

## Requirements and test procedures for energy relevant and acoustic assessment of Passive House ventilation units for certification as Passive House Components

### Supplementary sheet for the efficiency ratio - provisional

The efficiency ratio is used for the overall energy relevant assessment of a ventilation unit. It specifies the amount by which the energy demand caused by ventilation can be reduced through the use of a ventilation unit with heat recovery.

The efficiency ratio takes into account the final energy demand for covering the ventilation heat losses and the necessary auxiliary energy for the ventilation unit and the frost protection strategy. Because heat supply takes place with a heat pump, only electrical energy is incurred (different approaches for primary energy factors therefore do not play any role). The efficiency ratio is determined using a representative data set for the relevant climate zone.

The efficiency ratio is calculated in accordance with the following formula:

$$\varepsilon = \frac{Q_{V,end,ref} - Q_{V,end,HR} - Q_{rv,aux} - Q_{rv,defrost}}{Q_{V,end,ref}}$$

$Q_{V,end,ref}$  Final energy demand for covering the ventilation heat losses of a reference system without heat recovery [kWh/a]

$Q_{V,end,HR}$  Final energy demand for covering the ventilation heat losses of the ventilation system with heat recovery [kWh/a]

$Q_{rv,aux}$  Energy demand of the ventilation unit in the heating period [kWh/a]

$Q_{rv,defrost}$  Energy demand of the frost protection strategy for the heat exchanger [kWh/a]

With the following calculation approaches:

$$Q_{V,end,HR} = V \cdot n \cdot c \cdot (1 - \eta_{HR}) \cdot G_t \cdot e_H$$

$$Q_{V,end,ref} = V \cdot n \cdot c \cdot G_t \cdot e_H$$

$$V \cdot n = 1 \text{ m}^3/\text{h}$$

$$c = 0.33 \text{ Wh}/(\text{m}^3\text{K})$$

$\eta_{HR}$  measured heat recovery efficiency (according to the PHI test regulations) [-]

$G_t$  heating degree hours in accordance with the climate zone [kKh/a]

$e_H = 0.44$  performance ratio of the electric heat pump heating system [-]

$$Q_{rv,aux} = 0.001 \cdot V \cdot n \cdot P_{el} \cdot t_H$$

$P_{el}$  measured specific electrical power consumption of the ventilation unit (according to the PHI test regulations) [W/(m<sup>3</sup>/h)]

$t_H$  duration of the heating period (for ventilation system operation) according to the climate zone [h]

$Q_{rv,defrost}$  energy demand for the frost protection strategy [kWh/a]. Calculation algorithm according to [PHPP]

Frost protection strategy: the following switch-on points are used depending on the foreseen frost protection strategy.

Frost protection strategy	Switch-on point outside air temperature [°C]
Rotor/regenerative heat exchanger	< -15 °C
Recuperative heat exchanger with moisture recovery	Ca. -8 °C
Recuperative heat exchanger without moisture recovery	-3 °C
Recuperative heat exchanger without moisture recovery	-1.5 °C

For recuperative heat exchangers without moisture recovery a general switch-on temperature of -1.5°C is assumed initially; lower switch-on temperatures can be taken into account later on after verification. Please contact us for this.

Climate data:

Climate zone cool, temperate (representative location: Frankfurt am Main):

$G_t = 79 \text{ kKh/a}$ ,  $t_H = 5136 \text{ h}$