

TEST REPORT

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300-KLAB-23-025



**DANISH
TECHNOLOGICAL
INSTITUTE**

Teknologiparken
Kongsvang Allé 29
DK-8000 Aarhus C
+45 72 20 20 00
Info@teknologisk.dk
www.teknologisk.dk

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Customer: Company: ENERTECH AB
Address: Näsavägen 8
City: S - 341 34 Ljungby
Tel.: +46 7288000

Component: Brand: CTC
Type: Air to water heat pump
Model: Outdoor: EcoAIR 712M
Series no.: Outdoor: 7312-2324-1963
Production year: Outdoor: N/A

Components tested: September-October 2023

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. The unit was controlled with a PC program, supplied by the manufacturer.

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

Test engineer:
Rasmus Thisgaard
B.TecMan & MarEng.

Co-reader:
Preben Eskerod
B.TecMan & MarEng.



DIGITALLY SIGNED DOCUMENT

15 December 2023

DANISH TECHNOLOGICAL INSTITUTE



Test Reg. nr. 300



Objective

The objective of this report is to document the thermal and acoustic performance of the air to water heat pump. The following tests were carried out:

The Seasonal Coefficient of Performance (SCOP) at low and medium temperature application for average climate according to EN 14825:2022. In order to calculate the SCOP, tests were carried out at the part load conditions stated in the tables on page 4 and 5.

Testing at low temperature for colder climate according to EN 14825:2022:

- Test point F (bivalent temperature condition)

Testing at medium temperature for colder climate according to EN 14825:2022:

- Test point F (bivalent temperature condition)

Sound power level according to EN 12102-1:2017, chosen by the manufacturer.

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).



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Test conditions

SCOP test conditions for low temperature – EN 14825:2022

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	Part Load Ratio				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet ^d °C		
	Formula	A	W	C	Outdoor air	Exhaust air	All climates	A	W	C
A	$(-7 - 16) / (T_{\text{designh}} - 16)$	88	n/a	61	-7(-8)	20(12)	^a / 35	^a / 34	n/a	^a / 30
B	$(+2 - 16) / (T_{\text{designh}} - 16)$	54	100	37	2(1)	20(12)	^a / 35	^a / 30	^a / 35	^a / 27
C	$(+7 - 16) / (T_{\text{designh}} - 16)$	35	64	24	7(6)	20(12)	^a / 35	^a / 27	^a / 31	^a / 25
D	$(+12 - 16) / (T_{\text{designh}} - 16)$	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_{bivalent}	20(12)	^a / 35	^a / c	^a / c	^a / c
G	$(-15 - 16) / (T_{\text{designh}} - 16)$	n/a	n/a	82	-15	20(12)	^a / 35	n/a	n/a	^a / 32

^a 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.

^b Variable outlet shall be calculated by interpolation from T_{designh} and the temperature which is closest to the TOL.

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

^d 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_{designh} [°C]	T_{bivalent} [°C]	TOL [°C]	Outlet temperature	Flow rate
Average	-10	-10	-10	Variable	Variable





SCOP test conditions for medium temperature – EN 14825:2022

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				Outdoor heat exchanger		Indoor heat exchanger			
					Inlet dry (wet) bulb temperature °C		Fixed outlet °C	Variable outlet ^d °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 / 55	^a / 52	n/a	^a / 44
B	$\frac{(+2 - 16)}{(T_{\text{designh}} - 16)}$	54	100	37	2(1)	20(12)	^a / 55	^a / 42	^a / 55	^a / 37
C	$\frac{(+7 - 16)}{(T_{\text{designh}} - 16)}$	35	64	24	7(6)	20(12)	^a / 55	^a / 36	^a / 46	^a / 32
D	$\frac{(+12 - 16)}{(T_{\text{designh}} - 16)}$	15	29	11	12(11)	20(12)	^a / 55	^a / 30	^a / 34	^a / 28
E	$(TOL - 16) / (T_{\text{designh}} - 16)$				TOL	20(12)	^a / 55	^a / ^b	^a / ^b	^a / ^b
F	$(T_{\text{bivalent}} - 16) / (T_{\text{designh}} - 16)$				T _{bivalent}	20(12)	^a / 55	^a / ^c	^a / ^c	^a / ^c
G	$\frac{(-15 - 16)}{(T_{\text{designh}} - 16)}$	n/a	n/a	82	-15	20(12)	^a / 55	n/a	n/a	^a / 49

^a 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.

^b Variable outlet shall be calculated by interpolation T_{designh} and the temperature which is closest to the TOL.

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

^d 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 _{designh} [°C]	T _{bivalent} [°C]	TOL [°C]	Outlet temperature	Flow rate
Average	-10	-10	-10	Variable	Variable





Test results

Test results of SCOP test at low temperature - heating season average – EN14825:2022

Model (Outdoor)	EcoAir 712M
Air-to-water heat pump mono bloc	Y
Low-temperature heat pump	N
Equipped with supplementary heater	N
Heat pump combination heater	N

Rated heat output¹⁾	P_{rated}	7.3 [kW]
Seasonal space heating energy efficiency	η_s	197.1 [%]
	SCOP	5.00 [-]

Measured capacity for heating for part load at outdoor temperature T_j	Average Climate	$T_j = -15\text{ °C}$	P_{dh}	- [kW]
	-	$T_j = -7\text{ °C}$	P_{dh}	6.03 [kW]
	Low temperature application	$T_j = 2\text{ °C}$	P_{dh}	3.84 [kW]
		$T_j = 7\text{ °C}$	P_{dh}	2.53 [kW]
		$T_j = 12\text{ °C}$	P_{dh}	2.45 [kW]
		$T_j = \text{bivalent temperature}$	P_{dh}	7.23 [kW]
		$T_j = \text{operation limit}$	P_{dh}	7.23 [kW]

Measured coefficient of performance at outdoor temperature T_j	Average Climate	$T_j = -15\text{ °C}$	COP_d	- [-]
	-	$T_j = -7\text{ °C}$	COP_d	3.07 [-]
	Low temperature application	$T_j = 2\text{ °C}$	COP_d	4.94 [-]
		$T_j = 7\text{ °C}$	COP_d	6.46 [-]
		$T_j = 12\text{ °C}$	COP_d	8.23 [-]
		$T_j = \text{bivalent temperature}$	COP_d	2.54 [-]
		$T_j = \text{operation limit}$	COP_d	2.54 [-]

Bivalent temperature	$T_{bivalent}$	-10 [°C]
Operation limit temperatures	TOL	-10 [°C]
	WTOL	- [°C]
Degradation coefficient	C_{dh}	0.95 [-]

Power consumption in modes other than active mode	Off mode	P_{OFF}	0.015 [kW]
	Thermostat-off mode	P_{TO}	0.015 [kW]
	Standby mode	P_{SB}	0.015 [kW]
	Crankcase heater mode	P_{CK}	0.015 [kW]
Supplementary heater¹⁾	Rated heat output	P_{SUP}	0.00 [kW]
	Type of energy input		Electrical

Other items	Capacity control		Variable
	Water flow control		Variable
	Water flow rate		-
	Annual energy consumption	Q_{HE}	3015 [kWh]

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



Test results of SCOP test at medium temperature - heating season average – EN14825:2022

Model (Outdoor)	EcoAir 712M
Air-to-water heat pump mono bloc	Y
Low-temperature heat pump	N
Equipped with supplementary heater	N
Heat pump combination heater	N

Rated heat output¹⁾	P_{rated}	7 [kW]
Seasonal space heating energy efficiency	η_s	151.2 [%]
	SCOP	3.86 [-]

Measured capacity for heating for part load at outdoor temperature T_j	Average Climate - Medium temperature application	$T_j = -15\text{ °C}$	P_{dh}	- [kW]
		$T_j = -7\text{ °C}$	P_{dh}	5.97 [kW]
		$T_j = 2\text{ °C}$	P_{dh}	3.71 [kW]
		$T_j = 7\text{ °C}$	P_{dh}	2.39 [kW]
		$T_j = 12\text{ °C}$	P_{dh}	2.37 [kW]
		$T_j = \text{bivalent temperature}$	P_{dh}	6.78 [kW]
		$T_j = \text{operation limit}$	P_{dh}	6.78 [kW]

Measured coefficient of performance at outdoor temperature T_j	Average Climate - Medium temperature application	$T_j = -15\text{ °C}$	COPd	- [-]
		$T_j = -7\text{ °C}$	COPd	2.31 [-]
		$T_j = 2\text{ °C}$	COPd	3.77 [-]
		$T_j = 7\text{ °C}$	COPd	5.16 [-]
		$T_j = 12\text{ °C}$	COPd	6.31 [-]
		$T_j = \text{bivalent temperature}$	COPd	1.96 [-]
		$T_j = \text{operation limit}$	COPd	1.96 [-]

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

Power consumption in modes other than active mode	Off mode	P_{OFF}	0.015 [kW]
	Thermostat-off mode	P_{TO}	0.015 [kW]
	Standby mode	P_{SB}	0.015 [kW]
	Crankcase heater mode	P_{CK}	0.015 [kW]
Supplementary heater¹⁾	Rated heat output	P_{SUP}	0.00 [kW]
	Type of energy input		Electrical

Other items	Capacity control		Variable
	Water flow control		Variable
	Water flow rate		-
	Annual energy consumption	Q_{HE}	3751 [kWh]

¹⁾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 result for low temperature, colder climate according to EN 14825:2022

N#	Temperature application	Info	Heating capacity (kW)	COP	Compressor frequency (%)
1	Low temperature	Tbivalent F	6.371	2.849	100

Test result for medium temperature, colder climate according to EN 14825:2022

N#	Temperature application	Info	Heating capacity (kW)	COP	Compressor frequency (%)
1	Medium temperature	Tbivalent F	6.390	2.038	100

Test results of sound power measurements - EN 12102-1:2017

N#	Sound power level LW(A) [dB re 1pW]	Uncertainty (dB) (weighted value)
1*	47.2	0.5
2	60.2	0.5
3	58.9	1.0

* ErP energy labelling

The uncertainty value is based on the empirical value stated in ISO/EN 3743-1 (reverberant room) and the estimated influence of the measurement setup and acoustical conditions.

The sound power measurements are carried out by Kamalathasan Arumugam (KAMA) and co-read by Patrick Glibert (PGL), Danish Technological Institute.



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Photo

Outdoor rating plate



Outdoor unit





SCOP - detailed calculation

Detailed SCOP calculation of low temperature and average climate conditions – EN 14825:2022

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	6.46	6.03	3.07	0.99	1.00	3.07
B	2	54	3.93	3.57	4.64	0.98	1.00	4.64
C	7	35	2.53	2.46	6.44	0.96	1.00	6.44
D	12	15	1.12	2.45	8.23	0.95	0.46	7.77
E	-10	100	7.30	6.98	2.45	0.99	1.00	2.45
F - BIV	-10	100	7.30	6.98	2.45	0.99	1.00	2.45

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	0	0.015	0.015	0
Thermostat off	178	0.015	0.015	2.67
Standby	0	0.015	0.015	0
Crankcase heater	178	0.015	0	0





Calculation Bin for SCOP_{on}

Bin	Outdoor temperature [°C]	Hours [h]	Heat load [kW]	Heat load covered by heat pump [kW]	Electrical back up heater [kW]	backup heater energy input [kWh]	COP _{bin} [-]	Annual heating demand [kWh]	Annual energy input [kWh]	Net annual heating capacity [kWh]	Net annual power input [kWh]
E / F - BIV	21	-10	7.30	7.23	0.00	0.00	2.54	7.30	2.88	7.30	2.88
	22	-9	7.02	6.83	0.00	0.00	2.71	175.48	64.67	175.48	64.67
	23	-8	6.74	6.43	0.00	0.00	2.89	154.98	53.63	154.98	53.63
	24	-7	6.46	6.03	0.00	0.00	3.07	154.98	50.54	154.98	50.54
A	25	-6	6.18	5.78	0.00	0.00	3.27	166.78	50.93	166.78	50.93
	26	-5	5.90	5.54	0.00	0.00	3.48	400.94	115.13	400.94	115.13
	27	-4	5.62	5.30	0.00	0.00	3.69	511.00	138.46	511.00	138.46
	28	-3	5.33	5.06	0.00	0.00	3.90	474.78	121.78	474.78	121.78
	29	-2	5.05	4.81	0.00	0.00	4.11	833.88	203.06	833.88	203.06
	30	-1	4.77	4.57	0.00	0.00	4.31	825.74	191.38	825.74	191.38
	31	0	4.49	4.33	0.00	0.00	4.52	1078.15	238.39	1078.15	238.39
	32	1	4.21	4.08	0.00	0.00	4.73	1179.23	249.28	1179.23	249.28
	33	2	3.93	3.84	0.00	0.00	4.94	1257.85	254.70	1257.85	254.70
	34	3	3.65	3.58	0.00	0.00	5.24	1303.05	248.56	1303.05	248.56
	35	4	3.37	3.32	0.00	0.00	5.55	1199.45	216.26	1199.45	216.26
	36	5	3.09	3.05	0.00	0.00	5.85	935.80	159.96	935.80	159.96
	37	6	2.81	2.79	0.00	0.00	6.15	926.54	150.55	926.54	150.55
	38	7	2.53	2.53	0.00	0.00	6.46	823.78	127.56	823.78	127.56
	39	8	2.25	2.25	0.00	0.00	6.72	781.66	116.32	781.66	116.32
C	40	9	1.97	1.97	0.00	0.00	6.98	658.40	94.30	658.40	94.30
	41	10	1.68	1.68	0.00	0.00	7.24	530.65	73.26	530.65	73.26
	42	11	1.40	1.40	0.00	0.00	7.51	301.83	40.22	301.83	40.22
	43	12	1.12	1.12	0.00	0.00	7.77	189.80	24.44	189.80	24.44
	44	13	0.84	0.84	0.00	0.00	8.03	127.19	15.84	127.19	15.84
D	45	14	0.56	0.56	0.00	0.00	8.29	58.96	7.11	58.96	7.11
	46	15	0.28	0.28	0.00	0.00	8.55	20.78	2.43	20.78	2.43

SUM	15078.99	3011.64	15078.99	3011.64
SCOP _{on}	5.01		SCOP _{net}	5.01





Detailed SCOP calculation of medium temperature and average climate conditions – EN 14825:2022

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	6.19	5.97	2.31	0.99	1.00	2.31
B	2	54	3.77	3.71	3.77	0.98	1.00	3.77
C	7	35	2.42	2.39	5.16	0.97	1.00	5.16
D	12	15	1.08	2.37	6.31	0.96	0.45	6.02
E	-10	100	7.00	6.78	1.96	1.00	1.00	1.96
F - BIV	-10	100	7.00	6.78	1.96	1.00	1.00	1.96

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	0	0.015	0.015	0
Thermostat off	178	0.015	0.015	2.67
Standby	0	0.015	0.015	0
Crankcase heater	178	0.015	0	0





Calculation Bin for SCOP_{on}

Bin	Outdoor temperature [°C]	Hours [h]	Heat load [kW]	Heat load covered by heat pump [kW]	Electrical back up heater [kW]	backup heater energy input [kWh]	COP _{bin} [-]	Annual heating demand [kWh]	Annual energy input [kWh]	Net annual heating capacity [kWh]	Net annual power input [kWh]
E / F - BIV	21	-10	1	7.00	6.78	0.00	0.00	1.96	7.00	3.57	3.57
	22	-9	25	6.73	6.51	0.00	0.00	2.07	168.27	81.12	81.12
	23	-8	23	6.46	6.24	0.00	0.00	2.19	148.62	67.84	67.84
	24	-7	24	6.19	5.97	0.00	0.00	2.31	148.62	64.42	64.42
	25	-6	27	5.92	5.72	0.00	0.00	2.47	159.92	64.75	64.75
A	26	-5	68	5.65	5.47	0.00	0.00	2.63	384.46	146.04	146.04
	27	-4	91	5.38	5.22	0.00	0.00	2.80	490.00	175.28	175.28
	28	-3	89	5.12	4.97	0.00	0.00	2.96	455.27	153.90	153.90
	29	-2	165	4.85	4.71	0.00	0.00	3.12	799.62	256.20	256.20
	30	-1	173	4.58	4.46	0.00	0.00	3.28	791.81	241.12	241.12
	31	0	240	4.31	4.21	0.00	0.00	3.45	1033.85	299.95	299.95
	32	1	280	4.04	3.96	0.00	0.00	3.61	1130.77	313.27	313.27
	33	2	320	3.77	3.71	0.00	0.00	3.77	1206.15	319.73	319.73
	34	3	357	3.50	3.44	0.00	0.00	4.05	1249.50	308.52	308.52
	35	4	356	3.23	3.18	0.00	0.00	4.33	1150.15	265.78	265.78
B	36	5	303	2.96	2.92	0.00	0.00	4.60	897.35	194.87	194.87
	37	6	330	2.69	2.65	0.00	0.00	4.88	888.46	181.97	181.97
	38	7	326	2.42	2.39	0.00	0.00	5.16	789.92	153.09	153.09
	39	8	348	2.15	2.13	0.00	0.00	5.33	749.54	140.55	140.55
	40	9	335	1.88	1.86	0.00	0.00	5.51	631.35	114.67	114.67
C	41	10	315	1.62	1.60	0.00	0.00	5.68	508.85	89.61	89.61
	42	11	215	1.35	1.34	0.00	0.00	5.85	289.42	49.46	49.46
	43	12	169	1.08	1.08	0.00	0.00	6.02	182.00	30.21	30.21
	44	13	151	0.81	0.81	0.00	0.00	6.20	121.96	19.68	19.68
	45	14	105	0.54	0.55	0.00	0.00	6.37	56.54	8.88	8.88
D	46	15	74	0.27	0.29	0.00	0.00	6.54	19.92	3.04	3.04

SUM	14459.31	3747.50	14459.31	3747.50
SCOP _{on}	3.86		SCOP _{net}	3.86





Detailed test results

Detailed SCOP test results - low temperature application – EN 14825:2022

Detailed result for 'EN14825:2022' Average Low (A) A -7 /W34		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:		Average
Temperature application:		Low
Condition name:		A
Condition temperature:	°C	-7
Part load:	%	88%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	7.30
Heating demand:	kW	6.46
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	6.027
COP	-	3.067
Power consumption	kW	1.965
Measured		
Heating capacity	kW	6.016
COP	-	3.080
Power consumption	kW	1.953
During heating		
Air temperature dry bulb	°C	-7.01
Air temperature wet bulb	°C	-8.21
Inlet temperature	°C	28.99
Outlet temperature	°C	33.94
Outlet temperature (Time averaged)	°C	33.94
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	5515
Calculated Hydraulic power	W	2
Calculated global efficiency	η	0.13
Calculated Capacity correction	W	-11
Calculated Power correction	W	-12
Water Flow	m ³ /s	0.000292





Detailed result for 'EN14825:2022' Average Low (B) A 2 /W30		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:		Average
Temperature application:		Low
Condition name:		B
Condition temperature:	°C	2
Part load:	%	54%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	7.30
Heating demand:	kW	3.93
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	3.842
COP	-	4.939
Power consumption	kW	0.778
Measured		
Heating capacity	kW	3.839
COP	-	4.955
Power consumption	kW	0.775
During heating		
Air temperature dry bulb	°C	2.09
Air temperature wet bulb	°C	0.95
Inlet temperature	°C	25.03
Outlet temperature	°C	30.14
Outlet temperature (Time averaged)	°C	30.14
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	2002
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.12
Calculated Capacity correction	W	-3
Calculated Power correction	W	-3
Water Flow	m ³ /s	0.000180



Detailed result for 'EN14825:2022' Average Low (C) A 7 /W27		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:	Average	
Temperature application:	Low	
Condition name:	C	
Condition temperature:	°C	7
Part load:	%	35%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	7.30
Heating demand:	kW	2.53
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:	Steady State	
Integrated circulation pump:	No	
Included corrections (Final result)		
Heating capacity	kW	2.535
COP	-	6.458
Power consumption	kW	0.392
Measured		
Heating capacity	kW	2.534
COP	-	6.472
Power consumption	kW	0.392
During heating		
Air temperature dry bulb	°C	7.00
Air temperature wet bulb	°C	6.23
Inlet temperature	°C	22.02
Outlet temperature	°C	27.05
Outlet temperature (Time averaged)	°C	27.05
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	898
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.11
Calculated Capacity correction	W	-1
Calculated Power correction	W	-1
Water Flow	m³/s	0.000121



Detailed result for 'EN14825:2022' Average Low (D) A 12 /W24		
Tested according to:	EN14511:2022 and EN14825:2022	
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	7.30
Heating demand:	kW	1.12
CR:	-	0.5
Minimum flow reached:	-	No
Measurement type:	Steady State	
Integrated circulation pump:	No	
Included corrections (Final result)		
Heating capacity	kW	2.455
COP	-	8.225
Power consumption	kW	0.298
Measured		
Heating capacity	kW	2.454
COP	-	8.246
Power consumption	kW	0.298
During heating		
Air temperature dry bulb	°C	11.96
Air temperature wet bulb	°C	11.15
Inlet temperature	°C	21.71
Outlet temperature	°C	26.76
Outlet temperature (Time averaged)	°C	24.02
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	860
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.11
Calculated Capacity correction	W	-1
Calculated Power correction	W	-1
Water Flow	m³/s	0.000117



Detailed result for 'EN14825:2022' Average Low (E and F) A -10 /W35		
Tested according to:	EN14511:2022 and EN14825:2022	
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	7.30
Heating demand:	kW	7.30
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:	Steady State	
Integrated circulation pump:	No	
Included corrections (Final result)		
Heating capacity	kW	7.228
COP	-	2.537
Power consumption	kW	2.849
Measured		
Heating capacity	kW	7.214
COP	-	2.547
Power consumption	kW	2.833
During heating		
Air temperature dry bulb	°C	-10.01
Air temperature wet bulb	°C	-11.20
Inlet temperature	°C	29.99
Outlet temperature	°C	35.20
Outlet temperature (Time averaged)	°C	35.20
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	7151
Calculated Hydraulic power	W	2
Calculated global efficiency	η	0.14
Calculated Capacity correction	W	-14
Calculated Power correction	W	-17
Water Flow	m³/s	0.000333



Detailed SCOP test results - medium temperature application – EN 14825:2022

Detailed result for 'EN14825:2022' Average Medium (A) A -7 /W52		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:		Average
Temperature application:		Medium
Condition name:		A
Condition temperature:	°C	-7
Part load:	%	88%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	7.00
Heating demand:	kW	6.19
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	5.971
COP	-	2.307
Power consumption	kW	2.588
Measured		
Heating capacity	kW	5.968
COP	-	2.309
Power consumption	kW	2.585
During heating		
Air temperature dry bulb	°C	-7.00
Air temperature wet bulb	°C	-8.17
Inlet temperature	°C	44.00
Outlet temperature	°C	52.00
Outlet temperature (Time averaged)	°C	52.00
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	2155
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.12
Calculated Capacity correction	W	-3
Calculated Power correction	W	-3
Water Flow	m ³ /s	0.000181





Detailed result for 'EN14825:2022' Average Medium (B) A 2 /W42		
Tested according to:	EN14511:2022 and EN14825:2022	
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	7.00
Heating demand:	kW	3.77
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	3.708
COP	-	3.772
Power consumption	kW	0.983
Measured		
Heating capacity	kW	3.707
COP	-	3.775
Power consumption	kW	0.982
During heating		
Air temperature dry bulb	°C	2.12
Air temperature wet bulb	°C	0.86
Inlet temperature	°C	34.00
Outlet temperature	°C	42.04
Outlet temperature (Time averaged)	°C	42.04
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	721
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.11
Calculated Capacity correction	W	-1
Calculated Power correction	W	-1
Water Flow	m ³ /s	0.000111



Detailed result for 'EN14825:2022' Average Medium (C) A 7 /W36		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:		Average
Temperature application:		Medium
Condition name:		C
Condition temperature:	°C	7
Part load:	%	35%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	7.00
Heating demand:	kW	2.42
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	2.387
COP	-	5.160
Power consumption	kW	0.463
Measured		
Heating capacity	kW	2.387
COP	-	5.162
Power consumption	kW	0.462
During heating		
Air temperature dry bulb	°C	6.96
Air temperature wet bulb	°C	6.18
Inlet temperature	°C	28.00
Outlet temperature	°C	36.11
Outlet temperature (Time averaged)	°C	36.11
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	277
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.11
Calculated Capacity correction	W	0
Calculated Power correction	W	0
Water Flow	m³/s	0.000071



Detailed result for 'EN14825:2022' Average Medium (D) A 12 /W30		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:	Average	
Temperature application:	Medium	
Condition name:	D	
Condition temperature:	°C	12
Part load:	%	15%
Chosen Tbivalent	°C	-10
Tdesign	°C	-10
Pdesign	kW	7.00
Heating demand:	kW	1.08
CR:	-	0.5
Minimum flow reached:	-	No
Measurement type:	Steady State	
Integrated circulation pump:	No	
Included corrections (Final result)		
Heating capacity	kW	2.369
COP	-	6.313
Power consumption	kW	0.375
Measured		
Heating capacity	kW	2.369
COP	-	6.316
Power consumption	kW	0.375
During heating		
Air temperature dry bulb	°C	12.00
Air temperature wet bulb	°C	10.78
Inlet temperature	°C	26.38
Outlet temperature	°C	34.27
Outlet temperature (Time averaged)	°C	29.97
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	290
Calculated Hydraulic power	W	0
Calculated global efficiency	η	0.11
Calculated Capacity correction	W	0
Calculated Power correction	W	0
Water Flow	m³/s	0.000072



Detailed result for 'EN14825:2022' Average Medium (E and F) A -10 /W55		
Tested according to:	EN14511:2022 and EN14825:2022	
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	7.00
Heating demand:	kW	7.00
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:	Steady State	
Integrated circulation pump:	No	
Included corrections (Final result)		
Heating capacity	kW	6.777
COP	-	1.958
Power consumption	kW	3.461
Measured		
Heating capacity	kW	6.773
COP	-	1.960
Power consumption	kW	3.456
During heating		
Air temperature dry bulb	°C	-10.00
Air temperature wet bulb	°C	-11.07
Inlet temperature	°C	47.00
Outlet temperature	°C	54.98
Outlet temperature (Time averaged)	°C	54.98
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	2754
Calculated Hydraulic power	W	1
Calculated global efficiency	η	0.12
Calculated Capacity correction	W	-4
Calculated Power correction	W	-5
Water Flow	m³/s	0.000205



Detailed test results, low temperature, colder climate – EN14825:2022

Detailed result for 'EN14825:2022' Colder Low (F and G) A -15 /W32		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:		Colder
Temperature application:		Low
Condition name:		F and G
Condition temperature:	°C	-15
Part load:	%	82%
Chosen Tbivalent	°C	-15
Tdesign	°C	-22
Pdesign	kW	8.00
Heating demand:	kW	6.53
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	6.371
COP	-	2.375
Power consumption	kW	2.683
Measured		
Heating capacity	kW	6.360
COP	-	2.382
Power consumption	kW	2.670
During heating		
Air temperature dry bulb	°C	-15.02
Inlet temperature	°C	26.95
Outlet temperature	°C	32.02
Outlet temperature (Time averaged)	°C	32.02
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	5623
Calculated Hydraulic power	W	2
Calculated global efficiency	η	0.13
Calculated Capacity correction	W	-11
Calculated Power correction	W	-13
Water Flow	m ³ /s	0.000301






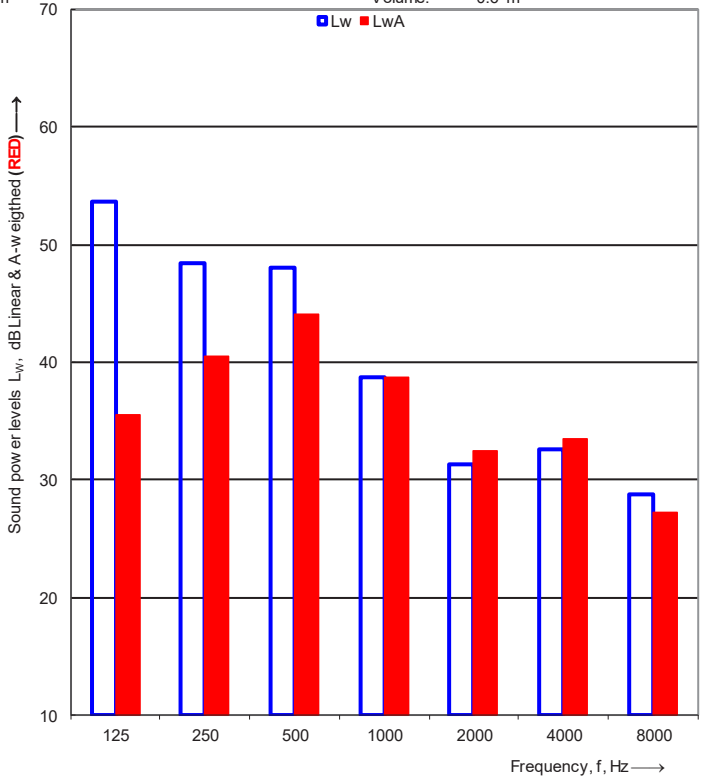
Detailed test results, medium temperature, colder climate – EN14825:2022

Detailed result for 'EN14825:2022' Colder Medium (F and G) A -13 /W47.75		
Tested according to:	EN14511:2022 and EN14825:2022	
Climate zone:		Colder
Temperature application:		Medium
Condition name:		F and G
Condition temperature:	°C	-13
Part load:	%	76%
Chosen Tbivalent	°C	-13
Tdesign	°C	-22
Pdesign	kW	8.40
Heating demand:	kW	6.41
CR:	-	1.0
Minimum flow reached:	-	No
Measurement type:		Steady State
Integrated circulation pump:		No
Included corrections (Final result)		
Heating capacity	kW	6.390
COP	-	2.038
Power consumption	kW	3.135
Measured		
Heating capacity	kW	6.386
COP	-	2.040
Power consumption	kW	3.131
During heating		
Air temperature dry bulb	°C	-13.00
Inlet temperature	°C	39.79
Outlet temperature	°C	47.73
Outlet temperature (Time averaged)	°C	47.73
Circulation pump		
Measured: Static differential pressure, liquid pump	Pa	2593
Calculated Hydraulic power	W	1
Calculated global efficiency	η	0.12
Calculated Capacity correction	W	-4
Calculated Power correction	W	-4
Water Flow	m ³ /s	0.000194



Detailed test results of sound power measurement - EN 12102-1:2017




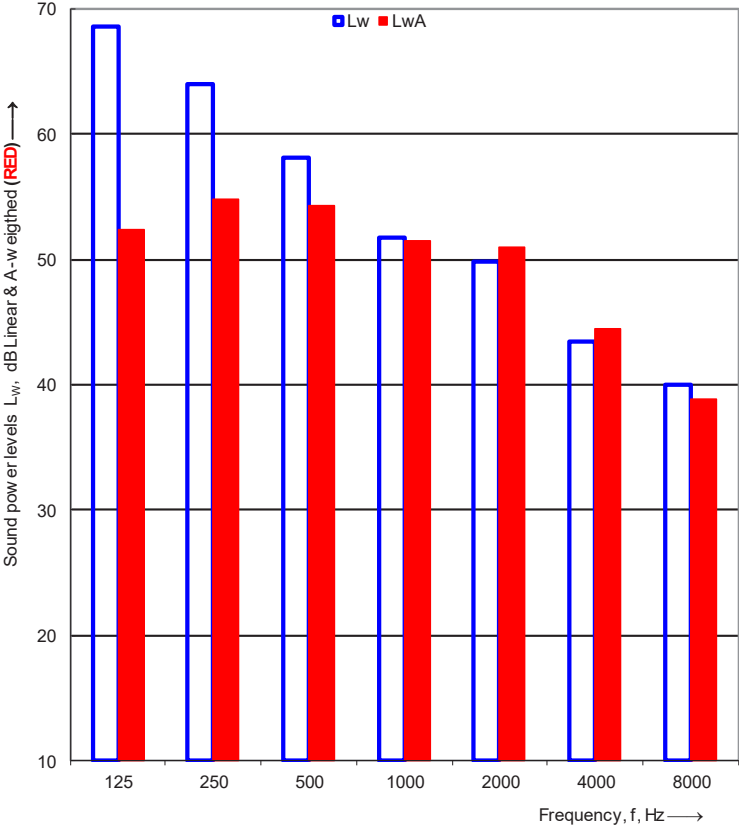
Test #1

 		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: CTC		Date of test: 28-11-2023																																																																					
Object: Type: Air to water heat pump Model: CTC EcoAir 712M																																																																							
Mounting conditions: The outdoor unit is mounted on the supporting metal support frame using four metal/rubber feet and placed on four pieces of concrete tiles (20x20x2.5 cm). All of these are placed in a water drop tray on two pieces of heavy concrete tiles (90x90x10cm) laying on a vibration damping mat on the floor. The noise radiated by the outdoor unit has been measured in Test room 2.																																																																							
Operating conditions: A7/W55, Compressor speed: 25[rps], Fan speed: 60[rps], Heating capacity: 2.4[kW], Power_input: 0.74 [kW], Water flow rate: 270 [l/h]																																																																							
Static pressure: 1008 kPa		Reference box:																																																																					
Air temperature: 7.0 °C		L1: 1.3 m																																																																					
Relative air humidity: 84.0 %		L2: 0.5 m																																																																					
Test room volume: 102.8 m³		L3: 1.0 m																																																																					
Area, S, of test room: 138.9 m²		Volume: 0.6 m³																																																																					
Room: Room 2																																																																							
<table border="1"><thead><tr><th>Frequency f [Hz]</th><th>L_w 1/3 octave [dB]</th><th>1/1 oct [dB]</th></tr></thead><tbody><tr><td>100</td><td>53.1</td><td></td></tr><tr><td>125</td><td>39.9 ¹</td><td>53.6</td></tr><tr><td>160</td><td>42.3 ¹</td><td></td></tr><tr><td>200</td><td>43.4</td><td></td></tr><tr><td>250</td><td>39.6</td><td>48.4</td></tr><tr><td>315</td><td>45.8</td><td></td></tr><tr><td>400</td><td>46.5</td><td></td></tr><tr><td>500</td><td>40.6</td><td>48.1</td></tr><tr><td>630</td><td>39.1</td><td></td></tr><tr><td>800</td><td>33.7</td><td></td></tr><tr><td>1000</td><td>33.8</td><td>38.7</td></tr><tr><td>1250</td><td>34.4</td><td></td></tr><tr><td>1600</td><td>27.3</td><td></td></tr><tr><td>2000</td><td>27.6</td><td>31.3</td></tr><tr><td>2500</td><td>23.6</td><td></td></tr><tr><td>3150</td><td>22.7</td><td></td></tr><tr><td>4000</td><td>31.0</td><td>32.6</td></tr><tr><td>5000</td><td>25.5</td><td></td></tr><tr><td>6300</td><td>16.6 ¹</td><td></td></tr><tr><td>8000</td><td>26.0</td><td>28.7</td></tr><tr><td>10000</td><td>24.7</td><td></td></tr></tbody></table>		Frequency f [Hz]	L _w 1/3 octave [dB]	1/1 oct [dB]	100	53.1		125	39.9 ¹	53.6	160	42.3 ¹		200	43.4		250	39.6	48.4	315	45.8		400	46.5		500	40.6	48.1	630	39.1		800	33.7		1000	33.8	38.7	1250	34.4		1600	27.3		2000	27.6	31.3	2500	23.6		3150	22.7		4000	31.0	32.6	5000	25.5		6300	16.6 ¹		8000	26.0	28.7	10000	24.7					
Frequency f [Hz]	L _w 1/3 octave [dB]	1/1 oct [dB]																																																																					
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6300	16.6 ¹																																																																						
8000	26.0	28.7																																																																					
10000	24.7																																																																						
¹ Diff. to backgr. noise < 6dB																																																																							
Sound power level L _w (A):		47.2 dB [re 1pW]																																																																					
Name of test institute: DTI		Date: 28-11-2023																																																																					
No. of test report: 300-KLAB-23-025																																																																							
Measurements are in full conformity with ISO 3743																																																																							






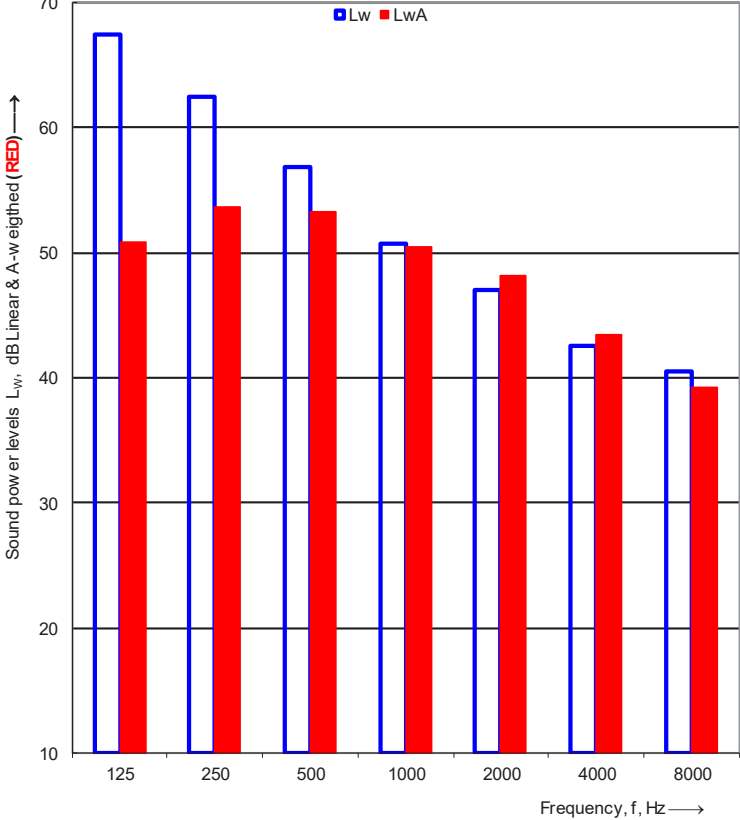


Test #2

 		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:	CTC			Date of test:	27-11-2023																																																																		
Object:	Type: Air to water heat pump Model: CTC EcoAir 712M																																																																						
Mounting conditions:	The outdoor unit is mounted on the supporting metal support frame using four metal/rubber feets and placed on four pieces of concrete tiles (20x20x2.5 cm). All of these are placed in a water drop tray on two pieces of heavy concrete tiles (90x90x10cm) laying on a vibration damping mat on the floor. The noise radiated by the outdoor unit has been measured in Test room 2.																																																																						
Operating conditions:	A7/W55, Compressor speed: 120[rps], Fan speed: 96[rps], Heating capacity: 10.5[kW], Power_input: 3.9 [kW], Water flow rate: 1150 [l/h]																																																																						
Static pressure:	1009 kPa			Reference box:																																																																			
Air temperature:	7.0 °C			L1:	1.3 m																																																																		
Relative air humidity:	84.0 %			L2:	0.5 m																																																																		
Test room volume:	102.8 m³	Room:	Room 2	L3:	1.0 m																																																																		
Area, S, of test room:	138.9 m²			Volume:	0.6 m³																																																																		
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Test #3

 		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: CTC		Date of test: 28-11-2023																																																																					
Object: Type: Air to water heat pump Model: CTC EcoAir 712M																																																																							
Mounting conditions: The outdoor unit is mounted on the supporting metal support frame using four metal/rubber feets and placed on four pices of concrete tiles (20x20x2.5 cm). All of these are placed in a water drop tray on two pieces of heavy concrete tiles (90x90x10cm) laying on a vibration damping mat on the floor. The noise radiated by the outdoor unit has been measured in Test room 2.																																																																							
Operating conditions: A7/W35, Compressor speed: 120Hz], Fan speed: 96[rps], Heating capacity: 11.1[kW], Power_input: 3.1 [kW], Water flow rate: 1940 [l/h]																																																																							
Static pressure: 1008 kPa		Reference box:																																																																					
Air temperature: 7.0 °C		L1: 1.3 m																																																																					
Relative air humidity: 84.0 %		L2: 0.5 m																																																																					
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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 14511:2018
- EN 12102:2017
- ISO 3743-1

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.