

Report No.: S 444 2014 T2
Test report Level 2

Testing

of Air/water heat pump
EHPA-testing regulation,
version 1.6. (01.05.2013)

Type:
WH-UX16FE8/ WH-SXC16F9E8

Company:
Panasonic Appliances Air-Conditioning
Malaysia Sdn Bhd



2014

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Publication of page 2 is permitted.

The test results presented in this report refer solely to the test object stated.

Test report Level 2
Additional requirements for granting the international quality label
for heat pumps
(EHPA testing regulation version 1.6 /01.05.2013)

Applicant/contractor: Panasonic Appliances Air-Conditioning R&D Malaysia Sdn Bhd
Lot 2 Persiaran Tengku Ampuan
Section 21, Shah Alam Industrial Site
40300 SHAH ALAM Selangor Darul Ehsan
Malaysia

European representative **Panasonic Marketing Europe GmbH**
Hagenauer Strasse 43
D-65203 Wiesbaden

Manufacturer Panasonic Appliances Air-Conditioning Malaysia Sdn Bhd
Lot 2 Persiaran Tengku Ampuan
Section 21, Shah Alam Industrial Site
40300 SHAH ALAM Selangor Darul Ehsan
Malaysia

Type of appliance: *Air/water heat pumps with electrically driven compressors for space heating*

Technical specifications:

Type	COP A2/W35	Heating capacity A2/W35	Heating capacity A7/W35
WH-UX16FE8/ WH-SXC16F9E8	3,1	16,0 kW	16,0 kW

Heat source

Air inlet temperature -20°C – 35 °C

Heat sink:

Outlet temperature 20°C - 55°C

Max. working pressure 3 bar

Test results:

The technical requirements of the above mentioned standard are fulfilled. The local applicable installation conditions are to be observed.

Cologne, 24.02 2014
432/pom

Test Centre for Energy Appliances
DIN Certco Testcenter PI096
EHPA / DACH – Testcenter Nr.2008004-EHPA-bwp

Expert

Deputy Head of Test Centre



Dipl.-Ing. A. Pomp



Dipl.-Ing. R. Verbert

1. Task

Testing for determination of compliance according requirements by the international seal of approval for heat-pumps (EHPA Test regulation version 1.6 dated 01.05.2013). Evaluation of the performance numbers (COP – Values) at the specified test points.

To achieve the international EHPA-DACH seal of approval, the test report in conjunction with furthermore documents can be presented at the national commission for the seal of approval.

2. Description of the appliance

The air/water heat-pump is split - devices with a nominal heat output of 16 kW at A7/W35.



The heat-pump contains an external and an internal unit, which are connected by copper pipes. The external unit is always filled with refrigerant sufficiently. After installation of the pipes, a service valve is opened and the refrigerant gets in the internal unit. The amount of refrigerant is dimensioned so as to a pipe length of 7.0 m no further refilling is necessary. The pipe length during the tests averages 7.0 m and the machines are inverter devices.



The devices are furthermore equipped with a circulation pump and with an additional electric heater. All testing was performed with deactivated electrical heating.



2.1. Nameplates WH-UX16FE8/ WH-SXC16F9E8

Indoor Nameplates

Panasonic	
AIR-TO-WATER HEATPUMP	
Model No.	WH-SXC16F9E8
OUTDOOR UNIT	WH-UX16FE8
POWER SUPPLY 1	
RATED VOLTAGE	400V
PHASE	3N~
RATED FREQUENCY	50Hz
POWER SUPPLY 2	
RATED VOLTAGE	400V
PHASE	3N~
RATED FREQUENCY	50Hz
MAXIMUM POWER	9.00kW
MAXIMUM CURRENT	13.0A
MWP (WATER)	0.3MPa
HEATING WATER FLOW	2.8 m ³ /h
COOLING WATER FLOW	2.1 m ³ /h
SERIAL NO.	
5514300000	
PRODUCTION DATE	2013.8
Panasonic Appliances Air-Conditioning Malaysia Sdn. Bhd. Shah Alam Malaysia Made in Malaysia	
Authorized representative in EU Panasonic Testing Centre Panasonic Marketing Europe GmbH Winsbergring 15, 22525 Hamburg, Germany	
R410A	
 	
F092233	

Panasonic	
AIR-TO-WATER HEATPUMP	
Model No.	WH-SXC16F9E8
OUTDOOR UNIT	WH-UX16FE8
POWER SUPPLY 1	
RATED VOLTAGE	400V
PHASE	3N~
RATED FREQUENCY	50Hz
POWER SUPPLY 2	
RATED VOLTAGE	400V
PHASE	3N~
RATED FREQUENCY	50Hz
MAXIMUM POWER	9.00kW
MAXIMUM CURRENT	13.0A
MWP (WATER)	0.3MPa
HEATING WATER FLOW	2.8m ³ /h
COOLING WATER FLOW	2.1m ³ /h
SERIAL NO.	
55143	
PRODUCTION DATE	2013.8
Panasonic Appliances Air-Conditioning Malaysia Sdn. Bhd. Shah Alam Malaysia Made in Malaysia	
Authorized representative in EU Panasonic Testing Centre Panasonic Marketing Europe GmbH Winsbergring 15, 22525 Hamburg, Germany	
R410A	
 	
F092233	

Outdoor Nameplates

Panasonic

AIR-TO-WATER HEATPUMP

Model No.	WH-UX16FE8		
RATED VOLTAGE	400V		
PHASE	3N~		
FREQUENCY	50Hz		
MAXIMUM INPUT	10.27kW/15.5A		
REFRIGERANT	R410A	2.90kg	

	COOLING (A35W7)	HEATING (A7W35)	HEATING (A2W35)
CAPACITY	12.20kW	16.00kW	16.00kW
CURRENT	7.2A	5.7A	7.8A
POWER INPUT	4.76kW	3.74kW	5.16kW
EER/COP	2.57	4.28	3.10

(EN 14511)

MWP	H.P. 4.15MPa	L.P. 2.00MPa
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SERIAL NO.
56141

PRODUCTION DATE 2013.11

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

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

THIS PRODUCT CONTAINS
FLUORINATED GREENHOUSE
GASES COVERED BY THE
KYOTO PROTOCOL

IP24
Made In Malaysia

R410A

F131414



Panasonic

AIR-TO-WATER HEATPUMP

Model No.	WH-UX16FE8		
RATED VOLTAGE	400V		
PHASE	3N~		
FREQUENCY	50Hz		
MAXIMUM INPUT	10.27kW/15.5A		
REFRIGERANT	R410A	2.90kg	

	COOLING (A35W7)	HEATING (A7W35)	HEATING (A2W35)
CAPACITY	12.20kW	16.00kW	16.00kW
CURRENT	7.2A	5.7A	7.8A
POWER INPUT	4.76kW	3.74kW	5.21kW
EER/COP	2.57	4.28	3.07

(EN 14511)

MWP	H.P. 4.15MPa	L.P. 2.00MPa
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SERIAL NO.
5614100000

PRODUCTION DATE 2013.8

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

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

THIS PRODUCT CONTAINS
FLUORINATED GREENHOUSE
GASES COVERED BY THE
KYOTO PROTOCOL

IP24
Made in Malaysia

R410A

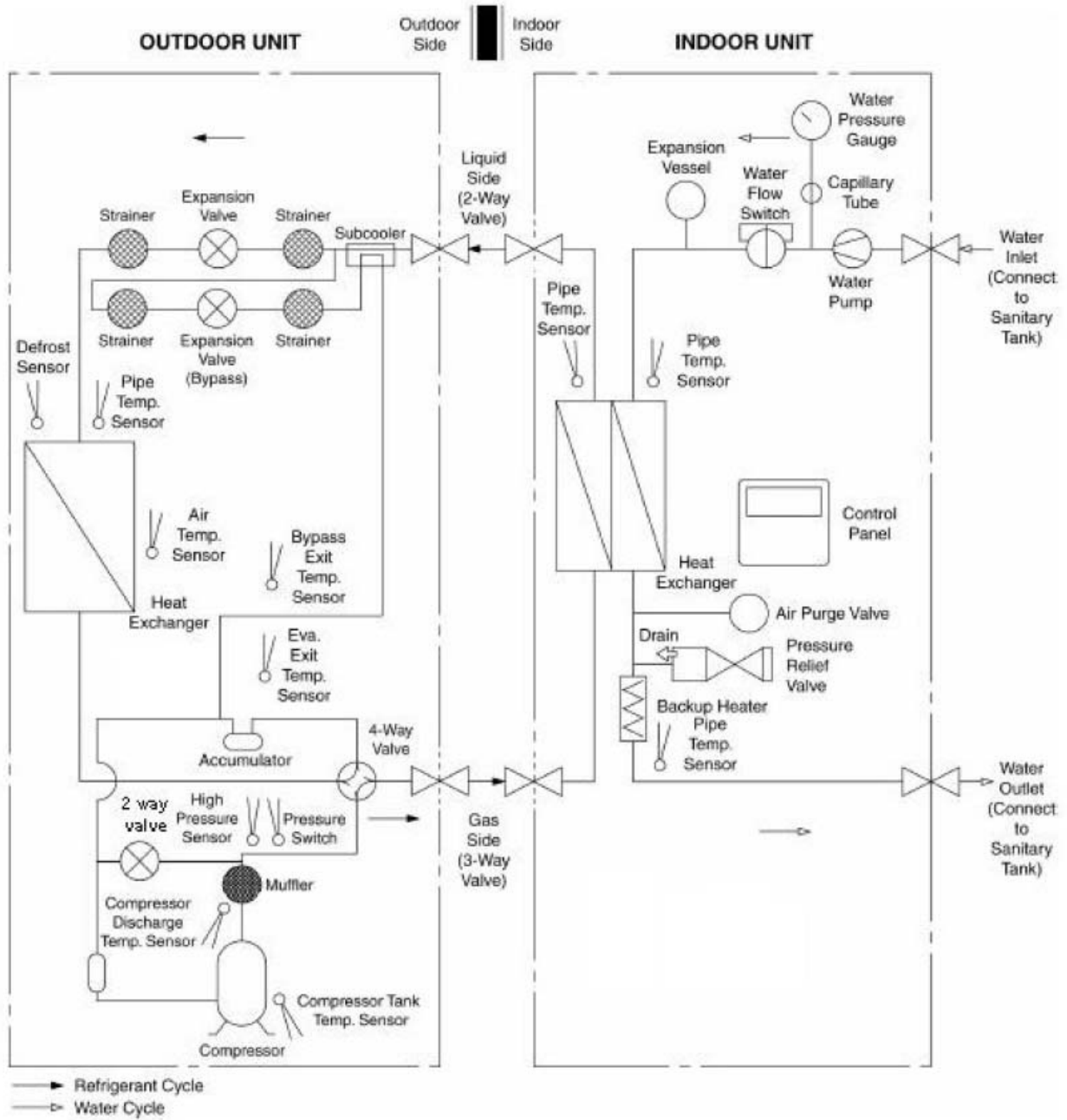
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2.2. Overview technical data's

Type	WH-UX16FE8-WH/SXC16F9E8
Air/water	
COP A2/W35	3,184
COP A2/W45	2,610
COP A2/W55	2,240
Heating capacity	
A2/W35 [kW]	15,921
A2/W45 [kW]	15,867
A2/W55 [kW]	11,792
Water volume flow	
A7/W35 heat sink side [m ³ /h]	2,750
A7/W45 heat sink side [m ³ /h]	2,750
A7/W55 heat sink side [m ³ /h]	1,722
Fan speed (top/bottom)	
A7/W35 air side [rpm]	583/622
A7/W45 air side [rpm]	580/620
A7/W55 air side [rpm]	580/620
Supply voltage	400 V
Frequency	50 Hz
Examined frequency of the compressor (Inverter)	
A2/W35 (Hz)	65
A2/W45 (Hz)	66
A2/W55 (Hz)	62
Effective power input	
A2/W35 [KW]	5,000
A2/W45 [KW]	6,078
A2/W55 [KW]	5,264
Dimensions (High x Width x Depths) mm	
Outdoor unit	1340 x 900 x 320
Indoor unit	892 x 502 x 353
Weight	
Outdoor unit	119 kg
Indoor unit	47 kg

Type	WH-UX16FE8/WH-SXC16F9E8
Heat source Air inlet temperature	(-20°C) – 35°C
Heat sink: Outlet temperature Max. working pressure	20°C –55°C 3 bar
Refrigerant cycle Refrigerant GWP (EU Ecolabel, 2007/742/EC)	R410a 1975
Compressor construction Compressor manufacturer Compressor type	Rotary Panasonic 5JD650XBA22
Filling capacity refrigerant	2,9 kg
Condenser	SWEP Type V26Hx52
Evaporator (upper)	Panasonic B324495
Evaporator (lower)	Panasonic B324496
Evaporator fan motor (upper)	Panasonic EHDS83CAC Alternative: Panasonic EHDS83LAC Alternative: F.G.L.S. Co., Ltd MFE-60MPA
Evaporator fan motor (lower)	Panasonic EHDS83DAC Alternative: Panasonic EHDS83MAC Alternative: F.G.L.S. Co., Ltd MFE-60MPA (B)
4 Way valve	Zhejiang Sanhua Typ SHF-20B-46-MS
Expansion valve 1	Fujikoki Corp. Typ CAM-BD18MS-1
Expansion valve 2	Fujikoki Corp. Typ CAM-BD24MS-1
Safety pressure switch	Saginomiya Typ ACB-4UB14 Alternative: Sensata Tech Typ PS80-17-0001
Circulation pump	Panasonic PY-122NDJA3

2.3. Water and refrigerant cycle



3. Testing (chapter 6.1)

The tests were carried out with the test institute TÜV Rheinland in October 2013 in the laboratory of Panasonic in Malaysia.

The supply voltage was during the examination 400 V ±1%

3.1. Test conditions for performance testing

Test condition:	Standard:	Type ¹	T.db (°C)	T.wb (°C)	T.out (°C)	T.in (°C)
Low temperatures						
A 7 / W 35	EN 14511-2	N	7	6	35	30
A 2 / W 35²	EN 14511-2	B/QL	2	1	35	a
A 2 / W 35	Eco label		2	1	35	30
A 10 / W 35	BAFA		10	9	35	a
A 12 / W 35	EN 14511-2	B	12	11	35	a
A -7 / W 35	EN 14511-2	B	-7	-8	35	a
A -7 / W 35 100% ³	EN 14511-2	B	-7	-8	35	a
A -15 / W 35	EN 14511-2	B	-15	b	35	a
Medium temperatures						
A 7 / W 45	EN 14511-2	N	7	6	45	30
A 2 / W 45²	EN 14511-2	B/QL	2	1	45	a
A 2 / W 45	Eco label		2	1	45	30
A 12 / W 45	EN 14511-2	B	12	11	45	a
A -7 / W 45	EN 14511-2	B	-7	-8	45	a
A -15 / W 45	EN 14511-2	B	-15	b	45	a
High temperatures						
A 7 / W 55	EN 14511-2	N	7	6	55	30
A 2 / W 55²	EN 14511-2	B/QL	2	1	55	a
A 2 / W 55	Eco label		2	1	55	30
A 12 / W 55	EN 14511-2	B	12	11	55	a
A -7 / W 55	EN 14511-2	B	-7	-8	55	a
A -15 / W 55	EN 14511-2	B	-15	b	55	a

¹ Type name: N = standard rated point, B = operating rated point, QL = Quality Label

² Relevant test conditions for the EHPA Quality

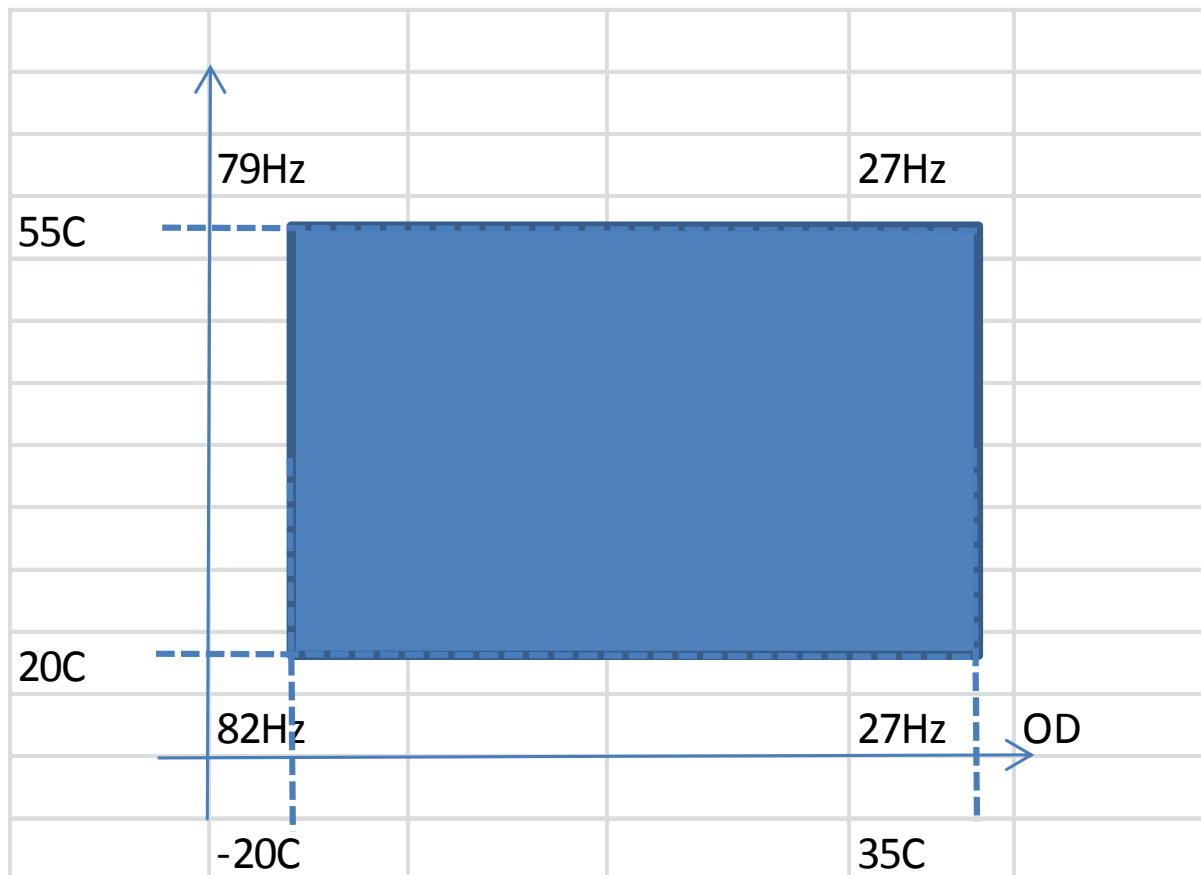
³ Additional test point for Inverter compressor EHPA 6.1.2.3

a The test is conducted with the volume flows indicated at A7/W35-55

b No specifications for air humidity

The results are summarized in chapter 4 and the detailed test results are enclosed in appendix A 1.

3.2. Testing of the usage limit (chapter 6.3)



Result: The limitation of use, defined by the manufacturer were tested and confirmed.

3.3. Sound measurement at A7/W(35-45-55) acc. EN 12102 (Class A); EN ISO 9614 (chapter 6.2)

Type	WH-UX16FE8/ WH-SXC16F9E8
Sound power level L _{Wo} [dB(A)]	
Outdoor unit	
A7/W35	63
A7/W45	65
A7/W55	69
Indoor unit	43

3.4. Safety test (chapter 6. 4)

3.4.1 Shutting off the heat transfer medium flows (see also EN 14511-4 clause 4.4)

Blocking the heat transfer medium flow of the heat usage system (switch the circulating pump off on the user side at the test point A2/W35 during defrost cycle).

Blocking the heat transfer medium flow of the heat usage system (switch the circulating pump off on the user side at the test point A7/W35).

Result: Switch off through flow sensor Error code H62, if the flow sensor is fail, the additional safety high pressure switch disconnects the power supply.

Pass

Blocking the heat transfer medium flow of the heat source system (switch the fan off on the source side).

Result: Switch off. Error code F15.

Pass

3.4.2 Complete power supply failure (see also EN 14511 clause 4.5)

Complete power failure for at least five seconds. The heat pump must return to a stable operating state no later than 20 minutes after restarting the compressor.

Result: After 205 sec restart, unit stabilized after 6 minutes.

Time < 20 minutes

Pass

3.4.3 Condensate draining and enclosure sweat test (see also EN 14511 clause 4.6)

Result: The condensate is drained off properly.

Pass

3.4.4 Defrosting (see also EN 14511 clause 4.7)

Result: No reduction of the average power. No water dripping, no ice formation on outdoor unit.

Pass

3.5. Marking (chapter 8)

Pass

4. Summary of the measurement results

4.1. Measurement of the heat pump: WH-UX16FE8/WH-SXC16F9E8

Low temperatures					
Test conditions		A7/W35	A2/W35	A2/W35	A-7/W35
Air/water		EN 14511	EN 14511	Eco label	EN 14511
Frequency	Hz	43	65	65	77
Average electrical power consumption	W	3556,6	5000,1	5000,1	6037,6
Max. start current	A	6,3	-	-	-
Output factor $\cos\phi$		0,945	0,905	0,905	0,914
Average heat output	W	16284	15921	15921	15750
Volume flow on the warm side	l/h	2749,8	2747,4	2747,4	2767,8
Coefficient of performance (COP)		4,578	3,184	3,184	2,609


Low temperatures					
Test conditions		A2/W35 >60%	A-15/W35	A10/W35	A12/W35
Air/water		EHPA	EN 14511	BAFA	EN 14511
Frequency	Hz	34	83	37	37
Average electrical power consumption	W	2578,3	6698,6	2960,3	3026,8
Output factor $\cos\phi$		0,964	0,952	0,916	0,914
Average heat output	W	9490	15888	14610	16241
Volume flow on the warm side	l/h	2763,0	2747,4	2752,2	2748,0
Coefficient of performance (COP)		3,681	2,372	4,935	5,366

Medium temperatures							
Test conditions		A7/W45	A2/W45	A2/W45	A-7/W45	A-15/W45	A12/W45
Air/water		EN 14511	EN 14511	Eco label	EN 14511	EHPA	EN 14511
Frequency	Hz	44	66	66	77	82	39
Average electrical power consumption	W	4534,2	6078,3	6078,3	7186,6	7808,1	4031,7
Output factor $\cos\phi$		0,974	0,886	0,886	0,894	0,916	0,969
Average heat output	W	16270	15867	15867	15907	15702	16252
Volume flow on the warm side	l/h	2750,4	2757,6	2757,6	2748,0	2745,6	2752,8
Coefficient of performance (COP)		3,588	2,610	2,610	2,213	2,011	4,031

High temperatures							
Test conditions		A7/W55	A2/W55	A-7/W55	A-15/W55	A12/W55	A20/W55
Air/water		EN 14511	EN 14511	EN 14511	EN 14511	EN 14511	EHPA
Frequency	Hz	47	62	76	80	41	31
Average electrical power consumption	W	5629,8	5263,5	8743,3	8665,0	4983,5	3761,8
Output factor $\cos\phi$		0,975	0,941	0,867	0,88	0,980	0,949
Average heat output	W	16351	11792	16070	11114	16142	13703
Volume flow on the warm side	l/h	1722,0	1722,6	1715,4	1719,0	1720,8	1716,0
Coefficient of performance (COP)		2,904	2,240	1,838	1,283	3,239	3,643

Details results: See appendix A1

Appendix A 1 Test results

Testing of Air/Water Heat Pumps										
Manufacturer: Panasonic			Indoor unit: WH-SXC16F9E8							
Type: Split Serial number: ID:551430000 / OD:561410000			Outdoor unit: WH-UX16FE8							
Test conditions	Symbol		A7/W35	A2/W35	A2/W35	A-7/W35	A-7/W35	A-15/W35	A10/W35	A12/W35
			EN 14511-2	EN 14511-2	60% EHPA 6.1.2.3	EN 14511-2	100% EHPA 6.1.2.3	EN 14511-2	BAFA	EN 14511-2
Duration		min	180	180	180	180	180	180	180	180
<i>Low temperature</i>										
Measurements Heat usage system (HUS)										
Volume flow on the warm side	Q _w	l/h	2749,8	2747,4	2763,0	2767,8	2767,8	2747,4	2752,2	2748,0
Flow temperature	T _{out}	°C	35,00	34,81	35,10	34,86	34,86	34,99	34,99	35,03
Return temperature	T _{in}	°C	29,84	29,76	32,09	29,90	29,90	29,95	30,36	29,88
Static pressure	ΔP	kPa	44,5	44,5	44,5	44,5	44,5	44,5	44,5	44,5
Measurements Heat source system (HSS)										
Outdoor Fan speed (Top)		rpm _{top}	583	580	580	580	580	580	580	580
Outdoor Fan speed (Bottom)		rpm _{bottom}	622	620	620	620	620	620	620	620
Temperature air inside	T _{db}	°C	7,01	2,01	2,03	-7,01	-7,01	-15,03	10,02	11,98
Temperature air inside	T _{wb}	°C	6,01	1,01	1,02	-7,90	-7,90	-15,22	8,19	11,04
Measurements Power consumption										
Average electrical power consumption	P _{HP,aver.}	W	3669,9	5113,3	2692,1	6151,6	6151,6	6811,8	3073,7	3140,0
Pump correction		W	113,3	113,2	113,8	114,0	114,0	113,2	113,4	113,2
Average operation current	I	A	5,6	7,8	4,4	9,4	9,4	10,3	4,8	5,0
Max. start current (inverter)	I _A	A	6,3	-	-	-	-	-	-	-
Output factor	cos φ		0,945	0,905	0,964	0,914	0,914	0,952	0,916	0,914
Frequency		Hz	43,0	65,0	34,0	77,0	77,0	83,0	37,0	37,0
Defrosting										
Length of the defrost phases during the working cycles	τ _D	h	-	0,076	0,063	0,079	0,079	-	-	-
Length of the working cycles with defrosting	τ _H	h	-	0,750	1,532	1,370	1,370	-	-	-
Relative defrost time	τ _{rel}	%	-	9,20	3,95	5,45	5,45	-	-	-
Acoustic power level	L _p	dB(A)	43/63	-	-	-	-	-	-	-
Calculations										
Average heat output	Q _{HP,aver.}	W	16284	15921	9490	15750	15750	15888	14610	16241
Average water temperature	T _{Aver.}	°C	32,42	32,29	33,60	32,38	32,38	32,47	32,68	32,46
Density at return temperature T _R	ρ _w (T _R)	kg/m ³	0,996	0,996	0,995	0,996	0,996	0,996	0,996	0,996
Specific heat capacity	c _{pW}	kJ/(kg K)	4,178	4,178	4,178	4,178	4,178	4,178	4,178	4,178
Average electrical power consumption	P _{HP,aver.}	W	3556,6	5000,1	2578,3	6037,6	6037,6	6698,6	2960,3	3026,8
Coefficient of performance (COP)	ε _{WP}		4,578	3,184	3,681	2,609	2,609	2,372	4,935	5,366

Test conditions	Symbol		A7/W45	A2/W45	A-7/W45	A-15/W45	A12/W45
			EHPA/EN 14511-2	EN 14511-2	EN 14511-2	EN 14511-2	EN 14511-2
Duration		min	180	180	180	180	180
<i>Medium temperature</i>							
Measurements Heat usage system (HUS)							
Volume flow on the warm side	q_w	l/h	2750,4	2757,6	2748,0	2745,6	2752,8
Flow temperature	T_{out}	°C	45,00	44,90	44,91	45,06	45,07
Return temperature	T_{in}	°C	39,83	39,87	39,85	40,06	39,91
Static pressure	Δp	kPa	44,5	44,5	44,5	44,5	44,5
Measurements Heat source system (HSS)							
Outdoor Fan speed (Top)		rpm _{top}	580	580	580	580	580
Outdoor Fan speed (Bottom)		rpm _{bottom}	620	620	620	620	620
Temperature air inside	T_{db}	°C	7,02	2,03	-7,03	-15,02	12,01
Temperature air inside	T_{wb}	°C	6,01	1,02	-7,90	-15,17	11,00
Measurements Power consumption							
Average electrical power consumption	$P_{HP, Aver.}$	W	4647,5	6191,9	7299,8	7921,2	4145,1
Pump correction		W	113,3	113,6	113,2	113,1	113,4
Average operation current	I	A	6,9	9,6	11,5	12,5	6,2
Max. start current (inverter)	I_A	A	-	-	-	-	-
Output factor	$\cos \varphi$		0,974	0,886	0,894	0,916	0,969
Frequency		Hz	44,0	66,0	77,0	82,0	39,0
Derfrosting							
Length of the defrost phases during the working cycles	τ_D	h	-	0,113	0,086	-	-
Length of the working cycles with defrosting	τ_H	h	-	0,894	1,953	-	-
Relative defrost time	τ_{rel}	%	-	11,22	4,22	-	-
Acoustic power level	L_p	dB(A)	65,0	-	-	-	-
Calculations							
Average heat output	$Q_{HP, aver.}$	W	16270	15867	15907	15702	16252
Average water temperature	$T_{Aver.}$	°C	42,42	42,39	42,38	42,56	42,49
Density at return temperature T_R	$\rho_w(T_R)$	kg/m ³	0,992	0,992	0,992	0,992	0,992
Specific heat capacity	c_{pw}	kJ/(kg K)	4,179	4,179	4,179	4,179	4,179
Average electrical power consumption	$P_{HP, Aver.}$	W	4534,2	6078,3	7186,6	7808,1	4031,7
Coefficient of performance (COP)	ϵ_{WP}		3,588	2,610	2,213	2,011	4,031

Testing of Air/Water Heat Pumps								
Manufacturer: Panasonic			Indoor unit: WH-SXC16F9E8					
Type: Split Serial number: ID:5514300000 / OD:56141000			Outdoor unit: WH-UX16FE8					
Test conditions	Symbol		A7/W55	A2/W55	A-7/W55	A-15/W55	A12/W55	A20/W55
			EN 14511-2	EN 14511-2	EN 14511-2	EN 14511-2	EN 14511-2	EHPA
Duration		min	180	180	180	180	180	180
High temperatures								
Measurements Heat usage system (HUS)								
Volume flow on the warm side	q _w	l/h	1722,0	1722,6	1715,4	1719,0	1720,8	1716,0
Flow temperature	T _{out}	°C	55,09	54,88	55,18	55,00	55,06	55,04
Return temperature	T _{in}	°C	46,78	48,87	46,98	49,32	46,85	48,04
Static pressure	ΔP	kPa	63,0	63,0	63,0	63,0	63,0	63,0
Measurements Heat source system (HSS)								
Outdoor Fan speed (Top)		rpm _{top}	580	580	580	580	580	510
Outdoor Fan speed (Bottom)		rpm _{bottom}	620	620	620	620	620	550
Temperature air inside	T _{db}	°C	7,01	2,03	-7,02	-15,02	12,00	20,00
Temperature air inside	T _{wb}	°C	6,01	1,03	-7,90	-15,18	11,01	14,56
Measurements Power consumption								
Average electrical power consumption	P _{HP,aver.}	W	5730,2	5364,0	8843,3	8765,3	5083,9	3861,9
Pump correction		W	100,5	100,5	100,1	100,3	100,4	100,1
Average operation current	I	A	8,5	8,1	14,6	14,3	7,5	5,9
Max. start current (inverter)	I _A	A	-	-	-	-	-	-
Output factor	cos φ		0,975	0,941	0,867	0,888	0,980	0,949
Frequency		Hz	47,0	62,0	76,0	80,0	41,0	31,0
Derfrosting								
Lenght of the defrost phases during the working cycles	τ _D	h	-	0,054	0,077	-	-	-
Lenght of the working cycles with defrosting	τ _H	h	-	1,535	5,122	-	-	-
Relative defrost time	τ _{rel}	%	-	3,40	1,48	-	-	-
Acoustic power level	L _p	dB(A)	69,0	-	-	-	-	-
Calculations								
Average heat output	Q _{HP,aver.}	W	16351	11792	16070	11114	16142	13703
Average water temperature	T _{Aver.}	°C	50,94	51,88	51,08	52,16	50,96	51,54
Density at return temperature T _R	ρ _{w(T_R)}	kg/m ³	0,990	0,989	0,990	0,989	0,990	0,989
Specific heat capacity	c _{pW}	kJ/(kg K)	4,182	4,182	4,182	4,182	4,182	4,182
Average electrical power consumption	P _{HP,Aver.}	W	5629,8	5263,5	8743,3	8665,0	4983,5	3761,8
Coefficient of performance (COP)	ε _{WP}		2,904	2,240	1,838	1,283	3,239	3,643

The tests were carried out under the conditions of DIN EN 14511-3, chapter 4.2

Appendix 2 Measurement Instruments

The requirements of the measuring instruments according DIN EN 14511-3 are fulfilled.

Instrument	Type	Company	Model	Index	Range	Valid	Uncertainty
Resistance Thermometer	4 Wire	OKAZAKI	Pt100	B7-EQ 040-096	0 – 60°C	March 2014	0,1 K
Flow meter	Type U	Oval Corperation	CA025L11SC 12AA1100	CN25-6733	6 – 60 kg/min	Aug. 2014	± 0,25%
Digital power meter	3 Ø 4 Wire AC	YOKOGAWA	WT230	A9-EQ 025-26	Wh 0,2% of rdg 1 digit V.A.W.	Aug. 2014	± 0,1% of range
Differential Pressure	-	YOKOGAWA	FP 101-B31-L20A*B	91J319318	0 – 500 kPa	July 2014	± 0,25%

Certificates of the instruments deployed have been deposited at the Test Centre.