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Industry insight.

EU f-gas regulations: impact on R404A and the opportunity for R442A (RS-50).

Author Jon Black, Global Head of Chemicals and Refrigerants
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The recently published revisions to the f-gas regulations will drive substantial change in the refrigeration and air conditioning industry.

The regulations will cap and phase-down the supply of HFCs, and will restrict the use of HFCs with a GWP of 2500 and above through the implementation of both new equipment bans and servicing and maintenance bans.

R404A is the most commonly used high-GWP refrigerant gas. This paper introduces R442A (RS-50) as an alternative for R404A across a wide range of applications.

Legislation impacting use of R404A

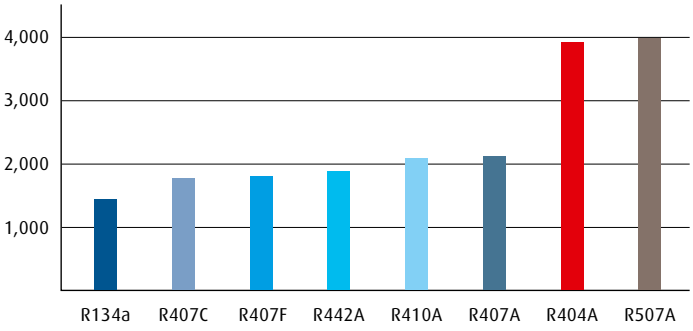
The revised f-gas regulations will become law from 1 January 2015. Three key areas of legislation will impact the future choice of refrigerant gas. These are:

1. Cap and phase-down of the supply of HFCs via a CO_2e-based quota system.
2. Bans on the sale of new refrigeration and air conditioning equipment using higher GWP f-gases.
3. Service and maintenance bans that will ban the use of virgin HFCs with a GWP of 2500 and above in refrigeration equipment with a charge size of greater than 40 tonnes CO_2 equivalent, from 2020.

All HFC refrigerants will be subject to the supply phase-down. However, gases with a high GWP will be more severely impacted due to their requirements for a large amounts of supply quota. These gases will also be subject to additional control due to restrictions on the supply of new equipment using them, and service and maintenance bans impacting their use in existing equipment.

R404A (GWP 3922) is the most widely used gas in the EU in stationary refrigeration systems, commonly used in low-temperature commercial systems such as those used in supermarkets. The use of R404A will be impacted by all three of the legislation measures detailed above. Therefore a solution is needed to replace this refrigerant whilst continuing to deliver the required cooling reliably and efficiently.

GWP of some common HFC refrigerants



R404A alternatives

As mentioned previously, the use of R404A will be phased out rapidly both in new and existing equipment, so industry needs to find a suitable alternative that can match its performance.

The only commercially available alternatives to R404A suitable for existing equipment are R407A, R407F and R442A (RS50). (See table 1.) The issue for users of R404A is which of these to select when specifying new equipment, or when moving on from R404A when retrofitting existing equipment.

Table 1: Common HFC refrigerants with GWP <2500

ASHRAE number	Brand name	GWP	Suitability as a retrofit replacement for R404A
R134a		1430	No
R407A		2107	Yes
R407C		1774	Possibly
R407F	Performax™ LT	1825	Yes
R410A		2088	No
R424A	RS44	2440	No
R427A	Forane® FX100	2138	No
R438A	ISCEON® MO99	2265	No
R442A	RS50	1888	Yes

Introducing R442A (RS-50)

Refrigerant Solutions Ltd has commissioned a series of independent tests to compare the performance of R404A, R407A, R407F, R507A, R22 and a new gas they have developed, R442A (RS-50).

The independent report concluded:

- Under dynamic conditions R442A shows a faster pull down time than any other currently available low temperature refrigerant
- Under steady state conditions the COP of R442A is 44% higher than that of R404A and 10% better than that of R407F
- Under steady state conditions the cooling capacity of R442A is 52% better than that of R404A and 18% better than that of R407F.

The key results are summarised in Table 2.

Following the independent tests, Refrigerant Solutions Ltd conducted field trials at SK Foods Ltd and other customers in the UK and Spain. The practical results support the independent tests, with R442A giving trouble-free use. As an example, the blast chiller at SK Foods, operating on R442A, saw an increase in energy efficiency of 22% and a higher capacity of 14% compared to R404A.

Summary

The revisions to f-gas legislation are making refrigerant selection a challenge for engineers and end users. To avoid future complications and unnecessary extra cost, refrigerants with a GWP <2500 should be selected for new equipment.

R404A is currently the most widely used refrigerant in the EU for stationary refrigeration applications. However, it is being targeted for a rapid phase-out in both existing and new equipment. There are a number of retrofit alternatives to R404A. Recent tests and trials highlight that R442A (RS50) is an excellent option to consider in your retrofit regime for the following reasons:

- ASHRAE rating of A1, i.e. non flammable/low toxicity
- GWP of 1888; less than half the GWP of R404A
- highest capacity of all R404A alternatives
- highest COP of all R404A alternatives
- good candidate to replace R404A/R507 in existing systems subject to original equipment specifications
- alternative to R404A and R507 in new equipment.

Table 2: Summary of results obtained under steady state conditions with the refrigerant condensing at +35 °C and evaporating at –35 °C.

	R22	R404A	R407A	R407F	R442A (RS-50)	R507A
P evaporation [bar]	1.27	1.64	1.3	1.35	1.35	1.7
P condensation [bar]	12.68	16.05	14.8	16.1	16.2	17
P high/P low	9.98	9.78	11.33	11.93	12	10
Discharge temperature [°C]	85	78	82	85	83	79
Cooling capacity [W]	1263	992	935	1252	1477	1090
Power input [W]	669	720	583	711	760	717
COP	1.89	1.37	1.6	1.76	1.94	1.52

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Linde AG
Linde Gases Division, Seitnerstrasse 70, 82049 Pullach, Germany
Phone +49.89.7446-2339, Fax +49.89.7446-2071, www.linde-gas.com/fgas

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