1. IDENTIFICATION OF THE SUBSTANCE/MIXTURE AND OF THE COMPANY/UNDERTAKING

Substance name:
Norflurane
CAS-No.: 811-97-2

Recommended use of the chemical and restrictions on use :

Use of the Substance/Mixture : Refrigerant, Blowing agent, Aerosol propellants

Company/Undertaking Identification:

Supplier

Arkema (Changshu) Fluorochemical Co., Ltd.
No.18 Haining Road, Advanced Materials Industrial Park
215522 Changshu, Jiangsu, China
Telephone: +86 512 5232 2688
Telefax: +86 512 5232 2788
E-mail address: arkemachina.info@arkema.com

Emergency telephone number **+65 31581074**

2. HAZARDS IDENTIFICATION

2.1. Classification of the substance or mixture:

Gases under pressure, Liquefied gas, H280

Additional information:
For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2. Label elements:

GHS-Labelling

Hazard pictograms:

Signal word: **Warning**

Hazard statements:
H280 : Contains gas under pressure; may explode if heated.

Precautionary statements:
Storage:
P410 + P403 : Protect from sunlight. Store in a well-ventilated place.

Special labelling:

Contains fluorinated greenhouse gases covered by the Kyoto Protocol. Contains: 1,1,1,2-Tetrafluoroethane.

2.3. Other hazards:

Potential health effects:
Ejection of liquefied gas : frostbite possible
Inhalation: At high vapour/fog concentrations : Loss of consciousness Cardiac rhythm problems

Environmental Effects:
Not readily biodegradable. Not bioaccumulable

Physical and chemical hazards:
Decomposition gives toxic and corrosive products
The gazeous product in presence of air can form, under certain conditions of temperature and pressure, a flammable mixture
Decomposition products: See chapter 10

3. COMPOSITION/INFORMATION ON INGREDIENTS

This product is a substance.

Halogenated hydrocarbon

Hazardous components:

Chemical name[1]	EC-No.	CAS-No.	Concentration	Classification
1,1,1,2-Tetrafluoroethane	212-377-0	811-97-2	100 %	Press. Gas LG; H280

[1]: See chapter 14 for Proper Shipping Name

4. FIRST AID MEASURES

4.1. Description of necessary first-aid measures:

General advice:
No hazards which require special first aid measures.

Inhalation:
Move patient from contaminated area to fresh air. In case of persistent problems : Oxygen or artificial respiration if needed. Consult a physician.

Skin contact:
Frostbite : treat as thermal burns.

Eye contact:
Wash immediately, abundantly and thoroughly with water. If irritation persists, consult an ophthalmologist.

Ingestion:
No hazards which require special first aid measures.

Protection of first-aiders:
In case of insufficient ventilation, wear suitable respiratory equipment.

4.2. Most important symptoms/effects, acute and delayed: No data available.

4.3. Indication of immediate medical attention and special treatment needed, if necessary

Treatment: Do not administer catecholamines (because of the cardiac effect caused by the product).

5. FIREFIGHTING MEASURES

5.1. Extinguishing media:

Suitable extinguishing media:
Use extinguishing measures to suit surroundings.

5.2. Specific hazards arising from the chemical:

The product is not flammable in air under ambient conditions of temperature and pressure. Certains mixtures of the product and air under pressure may be flammable
At high temperature :, Thermal decomposition giving toxic and corrosive products :, Hydrogen fluoride, Carbon oxides

5.3. Advice for firefighters:

Specific methods:
Cool containers/tanks with water spray. Ensure a system for the rapid emptying of containers. In case of fire nearby, remove exposed containers.

Special protective actions for fire-fighters:
In the event of fire, wear self-contained breathing apparatus. Complete suit protecting against chemicals.

6. ACCIDENTAL RELEASE MEASURES

6.1. Personal precautions, protective equipment and emergency procedures:
Evacuate non-essential staff and those not equipped with individual protection apparatus. Ensure adequate ventilation. Avoid contact with skin and eyes and inhalation of vapours. In enclosed areas : ventilate or wear a self-contained breathing apparatus (risk of anoxia). Remove all sources of ignition. Do not smoke.
Prevent further leakage or spillage if you can do so without risk. Evacuate area of all unnecessary personnel. Eliminate all ignition sources. Use Halogen leak detector or other suitable means to locate leaks or check atmosphere. Keep upwind. Evacuate enclosed spaces and disperse gas with floor-level forced-air ventilation. Avoid breathing leaked material. Consult a regulatory specialist to determine appropriate state or local reporting requirements, for assistance in waste characterization and/or hazardous waste disposal and other requirements listed in pertinent environmental permits.

6.2. Environmental precautions:
Do not release into the environment.

6.3. Methods and materials for containment and cleaning up:

Recovery:
Allow to evaporate.

Elimination: See chapter 13

6.4. Reference to other sections: None.

7. HANDLING AND STORAGE

7.1. Precautions for safe handling:

Technical measures/Precautions:
Storage and handling precautions applicable to products: Gases under pressure Liquefied gas
Provide appropriate exhaust ventilation at machinery. Provide showers, eye-baths. Provide water supplies near the point of use. Well ventilate empty vats and tanks before entering.

Safe handling advice:
Prohibit ignition sources and contact with hot surfaces - DO NOT SMOKE.

Hygiene measures:
Avoid contact with skin and eyes and inhalation of vapours. When using do not eat, drink or smoke.
Wash hands after handling. Remove contaminated clothing and protective equipment before entering eating areas.

7.2. Conditions for safe storage, including any incompatibilities:
Keep in a cool, well-ventilated place. Keep away from open flames, hot surfaces and sources of ignition. Keep away from heat and sources of ignition. Do not smoke. Protect full containers from sources of heat to avoid overpressurization. Protect against light. Keep away from direct sunlight.

Storage temperature: < 45 °C

Incompatible products:
Alkaline hydroxides Alkaline earth metals Strong oxidizing agents Finely divided metals

Packaging material:
Recommended: Ordinary steel, Stainless steel
To be avoided: Alloys containing more than 2% of magnesium, Plastic materials

7.3. Specific end use(s): None.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

8.1. Control parameters:

Exposure Limit Values Not relevant

8.2. Exposure controls:
General protective measures: Provide sufficient air exchange and/or exhaust in work rooms.

Personal protective equipment:

Respiratory protection:	In case of insufficient ventilation, wear suitable respiratory equipment.
Hand protection:	Leather gloves
Eye/face protection:	Safety glasses with side-shields
Skin and body protection:	Protective clothing (cotton)

Environmental exposure controls:
See chapter 6

9. PHYSICAL AND CHEMICAL PROPERTIES

9.1. Information on basic physical and chemical properties

Appearance:	
Physical state (20°C):	gaseous
Form:	Liquefied gas
Colour:	colourless
Odour:	No data available.
Olfactory threshold:	No data available.
pH:	Not applicable
Melting point/range :	-108 °C
Boiling point/boiling range :	-26 °C
Flash point:	Not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	
Flammability:	The product is not flammable.
Vapour pressure:	0.574 MPa , at 20 °C
Vapour density:	4.24 kg/m3 , at 20 °C
Density:	1,206 kg/m3 , at 25 °C
	1,102 kg/m3 , at 50 °C
	996 kg/m3 , at 70 °C
Relative density (Water=1):	1.21 at 20 °C
	1.1 at 50 °C
Water solubility:	1 g/l at 25 °C
Partition coefficient: n-octanol/water:	log Kow : 1.06 , at 25 °C (OECD Test Guideline 107)
Auto-ignition temperature:	> 743 °C at 1,013 hPa
Decomposition temperature:	> 370 °C
Viscosity, dynamic:	Not applicable
Explosive properties:	
Explosivity:	Not relevant (due to its chemical structure)
Oxidizing properties:	Not relevant (due to its chemical structure)

9.2. Other data:

Molecular weight:	102 g/mol
Critical point:	Critical pressure: 4.07 MPa, Critical temperature: 101 °C

10. STABILITY AND REACTIVITY

10.1. Reactivity: No data available.

10.2. Chemical stability:
The product is stable at ambient temperature
The gazeous product in presence of air can form, under certain conditions of temperature and pressure, a flammable mixture

10.3. Possibility of hazardous reactions: No data available.

10.4. Conditions to avoid:
Keep away from heat and sources of ignition. Avoid contact with flames and red hot metallic surfaces

10.5. Incompatible materials to avoid:
Alkaline hydroxides, Alkaline earth metals, Strong oxidizing agents, Finely divided metals

10.6. Hazardous decomposition products:

Thermal decomposition:
Decomposition temperature: > 370 °C
At high temperature :, Thermal decomposition giving toxic and corrosive products :, Gaseous hydrogen fluoride (HF)., Carbon oxides

11. TOXICOLOGICAL INFORMATION

11.1. Information on toxicological effects:

Acute toxicity:

Inhalation: **Slightly harmful by inhalation**
As with other volatile aliphatic halogenated compounds, through vapour accumulation and/or inhalation of large quantities, the product can cause :, Loss of consciousness and cardiac disorders aggravated by stress and lack of oxygen, risk of mortality
• In animals : No mortality/4 h/Rat: 567000 ppm (Method: OECD Test Guideline 403)
Central nervous system depression, narcosis

Local effects (Corrosion / Irritation / Serious eye damage):

Skin contact: **Ejection of liquefied gas : frostbite possible**

Eye contact: **Ejection of liquefied gas : frostbite possible**

Respiratory or skin sensitisation:

Inhalation:
• In animals : No-observed-effect level5 % (cardiac sensitization, Dog)

Skin contact: **Not a skin sensitizer**
• In animals : No effect is reported. (Method: Guinea pig maximization test, Guinea pig)

CMR effects :

Mutagenicity: **According to available experimental data: Not genotoxic**

In vitro

Ames test in vitro: Inactive (Method: OECD Test Guideline 471)
In vitro chromosomal abnormality test on human lymphocytes: Inactive (Method: OECD Test Guideline 473)
In vitro gene mutations test on mammalian cells: Inactive

In vivo

Micronucleus test in vivo mouse: Inactive (Method: OECD Test Guideline 474)
DNA repair test on rats hepatocytes: Inactive

Carcinogenicity: **Did not show carcinogenic or mutagenic effects in animal experiments.**
• In animals : Absence of carcinogenic effects (Rat, 2 years, By inhalation)
No Observed Adverse Effect Level (NOAEL): 10,000 ppm

Absence of carcinogenic effects (Rat, 1 year, By oral route)
No Observed Adverse Effect Level (NOAEL): 300 mg/kg bw/day

Reproductive toxicity:

Fertility: **Absence of toxic effects on fertility**
• In animals : Two-generation study
NOAEL (Parental toxicity): 50,000 ppm
NOAEL (Fertility): 50,000 ppm
NOAEL (Developmental Toxicity): 50000 ppm
(rat, By inhalation)

Foetal development: **Absence of toxic effects for foetal development (at non toxic concentrations for the mothers)**
• In animals : Absence of toxic effects for foetal development.
NOAEL (Developmental Toxicity): 40,000 ppm
NOAEL (Maternal Toxicity): 2,500 ppm
(Method: OECD Test Guideline 414, Rabbit, By inhalation)
Absence of toxic effects for foetal development.
NOAEL (Developmental Toxicity): 50,000 ppm
NOAEL (Maternal Toxicity): 50,000 ppm
(Method: OECD Test Guideline 414, Rat, By inhalation)

Specific target organ toxicity :
Single exposure : No data available.

Repeated exposure: **Studies of prolonged inhalation in animals have not shown chronic toxic effects**
• In animals : Inhalation: No adverse effects reported.
NOAEL= 50000ppm (Rat, Several years)

Aspiration hazard:

Not relevant

12. ECOLOGICAL INFORMATION

Ecotoxicology Assessment: All available and relevant data on this product and/or the components quoted in section 3 and/or the analogue substances/metabolites have been taken into account for the hazard assessment.

12.1. Acute toxicity :

Fish: **Slightly harmful to fish**
LC50, 96 h (Salmo gairdneri) : 450 mg/l (Method: OECD Test Guideline 203)

Aquatic invertebrates: **Slightly harmful to daphnia**
EC50, 48 h (Daphnia magna (Water flea)) : 980 mg/l (Method: OECD Test Guideline 202)

Aquatic plants: **Slightly harmful to algae**
May be considered as comparable to a similar product for which experimental results are:

PROPANE, 1,1,1,3,3-PENTAFLUORO- :
ErC50, 72 h (Pseudokirchneriella subcapitata) : > 118 mg/l (Method: OECD Test Guideline 201)

Microorganisms:
EC10, 6 h (Pseudomonas putida) : > 730 mg/l

12.2. Persistence and degradability :

Biodegradation (In water): **Not readily biodegradable.**
Not readily biodegradable.: 3 % after 28 d (Method: OECD Test Guideline 301D)

Photodegradation (In air):
Degradation by radicals OH: Direct photolysis (Half-life) : 9.7 y

12.3. Bioaccumulative potential :

Bioaccumulation: **Bioaccumulation is unlikely.**
Partition coefficient: n-octanol/water: log Kow : 1.06 , at 25 °C (Method: OECD Test Guideline 107)

12.4. Mobility in soil - Distribution among environmental compartments:

Distribution among environmental compartments :
Predicted distribution to environmental compartments

Water: 0.07 %
Air: 99.93 %
(Method: Calculation according Mackay, Level I)

Vapor pressure: 0.574 MPa, 20 °C

Absorption / desorption: **Slight adsorption**
log Koc: 1.57 (Method: calculated)

12.5. Results of PBT and vPvB assessment :

According to REACH regulation, annex XIII, the substance does not meet PBT and vPvB criteria.

12.6. Other adverse effects:

Global warming potential (GWP): Global warming potential with respect to CO2 (time horizon 100 years) , Value: 1,360

Ozone depletion potential: Ozone depletion potential; ODP; (R-11 = 1) , Value: 0

13. DISPOSAL CONSIDERATIONS

13.1. Waste treatment:

Disposal of product: Recycle or incinerate at an approved waste disposal site. In accordance with local and national regulations.

14. TRANSPORT INFORMATION

Regulation	14.1. UN number	14.2. UN proper shipping name	14.3. Class*	Label	14.4. PG*	14.5. Environmental hazards	14.6. Special precautions for user
IATA Cargo	3159	1,1,1,2-tetrafluoroethane (Refrigerant gas R 134a)	2.2	2.2		no	
IATA Passenger	3159	1,1,1,2-tetrafluoroethane (Refrigerant gas R 134a)	2.2	2.2		no	
IMDG	3159	1,1,1,2-TETRAFLUOROETHANE	2.2	2.2		no	EmS Number: F-C, S-V

*Description: 14.3. Transport hazard class(es)
14.4. Packing group

14.7. Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code: Not applicable

15. REGULATORY INFORMATION

Not listed	Stockholm Convention on Persistent Organic Pollutants (POPs)
This product contains one or more component(s) listed on:	Montreal Protocol. Substances that Deplete the Ozone Layer, as amended
This product contains one or more component(s) listed on:	Kyoto Protocol to the United Nations Framework Convention on Climate Change, Annex A, Greenhouse Gases
Not listed	Rotterdam Convention on the Prior Informed Consent (PIC) Procedure for Certain Hazardous Chemicals and Pesticides in International Trade
Not listed	International Chemical Weapons Convention (CWC) Schedules of Toxic Chemicals and Precursors

INVENTORIES:

EINECS:	Conforms to
TSCA:	Conforms to
DSL:	All components of this product are on the Canadian DSL
IECSC (CN):	Conforms to
ENCS (JP):	Does not conform
ISHL (JP):	Conforms to
KECI (KR):	Conforms to
PICCS (PH):	Conforms to
AICS:	Conforms to
NZIOC:	Conforms to

16. OTHER INFORMATION

Full text of H, EUH-phrases referred to under sections 2 and 3

H280	Contains gas under pressure; may explode if heated.

Bibliography Encyclopédie des gaz (Air liquide - Ed. 1976 - ELSEVIER AMSTERDAM)

Thesaurus:
NOAEL : No Observed Adverse Effect Level (NOAEL)
LOAEL : Lowest Observed Adverse Effect Level (LOAEL)
bw : Body weight
food : oral feed
dw : Dry weight

This information applies to the PRODUCT AS SUCH and conforming to specifications of ARKEMA. In case of formulations or mixtures, it is necessary to ascertain that a new danger will not appear. The information contained is based on our knowledge of the product, at the date of publishing and it is given quite sincerely. Users are advised of possible additional hazards when the product is used in applications for which it was not intended. This sheet shall only be used and reproduced for prevention and security purposes. The references to legislative, regulatory and codes of practice documents cannot be considered as exhaustive. It is the responsibility of the person receiving the product to refer to the totality of the official documents concerning the use, the possession and the handling of the product. It is also the responsibility of the handlers of the product to pass on to any subsequent persons who will come into contact with the product (usage, storage, cleaning of containers, other processes) the totality of the information contained within this safety data sheet and necessary for safety at work, the protection of health and the protection of environment.

NB: In this document the numerical separator of the thousands is the "." (point), the decimal separator is "," (comma).