

Sinop Triple Aqua Heat Pump Test Report



Test Report

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Summary

Sinop Triple Aqua CO₂ heating and cooling system is tested at Danfoss Application Development Center (ADC) Nordborg under calibrated heat pump test conditions. Testing includes **intermediate (IT) temperature heating** at standard SCOP conditions according to EN 14825:2022, as well as comparable conditions adjusted for a **larger water temperature difference**. Furthermore, **hot water production** and standardized **cooling** conditions (SEER) are covered in the test.

Conclusion

The heat pump's **heating performance** is maximized when operating with a 20K water temperature difference and a variable water outlet temperature, achieving a **seasonal coefficient of performance (SCOP) of 3,56**. This optimal strategy delivers a 24% better performance over standard test conditions with 5K water temperature difference.

For **cooling mode operation**, a **seasonal energy efficiency ratio (SEER) of 2,81** was measured. **Domestic hot water production** was found to lower the gas cooler pressure and improve performance in cooling mode operation.

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Background

Development of a 3-pipe CO₂ heating and cooling system as cooperation between Triple Aqua and Sinop. The development is supported by Danfoss with several components and testing at the Application Development Center (ADC) Nordborg. After functional testing in real outdoor air conditions (part 1, not part of this report), the unit is now tested in the psychrometric test chamber to optimize defrosting and evaluate performance under standardized test conditions for heating and cooling.

Task description

The unit is tested in standard EN 14825:2022 heat pump test conditions for intermediate temperature as well as a CO₂-adjusted version of the same conditions. Furthermore, hot water generation at 65°C and 75°C and cooling operation under standard test conditions is tested.

Applicable test standards

- EN 14511:2022 Air conditioners, liquid chilling packages and heat pumps for space heating and cooling and process chillers, with electrically driven compressors
- EN 14825:2022 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

Abbreviations

- SCOP Seasonal coefficient of performance (applicable for heating mode operation, see EN 14825:2022)
- SEER Seasonal energy efficiency ratio (applicable for cooling mode operation, see EN 14825:2022)
- Cpr compressor
- dP differential pressure across plate heat exchanger on water side of the test unit, in mbar
- Tdb dry-bulb air temperature in the test chamber, in °C
- Twb wet bulb air temperature in test chamber, in °C
- RH relative humidity in test chamber, in %
- SH superheat, in K
- EWT entering water temperature (into the heat pump), in °C
- LWT leaving water temperature (out of the heat pump), in °C
- dT temperature difference between EWT and LWT, in K
- COP coefficient of performance, either in heating or cooling mode (water-side capacity per power input)
- Uncalib Uncalibrated test data value (obtained from system controller)
- A7W35 *Example of (standard) test condition abbreviation. Here: Tdb = 7°C | Twb = Tdb – 1°C = 6°C | LWT = 35°C*

Test sample

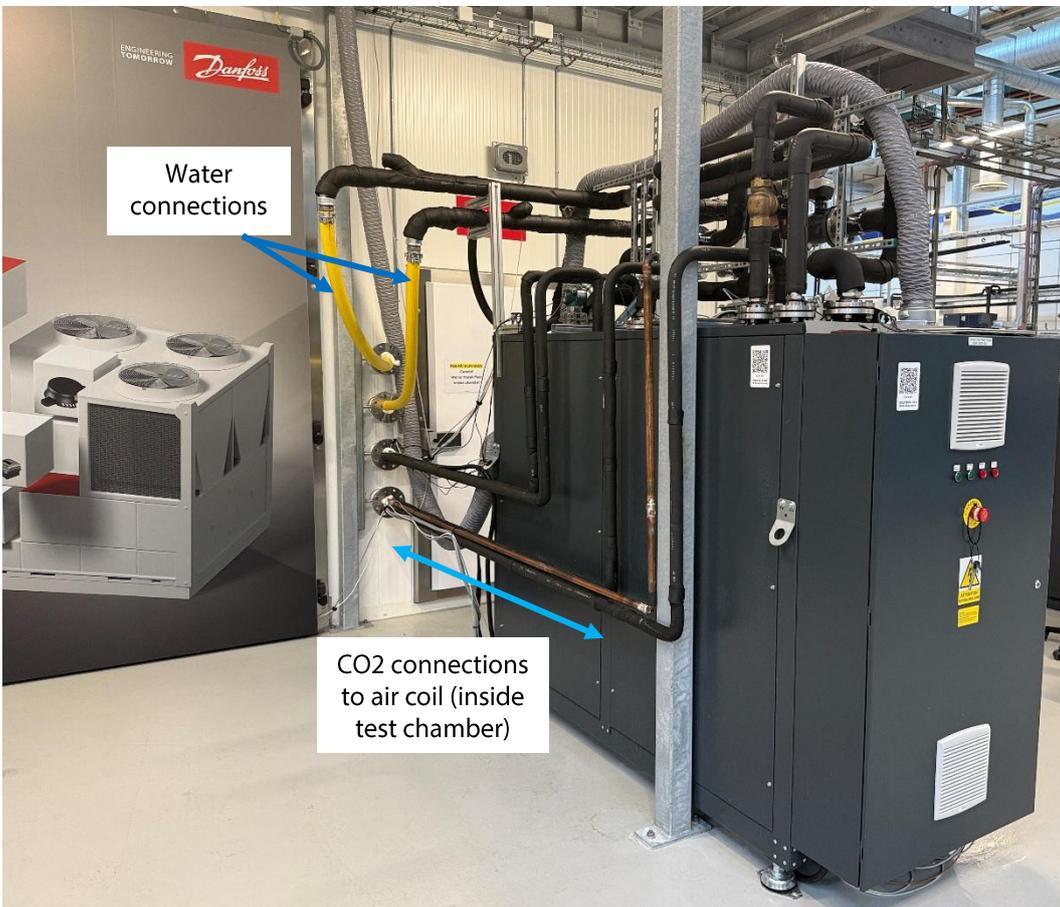
- Test unit built by Sinop and Triple Aqua:
 - Outdoor coil placed in Danfoss psychrometric test chamber Pos. 146 at Danfoss ADC Nordborg (see figure below).
 - Indoor machine setup and water-side connections placed in adjacent lab environment (see figure below).
 - Connecting refrigerant pipes between indoor and outdoor part were custom fitted for the test setup, each with about 5 meters length.
 - Compressors: 2x Bock HGX24/90-4 S CO₂ T, frequency controlled in range 30-70 Hz.
 - Control system based on Danfoss Alsmart platform with software version from 23-09-2025.
- Water circuit: The unit was tested not with the original water management system by Sinop but with a temporary water piping setup. The setup contains one main water flow with flow measurements and differential pressure measurement. This flow is split up into the heating, cooling and heat recovery water flows at the unit, which can be controlled by individual valves.
- Refrigerant charge: 43,2 kg of R744 (CO₂).
- Oil charge: 1 liter of oil added to the pre-charged amount of oil in compressors (1,5 liters per compressor).

Test setup

Air coil, placed inside test chamber



Machine setup, placed in adjacent lab area, with water connections



Test equipment

List of measurement equipment

Temperature sensors

Sensor ID	Calibr. ID	Description	Sensor placement for test
TT101	337762	water temp, unit inlet (inserted)	Water inlet temperature to test unit
TT102	337763	water temp, unit outlet (inserted)	Water outlet temperature from test unit
TT201	337611	air temperature	Part of "Tair_avg" average air temperature
TT202	337656	air temperature	Part of "Tair_avg" average air temperature
TT203	337657	air temperature	Part of "Tair_avg" average air temperature
TT204	337658	air temperature	Part of "Tair_avg" average air temperature
TT205	337659	air temperature	Part of "Tair_avg" average air temperature
TT206	337660	air temperature	Part of "Tair_avg" average air temperature
TT301	337669	water temp (outside at pipe)	Water Cooling, forward (LWT)
TT319	337714	water temp (outside at pipe)	Water Heating, forward (LWT)
TT320	337715	water temp (outside at pipe)	Water "Heat Recovery"/DHW, forward (LWT)

Pressure sensors

Sensor ID	Calibr. ID	Description	Sensor placement for test
PT305	337727	test unit pressure 0-16 bar(a)	LP suction pressure
PT311	337734	test unit pressure 0-160 bar(a)	HP gas cooler outlet pressure

Combined temperature/humidity sensors for air inlet measurement

Sensor ID	Calibr. ID	Description	Sensor Placement for test
TT221/ RH221	337741	temperature/humidity sensor	Part of "Tair_avg"/"RH_avg" average air temperature and humidity
TT222/ RH222	337742	temperature/humidity sensor	Part of "Tair_avg"/"RH_avg" average air temperature and humidity
TT223/ RH223	337743	temperature/humidity sensor	Part of "Tair_avg"/"RH_avg" average air temperature and humidity
TT224/ RH224	337744	temperature/humidity sensor	Part of "Tair_avg"/"RH_avg" average air temperature and humidity
TT225/ RH225	337745	temperature/humidity sensor	Part of "Tair_avg"/"RH_avg" average air temperature and humidity
TT226/ RH226	337746	temperature/humidity sensor	Part of "Tair_avg"/"RH_avg" average air temperature and humidity

Other sensors

Sensor ID	Calibr. ID	Description	Sensor Placement for test
FT-101	345841	water flow meter, DN25	Water line, option 1
FT-102	345842	water flow meter, DN40	Water line, option 2
WM-ext	346183	electrical power meter, external	Measures complete power supply to the test unit (including electrical controls, fans, compressors etc.)
dP-101	339904	water differential pressure	Water line between test unit water inlet and outlet

Notes on sensor placement and uncertainty

- Air temperature/humidity sensors are distributed equally across the complete air inlet of the heat pump.
- All measurements are provided with the maximum expanded uncertainty required in standard EN 14511:2022.
- Either flow meter FT-101 or flow meter FT-102 is used, depending on the flow range.

Test procedure

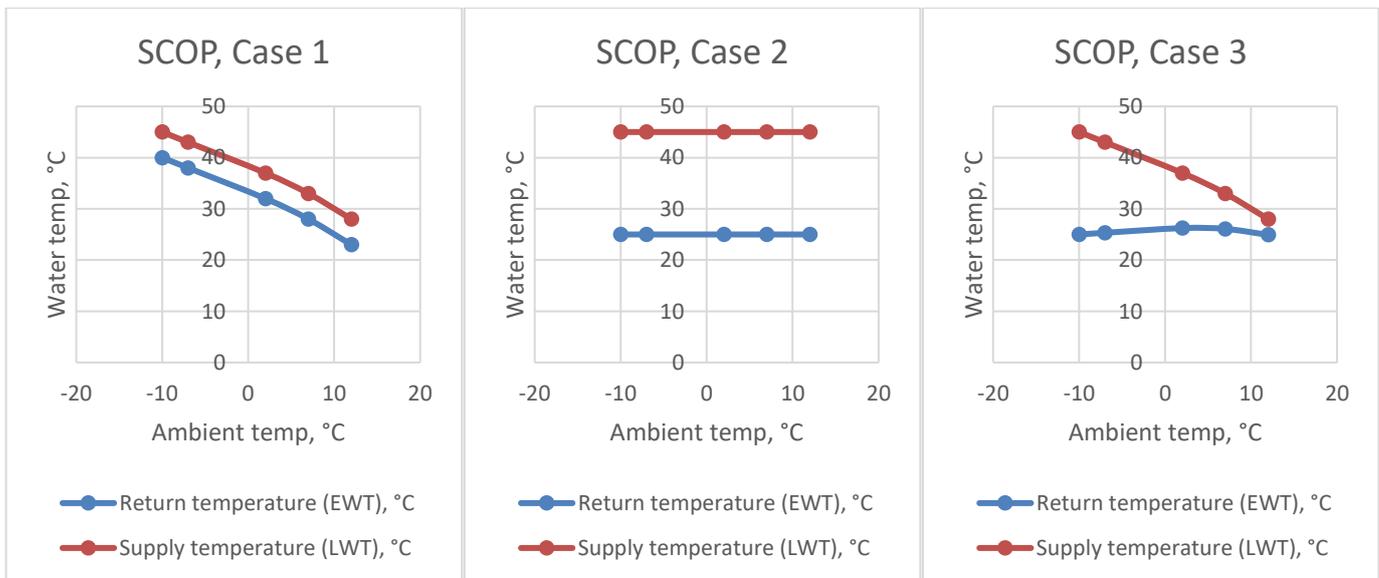
Following an initial functional check of the unit in outdoor ambient air at ADC Nordborg (not part of this report), the air coil of the system was cleaned to ensure proper measurements. For the calibrated testing, the outdoor air coil was then placed inside Pos. 146 HP test chamber while the indoor machine part was installed in front of the test chamber.

(S)COP heating test conditions

All SCOP tests were conducted at intermediate temperature (IT) air-to-water heat pump test conditions in outdoor air, with indoor heat exchangers in average climate (EN 14825:2022, section 6.4.3).

- SCOP case 1 was conducted with a **water temperature difference of 5K** in condition "E" (100% capacity), variable water outlet temperature and variable water flow (see figure below).
- For SCOP cases 2 and 3, the same test standard conditions were adjusted for a **water temperature difference of 20K** at test condition "E" (100% capacity), to fit the targeted application of the unit.
 - SCOP case 2 is run with fixed water outlet temperature and variable water flow (see figure below).
 - SCOP case 3 is run with variable water outlet temperature and fixed water flow (see figure below).

Water temperatures for SCOP test cases 1, 2 and 3:



5K temperature difference	20K temperature difference	20K temperature difference
VARIABLE supply temperature	FIXED supply temperature	VARIABLE supply temperature
VARIABLE water flow rate	VARIABLE water flow rate	FIXED water flow rate

For all SCOP test cases, the air temperatures and capacity targets are as follows, as described in EN 14825:2022.

SCOP condition	Air dry bulb temperature, °C	Air wet bulb temperature, °C	Capacity target, %	Running hours for temperature bin group *	Running hours % for temperature bin group *
E	-10	-11	100,00		
A	-7	-8	88,46	348	7%
B	2	1	53,85	1891	39%
C	7	6	34,62	1642	33%
D	12	11	15,38	1029	21%

Additional heating test conditions “HIGH” and “ULTRA”

Focus of these test conditions is a **large water temperature difference** for hot water production. During the test, hot water is produced on the main warm water heat exchanger.

Condition	Air dry bulb temperature, °C	Air wet bulb temperature, °C	Return water temperature (EWT), °C	Supply water temperature (LWT), °C	Capacity target %
HIGH A-10	-10	-11	35	65	100,00
ULTRA A-10	-10	-11	35	75	100,00

(S)EER cooling test conditions

SEER test was performed for air-to-water units in outdoor air, with indoor fan coil application at variable water outlet temperature and fixed water flow (EN 14825:2022, section 4.4).

For all SEER tests, the **maximum compressor frequency** was reduced from 70 Hz to 62 Hz in the inverters to remain within the compressor operating limits. 62 Hz on both compressors thus corresponds to 100% compressor load in these cases.

SEER condition	Air dry bulb temperature, °C	Return water temperature (EWT), °C	Supply water temperature (LWT), °C	Capacity target %	Running hours for temperature bin group *	Running hours % for temperature bin group *
A	35	12	7	100,00	71	3%
B	30	13,5	8,5	73,68	330	13%
C	25	15	10	47,37	888	34%
D	20	16,5	11,5	21,06	1313	50%

* For illustration purposes, the running hours for the individual temperature bins in EN 14825:2022 have been grouped around the respective SCOP/SEER test conditions to provide a quick impression of their distribution. This grouping is only intended to give an overview of the rough distribution of running hours. The final SCOP/SEER values presented in this report are calculated according to EN 14825:2022, using individual temperature bins in 1 K outdoor air temperature steps, with capacities and running hours interpolated between the measured conditions.

Cooling test condition, effect of domestic hot water (DHW)

The effect of DHW on the cooling EER is evaluated for a specific cooling test condition. Cold water is produced on the cold water plate heat exchanger (evaporator); domestic hot water is produced (in the first condition) on the HR plate heat exchanger; remaining heat is after the HR plate heat exchanger rejected via the outdoor air coil (gas cooler).

Condition	Air dry bulb temperature, °C	Return water temperature (EWT), °C	Cooling, Supply water temp. (LWT), °C	DHW, Supply water temp. (EWT)	Capacity target %
Cooling + DHW	35	25	7	65	100,00
Cooling Only	35	25	7	-	100,00

Data and result reporting

For all conditions, the **power input, heating or cooling capacity** and **COP or EER** are reported as **“corrected” values**, meaning that the recorded measurements have been corrected for the non-integrated liquid pump based on the differential pressure measurement, as described in EN 14825:2022.

If not stated otherwise, all **provided test data** are average values over the respective required data recording time period, recorded as calibrated measurements according to EN 14511:2022.

SCOP and SEER are calculated based on the individual measurements of COP and EER according to EN 14825:2022. For cases where the capacity of the unit exceeded the capacity target, on/off cycling correction was applied and a standard degradation coefficient of 0.9 is applied as recommended in EN 14825:2022.

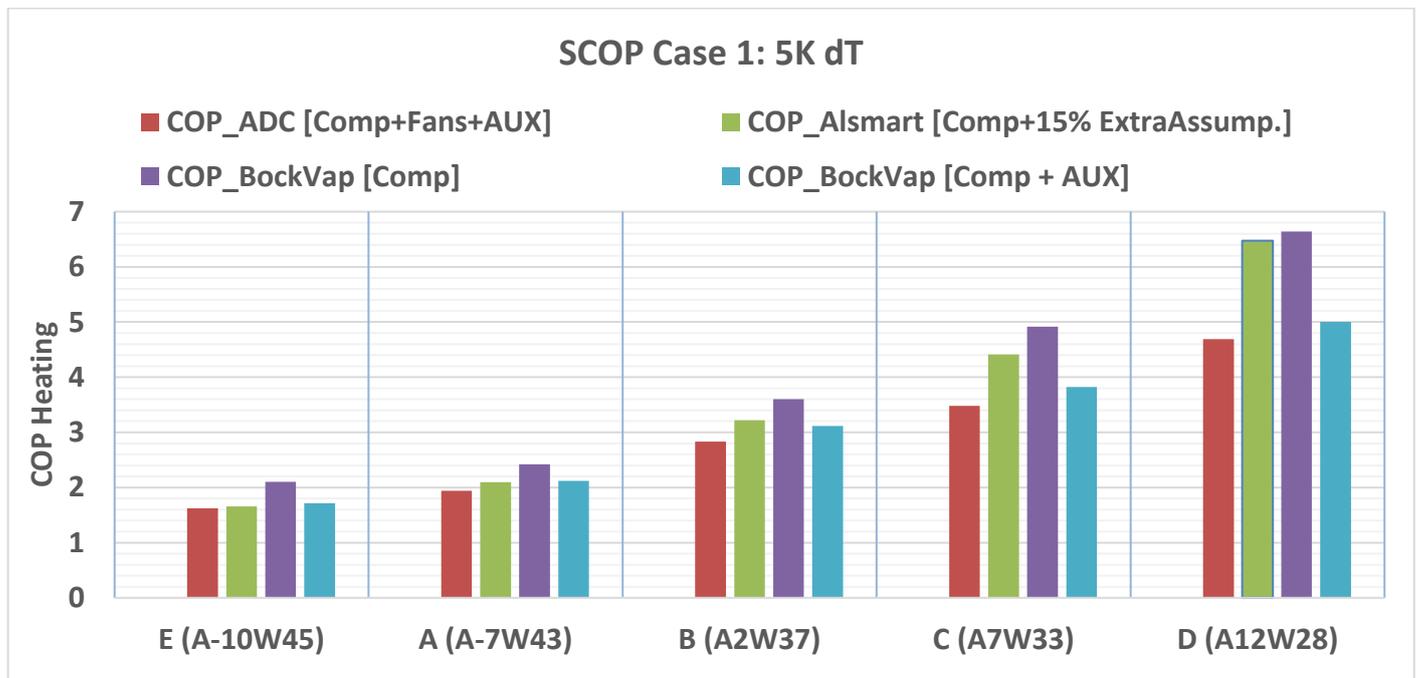
To compare the data to theoretical compressor data, the following 4 COP/EER values are indicated for each test condition in the result charts and tables:

- **COP/EER ADC [Comp+Fans+AUX]** (or “COP Heating, corrected” / “EER Cooling, corrected”):
 - Calibrated COP or EER measurement based on laboratory measurements
 - The heating or cooling capacity is calculated from the measured water flow, water inlet temperature (EWT) and water outlet temperature (LWT).
 - The power input is measured as total input to the entire test unit.
 - The given values are corrected for liquid pump power consumption according to EN 14825:2022.
- **COP/EER Alsmart [Comp+15% ExtraAssump.]** (or “COP (Alsmart)” / “EER (Alsmart)”):
 - Uncalibrated internal calculation of the COP or EER based on enthalpies at compressor inlet and outlet and gas cooler outlet. The respective enthalpies are calculated based on the measured temperatures and pressures in the Alsmart controller.
 - The value is adjusted with a correction factor assuming a fixed ratio of 15% auxiliary power consumption, based on observations in other CO₂ systems.
- **COP/EER BockVap [Comp]:**
 - Theoretical COP or EER value only for the compressors, based on Bock VAP selection tool.
 - The value excludes any auxiliary consumption or heat losses, therefore, a higher COP or EER is generally to be expected for this value.
- **COP/EER BockVap [Comp + AUX]:**
 - Theoretical COP or EER value based on the *COP/EER_BockVap [Comp]*. The obtained value for the compressor only is multiplied with a correction factor for the auxiliary power consumption.
 - The correction factor for the auxiliary power consumption is obtained as ratio between the real measured power consumption (used in *COP/EER_ADC [Comp+Fans+AUX]*) and the power consumption obtained in the Bock VAP selection tool.

Test results

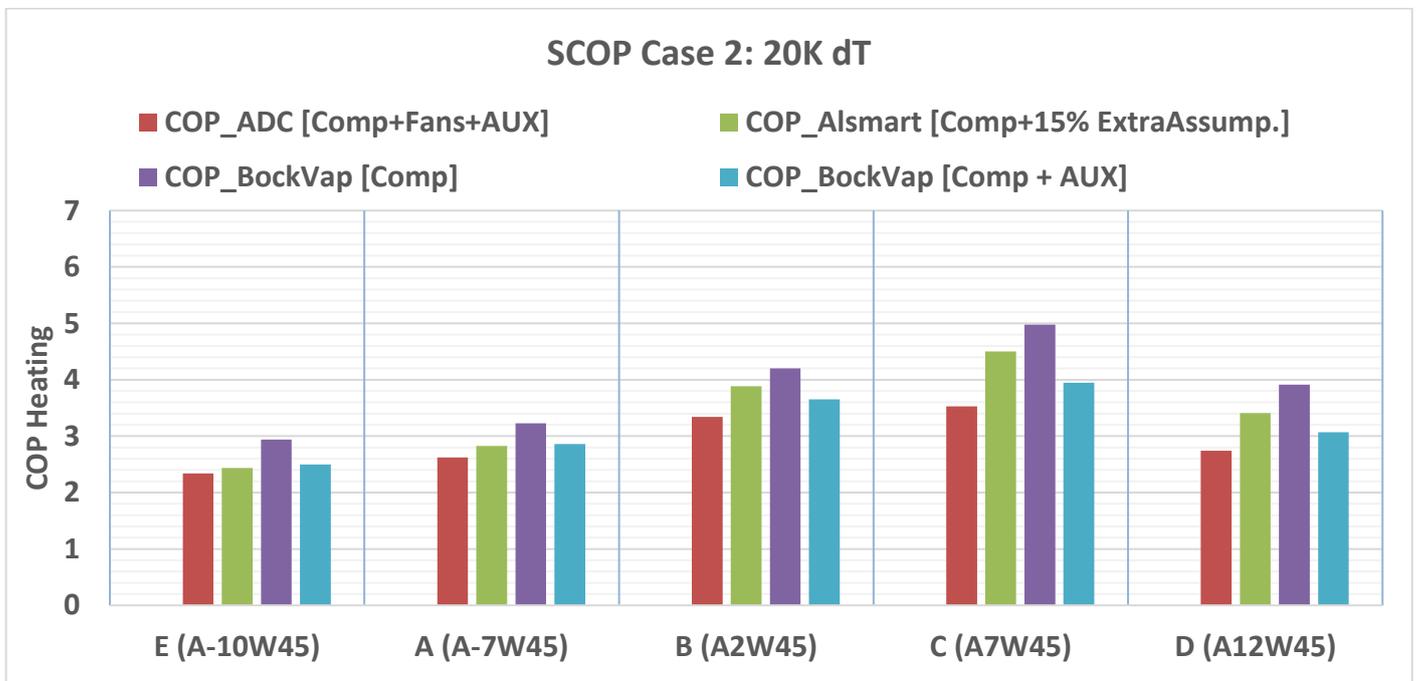
COPs for SCOP Case 1 conditions: 5K dT, variable outlet temperature | variable water flow

Test condition	E (A-10W45)	A (A-7W43)	B (A2W37)	C (A7W33)	D (A12W28)
Water return (EWT), °C	39,86	38,01	31,99	28,55	26,43
Water supply (LWT), °C	45,50	42,89	37,03	33,55	31,43
Water flow, m ³ /h	8,10	8,15	4,93	3,55	4,18
Air temperature, °C	-10,01	-7,01	2,02	7,00	12,00
Air relative humidity, %	75,23	75,87	83,22	87,07	89,06
Suction pressure, bar(a)	23,88	25,61	33,32	38,37	43,32
Sat. suction temperature, °C (calculated)	-13,26	-10,81	-1,38	3,88	8,58
Gas cooler outlet pressure, bar(a)	96,20	98,77	85,39	77,49	73,02
Gas cooler outlet temperature, (uncalib), °C	40,73	38,78	32,88	29,40	27,31
Suction SH (uncalib), K	4,01	5,41	6,01	5,99	6,02
Power Input, kW, corrected	32,70	23,80	10,18	5,91	5,18
Heating Cap, kW, corrected	53,09	46,15	28,84	20,58	24,28
COP Heating, corrected	1,62	1,94	2,83	3,48	4,69
COP Heating (Alsmart)	1,66	2,10	3,22	4,41	6,47
Compressor 1 Speed (calc), Hz	70,00	54,08	-	-	-
Compressor 2 Speed (calc), Hz	70,00	54,08	49,81	30,00	30,00



COPs for SCOP Case 2 conditions: 20K dT, fixed outlet temperature | variable water flow

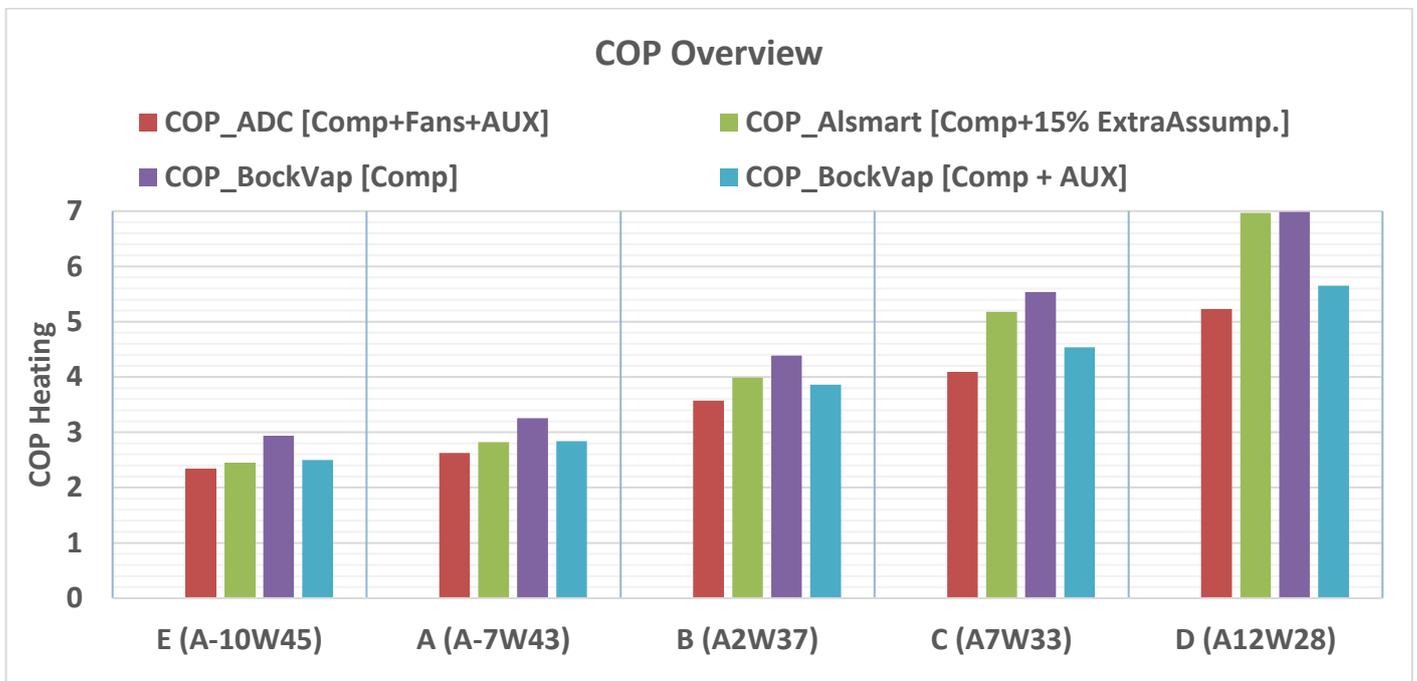
Test condition	E (A-10W45)	A (A-7W45)	B (A2W45)	C (A7W45)	D (A12W45)
Water return (EWT), °C	24,95	25,01	24,98	24,99	35,65
Water supply (LWT), °C	44,93	44,99	44,96	45,15	55,61
Water flow, m3/h	2,65	2,34	1,41	0,92	0,88
Air temperature, °C	-10,00	-7,00	2,02	7,00	12,00
Air relative humidity, %	67,87	71,15	83,13	87,08	89,06
Suction pressure, bar(a)	22,29	24,62	32,91	38,34	43,42
Sat. suction temperature, °C (calculated)	-15,58	-12,15	-1,85	3,85	8,64
Gas cooler outlet pressure, bar(a)	76,39	77,44	79,31	80,43	95,62
Gas cooler outlet temperature, (uncalib), °C	27,24	27,53	27,43	27,46	37,43
Suction SH (uncalib), K	10,00	6,00	6,02	6,00	6,00
Power Input, kW, corrected	26,10	20,56	9,71	6,06	7,40
Heating Cap, kW, corrected	61,13	53,96	32,42	21,38	20,30
COP Heating, corrected	2,34	2,62	3,34	3,53	2,74
COP Heating (Alsmart)	2,44	2,82	3,88	4,50	3,41
Compressor 1 Speed (calc), Hz	70,00	57,15	-	-	-
Compressor 2 Speed (calc), Hz	70,00	57,15	51,68	30,00	30,00



For case 2 condition "D", a higher supply temperature than 45°C is required during operation based on the test standard EN 14825:2022, due to the required On/Off cycling in this condition (minimum capacity of the unit is above required capacity). This penalty has a significant effect on the COP here. The alternative option to reduce the gas cooler pressure until reaching target capacity in steady-state operation yielded even lower performance in condition "D".

COPs for SCOP Case 3 conditions: 20K dT, variable outlet temperature | fixed water flow

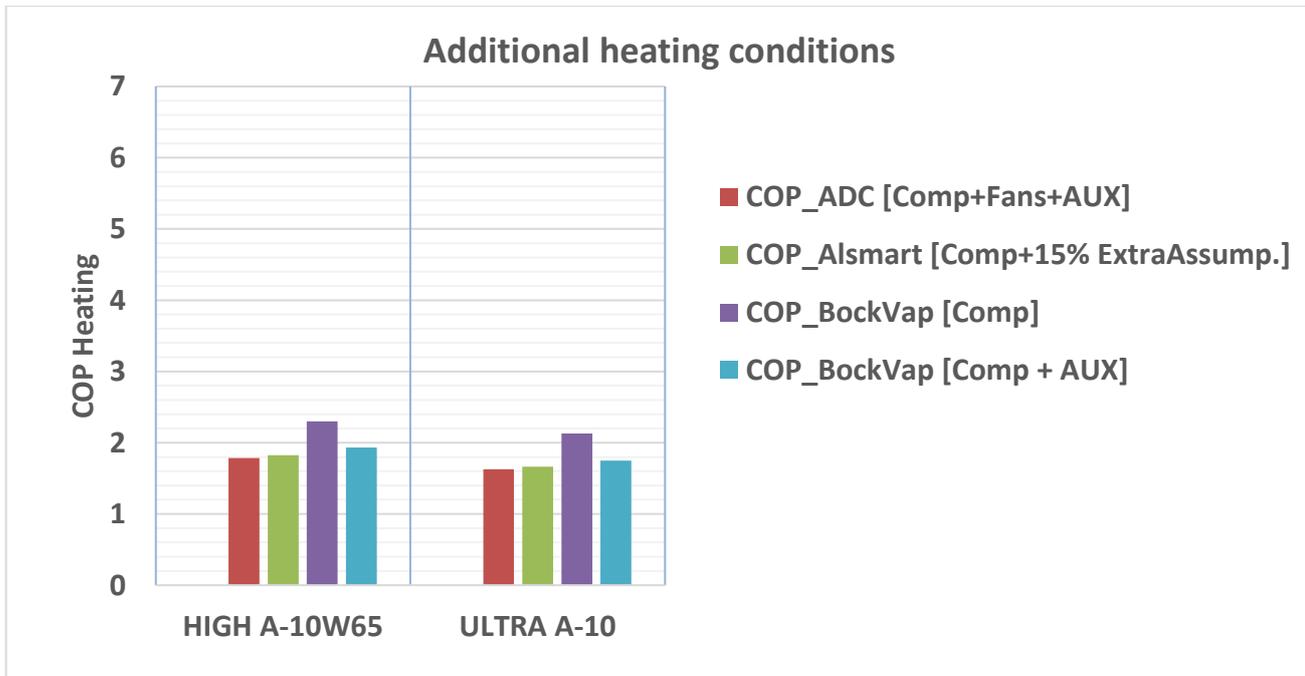
Test condition	E (A-10W45)	A (A-7W43)	B (A2W37)	C (A7W33)	D (A12W28)
Water return (EWT), °C	24,95	25,33	26,16	26,20	24,95
Water supply (LWT), °C	44,93	43,05	36,94	33,05	32,91
Water flow, m3/h	2,65	2,65	2,65	2,65	2,65
Air temperature, °C	-10,00	-6,99	2,02	7,01	12,00
Air relative humidity, %	67,87	73,76	83,63	86,84	88,97
Suction pressure, bar(a)	22,29	24,62	32,62	38,40	43,36
Sat. suction temperature, °C (calculated)	-15,58	-12,15	-2,17	3,92	8,62
Gas cooler outlet pressure, bar(a)	76,39	77,44	73,92	72,63	71,36
Gas cooler outlet temperature, (uncalib), °C	27,24	27,53	27,71	27,12	26,52
Suction SH (uncalib), K	10,00	6,00	6,01	6,00	6,00
Power Input, kW, corrected	26,10	20,78	9,25	5,13	4,67
Heating Cap, kW, corrected	61,13	54,22	33,03	21,02	24,44
COP Heating, corrected	2,34	2,61	3,57	4,09	5,23
COP Heating (Alsmart)	2,44	2,82	3,99	5,18	6,97
Compressor 1 Speed (calc), Hz	70,00	57,15	-	-	-
Compressor 2 Speed (calc), Hz	70,00	57,15	53,87	30,00	30,00



Case 3 condition "E" is equal to case 2 condition "E". For conditions "A" – "D", a better performance can be observed compared to case 2 due to the reduced water outlet temperature in case 3. The main benefit is visible in condition "D", where the penalty due to on/off cycling according to EN 14825:2022 is significantly lower in case 3 due to the lower temperature difference in this condition.

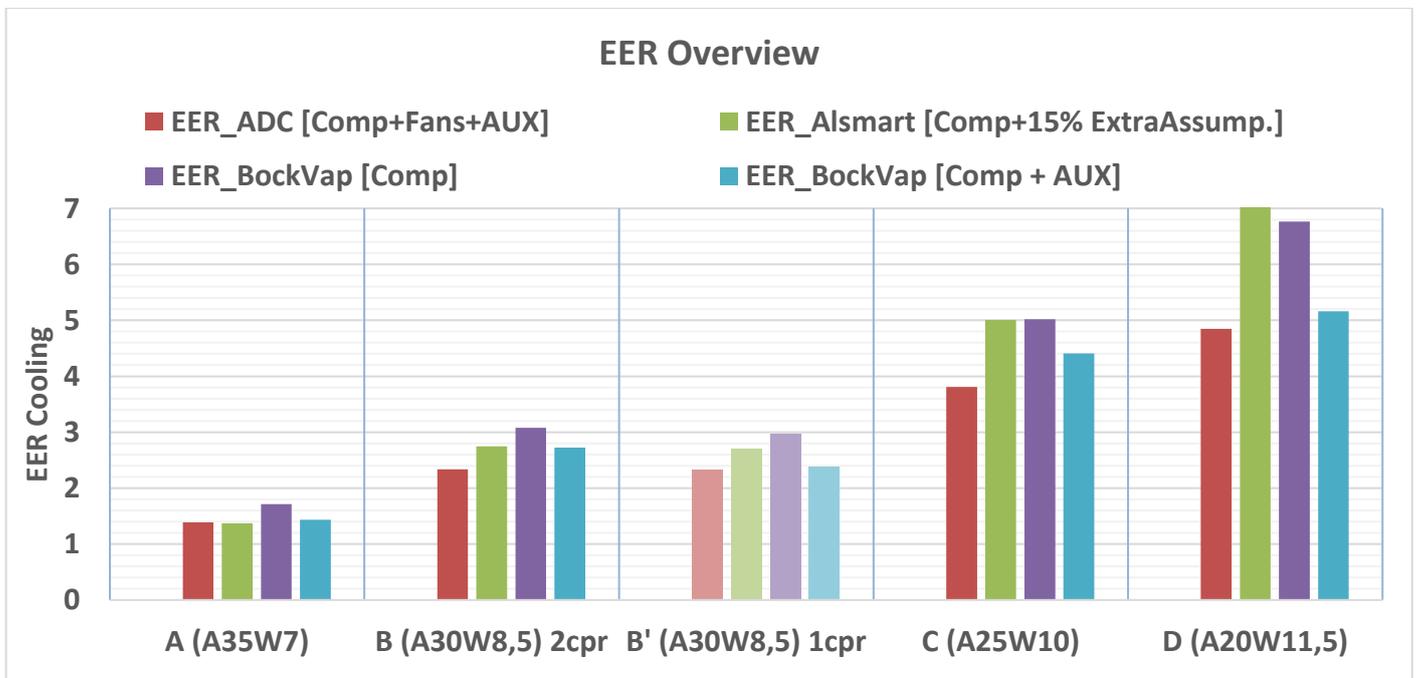
COPs for additional heating test conditions (“HIGH”, “ULTRA”)

Test condition	HIGH A-10W65	ULTRA A-10W75
Water return (EWT), °C	34,95	34,93
Water supply (LWT), °C	64,91	74,78
Water flow, m3/h	1,62	1,15
Air temperature, °C	-10,00	-9,99
Air relative humidity, %	72,44	74,51
Suction pressure, bar(a)	23,37	23,77
Sat. suction temperature, °C (calculated)	-13,99	-13,41
Gas cooler outlet pressure, bar(a)	94,84	95,91
Gas cooler outlet temperature, (uncalib), °C	37,44	40,44
Suction SH (uncalib), K	4,00	4,00
Discharge temperature (uncalib), °C	140,86	144,76
Power Input, kW, corrected	31,18	32,12
Heating Cap, kW, corrected	55,70	52,33
COP Heating, corrected	1,79	1,63
COP Heating (Alsmart)	1,82	1,66
Compressor 1 Speed (calc), Hz	70,00	70,00
Compressor 2 Speed (calc), Hz	70,00	70,00



EERs for SEER cooling conditions

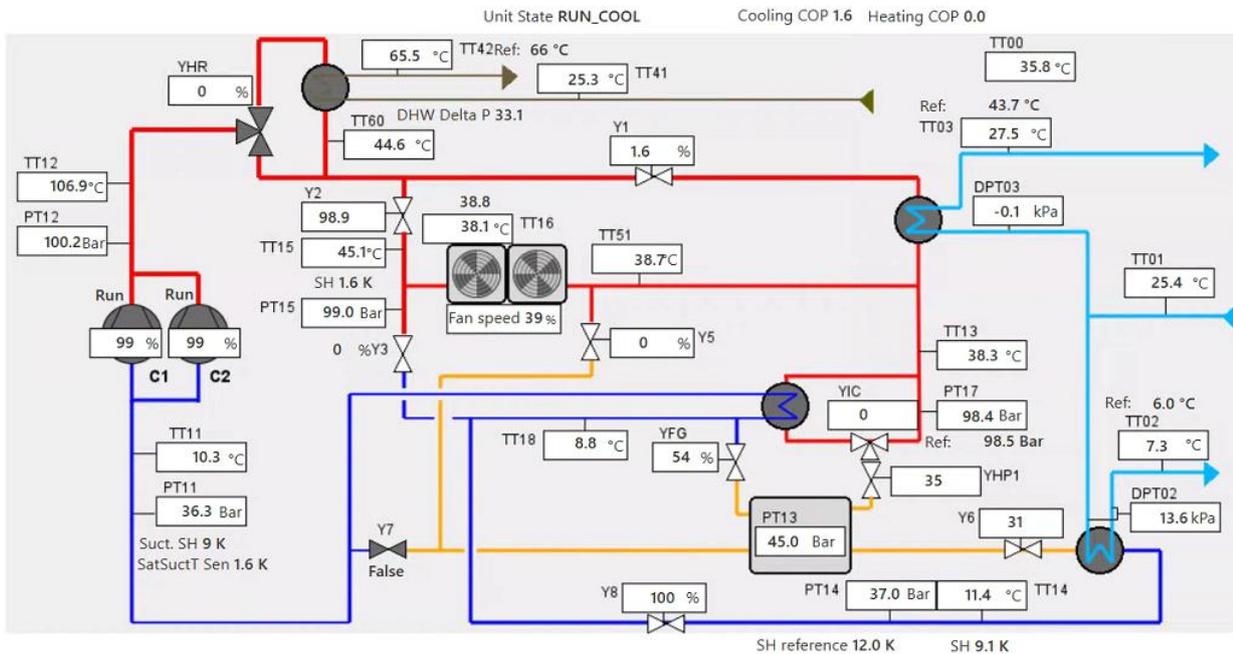
Test condition	A (A35W7)	B (A30W8,5) 2 cpr	B' (A30W8,5) 1 cpr	C (A25W10)	D (A20W11,5)
Water return (EWT), °C	11,99	13,51	13,51	14,95	13,63
Water supply (LWT), °C	7,01	8,54	8,61	10,04	8,56
Water flow, m3/h	7,73	5,69	5,69	3,66	3,64
Air temperature, °C	35,00	30,00	30,00	25,00	20,01
Air relative humidity, %	42,56	51,30	51,39	58,38	57,12
Suction pressure, bar(a)	38,45	41,38	41,32	43,90	42,31
Sat. suction temperature, °C (calculated)	3,93	6,77	6,72	9,12	7,66
Gas cooler outlet pressure, bar(a)	103,25	88,84	88,69	75,90	66,35
Gas cooler outlet temperature, (uncalib), °C	42,34	34,48	34,42	28,67	23,64
Suction SH (uncalib), K	6,00	6,00	6,00	5,99	6,00
Power Input, kW, corrected	32,11	14,03	13,90	5,47	4,42
Cooling Cap, kW, corrected	44,61	32,76	32,31	20,82	21,41
EER Cooling, corrected	1,39	2,34	2,32	3,81	4,85
EER Cooling (Alsmart)	1,37	2,75	2,70	5,01	7,28
Compressor 1 Speed (calc), Hz	61,99	35,44	62,00	34,92	30,00
Compressor 2 Speed (calc), Hz	61,99	35,44	-	-	-



For test condition "B", two operating modes were tested, either with both compressors operating at low speed, or one compressor operating at maximum speed. Both options yielded similar results.

Cooling test condition, effect of domestic hot water (DHW)

Impression of system operation (Alsmart Service Tool Dashboard) with cooling and domestic hot water



Data comparison (uncalibrated measurements from Alsmart controller only):

Test condition	with DHW	without DHW
Air temperature, °C	35,0	35,0
Wat Flow, m3h	3,7	2,4
DHW forward temperature (uncalib), °C	65,5	<i>n.a.</i>
Water return temperature (uncalib), °C	25,7	25,9
Cold water forward temp (uncalib), °C	7,4	8,9
Power Input, kW (not corrected)	27,9	31,2
Gas cooler outlet pressure, bar(a) (uncalib)	98,5	104,0
Gas cooler outlet temperature, °C (uncalib)	38,4	42,2
Compressor 1 Speed (calc), Hz	69,61	70,00
Compressor 2 Speed (calc), Hz	69,61	70,00
Fan speed, %	38,2	100,0
EER Cooling (Alsmart)	1,6	1,4

The uncalibrated data obtained from the unit controller indicates an improved cooling mode performance if domestic hot water is produced at the same time. This results from the improved heat rejection on the high-pressure side due to added surface area, which decreases the gas cooler pressure. In addition to the improved cooling performance, the overall performance improves further when taking the produced domestic hot water into account, showing a strong benefit from this combined production.

Summary

Electrical power input during thermostat-off mode, standby mode, crankcase heater mode and off mode

The electricity consumption for these operating modes is determined according to EN 14825:2022, section 12. It is assumed that the water pump is switched off during these operating modes.

Operating mode	Power input (W)
Thermostat-off mode consumption (P_{TO})	448
Standby mode consumption (P_{SB})	418
Off mode consumption (P_{OFF})	367
Crankcase heater (CK) mode consumption (P_{CK})	0

SCOP and SEER

The unit is considered a reversible unit for SCOP and SEER calculations.

With the test data provided above, the following SCOP and SEER results are calculated:

SCOP case 1 (5K dT)	SCOP case 2 (20K dT, fixed water outlet temperature)	SCOP case 3 (20K dT, variable water outlet temperature)	SEER
2,87	3,14	3,56	2,81

Key Observations

- **Effect of Water Temperature Difference (dT):** A significant improvement in heating performance was observed when increasing the water temperature difference from 5K to 20K. The SCOP rose from **2,87** in Case 1 (5K dT) to over 3.0 in both 20K dT scenarios, representing a performance gain of at least **9%**.
- **Impact of Control Strategy and On/Off Cycling:** The control strategy at 20K dT was a critical factor.
 - Operating with a **fixed water outlet temperature** (Case 2) yielded a SCOP of **3,14**. This value was negatively impacted by significant penalties applied due to the higher applicable water outlet temperature at on/off cycling of the unit in SCOP "D" condition.
 - Switching to a **variable water outlet temperature** (Case 3) reduced the penalty due to the lower water temperature difference in SCOP "D" condition, resulting in a SCOP of **3,56**. This is a **13% improvement** over the fixed water outlet temperature strategy (Case 2) and a **24% improvement** over the standard 5K test condition (Case 1).

Conclusion

The test results show that the heat pump's heating efficiency is optimized when operating with a 20K water temperature difference combined with a variable water outlet temperature control strategy (SCOP case 3). This configuration avoids the significant performance penalties associated with on/off cycling that occur with a fixed outlet temperature. The standard 5K water temperature difference condition yielded a comparatively lower heating performance.

The cooling performance was recorded with a SEER of 2,81. In cooling mode operation at 35°C air temperature with 7°C water supply temperature, the results indicate a lower gas cooler pressure and improved cooling mode performance when domestic hot water is produced at the same time.