Australia and New Zealand

Refrigerant handling code of practice 2007

Part 1 —

Self-contained low charge systems

Australian Government
Department of the Environment and Water Resources

AIRAH
achieving recognition

IRHACE NEW ZEALAND
The Institute of Refrigeration, Heating & Air Conditioning Engineers of New Zealand Inc.

Prepared by the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH)
and the Institute of Refrigeration, Heating and Air Conditioning Engineers New Zealand (IRHACE)

Part 1 –
Self-contained low charge systems

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II Scope

This code applies only to appliances which contain a fluorocarbon refrigerant charge of two kilograms or less, and do not require any work to be done on the refrigeration system at the time of installation.

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. This code specifies requirements which are mandatory for compliance with the code, and also includes best practice recommendations. Environmental benefits and cost savings from reduced losses can be expected from the application of this code including the use of alternative refrigerants.

Systems which do not use a fluorocarbon refrigerant (or do not use a refrigerant blend containing a fluorocarbon) are not covered by this code.

III Referenced Documents

Document		Title
AS/NZS	1200:2000	Pressure Equipment
	1677.2:1998	Refrigerating systems. Part 2: Safety Requirements for fixed applications
AS	2030.1:1999	The verification, filling, inspection, testing and maintenance of cylinders for storage and transport of compressed gases – Cylinders for compressed gases other than acetylene
	4211.3:1996	Gas recovery on combined recovery and recycling equipment. Part 3: Fluorocarbon refrigerants from commercial/domestic refrigeration and air conditioning systems
	4484:2004	Gas cylinders for industrial, scientific, medical and refrigerant use – Labelling and colour coding.
ARI	700-2004	Specification for Fluorocarbon Refrigerants
Australian Act		Ozone Protection and Synthetic Greenhouse Gas Management Act 1989 (as amended in 2003)
Australian Regulation		Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995
Australia / New Zealand Code of Practice		Australia and New Zealand refrigerant handling code of practice Part 2 – systems other than self-contained low charge systems
New Zealand Act		Ozone Layer Protection Act 1996

IV Acronyms for standards and organisations and relevant websites

Acronym	Standard/Organisation	Website
AIRAH	Australian Institute of Refrigeration Air Conditioning and Heating	www.airah.org.au
ANSI	American National Standards Institute	www.ansi.org
ARC	Australian Refrigeration Council	www.arctick.org
ARI	Air-Conditioning and Refrigeration Institute (American)	www.ari.org
AS	Australian Standard	www.standards.org.au
DEW	Department of Environment and Water Resources (Australia)	www.environment.gov.au
IRHACE	Institute of Refrigeration, Heating and Air Conditioning Engineers New Zealand	www.irhace.org.nz
NZCCO	New Zealand Climate Change Office	www.mfe.govt.nz
NZS	New Zealand Standard	www.standards.co.nz
RRA	Refrigerant Reclaim Australia	www.refrigerantreclaim.com.au
SAE	Society of Automotive Engineers (American)	www.sae.org

V Definitions

For the purp ose of this code the following definitions apply:

Alternative refrigerant
Alternative refrigerant means a **refrigerant** other than that for which a system was designed.

Blend
A combination of two or more **refrigerants** in a defined ratio which forms a **refrigerant** with specified thermodynamic properties.

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

Compatible
Components are **compatible** when they can be operated together without degrading the overall performance of the system.

Cylinder
A portable storage vessel designed for the safe storage and handling of **refrigerant** gases under pressure.

Decommissioning
The process whereby a system is deliberately rendered inoperable.

Destruction
A process whereby a **refrigerant** is permanently transformed or decomposed into other substances.

Disposable container, disposable refrigerant container
A non-refillable **cylinder.**

Fluorocarbon
A hydrocarbon in which some or all of the hydrogen atoms have been replaced by fluorine.

Fluorocarbon refrigerant
A **refrigerant** consisting of or containing **fluorocarbon.**

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).

Major components and sub assemblies
Equipment including compressors, air/water cooled condensers, liquid receivers, chilled water heat exchangers, evaporators and air/water cooled condensing units.

Must
When used for a provision, indicates that the provision is mandatory for compliance with this code.

Ozone depletion potential (ODP)
The capacity of a **refrigerant** to destroy stratospheric ozone. ODP is stated relative to the ODP of CFC-11, which is taken as having an ODP of 1.

Reclaim
To reprocess used **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 specialised **reclaim** or manufacturing facility.

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

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 rejects heat on condensing at a higher temperature and higher pressure. (The term 'gas' should be avoided when referring to **refrigerants**). Unless specified otherwise, **refrigerant** in this code refers to **fluorocarbon refrigerant only**.

Refrigerating system
An assembly of piping, vessels, and other components in a closed circuit in which a **refrigerant** is circulated for the purpose of transferring heat.

Retrofit
To replace the original **refrigerant** (and components, lubricant, etc as required) in a system with an alternative.

Returned refrigerant
Refrigerant recovered from a system and returned to the supplier or equivalent for **reclaim** or **destruction**.

Self-contained low charge systems
Appliances which contain a **fluorocarbon refrigerant** charge of two kilograms or less, and do not require any work to be done on the refrigeration system at the time of installation.

Should, recommended
Indicate provisions which are not mandatory for compliance with this code but which are desirable as best practice.

Split systems
Systems that require interconnecting pipe work and electrical connections between the separate evaporator unit and the condensing unit. Note that split systems fall outside the scope of this code – refer instead to the *Australia and New Zealand refrigerant handling code of practice 2007 Part 2 – systems other than self-contained low charge systems.*

For definitions of other components, refer to AS/NZS 1677.2-1998 section 1.4: Definitions.

VI How to read this code

Text in the remainder of this document is colour coded for ease of use.

Text with a blue background, and containing the term '**must**' in bold font, indicates compliance is mandatory.

Sections with a green background, and containing the terms '**should**' or '**recommended**' are not mandatory but are recommended as best practice.

Sections with plain background are explanatory notes, and are for informative purposes only.

Note for Australian users:

The use of **fluorocarbon refrigerants** in Australia is governed by the *Ozone Protection and Synthetic Greenhouse Gas Management Act 1989* (as amended in 2003) and the *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995*.

Any provisions contained in the Australian regulations take precedence over provisions in this code.
The provisions in this code, however, take precedence over any original equipment manufacturer instructions (except where specified otherwise herein).

1 General

1.1 Personnel

1.1.1 In Australia, any person whose business includes the manufacturing, installation, servicing, modifying, or dismantling of any refrigeration and/or air conditioning equipment which:

(a) contains

(b) is designed to use, or

(c) is manufactured using

fluorocarbon refrigerant, **must** ensure that they and/or any of their employees who handle **fluorocarbon refrigerant** are appropriately licensed under the *Ozone Protection and Synthetic Greenhouse Gas Management Regulations 1995* and any regulations that supersede it.

For further details on the Australian licensing system, see www.environment.gov.au or www.arctick.org

1.1.2 In New Zealand, any person whose business is or includes the manufacturing, installation, servicing, modifying, or dismantling of any refrigeration and/or air conditioning equipment which:

(a) contains

(b) is designed to use, or

(c) is manufactured using

fluorocarbon refrigerant, **must** ensure that they and/or any of their employees who handle **fluorocarbon refrigerant** possess a 'No-Loss' card.

The No-Loss card is a card indicating the completion of a voluntary training program run by the New Zealand government and the Institute of Refrigeration, Heating and Air Conditioning Engineers New Zealand (IRHACE). For more details see www.irhace.org.nz.

1.1.3 Any person whose business is or includes the manufacturing, installation, servicing, modifying, or dismantling of any refrigeration and/or air conditioning equipment which:

(a) contains

(b) is designed to use, or

(c) is manufactured using

a **fluorocarbon refrigerant**, **must** ensure that they and / or any of their employees who handle **fluorocarbon refrigerant** are provided with a copy of this code and work to the standards set out herein.

1.2 Refrigerant venting

1.2.1 Where the release is avoidable, **fluorocarbon refrigerant must not** be willingly released to the atmosphere by any person by any means, including:

(a) venting **refrigerant** directly, and

(b) charging **refrigerant** into equipment with identified leaks.

2 Design

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

2.1 Design to an equivalent or better standard

2.1.1 All systems **must** be designed so that they are able to be:

(a) manufactured,

(b) installed,

(c) operated,

(b) serviced, and

(c) decommissioned

without the avoidable loss of **refrigerant** as described in 1.2.1.

2.1.2 Where the designer can provide evidence that a system has been designed to an equivalent or better standard than is set out in this section, and complies with clause 2.1.1, the design will be exempt from sections 2.2 to 2.7 inclusive.

Where this can **not** be demonstrated, the system design **must** comply with sections 2.2 to 2.7 in their entirety.

2.2 General

A sound understanding of system design is necessary for the prevention of **refrigerant** leakage.

2.2.1 All systems **must** be designed in accordance with the applicable Australian and New Zealand standards.

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

2.3 Compressors

Leaks associated with compressors in **self-contained low charge systems** can generally be attributed to the connecting pipe work. Proper initial installation, combined with a correct ongoing maintenance program **should** minimise if not eliminate these problems.

Due to the small amount of **refrigerant** in **self-contained low charge systems** the cost/benefit of equipping such systems with service valves is considered to be inappropriate.

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 system life.

2.3.1 Where compressors are fitted with a process tube, a length greater than 100mm **must** be provided to the compressor 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.

2.4 Refrigerant condensers and evaporators

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

2.4.1 All systems **must** be designed and materials selected to minimise the risk of corrosion.

2.5 Refrigerant pipelines and fittings

2.5.1 All pipelines **must** be designed so that the number of joints is kept to the practical minimum.

2.5.2 Welding, brazing or another permanent hermetic sealing method are **recommended** wherever practicable for joining **refrigerant** pipelines since they offer increased resistance to pressure, temperature and vibration stresses.

2.5.3 All joints **must** be hermetically sealed and not flanged.

2.5.4 Pipelines **must** be designed to minimise breakage due to vibration.

2.6 Valves

Due to the size of **self-contained low charge systems**, valves are not normally included in the design.

2.6.1 Tube piercing or line tap valves and other similar devices **must** be used only to gain service access to the system in order to remove **refrigerant**. They **must** be removed before the completion of service. The system design **must not** require these valves to be left on the system after the completion of service.

2.7 Pump down capability

2.7.1 Due to the size of **self-contained low charge systems**, liquid receivers used for pump down are not normally included in the design. For these applications, one of the following two options **must** be undertaken:

(a) valves fitted to the system to allow the connection of a pump down unit for the removal of **refrigerant** prior to service or repair operations, or

(b) a process tube can be used for this purpose with the addition of a temporary clamp-on piercing type valve.

3 *Manufacture and assembly*

3.1 General

It is imperative that all supervisory personnel involved in the manufacturing process are conversant with **refrigerant** technology and familiar with all aspects of the manufacturing process.

3.1.1 Complete systems **must** be clean, dry, leak tested, evacuated, pressurised, sealed, labelled with the **refrigerant** type and run tested prior to despatch.

3.1.2 If the system is pressurised with a substance other than the specified **refrigerant**, this substance **must** be identified on the system label.

3.2 Leak Testing

3.2.1 Except where used as a trace gas (see 3.2.2), **fluorocarbon refrigerant must not** be put into a system for the purposes of leak testing.

Acceptable leak test methods include (but are not limited to):

(a) liquid submersion testing

(b) foam enhancer leak detection

(c) positive pressure holding test / pressure drop off test (gross leaks only)

(d) vacuum degradation test (gross leaks only)

(e) fluorescent leak detection

(f) electronic leak testing

(g) mass spectrometer

3.2.2 A **fluorocarbon** substance may be used as a trace gas for leak testing by manufacturers, however, they **must** comply with the following conditions:

(a) the trace gas **must** be pre-mixed with nitrogen as a homogenous mixture, with a fluorocarbon content not greater than 10% by volume in the nitrogen

(b) the trace gas mixture **must** be fully **recovered** after final leak testing and **must not** be dispatched with the unit as a holding charge

(c) the unit **must** be tested for gross leaks using one of the methods described in 3.2.1 prior to introducing the trace gas.

3.3 Charging of refrigerant

3.3.1 All charging **must** be carried out in accordance with AS/NZS 1677.2:1998 Section 6.1: *Charging and discharging refrigerant*, with the exception that **self-contained low charge systems** are **not** required to be charged into the low side of the system.

4 Provision of information on installation, use and maintenance

4.1 Instructions **must** be furnished with each new product, detailing correct methods and recommended procedures for installation, use, and maintenance that prevent the deliberate emission, and minimise the potential for accidental emission, of **refrigerants**.

4.2 Instructions **must** encourage the owner to pass on installation, use and maintenance procedures for the system to the purchaser if the system is sold and is to be reinstalled.

5 Installation procedures

The systems covered by this code are self-contained products which are manufactured and sold as completed units. As no work on the **refrigeration system** is required on site, installation is normally the responsibility of the purchaser.

6 Evacuation

This section refers to evacuation in the field **only** – not evacuation during the manufacturing process.

As the systems covered by this code are supplied pre-charged with **refrigerant** there is no need to evacuate the system upon installation. If evacuation is required at a later stage, however, the following procedure **must** be followed:

6.1 Instructions **must** be followed if the system manufacturer has supplied instructions for evacuation, except where the instructions specify a practice that will lead to emission of **refrigerant**.

6.2 The system **must** be evacuated to less than 117 Pa absolute (900 microns of mercury) if the system manufacturer has not supplied instructions with the system for evacuation.

6.3 After the system has been evacuated the vacuum pump **should** be isolated from the system. As a guide, with constant ambient conditions, the vacuum **should not** rise more than 13 Pa (100 microns of mercury) in one hour. A greater rate of rise may indicate a leak or the presence of moisture (see also 7.1.9).

6.4 Absolute vacuums **must** be measured using accurate measuring equipment selected for the specific application.

7 *Servicing of equipment*

Many of the points in this section also need to be considered in Section 1.1 on Personnel and Section 13 on Recovery, Recycling and Disposal of Refrigerants.

Note: if the system is being **retrofitted** with a **refrigerant**, lubricant or components other than those for which it was originally designed, see Section 11 on Retrofitting.

7.1 A service person **should** be aware of the possibility that the system may have been incorrectly charged or incorrectly labelled (See also Section 9).

7.2 Where there is any suspicion that the **refrigerant** is not true to label, or there is no label and the **refrigerant** cannot be identified by other means, the **refrigerant must not** be vented from the system. If the **refrigerant** is to be disposed of, it **must** be fully **recovered**.

7.3 Only qualified persons with relevant experience **should** work on refrigeration and air conditioning systems which contain toxic or flammable **refrigerants** (ie: non-A1 safety class) since they demand special precautions (see Appendix 1).

7.4 **Refrigerant** content of the oil **must** be minimised using procedures such as evacuation or the use of crankcase heaters, since the **refrigerant** vapours are soluble in compressor lubricating oils.

7.5 The compressor crankcase **must** be brought to atmospheric pressure before oil is removed.

7.6 The service person **must** check and repair as necessary all potential leak sites.

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

7.7 If work has been done on the refrigeration circuit, the systems **must** be leak tested after service and any identified leaks **must** be repaired. **Refrigerant must not** be put into the system for the purpose of leak testing.

7.8 The service person **should** examine the system for traces of **refrigerant** oil, which could indicate leaks, and repair where necessary

7.9 A system **must not** be recharged until appropriate repairs and leak testing have been undertaken if the service person doubts the integrity of the system due to leakage rate and charging history.

7.10 Tube piercing / line tap valves or equivalent devices **must** only be used to gain temporary access to the system. They **must** be removed prior to the completion of service.

7. 11 Where a tube piercing or line tap valve has been used and the remaining length of process tube is still 100mm or greater, the tube **must** be crimped off, the process fitting removed and the end of the pipe sealed.

7.12 Where a tube piercing or line tap valve has been used and the remaining length of process tube is less than 100mm, a new process pipe of equal length to that originally fitted to the system **must** be fitted and sealed.

7.13 The system **must not** be recharged before the system has been fully tested and all identified leaks repaired.

7.14 Due to the ease of contamination of **refrigerant** in **self-contained low charge systems**, only virgin **refrigerant should** be used to recharge the system.

7.15 In all cases, **refrigerant** used to recharge a system **must** meet the specification for new **refrigerant** set out by ARI 700-2004 *Specification for Fluorocarbon Refrigerants.*

7.16 Some lubricants are very hygroscopic (attracted to moisture) and will absorb moisture from the air. These lubricants **must not** be exposed to atmosphere for any longer than is necessary to complete the service.

8 *Cleaning and flushing*

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

8.1 **Contaminated refrigerant must** be fully **recovered.**

8.2 The **cylinder must not** be over-filled, as per AS 2030.1:1999.

8.3 **Refrigerants must not** be mixed in the same **cylinder** as clean / reusable **refrigerant**.

8.4 As many parts of the system as practical **must** be isolated.

8.5 Where possible, **self-contained low charge systems should** be taken to a workshop with appropriate facilities for cleaning and reinstating. When the system is empty and at atmospheric pressure, the faulty component parts **should** be removed and the system capped off.

8.6 F**luorocarbon refrigerant must not** be used for flushing components.

8.7 Occupational Health and Safety standards **must** be observed when handling solvents.

8.8 Relevant material safety data sheets (safety data sheets in New Zealand) **must** be obtained and made available to the technician handling solvents.

8.9 The cleaning solvent **should** be pumped throughout the system until only clean solvent emerges.

8.10 After ensuring the system has been thoroughly cleaned, caution **should** be taken to ensure no solvent residue remains in the system after purging.

8.11 All spent solvents **must** be disposed of in accordance with New Zealand *Hazardous Substances (Disposal) Regulations 2001* and / or Australian state and territory hazardous substance disposal regulations.

8.12 When cleaning is complete, the major component parts **should** be reassembled in the system with the replacement compressor.

8.13 In the event of a burnout in a **self-contained low charge** system, it is highly **recommended** that a suction line filter/dryer (a burnout dryer) be fitted.

8.14 The system **must** be flow tested to ensure there are no blockages or restrictions.

8.15 A new filter dryer **must** be fitted.

8.16 The system **must** then be pressurised, then leak tested, re-evacuated using the deep evacuation method and recharged with refrigerant.

If it has been established, after testing the **refrigerant** and oil for acidity, that the system has only been locally contaminated by the burnout, moisture, or mechanical failure, and does not require the cleaning procedure outlined in 8.1.5 and 8.1.6, then cleaning of the system by using purpose selected suction and liquid line filter dryers is an acceptable alternative.

8.17 All filters fitted **must** be capable of being replaced with a minimal loss of **refrigerant** to the atmosphere if cleaning of the system by using purpose selected suction and liquid line filter dryers is undertaken.

9 Labelling

9.1 Whenever the type of **refrigerant** and/or lubricant in a system is changed, the service person **must** clearly label the system with:

(a) the **refrigerant** type,

(b) name of service person, licence number (Australia only) and service organisation,

(c) date of service,

(d) any ultraviolet dye that has been added.

Wherever the type of lubricant in a system is changed (other than when it has been pre-charge d into a replacement compressor by its manufacturer), the service person **must** also clearly label the system with:

(e) the lubricant type

9.2 **Refrigerating systems** modified on site **must** be labelled as per Clause 9.1.1.

10 Maintenance

10.1 The owner of the unit **should** be held responsible for its use and care.

10.2 A malfunctioning unit **should** be attended to by a licensed service organisation as soon as the condition occurs to ensure that any leakage of **refrigerant** is minimised.

10.3 Users are advised that persons 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 of the system may be necessary to achieve the aim of the code of practice to minimise loss of **refrigerant**.

10.4 All **refrigerants must** be **recovered** and either recycled, **reclaimed** or held for **destruction** in an approved manner.

11 Retrofitting

11.1 Any procedures recommended by the system manufacturer or their distributor **must** be followed when **retrofitting** is to be carried out.

11.2 **Retrofitting** a system with an **alternative refrigerant** and/or lubricant **must** only be carried out based on written advice from the equipment and/or component manufacturers.

11.3 If the equipment and/or component manufacturers cannot be contacted and written advice from them is not available, written advice from a suitably qualified refrigeration or air conditioning engineer **must** be obtained prior to the **retrofit.**

11.4 High pressure, flammable or toxic **refrigerants must not** be used in systems where they will pose a safety risk.

11.5 **Alternative refrigerants must** be **compatible** with all parts of the system.

11.6 Correct lubricants **must** be used with **alternative refrigerants** (check with the **refrigerant** supplier if in doubt).

11.7 When an **alternative refrigerant** has been **retrofitted** to a system, the system's labelling, colour coding (if applicable) and nameplates **must** be changed to permanently identify the **refrigerant** contained and the type of lubricant.

11.8 A new filter drier appropriate for the new **refrigerant must** be fitted.

11.9 Where it is technically and economically feasible, **alternative refrigerants** with a lower **ozone depletion** and **global warming potential** than the original **refrigerant should** be used.

12 Decommissioning

12.1 All **refrigerant must** be **reclaimed** from all parts of the system at the time of **decommissioning**, unless the system is being **decommissioned** for service or immediate recommissioning.

13 Recovery, recycling and disposal of refrigerants

13.1 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 **cylinder** to burst during filling or warming.

In Australia, **recovery** and recycling of **refrigerant** at the end of its useful life using **recovery** and/or recycling equipment is mandatory. In New Zealand it is an offence under the Ozone Layer Protection Act 1996 to wilfully release an ozone depleting substance.

To avoid mixing **refrigerants** that can be recycled or reused and to ensure that no r**ecovery cylinder** is over-filled, it is necessary to either use dedicated **recovery** equipment for each **refrigerant** or to ensure that only **cylinders** marked with the correct filling ratio are used, and that this filling ratio is not exceeded for the **refrigerant** being **reclaimed.**

In smaller capacity systems using capillary expansion devices, or critical charge systems where pump down facilities are not provided, **refrigerant cylinders** will often be used as temporary receivers for all or part of the **refrigerant** charge.

Hazards can arise in the use of **refrigerant cylinders** in this way and the following two provisions apply:

13.1.1 The designed maximum safe working pressure of a **refrigerant cylinder must not** be exceeded in any filling operation, as per AS 2030.1:1999, no matter how temporary.

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

13.1.2 **Refrigerant must not** be **recovered** into a flexible bag.

13.1.3 **Cylinders must** only be used within the application for which they are designed.

If **contaminated refrigerant** is decanted into a **recovery cylinder** corrosion and contamination may occur.

13.1.4 If a **cylinder** is filled with **contaminated refrigerant,** an internal examination followed by cleaning **should** be carried out before it is reused.

13.1.5 The permission of the owner of the **cylinder must** be obtained in advance if a **refrigerant cylinder** belonging to a third party (for example, a **refrigerant** manufacturer, wholesaler or hirer), is to be used as a temporary receiver.

13.1.6 Where granted, the owner **must** be given the opportunity to carry out an internal inspection for corrosion and contamination immediately after such use, and the **refrigerant cylinder must** be labelled indicating such use.

13.1.7 Valves and non-return valves on **refrigerant cylinders must not** be tampered with without the permission of the owner.

13.1.8 **Cylinders must** conform with AS 4484:2004, AS 2030.1:1999 and AS/NZS 1200:2000 Appendix G: *Organisation of Australian, New Zealand and other pressure equipment standards.*

Portable equipment is available for **recovery** of **refrigerant** in the field.

13.1.9 **Refrigerant recovery** units **must** be appropriate for the **refrigerant** being **recovered.**

See Appendix 1 for further information if the presence of flammable **refrigerant** is suspected.

13.1.10 Special care **must** be taken to ensure cross contamination of **refrigerants** and lubricants does not occur within the equipment if the **refrigerant** is to be recycled or reused.

13.1.11 Proprietary equipment **must** be used in accordance with the manufacturer's instructions.

13.1.12 Hoses, fittings and procedures used during service, installation and decommissioning **must** be those which minimise the loss of **refrigerant.**

13.1.13 **Refrigerant must** be either disposed of or tested when it is suspected to be contaminated or is to be re-used in a system other than that from which it was removed.

13.1.14 **Refrigerant recovery** equipment and/or recycle equipment **must** conform to AS 4211.3:1996.

13.1.15 **Refrigerant** vapour as well as **refrigerant** liquid **must** be **recovered** when a system is repaired.

13.2 Disposal of refrigerants

If **refrigerant** is to be recycled or reprocessed, mixing different types of **refrigerants** may render large quantities of **refrigerant** unusable as separation may be impossible.

13.2.1 Unusable or unrequired **fluorocarbon refrigerant must not** be discharged to the atmosphere, and **must** be returned to a supplier or collection agent for disposal.

In Australia, **reclaimed refrigerant** can be returned to the supplier for disposal.
See www.refrigerantreclaim.com.au for more information.

For locations that accept r**eturned refrigerant** in New Zealand, visit www.opc.co.nz.

The importation and use of **fluorocarbon refrigerant** in **disposable refrigerant containers** is prohibited by law in Australia. Clauses 13.2.2 through 13.2.5 apply to New Zealand only.

13.2.2 Any residual **refrigerant** in a **disposable container must** be **recovered.**

13.2.3 A **disposable container must not** be refilled or used as a temporary receiver during service.

13.2.4 A **disposable container must not** be repaired or modified in any way.

13.2.5 Empty **disposable containers must** be disposed of at a recycling centre.

13.2.6 Refrigerators and freezer cabinets **must** have any locks removed or rendered inoperative upon removal from service. Doors, drawers and/or lids **must** be removed or otherwise rendered safe and inaccessible where refrigerators and freezer cabinets are stored or removed from service and left in any public place or any other place where children could have access.

13.2.7 The **refrigerant must** be **recovered** before disposal if the refrigeration system contains **refrigerant.**

14 Handling And Storage Of Refrigerants

14.1 Handling and storage

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

14.1.1 Refilling a **cylinder must** only be undertaken with the permission of the **cylinder** owner.

14.1.2 **Refrigerant must not** be vented to the atmosphere from the receiving **cylinder.**

The receiving **cylinder** may be cooled in an operating refrigerator or freezer.

14.1.3 **Refrigerant cylinders must not** be directly heated by flame, radiant heat or uncontrolled direct contact heat, however, warming of the discharging **cylinder** under controlled conditions to increase the rate of discharge of **refrigerant** during transfer is permissible.

14.1.4 Heating of **cylinders** using indirect forms of heating, e.g. controlled temperature air flow, **must** only be conducted where the control system is designed to be fail safe.

14.1.5 Where a **fluorocarbon refrigerant** is to be transferred to a charging station, **refrigerant** vapour vented to atmosphere **must** be minimised.

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

14.1.6 **Refrigerant must** be stored securely with appropriate signage (to provide ready identification by emergency teams).

14.1.7 There are limits on the amount that can be stored and reference **must** be made to current local legislation.

14.1.8 Service personnel **should** make reference to **refrigerant** manufacturers' Material Safety Data Sheets (safety data sheets in New Zealand) when handling **refrigerants.**

14.1.9 To avoid mechanical damage to the **refrigerant cylinder** and its valve, it **must** be handled carefully.

14.1.10 When a **refrigerant cylinder** is not in use its valve **must** be closed, the valve outlet sealing cap put in place and the valve protected.

14.1.11 **Cylinders must** be leak tested every three months and leaking **cylinders must** be returned to the supplier.

14.2 Charging

14.2.1 Except where charging is being carried out by the manufacturer on an assembly line, the pipework connecting a **cylinder** to a refrigeration system **must** be leak-tested before the **cylinder** valve is fully opened. This can be done by partially opening and then closing the **cylinder** valve to pressurise the connecting pipework.

14.2.2 **Refrigerant** being transferred **must** be accurately measured into the system with due reference to temperature as per AS 4211.3:1996.

14.2.3 Charging lines **must** be as short as possible and have suitable fittings to minimise losses during disconnection at the end of the transfer.

14.2.4 Care **should** be taken to avoid **refrigerant** liquid being trapped between closed valves as high pressures may develop.

14.2.5 **Refrigerant cylinders must 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 **cylinder.**

14.2.6 **Refrigerant cylinders must not** be connected to systems or other **cylinders** at a high temperature for similar reasons.

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

14.3 Refrigerant transfer between cylinders

Note that the provisions of section 14.1 also apply to **refrigerant** transfer between **cylinders.**

Where **refrigerant** is to be transferred from one **cylinder** to another a pressure or height difference will have to be established between the **cylinders** and this may be achieved by means of a pump or temperature differential.

14.3.1 The maximum gross weight **must not** be exceeded when filling **refrigerant cylinders.** The **cylinder must not** be used if the maximum gross weight is not marked on the **cylinder**.

The maximum gross weight is a function of the internal volume of the **cylinder**, **refrigerant** composition and oil content and temperature. The **cylinder** supplier **should** determine the maximum gross weight in accordance with AS 2030.1:1999.

14.3.2 **Refrigerant cylinders should not** be manifolded together if there is a possibility of temperature differences between the **cylinders**, since this will result in r**efrigerant** transfer and the danger of overfilling the cold **cylinder** (see also 14.2.5).

14.3.3 Care **should** be taken to ensure all the **cylinders** are at the same height to avoid gravity transfer between **cylinders** where **cylinders** are manifolded together.

14.3.4 It is highly **recommended** that single direction flow or check valves be installed at each **cylinder** when **cylinders** are manifolded together.

15 Appendices

15.1 Appendix 1 — dealing with the recovery of fluorocarbons mixed with other refrigerants

Over the past few years a number of different refrigerants and refrigerant mixtures have been used as replacements for CFCs and HCFCs. 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.

If the presence of flammable refrigerant is suspected in a system, proper care should be taken to recover the flammable refrigerant. Only properly trained personnel using equipment designed for recovering flammable refrigerant should perform this task.

Refrigerant containing a fluorocarbon **must not** be vented to the atmosphere.

15.2 Appendix 2 – Fluorocarbon Refrigerants

A long term replacement refrigerant should have a zero Ozone Depleting Potential (ODP), and a low Global Warming Potential (GWP).

The ODP and GWP figures listed below for refrigerant blends must not be used for the purposes of reporting on the import, export and manufacture of bulk Ozone Depleting Substances and Synthetic Greenhouse Gases, or imports of pre-charged equipment under Part VII of the *Ozone Protection and Synthetic Greenhouse Gas Management Act*. For further information on these reporting requirements, please contact the Ozone and Synthetic Gas Team in the Australian Department of the Environment and Water Resources.

No:	Name:	Chemical Formula or % Mass Mixture:	O.D.P.:	G.W.P.: 100 yrs	Safety
CFCs and CFC blends:					
R11	Trichlorofluoromethane	$C.Cl_3.F$	1.00	4,600	A1
R12	Dichlorodifluoromethane	$C.Cl_2.F_2$	1.00	10,600	A1
R113	Trichlorotrifluoroethane	$C.Cl_2.F.C.Cl.F_2$	0.80	6,000	A1
R114	Dichlorotetrafluoroethane	$C.Cl.F_2.C.Cl.F_2$	1.00	9,800	A1
R500	CFC Blend	CFC-12 (74%) HFC-152a (26%)	0.60	7,900	A1
R502	CFC Blend	CFC-115 (51%) HCFC-22 (49%)	0.22	4,500	A1
HCFCs and HCFC blends:					
R22	Chlorodifluoromethane	$C.H.Cl.F_2$	0.055	1,700	A1
R123	Dichlorotrifluoroethane	$C.H.Cl_2.C.F_3$	0.020	120	A1
R124	Chlorotetrafluoroethane	$CH.F.Cl.C.F_3$	0.022	620	A1
R401A	HCFC Blend	HCFC-22 (53%) HCFC-124 (34%) HFC-152a (13%)	0.027	1,100	A1/A1
R401B	HCFC Blend	HCFC-22 (61%) HFC-124 (28%) HFC-152a (11%)	0.028	1,200	A1/A1
R401C	HCFC Blend	HCFC-22 (33%) HFC-124 (52%) HFC-152a (15%)	0.025	900	A1/A1
R402A	HCFC Blend	HCFC-22 (38%) HFC-125 (60%) HC-290(Propane) (2%)	0.013	2,700	A1/A1
R402B	HCFC Blend	HCFC-22 (60%) HFC-125 (38%) HC-290(Propane) (2%)	0.020	2,300	A1/A1
R403A	HCFC Blend	HCFC-22 (75%) HFC-218 (20%) HC-290(Propane) (5%)	0.026	3,000	A1/A1

No:	Name:	Chemical Formula or % Mass Mixture:	O.D.P.:	G.W.P.: 100 yrs	Safety
R403B	HCFC Blend	HCFC-22 (56%) HFC-218 (39%) HC-290(Propane) (5%)	0.019	4,300	A1/A1
R405A	HCFC Blend	HCFC-22 (45%) HFC-142b (5.5%) HFC-152a (7%) HFC-318 (42.5%)	0.018	5,200	A1/A1
R406A	HCFC Blend	HCFC-22 (55%) HCFC-142b (41%) HC-600a (Isobutane) (4%)	0.036	1,900	A1/A2
R408A	HCFC Blend	HCFC-22 (47%) HFC-125 (7%) HFC-143a (46%)	0.016	3,000	A1/A1
R409A	HCFC Blend	HCFC-22 (60%) HCFC-124 (25%) HCFC-142b (15%)	0.039	1,500	A1/A1
R409B	HCFC Blend	HCFC-22 (65%) HCFC-124 (25%) HCFC-142b (10%)	0.039	1,500	A1/A1
R411A	HCFC Blend	HCFC-22 (87.5%) HCFC-152a (11%) HCFC-1270 (1.5%)	0.030	1,500	A1/A2
R411B	HCFC Blend	HCFC-22 (94%) HCFC-152a (3%) HCFC-1270 (3%)	0.032	1,600	A1/A2
R412A	HCFC Blend	HCFC-22 (70%) HCFC-142b (25%) HFC-218 (5%)	0.035	2,200	A1/A2
R416A	HCFC Blend	HCFC-124 (39.5%) HCFC-134a (59%) HFC-600 (1.5%)	0.009	1,000	A1/A1
R509A	HCFC Blend	HCFC-22 (44%) HFC-218 (56%)	0.015	5,600	A1

No:	Name:	Chemical Formula or % Mass Mixture:	O.D.P.:	G.W.P.: 100 yrs	Safety
HFCs and HFC blends:					
R125	Pentafluoroethane	$C_2.H.F_5$	0.0	2,800	A1
R134a	Tetrafluoroethane	$C.F_3.C.H_2.F$	0.0	1,300	A1
R143a	Trifluoroethane	$C.F_3.C.H_3$	0.0	4,300	A2
R404A	HFC Blend	HFC-125 (44%) HFC-134a (4%) HFC-143a (52%)	0.0	3,800	A1/A1
R407A	HFC Blend	HFC-32 (20%) HFC-125 (40%) HFC-134a (40%)	0.0	2,000	A1/A1
R407B	HFC Blend	HFC-32 (10%) HFC-125 (70%) HFC-134a (20%)	0.0	2,700	A1/A1
R407C	HFC Blend	HFC-32 (23%) HFC-125 (25%) HFC-134a (52%)	0.0	1,700	A1/A1
R410A	HFC Blend	HFC-32 (50%) HFC-125 (50%)	0.0	2,000	A1/A1
R507A	HFC Blend	HFC-125 (50%) HFC-143a (50%)	0.0	3,900	A1/A1

15.3 Appendix 3 – Safety Group Classifications

Introduction

Refrigerants have been classified into safety groups according to the following criteria:

Classification: The safety classifications consist of two alphanumeric characters (e.g. A2 or B1). The capital letter indicates the toxicity and the Arabic numeral denotes the flammability.

Toxicity classification: Refrigerants are assigned to one of two classes, A or B, based on the following exposure:

Class A signifies refrigerants with an LC50 ≥ 10,000 ppm.

Class B signifies refrigerants with an LC50 < 10,000 ppm..

Flammability Classification: Refrigerants are assigned to one of three classes, 1, 2 or 3, based on flammability. Tests have been conducted in accordance with ASTM E681-04 Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases) except that the ignition source must be an electrically activated kitchen match head for halocarbon refrigerants.

Class 1 refrigerants are non-flammable.

Class 2 refrigerants have a lower explosive limit (LEL) ≥ 3.5% volume.

Class 3 refrigerants have a lower explosive limit (LEL) < 3.5% volume.

All flammability classes are as tested in air at 101 kPa (standard atmospheric pressure) and 21°C ambient temperature.

Definitions of flammability differ depending on the purpose. For example, ammonia is classified for transportation purposes as a non-flammable gas by the U.S. Department of Transportation, but it is a Class 2 refrigerant.

Safety Classification of Refrigerant Blends: Blends whose flammability and/or toxicity characteristic may change as the composition changes during fractionation must be assigned a dual safety group classification with the two classifications separated by a slash (/). Each of the two classifications has been determined according to the same criteria as a single component refrigerant. The first classification listed is the classification of the 'as formulated' composition of the blend. The second classification is the classification of the blend composition of the 'worst case fractionation'. For flammability, 'worst case of fractionation' is defined as the composition during fractionation that results in the highest concentration of the flammable component(s) in the vapour or liquid phase. For toxicity, 'worst case of fractionation' is defined as the composition during fractionation that results in the highest concentration(s) in the vapour or liquid phase for which the TLV-TWA is less than 400 ppm. The TLV-TWA for a specified blend composition has been calculated from the TLV-TWA of the individual components.