code of practice

for the reduction of emissions of fluorocarbon refrigerants in refrigeration and air conditioning applications

2001

IRHACE
NEW ZEALAND

code of practice

Disclaimer

The information contained in this Code has been compiled as an aid only and is intended for the use of persons who have had adequate training in the field for which the Code has been compiled. The authors of this Code, disclaim responsibility for any inaccuracies contained within this document including any negligence in the preparation and publication of this code.

This Code of Practice has been prepared by:

IRHACE NEW ZEALAND

R.A.C.C.A

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NEW ZEALAND GOVERNMENT APPROVAL

This Code of Practice is the result of consultation between industry and government.
The following letter acknowledges the approval of the Minister for the Environment.

Office of Hon Marian Hobbs
Minister for the Environment
Minister of Broadcasting
Minister Responsible for the National Library and Archives New Zealand
Associate Minister of Education
Associate Minister for Biosecurity
MP for Wellington Central

Brian Jackson

President

IRHACE New Zealand

PO Box 97453

South Auckland Mail Centre

Auckland

Dear Mr Jackson,

I am pleased to approve the updated Code of Practice for the Reduction of Emissions of Fluorocarbon Refrigerants in Refrigeration and Air-Conditioning Applications. I understand that the updated Code has been prepared by your organisation in response to a request from the then Minister for the Environment, the Rt Hon Simon Upton, under Section 10 of the Ozone Layer Protection Act 1996.

I welcome this updated Code and acknowlege the work of the Institute for Refrigeration, Heating and Air Conditioning Engineers in its preparation. I am not qualified to comment on the technical content of the paper, but I understand it was the subject of extensive review. I am confident it is of the highest standard and that it will form a sound basis for training progammes and for best practice within industry.

As you know only too well, refrigerants have a good and a bad side. While they make our home and work environments more comfortable, they can do a lot of damage to the broader environment. Either they damage the ozone layer, or they contribute to global warming, or they do both! I therefore congratulate your industry for being “part of the solution” on environmental matters, and encouraging good environmental practice.

As I see it, the Code of Practice addresses two immediate issues:

- How to ensure that HCFCs and any remaining stocks of CFCs are managed carefully, so that as little as possible is released into the environment. While the Montreal Protocol has been very successful, scientists remind us that we still have some way to go. Every jug of gas matters.
- How to ensure that the increasing use of HFCs does not add to the burden of global warming. The success of the Montreal Protocol is proof that we can really make a difference on environmental issues, and I am keen to see the same level of commitment to global warming issues.

Thank you again for submitting this Code of Practice. I look forward to hearing that it has been adopted by all individuals and organisations that handle fluorocarbon-based refrigerants.

Marian L. Hobbs

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1 FOREWORD

ıes have emerged in the last decade which have focused the world's
ɔn on the atmosphere. These are the depletion of the stratospheric
r and the enhanced greenhouse effect (leading to global warming). Both
exacerbated by avoidable emissions of many of the refrigerants used in
ɔn and air conditioning applications.

ive of the Code of Practice is to assist in the reduction of emissions into
ɔhere of substances that deplete the ozone layer or contribute to global

recognises the important role the New Zealand refrigeration and air
ng industry can have in helping achieve the objectives of the Montreal
n Substances that Deplete the Ozone Layer by reducing emissions of
eting substances. This Code also recognises the potential environmental
refrigerants on global warming, both directly through emissions of
s and indirectly through inefficient use of energy.

ded that this Code be adopted by relevant trade associations, education
s and the industry in general and is supported by Government legislation.
is not exhaustive but covers a wide range of applications as related to
ration and air conditioning industry. To this end, the Code does not
a technical design document and must be used with other standards and
ractice already in existence.

has been revised to cover the use of chlorofluorocarbons (CFCs);
ofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) see Appendix 1.
hydrocarbons (HCs) and ammonia in refrigeration and air conditioning
will need to be considered separately, refer the joint Australian New
andard AS/NZS 1677.

e with this Code of Practice is required by those who manufacture, install,
aintain and dismantle refrigeration and air conditioning equipment
, or designed to use, or manufactured using, any ozone depleting
, as per the Ozone Layer Protection legislation in New Zealand.

e of this Code will assist New Zealand in meeting the objectives of the
ions Framework Convention on Climate Change.

2 ACKNOWLEDGMENTS

of Practice has been prepared by the Institute of Refrigeration Heating
Conditioning Engineers of New Zealand Inc. (IRHACE), and the
n Air Conditioning Companies Association (RACCA), at the request of
for the Environment, using as a base the Australian 'Codes of Good
e wish to thank AFCAM in Australia for sharing their documents, which
nd invaluable in the preparation of the New Zealand Code of Practice.

of the Code were distributed for industry comment and all submissions
ered by the committee

3 SCOPE and DEFINITIONS

3.1 SCOPE

This Code is intended to cover all systems classifiable as domestic, automotive, commercial and industrial refrigeration and air conditioning systems, including heat pumps, which use refrigerants, listed in Appendix 2, or any other fluorocarbon refrigerant.

This Code has been developed with the intention of reducing emissions into the atmosphere of refrigerants listed in Appendix 2 or any other fluorocarbon refrigerant.

Environmental benefits and cost savings from reduced losses can be expected from the application of this Code including the use of alternative refrigerants (see also Section 13).

3.2 DEFINITIONS

For the purpose of this Code the following definitions apply:

3.2.1 Alternative Refrigerant.

Any standard refrigerant or refrigerant blend that does not contain any substance listed in Appendix 2 under CFCs can be used as a replacement refrigerant in existing systems or in new systems, provided it complies with the equipment manufacturers' specifications.

3.2.2 Automotive Air Conditioning.

Any air conditioning or refrigerating system primarily designed for use in transport applications.

3.2.3 Azeotrope.

A mixture of two or more refrigerants which when mixed in precise proportions, behave as a single refrigerant.

3.2.4 Blend.

A proprietary combination of two or more refrigerants to form a single refrigerant with specified thermodynamic properties.

3.2.5 Container.

A portable storage vessel used for the storage and transport of refrigerant liquid and refrigerant vapour. It encompasses terms such as, drum, bottle, vessels, containers etc., so as to distinguish its use solely for refrigerant.

3.2.6 Contaminated Refrigerant.

A refrigerant containing oil, acid, non-condensable and/or moisture and/or other foreign substances. This could include mixed refrigerants (cocktails) which are not manufactured product.

3.2.7 Controlled Refrigerant.

Any substance listed in the New Zealand Ozone Protection legislation.

3.2.8 Destruction.

A process whereby a controlled substance is permanently transformed or decomposed into other substances.

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3.2.9 Domestic Refrigeration.

Any refrigeration system primarily designed for household use.

3.2.10 Fluorocarbon.

A halogenated hydrocarbon containing fluorine.

3.2.11 Global Warming Potential (GWP).

The atmospheric warming impact of a gas compared with an equal mass of carbon dioxide over a specified period of time (usually 100 years).

3.2.12 Major Components and Sub Assemblies.

Included under this heading are compressors, air/water cooled condensers, liquid receivers, chilled water heat exchangers, evaporators and air/water cooled condensing units.

3.2.13 Negative Pressure Systems.

Systems in which the pressure may fall below atmospheric and contain a refrigerant such as R11, R113 or R123.

3.2.14 Ozone Depleting Potential. (ODP).

The impact of a refrigerant on the ozone layer relative to the impact of CFC-11, which has an ODP of 1.

3.2.15 Packaged Systems.

For the purpose of this Code packaged systems are defined as having a self contained refrigeration system.

3.2.16 Plant.

A combination of one or any number of refrigerating systems.

3.2.17 Reclaim.

To process refrigerant to new product specification by means which may include distillation. Chemical analysis of the refrigerant is required to determine that appropriate product specifications have been met. This term usually implies the use of processes or procedures available only at a reclaim or manufacturing facility.

3.2.18 Recover.

To remove refrigerant in any condition from a system and store it in an external container, without necessarily testing or processing it in any way.

3.2.19 Refrigerant.

The medium used for heat transfer in a refrigerating system, which absorbs heat on evaporating at a low temperature and a low pressure and gives up heat on condensing at a higher temperature and higher pressure. (The term 'gas' should be avoided when referring to refrigerants).

3.2.20 Refrigerating System.

Means an assembly of piping, vessels, and other components in a closed circuit in which a refrigerant is circulated for the purpose of transferring heat.

3.2.21 Retrofit.

To replace the original refrigerant in a system with an alternative refrigerant.

3.2.22 Returned Refrigerant.

Refrigerant recovered from a system and returned to the supplier for reclaim or disposal.

3.2.23 Sealed Systems.

For the purpose of this code, are defined as systems having a liquid metering device, and with all interconnecting pipe work having brazed, welded, catalyst cured resins, or compression fitting joints.

3.2.24 "Shall" or "Shall not"

are used for a provision specified, that provision is mandatory if compliance with the code is claimed.

3.2.25 "Should" or "recommended"

indicate provisions which are not mandatory but which are desirable as good practice.

3.2.26 Split Systems.

For the purpose of this code are defined as systems that only require interconnecting pipe work and electrical connections between the fan coil unit and the condensing unit.

4 DESIGN

This section deals with the design considerations of new air conditioning and refrigeration systems and components and alterations to existing systems, and identifies possible sources of inadvertent loss of refrigerants to the atmosphere.

Refrigerating systems should be designed to minimise the amount of refrigerant required.

A sound understanding of system design is necessary for the prevention of refrigerant leakage. The fixings of plant, pipework and fittings shall be designed to resist wind, seismic and other loads that may be imposed on them during their life. Pipework shall have sufficient flexibility to accept structural movement during earthquakes.

4.1 COMPRESSORS

All compressors shall be in a clean, dry and serviceable condition when installed.

Leaks associated with compressors can generally be attributed to either the ancillary equipment attached to the compressor, (gauge and control connections, oil return, oil drain, oil sight glass, relief valve and connecting pipe work) or, in the case of open drive compressors the shaft seal. Proper initial installation, combined with a correct ongoing maintenance program, should minimise if not eliminate these problems (see also 9.1).

4.1.1

The shaft seal shall always be compatible with the compressor, oil and refrigerant used in the system. It shall be capable of containing any pressure or vacuum that may be attained during any shut down periods. Care shall be taken to ensure manufacturers' specifications always apply, especially when changing refrigerants and lubricants.

When available, superior shaft seals that do not rely on carbon faces should be used to prevent leakage of refrigerant. The provision of double shaft seals could be advantageous. It is essential to select the most effective and reliable shaft seal.

Shaft alignment shall be correct. Belts, when fitted should never be over tensioned as this can lead to premature bearing wear and shaft seal failure.

If contaminated oil reaches the seal it can cause damage to the shaft and seal. Oil can become contaminated in many ways, the most common being foreign matter such as minute copper particles or other metal dust mixing with the oil. Moisture also creates problems. Excess moisture in the system can combine with the refrigerant to form an acid solution leading to oil breakdown, component corrosion, and the formation of sludge. Therefore a clean dry system is essential for prolonged shaft seal effectiveness. Adequate provision for the removal of moisture and solids together with filtration of oil in the compressor must be provided to ensure the necessary level of cleanliness are maintained (see also 6.1).

Lack of lubrication can cause seal mating surfaces to dry out and adhere. Subsequently, dry starting can cause damage to the seal faces. To avoid this on large systems it may be necessary to have a separate oil pump to lubricate the compressor bearings and shaft prior to start-up. During long shut-down periods these pumps should be run periodically.

On compressors where a separate oil pump is not fitted, the shaft should be rotated periodically to ensure the seal is kept lubricated (see also 9.1.1). If this is not possible the shaft seal shall be thoroughly inspected, lubricated and leak tested before starting the system after a prolonged shut down period.

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4.1.2

Vibration often causes leaks. The compressor shall be mounted on an adequate solid foundation and if necessary anti-vibration mountings. Eliminating vibration in the suction and delivery lines in proximity to the compressor, and/or improving the balance of compressors during production will also minimise leaks. Inclusion of a gas muffler or equivalent to reduce gas pulsation is highly recommended, especially on large capacity systems.

Vibration is greatly increased on automobile air conditioning and mobile refrigeration systems. The use of vibration absorbing mountings, flexible refrigerant hosing or vibration eliminators shall be used, particularly between engine mounted and chassis mounted componentry.

Adequate support of pipeline connections to the compressor is important if unacceptable stresses, (which could lead to leakage or fracture), are to be avoided (see also 4.3.3).

4.1.3

Where gauges are fitted isolation valves shall be installed to minimise the chance of refrigerant loss during servicing or replacement, in accordance with AS/NZS 1677.

In the case of Domestic compressors fitted with a process tube, adequate length shall be provided for the purpose of evacuating and charging the system with refrigerant and the subsequent sealing and the later use (if ever required for servicing) of a temporary clamp-on piercing type valve assembly. Positioning of the process tube in the final assembly shall be such that the tube shall not be exposed to possible damage during transit of the finished product. Damage could cause a complete loss of the refrigerant charge to the atmosphere.

4.1.4

Service valves should be fitted to both the suction and delivery sides of the compressor to minimise refrigerant discharge during service work (see also 4.4). Where compressor service valves are not practical, pump out capability with appropriate valves shall be provided for system servicing.

Due to the small amount of refrigerant in domestic refrigeration systems the cost/benefit of equipping such systems with service valves is considered to be inappropriate

Auto air conditioning compressors used on light motor vehicles need not have service valves fitted at the compressor, however adequate service access ports must be provided on all systems, for refrigerant removal. Systems on larger vehicles shall have service valves located at the compressor and other locations (in accordance with AS/NZS 1677).

4.1.5

Multiple compressors should be fitted with independent isolation valves where practical. Oil equalising lines should be fitted with isolation valves that allow for the removal of individual compressors without the loss of refrigerant.

4.1.6

All lubricants used should meet the compressor manufacturer's specification and must be compatible with the refrigerant used.

4.1.7

Refrigerant driers shall be compatible with the refrigerant and lubricant used in

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the system. Due consideration should be given to the installation of replaceable core filter/driers.

4.2 REFRIGERANT CONDENSERS & EVAPORATORS

Properly designed and manufactured condensers and evaporators have few leakage problems. However, the following points need to be considered and appropriate action taken if necessary.

4.2.1

Excessive vibration from compressors or other equipment can cause heat exchanger tubing failure. Anti-vibration mountings and mufflers are highly recommended (see also 4.1.2).

4.2.2

The system shall be designed to avoid excessive fluid velocity through the heat exchangers. This can cause vibration or erosion failures. Fluid velocity shall not exceed the maximum safe working velocity of any material used.

4.2.3

Where cooling water quality is poor, for example with sea water or bore water, treatment and filtration should be installed in accordance with manufacturers' guidelines to avoid corrosion or erosion failure. Careful selection of the tube plate and tube materials can also minimise corrosion. Where it is necessary to reduce corrosion and protect against electrolytic action, sacrificial anodes or cathodic protection systems shall be provided.

4.2.4

Reduced or inactive water-flow may lead to serious corrosion problems especially on sea water cooled systems, therefore facilities for flushing and/or drainage should be fitted. A regular inspection and maintenance program shall be adopted. This should ensure that the protection offered by the sacrificial anode or other protection where fitted is maintained and that the heat exchangers stay clean and scale-free.

4.3 REFRIGERANT PIPELINES & FITTINGS

All pipelines shall be so designed that the number of joints are kept to the absolute minimum.

4.3.1

Welding or brazing offers increased resistance to pressure, temperature and vibration stresses and is recommended wherever practicable for joining refrigerant pipelines. Flared, screwed or flanged connections should be avoided wherever possible.

4.3.2

Domestic Refrigeration systems shall not use flanged joints. All joints are to be welded, brazed, joined by leak proof compression fittings or catalyst cured resins.

Where flanged joints are used in other systems, attention shall be given to the selection of gaskets, joining materials and joint design to withstand the pressures and temperatures involved, together with the effects of exposure to the refrigerant/oil mixtures. Welding or brazing of flanges to pipelines shall be used wherever possible.

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4.3.3

Pipelines shall be supported against vibration stresses by being adequately clamped to solid fixtures, with suitable vibration elimination and expansion bends. For large lines (75mm or above) trombone bends or spring hangers should be used. Small lines to fitted gauges, high pressure and low pressure cut outs and oil safety switches, etc., shall be installed with vibration loops to absorb vibration. Care should be taken where vibration loops are created on small lines to prevent pipes rubbing through, and to support the weight and forces developed in the vibration loop.

4.3.4

To ensure all the refrigerant and oil circulated throughout the system stays clean and moisture free, sufficient strainers, filters and driers shall be included.

Adequately sized driers should be included to minimise moisture in the system. A moisture indicating liquid line sight glass installed with the drier is strongly recommended. Full flow filter driers should be used in preference to bypass driers wherever practicable.

4.3.5

Every effort should be made to ensure the cleanliness of pipeline interiors. All unsealed tubing shall be thoroughly cleaned before assembly to remove any copper residue and/or scale particles such as dirt or metal. (See also 4.1.1). Pipework should be purged with dry nitrogen prior to the brazing process. (See also 8.1.5).

4.3.6

Refrigerant flexible hose should comply with SAE Standard J51 "Automotive Air Conditioning Hose".

4.3.7

Flexible hose connections should incorporate 'O' ring seals or flared fittings, to ensure minimum leakage of refrigerants. Each time an 'O' ring connection is remade, a suitable replacement 'O' ring seal must be used.

4.4 VALVES

Due to the size of domestic refrigeration systems, valves are not normally included in the design (see also 4.1.4).

Tube piercing valves or similar devices shall be used only to gain temporary access to the system in order to remove refrigerant. They shall never be left permanently attached to any system.

4.4.1

Where valves with removable packing are used they shall have retained or captive spindles, and facilities for tightening or replacement of the gland packing under line pressure.

4.4.2

The system shall be designed to enable valves which use packing to retain leakage from the spindle gland, to remain capped at all times unless being opened or closed. For example; expansion valves, service valves and packed line valves.

Where possible valves used regularly as part of the operation of the system, should be of the packless variety fitted with hand wheels and subject to periodic leak testing.

4.4.3

Valves with welded, brazed or flanged connections shall be used where the valve size exceeds 18mm outside diameter (See also 4.3.2).

4.4.4

An adequate number of isolation and service valves shall be included in the system, to enable the pump down and isolation of various components and equipment wherever practicable. In the case of capillary expansion, fully sealed systems or other critical charge designs where isolation valves may prove impractical, then access valves shall be provided so that the entire system can be evacuated without loss of refrigerant to the atmosphere (see also 4.7.2).

4.5 RELIEF DEVICE

This section should be read in conjunction with AS/NZS 1677.

Relief devices need not be used with domestic refrigeration, but all other systems shall have suitable relief devices.

4.5.1

It is recommended that where relief devices are activated they will not result in release of the total refrigerant charge. Such relief devices are to be of an automatically resetting design after activation. Fail-safe electrical and/or mechanical protection and isolation is preferable and should occur before any critical or safe working pressure can be exceeded. Safety cutout devices or switches should not be capable of being isolated from the system in normal operation.

4.5.2

Unnecessary operation of the pressure relief device shall be avoided, by providing an adequate safety margin between the normal high pressure cut-out setting of the system and the relief device setting.

4.5.3

Installing a rupture disc between the equipment and the relief valve will protect the valve from corrosion and resetting problems. When the rupture disc is utilised in this manner, an indicator system should be installed to indicate that the disc has ruptured and allowed refrigerant to contact the relief valve.

4.5.4

High side pressure relief devices may discharge into the low pressure side of the system provided that the system is not appreciably affected by increased downstream back pressure, or provided that the low side is equipped with a pressure relief valve, or bursting disc of sufficient capacity to protect all connected vessels, compressors and pumps simultaneously subjected to excess pressure. See also AS/NZS 1677.

This application has many attendant risks and the designer shall ensure that the pressure does not exceed the maximum safe working pressure of the vessel.

4.5.5

Pressure relief valves should be used in preference to fusible plugs.

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4.5.6

Pipe work should be designed so that cold liquid refrigerant cannot be trapped between isolation valves without pressure relief.

4.6 AIR PURGERS (NEGATIVE PRESSURE SYSTEMS)

A well designed and maintained negative (sub-atmospheric) pressure system should need to purge non-condensable gas for only a minimal amount of time. A high efficiency purge unit that recovers refrigerant should be fitted to all new equipment and retrofitted to existing equipment. The refrigerant loss due to non-condensable purging shall not exceed 0.8 kg of refrigerant per 1 kg of air. A purge monitor that indicates actual purging time shall be fitted in all cases. The performance of all air purgers shall comply with ARI-580 (1995). It is recommended that the purge unit be capable of operating independently of the chiller operation.

4.7 PUMP DOWN CAPABILITY

4.7.1

Due to the size of domestic refrigeration and light automotive air conditioning systems, liquid receivers used for pump down are not included in the design. Where practicable a suitable valve shall be fitted to the compressor to allow the connection of a pump down unit for the removal of refrigerant, prior to service or repair operations. Alternatively, the process tube on domestic refrigeration systems can be used for this purpose with the addition of a temporary clamp-on piercing type valve (see 4.1.3).

4.7.2

All refrigeration systems that have a liquid receiver or condenser/receiver combination, shall have the capacity to hold the refrigerant charge of the largest group of evaporators likely to be pumped out for service at any one time. Auxiliary receivers shall be installed if required.

Units using capillary expansion or other critical charge designs that do not have a liquid receiver as part of their design shall be fitted with permanently installed access valves for pumping out the system.

4.7.3

Systems containing a one piece condenser/receiver need not comply with 4.7.2 if the condenser shell is large enough to contain the pumped down refrigerant charge, is fully isolated by shut off valves and is protected by a pressure relief valve in accordance with AS/NZS 1677.

4.7.4

Flooded systems may be exempted from 4.7.2 provided the evaporator or liquid accumulator/separator or both can contain the entire charge. They shall be fully isolatable with shut off valves and protected by a pressure relief facility in accordance with AS/NZS 1677.

4.7.5

Flooded systems such as centrifugal machines shall have service valves to allow the transfer of the entire refrigerant charge to approved storage vessels without the loss of refrigerant.

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4.7.6

Parallel systems shall be designed with the necessary crossover connections and storage facilities to allow transfer of the refrigerant prior to service or repair operations.

4.7.7

To allow the connection of a pump down unit for the removal of refrigerant prior to service or repair operations, suitable valves shall be fitted to compressors and major items of equipment (see also 4.4).

4.8 OIL DRAINING

Since the refrigerant vapours are soluble in compressor lubricating oils, all practical steps shall be taken to minimise the refrigerant content of the oil, such as evacuation, or the use of crankcase heaters. The compressor crankcase shall be brought to atmospheric pressure before oil is removed.

4.9 CHARGE MONITORS AND LEAK DETECTORS

On new commercial and industrial installations a refrigerant charge monitor or leak detector should be fitted to alert equipment owners/operators of a refrigerant leak.

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5 DEVELOPMENT

The development phase covers laboratory, factory and field testing of components or systems.

5.1 SEALED SYSTEMS

Although the amount of refrigerant used in laboratory development of these systems is small, emissions shall be controlled by implementation of correct working and recovery procedures.

5.2 PACKAGED SYSTEMS

It is recommended that all the test rigs used in the development of these units be fitted with a receiver of sufficient capacity to hold the total refrigerant charge. Units not having a pump down facility shall have the refrigerant recovered prior to transport (see also 6.4).

5.3 SPLIT SYSTEMS

For the purposes of this code split systems are defined as having fully assembled and protected fan-coil and condensing unit shipped for site installation of interconnecting pipework. It is recommended that all the test rigs used in the development of these units be fitted with a receiver of sufficient capacity to hold the total refrigerant charge. Units not having a pump-down facility shall have the refrigerant recovered prior to transport (see also 6.4).

5.4 MAJOR COMPONENTS AND SUB ASSEMBLIES

Included under this heading are compressors, air/water cooled condensers, liquid receivers, chilled water exchangers, evaporators and air/water cooled condensing units (see also 5.3). When it becomes necessary to change refrigerants, the existing refrigerant is to be fully recovered into suitable containers.

6 MANUFACTURE

Complete refrigeration and air conditioning systems shall be cleaned, dried, leak free, evacuated (see Section 8.2), pressurised, sealed and labelled with the refrigerant and lubricant type before delivery (see Section 8.5).

Refrigeration and air conditioning system components shall be pressure tested, cleaned, dried, capped and labelled with the refrigerant and lubricant type.

6.1 CLEANLINESS OF SYSTEMS

Irrespective of the type of refrigerant being used, attention shall be paid to the cleanliness of the system thereby reducing the risk of contamination of refrigerant and the need for subsequent recharging. It is imperative therefore that all supervisory personnel involved are conversant with refrigerant technology and familiar with all aspects of the manufacturing process.

6.2 LEAK TESTING

Only a non-controlled substance shall be used as a leak test refrigerant. A mixture of a non-controlled refrigerant mixed with a pressurising substance such as dry nitrogen should be used. Leak test refrigerant should not be released into the atmosphere but recovered and reused. Acceptable alternative leak test methods which do not require the use of refrigerants may be used (see also AS/NZS 1677, ASHRAE Guideline 3 (1990)).

6.3 PUMP DOWN FACILITIES

Isolation/evacuation valves shall be fitted to systems to assist in the servicing and maintenance of plant (see also 4.1.4, 4.4.4 and 4.7.7). Where pump down facilities are provided, equipment should be pumped down before shipment.

6.4 HOLDING PRESSURES

All major components and sub assemblies (including fan coil units) shall have a positive holding pressure on delivery. One of the following substances should be used;

i) dry nitrogen or other inert gas.

ii) the refrigerant for which the equipment has been specifically designed.

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7 TRAINING OF PERSONNEL

Any person whose business is or includes the installation, servicing, modifying, or dismantling of any equipment containing or designed to use, or manufactured using any ozone depleting substance, should ensure that they and their employees are trained in the application of this Code.

8 INSTALLATION AND SERVICING

In principle those who install or service refrigeration and air conditioning equipment shall not charge refrigerant into equipment known to be leaking refrigerant, or which does not comply with the intent of this Code of Practice.

Domestic refrigeration and some self contained packaged products, are manufactured and sold as a complete package. As such installation is normally the responsibility of the purchaser. Detailed instructions are furnished with each product and provide correct methods and recommended procedures for installation and use.

The installation of split systems, can be the responsibility of the supplier, the purchaser or a nominated contractor. The person responsible shall ensure that installation is carried out in accordance with Section 8.1. Detailed instructions should be furnished with each product and describe correct methods and recommended procedures to reduce emissions of refrigerants in installation and use.

Recommendations on the design of pipe work and on the methods of connection can be found in Section 4 of this Code.

Refrigerants shall not be released to the atmosphere during the installation of any systems.

8.1 INSTALLATION OF EQUIPMENT

Only an adequately trained person shall carry out the installation of systems that involve the use of controlled refrigerants and other refrigerants with global warming potential.

During the process of locating and positioning major components, but before completion of the system, the following procedures shall be carried out.

8.1.1

Thoroughly examine all pipe work and fittings for cleanliness prior to assembling (see also 4.3.5).

8.1.2

Ensure no metal filings are left in pipe work after cutting (see also 4.3.5) as they can cause damage to shaft seals, compressor bearings and windings in hermetic and semi-hermetic compressors. Precautions shall be taken to ensure no particles or other foreign matter can get into the suction side of the compressor during the initial run-in period.

8.1.3

Care shall be taken when making flare connections. To avoid tearing the flare when tightening the nut, a suitable lubricant should be used between the back of the flare and the nut.

8.1.4

For flanged connections use only the correct type and grade of gasket material that is compatible with the relevant refrigerant and oil (see also 4.3.2).

8.1.5

After pipe work has been fixed in position, dry nitrogen shall be passed through the system to remove oxygen prior to brazing or silver soldering joints. Dry nitrogen shall be bleed continuously through the system during the brazing operation to eliminate oxidation (scaling), a common cause of choked driers, blocked expansion valve strainers, dirty oil and compressor failure (see also 4.3.5). The nitrogen must be at minimal pressure to eliminate the possibility of pinhole leaks.

8.1.6

Double check all mechanical joints for tightness.

8.1.7

On new installations pressure leak testing shall not be done with controlled refrigerants. The following are the recommended methods:

i) use a mixture of nitrogen and a trace refrigerant in conjunction with a suitable leak detection method (see also 6.2), or

ii) pressurise the complete system with dry nitrogen and leak-test using the soap bubble method.

Note: Having ensured there are no leaks using (i) or (ii) above the system should be pressurised to a safe test pressure. Observe over a period of time, relative to the size of the system, that no pressure drop occurs, having due regard to temperature variation throughout the system.

8.2 EVACUATION

After determining that there are no refrigerant leaks when the system is pressurised, the system shall be evacuated to remove moisture and non condensables. Evacuation shall be either the deep evacuation method, or triple evacuation using dry nitrogen only as the moisture absorber.

i) Deep vacuum method. Pull a deep vacuum to a pressure of less than 13 Pa absolute (100 microns of mercury). After isolating the vacuum pump, allow the system to stand for a time relative to the size of the installation to ensure the vacuum is maintained at or below 16 Pa absolute (120 microns of mercury); or

ii) Triple evacuation method. Use a vacuum pump to pull a vacuum to a pressure of at least 260 Pa absolute (2,000 microns of mercury). Break the vacuum with dry nitrogen and allow the system to stand. Re-evacuate the system and repeat the procedure twice more, breaking the vacuum each time with dry nitrogen.

8.2.1

After the initial running in period (100 hours) it is recommended that strainers and driers be changed, and that they be examined for signs of abnormalities.

8.3 SERVICING OF EQUIPMENT

Only an adequately trained person shall carry out repairs and service of systems that involve the use of controlled refrigerants and other refrigerants with global warming potential.

Many of the points in this section also need to be considered in Section 7 on Training and Section 11 on Recovery, Recycling and Disposal of Refrigerants.

A service person should be aware of the possibility that the system may have been incorrectly charged or incorrectly labelled (See also 8.5)

The service person should therefore first establish the type of refrigerant contained in the system by checking the pressure/temperature relationship or by using other tests and verify that the labelling is correct.

Warning: Some refrigeration and air conditioning systems contain hydrocarbons.

Any refrigerant that that cannot be identified, should be recovered from the system. (See also Section 10)

A different type of refrigerant or lubricant shall not be used or added to a system without following the recommendations of all relevant component manufacturers or suppliers (see also 9.2.5).

8.3.1

The service person should check that the condenser is clean and serviceable.

Controlled refrigerants shall not be used to clean debris and dirt from air cooled condenser fins and similar equipment, refrigerants having a global warming potential should also not be used.

8.3.2

The service person shall check, tighten and replace if necessary all potential leak sites such as:

i) all hand valves used on service equipment

ii) process tubes and attachments

iii) valve stem glands

iv) sealing caps over gauge points (check flare face for wear)

v) service valve caps (ensure a suitable washer is in place)

vi) pressure relief valves

All equipment must be thoroughly leak tested after service.

8.3.3

Various methods may be used for leak testing, eg. electronic leak detectors, ultrasonic leak detectors, propriety bubble solution, halide lamp, and/or ultra violet lamp. Some leak test methods are specific to refrigerant types.

The service person shall examine the following items for traces of refrigerant oil;

- flare joints,
- brazed joints,
- catalyst cured joints,
- compression fitting joints,
- compressor gaskets,
- control bellows,
- shaft seals,
- flanges,
- every other potential leakage point.

8.3.4

The low pressure side of a system shall be placed under a positive pressure before leak testing the evaporator, heat exchanger, expansion valve, solenoid valve, etc. If the system is of the hot gas type, this can be achieved by reversing the cycle. If the system has electric defrost, the compressor should be switched off and the defrost cycle initiated without pumping down the system. Care shall be taken to prevent excessive pressure build up on the low pressure side.

Negative pressure R11, R113 and R123 systems can be pressurised using electric blankets or hot water to heat the vessel to a controlled positive pressure for leak detection purposes.

Negative pressure systems can, if not controlled correctly during testing, burst the rupture disc. When leak testing on these systems, the test pressure shall not exceed 60% of the rated burst pressure of the disc.

8.3.5

Belts on open belt drive condensing units should be thoroughly checked for wear and damage. Worn or damaged belts, misalignment or over tensioning can cause failure of the compressor shaft seal and drive end bearing.

8.3.6

Having located a leak, that part of the system shall be isolated to minimise the loss of refrigerant. The repair can then be undertaken. Under no circumstances shall any refrigerant be wilfully discharged to atmosphere. If isolation is impracticable, or if that part of the system cannot be held at atmospheric pressure accurately while the repair is being carried out, then the refrigerant shall be pumped back into the system receiver or recovered to a suitable container.

8.3.7

If the service person doubts the integrity of the system it shall not be recharged until appropriate repairs and leak testing have been undertaken.

8.3.8

To eliminate air intake the connecting lines and/or flexible hose should be evacuated, or if impractical, lightly purged with a minimum refrigerant loss before charging the system.

8.3.9

Tube piercing valves or similar devices shall be used only to gain temporary access to the system where there is no other means of access in order to remove refrigerant. They shall never be left permanently attached to any system.

8.4 CLEANING AND FLUSHING

Cleaning and flushing a contaminated system after a hermetic or semi-hermetic compressor failure or motor burnout.

8.4.1

Isolate as many parts of the system as practical.

8.4.2

Remove contaminated refrigerant to suitable empty containers, by using a recovery unit to pump the refrigerant out. Great care must be taken not to over-fill the container. Refrigerants shall not be mixed in the same container.

8.4.3

When the system is empty and at atmospheric pressure, the component parts should be removed and capped off, and where possible taken to a workshop with appropriate facilities for cleaning. Cleaning should be done by flushing the components with

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a high quality non ozone depleting based solvent (see also 4.3.5).

Due care shall be taken when handling solvents to observe Occupational Health and Safety standards. The cleaning solvent should be pumped throughout the system until only clean solvent emerges. After ensuring the system has been thoroughly cleaned, the remaining solvent should be removed by purging with dry nitrogen.

Caution should be taken at this point to ensure no solvent residue remains in the system after purging.

8.4.4

When cleaning is complete, the major component parts should be reassembled in the system with the new compressor. It is highly recommended that a suction line filter/drier (a burnout drier) be fitted.

8.4.5

The system should be evacuated by the deep evacuation method. However, if because of the nature of the plant (eg. blood bank, plasma freezing, operating theatre equipment) the major consideration is bringing the plant back into service without delay, triple evacuation may be used. Between the second and third stages of triple evacuation, while there is zero pressure in the system, new driers should be fitted. The system should then be pressurised with dry nitrogen and trace gas then a thorough leak-test carried out before re-evacuating and recharging with refrigerant (see also 8.2).

8.4.6

If it has been established, after testing the refrigerant and oil for acidity, that the system has not been significantly contaminated by the burnout, moisture or mechanical failure and does not require the cleaning procedure outlined in 8.4.3, then cleaning of the system by using high quality suction and liquid line filter driers is an acceptable alternative. If this alternative is undertaken all filters fitted shall be capable of being replaced with a minimal loss of refrigerant to the atmosphere.

8.4.7

For field evacuation, every effort should be made to meet the evacuation guidelines as set out in section 8.2. In the case of equipment, such as centrifugal chillers, which have specific evacuation procedures, reference should be made to the manufacturers data:

After the system has been evacuated the vacuum pump should be isolated from the system and as a guide the vacuum should not rise more than 13 Pa absolute (100 microns of mercury) in one hour. A greater rate of rise may indicate a leak (see also 8.3.7). Absolute vacuums should be measured with suitably accurate measuring equipment.

8.5 LABELLING

Whenever a system is charged with a refrigerant and/or lubricant the service person shall clearly label the system with:

- the refrigeration type,
- lubricant type,
- name of service and organisation,
- date of service.

It is recommended that the ASHRAE refrigerant designated R number be clearly displayed.

9 MAINTENANCE

9.1 GENERAL MAINTENANCE

9.1.1

All plants should be regularly inspected for traces of oil or for a sign of leak indicating dye. If a system equipped with an open type compressor is to be shut down for any extended period of time, the equipment should be pumped down, all necessary valves closed to prevent the escape of refrigerant and suitably labelled. If this is not possible or practical it should be run once a week for at least half an hour, in order to ensure that mechanical seal faces, bearings, etc., have a continuous oil film on their surfaces. Such a procedure could prevent seal failure occurring over a long period of shutdown.

9.1.2

Negative pressure Chillers, R11, R113 and R123 when off can be under a vacuum and could draw in air and moisture. On open drive machines the shaft should be rolled periodically to minimise leakage at the shaft seal. A method of pressurising the chiller and controlling the chiller pressure at + 0.3 kPa (+/-0.2 kPa) when referenced to atmospheric pressure should be considered. A manual reset high pressure limit switch shall be provided to discontinue pressurisation when the chiller pressure reaches 2.0 kPa above the set point.

9.1.3

A high efficiency purge unit shall be fitted to existing negative pressure (sub atmospheric) systems as described in 4.6.

9.2 ADVICE TO EQUIPMENT USERS

The owner of the unit is responsible for its use and care. A malfunctioning unit should be attended to by a reputable service organisation, such as a RACCA member, as soon as possible to ensure that any leakage of refrigerant is minimised.

Users are advised that persons (such as IRHACE members), who service refrigeration and air conditioning equipment are required by legislation to observe this Code of Practice and not to “top up” systems known to be leaking or to service equipment unless it can be returned into service in a leak free condition. Some modification to plant or equipment may be necessary to achieve the aim of the Code of Practice to minimise loss of refrigerant.

If a user does not have trained staff to undertake service or maintenance work then it is recommended that a routine maintenance agreement for their plant be undertaken with a reputable service organisation, such as a RACCA member.

Automobile air conditioning vehicle owners should be advised to operate the air conditioning system compressor for a minimum of 5 minutes each week, regardless of the season, to ensure continued lubrication of the compressor shaft seal.

9.2.1

All users should monitor the operation of their installation weekly and call the service person immediately if any abnormal condition is found. (Apart from the likelihood of minimising loss of refrigerants to the atmosphere this may also save the cost of an expensive repair or replacement).

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9.2.2

When a refrigeration system contains in excess of 50 kg of refrigerant the system should be leaked tested at least on a quarterly basis (see also 8.3.2).

9.2.3

The installation, of a suitable sensing and alarm system, to detect a loss of refrigerant charge or the presence of leaked refrigerant is highly recommended.

9.2.4.

All refrigerants shall be recovered and either recycled, reclaimed or held for disposal in an approved manner.

9.2.5

Retrofitting a system with an alternative refrigerant and/or lubricant shall only be carried out after consultation with the equipment and/or component manufacturers.

When an alternative refrigerant has been retro-fitted to a system, the system's labelling colour coding and nameplates shall be changed to permanently identify the refrigerant contained and the type of lubricant (See also 8.5).

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10 RETROFITTING

When retrofitting is to be carried out the procedures to be followed are those recommended by the manufacturers or their distributors.

11 RECOVERY, RECYCLING AND DISPOSAL OF REFRIGERANTS

11.1 DURING MANUFACTURE, INSTALLATION AND SERVICING

Note: Non-Condensable gases mixed with refrigerant can be extremely hazardous, increasing the pressure above normal vapour pressure. They can cause a container to burst during filling or warming.

11.1.1

It is highly desirable, and in some cases mandatory, for recovery and/or recycling equipment to be used for the removal or recovery of refrigerant during service.

Warning: To avoid mixing refrigerants it may be necessary to use dedicated recovery equipment for each refrigerant.

When controlled refrigerant is used in performance testing of units or systems in both development and production operation, this refrigerant shall be recovered.

The provision of receivers or dump tanks on larger capacity refrigeration and air conditioning systems, facilitates re-using the refrigerant charge following servicing operations, or decommissioning of equipment.

In smaller capacity systems using capillary expansion devices, or critical charge systems where pump down facilities are not provided, refrigerant containers will often be used as temporary receivers for all or part of the refrigerant charge. Hazards can arise in the use of refrigerant containers in this way and the following provisions shall apply.

11.1.2

A refrigerant container is a pressure vessel designed for the transportation of a liquefied gas. Neither the designed maximum safe working pressure, nor the designed carrying capacity of the refrigerant container shall be exceeded in any filling operation, however temporary.

Refrigerant/oil mixtures have a lower density than refrigerant alone and for this reason the carrying capacity of refrigerant containers will be reduced for refrigerant/oil mixtures compared to pure refrigerants.

Containers shall only be used within the service for which they are designated by colour coding, labelling and valving in accordance with AS 1942 (1987).

11.1.3

If contaminated refrigerant is decanted into a recovery container, corrosion and contamination may occur. An internal examination followed by cleaning should be carried out on such containers before re-use.

11.1.4

If a refrigerant container belonging to a third party, (for example, a refrigerant manufacturer, wholesaler or hirer), is to be used as a temporary receiver, the permission of the owner of the container shall be obtained in advance. Where

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granted, the owner shall be given the opportunity to carry out an internal inspection for corrosion and contamination immediately after such use.

11.1.5

To avoid the danger of mixing different refrigerant types, the receiving containers shall be identified by the correct colour coding and labelling and shall only be used for the refrigerant type that is being transferred.

11.1.6

All recovery containers shall be identified, colour coded and only used for the refrigerant so marked. Containers shall conform with AS 1942 (1987).

11.1.7

Portable equipment is available for recovery of refrigerant in the field. Special care shall be taken to ensure cross contamination of refrigerants and lubricants, does not occur within the equipment. Proprietary equipment shall be used in accordance with the manufacturers instructions.

Always use hoses, fittings and procedures that minimise the loss of refrigerant during service, installation and decommissioning.

11.1.8

When refrigerant is suspected to be contaminated or is not to be re-used in the system from which it was removed, it is recommended that it is tested and if necessary, recycled or reprocessed to ensure it complies with the provisions of ARI 700 (1995).

11.1.9

Refrigerant recovery equipment and/or recycle equipment should conform to Australian Standard, AS4211.3 (1996) Gas Recovery or Combined Recovery and Recycling Equipment, Part 3.

11.1.10

Refrigerant vapour as well as refrigerant liquid shall be recovered from a system to be repaired.

As chillers have a large internal volume it is important that all refrigerant vapour be recovered. A chiller at atmospheric pressure can still hold many kilograms of refrigerant vapour after the liquid has been removed.

When recovering refrigerant from a chiller, the refrigerant should be recovered until the internal system pressure is reduced to 3kPa absolute for low pressure systems (eg. R11) and 70kPa absolute for positive pressure systems, eg. (R12 and R22). The internal system pressure should then be taken up to atmospheric pressure with dry nitrogen if the chiller is to be opened. This will prevent moisture-laden air entering the system which could lead to contamination and corrosion.

11.2 DISPOSAL OF REFRIGERANTS

11.2.1

Unusable or unrequired fluorocarbon refrigerant shall not be discharged to the atmosphere, but shall be returned to a depot of the Ozone Protection Company Limited, for disposal. Contact details are available from refrigerant wholesalers or the IRHACE Centre, telephone 0-9-262 1405.

11.2.2

Any residual refrigerant in a disposable container shall be recovered.

11.2.3

Disposable containers shall not be refilled or used as temporary receivers during service. A disposable container shall not be repaired or modified in any way.

11.2.4

Empty disposable containers should be disposed of at a recycling centre.

11.2.5

The utmost care must be taken to avoid mixing different types of refrigerants, as separation may be impossible and large quantities of refrigerant may be rendered unusable.

11.2.6

Refrigerators and freezer cabinets shall have the doors and/or lids removed before disposal.

11.2.7

If the refrigeration system contains refrigerant it shall be recovered before disposal.

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12 HANDLING AND STORAGE OF REFRIGERANTS

12.1 HANDLING AND STORAGE

Losses of refrigerant to the atmosphere can occur during the handling and storage of refrigerant containers. Service persons have a duty of care to avoid such losses.

12.1.1

Refilling a container shall only be undertaken with the permission of the container owner (usually the refrigerant supplier)

Where refrigerant is to be transferred from one container to another, this shall be carried out using the following guidelines.

A pressure difference will have to be established between the containers and this may be achieved by means of a pump, or temperature differential. In no circumstances shall refrigerant be vented to the atmosphere from the receiving container.

The receiving container may be cooled in an operating refrigerator or freezer. Warming of the discharging container under controlled conditions to increase the rate of discharge of refrigerant during transfer is permissible, but direct heating of refrigerant containers by flame, radiant heat uncontrolled direct contact heat shall not be used. Heating of containers using indirect forms of heating eg. controlled temperature airflow should only be permitted where the control system is designed to be fail safe. Where a fluorocarbon refrigerant is to be transferred to a charging station the refrigerant vapour shall not be vented to the atmosphere, during transfer operation and shall be recovered.

12.1.2

There are numerous hazards associated with the storage of refrigerant. These include: asphyxiation in confined spaces due to leakage from refrigerant containers and fire, which may overheat and explode refrigerant containers or decompose refrigerant into toxic substances.

Securing stored refrigerant in lockable cages with appropriate signage (to provide ready identification by emergency teams) should be considered. There are limits on the amount that can be stored and reference should be made to current legislation.

Note: Service personnel should make reference to Refrigerant manufacturers' Material Safety Data Sheets when handling fluorocarbon refrigerants.

12.1.3

Mechanical damage to the refrigerant container and its valve should be avoided by careful handling.

12.1.4

When a refrigerant container is not in use its valve should be closed, the valve outlet sealing cap put in place and the valve protected. Containers should be regularly leak tested and leaking containers returned to the supplier.

12.2 CHARGING

12.2.1

The pipe work connecting a container to a refrigeration system shall be leak-tested before the cylinder valve is fully opened. This can be done by partially opening

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and then closing the container valve to pressurise the connecting pipe work.

12.2.2

Refrigerant being transferred should be measured by either mass (using weigh scales) or by volume using a volumetric charging device with due reference to temperature.

12.2.3

Charging lines shall be as short as possible and have suitable fittings to minimise losses during disconnection at the end of the transfer. Take care to avoid refrigerant liquid being trapped between closed valves as high pressures may develop.

12.2.4

Refrigerant containers shall not be connected to a system at a higher pressure, or to a hydraulic leg, where the pressure is sufficient to cause a back flow of refrigerant into the container. For similar reasons refrigerant containers shall not be connected to systems or other container at a high temperature.

Back flow of refrigerant can result in containers being contaminated or overfilled with subsequent danger from the development of a pressure high enough to burst the container.

12.2.5

Refrigerant containers should not be manifolded together if there is a possibility of temperature differences between the containers, since this will result in refrigerant transfer and the danger of overfilling the cold container (see also 11.2.4). Where containers are manifolded together, care should be taken to ensure all the containers are at the same height to avoid gravity transfer between containers, it is highly recommended that single direction flow or check valves be installed at each container.

12.3 REFRIGERANT TRANSFER BETWEEN CONTAINERS

Refilling a container should only be undertaken with the permission of the container owner.

12.3.1

Where refrigerant is to be transferred from one container to another, this shall be carried out using the following guidelines. A pressure difference will have to be established between the containers and this may be achieved by means of a pump, or temperature differential. In no circumstances shall refrigerant be vented to the atmosphere from the receiving container. The receiving container may be cooled in a refrigerator or cold store.

Warming of the discharging container under controlled conditions to increase the rate of discharge of refrigerant during transfer is permissible, but direct heating of refrigerant containers by flames, radiant heaters or uncontrolled direct contact heaters is prohibited. Heating of containers using indirect forms of heating eg, controlled temperature airflow should only be permitted where the control system is designed to be fail safe.

12.3.2

When filling refrigerant containers, the maximum carrying capacity shall not be exceeded. The carrying capacity is a function of the internal volume of the container and the liquid density of the refrigerant at a reference temperature. This reference temperature is defined in current legislation. Allowance shall be made for oil content (if any) which can lower the container capacity (See also 11.1.2).

13 ALTERNATIVE REFRIGERANTS AND LUBRICANTS

Alternatives to controlled refrigerants should be used where this is technically and economically feasible (see Appendix 2).

13.1 ALTERNATIVE REFRIGERANTS

13.1.1

HCFC refrigerants have a lower estimated atmospheric life and/or lower chlorine content and therefore have lower ozone depleting potentials than CFC refrigerants (See also Appendix 2).

13.1.2

Non-ozone depleting fluorocarbon refrigerants such as the hydrofluorocarbons and their blends are long term replacements (See Appendix 2).

13.1.3

Ammonia is widely used as a primary refrigerant. Whilst it is toxic and flammable, it is the preferred option for large commercial and industrial refrigeration applications (refer AS/NZS 1677).

13.1.4

In certain installations, notably in hydrocarbon processing, all the process equipment installed is built to flameproof standards. In such cases the additional cost of flameproof refrigeration equipment for the use of a flammable refrigerant may be acceptable and use of hydrocarbon refrigerants can be considered.

13.1.5

Substitution of alternative refrigerants into an existing system should only be carried out with the agreement of the equipment and/or component manufacturer or authorised agent of the equipment concerned, and in accordance with relevant Codes. Particular care must be taken with flammable or toxic refrigerants.

13.1.6

With the introduction of HCFC and HFC alternative refrigerants, alternative lubricants need to be considered to ensure system reliability. Some of these alternative lubricants tend to exhibit greater hygroscopicity than mineral oils, so care should be taken to ensure that they are kept in sealed containers at all times.

APPENDIX 1

DEALING WITH RECOVERY OF FLUOROCARBONS MIXED WITH OTHER REFRIGERANTS

Over the last few years a number of different refrigerants and refrigerant mixtures have been used as replacements for R12 and R22. In some cases hydrocarbons and hydrocarbon mixtures have been used for this purpose.

In many instances the equipment in question may not be labelled to indicate the refrigerant used and as the operating pressures of these replacements are usually similar to those of the original refrigerant, identification in the field is extremely difficult.

Hydrocarbons or other refrigerants may have been used to 'top up' fluorocarbon refrigerant in some refrigeration or air conditioning systems.

It is not safe to recover flammable refrigerant using equipment designed only for non-flammable refrigerants such as R12, and R134a.

This code requires that fluorocarbon refrigerants be recovered. A refrigerant solely containing a hydrocarbons may be vented but due care should be taken to prevent ignition of the vapour or oil mist.

However a refrigerant containing a fluorocarbon shall not be vented to atmosphere.

Should you suspect a system contains an unidentifiable mixture, or if questioning the owner, examination of any labels present or a detecting instrument indicate that a hydrocarbon/fluorocarbon mixture or any other non standard mixture of refrigerants may be present, then the following procedure should be followed:

1. If a hydrocarbon or flammable mixture containing hydrocarbons is suspected, use only recovery equipment designed for recovery of flammable gases and recover the refrigerant into specially marked containers.
2. In a case of refrigerant mixtures it is not advisable to use recovery equipment as many mixtures have very high condensing pressures which could result in equipment failure and/or injury to persons operating or near to the equipment.
3. In most instances the safest method of recovery is to use an evacuated and preferably chilled container to depressurise the system.
4. Label the container to show it contains a mixture or with the suspected composition if known and deliver it to a supplier for reclaiming.
5. Purge the residual gas from the system with dry nitrogen before proceeding with any repairs.

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APPENDIX 2

FLUOROCARBON REFRIGERANTS

Environmental properties: A long term replacement refrigerant should have a zero Ozone Depletion Potential, a low Global Warming Potential and a short Estimated Atmospheric Life.

NUMBER	NAME	CHEMICAL FORMULA	O.D.P.	G.W.P.	E.A.L.
CFCs					
R11	Trichlorofluoromethane	CCl_3F	1.0	4000	50
R12	Dichlorodifluoromethane	CCl_2F_2	1.0	8500	102
R13	Chlorotrifluoromethane	$CClF_3$	1.0	11700	640
R113	Trichlorotrifluoroethane	CCl_2FCClF_2	0.8	5000	85
R114	Dichlorotetrafluoroethane	$CClF_2CClF_2$	1.0	9300	300
R500	CFC/HFC Blend	CFC-12 (74%) HFC-152a(26%)	0.5	5210	102*
R502	CFC/HCFC Blend	CFC-115 (51%) HCFC-22 (49%)	0.33	4510	1700*
R503	CFC/HFC Blend	CFC-13 (40%) HFC-23 (60%)	0.5	11900	640*
HCFCs & HFCs					
R22	Chlorodifluoromethane	$CHClF_2$	0.055	1700	13.3
R123	Dichlorotrifluoroethane	$CHCl_2F_3$	0.02	93	1.4
R124	Chlorotetrafluoroethane	$CHFClCF_3$	0.022	480	5.9
R401A	HCFC/HFC Blend	HCFC-22 (53%) HFC-152a(13%) HCFC-124 (34%)	0.04	1120	13.3*
R401B	HCFC/HFC Blend	HCFC-22(61%) HFC152a(11%) HCFC-124(28%)	0.04	1230	13.3*
R401C	HCFC/HFC Blend	HCFC-22 (33%) HFC-152a(15%) HCFC -124 (52%)	0.03	870	13.3*
R402A	HCFC/HFC/HC Blend	HCFC-22 (38%) HFC-125(60%) HC290(Propane) (2%)	0.02	2380	36*

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NUMBER	NAME	CHEMICAL FORMULA	O.D.P.	G.W.P.	E.A.L.
HCFCs and HFCs					
R402B	HCFC/HFC/HC Blend	HCFC-22(60%) HFC-125(38%) HC-290(2%)	0.03	2080	36*
R403B	HCFC/PFC/HC Blend	PFC-218(39%) HC-290(Propane) (5%) HCFC-22 (56%)	0.03	2640	2600*
R406A	HCFC/HC Blend	HCFC-22 (55%) HCFC-142b (42%) HC-600a (4%)	0.05	1700	19*
R408A	HCFC/HFC Blend	HFC-143a(46%) HFC-125(7%) HCFC-22(47%)	0.023	3060	55*
R409A	HCFC Blend	HCFC-124(25%) HCFC-142b(15%) HCFC-22(60%)	0.05	1530	19*
R409B	HCFC Blend	HCFC-124(25%) HCFC-142b(10%) HCFC-22(65%)	0.05	1510	19*
R134a	Tetrafluoroethane	CF_3CH_2F	0.0	1300	14
R125	Pentafluoroethane	C_2HF_5	0.0	3200	36
R404A	HFC Blend	HFC-125 (44%) HFC-134a (4%) HFC-143a (52%)	0.0	3850	55*
R407B	HFC Blend	HFC-32 (10%) HFC-125 (70%) HFC-134a (20%)	0.0	2300	36*
R407C	HFC Blend	HFC-32 (23%) HFC-125 (25%) HFC-134a (52%)	0.0	1370	36*
R410A	HFC Blend	HFC-32 (50%) HFC-125 (50%)	0.0	1370	36*
R413A	HFC/PFC/HC Blend	HFC-134a (88%) PFC-218 (9%) HC-600a (3)%	0.0	1770	2,600*
R507	HFC Blend	HFC-125 (50%) HFC-143a (50%)	0.0	3900	55*

For other refrigerants refer AS/NZS 1677.1:1998

Note: ODP refers to Ozone Depletion Potential relative to CFC-11.
GWP is based on a 100 year time horizon in comparison with carbon dioxide.
EAL denotes Estimated Atmospheric Lifetime.
*EALs noted for blends are for component with highest EAL.

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