

**ENVIRONMENTAL PROTECTION DEPARTMENT  
PRACTICE NOTE FOR PROFESSIONAL PERSONS**

**Air-Conditioning Refrigerants - A Time for Change**

This Practice Note (PN) is written to :

- (i) alert professionals involved with the air-conditioning of buildings to the impending shortage of conventional CFC-based refrigerants; and
- (ii) provide advice on the urgent measures which need to be taken to eliminate dependence on CFC-based refrigerants.

**Background**

2. The refrigerants commonly used in air-conditioning equipment are R11, R12 and R22, of which the first two are chlorofluorocarbons, also known as CFCs. In line with an international agreement to protect the earth's ozone layer, known as the Montreal Protocol, the enactment in 1989 of the Ozone Layer Protection Ordinance and its subsequent enforcement has brought about a steady decrease of imported quantity of CFCs into Hong Kong over the last few years. A total ban on import of CFCs will take effect on 1 January 1996.

**CFC Use in Hong Kong**

3. Since 1988 there has been a gradual decline in Hong Kong's total consumption of CFCs. There has however been no real change in the consumption of CFCs used in *air-conditioning* plant. Indeed, after a decline from 1988 to 1990, consumption has now *risen* to 1988 levels.

4. As a result of the international controls, only about **320 tonnes** of CFCs will be available for air-conditioning purposes in 1994 and 1995. ***From 1996 onwards, there will be no supply at all.***

5. No matter how carefully the air-conditioning equipment is maintained, some refrigerants are lost through small leaks in pipes and valves, during major or equipment overhauls, and through accidents. All practising professionals should be aware that in the near future CFCs will simply not be available to replenish these losses.

### **How to eliminate dependence on CFC for air-conditioning**

6. Short and Medium Term Measures (for existing installations)

- (i) To minimise losses from existing equipment :
  - (a) carry out routine leak checks at regular intervals ;
  - (b) install a refrigerant leak detection system to minimize the leakage of refrigerant by advance warning of minor leaks ;
  - (c) install high efficiency air purgers for low pressure centrifugal machines (i.e. those using R-11, HCFC-123) so as to minimize the refrigerant lost during air purging ;
  - (d) recover and recycle the refrigerant during servicing and maintenance of the refrigerant circuits. It should be noted that under the Ozone Layer Protection (Controlled Refrigerant) Regulation, it is mandatory to recover CFC-based refrigerants from motor vehicle air-conditioners or from large chiller plants containing more than 50kg. of controlled refrigerants (i.e. R-11, R-12 and R-115) during maintenance or servicing as well as prior to dismantling or disposal; and
  - (e) ensure that refrigerant circuits are well maintained by paying particular attention to joints, seals, and gaskets. After completion of any servicing or repair work, thoroughly check for leaks before recharging with refrigerant.

- (ii) Replace refrigerants in existing systems by HCFCs :

Some existing CFC air-conditioning plants can be retrofitted to run on hydrochlorofluorocarbons (HCFCs) or blends containing HCFC refrigerants. Such retrofits involve only minor modifications to equipment and an allowance should be made for a slight reduction in machine efficiency after conversion work. HCFCs are also ozone depleting substances albeit with less potential to cause damage to the ozone layer. They are expected to be phased-out within 30 years. Appendix I summarises the principal refrigerants used in building air-conditioning systems, and available alternatives.

## 7. Longer Term Measures (for existing and new installations)

- (i) Retrofit existing equipment to run on HFC refrigerants :

Some existing CFC air-conditioning plants can be retrofitted to run on hydrofluorocarbons (HFCs) which have zero ozone depletion potential (ODP), and blends containing HFC refrigerants, as listed in Appendix I. This usually involves major modifications to the machine such as replacing compressor motors, impellers, gear trains, gaskets and seals, as well as a complete oil change.

- (ii) Install new chillers running on non-CFC refrigerants :

Alternatives to CFC refrigerants are listed in Appendix I. HFCs have zero ODP and are attractive from a technical point of view. The present commercially available HFC is HFC-134a. However, the high global warming potential (GWP) of HFC-134a makes it less than ideal from an environmental perspective. Serious consideration should therefore be given to other alternatives.

## **Conclusion**

8. The message is clear : people who are still using air-conditioning equipment running on CFCs should replace or retrofit their equipment as soon as possible. Starting from 1996, there will be no imports of CFCs. If everyone waits until the last minute to make the necessary change, air-conditioning contractors are unlikely to be able to meet the sudden demand, and some buildings will lose their air-conditioning.

## Enquiries

9. Officers in the Air Management Group of the Environmental Protection Department will be glad to answer any enquiries concerning the recovery and recycling of CFC refrigerants as well as the requirements of the Ozone Layer Protection (Controlled Refrigerants) Regulation. Enquiries can be addressed to the Senior Environmental Protection Officer, Air Management Group, Environmental Protection Department (Telephone : 594-6241, Faxline No : 827 8040).

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**Alternatives to CFC refrigerants for existing air conditioners**

CFC and HCFC refrigerants were originally chosen largely for their low cost, effectiveness and safety. Ideally, their replacements should also have these properties, as well as zero ozone depletion potential (ODP) and low global warming potential (GWP).

EXISTING REFRIGERANT	MAIN USES	ALTERNATIVE REFRIGERANTS	ADVANTAGES	DISADVANTAGES
CFC-11 (R-11)	Centrifugal chillers (High efficiency and low operating pressure).	HCFC-123 (R-123)	<ul style="list-style-type: none"> <li>• low GWP.</li> <li>• relatively high efficiency compared with other substitutes.</li> </ul>	<ul style="list-style-type: none"> <li>• early phase out date.</li> <li>• relatively high toxicity.</li> <li>• attacks insulation of motor winding.</li> <li>• reduction in capacity and efficiency.</li> <li>• not a direct drop-in.</li> </ul>
CFC-12 (R-12)	Centrifugal chillers (most commonly used refrigerant in centrifugal chillers in HK).	<p>HFC-134a (R-134a)</p> <p>Blends of HCFC/HFC</p> <p>Hydrocarbons</p>	<ul style="list-style-type: none"> <li>• zero ODP.</li> <li>• high efficiency.</li> <li>• minimum retrofitting cost.</li> <li>• components of blends are existing chemicals and are well tested.</li> <li>• zero ODP.</li> <li>• low GWP</li> </ul>	<ul style="list-style-type: none"> <li>• incompatible with existing mineral oil.</li> <li>• high GWP.</li> <li>• reduction in cooling capacity.</li> <li>• not a direct drop-in substitute.</li> <li>• contains HCFC, hence has an early phase out date.</li> <li>• fractionation/vaporization of zeotropic blends.</li> <li>• not a direct drop-in substitute.</li> <li>• not suitable for retrofitting existing machines.</li> <li>• inflammable.</li> </ul>
HCFC-22 (R-22)	Most commonly used refrigerant in medium and large size air-conditioning systems (need not be phased out until 2030 under the current phase-out schedule of the Copenhagen Amendment).	<p>HFC blends</p> <p>Ammonia</p> <p>Hydrocarbons</p>	<ul style="list-style-type: none"> <li>• zero ODP.</li> <li>• minimum retrofitting cost.</li> <li>• most components are existing chemicals and are well tested.</li> <li>• zero ODP.</li> <li>• negligible GWP.</li> <li>• most efficient.</li> <li>• low cost.</li> <li>• refer to above</li> </ul>	<ul style="list-style-type: none"> <li>• fractional vaporization of zeotropic blends.</li> <li>• high toxicity.</li> <li>• inflammable.</li> <li>• refer to above.</li> </ul>

**Addendum to the ProPECC Practice Note PN 4/94**

Original	Amendments
<p>Para 9, last sentence</p> <p>“Enquiries can be addressed to ..... (Telephone: 594 6241, Faxline No. 827 8040).”</p>	<p>“Enquiries can be addressed to ..... (Telephone: 2594 6241, Faxline No. 2827 8040).”</p>
<p>Para 9, first sentence</p> <p>“Officers in the Air Management Group of...”</p> <p>Para 9, last sentence</p> <p>“Enquiries can be addressed to the..., Air Management Group,... (Telephone: 594 6241, Faxline No. 827 8040).”</p>	<p>“Officers in the Air Policy Group of...”</p> <p>“Enquiries can be addressed to the..., Air Policy Group,... (Telephone: 2594 6412, Faxline No. 2827 8040).”</p>