Certificate

Certified Passive House Component
For cool, temperate climates, valid until 31 December 2018

Passive House Institute
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Category: **Heat recovery unit**
Manufacturer: **Ventacity Systems, Inc.**
97201 Portland, UNITED STATES
Product name: **VS1000 RTe**

This certificate was awarded based on the following criteria:

Thermal comfort	$\theta_{supply\ air} \geq 16.5$ °C [2)] at $\theta_{outdoor\ air} = -10$ °C
Effective heat recovery rate	$\eta_{HR,eff} \geq 75\%$
Electric power consumption	$P_{el} \leq 0.45$ Wh/m³
Performance number	≥ 10
Airtightness	Interior and exterior air leakage rates less than 3% of nominal airflow rate
Balancing and adjustability	Airflow balancing possible: yes Automated airflow balancing: yes
Moisture recovery	Moisture recovery rate < 0.6 no Adjustment of airflow by means of moisture control required: yes [3)]
Sound insulation	It is assumed that large ventilation units are installed in a separate building services room. Sound levels documented in the appendix of this certificate.
Indoor air quality	Outdoor air filter F7 Extract air filter G4
Frost protection	Frost protection required Different strategies mentioned in the appendix of this certificate.

1) The real available external pressure with installed filters, internal electrical preheater and shut-off dampers is **172 Pa**. Additional components decrease the available pressure difference accordingly.
2) Achieved by use of an internal electrical preheater.
3) The limitation of indoor air humidity must be ensured separately for each zone.

Further information can be found in the appendix of this certificate.

Certified for airflow rates of 500-1050 m³/h at an external pressure of 228 Pa [1)]
Requirements non residential buildings (Therewith device also applicable for residential building)

$\eta_{HR,eff}$ 82%

Electric power consumption 0.36 Wh/m³

Moisture recovery $\eta_X = 0.70$

Performance number 11.5

CERTIFIED COMPONENT
Passive House Institute

Appendix of the certificate Ventacity Systems, Inc., VS1000 RTe

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Moisture recovery

By means of moisture recovery the indoor air humidity can be higher than without moisture recovery. Especially during the winter months that could lead to reduced heating demand caused by less evaporation of water from construction components and furniture. This energy relevant influence is considered, depending on the moisture recovery rate, with a bonus on the heat recovery rate of the ventilation device.

- Adjustment of air flow by means of moisture control:
  - Since the moisture recovery of the heat exchanger exceeds a humidity ratio of 0.6, humidity-controlled volume flow adjustment is required in order to avoid damage due to temporarily excessive indoor air humidity.
  - In cases of centralized ventilation systems serving several operation zones (i.e. several apartments), care should be taken to ensure that the recommended relative humidity of approx. 60 % will not be exceed in any of these zones.
  - The limitation of indoor air humidity due to higher volumetric flows must therefore be ensured separately for each zone. An appropriate solution must be developed for each project as part of the planning.
- Application of moisture recovery:
  - In cool temperate climates, heat exchanger with moisture recovery in general should only be used if the internal moisture load of the building is low compared to normal utilization (e.g. residential building with occupancy rate (far) below average).
  - If planning the application of moisture recovery in building with average occupancy rate, the energy balance of the building is to be calculated with an increased air flow rate according to following formula.

$$V_{eff} = V_{hyg} \cdot \frac{0{,}4}{1-\eta_x}$$

  - Adjustment of airflow by means of moisture control required, even though that in case of low internal moisture the increased air flow rate is not needed often.

Passive House comfort criterion

A supply air temperature of 17.1 °C is maintained at an outdoor air temperature of about -10 °C by use of an internal electrical preheater.

Effective heat recovery rate

The effective dry heat recovery efficiency is measured at the test facility with balanced mass flows on the external air/extract air side. The boundary conditions for the measurement are defined in the testing procedure.

$$\eta_{HR,eff} = \frac{(\vartheta_{ETA} - \vartheta_{EHA}) + \frac{P_{el}}{m \cdot c_p}}{(\vartheta_{ETA} - \vartheta_{ODA})} + 0{,}08 \cdot \eta_x$$

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Annotation: For moisture recovery the bonus is limited to a maximum of 4.8 %.
The (dry) ventilation heating load (the house is the system boundary) can be calculated using $\eta_{HR,eff}$ based on the formula $\dot{V}_{supply\_air} * (1- \eta_{HR,eff}) * 0.34 * \Delta\vartheta$ (multiplied by the infiltration rate). The rates of heat recovery are usually greater if condensation occurs in the heat exchanger. Initially, this will not be taken into account on purpose.

The heat recovery rate for this device:

$$\eta_{HR,eff} = 82\ \%$$

Airflow range and external pressure difference

The operational range of the device results from the efficiency criterion (see below). As per the certification criteria for ventilation units > 600 m³/h the applicable pressure differences vary with the nominal range of operation (as declared by the producer) and the application (residential or non-residential building).

The external pressure difference includes all pressure losses of the ventilation system caused by components apart from the tested unit (consisting of casing, heat exchanger and fans). If filters are installed inside of the unit, their pressure losses are to be reduced accordingly. The average filter pressure drop of an operational filter is assumed to be 30 % higher than that of the clean filter.

- According to the certification requirements for non-residential buildings the airflow range achieves 500-1050 m³/h at an external pressure difference of **228 Pa**. The available pressure difference with installed filters, internal electrical preheater and shut-off dampers is about **172 Pa.**

Efficiency criterion (power consumption)

The overall electrical power consumption of the device including controllers was measured at the test facility as per the requirements for non-residential buildings at an external pressure difference of 228 Pa. The measurements lead to values of:

0.36 Wh/m³

Based on the measured values for the calculation of heat recovery efficiency and power consumption and on the climatic data of central Europe (Gt: 84 kKh, heating time: 5400 h/a), an average performance number at the airflow range was determined:

✓ **Performance number: 11.5**

Airtightness and insulation

The airtightness of the unit is tested for under pressure and over pressure before the thermodynamic test is conducted. As per the certification criteria the leakage airflows must not exceed 3 % of the average airflow of the device's operating range.

Following leakage rates were measured:

Internal leakage: 2.48 %

External leakage: 1.75 %

This appliance meets the airtightness requirements.

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Balancing and adjustability

The ventilation unit must provide the opportunity to adjust the balance between the exhaust and outdoor airflow (unit located inside of the thermal envelope) or the extract and supply airflow (unit located outside of the thermal envelope). Possible operation modes are explained in detail in the operation manual.

- Balancing the airflow rates of the unit is possible
  - ✓ The airflow volumes can be held steady automatically (by measurement of pressure differences inside of the unit and adjusting of the fan speed).
- The standby consumption of this ventilation appliance of 15.0 W is regarded as high. In order to avoid unnecessary standby losses, a manual switch for complete disconnection from the power supply should be installed.
- After a power failure this appliance automatically returns into operation once the power supply is back online.

Acoustic testing

A ventilation unit > 600 m³/h is assumed to be operated in an installation room, for which sound limits are defined in the applicable regulations. For this device, the following sound level values have been derived from the measurements at an airflow rate of **1050 m³/h**:

Sound level unit [dB(A)]	Sound level ODA [dB(A)]	Sound level SUP [dB(A)]	Sound level ETA [dB(A)]	Sound level EHA [dB(A)]
58.7	56.0	66.1	56.8	65.3

- For complying with the required sound level in the supply air and extract air rooms, dimensioning of a suitable silencer is required for the specific project on the basis of the measured sound level.

Indoor air quality

This device is equipped with following filter qualities:

- ✓ Outdoor Air filter F7
- ✓ Extract Air filter M5

If the device is not operated during summer, the filter should be replaced before the next operation. The producer of the device has to ensure that based on the latest findings, room air hygiene can be maintained by means of integrated or obligatory components

For the operation of ventilation systems a strategy for avoiding permanent moisture penetration of the outdoor air filter needs to be considered. The strategies are mentioned in the full report and can be implemented through installation of either an additional component of the ventilation device or on the ventilation site system.

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Frost protection

Appropriate measures must be provided in order to avoid icing inside the heat exchanger and freezing of the hydraulic post-heater coil during winter at extreme temperatures (-15 °C). The actual function of the ventilation device must not be impaired by the regular operation of the frost protection system. A sufficient air supply must be provided with balanced airflows. Infiltration due to excess extract air would cause an unacceptable heat load. For the frost protection of the hydraulic post-heater coil the failure of a pre-heater coil or the exhaust air fan needs to be considered.

- Frost protection circuit for the heat exchanger:
  - ✓ In order to ensure a frost protection of the heat exchanger, the unit is equipped with an internal electrical preheater with a maximum power of 5.96 kW. In case that the internal preheater is not used, another sufficient frost protection strategy has to be additionally adopted in order to protect the heat exchanger from freezing (e.g. hydraulic heating coils).
- Frost protection circuit for the post heater coil:
  - ✓ In order to prevent damage to a hydraulic supply air heater coil, an internal control algorithm ensures switching off the fans in case that specific boundary conditions occur.

  It should be noted that cold air can also lead to freezing of stationary fans due to free circulation; this can only be ruled out if the air duct is closed (by means of a shut-off flap).

Bypass of the heat recovery

An automatically controlled summer bypass of the heat exchanger is part of this device. The effectiveness of bypass for night cooling of buildings has not been investigated within the scope of this testing.

Abbreviations:

ODA = Outdoor air

EHA = Exhaust air

SUP = Supply air

ETA = Extract air