

Certificate

Certified Passive House Component

For cool, temperate climates, valid until 31 December 2014

Category: **Heat recovery unit**
Manufacturer: **Atrea s.r.o**
46601 Jablonec nad Nisou, Czech Republic
Product name: **DUPLEX S 3600 Flexi**

This certificate was awarded based on the following criteria:

Thermal comfort	$\Theta_{\text{supply air}} \geq 16.5 \text{ }^\circ\text{C}$ at $\theta_{\text{outdoor air}} = -10 \text{ }^\circ\text{C}$
Effective heat recovery rate	$\eta_{\text{HR,eff}} \geq 75\%$
Electric power consumption	$P_{\text{el}} \leq 0.45 \text{ Wh/m}^3$
Performance number	≥ 10
Airtightness	Interior and exterior air leakage rates less than 3% of nominal air flow rate
Balancing and adjustability	Air flow balancing possible: yes Automated air flow balancing: yes ²⁾
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 at least F7 Extract air filter at least G4
Frostprotection	Frost protection required Different strategies mentioned in the appendix of this certificate

- 1) Available pressure difference with installed filter: **217 Pa**.
Additional components (e.g. heater coil) decrease the available pressure difference accordingly.
- 2) Only if pressure gauges are installed and the control system box is equipped with an additional mode for air flow balancing.

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

Certified for air flow rates of 800 – 2800 m³/h

At an external pressure of **286 Pa** ¹⁾

Requirements non residential buildings (Therewith device also applicable for residential building)

$\eta_{\text{HR,eff}}$ **84%**
(800 m³/h)

$\eta_{\text{HR,eff}}$ **80%**
(1700/ 2800 m³/h)

Electric power consumption
0.45 Wh/m³

Performance number
10



CERTIFIED COMPONENT

Passive House Institute

Appendix of the certificate Atrea s.r.o , DUPLEX S 3600 Flexi

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Passive House comfort criterion

With active frost protection of the heat exchanger a minimum supply air temperature of 16.5 °C is maintained at an external air temperature of -10 °C.

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.

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

The (dry) ventilation heating load (building is the system boundary: Plus Infiltration) can be calculated:

$$\dot{Q}_{Ventilation,dry} = \dot{V} \cdot (100\% - \eta_{HR,eff}) \cdot 0,34 \Delta \vartheta$$

In case of condensation the heat recovery rate usually is higher. For the thermodynamic testing air conditions are chosen which exclude condensation. The heat recovery rate of this device amounts to:

$$\eta_{HR,eff} = 84\% \text{ (measurement point 800 m}^3\text{/h)}$$

$$\eta_{HR,eff} = 80\% \text{ (measurement point 1700/ 2800 m}^3\text{/h)}$$

Air flow range and external pressure difference

The air flow range of this device is limited by the required maximum electric power consumption. Referred to the PHI-criteria for ventilation units > 600 m³/h different external pressure differences according to the upper limit of the air flow range and the application (residential building or non-residential building) are required.

Thereby the external pressure difference is defined by all pressure losses in the ventilation system (whole ducting system) outside of the tested unit, which only consists of casing, heat exchanger and fans. If filters are already installed in the appliance, the external pressure difference can be reduced by the average filter pressure drop. (it is assumed that the average filter pressure drop in operation is 30% higher than the filter pressure drop of the clean filter).

- This device was tested according to the requirement of non-residential building with an air flow range of 800 – 2800 m³/h at an external pressure difference of 286 Pa. The available pressure difference with installed filters is about **217 Pa**

Efficiency criterion (power consumption)

The overall electrical power consumption of the device including controllers was tested at the test facility for the requirements of non-residential buildings at an external pressure difference of 286 Pa.

Measurement results: **0.45 Wh/m³**

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

- ✓ **Performance number: 10**

Air tightness and insulation

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

The following result was obtained for the device being tested:

Internal leakage: 2.7%

External leakage: 1.8%

This appliance meets the air tightness requirements.

Balancing and adjustability

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

- Die Balance-Einstellung der Ventilatoren erfolgt
- Balancing the air flow rates of the unit is possible
 - ✓ the air flow rates are hold steady automatically (by measurement of pressure differences at the fan's injections)
- The standby consumption of this ventilation appliance is 10.3 W. In order to avoid unnecessary standby losses a manual switch for complete disconnection from supply should be installed.
- After a power failure the device automatically resets into its last operation mode.

Acoustic testing

For ventilation units > 600 m³/h an installation in a separate room for building services could be assumed, which is planned according to the valid regulation. Following sound levels have been determined at an air flow rate of **3000 m³/h** and an external pressure difference of 560 Pa:

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)]
68.7	64.2	87.5	64.2	87.5

- For complying with the required sound level in the supply air and extract air rooms, dimensioning of 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 F5

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If the device is not operated during the summer, the filter should be replaced before the next operation.

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

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 air flows. 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:
 - ✓ As per manufacturer information several frost protection systems can be applied. Exhaust and supply air temperatures are measured to control the frost protection. The device is pre-adjusted to activate the frost protection once the exhaust temperature drops below 2°C. The manufacturer recommends a frost protection system with brine heater exchanger.
The manual of this appliance describes the possibility of implementing frost protection with an electrical pre-heater (exhaust air temperature-controlled). This strategy is not recommended by the PHI since heating with electricity is not preferable in regards to primary energy consumption.
- Frost protection circuit for downstream hydraulic heater coils:
 - ✓ As described in the technical manual this appliance shuts down both the fans if the supply temperature drops below +5°C behind the heater coil .

It should be noted that cold air can also lead to freezing up 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

A summer bypass of the heat recovery is part of this appliance. It is controlled automatically by outdoor air temperature.

The effectiveness of this appliance's bypass for night cooling of buildings has been tested under following boundary conditions:

- extract air temperature = 26.4°C
- outdoor air temperature = 16.7°C
- air flow at the upper limit of the certified range
- by pass damper 100% open

A supply air temperature of 18°C has been achieved. Therewith the bypass of the heat recovery is applicable for night cooling of buildings.

Abbreviations: ODA = Outdoor air, EHA = Exhaust air, SUP = Supply air, ETA = Extract air