

Refrigerants

European legislation update

The new regulations introduced towards the end of 2001 were in accordance with the previously publicised proposals and are summarised in Table 1.

From Jan 1st 2001 there is a ban on the construction of all new refrigeration and air conditioning equipment containing HCFCs. This extension of the ozone depletion regulations means that R22, the dominant HCFC replacement for CFCs can no longer be used. The only exceptions are air conditioning equipment with less than 100 kW system capacity where the building of new systems is allowed until July 2002, and the construction of reversible heat pump systems which is allowed until January 2004.

Where a product such as a compressor or condensing unit is installed in a new system, that system may not be charged with R22 (except as indicated above). Mineral oil charged compressors and condensing units can be used as replacements on existing R22 systems. For the replacement market Copeland compressors which are factory charged with polyolester oil may be used with either R22 or the appropriate HFC, and so many of our distributors have been able to reduce stocks of mineral oil compressors and units.

New HCFC refrigerant for service of existing equipment will be available until January 2010, and the use of recycled refrigerant for service will be allowed and until January 2015. Both of these statements are expected to be reviewed before the end of 2008. Meanwhile the price of R22 could rise, forcing faster change out to occur.

In addition to the regulations relating to HCFCs it should be noted that there is now a ban on the transfer of ownership of CFCs and on the use of CFC use of any type for service purposes. There is a requirement to recover controlled substances which includes both CFCs and HCFCs, for destruction or recycling. Any any fixed equipment containing more than three kilograms of charge must be checked for leaks annually.

These are the regulations which now apply to countries with the EU. However some countries in northern Europe have more stringent regulations which already outlaw the use of R22 completely.

Table 1

<u>EU Regulation EC 2037/2000</u>	
From Jan 2001 there is a ban on new equipment containing HCFCs EXCEPT	
New Air Conditioning equipment having a system capacity of less than 100kW	From July 2002
New Reversible Air Conditioning/Heat pump equipment	From Jan 2004
New HCFC refrigerant is available for service until	Jan 2010
Recycled HCFC refrigerant is	Jan 2015

available for service until	
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Transitional refrigerants for service

The regulations for HCFCs also apply to the service refrigerants which were used to substitute CFCs. These are all R22 containing blends and are listed in Table 2. These blends were designed for service of existing R12 and R502 equipment. They may continue to be applied for this purpose and should be available in this service capacity until January 2010 as stated above. Most of these refrigerants have been tested by Copeland and they are all known to work in properly maintained systems without any problem. Over recent years they have sometimes been promoted to for used in new systems instead of HFCs such as R404A. Under the new regulations this is no longer allowable and they can only be used for service purposes.

Just as a reminder, if the refrigerant in a system is to be changed it should be completely changed . "Topping off" with a new refrigerant can give rise to unexpected problems because the properties of mixtures can be very different to the individual components.

Table 2

ASHRAE Number	Manufacturer/ Supplier	Trade Name	Previous CFC Refrigerant
R402A	DuPont	HP80	R502
R402B	DuPont	HP81	
R408A	Atochem	FX10	
R403A	Rhodia	Isceon 69S	
R403B	Rhodia	Isceon 69L	
R411B	Greencool	Greencool 411B	
R401A	DuPont	MP39	R12 & R500
R401B	DuPont	MP66	
R409A	Atochem	FX56	
R409B	Atochem	FX57	
R413A	Rhodia	Isceon 49	

ASHRAE classification

Most people are now familiar with the new refrigerant names but it is worth restating the nomenclature system. Azeotropic blends have been given numbers in the R500 series. The first refrigerant of this type to be used was of course R502. Today we have R507 which has also been categorized as an azeotrope although it only exhibits this constant boiling point property at one particular temperature. Theoretically the mixture proportions could be very slightly changed to shift this constant boiling point temperature and for this reason the nomenclature R507A is sometimes used in order to allow for the possibility of future different configurations. Other multi-component blends have been given numbers in the R400 series. A particular number such as R407 denotes the components of the blend (in this case R 32, R 125, and R134a). The upper case letter A, B, or C denote a specific percentage composition. These 400 series blends are termed zeotropic because they exhibit some temperature change during the boiling or condensation process. The lower case

"a" in R 134a denotes a particular isomer or arrangement of the molecule of tetrafluoroethane which is the chemical name for R134a.

R22 alternatives

There are three leading HFC alternatives to R22. These are R407C, R134a and R410A. properties can be briefly summarised as follows:

R407C has similar pressure to R22 and generally similar performance, but it has the glide of approximately 5 K which can result in small composition shifts if leaks occur in those parts of the system where two phases exist. The glide can be advantageous in liquid chillers using counter flow heat exchangers but does not give any real advantage in conventional air to refrigerant heat exchangers.

R134a has a lower pressure than R22 in a typical system and gives good performance at air conditioning conditions. A larger displacement compressor is required, and the system has to accommodate larger volume flows and this can increase costs. Because of its low pressure R134a is very suitable for applications where high condensing temperatures are required.

R410A operates at a significantly higher pressure than R22 and for this reason special systems have to be designed to utilise it. It has the potential to outperform R22 because the effect of pressure drop is reduced and because it has good heat transfer properties. It is limited at high condensing conditions, not because of the high pressures, but due to the effect of its relatively low critical temperature, below 75°C.

The vapour compression cycle has a very low efficiency when condensation is close to the critical temperature because the amount of latent heat, which produces the refrigeration effect, becomes small. A characteristic of the HFC refrigerants is that they tend to have lower critical temperatures than the previous CFCs and HFCs.

In refrigeration systems R404A has already been widely adopted as a replacement for R502. R404A performs better than R407C in medium and low temperature refrigeration systems, but R407C has the edge in high temperature applications. Some refrigeration applications moved from R502 to R22. For systems of this type R404A will be the usual replacement. Because of its high index of compression low temperature R22 systems frequently required the application of two-stage compression. The necessity for this is eliminated with R404A

Copeland scroll compressors are available for all these refrigerants and they cover a wide range of sizes and applications. Copeland piston and screw compressor types are available for R407C, R134a and R404A. The performance of the various models and the properties of the refrigerants can be explored using the Copeland Selection Software.

A further HFC refrigerant sometimes promoted in the marketplace is R417A (Isceon 59). This refrigerant is compatible with mineral oil at most conditions, and has been demonstrated as suitable for retro-fitting into existing R22 systems. It is not usually used in new equipment due to its lower performance compared to R407C.

HFCs are vital for the future if our present standards of food hygiene and comfort cooling are to be maintained and extended globally. Some applications will be able to move to alternatives which have no direct global warming effects, but all these alternatives have severe and well-known limitations.

Hydrocarbons are flammable, R717 (ammonia), proven over many years, is limited by its toxicity, and R744 (carbon dioxide), used in the very early days of refrigeration is limited by a very low critical temperature of 31°C. This is a property which limits R410A to some extent, as mentioned above. For R744 it rules out the simple refrigeration cycle for most applications.

Copeland supports EPEE (European Partnership for Energy and the Environment), which is promoting the essential need to keep HFCs as a major contributor to high efficiency, and therefore low environmental impact systems for the future.

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