Promouvoir une attitude responsable

INDUSTRY

INCLUDING COLD STORAGE

POSSIBLE SOLUTIONS

DESIGN OF THE SYSTEM
(ACCORDING TO EN 378 GUIDANCE)

		R-454C / R-455A	R-1233zd(E)	R-1234ze(E)	R-290
Class III In technical room or open range *(Full cooling piping)*	Medium temperature	Chiller	Chiller (centrifugal compressor)	Chiller	Chiller
	Low temperature				
Class II Compressor in technical room or open range *(indoor evaporator)*	Medium temperature	Semi-centralized or fully-centralized installation			
	Low temperature	Semi-centralized or fully-centralized installation			
Class I Indoor *(Full cooling piping)*	Medium temperature				
	Low temperature				

		R-717 (NH_3)	R-744 (CO_2)
Class III In technical room or open range *(Full cooling piping)*	Medium temperature	• Chiller • Centralized installation with chilled secondary refrigerant	
	Low temperature	• Chiller • Centralized installation with chilled secondary refrigerant	
Class II Compressor in technical room or open range *(indoor evaporator)*	Medium temperature		Transcritical booster installation
	Low temperature	Centralized installation in technical room	Transcritical centralized installation or LP cascade installation, with HFC/HFO or HC
Class I Indoor *(Full cooling piping)*	Medium temperature		
	Low temperature		Waterloop condensing unit (direct expansion)

Data collection by POLE CRISTAL
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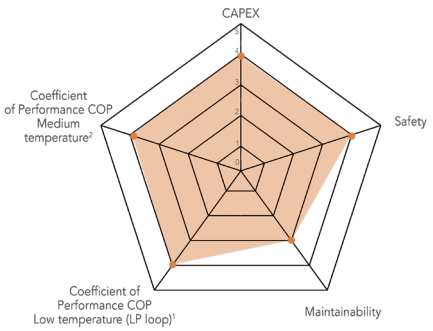
	R-454C / R-455A	R-1233zd(E)	R-1234ze(E)	R-290	R-717 (NH_3)	R-744 (CO_2)
Refrigerant type (HFC/HFO/HC/Inorganic)	HFC/HFO	HCFO	HFO	HC	Inorganic	Inorganic
GWP (according to F-Gas UE/2024/573)	146	3.88	1.37	0.02	0	1
Safety classification Lower Flammability Level LFL	R-454C: A2L - 0.293 kg/m^3 R-455A: A2L - 0.431 kg/m^3	A1	A2L - 0.303 kg/m^3	A3 - 0.038 kg/m^3	B2L - 0.116 kg/m^3	A1
Classification (according to Pressure Equipment Directive PED)	1	2	2	1	1	2
F-gas quotas	Applicable	Non-applicable	Non-applicable	Non-applicable	Non-applicable	Non-applicable
Specific regulatory constraints	++	+ to ++	++	+++	+++	++
Maintenance complexity (training, safety, tooling, Personal Protection Equipment PPE ..)	Training is mandatory Specific tooling PPE	Training is mandatory	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE	Training is mandatory Specific tooling PPE
Coefficient of Performance COP (theoritical) - Medium temperature[1]	3.8	4.1	3.9	3.9	3.9	2.9
Coefficient of Performance COP (theoritical) - Low temperature[2]	Single loop : 2.2	Not available	Not available	Not available	Single loop (eco) : 2.5	R-455A / R-744 Cascade : 2.4 Transcritical CO_2 : 1.8"
Technology readiness (prototyping, field test, availablity)	Available	Available	Available	Available	Available	Available

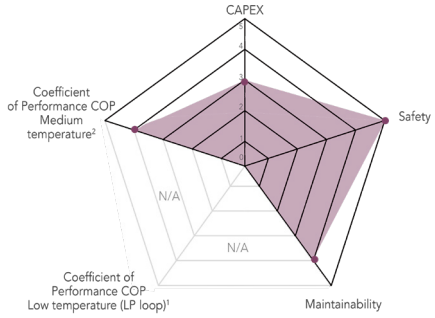
[1] *HFC/HFO / HFO / HC : Tk = 45°C - To = -10°C - SC = 5K - SR = 10K - Isentropic efficiency = 100% - Transcritical CO_2 with ejector : gas-cooler inlet pressure = 95barA - Gas-cooler outlet temperature = 37°C - To = -10°C - SC = 5K - Isentropic efficiency = 100% - Transcritical CO_2 with ejector*

[2] *HFC/HFO / HFO / HC : Tk = 45°C - To = -30°C - SC = 5K - SR = 5K - Isentropic efficiency = 100% - NH3 : single loop with economizer CO_2 cascade layout, with R-717 HP loop : Tk = 45°C - To = -5°C - SC et SR = 5K - Isentropic efficiency = 100% / LP loop with R-744 (CO_2) : Tk = 0°C - To = -30°C - SC and SR = 5K - Isentropic efficiency = 100% Transcritical CO_2 with ejector : Gas-cooler inlet pressure = 95barA - Gas-cooler outlet temperature = 37°C - To = -30°C - SC = 5K - Isentropic efficiency = 100%*

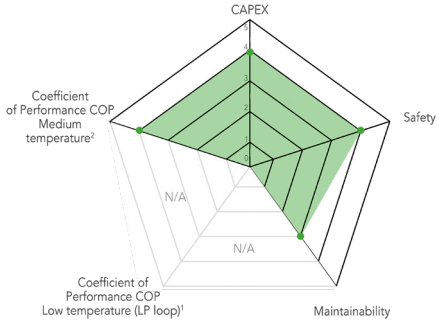
R-454C / R-455A



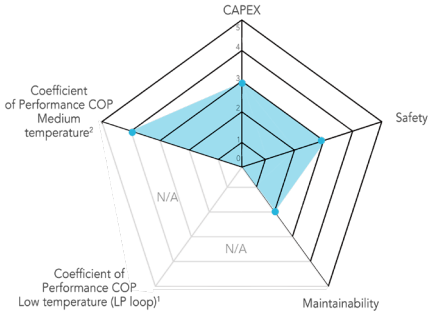
R-1233zd(E)



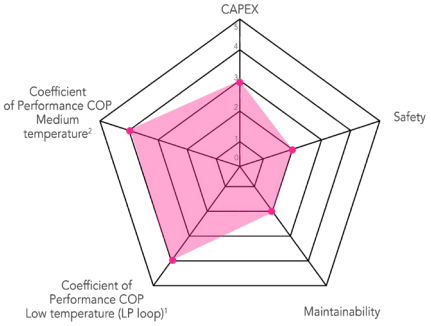
R-1234ze(E)



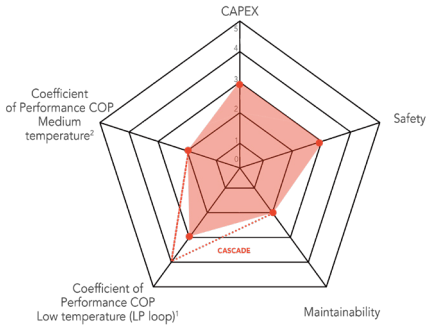
R-290



R-717 (NH_3)



R-744 (CO_2)



CONCLUSION

Class I : Very seldom application in industry, with the exception of direct expansion waterloop R-744 condensing units with low-temperature outputs.

Class II : Low-temperature application mainly rely on inorganic refrigerants, such as R-717 and R-744. HFO/HFC blends are rarely used, though there are neverthless LT and MT A2L applications by some logistic facilities.

Class III : Installers are currently moving to R-717 and R-290, combined with glycol waterloop installations. Some manufacturers do also deliver liquid coolers with R-1270 (propylene - HC - GWP according to UE/2024/573 F-Gas : 0), though still on very small scale. Absorbtion systems may be of an interest, when waste heat is available.

Data collection by

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POLE CRISTAL