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

Identification of the mixture: REFRIGERANT GAS R-407C

Recommended use of the chemical and restrictions on use :

Use of the Substance/Mixture : Refrigerant

Company/Undertaking Identification:

Supplier: Arkema Daikin Advanced Fluorochemical (Changshu) Co., Ltd
No.18 HaiNing Road, Advanced Material Industrial Park of Changshu
Jiangsu, 215522, P.R.China
Tel: +86 512 5232 2688
Fax: +86 512 5232 2788

Emergency telephone number: +86 512 5232 2599
+86 400 6267 911

2. HAZARDS IDENTIFICATION

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.

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.

Most important hazards:

Potential health effects:
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
Skin contact: Ejection of liquefied gas : frostbite possible

Environmental Effects:
Not readily biodegradable. Practically not bioaccumulable

Physical and chemical hazards:
Thermal decomposition giving toxic and corrosive products
Decomposition products: See chapter 10

3. COMPOSITION/INFORMATION ON INGREDIENTS

This product is a mixture.

Chemical nature of the mixture[1]:

Hazardous components :

Chemical Name[1]	EC-No.	CAS-No.	Concentration	Classification
1,1,1,2-Tetrafluoroethane	212-377-0	811-97-2	50 - 54%	Press. Gas Liquefied gas; H280
Difluoromethane	200-839-4	75-10-5	21 - 25%	Flam. Gas 1; H220 Press. Gas Liquefied gas; H280
Pentafluoroethane	206-557-8	354-33-6	23 - 27%	Press. Gas Liquefied gas; H280

[1]: See chapter 14 for Proper Shipping Name

4. FIRST AID MEASURES

Description of necessary first-aid measures, Most important symptoms/effects, acute and delayed:

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

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

Skin contact:
Frostbite : treat as thermal burns. Wash off with plenty of water.

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.

Indication of any immediate medical attention and special treatment needed:

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

5. FIREFIGHTING MEASURES

Extinguishing media:
Suitable extinguishing media:
Use extinguishing measures to suit surroundings.

Specific hazards arising from the chemical:
At high temperature :, Thermal decomposition giving toxic and corrosive products :
Hydrogen fluoride, Carbon oxides
One of the components of this preparation gives flammable mixtures with air

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:
Wear self-contained breathing apparatus and protective suit.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures:
Avoid contact with skin and eyes and inhalation of vapours. Avoid 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.

Environmental precautions:
Do not release into the environment.

Methods and materials for containment and cleaning up:

Recovery:
Allow to evaporate.

Elimination: See chapter 13

7. HANDLING AND STORAGE

Precautions for safe handling:

Technical measures/Precautions:
Storage and handling precautions applicable to products: pressurised liquified gas
Provide appropriate exhaust ventilation at machinery. Provide self-contained breathing apparatus nearby (for emergency intervention).
Provide showers, eye-baths. Well ventilate empty vats and tanks before entering.

Safe handling advice:
Prohibit ignition sources near the point where containers are opened - 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.

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 from light. Keep away from direct sunlight.

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

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

Specific use(s) (End Use): None.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

CONTROL PARAMETERS:
Exposure Limit Values Contains no substances with occupational exposure limit values.

EXPOSURE CONTROLS:

Appropriate engineering controls:
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

Appearance:

Physical state (20°C):	gaseous

Form:	Liquefied gas
Colour:	colourless
Odour:	slightly, ether-like
Olfactory threshold:	No data available.
pH:	not applicable
Melting point/range :	1,1,1,2-TETRAFLUOROETHANE : -108 °C
Melting point/range :	DIFLUOROMETHANE : -136 °C
Melting point/range :	PENTAFLUOROETHANE : -103 °C
Boiling point/boiling range :	-42,4 °C
Flash point:	not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	
Flammability:	Non flammable product (Standard : ASTM E 681-85)
Vapour pressure:	1,13 MPa , at 25 °C
	2,11 MPa , at 50 °C
	3,26 MPa , at 70 °C
Vapour density:	4,54 kg/m3 At the boiling point
Density:	1.133 kg/m3 , at 25 °C
	1.004 kg/m3 , at 50 °C
	861 kg/m3 , at 70 °C
Water solubility :	1,1,1,2-TETRAFLUOROETHANE : 1 g/l at 25 °C
	DIFLUOROMETHANE : 1,68 g/l at 25 °C
	PENTAFLUOROETHANE : 0,43 g/l at 25 °C (calculated)
Partition coefficient: n-octanol/water:	1,1,1,2-TETRAFLUOROETHANE : log Kow : = 1,06 , at 25 °C (OECD Test Guideline 107)
	DIFLUOROMETHANE : log Kow : = 0,21 , at 25 °C (OECD Test Guideline 107)
	PENTAFLUOROETHANE : log Kow : = 1,48 , at 25 °C (OECD Test Guideline 107)
Autoignition temperature :	1,1,1,2-TETRAFLUOROETHANE : 743 °C at 1 bar
	DIFLUOROMETHANE : 530 °C (Standard A15 (D. 92/69/EEC))
Decomposition temperature:	No data available.
Viscosity, dynamic:	not applicable
Explosive properties:	
Explosivity:	Not relevant (due to the chemical structure)
Oxidizing properties:	Not relevant (due to the chemical structure)
Other data:	
Henry constant :	1,1,1,2-TETRAFLUOROETHANE : 155E+03 Pa.m^3/mol
	DIFLUOROMETHANE : 29,60E+03 Pa.m^3/mol (calculated)
	PENTAFLUOROETHANE : 309E+03 Pa.m^3/mol (calculated)
Critical point:	Critical pressure: 4,64 MPa, Critical temperature: 89 °C

10. STABILITY AND REACTIVITY

Reactivity & Chemical stability:
The product is stable under normal handling and storage conditions.

Possibility of hazardous reactions:
No data available.

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

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

Hazardous decomposition products:
At high temperature :, Thermal decomposition giving toxic and corrosive products :
Gaseous hydrogen fluoride (HF)., Carbon oxides

11. TOXICOLOGICAL INFORMATION

Toxicological information:

Acute toxicity:

Inhalation: **According to its composition, can be considered as : Little or not harmful by inhalation**

1,1,1,2-TETRAFLUOROETHANE :

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

DIFLUOROMETHANE :

At high vapour/fog concentrations :, headache, Dizziness, Drowsiness

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: 520000 ppm (Method: OECD Test Guideline 403)

PENTAFLUOROETHANE :

Effects of breathing high concentrations of vapour may include:, headache, Dizziness, Drowsiness

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: 800000 ppm (Method: OECD Test Guideline 403)

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 sensitization:

Inhalation: No data available.

Skin contact:

Not relevant (gas)

CMR effects :

Mutagenicity: **According to its composition, can be considered as : Not genotoxic**

In vitro

1,1,1,2-TETRAFLUOROETHANE :

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

DIFLUOROMETHANE :

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 (Method: OECD Test Guideline 476)

PENTAFLUOROETHANE :

Ames test: negative (Method: OECD Test Guideline 471)
In vitro test for chromosomal abnormalities on CHO cells: negative (Method: OECD Test Guideline 473)
In vitro chromosomal abnormality test on human lymphocytes: negative (Method: OECD Test Guideline 476)

In vivo

1,1,1,2-TETRAFLUOROETHANE :

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

DIFLUOROMETHANE :

Micronucleus test in vivo mouse: Inactive (Method: OECD Test Guideline 474)

PENTAFLUOROETHANE :

Micronucleus test in vivo mouse: negative (Method: OECD Test Guideline 474)

Carcinogenicity: **Based on the available information, it is not possible to conclude on the hasard potential of this mixture.**

1,1,1,2-TETRAFLUOROETHANE :
• 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/d

Reproductive toxicity:

Fertility: **Based on the available data, the substance is not suspected of having reprotoxic potential.**

1,1,1,2-TETRAFLUOROETHANE :

According to limited available data in animals :, Absence of toxic effects on fertility (mouse, Inhalation)

DIFLUOROMETHANE :
• In animals :

NOAEL: > 50 000 ppm (rat, mouse, Inhalation)

Foetal development:

1,1,1,2-TETRAFLUOROETHANE :
• In animals :

NOAEL: 40 000 ppm Maternal concentration without effect: 2 500 ppm (Method: OECD Test Guideline 414, rabbit, By inhalation)
NOAEL: 50 000 ppm Maternal concentration without effect: 50 000 ppm (Method: OECD Test Guideline 414, rat, By inhalation)

DIFLUOROMETHANE :
• In animals :

NOAEL: > 50 000 ppm Maternal concentration without effect: > 50 000 ppm (Method: OECD Test Guideline 414, rat, rabbit, By inhalation)

PENTAFLUOROETHANE :
• In animals :

NOAEL: 245 mg/l (Method: OECD Test Guideline 414)

Maternal concentration without effect: 245 mg/l
(Method: OECD Test Guideline 414, rat, rabbit, By inhalation)

Specific target organ toxicity :
Single exposure :

Inhalation: **The substance or mixture is not classified as specific target organ toxicant, single exposure.**

Repeated exposure: **The substance or mixture is not classified as specific target organ toxicant, repeated exposure.**

1,1,1,2-TETRAFLUOROETHANE :
• In animals : Inhalation: No adverse effects reported.
NOAEL= 50 000 ppm (rat, Several years)

DIFLUOROMETHANE :
• In animals : Inhalation: No specific toxic effects
NOAEL= 50000 ppm (rat, 3 Months)

PENTAFLUOROETHANE :
• In animals : Studies of prolonged inhalation in animals have not shown sub-chronic toxic effects

Inhalation: NOAEL= 50000 ppm (Method: OECD Test Guideline 408, rat, 3 Months)

Aspiration hazard: Not relevant

12. ECOLOGICAL INFORMATION

Acute toxicity

Fish: **According to its composition : Slightly harmful to fish**

1,1,1,2-TETRAFLUOROETHANE :
LC50, 96 h (Salmo gairdneri) : = 450 mg/l

DIFLUOROMETHANE :
LC50, 96 h (Freshwater fish) : = 1.507 mg/l (Method: calculated)

PENTAFLUOROETHANE :
Through anology with a comparable product :
LC50, 96 h (Oncorhynchus mykiss) : > 100 mg/l

Aquatic invertebrates: **According to its composition : Slightly harmful to daphnia**

1,1,1,2-TETRAFLUOROETHANE :
EC(I)50, 48 h (Daphnia magna (Water flea)) : = 980 mg/l

DIFLUOROMETHANE :
EC50, 48 h (Daphnia) : = 652 mg/l (Method: calculated)

PENTAFLUOROETHANE :
Through anology with a comparable product :
LC50, 48 h (Daphnia magna (Water flea)) : > 100 mg/l

Aquatic plants: **According to its composition : Slightly harmful to algae**

1,1,1,2-TETRAFLUOROETHANE :
Through anology with a comparable product :
EC50, 72 h (Pseudokirchneriella subcapitata (green algae)) : > 114 mg/l (Method: OECD Test Guideline 202, growth rate)

DIFLUOROMETHANE :
EC50, 96 h (Algae) : = 142 mg/l (Method: calculated)

PENTAFLUOROETHANE :
Through anology with a comparable product :
EC50, 72 h (Pseudokirchneriella subcapitata) : > 114 mg/l

Microorganisms:

1,1,1,2-TETRAFLUOROETHANE :
EC10, 6 h (Pseudomonas putida) : > 730 mg/l

Persistence and degradability :

Biodegradation (In water): **According to its composition : Not readily biodegradable.**

1,1,1,2-TETRAFLUOROETHANE :
Not readily biodegradable.
3 % after 28 d (Method: OECD Test Guideline 301 D)

DIFLUOROMETHANE :
5 % after 28 d (Method: OECD Test Guideline 301 D)

PENTAFLUOROETHANE :

Not readily biodegradable.
5 % after 28 d (Method: OECD Test Guideline 301 D)

Photodegradation (In air):

1,1,1,2-TETRAFLUOROETHANE :
Degradation by radicals OH: Overall half-life time: 9,7 y

DIFLUOROMETHANE :
Degradation by radicals OH: Overall half-life time: 1.237 d

PENTAFLUOROETHANE :
Degradation by radicals OH: Overall half-life time: 29 y

Bioaccumulative potential :

Bioaccumulation: **According to its composition : Not bioaccumulable**

1,1,1,2-TETRAFLUOROETHANE :
Partition coefficient: n-octanol/water: log Kow : = 1,06 , at 25 °C (Method: OECD Test Guideline 107)

DIFLUOROMETHANE :
Partition coefficient: n-octanol/water: log Kow : = 0,21 , at 25 °C (Method: OECD Test Guideline 107)

PENTAFLUOROETHANE :
Partition coefficient: n-octanol/water: log Kow : = 1,48 , at 25 °C (Method: OECD Test Guideline 107)

Mobility in soil - Distribution among environmental compartments:

Henry constant:
1,1,1,2-TETRAFLUOROETHANE :
155E+03 Pa.m^3/mol,

DIFLUOROMETHANE :
29,60E+03 Pa.m^3/mol, , (Method: calculated)

PENTAFLUOROETHANE :
309E+03 Pa.m^3/mol, , (Method: calculated)

Absorption / desorption:
1,1,1,2-TETRAFLUOROETHANE :
In soils and sediments: Slight adsorption , log Koc: = 1,57, Koc: = 37,3 (Method: calculated)
Volatilization 1/2 life time: 8,6 - 16,7 y, Method: calculated

DIFLUOROMETHANE :
In soils and sediments: Slight adsorption , log Koc: 0,17 - 1,34 (Method: calculated)

PENTAFLUOROETHANE :
In aqueous environment: rapid evaporation
(Method: estimation) Volatilization 1/2 life time: 3,2 h
In soils and sediments: Slight adsorption , log Koc: 1,3 - 1,7

Results of PBT and vPvB assessment :

According to REACH regulation, annex XIII, this mixture contains no substance meeting PBT and vPvB criteria.

Other adverse effects:

Global warming potential (GWP): PENTAFLUOROETHANE , Global warming potential with respect to CO2 (time horizon 100 years) , Value: 3.400

1,1,1,2-TETRAFLUOROETHANE , Global warming potential with respect to CO2 (time horizon 100 years) , Value: 1.300

DIFLUOROMETHANE: , Global warming potential with respect to CO2 (time horizon 100 years) , Value: 650

Ozone depletion potential: 1,1,1,2-TETRAFLUOROETHANE , Ozone depletion potential; ODP; (R-11 = 1) , Value: 0

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

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

13. DISPOSAL CONSIDERATIONS

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	UN number	Proper shipping name	Class	Label	PG	Environmentally hazardous	Other information
IATA Cargo	3340	REFRIGERANT GAS R 407C	2.2	2.2		no	
IATA Passenger	3340	REFRIGERANT GAS R 407C	2.2	2.2		no	
IMDG	3340	REFRIGERANT GAS R 407C	2.2	2.2		no	EmS Number: F-C, S-V

15. REGULATORY INFORMATION

INVENTORIES:

EINECS:	Conforms to
TSCA:	Conforms to
AICS:	Conforms to
DSL:	All components of this product are on the Canadian DSL list.
ENCS (JP):	Conforms to
KECI (KR):	Conforms to
PICCS (PH):	Conforms to
IECSC (CN):	Conforms to
NZIOC:	Conforms to

16. OTHER INFORMATION

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

H220	Extremely flammable gas.
H280	Contains gas under pressure; may explode if heated.

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

Update:

Safety datasheet sections which have been updated:		Type:
1	Emergency telephone number	Revisions

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).