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ČSN EN ISO/IEC 17025:2018

Strojírenský zkušební ústav, s.p. Zkušební laboratoř
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TEST REPORT

39-17512/T

Product: Outdoor Air/Water Heat pump - monobloc

Type designation: HPMO2-8

Customer: Kospel spółka z o.o.
ul. Olchowa 1
75-136 Koszalin
POLAND

Manufacturer: Kospel spółka z o.o.
ul. Olchowa 1
75-136 Koszalin
POLAND

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SP-2021-000012_1_12

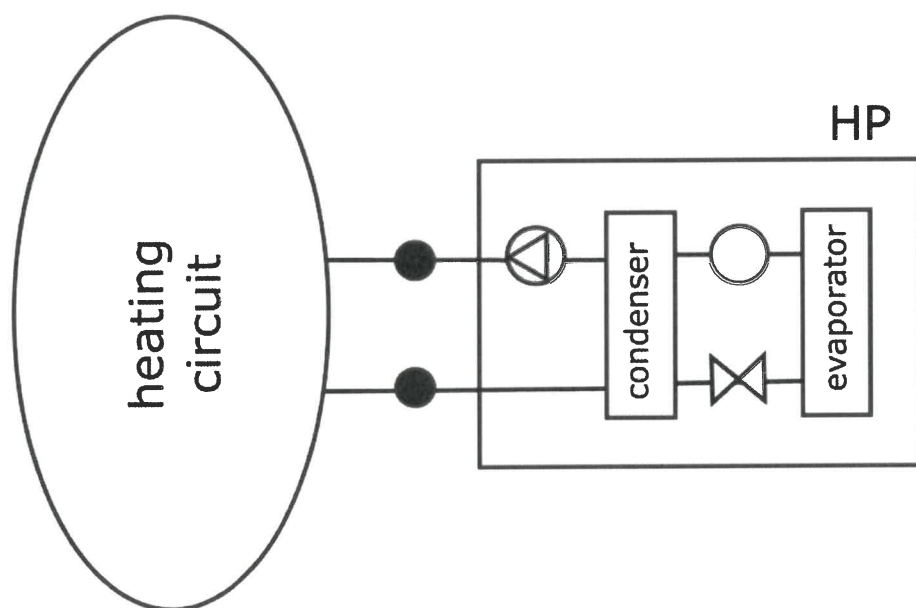
I. Description of product tested

The Heat pump HPMO2-8 supplied by the company **Kospel spolka z o.o.** is structurally adapted to operate in air/water system. Device is designed as monobloc placed outdoor. Outdoor unit is connected by water pipes. Refrigerant R32 is used with charge 1.1 kg. Power supply is a one-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 **HPMO2-8**:

- Serial number HNG08EU01Z00148
- Cuboid shape with dimensions 1170 × 400 × 770 mm (W × D × H)
- Frame and casing made of varnished steel sheets and plastics
- L-shaped evaporator, 2 rows, dimensions 960 × 40 × 730 mm (W × D × H), spacing 1.5 mm
- Plate condenser, dimensions 90 × 40 × 140 mm (W × D × H) including insulation
- Plate condenser, dimensions 130 × 60 × 530 mm (W × D × H) including insulation
- Compressor Panasonic 9RD138ZBA2J N0R14ED F0002288
- Refrigerant R32 (1.1 kg)
- Electric expansion valve
- 4-way reversing valve Sanhua SHF-7H-34U-P
- Refrigerant accumulator
- Axial fan Ø570 mm
- DC brushless motor ZWS150-F2 DC310V KBFN02522062121545
- Pressure sensors
- Temperature sensors
- Refrigerant pipes

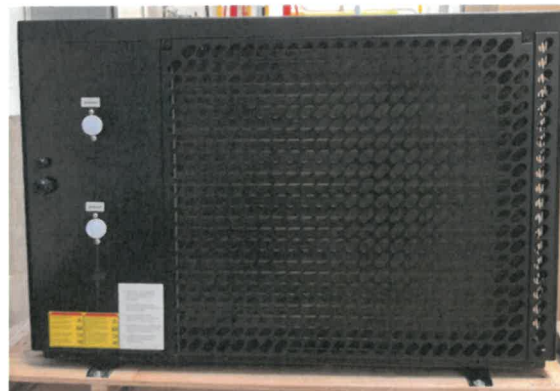
Scheme:



Photodocumentation:



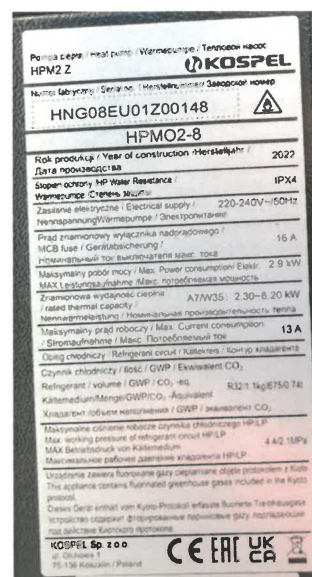
Heat pump HPMO2-8 – outdoor unit
– Front view –



Heat pump HPMO2-8 – outdoor unit
– Back view –

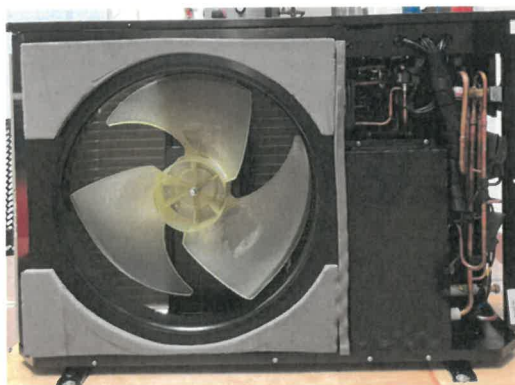


not fully recognized



Heat pump HPMO2-8 – outdoor unit
– Compressor label –

Heat pump HPMO2-8 – outdoor unit
– Label –



Heat pump HPMO2-8 – outdoor unit
– Without cover –

No.	Test objective	Requirement	Method of test	Documentation	Test evaluation/ verification *
1.	Rating conditions	–	ČSN EN 14511-2:2023 ČSN EN 14511-3:2023	Page No. 6	x
2.	Seasonal performance tests and SCOP calculation – Low temperature application	–	ČSN EN 14511-3:2023 ČSN EN 14825:2023	Page No. 7-13	x
3.	Seasonal performance tests and SCOP calculation – Medium temperature application	–	ČSN EN 14511-3:2023 ČSN EN 14825:2023	Page No. 14-20	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.

Test objective:	Rating conditions
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 14511-2:2023, ČSN EN 14511-3:2023
Sample tested:	HPMO2-8
Measuring equipment used:	see Chapter III

Specification of the assessment condition		A7/W35	A7/W55
Date of testing		2024-03-14	2024-03-15
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]	35.03	54.99
Input heating water – temperature calculation	[°C]	29.99	46.98
Output heating water temperature	[°C]	35.03	54.99
Input heating water temperature	[°C]	29.99	46.98
Air temperature – dry bulb temperature	[°C]	6.96	6.94
Air temperature – wet bulb temperature	[°C]	5.95	5.93
Relative humidity	[%]	86.75	86.72
Barometric pressure	[kPa]	98.304	98.398
Ambient temperature	[°C]	20.71	20.71
Secondary circuit pressure difference	[kPa]	-15.837	-5.539
Efficiency of the secondary liquid pump	[-]	0.173	0.125
Volume flow rate of heating water	[m ³ ·h ⁻¹]	1.0875	0.6361
Density of heating water	[kg·m ⁻³]	994.0	985.9
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.175	4.178
Voltage	[V]	230.90	230.88
Total current	[A]	5.59	9.47
Overall power input	[kW]	1.274	2.163
Capacity correction of sec. liquid pump	[W]	-22.830	-6.864
Power input correction of sec. liquid pump	[W]	-27.61	-7.84
Heating capacity – heating water	[kW]	6.325	5.826
Corrected heating capacity – heating water	[kW]	6.348	5.833
Uncertainty of corrected heating capacity	[kW]	± 0.107	± 0.063
Effective electric power input	[kW]	1.302	2.171
COP	[-]	4.876	2.687
Uncertainty of COP	[-]	± 0.083	± 0.029
Control settings	[Hz]	70	78
Circulation pump settings – heating water	[-]	–	–

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:	HPMO2-8
Measuring equipment used:	see Chapter III

Design			Air / water – monobloc			
Conditions specification according to ČSN 14825:2023	to EN	Temperature application			Low (reference water temperature 35 °C)	
		Reference heating season			Average	
		Outlet water temperature - indoor heat exchanger			Variable	
		Compressor speed control			Variable	
		Water flow rate – primary circuit			–	
		Water flow rate – secondary circuit			Variable	
Seasonal space heating efficiency	Heating	Average	ηs		188.4	%
		Warmer	ηs		–	%
		Colder	ηs		–	%
Seasonal efficiency according to ČSN 14825:2023	Heating	Average	SCOP		4.79	–
		Warmer	SCOP		–	–
		Colder	SCOP		–	–
Function	Cooling			–		
	Heating	Yes	Reference heating season	Average	Yes	
				Warmer	–	
				Colder	–	
Full heating load	Cooling		Pdesignc		–	kW
	Heating	Average	Pdesignh		5.54	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 14825:2023	Cooling		QCE		–	kWh
	Heating	Average	QHE		2393	kWh
		Warmer	QHE		–	kWh
		Colder	QHE		–	kWh
Modes other than „active mode“		Off mode			POFF	14.0 W
		Thermostat off mode			P _{TO}	14.0 W
		Standby mode			P _{SB}	14.0 W
		Crankcase heater mode			P _{CK}	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/heating only 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}	0.0140	[kW]
P _{SB}	0.0140	[kW]
P _{CK}	0	[kW]
P _{OFF}	0.0140	[kW]
P _{designh}	5.54	[kW]
SCOP _{ON}	4.79	[-]

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)

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

$$Q_H = 5.54 \cdot 2066 = 11453 \quad [\text{kWh}]$$

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

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

$$Q_{HE} = 11453 / 4.79 + 178 \cdot 0.014 + 0 \cdot 0.014 + 178 \cdot 0 + 0 \cdot 0.014 = 2393 \quad [\text{kWh}]$$

7.2 General formula for calculation of reference SCOP

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

$$\text{SCOP} = 11453 / 2393 = 4.79 \quad [-]$$

7.1 Calculation of the seasonal space heating efficiency η_s

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

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

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

$$\eta_s (A) = (1 / 2.5) \cdot 4.79 - 0.03 = 1.884 \quad [-]$$

Temperature level		Low (reference water temperature 35 °C)		
Reference heating season		„A“ = average ($T_{designh} = -7\text{ °C}$)		
Assessment condition		A, T _{biv} (F)	B	C
Specification of the assessment condition		A-7/W34	A2/W30	A7/W28.26
Date of testing		2024-03-18	2024-03-18	2024-03-18
Transient test procedure	YES / NO	NO	NO	NO
Average defrost time of 1 cycle	[min]	–	–	–
Average time of 1 cycle	[min]	–	–	–
Calculation time	[min]	70.0	70.0	70.0
Output heating water – temperature calculation	[°C]	33.99	30.01	28.26
Input heating water – temperature calculation	[°C]	28.96	25.09	23.85
Output heating water temperature	[°C]	33.99	30.01	28.26
Input heating water temperature	[°C]	28.96	25.09	23.85
Air temperature – dry bulb temperature	[°C]	-6.97	1.95	6.93
Air temperature – wet bulb temperature	[°C]	-8.02	0.96	5.94
Relative humidity	[%]	73.79	84.03	86.83
Barometric pressure	[kPa]	98.550	98.422	98.663
Ambient temperature	[°C]	19.39	19.26	18.58
Secondary circuit pressure difference	[kPa]	-9.898	-3.784	-3.819
Efficiency of the secondary liquid pump	[–]	0.142	0.119	0.119
Volume flow rate of heating water	[m ³ ·h ⁻¹]	0.8428	0.5024	0.5018
Density of heating water	[kg·m ⁻³]	994.3	995.6	996.1
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.175	4.177	4.178
Voltage	[V]	230.73	230.92	230.96
Total current	[A]	6.43	2.86	1.87
Overall power input	[kW]	1.469	0.636	0.394
Capacity correction of sec. liquid pump	[W]	-13.995	-3.910	-3.939
Power input correction of sec. liquid pump	[W]	-16.31	-4.44	-4.47
Heating capacity – heating water	[kW]	4.890	2.852	2.561
Corrected heating capacity – heating water	[kW]	4.904	2.856	2.565
Uncertainty of corrected heating capacity	[kW]	± 0.083	± 0.050	± 0.050
Effective electric power input	[kW]	1.485	0.641	0.399
COP	[–]	3.302	4.458	6.432
Uncertainty of COP	[–]	± 0.056	± 0.078	± 0.125
Control settings	[Hz]	77	38	29
Circulation pump settings – heating water	[–]	–	–	–

Temperature level		Low (reference water temperature 35 °C)	
Reference heating season		„A“ = average ($T_{designh} = -7\text{ °C}$)	
Assessment condition		D	TOL(E)
Specification of the assessment condition		A12/W27.52	A-10/W35
Date of testing		2024-03-19	2024-03-20
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]	27.46	34.94
Input heating water – temperature calculation	[°C]	22.46	29.98
Output heating water temperature	[°C]	27.46	34.94
Input heating water temperature	[°C]	22.46	29.98
Air temperature – dry bulb temperature	[°C]	11.95	-9.87
Air temperature – wet bulb temperature	[°C]	10.98	-10.83
Relative humidity	[%]	89.22	71.17
Barometric pressure	[kPa]	99.133	99.004
Ambient temperature	[°C]	18.45	18.64
Secondary circuit pressure difference	[kPa]	-3.764	-11.111
Efficiency of the secondary liquid pump	[-]	0.119	0.148
Volume flow rate of heating water	[m ³ ·h ⁻¹]	0.4971	0.8983
Density of heating water	[kg·m ⁻³]	996.3	994.0
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.178	4.175
Voltage	[V]	230.95	230.78
Total current	[A]	1.65	7.80
Overall power input	[kW]	0.341	1.782
Capacity correction of sec. liquid pump	[W]	-3.852	-15.971
Power input correction of sec. liquid pump	[W]	-4.37	-18.74
Heating capacity – heating water	[kW]	2.872	5.136
Corrected heating capacity – heating water	[kW]	2.875	5.152
Uncertainty of corrected heating capacity	[kW]	± 0.049	± 0.088
Effective electric power input	[kW]	0.345	1.801
COP	[-]	8.328	2.861
Uncertainty of COP	[-]	± 0.143	± 0.049
Control settings	[Hz]	28	90
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]	[%]	[kW]	[kW]	[-]	[-]	[-]	[-]	[kW]
A	-7	34.00	88.46	4.90	4.904	3.302	0.900	1.00	3.302	–
B	2	30.00	53.85	2.99	2.856	4.458	0.900	1.00	4.229	–
C	7	28.26	34.62	1.92	2.565	6.432	0.965	0.75	6.357	0.0140
D	12	27.52	15.38	0.85	2.875	8.328	0.959	0.30	7.597	0.0140
TOL (E)	-10	35.00	100.00	5.54	5.152	2.861	0.900	1.00	2.500	–
Tbiv (F)	-7	34.00	88.46	4.90	4.904	3.302	0.900	1.00	3.302	–

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

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

General formulas and derivation:

$$t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (t_{\text{outlet, capacity test}} - t_{\text{inlet, capacity test}}) \cdot CR \quad [^{\circ}\text{C}]$$

$$t_{\text{outlet, average}} = t_{\text{inlet, capacity test}} + (\Delta t) \cdot CR \quad [^{\circ}\text{C}]$$

$$t_{\text{outlet, average}} = t_{\text{outlet, capacity test}} - \Delta t + \Delta t \cdot CR \quad [^{\circ}\text{C}]$$

$$t_{\text{outlet, capacity test}} = t_{\text{outlet, average}} + \Delta t - \Delta t \cdot CR \quad [^{\circ}\text{C}]$$

For variable flow:

$$\Delta t = 5$$

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

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

Measured data:

$t_{\text{outlet, average}}$	24.00	[°C]
Declared capacity	2.875	[kW]
Declared capacity standard rating condition A7/W35	–	[kW]
Part load	0.85	[kW]

Calculation of water temperature

$$t_{\text{outlet, capacity test, variable flow}} = 24 + 5 - 0.85 / 2.875 \cdot 5 = \underline{\underline{27.52}} \quad [^{\circ}\text{C}]$$

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

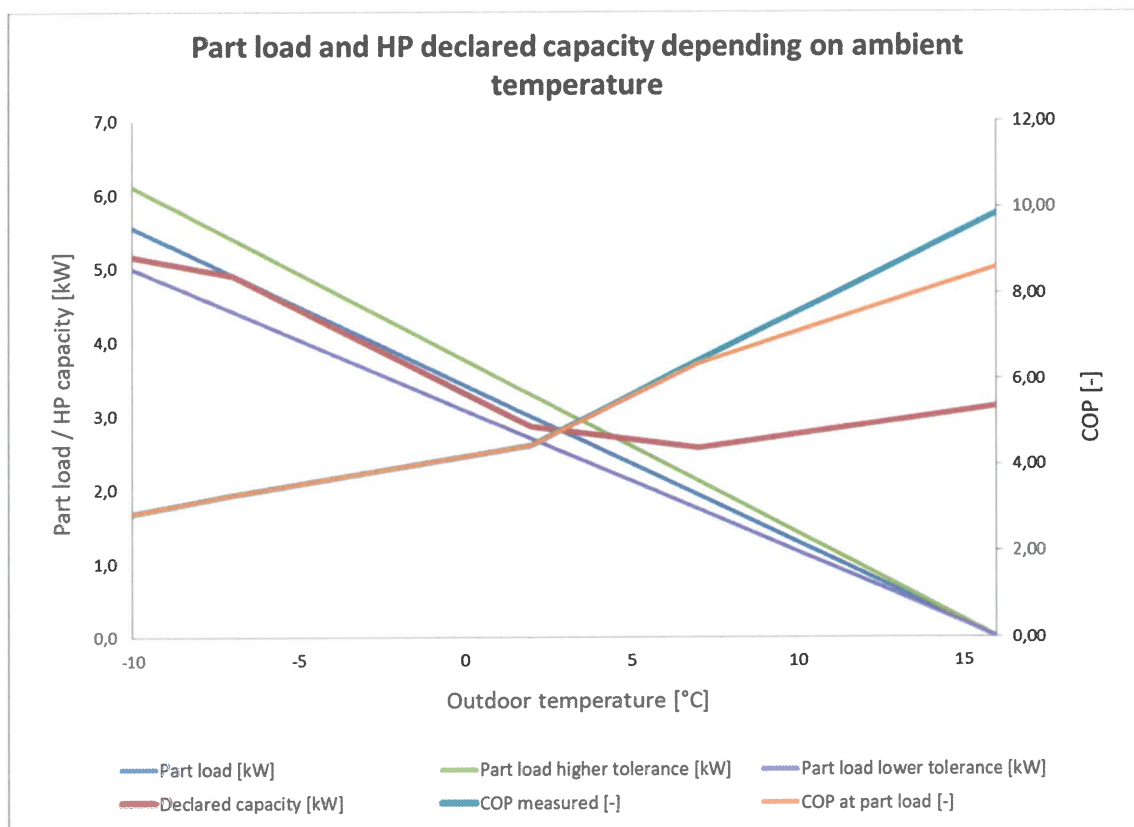
- Low temperature application (reference water temperature 35 °C)
- Reference heating season „A“ – average

	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)	COPbin (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	5.54	5.15	5.15	0.39	0.39	2.86	6	2	5	2
	22	-9	25	96.15	5.33	5.07	5.07	0.26	6.53	3.01	133	49	127	42
	23	-8	23	92.31	5.12	4.99	4.99	0.13	3.00	3.16	118	39	115	36
A, Tblv(F)	24	-7	24	88.46	4.90	4.90	4.90	0.00	0.00	3.30	118	36	118	36
	25	-6	27	84.62	4.69	4.68	4.68	0.00	0.00	3.43	127	37	127	37
	26	-5	68	80.77	4.48	4.45	4.45	0.00	0.00	3.56	304	86	304	86
	27	-4	91	76.92	4.26	4.22	4.22	0.00	0.00	3.69	388	105	388	105
	28	-3	89	73.08	4.05	3.99	3.99	0.00	0.00	3.82	361	94	361	94
	29	-2	165	69.23	3.84	3.77	3.77	0.00	0.00	3.94	633	161	633	161
	30	-1	173	65.38	3.62	3.54	3.54	0.00	0.00	4.07	627	154	627	154
	31	0	240	61.54	3.41	3.31	3.31	0.00	0.00	4.20	819	195	819	195
	32	1	280	57.69	3.20	3.08	3.08	0.00	0.00	4.33	896	207	896	207
B	33	2	320	53.85	2.99	2.86	2.86	0.00	0.00	4.46	955	214	955	214
	34	3	357	50.00	2.77	2.80	2.77	0.00	0.00	4.84	990	205	990	205
	35	4	356	46.15	2.56	2.74	2.56	0.00	0.00	5.22	911	175	911	175
	36	5	303	42.31	2.35	2.68	2.35	0.00	0.00	5.60	711	127	711	127
	37	6	330	38.46	2.13	2.62	2.13	0.00	0.00	5.98	704	118	704	118
C	38	7	326	34.62	1.92	2.57	1.92	0.00	0.00	6.36	626	98	626	98
	39	8	348	30.77	1.71	2.63	1.71	0.00	0.00	6.60	594	90	594	90
	40	9	335	26.92	1.49	2.69	1.49	0.00	0.00	6.85	500	73	500	73
	41	10	315	23.08	1.28	2.75	1.28	0.00	0.00	7.10	403	57	403	57
	42	11	215	19.23	1.07	2.81	1.07	0.00	0.00	7.35	229	31	229	31
D	43	12	169	15.38	0.85	2.88	0.85	0.00	0.00	7.60	144	19	144	19
	44	13	151	11.54	0.64	2.94	0.64	0.00	0.00	7.85	97	12	97	12
	45	14	105	7.69	0.43	3.00	0.43	0.00	0.00	8.09	45	6	45	6
	46	15	74	3.85	0.21	3.06	0.21	0.00	0.00	8.34	16	2	16	2
	Σ		4910							Σ	11451	2390	11441	2380

SCOP _{on}	4.79	SCOP _{net}	4.81
		SCOP	4.79

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:	HPMO2-8
Measuring equipment used:	see Chapter III

Design			Air / water – monobloc				
Conditions specification according to ČSN 14825:2023	to EN	Temperature application			Medium (reference water temperature 55 °C)		
		Reference heating season			Average		
		Outlet water temperature - indoor heat exchanger			Variable		
		Compressor speed control			Variable		
		Water flow rate – primary circuit			–		
		Water flow rate – secondary circuit			Variable		
Seasonal space heating efficiency	Heating	Average	ηs		125.6	%	
		Warmer	ηs		–	%	
		Colder	ηs		–	%	
Seasonal efficiency according to ČSN 14825:2023	Heating	Average	SCOP		3.21	–	
		Warmer	SCOP		–	–	
		Colder	SCOP		–	–	
Function	Cooling				–		
	Heating	Yes	Reference heating season	Average	Yes		
				Warmer	–		
				Colder	–		
Full heating load	Cooling		Pdesignc		–	kW	
	Heating	Average	Pdesignh		4.71	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 14825:2023	Cooling		QCE		–	kWh	
	Heating	Average	QHE		3029	kWh	
		Warmer	QHE		–	kWh	
		Colder	QHE		–	kWh	
Modes other than „active mode“		Off mode			POFF	14.0	W
		Thermostat off mode			PTo	14.0	W
		Standby mode			PSB	14.0	W
		Crankcase heater mode			PCK	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/heating only 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}	0.0140	[kW]
P _{SB}	0.0140	[kW]
P _{CK}	0	[kW]
P _{OFF}	0.0140	[kW]
P _{designh}	4.71	[kW]
SCOP _{ON}	3.22	[-]

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)

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

$$Q_H = 4.71 \cdot 2066 = 9737 \quad [\text{kWh}]$$

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

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

$$Q_{HE} = 9737 / 3.22 + 178 \cdot 0.014 + 0 \cdot 0.014 + 178 \cdot 0 + 0 \cdot 0.014 = 3029 \quad [\text{kWh}]$$

7.2 General formula for calculation of reference SCOP

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

$$\text{SCOP} = 9737 / 3029 = 3.21 \quad [-]$$

7.1 Calculation of the seasonal space heating efficiency η_s

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

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

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

$$\eta_s (A) = (1 / 2.5) \cdot 3.21 - 0.03 = 1.256 \quad [-]$$

Temperature level		Medium (reference water temperature 55 °C)		
Reference heating season		„A“ = average ($T_{\text{designh}} = -7 \text{ °C}$)		
Assessment condition		A, T _{biv} (F)	B	C
Specification of the assessment condition		A-7/W52	A2/W43.62	A7/W39.08
Date of testing		2024-03-15	2024-03-21	2024-03-15
Transient test procedure	YES / NO	NO	NO	NO
Average defrost time of 1 cycle	[min]	–	–	–
Average time of 1 cycle	[min]	–	–	–
Calculation time	[min]	70.0	70.0	70.0
Output heating water – temperature calculation	[°C]	52.02	43.67	39.04
Input heating water – temperature calculation	[°C]	44.89	38.19	34.53
Output heating water temperature	[°C]	52.02	43.67	39.04
Input heating water temperature	[°C]	44.89	38.19	34.53
Air temperature – dry bulb temperature	[°C]	-7.00	2.01	6.95
Air temperature – wet bulb temperature	[°C]	-8.03	1.03	5.98
Relative humidity	[%]	74.12	84.07	87.23
Barometric pressure	[kPa]	98.336	98.865	98.238
Ambient temperature	[°C]	20.77	19.06	20.82
Secondary circuit pressure difference	[kPa]	-3.643	-3.632	-3.835
Efficiency of the secondary liquid pump	[-]	0.119	0.119	0.119
Volume flow rate of heating water	[m ³ ·h ⁻¹]	0.5002	0.5043	0.5022
Density of heating water	[kg·m ⁻³]	987.4	990.9	992.6
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.177	4.175	4.175
Voltage	[V]	230.77	230.88	230.81
Total current	[A]	9.24	4.12	3.02
Overall power input	[kW]	2.110	0.935	0.674
Capacity correction of sec. liquid pump	[W]	-3.828	-3.775	-4.016
Power input correction of sec. liquid pump	[W]	-4.34	-4.28	-4.56
Heating capacity – heating water	[kW]	4.165	3.178	2.650
Corrected heating capacity – heating water	[kW]	4.169	3.181	2.654
Uncertainty of corrected heating capacity	[kW]	± 0.050	± 0.050	± 0.050
Effective electric power input	[kW]	2.115	0.939	0.679
COP	[-]	1.971	3.388	3.911
Uncertainty of COP	[-]	± 0.024	± 0.053	± 0.074
Control settings	[Hz]	84	40	34
Circulation pump settings – heating water	[-]	–	–	–

Temperature level		Medium (reference water temperature 55 °C)	
Reference heating season		„A“ = average ($T_{designh} = -7\text{ °C}$)	
Assessment condition		D	TOL(E)
Specification of the assessment condition		A12/W35.56	A-10/W55
Date of testing		2024-03-20	2024-03-20
Transient test procedure	YES / NO	YES	NO
Average defrost time of 1 cycle	[min]	–	–
Average time of 1 cycle	[min]	–	–
Calculation time	[min]	180.0	70.0
Output heating water – temperature calculation	[°C]	35.53	54.96
Input heating water – temperature calculation	[°C]	31.43	48.71
Output heating water temperature	[°C]	35.53	54.96
Input heating water temperature	[°C]	31.43	48.71
Air temperature – dry bulb temperature	[°C]	11.86	-10.00
Air temperature – wet bulb temperature	[°C]	10.87	-10.83
Relative humidity	[%]	89.07	74.55
Barometric pressure	[kPa]	98.964	99.162
Ambient temperature	[°C]	18.55	18.06
Secondary circuit pressure difference	[kPa]	-3.710	-3.480
Efficiency of the secondary liquid pump	[-]	0.119	0.118
Volume flow rate of heating water	[m ³ ·h ⁻¹]	0.5017	0.5043
Density of heating water	[kg·m ⁻³]	993.8	986.0
Specific heat capacity of heating water	[kJ·kg ⁻¹ ·K ⁻¹]	4.175	4.178
Voltage	[V]	230.85	230.71
Total current	[A]	2.30	10.68
Overall power input	[kW]	0.501	2.443
Capacity correction of sec. liquid pump	[W]	-3.833	-3.627
Power input correction of sec. liquid pump	[W]	-4.35	-4.11
Heating capacity – heating water	[kW]	2.373	3.611
Corrected heating capacity – heating water	[kW]	2.376	3.614
Uncertainty of corrected heating capacity	[kW]	± 0.049	± 0.050
Effective electric power input	[kW]	0.506	2.447
COP	[-]	4.700	1.477
Uncertainty of COP	[-]	± 0.098	± 0.020
Control settings	[Hz]	28	90
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]								
A	-7	52.00	88.46	4.17	4.169	1.971	0.900	1.00	1.971	–
B	2	43.62	53.85	2.54	3.181	3.388	0.985	0.80	3.375	0.0140
C	7	39.08	34.62	1.63	2.654	3.911	0.979	0.61	3.861	0.0140
D	12	35.56	15.38	0.73	2.376	4.700	0.972	0.31	4.421	0.0140
TOL (E)	-10	55.00	100.00	4.71	3.614	1.477	0.900	1.00	1.477	–
Tbiv (F)	-7	52.00	88.46	4.17	4.169	1.971	0.900	1.00	1.971	–

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

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

General formulas and derivation:

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

For variable flow:

$$\Delta t = 8$$

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

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

Measured data:

$t_{\text{outlet, average}}$	30.00	[°C]
Declared capacity	2.376	[kW]
Declared capacity standard rating condition A7/W55	–	[kW]
Part load	0.73	[kW]

Calculation of water temperature

$$t_{\text{outlet, capacity test, variable flow}} = 30 + 8 - 0.73 / 2.376 \cdot 8 = \underline{\underline{35.56}} \quad [^{\circ}\text{C}]$$

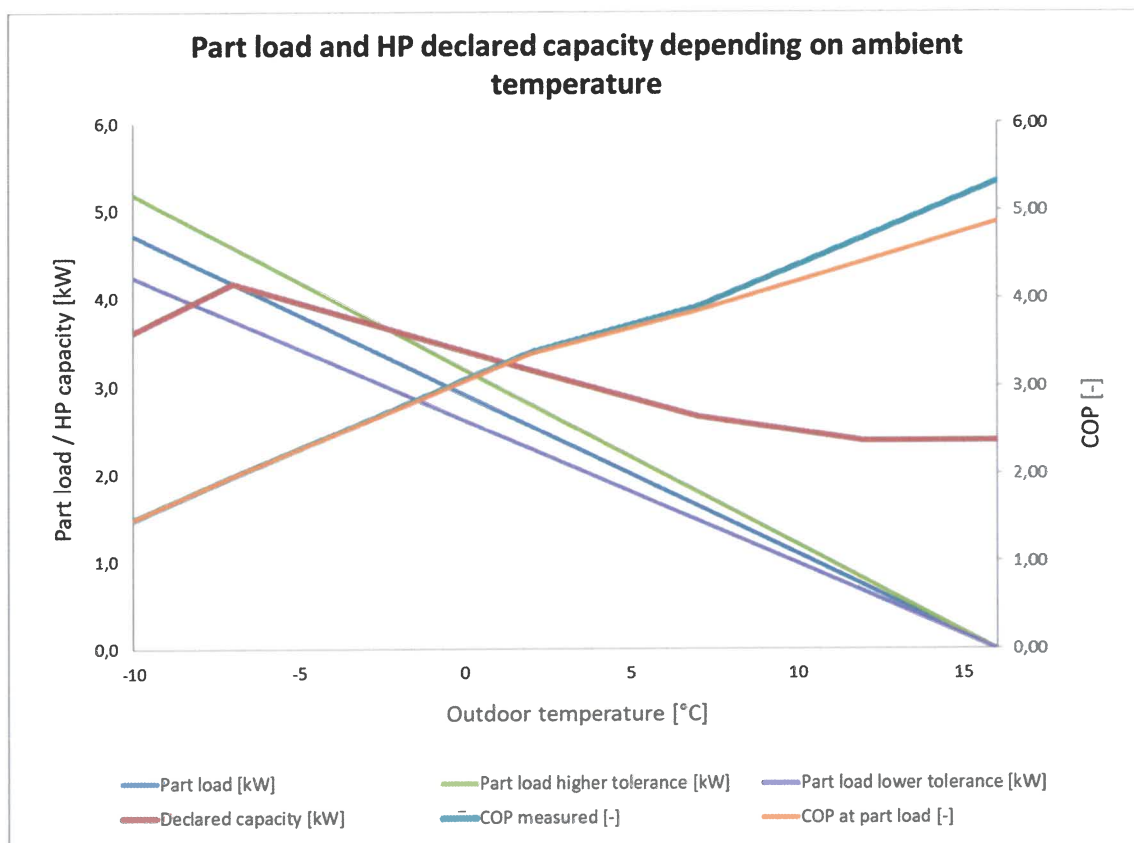
Calculation SCOP, SCOP_{on}, SCOP_{net}

- 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	4.71	3.61	3.61	1.10	1.10	1.48	5	4	4	2
	22	-9	25	96.15	4.53	3.80	3.80	0.73	18.31	1.64	113	76	95	58
	23	-8	23	92.31	4.35	3.98	3.98	0.37	8.42	1.81	100	59	92	51
A, T _{biv} (F)	24	-7	24	88.46	4.17	4.17	4.17	0.00	0.00	1.97	100	51	100	51
	25	-6	27	84.62	3.99	4.06	3.99	0.00	0.00	2.13	108	51	108	51
	26	-5	68	80.77	3.81	3.95	3.81	0.00	0.00	2.28	259	113	259	113
	27	-4	91	76.92	3.63	3.84	3.63	0.00	0.00	2.44	330	135	330	135
	28	-3	89	73.08	3.44	3.73	3.44	0.00	0.00	2.60	307	118	307	118
	29	-2	165	69.23	3.26	3.62	3.26	0.00	0.00	2.75	538	196	538	196
	30	-1	173	65.38	3.08	3.51	3.08	0.00	0.00	2.91	533	183	533	183
	31	0	240	61.54	2.90	3.40	2.90	0.00	0.00	3.06	696	227	696	227
	32	1	280	57.69	2.72	3.29	2.72	0.00	0.00	3.22	761	236	761	236
B	33	2	320	53.85	2.54	3.18	2.54	0.00	0.00	3.38	812	241	812	241
	34	3	357	50.00	2.36	3.08	2.36	0.00	0.00	3.47	841	242	841	242
	35	4	356	46.15	2.18	2.97	2.18	0.00	0.00	3.57	774	217	774	217
	36	5	303	42.31	1.99	2.86	1.99	0.00	0.00	3.67	604	165	604	165
	37	6	330	38.46	1.81	2.76	1.81	0.00	0.00	3.76	598	159	598	159
C	38	7	326	34.62	1.63	2.65	1.63	0.00	0.00	3.86	532	138	532	138
	39	8	348	30.77	1.45	2.60	1.45	0.00	0.00	3.97	505	127	505	127
	40	9	335	26.92	1.27	2.54	1.27	0.00	0.00	4.09	425	104	425	104
	41	10	315	23.08	1.09	2.49	1.09	0.00	0.00	4.20	343	82	343	82
	42	11	215	19.23	0.91	2.43	0.91	0.00	0.00	4.31	195	45	195	45
D	43	12	169	15.38	0.73	2.38	0.73	0.00	0.00	4.42	123	28	123	28
	44	13	151	11.54	0.54	2.32	0.54	0.00	0.00	4.53	82	18	82	18
	45	14	105	7.69	0.36	2.26	0.36	0.00	0.00	4.65	38	8	38	8
	46	15	74	3.85	0.18	2.21	0.18	0.00	0.00	4.76	13	3	13	3
		Σ	4910							Σ	9735	3026	9707	2998
											SCOP _{on}	3.22	SCOP _{net}	3.24
											SCOP		3.21	

Part load performance diagram

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



Tested by: Ing. Alexandr Jordanov

Date: 2024-03-28

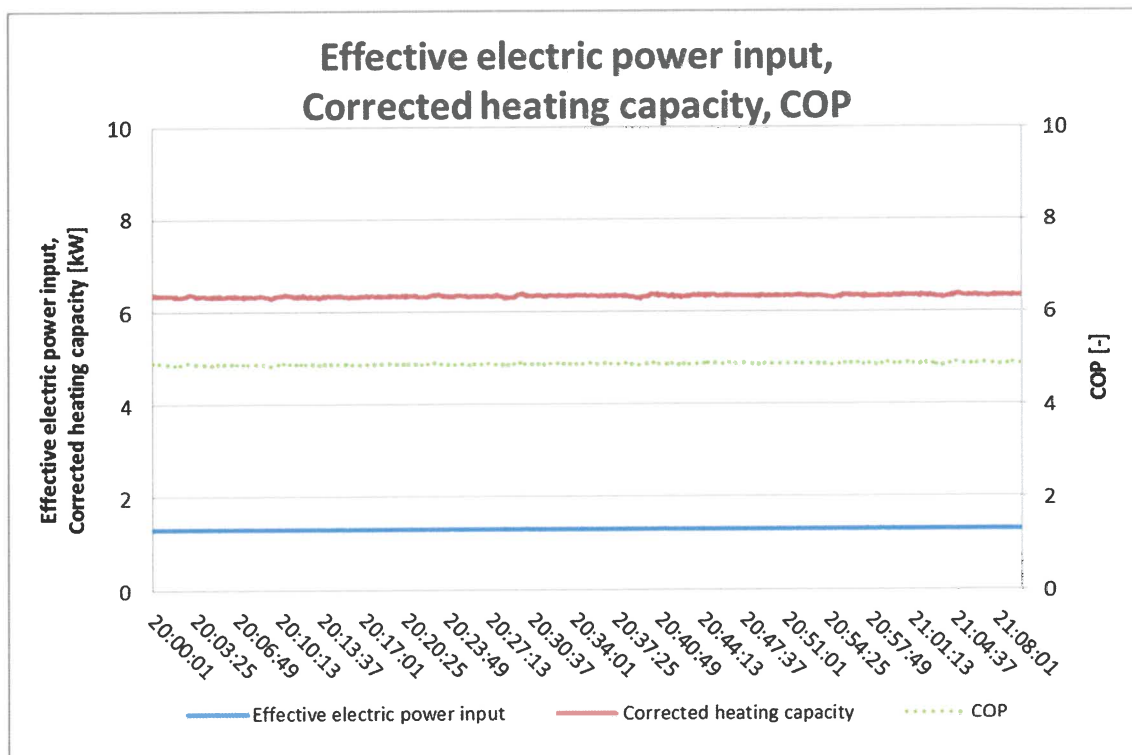
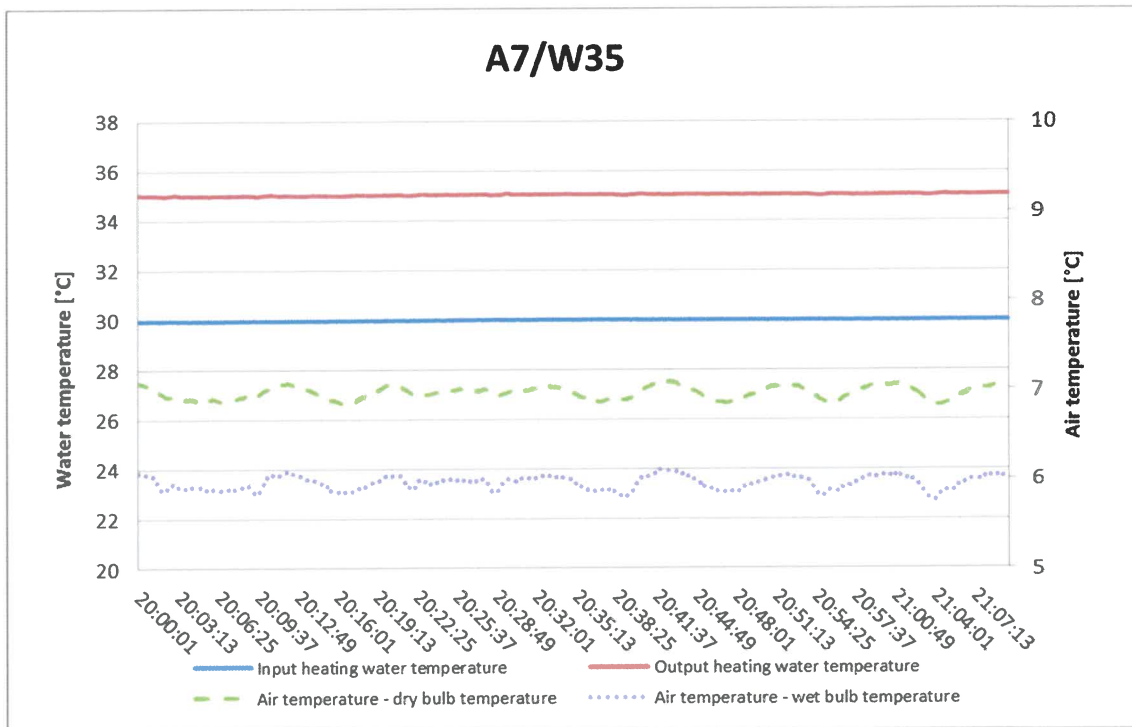
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Reviewed and approved by: Ing. Michal Faltýnek

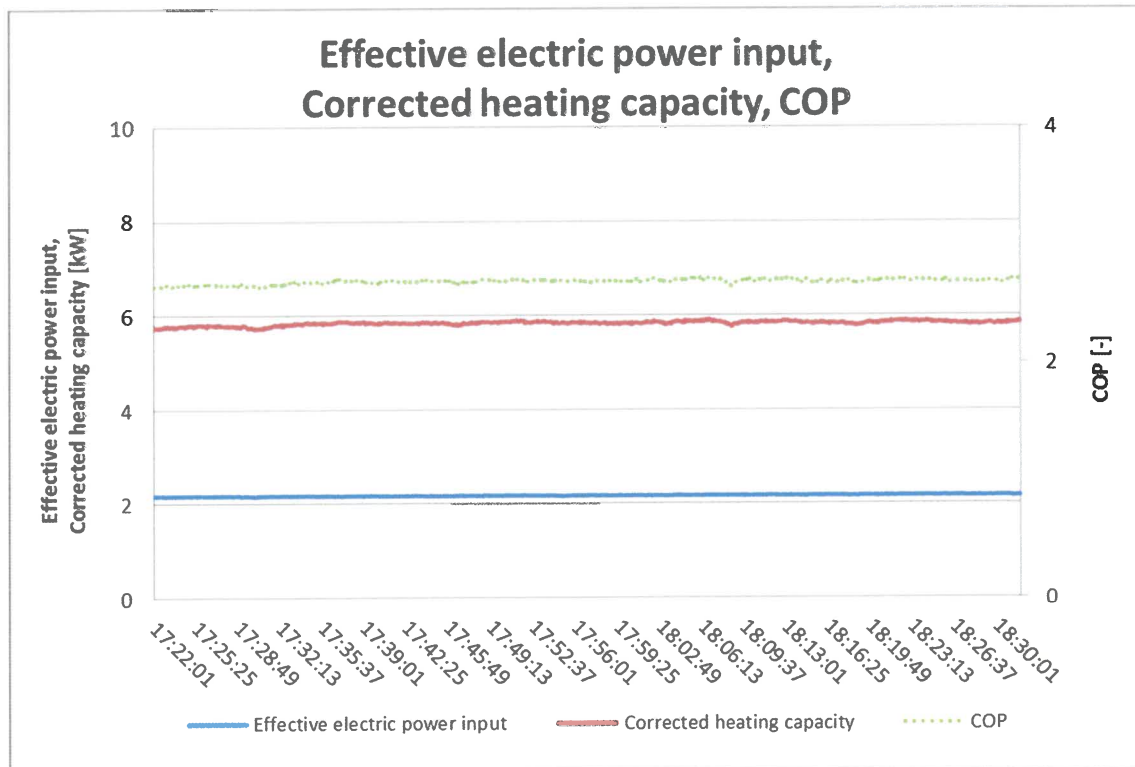
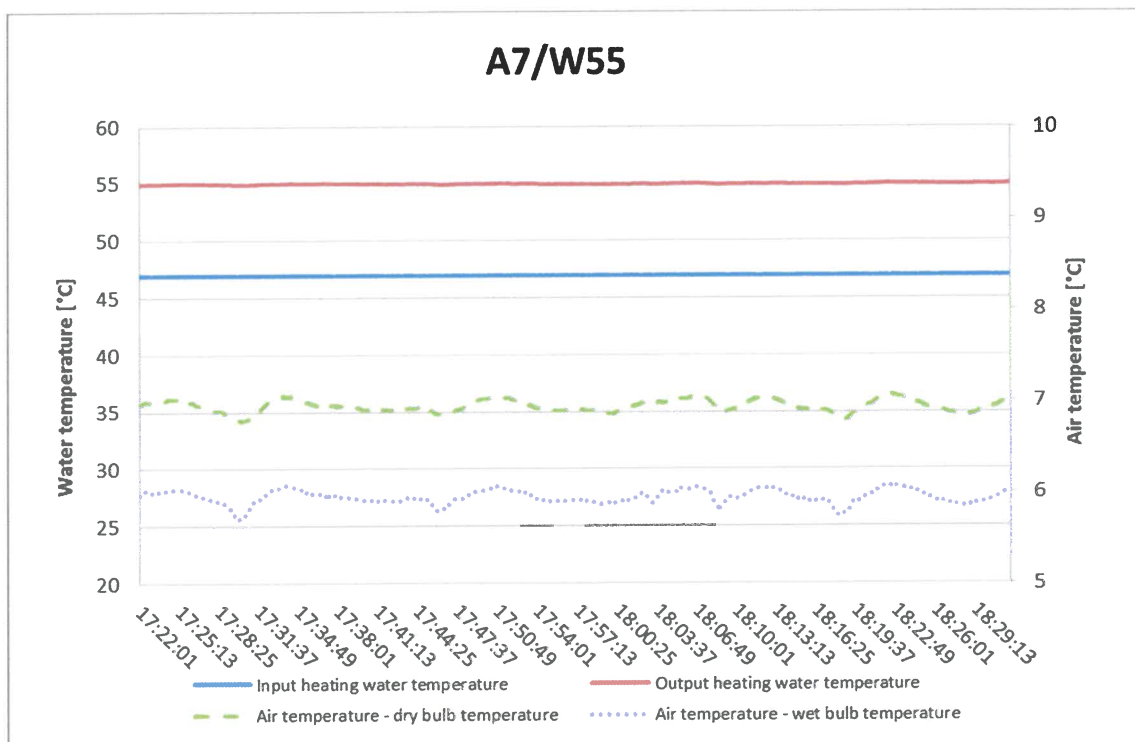
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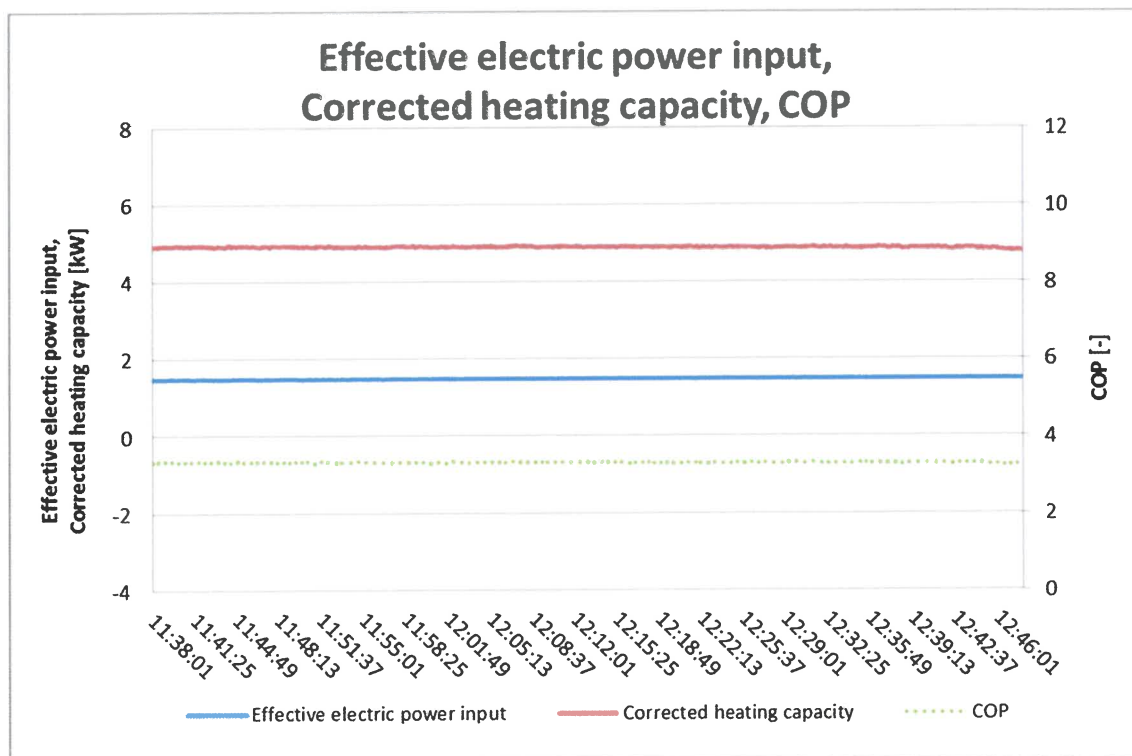
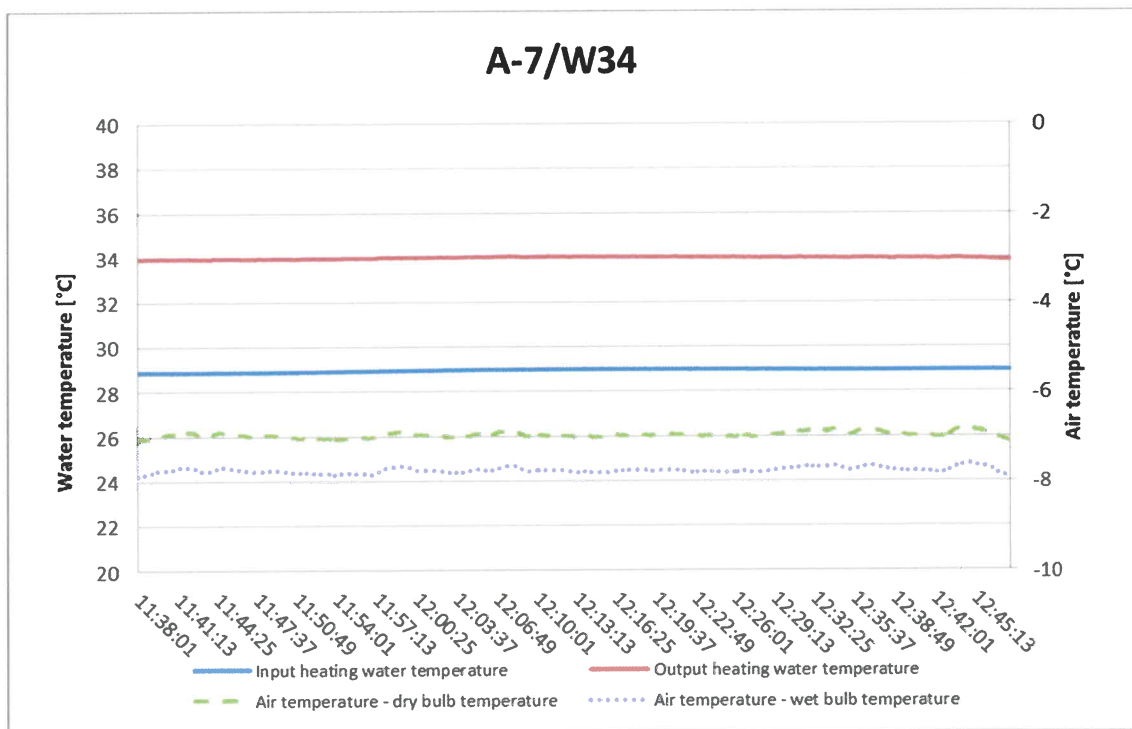
V. Graphs
Rating conditions
A7W35 (70 Hz)



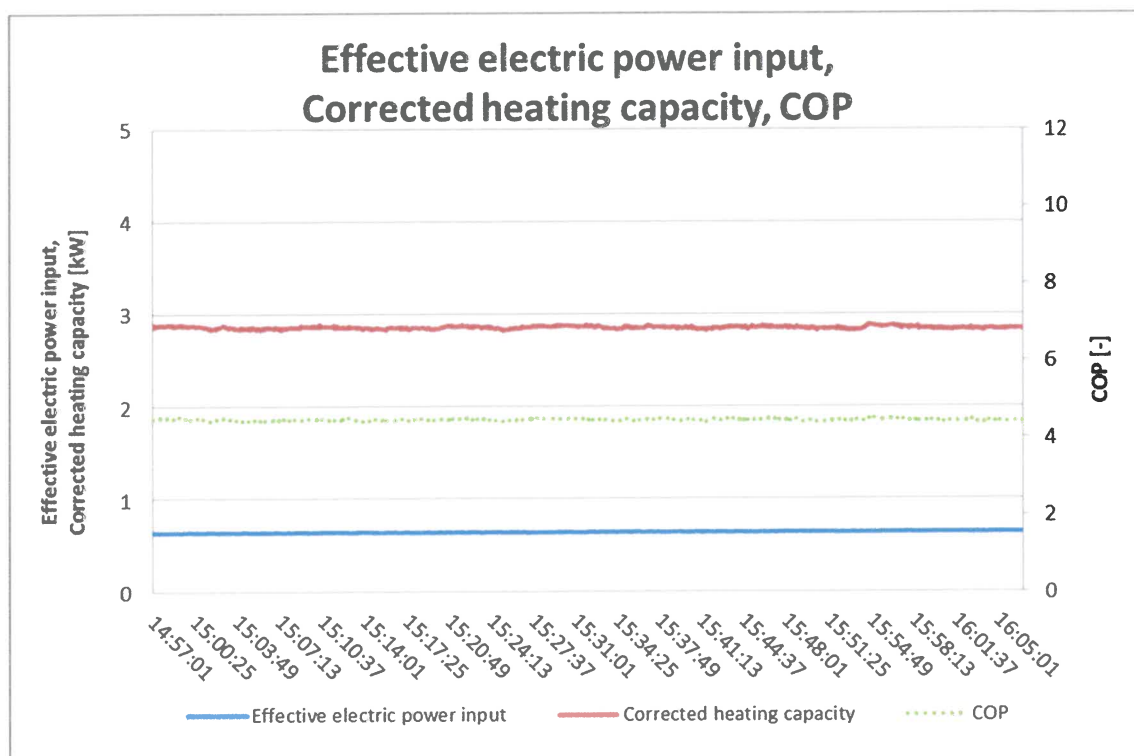
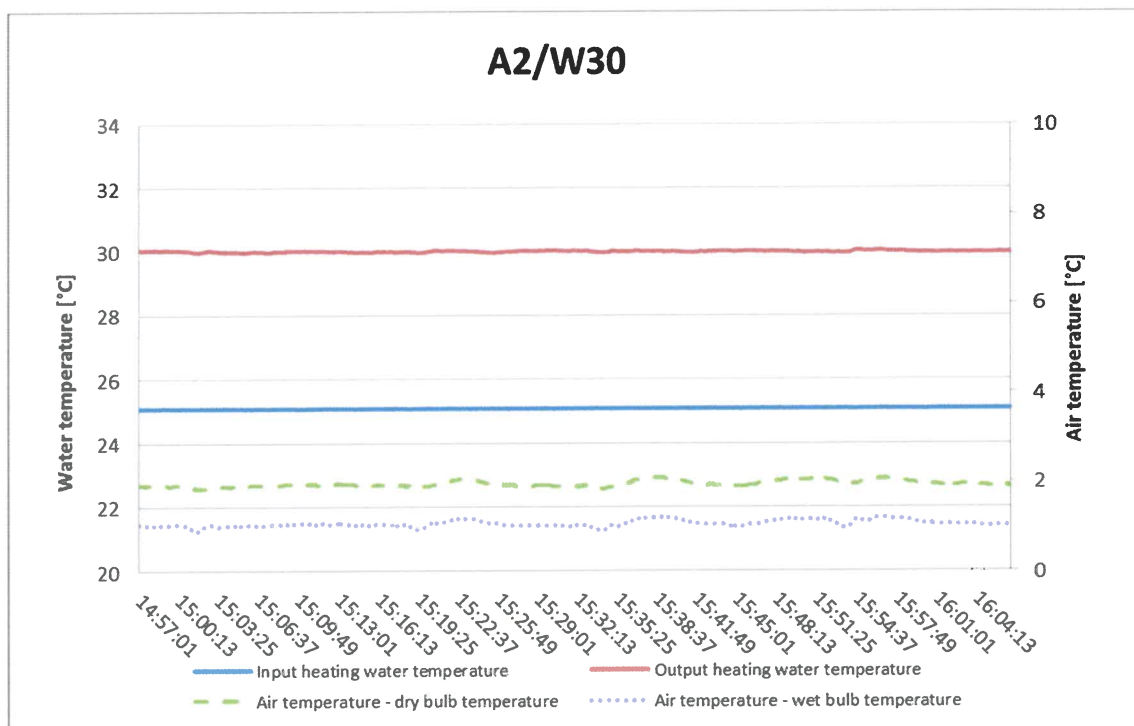
A7W55 (78 Hz)



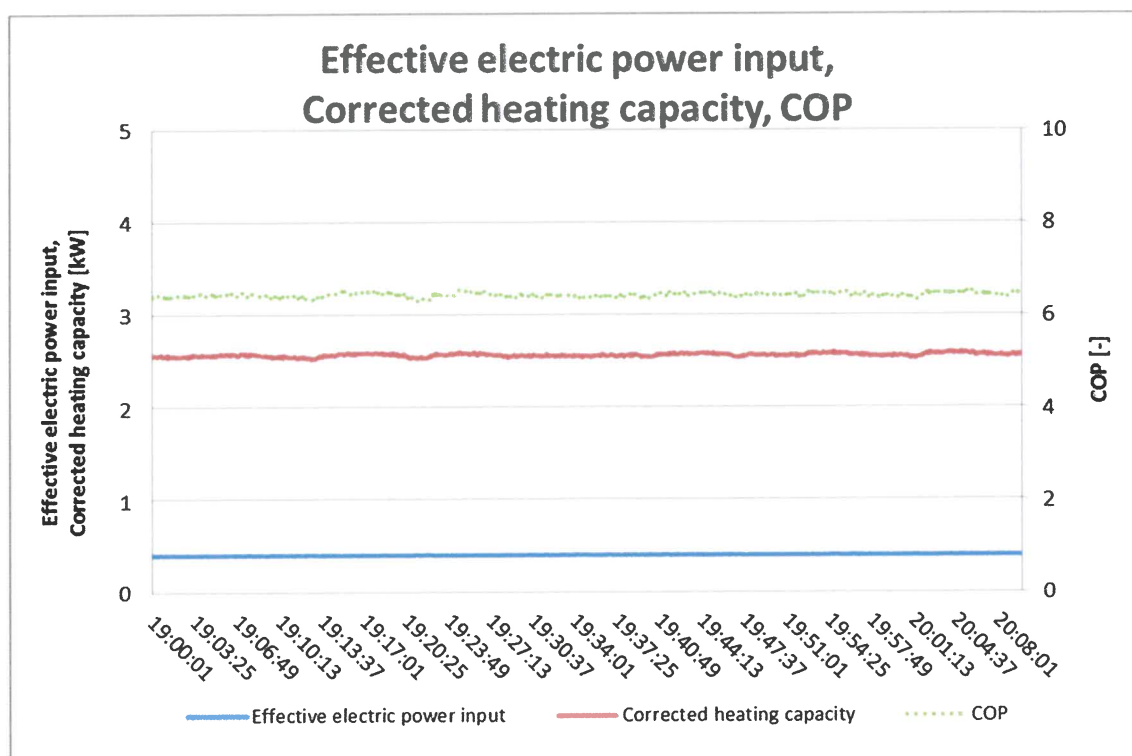
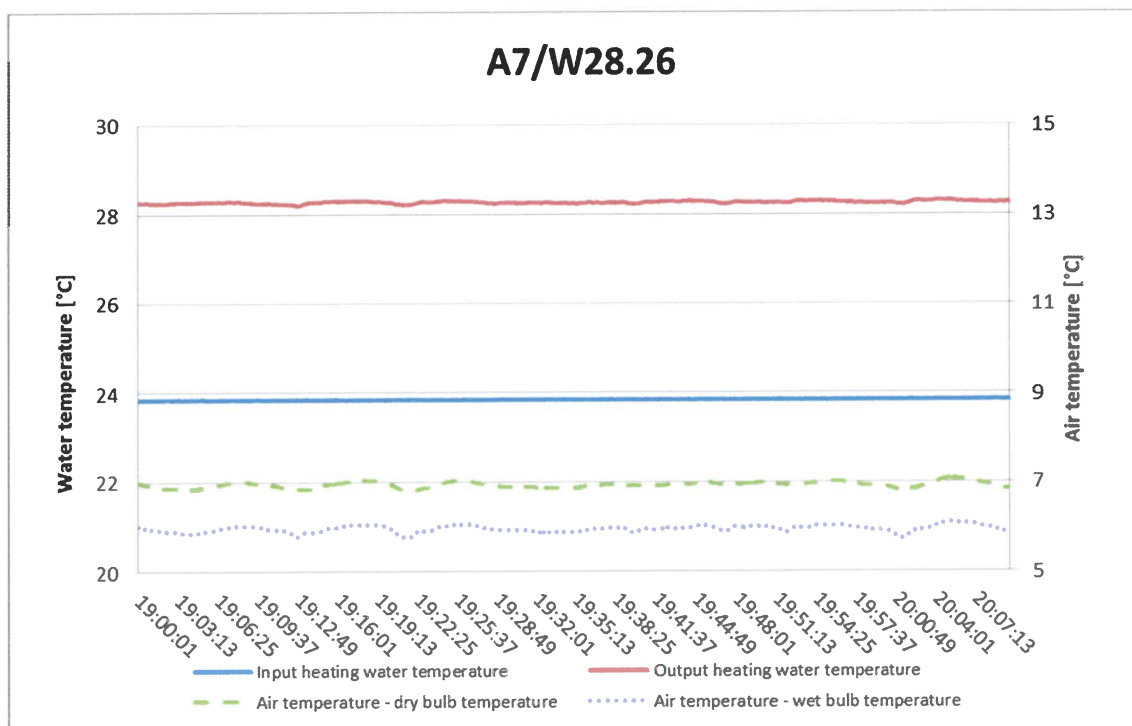
Low temperature application
A-7W34 (77 Hz)



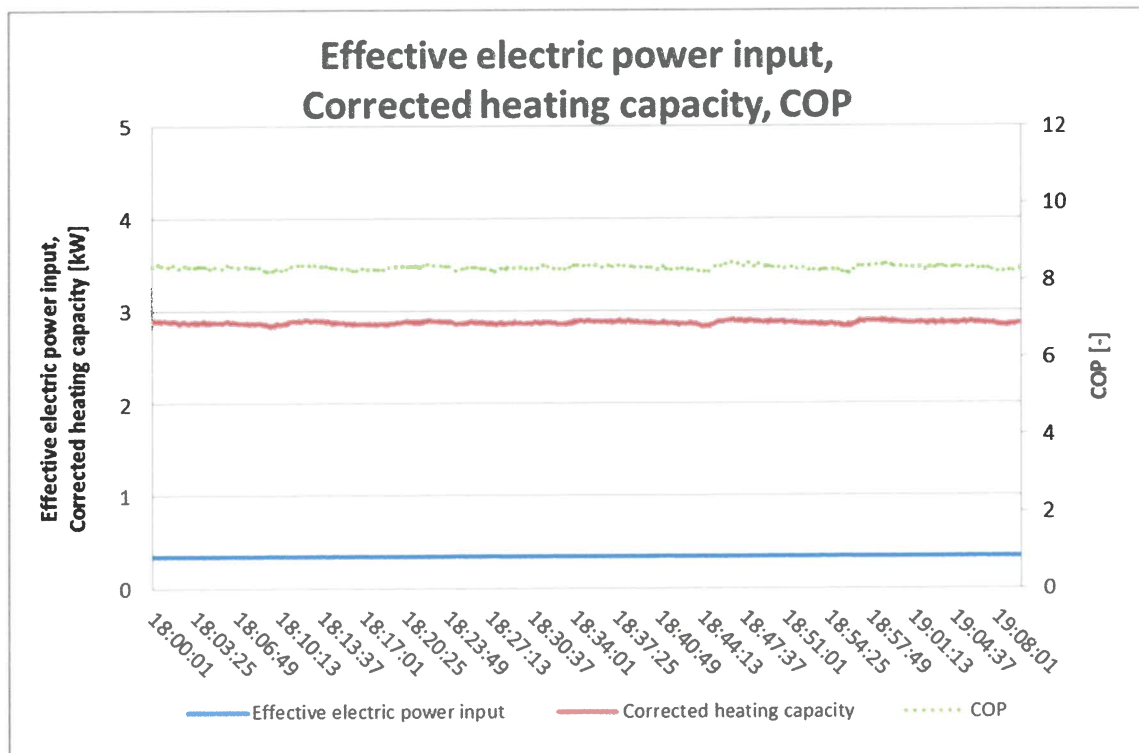
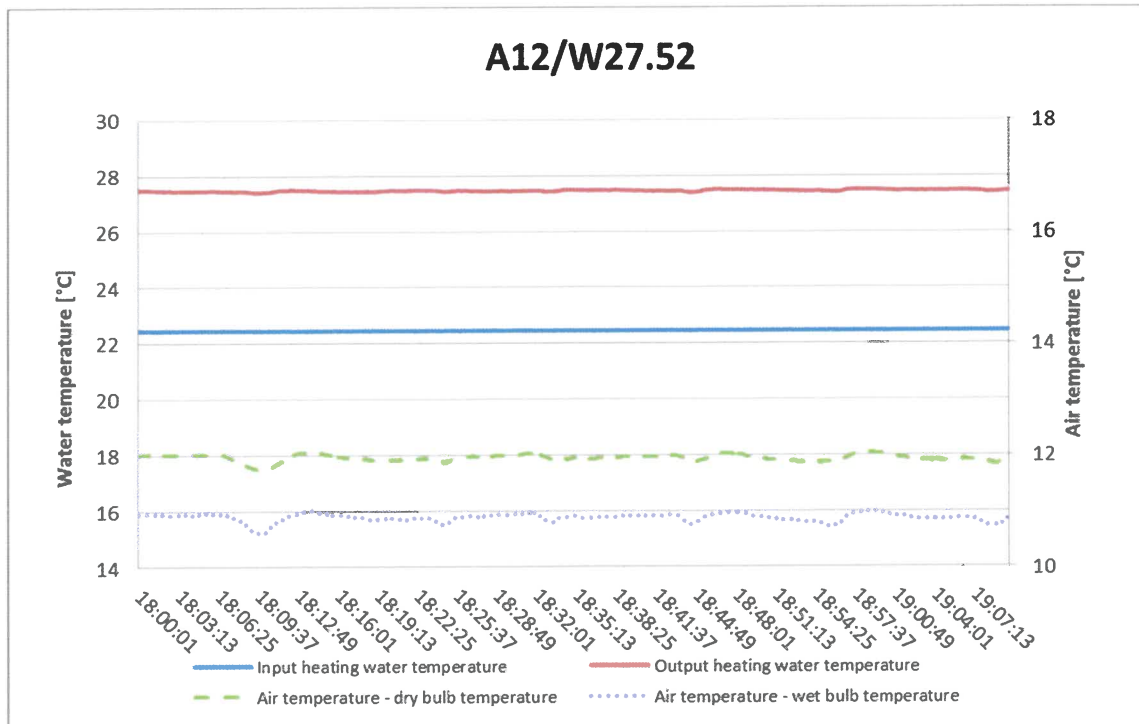
A2W30 (38 Hz)



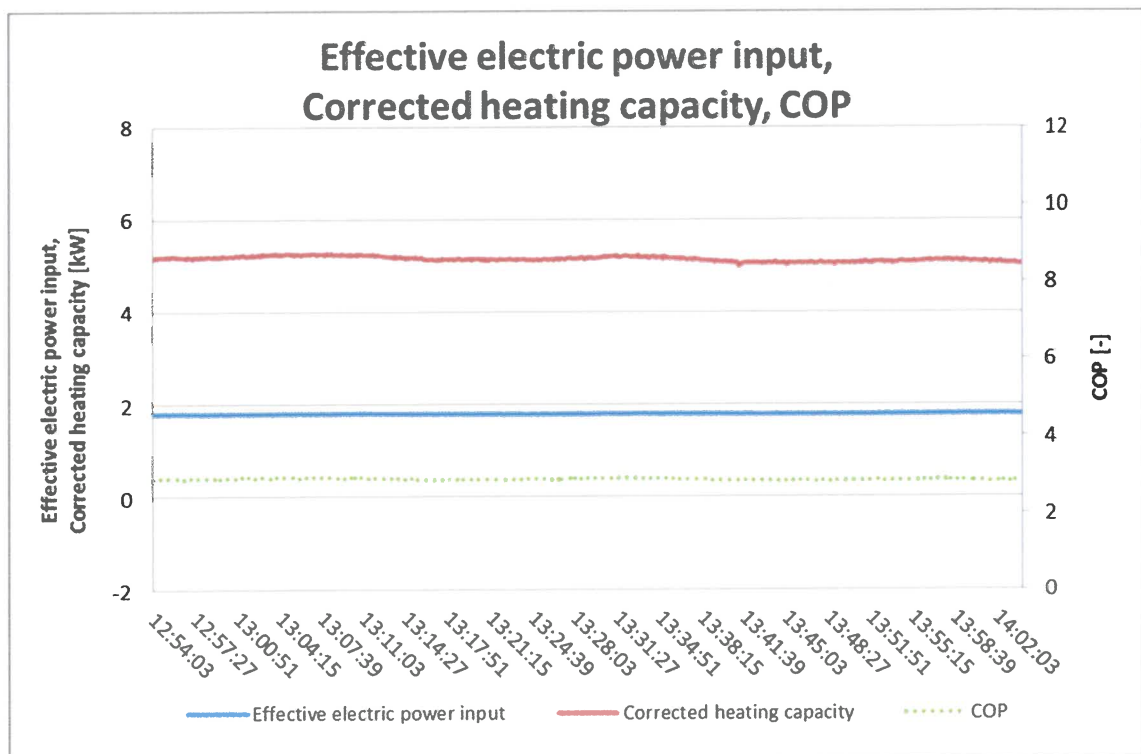
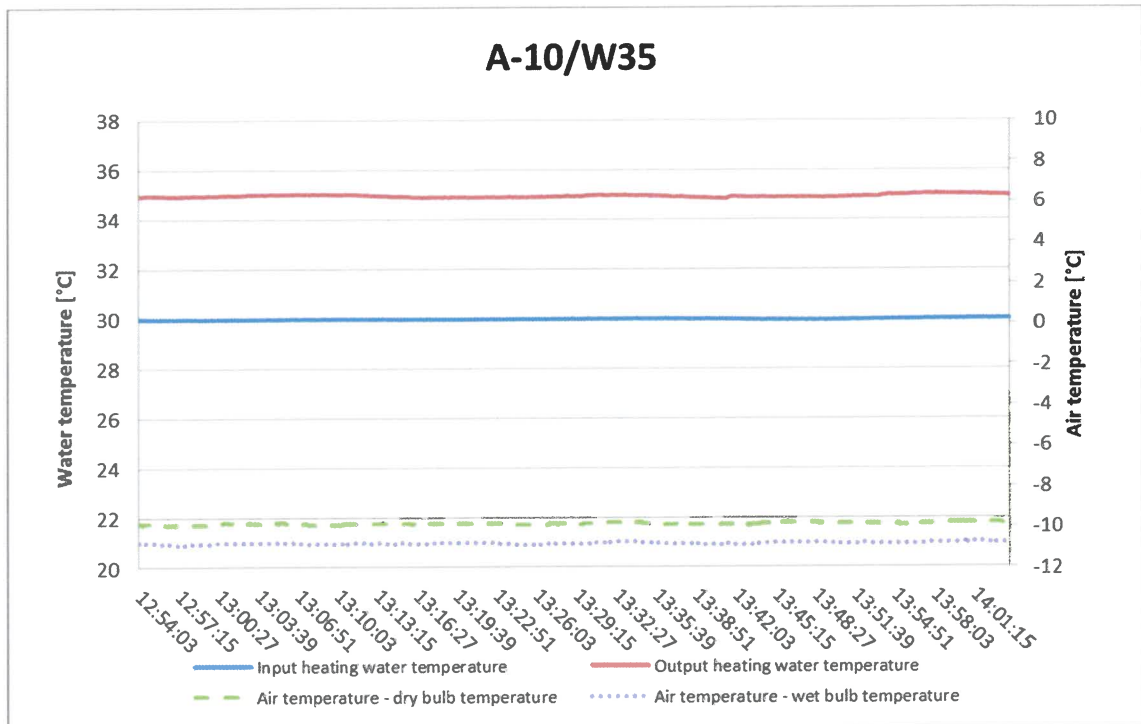
A7W28.26 (29 Hz)



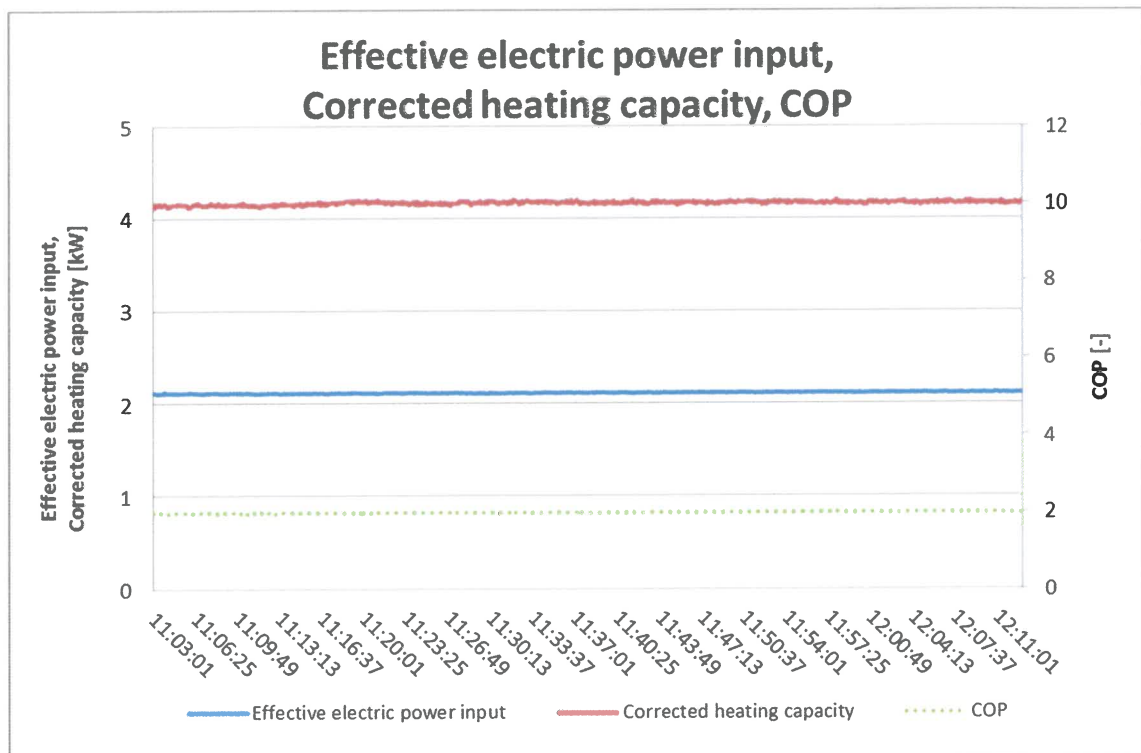
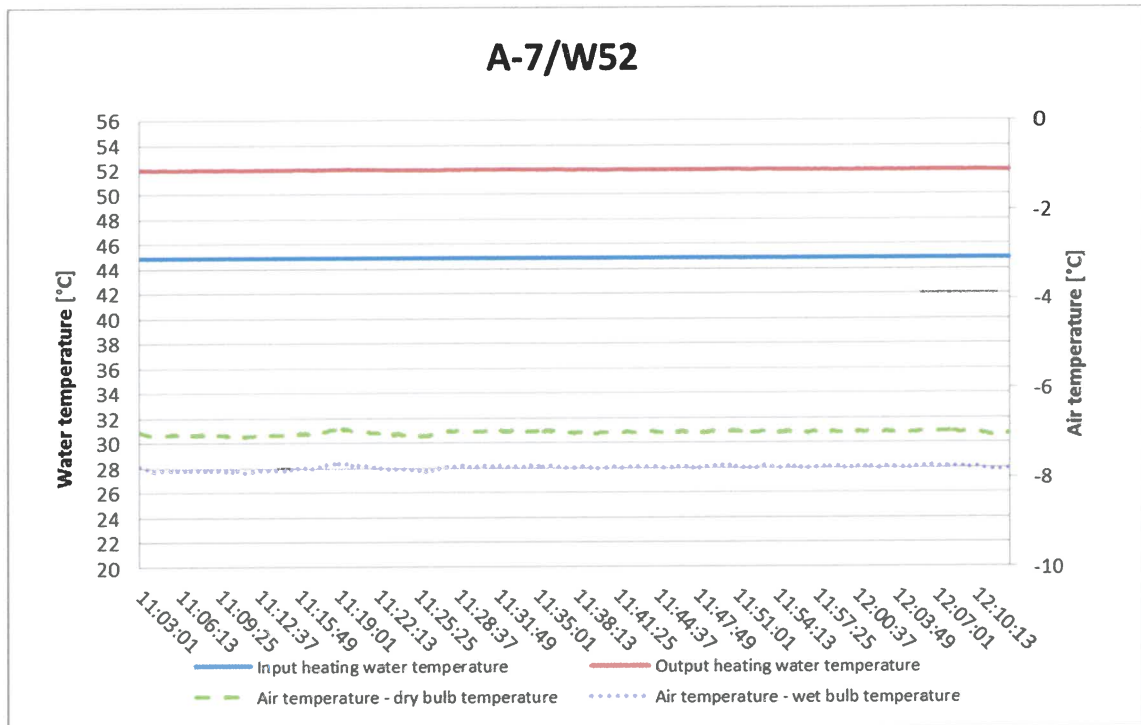
A12W27.52 (28 Hz)



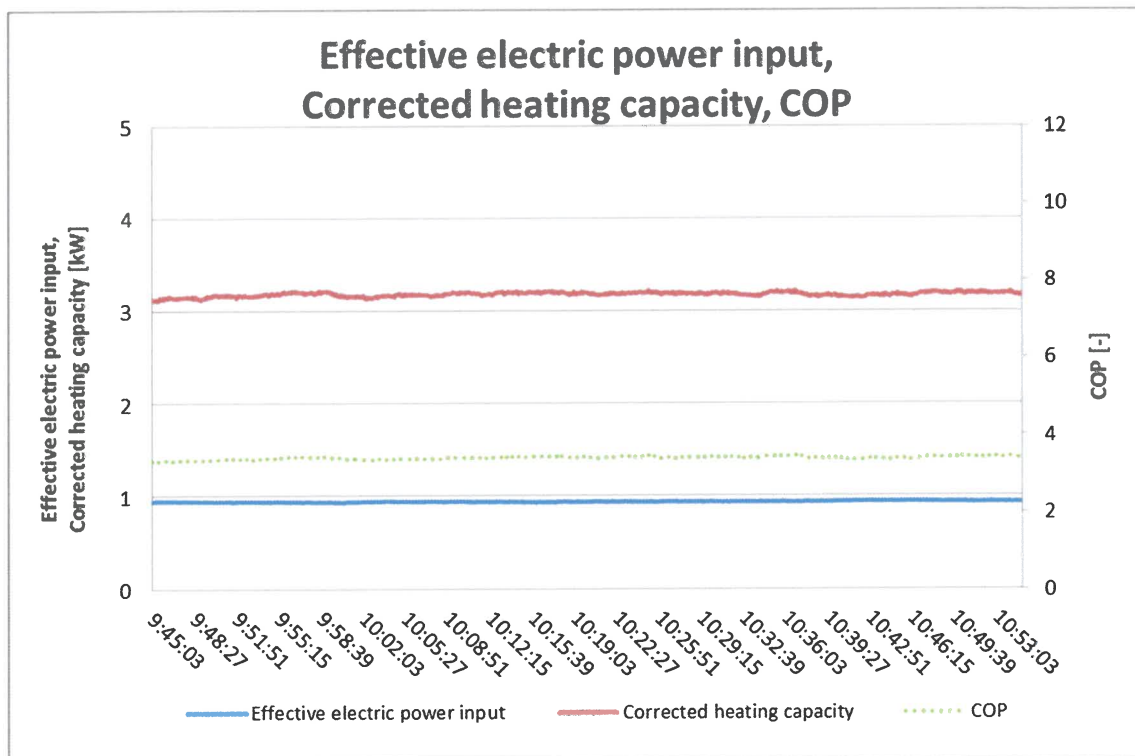
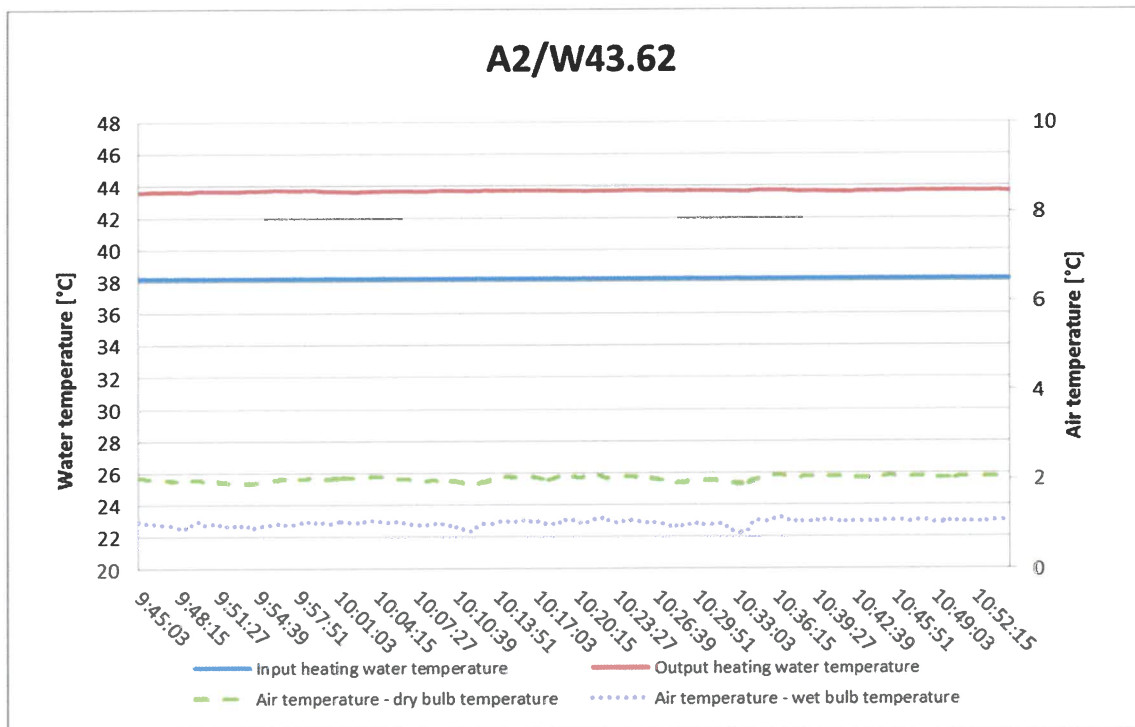
A-10W35 (90 Hz)



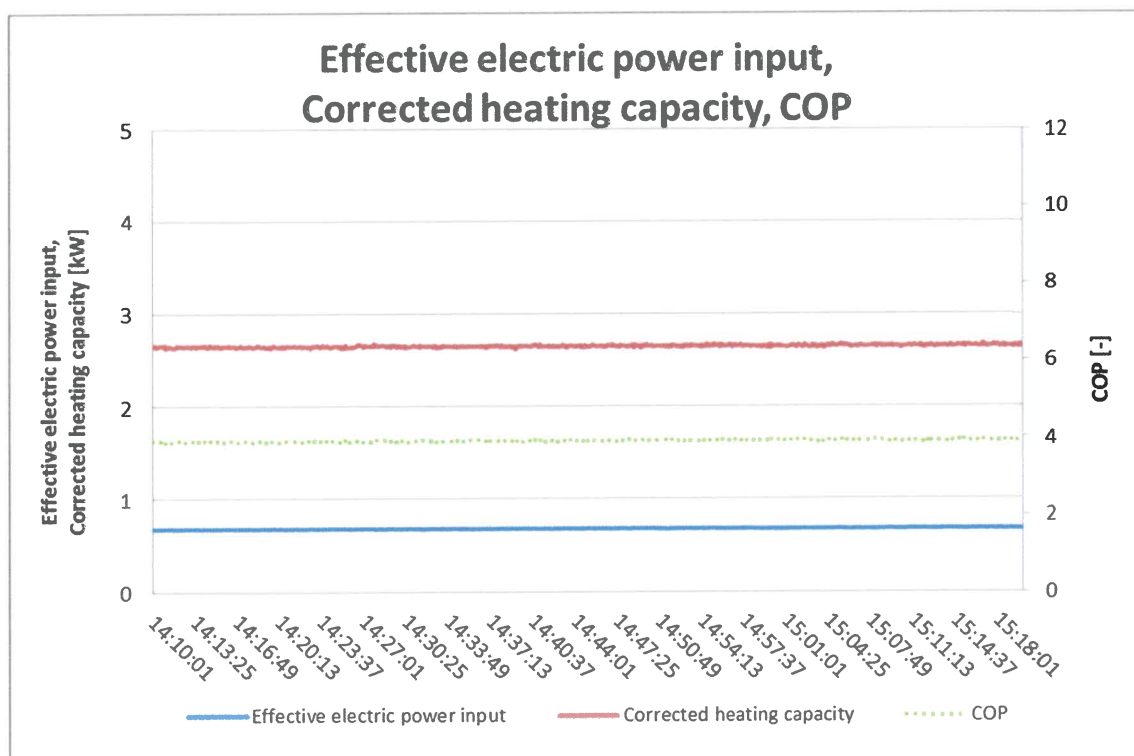
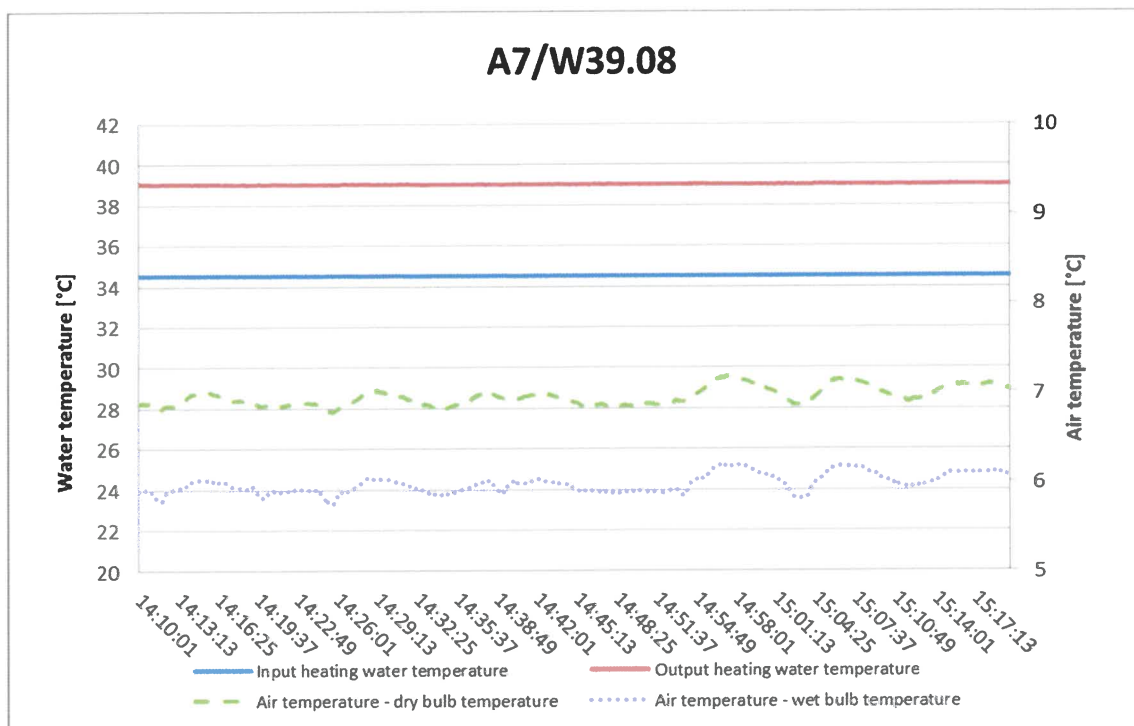
Medium temperature application
A-7W52 (84 Hz)



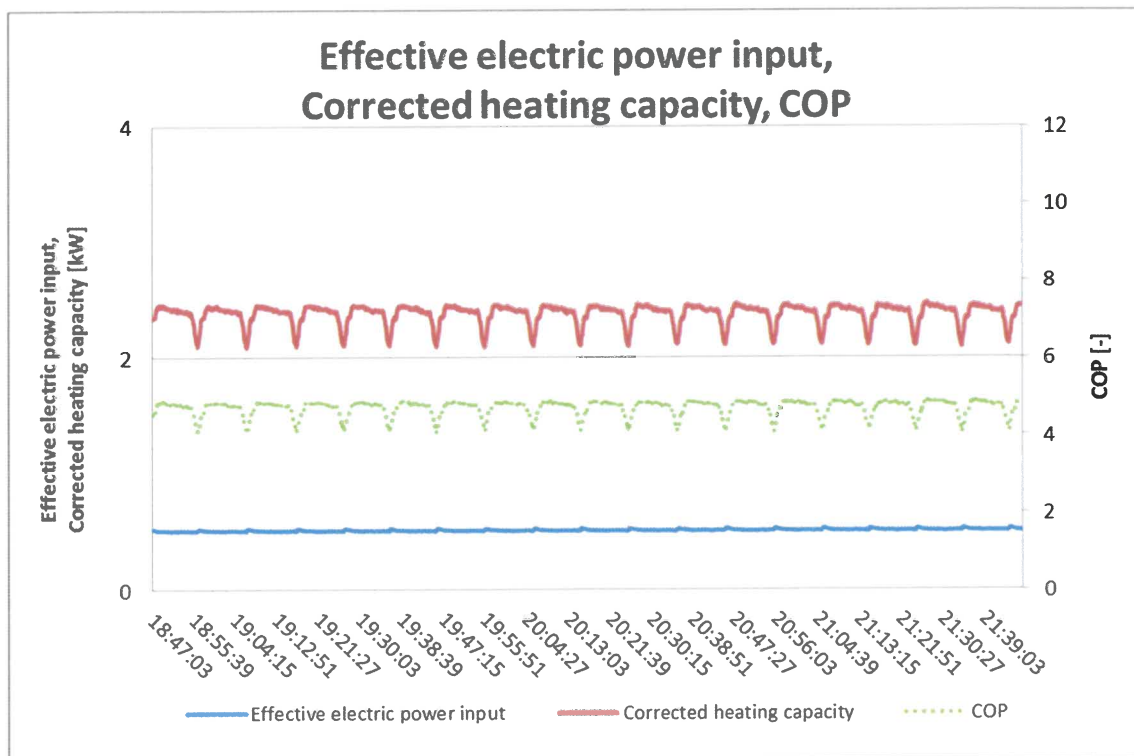
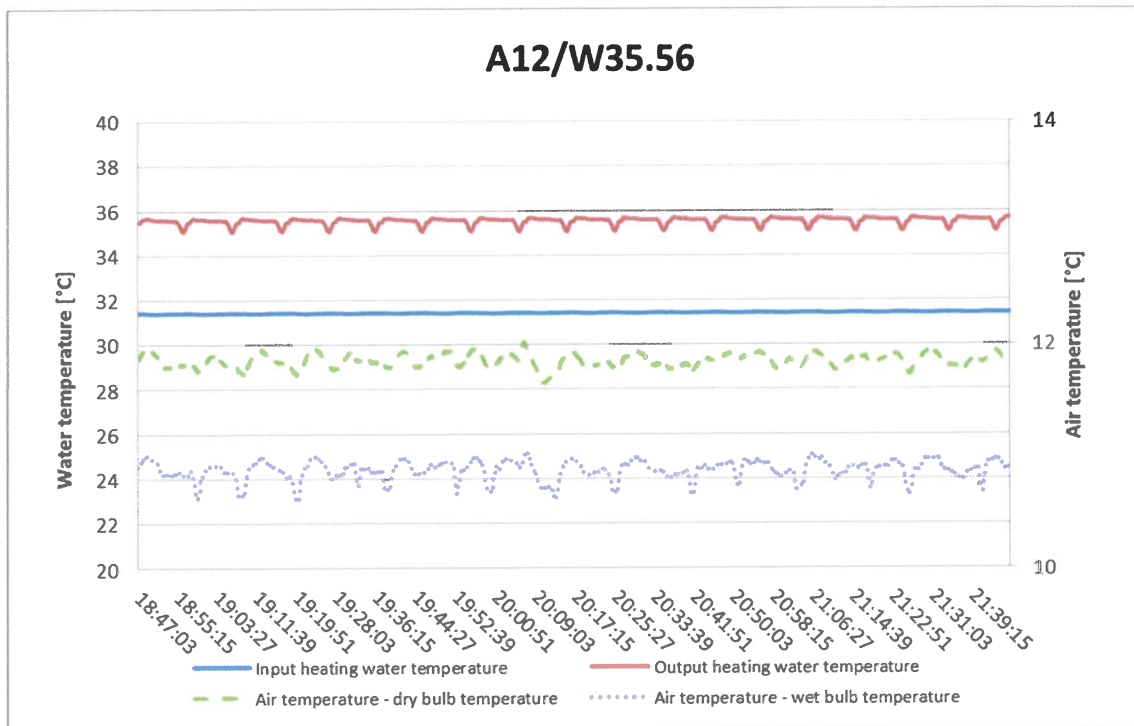
A2W43.62 (40 Hz)



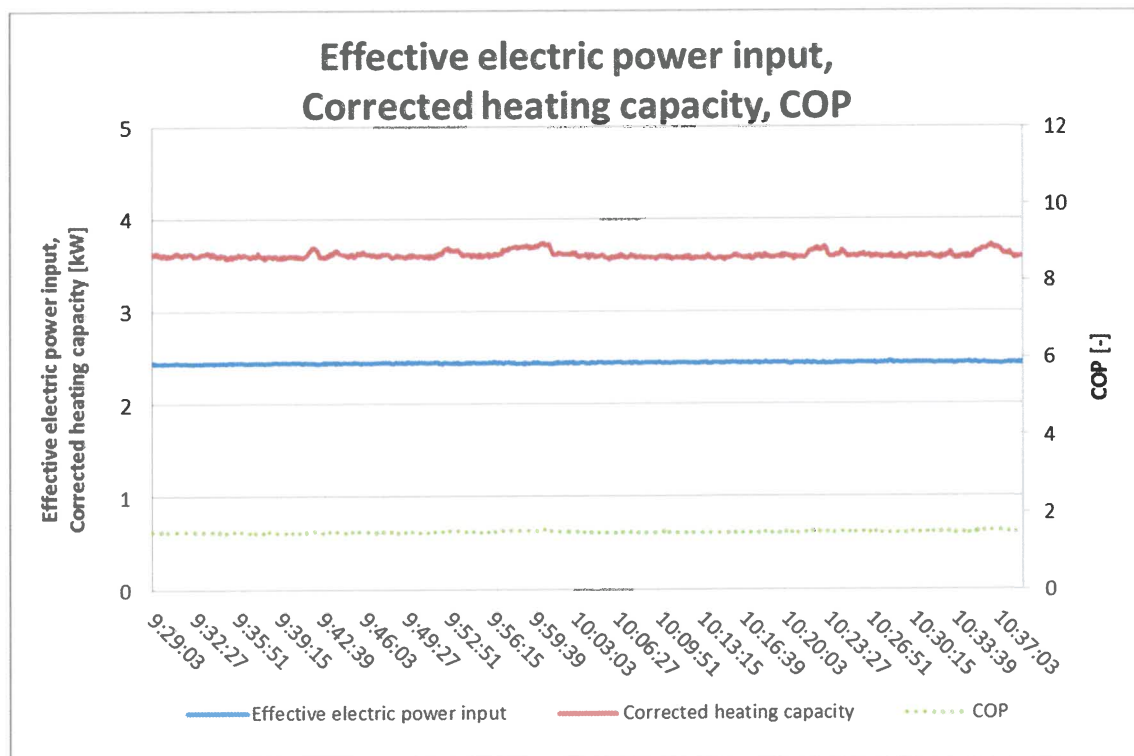
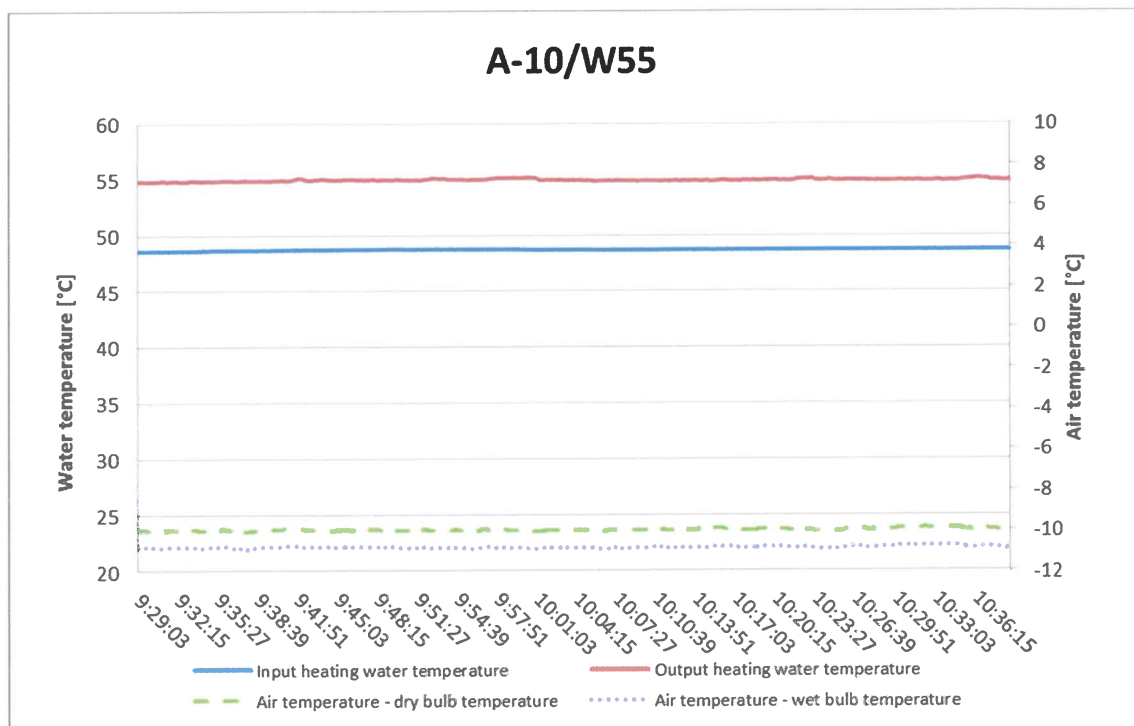
A7W39.08 (34 Hz)



A12W35.56 (28 Hz)



A-10W55 (90 Hz)

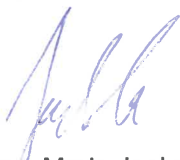


VI. A list of referenced documents

- Order of 2024-01-15 (Order reg. no. B-81200, received on 2024-01-15)
- Contract B-81200/39
- 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. Alexandr Jordanov



Test Report approved by:

Ing. Mario Jankola
Heating Equipment and Construction Products Manager



– End of Test Report –