Certificate

Certified Passive House Component
For cool, temperate climates, valid until 31 December 2025

Passivhaus Institut GmbH
Rheinstraße 44/46
64283 Darmstadt
Germany

Category: **Ventilation unit with heat recovery and heat pump (combi unit)**

Manufacturer: **Aernova Europe Srl.**
Cassola Via Valsugana 102
CAP 36022

Product name: **ETHOS 007 RS**

This certificate was awarded based on the following criteria for ventilation part:

Thermal comfort	$\theta_{supply\ air} \geq 16.5$ °C 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
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
Sound insulation	Sound level $L_w \leq 35$ dB(A) not met Here $L_w = 64.4$ dB(A) Unit should be installed so that it is acoustically separated from living areas
Indoor air quality	Outdoor air filter at least F7 Extract air filter at least G4
Frost protection	Frost protection for the heat exchanger with continuous fresh air supply down to $\theta_{outdoor\ air} = -15$ °C

This certificate was awarded based on the following criteria for heat pump part:
(limit values for final energy consumption):

Space heating	9 kWh/(m²y)
Space cooling (humid climate):	13 kWh/(m²y)
Space cooling (dry climate):	11 kWh/(m²y)

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

www.passivehouse.com **1441ch03**

Certified for air flow rates of
129-200 m³/h

Winter performance of ventilation
$\eta_{HR,eff}$: 80 %
$\eta_{MR,eff}$: 65 %
Pel: 0.44 Wh/m³

Summer performance of ventilation
$\eta_{HR,eff}$: 62 %
$\eta_{MR,eff}$: 66 %
Pel: 0.40 Wh/m³

Performance of heat pump

Heating
8.6 kWh/(m²y)

Cooling DRY
9.3 kWh/(m²y)

Cooling WET
8.8 kWh/(m²y)

CERTIFIED COMPONENT
Passive House Institute

Appendix to the certificate Aernova Europe Srl., ETHOS 007 RS

Manufacturer: Aernova Europe Srl.
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Part 1: Ventilation unit

Passive House comfort criterion

A minimum supply air temperature of 16.5 °C is maintained at an outdoor air temperature of -10 °C.

Efficiency criterion (heat recovery rate)

The effective dry heat recovery rate is measured at the test facility using balanced mass flows on the outdoor air/extract air side. The boundary conditions for the measurement should be taken from the documents relating to 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 (the house is the system boundary) can be calculated using $\eta_{HR,eff}$ based on the formula $\dot{V}$ * (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. For summer, the heat recovery for the unit should be further optimized. It is highly recommended that the heat recovery should be higher than 70 %

For this device the numbers are as follows:

$\eta_{HR,=}$ **80 (62) %**

Efficiency criterion (power consumption)

The overall electrical power consumption of the device including that for regulation, but without that for the frost protection heating, is tested at the test facility at an external pressure of 100Pa (50Pa for each of the pressure/intake sides).

For this device: **0.44 (0.40) Wh/m³**

Air tightness and insulation

Before starting the thermodynamic test, the air tightness test should be carried out for under pressure as well as for over pressure. The leakage air flows must not be greater than 3 % of the average air flow volume of the operating range of the ventilation device.

The following result was obtained for the device being tested according to DIBt guidelines:

Internal leakage: 1.9 %

External leakage:1.1 %

This ventilation unit meets the airtightness requirements.

Appendix to the certificate Aernova Europe Srl., ETHOS 007 RS

Adjustability

It must be possible to adjust the balance between the exhaust air flow rate and the outdoor air flow rate for all units.

- This unit is certified for air flow rates of **129-200 m³/h**
- Balancing the air flow rates of the unit is possible
  - ✓ The air flow rates are hold steady automatically
- The users should have at least have following possibilities for adjustment:
  - ✓ Switching the system on and off
  - ✓ Synchronized adjustment of the supply air and extract air flow to basic ventilation (= 70-80 %), standard ventilation (= 100 %) and increased ventilation (= 130 %) with clear readability of the set status.
  - ✓ Depending on the demand, the user can choose between several operating levels that can be set manually at the control unit of the operating element.
- The device being tested here has a standby power consumption of **2.0 W** and therefore does not comply with the target value of 1 W. The device must be equipped with an additional external switch to separate the device from the electric circuit if required.
- After a power failure the device automatically continues to operate in the mode that was set before the power failure.

Acoustical testing

In order to restrict the sound pressure level in the installation room, the sound power level should be restricted to 35 dB(A). With an equivalent room absorption area of 4 m² the amounts of sound power level and sound pressure level are nearly the same (the exact value of the sound pressure level in the specific installation room can be calculated with the help of the sound protection tool (download on www.passivehouse.com)).

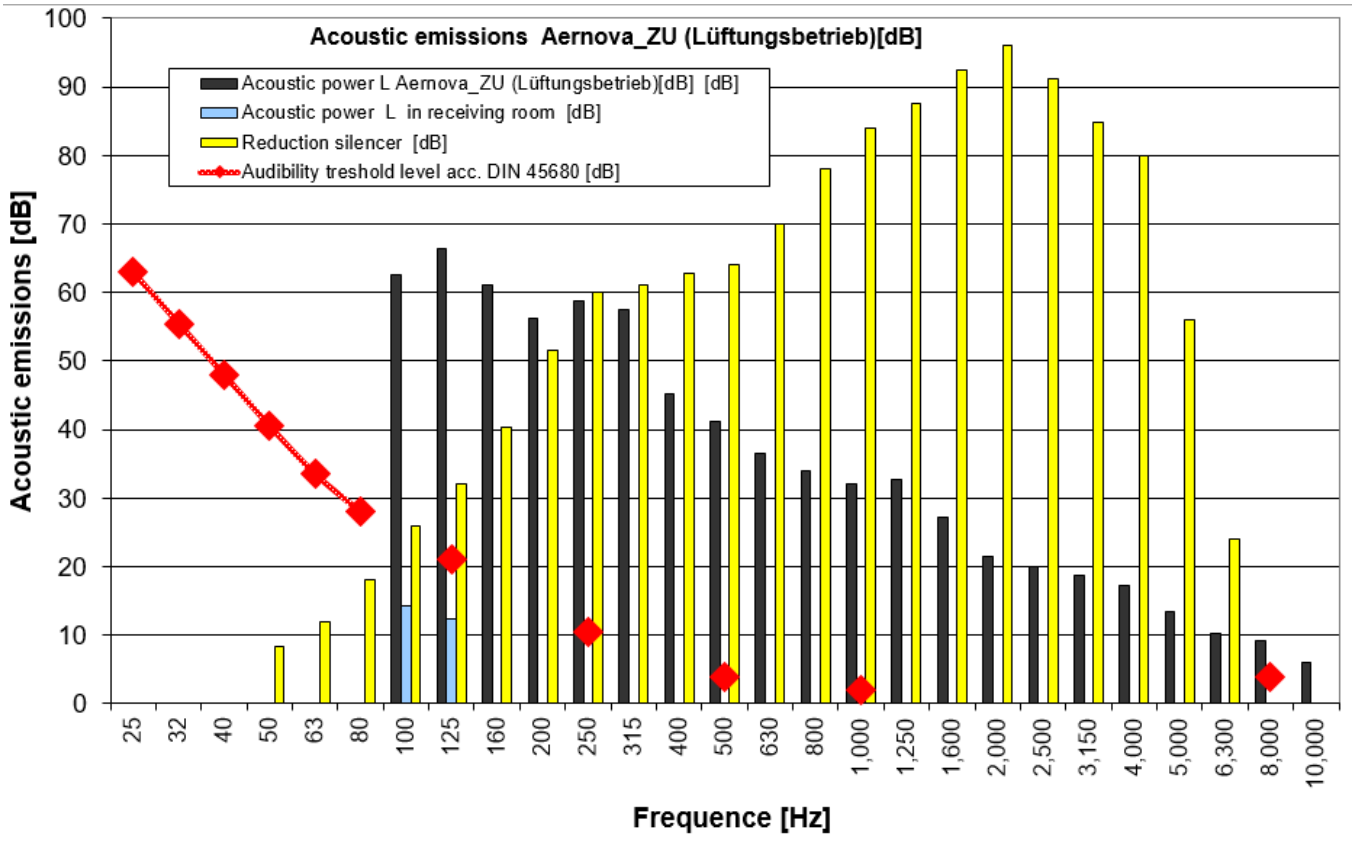
Installation instructions must be provided which describe how the sound level can be kept below 25 dB(A) in living areas and below 30 dB(A) in functional areas. The following sound power levels have been determined at an air flow rate of **184 m³/h**:

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)]
64.4	68.7	56.8	69.7	59.8

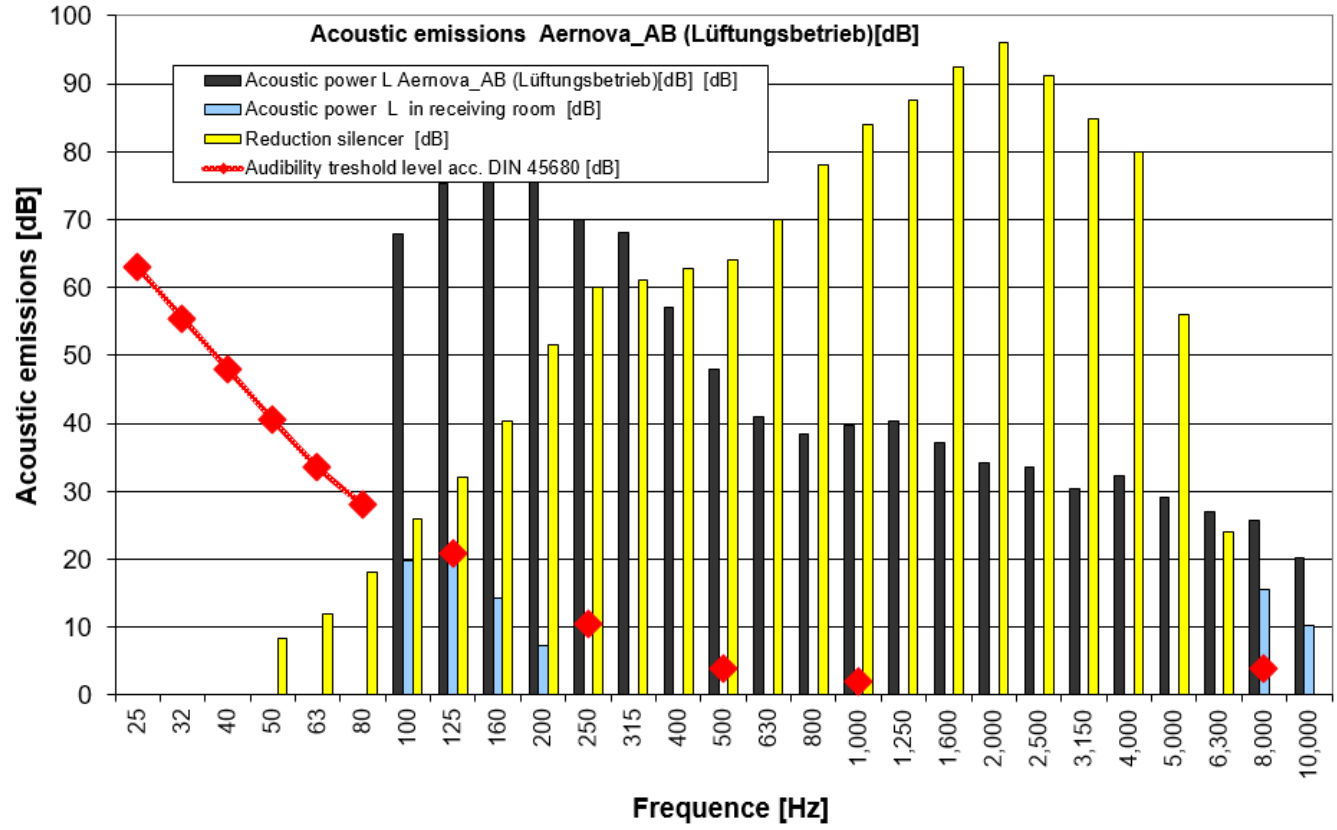
- The sound level of the unit exceeds the limit value of 35 dB(A). Therefore the unit should be installed so that it is acoustically separated from living areas.
- Silencers are needed to comply with the required sound level in the supply air and extract air rooms. Detailed information about these can be found in the full report. Dimensioning of a suitable silencer is required for the specific project on the basis of the measured sound intensity level. The following two Figures were evaluated with silencer Trox MSA100, s-40mm, l-1500.

Abbreviations

- AU/ODA = Outdoor air
- FO/EHA = Exhaust air
- ZU/SUP = Supply air
- AB/ ETA = Extract air



Acoustic emissions in supply air stream with use of silencer Trox MSA100, s-40mm, l-1500



Acoustic emissions in exhaust air stream with use of silencer Trox MSA100, s-40mm, l-1500

Indoor air hygiene

Inspection and cleaning of the central device including the heat exchanger is simple. The filter can be replaced by the user himself/herself (no specialist required). The unit is equipped with following filter qualities:

- ✓ Outdoor Air filter F7
- ✓ Extract Air filter G4

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

Filter replacement is recommended after an interval of 6 months. However, depending on environment in where the unit will operate, more often changes can be required.

Frost protection

Appropriate measures should be taken to ensure prevention of icing over of the heat exchanger and freezing up of hydraulic post-heater coils during extreme winter temperatures (-15°C). The regular functioning of the device should be permanently ensured during uninterrupted operation of the frost protection circuit (there is no interrupt circuit for outdoor air in the Passive House, as the heating loads caused by the forced infiltration would become too high). If heater coils for hot water are used, a suitable frost protection circuit should ensure prevention of frost damage to these heater coils. In the process, the possibility of failure of the pre-heating coils and extract air fans must also be taken into consideration.

- Frost protection circuit for the heat exchanger:
  - ✓ The frost protection of heat recovery unit is done by use of resistance direct electricity heater.
- Frost protection circuit for downstream hydraulic heater coils:
  - ✓ The unit is equipped with heat pump technology, which ensures the frost protection of heater coils.

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).

Part 2: Heat pump

The seasonal performance of tested unit is evaluated by the Passive House Institute for representative climates. This is based on the key characteristics determined for space heating, cooling and dehumidification operating modes at all test points specified in the testing regulations and stated in the certificate.

The Passive House Institute uses three reference climates, first for heating (cool,temperate), second for sensible cooling (hot and dry), and third for sensible cooling and dehumidification (hot and humid). This forms the basis for the calculation of the energy balance. Evaluation is based on final energy consumption. The limiting values for final energy consumption are 13 kWh/(m²y) for sensible/latent cooling (humid climate) and 9 kWh/(m²y) for heating. For cooling in dry climate, the limit for final energy is 11 kWh/(m²y).

Verification is based on a model Passive House with a heating demand of 15 kWh/(m²y), cooling demand for humid climate 23 kWh/(m²y) and cooling demand for dry climate 22 kWh/(m²y). All calculations are based on hourly method.

The certified range for heat pump matches the certified range for ventilation unit. The following relation between air flow rate and floor area has been used for reference building: 35 m²/person, 30 m³/(h.person). Based on this relation, the heat pump is certified for floor area of 129-200 m². If the unit is to be used in flats with smaller floor area than that, this can result in worse performance (it very much depends on control/regulation system of the particular unit. The performance of control system was not evaluated during certification).

The unit is using recirculation mode to ensure that enough heating/cooling capacity can be delivered to the house. During this time no fresh air is supplied, therefore the time use of recirculation mode is limited. The control/regulation system of the unit needs to be set up by producer in the way that will ensure the supply of required amount of fresh air per hour. During the time of recirculation mode, it must be ensured that only air from “clean” rooms is being recirculated. To ensure that, dampers need to be installed in ventilation ducts coming from spaces like bathroom or kitchen, which in no way can be used for recirculation purposes. Those dampers will be automatically controlled (connected to the main control/regulation system of the unit). Without installation of such dampers, unit is not allowed to work in recirculation mode. Air flow rate of recirculation air used during measurements in laboratory was in range of 450-500 m³/h.

Dehumidification function

The unit Ethos 007 is controlled not only based on room temperature but also based on room humidity. The unit is equipped with second coil which is being used for reheating of dehumidified air (being undercooled as a result of dehumidification process- dew point temperature has to be reached on surface of the cooling coil to provide dehumidification). The reheating coil is connected with heat pump circuit and is using energy to reheat the dehumidified air, which would otherwise be wasted, resulting in very efficient solution for dehumidification. During the laboratory measurements, SHR (sensible heat ratio) of as low as 0.1 have been reached.

Performance values of heat pump

Fresh air mode

Heating

Temperature		Capacity			COP		
outside air	room	On/OFF	ON/OFF Limit	Max	On/OFF	ON/OFF Limit	Max
7	20	0.4	1.8	3.4	2.1	3.5	2.6
2	20	0.4	1.5	3.1	1.6	1.6	2.0
-7	20	0.5	2.0	3.1	1.3	1.9	1.6

Cooling

Temperature		Capacity			EER		
outside air	room	On/OFF	ON/OFF Limit	Max	On/OFF	ON/OFF Limit	Max
25	25	0.6	1.6	3.6	3.3	3.5	3.7
30	25	0.6	1.6	3.8	3.0	3.2	3.4
35	25	0.6	1.5	4.0	2.2	2.4	2.8

Recirculation air mode

Heating

Temperature		Capacity			COP		
outside air	room	On/OFF	ON/OFF Limit	Max	On/OFF	ON/OFF Limit	Max
7	20	0.5	2.3	4.6	2.1	3.0	2.6
2	20	0.5	2.3	3.8	1.6	2.7	2.0
-7	20	0.5	2.2	3.9	1.3	1.8	1.7

Cooling

Temperature		Capacity			EER		
outside air	room	On/OFF	ON/OFF Limit	Max	On/OFF	ON/OFF Limit	Max
25	25	0.6	1.5	5.6	2.1	2.3	3.1
30	25	0.5	1.4	5.6	1.8	1.9	2.7
35	25	0.5	1.4	5.5	1.5	1.6	2.2