R22 Phase Out

The world community has committed to eliminating R22 refrigerants (HCFCs) to a series of deadlines. The first of these occurs in Europe, where new-build based on R22 is already prohibited, and the final phase-out of R22 in existing plants is scheduled for December 2014. Until this date it is still possible to use recycled R22 for service but after December 2014 although a system with R22 can still be used it is not allowed to add more R22 to that system.

For the rest of the world there are 2 important deadlines: 2020 for the non-Article 5 countries and 2040 for the Article 5 countries. The acceleration in phase-out of HCFCs in the course of the next 10 years implies that no new HCFC based systems may be operated in either developed or developing countries thereafter.

R22 Phase Out General Recommendations

Generally Danfoss recommends to replace the R22 systems with new ones, using alternative refrigerants. The main arguments to build new systems are:

- Higher reliability of new systems
- Higher efficiency / energy savings
- Lower service costs / warranty on system
- Reduced carbon footprint

In meeting the deadlines customers can pursue new-build or retrofit strategies to cater for introduction of R22 substitutes. Danfoss recommends “new-build” for R22 substitutes as the most economic and environmentally friendly solution in the long run.
It is unfortunately not feasible for Danfoss to test all possible R22 substitutes upon its entire extensive product range. Therefore no warranty is available for compressors and controls in the event of substitution of R22 by drop-in of substitute refrigerants.

On the other hand, Danfoss offers a complete range of hermetic compressors designed to run on the substitute refrigerants R404A and R507. These compressors are available in versions compatible with a wide range of voltages, controls and other components.

For AC applications, Danfoss also provides compressors and controllers designed for use with the refrigerants R407C and R410A.

**Retrofitting**

If the establishment of a complete new plant is not feasible, an option may be retrofitting with compressors suitable for use with the substitute refrigerants. When retrofitting there are several potential pitfalls to be aware of:

**Missing pressure manometers**

Pressure manometers may be unavailable or have the pressure-temperature scale for R22. This scale will be inaccurate when using substitute refrigerants. Most tables show absolute pressure, whereas most pressure manometers indicate over pressure.

Ensure that the real-time superheat and sub-cooling are monitored correctly especially with the refrigerants having temperature glide. There is a real risk of confusion, which may lead to poor system performance or even compressor failure. The system reliability could be affected seriously.

**Oil change**

Some refrigerants are promoted as drop-in, meaning that they can be used in combination with the same type of mineral oil which was used with R22. The level of oil return should be acceptable, such that only a slight oil film builds up in the heat exchanger, often enhancing heat transfer. If the oil return is not adequate the compressor can fail, in the worst case.

However, this oil film can become thick enough to actually create a thermal barrier in the heat exchanger. If this occurs, Danfoss recommends applying a Minor correction factor on the coil efficiency.

It is worth noting that reduction in heat exchanger efficiency can be avoided by using a polioester (POE) based lubricant instead of mineral oil.

**Capacity drop and COP**

Some of the refrigerants promoted as drop-in can affect the system performance adversely, resulting in a capacity drop. For example, shell and tube type heat exchangers are incompatible with refrigerants exhibiting a temperature glide.

A capacity drop can affect applications in various ways:
1. For applications which run continuously for long periods, such as cold rooms, compensation for lower capacity can be made by increasing the running time.

2. Conversely in other applications such as beer coolers or ice machines, the application demands instantaneous full capacity for a short cycle time. In these applications it is important to minimise capacity drop to maintain the required performance level.

3. Some applications, such as bottle coolers and milk tanks, are designed to comply with particular performance specifications. In these cases retrofit can extend lifetime, but the retrofitted plant will no longer be capable of meeting the original specifications.

**Controller and valve size**

A compulsory aspect of any retrofit is to check that the capacities of all controllers and valves, such as expansion valves, solenoid valves and check valves, are correct.

If not, then replace them as required.

When retrofitting, it is always advisable to change the expansion valve, or as a minimum, the expansion valve orifice.

**Maximum operating pressure**

The system maximum operating pressure with certain drop-in refrigerants may be higher than the permissible pressure limits of the existing pressure vessels and other components. Therefore it is advisable to check the maximum permissible operating pressure for all the system components, and replace them with correctly dimensioned components where necessary. We also recommend to change the old safety valve, because there is no guarantee it will operate correctly.

**System reliability**

In order to optimise system reliability, Danfoss recommends performing the following replacements and adjustments during the process of a retrofit.

- Replace all O-rings and gaskets
- Replace the expansion valve or the expansion valve orifice
- Replace the filter drier with a drier one size larger
- Replace the sight glass
- Adjust the expansion valve
- Adjust all controllers
- Adjust the pressure controls

**Conclusion**

In general, Danfoss offers hermetic compressors and controllers for tested and approved refrigerants only. Danfoss will not provide warranty for old and new compressors which are used with nonapproved refrigerants or substitutes.

Based on the complex problems described above, Danfoss recommends performing the following investigations before retrofitting a system or plant with hermetic compressors.

- Which modifications are needed?
- Are the heat exchangers compatible with the drop-in refrigerant?
• Please note that significant temperature glide may occur.
• How do the retrofits affect system performance?
• Is the maximum operating pressure of the new refrigerant higher than the permissible limit for the existing pressure vessels and components?


The principle objective of EC Regulation No 842/2006 on certain fluorinated greenhouse gases (F gases) (The EC Regulation) is to contain, prevent and thereby reduce emissions of F gases. As well as the EC Regulation, there are ten Commission Regulations which establish flushed out legal requirements for companies and qualifications for personnel working in five industry sectors covered by the EC Regulation as well as dealing with other requirements relating to leakage checking, reporting and labelling.

The UK has transposed the EC Regulation through its 2009 GB F gas Regulation, which came into force in March 2009.

The Department for Environment, Food and Rural Affairs (Defra) is the lead Government Department on F gas policy. The Department for Transport (DfT) lead on the use of F gases in mobile air conditioning systems in motor vehicles through the Mobile Air Conditioning (MAC) Directive.

When working towards achieving compliance with Regulation EC 842/2006, it is also worth considering investment in a new plant, which may well be the most environmentally responsible and economically viable option.

Danfoss offers a wide range of components approved for use with R404A / R507, R407C and R410A. Please contact your local Danfoss Sales office for further information according this subject. Or visit the local website @ [www.danfoss.co.uk/R22](http://www.danfoss.co.uk/R22)