Certificate

Passive House Suitable Component

For cool temperate climates, valid until 31. December 2016

Passivhaus Institut
Dr. Wolfgang Feist
64283 Darmstadt
GERMANY

Category: **Compact Heat Pump System**

Manufacturer: **Nilan A/S**
8722 Hedensted, DENMARK

Product name: **Compact P (92 m³/h)**

This certificate was awarded based on the following criteria (limit values*):

Thermal Comfort:	$\theta_{supply\ air} \geq 16{,}5°C$
Heat Recovery of ventilation system:	$\eta_{WRG,eff} \geq 75\%$
Electric efficiency ventilation system:	$P_{el} \leq 0{,}45$ Wh/m³
Air tightness (internal/external):	$V_{Leakage} \leq 3\%$
Total Primary Energy Demand (**):	$PE_{total} \leq 55$ kWh/(m²a)
Control and calibration (*)	
Air pollution filters (*)	
Anti freezing strategy (*)	
Noise emission and reduction (*)	

Measured values to be used in PHPP (set point 92 m³/h)
useful air flow rates 52 to 120 m³/h

Heating

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T_{amb}	**-7.0**	**2.1**	**7.1**		°C
Thermal Output Heating Heat Pump	$P_{WP,Heiz}$	**0.49**	**0.62**	**0.67**		kW
COP number Heating Heat Pump	COP_{Heiz}	**2.43**	**2.55**	**2.78**		-
Maximum available supply air temperature with Heat Pump only(*)		**33.6**				°C

Hot water

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T_{amb}	**-6.9**	**1.9**	**7.2**	**20.2**	°C
Thermal Output Heat Pump for heating up storage tank.	P_{DHW} heating up	**0.51**	**0.72**	**0.89**	**1.02**	kW
Thermal Output Heat Pump for reheating storage tank	P_{DHW} reheating	**0.54**	**0.71**	**0.83**	**0.94**	kW
COP Heat Pump for heating up storage tank	$COP_{DHW,}$ heating up	**2.11**	**2.60**	**3.08**	**3.38**	-
COP Heat Pump for reheating storage tank	COP_{DHW} reheating	**1.94**	**2.50**	**2.80**	**3.05**	-
Averge storage tank temperature		**50.5**				°C
Specific storage heat losses		**1.63**				W/K
Exhaust air addition (if applicable)						m³/h

(*) detailed description of criteria and key values see attachment.
(**) for heating, domestic hot water (DHW), ventilation, auxiliary electricity in the reference building, explanation see attachment.

Heat Recovery
$\eta_{WRG,eff}$ = 77%

Electric efficiency
0.43 Wh/m³

Air tightness
$V_{leak,\ internal}$ = 1.0%
$V_{leak,\ external}$ = 1.1%

Frost protection
down to -7 °C

Total Primary Energy Demand (**)
54.1 kWh/(m²a)

CERTIFIED COMPONENT
Passive House Institute

www.passivehouse.com

0390ch03

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Category: **Compact Heat Pump System**

Manufacturer: **Nilan A/S**
8722 Hedensted, DENMARK

Product name: **Compact P (172 m³/h)**

This certificate was awarded based on the following criteria (limit values*):

Thermal Comfort:	$\theta_{supply\ air} \geq 16{,}5°C$
Heat Recovery of ventilation system:	$\eta_{WRG,eff} \geq 75\%$
Electric efficiency ventilation system:	$P_{el} \leq 0{,}45$ Wh/m³
Air tightness (internal/external):	$V_{Leakage} \leq 3\%$
Total Primary Energy Demand (**):	$PE_{total} \leq 55$ kWh/(m²a)
Control and calibration (*)	
Air pollution filters (*)	
Anti freezing strategy (*)	
Noise emission and reduction (*)	

Measured values to be used in PHPP (set point 172 m³/h)
useful air flow rates 120 to 205 m³/h

Heating

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T_{amb}	**-3.7 °C**	**2.0 °C**	**6.9 °C**		°C
Thermal Output Heating Heat Pump	$P_{heating}$	**0.61**	**0.78**	**0.92**		kW
COP number Heating Heat Pump	$COP_{Heating}$	**2.65**	**3.18**	**3.58**		-
Maximum available supply air temperature with Heat Pump only(*)		**28.6**				°C

Hot water

		Test point 1	Test point 3	Test point 3	Test point 4	
Outside Air Temperature	T_{amb}	**-4.0 °C**	**2.0 °C**	**7.0 °C**	**20.2 °C**	°C
Thermal Output Heat Pump for heating up storage tank.	P_{DHW} heating up	**0.60**	**0.83**	**0.99**	**1.14**	kW
Thermal Output Heat Pump for reheating storage tank	P_{DHW} reheating	**0.53**	**0.82**	**0.95**	**1.05**	kW
COP Heat Pump for heating up storage tank	COP_{DHW} heating up	**2.13**	**2.87**	**3.31**	**3.68**	-
COP Heat Pump for reheating storage tank	COP_{DHW} reheating	**1.81**	**2.72**	**3.05**	**3.28**	-
Averge storage tank temperature		**50.5**				°C
Specific storage heat losses		**1.63**				W/K
Exhaust air addition (if applicable)						m³/h

(*) detailed description of criteria and key values see attachment.
(**) for heating, domestic hot water (DHW), ventilation, auxiliary electricity in the reference building, explanation see attachment.

Heat Recovery
$\eta_{WRG,eff}$ = 80%

Electric efficiency
0.40 Wh/m³

Air tightness
$V_{leak,\ internal}$ = 1.0%
$V_{leak,\ external}$ = 1.1%

Frost protection
down to -4 °C

Total Primary Energy Demand (**)
51.4 kWh/(m²a)

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Attachment to the Certificate(***) Nilan, Compact P

Hersteller Nilan A/S

Nilanvej 2, Box 10, 8722, Hedensted, DENMARK

t: +45 (0)7675-2500

e: info@nilan.dk

i: www.nilan.dk

Thermal Comfort: A minimum supply air temperature of 16,5°C is reached if the air first passes through earth tubes, i.e. the intake air of the ventilation system must have a temperature of at least –9 °C.

Efficiency Criterion – heat: The heat recovery of the ventilation system incorporated in the unit demonstrates an efficiency of η_{eff} = 77 % (92 m³/h) or η_{eff} = 80 % (172 m³/h) respectively.

Efficiency Criterion – electricity: With a power consumption of 0.43 Wh/m³ (92 m³/h) or 0.40 Wh/m³ (172 m³/h) the unit complies with the maximum consumption of 0,45 Wh/m³. The consumption of 9.6 W in standby-mode exceeds the target value of 1 W. As the unit is always in operation this value should be optimized.

Air tightness and thermal insulation: Testing the ventilation system showed that the limiting values of 3% for both the internal and external leakages were not exceeded.

Control and calibration: The user can select one of for ventilation levels via the console, which are factory-set at 25 % / 45% / 70% / 100% of the maximum air flow rate. These air flow rates can be adjusted separately when configuring or programming the unit.

Sound insulation: The acoustic pressure level was evaluated as 57 dB (A) in the room where the unit is installed with an equivalent absorbtion area of 4 m² and at an air flow rate of 212 m³/h. This is significantly higher than the threshold value of 35 dB(A), the unit must therefore be installed in an adequately sound insulated room separate from the living area.

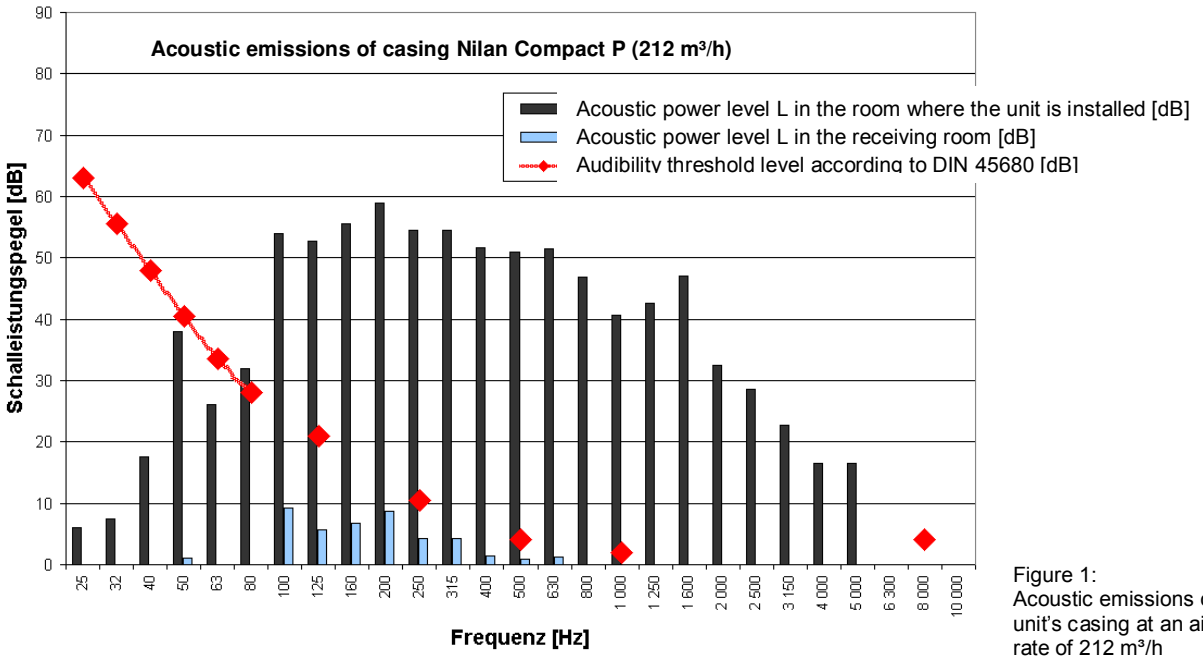

Figure 1:
Acoustic emissions of the unit's casing at an air flow rate of 212 m³/h

Hygienic Indoor Air: The central ventilation unit, including the heat exchanger, can be easily accessed and cleaned. The filters can be replaced by the user (rather than by a technical expert), instructions and suppliers are included in the manual. The following filter qualities should be used: intake air filter minimum F7, attached in front, exhaust air filter G4. The filter should be replaced, before recommissioning the unit after a summer period when it has not been in use. The manufacturer carries the responsibility to ensure that, through the use of either integral components or mandatory additional fittings, the hygienic quality of the air is sufficiently high. An F7 and a G4 filter are installed respectively in the intake and exhaust air streams within the unit. This configuration is in accordance with the recommendations for Passive Houses.

Frost protection: An **anti-freeze strategy** is included with this unit. This should be supported and used in conjunction with a ground to air heat exchanger. The ground heat exchanger or any similar device must guarantee a minimum air temperature of the intaken air higher than –7 °C (92 m³/h) or –4°C (172 m³/h) respectively. An electrical heater for anti-freeze protection is not allowed for operation with the heat pump, because the additional electrical energy consumption is not included in the COP numbers for the heat pump denoted in the certificate.

Assessment of the heat pump: The seasonal performance factor (SPF) of the system installed in the reference building is SPF = 1.67 (92 m³/h) and SPF = 1.96 (172 m³/h) respectively. The primary energy consumption for the reference building is 54.1 kWh/(m²a) (92 m³/h) and 51.4 (172 m³/h), respectively. This compact heat pump unit can be used in Passive Houses with an energy reference area of 60…140 m² (92 m³/h) or 140…240 m² (172 m³/h), respectively, based on a typical occupancy of 35 m²/person, an air flow rate of 30 m³/h/person and a heating load of 12 W/m². The unit was tested in combination with a specially selected **hot water storage.** If an other hot water storage is used the certified key values of the heat pump system especially the COP-values, the useful range of application and thus the seasonal performance factor (SPF) may differ significantly from the values denoted in the certification sheet.

Hint: The qualities (COP) of the heat pump were examined for the two nominal air flows of 92 m³/h and 172 m³/h respectively. The unit does not need to be operated necessarily exactly at one of these points. In fact the air flow of the device must be adjusted for any configuration and size of the building according to the air flow which is needed to provide hgyienic indoor air quality. For the energy balance calculation (PHPP) of the building the planer has to decide which point of operation is best compatible to the building configuration. According to that the key-values of the one or the other point of operation are to be chosen.

The **maximum available supply air temperature** at maximum heat load of the building if the heat pump is running exclusively was found to be **28.6 °C** (172 m³/h) or **33.6 °C** (92 m³/h) respectively. If there is a higher heat load needed for a building this may be realized by external electrical heaters. Then the available higher value ($T_{supplyair\_max}$) is taken for the sheet "heating load" in PHPP. In this case it must be assured that the direct-electrical backup heating is only used to cover the peak load. That means in detail: the direct electrical peak load heating may only be activated by the user if and only if the heat pump is working at full power and this thermal power is not enough. The maximum supply air temperature should never exceed 52 °C to avoid dust burning smell.

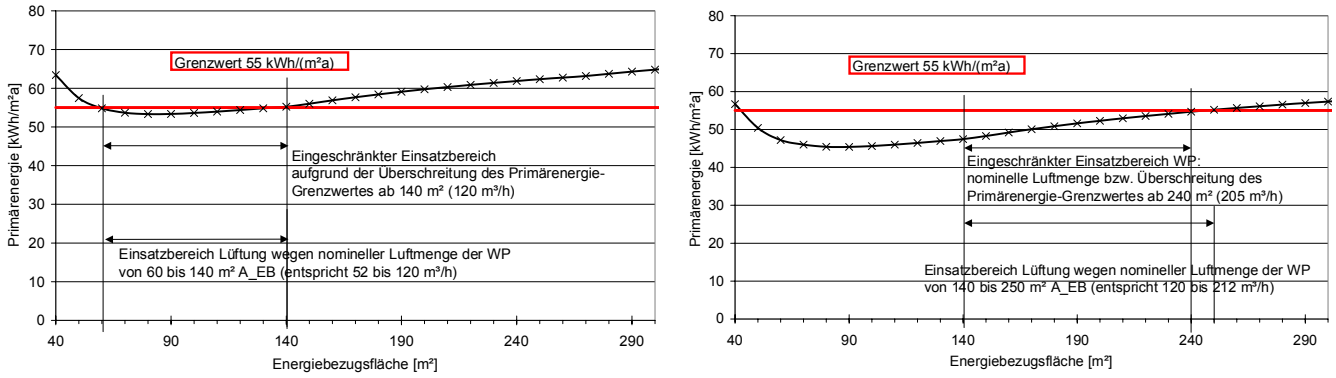

Figure 2: Application range of the unit for the air flow or 92 m³/h (left) or 172 m³/h (right).

(***) A full description of measured results (test report of PHI) is available from the manufacturer