TEST REPORT

Report no.:
300-KLAB-17-039

DANISH TECHNOLOGICAL INSTITUTE

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File no.:776382
Enclosures: 1

Customer:	Contact person:	Tomas Bærholm
	Company:	Panasonic Denmark,Fil. af Panasonic Marketing
	Address:	Naverland 2
	City:	2600 Glostrup
	Tel.:	+45 43200800
Component:	Brand:	
	Type:	Split air to air
	Model:	CU-LZ25TKE (outdoor) & CS-LZ25TKE (indoor)
	Series no.:	6567601040 (outdoor) & 4916902564 (indoor)
	Production year:	2017/2017
Dates:	Components tested:	December 2017/January 2018

Procedure: EN 14825:2016, EN 14511:2013 part 1, 2 and 3, and EN 12102:2013.
Test procedure calorimeter room method.

Remarks: The unit was delivered by the customer. The installation and test settings were done according to the manufacturer's instructions. Part load settings were done using a special remote controller supplied by the customer.

Terms: The test has been performed according to the conditions laid down by DANAK (The Danish Accreditation), cf. www.danak.dk, and the general terms and conditions of The Danish Technological Institute. The results from DTI's work in this report, i.e. analyses, assessments and instructions may only be used or reported in their entirety. The customer may not mention or refer to DTI or DTI's employees for advertising or marketing purposes unless the DTI has granted its written consent in each case.

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

Date: 2018-01-22

Signature: Kamalathasan Arumugam
B.Sc. Engineer

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Test Reg. nr. 300

Objective

The objective of this report is to document the following:

- The seasonal coefficient of performance (SCOP) for the average climate according to EN 14825:2016. In order to calculate the SCOP, test was carried out at the part load conditions stated in the table on page 3.

- The sound power level of the indoor and the outdoor unit according to EN 12102:2013. The measurement of the sound power level is performed using the Class A method. ISO 3743-1 is the basic method of carrying out sound power measurements. The method is briefly described in appendix 1. For a more detailed description, please view the accreditation papers DANAK-300 (in Danish only).

- Additional performance test according to EN 14511:2013 at full capacity for outdoor temperature at -35°C.

Test conditions for reference heating seasons

Part load conditions for reference SCOP and reference $SCOP_{on}$ calculation of air-to-air heat pumps for the reference heating season "A" = average, "W" = warmer, and "C" = colder.

Condition	Part Load Ratio in %				Outdoor heat exchanger	Indoor heat exchanger
	Formula	A	W	C	Inlet dry (wet) bulb temperature °C	Indoor air dry bulb temperature °C
A	$(-7 - 16) / (T_{designh} - 16)$	88	n/a	61	−7(−8)	20
B	$(+2 - 16) / (T_{designh} - 16)$	54	100	37	2(1)	20
C	$(+7 - 16) / (T_{designh} - 16)$	35	64	24	7(6)	20
D	$(+12 - 16) / (T_{designh} - 16)$	15	29	11	12(11)	20
E	$(TOL - 16) / (T_{designh} - 16)$				TOL	20
F	$(T_{bivalent} - 16) / (T_{designh} - 16)$				$T_{bivalent}$	20
G	$(-15 - 16) / (T_{designh} - 16)$	n/a	n/a	82	−15	20

The relevant $T_{designh}$ values are defined as follows:

— $T_{design\ "average"}$ dry bulb temperature conditions at −10 °C outdoor temperature and 20 °C indoor temperature;

Test conditions for sound power measurements

Test#	Test unit and conditions		Heat pump settings			
	Test unit	Temperature (dry/wet bulb) [°C]	*Compressor speed [Hz]	*Fan speed [rpm]	*Cooling capacity [kW]	Power input [kW]
1	Indoor	27/19	-	960	2.45	0.5
2	Outdoor	35/-	30	850		

* Data supplied by the manufacturer

Test conditions for the additional performance test

N°	Outdoor temperature (dry/wet bulb) [°C]	Indoor temperature (dry bulb) [°C]
1	-35/-	20

Main test results for average season

Model (indoor + outdoor)	CS-LZ25TKE (indoor) & CU-LZ25TKE (outdoor)

Function	Heating	Y	Average	Y
			Colder	-

Rated heat output[1)]	Prated	**3.29** [kW]
Seasonal efficiency	SCOP	**5.17** [-]

Measured capacity for heating for part load at outdoor temperature Tj	Average Climate	Tj=-7 °C	Pdh	2.94 [kW]
		Tj=2 °C	Pdh	1.65 [kW]
		Tj=7 °C	Pdh	1.09 [kW]
		Tj=12 °C	Pdh	1.36 [kW]
		Tj=bivalent temperature	Pdh	3.29 [kW]
		Tj=operation limit	Pdh	3.29 [kW]

Measured coefficient of performance at outdoor temperature Tj	Average Climate	Tj=-7 °C	COPd	3.44 [-]
		Tj=2 °C	COPd	5.19 [-]
		Tj=7 °C	COPd	6.28 [-]
		Tj=12 °C	COPd	8.14 [-]
		Tj=bivalent temperature	COPd	3.08 [-]
		Tj=operation limit	COPd	3.08 [-]

Bivalent temperature	Tbivalent	-10 [°C]
Operation limit	TOL	-10 [°C]
temperatures	WTOL	- [°C]
Degradation coefficient[2)]	Cdh	0.25 [-]

Power consumption in modes other than active mode	Off mode	P_{OFF}	0.006 [kW]
	Thermostat-off mode	P_{TO}	0.008 [kW]
	Standby mode	P_{SB}	0.006 [kW]
	Crankcase heater mode	P_{CK}	0.006 [kW]
Supplementary heater[1)]	Rated heat output	P_{SUP}	0.000 [kW]
	Type of energy input		-

Other items	Capacity control		Variable
	Water flow control		-
	Water flow rate		-
	Annual energy consumption	Q_{HE}	890 [kWh]

[1)]For heat pump space heaters and heat pump combination heaters, the rated heat output, Prated, is equal to the design load for heating, Pdesignh, and the rated heat output of a supplementary heater, Psup, is equal to the supplementary capacity for heating, sup(Tj).

[2)]Determined by measurements

Test results for sound power measurements

Test #	Sound power level LW(A) [dB re 1pW]	Uncertainty (dB) (weighted value)
1	**52**	0.5
2	**58**	0.5

The uncertainty value is a weighted value using the level and frequency dependant influence for each 1/1-octave level on the final A-weighted sound power level.

Test results for the additional performance test

N°	Outdoor temperature (dry/wet bulb) [°C]	Heating capacity [kW]	COP
1	-35/-	1.17	1.05

Calculation of $SCOP_{on}$ and reference SCOP

The calculation of SCOP is based on the measured values shown in the table containing the main test results. If the measured heating capacity of the heat pump is within ±10 % of the heat demand at the different part loads, the heat demand covered by the heat pump is set equal to the heat demand according to EN14825:2016, chapter 7.5.

Data for SCOP calculation (heating, average)

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 (1400), 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

PTO, PSB, PCK, POFF = Electricity consumption during thermostat off mode, standby mode, crankcase heater mode and off mode, kW, respectively

Data for SCOP calculation:

	Outdoor air [˚C]	Part load ratio [%]	Part load [kW]	Measured capacity [kW]	COP at measured capacity COPm [-]	Degradation coefficient Cd [-]	Capacity ratio CR [-]	COP at part load COPpl [-]
A	-7	88	2.91	2.94	3.44	0.25	1.00	3.44
B	2	54	1.77	1.65	5.19	0.25	1.00	5.19
C	7	35	1.14	1.09	6.28	0.25	1.00	6.28
D	12	15	0.51	1.36	8.14	0.25	0.37	6.86
E(TOL)	-10	100	3.29	3.29	3.08	0.25	1.00	3.08
F(Bivalent)	-10	100	3.29	3.29	3.08	0.25	1.00	3.08

	Hours [h]	Power input measured [W]	Power input applied for SCOP calculation [W]	Annual energy input [kWh]
Thermostat Off mode	179	8	2	0.36
Off mode	0	6	6	0.00
Crankcase Heater	179	6	0	0.00
Standby mode	0	6	6	0.00
			Total	0.36

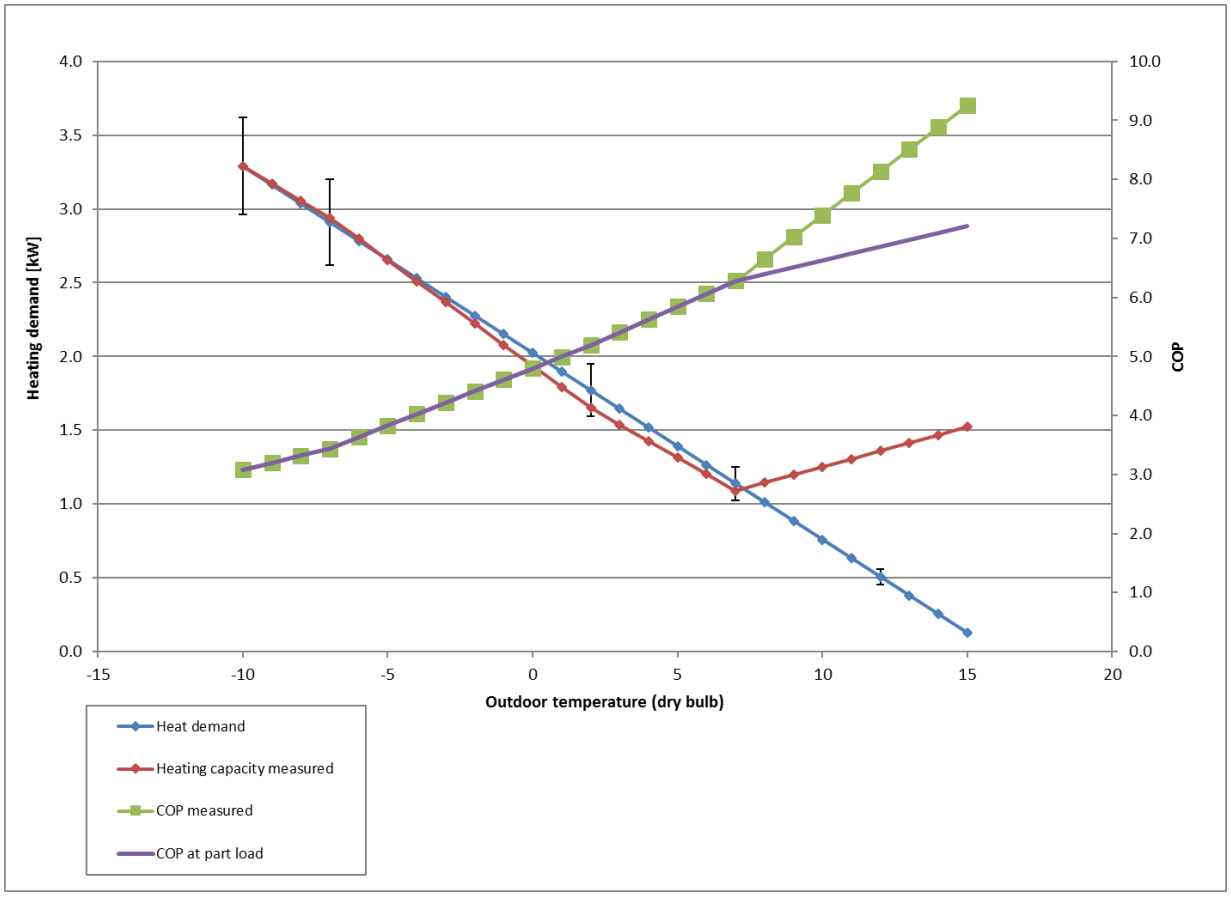
Note: Prior to the SCOP calculation, the power consumption during standby mode is deducted from the crankcase heater mode, according to EN14825:2016.

Calculation of SCOP

	Outdoor temperature (dry bulb)	Hours	Heat demand	Heat demand covered by heat pump	Electrical back up heater	COP(pl)	Annual heat demand	Annual energy input including electrical back up heater
	Tj	hj	Ph(Tj)		elbu(Tj)		hj x Ph(TJ)	
	[°C]	[h]	[kW]	[kW]	[kW]	[-]	[kWh]	[kWh]
E(TOL) and F(bival	-10	1	3.29	3.29	0.00	3.08	3.29	1.07
	-9	25	3.16	3.16	0.00	3.20	79.09	24.71
	-8	23	3.04	3.04	0.00	3.32	69.85	21.04
A	-7	24	2.91	2.91	0.00	3.44	69.85	20.31
	-6	27	2.78	2.78	0.00	3.63	75.16	20.68
	-5	68	2.66	2.65	0.00	3.83	180.70	47.19
	-4	91	2.53	2.51	0.00	4.02	230.30	57.24
	-3	89	2.40	2.37	0.00	4.22	213.98	50.73
	-2	165	2.28	2.22	0.00	4.41	375.82	85.18
	-1	173	2.15	2.08	0.00	4.61	372.15	80.79
	0	240	2.02	1.94	0.00	4.80	485.91	101.21
	1	280	1.90	1.79	0.00	5.00	531.46	106.39
B	2	320	1.77	1.65	0.00	5.19	566.89	109.23
	3	357	1.65	1.54	0.00	5.41	587.26	108.59
	4	356	1.52	1.43	0.00	5.63	540.57	96.08
	5	303	1.39	1.31	0.00	5.84	421.75	72.17
	6	330	1.27	1.20	0.00	6.06	417.58	68.88
C	7	326	1.14	1.09	0.00	6.28	371.26	59.12
	8	348	1.01	1.01	0.00	6.40	352.28	55.07
	9	335	0.89	0.89	0.00	6.51	296.73	45.56
	10	315	0.76	0.76	0.00	6.63	239.16	36.08
	11	215	0.63	0.63	0.00	6.75	136.03	20.16
D	12	169	0.51	0.51	0.00	6.86	85.54	12.47
	13	151	0.38	0.38	0.00	6.98	57.32	8.21
	14	105	0.25	0.25	0.00	7.10	26.57	3.75
	15	74	0.13	0.13	0.00	7.21	9.36	1.30
						Total	6795.87	1313.20

SCOP_on	5.18
SCOP_ref	5.17

Reference heat demand and measured part load capacity of the heat pump season average



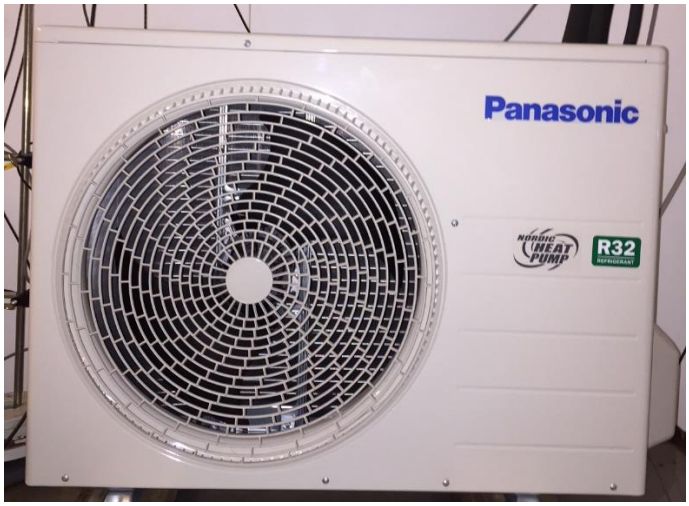
The heating capacity of the heat pump was adjusted by means of the inverter in order to fit within 10 % of the reference heat demand. For part load conditions above 10 % of the heating demand, a degradation factor is applied to the measured COP. For part load conditions below 10 % of the heating demand, electrical heating is applied to reach the full heating demand. The corrected COP is illustrated in the diagram as 'COP at part load'.

Indoor unit


Panasonic


300-KLAB-17-039
Panasonic
AIR CONDITIONER
SERIAL NO.
Model No. CS-LZ25TKE
4916902564
RATED VOLTAGE 230 V~
PRODUCTION DATE 2017.09
RATED FREQUENCY 50 Hz
Factory :
Panasonic Appliances Air-Conditioning
Guangzhou Co. Ltd. Guangzhou, China
R32
Manufacturer :
Panasonic Corporation
1006 Kadoma, Kadoma City,
Osaka, Japan
Authorized representative in EU
Panasonic Testing Centre
Panasonic Marketing Europe GmbH
Winsbergring 15, 22525 Hamburg,
Germany
Made in China

Outdoor unit



Detailed test results of SCOP for average

Detailed result for 'EN 14825:2016' Average (A) A20/A-7		
EN 14825:2016		EN 14825:2016
Mode:		Heating
Climate zone:		Average
Condition name:		A
Condition temperature:		-7
Part load:	%	88%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.29
Heating demand:	kW	2.91
Measurement type:		Steady state
Data treatment according to EN14511-3:2013 Annex C		
Capacity		
Heating capacity	kW	2.94
COP	-	3.44
Power consumption	kW	0.86
Indoor		
Air temperature dry bulb	°C	20.1
Air temperature wet bulb	°C	13.5
Outdoor		
Air temperature dry bulb	°C	-7.0
Air temperature wet bulb	°C	-7.9

Detailed result for 'EN 14825:2016' Average (B) A20/A2		
EN 14825:2016		EN 14825:2016
Mode:		Heating
Climate zone:		Average
Condition name:		B
Condition temperature:		2
Part load:	%	54%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.29
Heating demand:	kW	1.77
Measurement type:		Steady state
Data treatment according to EN14511-3:2013 Annex C		
Capacity		
Heating capacity	kW	1.65
COP	-	5.19
Power consumption	kW	0.32
Indoor		
Air temperature dry bulb	°C	20.0
Air temperature wet bulb	°C	12.2
Outdoor		
Air temperature dry bulb	°C	2.0
Air temperature wet bulb	°C	1.1

Detailed result for 'EN 14825:2016' Average (C) A20/A7		
EN 14825:2016		EN 14825:2016
Mode:		Heating
Climate zone:		Average
Condition name:		C
Condition temperature:		7
Part load:	%	35%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.29
Heating demand:	kW	1.14
Measurement type:		Steady state
Data treatment according to EN14511-3:2013 Annex C		
Capacity		
Heating capacity	kW	1.09
COP	-	6.28
Power consumption	kW	0.17
Indoor		
Air temperature dry bulb	°C	20.2
Air temperature wet bulb	°C	12.8
Outdoor		
Air temperature dry bulb	°C	7.2
Air temperature wet bulb	°C	6.1

Detailed result for 'EN 14825:2016' Average (D) A20/A12		
EN 14825:2016		EN 14825:2016
Mode:		Heating
Climate zone:		Average
Condition name:		D
Condition temperature:		12
Part load:	%	15%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.29
Heating demand:	kW	0.51
Measurement type:		Steady state
Data treatment according to EN14511-3:2013 Annex C		
Capacity		
Heating capacity	kW	1.36
COP	-	8.14
Power consumption	kW	0.17
Indoor		
Air temperature dry bulb	°C	20.1
Air temperature wet bulb	°C	12.5
Outdoor		
Air temperature dry bulb	°C	12.0
Air temperature wet bulb	°C	11.0

Detailed result for 'EN 14825:2016' Average (E and F) A20/A-10		
EN 14825:2016		EN 14825:2016
Mode:		Heating
Climate zone:		Average
Condition name:		E and F
Condition temperature:		-10
Part load:	%	100%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	3.29
Heating demand:	kW	3.29
Measurement type:		Steady state
Data treatment according to EN14511-3:2013 Annex C		
Capacity		
Heating capacity	kW	3.29
COP	-	3.08
Power consumption	kW	1.07
Indoor		
Air temperature dry bulb	°C	20.1
Air temperature wet bulb	°C	13.6
Outdoor		
Air temperature dry bulb	°C	-10.0
Air temperature wet bulb	°C	-11.0

Detailed test results of sound power measurement test 1

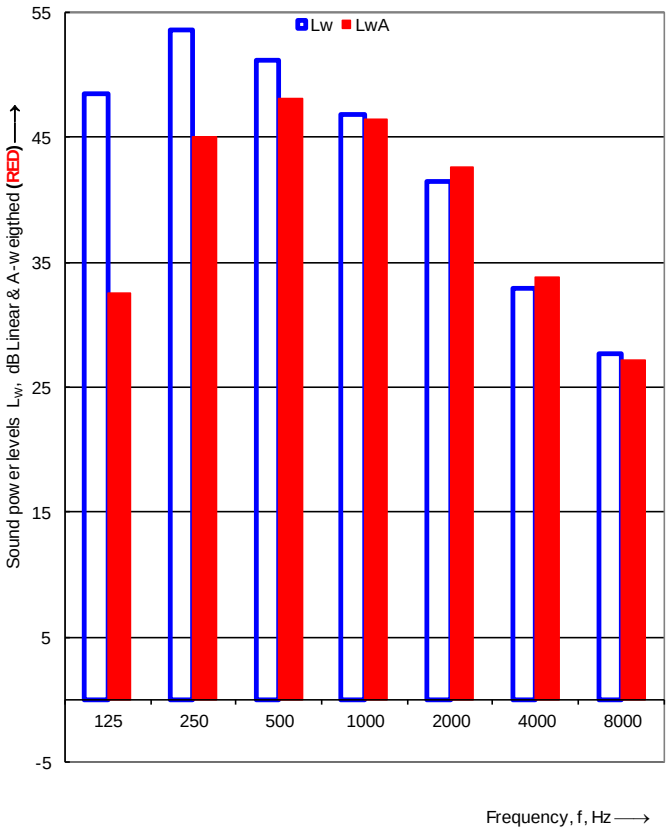
Sound power levels according to ISO 3743-1:2010

TEKNOLOGISK INSTITUT

Engineering method for small, movable sources in reverberant fields - Comparison method for hard-walled test rooms

Client:	Panasonic Denmark			Date of test:	06-12-2017
Object:	Type: Air to air heat pumpModel: CS-LZ25TKE (Indoor) + CU-LZ25TKE (Outdoor)				
Mounting conditions:	The tested indoor unit is mounted at a hight of 1.7 meter above floor level using a metal support frame and rubber vibration isolatores. The metal frame is damped by filling the pipes with dry sand and placed it all on vibration isolation mat on the floor . The outdoor unit is installed in the neighboring test room.				
Operating conditions:	A27/19, Cooling capacity: 2.45[kW], Power_input: 0.5[kW], Fan speed: 960[rpm]				
Static pressure:	1013 kPa			Reference box:	
Air temperature:	27,0 °C			L1:	0,8 m
Relative air humidity:	45,0 %			L2:	0,4 m
Test room volume:	102,8 m³	Room:	Room 2	L3:	0,2 m
Area, S, of test room:	138,9 m²			Volume:	0,1 m³

Frequency f [Hz]	L_W 1/3 octave [dB]	1/1 oct [dB]
100	44,3 [1]	
125	43,6	48,4
160	42,9	
200	48,8	
250	49,5	53,6
315	47,9	
400	46,0	
500	46,1	51,1
630	46,8	
800	44,1	
1000	41,2	46,8
1250	39,3	
1600	39,0	
2000	36,4	41,4
2500	32,1	
3150	27,9	
4000	25,7	32,9
5000	29,9	
6300	26,2	
8000	18,4 [1]	27,6
10000	19,6 [1]	



Sound power level $L_W(A)$: **52 dB [re 1pW]**

Name of test institute:	DTI
No. of test report:	300-KLAB-17-039

Date: 06-12-2017

Detailed test results of sound power measurement test 2

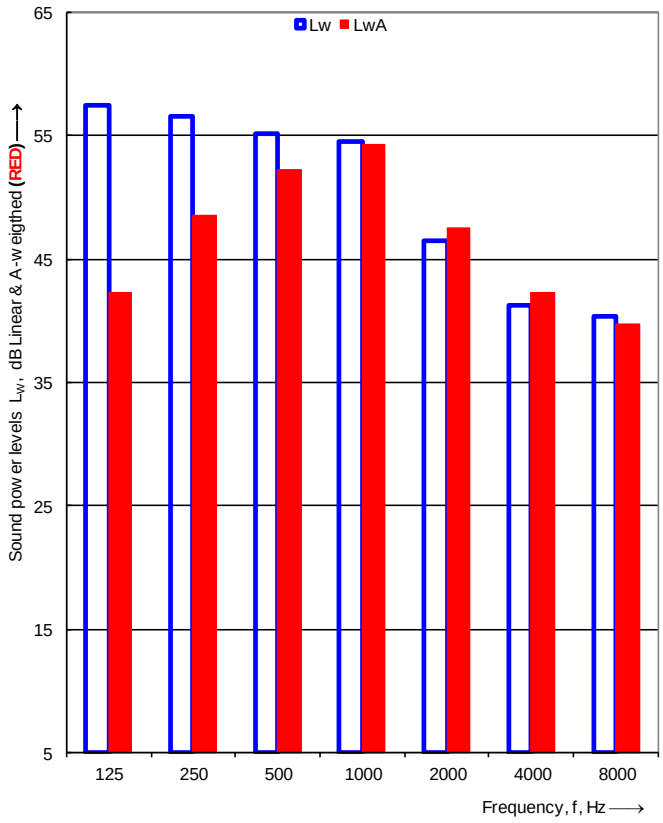
Sound power levels according to ISO 3743-1:2010

TEKNOLOGISK INSTITUT

Engineering method for small, movable sources in reverberant fields - Comparison method for hard-walled test rooms

Client:	Panasonic Denmark			Date of test:	06-12-2017
Object:	Type: Air to air heat pumpModel: CS-LZ25TKE (Indoor) + CU-LZ25TKE (Outdoor)				
Mounting conditions:	The tested outdoor unit is standing free on four 5.5 cm thick heavy concrete tiles placed on a vibration damping mat, which is placed on a water drop tray. The water drop tray is located on a 2.5 cm thick wooden board laying on the floor. The testing outdoor unit is mounted on the supporting metal support frame using 4 vibration isolatores. The indoor unit is installed in the neighboring test room.				
Operating conditions:	A35, Compressor speed: 30 [Hz], Cooling capacity: 2.45 [kW], Power_input: 0.5[kW], Fan speed: 850[rpm]				
Static pressure:	1013 kPa			Reference box:	
Air temperature:	35,0 °C			L1:	0,8 m
Relative air humidity:	18,0 %			L2:	0,3 m
Test room volume:	102,8 m³	Room:	Room 1	L3:	0,6 m
Area, S, of test room:	138,9 m²			Volume:	0,1 m³

Frequency f [Hz]	L_W 1/3 octave [dB]	1/1 oct [dB]
100	48,6	
125	54,6	57,4
160	52,8	
200	51,5	
250	50,5	56,6
315	53,0	
400	50,4	
500	49,4	55,2
630	51,3	
800	51,2	
1000	50,5	54,5
1250	45,7	
1600	43,4	
2000	41,3	46,4
2500	39,3	
3150	37,9	
4000	36,3	41,3
5000	34,8	
6300	37,6	
8000	36,4	40,3
10000	28,4	



Sound power level $L_W(A)$: **58 dB [re 1pW]**

Name of test institute: DTI
No. of test report: 300-KLAB-17-039

Date: 06-12-2017

Detailed test results for the additional performance test

Detailed result for 'EN 14511:2013' A20/A-35		
Tested according to:		EN 14511:2013
Mode:		Heating
Measurement type:		Transient
Data treatment according to EN14511-3:2013 Annex C		
Capacity		
Heating capacity	kW	1.17
COP	-	1.05
Power consumption	kW	1.12
Indoor		
Air temperature dry bulb	°C	19.9
Air temperature wet bulb	°C	11.7
Outdoor		
Air temperature dry bulb	°C	-35.0
Air temperature wet bulb	°C	-

Appendix 1: Test Procedure

The measurements of the emitted sound power level from the heat pump are carried out according to the following:

- DS/EN 14511:2013
- EN 12102:2013
- ISO 3743-1:2010

The basic acoustic measurement standard ISO 3743-1 is a comparison method using a calibrated reference sound source. Two series of sound pressure measurements are made under exactly the same acoustic conditions, e.g. the same microphone positions, temperature and air humidity. The calibrated sound power levels are known for the reference sound source at each frequency band, and they are used in the estimation of the acoustical correction factor for the calculation of the sound power emitted from the tested heat pump. The background noise levels are measured and used for relevant corrections.

The final total A-weighted sound power level is based on measurements and calculations in 1/3-octave levels, which then are summed into 1/1-octave levels. The uncertainty is estimated on the weighted standard deviations in 1/1-octave levels.

The actual microphone positions and correction values are saved in data files linked to the complete project documentation according to the DANAK-accreditation.

The complete measurement system is documented and regularly calibrated according to DANAK.

The detailed description of the measurement method is given in Danish in the quality database system "QA Web" at Danish Technological Institute, which is accessible by DANAK.