Material Safety Data Sheet

1. IDENTIFICATION OF T HE SUBSTANCE/PREPARATION AND COMPANY/UNDERTAKING

Material Name : **Shell Gas**

Uses : Used as a domestic, commercial, industrial and automotive fuel, a feedstock in chemical processes.

Manufacturer/Supplier : **DSG Energy (Macau) Limited**
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3/F Marine Gardens
876 Avenida da Amizade
Macau

Telephone : (+853) 2870 0555
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Emergency Telephone Number : (+853) 2892 3456

2. COMPOSITION/INFORMATION ON INGREDIENTS

Mixture Description : A complex combination of hydrocarbons produced by the distillation of crude oil. It consists of hydrocarbons having carbon numbers predominantly in the range of C3 through C7 and boiling in the range of approximately -40 °C to 80 °C (-40 °F to 176 °F). It may also contain one or more of the following additives: odourants (usually ethyl mercaptan), anti-icing agents. 1,3-butadiene, classified as a Category 1 carcinogen and Category 2 mutagen, may be present at concentrations of greater than 0.1%(m/m).

CAS No. : 68476-85-7

Hazardous Components

Chemical Identity	CAS	EINECS	Symbol(s)	R-phrase(s)	Conc.
Petroleum gases, liquefied	68476-85-7	270-704-2	F+,	R12	<= 100,00 %
CONTAINS:					
Butane	106-97-8	203-448-7	F+	R12	70.00 - 80.00 %
Propane	74-98-6	200-827-9	F+	R12	20.00 - 30.00 %
Butadiene, 1,3-	106-99-0	203-450-8	F+, T	R12, R45, R46	0.00 - 0.50 %

Additional Information : Refer to chapter 16 for full text of EC R-phrases.

3. HAZARDS IDENTIFICATION

EC Classification : Extremely flammable.

Health Hazards : High gas concentrations will displace available oxygen from the

		air; unconsciousness and death may occur suddenly from lack of oxygen. Exposure to rapidly expanding gases may cause frost burns to eyes and/or skin.
Signs and Symptoms	:	High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued exposure may result in unconsciousness and/or death.
Safety Hazards	:	Extremely flammable. Vapours are heavier than air. Vapours may travel across the ground and reach remote ignition sources causing a flashback fire danger. This material has the potential to be a static accumulator. Contents under pressure and can explode when exposed to heat or open flame.
Environmental Hazards	:	Not classified as dangerous for the environment. No specific hazards under normal use conditions.

4. FIRST-AID MEASURES

Inhalation	:	Remove to fresh air. If breathing but unconscious, place in the recovery position. If breathing has stopped, apply artificial respiration. If heartbeat absent, give external cardiac compression. Monitor breathing and pulse. Seek urgent medical advice.
Skin Contact	:	Do not remove clothing that adheres to skin due to freezing. In the event of frostbite, slowly warm the exposed area by rinsing with warm water. Otherwise: Obtain medical treatment immediately. Contaminated clothing may be a fire hazard and therefore should be soaked with water before being removed. Loosen tight clothing. Keep warm and at rest.
Eye Contact	:	DO NOT DELAY. Obtain medical treatment immediately. Remove contact lenses, if present and easy to do. Continue rinsing. Flush eye with copious quantities of water.
Ingestion	:	In the unlikely event of ingestion, obtain medical attention immediately.
Most Important Symptoms/Effects, Acute & Delayed	:	High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued exposure may result in unconsciousness and/or death.
Advice to Physician	:	Treat symptomatically. Administer oxygen if necessary.

5. FIRE-FIGHTING MEASURES

Clear fire area of all non-emergency personnel.

Specific Hazards	:	Hazardous combustion products may include: Carbon monoxide may be evolved if incomplete combustion occurs. Unidentified organic and inorganic compounds. Sustained fire attack on vessels may result in a Boiling Liquid Expanding Vapour Explosion (BLEVE). Contents are under pressure and can explode when exposed to heat or flames. The vapour is heavier than air, spreads along the ground and distant ignition is possible.
Suitable Extinguishing Media	:	Shut off supply. If not possible and no risk to surroundings, let the fire burn itself out. Use foam, water fog for major fires. Use dry chemical powder, carbon dioxide, sand or earth for minor fires.

Unsuitable Extinguishing Media	:	Do not use direct water jets on the burning product as they could cause a steam explosion and spread of the fire. Simultaneous use of foam and water on the same surface is to be avoided as water destroys the foam.
Protective Equipment for Firefighters	:	Proper protective equipment including chemical resistant gloves are to be worn; chemical resistant suit is indicated if large contact with spilled product is expected. Self-Contained Breathing Apparatus must be worn when approaching a fire in a confined space. Select fire fighter's clothing approved to relevant Standards (e.g. Europe: EN469).
Additional Advice	:	Keep adjacent containers cool by spraying with water.

6. ACCIDENTAL RELEASE MEASURES

Evacuate the area of all non-essential personnel. Ventilate contaminated area thoroughly. Avoid contact with spilled or released material. Immediately remove all contaminated clothing. Do not attempt to do so if clothing is adhering to skin. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. For guidance on disposal of spilled material see Chapter 13 of this Material Safety Data Sheet.

Protective measures	:	Shut off leaks, if possible without personal risks. Remove all possible sources of ignition in the surrounding area and evacuate all personnel. Attempt to disperse the gas or to direct its flow to a safe location for example by using fog sprays. Take precautionary measures against static discharge. Ensure electrical continuity by bonding and grounding (earthing) all equipment. Monitor area with combustible gas meter. Test atmosphere for flammable gas concentrations to ensure safe working conditions before personnel are allowed to enter the area. Use appropriate containment to avoid environmental contamination.
Clean Up Methods	:	Allow to evaporate. Attempt to disperse the gas or to direct its flow to a safe location, for example by using fog sprays. Take precautionary measures against static discharges.
Additional Advice	:	Notify authorities if any exposure to the general public or the environment occurs or is likely to occur. Vapour may form an explosive mixture with air. Risk of explosion. Inform the emergency services if product enters surface water drains.

7. HANDLING AND STORAGE

General Precautions	:	Avoid breathing vapours or contact with material. Only use in well ventilated areas. Wash thoroughly after handling. For guidance on selection of personal protective equipment see Chapter 8 of this Material Safety Data Sheet. Use the information in this data sheet as input to a risk assessment of local circumstances to help determine appropriate controls for safe handling, storage and disposal of this material. Air-dry contaminated clothing in a well-ventilated area before laundering. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols. Take precautionary measures against static discharges.
Handling	:	This product can create a low temperature exposure hazard when released as a liquid. Extinguish any naked flames. Do

		not smoke. Remove ignition sources. Avoid sparks. Avoid prolonged or repeated contact with skin. Electrostatic charges may be generated during handling. Electrostatic discharge may cause fire. Earth all equipment. Use local exhaust ventilation if there is risk of inhalation of vapours, mists or aerosols.
Storage	:	Store only in purpose-designed, appropriately labelled pressure vessels or cylinders. Must be stored in a well-ventilated area, away from sunlight, ignition sources and other sources of heat. Do not store near cylinders containing compressed oxygen or other strong oxidizers. Refer to section 15 for any additional specific legislation covering the packaging and storage of this product.
Product Transfer	:	Do not use compressed air for filling, discharging or handling. Electrostatic charges may be generated during pumping. Electrostatic discharge may cause fire. Delivery lines may become cold enough to present a cold burns hazard. Ensure electrical continuity by bonding and grounding (earthing) all equipment.
Recommended Materials	:	For containers and container linings, use materials specifically approved for use with this product. Examples of suitable materials are: PA-11, PEEK, PVDF, PTFE, GRE (Epoxy), GRVE (vinyl ester), Viton (FKM), type F and GB, Neoprene (CR).
Unsuitable Materials	:	Some forms of cast iron. Examples of materials to avoid are: ABS, polymethyl methacrylate (PMMA), polyethylene (PE / HDPE), polypropylene (PP), PVC, natural rubber (NR), Nitrile (NBR) ethylene propylene rubber (EPDM), Butyl (IIR), Hypalon (CSM), polystyrene, polyvinyl chloride (PVC), polyisobutylene. For containers and container linings, aluminium should not be used if there is a risk of caustic contamination of the product.
Container Advice	:	Containers, even those that have been emptied, can contain explosive vapours. Do not cut, drill, grind, weld or perform similar operations on or near containers.
Additional Information	:	This product is intended for use in closed systems only. Ensure that all local regulations regarding handling and storage facilities are followed.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

If the American Conference of Governmental Industrial Hygienists (ACGIH) value is provided on this document, it is provided for information only.

Occupational Exposure Limits

Material	Source	Type	ppm	mg/m3	Notation
Petroleum gases, liquefied	ACGIH				Included in the regulation but with no data values. See regulation for further details
Propane	HK OEL	TWA	2,500 ppm	4,508 mg/m3	

	ACGIH				Included in the regulation but with no data values. See regulation for further details
Butane	HK OEL	TWA	800 ppm	1,900 mg/m3	
	ACGIH	STEL	1,000 ppm		
Butadiene, 1,3-	ACGIH	TWA	2 ppm		
	OSHA	OSHA_ACT	0,5 ppm		
	OSHA	TWA	1 ppm		
	OSHA	STEL	5 ppm		

Biological Exposure Index (BEI)

Material	Determinant	Sampling Time	BEI	Reference
Butadiene, 1,3-	1,2-Dihydroxy-4-(N-acetylcysteinyl)-butane in Urine	Sampling time: End of shift.	2,5 mg/l	ACGIH BEL (2011)
	Mixture of N-1- and N-2-(hydroxybutenyl) valine hemoglobin (Hb) adducts in Hemoglobin in blood	Sampling time: Not critical.	2.5 pmol/g	ACGIH BEL (2011)

Exposure Controls : The level of protection and types of controls necessary will vary depending upon potential exposure conditions. Select controls based on a risk assessment of local circumstances. Appropriate measures include: Use sealed systems as far as possible. Adequate explosion-proof ventilation to control airborne concentrations below the exposure guidelines/limits. Local exhaust ventilation is recommended. Exhaust emission systems should be designed in accordance with local conditions; the air should always be moved away from the source of vapour generation and the person working at this point. Firewater monitors and deluge systems are recommended. Always observe good personal hygiene measures, such as washing hands after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants. Discard contaminated clothing and footwear that cannot be cleaned. Practice good housekeeping. Define

		procedures for safe handling and maintenance of controls. Educate and train workers in the hazards and control measures relevant to normal activities associated with this product. Ensure appropriate selection, testing and maintenance of equipment used to control exposure, e.g. personal protective equipment, local exhaust ventilation. Drain down system prior to equipment break-in or maintenance.
Personal Protective Equipment	:	Personal protective equipment (PPE) should meet recommended national standards. Check with PPE suppliers.
Respiratory Protection	:	If engineering controls do not maintain airborne concentrations to a level which is adequate to protect worker health, select respiratory protection equipment suitable for the specific conditions of use and meeting relevant legislation. Check with respiratory protective equipment suppliers. Where air-filtering respirators are unsuitable (e.g. airborne concentrations are high, risk of oxygen deficiency, confined space) use appropriate positive pressure breathing apparatus. Where air-filtering respirators are suitable, select an appropriate combination of mask and filter. Select a filter suitable for organic gases and vapors [Type AX boiling point < 65°C (149°F)] meeting EN14387. All respiratory protection equipment and use must be in accordance with local regulations.
Hand Protection	:	Personal hygiene is a key element of effective hand care. Gloves must only be worn on clean hands. After using gloves, hands should be washed and dried thoroughly. Application of a non-perfumed moisturizer is recommended. Suitability and durability of a glove is dependent on usage, e.g. frequency and duration of contact, chemical resistance of glove material, dexterity. Always seek advice from glove suppliers. Contaminated gloves should be replaced. Where hand contact with the product may occur the use of gloves approved to relevant standards (e.g. Europe: EN374, US: F739) made from the following materials may provide suitable chemical protection: Neoprene rubber. Nitrile rubber. If contact with liquefied product is possible or anticipated, gloves should be thermally insulated to prevent cold burns. For continuous contact we recommend gloves with breakthrough time of more than 240 minutes with preference for > 480 minutes where suitable gloves can be identified. For short-term/splash protection we recommend the same, but recognise that suitable gloves offering this level of protection may not be available and in this case a lower breakthrough time may be acceptable so long as appropriate maintenance and replacement regimes are followed. Glove thickness is not a good predictor of glove resistance to a chemical as it is dependent on the exact composition of the glove material.
Eye Protection	:	Chemical splash goggles (gas-tight monogoggles) and face shield with chin guard. Approved to EU Standard EN166.
Protective Clothing	:	Chemical and cold resistant gloves/gauntlets, boots, and apron.

Monitoring Methods	:	Monitoring of the concentration of substances in the breathing zone of workers or in the general workplace may be required to confirm compliance with an OEL and adequacy of exposure controls. For some substances biological monitoring may also be appropriate. Validated exposure measurement methods should be applied by a competent person and samples analysed by an accredited laboratory. Examples of sources of recommended exposure measurement methods are given below or contact the supplier. Further national methods may be available. National Institute of Occupational Safety and Health (NIOSH), USA: Manual of Analytical Methods http://www.cdc.gov/niosh/ Occupational Safety and Health Administration (OSHA), USA: Sampling and Analytical Methods http://www.osha.gov/
Environmental Exposure Controls	:	Local guidelines on emission limits for volatile substances must be observed for the discharge of exhaust air containing vapour.

9. PHYSICAL AND CHEMICAL PROPERTIES

Appearance	:	Colourless. Liquid under pressure.
Odour	:	Distinctive and unpleasant if stenched, odourless if unstenched..
Initial Boiling Point and Boiling Range	:	Typical -40 - -2 °C / -40 - 28 °F
Freezing Point	:	Typical -187,6 - -138,3 °C / -305,7 - -216,9 °F
Flash point	:	ca. -140 - -60 °C / -220 - -76 °F
Upper / lower Flammability or Explosion limits	:	Typical 1,4 - 10,9 %(V)
Auto-ignition temperature	:	> 287 °C / 549 °F
Vapour pressure	:	ca. 345 - 980 kPa at 20 °C / 68 °F
Density	:	ca. 500 - 580 kg/m3
Water solubility	:	Data not available
n-octanol/water partition coefficient (log Pow)	:	ca. 2,3 - 2,8
Dynamic viscosity	:	Not applicable.
Kinematic viscosity	:	Not applicable.
Vapour density (air=1)	:	> 1,5 at 15 °C / 59 °F
Electrical conductivity	:	This material is not expected to be a static accumulator.
Evaporation rate (nBuAc=1)	:	Data not available

10. STABILITY AND REACTIVITY

Stability	:	Stable under normal conditions of use.
Conditions to Avoid	:	Heat, open flames, sparks and flammable atmospheres.
Materials to Avoid	:	Strong oxidising agents.
Hazardous Decomposition Products	:	Hazardous decomposition products are not expected to form during normal storage.
Hazardous Polymerisation	:	No, hazardous, exothermic polymerization cannot occur.
Sensitivity to Mechanical Impact	:	No, product will not become self-reactive.

11. TOXICOLOGICAL INFORMATION

Basis for Assessment	:	Information given is based on product data, a knowledge of the components and the toxicology of similar products.

Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Acute Oral Toxicity : Not applicable.

Acute Dermal Toxicity : Not applicable.

Acute Inhalation Toxicity : Low toxicity: LC50 >20 mg/l / 4,00 h, Rat
High concentrations may cause central nervous system depression resulting in headaches, dizziness and nausea; continued inhalation may result in unconsciousness and/or death.

Skin Irritation : Not irritating to skin.

Eye Irritation : Essentially non-irritating to eyes.

Respiratory Irritation : Inhalation of vapours or mists may cause irritation to the respiratory system.

Sensitisation : Not expected to be a sensitiser.

Repeated Dose Toxicity : Low systemic toxicity on repeated exposure.

Mutagenicity : May cause heritable genetic damage. Mutagen classification based on Butadiene content at >= 0.1%.

Carcinogenicity : Causes cancer in laboratory animals. Carcinogen classification based on Butadiene content at >= 0.1%.

Material	:	**Carcinogenicity Classification**
Petroleum gases, liquefied	:	GHS / CLP**:** Carcinogenicity Category 1B
Propane	:	GHS / CLP**:** No carcinogenicity classification
Butane	:	GHS / CLP**:** No carcinogenicity classification
Butadiene, 1,3-	:	ACGIH Group A2: Suspected human carcinogen.
Butadiene, 1,3-	:	NTP: Known To Be Human Carcinogen.
Butadiene, 1,3-	:	IARC 1: Carcinogenic to humans.
Butadiene, 1,3-	:	GHS / CLP**:** Carcinogenicity Category 1A

Reproductive and Developmental Toxicity : Not expected to impair fertility. Not a developmental toxicant.

Additional Information : Rapid release of gases which are liquids under pressure may cause frost burns of exposed tissues (skin, eye) due to evaporative cooling. High gas concentrations will displace available oxygen from the air; unconsciousness and death may occur suddenly from lack of oxygen. Exposure to very high concentrations of similar materials has been associated with irregular heart rhythms and cardiac arrest.
Classifications by other authorities under varying regulatory frameworks may exist. For skin sensitisation:

12. ECOLOGICAL INFORMATION

Information given is based on product testing, and/or similar products, and/or components.

Unless indicated otherwise, the data presented is representative of the product as a whole, rather than for individual component(s).

Acute Toxicity : Physical properties indicate that petroleum gases will rapidly volatilise from the aquatic environment and that acute and chronic effects would not be observed in practice. Practically non toxic: LL/EL/IL50 > 100 mg/l LL/EL50 expressed as the nominal amount of product required to prepare aqueous test

extract.

Fish	:	Practically non toxic: LL/EL/IL50 > 100 mg/l
Aquatic crustacea	:	Practically non toxic: LL/EL/IL50 > 100 mg/l
Algae/aquatic plants	:	Practically non toxic: LL/EL/IL50 > 100 mg/l
Microorganisms	:	Expected to be practically non toxic: LL/EL/IL50 > 100 mg/l
Chronic Toxicity		
Fish	:	Data not available
Aquatic crustacea	:	Data not available
Mobility	:	Because of their extreme volatility, air is the only environmental compartment that hydrocarbon gases will be found.
Persistence/degradability	:	Expected to be readily biodegradable. Oxidises rapidly by photo-chemical reactions in air.
Bioaccumulation	:	Not expected to bioaccumulate significantly.
Other Adverse Effects	:	In view of the high rate of loss from solution, the product is unlikely to pose a significant hazard to aquatic life.

13. DISPOSAL CONSIDERATIONS

Material Disposal	:	It is the responsibility of the waste generator to determine the toxicity and physical properties of the material generated to determine the proper waste classification and disposal methods in compliance with applicable regulations. Waste arising from a spillage or tank cleaning should be disposed of in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand. Do not dispose into the environment, in drains or in water courses. Given the nature and uses of this product, the need for disposal seldom arises. If necessary, dispose by controlled combustion in purpose-designed equipment. If this is not possible, contact the supplier.
Container Disposal	:	Drain container thoroughly. After draining, vent in a safe place away from sparks and fire. Residues may cause an explosion hazard. Do not pollute the soil, water or environment with the waste container. Return part-used or empty cylinders to the supplier. For tanks seek specialist advice from suppliers. Dispose in accordance with prevailing regulations, preferably to a recognised collector or contractor. The competence of the collector or contractor should be established beforehand.
Local Legislation	:	Disposal should be in accordance with applicable regional, national, and local laws and regulations. Local regulations may be more stringent than regional or national requirements and must be in compliance.

14. TRANSPORT INFORMATION

Land (as per ADR classification): Regulated

Class	:	2
Hazard indentification no.	:	23
UN number	:	1075
Danger label (primary risk)	:	2.1
Proper shipping name	:	PETROLEUM GASES, LIQUEFIED
Environmentally Hazardous	:	No

IMDG

Identification number	UN 1075
Proper shipping name	PETROLEUM GASES, LIQUEFIED
Technical name	(LPG)
Class / Division	2.1
Marine Pollutant:	No

IATA (Country variations may apply)

UN number	:	1075
Proper shipping name	:	Petroleum gases, liquefied
Technical name	:	(LPG)
Class / Division	:	2.1

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Pollution Category	**:**	Not applicable.
Ship Type	**:**	Not applicable.
Product Name	**:**	Not applicable.
Special Precaution	**:**	Not applicable.

Additional Information **:** Relevant Macau Administrative Regulations

15. REGULATORY INFORMATION

The regulatory information is not intended to be comprehensive. Other regulations may apply to this material.

EC Classification	:	Extremely flammable.
EC Symbols	:	F+ Extremely flammable. T Toxic.
EC Risk Phrases	:	R12 Extremely flammable. R45 May cause cancer. R46 May cause heritable genetic damage.
EC Safety Phrases	:	S9 Keep container in a well-ventilated place. S16 Keep away from sources of ignition - No smoking. S33 Take precautionary measures against static discharges. S45 In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible). S51 Use only in well-ventilated areas. S53 Avoid exposure. Obtain special instructions before use.
Other Information (Other regulations (SDS)) Other Information	:	Relevant Macau Administrative Regulations

16. OTHER INFORMATION

Additional Information	:	This document contains important information to ensure the safe storage, handling and use of this product. The information in this document should be brought to the attention of the person in your organisation responsible for advising on safety

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matters.

R-phrase(s)

R12	Extremely flammable.
R45	May cause cancer.
R46	May cause heritable genetic damage.

SDS Version Number	:	1.0
SDS Effective Date	:	2014/09/12
SDS Revisions	:	A vertical bar (|) in the left margin indicates an amendment from the previous version.
Uses and Restrictions	:	This product must not be used in applications other than those recommended in Section 1, without first seeking the advice of the supplier.
SDS Distribution	:	The information in this document should be made available to all who may handle the product.
Disclaimer	:	This information is based on our current knowledge and is intended to describe the product for the purposes of health, safety and environmental requirements only. It should not therefore be construed as guaranteeing any specific property of the product.