A Technical Note from the Experts in Business-Critical Continuity™

Technical Note: Comparing R407C and R410A as Alternatives for R22

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Purpose

The purpose of this document is to provide a brief overview of refrigerants R410A and R407C, describe their characteristics and compare their environmental impact, regulatory compliance and resulting system efficiency.

Background

Chlorodifluoromethane (R22 or HCFC22) has been used as a refrigerant within refrigeration, industrial cooling, air conditioning and heating applications for many years. The low ozone depletion potential of R22 compared to CFC11 and CFC12 combined with its excellent refrigerant properties have helped facilitate the transition away from CFCs. However, even if HCFCs, such as R22, are less damaging to the ozone layer than CFCs, they still contain ozone-destroying chlorine. In addition, R22 is a greenhouse gas and the manufacture of R22 results in a byproduct (HFC23) that contributes significantly to global warming. Therefore R22 is being phased out and replaced with ozone-friendly refrigerants.

Under the terms of the Montreal Protocol, the U.S. agreed to a phase-out schedule as follows:

January 1, 2010 – Equipment manufacturers can no longer manufacture equipment that contains R22. Chemical manufacturers may still produce R22 to service existing equipment, but not for use in new equipment.

January 1, 2020 – Manufacturers will no longer be able to produce R22 to service existing equipment.

As the manufacture of R22 is phased out over the coming years to end production of HCFCs, alternatives such as R407C and R410A will be manufactured.

R407C and R410A

R407C is a non-ozone depleting blend of three HFC refrigerants (R32, R125, R134A) and was designed to match as closely as possible R22 pressure and performance to allow a smooth transition from R22 to R407C. It exhibits performance characteristics similar to R22.

R410A is a non-ozone depleting blend of two HFC refrigerants (R32, R125) and was designed to provide benefits in efficiency and system size by increasing system pressure and taking advantage of thermodynamic and transport properties. It exhibits higher pressures and refrigeration capacity than R22.

The properties and performance of R407C and R410A are compared in Table 1.

R407C and R410A Comparative Data

Properties/Performance	R407C	R410A	Comments
Ozone depletion potential, ODP, (CFC11=1.0)	0	0	ODP value for R22 is 0.055. The lower the value, the better the environmental performance.
Global warming potential, GWP, (CO2=1.0 [100 yr integrated time horizon])	1600	1725	GWP value for R22 is 1600. The lower the value, the better the environmental performance.
Maximum allowable concentration in the workplace (ppm)	1000	1000	
Flammable	No	No	
Toxicity	Very Low	Very Low	
Relative energy efficiency ratio, EER (%) [a]	-7 to -3 [b]	-2 to +2 [c]	
Change in discharge temperature (°F) [a]	-15 to -8 [b]	-9 to -11 [c]	
Change in discharge pressure (psi) [a]	+15 to +40 [b]	+131 to +150 [c]	

[a] Compared with R22.
[b] Values compared with HCFC-22 in unmodified split system heat pumps and an unmodified window air conditioner using the Department of Energy cooling test conditions A and B.
[c] Values compared with HCFC-22 in split system heat pump with capacity-matched compressor using the DOE cooling test conditions A and B.

Source: DuPont Fluorochemicals

Table 1. Properties and performance of R407C and R410A .

Advantages and Disadvantages of R407C and R410A

R407C

Advantages

- Less harmful influence on the environment than R22. Value of global warming potential of R407 is similar to that of R22 but ozone depletion potential is zero.
- Exhibits thermo-physical properties that are similar to R22, so when changing from R22 to R407C, minimal alterations in the refrigeration system are required. An R22 system and an R407C system use many of the exact same components.

Disadvantages

- Multiple significant leaks (50 wt. %), and recharges, can in some cases cause the refrigerant composition to change, which could have a minor impact on energy efficiency and heat transfer conditions.

R410A

Advantages

- Less harmful influence on the environment than R22. Value of global warming potential of R410A is higher than that of R22 but ozone depletion potential is zero.
- Characteristics of R410A permit using a smaller displacement compressor, less coil and less refrigerant while maintaining system efficiencies comparable to current R22 equipment.

Disadvantages

- Operating pressures more than 50 percent higher than R22, which requires thicker walled tubing, high pressure compressors and use of components capable of withstanding these high pressures. An R22 system and an R410A system use none of the same components. A complete redesign of an R22 system is required to use R410A.The high operating pressures can also restrict the use of R410A to smaller systems, especially on water cooled systems.

Conclusion

Both R407C and R410A are less harmful to the environment than R22 and they offer equivalent performance and higher capacity alternatives to R22. They have the same designation (A1) in ASHRAE Standard 34 – Designation and Safety Classification of Refrigerants. Because both refrigerants are widely available, their resulting system performance is very similar and they have a common classification within the Montreal Protocol, they are equal alternatives for projects where compressorized cooling is included. Currently R410A is being used extensively for most new, small residential air cooled systems.

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TN-00007