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

Identification of the mixture: REFRIGERANT GAS R-404A

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 6264 911

2. HAZARDS IDENTIFICATION

Classification of the substance or mixture:

Gases under pressure, Liquefied gas, H280
Acute aquatic toxicity, Category 3, H402

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.
H402 : Harmful to aquatic life.

Precautionary statements:
Prevention:
P273 : Avoid release to the environment.
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. Not bioaccumulable. Harmful to algae.

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
Pentafluoroethane	206-557-8	354-33-6	44 %	Press. Gas Liquefied gas; H280
1,1,1-Trifluoroethane	206-996-5	420-46-2	52 %	Flam. Gas 1; H220 Press. Gas Liquefied gas; H280
1,1,1,2-Tetrafluoroethane	212-377-0	811-97-2	4 %	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:
Wash off with plenty of water. 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:
If entering a saturated atmosphere, wear a self contained breathing apparatus.

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:
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:
Prohibit all sources of sparks and ignition - Do not smoke. Ensure a system for the rapid emptying of containers. In case of fire, remove exposed containers. Cool containers / tanks with water spray.

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 the skin and the eyes. 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. Evacuate non-essential staff and those not equipped with individual protection apparatus.

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. Provide showers, eye-baths. 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 the skin and the eyes. Avoid exposure to vapor. 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:
Store at room temperature in the original container. Keep away from open flames, hot surfaces and sources of ignition. Keep away from heat and sources of ignition. Do not smoke. Keep in a cool, well-ventilated place. Protect full containers from sources of heat to avoid overpressurization.

Incompatible products: No data available.

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 :	PENTAFLUOROETHANE : -103 °C
Melting point/range :	1,1,1-TRIFLUOROETHANE : -111 °C
Boiling point/boiling range :	-45,8 °C
Flash point:	not applicable
Evaporation rate:	No data available.
Flammability (solid, gas):	
Flammability:	Non flammable product (Standard NF EN 378-1)
Vapour pressure:	1,27 MPa , at 25 °C
	2,33 MPa , at 50 °C
	3,53 MPa , at 70 °C
Vapour density:	5,39 kg/m3 At the boiling point
Density:	1.041 kg/m3 , at 25 °C Liquefied gas
Water solubility :	1,1,1,2-TETRAFLUOROETHANE : 1 g/l at 25 °C
	PENTAFLUOROETHANE : 0,43 g/l at 25 °C (calculated)
	1,1,1-TRIFLUOROETHANE : 0,761 g/l at 25 °C (calculated)
Partition coefficient: n-octanol/water:	1,1,1-TRIFLUOROETHANE : log Kow : = 1,73 , at 20 °C (calculated)
	PENTAFLUOROETHANE : log Kow : = 1,48 , at 25 °C (OECD Test Guideline 107)
	1,1,1,2-TETRAFLUOROETHANE : log Kow : = 1,06 , at 25 °C (OECD Test Guideline 107)
Autoignition temperature :	1,1,1-TRIFLUOROETHANE : 750 °C
	PENTAFLUOROETHANE : not applicable
	1,1,1,2-TETRAFLUOROETHANE : > 743 °C
Decomposition temperature:	No data available.
Viscosity, kinematic:	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-TRIFLUOROETHANE : 11,20E+03 $Pa.m^3/mol$, at 25 °C
	PENTAFLUOROETHANE : 28,2E+03 $Pa.m^3/mol$, at 25 °C (calculated)
	1,1,1,2-TETRAFLUOROETHANE : 10,2E+03 $Pa.m^3/mol$, at 25 °C (calculated)
Critical point:	Critical pressure: 3,74 MPa, Critical temperature: 72 °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. Protect from light. 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:
Thermal decomposition giving very toxic and corrosive products, Hydrogen fluoride, Carbon oxides

11. TOXICOLOGICAL INFORMATION

Toxicological information:

Acute toxicity:

Inhalation: **According to its composition, can be considered as : Slightly harmful by inhalation**

1,1,1-TRIFLUOROETHANE :

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: 591000 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)

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

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 : According to available experimental data: Not genotoxic**

In vitro

1,1,1-TRIFLUOROETHANE :

Ames test: negative
In vitro chromosomal abnormality test on human lymphocytes: negative

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)

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

In vivo

1,1,1-TRIFLUOROETHANE :

Micronucleus test in vivo mouse: negative

PENTAFLUOROETHANE :

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

1,1,1,2-TETRAFLUOROETHANE :

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

Carcinogenicity: **Based on the available data, the substance is not suspected of having carcinogenic potential**

1,1,1-TRIFLUOROETHANE :
• In animals : According to available experimental data:
No effect maximum concentration300 mg/kg
(rat, 1 year, By oral route)

PENTAFLUOROETHANE :
No data available.

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

1,1,1-TRIFLUOROETHANE :
No data available.

PENTAFLUOROETHANE :
No data available.

1,1,1,2-TETRAFLUOROETHANE :
According to limited available data in animals :, Absence of toxic effects on fertility (mouse, Inhalation)

Foetal development: **Based on the available data, the substance is not suspected of having developmental toxicity potential.**

1,1,1-TRIFLUOROETHANE :
• In animals : NOAEL: 137 mg/l Maternal concentration without effect: 137 mg/l (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)

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)

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-TRIFLUOROETHANE :
Studies of prolonged inhalation in animals have not shown sub-chronic toxic effects
• In animals : Inhalation: No specific toxic effects
NOAEL= 40000 ppm (Method: OECD Test Guideline 408, 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)

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

Aspiration hazard: Not relevant

12. ECOLOGICAL INFORMATION

Ecotoxicology Assessment: All available 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.

Acute toxicity

Fish: **According to its composition, can be considered as : Slightly harmful to fish**

1,1,1-TRIFLUOROETHANE :

LC50, 96 h (Oncorhynchus mykiss) : > 40 mg/l
LC50 (Freshwater fish) : = 109 mg/l (Method: calculated)

PENTAFLUOROETHANE :

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

1,1,1,2-TETRAFLUOROETHANE :

LC50, 96 h (Salmo gairdneri) : = 450 mg/l

Aquatic invertebrates: **According to its composition, can be considered as : Slightly harmful to daphnia**

1,1,1-TRIFLUOROETHANE :

LC50, 48 h (Daphnia magna (Water flea)) : = 300 mg/l (Method: OECD Test Guideline 202)
EC(I)50, 48 h (Daphnia) : = 115 mg/l (Method: calculated)

PENTAFLUOROETHANE :

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

1,1,1,2-TETRAFLUOROETHANE :

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

Aquatic plants: **According to its composition, can be considered as : Harmful to algae.**

1,1,1-TRIFLUOROETHANE :

Through analogy with a comparable product :
EC50, 96 h (Algae) : = 71 mg/l (Method: calculated)
NOEC, 96 h (Selenastrum capricornutum) : > 44 mg/l

PENTAFLUOROETHANE :

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

1,1,1,2-TETRAFLUOROETHANE :

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

Microorganisms:

1,1,1-TRIFLUOROETHANE :

Through analogy with a comparable product :
EC0, 6 h (Pseudomonas putida) : > 730 mg/l

1,1,1,2-TETRAFLUOROETHANE :

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

Persistence and degradability :

Biodegradation (In water): **According to its composition, can be considered as Not readily biodegradable.**

1,1,1-TRIFLUOROETHANE :

Not readily biodegradable.
Through analogy with a comparable product : 3 % after 28 d

PENTAFLUOROETHANE :

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

1,1,1,2-TETRAFLUOROETHANE :

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

Photodegradation (In air):

1,1,1-TRIFLUOROETHANE :

Degradation by radicals OH: Overall half-life time: 1.108 d

PENTAFLUOROETHANE :

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

1,1,1,2-TETRAFLUOROETHANE :

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

Bioaccumulative potential :

Bioaccumulation: **According to its composition, can be considered as : Not bioaccumulable**

1,1,1-TRIFLUOROETHANE :
Partition coefficient: n-octanol/water: log Kow : = 1,73 , at 20 °C (Method: calculated)

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

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

Mobility in soil - Distribution among environmental compartments:

Henry constant:
1,1,1-TRIFLUOROETHANE :
11,20E+03 $Pa.m^3/mol$, 25 °C,

PENTAFLUOROETHANE :
28,2E+03 $Pa.m^3/mol$, 25 °C, , (Method: calculated)

1,1,1,2-TETRAFLUOROETHANE :
10,2E+03 $Pa.m^3/mol$, 25 °C, , (Method: calculated)

Absorption / desorption:
1,1,1-TRIFLUOROETHANE :
In soils and sediments: Slight adsorption

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

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

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): 1,1,1-TRIFLUOROETHANE: , Global warming potential with respect to CO2 (time horizon 100 years) , Value: 3.800

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

NORFLURANE , Global warming potential with respect to CO2 (time horizon 100 years) , Value: 1.300

Ozone depletion potential: 1,1,1-TRIFLUOROETHANE: , Not an atmospheric ozone precursor : POCP , Value: 0

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

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

NORFLURANE , 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	3337	REFRIGERANT GAS R 404A	2.2	2.2		no	
IATA Passenger	3337	REFRIGERANT GAS R 404A	2.2	2.2		no	
IMDG	3337	REFRIGERANT GAS R 404A	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.
H402	Harmful to aquatic life.

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).