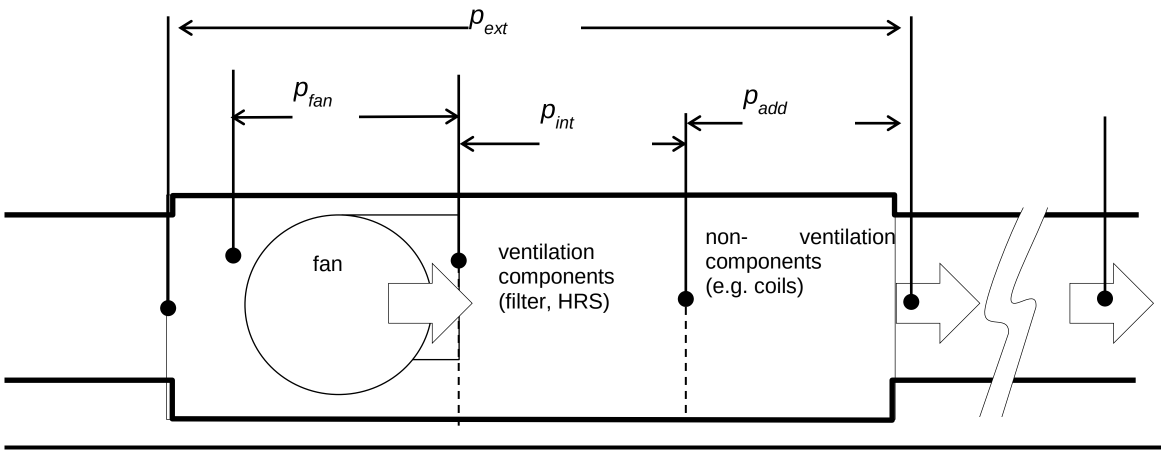
CALCULATION OF SFPINT

1. CLARIFICATION ON SFP

1. Definition, physical background and calculation of SFP

For simplicity of presentation, we consider only one air stream, in reference conditions as set in ErP Regulation but the methodology is of course applicable on both streams :



A SFP (Specific Fan Power) is defined as the ratio between an electrical input power and an airflow. It is expressed as kW/(m3/h)

$$SFP = \frac{P}{qv} \tag{1}$$

With :

P : Electrical power input of the unit

qv : Airflow through the unit

If we consider the fan being integrated in the unit, we can express the fan efficiency as follows:

$$\eta_{fan} = \frac{Aerodynamic\ power\ output}{Electrical\ power\ input} = \frac{qv \times p_{fan}}{P} \tag{2}$$

With :

p_{fan} : Total fan pressure difference outlet/inlet

By combining **Erreur ! Source du renvoi introuvable.** and (2) we get :

$$SFP = \frac{p_{fan}}{\eta_{fan}} \tag{3}$$

With :

η_{fan} : Total efficiency of the fan while integrated in the unit

2. Definition, physical background and calculation of SFPint (internal SFP)

We can split p_{fan} in several elements:

$$p_{fan} = p_{ext} + p_{int} + p_{add} \tag{4}$$

With :

p_{ext} : External pressure for the ductwork (easy to measure).

p_{add} : Pressure loss of additional components according to ErP (known)

p_{int} : **It's the remaining part, not easy to measure**. By definition it is internal pressure losses

$$p_{int} = p_{fan} - p_{ext} - p_{add} \tag{5}$$

In the same way we can split the SFP as follows:

$$SFP = \frac{p_{fan}}{\eta_{fan}} = \frac{p_{ext} + p_{int} + p_{add}}{\eta_{fan}}$$

$$= \frac{p_{ext}}{\eta_{fan}} + \frac{p_{int}}{\eta_{fan}} + \frac{p_{add}}{\eta_{fan}}$$

$$= SFP_{ext} + SFP_{int} + SFP_{add} \tag{6}$$

And this is SFP_{int} that is regulated in ErP regulation

$$SFP_{int} = \frac{p_{int}}{\eta_{fan}} \tag{7}$$

By combining with (2) and (5)

$$SFP_{int} = \frac{(p_{fan} - p_{ext} - p_{add}).P}{qv \times p_{fan}} \tag{8}$$

In order to evaluate it we need to know:

- qv
- P
- p_{fan}
- p_{ext}
- p_{add}

The most difficult parameter to access is p_{fan}

3. Discussion on the efficiency to consider

The formulas developed above are only valid for p_{fan} and η_{fan} evaluated on the fan **while being integrated** in the ventilation unit.

Any approach considering data of the fan out of the unit is wrong and would lose consistency with SFP fundamentals and direct measurement approach.

2. Determination of SFP_{int}

1. Direct measurement with total pressure probes

Direct measurement of p_{fan} is complex and sensitive because the unit must be equipped with pressure inlet properly installed in order to measure inlet/outlet pressure without being disturbed by recirculation or high speed streams. It's really a challenge in compact units.

2. By calculation

If direct measurement of p_{fan} is not possible, SFP_{int} may be estimated from p_{int} by calculation.

We get p_{int} from the following formula:

$$p_{int} = \sum p_{comp} \quad (9)$$

With :
$\sum p_{comp}$:Sum of pressure losses of components of the reference configuration according the the ErP regulation, **including the pressure loss of the casing**

It is important to notice that p_{comp} may be higher than the theroretical pressure loss of the component calculated or given by the manufacturer that is often the lowest value when the component is crossed by an ideally distributed airflow. **If the airflow is non-homogeneously distributed (for instance at the outlet of a fan), the pressure drop of the component will be higher**. This phenomenon has to be taken into account.

And from there and equations (4), (8) and (9) we get SFP_{int} :

$$SFP_{int} = \frac{\sum p_{comp} \times P}{qv \times (p_{unit} + \sum p_{comp} + p_{add})} \quad (10)$$

For ErP calculation, the calculation has to be done on both supply and extraction air streams, and values are added.