GUIDEBOOK FOR IMPLEMENTATION OF CODES OF GOOD PRACTICE

Phasing out ODS in Developing Countries

REFRIGERATION SECTOR

Multilateral Fund for the Implementation
of the Montreal Protocol

United Nations Environment Programme
Industry and Environment

UNEP

OzonAction Programme

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Foreword

The ozone layer is vital to life on the Earth's surface. Yet in the 1980s it was discovered that it was vulnerable to damage by emissions into the atmosphere of particular industrial chemicals, of which the most important was the family of chlorofluorocarbons (CFCs). In September 1987, nations concerned with this crisis signed the Montreal Protocol, a landmark agreement that identified the major ozone-depleting substances (ODS) and established a timetable for the reduction and eventual elimination of their use.

The production and consumption of CFCs was phased out in developed countries by the beginning of 1996. Developing countries are given a longer timetable by the Montreal Protocol, and in July 1999 they will face their first target: a freeze on the consumption of Annex A CFCs at 1995–97 levels. Total phaseout is to be achieved by 2010.

In many developing countries the most important sector in which CFCs are used is refrigeration, and in many countries the most important single use is in the servicing of CFC-containing equipment. Yet poor servicing procedures often lead to the release of a significant proportion of the refrigerants directly into the atmosphere.

It is widely recognized that the phaseout of CFCs in the refrigeration sector in developing countries can be best achieved through an overall strategy that integrates the relevant technical and policy options. Such overall strategy is known as a "Refrigerant Management Plan" which includes and prioritizes various activities including public awareness campaigns, training and certification of service technicians, conversion projects, establishment of refrigerant recovery and recycling systems and suitable policy and regulatory support frameworks, improvement of data collection systems and control and monitoring of the ODS consumption.

This Guidebook is designed to help governments and industry to design and establish appropriate codes of good practice for the refrigeration servicing sector. Such codes of good practice are an important part of the regulatory framework to support all other phaseout efforts within the Refrigerant Management Plan. This Guidebook is part of a series of documents produced by UNEP within the OzonAction Programme under the Multilateral Fund, in order to assist developing countries in the implementation of the Montreal Protocol.

About this Guidebook

Codes of good practice in refrigeration already exist in many developed countries. This Guidebook does not simply present versions for developing countries – widely varying national circumstances would make that pointless.

Instead, it aims to guide developing countries in the design and establishment of their own codes of good practice for the refrigeration servicing sector. It seeks to provide a common base for discussion among decision-makers and relevant stakeholders in developing countries, including representatives from:

- *National Ozone Units and other government institutions*
- *Industry and trade associations*
- *Service workshops and technicians*
- *System owners and operators*
- *Manufacturers.*

What's the scope of this Guidebook?

Refrigeration includes air-conditioning and heat pump applications that are relevant to developing countries. The same basic principles for servicing CFC refrigeration systems apply to all refrigeration sub-sectors, such as:

- *Commercial and industrial refrigeration, e.g. chilling, freezing and cold storage plants, usually designed as remote systems*
- *Domestic refrigeration, e.g. household freezers and refrigerators, and other self-contained applications*
- *Mobile refrigeration, e.g. transport refrigeration for goods in ships, containers, rail and road transport, and vehicle air-conditioning in motorcars, trains, trucks and buses.*

Servicing includes all kind of activities which may be performed by a service technician, ranging from installation, commissioning, operation, inspection, maintenance, repair, retrofitting, redesign and de-commissioning of refrigeration systems to handling, storage and recovery and recycling of CFCs, in addition to essential record-keeping.

The design and manufacture of new equipment or refrigerants, laboratory and field testing and disposal or destruction of end-of-life equipment or refrigerants is not considered in this Guidebook. Thermal insulation of refrigeration equipment on the basis of ODS-containing foams is also excluded.

What's in this Guidebook?

An introduction to the issue and background information: what is the Montreal Protocol? How are CFCs used in developing countries? Why is the refrigeration sector so important? What can codes of good practice achieve?

The challenges faced in achieving a cost-effective phaseout: the Refrigerant Management Plan. What can the different groups of individuals and organizations do to reduce CFC use in refrigeration? This chapter covers the tasks for 1) governments, 2) industry and trade associations, 3) servicing workshops and technicians, 4) system owners and operators and 5) manufacturers.

The steps that should be taken in designing and implementing codes of good practice to reduce CFC use: what are the tasks of the implementation team? What are the tasks of the design team? Which steps to be taken for designing codes of good practice?

The details of such codes of good practice including general servicing practices to be followed or to be eliminated.

Where to find more information and related documents.

The annexes contain further background information such as templates for recording forms and labels and examples of company policy statements and voluntary industry agreements.

Contents

Common abbreviations

CFC	Chlorofluorocarbons
HCFC	Hydrochlorofluorocarbons
HFC	Hydrofluorocarbons
LVC countries	Low-volume-ODS-consuming countries
ODS	Ozone-depleting substance
OZAP	OzonAction Programme
R&R	Recovery and Recycling
TOC	Technical Options Committee
UNEP	United Nations Environment Programme
UNEP IE	UNEP Industry and Environment

1. Introducing the Issues …

What is the Montreal Protocol?

The ozone layer

The fragile ozone layer high in the Earth's stratosphere plays a crucial role in protecting human, animal and plant life from harmful ultraviolet radiation emanating from the sun. In the 1980s it was discovered that this ozone layer was vulnerable to damage by CFCs and other industrial chemicals. Stable, non-toxic and highly versatile, CFCs have been employed for a wide variety of uses, including refrigerants and air-conditioning fluids, aerosol propellants, solvents and foam-blowing agents. Other ozone-depleting substances (ODS) include halons, carbon tetrachloride, methyl chloroform, methyl bromide and hydrochlorofluorocarbons (HCFCs); this latter category is much less ozone-depleting than CFCs, and is often used as a transitional substitute.

The ozone treaties

The United Nations, through UNEP, was instrumental in negotiating the 1985 Vienna Convention for the Protection of the Ozone Layer, and the subsequent 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. These international treaties, which have now achieved almost universal adherence, applied quantitative controls to the production and consumption of ODS.

These controls have been made steadily stricter as the scientific evidence for ozone depletion has strengthened, and as industry has succeeded in developing non-ozone depleting substitutes. In the industrialized world, total phaseout of most categories of ODS, including all CFCs, was achieved by the beginning of 1996.

Developing countries

Developing countries – 'Article 5 parties' as defined in the Montreal Protocol – enjoy longer control schedules. The first target for CFCs they face is a freeze on production and consumption of Annex A CFCs at 1995–97 levels by 1 July 1999.

The Montreal Protocol contains a mechanism (the Multilateral Fund) for providing financial support to developing countries to assist them in drawing up and implementing ODS phaseout programmes. The Fund operates through four implementing agencies, UNEP, UNDP, UNIDO and the World Bank. UNEP IE, through its OzonAction Programme, assists developing countries in the implementation of the Montreal Protocol through an information clearinghouse (information exchange, training and networking) and other country specific activities. More information on the OzonAction Programme can be found in Annex K.

Phasing out ODS

Substitutes now exist for virtually all uses of CFCs, and in some areas - aerosol propellants and solvents, for example – ODS are now almost never used in new products. Refrigeration has proved a more difficult sector, however, and much of the equipment involved has fairly long lifetimes. Thus the servicing of this equipment plays an important part in an effective strategy for ODS phaseout.

How are CFCs used in developing countries?

Developing countries vary widely in their pattern of ODS use, and of course this is rapidly changing over time. For the purposes of this Guidebook, there are two key pairs of distinctions:

First, in terms of production of ODS:

Large countries with relatively sophisticated technologies and research capabilities, which produce ODS both for local use and for export markets; examples include China, India and Brazil. Since CFC prices in these countries are still low, there is little incentive for recovery and recycling – but there are plans to convert CFC to HCFC production and to introduce the production of non-ozone depleting substitutes such as hydrofluorocarbons (HFCs).

Other developing countries which rely on imported ODS and where local equipment manufacture is limited to assembly. These countries usually have weak industry associations and a limited access to up-to-date information on available technology.

Second, in terms of consumption of ODS:

Countries consuming large amounts of ODS (more than 360 tonnes per year), including producer countries such as Brazil, India, China, Argentina and Mexico, and non-producer countries such as Thailand, Malaysia, Philippines, Indonesia, Turkey, Iran, Egypt, Colombia, Ecuador, Chile, Sudan and Algeria. Differences in market and industrial structures, institutional set-up and government policies are huge, and require a case-by-case approach to the definition of ODS phaseout strategies. The refrigeration sector is usually not the only phaseout target area in these countries; other sectors may occasionally be more important.

Low-volume consuming (LVC) countries accounted for 75% of Article 5 countries in 1996 (86 out of 114); examples include Ghana, Sri Lanka, Guatemala, Burkina Faso and Mozambique. These countries import all ODS and ODS-containing products for their local markets. They face particular difficulties in phaseout because of problems such as a weak institutional set-up, limited technological expertise and difficulties in regulating a large informal service sector with poor equipment and unskilled personnel.

Why is the refrigeration sector so important?

The refrigeration sector is the most important ODS-consuming sector in almost all developing countries. Table 1 shows how the sector accounted for between one-third and two-thirds of total consumption in the 78 developing countries analyzed. The smaller the country's total consumption, the larger the proportion accounted for by refrigeration. In addition, of course, the sector is of strategic importance for the supply of food and medicines and the export of crops.

Consumption categories	Refrige -ration	Aerosol	Foam	Halons	Solvents
1000 and more tonnes ODS (N=18)	33%	12%	26%	16%	12%
360<...<1000 tonnes ODS (N=9)	54%	23%	13%	5%	1%
360 and less tonnes ODS (N=51)	69%	12%	8%	7%	4%

Table 1: ODS consumption in small-, medium- and high-ODS-consuming Article 5 countries in 1992–94. These data may change rapidly with the advancing phaseout of ODS (Source: Country Programme reports).

What do codes of good practice achieve?

The refrigeration industry estimates that about one-sixth of the worldwide CFC use in the refrigeration sector could be reduced through proper servicing and maintenance practices. In LVC countries, nearly all CFC consumption is devoted to servicing existing refrigeration systems. There is huge potential to reduce CFC consumption by preventing unnecessary emissions in servicing.

Codes of good practice in the refrigeration sector are designed to:

- *Define minimum standards of good practice for servicing refrigeration systems*
- *Act as resource documents in the training of service technicians and the development of training materials*
- *Help to initiate communication between relevant stakeholders, including service companies from the informal sector.*

Such codes of good practice therefore form a highly important part of a country's ODS phaseout strategy. Properly designed and implemented codes:

- *Reduce CFC consumption in a cost-effective manner, without requiring major capital investment*

- *Help ensure a smooth transition from CFC to non-CFC technology by allowing existing refrigeration systems to run until the end of their useful life (through lower consumption and the use of recovery and recycling systems), thereby avoiding premature replacement*
- *Also improve quality, safety and health aspects.*

2. Facing the Challenge: What You Need to Do

Government

A major responsibility of the Government is to initiate, plan, coordinate and monitor the transformation process towards non-ODS technology in the country. The initiation phase may comprise:

- *Demonstration of the country's commitment for ODS phaseout through becoming a Party to the Montreal Protocol*
- *Identification and involvement of relevant stakeholders including the international community*
- *Formulation of a Country Programme for ODS phaseout and establishment of an ODS phaseout plan and a Refrigerant Management Plan*
- *Establishment of a National Ozone Unit*

The Country Programme

This Guidebook assumes that the country in question is already a party to the Montreal Protocol and is in the process of establishing or implementing its Country Programme for ODS phaseout. Such Country Programme establishes a baseline survey on the use of the controlled substances and draws up appropriate policies and strategies. These form the basis for the definition of an overall phaseout plan for the replacement and control of ODS and the creation of a National Ozone Unit as part of an Institutional Strengthening project. The National Ozone Unit coordinates and monitors the phaseout plan.

The phaseout plan for ODS

The phaseout plan for ODS defines the phaseout time schedule for each controlled substance and the specific actions to be undertaken and takes into account the specific industrial, political and legislative situation in the country. It should specify how to overcome obstacles and how to allocate financial and human resources as well as necessary equipment.

All relevant stakeholders – the groups listed below – should be involved and consulted during the establishment of the ODS phaseout plan detailing the timing of all of the key elements in such plan, of milestones for ODS phaseout and of the implementation of supporting measures. Responsibilities need to be allocated to the relevant stakeholders and clear policy statements should be communicated to all stakeholders and the general public.

As the phaseout plan is being implemented and new obstacles and opportunities arise – and as the Montreal Protocol continues to evolve – the plan will need review and modification.

The Refrigerant Management Plan (RMP)

As the refrigeration sector is a priority in most Article 5 countries, a Refrigerant Management Plan [57] needs to be established as part of the overall phaseout plan for ODS. The objective of a RMP at country level is to design and implement an integrated and overall strategy for cost-effective phaseout of CFC in the refrigeration servicing sector which includes the most relevant technical and policy options. Projects previously implemented in isolation from one another are thus part of an overall approach, and synchronized for optimal results. Such an integrated strategy may include:

- *Strengthening of the instututional framework and the establishment of a suitable policy and regulatory support framework*
- *Establishment of refrigerant R&R systems*
- *Establishment of systems for monitoring and control of CFC consumption, imports and exports*
- *Training of service technicians on good practices in refrigeration and R&R*
- *Training of customs officers on control and monitoring of CFC imports and exports*
- *Public awareness campaigns*

The implementation of codes of good practices in this context represents a supporting measure for the training of technicians in good servicing practices. The emphasis on different elements will of course change over time as phaseout advances. The following example shows how the different elements can be fitted together and progress through different stages:

- *In the initial stages, the country should concentrate on containment practices to preserve scarce CFCs and to run existing equipment until the end of its economic life. This may require training for technicians on good servicing practices.*
- *Monitoring and control of any equipment manufacturing in the country in order to avoid the installation of new plants for CFC systems and to promote the early conversion of manufacturing plants for refrigeration equipment is crucial to minimize the number of CFC systems existing in the country.*
- *Monitoring and control of imports of new and second-hand CFCs and CFC systems will require the establishment of a regulatory framework including import licenses and customs controls. This may require training of customs officers.*
- *Retrofitting CFC systems may take place if it is technically and economically feasible. This may be the case for equipment with a long remaining life-time.*
- *If equipment is at the end of its economic life, replacement is the suggested approach. The decommissioning of the old systems may require the establishment of proper disposal practices, a permit system to dispose of CFCs and CFC systems and destruction facilities.*
- *In the latter stages of the phaseout programme, training for technicians may focus on how to service alternative systems and handle alternative refrigerants.*

The involvement and commitment of all relevant stakeholders and the

coordinated implementation of the chosen elements, is crucial to achieve a successful phaseout. The Guidebook now considers the roles of the other stakeholders identified earlier.

Industry and Trade Associations

Industry and trade associations (where they exist in developing countries) can play a crucial role in defining and supporting the national ODS phaseout plan. Their responsibility is primarily to protect the interests of their member companies in the context of the phaseout plan, and to inform them about new trends and developments. In particular, they can:

- *Act as a communication route between stakeholders and initiate networking with international associations, training institutes and research bodies.*
- *Collect and provide data for decision-making and monitoring to the National Ozone Units.*
- *Identify service workshops and technicians in the formal and informal sectors, e.g. through wholesalers' distribution networks.*
- *Encourage system owners, operators, service technicians and workshops to adopt good servicing practices and inform on new and future legislation, micro- and macroeconomic developments, innovative and alternative technologies, business opportunities and partnerships.*
- *Promote technology transfer.*
- *Participate in the development training and information materials including codes of good practice as well as in the organization of training workshops and seminars on technical options, good servicing practices and environmental awareness.*
- *Advise government on the legislative and supporting measures needing to be implemented.*
- *Initiate voluntary action and business commitments.*

Service workshops and technicians

Service workshops and technicians have to be aware of recent policy and technological trends in order to be able to advise and inform their clients and to apply proper servicing practices. They need, therefore, to stay in close contact with industry and trade associations, equipment and refrigerant suppliers and government institutions. In particular, they should:

- *Remain aware of government policies, ODS phaseout plans and the environmental implications of CFC emissions.*
- *Stay abreast of the regulatory requirements, alternative refrigerants and technologies, and all the cost implications.*
- *Keep informed of and participate in training opportunities and certification schemes for service technicians.*
- *Procure the necessary R&R equipment.*

- *Establish the necessary record-keeping procedures.*
- *Disseminate information to customers on their legal obligations, record-keeping, self-inspections and preventive maintenance.*
- *Advise customers on their technological options and the associated cost implications.*

System owners and operators

Owners and operators of refrigeration systems should be aware of, and maintain contact with, relevant industry bodies, trade associations, their local service companies and, if practical, the suppliers and manufacturers of the refrigerants and refrigeration systems they use. In particular, they should:

- *Remain aware of government policies and ODS phaseout plans, and of the environmental implications of CFC emissions.*
- *Obtain information on the regulatory requirements, record-keeping, self-inspections and preventive maintenance, and on innovative technology options.*
- *Establish a Refrigerant Management Plan at company level, including the necessary management commitment and the designation of a facility refrigerant manager.*
- *Raise awareness and train the employees.*

Manufacturers

Manufacturers of refrigeration systems must keep in close contact with government institutions and industry associations to be aware of government policies and ODS phaseout plans and to keep informed about legislative requirements. In particular, they should:

- *Network and exchange information with other companies, research institutes, refrigerant producers and suppliers to ensure they are kept informed of policy developments and innovative technologies.*
- *Evaluate the technological options for the conversion of their manufacturing facility to non-CFC products.*
- *Train personnel on good practices and environmental awareness.*
- *Provide product stewardship and the necessary information to customers on servicing or retrofitting their existing refrigeration systems.*
- *Display management commitment e.g. by issuing a company policy statement (see Annex B).*
- *The conversion of manufacturing facilities should have a high priority in order to reduce the future stock of CFC systems and to ensure competiveness in, and access to, international markets.*

3. Designing and Implementing Codes of Good Practice

The design and implementation of national codes of good practice for the refrigeration servicing sector should form an integrated part of the Refrigerant Management Plan, which itself forms part of the wider national phaseout plan for ODS.

Usually, the National Ozone Unit should estimate the necessary resources for the project and define scope, time schedule, and target groups.

In turn the National Ozone Unit should establish an interdisciplinary Implementation Team for the detailed planning and coordination of the project. This team may design the codes of good practice itself or delegate it to an interdisciplinary Design Team.

The composition of the Design Team may be the same or similar to the Implementation Team, if the team members have sufficient time and technical expertise to prepare the codes. It is advisable to have at least one representative from the Implementation Team, to ensure communication between both teams and to monitor the work of the Design Team. The purpose of the Design Team is to concentrate on the acquisition of information and the compilation of the codes of good practice themselves.

The rest of this chapter describes the steps that need to be taken by both teams in drawing up the codes of good practice. The next chapter contains more detail about the content of the codes.

Tasks for the Implementation Team

The Implementation Team should follow these steps:

Plan and prioritize

Plan and prioritize activities and necessary resources. The planned actions should take into account the priorities of the Country Programme, to achieve maximum effectiveness and coordination with other activities.

Define time schedule

Establish a detailed schedule for the implementation process, which should conform with the time schedules of other supporting activities and the implementation of the Country Programme. The successful introduction of codes of good practice needs to consider many measures, including awareness-raising and training, and the establishment of legal and economic incentives. All stakeholders must be informed about the time schedules, milestones and the steps they need to take.

Identify stakeholders and gain commitment

Identify the relevant stakeholders, such as service companies, technical training schools and institutes, government and industry partners, distributors and wholesalers of refrigeration equipment and refrigerants. Maintain an up-to-date list of contact addresses.

The early involvement and consultation of these individuals and organizations in the planning, design and implementation process will train and familiarize key decision-makers with ozone issues and develop their commitment and support.

Information and awareness campaigns and the organization of national workshops on good servicing practices help to gain industry commitment. Industry may support the implementation of such codes of good practice by officially approving the established codes and signing relevant policy statements. An example of such a policy statement is given in Annex B.

Identify target groups

Identify and characterize the target groups for the codes of good practice, such as directly hired system operators and service technicians in manufacturing companies, and technicians from small or large service workshops as well as the informal service sector. Wholesalers and distributors of refrigeration systems, spare parts and refrigerants may help in the identification process and in establishing the necessary contacts.

Investigate existing servicing practices for refrigeration systems, working conditions and constraints and the educational level of technicians. Again, maintain an up-to-date list of contact addresses.

Investigate existing equipment

Investigate the inventory of existing CFC and non-CFC refrigeration equipment, working fluids, R&R and leak-testing equipment, and consider their availability in national markets.

Improve communication

Advertise and communicate good service practices in refrigeration to the relevant stakeholders and the public. Press releases, leaflets, posters, and radio and television interviews and programmes can be used. Other channels, such as technical training institutes, wholesalers and distributors, and companies and service workshops should also be investigated.

Establish the Design Team

Identify appropriate team members and a preliminary time schedule for their work – which should be supervised by the Implementation Team and reported back to the National Ozone Unit. The Design Team may need to be trained and prepared by participating in seminars and field visits. Their tasks are outlined below.

Enforce the codes

Established codes of good practice need to be enforced: command and control measures (e.g. regulations), market-based measures (e.g. taxes or permits) or voluntary agreements are all possible routes. Command and control approaches – the most common approach – do require an effective legal framework.

The Implementation Team should propose the combination of different types of measures which best suits the country situation. Relevant stakeholders should of course be involved in the discussions, and the existing legislative and administrative framework should be used as far as possible – any proposed changes will have to be submitted to government. If new measures are necessary, industry should be allowed a phase-in schedule to adapt to them in order to avoid unnecessary disruption.

Since foreign-owned multinational companies usually have ready access to innovative technology, investment capital and the skilled personnel needed to perform the transition, indigenous industries may need protection during the transition phase, while at the same time ensuring that demand for alternative technologies can be met. Any new legislation should be accompanied by appropriate monitoring, control and enforcement measures.

Establish voluntary agreements

Voluntary – but binding – agreements with industry may avoid the need for new regulations if agreement on the content and legal status of the codes of good practice can be reached with the relevant stakeholders. Service contracts should require that refrigeration systems are serviced in compliance with the established codes of good practice. Annex C gives an example of such a voluntary agreement.

Incorporate codes of good practice in regular training

Ensure that the regular training agenda of technical training institutions is based on the established codes of good practice. National training workshops should incorporate codes of good practice and provide certificates for participants – such certificates could become mandatory for service technicians.

Apply project management techniques

Apply proper project management techniques, including regular control and monitoring of the implementation process and documentation and reporting of progress to the National Ozone Unit.

Review and update the codes of good practice

Establish a procedure to survey technology developments and changing conditions in the country. New technologies will probably require reviews and updates of the established codes of good practice, especially when servicing practices or safety requirements change.

Tasks for the Design Team

The Design Team should follow these steps:

Plan and establish time schedule

Plan the design process, define the necessary activities, and establish a detailed time schedule. This should be coordinated with existing schedules for the implementation of codes of good practice, other supporting activities and the implementation of the wider Country Programme.

Collect and analyze data

Collect and analyze information from:
The Country Programme – including country characteristics, strategies, and the different CFC-consuming sub-sectors; and
The Implementation Team – on the profiles of target groups and the inventory of existing CFC systems in the country.
Existing codes of good practice, standards and specifications represent a valuable source of technical information. Annex G contains a list of such documents and Annex H a list of standards.

Establish contacts

Make contact and cooperate with similar bodies in other countries and the relevant stakeholders to exchange information and experiences and to gain expertise on new technical developments. Participation in regional and international conferences and workshops, and direct contact with key institutions, is often useful.

Compile the codes of good practice

Draw up the codes of good practice and involve stakeholders and expert reviewers for comments and approval. This is considered in more detail in the next section, and a suggested table of contents for these codes is provided in Annex D.

Report on progress

Report progress to the Implementation Team.

Designing codes of good practice

The Design Team should follow these three steps in drawing up the codes of good practice:

Define their scope

Codes of good practice should focus on the defined target groups and specify clearly their scope and limit of applicability.

In principle there should be separate codes for the different refrigeration sub-sectors. However, technicians in developing countries, particularly from the informal sector, often service a wide variety of equipment. Since the principles of good servicing practices are essentially the same for different sub-sectors, the Design Team should avoid duplication by concentrating primarily on the commercial/industrial sub-sector, and then highlighting separately any specific issues concerned with the domestic and mobile sub-sectors.

Codes of good practice should avoid burdening particular groups more than others, e.g. service workshops from the informal sector, small workshops or end-users of refrigeration equipment. Codes need regular reviewing and updating and should motivate the user to send comments and feedback.

Structure their format

Codes of good practice should be neither too brief not too exhaustive. They must be practical and easy to understand and should therefore be well structured and written in the local language.

Checklists or questionnaires may be appropriate for service technicians to become familiar with new servicing practices and to encourage the learning process. Specifically, checklists for trouble-shooting of CFC equipment and recording forms for proper record-keeping and documentation will be a practical help for service technicians. Illustrations can be used to help users visualize new procedures, servicing practices, alternative refrigeration and R&R equipment.

Decide their contents

Existing codes of good practice, standards or specifications related to the refrigeration sector represent a valuable source of information for developing countries. They vary in scope and purpose and usually originate from developed countries such as Australia, Canada, South Africa, Sweden, United States and the European Union. A list of such documents is given in the bibliography in Annex G, and Table G includes an outline of the contents of each document.

It is important to motivate technicians and to explain why proper servicing practices should be adopted, while at the same time giving them the necessary technical information and support. Since service technicians in many developing countries may have poor access to recent information and training, codes of good practice could include also non-technical sections on certification and training, to explain the regulatory and policy framework and to provide useful contact addresses and hints.

The next chapter provides details on the possible contents of the codes of good practice.

4. Elements of Codes of Good Practice

This chapter contains a compilation of general servicing practices to be followed or to be eliminated, derived from selected technical publications (see Table G). It is not exhaustive. The following sections are included:

1 - *Redesign of refrigeration systems*
2 - *Installation of equipment*
3 - *System operation and maintenance*
4 - *Preventive inspection and maintenance*
5 - *Record-keeping and documentation*
6 - *Recovery, recycling and reclamation*
7 - *Handling and storage of refrigerants*
8 - *Disposal of ODS refrigerants and systems*
9 - *Retrofitting and alternatives*
10 - *Safety requirements*
11 - *Training and certification*
12 - *Regulatory inventory*
13 - *Contact addresses and hints.*

1 Redesign of refrigeration systems

The design and manufacture of systems and components is beyond the scope of this Guidebook. Nevertheless, larger refrigeration systems with sufficient remaining lifetimes may be eligible for preventive redesign and upgrading in order to reduce unnecessary emissions and repair work.

Practices to follow:

- ✓ *Improve cleanliness through appropriate filters and driers in the system.*
- ✓ *Reduce vibrations through adequate foundations and anti-vibration mountings.*
- ✓ *Facilitate containment and recovery practices through fully protected liquid receivers which hold the entire refrigerant charge of the system and can be isolated.*
- ✓ *Incorporate a separate pump-down condensing unit and receiver in larger systems.*

- ✓ *Consider the fitting of suitable valves to compressors and major items of equipment to allow the connection of a pump-down unit for smaller systems.*
- ✓ *Install isolating and manifold valves to allow isolation of vessels and system components.*
- ✓ *Minimize lengths of hoses and pipes that require purging.*
- ✓ *Perform leak testing of charging lines.*
- ✓ *Use capped service valves to retain any leakage from the spindle gland, or valves with retained or captive spindles.*
- ✓ *Minimize mechanical joints in the piping system; use welded or brazed connections instead of flared or screwed connections wherever possible.*
- ✓ *Install leak detection systems.*
- ✓ *Install charging valve quick connects.*
- ✓ *Ensure that pressure-limiting devices are correctly set to 90% of relief valve settings to avoid unnecessary opening due to operational faults.*

2 - Installation of equipment

New installations should not use CFC refrigerants. Where possible, refrigerant with small or zero ozone- depleting potential (ODP) should be used, bearing in mind the overall environmental impact with regard to e.g global warming or safety issues.

If CFC refrigeration systems need to be installed, the following aspects should be considered in addition to goodservicing principles for operation and maintenance. Additional design features are described above in Section 1.

Practices to follow:

- ✓ *Check the machinery room for appropriate size and ventilation; maintain a minimum distance from the walls to avoid overheating of compressors and condensers.*
- ✓ *Ensure cleanliness of piping systems and fittings prior to fitting into position and during installation.*
- ✓ *Prevent oxidation during brazing or soldering by flushing through with dry nitrogen.*
- ✓ *Blow through the pipework with dry nitrogen to remove welding, brazing or cutting debris; under no circumstances should oxygen be used.*

- ✓ *Check the accessibility of piping with regard to inspection, maintenance and repair and avoid refrigerant-carrying lines in the ground, lakes or watercourses.*
- ✓ *Check all refrigerant lines and mechanical joints for tightness before introducing tracer gas.*
- ✓ *Perform leak testing to ensure system tightness.*
- ✓ *Label each system with clear details of the equipment, technical data, and the type and volume of the refrigerant and lubricant.*
- ✓ *Check the pressure vessel documents and pressure-testing certificates and ensure that containers have appropriate name plates.*
- ✓ *Check the necessary safety equipment ensuring that it is in working order e.g. safety valves, high-pressure monitors, emergency stop system, pressure reliefs and discharge lines.*
- ✓ *Check the tightness of the system again before commissioning.*
- ✓ *Recheck the commissioned system for tightness for transport or storage.*
- ✓ *Prepare the service logbook containing all relevant data, including templates to record forthcoming plant inspection, maintenance and repairs; the logbook must be accessible for service technicians.*
- ✓ *Check that instructions for safe operation and maintenance are attached to the service logbook and are written in the local language.*
- ✓ *Record installation and commissioning of the system in the service logbook, specifying the results of leak testing and installation checking and indicating the dates and names of the service technicians.*

3 - System operation and maintenance

The following principles should be respected during the operation and maintenance of CFC systems:

Practices to follow:

- ✓ *Think of CFC conservation and safety.*
- ✓ *Shut down systems and make repairs when leaks exist.*
- ✓ *Recover CFCs from the discharge of the vacuum pump by means of a condenser and a container, if evacuation is needed.*

- ✓ *Follow the instructions of the manufacturer for the cleaning and flushing of a contaminated system and for the replacement of filters, driers, accumulators etc.*
- ✓ *Raise the oil temperature prior to service work to reduce the amount of refrigerant dissolved in the oil.*
- ✓ *Evacuate and pressure test a refrigeration system thoroughly prior to commissioning when it has been opened to the atmosphere for servicing; use the triple evacuation method if necessary.*
- ✓ *Calibrate the controls with air, nitrogen, or controlled calibration sets.*
- ✓ *Perform leak testing and purge the connection lines prior to recharging a system.*
- ✓ *Check the amount of remaining oil or lubricant in order to add no more than the necessary amount.*
- ✓ *Adjust the refrigerant charge by using pressure-temperature charts until proper operating conditions are realized; the sightglass cannot be used to adjust the charge properly.*
- ✓ *Ensure that mixtures of refrigerants are charged as a liquid and not as a gas.*
- ✓ *Conduct performance testing after recharging or commisioning.*
- ✓ *Defrost regularly to avoid excessive built-up of ice on the evaporator and to ensure efficient heat transfer.*
- ✓ *Keep the machinery room clean and pest free.*
- ✓ *Ensure that doors of freezer compartments lock the appliances airtight to avoid the entrance of humid and warm air.*

Practices to eliminate:

- ❑ *Do not release the contents of charging lines into the atmosphere.*
- ❑ *Do not use CFCs to clean tools, coils, machinery or as cleaning solvents for compressor cleaning if there are alternative solvents available; otherwise, R&R must be ensured.*
- ❑ *Do not attempt to service a system before identifying the type of refrigerant and the oil used in the system.*
- ❑ *Do not add lubricating oil to a system without establishing the type in use and the acidity level within the system.*

- ❏ *Do not top up a system short of CFCs before examination for oil traces and leakages.*
- ❏ *Do not charge refrigerant through the suction line of the compressor if you cannot ensure that the refrigerant is charged as a gas and not as a liquid, as the liquid entry can damage the compressor.*
- ❏ *Do not recharge any refrigeration system if there are doubts about the pressure integrity.*
- ❏ *Do not open the refrigerant side of a system unless absolutely necessary' prior to opening, isolate the component to be serviced and recover the CFCs.*
- ❏ *Do not use CFCs as a tracer gas for leak testing.*
- ❏ *Do not operate a system known to have leaks without establishing and rectifying the source of leakage.*
- ❏ *Do not cool bearings and parts for fitting with directly evaporating refrigerants, unless full recovery is ensured.*
- ❏ *Do not use sharp or metallic items to remove ice from the evaporator or the freezer compartment.*
- ❏ *Do not use the condenser for drying purposes, because this hinders the heat transfer.*
- ❏ *Do not restart a compressor immediately after a power breakdown.*

In addition to the general good servicing principles for CFC equipment, there are particular servicing principles for non-CFC equipment to be addressed, especially concerning retrofitted systems and hydrocarbon systems, where toxicity, flammability, etc. require additional safety measures. This information is beyond the scope of this report and should be addressed by equipment manufacturers and refrigerant suppliers.

4 - Preventive inspection and maintenance

The regular preventive inspection and maintenance of larger refrigeration systems helps to ensure their reliability and continued efficiency. Qualified technicians should be employed, preferably in the framework of a long-term maintenance agreement. Further options to reduce failure rates and leakages are described in section 1, on redesign.

Preventive inspection by service technicians will be cost-effective for vulnerable applications such as refrigerated transport or larger commercial and industrial applications, where even short but unexpected shut-down times may cause major financial damage.

For small systems, regular examination of the obvious elements by the user can be very effective in preventing future problems. Early attention to minor matters can be beneficial and cost-effective in the long term.

Practices to follow:

- ✓ *Draw up a preventive maintenance scheme and leak-testing routine to ensure logical and sequential examination and servicing of the system; the examination frequency should avoid unexpected interruptions to normal operation.*
- ✓ *Follow the manufacturer's instructions for preventive maintenance, and use its information hotline, where available.*
- ✓ *Inspect the system for leakages and damages (refrigerant and oil charge, operating parameters, mechanical damage or signs of ageing, oil traces).*
- ✓ *Inspect the system for signs of abnormal vibration (rubber between the pipework and its support).*
- ✓ *Monitor operating conditions and performance on a regular basis.*
- ✓ *Run auxiliary oil pumps weekly to ensure the lubrication of mechanical seal faces, bearings and glands during periods of system shutdown; if this practice has not been followed, inspect and lubricate the items before starting the system.*
- ✓ *Replace and tighten the seal caps on all valves, including around filters and driers, in accordance with the manufacturer's instructions after servicing.*
- ✓ *Follow established leak-testing procedures such as a standard vacuum test; use approved leak-testing tools and equipment.*
- ✓ *Use non-ODS gas as a tracer gas when leak testing, e.g. dry nitrogen (soap bubble method), where possible; avoid the use of mixtures of dry nitrogen and R22 (halide leak detectors) if R&R cannot be ensured.*
- ✓ *Install permanent leak detection systems with sensors located at vulnerable locations where possible.*
- ✓ *Obtain professional advice, e.g. from a service technician, when any abnormal condition is observed.*
- ✓ *Record the results of preventive inspections to alert the owners and operators to the actions taken and future requirements, such as planning shut downs for major services.*

5 - Record-keeping and Documentation

The detailed and regular documentation of operational parameters and performance data, abnormal operating conditions, repair work performed

and services carried out allows service technicians to assess the system history. It can assist in the diagnosis of abnormal conditions and also in providing recommendations as to the preferred solution. This could identify the need to plan for a major action or simply effect a minor change or repair.

The type of information to be documented depends on the type, size and application of the refrigeration system. For domestic refrigerators, operational parameters and performance indicators may not be available, but basic data concerning the equipment and the equipment supplier, type and charge of refrigerant, repair and servicing operations should be included.
The plant manual should contain the following data, documented in record

Practices to follow:

- ✓ *Locate and maintain a service book in a place accessible for service technicians and in close proximity to the refrigeration system.*
- ✓ *Locate and maintain a plant manual in a place accessible for service technicians and in close proximity to the refrigeration system.*
- ✓ *Record the loss, recovery and consumption of refrigerant for each type of refrigerant at company level if your company operates numerous refrigeration systems (see Annex A.6).*
- ✓ *Record the loss, recovery and consumption of refrigerant for each type of refrigerant and each customer, as well as purchase and recycling, if your company is a service or disposal company (see Annex A.7).*
- ✓ *Certify the purchase of R&R equipment to the relevant government institutions if required by law (see Annex A.8).*
- ✓ *Advise the owner of a company to maintain a refrigerant use book for all refrigeration systems specifying the overall consumption of refrigerants.*
- ✓ *Keep a copy of all records in a safe place and store them for an appropriate time period, which may be defined by law.*

forms as contained in Annex A:

- *Technical and design data (Annex A.1)*
- *User-specific data (Annex A.2)*
- *Manufacturer's instructions for safe service and maintenance.*

The service book should contain the following data documented in record forms as presented in Annex A:

- *Service data (Annex A.3)*

- *Retrofitting data (Annex A.4)*
- *Refrigerant use data (Annex A.5).*

6 - Recovery, recycling and reclamation

The containment of refrigerant during servicing and repair operations, with subsequent reuse, recycling or reclaim, is an effective practice in reducing emissions to a minimum.

Practices to follow:

- ✓ *Recover all refrigerant during service and maintenance as well as decommissioning for reuse, recycling, reclaim or final disposal and destruction; the decision matrix in Annex E might be helpful for decision-making.*
- ✓ *Use certified R&R equipment which meets relevant specifications.*
- ✓ *Operate and maintain R&R equipment in accordance with the manufacturer's instructions and only when you are trained on how to use it, or if already certified.*
- ✓ *Use refrigerant containers or recovery bags as temporary receivers for very small systems where permanent liquid receivers are not installed.*
- ✓ *Use purge compressors or portable evacuation devices to recover refrigerant liquid and vapor from refrigerant drums and cylinders.*
- ✓ *Investigate the economics of the recovery of mixtures of refrigerant and inert pressurizing gases which were used for pressure and leak testing.*

7 - Handling and storage of refrigerants

Refrigerant cylinders need to be handled carefully. These cylinders are pressure vessels and are subject to mandatory safety conditions and inspections.

Practices to follow:

- ✓ *Follow industry-recommended procedures and use approved equipment for handling and storing refrigerants.*
- ✓ *Use closed-loop refrigerant transfer equipment when removing, charging, and storing refrigerants.*

- ✓ *Transfer refrigerant to another container by using a pump or by establishing a pressure difference between the containers. This may be achieved by heating the discharging container under controlled conditions, e.g. with hot water, where the control system is designed to be fail proof. However, reducing the cylinder pressure using a recycle unit is the preferred method.*
- ✓ *Use both weighing and liquid level gauges to avoid overfilling of refrigerant cylinders; be aware of the weight of refrigerant being transferred.*
- ✓ *Be aware that filling of refrigerant cylinders with mixtures of refrigerant and oil risks exceeding their safe capacity, because the density of the mixture is lower than that of the refrigerant alone.*
- ✓ *Cool refrigerant cylinders to the ambient temperature prior to use.*
- ✓ *Store refrigerant in a manner conducive to refrigerant conservation during periods of system shutdown.*
- ✓ *Request permission to use third-party containers as temporary receivers, because contaminated refrigerant may cause corrosion.*
- ✓ *Store refrigerant cylinders vertically and secure in a ventilated area away from fire risk and direct heating.*
- ✓ *Inspect stored cylinders containing refrigerant for leaking glands and effective gaskets on the cap.*
- ✓ *Arrange for the inspection of refrigerant containers for corrosion after use for recovered refrigerant; third-party containers should be inspected by the owners.*
- ✓ *Observe local regulations on handling, transport and storage of virgin, recovered, contaminated or recycled refrigerants.*

Practices to eliminate:

- ❑ *Do not vent refrigerant into the atmosphere knowingly.*
- ❑ *Do not dispose of any refrigerant by using methods other than R&R, reclaim, reuse, adequate storage or destruction.*
- ❑ *Do not exceed the designed maximum working pressure or the designed capacity shown on the refrigerant cylinder.*
- ❑ *Do not mix refrigerants; in many cases reclaim by specialists will not be possible and destruction is the only alternative.*
- ❑ *Do not connect refrigerant containers to systems or other containers at a higher pressure, temperature or height, because back flow of the refrigerant may result in overfilled or liquid-full containers with a subsequent danger of bursting.*

- ❏ *Do not heat refrigerant cylinders by flames, radiant heaters or direct-contact heaters in order to drive refrigerant into another vessel.*
- ❏ *Do not cool down receiving refrigerant cylinders by venting of refrigerant into the atmosphere in order to transfer the refrigerant.*
- ❏ *Do not vent into the atmosphere the heel in empty refrigerant cylinders, tanks, drums etc.*
- ❏ *Do not drop cylinders, because this may lead to valve or valve thread damage; warnings should be clearly shown in storage areas.*

8 - Disposal of refrigerants and systems

Destruction facilities for hazardous wastes are currently limited to North America, Western Europe and Japan. It is assumed that new facilities will appear in other parts of the world as soon as there are sufficient economic incentives and regulatory demand. The following destruction technologies (in the thermal oxidation category) could be considered:

- *Liquid injection incinerators*
- *Reactor cracking*
- *Gaseous/fume oxidation*
- *Rotary kiln incinerators*
- *Cement kilns.*

Until appropriate destruction capacity is available in the developing country in question or in the region, governments, in cooperation with refrigerant manufacturers and suppliers, refrigeration associations and hazardous waste managers, have to define an intermediate containment strategy, such as long-term storage until final destruction or shipping to established plants.

Practices to follow:

- ✓ *Advise owners of refrigeration systems with major leaks, pipe fractures, compressor breakdown or motor burnout whether repair of the system is economically feasible.*
- ✓ *Remove and recover all refrigerant and oil from systems which are to be decommissioned, scrapped or dismantled.*
- ✓ *Dispose of contaminated or mixed end-of-life refrigerants in an appropriate manner, if recycling or reclaim is not technically or economically feasible.*

- ✓ *Observe local regulations concerning the collection, transport, storage and destruction of hazardous waste; contact refrigerant suppliers, refrigeration associations or appropriate government institutions.*

9 - Retrofitting and alternatives

Retrofitting to alternative refrigerants should be considered when the replacement of the existing system is economically unacceptable – whether due to a long remaining lifetime, high investment costs, or the scarcity and cost of CFCs.

Retrofitting to refrigerants with a low ozone-depleting potential (such as HCFCs) provides an acceptable alternative, where non-ozone-depleting alternatives are not yet available.

Practices to follow:

- ✓ *Consider the expected energy efficiency, performance and operating costs of the retrofitted system in addition to the direct retrofit costs.*
- ✓ *Consider the properties of the alternative refrigerant such as flammability, toxicity and its global warming potential; some of these properties may require additional safety measures.*
- ✓ *Consider retrofitting when major damage of the existing system requires expensive repair work.*
- ✓ *Consult the system manufacturer for the appropriate alternative refrigerant/lubricant system and the necessary replacement of system components, such as compressor, filters, driers etc., before retrofitting.*
- ✓ *Consult the system manufacturer for the appropriate retrofitting procedure which is, in general, equipment-specific.*
- ✓ *Investigate the operating parameters and performance data of the existing system before retrofitting.*
- ✓ *Investigate the operating parameters and performance data of the system and control settings after completion of the retrofit.*
- ✓ *Relabel the retrofitted system and components to reflect the refrigerant and lubricant change and to indicate future service needs.*
- ✓ *Record the retrofitting procedure in the service logbook.*

Practice to eliminate:

- ❑ *Do not substitute refrigerants with drop-in alternatives without consulting the system manufacturer.*

10 - Safety requirements

Low- and high-pressure refrigerants need to be handled as compressed gases, and refrigerant containers are pressure vessels, which require particular safety considerations. Safety-related issues are also described in Section 7, on handling and storage of refrigerants.

Practices to follow:

- ✓ *Use pressure-relief valves to protect equipment against exceeding the maximum working pressure.*
- ✓ *Use dual-relief valves with change-over devices to facilitate the repair or replacement of pressure-relief valves without impairing plant protection.*
- ✓ *Ensure that the maximum working pressure will in no circumstances be exceeded when combining a bursting disc and a pressure-relief valve to prevent loss of refrigerant; the design must prevent any restriction to the inlet of the relief valve in the event of a bursting disc rupture.*
- ✓ *Avoid the trapping of liquid refrigerant between two points of a system when not protected by a pressure relief, such as a bypass check valve to a lower vapor pressure side of the system.*
- ✓ *Install alarm systems to warn of excessive machine pressure during shutdown.*
- ✓ *Implement an effective water treatment control.*
- ✓ *Use specific colors for containers for different refrigerant types (see document 14 in Annex G).*
- ✓ *Comply with mandatory safety precautions for systems retrofitted with alternative refrigerants, such as hydrocarbons or ammonia, which might be flammable or toxic (these are beyond the scope of this Guidebook).*
- ✓ *Properly label all cylinders using country-approved hazard labels where applicable.*
- ✓ *Use proper protective caps over refrigerant valves to prevent damage to the valve on top of the cylinder.*

Practices to eliminate:

- ❑ *Do not exceed the manufacturer's recommended pressure or system strength test pressure when leak testing.*
- ❑ *Do not overfill refrigerant containers, tanks, drums, recovery units, receivers, etc.*
- ❑ *Do not refill disposable cylinders.*
- ❑ *Do not use an open flame on any refrigeration system that has not been properly evacuated for servicing.*
- ❑ *Do not service refrigeration systems unless wearing protective clothing, including goggles and gloves.*
- ❑ *Do not attempt to service equipment unless fully trained in the safe handling of refrigerants.*
- ❑ *Do not work with refrigerants in a confined space lacking ventilation.*
- ❑ *Do not blow off a piping system with air or oxygen to remove welding, brazing or cutting debris, because this may cause contamination and the risk of explosion; only dry nitrogen should be used for this task.*
- ❑ *Do not pressurize refrigeration or piping systems with air or oxygen.*

11 - Training and certification

The certification of service workshops, of R&R equipment and of service technicians may be based on a voluntary or a legally-binding approach. Only certified workshops or technicians may be allowed to purchase refrigerants. A suggested agenda for a training programme for refrigeration mechanics is contained in Annex F. More detailed information for the design, implementation and follow-up of training courses can be found in the OzonAction Training Module on National Training Courses on Good Practices – Refrigeration Sector [56].

National codes of good practice should therefore contain information about the requirements, contact addresses, training institutes and training events, certification procedures and available grants. Such certification procedures require the establishment of an approved certifying organization, detailed criteria for the certification of workshops and equipment and an approved test for the certification of technicians.

Practices to follow:

- ✓ *Be aware of certification requirements for service technicians and encourage participation in such certification schemes and training.*
- ✓ *Be aware of certification requirements for R&R equipment and purchase and use only certified equipment.*
- ✓ *Inform customers about certification requirements and the advantages of contracting with certified service technicians.*

12 - Regulatory inventory

Codes of good servicing practice should explain the relevant regulatory framework in the country and the resulting obligations for service technicians and system owners and operators.

Regulations, economic incentives and voluntary agreements may restrict the import or local manufacturing of CFC and CFC systems through bans, quotas or taxes, and/or promote the use of alternative technologies and the purchase of R&R equipment through subsidies or tax exemption.

Practices to follow:

- ✓ *Be informed about regulatory requirements to be respected during the installation, servicing, operation and decommissioning of refrigeration systems.*
- ✓ *Be informed about regulatory requirements concerning the transport, storage, import and export, R&R, disposal and destruction of refrigerants.*
- ✓ *Be informed about regulatory requirements concerning record-keeping and documentation.*
- ✓ *Be informed about certification procedures for refrigeration and R&R equipment as well as service workshops and technicians; training or certification of service technicians and other persons handling refrigerants may become compulsory for the purchase of refrigerants.*
- ✓ *Be informed about economic incentives or penalties which may influence the viability of technological options.*
- ✓ *Be informed about the legal status of national or international standards or specifications for refrigeration and R&R equipment and codes of good servicing practice; such codes may be implemented on a voluntary or a legally-binding basis.*

- ✓ *Be informed about enforcement measures such as penalties, fines or withdrawal of operating or servicing permissions in cases of non-compliance.*
- ✓ *Inform customers about regulatory obligations and the associated risks of non-compliance.*

13 - Contact addresses and hints

Additional information considered useful for service technicians may be included in this section of national codes of good servicing practice. Specific support and encouragement should be given to technicians from the informal servicing sector.

Practices to follow:

- ✓ *Be informed about relevant contact addresses of government institutions, manufacturers and suppliers of refrigerants and refrigeration equipment, approved certification organizations, workshops with recycling capacities and reclaim centers and training institutes.*
- ✓ *Be informed about further information sources such as related documents, companies already having performed retrofitting or converted manufacturing plants, research and development activities or specialized experts and consultants.*
- ✓ *Be informed about the availability of grants or free-of-charge training opportunities and how to obtain access to recycling equipment or facilities; hotline and emergency numbers may help to respond to specific information needs.*

5 - Further Information

This Guidebook is part of a series of documents produced by UNEP IE within the OzonAction Programme under the Multilateral Fund. For further information, please contact:

OzonAction Programme of UNEP IE:

Tel: *(33-1) 44 37 14 50*
Fax: *(33-1) 44 37 14 74*
Email: *ozonaction@unep.fr*
WWW: *http://www.unepie.org/ozonaction.html*

Related documents and references

A number of documents specific to developing countries have been developed by UNEP IE; these are included in the bibliography in Annex G. The following publications are closely related to this document and readers may wish to consult them for further details. (The number in brackets refers to the numbering in the bibliography (Annex G).)

- *Elements for Establishing Policies, Strategies and Institutional Framework for Ozone Layer Protection [36]*

This publication provides general guidance to government officials in developing countries about how to develop and implement an ODS phaseout strategy. It begins with finding out about and becoming a party to the Montreal Protocol, and covers taking the institutional, legislative, fiscal and other measures necessary to achieve phaseout in different industry sectors.

- *Reducing CFC Use in Refrigeration: Strategic Options for Countries with Low CFC Consumption [58]*

This document was prepared by the US Environmental Protection Agency (US EPA) in cooperation with UNIDO. It addresses the specific conditions in low volume ODS-consuming (LVC) countries and is intended to help ozone officials in LVC countries collect data and develop and implement appropriate, cost-effective ODS phaseout strategies. It focuses on priority sub-sectors in refrigeration, which account for nearly 70% of the total calculated ODS consumption in these countries.

Other publications related to this document are:

- *Training Manual on Chillers and Refrigerant Management [44]*
- *Training Manual on Good Practices in Refrigeration [43]*
- *Practical Guidelines for Industry for Managing the Phaseout of Ozone-Depleting Substances [42]*
- *Guidelines for Establishment of Recovery and Recycling Systems – Refrigeration Sector [54]*
- *Resource Module for ODS Import/Export Licensing Systems [55]*
- *Training Module for National Training Courses on Good Practices – Refrigeration Sector [56]*
- *Guidelines for the Preparation of Refrigerant Management Plan [57].*

Annexes

Annex A.1: Equipment label

Labels identifying refrigeration systems should be provided by the system manufacturer and visibly placed for service technicians. The equipment label should indicate the location of the service log-book to enable service technicians to consult the log-book. The owner/operator or the technician servicing the system should update the label. A copy of the label should also be included in the log-book.

An equipment label should specify the most relevant information for service technicians. For smaller systems, the identification of the equipment and the indication of the current contractor and its service emergency phone number may be sufficient. The information in the below table may be appropriate for more complex systems, including the refrigerant/lubricant system and safety related data.

Equipment label

EQUIPMENT / SYSTEM

Manufacturer:
Type:
Model number:
Serial number:
Year:

TECHNICAL DESIGN DATA

Max. allowable pressure:
Test pressure:
Max. allowable temperature:
Min. allowable temperature:

ADDITIONAL DATA FOR RELIEF VALVES

Pressure settings:
Capacity:
Date of installation:
Date of next examination:

REFRIGERANT

Type:
Quantity:
Manufacturer:

OIL / LUBRICANT

Type:
Quantity:
Viscosity:

SAFETY RELATED DATA

Responsible plant manager:
Phone of plant manager:
Location of log-book:
Warning notices:

SERVICE CONTRACTOR

Company name:
Emergency number:

Annex A.2 : User specific data

The user should document user specific data in the service log-book. User specific data may include a reference to separate policy statements, the location of the refrigeration system, and should identify the responsible plant manager, the responsible technician for preventive inspections, and the contracted service company.

User specific data

OWNER COMPANY

Name:
Address:
Phone:
Fax:
Email:

POLICY STATEMENT

The company's / owner's commitment to protect the ozone layer and to require all personnel to take all steps to achieve this goals has been documented in the separate policy statement.

EQUIPMENT / SYSTEM

Type:
Model number:
Serial number:
Year:

LOCATION

Building address:
Floor:
Room:

RESPONSIBILITY

Department:
Responsible plant manager:
Phone of plant manager:

PREVENTIVE INSPECTION

Responsible technician:
Phone of technician:
Inspection interval:
Date of last inspection:

SERVICE CONTRACT

Name of service contractor:
Address:
Phone:
Fax:
Email:
Service interval:
Expiration of contract:

Annex A.3 : Service record

This sheet is part of the service log-book and should document all standard services carried out on a refrigeration system including inspection, repair and leak testing. The service company and technician should be identified as well as date and time of the service.

Other services may range from installation and commissioning, redesign, retrofitting, performance testing to decommissioning, dismantling and disposal. If necessary, separate reports should be incorporated into the service log-book. A report sheet for retrofitting is proposed in Annex A.4.

Service record

CONTRACTOR / SERVICE COMPANY

Name of company:
Name of technician:
Certificate No:
Expiry date:
Date of service:
Time of service:

SERVICES CARRIED OUT

- ❑ ***INSPECTION***
  Specify:
  Observations:

- ❑ ***REPAIR***
  Specify:
  Observations:

- ❑ ***LEAK TESTING***
  Method:
  Observation:

- ❑ ***OTHER SERVICES***
  Specify:
  Observations:

REFRIGERANT

- ❑ *Initial charge:*
- ❑ *Lost:*
- ❑ *Recovered for reuse:*
- ❑ *Recovered for recycling:*
- ❑ *Recharged with old refrigerant:*
- ❑ *Recharged with new refrigerant:*
- ❑ *Contractor for recycling or reclaim:*

RECOMMENDATIONS:

NEXT SERVICE / INSPECTION:

SIGNATURE TECHNICIAN

DATE

Annex A.4 : Retrofitting report

This sheet should be incorporated into the service log-book in the case of retrofitting of a refrigeration system to an alternative refrigerant/lubricant system.

Retrofitting report

CONTRACTOR / SERVICE COMPANY

Name of company:
Name of technician:
Certificate No:
Expiry date:

DATES

Start of retrofitting:
End of retrofitting:
Next service / inspection:

CHECKLIST

- ❑ *Manufacturer consulted*
- ❑ *Manufacturer's instructions followed*
- ❑ *System components changed*
- ❑ *Performance tested prior to retrofitting*
- ❑ *Performance tested after retrofitting*
- ❑ *Equipment label changed*

REFRIGERANT

From type:	*To type:*
From quantity:	*To quantity:*
From manufacturer:	*To manufacturer:*
From ODP:	*To ODP:*
From GWP 100:	*To GWP 100:*

OIL / LUBRICANT

From type:	*To type:*
From quantity:	*To quantity:*
From manufacturer:	*To manufacturer:*
From viscosity:	*To viscosity:*

LEAK TEST

Method:
Observation:

CONTAINMENT

- ❑ *Initial charge:*
- ❑ *Recovered for reuse:*
- ❑ *Recovered for recycling:*
- ❑ *Recharged with alternative refrigerant:*
- ❑ *Contractor for recycling or reclaim:*

RECOMMENDATIONS:

SIGNATURE TECHNICIAN

DATE

Annex A.5: Refrigerant use record

This sheet should be incorporated into the service log-book and updated periodically or after each service activity. It allows a calculation of the total loss of refrigerant due to leaks, poor servicing practices, or improper operating conditions and whether refrigerant has been recovered for reuse or recycling. For each refrigeration system, this data should be transferred to the refrigerant inventory form, which gives an overview about refrigerant use at company level.

Refrigerant use record

EQUIPMENT / SYSTEM : **LOCATION :** **REFRIGERANT :**

SERVICE CARRIED OUT	REMARK	INITIAL CHARGE	REFRIGERANT LOST	RECOVERED FOR REUSE	RECOVERED FOR RECYCLING	OLD REFRIGERANT CHARGED	NEW REFRIGERANT CHARGED	DATE/TIME	SIGNATURE
TOTAL REFRIGERANT LOST, RECOVERED, RECHARGED									

Annex A.6: Refrigerant inventory form (owners / operators)

This sheet is based on the data of the refrigerant use record described in Annex A.5. It should be used by plant or refrigerant managers of companies operating numerous refrigeration systems to calculate the total loss of refrigerant (LOST), the amount recovered for external recycling or reclaim (REC.) and the amount of virgin or reclaimed but quality tested refrigerant (NEW). This data is the base for cost calculations and investment decisions.

Refrigerant inventery form (owner / operator)															
YEAR:	EQUIPMENT 1			EQUIPMENT 2			EQUIPMENT ...			EQUIPMENT ...			EQUIPMENT N		
TYPE															
LOCATION															
REFRIGERANT															
CHARGE															
	Lost	Rec.	New	Lost	Rec.	New	Lost	Rec.	New	Lost	Rec.	New	Lost	Rec.	New
JANUARY															
FEBRUARY															
MARCH															
...															
OCTOBER															
NOVEMBER															
DECEMBER															
YEARLY TOTAL															
REMARKS															

Annex A.7: Refrigerant inventory form (service companies)

This sheet should be used by service workshops carrying out service activities for different companies. For each type of refrigerant and for each service activity, the amount of refrigerant lost, recovered for recycling and recharged should be documented. In addition, the amount of refrigerant purchased or sent for recycling or reclaim should be recorded as well as the addresses of the suppliers and reclaimers.

Refrigerant inventory form (service companies)

SERVICING COMPANY
Name:
Address:
Phone:
Fax:
Email:

REFRIGERANT
Type:

PERIOD
Year:
Month:

COMPANY	EQUIPMENT	LOCATION	REFRIGERANT LOST	RECOVERED FOR RECYCLING	NEW REFRIGERANT RECHARGED	DATE/TIME	TECHNICIAN
TOTAL REFRIGERANT (1) LOST, (2) RECOVERED, (3) RECHARGED			(1)	(2)	(3)		
TOTAL REFRIGERANT (4) RECYCLED, (5) PURCHASED				(4)	(5)		
REFRIGERANT STORED: (6) CONTAMINATED, (7) RECYCLED OR VIRGIN (6)				(7)			

Annex A.8: Refrigeration R&R device acquisition form (service and disposal companies)

Service and disposal companies may be required by law to purchase R&R equipment in order to continue their activities. This form may be used to certify the purchase of the required equipment.

R&R device aquisition certification form (service and disposal companies)

CONTRACTOR / SERVICE / DISPOSAL COMPANY

Name:
Address:
Phone:
Fax:
Email:

TYPE OF SERVICE WORK PERFORMED (CHECK ALL BOXES THAT APPLY)

- ❑ *Service of small appliances*
- ❑ *Service of other than small appliances*
- ❑ *Disposal of small appliances*
- ❑ *Disposal of other than small appliances*

DEVICE IDENTIFICATION (COMPLETE FOR EACH DEVICE ACQUIRED)

1 Name of manufacturer: *Self-contained:*
Type of equipment: *Technical data:*
Model number:
Serial number:
Year:

2 Name of manufacturer: *Self-contained:*
Type of equipment: *Technical data:*
Model number:
Serial number:
Year:

3 Name of manufacturer: *Self-contained:*
Type of equipment: *Technical data:*
Model number:
Serial number:
Year:

4 Name of manufacturer: *Self-contained:*
Type of equipment: *Technical data:*
Model number:
Serial number:
Year:

I certify that «SERVICE / DISPOSAL COMPANY» has acquired the listed R&R device(s) as required by national regulations, and that the information given is true and correct.

SIGNATURE COMPANY OWNER

DATE

Annex B: Company policy statement for venting of refrigerants

Any company committed to the phaseout of CFC, whether manufacturing, using or servicing refrigeration equipment, may wish to demonstrate its commitment by means of a written and signed policy statement. Such a statement encourages employees to adopt proper working and servicing practices and can be an efficient tool for marketing and communication with contractors. User companies may adopt a contracting policy towards service workshops which requires contracted service technicians to adhere to the company policy. Such a policy statement should be communicated to relevant stakeholders and included in the service log-book.

Company policy statement

OWNER COMPANY	***CONTRACTOR / SERVICE COMPANY***
Name:	*Name:*
Address:	*Address:*
Phone:	*Phone:*
Fax:	*Fax:*
Email:	*Email:*

STATEMENT

It is the policy of «OWNER / CONTRACTOR COMPANY» that the venting of CFC is strictly prohibited and that all personnel servicing equipment using CFC shall comply with all regulations pertaining to the handling of said substances.

This policy requires that all technicians servicing refrigeration equipment shall be certified in conformance with legal provisions. All maintenance and service procedures shall contain provisions to prevent intentional venting, leakage, and to the greatest extend possible, accidental venting of refrigerants.

The «OWNER / CONTRACTOR COMPANY» is committed to protecting the ozone-layer and all personnel are required to take all steps necessary to achieve this goal. Deliberate or veritably negligent leakage of any CFC by an employee shall be grounds for dismissal.

SIGNATURE	***SIGNATURE***
OWNER COMPANY	***CONTRACTOR / SERVICE COMPANY***
DATE	***DATE***

Annex C: Voluntary industry agreement

DECLARATION

Recognizing that alternative refrigerants have an essential role in replacing CFCs and HCFCs as refrigerants;

Recognizing that emissions of alternative refrigerants to the atmosphere are considered to have the potential to damage the environment by contributing to the accumulation of greenhouse gases;

Recognizing that the global warming potential of a refrigeration system comprises both a direct effect from the emission of greenhouse gas refrigerants and an indirect effect from energy consumption and limiting greenhouse gas emissions requires that both these effects be considered;

Recognizing that careful and responsible use of all refrigerants, including existing product stewardship measures, benefits both the user and the environment.

The air-conditioning and refrigeration industry, together with the users of air-conditioning and refrigeration equipment in all its applications hereby declares its intention to contribute to the national ODS phaseout plan by :

a) Encouraging the manufacture, installation, commissioning, operation, service and decommissioning of refrigeration systems to the highest professional standards and guidelines;

b) Encouraging the design, installation and operation of refrigeration systems in a manner which promotes the efficient use of energy;

c) Encouraging all reasonably practicable precautionary measures to minimize refrigerant leakage, and recommending that refrigerants are recovered for reuse, reclamation or disposal during servicing and prior to equipment decommissioning;

d) Discouraging the use of ODS refrigerants for any application where a risk of high emissions exists, by promoting the use of safe, reasonably practical, environmentally acceptable and energy efficient alternatives, where available (For the purposes of this declaration, high emissions are those in excess of 10% loss of initial charge annually from service and/or breakdown of any refrigeration system.);

e) Encouraging the practice of maintaining a log detailing the quantity of refrigerant used in and extracted from refrigerating systems and equipment with a total charge exceeding 50 kg;

f) Recommending that only competent persons carry out design, installation, commissioning, servicing, maintenance and decommissioning and that refrigerant handling is restricted to those with a current registration of competence;

g) Assisting the Government in obtaining regular information on the use and emissions of alternative refrigerants.

The Government and industry undertake to meet annually to review the effectiveness of the declaration and actions resulting from it.

Signed on behalf of the air-conditioning and refrigeration industry and users.

Annex D: Table of contents for codes of good practice

Notice on the status of the document
Committee involved in the preparation
Table of contents

Background

History of the ozone issue and the Montreal Protocol
Phaseout time schedule for regulated ODS
Country specific context and Country Programme

Introduction

Purpose and scope
Normative references
Definitions
Refrigerating systems

Redesign and upgrading of existing systems

Compressors
Condensers and evaporators
Pipelines and connections
Relief devices
Isolating and access devices
Seals design
High head pressure
Refrigerant moisture tolerance
Vibration

Installation of refrigeration systems

Location of refrigerant piping
Refrigerant detectors
Electrical equipment
Machinery areas and plant rooms
Plant and equipment in the open air
Cleanliness of system
Piping fittings
Labels

System operation and maintenance

Acceptability of venting
Responsibility for operation of the system
Instruction manual
Schedule of operation
Preventive maintenance
Use of arc-producing and flame-producing apparatus
Inspection of refrigerant vessels under pressure
Standard operation procedure
Charging, discharging and substituting refrigerants
Cleaning and flushing
System dehydratization
Shortage of refrigerant
Belt drives
Component isolation
Purging manifold gauge sets

Preventive inspection and self-checking

Servicing and inspection procedures
Service contracts and inspection intervals
Visual inspections and self-checking
Leak detection

Record-keeping and documentation

Service records and log book
Labeling of equipment and refrigerants
Inventory of equipment and refrigerants
Reporting of emissions and spills

Recovery, recycling and reclaim

Maintenance of R&R equipment
Standards for R&R equipment
Performance testing of R&R equipment
Contaminated refrigerant and refrigerant/oil mixtures
Approved refrigerant cylinders
Refrigerant containers belonging to a Third Party

Handling and storage of refrigerants

Refrigerant storage
Refillable refrigerant containers
Pressure testing of hoses and equipment
Charging lines
Refrigerant transferred
Charging cylinders
Refrigerant container handling
Refrigerant transfer between containers

Disposal of equipment and refrigerants

Decommissioning of equipment
Building demolition
Disposal of equipment
Disposal and destruction of recovered refrigerants and lubricants

Retrofitting and alternatives

Basics of conversion
Preplanning to avoid emissions and leaks
Recommended procedure
Alternative refrigerant / lubricant system
Surplus of used refrigerant

Safety requirements and designation

Properties of refrigerants
Personnel inside cold rooms
Lightning protection
Protection against fire risk
Danger inherent in refrigeration systems
Inspection of refrigerant cylinders and cylinder hazards
Personal protective equipment
Pressure relief devices
Emergency discharge of refrigerant
Discharge capacity of pressure relief devices

Annex E: Decision matrix for reuse, recycling and reclaim

Decision matrix for reuse, recycling and reclaim				
1.	*Determine the reason why the system is being serviced. Determine the condition of the refrigerant. Does the refrigerant need to be cleaned?*	⑨	*IF NOT, put the refrigerant back into the system after service without recycling it.*	
2.	*IF YES, can the available recycling equipment clean the refrigerant to a minimum quality level specified in Table E.2 below?*	⑨	*IF NOT, send the refrigerant to a certified reclaimer.*	
3.	*IF YES, does the contractor feel it is feasible to recycle the refrigerant?*	⑨	*IF NOT, send the refrigerant to a certified reclaimer.*	
4.	*IF YES, recycle the refrigerant following the instruction of the ecycling equipment manufacturer. Does the recycled refrigerant need to be tested?*	⑨	*IF NOT, does the policy of the contractor allow the use of recycled refrigerant?*	⑨ *IF NOT, send the refrigerant to a certified reclaimer.* ⑨ *IF YES, put it back to the system from which it was removed or back into a system with the same owner.*
5.	*IF YES, does the recycled refrigerant meet appropriate quality standards (ARI 700)?*	⑨	*IF NOT, does it meet the minimum quality level specified in Table E.2 below?*	⑨ *IF NOT, send the refrigerant to a certified reclaimer.* ⑨ *IF YES, put it back to the system from which it was removed or back into a system with the same owner.*
6.	*IF YES, reuse the refrigerant in a different owner's equipment provided that the refrigerant remains in the customer's custody and control at all times from recovery through recycling to reuse.*			

Table E.1: Decision matrix for reuse, recycling and reclaim as suggested from the Industry Recycling Guide 2 (IRG-2), ARI.

Minimum quality level of recycled refrigerants for use in same owner's equipment

CONTAMINANTS*	LOW PRESSURE SYSTEMS	R-12 SYSTEMS	ALL OTHER SYSTEMS
Acid content (by weight)	1,0 ppm	1,0 ppm	1,0 ppm
Moisture (by weight)	20 ppm	10 ppm	20 ppm
Non-condensible gas (by volume)	N/A	2,0 %	2,0 %
High boiling residues (by volume)	1,0 %	0,02 %	0,02 %
Chlorides by silver nitrate test	no turbidity	no turbidity	no turbidity
Particulate	visually clean	visually clean	visually clean
Other refrigerants	2,0 %	2,0 %	2,0 %

Table E.2: Maximum contaminant levels of recycled Refrigerants for reuse in same owner's equipment as suggested from the Industry Recycling Guide 2 (IRG-2), ARI.
** To ensure that the recycling equipment maintains its demonstrated capability to achieve above levels, it must be operated and maintained per the equipment manufacturer's recommendations.*

Annex F: Training programme for refrigeration mechanics

Responsabilities

The responsibility of refrigeration personnel include the planning, calculation, assembly, maintenance and repair of refrigeration and air-conditioning plants and equipment for all applications. In particular this means:

- ❏ *Design and construction of refrigerating plants and equipment for the preservation, conservation, cold storage and refrigerant transport of heat sensitive goods, and for the production of ice and ice cream*
- ❏ *Design and construction of refrigerating equipment for processing and manufacturing plants, air-conditioning and heat pump plants, and for medical and laboratory applications.*

Skill levels

In the training of refrigeration personnel three levels of skill and knowledge are identified, mechanic, technician and technician engineer.

Refrigeration mechanic

A refrigeration mechanic is trained to perform the required practical tasks and has the theoretical knowledge necessary to carry out these tasks. He is able to:

- ❏ *Install refrigerating plants on site, to assemble units in the factory, and to charge them with normal refrigerant without supervision*
- ❏ *Commission normal refrigerating plants and units in the factory and to hand them over to the customer*
- ❏ *Detect a malfunction of plants and units and to report the main symptoms*
- ❏ *Rectify faults on plants and units and to carry out remedial and service work*
- ❏ *Have regard at all times for health, safety and environmental protection.*

Table F: Training programme for refrigeration mechanics, recommended by European Committee of Manufacturers of Refrigeration Equipment (CECOMAF)

Training programme for refrigeration mechanics

General knowledge

- ❑ *Health and safety*
- ❑ *Environmental protection*
- ❑ *Working in factories and on site*
- ❑ *Working and social rules and laws*
- ❑ *Communication*
- ❑ *Technical mathematics*
- ❑ *Basic science*

Basic skills

- ❑ *Working with metals and plastic*
- ❑ *Installation of piping*
- ❑ *Installation of electrical cables*
- ❑ *Maintenance of tools and equipment*

Basic technologies

- ❑ *Refrigeration*
- ❑ *Air-conditioning*
- ❑ *Applications*
- ❑ *Electric*
- ❑ *Electronics*
- ❑ *Controls*
- ❑ *Materials*
- ❑ *Technical drawing*
- ❑ *Standards and rules*

Specialist skills

- ❑ *Handling of special tools and equipment*
- ❑ *Handling of refrigeration components*
- ❑ *Installation of refrigeration and air-conditioning components, plants and units*
- ❑ *Installation of controlling and measuring devices*
- ❑ *Installation of insulation, sound and corrosion protection devices*
- ❑ *Measuring and testing on refrigerating and air-conditioning plants, units and components*
- ❑ *Measuring and testing on electrical and electronic systems*
- ❑ *Commissioning and hand-over*
- ❑ *Maintenance and servicing*
- ❑ *Fault finding and rectification*
- ❑ *Inspection and reporting*

Specialist technology

- ❑ *Refrigeration and air-conditioning components, plants and units*
- ❑ *Refrigerants, other working fluids and auxiliary materials*
- ❑ *Heat and sound insulation*
- ❑ *Measuring instruments, control devices*
- ❑ *Driving motors*
- ❑ *Electrical circuits*
- ❑ *Electrical and electronic components and devices*
- ❑ *Installation plans*
- ❑ *Handbooks, tables, charts and diagrams*

Table F: *Training programme for refrigeration mechanics, recommended by European Committee of Manufacturers of Refrigeration Equipment (CECOMAF). Training programmes for the technician and technician engineer are beyond the scope of this report.*

Annex G: Bibliography

Standards and codes of practice in refrigeration

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Request for new or updated information

Many of the documents in the OzonAction library have been identified and donated by the kind efforts of organizations and individuals throughout the world who are concerned with the protection of the stratospheric ozone layer. Our ability to furnish this information to the public is greatly enhanced by such cooperation. We therefore strongly encourage you to donate or identify documents for the library, so that we can make other people aware of these important information resources. Please send any documents, citations, or bibliographies to:

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DOCUMENT*	1	2	3	4	5	6	7	8	9	10
SCOPE										
Industrial, commercial refrigeration	X			X		X	X			
Domestic refrigeration		X	X			X				
Mobile refrigeration					X	X		X	X	X
BACKGROUND										
Year of issuing	92	90	93	93	91	96	88	93	93	93
Number of pages	24	15	4	5	8	40	22	6	2	4
FOCUS										
Redesign of refrigeration systems	X	X	X	X		X	X			
Installation of equipment	X	X	X			X	X			
System operation and maintenance	X	X	X	X	X	X	X		X	X
Preventive inspection and maintenance					X	X				
Record-keeping and documentation						X				
R&R, reclaim and reuse	X	X	X		X	X	X	X		X
Handling and storage of refrigerants	X	X	X	X	X	X	X			X
Disposal of ODS refrigerants, systems	X	X		X	X	X	X			X
Retrofitting and alternatives	X	X				X	X			
Safety requirements								X		X
Training and certification					X	X	X		X	
Regulatory inventory										
Contact addresses and hints										

Table G: *Comparison of existing codes of practice in refrigeration and related specifications and standards.*
** The numbering of the documents refers to the bibliography.*
X The documents focuses partly or predominantly on the indicated aspects.

DOCUMENT*	11	12	13	14	15	16	17	18	19	20
SCOPE										
Industrial, commercial refrigeration	X		X	X	X	X	X	X	X	X
Domestic refrigeration	X			X	X	X	X	X	X	X
Mobile refrigeration		X		X	X	X	X	X	X	
BACKGROUND										
Year of issuing	88	92	93	92	90	93	95	93	92	92
Number of pages	175	40	141	4	3	7	14	11	20	22
FOCUS										
Redesign of refrigeration systems	X	X							X	
Installation of equipment	X	X							X	
System operation and maintenance	X	X	X						X	
Preventive inspection and maintenance	X	X							X	
Record-keeping and documentation			X							
R&R, reclaim and reuse			X			X	X			
Handling and storage of refrigerants					X				X	
Disposal of ODS refrigerants, systems			X						X	
Retrofitting and alternatives			X						X	
Safety requirements	X	X		X	X	X		X		X
Training and certification			X						X	
Regulatory inventory	X	X	X							
Contact addresses and hints			X							

Table G: *Comparison of existing codes of practice in refrigeration and related specifications and standards.*
** The numbering of the documents refers to the bibliography.*
X The documents focuses partly or predominantly on the indicated aspects.

DOCUMENT*	21	22	23	24	25	26	27	28	29	30
SCOPE										
Industrial, commercial refrigeration	X	X				X	X			
Domestic refrigeration	X	X	X			X	X			
Mobile refrigeration	X	X			X	X	X			
BACKGROUND										
Year of issuing	94	89	93	93	92	93	94			
Number of pages	12	90	20	12	150	5	2			
FOCUS										
Redesign of refrigeration systems										
Installation of equipment										
System operation and maintenance				X			X			
Preventive inspection and maintenance										
Record-keeping and documentation				X						
R&R, reclaim and reuse	X	X		X	X					
Handling and storage of refrigerants	X									
Disposal of ODS refrigerants, systems				X						
Retrofitting and alternatives						X				
Safety requirements			X			X				
Training and certification				X	X					
Regulatory inventory				X						
Contact addresses and hints										

Table G: Comparison of existing codes of practice in refrigeration and related specifications and standards.
** The numbering of the documents refers to the bibliography.*
X The documents focuses partly or predominantly on the indicated aspects.

Annex H: List of standards

All currently valid national and international standards are subject to revision. Any reference to a standard is deemed to be a reference to the latest edition of that standard. Parties to agreements based on such standards are encouraged to take steps to ensure the use of the most recent edition of the standards indicated below:

ANSI/ARI 700	Specification for fluorocarbon refrigerants
ANSI/ASHRAE B16.5	Pipe flanges and flange fittings
ANSI/ASHRAE 34	Number designation and safety classification of refrigerants
ANSI/ASME B31.5	Refrigeration piping
ANSI/ASME B36.10M	Welded and seamless wrought steel pipe
ANSI/UL 1963	Refrigerant recovery/recycling equipment
ARI Standard 700	Standard for specification for fluorocarbon refrigerants
ARI Standard 740	Standard for refrigeration recovery/recycling equipment
ARI Standard 793	Specification for fluorocarbon and other refrigerants
AS 1571	Copper - seamless tubes for air-conditioning and refrigeration
AS 4041	Pressure piping
AS D26	Tube fittings Dryseal American standard taper pipe and unified threads for automotive and industrial use
ASHRAE 3	Reducing emissions of fully halogenated CFC refrigerants in refrigeration and air-conditioning equipment and applications
ASHRAR 15	Safe use of flammable refrigerants
ASTM B280	Specification for seamless copper tube for air-conditioning and refrigeration field service
ASTM D93	Test methods for flash point by Pensky-Martens closed tester
BS 1560-3	Circular flanges for pipes, valves and fittings (class designated) - Part 3: steel, cast iron and copper alloy flanges
BS 3463	Specification for observation and gauge glasses for pressure vessels
BS 3601	Specification carbon steel pipes and tubes with specified room temperature properties for pressure purposes
BS 3602-1	Specification for steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties - Part 1: seamless and electric resistance welded including induction welded tubes
BS 3602-2	Specification for steel pipes and tubes for pressure purposes: carbon and carbon manganese steel with specified elevated temperature properties - Part 2: longitudinally arc welded tubes
BS 3603	Specification for carbon and alloy steel pipes and tubes with specified low temperature properties for pressure purposes
BS 4434	Specification for safety aspects in the design, construction and installation of refrigerating appliances and systems
BS 4504-3	Circular flanges for pipes, valves and fittings (PN designated) - Part 3: steel, cast iron and copper alloy flanges
CSA Code B51-M1995	Boiler, pressure vessel, and pressure, public safety
CSA Code B57-M1995	Mechanical refrigeration
DIN 2634	Welding neck flanges: nominal pressure 25
DIN 2635	Welding neck flanges: nominal pressure 40
DIN 3158	Valves for use in refrigeration systems: safety requirements, testing and marking

DIN 7003 (draft)	Safe use of flammable refrigerants
DIN 8960 (draft)	Classification of flammable refrigerants
DIN 8975	Safe use of flammable refrigerants
EN 378	European safety standard for refrigerants
IEC 60335-2-24	Safe use of flammable refrigerants: household refrigerators
IEC 60335-2-40	Safe use of flammable refrigerants: heat pumps and air-conditioners
ISO 817	Organic refrigerants: number designation
ISO 11650	Performance of refrigerant recovery and/or recycling equipment
JAPON	General high pressure gas safety regulations
JAPON	Refrigeration safety regulations
NF E35-400	Classification and safe use of flammable refrigerants
NF E35-402	Safe use of flammable refrigerants
SABS 0108	Classification of hazardous locations and the selection of electrical apparatus for use in such locations
SABS 1583	Refrigerant recycle equipment for the minimization of environmental pollution during the servicing and repair of automotive air-conditioning equipment
SABS 250-1	Minimization of environmental pollution during the servicing and repair of automotive air-conditioning equipment - Part 1: establishment of procedures for the servicing and repair of road vehicles' comfort-cooling air-conditioning equipment
SABS 250-2	Minimization of environmental pollution during the servicing and repair of automotive air-conditioning equipment - Part 2: Servicing and repairs using refrigerant recycle equipment
SABS 0147	Code of practice: refrigerating systems including plants associated with air- conditioning systems
SAE j 1627	Rating criteria for electronic refrigerant leak detectors
SAE j 1628	Technical procedure for using electronic refrigerant leak detector for service of mobile air-conditioning systems
SAE j 1657	Selection criteria for retrofit refrigerant to replace R-12 in mobile air-conditioning systems
SAE j 1658	Alternative refrigerant consistency criteria for use in mobile air-conditioning systems
SAE j 1661	Procedure for retrofitting CFC-12 (R-12) mobile air-conditioning systems to HFC-134a (R-134a)
SAE j 1991	Standard of purity for use in mobile air-conditioning systems
SAE j 2209	CFC-12 (R-12) extraction equipment for mobile air-conditioning systems
SAE j 2211	Recommended service procedures for the containment of HFC-134a
UL 250	Safe use of flammable refrigerants: household refrigerators and freezers
UL 1995	Safe use of flammable refrigerants: heating & cooling equipment
US DOT (49CFR 173)	Classification of flammable refrigerants

Annex I: Glossary

Article 5 countries
are Parties of the Montreal Protocol with an annual calculated level of consumption less than 0,3 kg per capita of the controlled substances in Annex A, and less than 0,2 kg per capita of the controlled substances in Annex B, on the date of the entry into force of the Montreal Protocol, or any time thereafter. These countries are permitted a ten year grace period compared to the phaseout schedule in the Montreal Protocol for developed countries.

Calculated level of consumption
is calculated by adding together its calculated levels of production and imports and subtracting its calculated levels of exports. However, beginning on 1 January 1993, any export to non-Parties of the Montreal Protocol shall not be subtracted in calculating the consumption level of the exporting Party. The result will be indicated in weighted tonens ODS.

Calculated level of production, imports and exports
is calculated by multiplying the annual amount of each controlled substance by the Ozone Depleting Potential specified in respect of it in Annexes A,B,C,E and adding together, for each group, the resulting figures. The result will be indicated in weighted tonnes ODS.

Containment
means the application of service techniques or special equipment designed to preclude or reduce loss of refrigerant from equipment during installation, operation, service and disposal of refrigeration equipment.

Controlled substance
means a substance controlled under the Montreal Protocol, whether existing alone or in a mixture. It includes the isomers of any such substance, except as specified in the relevant Annex, but excludes any controlled substance or mixture which is in a manufactured product other than a container used for the transportation or storage of that substance.

Country Programme
establishes a baseline survey on the use of the controlled substances in a country and draws up policy, strategies and a phaseout plan for their replacement and control. The collected data represents the basis for the definition of the phaseout plan which is part of the Country Programme.

Low volume ODS-consuming countries (LVC countries)
have been defined by the ExCom as Article 5 countries whose calculated level of ODS consumption is less than 360 weighted tonens annually.

Destruction
means to destroy refrigerant by approved destruction plants, in order to remove these substances effectively without any damaging emissions.

Drop-in replacement
means the procedure when replacing ODS with alternative refrigerants in existing refrigeration plants without doing any plant modifications.

Informal sector
is very common in LVC countries and consists of enterprises having the following characteristics among others: small scale of operation, easy entry into the market, reliance on local resources, family rather than corporate ownership, staff skills acquired outside the formal school system or on-the-job, ability to operate in an unregulated and competitive market.

Ozone depleting potential
quantifies the potential ozone depleting effect of an ODS in the stratospheric ozone layer in relation to CFC-11, which has therefore an ODP=1.

Phaseout plan

for ODS is part of the Country Programme and describes the strategy statement of the government defining the phaseout time schedule for each controlled substance and the government actions to be taken for achieving phaseout. It contains a prioritised list of projects to be undertaken and takes into account the specific industrial, political and legislative situation in the country.

Production

means the amount of controlled substances produced, minus the amount destroyed by technologies to be approved by the Parties and minus the amount entirely used as feedstock in the manufacture of other chemicals. The amount recycled or reused is not to be considered as production.

Reclamation

means re-processing and upgrading of a recovered controlled substance through such mechanisms as filtering, drying, distillation and chemical treatment in order to restore the substance to a specified standard of performance. Chemical analysis is required to determine that appropriate product specifications are met. It often involves processing off-site at a central facility.

Recovery

means the collection and storage of controlled substances from machinery, equipment, containment vessels, etc., during servicing or prior to disposal without necessarily testing or processing it in any way.

Recycling

means the reuse of a recovered controlled substance following a basic cleaning process such as filtering and drying. For refrigerants, recycling normally involves recharge back into equipment. It often occurs on-site.

Refrigerant Management Plan (RMP)

is being developed on a trial basis for selected LVC countries. The objective of a RMP at country level is to design and implement an integrated and overall strategy for cost-effective phaseout of ODS refrigerants, which considers and evaluates all alternative technical and policy options. Projects previously implemented in isolation from one another are thus part of an overall approach synchronized for optimal results. Note that the RMP concept may also be used as a management tool at company level.

Refrigeration

in this document describes all kinds of equipment based on a refrigerant circuit including air-conditioning and as far as applicable to Article 5 countries the heat pump applications as well.

Replacement

means the removal of the existing and installation of a new compressor based on an alternative refrigerant.

Retrofitting

means the conversion of a refrigeration system to an alternative refrigerant. Unlike a replacement, only parts of components of the existing system may need to be replaced.

Servicing

in this document shall include all kind of work which may be performed by a service technician, from installation, operations, inspection, repair, retrofitting, redesign and de-commissioning of refrigeration systems to handling, storage, R&R of refrigerants as well as record-keeping.

Venting

means a service practice where the refrigerant vapor is allowed to escape into the atmosphere after the refrigerant liquid has been recovered. This practice is no longer acceptable.

Annex J: Contact addresses

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Annex K: UNEP OzonAction Programme

About the UNEP IE OzonAction Programme

Nations around the world are concerned about the emissions of man-made CFCs, halons, carbon tetrachloride, methyl chloroform, methyl bromide and other ozone-depleting substances (ODS) that have damaged the stratospheric ozone layer — a shield around the Earth which protects life from dangerous ultraviolet radiation from the Sun. More than 160 countries have committed themselves under the Montreal Protocol to phase out the use and production of these substances. Recognizing the special needs of developing countries, the Parties to the Protocol also established a Multilateral Fund and appointed implementing agencies to provide technical and financial assistance to enable the developing countries to meet their commitments under the treaty. UNEP is one of the Fund's implementing agencies; the others are UNDP, UNIDO and the World Bank.

Since 1991, the UNEP IE OzonAction Programme in Paris has been strengthening the capacity of governments (especially National Ozone Units) and industry in developing countries to make informed decisions on technology and policy options that will result in cost-effective ODS phase-out activities with minimal external intervention. The Programme accomplishes this by delivering a range of need-based services, including:

Information exchange

to enable decision makers to take informed decisions on policies and investments. Information and management tools already provided for developing countries include the OzonAction Information Clearinghouse (OAIC) diskette and World Wide Web site, a quarterly newsletter, sector-specific technical publications for identifying and selecting alternative technologies, and policy guidelines.

Training and networking

that provide platforms for exchanging experiences, developing skills, and tapping the expertise of peers and other experts in the global ozone protection community. Training and network workshops build skills for implementing and managing phase-out activities, and are conducted at the regional level (support is also extended to national activities). The Programme currently operates seven regional and sub-regional Networks of ODS Officers comprising more than 80 countries, which have resulted in member countries' taking early steps to implement the Montreal Protocol.

Country Programmes and Institutional Strengthening

that support the development of national ODS phase-out strategies and programmes, especially for low-volume ODS-consuming countries. The Programme currently assists 74 countries in the development of their Country Programmes and implements Institutional-Strengthening projects for 50 countries.

For more information about these services please contact:

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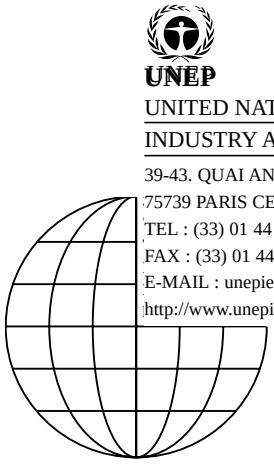
About UNEP Industry and Environment

UNEP established its Industry and Environment office (UNEP IE) in 1975 to bring industry and government together to promote environmentally-sound industrial development. UNEP IE is located in Paris. Its goals are:

- *to encourage the incorporation of environmental criteria in industrial development plans;*
- *to facilitate the implementation of procedures and principles for the protection of the environment;*
- *to promote preventive environmental protection through cleaner production and other pro-active approaches; and*
- *to stimulate the exchange of information and experience throughout the world.*

To achieve these goals, UNEP IE has developed the following main programme elements: Accident Prevention (APELL), Cleaner Production, Energy, OzonAction, Industrial Pollution Management and Tourism. UNEP IE organizes conferences and seminars, and undertakes training and cooperative activities backed by regular follow-up and assessment. To promote the transfer of information and the sharing of knowledge and experience, UNEP IE has developed three complementary tools: technical reports, the quarterly Industry and Environment review and a technical query-response service.



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READER FEEDBACK

GUIDEBOOK FOR IMPLEMENTATION OF CODES OF GOOD PRACTICE REFRIGERATION SECTOR

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1. Quality (Please type or write clearly)

Please rate the following quality aspects (tick the appropriate boxes):

	Very Good	***Good***	***Adequate***	***Poor***
Objectivity	❒	❒	❒	❒
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In general, how much of this document is:

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Relevant to you?	❒	❒	❒	❒
New to you?	❒	❒	❒	❒
Will be used by you?	❒	❒	❒	❒

3. Effectiveness

This document is designed to facilitate the implementation and design of codes of good practice in Article 5 countries and to provide a common base for discussion among decision makers and relevant stakeholders, such as representatives from national ozone units, government institutions, industry and trade associations and technical training institutes. Has this document been effective in meeting these objectives?

Please tick one box: ❒ ***Fully*** ❒ ***Adequately*** ❒ ***Inadequately***

Please explain the reason for your rating:

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4. Uses

A. Please indicate in general how you have used the document (tick all that apply):

- ❒ *Guidebook on how to design codes of good practice*
- ❒ *Guidebook on how to implement codes of good practice*
- ❒ *Ressource document for existing codes of practice and contact points*
- ❒ *Technical background document for designing national codes of good practice*

B. Please explain in more specifics how the document will/has assisted your ODS phaseout programme and the implementation of codes of good practice for the refrigeration sector in your country:

_____

_____

_____

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- ❒ *Industry and trade associations*
- ❒ *Technical training institutes*
- ❒ *Other (please specify) _____*

Your name (optional) _____ *Country _____*

Organization _____ *Date _____*

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