_{gl} = \frac{2 \cdot a \cdot b}{a + b}$$



The following pictures are guidelines for correct installation of air velocity transmitters. Reliable measurements can be made by positioning the transmitter after filters (clean rooms), air heaters or air coolers, where the turbulence is very low.



The probe shall be installed in the middle of the duct.



Preferred location after filters, rectifiers, coolers
(no turbulances)

The probe shall be placed in front of diffusers or confusers.

Filters and coolers calm down the air flow.

Maintenance of E+E Air Velocity Transmitters

Due to the absence of moving parts, the E+E air velocity transmitters are very reliable. Their innovative hot film anemometer principle makes them highly insensitive to dust and dirt. Under normal environmental conditions no maintenance is required.
For operation in polluted environment we recommend to clean the sensor periodically by washing it in isopropyl alcohol and let it dry. Do not touch or rub.

Measuring Air Velocity-Basics