CERTIFICATE

Certified Passive House Component

Valid until 31st December 2023

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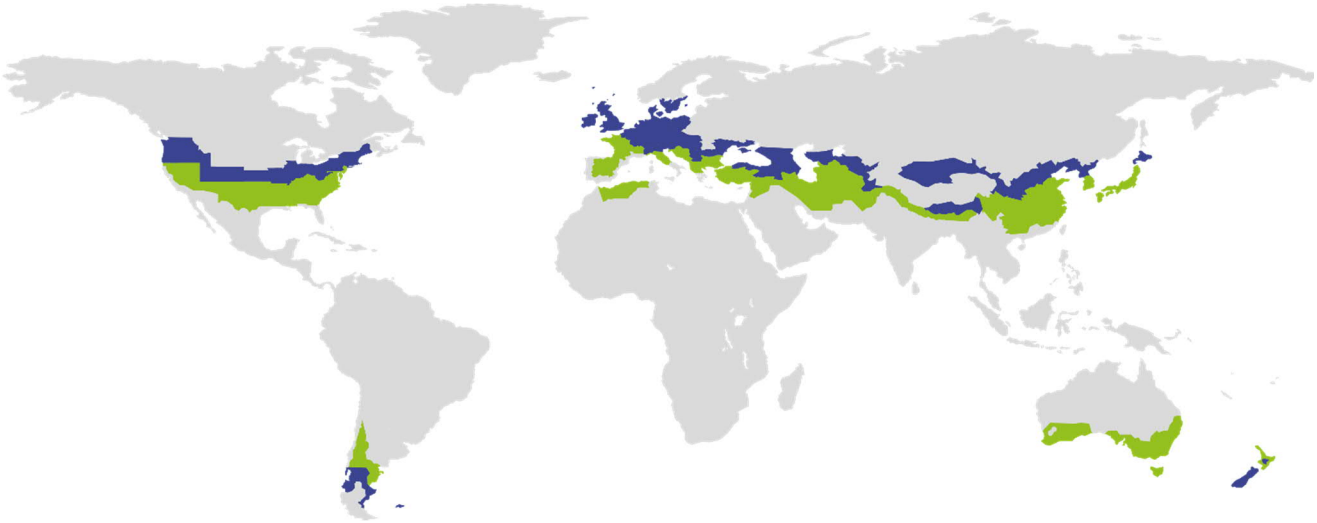

Category:	**Air handling unit with heat recovery**
Manufacturer:	**Airflow Lufttechnik GmbH**
	Germany
Product name:	**Ventilation unit series**
	DUPLEX 650 Flex – DUPLEX 3600 Flex
	(DUPLEXbase 650; DUPLEXbase 1100)*
Specification:	Airflow rate > 600 m³/h
Heat exchanger:	Recuperative

This certificate was awarded based on the product meeting the following main criteria

Heat recovery rate	η_{HR}	≥	75 %
Specific electric power	$P_{el,spec}$	≤	0.45 Wh/m³
Leakage		<	3 %
Performance number		≥	10
Comfort	Supply air temperature ≥ 16.5 °C at outdoor air temperature of -10 °C		

Airflow range
150-2800 m³/h
at an external pressure of
190-286 Pa [1)]
Requirements non-residential buildings (Therefore also applicable for residential buildings)
Heat recovery rate
η_{HR} ≥ 79 %
Specific electric power
$P_{el,spec}$ ≤ 0.43 Wh/m³
Performance number
> 10

cool, temperate climate

CERTIFIED COMPONENT
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* 2 sizes of the unit were replaced with new model

[1)] The pressure drop of filters is covered in the listed external pressure. Additional components (e.g. heating coil) decrease the available external pressure accordingly.

Component ID	Unit model	Testing requirements	Airflow range		External pressure	Actual available external pressure [1]	Specific electric power	Heat recovery rate	Performance number
			Min	Max					
			m³/h	m³/h	Pa	Pa	Wh/m³	%	-
2004vl03	PS 650	Non-residential	150	600	190	123	0.41	79	11.8
2005vl03	PS 1100	Non-residential	250	700	200	144	0.40	89	12.0
0226vl03	1600 Flex	Non-residential	300	1400	243	178	0.40	86	11.4
0227vl03	2600 Flex	Non-residential	500	1800	259	202	0.41	85	10.8
0117vl03	3600 Flex	Non-residential	800	2800	286	225	0.43	85	10.7

Table 1: Certified values for each unit model. [1] Pressure drop of filters were taken into account.

Passive House comfort criterion

A supply air temperature of 16.5 °C is maintained at an outdoor air temperature of about -10.0 °C by use of a suitable supply air heater.

Efficiency criterion (heat recovery rate)

The effective heat recovery rate is measured at a test facility using balanced mass flows of the outdoor and exhaust air. The boundary conditions for the measurement are documented in the testing procedure.

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

With

η_{HR} Heat recovery rate in %
θ_{ETA} Extract air temperature in °C
θ_{EHA} Exhaust air temperature in °C
θ_{ODA} Outdoor air temperature in °C
P_{el} Electric power in W
$\dot{m}$ Mass flow in kg/h
c_p Specific heat capacity in Wh/(kg.K)

- The heat recovery rates for each model of the unit are listed in Table 1.

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 m^3/h the applicable pressure differences vary with the nominalrange of operation (as declared by the producer) and the application (residential or non residentialbuilding).

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

- The airflow ranges and available external pressures for each model of the unit are listed in Table 1.

Efficiency criterion (electric power)

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 190-286 Pa.

- The specific electric powers for each model of the unit are listed in Table 1.

Performance number

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.

- The performance numbers for each model of the unit are listed in Table 1.

Leakage

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.

- These appliances meet the airtightness requirements.

Settings and airflow balance

It must be possible to adjust the balance of airflows at the unit itself (either between the exhaust and the outdoor airflows or between the supply and the extract airflows, if the unit is respectively placed inside or outside of the insulated thermal envelope of the building). Availeable operation modes are explained in detail in the operation manual.

- Balancing of the airflow rates of the unit is possilbe.
  - ✓ The airflow volumes can be held steady automatically (by measurement of pressure differences in extract and supply air duct, only available if pressure gauges are installed and the control system is equipped with an additional mode).
- The standby power consumption of these device achieves from 3 W to 9.3 W. The target value of 1 W was exceeded.The device should be equipped with an additional external switch so that it can be disconnected from the mains, if required.
- After a power failure, the device will automatically resume operation.

Acoustical 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. The total acoustic power levels were determined by producer for each model of the units at an upper limit of the airflow range.

Unit model	Testing requirements	Airflow range		Total acoustic power level				
					Duct			
		Min	Max	Casing	ODA	SUP	ETA	EHA
		m³/h	m³/h	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
PS 650	Non-residential	150	600	49	59	78	63	77
PS 1100	Non-residential	250	700	65	62	89	62	89
1600 Flex	Non-residential	300	1400	59	54	80	56	77
2600 Flex	Non-residential	500	1800	56	50	75	53	73
3600 Flex	Non-residential	800	2800	60	56	78	53	82

Tabele 2: Acoustic power levels at an upper limit of the airflow range.

- 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

Instructions for changing of the air filters are documented in the operation manual. This device is equipped with following filter qualities:

Outdoor air filter	Extract air filter
ePM1 55%	ePM10 50%

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.

Frost protection

Appropriate measures should be taken to prevent the heat exchanger and optional downstream hydraulic heater coil from getting damaged by frost during extreme winter temperatures (−15 °C). It must be ensured that the unit's ventilation performance is not affected during frost protection cycles.

- Frost protection of 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 heat exchanger.

    Equally the Passive House Institute is in favour of using of hydraulic heaters, since the electric preheating is not recommended due to the effect on primary energy consumption.
- Frost protection of 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, due to free circulation, cold air can also lead to freezing – even when the fans are stationary. 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.