NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

Section 1 - CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME
natural gas, refrigerated liquid

SYNONYMS
LNG, "high methane natural gas", "Radon 222"

PROPER SHIPPING NAME
METHANE, REFRIGERATED LIQUID or NATURAL GAS, REFRIGERATED LIQUID

PRODUCT USE
Constituent of illuminating and cooking gas, in the manufacture of hydrogen, hydrogen cyanide, ammonia, acetylene, formaldehyde, in organic syntheses.

HAZARD RATINGS

		Min — Max
Flammability:	4	
Toxicity:	2	
Body Contact:	2	
Reactivity:	1	
Chronic:	2	

Min/Nil=0
Low=1
Moderate=2
High=3
Extreme=4

Section 2 - HAZARDS IDENTIFICATION

STATEMENT OF HAZARDOUS NATURE
DANGEROUS GOODS. NON-HAZARDOUS SUBSTANCE. According to the Criteria of NOHSC, and the ADG Code.

POISONS SCHEDULE
None

RISK
- Extremely flammable.
- Risk of explosion if heated under confinement.
- Inhalation may produce health damage*.
- Cumulative effects may result following exposure*.
- May produce discomfort of the eyes and respiratory tract*.
- Limited evidence of a carcinogenic effect*.
- Vapours potentially cause drowsiness and dizziness*.

* (limited evidence).

SAFETY
- Keep away from sources of ignition. No smoking.
- Do not breathe gas/ fumes/ vapour/ spray.
- Avoid contact with skin.
- Wear eye/ face protection.
- Use only in well ventilated areas.
- Keep container in a well ventilated place.
- Keep container tightly closed.
- In case of contact with eyes rinse with plenty of water and contact Doctor or Poisons Information Centre.
- This material and its container must be disposed of as hazardous waste.

Section 3 - COMPOSITION / INFORMATION ON INGREDIENTS

NAME	CAS RN	%
methane	74-82-8	<93
Typical impurities:		
ethane	74-84-0	<4
propane	74-98-6	<1

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

butanes		<0.4
CxH2x+2 (x=5 and above)		<0.1
carbon dioxide	124-38-9	<0.7^
nitrogen	7727-37-9.	<0.6^
oxygen	7782-44-7.	<0.1^
radon-222	14859-67-7	

Section 4 - FIRST AID MEASURES

SWALLOWED

■

- Not considered a normal route of entry.

EYE

■

- 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.

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.

SKIN

■ If skin or hair contact occurs:

- Flush skin and hair with running water (and soap if available).
- Seek medical attention in event of irritation.

For hypothermia:

- Move person to a warm place.
- Wrap in blankets.
- Shock may occur during the correction of hypothermia; cardiac dysrhythmias may be associated with severe hypothermia.
- Seek medical attention.
- Avoid direct heat.
- Arrange for admission to hospital for observation

In case of cold burns (frost-bite):

- 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
- 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 paracetomol
- Transport to hospital, or doctor
- Subsequent blackening of the exposed tissue indicates potential of necrosis, which may require amputation.

INHALED

■

- 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)

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

or CPR if necessary.

NOTES TO PHYSICIAN

■ 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].
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.

Section 5 - FIRE FIGHTING MEASURES

EXTINGUISHING MEDIA

■ DO NOT EXTINGUISH BURNING GAS UNLESS LEAK CAN BE STOPPED SAFELY:
OTHERWISE: LEAVE GAS TO BURN.
FOR SMALL FIRE:

- Dry chemical, CO_2 or water spray to extinguish gas (only if absolutely necessary and safe to do so).
- DO NOT use water jets.

FOR LARGE FIRE:

- Cool cylinder by direct flooding quantities of water onto upper surface until well after fire is out.
- DO NOT direct water at source of leak or venting safety devices as icing may occur.

FIRE FIGHTING

■

- Cryogens can be particularly dangerous during fires.
- Cryogenic liquids can freeze water very rapidly.
- Careless use of water can lead to heavy icing, possibly blocking pressure relief valves.
- The relatively warm water can also cause a cryogenic liquid to vapourise more rapidly. This rapid evaporation introduces large volumes of gas into the vicinity of the fire..
- Where water is used in fires involving cryogenic liquids, avoid spraying cold areas of equipment containing the liquid, and avoid directing water onto the liquid.
- Keep water away from vent stacks and safety relief valves if possible; these may become plugged with ice.

NOTE: If an inert cryogenic liquid is involved, there is a possibility of reducing the oxygen content of the air with a potential risk of asphyxiation of the fire-fighters. Judgment should be used to determine which risk is greater - that of shutting a supply valve which may be in the area but not easily accessible because of the fire, or the risk of an oxygen deficient atmosphere.
FOR FIRES INVOLVING MANY GAS CYLINDERS:

- To stop the flow of gas, specifically trained personnel may inert the atmosphere to reduce oxygen levels thus allowing the capping of leaking container(s).
- Reduce the rate of flow and inject an inert gas, if possible, before completely stopping the flow to prevent flashback.
- DO NOT extinguish the fire until the supply is shut off otherwise an explosive re-ignition may occur.

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

- If the fire is extinguished and the flow of gas continues, used increased ventilation to prevent build-up, of explosive atmosphere.
- Use non-sparking tools to close container valves.
- Be CAUTIOUS of a Boiling Liquid Evaporating Vapour Explosion, BLEVE, if fire is impinging on surrounding containers.
- Direct 2500 litre/min (500 gpm) water stream onto containers above liquid level with the assistance remote monitors.

GENERAL

- Alert Fire Brigade and tell them location and nature of hazard.
- May be violently or explosively reactive.
- Wear breathing apparatus plus protective gloves.
- Consider evacuation
- Fight fire from a safe distance, with adequate cover.
- If safe, switch off electrical equipment until vapour fire hazard removed.
- Use water delivered as a fine spray to control fire and cool adjacent area.
- DO NOT approach cylinders suspected to be hot.
- Cool fire-exposed cylinders with water spray from a protected location.
- If safe to do so, remove containers from path of fire.

FIRE FIGHTING PROCEDURES:

- The only safe way to extinguish a flammable gas fire is to stop the flow of gas.
- If the flow cannot be stopped, allow the entire contents of the cylinder to burn while cooling the cylinder and surroundings with water from a suitable distance.
- Extinguishing the fire without stopping the gas flow may permit the formation of ignitable or explosive mixtures with air. These mixtures may propagate to a source of ignition.

SPECIAL HAZARDS

- Excessive pressures may develop in a gas cylinder exposed in a fire; this may result in explosion.
- Cylinders with pressure relief devices may release their contents as a result of fire and the released gas may constitute a further source of hazard for the fire-fighter.
- Cylinders without pressure-relief valves have no provision for controlled release and are therefore more likely to explode if exposed to fire.

FIRE FIGHTING REQUIREMENTS:

The need for proximity, entry and flash-over protection and special protective clothing should be determined for each incident, by a competent fire-fighting safety professional.

FIRE/EXPLOSION HAZARD

■

- HIGHLY FLAMMABLE: will be easily ignited by heat, sparks or flames.
- Will form explosive mixtures with air
- Fire exposed containers may vent contents through pressure relief valves thereby increasing fire intensity and/ or vapour concentration.
- Vapours may travel to source of ignition and flash back.
- Containers may explode when heated - Ruptured cylinders may rocket
- Fire may produce irritating, poisonous or corrosive gases.
- Runoff may create fire or explosion hazard.
- May decompose explosively when heated or involved in fire.
- High concentration of gas may cause asphyxiation without warning.
- Contact with gas may cause burns, severe injury and/ or frostbite.

Combustion products include: carbon monoxide (CO).
Combustible. Will burn if ignited, carbon dioxide (CO_2), other pyrolysis products typical of burning organic material.
Contains low boiling substance: Closed containers may rupture due to pressure buildup under fire conditions.

FIRE INCOMPATIBILITY

■

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

HAZCHEM

2YE

Personal Protective Equipment

Gas tight chemical resistant suit.
Limit exposure duration to 1 BA set 30 mins.

Section 6 - ACCIDENTAL RELEASE MEASURES

EMERGENCY PROCEDURES

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

MINOR SPILLS

■

- 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.
- Shut off all sources of possible ignition and increase ventilation.
- Clear area of personnel.
- Stop leak only if safe to so do.
- Remove leaking cylinders to safe place. release pressure under safe controlled conditions by opening valve.
- Orientate cylinder so that the leak is gas, not liquid, to minimise rate of leakage
- Keep area clear of personnel until gas has dispersed.

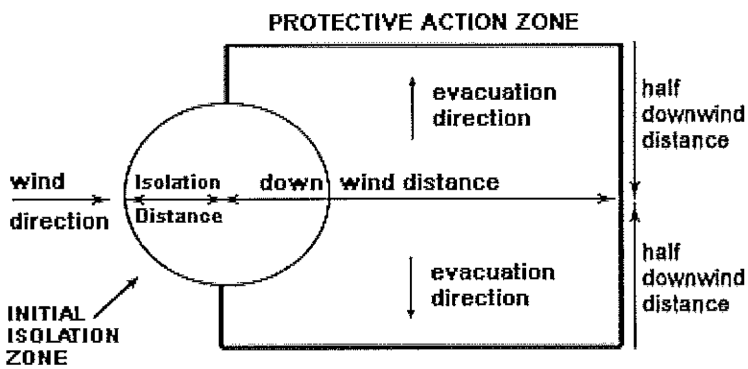
MAJOR SPILLS

■

- Clear area of all unprotected personnel and move upwind.
- Alert Emergency Authority and advise them of the location and nature of hazard.
- May be violently or explosively reactive.
- Wear full body clothing with breathing apparatus.
- Prevent by any means available, spillage from entering drains and water-courses.
- Consider evacuation.
- Shut off all possible sources of ignition and increase ventilation.
- No smoking or naked lights within area.
- Use extreme caution to prevent violent reaction.
- Stop leak only if safe to so do.
- Water spray or fog may be used to disperse vapour.
- DO NOT enter confined space where gas may have collected.
- Keep area clear until gas has dispersed.
- 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.

Gas will immediately disperse.
Leaks with no fire will disperse upwards quickly

PROTECTIVE ACTIONS FOR SPILL



From IERG (Canada/Australia)	
Isolation Distance	100 metres
Downwind Protection Distance	800 metres
IERG Number	4

FOOTNOTES

1 PROTECTIVE ACTION ZONE is defined as the area in which people are at risk of harmful exposure. This zone assumes that random changes in wind direction confines the vapour plume to an area within 30 degrees on either side of the predominant wind direction, resulting in a crosswind protective action distance equal to the downwind protective action distance.
2 PROTECTIVE ACTIONS should be initiated to the extent possible, beginning with those closest to the spill and working away from the site in the downwind direction. Within the protective action zone a level of vapour concentration may exist resulting in nearly all unprotected persons becoming incapacitated and unable to take protective action and/or incurring serious or irreversible health effects.
3 INITIAL ISOLATION ZONE is determined as an area, including upwind of the incident, within which a high probability of localised wind reversal may expose nearly all persons without appropriate protection to life-threatening concentrations of the material.
4 SMALL SPILLS involve a leaking package of 200 litres (55 US gallons) or less, such as a drum (jerrican or box with inner containers). Larger packages leaking less than 200 litres and compressed gas leaking from a small cylinder are also considered "small spills". LARGE SPILLS involve many small leaking packages or a leaking package of greater than 200 litres, such as a cargo tank, portable tank or a "one-tonne" compressed gas cylinder.
5 Guide 115 is taken from the US DOT emergency response guide book.
6 IERG information is derived from CANUTEC - Transport Canada.

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

Section 7 - HANDLING AND STORAGE

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

PROCEDURE FOR HANDLING

■

- Anyone who handles, stores or transfers cryogenic liquids requires instruction on safe handling practices. Specific areas of instruction should include:
- properties of the cryogen both as a liquid and a gas
- specific instructions on the equipment being used, including safety devices
- approved materials that are compatible with the cryogen
- selection, use and care of protective equipment and clothing
- first aid, including self-treatment
- dealing with emergencies such as fires, leaks and spills
- good housekeeping practices
- Inspect all incoming containers containing cryogenic liquids before storing to ensure they are not damaged and are properly labelled. Do not accept delivery of defective containers
- Store, handle and use cryogen containers securely fastened in place in the upright position.
- Cryogenic liquids cause many materials such as carbon steel, rubber and plastics to become brittle or even break under stress This process is called "embrittlement". Do not pour cryogenics down the drain.
- Many materials also shrink at cryogenic temperatures, potentially causing leaks at hose connections. Therefore, take care when selecting materials to be used with cryogens. Regardless of the materials chosen do not allow water to contaminate equipment. Freezing ice will expand and can crack equipment.
- Cryogenic liquids in containers and piping at temperatures at or below the boiling point of liquefied air (-194 deg C) may condense the surrounding air and cause a localised oxygen-enriched atmosphere because nitrogen evaporates more rapidly than oxygen from the liquid air This oxygen-enriched air now presents all of the same hazards as oxygen
- Extremely cold cryogens, such as hydrogen and helium, may liquefy air or may even freeze or solidify the surrounding air.
- All cryogenic liquids produce large volumes of gas when they vaporise (often expanding more than 500 times their original volume). A cryogenic liquid cannot be indefinitely maintained as a liquid even in a well-insulated container. If these liquids are vapourised in a sealed container, they produce enormous pressures that may rupture the container. For this reason pressurised cryogenic containers are normally protected with multiple devices for over-pressure prevention.
- Common pressure relief devices are a pressure relief valve for primary protection and a rupture disc for secondary protection - materials of construction must "cold-rated". Without adequate venting or pressure-relief devices on the containers, enormous pressures can build up. The pressure can cause an explosion called a "boiling liquid expanding vapour explosion" (BLEVE). Unusual or accidental conditions such as an external fire, or a break in the vacuum which provides thermal insulation, may cause a very rapid pressure rise.
- All sections of equipment that may allow for the liquid to be become trapped must be protected by a pressure relief device; the product vented by these relief devices should be routed to a safe outdoor location.
- Vaporisation of a cryogenic liquid, except oxygen, in an enclosed area can cause asphyxiation by the displacement of air. Vapourisation of liquid oxygen in an enclosed area can cause oxygen enrichment which can saturate combustibles in the area (such as workers' clothing). This may result in fire if an ignition source is present.
- Cryogenic liquids and other extremely cold liquids, and their vapours have a built-in warning property whenever they are exposed to the atmosphere. The cold "boil-off" gases condense moisture in surrounding air, creating a highly visible fog. This fog can also be formed around cold equipment when no release of cold liquid or vapours has occurred. Fog clouds do NOT define the vapour cloud. The vapours can extend well beyond the fog cloud depending on the product and atmospheric conditions. Although fog clouds may be indicative of a release, they can never be used to define the leak area and personnel must be warned to stay a considerable distance from the origin of the cloud. Fog clouds may be dense and obstruct visibility. care must be taken to ensure that such clouds do not interfere with vehicle traffic or safety escape routes.
- When spilled on a surface, cryogenic liquids tend to spread, as far as the quantity of liquid spilled and the physical confines of the area, permit.
- Exposure to the cold gases, which generally is too brief to affect the skin of the face or hands may affect delicate tissues such as the eye. It is essential to stand clear of boiling and splashing liquid and their cold vapours. Boiling and splashing always occur when charging a warm container or when inserting objects into the liquid. Always perform these operations slowly to minimise splashing and boiling. use tongs to immerse or remove objects from cryogenic liquids. When cryogenic liquids are spilled on the skin a thin gaseous layer apparently forms next to the skin. This thin layer protects the skin from freezing provided the contact with the cryogen is brief and restricted to small quantities.
- Never allow any unprotected part of the body to touch uninsulated pipes or vessels containing cryogenic liquids. The extremely cold surface may stick to skin and tear the flesh when an attempt is made to withdraw. Even non-metallic materials are dangerous to touch at these low temperatures.
- Never wear watches, rings, bracelets, or other jewellery that could freeze to your skin.
- Objects that are soft and pliable at room temperature, such as rubber and plastics, may be easily broken when immersed in these liquid, because they turn brittle and may break with slight stress
- The potential for asphyxiation must be recognised when handling inert cryogenic liquids, other than oxygen. Because of the high expansion ratios of cryogens air can be rapidly displaced. Oxygen monitors are recommended wherever these liquids are handled in enclosed areas.
- When transferring cryogenic liquids from one container to another, cool the receiving vessel before filling it. Always start filling slowly to allow the vapourisation to chill the receiving container. After the vapourisation and liquid boiling has decreased, fill the container at the normal rate. Devices which reduce turbulence while filling are available for attachment to your transfer hose. These attachments will significantly reduce the release of gas.
- When pouring cryogenic liquids, use an appropriate filling device. For wide mouthed containers this may be a funnel. When it is not safe or convenient to tilt the container, use a discharge tube to remove the liquid. Insert the discharge tube through the neck of the container and well down into the liquid. The packing material or stopper on the discharge tube should form a seal in the neck of the container. Normal evaporation usually produces enough pressure to push liquid out. If necessary, the container may be pressurized with the same gas as the liquid or with an oil-free inert gas. Use just enough pressure to force liquid out. Never fill containers higher than the indicated level.
- Move cryogenic liquid containers carefully. Do not move a container by rolling it on its lower rim. Always use a hand truck, cart,

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

or other proper handling device. Use a strap to secure the container to the handcart. Keep the cryogenic liquid containers upright at all times except for the minor tilting on the cart during transport. Always push the container (don't pull) as pushing reduces the chance of the container falling on you or a co-worker. If cryogens must be transported by elevator, take adequate precautions to prevent possible injury. Send cryogenic liquids in elevators without any passengers and ensure that no passengers get on the elevator while the cryogen is being transported. If a power failure occurred, a passenger would be trapped in the confined space of an elevator with the cryogen. Excessive amounts of the cryogen could vapourise and displace the oxygen.

- Containers, even those that have been emptied, may contain explosive vapours.
- Do NOT cut, drill, grind, weld or perform similar operations on or near containers.

Radon and its radioactive decay products are hazardous if inhaled or ingested.

- Consider use in closed pressurised systems, fitted with temperature, pressure and safety relief valves which are vented for safe dispersal.
- Consider the use of doubly-contained piping; diaphragm or bellows sealed, soft seat valves; backflow prevention devices; flash arrestors; and flow monitoring or limiting devices. Gas cabinets, with appropriate exhaust treatment, are recommended, as is automatic monitoring of the secondary enclosures and work areas for release.
- Use a pressure reducing regulator when connecting cylinder to lower pressure (<100 psig) piping or systems
- Use a check valve or trap in the discharge line to prevent hazardous back-flow into the cylinder
- Check regularly for spills or leaks. Keep valves tightly closed but do not apply extra leverage to hand wheels or cylinder keys.
- Valve protection caps must remain in place must remain in place unless container is secured with valve outlet piped to use point.
- Do NOT drag, slide or roll cylinders - use a suitable hand truck for cylinder movement
- Test for leakage with brush and detergent - NEVER use a naked flame.
- Do NOT heat cylinder by any means to increase the discharge rate of product from cylinder.
- Leaking gland nuts may be tightened if necessary.
- If a cylinder valve will not close completely, remove the cylinder to a well ventilated location (e.g. outside) and, when empty, tag as FAULTY and return to supplier.
- Obtain a work permit before attempting any repairs.
- DO NOT attempt repair work on lines, vessels under pressure.
- Atmospheres must be tested and O.K. before work resumes after leakage.
- When connecting or replacing cylinders take care to avoid airborne particulates violently ejected when system pressurises.
- Avoid generation of static electricity. Earth all lines and equipment.
- DO NOT transfer gas from one cylinder to another.

SUITABLE CONTAINER

■

- Equipment must be able to withstand process pressure and especially cryogenic temperature.
- Commonly used materials are copper or stainless steel.
- Mild steel must NOT be used.
- Most plastics and rubbers are not suitable as they become brittle. Teflon may be acceptable.
- Keep dewar flasks covered with a loose fitting cap. This method prevents air or moisture from entering the container yet allows pressure to escape. Use only the stopper or plug supplied with the container. Glass dewar flasks are available but never use them to store combustible or oxidising cryogenic liquids. Put tape on glass dewar flasks. The tape will minimise any hazards from flying glass should the flask fracture when a cryogenic liquid is poured into it. Laboratory liquid dewars have wide-mouthed openings and do not have lids or covers. These small containers are primarily used in laboratories for temporary storage
- Ensure that ice does not form in the neck of flasks. Liquids such as helium and hydrogen can freeze the water vapour in the surrounding air which can create a pressure hazard. Dewar flasks are not pressure vessels so if the opening is blocked pressure can slowly build up. Eventually, the pressure may cause a violent rupture. If the neck of the dewar flask is blocked by ice or "frozen" air, follow the manufacturer's instruction for removing it. Ice can also cause pressure relief valves to malfunction or become blocked.
- Do not store containers where they may come into contact with moisture. Moving parts, such as valves or pressure relief devices, can malfunction due to external ice formation.
- Cylinder:
- 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.
- Cylinder valve must be closed when not in use or when empty.
- Segregate full from empty cylinders.

WARNING: Suckback into cylinder may result in rupture. Use back-flow preventive device in piping.

STORAGE INCOMPATIBILITY

■ Methane:

- reacts violently with oxidizing agents such as chlorine, bromine pentafluoride, oxygen trifluoride and nitrogen trifluoride in the presence of catalysts or sources of ignition.
- contact with chlorine dioxide causes spontaneous explosion.
- contact with liquid fluorine causes spontaneous explosion, even at very low temperatures (-19 deg.C).

A mixture of liquid methane and liquid oxygen is an explosive.
Carbon dioxide:

- reacts violently with strong bases and alkali metals (especially their dusts)
- may ignite or explode when heated or in suspended chemically active metals (and their hydrides) such as aluminium, chromium, manganese, magnesium (above 775 C), titanium (above 550 C), uranium (above 750 C) or zirconium , diethylmagnesium

- is incompatible with water, acrolein, acrylaldehyde, amines, anhydrous ammonia, aziridine, metal acetylides (such as lithium acetylide), caesium monoxide (moist), lithium, potassium, sodium, sodium carbide, sodium-potassium alloy, sodium peroxide, titanium
- may build up static electricity when discharged at high flow rates from storage cylinders or fire extinguishers - this may produce sparks resulting in ignition of flammables or explosives.
- may decompose to toxic carbon monoxide and flammable oxygen when exposed to electrical discharges or very high temperatures
- Explosion hazard may follow contact with incompatible materials
- Avoid reaction with oxidising agents
- 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

STORAGE REQUIREMENTS

■

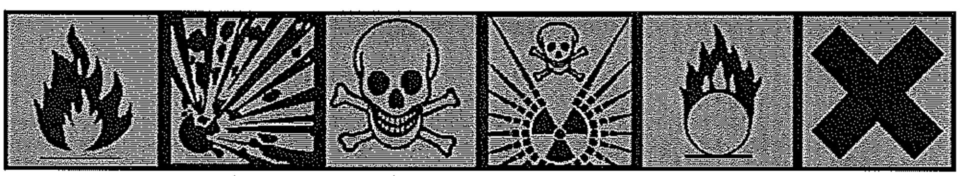
- Store in an upright position.
- Outside or detached storage is preferred.

Rotate all stock to prevent ageing. Use on FIFO (First In-First Out) basis.

- 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.
- Cylinders in storage should be properly secured to prevent toppling or rolling.
- Cylinder valves should be closed when not in use.
- Where cylinders are fitted with valve protection this should be in place and properly secured.
- Gas cylinders should be segregated according to the requirements of the Dangerous Goods Act(s).
- Cylinders containing flammable gases should be stored away from other combustible materials. Alternatively a fire-resistant partition may be used.
- Check storage areas for flammable or hazardous concentrations of gases prior to entry.
- Preferably store full and empty cylinders separately.
- Full cylinders should be arranged so that the oldest stock is used first.
- Cylinders in storage should be checked periodically for general condition and leakage.
- Protect cylinders against physical damage. Move and store cylinders correctly as instructed for their manual handling.

NOTE: A 'G' size cylinder is usually too heavy for an inexperienced operator to raise or lower.
Not applicable to pipeline supplies.

SAFE STORAGE WITH OTHER CLASSIFIED CHEMICALS



+	X	X	X	X	+

X: Must not be stored together
O: May be stored together with specific preventions
+: May be stored together

Section 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

EXPOSURE CONTROLS

Source	Material	TWA ppm	TWA mg/m³	STEL ppm	STEL mg/m³	Peak ppm	Peak mg/m³	TWA F/CC	Notes
Australia Exposure Standards	carbon dioxide (Carbon dioxide in coal mines)	12500	22500	30000	54000				
Australia Exposure Standards	carbon dioxide (Carbon dioxide)	5000	9000	30000	54000				

The following materials had no OELs on our records

- natural gas, refrigerated liquid: CAS:68410-63-9
- oxygen: CAS:7782-44-7
- radon-222: CAS:14859-67-7

EMERGENCY EXPOSURE LIMITS

Material	Revised IDLH Value (mg/m3)	Revised IDLH Value (ppm)
propane		2,100 [LEL]

NOTES

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) | Revision No: 6 | Chemwatch 1972-2

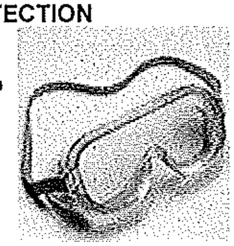
Issue Date: 9-Jul-2009 | CD 2009/2

Values marked LEL indicate that the IDLH was based on 10% of the lower explosive limit for safety considerations even though the relevant toxicological data indicated that irreversible health effects or impairment of escape existed only at higher concentrations.

MATERIAL DATA

NATURAL GAS, REFRIGERATED LIQUID:
▪ For oxygen:
No exposure standards available.
NOTE: Detector tubes for oxygen, measuring in excess of 5 vol%, are commercially available.
For carbon dioxide:
NOTE: Detector tubes for carbon dioxide, measuring in excess of 0.01 % vol.,are commercially available. Long-term measurements (4 hrs) may be conducted to detect concentrations exceeding 250 ppm.
Studies using physically fit males in confined spaces indicate the TLV-TWA and STEL provides a wide margin of safety against asphyxiation and from undue metabolic stress, provided normal amounts of oxygen are present in inhaled air. Lowered oxygen content, increased physical activity and prolonged exposures each impact on systemic and respiratory effects.
Stimulation of the respiratory centre is produced at 50,000 ppm (5%). The gas is weakly narcotic at 30,000 ppm giving rise to reduced acuity of hearing and increasing blood pressure and pulse, Persons exposed a 20,000 ppm for several hours developed headaches and dyspnea on mild exertion, Acidosis and adrenal cortical exhaustion occurred as a result of prolonged continuous exposure at 10,000-20,0000 ppm.
Intoxication occurs after a 30 minute exposure at 50,000 ppm whilst exposure at 70,000-100,000 ppm produces unconsciousness within a few minutes.
Odour Safety Factor (OSF)
OSF=0.068 (CARBON DIOXIDE).
For propane
Odour Safety Factor(OSF)
OSF=0.16 (PROPANE).
ETHANE:
▪ Not available. Refer to individual constituents.
PROPANE:
▪ May act as a simple asphyxiants; these are gases which, when present in high concentrations, reduce the oxygen content in air below that required to support breathing, consciousness and life; loss of consciousness, with death by suffocation may rapidly occur in an oxygen deficient atmosphere.
CARE: Most simple asphyxiants are odourless or possess low odour and there is no warning on entry into an oxygen deficient atmosphere. If there is any doubt, oxygen content can be checked simply and quickly. It may not be appropriate to only recommend an exposure standard for simple asphyxiants rather it is essential that sufficient oxygen be maintained. Air normally has 21 percent oxygen by volume, with 18 percent regarded as minimum under normal atmospheric pressure to maintain consciousness / life. At pressures significantly higher or lower than normal atmospheric pressure, expert guidance should be sought.
RADON-222:
▪ For propane
Odour Safety Factor(OSF)
OSF=0.16 (PROPANE).

PERSONAL PROTECTION

EYE

▪ For cryogenic liquids:

- The eyes are the most sensitive body part to the extreme cold of the liquid and vapours.
- A full face shield over safe glasses is recommended when handling cryogens.
- 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 lens or restrictions on use, should be created for each workplace or task. This should include a review of lens absorption and adsorption for the class of chemicals in use and an account of injury experience. Medical and first-aid personnel should be trained in their removal and suitable equipment should be readily available. In the event of chemical exposure, begin eye irrigation immediately and remove contact lens as soon as practicable. Lens should be removed at the first signs of eye redness or irritation - lens should be removed in a clean environment only after workers have washed hands thoroughly. [CDC NIOSH Current Intelligence Bulletin 59]

HANDS/FEET

▪

- Insulated gloves:

NOTE: Insulated gloves should be loose fitting so that 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.

- When handling sealed and suitably insulated cylinders wear cloth or leather gloves.

OTHER

▪ For cryogenic liquids

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

- Cryogenic liquids flow very freely and can penetrate woven or other porous clothing much faster than water
- Wear a non-porous, knee length laboratory coat, without pockets or cuffs which could catch the liquid.
- If using larger quantities of cryogenic liquids, wear an apron of a non-woven material such as leather.
- Wear boots with tops high enough to be covered by pants without cuffs.
- Wear loose fitting, insulated gloves when handling anything that may have been in contact with a cryogenic liquid.
- The clothing worn by process operators insulated from earth may develop static charges far higher (up to 100 times) than the minimum ignition energies for various flammable gas-air mixtures. This holds true for a wide range of clothing materials including cotton.
- Avoid dangerous levels of charge by ensuring a low resistivity of the surface material worn outermost.

BRETHERICK: Handbook of Reactive Chemical Hazards.

- Protective overalls, closely fitted at neck and wrist.
- Eye-wash unit.

IN CONFINED SPACES:

- Non-sparking protective boots
- Static-free clothing.
- Ensure availability of lifeline.

Staff should be trained in all aspects of rescue work.
Rescue gear: Two sets of SCUBA breathing apparatus Rescue Harness, lines etc.

- Some plastic personal protective equipment (PPE) (e.g. gloves, aprons, overshoes) are not recommended as they may produce static electricity.
- For large scale or continuous use wear tight-weave non-static clothing (no metallic fasteners, cuffs or pockets), non sparking safety footwear.

■

- 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.

RESPIRATOR

■ Selection of the Class and Type of respirator will depend upon the level of breathing zone contaminant and the chemical nature of the contaminant. Protection Factors (defined as the ratio of contaminant outside and inside the mask) may also be important.

Breathing Zone Level ppm (volume)	Maximum Protection Factor	Half-face Respirator	Full-Face Respirator
1000	10	GAXNO-AUS	-
1000	50	-	GAXNO-AUS
5000	50	Airline *	-
5000	100	-	GAXNO-2
10000	100	-	GAXNO-3
	100+		Airline**

* - Continuous Flow ** - Continuous-flow or positive pressure demand.
The local concentration of material, quantity and conditions of use determine the type of personal protective equipment required.
For further information consult site specific CHEMWATCH data (if available), or your Occupational Health and Safety Advisor.

ENGINEERING CONTROLS

■

- Areas where cylinders are stored require good ventilation and, if enclosed need discrete/ controlled exhaust ventilation.
- Vented gas is flammable, may be denser than air and will spread. Vent path must not contain ignition sources, pilot lights, naked flames.
- Secondary containment and exhaust gas treatment may be required by certain jurisdictions.
- Local exhaust ventilation (explosion proof) is usually required in workplaces.
- Consideration should be given to the use of doubly-contained piping; diaphragm or bellows-sealed, soft-seat valves; backflow prevention devices; flash arrestors and flow- monitoring or limiting devices.
- Automated controls should ensure that workplace atmospheres do not exceed 25% of the lower explosive limit (LEL) (if available).
- Monitor the work area and secondary containments for release of gas.
- Automated alerting systems with automatic shutdown of gas-flow may be appropriate and may in fact be mandatory in certain jurisdictions.
- Respiratory protection in the form of air-supplied or self-contained breathing equipment must be worn if the oxygen concentration in the workplace air is less than 19%.
- Cartridge respirators DO NOT give protection and may result in rapid suffocation.

Air contaminants generated in the workplace possess varying "escape" velocities which, in turn, determine the "capture velocities" of fresh circulating air required to effectively remove the contaminant.

Type of Contaminant:	Air Speed:
gas discharge (active generation into zone of rapid air motion)	1-2.5 m/s (200-500 f/min.)

Within each range the appropriate value depends on:

Lower end of the range	Upper end of the range
1: Room air currents minimal or favourable to capture	1: Disturbing room air currents
2: Contaminants of low toxicity or of nuisance value only.	2: Contaminants of high toxicity
3: Intermittent, low production.	3: High production, heavy use
4: Large hood or large air mass in motion	4: Small hood-local control only

Simple theory shows that air velocity falls rapidly with distance away from the opening of a simple extraction pipe. Velocity

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

generally decreases with the square of distance from the extraction point (in simple cases). Therefore the air speed at the extraction point should be adjusted, accordingly, after reference to distance from the contaminating source. The air velocity at the extraction fan, for example, should be a minimum of 1-2.5 m/s (200-500 f/min.) for extraction of gases discharged 2 meters distant from the extraction point. Other mechanical considerations, producing performance deficits within the extraction apparatus, make it essential that theoretical air velocities are multiplied by factors of 10 or more when extraction systems are installed or used.

Section 9 - PHYSICAL AND CHEMICAL PROPERTIES

APPEARANCE

■ Cryogenic liquid; Such liquids are defined as those with a normal boiling point below -150 deg. C Liquefied refrigerated gases are generally cryogens. These gases must cooled below room temperature before an increase in pressure can liquefy them.them Gases are processed into cryogenic liquids by a combination of pressurisation, cooling, and ultimately, release of pressure. Therefore cryogenics don't require pressure to keep them in the liquid state unless they remain in a container for a long period of time. Cryogenic liquids are shipped and used in thermally insulated containers. These cryogenic liquid containers are specifically designed to withstand rapid temperature changes and extreme differences in temperature. Natural gas is a colorless, odourless and tasteless liquid or gas (unless mercaptan added to odourise). Soluble in alcohol, ether, other organic solvents.

PHYSICAL PROPERTIES

Gas.
Does not mix with water.
Floats on water.

Molecular Weight: Not applicable	Boiling Range (°C): -162
Melting Range (°C): -183	Specific Gravity (water=1): 0.42 (as liquid)
Solubility in water (g/L): Immiscible	pH (as supplied): Not applicable
pH (1% solution): Not applicable.	Vapour Pressure (kPa): Not available
Volatile Component (%vol): 100	Evaporation Rate: Fast
Relative Vapour Density (air=1): 0.55	Flash Point (°C): -218
Lower Explosive Limit (%): 5.0	Upper Explosive Limit (%): 15.0
Autoignition Temp (°C): 540	Decomposition Temp (°C): Not Applicable
State: Liquefied gas	Viscosity: Not Applicable

Material	Value
log Kow	1.09
log Kow	1.09

Section 10 - CHEMICAL STABILITY

CONDITIONS CONTRIBUTING TO INSTABILITY

■
- Presence of incompatible materials.
- Product is considered stable.
- Hazardous polymerisation will not occur.
- Presence of elevated temperatures.
- Presence of heat source and ignition source

For incompatible materials - refer to Section 7 - Handling and Storage.

Section 11 - TOXICOLOGICAL INFORMATION

POTENTIAL HEALTH EFFECTS

ACUTE HEALTH EFFECTS

SWALLOWED

■ Not normally a hazard due to physical form of product.
Considered an unlikely route of entry in commercial/industrial environments.

EYE

■ There is some evidence to suggest that this material can cause eye irritation and damage in some persons.
Not considered to be a risk because of the extreme volatility of the gas.

SKIN

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

■ The material is not thought to produce adverse health effects or skin irritation following contact (as classified by EC Directives using animal models). Nevertheless, good hygiene practice requires that exposure be kept to a minimum and that suitable gloves be used in an occupational setting.
Open cuts, abraded or irritated skin should not be exposed to this material.
Entry into the blood-stream, through, for example, cuts, abrasions 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.
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 an 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).

INHALED

■ Inhalation of vapours may cause drowsiness and dizziness. This may be accompanied by sleepiness, reduced alertness, loss of reflexes, lack of co-ordination, and vertigo.
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.
There is some evidence to suggest that the material can cause respiratory irritation in some persons. The body's response to such irritation can cause further lung damage.
Inhalation of non-toxic gases may cause:

- CNS effects: headache, confusion, dizziness, stupor, seizures and coma;
- respiratory: shortness of breath and rapid breathing;
- cardiovascular: collapse and irregular heart beats;
- gastrointestinal: mucous membrane irritation, nausea and vomiting.

Symptoms of asphyxia (suffocation) may include headache, dizziness, shortness of breath, muscular weakness, drowsiness and ringing in the ears. If the asphyxia is allowed to progress, there may be nausea and vomiting, further physical weakness and unconsciousness and, finally, convulsions, coma and death. Significant concentrations of the non-toxic gas reduce the oxygen level in the air. As the amount of oxygen is reduced from 21 to 14 volume %, the pulse rate accelerates and the rate and volume of breathing increase. The ability to maintain attention and think clearly is diminished and muscular coordination is somewhat disturbed. As oxygen decreases from 14-10% judgement becomes faulty; severe injuries may cause no pain. Muscular exertion leads to rapid fatigue. Further reduction to 6% may produce nausea and vomiting and the ability to move may be lost. Permanent brain damage may result even after resuscitation at exposures to this lower oxygen level. Below 6% breathing is in gasps and convulsions may occur. Inhalation of a mixture containing no oxygen may result in unconsciousness from the first breath and death will follow in a few minutes.
Material is highly volatile and may quickly form a concentrated atmosphere in confined or unventilated areas. Vapour is heavier than air and may displace and replace air in breathing zone, acting as a simple asphyxiant. This may happen with little warning of overexposure.
The paraffin gases C1-4 are practically nontoxic below the lower flammability limit, 18,000 to 50,000 ppm; above this, low to moderate incidental effects such as CNS depression and irritation occur, but are completely reversible upon cessation of the exposure.

CHRONIC HEALTH EFFECTS

■ Substance accumulation, in the human body, may occur and may cause some concern following repeated or long-term occupational exposure.
There has been some concern that this material can cause cancer or mutations but there is not enough data to make an assessment.
Principal route of occupational exposure to the gas is by inhalation.
Constant or exposure over long periods to mixed hydrocarbons may produce stupor with dizziness, weakness and visual disturbance, weight loss and anaemia, and reduced liver and kidney function. Skin exposure may result in drying and cracking and redness of the skin. Chronic exposure to lighter hydrocarbons can cause nerve damage, peripheral neuropathy, bone marrow dysfunction and psychiatric disorders as well as damage the liver and kidneys.
A single large or prolonged low exposure to radiation can cause delayed effects, including blood cancers, genetic disorders, shortened lifespan and cataracts. Leukaemia is the most common cancer caused; cancers of the thyroid, bone, lung (due to radioactive particle deposits) and skin are also seen. Many and varied genetic changes can occur; if they affect cells of the reproductive system, they may only display themselves after being inherited.

TOXICITY AND IRRITATION

■ Not available. Refer to individual constituents.

METHANE:

■ No significant acute toxicological data identified in literature search.

ETHANE:

■ No significant acute toxicological data identified in literature search.

PROPANE:

■ No significant acute toxicological data identified in literature search.

CARCINOGEN

Radionuclides, α-particle-emitting, internally deposited (NB: Specific radionuclides for which there is sufficient evidence for carcinogenicity to humans are also listed individually as Group 1 agents)	International Agency for Research on Cancer (IARC) Carcinogens	Group 1
Radionuclides, β-particle-emitting, internally deposited (NB: Specific radionuclides for which there is sufficient evidence for carcinogenicity to humans are also listed individually as Group 1 agents)	International Agency for Research on Cancer (IARC) Carcinogens	Group 1
Radon-222 and its decay products	International Agency for Research on Cancer (IARC) Carcinogens	Group 1

Section 12 - ECOLOGICAL INFORMATION

■ For methane:
log Kow : 1.09
Koc : 753
Half-life (hr) air : 21600
Half-life (hr) H2O surface water : 1.17-14
Half-life (hr) soil : 1680
ThOD : 3.99
Environmental Fate
Terrestrial fate: An estimated Koc value of 90, determined from a log Kow of 1.09 indicates that methane is expected to have high mobility in soil Volatilisation is expected to be the most important fate process for methane in soil based on its vapor pressure of 4.7x10+5 mm Hg at 25 deg C. Volatilisation of methane from moist soil surfaces is expected to be an important fate process given an estimated Henry's Law constant of 0.66 atm-cu m/mole derived from its vapor pressure, and water solubility, 22 mg/l. Utilisation of methane by soil microorganisms has been detected from five soil samples collected from sites near Adelaide, South Australia(6).
Aquatic fate: The estimated Koc value indicates that methane is not expected to adsorb to suspended solids and sediment(. Volatilisation from water surfaces is expected to be the dominant fate process in aqueous systems based upon an estimated Henry's Law . Using this Henry's Law constant volatilisation half-lives for a model river and model lake are both 2 hrs. An estimated BCF of 1, derived from its log Kow suggests the potential for bioconcentration in aquatic organisms is low. The biodegradation half-life of methane was estimated to range from 70 days to infinity based on gas exchange biodegradation experiments conducted in model estuarine ecosystems.
Atmospheric fate:: Methane exists in the gas-phase in the ambient atmosphere with a vapor pressure of 4.7x10+5 mm Hg. Gas-phase methane is very slowly degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be about 6 yrs, calculated from its rate constant of 6.9x10-15 cu cm/molecule-sec at 25 deg C.
Methane is not expected to undergo hydrolysis in the environment due to the lack of hydrolysable functional groups nor to directly photolyse due to the lack of absorption in the environmental UV spectrum (>290 nm).
Ecotoxicity:
Fish LC50 996 h): 14 mg/l.
■ DO NOT discharge into sewer or waterways.
Refer to data for ingredients, which follows:
NATURAL GAS, REFRIGERATED LIQUID:
METHANE:
■ For methane:
log Kow : 1.09
Koc : 753
Half-life (hr) air : 21600
Half-life (hr) H2O surface water : 1.17-14
Half-life (hr) soil : 1680
ThOD : 3.99
Environmental Fate
Terrestrial fate: An estimated Koc value of 90, determined from a log Kow of 1.09 indicates that methane is expected to have high mobility in soil Volatilisation is expected to be the most important fate process for methane in soil based on its vapor pressure of 4.7x10+5 mm Hg at 25 deg C. Volatilisation of methane from moist soil surfaces is expected to be an important fate process given an estimated Henry's Law constant of 0.66 atm-cu m/mole derived from its vapor pressure, and water solubility, 22 mg/l. Utilisation of methane by soil microorganisms has been detected from five soil samples collected from sites near Adelaide, South Australia(6).
Aquatic fate: The estimated Koc value indicates that methane is not expected to adsorb to suspended solids and sediment(. Volatilisation from water surfaces is expected to be the dominant fate process in aqueous systems based upon an estimated Henry's Law . Using this Henry's Law constant volatilisation half-lives for a model river and model lake are both 2 hrs. An estimated BCF of 1, derived from its log Kow suggests the potential for bioconcentration in aquatic organisms is low. The biodegradation half-life of methane was estimated to range from 70 days to infinity based on gas exchange biodegradation experiments conducted in model estuarine ecosystems.
Atmospheric fate:: Methane exists in the gas-phase in the ambient atmosphere with a vapor pressure of 4.7x10+5 mm Hg. Gas-phase methane is very slowly degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be about 6 yrs, calculated from its rate constant of 6.9x10-15 cu cm/molecule-sec at 25 deg C.
Methane is not expected to undergo hydrolysis in the environment due to the lack of hydrolysable functional groups nor to directly photolyse due to the lack of absorption in the environmental UV spectrum (>290 nm).
Ecotoxicity:
Fish LC50 996 h): 14 mg/l.
NATURAL GAS, REFRIGERATED LIQUID:
METHANE:

■ log Kow (Sangster 1997):	1.09
■ BOD20:	3.04
■ ThOD:	3.99

ETHANE:

■ log Kow (Sangster 1997):	1.81
■ BOD5:	2.45
■ ThOD:	3.73

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

■ For ethane:
ThOD : 3.73
Environmental Fate
Terrestrial fate: An estimated Koc value of 230, determined from a log Kow of 1.81, indicates that ethane is expected to have moderate mobility in soil. Volatilisation of ethane from moist soil surfaces is expected to be an important fate process given an estimated Henry's Law constant of 0.5 atm-cu m/mole derived from its vapor pressure, 31,500 mm Hg, and water solubility, 60.2 mg/L. Ethane is expected to volatilise from dry soil surfaces based upon its vapor pressure. Ethane was oxidized to ethanol in lake water and soil within 24 hours using cell suspensions from over 20 methyltrophic organisms. This suggests that biodegradation may be an important fate process. However ethane is a gas and therefore volatilisation is expected to be the most important fate process.
Aquatic fate: Based on an estimated Koc value ethane is not expected to adsorb to suspended solids and sediment. Volatilisation from water surfaces is expected based upon an estimated Henry's Law constant. Using this Henry's Law constant , volatilisation half-lives for a model river and model lake are estimated to be 34 min and 2.2 days, respectively. An estimated BCF of 5 derived from, from its log Kow suggests the potential for bioconcentration in aquatic organisms is low . Alkanes are generally resistant to hydrolysis. Ethane was oxidized to ethanol in lake water and soil within 24 hours using cell suspensions from over 20 methyltrophic organisms. Biodegradation may be an important fate process, however ethane is a gas and therefore volatilisation is expected to be the most important fate process(SRC).
Atmospheric fate: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere and its vapour pressure, ethane, is expected to exist solely as a gas in the ambient atmosphere. Gas-phase ethane is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 50-70 days, calculated from its range of rate constants of 3.08x10 to 13-2.28x10-13 cu cm/molecule-sec at 25 deg C. Based on data for iso-octane and n-hexane, ethane is not expected to absorb UV light at wavelengths >290 nm.
PROPANE:

■ log Kow (Sangster 1997): 2.36

■ For propane:
Environmental Fate
Terrestrial fate:: An estimated Koc value of 460 determined from a log Kow of 2.36 indicates that propane is expected to have moderate mobility in soil. Volatilisation of propane from moist soil surfaces is expected to be an important fate process given an estimated Henry's Law constant of 7.07x10-1 atm-cu m/mole, derived from its vapor pressure, 7150 mm Hg, and water solubility, 62.4 mg/L. Propane is expected to volatilise from dry soil surfaces based upon its vapor pressure. Using cell suspensions of microorganisms isolated from soil and water, propane was oxidised to acetone within 24 hours, suggesting that biodegradation may be an important fate process in soil and sediment.
Aquatic fate: The estimated Koc value indicates that propane is expected to adsorb to suspended solids and sediment. Volatilisation from water surfaces is expected based upon an estimated Henry's Law constant. Using this Henry's Law constant volatilisation half-lives for a model river and model lake are estimated to be 41 minutes and 2.6 days, respectively. An estimated BCF of 13.1 using log Kow suggests the potential for bioconcentration in aquatic organisms is low. After 192 hr, the trace concentration of propane contained in gasoline remained unchanged for both a sterile control and a mixed culture sample collected from ground water contaminated with gasoline. This indicates that biodegradation may not be an important fate process in water.
Atmospheric fate:: According to a model of gas/particle partitioning of semivolatile organic compounds in the atmosphere and vapour pressure, propane is expected to exist solely as a gas in the ambient atmosphere. Gas-phase propane is degraded in the atmosphere by reaction with photochemically-produced hydroxyl radicals; the half-life for this reaction in air is estimated to be 14 days, calculated from its rate constant of 1.15x10-12 cu cm/molecule-sec at 25 deg C. Propane does not contain chromophores that absorb at wavelengths >290 nm and therefore is not expected to be susceptible to direct photolysis by sunlight.
RADON-222:

Ecotoxicity

Ingredient	Persistence: Water/Soil	Persistence: Air	Bioaccumulation	Mobility
natural gas, refrigerated liquid		No data		
methane		No data		
ethane		No data		
propane		No data		
radon-222		No data		

Section 13 - DISPOSAL CONSIDERATIONS

■

- Evaporate or incinerate residue at an approved site.
- Return empty containers to supplier.
- Ensure damaged or non-returnable cylinders are gas-free before disposal.

Discharge to burning flare.
Not applicable to gas supplies delivered on demand by pipeline.

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Chemwatch Material Safety Data Sheet (REVIEW) Revision No: 6 Chemwatch 1972-2

Issue Date: 9-Jul-2009 CD 2009/2

Section 14 - TRANSPORTATION INFORMATION

Labels Required: FLAMMABLE GAS
HAZCHEM: 2YE (ADG7)
ADG7:

Class or division:	2.1	Subsidiary risk:	None
UN No.:	1972	UN packing group:	None
Special provisions:	None	Packing Instructions:	None
Notes:	None	Limited quantities:	0
Portable tanks and bulk containers - Instructions:	T75	Portable tanks and bulk containers - Special provisions:	TP5
Packagings and IBCs - Packing instruction:	P203	Packagings and IBCs - Special packing provisions:	None

Shipping Name:METHANE, REFRIGERATED LIQUID or NATURAL GAS, REFRIGERATED LIQUID with high methane content
Land Transport UNDG:

Class or division:	2.1	Subsidiary risk:	None
UN No.:	1972	UN packing group:	None

Shipping Name:METHANE, REFRIGERATED LIQUID or NATURAL GAS, REFRIGERATED LIQUID with high methane content

Air Transport IATA:

Maritime Transport IMDG:

IMDG Class:	2.1	IMDG Subrisk:	None
UN Number:	1972	Packing Group:	None
EMS Number:	F-D,S-U	Special provisions:	None
Limited Quantities:	None		

Shipping Name: METHANE, REFRIGERATED LIQUID or NATURAL GAS, REFRIGERATED LIQUID with high methane content

Section 15 - REGULATORY INFORMATION

POISONS SCHEDULE

None

REGULATIONS

natural gas, refrigerated liquid (CAS: 68410-63-9) is found on the following regulatory lists;

"Australia Inventory of Chemical Substances (AICS)","India Chemical Accidents Rules - Schedule 2: Threshold Quantities","India Chemical Accidents Rules - Schedule 3: Named Chemicals","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 2: Isolated storage at installations other than those covered by Schedule 4","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 3: List of Hazardous Chemicals for Application of Rules 5 and 7 to 15","Korea (South) Existing Chemicals List (KECL)","OECD Representative List of High Production Volume (HPV) Chemicals"

Regulations for ingredients

methane (CAS: 74-82-8) is found on the following regulatory lists;

"Australia - Queensland Hazardous Materials and Prescribed Quantities for Major Hazard Facilities","Australia Exposure Standards","Australia Hazardous Substances","Australia Inventory of Chemical Substances (AICS)","China Classification and Labelling of Dangerous Chemical Substances","China Dangerous Chemicals Names List","China Inventory of Existing Chemical Substances","India Chemical Accidents Rules - Schedule 2: Threshold Quantities","India Chemical Accidents Rules - Schedule 3: Named Chemicals","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 2: Isolated storage at installations other than those covered by Schedule 4","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 3: List of Hazardous Chemicals for Application of Rules 5 and 7 to 15","Indonesia Threshold Limit Value for chemical substances in the workplace (Bahasa Indonesian)","International Council of Chemical Associations (ICCA) - High Production Volume List","Japan Air Pollution Control Law - VOC Exclusion Substances (Japanese)","Japan Chemical Substances Control Law - Existing/New Chemical Substances","Japan GHS Classifications (Japanese)","Japan High Pressure Gas Safety Law","Japan Road Law","Korea (South) Existing Chemicals List (KECL)","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals - Classification Data","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Dangerous Goods","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Hazardous Substances Register","New Zealand Inventory of Chemicals (NZIoC)","New Zealand Workplace Exposure Standards (WES)","OECD Representative List of High

NATURAL GAS, REFRIGERATED LIQUID

Hazard Alert Code: EXTREME

Production Volume (HPV) Chemicals","Philippines Inventory of Chemicals and Chemical Substances (PICCS)","Taiwan Rules for Hazard Communication for Dangerous and Harmful Materials - Dangerous Materials (Chinese)","Thailand Harmful Chemicals - List I"

ethane (CAS: 74-84-0) is found on the following regulatory lists;

"Australia Exposure Standards","Australia Hazardous Substances","Australia Inventory of Chemical Substances (AICS)","China (Hong Kong) Fire Service Department - List of Dangerous Goods","China Classification and Labelling of Dangerous Chemical Substances","China Dangerous Chemicals Names List","China Hygienic Standards for Uses of Food Additives (GB 2760-1996) - List of Processing Assistants Recommended for Use in Food Industry","China Inventory of Existing Chemical Substances","India Chemical Accidents Rules - Schedule 2: Threshold Quantities","India Chemical Accidents Rules - Schedule 3: Named Chemicals","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 2: Isolated storage at installations other than those covered by Schedule 4","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 3: List of Hazardous Chemicals for Application of Rules 5 and 7 to 15","Indonesia Threshold Limit Value for chemical substances in the workplace (Bahasa Indonesian)","International Council of Chemical Associations (ICCA) - High Production Volume List","Japan Chemical Substances Control Law - Existing/New Chemical Substances","Japan GHS Classifications (Japanese)","Japan High Pressure Gas Safety Law","Japan Road Law","Korea (South) Existing Chemicals List (KECL)","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals - Classification Data","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Dangerous Goods","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Hazardous Substances Register","New Zealand Inventory of Chemicals (NZIoC)","New Zealand Workplace Exposure Standards (WES)","OECD Representative List of High Production Volume (HPV) Chemicals","Philippines Inventory of Chemicals and Chemical Substances (PICCS)","Taiwan Rules for Hazard Communication for Dangerous and Harmful Materials - Dangerous Materials (Chinese)","Thailand Harmful Chemicals - List I"

propane (CAS: 74-98-6) is found on the following regulatory lists;

"Australia - Queensland Hazardous Materials and Prescribed Quantities for Major Hazard Facilities","Australia Exposure Standards","Australia Hazardous Substances","Australia Inventory of Chemical Substances (AICS)","China (Hong Kong) Occupational Exposure Limits","China Classification and Labelling of Dangerous Chemical Substances","China Dangerous Chemicals Names List","China Inventory of Existing Chemical Substances","CODEX General Standard for Food Additives (GSFA) - Additives Permitted for Use in Food in General, Unless Otherwise Specified, in Accordance with GMP","India Chemical Accidents Rules - Schedule 1: List of Hazardous Chemicals","India Chemical Accidents Rules - Schedule 2: Threshold Quantities","India Chemical Accidents Rules - Schedule 3: Named Chemicals","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 2: Isolated storage at installations other than those covered by Schedule 4","India Manufacture, Storage and Import of Hazardous Chemical Rules - Schedule 3: List of Hazardous Chemicals for Application of Rules 5 and 7 to 15","Indonesia Threshold Limit Value for chemical substances in the workplace (Bahasa Indonesian)","International Council of Chemical Associations (ICCA) - High Production Volume List","Japan Chemical Substances Control Law - Existing/New Chemical Substances","Japan GHS Classifications (Japanese)","Japan High Pressure Gas Safety Law","Japan List of Existing Food Additives","Japan Road Law","Korea (South) Existing Chemicals List (KECL)","Malaysia Permissible Exposure Limits","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Classification of Chemicals - Classification Data","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Dangerous Goods","New Zealand Hazardous Substances and New Organisms (HSNO) Act - Hazardous Substances Register","New Zealand Inventory of Chemicals (NZIoC)","New Zealand Workplace Exposure Standards (WES)","OECD Representative List of High Production Volume (HPV) Chemicals","Philippines Inventory of Chemicals and Chemical Substances (PICCS)","Philippines Regulatory Guidelines Concerning Food Additives - Permitted Food Additives","Taiwan Permissible Concentration of Airborne Harmful Substances","Taiwan Rules for Hazard Communication for Dangerous and Harmful Materials - Dangerous Materials (Chinese)","Thailand Harmful Chemicals - List I"

radon-222 (CAS: 14859-67-7) is found on the following regulatory lists;

"Australia Standard for the Uniform Scheduling of Drugs and Poisons (SUSDP) - Appendix A","International Agency for Research on Cancer (IARC) Carcinogens","Japan Port Regulations Law (Japanese) - Dangerous Goods"

Section 16 - 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.
A list of reference resources used to assist the committee may be found at:
www.chemwatch.net/references.

■ The (M)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.