7.6 Environmental Properties

A long term replacement refrigerant should have zero or a low ozone depletion potential, a low global warming potential and a short estimated atmospheric life.

No:	Name:	Chemical Formula or %Mass Mixture:	O.D.P.:	G.W.P.: 20; 100; 500 yrs	Safety Classification
CFC's:					
R11	Trichlorofluoromethane	$C.Cl_3.F$	1.00	6,300; **4,600**; 1,600	A1
R12	Dichlorodifluoromethane	$C.Cl_2.F_2$	0.95	10,200; **10,600**; 5,200	A1
R113	Trichlorotrifluoroethane	$C.Cl_2.F.C.Cl.F_2$	0.85	6,100; **6,000**; 2,700	A1
R114	Dichlorotetrafluoroethane	$C.Cl.F_2.C.Cl.F_2$	0.70	7,500; **9,800**; 8,700	A1
R500	CFC Blend	CFC-12 (74%) HFC-152a (26%)	0.70	7,700; **7,900**; 3,90	A1
R502	CFC Blend	CFC-115 (51%) HCFC-22 (49%)	0.23	4,900; **4,600**; 5,300	A1
HCFC's:					
R22	Chlorodifluoromethane	$C.H.Cl.F_2$	0.055	4,800; **1,700**; 540	A1
R123	Dichlorotrifluoroethane	$C.H.Cl_2.C.F_3$	0.020	390; **120**; 36	B1
R124	Chlorotetrafluoroethane	$CH.F.Cl.C.F_3$	0.022	2,000; **620**; 190	A1
R401A	HCFC Blend	HCFC-22 (53%) HCFC-124 (34%) HFC-152a (13%)	0.037	3,300; **1,100**; 400	A1/A1
R401B	HCFC Blend	HCFC-22 (61%) HFC-124 (28%) HFC-152a (11%)	0.040	3,500; **1,200**; 400	A1/A1
R401C	HCFC Blend	HCFC-22 (33%) HFC-124 (52%) HFC-152a (15%)	0.030	2,700; **900**; 300	A1/A1
R402A	HCFC Blend	HCFC-22 (38%) HFC-125 (60%) HC-290(Propane) (2%)	0.021	5,400; **2,700**; 900	A1/A1
R402B	HCFC Blend	HCFC-22 (60%) HFC-125 (38%) HC-290(Propane) (2%)	0.033	5,100; **2,300**; 700	A1/A1
R403A	HCFC Blend	HCFC-22 (75%) HFC-218 (20%) HC-290(Propane) (5%)	0.041	4,800; **3,000**; 3000	A1/A1
R403B	HCFC Blend	HCFC-22 (56%) HFC-218 (39%) HC-290(Propane) (5%)	0.030	5,000; **4,300**; 5,100	A1/A1
R405A	HCFC Blend	HCFC-22 (45%) HFC-142b (5.5%) HFC-152a (7%) HFC-318 (42.5%)	0.028	5,200; **5,000**; 6,400	A1/A1

No:	Name:	Chemical Formula or %Mass Mixture:	O.D.P.:	G.W.P.: 20; 100; 500 yrs	Safety Classification
R406A	HCFC Blend	HCFC-22 (55%) HCFC-142b (41%) HC-600a(Isobutane) (4%)	0.057	3,500; **1,200**; 400	A1/A2
R408A	HCFC Blend	HCFC-22 (47%) HFC-125 (7%) HFC-143a (46%)	0.026	4,900; **2,800**; 1,000	A1/A1
R409A	HCFC Blend	HCFC-22 (60%) HCFC-124 (25%) HCFC-142b (15%)	0.048	4,200; **1,500**; 500	A1/A1
R409B	HCFC Blend	HCFC-22 (65%) HCFC-124 (25%) HCFC-142b (10%)	0.039	4,100; **1,500**; 500	A1/A1
R411A	HCFC Blend	HCFC-22 (87.5%) HCFC-152a (11%) HCFC-1270 (1.5%)	0.048	4,200; **1,500**; 500	A1/A2
R411B	HCFC Blend	HCFC-22 (94%) HCFC-152a (3%) HCFC-1270 (3%)	0.052	4,500; **1,600**; 500	A1/A2
R412A	HCFC Blend	HCFC-22 (70%) HCFC-142b (25%) HFC-218 (5%)	0.055	5,000; **2,200**; 1,200	A1/A2
R416A	HCFC Blend	HCFC-124 (39.5%) HCFC-134a (59%) HFC-600 (1.5%)	0.009	2,700; **1,000**; 300	A1/A1
R509A	HCFC Blend	HCFC-22 (44%) HFC-218 (56%)	0.024	5,400; **5,600**; 7,200	A1
HFC's:					
R125	Pentafluoroethane	$C_2.H.F_5$	0.0	5,900; **3,400**; 1,100	A1
R134a	Tetrafluoroethane	$C.F_3.C.H_2.F$	0.0	3,300; **1,300**; 400	A1
R404A	HFC Blend	HFC-125 (44%) HFC-134a (4%) HFC-143a (52%)	0.0	5,600; **3,800**; 1,300	A1/A1
R407A	HFC Blend	HFC-32 (20%) HFC-125 (40%) HFC-134a (40%)	0.0	4,000; **2,000**; 600	A1/A1
R407B	HFC Blend	HFC-32 (10%) HFC-125 (70%) HFC-134a (20%)	0.0	5,000; **2,700**; 900	A1/A1
R407C	HFC Blend	HFC-32 (23%) HFC-125 (25%) HFC-134a (52%)	0.0	3,600; **1,700**; 500	A1/A1
R410A	HFC Blend	HFC-32 (50%) HFC-125 (50%)	0.0	3,900; **2,000**; 600	A1/A1

No:	Name:	Chemical Formula or %Mass Mixture:	O.D.P.:	G.W.P.: 20; 100; 500 yrs	Safety Classification
R413A	HFC Blend	HFC-134a (88%) HFC-218 (9%) HC-600a (3%)	0.0	3,400; **1,900**; 1,500	A1/A2
R417A	HFC Blend	HFC-125 (46.6%) HFC-134a (50%) HC-600 (3.4%)	0.0	4,400; **2,200**; 700	A1/A2
R507A	HFC Blend	HFC-125 (50%) HFC-143a (50%)	0.0	5,700; **3,900**; 1,400	A1

NOTES:

- **O.D.P.** referenced to Ozone Depletion Potential of CFC-11 (i.e. O.D.P. of CFC-11 = 1.0).
- **G.W.P.** referenced to the absolute global warming potential for CO_2 using time horizons of 20, 100 and 500 years. The **bold** figures refer to the 100 year time horizon commonly used as the inventory standard. Calculated GWP values for refrigerant blends have been rounded to the nearest 100.
- **SAFETY GROUP CLASSIFICATIONS** as noted in AS 1677 part 1 are indicated by alphanumeric characters (e.g. A1, A2, B3 etc). The capital letters A or B indicate lower or higher toxicity respectively and the numeric value refers to the refrigerant's flammability (the number 1 being no flame propagation and 3 being higher flammability).

7.7 Refrigerant Performance

As all refrigerants perform differently, it is necessary to check the performance characteristic of each alternative refrigerant being considered for a particular system.

A full comparative performance analysis should be based on identical operating conditions (such as evaporating and condensing temperatures) and should include Coefficient of Performance, Compression Ratio, Mass Flow Rate and Temperature Glide. All comparisons should be based on a standard method such as that published by ASHRAE.

A variation in operating conditions will result in a meaningless comparison. Should a refrigerant be selected as a replacement refrigerant for an existing system, it will then be necessary to include the existing refrigerant in the comparative analysis. Performance characteristics of fluorinated refrigerants and blends, based on ASHRAE conditions have been included in appendix C of this guide.

7.8 Refrigerants, Lubricants and System Considerations

New generation refrigerants, in some instances, are more dependent on the correct application and type of refrigerant oil. Particular care should therefore be taken to ensure that the replacement refrigerant and compressor manufacturers' requirements are satisfied and conversion procedures (if necessary) are adopted.

HCFC-123

Is classed as a low pressure refrigerant, designed to replace CFC-11 in centrifugal chillers. HCFC-123 is compatible with most material used on CFC-11 systems (including refrigerant oil) with the exception of some motor insulation and gasketing materials.

HCFC-123 has been subjected to rigorous analysis by the National Industrial Chemical Notification and Assessment Scheme (NICNAS), a division of Worksafe Australia in their Priority Existing Chemical No. 4 report dated March 1996.

The report indicates that HCFC-123 should be classified as Carcinogenic (Category 3). Toxicity testing of HCFC-123 has indicated caution is needed with long term exposure in the work place.

HFC-134a

Operates at pressures similar to CFC-12 and it is compatible with most materials in CFC-12 systems. However, different HFC-134a driers are required and other minor system changes may be necessary. HFC-134a will not operate with the conventional mineral oils used with CFC-12. The industry has elected in most cases to use a synthetic polyol ester lubricant in new HFC-134a systems.

Polyol ester lubricants absorb moisture at a much greater rate than mineral oils and thus should not be left open to the atmosphere more than the absolute minimum. CFC-12 and the mineral oils used in CFC-12 systems are compatible with polyol ester lubricants, enabling existing CFC-12/mineral oil systems to be retrofitted to HFC134a/polyol ester. Polyol ester lubricants should be stored in metal containers as moisture can penetrate some plastic containers.

The only deviation from the above is the automotive industry where PAG (poly alkylene glycol) oils are recommended for new compressors and occasionally for retrofit. PAG oils absorb moisture ten times more readily than polyol ester lubricants. PAG oils are not generally compatible with either CFC-12 or mineral oil and so are not usually suitable for retrofits.

R401A

Is an HCFC blend or mixture refrigerant designed to replace CFC-12 refrigerant in existing systems, with evaporating temperatures between -23 °C and - 7 °C, and is compatible with most materials in CFC-12 systems. Drier cores may require upgrading or changing and other minor design changes may be necessary.

It is recommended that 50% of the mineral oil in existing systems be replaced with alkyl benzene lubricant (polyol ester oil may be used). Alkyl benzene does not readily absorb moisture and can therefore be handled in the same way as mineral oil.

R401B

Is an HCFC blend or mixture refrigerant designed to replace CFC-12 refrigerants in existing systems with evaporating temperatures between -40 °C and -23 °C. It is recommended that 50% of the mineral oil in the existing CFC-12 systems be replaced with alkyl benzene lubricant (polyol ester oil may be used). Alkyl benzene lubricant does not readily absorb moisture and can therefore be handled in the same way as mineral oil. Drier cores may require upgrading or changing and other minor system changes may be necessary.

R401C

Is an HCFC blend or mixture refrigerant designed to replace CFC-12 in existing automotive air conditioning systems. The receiver/drier should be replaced with a suitable desiccant core and the flexible hoses should be replaced with nylon barrier hoses. It is not necessary to flush mineral oil from the system, but it is necessary that the 55cc's of alkyl benzene lubricant be added to replace the mineral oil lost during evacuation of the CFC-12 and also in the receiver/drier.

R402A

Is an HCFC blend or mixture refrigerant designed to replace CFC-502 refrigerant. R402A is compatible with most materials in CFC-502 systems. Drier cores may require upgrading or changing and other minor system changes may be necessary. The manufacturers recommend that 50% of the mineral oil in existing systems be replaced with alkyl benzene lubricant. Alkyl benzene does not absorb moisture.