

OŚWIADCZENIE

Firma Przedsiębiorstwo Produkcyjno Handlowe Kostrzewa sp.k. oświadcza, iż pompy ciepła

1. HPR 400 Deluxe

2. HPR 500 Deluxe

należą do jednego podtypu w danym typoszeregu i spełniają łącznie następujące warunki:

- identyczna konstrukcja obiegu chłodniczego, ten sam czynnik chłodniczy/roboczy;
- ten sam producent, typ i liczba sprężarek;
- ten sam typ elementu rozprężnego;
- ten sam typ skraplacza;
- ten sam typ parownika;
- ten sam typ procesu odszraniania;
- ten sam sterownik i zasada sterowania wydajnością;
- ten sam producent, typ i liczba wentylatorów parownika (w przypadku powietrznych pomp ciepła) i zasada sterowania wydajnością (stała, zmienna lub stopniowana regulacja prędkości obrotowej);
- urządzenia z i bez zaworu czterodrogowego nie mogą być zaliczone do tego samego typoszeregu.

Giżycko, dnia 25.07.2024

Paweł Kostrzewa
Współwłaściciel



Przetłumaczenie z oryginału dokumentu w języku angielskim

/logo/
SZU

Strojírenský zkušební ústav, s.p., Brno, Česká republika
Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, Republika Czeska

ŚWIADECTWO BADAŃ

Numer **O-B-00432-24**

Klient PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLSKA

Wyrób Pompa ciepła powietrze/woda - monoblok

Oznaczenie typu / Znak towarowy **HPR 500 DELUXE**

Metody badań ČSN EN 14511-2:2023, ČSN EN 14511-3:2023,
ČSN EN 14825:2023;

Podstawa wydania świadectwa Raporty z badań:
39-17488/T z dnia 21.03.2024 r.
Dokumentacja techniczna PPH Kostrzewa sp.k.

Referencyjny sezon grzewczy „A” = klimat umiarkowany
(Temperatura obliczeniowa odniesienia $T_{designh} = -10\text{ °C}$)

Wyniki:

NISKA TEMPERATURA
(Referencyjna temperatura wody 35 °C)

ŚREDNIA TEMPERATURA
(Referencyjna temperatura wody 55 °C)

10,39	P_{designh} [kW] ... Ogrzewanie przy pełnym obciążeniu				9,99
4,03	SCOP [-] ... Wskaźnik sezonowej efektywności				3,39
Temperatura zewnętrzna T_j [°C]	Deklarowana wydajność grzewcza P_{dh} [kW]	Wskaźnik efektywności przy deklarowanej wydajności COP_d [-]	Temperatura zewnętrzna T_j [°C]	Deklarowana wydajność grzewcza P_{dh} [kW]	Wskaźnik efektywności przy deklarowanej wydajności COP_d [-]
T _j = -7	9,193	3,289	T _j = -7	8,839	2,566
T _j = +2	10,077	3,756	T _j = +2	10,130	3,232
T _j = +7	13,365	5,029	T _j = +7	13,211	4,173
T _j = +12	15,372	5,722	T _j = +12	15,119	5,056
T _j = TOL = -10	8,437	3,129	T _j = TOL = -10	8,252	2,336
T _j = T _{bivalent} = -7	9,193	3,289	T _j = T _{bivalent} = -7	8,839	2,566

/okrągła pieczęć z logo SZU w środku i napisem w otoku: STROJÍRENSKÝ ZKUŠEBNÍ ÚSTAV, s.p., CZ 16

O-B-00432-24, strona 1 (2)

Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, Hudcova 424/56b, 621 00 Brno,
Republika Czeska

www.szutest.cz

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NISKA TEMPERATURA
(Referencyjna temperatura wody 35 °C)

/logo SZU/

ŚREDNIA TEMPERATURA
(Referencyjna temperatura wody 55 °C)

Pobór mocy w trybach innych niż aktywny:

9,5	Tryb wyłączenia	P _{OFF}	[W]	9,5
12,8	Tryb wyłączzonego termostatu	P _{TO}	[W]	12,8
12,7	Tryb czuwania	P _{SB}	[W]	12,7
0,0	Tryb włączonej grzałki karteru	P _{CK}	[W]	0,0

Roczne zużycie energii elektrycznej na ogrzewanie według:

5323	ČSN EN 14825:2023	Q _{HE}	[kWh]	6089
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Sezonowa efektywność energetyczna ogrzewania pomieszczeń

158,3	ČSN EN 14825:2023	η _s	[%]	132,6
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Natężenie przepływu cieczy w zewnętrznym wymienniku ciepła:

–	Ciecz źródłowa	Min/Max	[m³/h]	–
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Natężenie przepływu cieczy w wewnętrznym wymienniku ciepła:

1,4608 / 2,6539	Woda grzewcza	Min/Max	[m³/h]	0,8999 / 1,6387
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Specyfikacja warunków:

Kontrola prędkości kompresora	Stała	Objęściowe natężenie przepływu wody grzewczej (wewnętrzny wymiennik ciepła)	Zmienne
Temperatura wylotowa wody (wewnętrzny wymiennik ciepła)	Zmienna	Objęściowe natężenie przepływu cieczy źródłowej (zewnętrzny wymiennik ciepła)	–
Funkcja	Odwracalna		

Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, niniejszym świadectwem badania potwierdza, że przeprowadzono dla przedmiotowego wyrobu badania z wynikami podanymi powyżej. Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, jest akredytowanym laboratorium badawczym nr 1045.1.

Brno, 21.03.2024 r.

/nieczytelny podpis odręczny/
Inż. Mario Jankola
Kierownik ds. urządzeń grzewczych i wyrobów budowlanych
– KONIEC ŚWIADECTWA BADAŃ –

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O-B-00432-24, strona 2 (2)

Instytut Badawczy Przemysłu Maszynowego, przedsiębiorstwo państwowe, Hudcova 424/56b, 621 00 Brno,
Republika Czeska
www.szutest.cz

Ja, Urszula Dorota Kallas, tłumacz przysięgły języka angielskiego i francuskiego, wpisana na listę tłumaczy przysięgłych Ministra Sprawiedliwości pod numerem TP/4520/05, stwierdzam, że niniejsze tłumaczenie w pełni odpowiada przedstawionemu mi oryginałowi dokumentu.
Warszawa, 27.03.2024 r. Rep. Nr 225/2024





Strojírenský zkušební ústav, s.p., Brno, Česká republika
Engineering Test Institute, Public Enterprise, Brno, Czech Republic

TEST CERTIFICATE

Number **O-B-00432-24**

Customer PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Product Air/water heat pump – monobloc

Type designation / Trademark **HPR 500 DELUXE**

Test methods ČSN EN 14511-2:2023, ČSN EN 14511-3:2023,
ČSN EN 14825:2023;

Basis of certificate Test reports:
39-17488/T of 2024-03-21
Technical documents of PPH Kostrzewa sp.k.

Reference heating season „A“ = average
(Reference design temperature $T_{designh} = -10\text{ °C}$)

Results:

LOW TEMPERATURE (Reference water temperature 35 °C)

MEDIUM TEMPERATURE (Reference water temperature 55 °C)

10.39	$P_{designh}$ [kW] ... Full load heating				9.99
4.03	SCOP [-] ... Seasonal coefficient of performance				3.39
Outdoor temperature T_j [°C]	Heating declared capacity P_{dh} [kW]	Coefficient of performance at the declared capacity COP_d [-]	Outdoor temperature T_j [°C]	Heating declared capacity P_{dh} [kW]	Coefficient of performance at the declared capacity COP_d [-]
$T_j = -7$	9.193	3.289	$T_j = -7$	8.839	2.566
$T_j = +2$	10.077	3.756	$T_j = +2$	10.130	3.232
$T_j = +7$	13.365	5.029	$T_j = +7$	13.211	4.173
$T_j = +12$	15.372	5.722	$T_j = +12$	15.119	5.056
$T_j = TOL = -10$	8.437	3.129	$T_j = TOL = -10$	8.252	2.336
$T_j = T_{bivalent} = -7$	9.193	3.289	$T_j = T_{bivalent} = -7$	8.839	2.566

LOW TEMPERATURE

(Reference water temperature 35 °C)



MEDIUM TEMPERATURE

(Reference water temperature 55 °C)

Power consumption in modes other than „active mode“:

9.5	Off mode	P _{OFF}	[W]	9.5
12.8	Thermostat off mode	P _{TO}	[W]	12.8
12.7	Standby mode	P _{SB}	[W]	12.7
0.0	Crankcase heater mode	P _{CK}	[W]	0.0

Annual electricity consumption for heating according to:

5323	ČSN EN 14825:2023	Q _{HE}	[kWh]	6089
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Seasonal Space heating energy efficiency

158.3	ČSN EN 14825:2023	η _s	[%]	132.6
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Liquid flow rate in outdoor heating exchanger:

–	Source liquid	Min/Max	[m ³ /h]	–
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Liquid flow rate in indoor heating exchanger:

1.4608 / 2.6539	Heating water	Min/Max	[m ³ /h]	0.8999 / 1.6387
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Specification of conditions:

Compressor speed control	Fixed	Heating water volume flow rate (indoor heat exchanger)	Variable
Outlet water temperature (indoor heat exchanger)	Variable	Source liquid volume flow rate (outdoor heat exchanger)	–
Function	Reversible		

Engineering Test Institute, Public Enterprise, confirms by this Test Certificate that the testing of the product in question was performed with the results as stated above. Engineering Test Institute, Public Enterprise, is an accredited Testing Laboratory 1045.1.

Brno, 2024-03-21

Ing. Mario Jankola

Heating Equipment and Construction Products Manager

– END OF TEST CERTIFICATE –

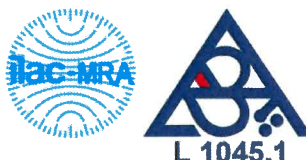




Testing Laboratory 1045.1 accredited by the Czech Accreditation Institute pursuant to
ČSN EN ISO/IEC 17025:2018

Strojírenský zkušební ústav, s.p. Zkušební laboratoř
(Engineering Test Institute, Public Enterprise, Testing Laboratory)
Hudcova 424/56b, Medlánky, 621 00 Brno

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TEST REPORT

39-17727/1/H_shortened

Product: Outdoor Air/Water Heat pump - monobloc

Type designation: HPR 500 DELUXE

Customer: PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Manufacturer: PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Report issue date: 2024-07-02

Distribution list: 1 copy to the Customer
1 copy to the Engineering Test Institute

This document may be copied in its entirety without written consent of the Engineering Test Institute. Partial copies are subject to approval. The results of the tests and verifications shall relate only to the products tested as received or presented. The testing laboratory is not responsible for the data provided by the customer specified in the report.

SP-2021-000012_1_12

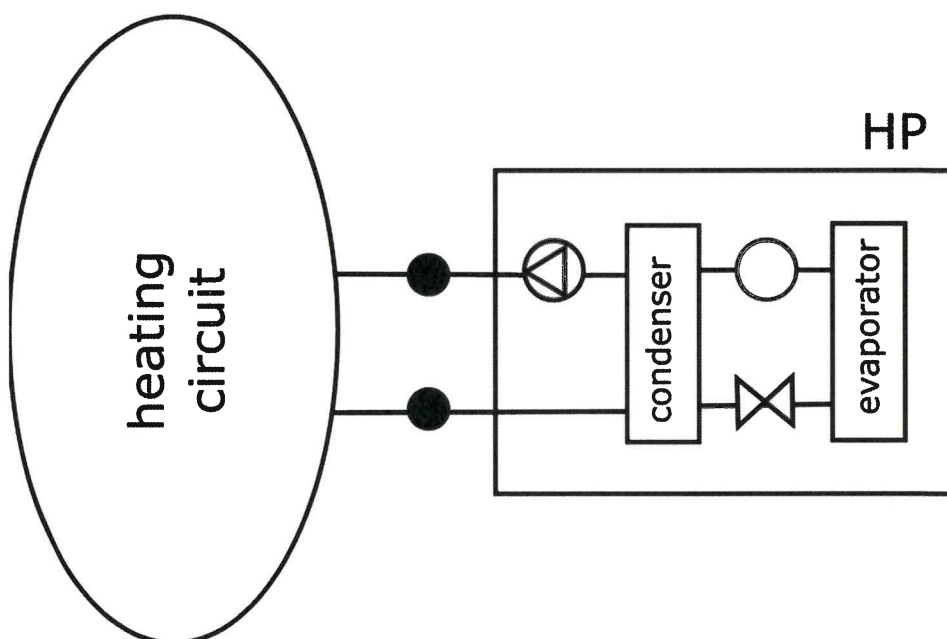
I. Description of product tested

The Heat pump **HPR 500 DELUXE** supplied by the company **PPH Kostrzewa sp.k.** is structurally adapted to operate in air/water system. Device is designed as monobloc placed outdoor. Refrigerant R290 is used with charge 0.95 kg. Power supply is a three-phase. Heat pump is able to work in heating and cooling mode. Heat pump is working with variable flow rate.

Main components of the outdoor unit **HPR 500 DELUXE**:

- Serial number 500143
- Refer to report 39-17727/1/H of 2024-06-28

Scheme:



II. Sample tested

SZU reg. no.	Product name	Date of submission
1212.24.39878.001	HPR 500 DELUXE	2024-04-17

The visual inspection, tests and verification were carried out by Ing. Ondrej Bilkovič at the test station of SZU. The tests were performed using measuring and testing equipment with valid calibration.

III. Measuring and test equipment:

No.	Description	Inventory number
1.	Electrical energy meter	E2.1
2.	Digital watt meter	1.2.2 ENERGIE ANALYZATOR_2
3.	Flow meter Krohne Optiflux	8.1.2 TECH_K2_V_DN15
4.	Barometer	2.3 MAR18_1_PB
5.	Differential pressure gauge	3.2 MAR18_2_dP
6.	Thermometers	3.4 MAR18_T
7.	Thermo-hydro meter 608-H1	117043
8.	Tape measure	ME 475
9.	Multi-analyser SINUS SoundBook MK2	000-000-000-875/1
10.	Microphone pair G.R.A.S. 40 AK, wind deflector	000-000-000-875/2
11.	Calibrator G.R.A.S. 42AG	000-000-000-875/3

IV. Methods, results of tests and verifications

No.	Test objective	Requirement	Method of test	Documentation	Test evaluation/ verification *
1.	Calculation of sound power level	Art. 9	ČSN ISO 9614-2:1997	Page No. 5-12	+
2.	Acoustic measurements – Sound power level	Art. 8	ČSN EN 12102-1:2023	Page No. 4-12	+

*) **Evaluation / statement of conformity:**

+ Requirement fulfilled	0Not applicable
- Requirement not fulfilled	xNot evaluated

Note:

The stated extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient $k=2$, corresponding to the coverage certainty of 95% as regards standard classification.

If a statement of conformity is provided, the decision rule pursuant to ILAC-G8:09/2019, Art. 4.2.1 – binary statement for the simple acceptance rule shall apply.

Test objective:	Heating and cooling equipment
Exact name of the test procedure:	2.136* - Measurement of noise characteristics
Test method:	ČSN EN 12102-1:2023; ČSN ISO 9614-2:1997
Sample tested:	Air/Water Heat pump HPR 500 DELUXE
Measuring equipment used:	see Chapter III
Place of test:	Engineering Test Institute, Hudcova 424/56b, 621 00 Brno, CZ

Measurement uncertainty:

Measured quantity	Unit	Uncertainty of measurement	Evaluation
Liquid			
- temperature difference (dT)	[K]	± 0.15 K	fulfilled
- temperature inlet/outlet	[°C]	± 0.15 K	fulfilled
- volume flow	[m³/s]	± 1 %	fulfilled
- static pressure difference	[kPa]	± 1 kPa ($\Delta p \leq 20$ kPa) or ± 5 % ($\Delta p > 20$ kPa)	fulfilled
Air			
- dry bulb temperature	[°C]	± 0.2 K	fulfilled
- wet bulb temperature	[°C]	± 0.4 K	fulfilled
- volume flow	[m³/s]	± 5 %	not applied
- static pressure difference	[Pa]	± 5 Pa ($\Delta p \leq 100$ Pa) or ± 5 % ($\Delta p > 100$ Pa)	not applied
Refrigerant			
- pressure at compressor outlet	[kPa]	± 1 %	not applied
- temperature	[°C]	± 0.5 K	not applied
Concentration (in volume)			
- heat transfer medium	[%]	± 2	not applied
Electrical quantities			
- electric power	[W]	± 1 %	fulfilled
- voltage	[V]	± 0.5 %	fulfilled
- current	[A]	± 0.5 %	fulfilled
- electric energy	[kWh]	± 1 %	not applied
Compressor rotational speed	[min⁻¹]	± 0.5 %	not applied
The heating or cooling capacities measured on the liquid side shall be determined within a maximum uncertainty of 5 % independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.			fulfilled

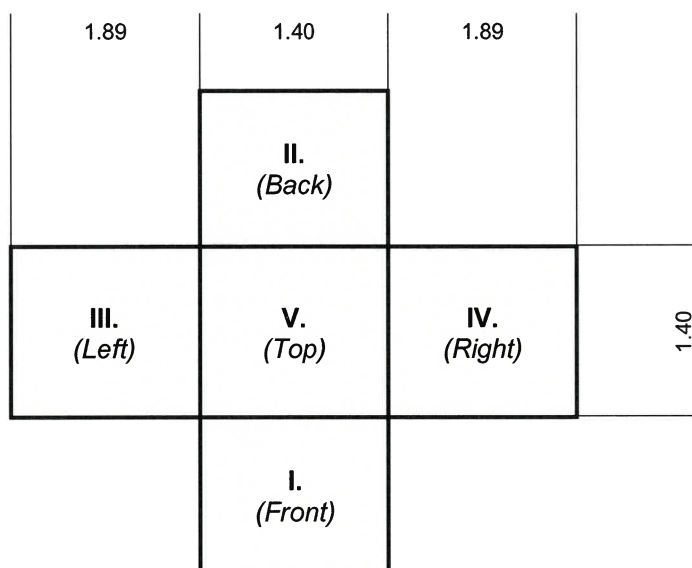
a) Measurement surface

Tested samples were surrounded by a cuboid-shape measuring surface set at the distance d [m].

Test Sample: Air/Water Heat pump HPR 500 DELUXE			
Distance from the test sample	d	[m]	0.20
Height of measurement surface	h	[m]	1.89
Width of measurement surface	w	[m]	1.40
Depth of measurement surface	l	[m]	1.40
Total measurement surface area	S	[m ²]	12.54
Minimal measuring time per surface	t_M	[s]	90.00

Sketch of measurement surface (not to scale):

Air/Water Heat pump **HPR 500 DELUXE**
– Outdoor unit –



b) Acoustic environment

The device under test was placed inside a climate chamber (dimensions shown below). The chamber was acoustically treated to be compliant with ČSN EN ISO 3745:2012 requirements for hemi-anechoic chambers. The background noise was stable with the main noise source being the air conditioning of the climate chamber which was set to lower power or momentarily turned off for sufficient signal to noise ratio. The device under test was placed in a position offset from the middle of the chamber, at a sufficient distance from the surrounding walls, and was rotated by about $5 \pm 10^\circ$. Care was taken to ensure low air flow at the measurement surface by varying the measurement distance and positions. The DUT was taken off from the delivery palette.

Climate-acoustic chamber (corresponds to free field over a reflecting plane)			
Width of testing room	l_1	[m]	3.75
Length of testing room	l_2	[m]	4.50
Height of testing room	l_3	[m]	4.25

c) Measured and calculated data – General overview:

Test sample			Air/Water Heat pump HPR 500 DELUXE
The measured values are in accordance with ČSN EN 12102-1:2023			YES
The measured values are in accordance with ČSN EN ISO 9614-2:1997			YES
Operation mode			Heating
Specification of the assessment condition			A7/W55*
Type of HP capacity regulation			Fixed
Compressor speed settings			on/off (50 Hz)
Fan speed settings			AUTO
Date of testing (YYYY-MM-DD)			2024-05-15
Reference air temperature	t_{amb}	[°C]	7.0
Relative humidity of air	RH	[%]	87.1
Ambient pressure	p_{amb}	[hPa]	984.5
Overall sound power level (linear)	L_W	[dB]	66.1 ± 1.5
Overall A-weighted sound power level	L_{WA}	[dB(A)]	58.1 ± 1.5
Accuracy class			Engineering (grade 2)

^{*)} Comment to abbreviated marking: i.e. A7/W55
A (water), 7 (input source liquid temperature in °C) / W (water), 55 (outlet heating water temperature in °C)

1A) Measurement results – octave bands

Air/Water Heat pump HPR 500 DELUXE Outdoor unit at A7/W55; on/off	Engineering (Grade 2)
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f_m [Hz]	Criterion 1			Criterion 2		Criterion 3	All criteria passed?	L_w [dB]	L_{WA} [dB(A)]	U [dB]	Evaluation
	L_d	F_{pl}	$L_d > F_{pl}$	$F_{+/-}$	$F_{+/-} \leq 3$	$L_{w(1)} - L_{w(2)} \leq 5$					
125	27.7	4.3	YES	0.0	YES	YES	YES	65.0	51.2	± 3.0	c
250	28.0	1.8	YES	0.0	YES	YES	YES	54.4	45.7	± 2.0	passed
500	28.3	3.0	YES	0.0	YES	YES	YES	55.6	52.6	± 1.5	passed
1000	20.7	2.9	YES	0.0	YES	YES	YES	53.3	53.2	± 1.5	passed
2000	21.1	2.5	YES	0.0	YES	YES	YES	46.8	48.0	± 1.5	c
4000	20.3	2.6	YES	0.0	YES	YES	YES	41.4	42.3	± 1.5	c
8000**)	19.9	5.0	YES	0.0	YES	YES	YES	37.0	36.9	± 2.5	c
Total								66.1	58.1	± 1.5	

**) Due to the sound intensity method limitations, the frequency of 6300 Hz was measured only.

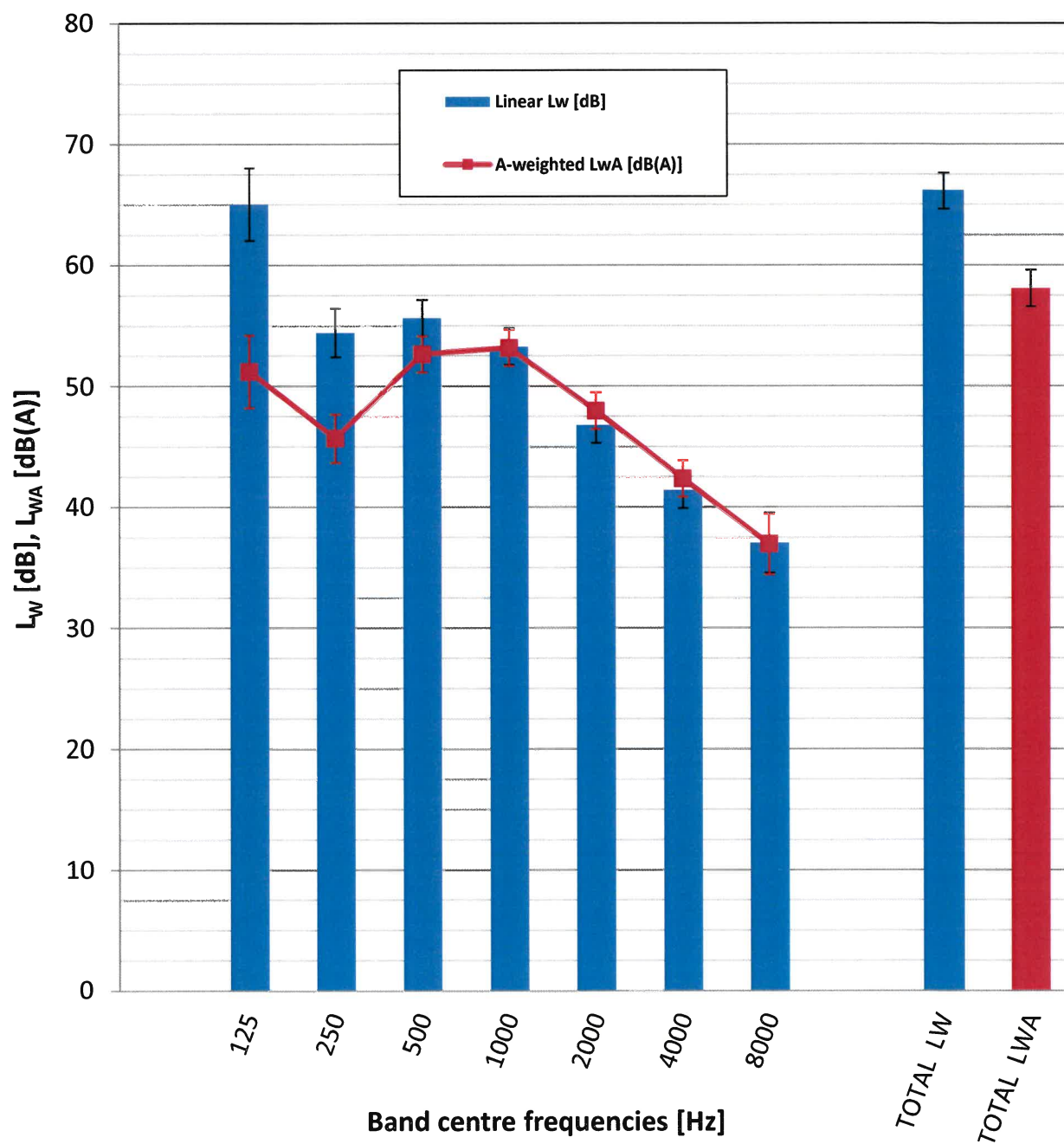
Legend:

<i>passed</i>	Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA} . Required accuracy class is fulfilled in this band.
<i>not passed</i>	Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA} . Required accuracy class is not fulfilled in this band.
<i>c</i>	Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA} . These bands are evaluated in the calculation of L_{WA} .
<i>nc</i>	Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA} . These bands are not evaluated in the calculation of L_{WA} .

Spectrum of Sound power level L_W – octave bands

Air/Water Heat pump **HPR 500 DELUXE**
Outdoor unit at A7/W55; on/off

**Engineering
(Grade 2)**



1B) Measurement results – one-third octave bands

Air/Water Heat pump HPR 500 DELUXE Outdoor unit at A7/W55; on/off	Engineering (Grade 2)
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f_m [Hz]	Criterion 1			Criterion 2		Criterion 3	All criteria passed?	L_w [dB]	L_{WA} [dB(A)]	U [dB]	Evaluation
	L_d	F_{pl}	$L_d > F_{pl}$	$F_{+/-}$	$F_{+/-} \leq 3$	$L_{W(1)} - L_{W(2)} \leq 5$					
100	27.8	4.5	YES	0.0	YES	YES	YES	53.6	34.5	± 3.0	c
125	27.7	4.3	YES	0.0	YES	YES	YES	55.0	38.9	± 3.0	c
160	27.8	2.6	YES	0.0	YES	YES	YES	64.2	50.8	± 3.0	passed
200	27.9	3.0	YES	0.0	YES	YES	YES	50.3	39.4	± 2.0	c
250	28.0	1.8	YES	0.0	YES	YES	YES	50.4	41.8	± 2.0	passed
315	28.4	2.7	YES	0.0	YES	YES	YES	47.8	41.2	± 2.0	passed
400	28.5	3.5	YES	0.0	YES	YES	YES	48.3	43.5	± 1.5	passed
500	28.3	3.0	YES	0.0	YES	YES	YES	52.8	49.6	± 1.5	passed
630	28.1	2.7	YES	0.0	YES	YES	YES	50.3	48.4	± 1.5	passed
800	21.8	3.3	YES	0.1	YES	YES	YES	49.5	48.7	± 1.5	passed
1000	20.7	2.9	YES	0.0	YES	YES	YES	47.7	47.7	± 1.5	passed
1250	21.0	2.6	YES	0.0	YES	YES	YES	48.2	48.8	± 1.5	passed
1600	21.0	2.8	YES	0.0	YES	YES	YES	42.5	43.5	± 1.5	passed
2000	21.1	2.5	YES	0.0	YES	YES	YES	39.5	40.7	± 1.5	c
2500	20.8	1.6	YES	0.0	YES	YES	YES	43.2	44.5	± 1.5	passed
3150	20.6	1.9	YES	0.0	YES	YES	YES	37.1	38.3	± 1.5	c
4000	20.3	2.6	YES	0.0	YES	YES	YES	37.0	38.0	± 1.5	c
5000	19.9	2.6	YES	0.0	YES	YES	YES	35.7	36.2	± 1.5	c
6300	19.9	5.0	YES	0.0	YES	YES	YES	32.3	32.2	± 2.5	c
Total								66.1	58.1	± 1.5	

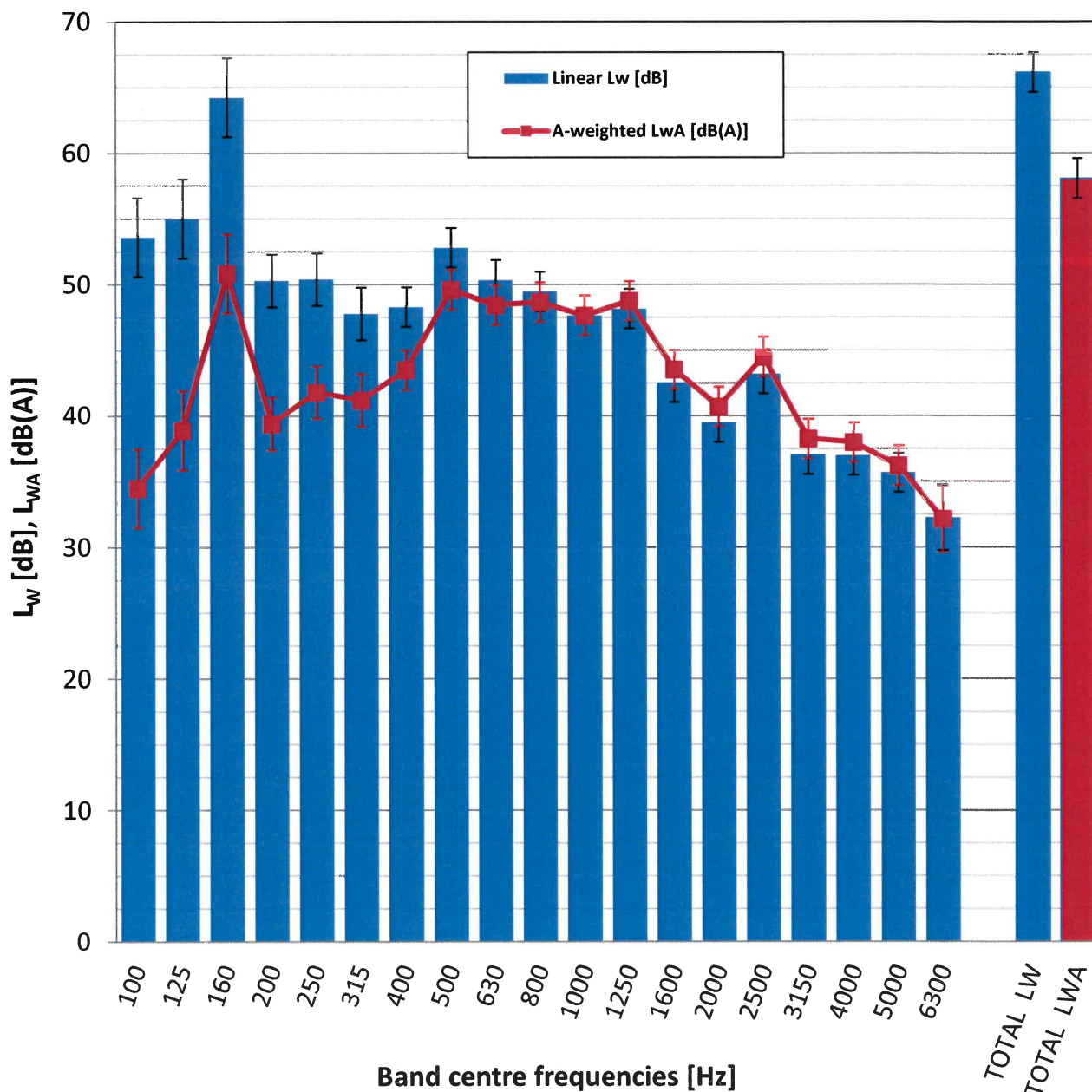
Legend:

- passed* Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA} . Required accuracy class is fulfilled in this band.
- not passed* Frequency bands with this description are significant for the calculation of A-weighted total sound power level L_{WA} . Required accuracy class is not fulfilled in this band.
- c* Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA} . These bands are evaluated in the calculation of L_{WA} .
- nc* Frequency bands with this description are not significant for the calculation of A-weighted total sound power level L_{WA} . These bands are not evaluated in the calculation of L_{WA} .

Spectrum of Sound power level L_W – one-third octave bands

Air/Water Heat pump **HPR 500 DELUXE**
Outdoor unit at A7/W55; on/off

**Engineering
(Grade 2)**



Tested by: Ing. Ondrej Bilkovič

Date: 2024-06-27

Signed: 

Reviewed and approved by: Ing. Antonín Kolbábek, Ph.D.

Date: 2024-06-27

Signed: 

V. A list of referenced documents

- Order of 2024-04-26 (Order reg. no. B-82131, received on 2024-04-29)
- Contract B-82131/39
- ČSN EN 12102-1:2023 - Air conditioners, liquid chilling packages, heat pumps, process chillers and dehumidifiers with electrically driven compressors - Determination of the sound power level - Part 1: Air conditioners, liquid chilling packages, heat pumps for space heating and cooling, dehumidifiers and process chillers
- ČSN ISO 9614-2:1997 - Acoustics - Determination of sound power levels of noise sources using sound intensity - Part 2: Measurement by scanning
- ČSN EN 14511-2:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 2: Test conditions
- ČSN EN 14511-3:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 3: Test methods
- ČSN EN 14511-4:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 4: Requirements
- ČSN EN 14825:2023 - Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling, commercial and process cooling - Testing and rating at part load conditions and calculation of seasonal performance
- Background of the SZU task no. 39-17727
- Record measurement file 39-17727-H.zip

Test Report compiled by:

Ing. Ondřej Bilkovič
Test engineer

Test Report approved by:

Ing. Antonín Kolbábek, Ph.D.
Hydraulic and Pressure Equipment Manager

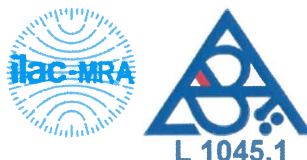
– End of Test Report –



Testing Laboratory 1045.1 accredited by the Czech Accreditation Institute pursuant to
ČSN EN ISO/IEC 17025:2018

Strojírenský zkušební ústav, s.p. Zkušební laboratoř
(Engineering Test Institute, Public Enterprise, Testing Laboratory)
Hudcova 424/56b, Medlánky, 621 00 Brno

Page 1 of 29



TEST REPORT

39-17762/T_shortened

Product: Outdoor Air/Water Heat Pump - Monobloc

Type designation: HPR 500 DELUXE

Customer: PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Manufacturer: PPH Kostrzewa sp.k.
Przemysłowa 11A
11-500 Giżycko
POLAND

Report issue date: 2024-06-10

Distribution list: 1 copy to the Customer
1 copy to the Engineering Test Institute

This document may be copied in its entirety without written consent of the Engineering Test Institute. Partial copies are subject to approval. The results of the tests and verifications shall relate only to the products tested as received or presented. The testing laboratory is not responsible for the data provided by the customer specified in the report.

SP-2021-000012_1_12

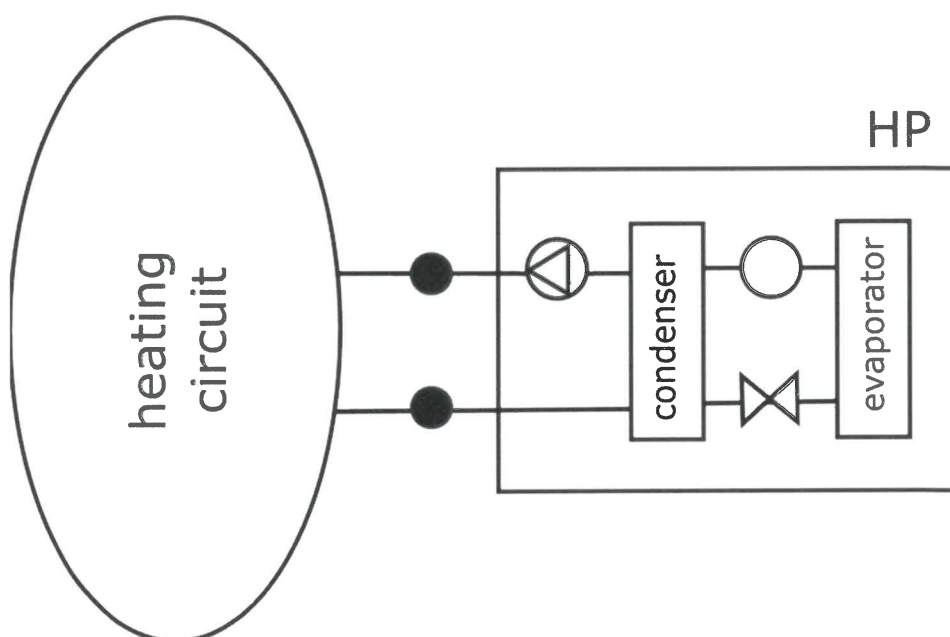
I. Description of product tested

The Heat pump **HPR 500 DELUXE** supplied by the company **PPH KOSTRZEWA Sp.k.** is structurally adapted to operate in air/water system. Device is designed as monobloc placed outdoor. Refrigerant R290 is used with charge 0.95 kg. Power supply is a three-phase. Heat pump is able to work in heating and cooling mode. Heat pump is working with variable flow rate.

Main components of the outdoor unit **HPR 500 DELUXE**:

- Serial number 500143
- Refer to report 39-17488/T of 2024-03-21

Scheme:



II. Sample tested

SZU reg. no.	Product name	Date of submission
1212.24.39619.001	HPR 500 DELUXE	2024-02-29

The visual inspection, tests and verification were carried out by Ing. Tomáš Sedláček and Ing. Jakub Čederle at the test station of SZU.

The tests were performed using measuring and testing equipment with valid calibration.

III. Measuring and test equipment:

No.	Description:	Inventory number:
1.	Electrical energy meter	E3.1
2.	Digital watt meter	1.2.3 ENERGIE ANALYZATOR_3
3.	Flow meter Krohne Optiflux	8.1.5 TECH_K3_V_DN15_SEK
4.	Barometer	2.4 MAR18_1_PB
5.	Differential pressure gauge	14.2.2 MAR18_3_dP_2
6.	Temperature-humidity meter HF532	14.1.1 K3_VLHKOST_1
7.	Temperature-humidity meter HF532	14.1.3 K3_VLHKOST_2
8.	Thermometers	14.4 MAR18_T

IV. Methods, results of tests and verifications

No.	Test objective	Requirement	Method of test	Documentation	Test evaluation/ verification *
1.	Seasonal performance tests and SCOP calculation – Low temperature application	–	ČSN EN 14511-3:2023 ČSN EN 14825:2023	Page No. 5-11	x
2.	Seasonal performance tests and SCOP calculation – Medium temperature application	–	ČSN EN 14511-3:2023 ČSN EN 14825:2023	Page No. 12-18	x

*) **Evaluation / statement of conformity:**
+ Requirement fulfilled 0 Not applicable
-..... Requirement not fulfilled x Not evaluated

Measured quantity	Unit	Uncertainty measurement of	Evaluation
Liquid			
- temperature difference (dT)	[K]	$\pm 0.15 \text{ K}$	fulfilled
- temperature inlet/outlet	[°C]	$\pm 0.15 \text{ K}$	fulfilled
- volume flow	[m ³ /s]	$\pm 1 \%$	fulfilled
- static pressure difference	[kPa]	$\pm 1 \text{ kPa}$ ($\Delta p \leq 20 \text{ kPa}$) or $\pm 5 \%$ ($\Delta p > 20 \text{ kPa}$)	fulfilled
Air			
- dry bulb temperature	[°C]	$\pm 0.2 \text{ K}$	fulfilled
- wet bulb temperature	[°C]	$\pm 0.4 \text{ K}$	fulfilled
- volume flow	[m ³ /s]	$\pm 5 \%$	not applied
- static pressure difference	[Pa]	$\pm 5 \text{ Pa}$ ($\Delta p \leq 100 \text{ Pa}$) or $\pm 5 \%$ ($\Delta p > 100 \text{ Pa}$)	not applied
Refrigerant			
- pressure at compressor outlet	[kPa]	$\pm 1 \%$	not applied
- temperature	[°C]	$\pm 0.5 \text{ K}$	not applied
Concentration (in volume)			
- heat transfer medium	[%]	± 2	not related
Electrical quantities			
- electric power	[W]	$\pm 1 \%$	fulfilled
- voltage	[V]	$\pm 0.5 \%$	fulfilled
- current	[A]	$\pm 0.5 \%$	fulfilled
- electric energy	[kWh]	$\pm 1 \%$	not applied
Compressor rotational speed	[min ⁻¹]	$\pm 0.5 \%$	not applied
The heating or cooling capacities measured on the liquid side shall be determined within a maximum uncertainty of 5 % independent of the individual uncertainties of measurement including the uncertainties on the properties of fluids.			fulfilled

Note:

The stated extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient $k=2$, corresponding to the coverage certainty of 95% as regards standard classification.

If a statement of conformity is provided, the decision rule pursuant to ILAC-G8:09/2019, Art. 4.2.1 - binary statement for the simple acceptance rule shall apply.

Comment to abbreviated marking: e.g. A7/W35

A (air) 7 (input air, dry-bulb temperature in °C) / W (water), 35 (output heating water temperature in °C)

Test objective:	Seasonal performance tests and SCOP calculation – Low temperature application
Exact name of the test procedure:	1.37* - Tests of leakage, pressure resistance, thermal and technical parameters, combustion efficiency, safety functions
Test method:	ČSN EN 14511-3:2023, ČSN EN 14825:2023
Sample tested:	Heat pump HPR 500 DELUXE
Measuring equipment used:	see Chapter III

Design			Air / water – monobloc			
Conditions specification according to ČSN 14825:2020	to EN	Temperature application			Low (reference water temperature 35 °C)	
		Reference heating season			Average	
		Outlet water temperature - indoor heat exchanger			Variable	
		Compressor speed control			Fixed	
		Water flow rate – primary circuit			–	
		Water flow rate – secondary circuit			Variable	
Seasonal space heating efficiency	Heating	Average	ηs		158.3	%
		Warmer	ηs		–	%
		Colder	ηs		–	%
Seasonal efficiency according to ČSN 14825:2020	Heating	Average	SCOP		4.03	–
		Warmer	SCOP		–	–
		Colder	SCOP		–	–
Function	Cooling				Yes	
	Heating	Yes	Reference heating season	Average	Yes	
				Warmer	Yes	
				Colder	Yes	
Full heating load	Cooling		Pdesignc		–	kW
	Heating	Average	Pdesignh		10.39	kW
		Warmer	Pdesignh		–	kW
		Colder	Pdesignh		–	kW
Bivalent temperatures	Heating	Average	Tbivalent		-7	°C
		Warmer	Tbivalent		–	°C
		Colder	Tbivalent		–	°C
Operation temperatures limit	Heating	Average	TOL		-10	°C
		Warmer	TOL		–	°C
		Colder	TOL		–	°C
Seasonal power consumption according to ČSN EN 14825:2020	Cooling		QCE		–	kWh
	Heating	Average	QHE		5323	kWh
		Warmer	QHE		–	kWh
		Colder	QHE		–	kWh
Modes other than „active mode“		Off mode			POFF	9.5 W
		Thermostat off mode			PTO	12.8 W
		Standby mode			PSB	12.7 W
		Crankcase heater mode			PCK	0.0 W

Calculation of SCOP according to ČSN EN 14825:2023:

Number of hours used for calculation of reference SCOP (Annex B – Table B. 2, B. 3)

- For reversible heat pumps and reference heating season „A“ = average

H _{HE}	2066	[h]
H _{TO}	178	[h]
H _{SB}	0	[h]
H _{CK}	178	[h]
H _{OFF}	0	[h]

Measured data:

P _{TO}	0.0128	[kW]
P _{SB}	0.0127	[kW]
P _{CK}	0.0000	[kW]
P _{OFF}	0.0095	[kW]
P _{designh}	10.39	[kW]
SCOP _{ON}	4.03	[-]

Coefficient and correction:

F(1)	3	[%]
F(2)	0	[%]
CC	2.5	[-]

Calculation of SCOP:

7.3 Calculation of the reference annual heating demand (Q_H)

$$Q_H = P_{\text{designh}} \cdot H_{HE} \quad [\text{kWh}]$$

$$Q_H = 10.39 \cdot 2066 = 21470 \quad [\text{kWh}]$$

7.4 Calculation of the annual electricity consumption (Q_{HE})

$$Q_{HE} = Q_H / \text{SCOP}_{\text{on}} + H_{TO} \cdot P_{TO} + H_{SB} \cdot P_{SB} + H_{CK} \cdot P_{CK} + H_{OFF} \cdot P_{OFF} \quad [\text{kWh}]$$

$$Q_{HE} = 21470 / 4.03 + 178 \cdot 0.0128 + 0 \cdot 0.0127 + 178 \cdot 0 + 0 \cdot 0.0095 = 5323 \quad [\text{kWh}]$$

7.2 General formula for calculation of reference SCOP

$$\text{SCOP} = Q_H / Q_{HE} \quad [-]$$

$$\text{SCOP} = 21470 / 5323 = 4.03 \quad [-]$$

7.1 Calculation of the seasonal space heating efficiency η_s

$$\Sigma F(i) = F(1) + F(2) \quad [-]$$

$$\Sigma F = 0.03 + 0 = 0.03 \quad [-]$$

$$\eta_s = 1 / \text{CC} \cdot \text{SCOP} - \Sigma F(i) \quad [-]$$

$$\eta_s (A) = (1 / 2.5) \cdot 4.03 - 0.03 = \underline{\underline{1.583}} \quad [-]$$

Temperature level		Low (reference water temperature 35 °C)		
Reference heating season		„A“ = average ($T_{designh} = -10\text{ °C}$)		
Assessment condition		A, T _{biv} (F)	B	C
Specification of the assessment condition*		A-7/W34	A2/W32.23	A7/W30.65
Date of testing		2024-03-04	2024-03-06	2024-03-07
Transient test procedure	YES / NO	NO	YES	NO
Average defrost time of 1 cycle	[min]	–	4.5	–
Average time of 1 cycle	[min]	–	104.9	–
Calculation time	[min]	70.0	104.9	70.0
Output heating water – temperature calculation	[°C]	33.98	31.82	30.62
Input heating water – temperature calculation	[°C]	28.99	27.33	25.64
Output heating water temperature	[°C]	33.98	32.31	30.62
Input heating water temperature	[°C]	28.99	27.32	25.64
Air temperature – dry bulb temperature	[°C]	-7.00	1.85	7.00
Air temperature – wet bulb temperature	[°C]	-8.02	0.92	6.02
Relative humidity	[%]	74.69	84.82	87.08
Barometric pressure	[kPa]	97.634	98.809	98.925
Ambient temperature	[°C]	-6.72	2.38	7.56
Secondary circuit pressure difference	[kPa]	-48.973	-38.807	-13.971
Efficiency of the secondary liquid pump	[-]	0.307	0.302	0.221
Volume flow rate of heating water	[m ³ ·h ⁻¹]	1.5877	1.9008	2.3182
Density of heating water	[kg·m ⁻³]	994.3	994.9	995.3
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.175	4.176	4.177
Voltage	[V]	403.30	401.85	401.75
Total current	[A]	19.63	19.22	19.22
Overall power input	[kW]	2.729	2.615	2.617
Capacity correction of sec. liquid pump	[W]	-44.836	-47.363	-31.794
Power input correction of sec. liquid pump	[W]	-66.41	-67.88	-40.79
Heating capacity – heating water	[kW]	9.148	10.030	13.333
Corrected heating capacity – heating water	[kW]	9.193	10.077	13.365
Uncertainty of corrected heating capacity	[kW]	± 0.160	± 0.191	± 0.234
Effective electric power input	[kW]	2.795	2.683	2.658
COP	[-]	3.289	3.756	5.029
Uncertainty of COP	[-]	± 0.058	± 0.072	± 0.089
Control settings	[-]	–	–	–
Circulation pump settings – heating water	[-]	–	–	–

Temperature level		Low (reference water temperature 35 °C)	
Reference heating season		„A“ = average ($T_{\text{designh}} = -10\text{ °C}$)	
Assessment condition		D	TOL (E)
Specification of the assessment condition*		A12/W28.48	A-10/W35
Date of testing		2024-03-08	2024-03-05
Transient test procedure	YES / NO	NO	NO
Average defrost time of 1 cycle	[min]	–	–
Average time of 1 cycle	[min]	–	–
Calculation time	[min]	70.0	70.0
Output heating water – temperature calculation	[°C]	28.47	35.00
Input heating water – temperature calculation	[°C]	23.47	30.00
Output heating water temperature	[°C]	28.47	35.00
Input heating water temperature	[°C]	23.47	30.00
Air temperature – dry bulb temperature	[°C]	11.99	-10.01
Air temperature – wet bulb temperature	[°C]	11.00	-10.90
Relative humidity	[%]	89.02	72.83
Barometric pressure	[kPa]	98.892	98.397
Ambient temperature	[°C]	12.58	-9.71
Secondary circuit pressure difference	[kPa]	-18.396	-10.337
Efficiency of the secondary liquid pump	[-]	0.260	0.166
Volume flow rate of heating water	[m ³ ·h ⁻¹]	2.6539	1.4608
Density of heating water	[kg·m ⁻³]	995.9	994.0
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.178	4.175
Voltage	[V]	400.75	402.52
Total current	[A]	19.25	19.47
Overall power input	[kW]	2.634	2.671
Capacity correction of sec. liquid pump	[W]	-38.510	-21.079
Power input correction of sec. liquid pump	[W]	-52.07	-25.27
Heating capacity – heating water	[kW]	15.333	8.416
Corrected heating capacity – heating water	[kW]	15.372	8.437
Uncertainty of corrected heating capacity	[kW]	± 0.268	± 0.147
Effective electric power input	[kW]	2.686	2.696
COP	[-]	5.722	3.129
Uncertainty of COP	[-]	± 0.102	± 0.055
Control settings	[-]	–	–
Circulation pump settings – heating water	[-]	–	–

Data for SCOP calculation

- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A“ – average

	Outdoor heat exchanger	Indoor heat exchanger	Part load ratio	Part load	DC Declared capacity	COPd at declared capacity	Cdh degradation coefficient	CR	COPbin (Tj)	Eff. power input of compressor off state
	Outdoor air inlet	Outlet water temperature								
	[°C]	[°C]								
A	-7	34.00	88.46	9.19	9.193	3.289	0.900	1.00	3.289	–
B	2	32.22	53.85	5.60	10.077	3.756	0.995	0.56	3.742	0.0128
C	7	30.65	34.62	3.60	13.365	5.029	0.995	0.27	4.964	0.0128
D	12	28.48	15.38	1.60	15.372	5.722	0.995	0.10	5.496	0.0128
TOL (E)	-10	35.00	100.00	10.39	8.437	3.129	0.900	1.23	3.129	–
Tbiv (F)	-7	34.00	88.46	9.19	9.193	3.289	0.900	1.00	3.289	–

Adaption of water temperature – according to ČSN EN 14825:2023, Annex F

- Low temperature application (reference water temperature 35 °C)
- Reference season „A“ – average
- Condition D
- Variable water flow rate – secondary circuit

General formulas and derivation:

$$\begin{aligned}
 t_{\text{outlet, average}} &= t_{\text{inlet, capacity test}} + (t_{\text{outlet, capacity test}} - t_{\text{inlet, capacity test}}) \cdot \text{CR} & [\text{°C}] \\
 t_{\text{outlet, average}} &= t_{\text{inlet, capacity test}} + (\Delta t) \cdot \text{CR} & [\text{°C}] \\
 t_{\text{outlet, average}} &= t_{\text{outlet, capacity test}} - \Delta t + \Delta t \cdot \text{CR} & [\text{°C}] \\
 t_{\text{outlet, capacity test}} &= t_{\text{outlet, average}} + \Delta t - \Delta t \cdot \text{CR} & [\text{°C}]
 \end{aligned}$$

For variable flow:

$$\Delta t = 5$$

$$\text{CR} \cdot \Delta t = \text{Part load} / \text{Declared capacity} \cdot 5$$

$$t_{\text{outlet, capacity test, variable flow}} = t_{\text{outlet, average}} + 5 - \text{Part load} / \text{Declared capacity} \cdot 5$$

Measured data:

$t_{\text{outlet, average}}$	24.00	[°C]
Declared capacity	15.372	[kW]
Declared capacity standard rating condition A7/W35	-	[kW]
Part load	1.60	[kW]

Calculation of water temperature

$$t_{\text{outlet, capacity test, variable flow}} = 24 + 5 - 1.6 / 15.372 \cdot 5 = \underline{\underline{28.48}} \quad [\text{°C}]$$

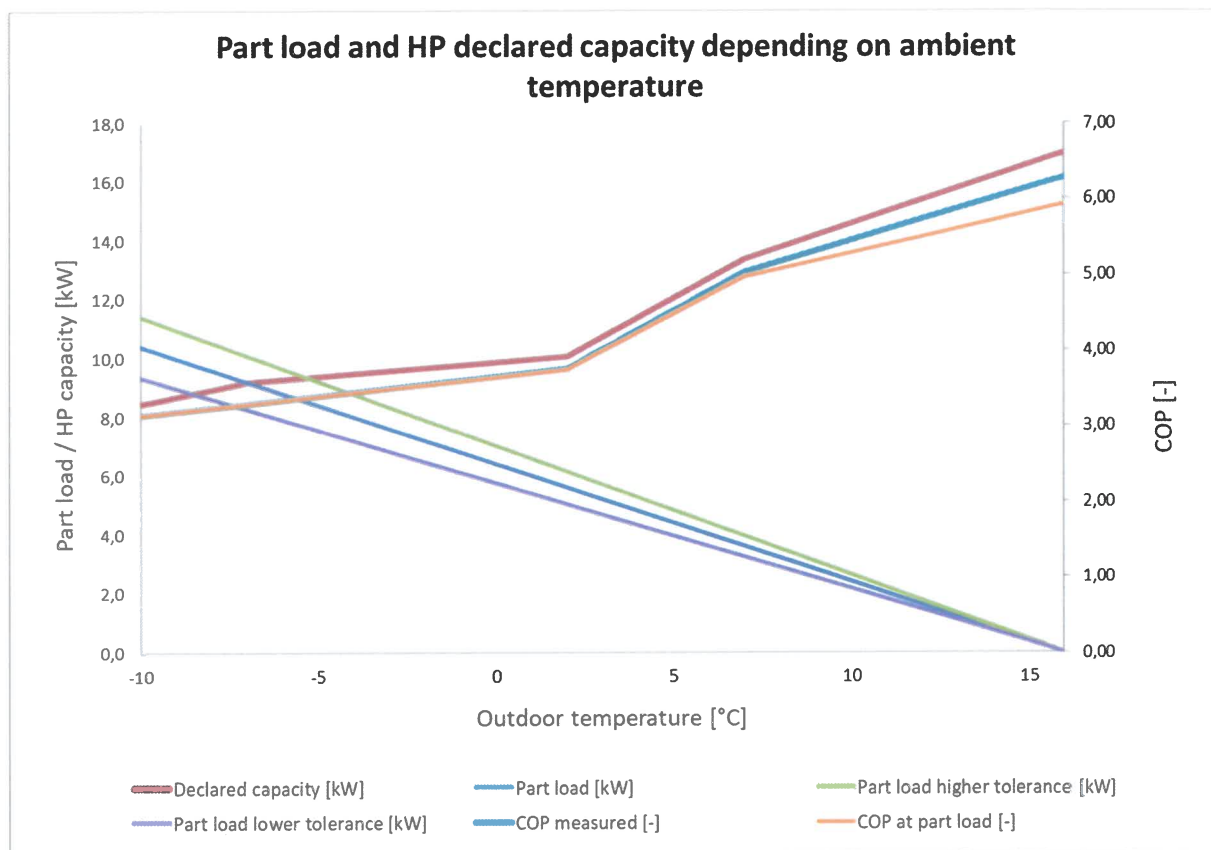
Calculation SCOP, SCOP_{on}, SCOP_{net}

- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A“ – average

	Bin	Outdoor temp. (dry bulb)	Hours	Part load ratio	Heat load	Capacity of HP	Heat load covered by heat pump	Resistive heat elbu (Tj)	Annual resistive heat	COPbin (Tj)	Annual heating demand	Annual power input including electric back up heating	Net annual heating capacity	Net annual power input without electric back up heating
	j	Tj	hj		Ph(Tj)			elbu(Tj)	hj x elbu(Tj)	COPb in (Tj)	hj x Ph(Tj)		hj x (Ph(Tj) - elbu(Tj))	
	[-]	[°C]	[h]	[%]	[kW]	[kW]	[kW]	[kW]	[kWh]	[-]	[kWh]	[kWh]	[kWh]	[kWh]
TOL(E)	21	-10	1	100.00	10.39	8.44	8.44	1.96	1.96	3.13	10	5	8	3
	22	-9	25	96.15	9.99	8.69	8.69	1.30	32.58	3.18	250	101	217	68
	23	-8	23	92.31	9.59	8.94	8.94	0.65	14.99	3.24	221	79	206	64
A, Tbiv(F)	24	-7	24	88.46	9.19	9.19	9.19	0.00	0.00	3.29	221	67	221	67
	25	-6	27	84.62	8.79	9.29	8.79	0.00	0.00	3.34	237	71	237	71
	26	-5	68	80.77	8.39	9.39	8.39	0.00	0.00	3.39	571	168	571	168
	27	-4	91	76.92	7.99	9.49	7.99	0.00	0.00	3.44	727	211	727	211
	28	-3	89	73.08	7.59	9.59	7.59	0.00	0.00	3.49	676	194	676	194
	29	-2	165	69.23	7.19	9.68	7.19	0.00	0.00	3.54	1187	335	1187	335
	30	-1	173	65.38	6.79	9.78	6.79	0.00	0.00	3.59	1176	327	1176	327
	31	0	240	61.54	6.40	9.88	6.40	0.00	0.00	3.64	1535	422	1535	422
	32	1	280	57.69	6.00	9.98	6.00	0.00	0.00	3.69	1679	455	1679	455
B	33	2	320	53.85	5.60	10.08	5.60	0.00	0.00	3.74	1791	479	1791	479
	34	3	357	50.00	5.20	10.73	5.20	0.00	0.00	3.99	1855	465	1855	465
	35	4	356	46.15	4.80	11.39	4.80	0.00	0.00	4.23	1707	404	1707	404
	36	5	303	42.31	4.40	12.05	4.40	0.00	0.00	4.48	1332	298	1332	298
	37	6	330	38.46	4.00	12.71	4.00	0.00	0.00	4.72	1319	279	1319	279
C	38	7	326	34.62	3.60	13.37	3.60	0.00	0.00	4.96	1173	236	1173	236
	39	8	348	30.77	3.20	13.77	3.20	0.00	0.00	5.07	1113	219	1113	219
	40	9	335	26.92	2.80	14.17	2.80	0.00	0.00	5.18	937	181	937	181
	41	10	315	23.08	2.40	14.57	2.40	0.00	0.00	5.28	755	143	755	143
	42	11	215	19.23	2.00	14.97	2.00	0.00	0.00	5.39	430	80	430	80
D	43	12	169	15.38	1.60	15.37	1.60	0.00	0.00	5.50	270	49	270	49
	44	13	151	11.54	1.20	15.77	1.20	0.00	0.00	5.60	181	32	181	32
	45	14	105	7.69	0.80	16.17	0.80	0.00	0.00	5.71	84	15	84	15
	46	15	74	3.85	0.40	16.58	0.40	0.00	0.00	5.82	30	5	30	5
		Σ	4910							Σ	21466	5320	21417	5271
											SCOPon	4.03	SCOPnet	4.06
													SCOP	4.03

Part load performance diagram

- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A“ – average



Test objective:	Seasonal performance tests and SCOP calculation – Medium temperature application
Exact name of the test procedure:	1.37* - Tests of leakage, pressure resistance, thermal and technical parameters, combustion efficiency, safety functions
Test method:	ČSN EN 14511-3:2023, ČSN EN 14825:2023
Sample tested:	Heat pump HPR 500 DELUXE
Measuring equipment used:	see Chapter III

Design			Air / water – monobloc				
Conditions specification according to ČSN 14825:2020	to EN	Temperature application			Medium (reference water temperature 55 °C)		
		Reference heating season			Average		
		Outlet water temperature - indoor heat exchanger			Variable		
		Compressor speed control			Fixed		
		Water flow rate – primary circuit			–		
		Water flow rate – secondary circuit			Variable		
Seasonal space heating efficiency	Heating	Average	ηs		132.6	%	
		Warmer	ηs		–	%	
		Colder	ηs		–	%	
Seasonal efficiency according to ČSN 14825:2020	Heating	Average	SCOP		3.39	–	
		Warmer	SCOP		–	–	
		Colder	SCOP		–	–	
Function	Cooling				Yes		
	Heating	Yes	Reference heating season	Average	Yes		
				Warmer	Yes		
				Colder	Yes		
Full heating load	Cooling		Pdesignc		–	kW	
	Heating	Average	Pdesignh		9.99	kW	
		Warmer	Pdesignh		–	kW	
		Colder	Pdesignh		–	kW	
Bivalent temperatures	Heating	Average	Tbivalent		-7	°C	
		Warmer	Tbivalent		–	°C	
		Colder	Tbivalent		–	°C	
Operation limit temperatures	Heating	Average	TOL		-10	°C	
		Warmer	TOL		–	°C	
		Colder	TOL		–	°C	
Seasonal power consumption according to ČSN EN 14825:2020	Cooling		QCE		–	kWh	
	Heating	Average	QHE		6089	kWh	
		Warmer	QHE		–	kWh	
		Colder	QHE		–	kWh	
Modes other than „active mode“		Off mode			POFF	9.5	W
		Thermostat off mode			PTO	12.8	W
		Standby mode			PSB	12.7	W
		Crankcase heater mode			PCK	0.0	W

Calculation of SCOP according to ČSN EN 14825:2023:

Number of hours used for calculation of reference SCOP (Annex B – Table B. 2, B. 3)

- For reversible heat pumps and reference heating season „A“ = average

H _{HE}	2066	[h]
H _{TO}	178	[h]
H _{SB}	0	[h]
H _{CK}	178	[h]
H _{OFF}	0	[h]

Measured data:

P _{TO}	0.0128	[kW]
P _{SB}	0.0127	[kW]
P _{CK}	0.0000	[kW]
P _{OFF}	0.0095	[kW]
P _{designh}	9.99	[kW]
SCOP _{ON}	3.39	[–]

Coefficient and correction:

F(1)	3	[%]
F(2)	0	[%]
CC	2.5	[–]

Calculation of SCOP:

7.3 Calculation of the reference annual heating demand (Q_H)

$$Q_H = P_{\text{designh}} \cdot H_{HE} \quad [\text{kWh}]$$

$$Q_H = 9.99 \cdot 2066 = 20643 \quad [\text{kWh}]$$

7.4 Calculation of the annual electricity consumption (Q_{HE})

$$Q_{HE} = Q_H / \text{SCOP}_{\text{on}} + H_{TO} \cdot P_{TO} + H_{SB} \cdot P_{SB} + H_{CK} \cdot P_{CK} + H_{OFF} \cdot P_{OFF} \quad [\text{kWh}]$$

$$Q_{HE} = 20643 / 3.39 + 178 \cdot 0.0128 + 0 \cdot 0.0127 + 178 \cdot 0 + 0 \cdot 0.0095 = 6089 \quad [\text{kWh}]$$

7.2 General formula for calculation of reference SCOP

$$\text{SCOP} = Q_H / Q_{HE} \quad [–]$$

$$\text{SCOP} = 20643 / 6108 = 3.39 \quad [–]$$

7.1 Calculation of the seasonal space heating efficiency η_s

$$\Sigma F(i) = F(1) + F(2) \quad [–]$$

$$\Sigma F = 0.03 + 0 = 0.03 \quad [–]$$

$$\eta_s = 1 / \text{CC} \cdot \text{SCOP} - \Sigma F(i) \quad [–]$$

$$\eta_s (A) = (1 / 2.5) \cdot 3.39 - 0.03 = \underline{\underline{1.326}} \quad [–]$$

Temperature level		Medium (reference water temperature 55 °C)		
Reference heating season		„A“ = average ($T_{designh} = -10\text{ °C}$)		
Assessment condition		A, T _{biv} (F)	B	C
Specification of the assessment condition*		A-7/W52	A2/W45.75	A7/W41.91
Date of testing		2024-03-05	2024-03-06	2024-03-07
Transient test procedure	YES / NO	NO	YES	NO
Average defrost time of 1 cycle	[min]	–	4.6	–
Average time of 1 cycle	[min]	–	132.0	–
Calculation time	[min]	70.0	132.0	70.0
Output heating water – temperature calculation	[°C]	52.00	45.23	41.87
Input heating water – temperature calculation	[°C]	44.00	37.85	33.87
Output heating water temperature	[°C]	52.00	45.81	41.87
Input heating water temperature	[°C]	44.00	37.83	33.87
Air temperature – dry bulb temperature	[°C]	-7.01	1.98	7.00
Air temperature – wet bulb temperature	[°C]	-8.01	1.00	6.01
Relative humidity	[%]	74.91	84.02	86.98
Barometric pressure	[kPa]	98.238	98.713	98.936
Ambient temperature	[°C]	-6.74	2.46	7.47
Secondary circuit pressure difference	[kPa]	-9.109	-12.304	-5.101
Efficiency of the secondary liquid pump	[-]	0.144	0.165	0.138
Volume flow rate of heating water	[m ³ ·h ⁻¹]	0.9627	1.1958	1.4351
Density of heating water	[kg·m ⁻³]	987.4	990.2	991.5
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.177	4.175	4.175
Voltage	[V]	401.76	402.01	400.67
Total current	[A]	21.51	20.90	20.63
Overall power input	[kW]	3.428	3.208	3.151
Capacity correction of sec. liquid pump	[W]	-14.528	-20.669	-12.659
Power input correction of sec. liquid pump	[W]	-16.96	-24.76	-14.69
Heating capacity – heating water	[kW]	8.825	10.109	13.198
Corrected heating capacity – heating water	[kW]	8.839	10.130	13.211
Uncertainty of corrected heating capacity	[kW]	± 0.100	± 0.124	± 0.150
Effective electric power input	[kW]	3.445	3.232	3.166
COP	[-]	2.566	3.134	4.173
Uncertainty of COP	[-]	± 0.029	± 0.039	± 0.048
Control settings	[-]	–	–	–
Circulation pump settings – heating water	[-]	–	–	–

Temperature level		Medium (reference water temperature 55 °C)	
Reference heating season		„A“ = average ($T_{\text{designh}} = -10\text{ °C}$)	
Assessment condition		D	TOL (E)
Specification of the assessment condition*		A12/W37.19	A-10/W55
Date of testing		2024-03-07	2024-03-05
Transient test procedure	YES / NO	NO	NO
Average defrost time of 1 cycle	[min]	–	–
Average time of 1 cycle	[min]	–	–
Calculation time	[min]	70.0	70.0
Output heating water – temperature calculation	[°C]	37.11	55.01
Input heating water – temperature calculation	[°C]	29.11	47.01
Output heating water temperature	[°C]	37.11	55.01
Input heating water temperature	[°C]	29.11	47.01
Air temperature – dry bulb temperature	[°C]	12.01	-10.01
Air temperature – wet bulb temperature	[°C]	11.01	-10.83
Relative humidity	[%]	88.99	75.11
Barometric pressure	[kPa]	98.989	98.261
Ambient temperature	[°C]	12.58	-9.88
Secondary circuit pressure difference	[kPa]	-6.728	-10.404
Efficiency of the secondary liquid pump	[-]	0.152	0.146
Volume flow rate of heating water	[m ³ ·h ⁻¹]	1.6387	0.8999
Density of heating water	[kg·m ⁻³]	993.2	986.0
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.175	4.178
Voltage	[V]	401.05	401.40
Total current	[A]	20.11	21.77
Overall power input	[kW]	2.970	3.514
Capacity correction of sec. liquid pump	[W]	-17.131	-15.247
Power input correction of sec. liquid pump	[W]	-20.19	-17.85
Heating capacity – heating water	[kW]	15.102	8.237
Corrected heating capacity – heating water	[kW]	15.119	8.252
Uncertainty of corrected heating capacity	[kW]	± 0.172	± 0.094
Effective electric power input	[kW]	2.990	3.532
COP	[-]	5.056	2.336
Uncertainty of COP	[-]	± 0.058	± 0.027
Control settings	[-]	–	–
Circulation pump settings – heating water	[-]	–	–

Data for SCOP calculation

- Medium temperature application (reference water temperature 55 °C)
- Reference heating season „A“ – average

	Outdoor heat exchanger	Indoor heat exchanger	Part load ratio	Part load	DC Declared capacity	COPd at declared capacity	Cdh degradation coefficient	CR	COPbin (Tj)	Eff. power input of compressor off state
	Outdoor air inlet	Outlet water temperature								
	[°C]	[°C]	[%]	[kW]	[kW]	[-]	[-]	[-]	[-]	[kW]
A	-7	52.00	88.46	8.84	8.839	2.566	0.900	1.00	2.566	–
B	2	45.75	53.85	5.38	10.130	3.232	0.996	0.53	3.220	0.0128
C	7	41.91	34.62	3.46	13.211	4.173	0.996	0.26	4.126	0.0128
D	12	37.19	15.38	1.54	15.119	5.056	0.996	0.10	4.872	0.0128
TOL (E)	-10	55.00	100.00	9.99	8.252	2.336	0.900	1.21	2.336	–
Tbiv (F)	-7	52.00	88.46	8.84	8.839	2.566	0.900	1.00	2.566	–

Adaption of water temperature – according to ČSN EN 14825:2023, Annex F

- Medium temperature application (reference water temperature 55 °C)
- Reference season „A“ – average
- Condition D
- Variable water flow rate – secondary circuit

General formulas and derivation:

$$\begin{aligned}
 t_{\text{outlet, average}} &= t_{\text{inlet, capacity test}} + (t_{\text{outlet, capacity test}} - t_{\text{inlet, capacity test}}) \cdot \text{CR} & [\text{°C}] \\
 t_{\text{outlet, average}} &= t_{\text{inlet, capacity test}} + (\Delta t) \cdot \text{CR} & [\text{°C}] \\
 t_{\text{outlet, average}} &= t_{\text{outlet, capacity test}} - \Delta t + \Delta t \cdot \text{CR} & [\text{°C}] \\
 t_{\text{outlet, capacity test}} &= t_{\text{outlet, average}} + \Delta t - \Delta t \cdot \text{CR} & [\text{°C}]
 \end{aligned}$$

For variable flow:

$$\Delta t = 8$$

$$\text{CR} \cdot \Delta t = \text{Part load} / \text{Declared capacity} \cdot 8$$

$$t_{\text{outlet, capacity test, variable flow}} = t_{\text{outlet, average}} + 8 - \text{Part load} / \text{Declared capacity} \cdot 8$$

Measured data:

$t_{\text{outlet, average}}$	30.00	[°C]
Declared capacity	15.119	[kW]
Declared capacity standard rating condition A7/W55	-	[kW]
Part load	1.54	[kW]

Calculation of water temperature

$$t_{\text{outlet, capacity test, variable flow}} = 30 + 8 - 1.54 / 15.119 \cdot 8 = \underline{\underline{37.19}} \quad [\text{°C}]$$

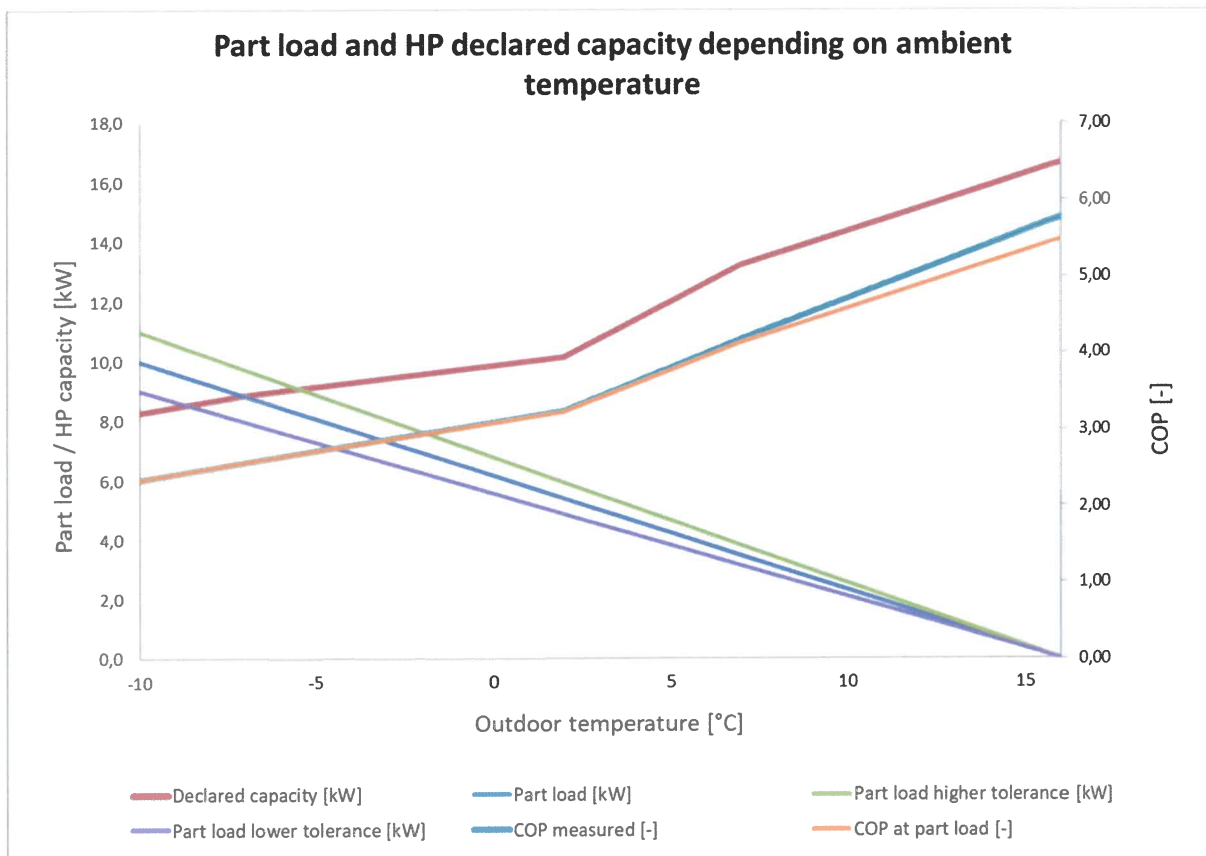
Calculation SCOP, SCOP_{on}, SCOP_{net}

- Medium temperature application (reference water temperature 55 °C)
- Reference heating season „A“ – average

	Bin	Outdoor temp. (dry bulb)	Hours	Part load ratio	Heat load	Capacity of HP	Heat load covered by heat pump	Resistive heat elbu (Tj)	Annual resistive heat	COPbin (Tj)	Annual heating demand	Annual power input including electric back up heating	Net annual heating capacity	Net annual power input without electric back up heating
	j	Tj	hj		Ph(Tj)			elbu(Tj)	hj x elbu(Tj)	COPb in (Tj)	hj x Ph(Tj)		hj x (Ph(Tj) - elbu(Tj))	
	[-]	[°C]	[h]	[%]	[kW]	[kW]	[kW]	[kW]	[kWh]	[-]	[kWh]	[kWh]	[kWh]	[kWh]
TOL(E)	21	-10	1	100.00	9.99	8.25	8.25	1.74	1.74	2.34	10	5	8	4
	22	-9	25	96.15	9.61	8.45	8.45	1.16	29.00	2.41	240	117	211	88
	23	-8	23	92.31	9.22	8.64	8.64	0.58	13.34	2.49	212	93	199	80
A, T _{biv} (F)	24	-7	24	88.46	8.84	8.84	8.84	0.00	0.00	2.57	212	83	212	83
	25	-6	27	84.62	8.45	8.98	8.45	0.00	0.00	2.64	228	87	228	87
	26	-5	68	80.77	8.07	9.13	8.07	0.00	0.00	2.71	549	202	549	202
	27	-4	91	76.92	7.69	9.27	7.69	0.00	0.00	2.78	699	251	699	251
	28	-3	89	73.08	7.30	9.41	7.30	0.00	0.00	2.86	650	227	650	227
	29	-2	165	69.23	6.92	9.56	6.92	0.00	0.00	2.93	1141	390	1141	390
	30	-1	173	65.38	6.53	9.70	6.53	0.00	0.00	3.00	1130	376	1130	376
	31	0	240	61.54	6.15	9.84	6.15	0.00	0.00	3.07	1476	480	1476	480
	32	1	280	57.69	5.76	9.99	5.76	0.00	0.00	3.15	1614	513	1614	513
B	33	2	320	53.85	5.38	10.13	5.38	0.00	0.00	3.22	1722	535	1722	535
	34	3	357	50.00	5.00	10.75	5.00	0.00	0.00	3.40	1784	524	1784	524
	35	4	356	46.15	4.61	11.36	4.61	0.00	0.00	3.58	1642	458	1642	458
	36	5	303	42.31	4.23	11.98	4.23	0.00	0.00	3.76	1281	340	1281	340
	37	6	330	38.46	3.84	12.59	3.84	0.00	0.00	3.94	1268	321	1268	321
C	38	7	326	34.62	3.46	13.21	3.46	0.00	0.00	4.13	1128	273	1128	273
	39	8	348	30.77	3.07	13.59	3.07	0.00	0.00	4.28	1070	250	1070	250
	40	9	335	26.92	2.69	13.97	2.69	0.00	0.00	4.42	901	204	901	204
	41	10	315	23.08	2.31	14.36	2.31	0.00	0.00	4.57	726	159	726	159
	42	11	215	19.23	1.92	14.74	1.92	0.00	0.00	4.72	413	87	413	87
D	43	12	169	15.38	1.54	15.12	1.54	0.00	0.00	4.87	260	53	260	53
	44	13	151	11.54	1.15	15.50	1.15	0.00	0.00	5.02	174	35	174	35
	45	14	105	7.69	0.77	15.88	0.77	0.00	0.00	5.17	81	16	81	16
	46	15	74	3.85	0.38	16.26	0.38	0.00	0.00	5.32	28	5	28	5
		Σ	4910							Σ	20639	6086	20595	6041
											SCOP _{on}	3.39	SCOP _{net}	3.41
											SCOP		3.39	

Part load performance diagram

- Medium temperature application (reference water temperature 55 °C)
- Reference heating season „A“ – average



Tested by: Ing. Jakub Čederle

Date: 2024-06-10

Signed:

Reviewed and approved by: Ing. Michal Faltýnek

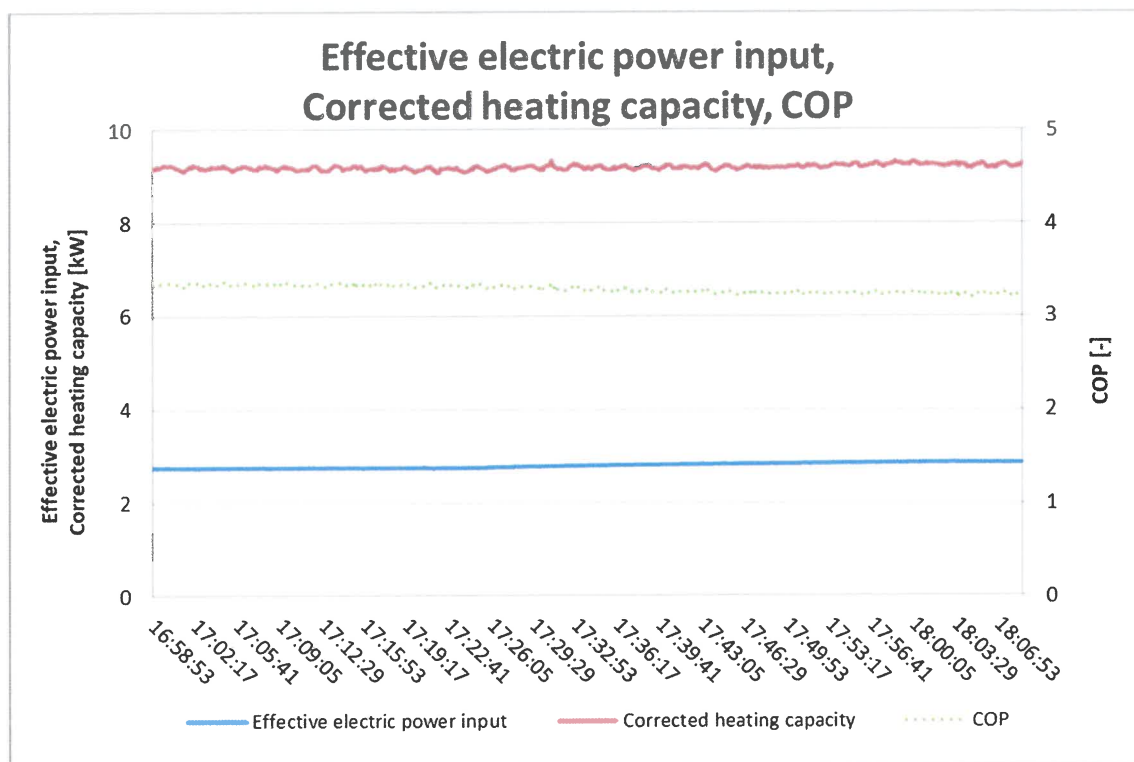
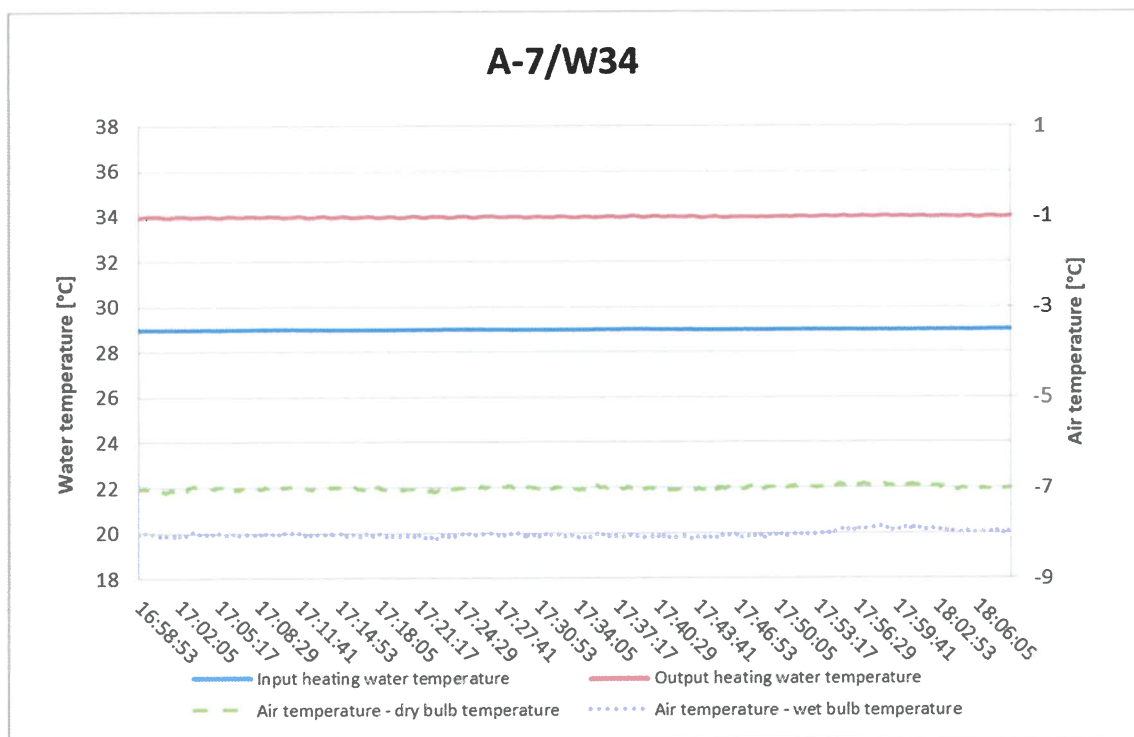
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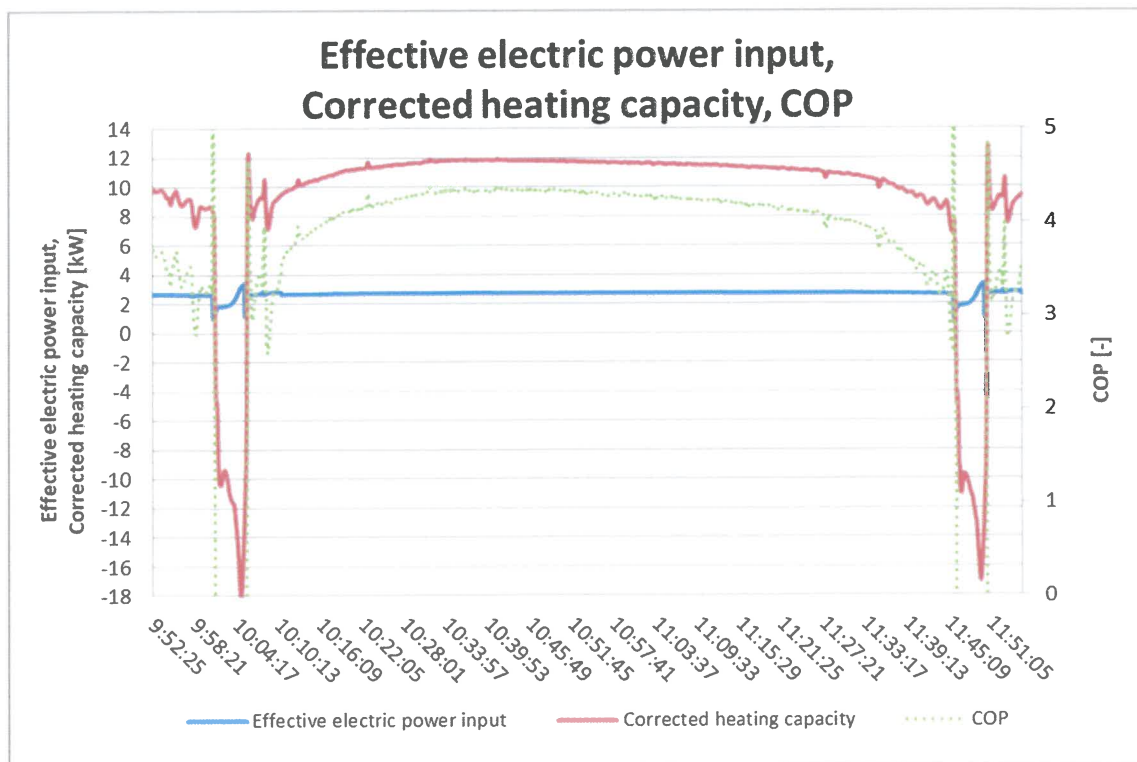
V. Graphs

1. Seasonal performance tests and SCOP calculation – Low temperature application

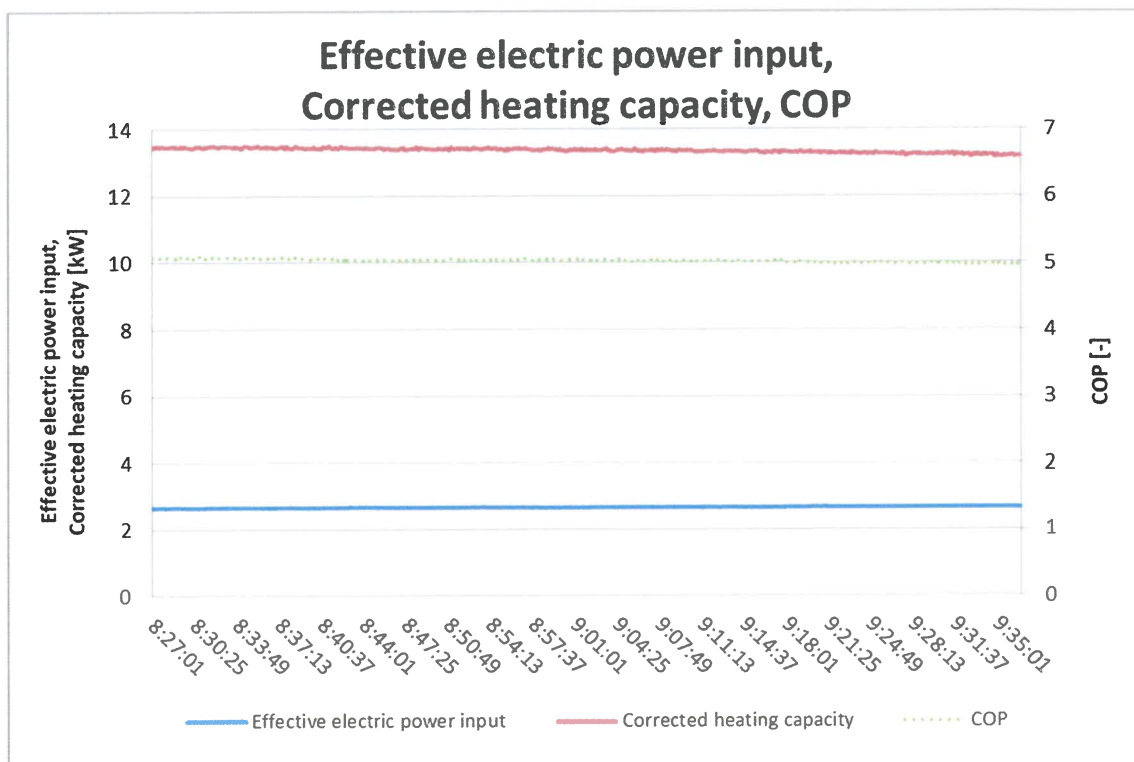
A-7/W34



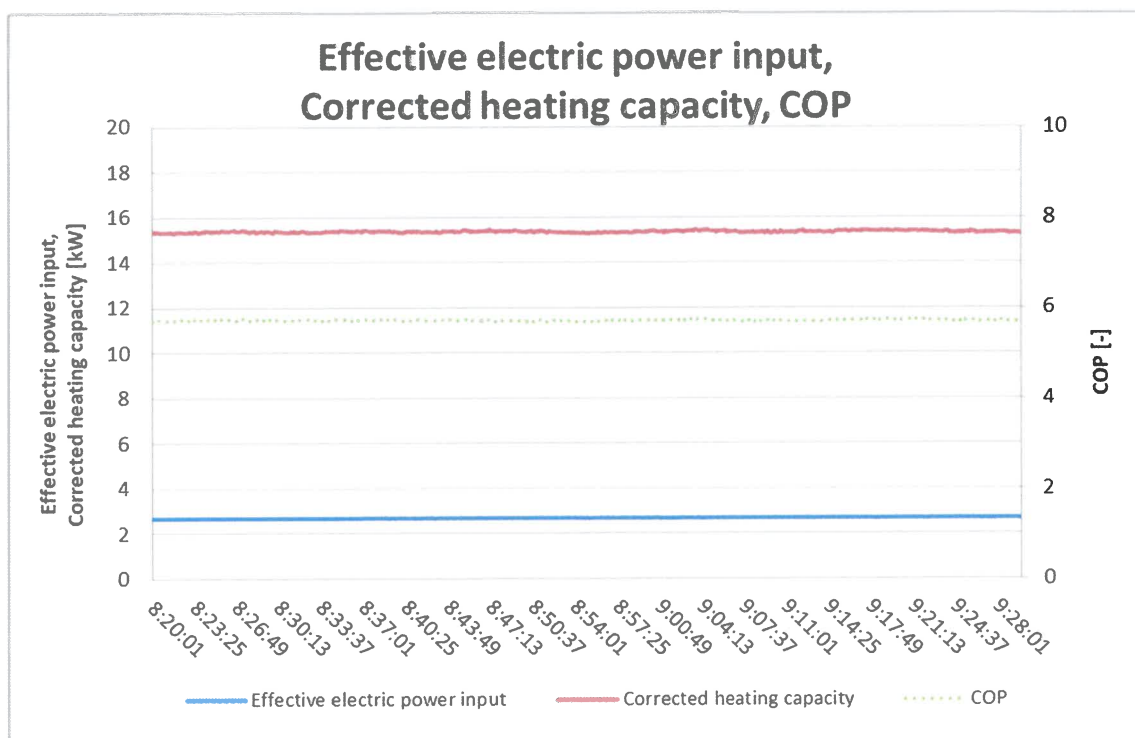
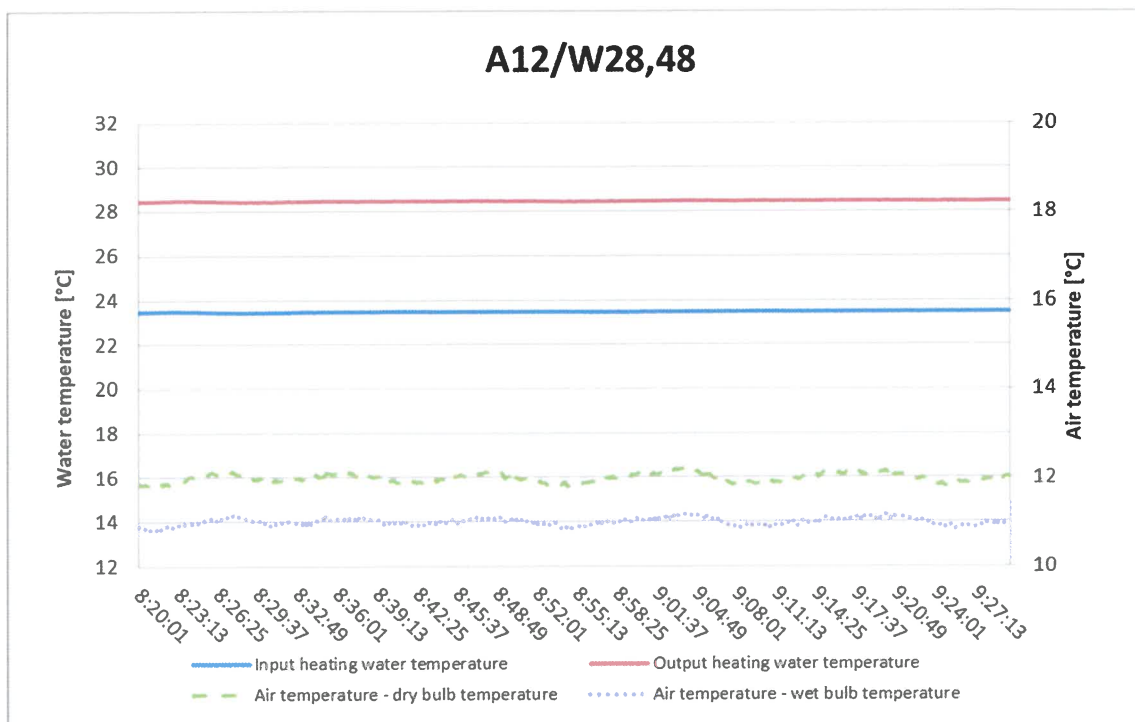
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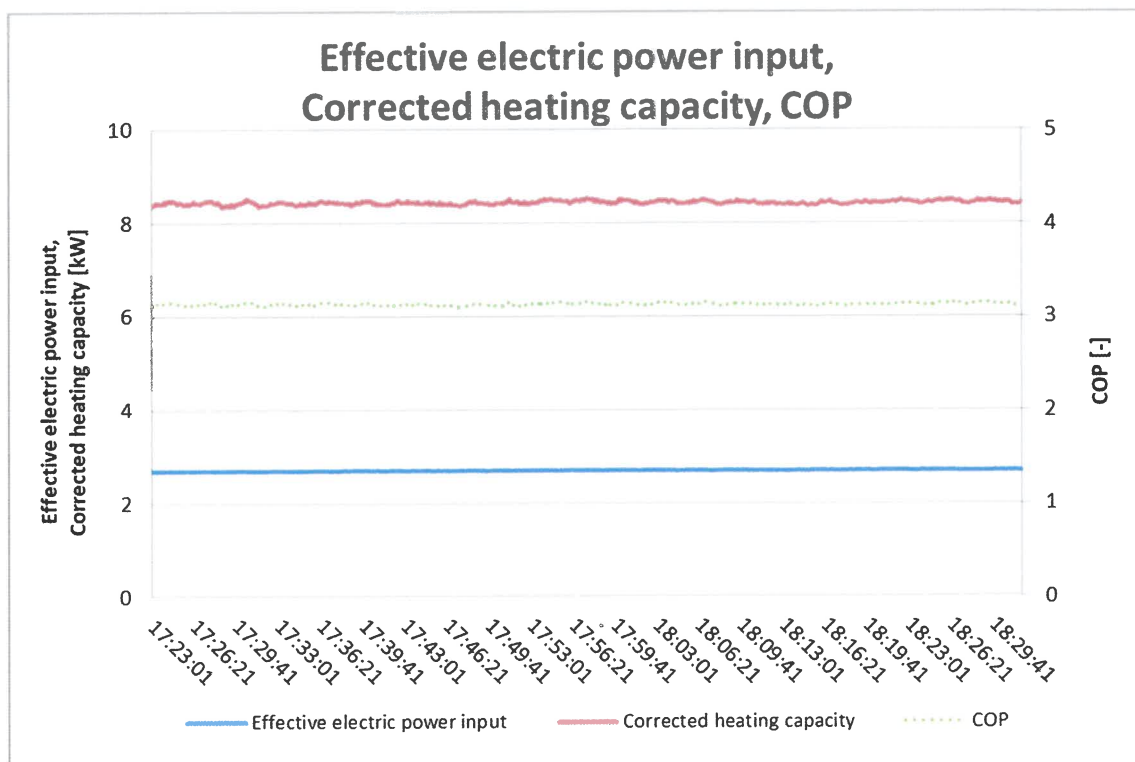
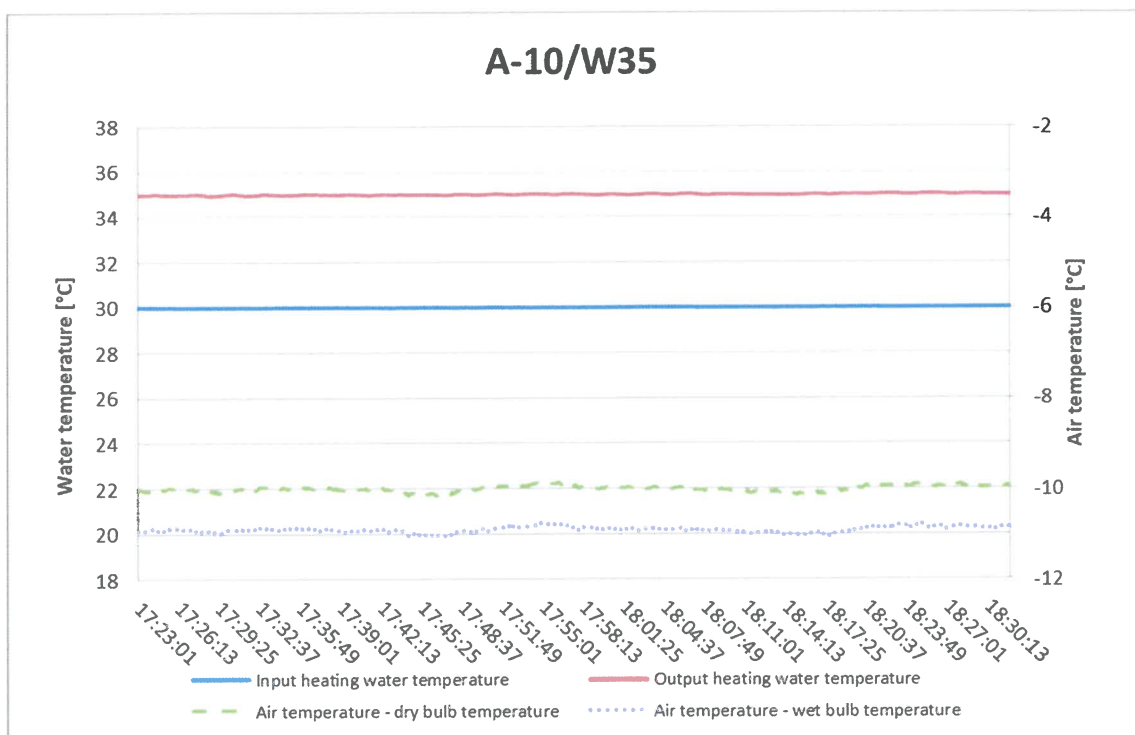
A7/W30.65



A12/W28.48

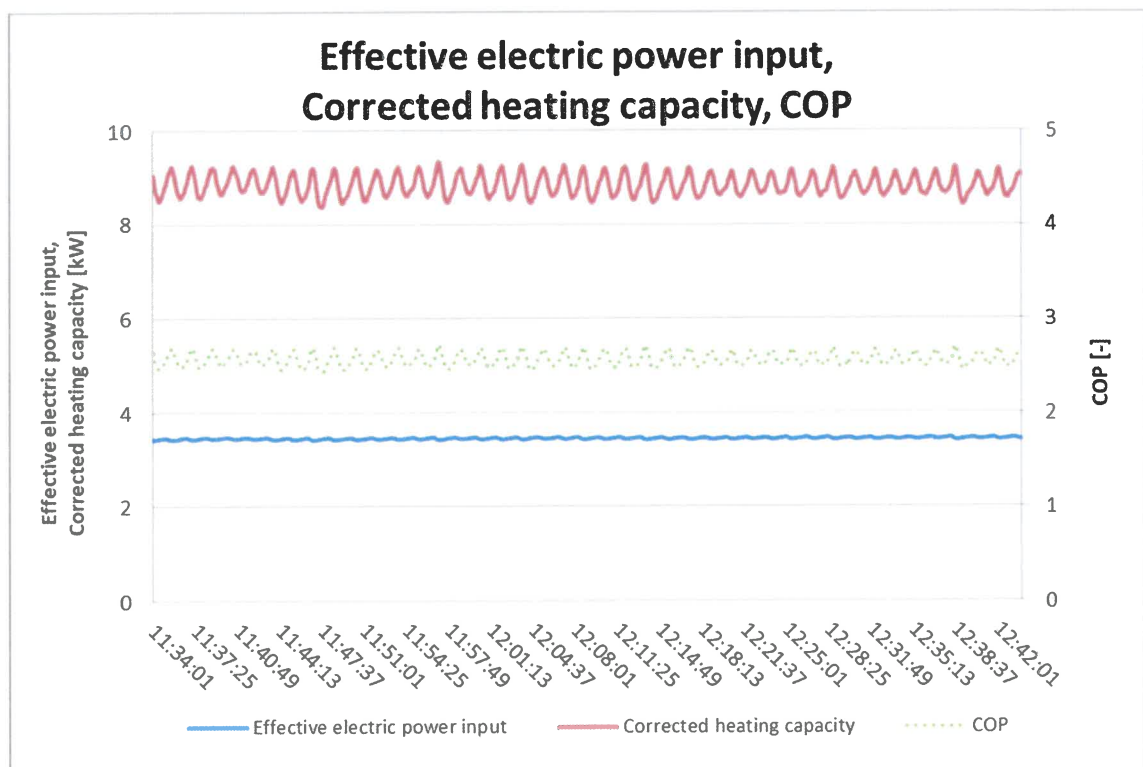
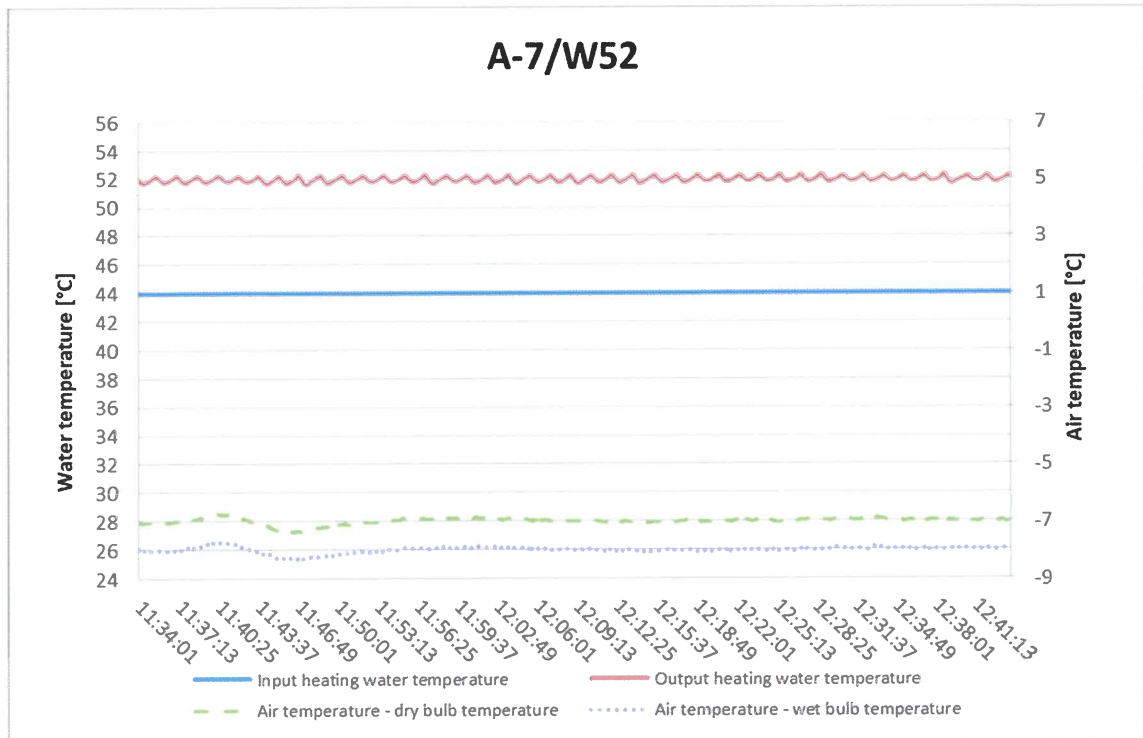


A-10/W35

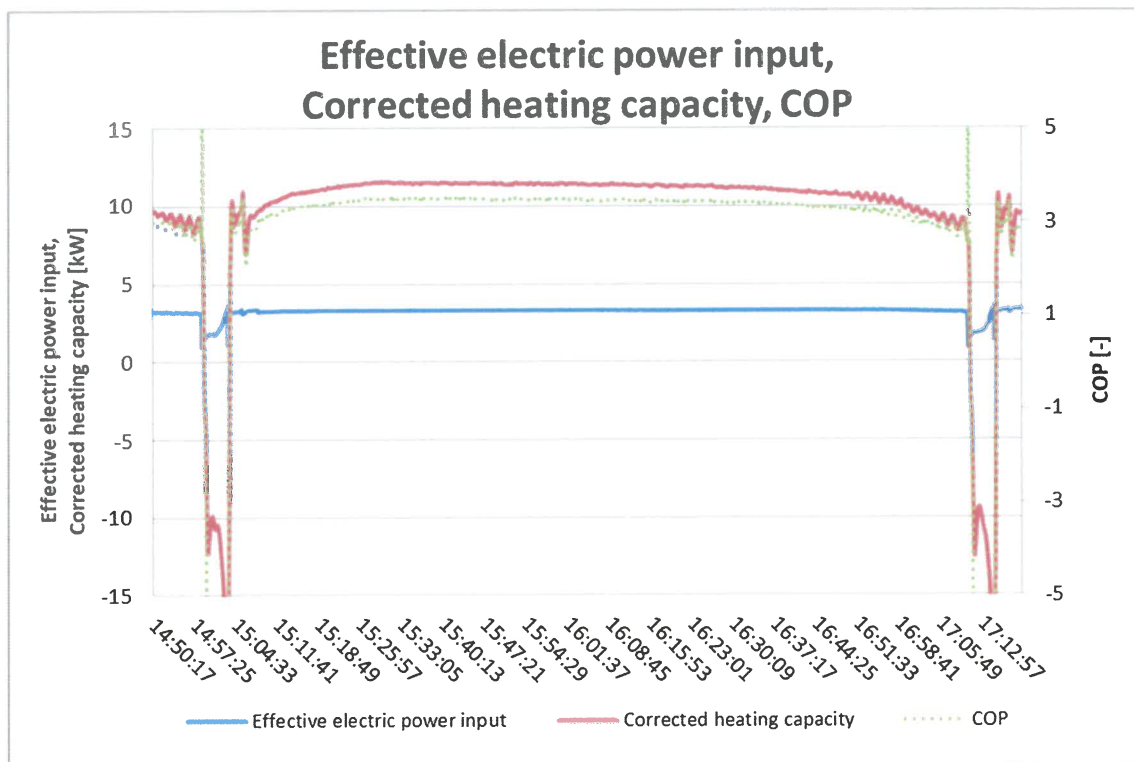
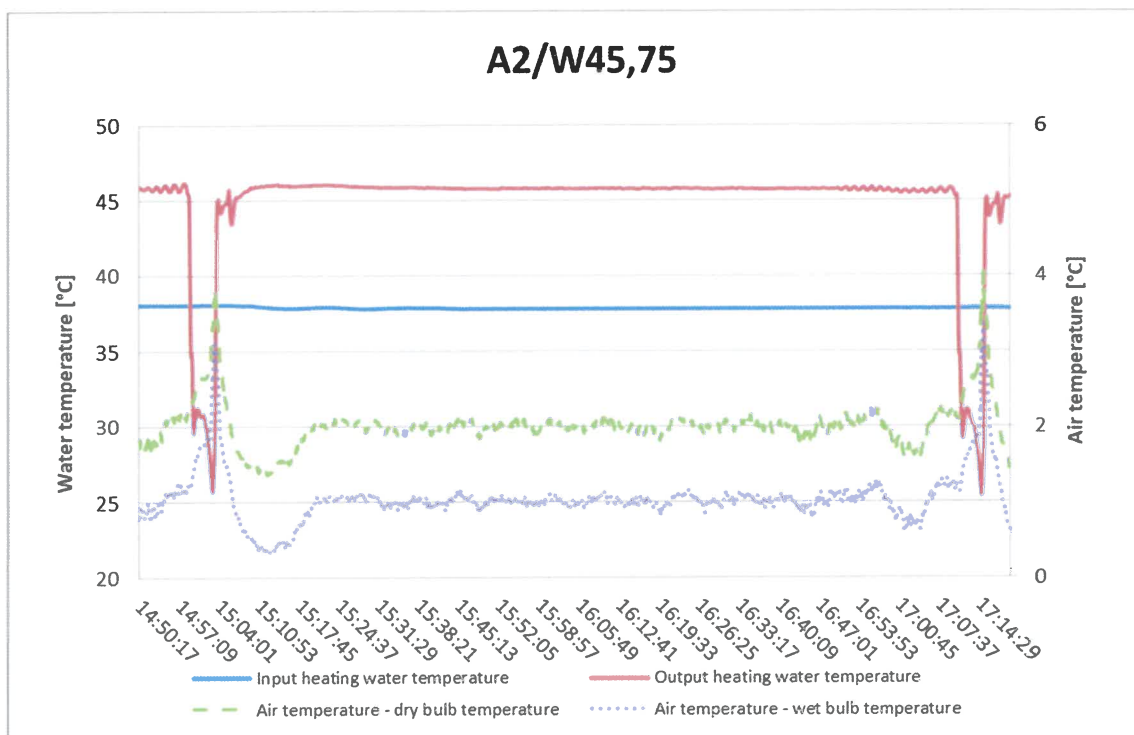


2. Seasonal performance tests and SCOP calculation – Medium temperature application

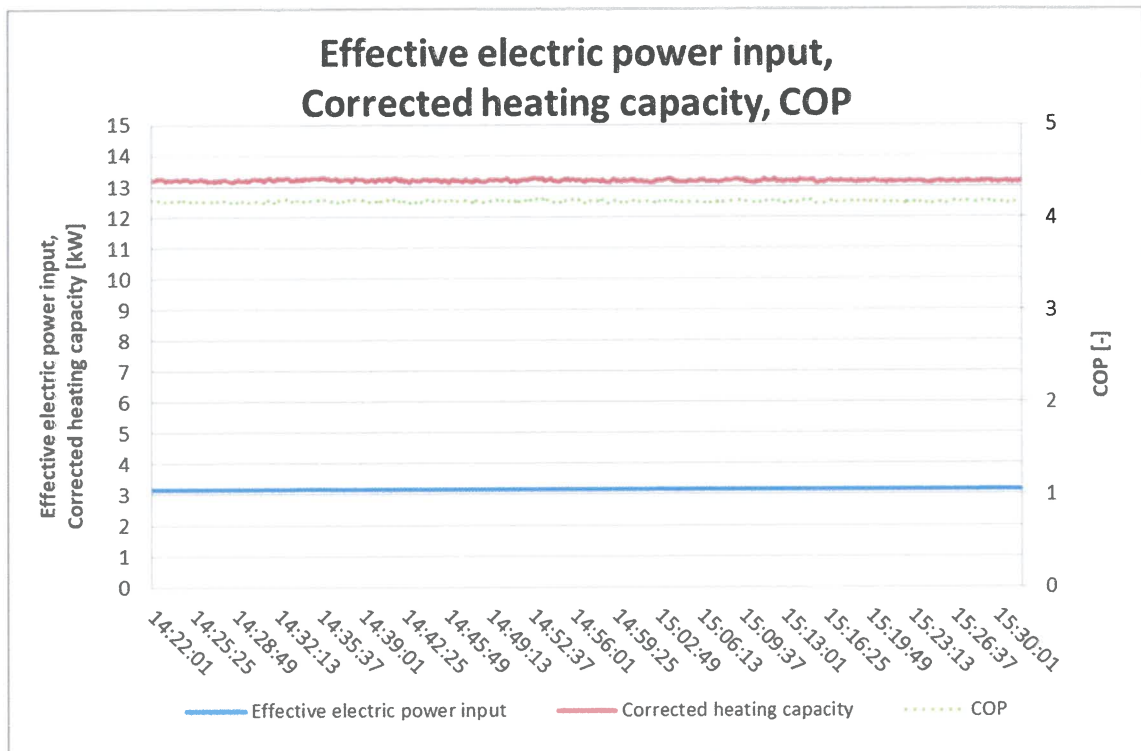
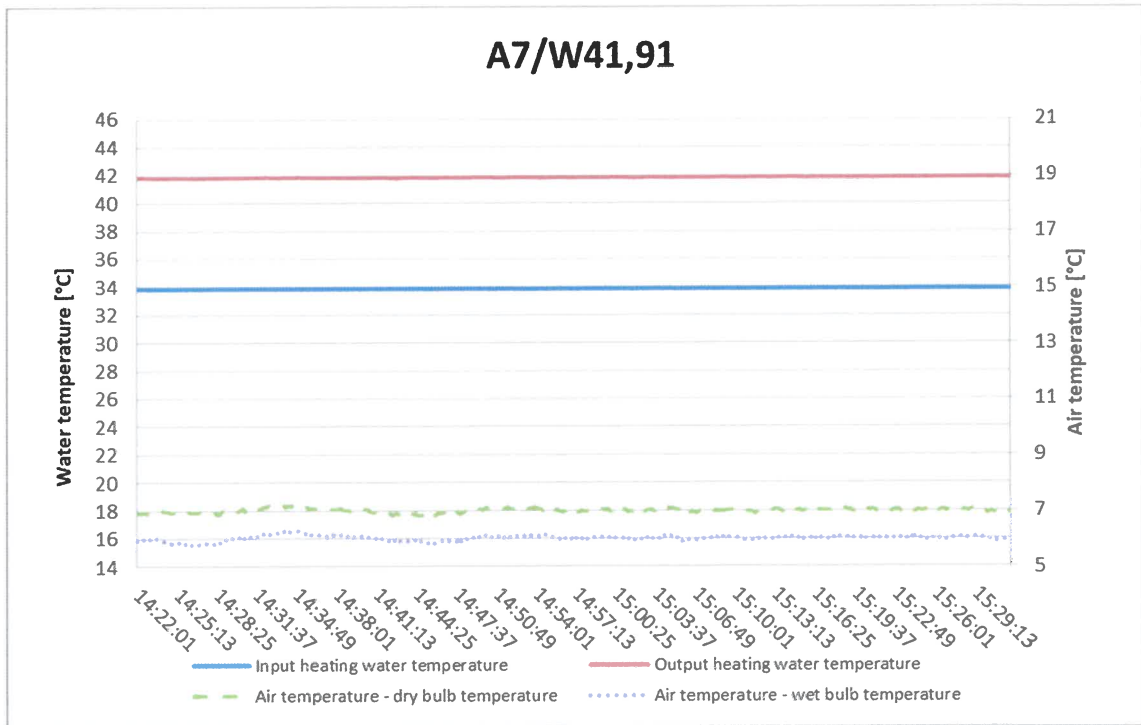
A-7/W52



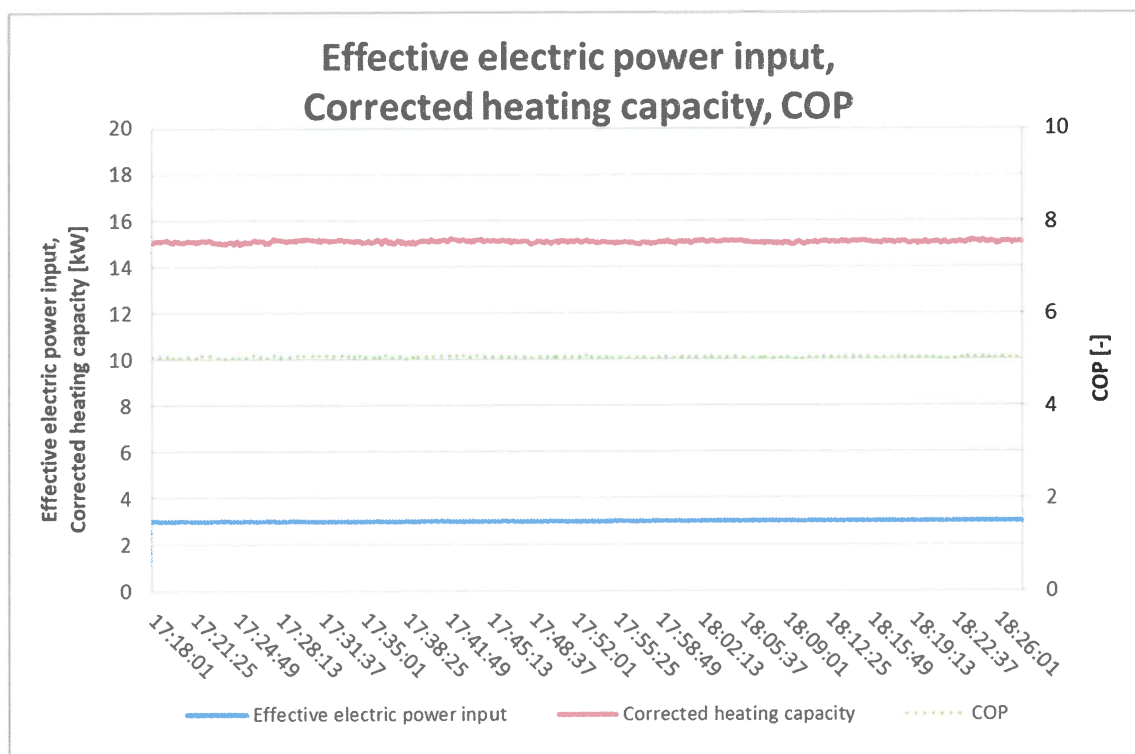
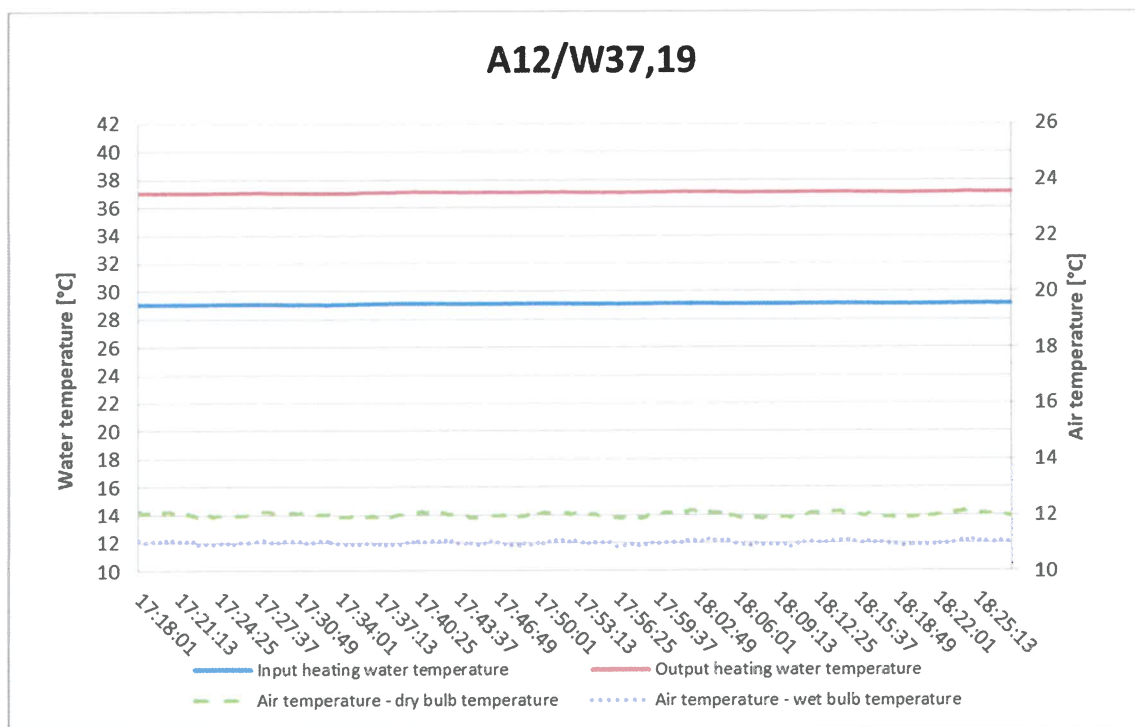
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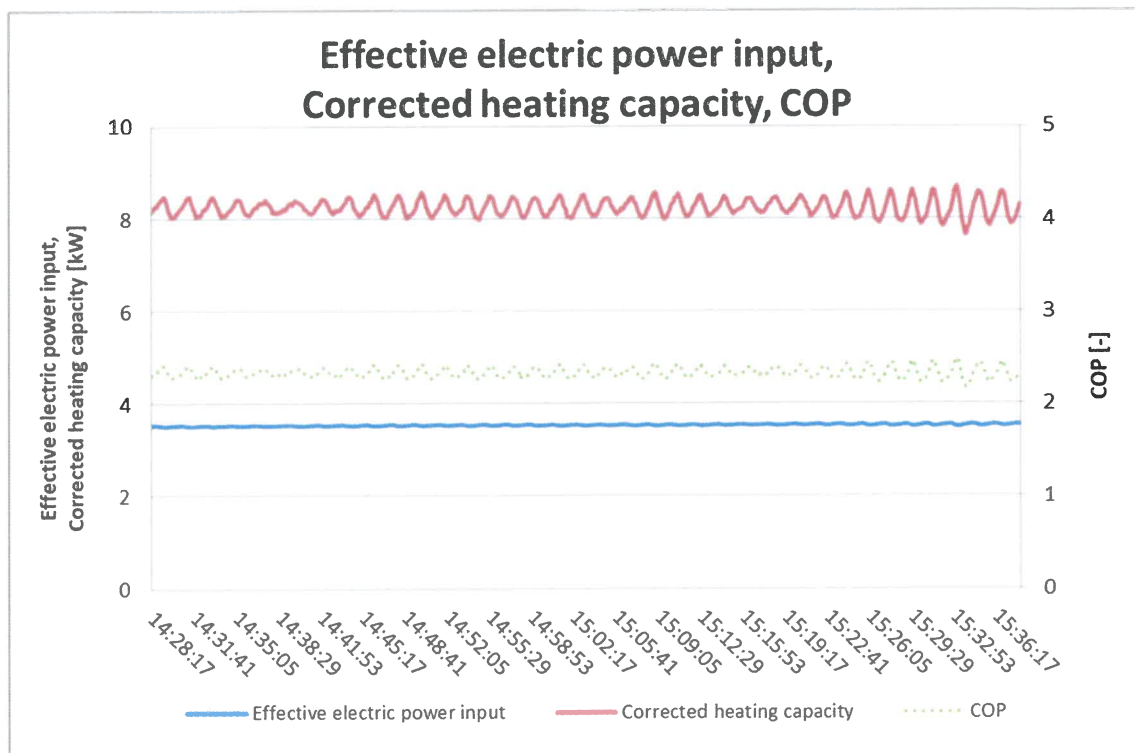
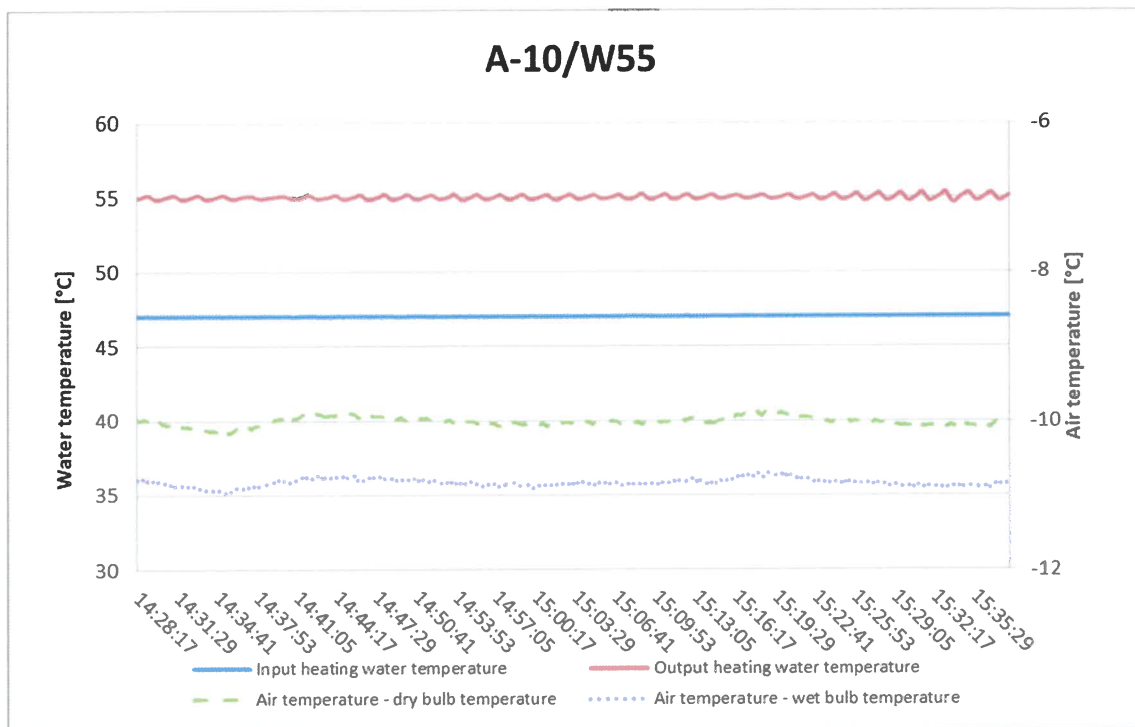
A7/W41.91



A12/W37.19



A-10/W55



VI. A list of referenced documents

- Order of 2023-05-21 (Order reg. no. B-82288, received on 2023-05-21)
- Test report 39-17488/T of 2024-03-21
- ČSN EN 14511-2:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 2: Test conditions
- ČSN EN 14511-3:2023 - Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors - Part 3: Test methods
- ČSN EN 14825:2023 - Air conditioners, liquid chilling packages and heat pumps, with electrically driven compressors, for space heating and cooling, commercial and process cooling - Testing and rating at part load conditions and calculation of seasonal performance

Test Report compiled by:

Ing. Jakub Čederle



Test Report approved by:

Ing. Mario Jankola
Heating Equipment and Construction Products Manager

– End of Test Report –