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Advanced technologies and products
GENVEX: Heat pump for single family houses

CONCERTO INITIATIVE
Class 1

Cost-effective Low-energy Advanced Sustainable
So1utions

Instrument: Integrated Project
Thematic Priority: Energy 2005

Period covered:
1.11.07- 31.10. 08
Start date of project:
November 1, 2007

Date of preparation:
December 1, 2008

Duration: 5 years



CONCERTO is co-funded by the European Commission

PREFACE

The class 1 project

The idea of the project CLASS 1 is to use the strengthening of the energy requirements to boost and drive the technological developments and to prove the economical and environmental benefits of ultra-low energy buildings (50% below the new requirements in the Danish building regulations) integrated with biomass- and solar heating based renewable energy supply.

In this context the objectives are to:

1. Optimise the integration of low-energy building technologies with supply (renewable and conventional) and distribution (heating and electricity) technologies.
2. Advance selected technologies within the 3 areas: low-energy building, renewable energy supply and distribution
3. Improve the design, checking and verification procedures (this relates directly to the implementation of the building energy performance directive - EPBD).
4. Integrate the European ecolabel in the building projects (houses and components)
5. Demonstrate large scale implementation at close to market technical and economical conditions.

The Class 1 project is focused on the optimisation of sustainable energy systems in local communities, through an innovative integration of RE technologies with ultra low-energy buildings.

Deliverable 9

Deliverable 9 is the first out of 12 deliverables of work package 3 - Advancement of technologies and solutions - of the Class 1 project. The first 6 of the deliverables of work package 3 present the result of the development work - the advancement of the technologies in question and the 6 latter deliverables present the sales brochures developed by each producer and the guidance notes on how to employ the advanced technologies.

List of contents

Preface 2
1. INTRODUCTION..... 4
2. DATASHEETS for the 2 advanced products:..... 6

1. INTRODUCTION

Deliverable 9 presents the results of the development carried out by GENVEX. GENVEX has advanced a mechanical ventilation system with heat recovery and integrated heat pump for house heating

Research and development - contributed to by the Class 1 involvement

GENVEX reports:

HVPC is the further development of our product series VPC. The new product series will be developed in 3 sizes in order for us to be able to cover dwellings from 50 m² to 300 m².

The products are designed for use in highly insulated dense dwellings in Europe and they must be able to observe the regulations of the different countries, among others be approved according to regulations and requirements of Minergie P+, Passive House and Low Energy Class 1.

HVPC will have the following improvements:

- 01: New fans with lower energy consumption
- 02: Counter current heat exchanger
- 03: Less drop of pressure in the unit
- 04: Full automatic control with lower energy consumption
- 05: Adjustable compressor with frequency control
- 06: Bypass
- 07: Exploitation of solar energy at low temperatures.

The project development is planned to take place in 2 phases:

Phase 1 comprises the items 01 to 03, which have been developed during this period (November 2007 till October 2008) - contributed to by the Class 1 project, so today we have units in 2 sizes ready for sale.

These 2 new units meet the increased requirements which this year have become effective in several European countries regarding the minimum passive rate of efficiency and the maximum energy consumption of the fans compared with the air flow (SFP). At the same time the quality of the filter for the supply air has been improved to a EU7 filter. To achieve these results, it has been necessary to reduce the internal drop of pressure of the unit.

Data sheets for the first 2 sizes named GE Premium 1 and 2 are included in this report.

Phase 2 comprises the items 04 to 07, which are being developed and for which items the development will presumably be finished during the next period.

When developing the frequency converter, which will function together with a standard rotary compressor, totally new technical facts have appeared which have not been tested sufficiently earlier. Consequently, we have been obliged to start quite a few function and lifetime tests of both the frequency converter, which is a new development (own development), since a standard frequency

converter does not apply, and of the compressor, since it has not been released for the operating conditions / operation areas requested.

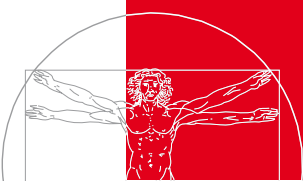
Parallel, we are developing a completely new control for this new product series, since completely new possibilities have opened to optimize the operation of the unit and with that reducing the energy consumption, including optimizing the air renewal in the dwelling depending on temperature, humidity and CO₂.

In the months to come 2 prototypes will be tested under real operating conditions in both Denmark and Germany and at the same time our test in laboratory will continue.

2. DATASHEETS FOR THE 2 ADVANCED PRODUCTS:

GE Premium 1/1L

GE Premium 2



GE Premium 1/1L



Description

GE Premium 1/1L is a ventilation unit consisting of a counter current heat exchanger, a heat pump, supply and extract air fans, F7 supply air filter, G4 extract air filter, complete Optima 300 automatics and control panel. GE Premium 1/1L has also got a cooling function.

GE Premium 1/1L can be delivered with the following options:

- Water and electrical heating element for Ø160 mm duct mounting
- Water frost sensor
- Fresh air and extract air damper with motor for Ø160 mm duct
- Thermostat or motor valve

Suitability

GE Premium 1/1L is suitable in ventilation systems where balanced ventilation, heat recovery and warm/cool supply air is needed.

At first the heat will be recovered in the counter current heat exchanger and then further heat will be supplied to the supply air by the heat pump. During the summer the heat pump can switch to a cooling mode which means that the heat pump will supply cooling to the supply air.

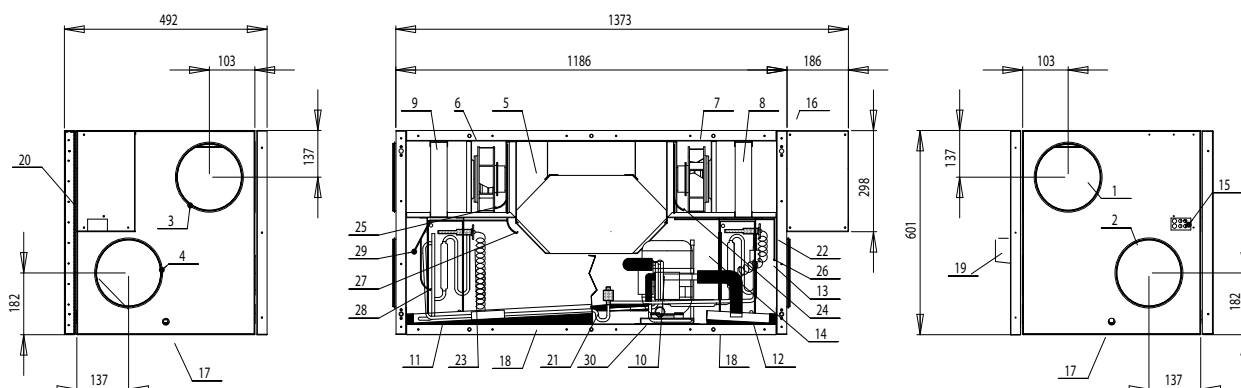
GE Premium 1/1L and is normally used in homes with an area of app. 270 to 450 m² (at an average room height at 2.4 m) the living area is calculated to cover (max. external pressure: 100 Pa):

Air exchange/h	Max. capacity m ³ /h	Living area m ² *
0.3	325	450
0.4	325	340
0.5	325	270

* The power consumption is not included when calculating the living area

Dimensions

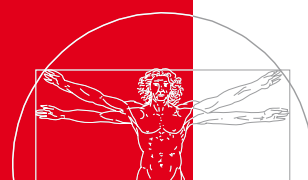
GE Premium 1/1L
Dimension in mm



- | | | | | |
|-------------------------------|------------------------|-------------------------|----------------------------------|-------------------------------|
| 1: Extract air Ø160 | 7: Extract air fan | 13: High-pressure gov. | 19: Supply boss at the back Ø100 | 25: Sensor for fresh air |
| 2: Supply air Ø160 | 8: Filter, extract air | 14: Process valve | 20: Switch | 26: Sensor for supply air |
| 3: Fresh air Ø160 | 9: Filter, supply air | 15: Cable entry | 21: Magnetic valve defrosting | 27: Sensor before cooling air |
| 4: Exhaust air Ø160 | 10: Compressor | 16: Electrical box | 22: Thermostat evaporator | 28: Sensor for cooling coil |
| 5: Counter current heat exch. | 11: Evaporator | 17: Condensat.conn. Ø15 | 23: Thermostat evaporator | 29: Sensor for exhaust air |
| 6: Supply air fan | 12: Condensator | 18: Condensation tub | 24: Sensor for extract air | 30: Four-way valve |

Construction changes reserved P (V1 - 0708)

GE Premium 1/1L



Technical data

Electrical connections:

Without electrical heating and preheating coil

1 x 230V + N + PE + 10 A, 50 Hz

With electrical heating and preheating coil

Max 1.2 + 1.0 kW

1 x 230V + N + PE + 16 A, 50 Hz

Fans:

R3G 190

Motor:

EC motor with integrated electronics

Isolation class

B

Class

IP 44

Motor capacity (Max. per motor):

3320 Rpm

Current input (Max. per motor):

71 W

Power consumption (Max. per motor):

0.50 A

Speed regulation:

Individually the fans can be set to 3 different speeds

The working area of the heat pump:

-15°/+35°C

Compressor:

NB 6165 GK / NE 6210 GK (1/1L)

Min. air volume:

100 / 150 m³/h (1/1L)

Effect collection (max.):

331/585W (1/1L)

Power consumption (max.):

1,9/3.14A (1/1L)

Average performance:

895/1363W (1/1L)

Average effect consumption:

295/425W (1/1L)

Cooling medier:

R134a

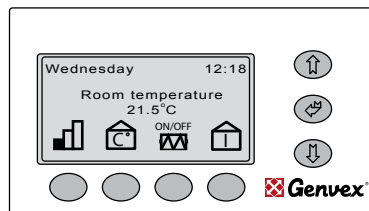
Filling

1100 gram

Automatics

GE Premium 1/1L is delivered with Optima 300 automatics with a factory settings, so that the unit can be started, without setting up the menu. The factory settings are standard settings, that can be changed to the specific needs and demands of your living area.

Control panel



On this button you can change between low, medium and high speed (step 1, step 2 and step 3) and stop the unit.



On this button you can change the room temperature.



On this button you can give signal to heating elements to switch on when required



Info menu

On this button you can see all temperatures of the unit, and by pushing arrow down, you can see which relays are in action.



Press »Arrow down« to change from one menu point to the next. Press »Arrow up« to change from one menu point to the previous one.



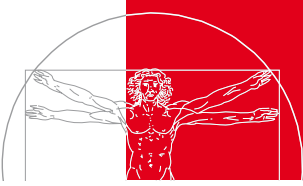
If you wish to flick through the pages of the "operation menu" just press the »Enter-button« in the middle and this will change the whole page to the next set of menu points.



Sound data

Measuring point	1 m in front of the unit			Extract air duct			Supply air duct		
	1	2	3	1	2	3	1	2	3
Airflow									
	Lp dB			Lwu dB			Lwi dB		
63 Hz	53	46	52	93	95	98	85	89	93
125 Hz	47	52	54	87	95	97	81	88	91
250 Hz	43	50	53	84	91	95	78	83	87
500 Hz	33	37	44	66	77	84	60	73	83
1000 Hz	-	-	34	60	70	76	58	68	73
2000 Hz	-	-	30	57	68	73	54	63	68
4000 Hz	-	-	-	44	61	67	43	50	55
8000 Hz	-	-	-	32	49	58	39	40	43
Average	Lp dB(A)			Lwu dB(A)			Lwi dB(A)		
	37	43	47	77	85	89	71	78	84

1: Measured at 40% of max. speed with compressor on
 2: Measured at 70% of max. speed with compressor on
 3: Measured at 100% of max. speed with compressor on



GE Premium 1/1L

Capacity

The capacity lines are based on an average of the supply and extract air volume in a unit with filters.

Max. Capacity:

At 100 Pa the max. capacity is: 325 m³/h.

With an average room height of 2.4 m, the living area is calculated as follows:

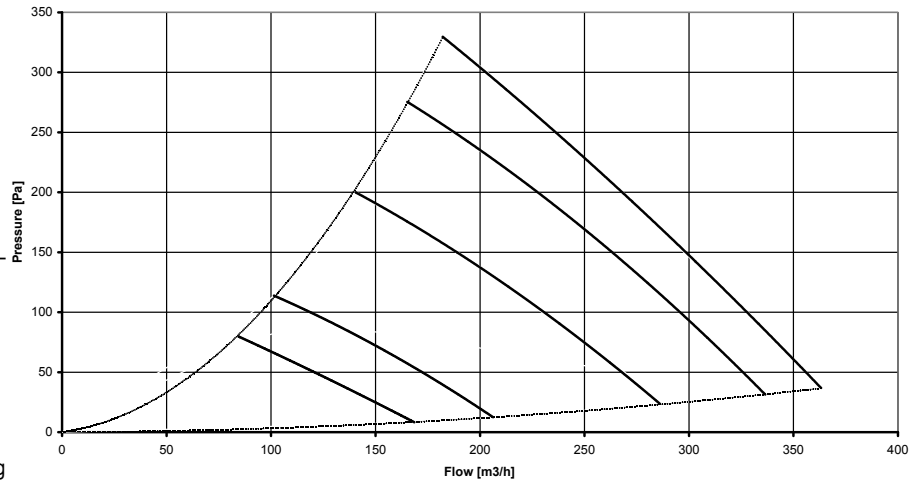
Living area (m²) x Room height (m) x Air exchange/h = Max. capacity

$$\text{Living area (m}^2\text{)} = \frac{\text{Max. capacity (m}^3\text{/h)}}{\text{Room height (m) x Air exchange (h}^{-1}\text{)}}$$

Example:

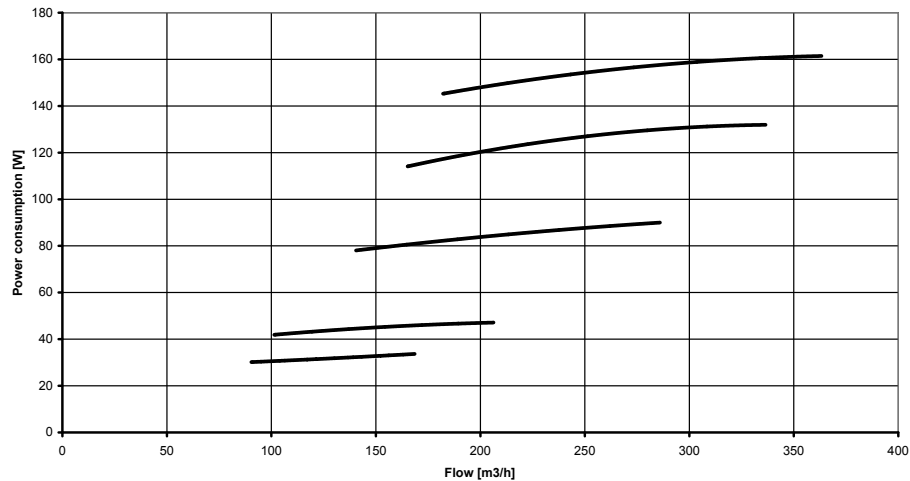
$$\text{Living area (m}^2\text{)} = \frac{325 \text{ m}^3\text{/h}}{2.4 \times 0.5 \text{ h}^{-1}} = 270 \text{ m}^2 *$$

* The power consumption is not included when calculating the living area



Total power consumption:

For both fans and control.

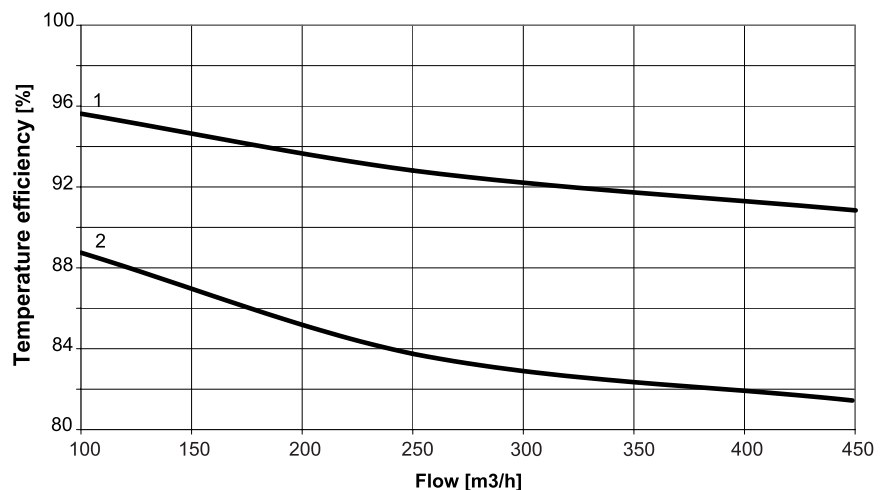


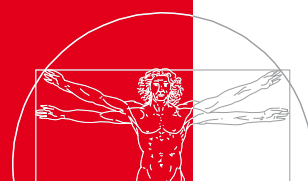
Heat recovery rate

Heat recovery rate, flow $m_{in} = m_{out}$
Icing of the heat exchanger at low outdoor temperatures has been left out of account.

1 = Temp.: -12 °C
RF.: 50%

2 = Temp.: 4 °C
RF.: 50%





Construction

Size:
(h x l x d) ex. connecting pieces and electric box
600 x 1186 x 492 mm

Cabinet:
Fully closed hot galvanised plate with 30 mm Isolation.
Plastic-coated white RAL 9010.

Duct connection:
Ø160 mm with rubber ring seal
Ø100 mm supply air connection pieces (back)

Front:
Front with quick locks for filter service

Heat exchanger:
See water resistant aluminium

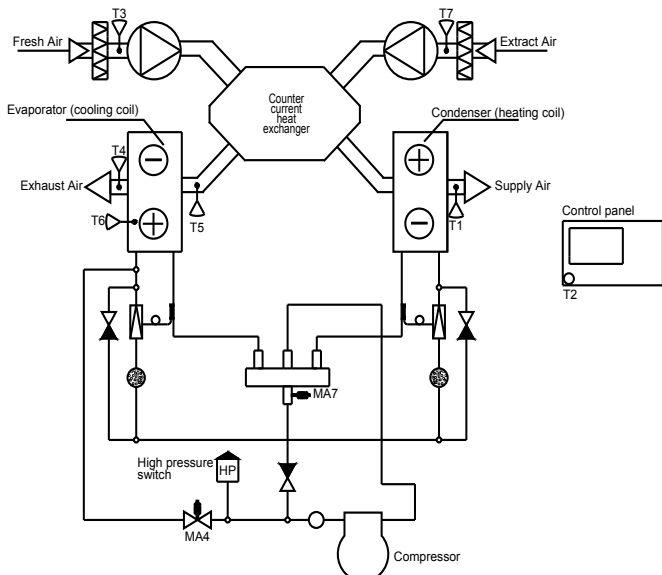
Condensation tub:
Stainless steel

Condensation connection:
Stainless steel Ø15 mm

Filters:
Fresh air: F7 filter
Exhaust air: G4 filter

Weight:
105 kg

Flow diagram



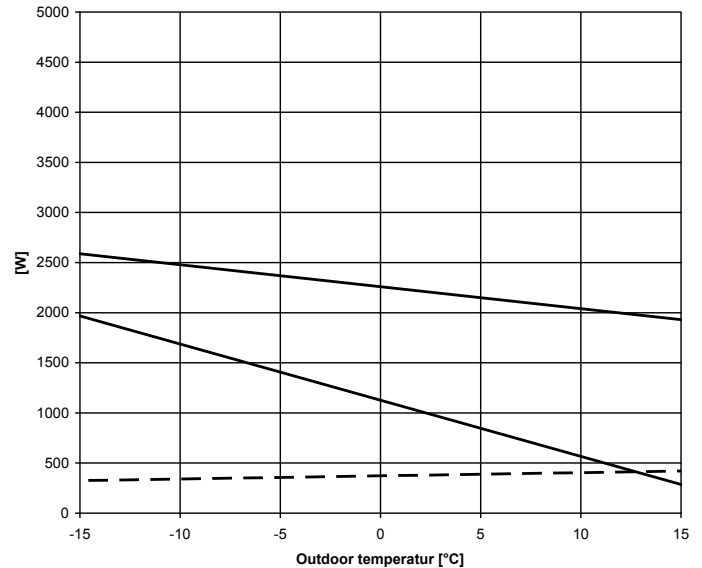
Sensors:
T1: Supply air
T2: Room
T3: Fresh air
T4: Extract air
T5: Before the cooling coil
T6: Cooling coil
T7: Exhaust air

Magnetic valve:
MA4: Defrosting
MA7: Heat/cooling

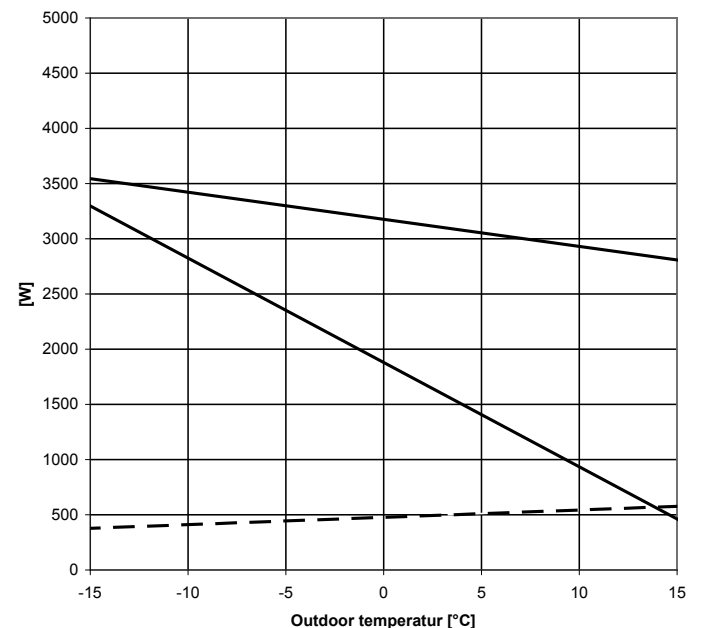
Capacity

GE Premium 1/1L' capacity varies with air quantity and outdoor air temperature

Airflow 159 m³/h. (GE Premium 1)



Airflow. 259 m³/h. (GE Premium 1L)



- 1) Energy consumption for heating supply air to room temperature 20°C.
- 2) Total capacity of the unit
- 3) Power input with compressor running

The hatched area is GE Premium 1/1L's contribution for room-heating

Cooling capacity:
With an outside temperature of 26°C, relative humidity of 45% and full speed, the cooling power output is 1040/685 W.(1/1L)



GE Premium 2



Description

GE Premium 2 is a ventilation unit consisting of a counter current heat exchanger, at heat pump, supply and extract air fans, F7 supply air filter, G4 extract air filter, complete Optima 300 automatics and control panel. GE Premium 2 has also got a cooling function.

GE Premium 2 can be delivered with the following options:

- Water and electrical heating element for Ø200 mm duct mounting
- Water frost sensor
- Fresh air and extract air damper with motor for Ø200 mm duct
- Thermostat or motor valve
- Fan guard

Suitability

GE Premium 2 is used in ventilation systems where balanced ventilation, heat recovery and warm/cool supply air is needed.

At first the heat will be recovered in the counter current heat exchanger and then further heat will be supplied to the supply air by the heat pump. During the summer the heat pump can switch to a cooling mode which means that the heat pump will supply cooling to the supply air.

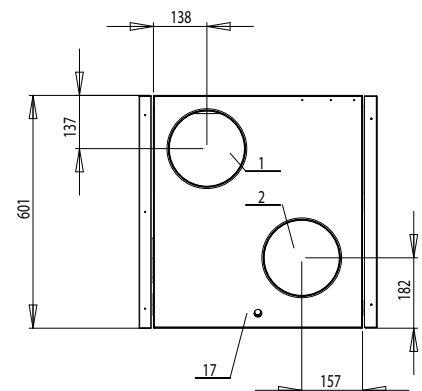
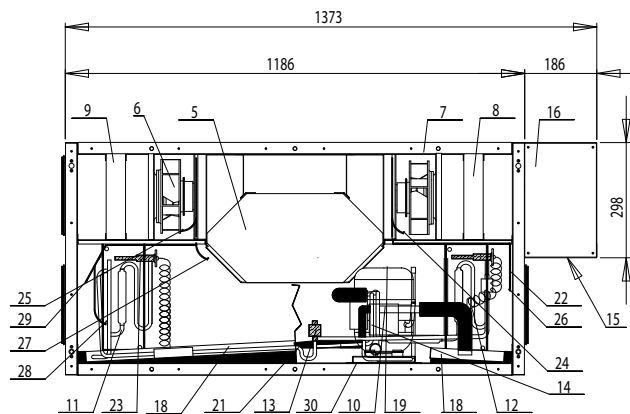
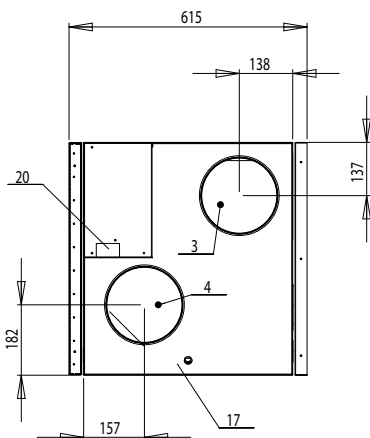
GE Premium 2 is normally used in homes with an area of app. 333 to 555 m² (at an average room height at 2.4 m) the living area is calculated to cover (Max. 1200 J/m³/h, max. outside pressure: 100 Pa):

Air exchange/h	Max. capacity m ³ /h	Living area m ² *
0.3	400	555
0.4	400	417
0.5	400	333

* The power consumption is not included when calculating the living area

Dimensions

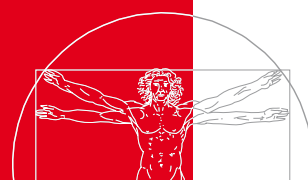
GE Premium 2
Dimensions in mm



Types

GE Premium 2 - H (Right - shown)
GE Premium 2 - V (Left)

- | | | | | |
|-------------------------------|------------------------|-------------------------|----------------------------------|-------------------------------|
| 1: Extract air | 7: Extract air fan | 13: High-pressure gov. | 19: Condensation tub | 25: Sensor for fresh air |
| 2: Supply air | 8: Filter, extract air | 14: Process valve | 20: Supply boss at the back Ø100 | 26: Sensor for supply air |
| 3: Fresh air | 9: Filter, supply air | 15: Cable entry | 21: Magnetic valve defrosting | 27: Sensor before cooling air |
| 4: Exhaust air | 10: Compressor | 16: Switch | 22: Thermostat condenser | 28: Sensor for cooling coil |
| 5: Counter current heat exch. | 11: Evaporator | 17: Electrical box | 23: Thermostat evaporator | 29: Sensor for exhaust air |
| 6: Supply air fan | 12: Condensator | 18: Condensat.conn. Ø15 | 24: Sensor for extract air | 30: Four-way valve |



Technical data

Electrical connections:

Without electrical heating and preheating coil

1 x 230V + N + PE + 10 A, 50 Hz

With electrical heating and preheating coil

Max 1.2 + 1.0 kW

1 x 230V + N + PE + 16 A, 50 Hz

Fans:

R3G 190

Motor:

EC motor with integrated electronics

Isolation class

B

Class

IP 44

Motor capacity (Max. per motor):

3320 Rpm

Current input (Max. per motor):

71 W

Power consumption (Max. per motor):

0.50 A

Speed regulation:

Individually the fans can be set to 3 different speeds

The working area of the heat pump:

-15°/+35°C

Compressor:

NE 9213GK

Effect collection (max.):

767W

Power consumption (max.):

3.3A

Average performance:

1800W

Average effect consumption:

575W

Cooling medier:

R407c

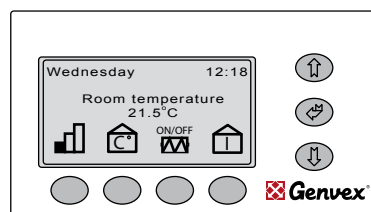
Filling

900/1000 gram

Automatics

GE Premium 2 is delivered with Optima 300 automatics with a factory settings, so that the unit can be started, without setting up the menu. The factory settings are standard settings, that can be changed to the specific needs and demands of your living area.

Control panel



On this button you can change between low, medium and high speed (step 1, step 2 and step 3) and stop the unit.



On this button you can change the room temperature.



On this button you can give signal to heating elements to switch on when required



Info menu

On this button you can see all temperatures of the unit, and by pushing arrow down, you can see which relays are in action.



Press »Arrow down« to change from one menu point to the next. Press »Arrow up« to change from one menu point to the previous one.



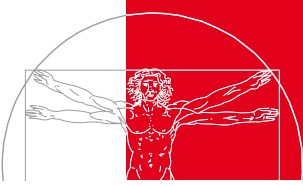
If you wish to flick through the pages of the "operation menu" just press the »Enter-button« in the middle and this will change the whole page to the next set of menu points.



Sound data

Measuring point	1 m in front of the unit			Extract duct			Supply duct		
	1	2	3	1	2	3	1	2	3
Airflow									
	Lp dB			Lwu dB			Lwi dB		
63 Hz	49	50	58	90	92	94	89	93	94
125 Hz	51	55	55	87	94	97	87	97	98
250 Hz	47	53	55	82	90	94	84	93	94
500 Hz	34	43	45	65	78	84	74	79	83
1000 Hz	-	-	33	60	71	77	64	73	77
2000 Hz	-	-	-	59	70	75	61	71	74
4000 Hz	-	-	-	44	63	68	51	64	68
8000 Hz	-	-	-	31	49	57	38	50	55
Average	Lp dB(A)			Lwu dB(A)			Lwi dB(A)		
	41	46	48	75	84	88	76	86	88

1: Measured at 40% of max. speed with compressor on
 2: Measured at 70% of max. speed with compressor on
 3: Measured at 100% of max. speed with compressor on



Capacity

The capacity lines are based on an average of the supply and extract air volume in a unit with filters.

Max. Capacity:

At 100 Pa the max. capacity is: 400 m³/h.

With an average room height of 2.4 m, the living area is calculated as follows:

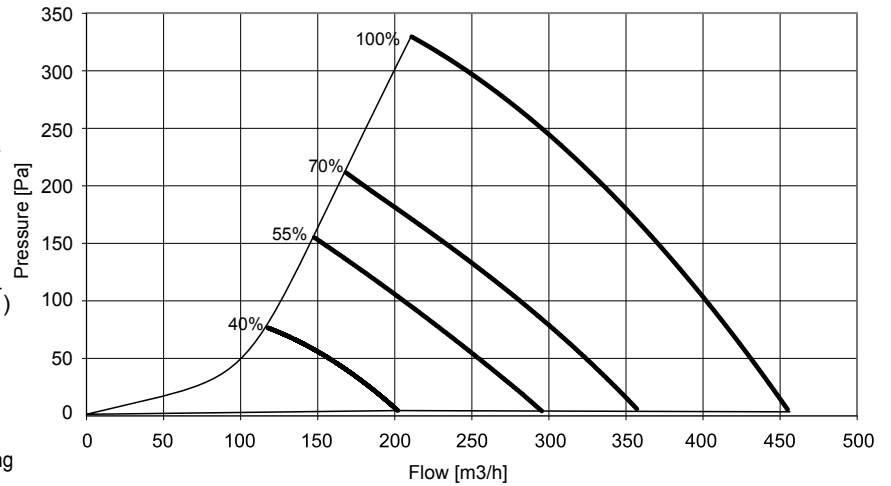
Living area (m²) x Room height (m) x Air exchange/h = Max. capacity

$$\text{Living area (m}^2\text{)} = \frac{\text{Max. capacity (m}^3\text{/h)}}{\text{Room height (m)} \times \text{Air exchange (h}^{-1}\text{)}}$$

Example:

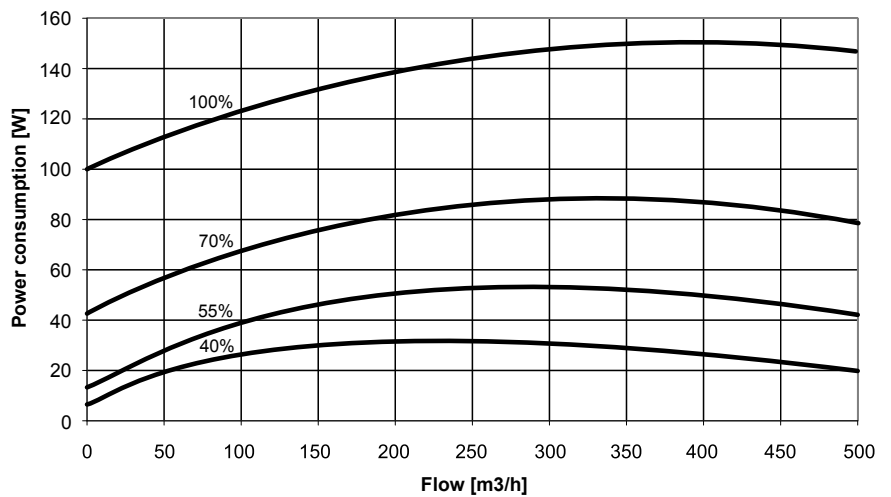
$$\text{Living area (m}^2\text{)} = \frac{400 \text{ m}^3\text{/h}}{2.4 \times 0.5 \text{ h}^{-1}} = 333 \text{ m}^2 *$$

* The power consumption is not included when calculating the living area



Total power consumption:

For both fans and control.



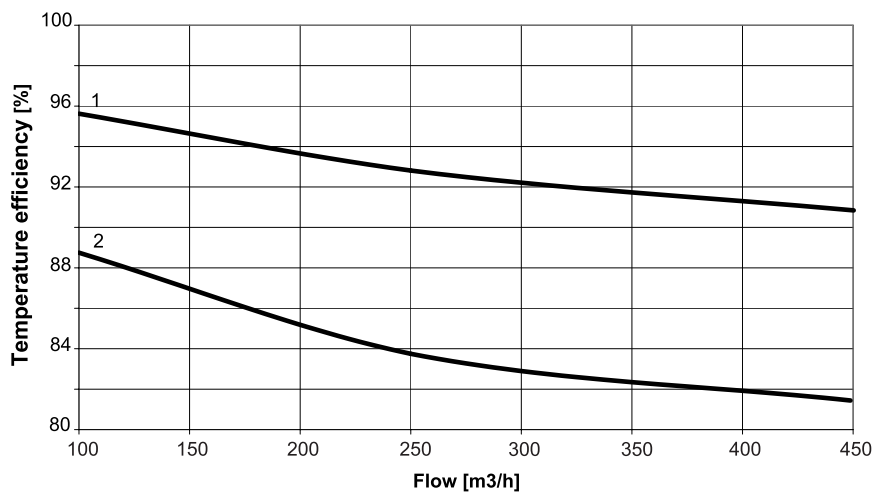
Heat recovery rate

Heat recovery rate, flow $m_{in} = m_{out}$

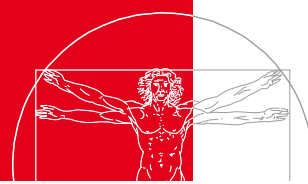
Icing of the heat exchanger at low outdoor temperatures has been left out of account.

1 = Temp.: -12 °C
RF.: 50%

2 = Temp.: 4 °C
RF.: 50%



GE Premium 2



Construction

Size:

(h x l x d) ex. connecting pieces and electric box
601 x 1186 x 615 mm

Cabinet:

Fully closed hot galvanised plate with 30 mm Isolation.
Plastic-coated white RAL 9010.

Duct connection:

Ø200 mm with rubber ring seal

Front:

Front with quick locks for filter service

Heat exchanger:

See water resistant aluminium

Condensation tub:

Stainless steel

Condensation connection:

Stainless steel Ø15 mm

Filters:

Fresh air

F7 filter

Exhaust air

G4 filter

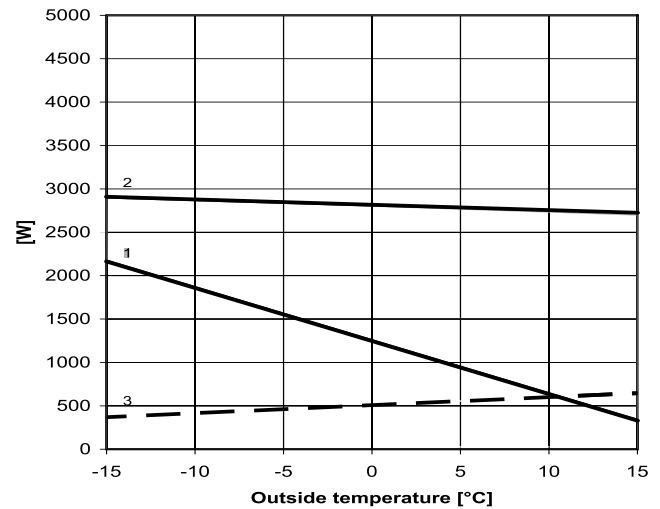
Weight:

101 kg

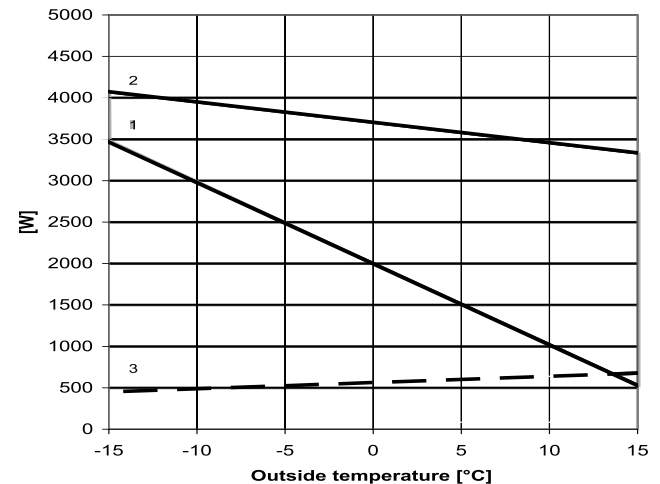
Capacity

GE Premium 2' capacity varies with air quantity and outdoor air

Airflow 178 m³/h.



Airflow 285 m³/h.



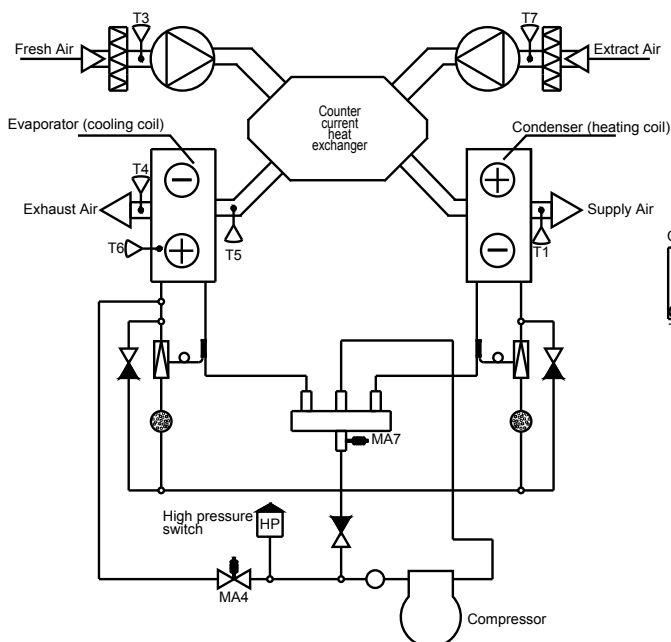
- 1) Energy consumption for heating incoming fresh air to room temperature 20°C.
- 2) Total capacity of the unit
- 3) Power input with compressor running

The hatch area is GE Premium 2's contribution for roomheating

Cooling capacity:

With an outside temperature of 26°C, relative humidity of 45% and full speed, the cooling power output is 3680 W.

Flow diagram



Sensors:

- T1: Supply air
- T2: Room
- T3: Fresh air
- T4: Extract air
- T5: Before the cooling coil
- T6: Cooling coil
- T7: Exhaust air
- T8: Water freezing (for the water-afterheating surface)

Magnetic valve:

- MA4: Defrosting
- MA7: Heat/cooling