R152a vs. **R134a**
in refrigerant gases

R152a (DFE or difluoroethane) is an eco-friendly refrigerant used in positive-temperature refrigeration as a direct replacement for R134a. Difluoroethane is not ozone-depleting, features excellent energy efficiency and extremely low GWP, that is, 124.

R152a is commonly used as an aerosol propellant, a blowing gas with plastic materials or a component in various refrigerant blends. It is classified as **A2** (mildly flammable) by ASHRAE.

FEATURES OF R152a

Difluorethane is a pure fluorinated hydrocarbon, whose chemical composition displays many similarities with R134a. Its vapour pressure curve is equivalent to R134a's, with minimal deviations of approximately 2K. R152a also displays equivalent chemical features. Hence, it is suitable for all the materials used in commercial air compressors and refrigeration components, thermostatic expansion valves and lubricants.

R152a also displays higher thermodynamic features than R134a's or HFOs'. Heat exchange coefficients in evaporators and condensers are about 20% higher, as R152a has improved physical properties compared to R134a. Furthermore, lower gas viscosity involves a 30% lower load pressure drop in the suction line. R152a's lower molecular weight involves high latent heat capacity, greater compressor volumetric efficiency and higher COP performance in the cooling cycle. Discharge temperature also shows a 10K increase compared to R134a.

PROPERTIES OF R152a COMPARED WITH R134a AND R1234yf

	R134a	R1234yf	R152a
Molecular weight (gr/mol)	102	114	66
Boiling temperature at standard pressure	-26,1°C	- 29,5°C	- 24,0°C
Boiling temperature at standard pressure	199	163	307
Volumetric cooling capacity, kJ/m3	1293	1186	1283
GWP (IPCC AR4)	1430	4	124
Lower flammable limit % vol	-	6%	4%
Heat of combustion, kJ/mol	428	1220	1090
Auto-ignition temperature	-	405°C	454°C
ASHARE Safety Class	A1	A2L	A2

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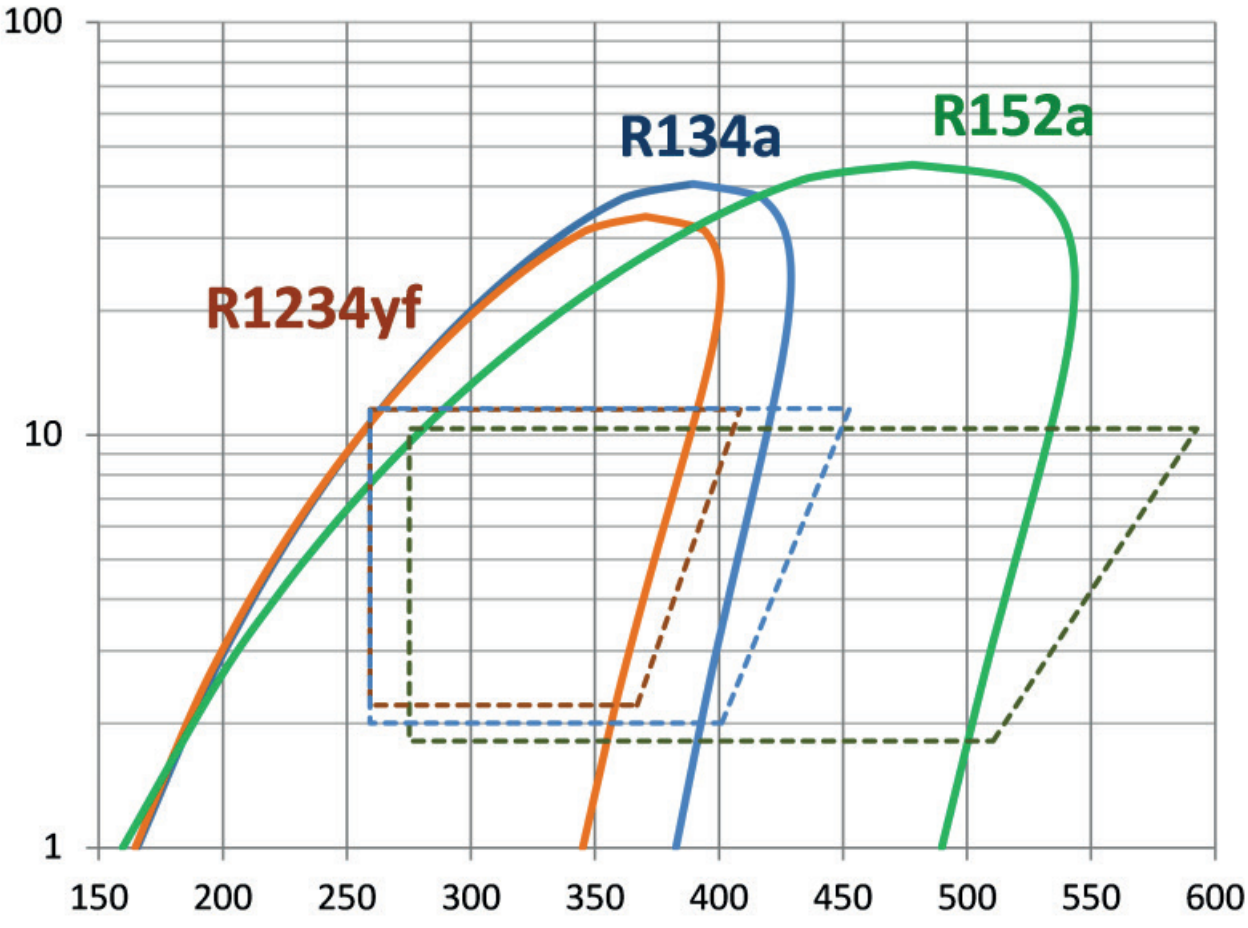
THERMODYNAMIC PERFORMANCE

Operating pressure for R152a is slightly lower (-10%) than R134a's at the same evaporation temperature rate. However, R152a has an equivalent cooling capacity (-1% compared to R134a) and might thus be used as a replacement in cooling systems operating with R134a.

Namely, adding up all the factors in one cooling system allows a performance gain of approximately 20% with R152a compared to R134a and also a better rate than with R1234yf. Considering a sample system, refrigerant load reduction with R152a is approximately 40%, due to the lower molecular weight.

When calculating the environmental impact – or TEWI factor – of a system R152a would get a lower rate than R1234yf, as the higher direct effect on atmospheric heating, due to a higher PCA index, is clearly offset by lower electricity consumption.



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CHEMICAL COMPATIBILITY

A report by the Air-Conditioning & Refrigeration Technology Institute, prepared on account of a research project on material compatibility and lubricants sponsored by the US Department of Energy in 1993, examined a certain number of fluorocarbons with various concentrations in refrigerants and various viscosity grades in lubricants. R152a displayed miscibility at all concentrations within the test temperature range (from -50 ° C to 90 ° C).

The project also examined the compatibility of no. 24 materials of hermetic scroll compressors with eleven pure refrigerants and seventeen refrigerant/lubricant combinations.

Elastomer samples were fully submerged into the test refrigerant. Samples exposed to R32, R125, R134a, R143a and R152a displayed the smallest swelling. As with most refrigerants, large swelling (> 35%) was found with fluorinated rubber types and silicones.

Plastic materials were also assessed with pure refrigerants. HFC refrigerants appear to have the smallest effect size on plastic, except for ABS plastics which failed with most refrigerants.

SAFETY REQUIREMENTS

R152a is classified as a non-toxic but mildly flammable Class A2 refrigerant – medium safety level – by ASHRAE.

As refrigerants in Group 2 are mildly flammable, further safety guidelines will be required, which calls for specific system engineering and risk analysis solutions. Explosive atmosphere safety standards would classify cooling systems as Hazardous Area 2: work areas where an explosive atmosphere is not likely to be created under normal operating conditions. This classification does not mean that ATEX measures should initially be applied, but it will help identify the areas that might not fall within the classification group and thus apply preventive measures (such as local exhaust ventilation, adequate natural ventilation etc.).

In order to mitigate hazards in cold storage units installing a leak detector is recommended, which will isolate the evaporator and actuate mechanical ventilation. This will avoid reaching a dangerous refrigerant/air concentration and thus prevent an explosive mixture. As a matter of fact, the refrigerant load still found within an evaporator is generally below 20gr per cold storage unit cu.mt. This value is much lower than the lower flammable limit, that is, 0.137 kg / m3.

Installing an automatic ventilation system in utility rooms is recommended, in order to provide an adequate ventilation air flow in the event of refrigerant leak. Finally, airtight/watertight welded piping is not considered a hazardous area.

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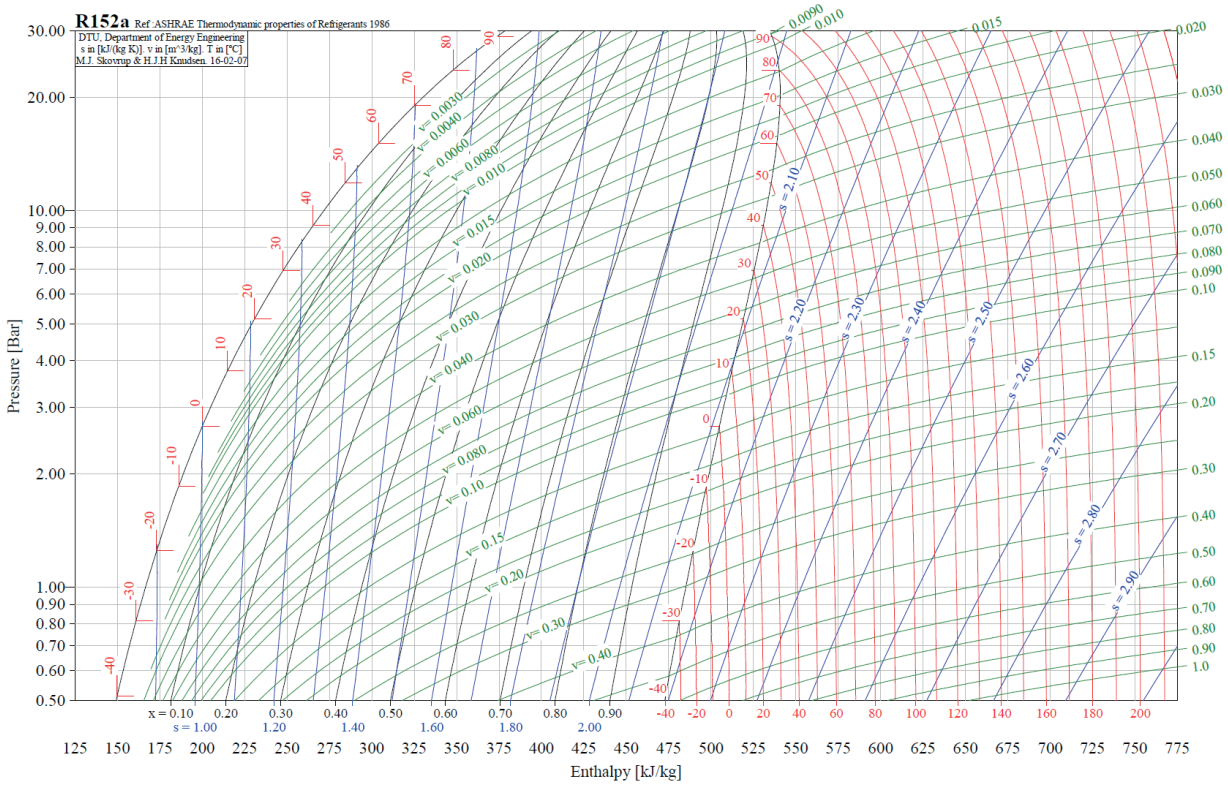

R152a PRESSURE-ENTHALPY GRAPH

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