

# TEST REPORT

Report no. :  
300-KLAB-19-025



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Page 1 of 27  
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Enclosures: 0

**Customer:** Company: Panasonic DE GmbH  
Address: Hagenauer Strasse 43  
City: 65203 Wiesbaden  
Tel.: +49 1724 141441

**Component:** Brand: Panasonic  
Type: Air to water heat pump  
Model: Outdoor: WH-UD03JE5 Indoor: WH-ADC0309J3E5  
Series no.: Outdoor: 5621201008 Indoor: 5704001319  
Production year: Outdoor:2019.04 Indoor: 2019.05

**Dates:** Component tested: October 2019

**Procedure:** See objective (page 2) for list of standards

**Remarks:** The unit was delivered by the customer. The installation and test settings were done according to the manufacturer's instructions.

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**Division/Centre:** Danish Technological Institute  
Energy and Climate  
Heat Pump Laboratory, Aarhus

**Date:** 2019.11.18

**Signature:** Kamalathan Arumugam  
B.Sc. Engineer



 **DANAK**  
Test Reg. nr. 300



## Objective

The objective of this report is to document the following:

- The Seasonal Coefficient of Performance (SCOP) according to EN 14825:2016. In order to calculate the SCOP, tests were carried out at the part load conditions stated in the table below.
- Part load test according to EN14511:2018 at A7/W35 and A2/W35
- Full load test according to EN14511:2018 at A-7/W35





## Test conditions for low temperature application at reference heating season average

Part load conditions for reference SCOP and reference SCOPon calculation of air to water units for low temperature application for the reference heating season "A" = average, "W" = warmer, and "C" = colder.

Condition <sup>a</sup>	Part Load Ratio in %				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet <sup>d</sup> °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	$\frac{-7 - 16}{(T_{\text{designh}} - 16)}$	88	n/a	61	-7(-8)	20(12)	a / 35	a / 34	n/a	a / 30
B	$\frac{+2 - 16}{(T_{\text{designh}} - 16)}$	54	100	37	2(1)	20(12)	a / 35	a / 30	a / 35	a / 27
C	$\frac{+7 - 16}{(T_{\text{designh}} - 16)}$	35	64	24	7(6)	20(12)	a / 35	a / 27	a / 31	a / 25
D	$\frac{+12 - 16}{(T_{\text{designh}} - 16)}$	15	29	11	12(11)	20(12)	a / 35	a / 24	a / 26	a / 24
E	$(TOL - 16) / (T_{\text{designh}} - 16)$				TOL	20(12)	a / 35	a / b	a / b	a / b
F	$(T_{\text{bivalent}} - 16) / (T_{\text{designh}} - 16)$				T <sub>bivalent</sub>	20(12)	a / 35	a / c	a / c	a / c
G	$\frac{-15 - 16}{(T_{\text{designh}} - 16)}$	n/a	n/a	82	-15	20(12)	a / 35	n/a	n/a	a / 32

<sup>a</sup> With the water flow rate as determined at the standard rating conditions given in EN 14511-2 at 30/35 conditions for units with a fixed water flow rate, and with a fixed delta T of 5 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

<sup>b</sup> Variable outlet shall be calculated by interpolation from T<sub>designh</sub> and the temperature which is closest to the TOL.

<sup>c</sup> Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

<sup>d</sup> If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

## Additional information

Climate	T <sub>designh</sub> [°C]	T <sub>bivalent</sub> [°C]	TOL [°C]	Outlet temperature	Flow rate
Average	-10	-10	-10	Variable	Variable





## Test conditions for medium temperature application at reference heating season average

Part load conditions for reference SCOP and reference SCOPon calculation of air to water units for medium temperature application for the reference heating season "A" = average, "W" = warmer, and "C" = colder.

Condition	Part Load Ratio in %				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet <sup>d</sup> °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	$\frac{-7 - 16}{(T_{designh} - 16)}$	88	n/a	61	-7(-8)	20(12)	<sup>a</sup> / 55	<sup>a</sup> / 52	n/a	<sup>a</sup> / 44
B	$\frac{+2 - 16}{(T_{designh} - 16)}$	54	100	37	2(1)	20(12)	<sup>a</sup> / 55	<sup>a</sup> / 42	<sup>a</sup> / 55	<sup>a</sup> / 37
C	$\frac{+7 - 16}{(T_{designh} - 16)}$	35	64	24	7(6)	20(12)	<sup>a</sup> / 55	<sup>a</sup> / 36	<sup>a</sup> / 46	<sup>a</sup> / 32
D	$\frac{+12 - 16}{(T_{designh} - 16)}$	15	29	11	12(11)	20(12)	<sup>a</sup> / 55	<sup>a</sup> / 30	<sup>a</sup> / 34	<sup>a</sup> / 28
E	$(TOL - 16) / (T_{designh} - 16)$				TOL	20(12)	<sup>a</sup> / 55	<sup>a</sup> / <sup>b</sup>	<sup>a</sup> / <sup>b</sup>	<sup>a</sup> / <sup>b</sup>
F	$(T_{bivalent} - 16) / (T_{designh} - 16)$				T <sub>bivalent</sub>	20(12)	<sup>a</sup> / 55	<sup>a</sup> / <sup>c</sup>	<sup>a</sup> / <sup>c</sup>	<sup>a</sup> / <sup>c</sup>
G	$\frac{-15 - 16}{(T_{designh} - 16)}$	n/a	n/a	82	-15	20(12)	<sup>a</sup> / 55	n/a	n/a	<sup>a</sup> / 49

<sup>a</sup> With the water flow rate as determined at the standard rating conditions given in EN 14511-2 at 47/55 conditions for units with a fixed water flow rate, and with a fixed delta T of 8 K for units with a variable flow rate. If the resulting flow rate is below the minimum flow rate then this minimum flow rate is used with the outlet temperature.

<sup>b</sup> Variable outlet shall be calculated by interpolation T<sub>designh</sub> and the temperature which is closest to the TOL.

<sup>c</sup> Variable outlet shall be calculated by interpolation between the upper and lower temperatures which are closest to the bivalent temperature.

<sup>d</sup> If the variable outlet temperature is below the minimum of the operation range of the unit, this minimum should be considered.

## Additional information

Climate	T <sub>designh</sub> [°C]	T <sub>bivalent</sub> [°C]	TOL [°C]	Outlet temperature	Flow rate
Average	-10	-10	-10	Variable	Variable





## Test conditions for EN14511:2018, part load and full load tests

No.	Inlet dry bulb air temperature (°C)	Inlet wet bulb air temperature (°C)	Outlet water temperature (°C)	Inlet water temperature (°C)
1 <sup>a</sup>	2	1	35	30
2 <sup>b</sup>	7	6	35	30
3 <sup>c</sup>	-7	-8	35	30

- a) Part load test at test mode 17 (60% of the heating capacity of A-7W35)  
b) Part load test at test mode 16 (40% of the heating capacity of A-7W35)  
c) Full load test at test mode 1





## Main test results for low temperature application at reference heating season average

<b>Model (Indoor + Outdoor)</b>	WH-ADC0309J3E5 + WH-UD03JE5
<b>Air-to-water heat pump monobloc</b>	N
<b>Low-temperature heat pump</b>	N
<b>Equipped with supplementary heater</b>	Y
<b>Heat pump combination heater</b>	Y

<b>Rated heat output<sup>1)</sup></b>	$P_{rated}$	<b>4 [kW]</b>
<b>Seasonal space heating energy efficiency</b>	$\eta_s$	<b>206.8 [%]</b>
	SCOP	<b>5.25 [-]</b>

<b>Measured capacity for heating for part load at outdoor temperature <math>T_j</math></b>	Average Climate	$T_j = -15\text{ °C}$	$P_{dh}$	- [kW]
	-	$T_j = -7\text{ °C}$	$P_{dh}$	3.65 [kW]
	Low temperature application	$T_j = 2\text{ °C}$	$P_{dh}$	2.10 [kW]
		$T_j = 7\text{ °C}$	$P_{dh}$	1.45 [kW]
		$T_j = 12\text{ °C}$	$P_{dh}$	1.64 [kW]
		$T_j = \text{bivalent temperature}$	$P_{dh}$	4.12 [kW]
		$T_j = \text{operation limit}$	$P_{dh}$	4.12 [kW]

<b>Measured coefficient of performance at outdoor temperature <math>T_j</math></b>	Average Climate	$T_j = -15\text{ °C}$	COP <sub>d</sub>	- [-]
	-	$T_j = -7\text{ °C}$	COP <sub>d</sub>	3.02 [-]
	Low temperature application	$T_j = 2\text{ °C}$	COP <sub>d</sub>	5.20 [-]
		$T_j = 7\text{ °C}$	COP <sub>d</sub>	7.12 [-]
		$T_j = 12\text{ °C}$	COP <sub>d</sub>	9.92 [-]
		$T_j = \text{bivalent temperature}$	COP <sub>d</sub>	2.78 [-]
		$T_j = \text{operation limit}$	COP <sub>d</sub>	2.78 [-]

<b>Bivalent temperature</b>	$T_{bivalent}$	-10 [°C]
<b>Operation limit temperatures</b>	TOL	-10 [°C]
<b>Degradation coefficient</b>	$C_{dh}$	0.96 [-]

<b>Power consumption in modes other than active mode</b>	Off mode	$P_{OFF}$	0.005 [kW]
	Thermostat-off mode	$P_{TO}$	0.007 [kW]
	Standby mode	$P_{SB}$	0.005 [kW]
	Crankcase heater mode	$P_{CK}$	0.005 [kW]
<b>Supplementary heater<sup>1)</sup></b>	Rated heat output	$P_{SUP}$	0.00 [kW]
	Type of energy input		Electrical

<b>Other items</b>	Capacity control		Variable
	Water flow control		Variable
	Water flow rate		-
	Annual energy consumption	$Q_{HE}$	1575 [kWh]

<sup>1)</sup>For heat pump space heaters and heat pump combination heaters, the rated heat output,  $P_{rated}$ , is equal to the design load for heating,  $P_{designh}$ , and the rated heat output of a supplementary heater,  $P_{sup}$ , is equal to the supplementary capacity for heating,  $sup(T_j)$ .



## Main test results for medium temperature application at reference heating season average

<b>Model (Indoor + Outdoor)</b>	WH-ADC0309J3E5 + WH-UD03JE5
<b>Air-to-water heat pump monobloc</b>	N
<b>Low-temperature heat pump</b>	N
<b>Equipped with supplementary heater</b>	Y
<b>Heat pump combination heater</b>	Y

<b>Rated heat output<sup>1)</sup></b>	$P_{rated}$	<b>3 [kW]</b>
<b>Seasonal space heating energy efficiency</b>	$\eta_s$	<b>139.5 [%]</b>
	SCOP	<b>3.56 [-]</b>

<b>Measured capacity for heating for part load at outdoor temperature <math>T_j</math></b>	Average Climate	$T_j = -15\text{ °C}$	$P_{dh}$	- [kW]
	-	$T_j = -7\text{ °C}$	$P_{dh}$	2.76 [kW]
	Medium temperature application	$T_j = 2\text{ °C}$	$P_{dh}$	1.73 [kW]
		$T_j = 7\text{ °C}$	$P_{dh}$	1.20 [kW]
		$T_j = 12\text{ °C}$	$P_{dh}$	1.53 [kW]
		$T_j = \text{bivalent temperature}$	$P_{dh}$	3.14 [kW]
		$T_j = \text{operation limit}$	$P_{dh}$	3.14 [kW]

<b>Measured coefficient of performance at outdoor temperature <math>T_j</math></b>	Average Climate	$T_j = -15\text{ °C}$	COP <sub>d</sub>	- [-]
	-	$T_j = -7\text{ °C}$	COP <sub>d</sub>	2.25 [-]
	Medium temperature application	$T_j = 2\text{ °C}$	COP <sub>d</sub>	3.48 [-]
		$T_j = 7\text{ °C}$	COP <sub>d</sub>	4.60 [-]
		$T_j = 12\text{ °C}$	COP <sub>d</sub>	7.19 [-]
		$T_j = \text{bivalent temperature}$	COP <sub>d</sub>	1.73 [-]
		$T_j = \text{operation limit}$	COP <sub>d</sub>	1.73 [-]

<b>Bivalent temperature</b>	$T_{bivalent}$	-10 [°C]
<b>Operation limit temperatures</b>	TOL	-10 [°C]
<b>Degradation coefficient</b>	$C_{dh}$	0.97 [-]

<b>Power consumption in modes other than active mode</b>	Off mode	$P_{OFF}$	0.005 [kW]
	Thermostat-off mode	$P_{TO}$	0.007 [kW]
	Standby mode	$P_{SB}$	0.005 [kW]
	Crankcase heater mode	$P_{CK}$	0.005 [kW]
<b>Supplementary heater<sup>1)</sup></b>	Rated heat output	$P_{SUP}$	0.00 [kW]
	Type of energy input		Electrical

<b>Other items</b>	Capacity control		Variable
	Water flow control		Variable
	Water flow rate		-
	Annual energy consumption	$Q_{HE}$	1739 [kWh]

<sup>1)</sup>For heat pump space heaters and heat pump combination heaters, the rated heat output,  $P_{rated}$ , is equal to the design load for heating,  $P_{designh}$ , and the rated heat output of a supplementary heater,  $P_{sup}$ , is equal to the supplementary capacity for heating,  $sup(T_j)$ .



## Test results for EN14511:2018, part load and full load tests

No.	Test condition	Heating capacity – [kW]	COP
1 <sup>a</sup>	A2/W35	2.40	4.52
2 <sup>b</sup>	A7/W35	1.56	5.10
3 <sup>c</sup>	A-7/W35	3.27	3.11

- a) Part load test at test mode 17 (60% of the heating capacity of A-7W35)  
b) Part load test at test mode 16 (40% of the heating capacity of A-7W35)  
c) Full load test at test mode 1





## Outdoor unit



## Outdoor unit rating plate

**Panasonic**  
AIR-TO-WATER HEATPUMP

OUTDOOR UNIT  
Model No. **WH-UD03JE5**

RATED VOLTAGE 230 V~  
FREQUENCY 50 Hz  
MAXIMUM INPUT 2.59kW/12.0A  
REFRIGERANT R32 900g

	HEATING (A7W35)	HEATING (A2W35)
CAPACITY	3.20kW	3.20kW
CURRENT	2.9A	4.2A
POWER INPUT	0.60kW	0.88kW
COP	5.33	3.64

	COOLING (A35W7)
CAPACITY	3.20kW
CURRENT	4.3A
POWER INPUT	0.91kW
EER	3.52

( E N 1 4 5 1 1 )

PS H.P. 4. 15MPa (41.5bar)  
L.P. 2. 00MPa (20.0bar)

SERIAL NO.  
**5621201008**  
PRODUCTION DATE 2019.04

Panasonic Appliances  
Air-Conditioning Malaysia  
Sdn. Bhd.  
Shah Alam, Malaysia

Authorized representative in EU  
Panasonic Testing Centre  
Panasonic Marketing Europe GmbH  
Winsberggring 15, 22525 Hamburg,  
Germany

IPX4  
Made in Malaysia

CE 0035

**R32**

THIS PRODUCT  
CONTAINS FLUORINATED  
GREENHOUSE GASES

**WARNING**

**RISK OF  
EXPLOSION  
DURING SERVICE**

After pump down operation,  
fully close 2, 3 way valve.  
Before remove refrigerant  
pipes, compressor must be  
stopped.

ACXF02-40630





## Indoor unit



## Indoor unit rating plate

**Panasonic**

AIR-TO-WATER HYDROMODULE + TANK  
Model No. WH-ADC0309J3E5  
OUTDOOR UNIT WH-UD03JE5  
WH-UD05JE5  
WH-UD07JE5  
WH-UD09JE5

POWER SUPPLY 1 (HEAT PUMP)  
RATED VOLTAGE 230V~  
RATED FREQUENCY 50Hz  
POWER SUPPLY 2 (BACKUP HEATER)  
RATED VOLTAGE 230V~  
RATED FREQUENCY 50Hz  
MAXIMUM POWER 3.00kW  
MAXIMUM CURRENT 13.00A  
MAX. WORKING PRESSURE MPa (Bar)  
- SPACE HEAT/COOL 0.3 (3.0)  
- TANK CIRCUIT 0.8 (8.0)  
TANK UNIT CAPACITY (NETT) 185L

Panasonic AVC Networks Czech, s.r.o.  
U Panasoniku 1, 320 84 Plzeň, Czech Republic  
Assembled in the Czech Republic  
Authorized representative in EU  
Panasonic Testing Centre  
Panasonic Marketing Europe GmbH  
Winsberggring 15, 22525 Hamburg, Germany  
SERIAL NO. **5704001319**

CE  
IP21  
ACXF09-04700  
R32  
QR CODE

PRODUCTION DATE 2019.05





## Detailed SCOP calculation for low temperature and average climate conditions

Calculation of reference SCOP

$$SCOP = \frac{P_{designh} \times H_{he}}{\frac{P_{designh} \times H_{he}}{SCOP_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF}}$$

Where

$P_{design}$  =

Heating load of the building at design temperature, kW

$H_{he}$  =

Number of equivalent heating hours, 2066 h

$H_{TO}$ ,  $H_{SB}$ ,  $H_{CK}$ ,  $H_{OFF}$  =

Number of hours for which the unit is considered to work in thermostat off mode, standby mode, crankcase heater mode and off mode, h, respectively

$P_{TO}$ ,  $P_{SB}$ ,  $P_{CK}$ ,  $P_{OFF}$  =

Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

Data for SCOP

	Outdoor temperature [°C]	Part load ratio [%]	Part load [kW]	Declared capacity [kW]	Declared COP [-]	cdh [-]	CR [-]	COPbin [-]
A	-7	88	3.54	3.65	3.02	0.99	1.00	3.02
B	2	54	2.15	2.10	5.20	0.98	1.00	5.20
C	7	35	1.38	1.45	7.12	0.97	1.00	7.12
D	12	15	0.62	1.64	9.92	0.96	0.38	9.27
E	-10	100	4.00	4.12	2.78	1.00	1.00	2.78
F - BIV	-10	100	4.00	4.12	2.78	1.00	1.00	2.78

Energy consumption for thermostat off, standby, off mode, crankcase heater mode

	Hours [h]	Power input [kW]	Applied to SCOP calculation [kW]	Energy consumption [kWh]
Off mode	3672	0.005	0.005	18.36
Thermostat off	178	0.007	0.007	1.246
Standby	0	0.005	0.005	0
Crankcase heater	3850	0.005	0	0



Calculation Bin for SCOPon

	Bin	Outdoor temperature [°C]	Hours [h]	Heat load [kW]	Heat load covered by heat pump [kW]	Electrical back up heater [kW]	Annual backup heater energy input [kWh]	COPbin	Annual heating demand [kWh]	Annual energy input [kWh]	Net annual heating capacity [kWh]	Net annual power input [kWh]	
<b>E / F - BIV</b>	21	-10	1	4.00	4.00	0.00	0.00	2.78	4.00	1.44	4.00	1.44	
	22	-9	25	3.85	3.85	0.00	0.00	2.86	96.15	33.62	96.15	33.62	
	23	-8	23	3.69	3.69	0.00	0.00	2.94	84.92	28.89	84.92	28.89	
<b>A</b>	24	-7	24	3.54	3.54	0.00	0.00	3.02	84.92	28.12	84.92	28.12	
	25	-6	27	3.38	3.38	0.00	0.00	3.26	91.38	28.01	91.38	28.01	
	26	-5	68	3.23	3.22	0.00	0.00	3.50	219.69	62.69	219.69	62.69	
	27	-4	91	3.08	3.06	0.00	0.00	3.75	280.00	74.73	280.00	74.73	
	28	-3	89	2.92	2.90	0.00	0.00	3.99	260.15	65.22	260.15	65.22	
	29	-2	165	2.77	2.74	0.00	0.00	4.23	456.92	107.99	456.92	107.99	
	30	-1	173	2.62	2.58	0.00	0.00	4.47	452.46	101.15	452.46	101.15	
	31	0	240	2.46	2.42	0.00	0.00	4.72	590.77	125.28	590.77	125.28	
	32	1	280	2.31	2.26	0.00	0.00	4.96	646.15	130.33	646.15	130.33	
<b>B</b>	33	2	320	2.15	2.10	0.00	0.00	5.20	689.23	132.54	689.23	132.54	
	34	3	357	2.00	1.96	0.00	0.00	5.58	714.00	127.87	714.00	127.87	
	35	4	356	1.85	1.81	0.00	0.00	5.97	657.23	110.13	657.23	110.13	
	36	5	303	1.69	1.67	0.00	0.00	6.35	512.77	80.73	512.77	80.73	
	37	6	330	1.54	1.53	0.00	0.00	6.74	507.69	75.37	507.69	75.37	
<b>C</b>	38	7	326	1.38	1.38	0.00	0.00	7.12	451.38	63.40	451.38	63.40	
	39	8	348	1.23	1.23	0.00	0.00	7.55	428.31	56.73	428.31	56.73	
	40	9	335	1.08	1.08	0.00	0.00	7.98	360.77	45.22	360.77	45.22	
	41	10	315	0.92	0.92	0.00	0.00	8.41	290.77	34.58	290.77	34.58	
	42	11	215	0.77	0.77	0.00	0.00	8.84	165.38	18.71	165.38	18.71	
<b>D</b>	43	12	169	0.62	0.62	0.00	0.00	9.27	104.00	11.22	104.00	11.22	
	44	13	151	0.46	0.46	0.00	0.00	9.70	69.69	7.19	69.69	7.19	
	45	14	105	0.31	0.31	0.00	0.00	10.13	32.31	3.19	32.31	3.19	
	46	15	74	0.15	0.15	0.00	0.00	10.55	11.38	1.08	11.38	1.08	
<b>SUM</b>									8262.46	1555.43	8262.46	1555.43	
<b>SCOPon</b>									5.31		<b>SCOPnet</b>		5.31





## Detailed SCOP calculation for medium temperature and average climate conditions

Calculation of reference SCOP

$$SCOP = \frac{P_{designh} \times H_{he}}{\frac{P_{designh} \times H_{he}}{SCOP_{on}} + H_{TO} \times P_{TO} + H_{SB} \times P_{SB} + H_{CK} \times P_{CK} + H_{OFF} \times P_{OFF}}$$

Where

$P_{design}$  =

Heating load of the building at design temperature, kW

$H_{he}$  =

Number of equivalent heating hours, 2066 h

$H_{TO}$ ,  $H_{SB}$ ,  $H_{CK}$ ,  $H_{OFF}$  =

Number of hours for which the unit is considered to work in thermostat off mode, standby mode, crankcase heater mode and off mode, h, respectively

$P_{TO}$ ,  $P_{SB}$ ,  $P_{CK}$ ,  $P_{OFF}$  =

Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

Data for SCOP

	Outdoor temperature [°C]	Part load ratio [%]	Part load [kW]	Declared capacity [kW]	Declared COP [-]	cdh [-]	CR [-]	COPbin [-]
A	-7	88	2.65	2.76	2.25	0.99	1.00	2.25
B	2	54	1.62	1.73	3.48	0.99	1.00	3.48
C	7	35	1.04	1.20	4.60	0.97	0.87	4.58
D	12	15	0.46	1.53	7.19	0.97	0.30	6.68
E	-10	100	3.00	3.14	1.73	1.00	1.00	1.73
F - BIV	-10	100	3.00	3.14	1.73	1.00	1.00	1.73

Energy consumption for thermostat off, standby, off mode, crankcase heater mode

	Hours [h]	Power input [kW]	Applied to SCOP calculation [kW]	Energy consumption [kWh]
Off mode	3672	0.005	0.005	18.36
Thermostat off	178	0.007	0.007	1.246
Standby	0	0.005	0.005	0
Crankcase heater	3850	0.005	0	0



Calculation Bin for SCOPon

	Bin	Outdoor temperature [°C]	Hours [h]	Heat load [kW]	Heat load covered by heat pump [kW]	Electrical back up heater [kW]	Annual backup heater energy input [kWh]	COPbin [-]	Annual heating demand [kWh]	Annual energy input [kWh]	Net annual heating capacity [kWh]	Net annual power input [kWh]
<b>E / F - BIV</b>	21	-10	1	3.00	3.00	0.00	0.00	1.73	3.00	1.73	3.00	1.73
	22	-9	25	2.88	2.88	0.00	0.00	1.90	72.12	37.89	72.12	37.89
	23	-8	23	2.77	2.77	0.00	0.00	2.08	63.69	30.67	63.69	30.67
<b>A</b>	24	-7	24	2.65	2.65	0.00	0.00	2.25	63.69	28.31	63.69	28.31
	25	-6	27	2.54	2.54	0.00	0.00	2.39	68.54	28.72	68.54	28.72
	26	-5	68	2.42	2.42	0.00	0.00	2.52	164.77	65.30	164.77	65.30
	27	-4	91	2.31	2.31	0.00	0.00	2.66	210.00	78.95	210.00	78.95
	28	-3	89	2.19	2.19	0.00	0.00	2.80	195.12	69.77	195.12	69.77
	29	-2	165	2.08	2.08	0.00	0.00	2.93	342.69	116.83	342.69	116.83
	30	-1	173	1.96	1.96	0.00	0.00	3.07	339.35	110.54	339.35	110.54
	31	0	240	1.85	1.85	0.00	0.00	3.21	443.08	138.17	443.08	138.17
	32	1	280	1.73	1.73	0.00	0.00	3.34	484.62	144.95	484.62	144.95
<b>B</b>	33	2	320	1.62	1.62	0.00	0.00	3.48	516.92	148.54	516.92	148.54
	34	3	357	1.50	1.50	0.00	0.00	3.70	535.50	144.72	535.50	144.72
	35	4	356	1.38	1.38	0.00	0.00	3.92	492.92	125.73	492.92	125.73
	36	5	303	1.27	1.27	0.00	0.00	4.14	384.58	92.88	384.58	92.88
	37	6	330	1.15	1.15	0.00	0.00	4.36	380.77	87.32	380.77	87.32
<b>C</b>	38	7	326	1.04	1.04	0.00	0.00	4.58	338.54	73.90	338.54	73.90
	39	8	348	0.92	0.92	0.00	0.00	5.00	321.23	64.23	321.23	64.23
	40	9	335	0.81	0.81	0.00	0.00	5.42	270.58	49.91	270.58	49.91
	41	10	315	0.69	0.69	0.00	0.00	5.84	218.08	37.34	218.08	37.34
	42	11	215	0.58	0.58	0.00	0.00	6.26	124.04	19.81	124.04	19.81
<b>D</b>	43	12	169	0.46	0.46	0.00	0.00	6.68	78.00	11.67	78.00	11.67
	44	13	151	0.35	0.35	0.00	0.00	7.10	52.27	7.36	52.27	7.36
	45	14	105	0.23	0.23	0.00	0.00	7.52	24.23	3.22	24.23	3.22
	46	15	74	0.12	0.12	0.00	0.00	7.94	8.54	1.08	8.54	1.08

<b>SUM</b>	6196.85	1719.54	6196.85	1719.54
<b>SCOPon</b>		3.60	<b>SCOPnet</b>	3.60





## Detailed test results - low temperature application

<b>Detailed result for 'EN14825:2016' Average Low (A) A-7/W34</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:		Average
Temperature application:		Low
Condition name:		A
Condition temperature:	°C	-7
Part load:	%	88%
Chosen Tivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	4.00
Heating demand:	kW	3.54
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Transient
Integrated circulation pump:		Yes
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>3.65</b>
COP	-	<b>3.02</b>
Power consumption	kW	<b>1.21</b>
<b>Measured</b>		
Heating capacity	kW	3.68
COP	-	2.96
Power consumption	kW	1.24
<b>During heating</b>		
Air temperature dry bulb	°C	-7.0
Air temperature wet bulb	°C	-8.1
Inlet temperature	°C	29.0
Outlet temperature	°C	34.0
Outlet temperature (Time averaged)	°C	<b>34.0</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	33934
Calculated Hydraulic power	W	7
Calculated global efficiency	η	0.20
Calculated Capacity correction	W	27
Calculated Power correction	W	34
Water Flow	m <sup>3</sup> /s	0.000197





<b>Detailed result for 'EN14825:2016' Average Low (B) A2/W30</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Low	
Condition name:	B	
Condition temperature:	°C	2
Part load:	%	54%
Chosen Tivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	4.00
Heating demand:	kW	2.15
CR:	-	1.0
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>2.10</b>
COP	-	<b>5.20</b>
Power consumption	kW	<b>0.40</b>
<b>Measured</b>		
Heating capacity	kW	2.12
COP	-	4.92
Power consumption	kW	0.43
<b>During heating</b>		
Air temperature dry bulb	°C	2.1
Air temperature wet bulb	°C	0.9
Inlet temperature	°C	26.0
Outlet temperature	°C	30.0
Outlet temperature (Time averaged)	°C	<b>30.0</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	37372
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000127





<b>Detailed result for 'EN14825:2016' Average Low (C) A7/W27</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Low	
Condition name:	C	
Condition temperature:	°C	7
Part load:	%	35%
Chosen Tivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	4.00
Heating demand:	kW	1.38
CR:	-	1.0
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>1.45</b>
COP	-	<b>7.12</b>
Power consumption	kW	<b>0.20</b>
<b>Measured</b>		
Heating capacity	kW	1.47
COP	-	6.38
Power consumption	kW	0.23
<b>During heating</b>		
Air temperature dry bulb	°C	7.0
Air temperature wet bulb	°C	5.9
Inlet temperature	°C	24.2
Outlet temperature	°C	27.0
Outlet temperature (Time averaged)	°C	<b>27.0</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	36770
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	27
Water Flow	m <sup>3</sup> /s	0.000127



<b>Detailed result for 'EN14825:2016' Average Low (D) A12/W24</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Low	
Condition name:	D	
Condition temperature:	°C	12
Part load:	%	15%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	4.00
Heating demand:	kW	0.62
CR:	-	0.4
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>1.64</b>
COP	-	<b>9.92</b>
Power consumption	kW	<b>0.17</b>
<b>Measured</b>		
Heating capacity	kW	1.66
COP	-	8.64
Power consumption	kW	0.19
<b>During heating</b>		
Air temperature dry bulb	°C	12.0
Air temperature wet bulb	°C	10.9
Inlet temperature	°C	22.8
Outlet temperature	°C	25.9
Outlet temperature (Time averaged)	°C	<b>23.9</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	36605
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	27
Water Flow	m <sup>3</sup> /s	0.000127





<b>Detailed result for 'EN14825:2016' Average Low (E and F) A-10/W35</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Low	
Condition name:	E and F	
Condition temperature:	°C	-10
Part load:	%	100%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	4.00
Heating demand:	kW	4.00
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>4.12</b>
COP	-	<b>2.76</b>
Power consumption	kW	<b>1.49</b>
<b>Measured</b>		
Heating capacity	kW	4.15
COP	-	2.72
Power consumption	kW	1.52
<b>During heating</b>		
Air temperature dry bulb	°C	-10.0
Air temperature wet bulb	°C	-11.1
Inlet temperature	°C	30.0
Outlet temperature	°C	35.1
Outlet temperature (Time averaged)	°C	<b>35.1</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	33997
Calculated Hydraulic power	W	7
Calculated global efficiency	$\eta$	0.20
Calculated Capacity correction	W	28
Calculated Power correction	W	34
Water Flow	m <sup>3</sup> /s	0.000197





## Detailed test results - medium temperature application

<b>Detailed result for 'EN14825:2016' Average Medium (A) A-7/W52</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Medium	
Condition name:	A	
Condition temperature:	°C	-7
Part load:	%	88%
Chosen Tivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.00
Heating demand:	kW	2.65
CR:	-	1.0
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>2.76</b>
COP	-	<b>2.25</b>
Power consumption	kW	<b>1.23</b>
<b>Measured</b>		
Heating capacity	kW	2.79
COP	-	2.22
Power consumption	kW	1.26
<b>During heating</b>		
Air temperature dry bulb	°C	-7.0
Air temperature wet bulb	°C	-8.1
Inlet temperature	°C	46.7
Outlet temperature	°C	52.0
Outlet temperature (Time averaged)	°C	<b>52.0</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	40178
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.18
Calculated Capacity correction	W	24
Calculated Power correction	W	29
Water Flow	m <sup>3</sup> /s	0.000126





<b>Detailed result for 'EN14825:2016' Average Medium (B) A2/W42</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Medium	
Condition name:	B	
Condition temperature:	°C	2
Part load:	%	54%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.00
Heating demand:	kW	1.62
CR:	-	1.0
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>1.73</b>
COP	-	<b>3.48</b>
Power consumption	kW	<b>0.50</b>
<b>Measured</b>		
Heating capacity	kW	1.76
COP	-	3.34
Power consumption	kW	0.53
<b>During heating</b>		
Air temperature dry bulb	°C	2.1
Air temperature wet bulb	°C	0.9
Inlet temperature	°C	38.7
Outlet temperature	°C	42.0
Outlet temperature (Time averaged)	°C	<b>42.0</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	38686
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000128





<b>Detailed result for 'EN14825:2016' Average Medium (C) A7/W36</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Medium	
Condition name:	C	
Condition temperature:	°C	7
Part load:	%	35%
Chosen Tivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.00
Heating demand:	kW	1.04
CR:	-	0.9
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>1.20</b>
COP	-	<b>4.60</b>
Power consumption	kW	<b>0.26</b>
<b>Measured</b>		
Heating capacity	kW	1.23
COP	-	4.24
Power consumption	kW	0.29
<b>During heating</b>		
Air temperature dry bulb	°C	7.0
Air temperature wet bulb	°C	5.9
Inlet temperature	°C	33.9
Outlet temperature	°C	36.3
Outlet temperature (Time averaged)	°C	<b>35.9</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	37761
Calculated Hydraulic power	W	5
Calculated global efficiency	η	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000127



<b>Detailed result for 'EN14825:2016' Average Medium (D) A12/W30</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Medium	
Condition name:	D	
Condition temperature:	°C	12
Part load:	%	15%
Chosen Tivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.00
Heating demand:	kW	0.46
CR:	-	0.3
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>1.53</b>
COP	-	<b>7.19</b>
Power consumption	kW	<b>0.21</b>
<b>Measured</b>		
Heating capacity	kW	1.55
COP	-	6.45
Power consumption	kW	0.24
<b>During heating</b>		
Air temperature dry bulb	°C	12.0
Air temperature wet bulb	°C	10.9
Inlet temperature	°C	29.1
Outlet temperature	°C	32.0
Outlet temperature (Time averaged)	°C	<b>30.0</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	38017
Calculated Hydraulic power	W	5
Calculated global efficiency	η	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000127



<b>Detailed result for 'EN14825:2016' Average Medium (E and F) A-10/W55</b>		
Tested according to:	EN14511:2018 and EN14825:2016	
Climate zone:	Average	
Temperature application:	Medium	
Condition name:	E and F	
Condition temperature:	°C	-10
Part load:	%	100%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.00
Heating demand:	kW	3.00
CR:	-	1.0
Minimum flow reached:	-	Yes
Measurement type:	Steady State	
Integrated circulation pump:	Yes	
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>3.14</b>
COP	-	<b>1.73</b>
Power consumption	kW	<b>1.82</b>
<b>Measured</b>		
Heating capacity	kW	3.17
COP	-	1.72
Power consumption	kW	1.85
<b>During heating</b>		
Air temperature dry bulb	°C	-10.0
Air temperature wet bulb	°C	-11.1
Inlet temperature	°C	48.8
Outlet temperature	°C	54.9
Outlet temperature (Time averaged)	°C	<b>54.9</b>
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	39908
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.18
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000125





## Detailed test results – for EN14511 full load test

<b>Detailed result for 'EN14511:2018' A-7/W35 Full load</b>		
Tested according to:		EN14511:2018
Minimum flow reached:		No
Measurement type:		Transient
Integrated circulation pump:		Yes
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>3.27</b>
COP	-	<b>3.11</b>
Power consumption	kW	<b>1.05</b>
<b>Measured</b>		
Heating capacity	kW	3.30
COP	-	3.04
Power consumption	kW	1.08
<b>During heating</b>		
Air temperature dry bulb	°C	-6.9
Air temperature wet bulb	°C	-8.1
Inlet temperature	°C	30.0
Outlet temperature	°C	35.1
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	35194
Calculated Hydraulic power	W	6
Calculated global efficiency	$\eta$	0.19
Calculated Capacity correction	W	26
Calculated Power correction	W	32
Water Flow	m <sup>3</sup> /s	0.000172





## Detailed test results – for EN14511 part load test

<b>Detailed result for 'EN14511:2018' A2/W35 Part load</b>		
Tested according to:		EN14511:2018
Minimum flow reached:		Yes
Measurement type:		Steady State
Integrated circulation pump:		Yes
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>2.40</b>
COP	-	<b>4.52</b>
Power consumption	kW	<b>0.53</b>
<b>Measured</b>		
Heating capacity	kW	2.42
COP	-	4.34
Power consumption	kW	0.56
<b>During heating</b>		
Air temperature dry bulb	°C	2.1
Air temperature wet bulb	°C	0.9
Inlet temperature	°C	30.5
Outlet temperature	°C	35.1
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	38107
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000127





<b>Detailed result for 'EN14511:2018' A7/W35 Part load</b>		
Tested according to:		EN14511:2018
Minimum flow reached:		Yes
Measurement type:		Steady State
Integrated circulation pump:		Yes
<b>Included corrections (Final result)</b>		
Heating capacity	kW	<b>1.56</b>
COP	-	<b>5.10</b>
Power consumption	kW	<b>0.31</b>
<b>Measured</b>		
Heating capacity	kW	1.59
COP	-	4.74
Power consumption	kW	0.33
<b>During heating</b>		
Air temperature dry bulb	°C	7.0
Air temperature wet bulb	°C	5.9
Inlet temperature	°C	32.0
Outlet temperature	°C	35.1
<b>Circulation pump</b>		
Measured: Static differential pressure, liquid pump	Pa	38100
Calculated Hydraulic power	W	5
Calculated global efficiency	$\eta$	0.17
Calculated Capacity correction	W	23
Calculated Power correction	W	28
Water Flow	m <sup>3</sup> /s	0.000127

