File No: NA/174

Date: August 2, 1994

NATIONAL INDUSTRIAL CHEMICALS NOTIFICATION AND ASSESSMENT SCHEME

FULL PUBLIC REPORT

1,1,1-TRIFLUOROETHANE

This Assessment has been compiled in accordance with the provisions of *the Industrial Chemicals (Notification and Assessment) Act 1989,* and Regulations. This legislation is an Act of the Commonwealth of Australia. The National Industrial Chemicals Notification and Assessment Scheme (NICNAS) is administered by Worksafe Australia which also conducts the occupational health & safety assessment. The assessment of environmental hazard is conducted by the Department of the Environment, Sport, and Territories and the assessment of public health is conducted by the Department of Health, Housing, Local Government and Community Services.

For the purposes of subsection 78(1) of the Act, copies of this full public report may be inspected by the public at the Library, Worksafe Australia, 92-94 Parramatta Road, Camperdown NSW 2050, between the hours of 10.00 a.m. and 12.00 noon and 2.00 p.m. and 4.00 p.m. each week day except on public holidays.

For Enquiries please contact the Administration Coordinator at:

Street Address: 92 Parramatta Rd Camperdown, NSW 2050, AUSTRALIA
Postal Address: GPO Box 58, Sydney 2001, AUSTRALIA
Telephone: (61) (02) 565-9466 **FAX (61) (02) 565-9465**

Director
Chemicals Notification and Assessment

FULL PUBLIC REPORT

1,1,1-TRIFLUOROETHANE

1. APPLICANTS

The Commonwealth Industrial Gases Limited, 799 Pacific Hwy, Chatswood, NSW, 2067 and Allied Corporation (Australia) Sales Limited, 2/71 Queens Rd, Melbourne, Victoria, 3004.

2. IDENTITY OF THE CHEMICAL

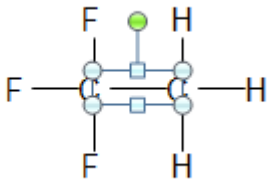
Chemical name: Ethane, 1,1,1-trifluoro-

Chemical Abstracts Service (CAS) Registry No.: 420-46-2

Trade names: HFC-143a
Genetron 143a
R-143a
HFA-143a
(the notified chemical will be imported as a component (50%wt) of Genetron AZ-50 also containing 50%wt pentafluoroethane)

Molecular formula: CF_3CH_3

Structural formula:



Molecular weight: 84.04

Method of detection and determination:

Infrared Spectroscopy

Spectral data:

IR spectrum: Major peaks were observed at: 966, 1232, 1266, 1279, 1290 and 1390-1460 cm^{-1}.

3. PHYSICAL AND CHEMICAL PROPERTIES

Appearance at 20°C and 101.3 kPa: colourless gas

Boiling Point: -47.6°C

Melting Point: -111°C
Specific Gravity (liquid): 0.98 at 21.1°C
0.8 at 54.4°C

Vapour Density: 2.92 (Air = 1)

Vapour Pressure: 1139 kPa at 21.1°C
2555 kPa at 54.4°C

Water Solubility: Not known, but likely to be low at atmospheric pressure because of low boiling point. The solubility of the gas at atmospheric pressure was estimated to be approximately 560 mg/L using Irmann's equation (1).

Hydrolytic stability: No data available. However, hydrolysis is not expected to be a significant degradation pathway as similar compounds do not hydrolyse at significant rates

Partition coefficient: Not measured. The notified substance would be expected to partition to the atmosphere in open systems, rather than between liquid media

Soil adsorption/desorption: Not measured. Significant sorption to soil is not expected as the notified substance is a gas

Flammability Limits:
Lower Flammability Limit: 7.0% by volume in air
Upper Flammabliity Limit: 19% by volume in air

Decomposition Products: Hydrogen fluoride and carbonyl halides

Autoignition Temperature: 750°C

Reactivity/Stability: Extremely flammable gas; reacts with oxidising materials

4. PURITY OF THE CHEMICAL

Degree of purity: 99.5%

Toxic or hazardous impurities (> 0.1% by weight): None

Non-hazardous impurities (> 1% by weight): None

Additives/Adjuvants: None

5. INDUSTRIAL USE

Genetron AZ-50 containing 50%wt of the notified chemical is intended to be used as working fluid in vapour compression refrigeration systems. These systems will include supermarket food storage as the main use (about half the amount used), transportation refrigeration, self-contained refrigeration, industrial refrigeration (about a third of the amount used each) and minor uses in ice machines and environmental test chambers.

6. OCCUPATIONAL EXPOSURE

The notified chemical is intended to be imported as a component of Genetron AZ-50 in gas cylinders of 11.4 kg net contents at a rate of 15 tonnes in the first year increasing to 130 tonnes by the fifth year.

The number and category of workers potentially exposed to the notified chemical are shown in the following table:

Stage of Use	Category of Worker	Number Exposed	Exposure Route
Import	Stevedore/ Dock worker	5-25	cylinder leakage
Transport from Docks to CIG stores	Transport drivers	5-10	cylinder leakage
Storage at CIG NSW	Gas stores staff/ site workers	20-50	cylinder leakage
Transport to branches	Contract or CIG drivers	30-50	cylinder leakage
Storage at CIG branches	Gas stores staff	50-100	cylinder leakage
Transport to CIG retail centres	Contract or CIG drivers	70-100	cylinder leakage
Storage/sale at CIG retail centres	CIG retail staff/ dock hands	150-200	cylinder leakage
Transport to end use sites	Contract/ CIG drivers or customers	500-1000	cylinder leakage
Charging/ servicing of refrigeration plant	Refrigeration mechanics	2000-5000	cylinder leakage, emissions from coupling/ uncoupling charging hoses leakage from refrigeration plant during operation

The nature of work done by various categories of worker and the likely duration of exposure are as follows:

Category of worker	Nature of work done	Maximum duration (hrs/day, days/yr)	Form of chemical during exposure
Stevedore/ dock worker	Supervise unloading of 20ft containers or ISO tanks from ships	1,5	liquefied compressed gas
Transport drivers	Load/ unload ex dock transport vehicles	2,5	liquefied compressed gas
Gas stores staff/ CIG sites workers	Load/ unload transport vehicles Transfer stock to stores Make up gas orders, handle cylinders	2,50	liquefied compressed gas
CIG retail staff/ dock hands	Unpack pallets of gas, handle gas cylinders, assist customers to load vehicles	2,250	liquefied compressed gas
Customers/ refrigeration mechanics	carry cylinders between jobs/ vehicles, connect and disconnect charging hoses to cylinders, service refrigeration plant	2,250	liquefied compressed gas or vapour

Exposure to 1,1,1-trifluoroethane is expected to be minimal in view of the methods employed to minimise release of ozone depleting gases to the atmosphere (2). During charging of refrigeration units with refrigerant closed piping is employed. Release of about 0.1 g of refrigerant can normally occur when the flexible hose connectors between the refrigeration system and the cylinder are disconnected at the end of charging. The hoses are fitted with automatic shut off valves which prevent release of the contents of the hose.

Procedures for leak prevention and testing are well established (2). Detection of 1,1,1-trifluoroethane at 0.1 ppm is possible. It is recommended that leak testing be conducted quarterly on equipment containing in excess of 50 kg of refrigerant.

7. PUBLIC EXPOSURE

There will be low potential for public exposure to the notified chemical during shipment and transportation.

The product containing the notified chemical, a non-flammable blended gas, is sold only to commercial equipment manufacturers and service contractors with experience in the safe handling of fluorocarbon refrigerants. There should be low potential for public exposure during proper work practices.

Disposal practices for this refrigerant will be to recover, reclaim and recycle gas for continued use. Any additional disposal/destruction, if required, will be by high temperature incineration or plasma arc.

8. ENVIRONMENTAL EXPOSURE

. Release

Use

Genetron AZ-50 will be used to replace R-502 (an azeotropic blend of HCFC-22 and CFC-115) in commercial applications such as supermarket refrigeration and food storage, transport refrigeration, medical storage and industrial refrigeration. Use of Genetron AZ-50 in domestic equipment will not occur, with the exception of ice machines.

The notified substance will not enter the environment intentionally, but any releases during filling or use of cooling systems, or following disposal of obsolete equipment or recovery of refrigerants therefrom, will rapidly volatilise to the atmosphere. No estimate is provided of likely releases, but commercial systems generally lose less than 10% of working charge per annum. The new blends are expensive, providing a financial incentive to minimise losses and install area monitors around large installations.

The Australian Refrigeration and Air Conditioning Code of Good Practice (2) requires that releases of ozone depleting refrigerants to the atmosphere during manufacturing, installation or servicing operations be reduced to the minimum level by re-use of refrigerant recovered. Recovery of refrigerant is required from performance testing during development and production. Refrigerant must be recovered in dedicated cylinders, identified by valving, labelling and colour coding. Where contaminated refrigerants are stored, they must be labelled to indicate the contents. The Code is called up in most State legislation. In Tasmania, the Code is practically applied, with legislative backing being developed.

Formulation, handling and disposal

The notified gas will be stored and transported in pressurised cylinders, to be fully emptied when refrigeration systems are charged. The need for disposal should not arise, as the gas maintains its integrity and can be recovered for reuse when servicing or decommissioning of equipment occurs. Disposal would require high temperature incineration.

. Fate

Given its high volatility, any trifluoroethane released to the environment will partition almost entirely to the atmosphere. The main degradation pathway in the environment is reaction with tropospheric hydroxyl radicals, which abstract hydrogen. According to Association of Fluorocarbon Consumers and Manufacturers (AFEAS) data sheets, 1,1,1-trifluoroethane has an atmospheric lifetime of 64.2 years. Earlier model calculations (3) indicated an atmospheric lifetime in the order of 40-50 years.

No information on atmospheric degradation mechanisms was provided. However, apart from a slower rate these may be expected to be similar to those elucidated for HFC-134a (4). Atmospheric degradation would lead to the the photostable fragment carbonyl fluoride which would undergo wet or dry deposition.

9. EVALUATION OF TOXICOLOGICAL DATA

9.1 Acute Toxicity

Studies on acute oral toxicity, acute dermal toxicity, skin irritation, eye irritation and skin sensitisation were not conducted. This is acceptable since 1,1,1-trifluoroethane is a gas.

9.1.1 Inhalation Toxicity (5)

Groups of 6 male Crl:CD BR rats were exposed nose-only for a single 4 hour period to 0, 97,000 or 540,000 ppm 1,1,1-trifluoroethane. Following termination of treatment, the rats were observed for 14 days.

Rats exposed to the 1,1,1-trifluoroethane exhibited dry, red ocular and nasal discharges but this was said to be the result of being held in restrainers.

Three rats exposed to 97,000 ppm 1,1,1-trifluoroethane showed slight weight loss on the day following exposure and 4 rats in the high dose group showed moderate to severe weight loss on the same day.

No mortality was observed during the observation period and no clinical signs of toxicity were observed in either of the exposure groups.

It can be concluded that the 4 hour acute inhalation LC_{50} is greater than 540,000 ppm.

9.2 Repeated Dose Toxicity

9.2.1 Four-Week Repeated Dose Study (6)

Charles River rats (10/sex/dose) were exposed nose only by inhalation to 1,1,1-trifluoroethane at concentrations of 0, 2,000, 10,000 or 39,000 ppm for 6 hours per day for 20 days over a 31 day period. There was no recovery period.

Male rats exposed to 2,000, 10,000 or 39,000 ppm 1,1,1-trifluoroethane had statistically significant decreased body weights and body weight gains compared to controls at various intervals during the exposure period but the decreases were not dose-dependent.

A number of functional observations were made to determine an effect of the nervous system. No compound-related neurotoxic effects were observed.

No compound-related effects on haemotology or clinical chemistry were observed.

One male animal in each of the 2,000, 10,000 ppm dose groups and one female animal in the 39,000 ppm dose group was found dead on test days 8, 9 and 15 respectively. The cause of death was not determined.

There were no statistically significant changes in final body or organ weights in treated groups relative to controls.

Regarding gross organ changes, small testes were noted in 1/10 and 2/10 male rats in the 10,000 and 39,000 ppm dose groups respectively.

Significant pathological changes were noted in the testes of exposed male rats. Degenerative changes were present at all exposure concentrations. Microscopically, these changes were characterised by minimal to mild accumulation of eosinophilic debris within the lumen of seminiferous tubules. Tubular architecture was generally intact and germ cell necrosis was not prominent. In the epididymes of affected animals, decreased sperm density and increased exfoliated germ cell debris were correlated to the testicular changes. The changes were minimal to mild in both the 39,000 and 10,000 ppm dose groups and less severe in the 2,000 ppm dose group where testicular changes were generally very slight and epididymal sperm density was affected in 3/10 animals.

All other microscopic findings noted were considered incidental occurences of spontaneous lesions common to rats on this strain and age.

A possible explanation of the testicular changes advanced was that the rats were inadvertently exposed to excessive heat leading to increased body temperatures during the nose-only exposures

9.2.2 Four-Week Repeated Dose Study (7)

A second four-week repeated dose study was conducted to discover if the testicular changes observed in a previous study (see section 9.2.2 above) could be confirmed. Toxicity evaluations were limited to body weights, clinical signs and anatomic and/or histopathological evaluations of the testes and epididymes.

Charles River rats (10 males/dose) were exposed whole-body to 1,1,1-trifluoroethane at concentrations of 0, 2,000, 10,000 or 40,000 ppm for 6 hours per day, for 20 days over a 28-day period. One day following the 20th exposure all rats were killed for pathological examination.

Exposed rats did not exhibit any statistically significant changes in body weights or body weight gains compared to controls.

All rats survived to scheduled termination and no compound-related clinical signs were observed in any of the exposed groups.

No effect of exposure to 1,1,1-trifluoroethane was observed on testes weights and there were no compound-related changes in gross or microscopic findings.

9.2.3 90-Day Repeated Dose Study (8)

Charles River rats (20/sex/dose) were exposed whole body to 0, 2,020, 10141 or 40,072 ppm 1,1,1-trifluoroethane , 6 hours per day, 5 days per week for 90 days.

At the conclusion of the 90 day exposure approximately 10 rats per dose group were allowed to recover for approximately one month.

There were no compound-related effects on body weight or body weight gain or food consumption at any exposure concentration during either the exposure period or the recovery period.

During the exposure and recovery periods there were no compound-related effects on clinical signs.

No compound-related deaths were observed. Three rats died or were killed *in extremis*.

No compound-related effects on ocular tissue were observed.

Isolated statistically significant differences in haemotology and clinical chemistry values were within normal ranges and not considered to be biologically significant.

There were no statistically significant or biologically significant differences in organ weights at any exposure concentration at either 90 days or at the end of the one month recovery period.

There were no compound-related gross or microscopic morphological changes to any organ an any exposure concentration at 90 days. In particular, there was no evidence of pathological changes in the testes.

9.3 Developmental Toxicity

9.3.1 Inhalation Developmental Toxicity Study in Rabbits (9)

Three groups of 24 artificially inseminated New Zealand White rabbits were exposed to 0, 2,000, 10,000 or 40,000 ppm 1,1,1-trifluoroethane by whole-body inhalation for 6 hours on each on 13 consecutive days (gestational days 6-18). A control group of 24 artificially inseminated rabbits was exposed to air. All surviving females were killed on day 29 of gestation for a scheduled laparohysterectomy.

One animal in the 2,000 ppm dose group spontaneously aborted on day 17 but was not considered compound-related in view of the fact that spontaneous abortions are not uncommon in this species and strain.

No compound-related clinical signs were noted during the study.

No compound-related changes in mean body weights, body weight gains, gravid uterine weights, net body weights or net body weight changes were observed. No compound-related changes in food consumption were observed.

At the scheduled necropsy at day 29, a number of gross organ changes were noted but these were not attributable to 1,1,1-trifluoroethane including a white precipitate in the amniotic fluid at one implantation site for one 2,000 ppm animal.

Organ weights (kidney, liver and lung) were comparable in the control and exposed groups.

No adverse effects on intrauterine growth or survival were observed at any exposure level. An increased mean number of implantation sites in the 10,000 ppm dose group compared to the control was statistically significant but within the historical control data. One animal in the 2,000 ppm dose group had a completely resorbed litter.

Regarding the foetal morphology, external, soft tissue and skeletal malformations were observed in 4, 14, 5 and 5 foetuses in the control, 2,000, 10,000 and 40,000 ppm dose groups, respectively. The total malformation rate (expressed as per cent per litter) was 3.1%, 8.2%, 3.4% and 7.1% for these same groups respectively which is well within the historical control range for total malformations (0.0 - 12.9%).

9.3.2 Inhalation Developmental Toxicity Study in Rats (10)

1,1,1-Trifluoroethane was admininstered by inhalation to groups of 25 female Crl:CD BR rats on days 7-16 of gestation (the day copulation was confirmed was termed day 1 of gestation). The target dose levels chosen were 0, 2,000, 10,000 and 40,000 ppm.

All animals survived to scheduled termination on day 22 of gestation. No adverse effects on body weight or body weight gain were observed. No significant effects on clinical signs were noted and no compound-related effects were observed during gross postmortem examinations.

No significant dose-related effects on reproductive parameters (early deliveries, incidence of dams with total resorptions, litter means for live, dead or resorbed foetuses or mean corpora lutea) were detected.

Regarding effects on the foetus, no significant effects on mean foetal weights were observed. No compound-related effects on the incidence of foetal malformations were detected.

The mean percent of affected foetuses examined for variations due to retarded development during the visceral examination was significantly increased for all test groups. The incidences were 1.6, 10.5, 8.7 and 10.0 percent for the 0, 2,000, 10,000 and 40,000 ppm dose groups, respectively. Retarded renal papillary development was the primary and most frequently recorded observation for this category. However, it was concluded that these effects were not biologically significant because the control value was abnormally low, the increases were not dose-dependent and there was no other evidence of developmental toxicity.

9.4 Genotoxicity

9.4.1 Bacterial Reverse Mutation Assay (11)

The effect of the notified chemical on back mutation to prototrophy was tested in *Salmonella typhimurium* strains TA 98, TA 100, TA 1535, TA 1537 and TA 1538 and in *Escherichia coli* strain WP2 *uvrA* both in the presence and the absence of metabolic activation provided by rat liver S9.

Agar plates seeded with the tester strains were exposed to the notified chemical in the vapour phase at nominal concentrations up to 100% v/v.

Negative controls were within acceptable limits. Positive controls of dichloromethane (in vapour phase), benzo[a]pyrene (BaP), 2-nitrofluorene, 2-aminoanthracene (2AA), 9-aminoacridine (9AA), N-ethyl-N'-nitro-N-nitrosoguanidine (ENNG) and sodium azide gave the expected increases in mutant yields. In the absence of S9, dichloromethane was tested on all strains, sodium azide on TA 1535 and TA 100, 9AA on TA 1537, 2-nitrofluorene on TA 1538 and TA 98 and ENNG on WP2 *uvrA*. In the presence and absence of S9, 2AA was tested on TA 1535 and WP2 *uvrA* and BaP on TA 1537, TA 1538 and TA 100.

1,1,1-Trifluoroethane did not increase the level of back mutation in any strain at any dose level.

It can be concluded that 1,1,1-trifluoroethane is not genotoxic as measured by this assay.

9.4.2 Micronucleus Assay in the Bone Marrow Cells of the Mouse (12)

Groups of 10 male and 10 female CD-1(ICR)BR mice were exposed to target concentrations of 0, 2,000, 10,000 or 40,000 ppm 1,1,1-trifluoroethane for approximately 6 hours/day on 2 consecutive days. Groups of 5 males and 5 females from each negative control and treated group were killed approximately 24 and 48 hours after the final exposure. The positive control group, consisting of 5 male and 5 female mice were treated with 20 mg/kg cyclophosphamide (CP) of 2 consecutive days (during which time they were sham-exposed to air) and killed approximately 24 hours after the second exposure.

No significant clinical signs were observed as a result of treatment.

One thousand polychromatic erythrocytes (PCEs) per animal were scored for the presence of micronuclei. No statistically significant increases in micronucleated PCEs were observed in male or female mice at either the 24 or 48 hour time points. As expected, CP-treated males and females showed significant increases in micronucleated PCEs compared to controls. Treatment did not change the ratio of PCEs to normochromatic erythrocytes.

It can be concluded that 1,1,1-trifluoroethane is not genotoxic as measured by this assay.

9.5 Cardiac Sensitisation in Dogs (13)

The effect of intravenous injection of beagle dogs with adrenaline before and during inhalation of 1,1,1-trifluoroethane on the electrocardiogram was studied.

Optimal doses of adrenaline were chosen on the basis of the number of ectopic beats and ranged from 2 - 12µg/kg.

The concentration of 1,1,1-trifluoroethane in the air supply ranged from 5 - 30% (v/v). Postive responses were observed only at 30% 1,1,1-trifluoroethane in 2/5 dogs.

9.6 Overall Assessment of Toxicological Data

1,1,1-Trifluoroethane is of low acute inhalation toxicity in rats.

Repeated dose studies suggest that 1,1,1-trifluoroethane does not exhibit toxic effects in rats exposed by inhalation for up to 90 days.

Developmental toxicological studies with dosing of females did not reveal any effects on foetal development in either rats or rabbits.

1,1,1-Trifluoroethane was found not to be genotoxic in the bacterial reverse mutation and mouse micronucleus assays.

1,1,1-Trifluoroethane was found to induce cardiac sensitisation in dogs at a dose of 30% v/v.

10. ASSESSMENT OF ENVIRONMENTAL EFFECTS

The notifier did not provide any ecotoxicological data on the justifiable basis that significant exposure of living organisms to the notified gas is precluded by its use pattern and properties.

Halocarbon refrigerants can affect the atmosphere. 1,1,1-Trifluoroethane contains neither chlorine nor bromine, and thus will not act as a source of ozone depleting halogen radicals in the stratosphere. Scientists from the US National Oceanic and Atmospheric Administration concluded recently that hydrofluorocarbons have negligible potential to destroy ozone (14).

Like other halocarbons, 1,1,1-trifluoroethane makes a positive contribution to the global warming potential of the atmosphere. Such contributions may be quantified by comparison with CFC-11, to which a halocarbon global warming potential (HGWP) of unity is arbitrarily assigned. The HGWP of HFC 143a (based on a reference lifetime of 41 years) is about 0.7, and that for the other refrigerant in the blend, HFC-125, about 0.6 (15). The HGWPs of the gases to be replaced, CFC-115 and HCFC-22, are about 7.5 and 0.4, respectively. Since R-502 contains roughly equal amounts by weight of HCFC-22 and CFC-115, its replacement by Genetron AZ-50 should entail an easing of the global warming potential.

Alternatively, global warming potentials (GWPs) may be estimated by comparison with carbon dioxide, provided an integration time horizon is specified. No such specification is necessary for HGWP as atmospheric lifetimes are included in its derivation. GWP calculations compiled by AFEAS

indicate only marginal improvements over short time horizons (100 years or less). However, taking a longer term perspective (500 year integration time horizon) significant improvements in GWP accrue from the transition from R-502 to AZ-50.

The warming impact of refrigerants may also be compared with that from the carbon dioxide emitted as by-product from generation of the power required to operate a refrigerator over its entire lifetime. Such calculations, known as total global warming impact (TEWI), have been carried out by AFEAS and show that the contribution of the refrigerant (HCFC or HFC) is around 1% of the total impact, assuming the total charge is released. Importantly, use of HCFC or HFC refrigerants entails improvements in TEWI relative to not-in-kind replacements because of the efficiency gains conferred by the excellent heat transfer capabilities of the halocarbons.

11. ASSESSMENT OF ENVIRONMENTAL HAZARD

1,1,1-Trifluoroethane is not expected to exert a direct effect on living organisms as it belongs to a class of compound that lacks significant biological activity. Its use pattern and properties should ensure minimal exposure of aquatic and terrestrial compartments, and therefore minimal hazard to organisms inhabiting them.

Hazard to the atmosphere will be reduced when Genetron AZ-50 replaces R-502, as the replacement refrigerant will not carry ozone depleting chlorine or bromine to the stratosphere and has a lower global warming potential.

12. ASSESSMENT OF PUBLIC AND OCCUPATIONAL HEALTH AND SAFETY EFFECTS

Animal tests suggest that 1,1,1-trifluoroethane is unlikely to exhibit toxic effects in individuals exposed by inhalation either acutely or to repeated doses. The acute studies described above extend limited data previously published (16) in which no mortality was observed in mice exposed for 2 hours to 500,000 ppm.

Based on developmental toxicity studies, 1,1,1-trifluoroethane is not expected to have effects on the developing foetus.

The data on genotoxicity described above suggest that 1,1,1-trifluoroethane is not genotoxic. However, there is evidence in the literature that 1,1,1-trifluoroethane may be mutagenic in *Salmonella typhimurium* strains TA 1535 and TA 100 (17). In the same paper 1,1,1-trifluoroethane was reported to be negative for transformation of hamster kidney cells and was not carcinogenic in Wistar rats dosed at 300 mg/kg for 52 weeks by gavage. The genotoxic potential of 1,1,1-trifluoroethane remains uncertain.

1,1,1-Trifluoroethane induces cardiac sensitisation in dogs though at higher doses than refrigerants it is designed to replace. For example, the lowest dose at which 1,1,1-trifluoroethane induces cardiac sensitisation is 60 times higher than for CFC-11 (trichlorofluoromethane).

Exposure to 1,1,1-trifluoroethane during charging or recharging refrigeration equipment is expected to be minimal in view of the well established procedures to minimise release of ozone-depleting gases to the atmosphere (2).

From the above considerations, the risk of adverse health effects resulting from the use of 1,1,1-trifluoroethane is low.

Although pure 1,1,1-trifluoroethane is highly flammable, the mixture (Genetron AZ-50) that is used to charge refrigeration equipment is not. Nevertheless, contact of the refrigerant with hot surfaces or open flames should be avoided because of the potential for release of hydrogen fluoride and carbonyl halides.

A possible hazard from spills of liquid Genetron AZ-50 contained in gas cylinders is its potential to cause frostbite.

13. RECOMMENDATIONS

To minimise the occupational health risk of and environmental exposure to 1,1,1-trifluoroethane the following guidelines and precautions should be observed:

- those taking sympathomimetics, bronchodilators or cough and cold medications should have their medication evaluated by their medical adviser, if exposure to the notified chemical is likely;
- physicians treating a patient after exposure to high concentrations of notified chemical should not administer adrenalin or other sympathomimetic amine stimulants;
- the code of practice (2) governing reduction of emissions of ozone depleting refrigerants should be adhered to;
- charging and recharging of refrigeration equipment should be conducted in well ventilated areas;
- 1,1,1-trifluoroethane is heavier than air and may displace oxygen. Care should be taken not to allow concentrations to accumulate in confined areas. Floor level ventilation should be used and pits and drains avoided.
- if engineering controls and work practices are insufficient to reduce exposure to 1,1,1-trifluoroethane to a safe level, then personal protective devices which conform to and are used in accordance with Australian Standards (AS) for eye protection (in this case a face shield) (AS 1336, AS 1337) (18,19), respiratory protection (20), thermal gloves (AS 2161) (21) and protective clothing (AS 3765.1, 3765.2) (22,23) should be worn;
- a copy of the Material Safety Data Sheet should be easily accessible to employees.

14. MATERIAL SAFETY DATA SHEET

The attached Material Safety Data Sheets (MSDS) for 1,1,1-trifluoroethane and Genetron AZ-50 were provided in Worksafe Australia format (24).

These MSDS were provided by The Commonwealth Industrial Gases Limited as part of their notification statement. The accuracy of this information remains the responsibility of The Commonwealth Industrial Gases Limited.

15. REQUIREMENTS FOR SECONDARY NOTIFICATION

Under the *Industrial Chemicals (Notification and Assessment) Act 1989*, secondary notification of 1,1,1-trifluoroethane shall be required if any of the circumstances stipulated under subsection 64(2) of the Act arise. No other specific conditions are prescribed.

16. REFERENCES

1. Irmann F, *A Simple Correlation Between Water Solubility and Structure of Hydrocarbons an Halohydrocarbons*, Chem Ing Tech, 1965, 37, 789-798 [W J Lyman, W F Reehl and D H Rosenblatt (Eds), *Handbook of Chemical Property Estimation Methods*, McGraw Hill, 1982]

2. Association of Fluorocarbon Consumers and Manufacturers, *The Australian Refrigeration and Air Conditioning Code of Good Practice*, Standards Australia, Revised Edition, HB40-1992.

3. Fisher D A, Hales C H, Filkin D L, Ko M K W, Sze N D, Connell P S, Wuebbles D J, Isaksen, I S A and Stordal F *Model calculations of the relative effects of CFCs and their replacements on stratospheric ozone*, Nature, 344, 508-512, 1990.

4. Franklin J, *The atmospheric degradation and impact of 1,1,1,2-tetrafluoroethane (hydrofluorocarbon 134a)*, Chemosphere, 27, 1565-1601, 1993.

5. *Four-Hour Acute Inhalation Toxicity Study with FC-143a in Rats,* Data on File, E I du Pont de Nemours and Company, Delaware, USA, Project No.: HLR 283-90, 1990.

6. *Four-Week Inhalation Toxicity Study with HFC-143a in Rats,* Data on File, E I du Pont de Nemours and Company, Delaware, USA, Project No.: HLR 99-91, 1991.

7. *Four-Week Inhalation Toxicity Study with HFC-143a in Rats,* Data on File, E I du Pont de Nemours and Company, Delaware, USA, Project No.: HLR 6-92, 1992.

8. *Subchronic Inhalation Toxicity: 90-Day Study with HFC-143a in Rats,* Data on File, E I du Pont de Nemours and Company, Delaware, USA, Project No.: HLR 690-92, 1992.

9. *An Inhalation Developmental Toxicity Study of HFC-143a in Rabbits,* Data on File, ELF Atochem, Pennsylvania, USA, Project No.: WIL-189005, 1993.

10. *Developmental Toxicity Study of H-19440 (HFC-143a) in Rats,* Data on File, , E I du Pont de Nemours and Company, Delaware, USA, Project No.: HLR 700-92, 1993.

11. *Forane 143a in Vapour Phase: Assessment of Mutagenic Potential in Amino acid Auxotrophs of Salmonella typhimurium and Escherichia coli (the Ames Test),* Data on File, Pharmaco-LSR, Paris, France, Schedule No.: ATH/008, Report No.: 93/ATH/008/0209, 1993.

12. *Mouse Bone Marrow Micronucleus Assay of H-19440 (HFC-143a) by Inhalation,* Data on File, , E I du Pont de Nemours and Company, Delaware, USA, Project No.: HLR 770-92, 1993.

13. *HFC-143a Assessment of Cardiac Sensitisation Potential in Dogs,* Data on File, , E I du Pont de Nemours and Company, Delaware, USA, Project No.: DPT 281/930477, 1993.

14. Ravishankara A R, Turnipseed A A, Jensen N R, Barone S, Mills M, Howard C J and Solomon S, Science, 1994, 7, 71-75.

15. Fisher D A, Hales C H, Wang W-C, Ko M K W and Sze N D, Model calculations of the relative effects of CFCs and their replacements on global warming, Nature, 1990, 344, 513-516.

16. Nikitenko T K and Tolgskaya M S, *On the Toxico-pathomorphological Changes in Animals under the Effect of Freons-141, 142 and 143 and the Intermediate Products of Their Production,* Gig. Tr. Prof. Zabol., 9, 37-44, 1965.

17. Longstaff E, Robinson M, Bradbrook C, Styles J A and Purchase I F H, *Genotoxicity and Carcinogenicity of Fluorocarbons: Assessment by Short-Term in vitro Tests and Chronic Exposure in Rats*, Toxicol. and Appl. Pharmacol., 72, 15-31 1984.

18. Australian Standard 1336-1982, *Recommended Practices for Eye Protection in the Industrial Environment*, Standards Association of Australia Publ., Sydney, 1982.

19. Australian Standard 1337-1984*, Eye Protectors for Industrial Applications*, Standards Association of Australia Publ., Sydney, 1984.

20. Australian Standard 1715-1991 *Selection, use and maintenance of Respiratory Protective Devices*, Standards Association of Australia Publ., Sydney, 1991.

21. Australian Standard 2161-1978, *Industrial Safety Gloves and Mittens (excluding Electrical and Medical Gloves),* Standards Association of Australia Publ., Sydney, 1978.

22. Australian Standard 3765.1-1990, *Clothing for Protection Against Hazardous Chemicals, Part 1: Protection Against General or Specific Chemicals*, Standards Association of Australia Publ., Sydney, 1990.

23. Australian Standard 3765.2-1990, *Clothing for Protection Against Hazardous Chemicals, Part 2: Limited Protection Against Specific Chemicals*, Standards Association of Australia Publ., Sydney, 1990.

24. National Occupational Health and Safety Commission, *Guidance Note for the Completion of a Material Safety Data Sheet*, 2nd. edition, AGPS, Canberra, 1990.