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SECTION 1: Product and Company Identification

1.1 Product identifier

Product name : Butane Cartridge Gas
 Trade name : No applicable.

1.2 Other means of identification

Chemical Name : Butane
 Chemical Formula : C4H10

1.3 Recommended use and restrictions on use

Product use : Semiconductor Processes
 Industrial & Professional use
 Synthetic/Analytical chemistry
 Photovoltaic Processes

1.4 Details of supplier of the safety data sheet

Company identification : Iwatani Corporation (Singapore) Pte. Ltd.
 Address : 6 Shenton Way, OUE Downtown 2 #13-11,
 Singapore 068809
 Phone : +65 6862 2111

1.5 Emergency contact

Emergency phone number : +65 6220 8347

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Physical hazards : Gases under pressure- liquefied gas (Warning)
 Characteristic : Flammable, Category 1 (Danger)
 Acute toxicity (inhalation) : Category 4
 Skin corrosion/irritation : Not classified.
 Target organ systemic toxicity- single exposure : Categories 2&3 (Warning)
 Serious eye damage/eye irritation : Not classified.
 Acute aquatic toxicity : Not classified.

2.3 GHS label elements, including precautionary statements

Pictogram(s) :    

Signal word(s) : Danger
 Hazard statement(s) : H220 - Extremely flammable gas
 H280 – Contains gas under pressure; may explode if heated

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H335 - May cause respiratory irritation
 H336 - May cause drowsiness and dizziness
 H371: May cause damage to organs

Precautionary statements	
Prevention	<ul style="list-style-type: none"> : P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. - No smoking. P261- Avoid breathing dust/fume/gas/mist/vapours/spray. P271 - Use only outdoors or in a well-ventilated area. P260 - Do not breathe dust/fume/gas/mist/vapours/ spray P264 - Wash skin thoroughly after handling. P270 - Do not eat, drink or smoke when using this product.
Response	<ul style="list-style-type: none"> : P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely. P381 - In case of leakage, eliminate all ignition sources. P304+P340 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. P312 - Call a POISON CENTRE/doctor if you feel unwell. P308+P311 - IF exposed or concerned: Call a POISON CENTER/doctor.
Storage	<ul style="list-style-type: none"> : P403 - Store in a well-ventilated place. P403+P410 - Store in a well-ventilated place. Protect from sunlight. P404+P233 - Store in a well-ventilated place. Keep container tightly closed. P405 - Store locked up.
Disposal	<ul style="list-style-type: none"> : P501 - Dispose of contents/ container to an approved waste disposal plant.
Emergency Overview	Flammable gas, will turn into explosive mixtures if being mixed with the air; show risks of combustion and explosion if being exposed in heat or open fire; low-pressure liquefied gas, will possibly lead to explosion of the cartridge if being exposed in heat.

2.3 Other hazards which do not result in classification

Physical and chemical hazards	<ul style="list-style-type: none"> : If kept in narrow space, a great deal of flammable gas may easily result in reduction of oxygen contents in the air and consequently lead to asphyxia; skin exposure with the liquefied gas may result in cold injury; sufficient mixing the flammable gas and the air may easily produce explosive mixtures.
Health hazards	<ul style="list-style-type: none"> : Long-term repeated exposure with the skin will result in de-oiling, skin irritation or chafing. Exposure with the eyes leads to eye irritation; show anaesthetic effects. Acute toxicity: will lead to dizziness, headache, excitation or drowsiness, nausea, vomiting, and slow pulse, etc; critical victims may fall down suddenly with urinary incontinence, loss of consciousness or even respiratory arrest if serious; will lead to cold injury of the skin. Chronic effects: long-term exposure in low concentration may result in dizziness and headache, poor sleep, easy fatigue, emotional instability or vegetative nerve function disorder.
Environmental hazards	<ul style="list-style-type: none"> : The product itself has no hazards to the environment but the derivatives including

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CO, nitric oxide, sulfide from incomplete combustion will pollute the environment.

SECTION 3. Composition/Information on ingredients

3.1 Substances / 3.2. Mixture

Substance name	Contents	CAS No.
Butane;	95-100 %	106-97-8
Isobutane		75-28-5
Propane	0-5 %	74-98-6

The concentrations listed represent actual ranges that result from batch variability.

SECTION 4. First-aid measures

4.1 Description of first aid measures

Inhalation	: If breathing is difficult, remove victim to fresh air and keep at rest in a position comfortable for breathing. Get medical advice/attention if you feel unwell.
Skin contact	: See the doctor immediately if exposure by accident and immediately wash for 15 minutes with a great deal of clean water, remove the clothes or shoes contaminated by the gas and wash clean before re-using the same again. Exposure in liquefied butane will probably lead to cold injury, if so, don't rub the affected part or heat such part slowly if necessary.
Eye contact	: See the doctor immediately if exposure by accident and immediately wash flush eyes thoroughly for 15 minutes with a great deal of clean water.
Ingestion	: Impossible to contact through this way. See the doctor immediately and don't vomit if ingestion.

4.2 Most important symptoms/effect, acute and delayed

Symptoms/effects after inhalation	: May cause irritation to the respiratory tract.
Symptoms/effects after skin contact	: May cause skin irritation. Repeated exposure may cause skin dryness or cracking.
Symptoms/effects after eye contact	: May cause eye irritation. Symptoms may include discomfort or pain, excess blinking and tear production, with possible redness and swelling.
Symptoms/effects after ingestion	: May be harmful if swallowed. May cause gastrointestinal irritation, nausea, vomiting and diarrhoea.

4.3 Indication of immediate medical attention and special treatment needed, if necessary

Symptoms may be delayed. In case of accident or if you feel unwell, seek medical advice immediately (show the label where possible).

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SECTION 5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media : Dry Chemical, Water Spray, Foam, Carbon Dioxide and Dry Sand.

Unsuitable extinguishing media : Water-steam nozzle.

5.2 Special hazards arising from the substance or mixture

Specific hazards : **EXTREMELY FLAMMABLE**

Turn explosive if being mixed with the air; show risk of combustion and explosion if being exposed in heat or open flame; will set off violent chemical reaction if exposed in fluorine, chlorine or other oxidizing gases. With the density greater than air, the gas will diffuse to extremely long distance and will catch fire and flashback if being exposed in the fire.

5.3 Advice for fire-fighters

Specific methods : Extinguish fire from the protected area.

Fire fighters shall wear protective clothes and self-contained breathing apparatus. Spray water to make the gas cartridge cool down.

SECTION 6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Operators entering the emergency site shall put on protective appliances and SCBA.

Immediately stop leakage or cut off air supply; keep ventilated and cut off all the fire or power supplies; prevent electrostatic charges strictly. Keep away from the flammables and notify the risk of fire or explosion.

Discuss the fire measures and handling methods before handling and cleaning.

Turn off and keep away from the fire source. Evacuate people.

Try to minimize inhalation of gas and skin exposure with the gas. Open the door and window to improve ventilation in the narrow space.

The high volatility of the material will result in extremely quick evaporation. Thus, no other handling measures are required.

6.2 Environmental precautions

None.

6.3 Methods and materials for containment and cleaning up

Stop the leakage in time, and if possible, make the leaking container fall down, so that the gas is not liquid, but in the form of gas.

All equipment used for handling leakage shall be grounded.

Keep away from the nearby fire source and cut off the gas supply.

The relative density of butane cartridge gas is larger than air, so it is possible to stack on the ground.

If leaks, make environment ventilated.

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SECTION 7. Handling and storage

7.1 Precautions for safe handling

The container shall take measures to prevent falling down, and rough handling is not allowed.

To avoid incomplete combustion, Ensure good air circulation.

Measures to be taken when using in places where butane cartridge gas may be detained.

When the butane cartridge gas is mixed with air or oxygen, it will produce explosive gas mixture. The explosion range in the air is 1.8% - 9.5%. LEL is low while risk is high. Therefore, pay attention to the leakage.

Since it is a kind of gas with strong ignitability, it is strictly prohibited to use fire gas nearby.

There is residual pressure when the gas is not completely used up.

7.2 Conditions for safe storage, including any incompatibilities

The container shall be stored in dry place with good drainage and ventilation.

The container shall be kept below 40 °C and avoid direct sunlight.

The container shall be kept in a place where no outsiders enter.

Put the warning sign of [combustible gas] or [LPG] in the storage place of the container.

In the container yard, the container shall be placed separately from toxic and oxygen.

Within 2m around the container yard, except for setting necessary barriers, forbid to place ignitable substances.

SECTION 8. Exposure controls/personal protection

8.1 Control parameters/Occupational exposure limits

Components	CAS-No.	Value type (form of exposure)	Control parameters/permmissible concentration
Butane; Isobutane	106-97-8 72-28-5	Japan Society for Occupational Health	1000 ppm
		ACGIH (TLV-TWA)	800 ppm
		GBZ 2.1-2007	Not available
Propane	74-98-6	Japan Society for Occupational Health	1000 ppm
		ACGIH (TLV-TWA)	1000 ppm
		GBZ 2.1-2007	Not available

TWA=Time weighted average; TLV= threshold limit value

8.2 Appropriate engineering control measures

Ensure good ventilation of the work station.

8.3 Personal protection

Individual protection measures, such as personal protective equipment (PPE)

A risk assessment should be conducted and documented in each work area to assess the risks related to the use of the product and to select the PPE that matches the relevant risk. The following recommendations should be considered: Protect eyes, face and skin from liquid splashes. PPE compliant to the recommended EN/ISO standards should be selected.

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Hand protection : Wear appropriate protective chemical-resistant gloves that protect chemicals directly. Standard EN 388 – Protective gloves against mechanical risk.

Eye/face protection : Wear facepiece with goggles to protect from scattering dust or toxic liquid. Further eye protection such as chemical goggles and/or protecting glasses must be worn when the possibility exists for eye contact due to splashing or spraying liquid or airborne particle. EN 166 - Personal Eye Protection.

Skin and Body protection : As needed, wear hand, and body protection, which help to prevent injury from radiation and sparks (see ANSI Z49.1. at a minimum).

Respiratory protection : If the gas concentration in the gas exceeds the limit, turn off the gas supply and escape from the work site immediately; carry out on-site rescue service and put on SCBA if necessary.
No respiratory protection is required if this product is used in normal conditions. Use complete apparatus in massive leakage situations.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

	Butane	Propane
Appearance		
Physical state	: Gas	Gas
Colour	: Colourless	Colourless
Odour	: Faint.	Faint.
Odour threshold	: No applicable.	No applicable.
pH	: No applicable.	No applicable.
Melting point	: -138.4 to -159.6 °C (-217.1 to -255.3 °F)	187.69 °C (369.8 °F)
Boiling point	: -11.7 to -0.5 °C (10.9 to 31.1 °F)	-42.04 °C (-43.7 °F)
Flash point	: -81 to -72 °C (-113.8 to -97.6 °F)	-90 °C (-130 °F)
Critical Temperature	: 134.98 to 152.03 °C (275 -305.6 °F)	96.67 °C (206 °F)
Critical pressure (MPa)	: 3.62-3.69	4.15
Flammability (solid, gas)	: Extremely flammable gas.	Extremely flammable gas.
Lower explosive limit	: 8.5	9.5
Upper explosive limit	: 1.8	2.2
Relative density (water = 1)	: 0.557-0.579	0.501
Relative vapor density (air = 1)	: 2.07	1.55
Saturated vapor pressure (KPa)	: 120-210	750
Molecular mass	: 58.12 g/mol	44.10 g/mol
Solubility	: Low solubility in the water.	Low solubility in the water.
Viscosity	: No data available.	No data available.
Partition coefficient: n-octanol/water	: 2.89 (Butane). 2.88 (Isobutane).	2.36
Evaporation rate	: No data available.	No data available.

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Decomposition temperature : No data available.
 Auto-Ignition temperature : 405-550 °C No data available.
 493 °C

Section 10. Stability and reactivity

10.1 Reactivity

This product is stable and will not react sharply with the water or start polymerization reaction.

10.2 Chemical stability

Stable under normal conditions. Extremely flammable gas. Contains gas under pressure; may explode if heated.

10.3 Possibility of hazardous reactions

Exposure in prohibited mixing agents such as oxidants may lead to fire disaster or explosion; will set off violent reaction if being exposed in halogens including fluorine, chlorine, and bromine.

10.4 Conditions to avoid

Open flames, high temperature, oxidants.

10.5 Incompatible materials

Oxidants, halogens, oils, nature gum, strong acid and strong alkali.

10.6 Hazardous decomposition products

Carbon monoxide, carbon dioxide.

SECTION 11. Toxicology information

11.1 Information on toxicological effects

Acute toxicity (Oral) : Not classified.
 Acute toxicity (Inhalation) : Isobutene classified as Category 4, if calculate estimation value of all comments
 Butane cartridge gas classified to Category 4.
 Skin corrosion or irritation : Not classified.
 Serious eye damage or irritation : Not classified.
 Respiratory or skin sensitization : Not classified
 Germ cell mutagenicity : Not classified.
 Carcinogenicity : Not classified.
 Reproductive toxicity : Not classified.
 Specific Target Organ Toxicity (STOT)-single exposure : Isobutane is classified to Category 2(heart).
 If calculate all components concentration limits, it classified to Category 2(heart).
 All components classified to Category 3(anaesthetic effect).
 STOT-repeated exposure : Not classified.

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Aspiration hazard : Not classified.

SECTION 12. Ecological information

12.1 Ecotoxicity

May cause long-term adverse effects in the aquatic environment.

12.2 Persistence and degradability

Not established.

12.3 Bioaccumulative potential

Not established.

12.4 Mobility in soil

No additional information available.

SECTION 13. Disposal information

13.1 Disposal methods

Residue Waste : Don't abandon the gas cartridge until the gas inside the same is fully used up. Refer to the EIGA code of practice (Doc.30 "Disposal of Gases", downloadable at <http://www.eiga.org>) for more guidance on suitable disposal methods.

Contaminated packaging : Please separate it from other wastes at the time of abandoning.

SECTION 14. Transport information

14.1 UN number

: UN2037

14.2 UN proper shipping name

: Gas cartridges (flammable) without a release device, non-refillable or Receptacles, small, containing gas (gas cartridges) flammable or non-flammable, without release device, not refillable and not exceeding 1 L capacity.

14.3 Transport Hazard Class(es)

UNRTDG (United Nations Recommendations Transport Dangerous Goods)

Class : 2.1
 Subsidiary risk : Not classified.

IATA-DGR (International Air Transport Association – Dangerous Goods)

Class : 2.1
 Subsidiary risk : Not classified.

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IMDG (International Maritime Dangerous Goods) – Code

Class : 2.1
 Subsidiary risk : Not classified.

14.4 Packing group

Not assigned by regulation.

14.5 Environmental hazards

None.

14.6 Special precaution for user

Keep the gas carefully and gently. Don't throw, slide or roll it. Keep the gas cartridge from strong direct sunshine during transportation and the place where it is to be kept shall be away from fire, heater or hot places. Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency.

Before transporting product containers:

- Ensure there is adequate ventilation.
- Ensure that containers are firmly secured.
- Ensure valve is closed and not leaking.
- Ensure valve outlet cap nut or plug (where provided) is correctly fitted.
- Ensure valve protection device (where provided) is correctly fitted.

SECTION 15. Regulatory information

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

Restrictions on use : None.
 Other information, restriction and prohibition regulations : Ensure all national/local regulations are observed.
 Applicable national regulations : Safety, health and environmental regulations/legislation specific for the substance or mixture are observed.

SECTION 16. Other information

16.1 Other information

Indication of changes : Ensure all national/local regulations are observed.
 Disclaimer of liability : Before using this product in any new process or experiment, a thorough material compatibility and safety study should be carried out. Details given in this document are believed to be correct at the time of going to press. Whilst proper care has been taken in the preparation of this document, no liability for injury or damage resulting from its use can be accepted.