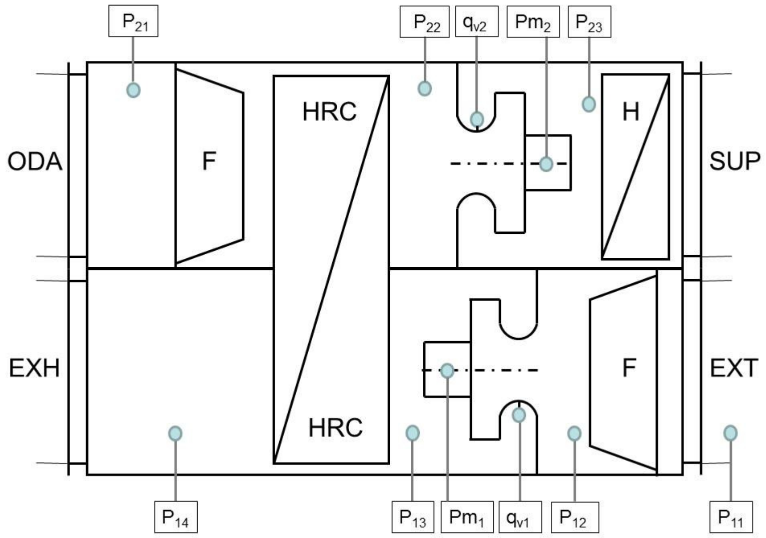
I Measurement of ventilation data (capacity measurement) SFP_{int}

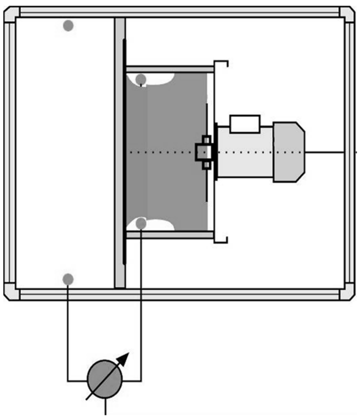
Capacity measurements occur at constant nominal airflow rates under the reference condition.



Following values are measured:

1. Airflow rates

   Airflows q_v are preferable measured by a pressure loss measurement at the fan nozzle or by a measurement nozzle in the laboratory.



$$q_v = \alpha \cdot \varepsilon \cdot d^2 \cdot \pi/4 \cdot \sqrt{2 \cdot \Delta p/\rho}$$

where:

q_v	air flow in m³/s
α	flow coefficient
ε	compression index (ε = 1 bei < 2.000 Pa)
d	diameter of nozzle (most narrow cross section) in m
Δp	pressure loss between suction space and nozzle in Pa
ρ	air density in kg/m³ during the measurement in kg/m³

Alternatively the airflows can be measured by a duct related measurement according to EN 12599.

2. Pressure
   The system pressure p need to be measured before and after the respective components. Therefore it is recommended to install loops (ring lines) to measure static pressure as an average value before and after the respective measuring point. Ring lines should be installed properly (if plastic tubes are used, the holes should be drilled after mounting the ring lines to ensure 90° alinement to the airstream or non twisting copper tubes should be used)

3. Absorbed electric motor power
   The absorbed electric motor power Pm is measured by an electric effective capacity measurement.

Measured air flows, pressure losses and absorped motor power have to be recalculated to the standard density (base of the selection, in general 1,2 kg/m³) with:

$$\Delta p_{corr.} = \Delta p_{meas.} \frac{\rho_S}{\rho_{meas.}} \quad \text{and:} \quad q_{v\,corr.} = q_{v\,meas.} \sqrt{\frac{\Delta p_{corr.}}{\Delta p_{meas.}} \frac{\rho_{meas.}}{\rho_S}} \quad \text{and:} \quad Pm_{corr.} = Pm_{meas.} \frac{\rho_S}{\rho_{meas.}}$$

with : ρ_S standard air density (e. g. 1,2 kg/m³)

The specific fan capacity results from the physical law:

$$\mathrm{S}FP_{\mathrm{int}} = \frac{\mathrm{Pm}_{\mathrm{int}}}{\dot{q}_v} = \frac{\Delta \mathrm{P}_{\mathrm{int}}}{\eta_v}$$

where Pm_{int} results from Pm:

$$Pm_{\mathrm{int}} = \frac{Pm}{\Delta P_{static}} \cdot \Delta P_{\mathrm{int}}$$

with:

$$\Delta P_{\mathrm{int}} = \Delta P_{HRS} + \Delta P_F + \Delta P_{Casing} = \Delta P_{static} - \Delta P_{external} - \Delta P_{additional}$$

and:

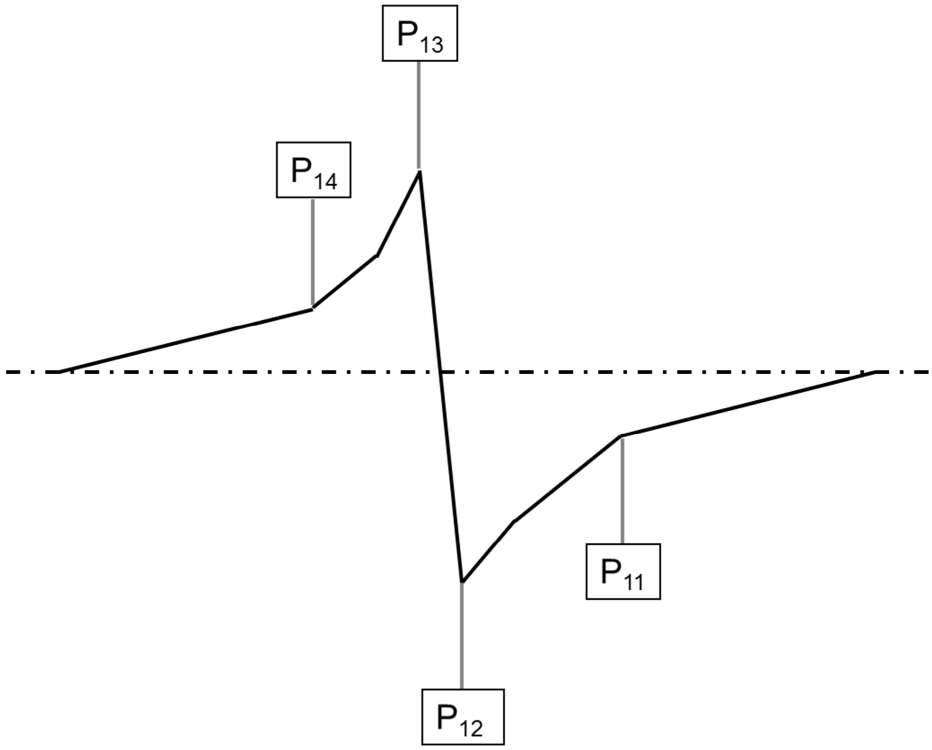
$$\Delta P_{static} = P_{13} - P_{12} \qquad \text{or:} \qquad \Delta P_{static} = P_{23} - P_{22}$$

with:

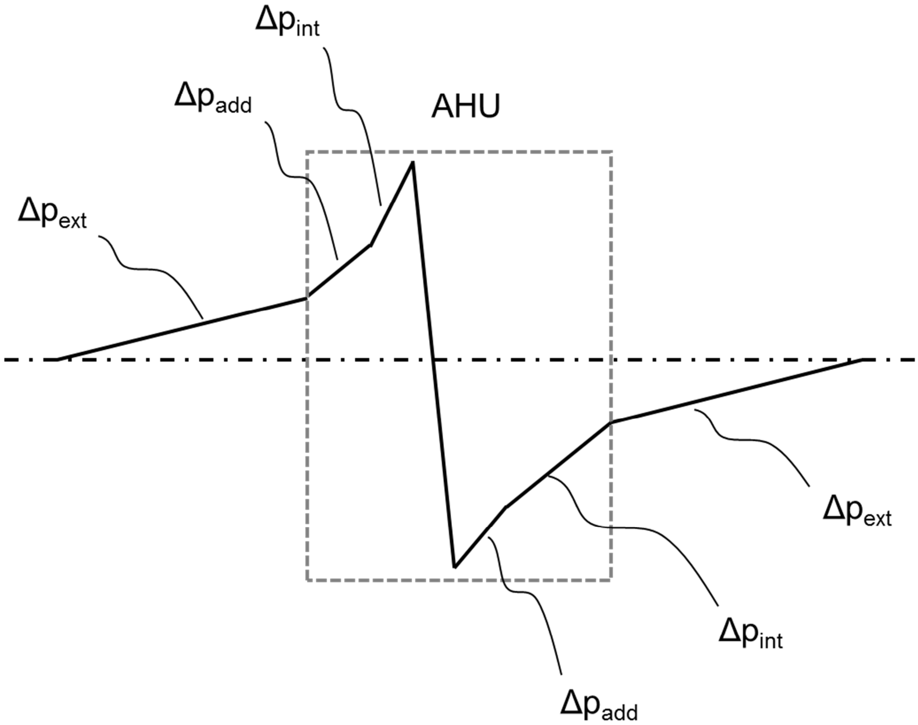
η_v fan efficiency (system) incl. motor, drives and controller (e. g. frequency inverter) in a installed condition

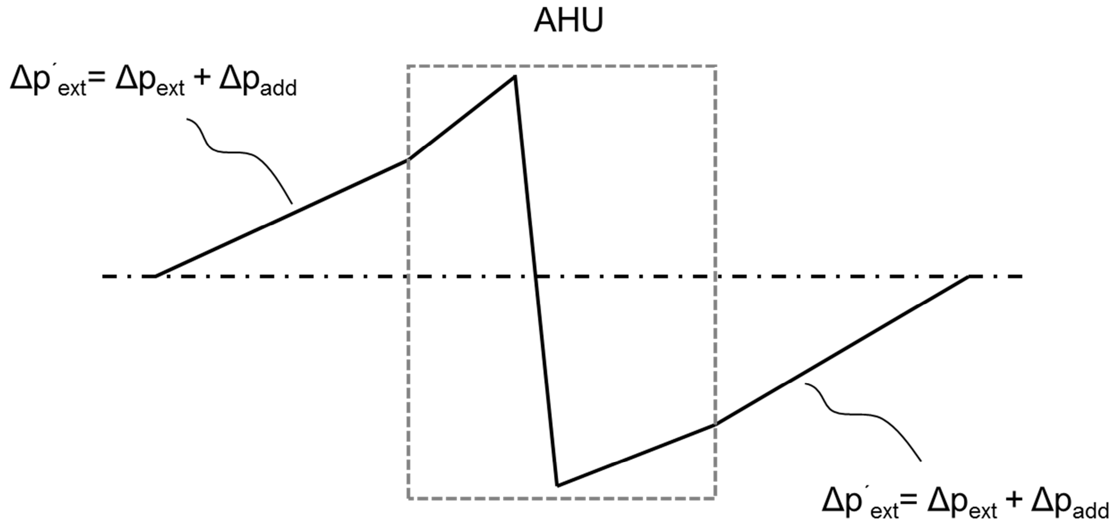
$$\eta_v = \frac{\dot{q}_v \cdot \Delta \mathrm{P}_{\mathrm{static}}}{Pm}$$

Note: With additional components: After a first measurement in the reference condition, additional components have to dismounted and $\Delta p_{additional}$ has to added to $\Delta p_{external}$ by adapting the external pressure by e. g. dampers on suction oder pressure side (depending the preinstalled condition of the additional components). See sketches below.



$$\eta_v = \frac{\dot{q}_v \cdot (P_{13} - P_{13})}{Pm}$$





$$SFP_{\text{int}} = \frac{\Delta \mathrm{P}_{\text{int}}}{\eta_v}$$

with:

$$\Delta P_{\text{int}} = (\mathrm{P}_{13} - \mathrm{P}_{13}) - \Delta P'_{external}$$

The measuring error results from the partial transmission with:

$$u_{\Phi} = \pm \sqrt{\left(\frac{\partial f(SFP)}{\partial Pm}\right)^2 u_{Pm}^2 + \left(\frac{\partial f(SFP)}{\partial \dot{q}_v}\right)^2 u_{\dot{q}_v}^2}$$

for the absorbed motor power for the airflow

$$\frac{\partial f(SFP)}{\partial Pm} = \frac{1}{\dot{q}_v} \qquad \frac{\partial f(SFP)}{\partial \dot{q}_v} = -\frac{Pm}{\dot{q}_v^2}$$

As a result of the partial error calculation, it becomes obvious that the usual measurement uncertainties of the absorbed motor power and the measurement of pressure losses increase with **~1%.** The measurement uncertainty of the **airflow** increases obviously with **~3%.**