

R438A (Isceon MO99)

A-Gas (U.S. Headquarters)

Chemwatch Hazard Alert Code: 1

Chemwatch: 22-9861

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Safety Data Sheet according to OSHA HazCom Standard (2012) requirements

L.GHS.USA.EN

SECTION 1 IDENTIFICATION

Product Identifier

| | |
|--------------------------------------|---------------------------|
| Product name | R438A (Isceon MO99) |
| Synonyms | Not Available |
| Proper shipping name | Refrigerant gases, n.o.s. |
| Other means of identification | Not Available |

Recommended use of the chemical and restrictions on use

| | |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Relevant identified uses | Use according to manufacturer's directions. The use of a quantity of material in an unventilated or confined space may result in increased exposure and an irritating atmosphere developing. Before starting consider control of exposure by mechanical ventilation. |
|---------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party

| | |
|--------------------------------|----------------------------------------|
| Registered company name | A-Gas (U.S. Headquarters) |
| Address | 1100 Haskins Rd OH 43402 United States |
| Telephone | 14198678990 |
| Fax | 1-419-867-3279 |
| Website | www.agasamericas.com |
| Email | tammy.myers@agas.com |

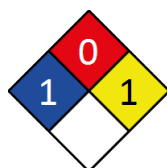
Emergency phone number

| | |
|------------------------------------------|------------------------------|
| Association / Organisation | PERS |
| Emergency telephone numbers | 1-800-633-8253 |
| Other emergency telephone numbers | International 1-801-629-0667 |

SECTION 2 HAZARD(S) IDENTIFICATION

Classification of the substance or mixture

NFPA 704 diamond



Note: The hazard category numbers found in GHS classification in section 2 of this SDSs are NOT to be used to fill in the NFPA 704 diamond. Blue = Health Red = Fire Yellow = Reactivity White = Special (Oxidizer or water reactive substances)

| | |
|-----------------------|-------------------------------------------------------|
| Classification | Simple Asphyxiant, Gas under Pressure (Liquefied gas) |
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Label elements

| | |
|----------------------------|--|
| Hazard pictogram(s) | |
|----------------------------|--|

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R438A (Isceon MO99)

SIGNAL WORD **WARNING**

Hazard statement(s)

| | |
|-------------|-----------------------------------------------------|
| H280 | Contains gas under pressure; may explode if heated. |
| | May displace oxygen and cause rapid suffocation |

Hazard(s) not otherwise classified

Not Applicable

Precautionary statement(s) Prevention

Not Applicable

Precautionary statement(s) Response

Not Applicable

Precautionary statement(s) Storage

| | |
|------------------|----------------------------------------------------------|
| P410+P403 | Protect from sunlight. Store in a well-ventilated place. |
|------------------|----------------------------------------------------------|

Precautionary statement(s) Disposal

Not Applicable

SECTION 3 COMPOSITION / INFORMATION ON INGREDIENTS

Substances

See section below for composition of Mixtures

Mixtures

| CAS No | %[weight] | Name |
|-----------|-----------|-------------------------|
| 75-10-5 | 8.5 | <u>R32</u> |
| 354-33-6 | 45 | <u>R125</u> |
| 811-97-2 | 44.2 | <u>R-134A</u> |
| 106-97-8. | 1.7 | <u>n-Butane, 99.95%</u> |
| 78-78-4 | 0.6 | <u>Isopentane</u> |

SECTION 4 FIRST-AID MEASURES

Description of first aid measures

| | |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Eye Contact | <ul style="list-style-type: none"> ▶ If product comes in contact with eyes remove the patient from gas source or contaminated area. ▶ Take the patient to the nearest eye wash, shower or other source of clean water. ▶ Open the eyelid(s) wide to allow the material to evaporate. ▶ Gently rinse the affected eye(s) with clean, cool water for at least 15 minutes. Have the patient lie or sit down and tilt the head back. Hold the eyelid(s) open and pour water slowly over the eyeball(s) at the inner corners, letting the water run out of the outer corners. ▶ The patient may be in great pain and wish to keep the eyes closed. It is important that the material is rinsed from the eyes to prevent further damage. ▶ Ensure that the patient looks up, and side to side as the eye is rinsed in order to better reach all parts of the eye(s) ▶ Transport to hospital or doctor. ▶ Even when no pain persists and vision is good, a doctor should examine the eye as delayed damage may occur. ▶ If the patient cannot tolerate light, protect the eyes with a clean, loosely tied bandage. ▶ Ensure verbal communication and physical contact with the patient. <p>DO NOT allow the patient to rub the eyes DO NOT allow the patient to tightly shut the eyes DO NOT introduce oil or ointment into the eye(s) without medical advice DO NOT use hot or tepid water.</p> |
| Skin Contact | <p>If skin contact occurs:</p> <ul style="list-style-type: none"> ▶ Immediately remove all contaminated clothing, including footwear. ▶ Flush skin and hair with running water (and soap if available). ▶ Seek medical attention in event of irritation. <p>In case of cold burns (frost-bite):</p> <ul style="list-style-type: none"> ▶ Move casualty into warmth before thawing the affected part; if feet are affected carry if possible ▶ Bathe the affected area immediately in luke-warm water (not more than 35 deg C) for 10 to 15 minutes, immersing if possible and without rubbing ▶ DO NOT apply hot water or radiant heat. ▶ Apply a clean, dry, light dressing of "fluffed-up" dry gauze bandage |

| | |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | <ul style="list-style-type: none"> ▶ If a limb is involved, raise and support this to reduce swelling ▶ If an adult is involved and where intense pain occurs provide pain killers such as paracetamol ▶ Transport to hospital, or doctor ▶ Subsequent blackening of the exposed tissue indicates potential of necrosis, which may require amputation. |
| Inhalation | <ul style="list-style-type: none"> ▶ Following exposure to gas, remove the patient from the gas source or contaminated area. ▶ NOTE: Personal Protective Equipment (PPE), including positive pressure self-contained breathing apparatus may be required to assure the safety of the rescuer. ▶ Prostheses such as false teeth, which may block the airway, should be removed, where possible, prior to initiating first aid procedures. ▶ If the patient is not breathing spontaneously, administer rescue breathing. ▶ If the patient does not have a pulse, administer CPR. ▶ If medical oxygen and appropriately trained personnel are available, administer 100% oxygen. ▶ Summon an emergency ambulance. If an ambulance is not available, contact a physician, hospital, or Poison Control Centre for further instruction. ▶ Keep the patient warm, comfortable and at rest while awaiting medical care. ▶ MONITOR THE BREATHING AND PULSE, CONTINUOUSLY. ▶ Administer rescue breathing (preferably with a demand-valve resuscitator, bag-valve mask-device, or pocket mask as trained) or CPR if necessary. |
| Ingestion | <ul style="list-style-type: none"> ▶ Not considered a normal route of entry. ▶ Avoid giving milk or oils. ▶ Avoid giving alcohol. ▶ If spontaneous vomiting appears imminent or occurs, hold patient's head down, lower than their hips to help avoid possible aspiration of vomitus. |

Most important symptoms and effects, both acute and delayed

See Section 11

Indication of any immediate medical attention and special treatment needed

For gas exposures:

BASIC TREATMENT

- ▶ Establish a patent airway with suction where necessary.
- ▶ Watch for signs of respiratory insufficiency and assist ventilation as necessary.
- ▶ Administer oxygen by non-rebreather mask at 10 to 15 l/min.
- ▶ Monitor and treat, where necessary, for pulmonary oedema .
- ▶ Monitor and treat, where necessary, for shock.
- ▶ Anticipate seizures.

ADVANCED TREATMENT

- ▶ Consider orotracheal or nasotracheal intubation for airway control in unconscious patient or where respiratory arrest has occurred.
- ▶ Positive-pressure ventilation using a bag-valve mask might be of use.
- ▶ Monitor and treat, where necessary, for arrhythmias.
- ▶ Start an IV D5W TKO. If signs of hypovolaemia are present use lactated Ringers solution. Fluid overload might create complications.
- ▶ Drug therapy should be considered for pulmonary oedema.
- ▶ Hypotension with signs of hypovolaemia requires the cautious administration of fluids. Fluid overload might create complications.
- ▶ Treat seizures with diazepam.
- ▶ Proparacaine hydrochloride should be used to assist eye irrigation.

BRONSTEIN, A.C. and CURRANCE, P.L.

EMERGENCY CARE FOR HAZARDOUS MATERIALS EXPOSURE: 2nd Ed. 1994

for intoxication due to Freons/ Halons;

A: Emergency and Supportive Measures

- ▶ Maintain an open airway and assist ventilation if necessary
- ▶ Treat coma and arrhythmias if they occur. Avoid (adrenaline) epinephrine or other sympathomimetic amines that may precipitate ventricular arrhythmias. Tachyarrhythmias caused by increased myocardial sensitisation may be treated with propranolol, 1-2 mg IV or esmolol 25-100 microgm/kg/min IV.
- ▶ Monitor the ECG for 4-6 hours

B: Specific drugs and antidotes:

- ▶ There is no specific antidote

C: Decontamination

- ▶ Inhalation; remove victim from exposure, and give supplemental oxygen if available.
- ▶ Ingestion; (a) Prehospital: Administer activated charcoal, if available. **DO NOT** induce vomiting because of rapid absorption and the risk of abrupt onset CNS depression. (b) Hospital: Administer activated charcoal, although the efficacy of charcoal is unknown. Perform gastric lavage only if the ingestion was very large and recent (less than 30 minutes)

D: Enhanced elimination:

- ▶ There is no documented efficacy for diuresis, haemodialysis, haemoperfusion, or repeat-dose charcoal.

POISONING and DRUG OVERDOSE, Californian Poison Control System Ed. Kent R Olson; 3rd Edition

- ▶ Do not administer sympathomimetic drugs unless absolutely necessary as material may increase myocardial irritability.
- ▶ No specific antidote.
- ▶ Because rapid absorption may occur through lungs if aspirated and cause systematic effects, the decision of whether to induce vomiting or not should be made by an attending physician.
- ▶ If lavage is performed, suggest endotracheal and/or esophageal control.

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- Danger from lung aspiration must be weighed against toxicity when considering emptying the stomach.
- Treatment based on judgment of the physician in response to reactions of the patient

For frost-bite caused by liquefied petroleum gas:

- If part has not thawed, place in warm water bath (41-46 C) for 15-20 minutes, until the skin turns pink or red.
- Analgesia may be necessary while thawing.
- If there has been a massive exposure, the general body temperature must be depressed, and the patient must be immediately rewarmed by whole-body immersion, in a bath at the above temperature.
- Shock may occur during rewarming.
- Administer tetanus toxoid booster after hospitalization.
- Prophylactic antibiotics may be useful.
- The patient may require anticoagulants and oxygen.

[Shell Australia 22/12/87]

SECTION 5 FIRE-FIGHTING MEASURES

Extinguishing media

SMALL FIRE: Use extinguishing agent suitable for type of surrounding fire.

LARGE FIRE: Cool cylinder.

DO NOT direct water at source of leak or venting safety devices as icing may occur.

Special hazards arising from the substrate or mixture

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|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| Fire Incompatibility | ‣ Avoid contamination with oxidising agents i.e. nitrates, oxidising acids, chlorine bleaches, pool chlorine etc. as ignition may result |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------|

Special protective equipment and precautions for fire-fighters

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| Fire Fighting | <p>----- GENERAL -----</p> <ul style="list-style-type: none"> ‣ Alert Fire Brigade and tell them location and nature of hazard. ‣ Wear breathing apparatus and protective gloves. ‣ Fight fire from a safe distance, with adequate cover. ‣ Use water delivered as a fine spray to control fire and cool adjacent area. |
| Fire/Explosion Hazard | <ul style="list-style-type: none"> ‣ Containers may explode when heated - Ruptured cylinders may rocket ‣ Fire exposed containers may vent contents through pressure relief devices. ‣ High concentrations of gas may cause asphyxiation without warning. ‣ May decompose explosively when heated or involved in fire. ‣ Contact with gas may cause burns, severe injury and/ or frostbite. <p>Decomposition may produce toxic fumes of: carbon monoxide (CO) carbon dioxide (CO₂) hydrogen fluoride other pyrolysis products typical of burning organic material.</p> <p>Contains low boiling substance: Closed containers may rupture due to pressure buildup under fire conditions.</p> |

SECTION 6 ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

See section 8

Environmental precautions

See section 12

Methods and material for containment and cleaning up

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|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Minor Spills | <ul style="list-style-type: none"> ‣ Avoid breathing vapour and any contact with liquid or gas. Protective equipment including respirator should be used. ‣ DO NOT enter confined spaces where gas may have accumulated. ‣ Increase ventilation. |
| Major Spills | <ul style="list-style-type: none"> ‣ Clear area of all unprotected personnel and move upwind. ‣ Alert Emergency Authority and advise them of the location and nature of hazard. ‣ Wear breathing apparatus and protective gloves. ‣ Prevent by any means available, spillage from entering drains and water-courses. ‣ Remove leaking cylinders to a safe place. ‣ Fit vent pipes. Release pressure under safe, controlled conditions ‣ Burn issuing gas at vent pipes. ‣ DO NOT exert excessive pressure on valve; DO NOT attempt to operate damaged valve. |

Personal Protective Equipment advice is contained in Section 8 of the SDS.

SECTION 7 HANDLING AND STORAGE

Precautions for safe handling

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| Safe handling | <ul style="list-style-type: none"> ·Consider use in closed pressurised systems, fitted with temperature, pressure and safety relief valves which are vented for safe dispersal. Use only properly specified equipment which is suitable for this product, its supply pressure and temperature ·The tubing network design connecting gas cylinders to the delivery system should include appropriate pressure indicators and vacuum or suction lines. ·Fully-welded types of pressure gauges, where the bourdon tube sensing element is welded to the gauge body, are recommended. ·Before connecting gas cylinders, ensure manifold is mechanically secure and does not containing another gas. <p>▶ DO NOT transfer gas from one cylinder to another.</p> |
| Other information | <ul style="list-style-type: none"> ▶ Cylinders should be stored in a purpose-built compound with good ventilation, preferably in the open. ▶ Such compounds should be sited and built in accordance with statutory requirements. ▶ The storage compound should be kept clear and access restricted to authorised personnel only. ▶ Cylinders stored in the open should be protected against rust and extremes of weather. |

Conditions for safe storage, including any incompatibilities

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|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Suitable container | <ul style="list-style-type: none"> ▶ DO NOT use aluminium or galvanised containers ▶ Cylinder: <ul style="list-style-type: none"> ▶ Ensure the use of equipment rated for cylinder pressure. ▶ Ensure the use of compatible materials of construction. ▶ Valve protection cap to be in place until cylinder is secured, connected. ▶ Cylinder must be properly secured either in use or in storage. |
| Storage incompatibility | <p>As a general rule, hydrofluorocarbons tend to be flammable unless they contain more fluorine atoms than hydrogen atoms.</p> <p>Haloalkanes:</p> <ul style="list-style-type: none"> ▶ are highly reactive:some of the more lightly substituted lower members are highly flammable; the more highly substituted may be used as fire suppressants, not always with the anticipated results. ▶ may react with the lighter divalent metals to produce more reactive compounds analogous to Grignard reagents. ▶ may produce explosive compounds following prolonged contact with metallic or other azides ▶ may react on contact with potassium or its alloys - although apparently stable on contact with a wide rage of halocarbons, reaction products may be shock-sensitive and may explode with great violence on light impact; severity generally increases with the degree of halocarbon substitution and potassium-sodium alloys give extremely sensitive mixtures . <p>BREThERICK L.: Handbook of Reactive Chemical Hazards</p> <ul style="list-style-type: none"> ▶ react with metal halides and active metals, eg. sodium (Na), potassium (K), lithium (Li),calcium (Ca), zinc (Zn), powdered aluminium (Al) and aluminium alloys, magnesium (Mg) and magnesium alloys. ▶ Compressed gases may contain a large amount of kinetic energy over and above that potentially available from the energy of reaction produced by the gas in chemical reaction with other substances |

SECTION 8 EXPOSURE CONTROLS / PERSONAL PROTECTION

Control parameters

OCCUPATIONAL EXPOSURE LIMITS (OEL)

INGREDIENT DATA

| Source | Ingredient | Material name | TWA | STEL | Peak | Notes |
|---------------------------------------------|------------|-----------------------------------------------------------------------------------------------------------|----------------------------------|---------------|----------------------------------|--------------------------------------|
| US NIOSH Recommended Exposure Limits (RELs) | butane | normal-Butane, Butyl hydride, Diethyl, Methylene methane [Note: Also see specific listing for isobutane.] | 800 ppm / 1900 mg/m ³ | Not Available | Not Available | Not Available |
| US ACGIH Threshold Limit Values (TLV) | butane | * Butane, all isomers | Not Available | 1000 ppm | Not Available | TLV® Basis: CNS impair |
| US NIOSH Recommended Exposure Limits (RELs) | isopentane | Pentane, normal-Pentane | 120 ppm / 350 mg/m ³ | Not Available | 610 ppm / 1800 mg/m ³ | [15-minute] |
| US ACGIH Threshold Limit Values (TLV) | isopentane | Pentane, all isomers | 1000 ppm | Not Available | Not Available | TLV® Basis: Narcosis; resp tract irr |

EMERGENCY LIMITS

| Ingredient | Material name | TEEL-1 | TEEL-2 | TEEL-3 |
|------------------|------------------------------------------------------|---------------|---------------|---------------|
| R32 | Methylene fluoride; (Difluoromethane; HFC-32) | 3,000 ppm | 6,500 ppm | 39,000 ppm |
| R-134A | HFC 134a; (Tetrafluoroethane, 1,1,1,2-) | Not Available | Not Available | Not Available |
| n-Butane, 99.95% | Butane | Not Available | Not Available | Not Available |
| Isopentane | Isopentane; (Ethyl dimethyl methane; 2-Methylbutane) | 3000 ppm | 33000 ppm | 200000 ppm |

| Ingredient | Original IDLH | Revised IDLH |
|------------|---------------|--------------|
| | | |

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| | | |
|------------------|---------------|---------------|
| R32 | Not Available | Not Available |
| R125 | Not Available | Not Available |
| R-134A | Not Available | Not Available |
| n-Butane, 99.95% | Not Available | 1,600 ppm |
| Isopentane | Not Available | Not Available |

MATERIAL DATA

For butane:


Odour Threshold Value: 2591 ppm (recognition)

Butane in common with other homologues in the straight chain saturated aliphatic hydrocarbon series is not characterised by its toxicity but by its narcosis-inducing effects at high concentrations. The TLV is based on analogy with pentane by comparing their lower explosive limits in air. It is concluded that this limit will protect workers against the significant risk of drowsiness and other narcotic effects.

Odour Safety Factor(OSF)

OSF=0.22 (n-BUTANE)

Exposure controls

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|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Appropriate engineering controls | <p>Engineering controls are used to remove a hazard or place a barrier between the worker and the hazard. Well-designed engineering controls can be highly effective in protecting workers and will typically be independent of worker interactions to provide this high level of protection.</p> <p>The basic types of engineering controls are:</p> <p>Process controls which involve changing the way a job activity or process is done to reduce the risk.</p> <p>Enclosure and/or isolation of emission source which keeps a selected hazard "physically" away from the worker and ventilation that strategically "adds" and "removes" air in the work environment.</p> |
| Personal protection |  |
| Eye and face protection | <ul style="list-style-type: none"> Chemical goggles. Full face shield may be required for supplementary but never for primary protection of eyes. Contact lenses may pose a special hazard; soft contact lenses may absorb and concentrate irritants. A written policy document, describing the wearing of lenses or restrictions on use, should be created for each workplace or task. |
| Skin protection | See Hand protection below |
| Hands/feet protection | <ul style="list-style-type: none"> When handling sealed and suitably insulated cylinders wear cloth or leather gloves. Insulated gloves: <p>NOTE: Insulated gloves should be loose fitting so that they may be removed quickly if liquid is spilled upon them. Insulated gloves are not made to permit hands to be placed in the liquid; they provide only short-term protection from accidental contact with the liquid.</p> |
| Body protection | See Other protection below |
| Other protection | <ul style="list-style-type: none"> Protective overalls, closely fitted at neck and wrist. Eye-wash unit. Ensure availability of lifeline in confined spaces. Staff should be trained in all aspects of rescue work. |

Respiratory protection

Type AX Filter of sufficient capacity. (AS/NZS 1716 & 1715, EN 143:2000 & 149:2001, ANSI Z88 or national equivalent)

Where the concentration of gas/particulates in the breathing zone, approaches or exceeds the "Exposure Standard" (or ES), respiratory protection is required.

Degree of protection varies with both face-piece and Class of filter; the nature of protection varies with Type of filter.

| Required Minimum Protection Factor | Half-Face Respirator | Full-Face Respirator | Powered Air Respirator |
|------------------------------------|----------------------|----------------------|------------------------|
| up to 5 x ES | AX-AUS / Class 1 | - | AX-PAPR-AUS / Class 1 |
| up to 25 x ES | Air-line* | AX-2 | AX-PAPR-2 |
| up to 50 x ES | - | AX-3 | - |
| 50+ x ES | - | Air-line** | - |

* - Continuous-flow; ** - Continuous-flow or positive pressure demand

^ - Full-face

A(All classes) = Organic vapours, B AUS or B1 = Acid gasses, B2 = Acid gas or hydrogen cyanide(HCN), B3 = Acid gas or hydrogen cyanide(HCN), E = Sulfur dioxide(SO₂), G = Agricultural chemicals, K = Ammonia(NH₃), Hg = Mercury, NO = Oxides of nitrogen, MB = Methyl bromide, AX = Low boiling point organic compounds(below 65 degC)

- Cartridge respirators should never be used for emergency ingress or in areas of unknown vapour concentrations or oxygen content.
- The wearer must be warned to leave the contaminated area immediately on detecting any odours through the respirator. The odour may indicate that the mask is not functioning properly, that the vapour concentration is too high, or that the mask is not properly fitted. Because of these limitations, only restricted use of cartridge respirators is considered appropriate.
- Cartridge performance is affected by humidity. Cartridges should be changed after 2 hr of continuous use unless it is determined that the humidity is less than 75%, in which case, cartridges can be used for 4 hr. Used cartridges should be discarded daily, regardless of the length of time used

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- ▶ Positive pressure, full face, air-supplied breathing apparatus should be used for work in enclosed spaces if a leak is suspected or the primary containment is to be opened (e.g. for a cylinder change)
- ▶ Air-supplied breathing apparatus is required where release of gas from primary containment is either suspected or demonstrated.

SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

| | | | |
|-----------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------|-----------------|
| Appearance | Colourless liquefied gas with slight ether-like odour; does not mix with water. | | |
| Physical state | Liquefied Gas | Relative density (Water = 1) | 1.14 @ 25 deg.C |
| Odour | Not Available | Partition coefficient n-octanol / water | Not Available |
| Odour threshold | Not Available | Auto-ignition temperature (°C) | Not Available |
| pH (as supplied) | Not Available | Decomposition temperature | Not Available |
| Melting point / freezing point (°C) | Not Available | Viscosity (cSt) | Not Available |
| Initial boiling point and boiling range (°C) | -43 @ atmospheric pressure | Molecular weight (g/mol) | Not Applicable |
| Flash point (°C) | Not Available | Taste | Not Available |
| Evaporation rate | Not Available | Explosive properties | Not Available |
| Flammability | Not Available | Oxidising properties | Not Available |
| Upper Explosive Limit (%) | Not Available | Surface Tension (dyn/cm or mN/m) | Not Available |
| Lower Explosive Limit (%) | Not Available | Volatile Component (%vol) | 100 |
| Vapour pressure (kPa) | 1112.1 @ 25 deg.C | Gas group | Not Available |
| Solubility in water | Immiscible | pH as a solution (1%) | Not Available |
| Vapour density (Air = 1) | 3.5 @ 25 deg.C | VOC g/L | Not Available |

SECTION 10 STABILITY AND REACTIVITY

| | |
|-------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Reactivity | See section 7 |
| Chemical stability | <ul style="list-style-type: none"> ▶ Unstable in the presence of incompatible materials. ▶ Product is considered stable. ▶ Hazardous polymerisation will not occur. ▶ Extremely high temperatures. |
| Possibility of hazardous reactions | See section 7 |
| Conditions to avoid | See section 7 |
| Incompatible materials | See section 7 |
| Hazardous decomposition products | See section 5 |

SECTION 11 TOXICOLOGICAL INFORMATION

Information on toxicological effects

| | |
|----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Inhaled | <p>Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by narcosis, reduced alertness, loss of reflexes, lack of coordination and vertigo.</p> <p>Inhalation of vapours or aerosols (mists, fumes), generated by the material during the course of normal handling, may be damaging to the health of the individual.</p> <p>Limited evidence or practical experience suggests that the material may produce irritation of the respiratory system, in a significant number of individuals, following inhalation. In contrast to most organs, the lung is able to respond to a chemical insult by first removing or neutralising the irritant and then repairing the damage. The repair process, which initially evolved to protect mammalian lungs from foreign matter and antigens, may however, produce further lung damage resulting in the impairment of gas exchange, the primary function of the lungs. Respiratory tract irritation often results in an inflammatory response involving the recruitment and activation of many cell types, mainly derived from the vascular system.</p> <p>Common, generalised symptoms associated with non-toxic gas inhalation include :</p> <ul style="list-style-type: none"> ▶ central nervous system effects such as headache, confusion, dizziness, progressive stupor, coma and seizures; ▶ respiratory system complications may include tachypnoea and dyspnoea; ▶ cardiovascular effects may include circulatory collapse and arrhythmias; ▶ gastrointestinal effects may also be present and may include mucous membrane irritation and nausea and vomiting. |
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| | <p>Material is highly volatile and may quickly form a concentrated atmosphere in confined or unventilated areas. The vapour may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.</p> <p>Exposure to high concentrations of fluorocarbons may produce cardiac arrhythmias or cardiac arrest due sensitisation of the heart to adrenalin or noradrenalin. Deaths associated with exposures to fluorocarbons (specifically halogenated aliphatics) have occurred in occupational settings and in inhalation of bronchodilator drugs.</p> <p>Bronchospasm consistently occurs in human subjects inhaling fluorocarbons. At a measured concentration of 1700 ppm of one of the commercially available aerosols there is a biphasic change in ventilatory capacity, the first reduction occurring within a few minutes and the second delayed up to 30 minutes.</p> <p>Acute intoxication by halogenated aliphatic hydrocarbons appears to take place over two stages. Signs of a reversible narcosis are evident in the first stage and in the second stage signs of injury to organs may become evident, a single organ alone is (almost) never involved.</p> | | | | | | |
|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|------------|----------------------------------------------------|---------------|--------------------------------------------|--|
| Ingestion | <p>Overexposure is unlikely in this form.</p> <p>Not normally a hazard due to physical form of product.</p> <p>Considered an unlikely route of entry in commercial/industrial environments</p> | | | | | | |
| Skin Contact | <p>Repeated exposure may cause skin cracking, flaking or drying following normal handling and use.</p> <p>Limited evidence exists, or practical experience predicts, that the material either produces inflammation of the skin in a substantial number of individuals following direct contact, and/or produces significant inflammation when applied to the healthy intact skin of animals, for up to four hours, such inflammation being present twenty-four hours or more after the end of the exposure period. Skin irritation may also be present after prolonged or repeated exposure; this may result in a form of contact dermatitis (nonallergic). The dermatitis is often characterised by skin redness (erythema) and swelling (oedema) which may progress to blistering (vesiculation), scaling and thickening of the epidermis. At the microscopic level there may be intercellular oedema of the spongy layer of the skin (spongiosis) and intracellular oedema of the epidermis.</p> <p>In common with other halogenated aliphatics, fluorocarbons may cause dermal problems due to a tendency to remove natural oils from the skin causing irritation and the development of dry, sensitive skin. They do not appear to be appreciably absorbed.</p> <p>Open cuts, abraded or irritated skin should not be exposed to this material</p> <p>Entry into the blood-stream through, for example, cuts, abrasions, puncture wounds or lesions, may produce systemic injury with harmful effects. Examine the skin prior to the use of the material and ensure that any external damage is suitably protected.</p> <p>Vapourising liquid causes rapid cooling and contact may cause cold burns, frostbite, even through normal gloves. Frozen skin tissues are painless and appear waxy and yellow. Signs and symptoms of frost-bite may include "pins and needles", paleness followed by numbness, a hardening and stiffening of the skin, a progression of colour changes in the affected area, (first white, then mottled and blue and eventually black; on recovery, red, hot, painful and blistered).</p> | | | | | | |
| Eye | <p>Although the material is not thought to be an irritant (as classified by EC Directives), direct contact with the eye may produce transient discomfort characterised by tearing or conjunctival redness (as with windburn).</p> <p>Vapourising liquid causes rapid cooling and contact may cause cold burns, frostbite, even through normal gloves. Frozen skin tissues are painless and appear waxy and yellow. Signs and symptoms of frost-bite may include "pins and needles", paleness followed by numbness, a hardening and stiffening of the skin, a progression of colour changes in the affected area, (first white, then mottled and blue and eventually black; on recovery, red, hot, painful and blistered).</p> | | | | | | |
| Chronic | <p>Limited evidence suggests that repeated or long-term occupational exposure may produce cumulative health effects involving organs or biochemical systems.</p> <p>Principal route of occupational exposure to the gas is by inhalation.</p> <p>It is generally accepted that the fluorocarbons are less toxic than the corresponding halogenated aliphatic based on chlorine. Repeated inhalation exposure to the fluorocarbon FC-11 does not produce pathologic lesions of the liver and other visceral organs in experimental animals. There has been conjecture in non-scientific publications that fluorocarbons may cause leukemia, cancer, sterility and birth defects; these have not been verified by current research. The high incidence of cancer, spontaneous abortion and congenital anomalies amongst hospital personnel, repeatedly exposed to fluorine-containing general anaesthetics, has caused some scientists to call for a lowering of the fluorocarbon exposure standard to 5 ppm since some are mutagens.</p> | | | | | | |
| R438A (Isceon MO99) | <table border="1"> <thead> <tr> <th>TOXICITY</th> <th>IRRITATION</th> </tr> </thead> <tbody> <tr> <td>Not Available</td> <td>Not Available</td> </tr> </tbody> </table> | TOXICITY | IRRITATION | Not Available | Not Available | | |
| TOXICITY | IRRITATION | | | | | | |
| Not Available | Not Available | | | | | | |
| R32 | <table border="1"> <thead> <tr> <th>TOXICITY</th> <th>IRRITATION</th> </tr> </thead> <tbody> <tr> <td>Inhalation (rat) LC50: 1890 mg/l/4H^[2]</td> <td>Not Available</td> </tr> <tr> <td>Oral (rat) LD50: 1890 mg/kg^[2]</td> <td></td> </tr> </tbody> </table> | TOXICITY | IRRITATION | Inhalation (rat) LC50: 1890 mg/l/4H ^[2] | Not Available | Oral (rat) LD50: 1890 mg/kg ^[2] | |
| TOXICITY | IRRITATION | | | | | | |
| Inhalation (rat) LC50: 1890 mg/l/4H ^[2] | Not Available | | | | | | |
| Oral (rat) LD50: 1890 mg/kg ^[2] | | | | | | | |
| R125 | <table border="1"> <thead> <tr> <th>TOXICITY</th> <th>IRRITATION</th> </tr> </thead> <tbody> <tr> <td>Inhalation (rat) LC50: 2910 mg/l/4H^[2]</td> <td>Not Available</td> </tr> </tbody> </table> | TOXICITY | IRRITATION | Inhalation (rat) LC50: 2910 mg/l/4H ^[2] | Not Available | | |
| TOXICITY | IRRITATION | | | | | | |
| Inhalation (rat) LC50: 2910 mg/l/4H ^[2] | Not Available | | | | | | |
| R-134A | <table border="1"> <thead> <tr> <th>TOXICITY</th> <th>IRRITATION</th> </tr> </thead> <tbody> <tr> <td>Inhalation (rat) LC50: 1500 mg/l/4h^[2]</td> <td>Not Available</td> </tr> </tbody> </table> | TOXICITY | IRRITATION | Inhalation (rat) LC50: 1500 mg/l/4h ^[2] | Not Available | | |
| TOXICITY | IRRITATION | | | | | | |
| Inhalation (rat) LC50: 1500 mg/l/4h ^[2] | Not Available | | | | | | |
| n-Butane, 99.95% | <table border="1"> <thead> <tr> <th>TOXICITY</th> <th>IRRITATION</th> </tr> </thead> <tbody> <tr> <td>Inhalation (rat) LC50: 658 mg/l/4H^[2]</td> <td>Not Available</td> </tr> </tbody> </table> | TOXICITY | IRRITATION | Inhalation (rat) LC50: 658 mg/l/4H ^[2] | Not Available | | |
| TOXICITY | IRRITATION | | | | | | |
| Inhalation (rat) LC50: 658 mg/l/4H ^[2] | Not Available | | | | | | |

R438A (Isceon MO99)

| | | |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| Isopentane | TOXICITY | IRRITATION |
| | Inhalation (rat) LC50: 280 mg/l/4h ^[2] | Not Available |
| | Oral (rat) LD50: >2000 mg/kg ^[1] | |
| Legend: | 1. Value obtained from Europe ECHA Registered Substances - Acute toxicity 2. * Value obtained from manufacturer's SDS. Unless otherwise specified data extracted from RTECS - Register of Toxic Effect of chemical Substances | |

| | |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| R125 | Cardiac sensitisation threshold limit >245400 mg/m3 Anaesthetic effects threshold limit 490800 mg/m3 * DuPont SDS |
| R-134A | Disinfection by products (DBPs) re formed when disinfectants such as chlorine, chloramine, and ozone react with organic and inorganic matter in water. The observations that some DBPs such as trihalomethanes (THMs), di-/trichloroacetic acids, and 3-chloro-4-(dichloromethyl)-5-hydroxy-2(5H)-furanone (MX) are carcinogenic in animal studies have raised public concern over the possible adverse health effects of DBPs. To date, several hundred DBPs have been identified. Numerous haloalkanes and haloalkenes have been tested for carcinogenic and mutagenic activities. * with added oxygen - ZhongHao New Chemical Materials MSDS Excessive concentration can have a narcotic effect; inhalation of high concentrations of decomposition products can cause lung oedema. |

| | | | |
|-----------------------------------|---|--------------------------|---|
| Acute Toxicity | ✗ | Carcinogenicity | ✗ |
| Skin Irritation/Corrosion | ✗ | Reproductivity | ✗ |
| Serious Eye Damage/Irritation | ✗ | STOT - Single Exposure | ✗ |
| Respiratory or Skin sensitisation | ✗ | STOT - Repeated Exposure | ✗ |
| Mutagenicity | ✗ | Aspiration Hazard | ✗ |

Legend: ✗ – Data either not available or does not fill the criteria for classification
✓ – Data available to make classification

SECTION 12 ECOLOGICAL INFORMATION

Toxicity

| R438A (Isceon MO99) | ENDPOINT | TEST DURATION (HR) | SPECIES | VALUE | SOURCE |
|---------------------|---------------|-------------------------------|-------------------------------|---------------|---------------|
| | Not Available | Not Available | Not Available | Not Available | Not Available |
| R32 | ENDPOINT | TEST DURATION (HR) | SPECIES | VALUE | SOURCE |
| | LC50 | 96 | Fish | 1-405mg/L | 2 |
| | EC50 | 48 | Crustacea | 1-573mg/L | 2 |
| | EC50 | 96 | Algae or other aquatic plants | 1-888mg/L | 2 |
| R125 | ENDPOINT | TEST DURATION (HR) | SPECIES | VALUE | SOURCE |
| | NOEC | 96 | Fish | 10mg/L | 2 |
| | LC50 | 96 | Fish | 43.427mg/L | 3 |
| | EC50 | 48 | Crustacea | >97.9mg/L | 2 |
| R-134A | ENDPOINT | TEST DURATION (HR) | SPECIES | VALUE | SOURCE |
| | EC50 | 72 | Algae or other aquatic plants | >114mg/L | 2 |
| | EC50 | 96 | Algae or other aquatic plants | 97.260mg/L | 3 |
| | NOEC | 72 | Algae or other aquatic plants | ca.13.2mg/L | 2 |
| n-Butane, 99.95% | ENDPOINT | TEST DURATION (HR) | SPECIES | VALUE | SOURCE |
| | LC50 | 96 | Fish | 5.862mg/L | 3 |
| EC50 | 96 | Algae or other aquatic plants | 7.71mg/L | 2 | |
| Isopentane | ENDPOINT | TEST DURATION (HR) | SPECIES | VALUE | SOURCE |
| | LC50 | 96 | Fish | 3.653mg/L | 3 |

Continued...

R438A (Isceon MO99)

| | | | | | |
|----------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----|-------------------------------|----------|---|
| | EC50 | 48 | Crustacea | 2.3mg/L | 2 |
| | EC50 | 72 | Algae or other aquatic plants | 1.26mg/L | 2 |
| | NOEC | 72 | Algae or other aquatic plants | 7.51mg/L | 2 |
| Legend: | Extracted from 1. IUCLID Toxicity Data 2. Europe ECHA Registered Substances - Ecotoxicological Information - Aquatic Toxicity 3. EPIWIN Suite V3.12 (QSAR) - Aquatic Toxicity Data (Estimated) 4. US EPA, Ecotox database - Aquatic Toxicity Data 5. ECETOC Aquatic Hazard Assessment Data 6. NITE (Japan) - Bioconcentration Data 7. METI (Japan) - Bioconcentration Data 8. Vendor Data | | | | |

In addition to carbon dioxide (CO2), methane (CH4) and nitrous oxide (N2O), the greenhouse gases mentioned in the Kyoto Protocol include synthetic substances that share the common feature of being highly persistent in the atmosphere and exhibiting very high specific radiative forcing (radiative forcing is the change in the balance between radiation coming into the atmosphere and radiation out; a positive radiative forcing tends on average to warm the surface of the earth). These synthetic substances include hydrocarbons that are partially fluorinated (HCFs) or totally fluorinated (PFCs) as well as sulfur hexafluoride (SF6).

The greenhouse potential of these substances, expressed as multiples of that of CO2, are within the range of 140 to 11,700 for HFCs, from 6500 to 9,200 for PFCs and 23,900 for SF6. Once emitted into the atmosphere, these substances have an impact on the environment for decades, centuries, or in certain instances, for thousands of years.

DO NOT discharge into sewer or waterways.

Persistence and degradability

| Ingredient | Persistence: Water/Soil | Persistence: Air |
|------------------|-------------------------|------------------|
| R32 | LOW | LOW |
| R125 | HIGH | HIGH |
| R-134A | HIGH | HIGH |
| n-Butane, 99.95% | LOW | LOW |
| Isopentane | HIGH | HIGH |

Bioaccumulative potential

| Ingredient | Bioaccumulation |
|------------------|-----------------------|
| R32 | LOW (LogKOW = 0.2) |
| R125 | LOW (LogKOW = 1.5472) |
| R-134A | LOW (LogKOW = 1.68) |
| n-Butane, 99.95% | LOW (LogKOW = 2.89) |
| Isopentane | LOW (LogKOW = 2.7234) |

Mobility in soil

| Ingredient | Mobility |
|------------------|-------------------|
| R32 | LOW (KOC = 23.74) |
| R125 | LOW (KOC = 154.4) |
| R-134A | LOW (KOC = 96.63) |
| n-Butane, 99.95% | LOW (KOC = 43.79) |
| Isopentane | LOW (KOC = 67.7) |


SECTION 13 DISPOSAL CONSIDERATIONS

Waste treatment methods

| | |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product / Packaging disposal | <ul style="list-style-type: none"> ▶ Evaporate residue at an approved site. ▶ Return empty containers to supplier. If containers are marked non-returnable establish means of disposal with manufacturer prior to purchase. ▶ Ensure damaged or non-returnable cylinders are gas-free before disposal. |
|-------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

SECTION 14 TRANSPORT INFORMATION

Labels Required

| | |
|-------------------------|-------------------------------------------------------------------------------------|
| |  |
| Marine Pollutant | NO |

R438A (Isceon MO99)

Land transport (DOT)

| | | |
|------------------------------|---------------------------|----------------|
| UN number | 1078 | |
| UN proper shipping name | Refrigerant gases, n.o.s. | |
| Transport hazard class(es) | Class | 2.2 |
| | Subrisk | Not Applicable |
| Packing group | Not Applicable | |
| Environmental hazard | Not Applicable | |
| Special precautions for user | Hazard Label | 2.2 |
| | Special provisions | T50 |

Air transport (ICAO-IATA / DGR)

| | | |
|------------------------------|-----------------------------------------------------------|----------------|
| UN number | 1078 | |
| UN proper shipping name | Refrigerant gas, n.o.s. * | |
| Transport hazard class(es) | ICAO/IATA Class | 2.2 |
| | ICAO / IATA Subrisk | Not Applicable |
| | ERG Code | 2L |
| Packing group | Not Applicable | |
| Environmental hazard | Not Applicable | |
| Special precautions for user | Special provisions | Not Applicable |
| | Cargo Only Packing Instructions | 200 |
| | Cargo Only Maximum Qty / Pack | 150 kg |
| | Passenger and Cargo Packing Instructions | 200 |
| | Passenger and Cargo Maximum Qty / Pack | 75 kg |
| | Passenger and Cargo Limited Quantity Packing Instructions | Forbidden |
| | Passenger and Cargo Limited Maximum Qty / Pack | Forbidden |

Sea transport (IMDG-Code / GGVSee)

| | | |
|------------------------------|-------------------------|----------------|
| UN number | 1078 | |
| UN proper shipping name | REFRIGERANT GAS, N.O.S. | |
| Transport hazard class(es) | IMDG Class | 2.2 |
| | IMDG Subrisk | Not Applicable |
| Packing group | Not Applicable | |
| Environmental hazard | Not Applicable | |
| Special precautions for user | EMS Number | F-C, S-V |
| | Special provisions | 274 |
| | Limited Quantities | 120 mL |

Transport in bulk according to Annex II of MARPOL and the IBC code

Not Applicable

SECTION 15 REGULATORY INFORMATION

Safety, health and environmental regulations / legislation specific for the substance or mixture

R32(75-10-5) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Air Transport Association (IATA) Dangerous Goods Regulations
 International Maritime Dangerous Goods Requirements (IMDG Code)
 United Nations Recommendations on the Transport of Dangerous Goods Model Regulations
 US - Pennsylvania - Hazardous Substance List
 US AIHA Workplace Environmental Exposure Levels (WEELs)
 US CWA (Clean Water Act) - Toxic Pollutants
 US Department of Transportation (DOT) List of Hazardous Substances and Reportable Quantities - Hazardous Substances Other Than Radionuclides
 US Department of Transportation (DOT), Hazardous Material Table

US DOE Temporary Emergency Exposure Limits (TEELs)
 US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide
 US Postal Service (USPS) Numerical Listing of Proper Shipping Names by Identification (ID) Number
 US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory
 US Toxicology Excellence for Risk Assessment (TERA) Workplace Environmental Exposure Levels (WEEL)
 US TSCA Chemical Substance Inventory - Interim List of Active Substances
 US TSCA New Chemical Exposure Limits (NCEL)

R125(354-33-6) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Air Transport Association (IATA) Dangerous Goods Regulations
 International Maritime Dangerous Goods Requirements (IMDG Code)
 United Nations Recommendations on the Transport of Dangerous Goods Model Regulations
 US AIHA Workplace Environmental Exposure Levels (WEELs)
 US Department of Transportation (DOT), Hazardous Material Table

US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide
 US Postal Service (USPS) Numerical Listing of Proper Shipping Names by Identification (ID) Number
 US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory
 US Toxicology Excellence for Risk Assessment (TERA) Workplace Environmental Exposure Levels (WEEL)
 US TSCA Chemical Substance Inventory - Interim List of Active Substances

R-134A(811-97-2) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Air Transport Association (IATA) Dangerous Goods Regulations
 International Maritime Dangerous Goods Requirements (IMDG Code)
 United Nations Recommendations on the Transport of Dangerous Goods Model Regulations
 US - Washington Toxic air pollutants and their ASIL, SQER and de minimis emission values
 US AIHA Workplace Environmental Exposure Levels (WEELs)
 US Department of Transportation (DOT), Hazardous Material Table

US DOE Temporary Emergency Exposure Limits (TEELs)
 US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide
 US Postal Service (USPS) Numerical Listing of Proper Shipping Names by Identification (ID) Number
 US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory
 US Toxicology Excellence for Risk Assessment (TERA) Workplace Environmental Exposure Levels (WEEL)
 US TSCA Chemical Substance Inventory - Interim List of Active Substances

N-BUTANE, 99.95%(106-97-8.) IS FOUND ON THE FOLLOWING REGULATORY LISTS

International Air Transport Association (IATA) Dangerous Goods Regulations
 International Maritime Dangerous Goods Requirements (IMDG Code)
 United Nations Recommendations on the Transport of Dangerous Goods Model Regulations
 US - Alaska Limits for Air Contaminants
 US - California Permissible Exposure Limits for Chemical Contaminants
 US - Hawaii Air Contaminant Limits
 US - Massachusetts - Right To Know Listed Chemicals
 US - Michigan Exposure Limits for Air Contaminants
 US - Minnesota Permissible Exposure Limits (PELs)
 US - Oregon Permissible Exposure Limits (Z-1)
 US - Pennsylvania - Hazardous Substance List
 US - Rhode Island Hazardous Substance List
 US - Tennessee Occupational Exposure Limits - Limits For Air Contaminants
 US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants

US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants
 US - Washington Permissible exposure limits of air contaminants
 US ACGIH Threshold Limit Values (TLV)
 US Chemical Footprint Project - Chemicals of High Concern List
 US Department of Homeland Security (DHS) - Chemical Facility Anti-Terrorism Standards (CFATS) - Chemicals of Interest
 US Department of Transportation (DOT), Hazardous Material Table
 US DOE Temporary Emergency Exposure Limits (TEELs)
 US DOT Coast Guard Bulk Hazardous Materials - List of Flammable and Combustible Bulk Liquid Cargoes
 US NIOSH Recommended Exposure Limits (RELs)
 US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide
 US Postal Service (USPS) Numerical Listing of Proper Shipping Names by Identification (ID) Number
 US Spacecraft Maximum Allowable Concentrations (SMACs) for Airborne Contaminants
 US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory
 US TSCA Chemical Substance Inventory - Interim List of Active Substances

ISOPENTANE(78-78-4) IS FOUND ON THE FOLLOWING REGULATORY LISTS

| | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IMO IBC Code Chapter 17: Summary of minimum requirements | US - Vermont Permissible Exposure Limits Table Z-1-A Transitional Limits for Air Contaminants |
| IMO MARPOL (Annex II) - List of Noxious Liquid Substances Carried in Bulk | US ACGIH Threshold Limit Values (TLV) |
| IMO Provisional Categorization of Liquid Substances - List 2: Pollutant only mixtures containing at least 99% by weight of components already assessed by IMO | US Coast Guard, Department of Homeland Security Part 153: Ships Carrying Bulk Liquid, Liquefied gas or compressed gas hazardous materials. Table 1 to Part 153 --Summary of Minimum Requirements |
| International Air Transport Association (IATA) Dangerous Goods Regulations | US Department of Homeland Security (DHS) - Chemical Facility Anti-Terrorism Standards (CFATS) - Chemicals of Interest |
| International Maritime Dangerous Goods Requirements (IMDG Code) | US Department of Transportation (DOT), Hazardous Material Table |
| United Nations Recommendations on the Transport of Dangerous Goods Model Regulations | US DOE Temporary Emergency Exposure Limits (TEELs) |
| US - Alaska Limits for Air Contaminants | US DOT Coast Guard Bulk Hazardous Materials - List of Flammable and Combustible Bulk Liquid Cargoes |
| US - Idaho - Limits for Air Contaminants | US NIOSH Recommended Exposure Limits (RELs) |
| US - Massachusetts - Right To Know Listed Chemicals | US Postal Service (USPS) Hazardous Materials Table: Postal Service Mailability Guide |
| US - Minnesota Permissible Exposure Limits (PELs) | US Postal Service (USPS) Numerical Listing of Proper Shipping Names by Identification (ID) Number |
| US - Pennsylvania - Hazardous Substance List | US Spacecraft Maximum Allowable Concentrations (SMACs) for Airborne Contaminants |
| US - Rhode Island Hazardous Substance List | US Toxic Substances Control Act (TSCA) - Chemical Substance Inventory |
| US - Vermont Permissible Exposure Limits Table Z-1-A Final Rule Limits for Air Contaminants | US TSCA Chemical Substance Inventory - Interim List of Active Substances |

Federal Regulations

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SECTION 311/312 HAZARD CATEGORIES

| | |
|--------------------------------------------------------------|-----|
| Flammable (Gases, Aerosols, Liquids, or Solids) | No |
| Gas under pressure | Yes |
| Explosive | No |
| Self-heating | No |
| Pyrophoric (Liquid or Solid) | No |
| Pyrophoric Gas | No |
| Corrosive to metal | No |
| Oxidizer (Liquid, Solid or Gas) | No |
| Organic Peroxide | No |
| Self-reactive | No |
| In contact with water emits flammable gas | No |
| Combustible Dust | No |
| Carcinogenicity | No |
| Acute toxicity (any route of exposure) | No |
| Reproductive toxicity | No |
| Skin Corrosion or Irritation | No |
| Respiratory or Skin Sensitization | No |
| Serious eye damage or eye irritation | No |
| Specific target organ toxicity (single or repeated exposure) | No |
| Aspiration Hazard | No |
| Germ cell mutagenicity | No |
| Simple Asphyxiant | Yes |
| Hazards Not Otherwise Classified | No |

US. EPA CERCLA HAZARDOUS SUBSTANCES AND REPORTABLE QUANTITIES (40 CFR 302.4)

None Reported

State Regulations

US. CALIFORNIA PROPOSITION 65

None Reported

National Inventory Status

| National Inventory | Status |
|--------------------|--------|
|--------------------|--------|

| | |
|-------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Australia - AICS | Yes |
| Canada - DSL | Yes |
| Canada - NDSL | No (Isopentane; R32; R125; n-Butane, 99.95%; R-134A) |
| China - IECSC | No (R32) |
| Europe - EINEC / ELINCS / NLP | Yes |
| Japan - ENCS | Yes |
| Korea - KECI | Yes |
| New Zealand - NZIoC | Yes |
| Philippines - PICCS | Yes |
| USA - TSCA | Yes |
| Taiwan - TCSI | Yes |
| Mexico - INSQ | Yes |
| Vietnam - NCI | Yes |
| Russia - ARIPS | Yes |
| Thailand - TECl | Yes |
| Legend: | <p><i>Yes = All CAS declared ingredients are on the inventory</i></p> <p><i>No = Not determined or one or more ingredients are not on the inventory and are not exempt from listing(see specific ingredients in brackets)</i></p> |

SECTION 16 OTHER INFORMATION

| | |
|----------------------|---------------|
| Revision Date | 25/01/2016 |
| Initial Date | Not Available |

SDS Version Summary

| Version | Issue Date | Sections Updated |
|---------|------------|------------------|
| 5.1.1.1 | 25/01/2016 | Classification |

Other information

Classification of the preparation and its individual components has drawn on official and authoritative sources as well as independent review by the Chemwatch Classification committee using available literature references.

The SDS is a Hazard Communication tool and should be used to assist in the Risk Assessment. Many factors determine whether the reported Hazards are Risks in the workplace or other settings. Risks may be determined by reference to Exposures Scenarios. Scale of use, frequency of use and current or available engineering controls must be considered.

Definitions and abbreviations

PC—TWA: Permissible Concentration-Time Weighted Average
 PC—STEL: Permissible Concentration-Short Term Exposure Limit
 IARC: International Agency for Research on Cancer
 ACGIH: American Conference of Governmental Industrial Hygienists
 STEL: Short Term Exposure Limit
 TEEL: Temporary Emergency Exposure Limit.
 IDLH: Immediately Dangerous to Life or Health Concentrations
 OSF: Odour Safety Factor
 NOAEL :No Observed Adverse Effect Level
 LOAEL: Lowest Observed Adverse Effect Level
 TLV: Threshold Limit Value
 LOD: Limit Of Detection
 OTV: Odour Threshold Value
 BCF: BioConcentration Factors
 BEI: Biological Exposure Index

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