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A TUFFIN FERRABY TAYLOR GUIDANCE NOTE

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REFRIGERATION
SELECTION AND LEGISLATION

The most harmful ozone-depleting substances (e.g. CFCs like R12) were banned in the 1990s. New equipment using less harmful "transitional" HCFC refrigerants like R22 was banned in 2001 (or 2004 for small air-conditioning systems). Since 2009 it is illegal to use virgin HCFCs to service and maintain existing refrigeration and air-conditioning (RAC) equipment. Under the Ozone Regulation such HCFC's are now banned in EC Member States.

The two key phase-out dates are:

- From **1st January 2010** it is illegal to use virgin HCFCs to service RAC equipment. Note, this ban applies even if HCFC was purchased before the ban date. It is illegal to stockpile and use any supplies of virgin HCFCs after the end of 2009.

- From **1st January 2015** it will be illegal to use recycled or reclaimed HCFCs to service RAC equipment. It should be noted that supplies of recycled or reclaimed HCFCs may be very limited and very expensive. See Section 5 below for more details.

CFCs and HCFCs today are highly regulated under the Montreal Protocol due to their undesirable ozone depleting effects; and HFCs and PFCs which have shown strong greenhouse effects, are included as greenhouse gases in and regulated under the Kyoto Protocol.

CFCs AND HCFCs

Chlorinated fluoro-carbons (CFCs) and hydro-chloro-fluoro-carbons (HCFCs) are synthetic cooling agents that highly contribute to the depletion of the natural ozone layer in the stratosphere and are intensive greenhouse gases.

Most commonly used CFCs and HCFCs include:

- CFC R11, R12, R13 and R13b1
- CFC mixture R500
- CFC/HCFC mixture R502
- **HCFC R22**
- HCFC R123, R124 and R142b
- HCFC mixtures R401a, R402a and b
- HCFC mixture R408a and R409a

HFCs AND PFCs

Hydro-fluoro-carbons (HFCs) and per-fluoro-carbons (PFCs) contain no chlorine and have no known effects on the ozone layer. However, HFCs and PFCs are strong greenhouse gases and therewith contribute to climate change.

Most commonly used HFCs and PFCs include:

- HFC R 32, R125, R134a and R143a, R152a
- HFC mixtures R404a, R407a and c, R410a, R413a, R417a, and R507
- PFC R14

"**Natural**" refrigerant materials are substances or mixtures of substances which occur in nature or (in other terms) which are not synthetic chemical substances. Natural refrigerants divide mainly between hydrocarbons, ammonia and carbon dioxide.

Natural refrigerant materials include:

- Ammonia R717
- Ethane R170, Propane R290, Propylene R1270, and Isobutane 600a
- Carbon Dioxide R744
- Water R718
- Mixtures of the above substances

PHASE-OUT SOLUTIONS

Replace

Some old systems, including those that are in poor condition, inefficient or not meeting their current (or forecast) cooling load, should be replaced with new systems using a non-ODS (Ozone Depleting Substance) refrigerant.

This option can have a number of important benefits, most importantly the opportunity to significantly improve energy efficiency. Replacement is however likely to be the most expensive option in up-front cost terms (around 10 times more than a conversion).

Convert

For many types of RAC (Refrigeration and Air Conditioning) systems, which are in good order, it will be possible to recommend a Convert Solution.

This can be in the form of a relatively simple "retrofill" operation (using a "drop-in" HFC compatible with the system's existing mineral oil) to a more comprehensive modification requiring additional compressor and/or heat exchanger capacity). There are a number of "drop-in" gases offered by the main refrigerant suppliers (HFC 417A, HFC 422A, HFC 422D are some of the main ones). There is not, however, a recognised "retrofill" solution for flooded or pump-circulation systems.

Leave As-Is

This is not a "do nothing" option. It is only applicable if:

(a) a guaranteed stock of recycled HCFC is assured; or

(b) the system represents no business-critical risk.

Case (a) may be appropriate if it is not practical to either Replace or Convert the system. This may be true if the refrigeration system must be kept running, pending say an annual shutdown. This is however a risky option, since leaks are unpredictable both in frequency and scale.

Case (b) may be appropriate for say small split air-conditioning systems in non-critical offices. These systems are typically very reliable and may continue to operate without trouble for many years. They can then be replaced relatively quickly and cheaply with new systems using a non-ODS refrigerant.

DECISION CRITERIA

The decision to either Replace, Convert or Leave an HCFC plant should be based on a number of criteria.

System Type – does the system use "direct expansion" or a "flooded" evaporator? Direct expansion (or DX) systems may be suitable for conversion to an HFC replacement gas, but flooded systems need further consideration. This is an important distinction and requires an assessment by an experienced refrigeration or air conditioning engineer.

Age – refrigeration and air-conditioning plant over 20 years old are likely to be approaching the end of their natural life and should probably be replaced. Systems under 10 years should probably be retrofilled. The bulk of HCFC systems will be between 10 to 20 years old and these should be assessed further. As a further guide, if a system has previously been converted from R12 or R502 to R22, then this should also be replaced and not converted a second time.

Condition – if a system has been well maintained and is in good condition, this would tend to be more suitable for a convert solution. Records of refrigerant leakage are important indicators to the likely success of a "retrofill" operation.

Meeting Current Requirements – due to the rapid rate of change in many industries, many refrigeration systems are no longer operating within their original design specification. This is likely to impinge on operating performance, reliability and energy efficiency. The HCFC Phase Out presents an opportunity to Replace the system (or alter it) to meet the current and forecast application requirements.

Energy Efficiency – capital costs of commercial and industrial refrigeration and air-conditioning systems are typically around 20% of the total lifetime costs. The benefits of replacing an old system with a new energy-efficient system should be assessed. New options such as free-cooling can be specified to provide significant on-going savings.

Availability – system-specific characteristics must be considered to identify the correct option. Some systems are so "embedded" within the factory or building that replacement may be almost impossible. Alternatively, it may be possible to build a replacement plant alongside the existing HCFC plant and then switch-over with the minimum or disruption.

Conclusions – For most office and retail applications, the decision whether to replace or convert a HCFC (R22) system for a HFC (R410A) will more often favour replacement. This is due to the technical considerations such as suitability of pipework to be re-used and compatibility of materials and oils alongside age.

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