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# HVAC

## AIR-TO-WATER AND WATER-TO-WATER SOLUTIONS - TERTIARY SECTOR HEATING AND COOLING



### POSSIBLE SOLUTIONS

#### DESIGN OF THE SYSTEM (ACCORDING TO EN 378 GUIDANCE)

#### R-454C / R-455A

Chiller

#### R-1233zd(E)

- Chiller
- High-temperature heat pump

#### R-1234ze(E)

- Chiller
- Air-to-water heat pump

#### Class III

In technical room or open range  
(*Full cooling piping*)

#### R-290

- Chiller
- Air-to-water heat pump

#### R-717 (NH<sub>3</sub>)

- Exhaust-gas cooler
- Heat pump (district heating)

#### Class III

In technical room or open range  
(*Full cooling piping*)

	R-454C / R-455A	R-1233zd(E)	R-1234ze(E)	R-290	R-717 (NH <sub>3</sub> )
<b>Refrigerant type (HFC/HFO/HC/Inorganic)</b>	HFC/HFO	HCFO	HFO	HC	Inorganic
<b>GWP (according to F-Gas UE/2024/573)</b>	146	3.88	1.37	0.02	0
<b>Safety classification Lower Flammability Level LFL</b>	R-454C: A2L - 0.293 kg/m <sup>3</sup> R-455A: A2L - 0.431 kg/m <sup>3</sup>	A1	A2L - 0.303 kg/m <sup>3</sup>	A3 - 0.038 kg/m <sup>3</sup>	B2L - 0.116 kg/m <sup>3</sup>
<b>Classification (according to Pressure Equipment Directive PED)</b>	1	2	2	1	1
<b>F-gas quotas</b>	Applicable	Non-applicable	Non-applicable	Non-applicable	Non-applicable
<b>Specific regulatory constraints</b>	++	+ to ++	++	+++	+++
<b>Maintenance complexity (training, safety, tooling, Personal Protection Equipment PPE ..)</b>	Training is mandatory Specific tooling PPE	-	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE
<b>Coefficient of Performance COP (theoretical)<sup>1</sup></b>	7.8	8.3	8.0	7.9	8.0
<b>Energy Efficiency Ratio EER (theoretical)<sup>2</sup></b>	5.7	6.2	5.8	5.7	6.0
<b>Technology readiness (prototyping, field test, availability)</b>	Available	Available	Available	Available	Available

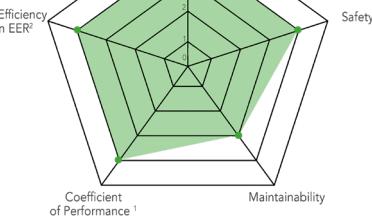
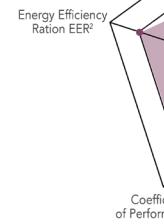
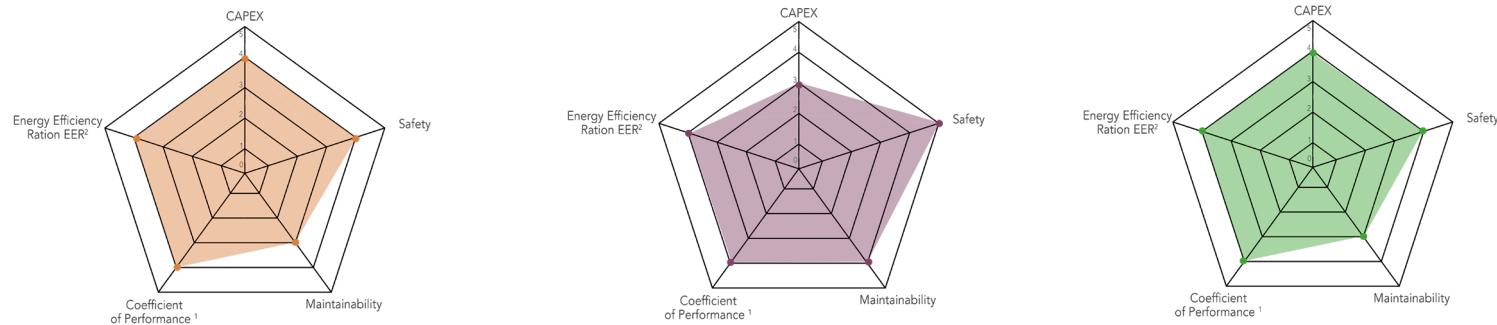
<sup>1</sup> Air-to-Water systems: Tk = 36°C - To = 2°C - SC = 5K - SR = 3K - Isentropic efficiency = 100%

<sup>2</sup> Air-to-Water systems: Tk = 45°C - To = 2°C - SC = 5K - SR = 5K - Isentropic efficiency = 100%

R-454C / R-455A

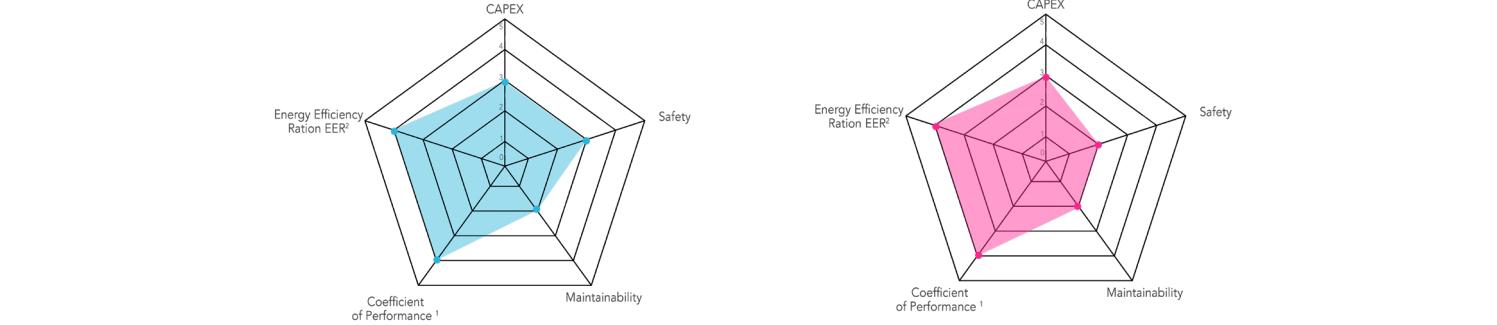
R-1233zd(E)

R-1234ze(E)



R-290

R-717 (NH<sub>3</sub>)



R-717 (NH<sub>3</sub>)

## CONCLUSION

**Class III :** HFC/HFO blends, HFO and R-717 are installed in this specific installation class, as well as R-290. Units running with R-290 are installed outdoor, not only to simplify the risk analysis as per required by the EN 378 regulation, but also to reduce the costs associated with the implementation of the necessary safety devices in technical rooms (ATEX equipment, detection, ventilation etc.). It is worth noting, that some manufacturers also deliver R-1270 outdoor liquid chillers (propylene - refrigerant type : HC - flammability class: A3). R-1233zd (E) is a low-pressure HFO (PED group: 2) that is used with large-capacity centrifugal compressors. Low-charge R-717 solutions do also exist. Absorbtion systems may eventually be of an interest, when using waste heat.