CERTIFICATE

Certified Passive House Component

Valid until 31st December 2025

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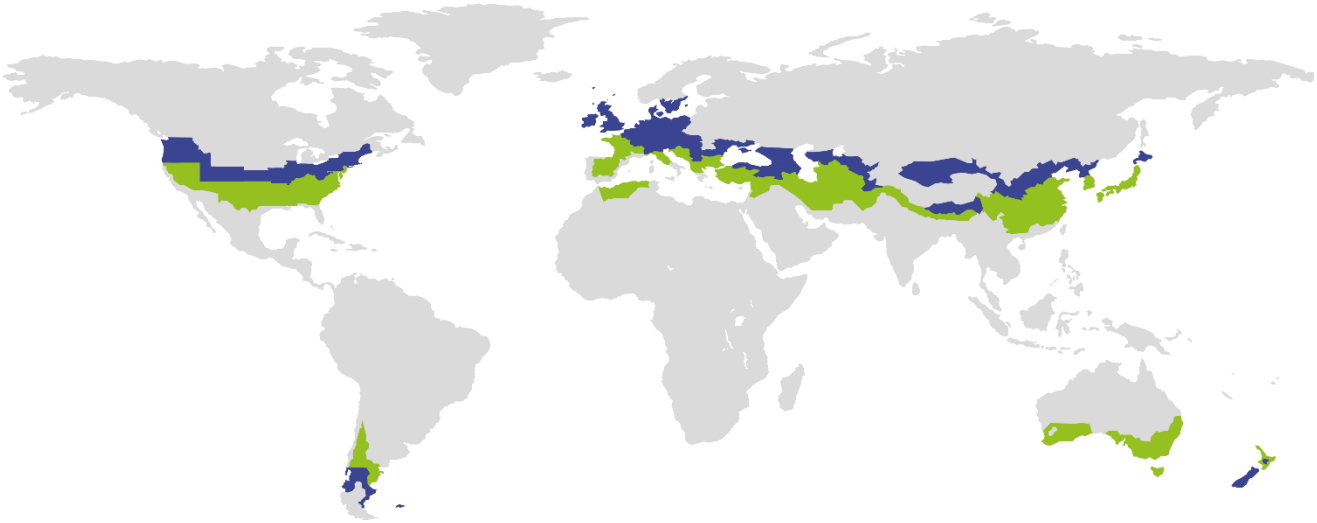

Category:	**Air handling unit with heat recovery**
Manufacturer:	**Zehnder Group France**
	France
Product name:	**Ventilation unit series**
	ZEHNDER CARMA 9010-9070
Specification:	Airflow rate > 600 m³/h
Heat exchanger:	Recuperative

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 [2]		

Airflow range
430-4000 m³/h
at an external pressure of
199-308 Pa [1]
Requirements non-residential buildings (Therefore also applicable for residential buildings)
Heat recovery rate
η_{HR} ≥ 82 %
Specific electric power
$P_{el,spec}$ ≤ 0.45 Wh/m³
Performance number
> 9.4 [3]

[1] The pressure drop of filters is covered in the listed external pressure.
[2] By use of a suitable additional heater.
[3] The recommended value of 10.0 was not achieved at some models.

cool, temperate climate

CERTIFIED COMPONENT
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Component ID	Unit model	Testing requirements	Airflow range Min m³/h	Airflow range Max m³/h	External pressure Pa	Actual available externalpressure [1] Pa	Specific electric power Wh/m³	Heat recovery rate %	Performance number -
2130vl03	Zehnder CARMA 9010	Non-residential	430	690	199	143	0.45	82	9.4
2131vl03	Zehnder CARMA 9016	Non-residential	680	1100	228	177	0.42	82	9.6
2132vl03	Zehnder CARMA 9023	Non-residential	930	1500	247	200	0.40	83	10.4
2133vl03	Zehnder CARMA 9035	Non-residential	1300	2100	268	221	0.41	84	9.8
2134vl03	Zehnder CARMA 9048	Non-residential	1810	2900	288	240	0.43	86	10.2
2135vl03	Zehnder CARMA 9070	Non-residential	2470	4000	308	276	0.43	82	9.8

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

Passive House comfort criterion

At an outdoor air temperature of - 10 °C a supply air temperatur higher than 16.5 °C is achieved by use of a recommended internal electric preheater. The criterion is therefore met. Alternatively to the electric preheater, an additional electric or hydraulic post-heater can be used.The all heating elements are available as an optinal acessory for the units.

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 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.

- 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 199-308 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 (available with otional additional equipment and control system).
- The standby power consumption of these devices can reach up to 26 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. The provided values were not verified in frame of this the certification.

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)
Zehnder CARMA 9010	Non-residential	430	690	45	55	65	55	65
Zehnder CARMA 9016	Non-residential	680	1100	48	57	68	57	68
Zehnder CARMA 9023	Non-residential	930	1500	50	58	69	59	69
Zehnder CARMA 9035	Non-residential	1300	2100	52	61	72	62	72
Zehnder CARMA 9048	Non-residential	1810	2900	52	60	71	62	72
Zehnder CARMA 9070	Non-residential	2470	4000	54	62	73	63	73

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
ISO ePM1 55%	ISO 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:
  - ✓ In order to protect the heat exchanger from freezing, the units can be equipped with an internal electric preheater or alternatively, the frost protection can be ensured by means of modulating bypass in combination with an additional hydraulic or electric supply air heater.
- Frost protection of downstream hydraulic heater coils:
  - ✓ In order to protect a downstream hydraulic heater coil, both fans are switched off in case the supply air temperature drops below the preset limit value. An emergency notice is displayed on the control panel.

  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

The units are equipped with a summer bypass, which is operated automatically according to the outdoor and extract air temperature.