



SAFE USE OF HCFC ALTERNATIVES IN REFRIGERATION AND AIR-CONDITIONING

An overview for
developing countries

UNITED NATIONS ENVIRONMENT PROGRAMME



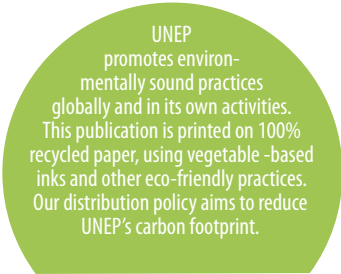
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Executive Summary

As the phase-out of hydrochlorofluorocarbons (HCFCs) progresses under the *Montreal Protocol on Substances that Deplete the Ozone Layer*, it is expected that there will be a considerably higher uptake around the world, and in particular in developing countries of 'alternative refrigerants', such as hydrocarbons, ammonia, carbon dioxide, unsaturated hydrofluorocarbons (HFCs) –or HFO- and HFO mixtures. Many of these alternative refrigerants have particular characteristics in terms of toxicity, flammability and high pressure which are different from those used previously such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). When refrigeration and air-conditioning equipment is installed, serviced, repaired and dismantled, safety issues need to be carefully evaluated and considered particularly when servicing technicians have to deal with refrigerants with properties that they were previously not familiar with. It is therefore important that the refrigeration and air-conditioning industry adapts to both the technical and safety issues concerning these refrigerants.

This publication provides an overview of the alternatives to HCFCs, their general characteristics and the situations in

which they may be considered appropriate to be used in the context of the safety implications posed by these refrigerants.

Specific information is provided on flammable, higher toxicity and higher pressure alternatives to better understand how such alternatives may be used and the measures which should be considered to assist the industry to implement them in a safe and appropriate manner.

The publication, which is intended for National Ozone Units (NOUs) and other interested parties in developing countries, provides general suggestions and guidance on how NOUs can advise and assist their national stakeholders. The focus of the publication is on new systems, since the use of flammable, higher toxicity and/or higher pressure alternatives is strongly discouraged from being used in existing HCFC systems. Consideration is also given to the relevant requirements and recommendations of the *Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol*.

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Foreword

On the 1st January 2015 developing countries reached the second significant milestone in the phase-out of hydrochlorofluorocarbons (HCFCs) under the Montreal Protocol on Substances that Deplete the Ozone Layer – the 10% reduction in their production and consumption. Since many of the low GWP alternatives to HCFCs have properties such as flammability, toxicity, and high operating pressure the adoption of such alternative refrigerants needs to be carefully considered to ensure the safety of those who install, service and use the relevant equipment. This is particularly important when servicing technicians have to deal with refrigerants with properties that they were previously not familiar with.

UNEP OzonAction is assisting developing countries to comply with their commitments under the Montreal Protocol, particularly those related to the HCFC phase-out, which involves a range of sectors and approaches. A very important sector in developing countries is of course the refrigeration and air-conditioning sector and it is consequently important that the refrigeration and air-conditioning industry adapts to both the technical and safety issues concerning these refrigerants.

We are therefore pleased to bring you this short publication on the safe use of HCFC alternatives. While this guide is principally designed as an information tool for NOUs, it should also be of interest to refrigeration servicing technicians, refrigeration associations, and other stakeholders in the refrigeration and air-conditioning sector.

I hope you will find this guide interesting and informative and that it provides a useful overview and some practical guidance when considering the adoption of HCFC alternatives. OzonAction looks forward to continue supporting your efforts to phase out HCFCs and adopting non-ozone depleting, non-global warming and energy-efficient alternatives in a safe and reliable manner.

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1 Introduction



Hydrochlorofluorocarbons (HCFCs), such as HCFC-123 and HCFC-22, are in the process of being phased-out in Article 5 countries by 2030, with a small allowance for servicing thereafter. Many of the alternatives – especially those with lower GWP – have characteristics that demand a greater attention to safety than is required for ordinary HCFC and hydrofluorocarbon (HFC) refrigerants. Whilst the replacements for HCFC-123 (which include HFC-245fa, HFC-134a and more recently HCFC-1233zd) do not pose additional safety risks, the numerous alternatives that may be used to replace HCFC-22 in various applications are flammable, have higher toxicity or operate at substantially higher pressures.

Although many of these refrigerants have been in use to a greater or lesser extent, often in non-Article 5 countries, it is important for those involved in the substitution of HCFC-22 to alternative refrigerants to become aware of these characteristics and how to address them. In particular, safe and successful application of these refrigerants requires adequate policies and legislation, minimum skills of service technicians, relevant safety standards, proper maintenance procedures to be followed and necessary safety devices installed according to manufacturer instructions.

This publication is therefore intended to provide National Ozone Units (NOUs) with the background to understand when and where such alternatives may be used and the measures that need to be

considered in order to assist the industry and other stakeholders to implement them in a safe and responsible manner, if and when they are chosen. The safety considerations apply broadly, including the production, installation, operation, servicing and decommissioning of systems.

Hence, this publication aims to provide:

- An overview of key ozone- and climate-friendly alternatives refrigerants for HCFC-22 and their basic characteristics
- The types of situations that these alternatives may be considered for use
- An appreciation of the different stages and associated stakeholders that the choice of refrigerant can affect
- A general introduction to the safety implications posed by refrigerants in general
- Classifications of different refrigerants and an understanding of the different types of refrigeration systems¹
- A summary of the various safety standards that relates to the application of refrigerants

- Quantitative examples of limitations that can apply to different alternative refrigerants
- Specific implications important for flammable, higher toxicity and higher pressure alternatives
- Some examples of how the Montreal Protocol and developing countries have approached the issue of safety in projects
- General suggestions for how NOUs can advise and assist their national stakeholders accordingly

The focus of this publication is primarily upon new systems, since the use of flammable, higher toxicity and/or higher pressure alternatives should be strongly discouraged from being used in existing HCFC systems.

Lastly, the common HFC refrigerants – such as HFC-134a, R-404A and R-407C – are not addressed here since their safety characteristics are not substantially different from HCFC-22. Information relating to the application of these substances can be found widely in the literature.

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