SECTION 1: Product and Company Identification

1.1 Product identifier

Product name	:	Isobutane, R-600a
Trade name	:	Refrigerant gas R600a

1.2 Other means of identification

Chemical Name	:	Isobutane
Chemical Formula	:	$CH(CH_3)_3$

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 (Simple asphyxiants).
Characteristic	:	Flammable, Category 1
Acute toxicity (inhalation)	:	Not classified.
Skin corrosion/irritation	:	Not classified.
Target organ systemic toxicity-single exposure	:	Not classified.
Serious eye damage/eye irritation	:	Not classified.
Acute aquatic toxicity	:	Not classified.

2.2 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

H380 - May displace oxygen and cause rapid suffocation

Precautionary statements

Prevention : P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. - No smoking.

Response : P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
P381 - In case of leakage, eliminate all ignition sources.

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

Disposal : None.

2.3 Other hazards which do not result in classification

Exposure may aggravate pre-existing eye, skin, or respiratory conditions.
Contacts with gas escaping the container can cause frostbite.

Potential Health Effects :

Inhalation : Asphyxiant, effects are due to lack of oxygen. Moderate concentrations may cause headache, drowsiness, dizziness, excitation, excess salivation, nausea, vomiting, and unconsciousness. The vapor from a liquid release may also cause incoordination, abdominal pain. Effects may be delayed. Lack of oxygen can kill.

SECTION 3. Composition/Information on ingredients

3.1 Substances / 3.2. Mixture

Substance name	Contents	CAS No.
Isobutane	100 %	75-28-5

SECTION 4. First-aid measures

4.1 Description of first aid measures

General : Never give anything by mouth to an unconscious person.
If you feel unwell, seek medical advice (show the label where possible).
If frostbite or freezing occurs, immediately flush with plenty of lukewarm water to GENTLY warm the affected area.
Do not use hot water.
Do not rub affected area.
Get medical attention.

Inhalation : Obtain medical attention if breathing difficulty persists. First, take proper precautions to ensure your own safety before attempting reuse. (e.g. wear appropriate respiratory protective equipment, use the buddy system), then remove the exposed person to fresh air. Keep at rest in apposition comfortable for breathing.

Skin contact : Remove contaminated clothing. Drench affected are with water for at least 15 minutes.
Obtain medical attention if irritation develops or persists.
Thaw frosted parts with lukewarm water. DO not rub affected area. Get medical

advice/attention.

Eye contact	:	Rinse cautiously with water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Obtain medical attention.
Ingestion	:	Rinse mouth. Do NOT induce vomiting. Obtain medical attention.

4.2 Most important symptoms/effect, acute and delayed

General	:	May cause frostbite on contact with the liquid. Asphyxia by lack of oxygen: risk of health.
Symptoms/effects after inhalation	:	In elevated concentrations may cause asphyxiation, central nervous system effects and increased breathing rate. Symptoms of asphyxiation include headache, dizziness, rapid breathing, increased pulse, mood changes, tremors, cyanosis, muscular weakness, narcosis, numbness of extremities, unconsciousness and death.
Symptoms/effects after skin contact	:	Contact with gas/liquid escaping the container can cause frostbite and freeze burns.
Symptoms/effects after eye contact	:	Contact with gas/liquid escaping the container can cause frostbite, freeze burns. And permanent eye damage.
Symptoms/effects after ingestion	:	Not considering a potential route of exposure, but contact with gas/liquid escaping the container can cause freeze burns and frostbite.

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

If exposed or concerned, get medical advice and attention.
If medical advice is needed, have product container or label at hand.

SECTION 5. Fire-fighting measures

5.1 Extinguishing media

Suitable extinguishing media	:	Do not extinguish burning gas if flow cannot be shut off immediately. Extinguish secondary FIRES with appropriate materials. Water Spray, Foam, Carbon Dioxide and Dry powder
Unsuitable extinguishing media	:	Do not use a heavy eater stream. Use of heavy stream if water may spread fire. Carbon dioxide.

5.2 Special hazards arising from the substance or mixture

Fire hazards	:	**EXTREMELY FLAMMABLE** **Explosion hazard:** May form flammable/explosive vapour-air mixture. Heat may build pressure, rupturing closed containers, spreading fire and increasing risk of burns and injuries. Reactivity: Hazardous reactions will not occur under normal conditions.

5.3 Advice for fire-fighters

Precautionary measure fire	:	Exercise caution when fighting any chemical fire. Vapours are heavier than air and may travel considerable distance to an ignition source and flash back to source of vapours.
Firefighting instruction	:	Use water spray or fog for cooling exposed containers. Leaking gas fire. DO not extinguish, unless leak can be stopped safely. Elimate all ignition source if safe to do so. Fight fire remotely due to the risk of explosion.
Protection during firefighting	:	Do not enter fire area without proper protective equipment, including respiratory protection.
Hazardous combustion products	:	Carbon oxides (CO, CO_2). Hydrocarbons, Toxic vapours.
Other information	:	Use water spray to disperse vapours.

SECTION 6. Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

General measure	:	Gas/vapour heavier than air. May accumulate in confined spaces, particularly at or below ground level. Elimate every possible source of ignition. Do not get un eyes, on skin, or on clothing. Do not breathe vapour or gas.
For non-emergency personnel	:	Protective equipment: Use appropriate personal protection equipment (PPE). Emergency procedure: Evacuate unnecessary personnel.
For emergency personnel	:	Protective equipment: Equip cleanup crew with proper protection. Emergency procedure: Upon arrival at the scene, a first responder is expected to recognize he presence of dangerous goods, protect oneself and the public, secure the area, and call for the assistance of trained personnel as soon as conditions permit. Evacuate unnecessary personnel, isolate, and ventilate area.

6.2 Environmental precautions

Prevent entry to sewers and public waters.

6.3 Methods and materials for containment and cleaning up

For containment	:	Stop leak, if possible, without risk. As an immediate precautionary measure, isolate spill or leak area in all direction.
Methods for cleaning up	:	Stop the source of the release, if safe to dos so. Consider the use of water spray to disperse vapours. Isolate the area until gas has dispersed. Ventilate and gas test area before entering. Contact competent authorities after a spill.

SECTION 7. Handling and storage

7.1 Precautions for safe handling

Handle empty container with care because residual vapours are flammable. Ruptured cylinders may rocket. DO not pressurize, cut or weld containers. Ensure adequate ventilation, Asphyxiating gas at high concentrations.
Wah hands and other exposed area with mild soap and water before eating, drinking or smoking and when leaving work. Avoid prolonged contact with eyes, skin and clothing. Do not breathe gas.

Handle in accordance with good industrial hygiene and safety procedures.

7.2 Conditions for safe storage, including any incompatibilities

Comply with applicable regulations. Proper grounding procedures to avoid static electricity should be followed. Keep container closed when not in use/Store in a dry, cool place.
Keep/store away from direct sunlight, extremely high or low temperatures and incompatible materials. Keep in fireproof place. Cylinder should be stored upright with valve protection cap in place and firmly secured to prevent failing.
Incompatible materials: Strong acids, strong bases, strong oxidizers.

7.3 Specific end use(s)

Refrigerant. For professional use only.

SECTION 8. Exposure controls/personal protection

8.1 Control parameters/Occupational exposure limits

Components	CAS-No.	Value type (form of exposure)	Control parameters/permissible concentration	
Isobutane	72-28-5	STEL	1000 ppm	USA ACGIH
		REL TWA	800 ppm; 1900 mg/m^3	USA NIOSH
		OEL STEL	1000 ppm	Manitoba
		OEL STEL	1000 ppm	Newfoundland & Labrador
		OEL STEL	1000 ppm	Nova Scotia
		OEL STEL	1250 ppm	Nunavut
		OEL TWA	1000 ppm	Nunavut
		OEL STEL	1250 ppm	Northwest Territories
		OEL TWA	1000 ppm	Northwest Territories
		OEL STEL	1000 ppm	Ontario
		OEL TWA	800 ppm	Ontario
		OEL STEL	1000 ppm	Prince Edward Island
		OEL STEL	1250 ppm	Saskatchewan
		OEL TWA	1000 ppm	Saskatchewan

STEL = Short term exposure limit; TWA=Time weighted average; REL=Recommended Exposure Limit; OEL= Occupational exposure limits

8.2 Appropriate engineering control measures

Emergency eye wash fountains and safety showers should be available in the immediate vicinity of any potential exposure. Ensure adequate ventilation, especially in confined areas. Ensure all national regulation observed. Use explosion-proof equipment. Proper grounding procedures to avoid static electricity should be followed. Gas detectors should be used when flammable gases or vapours may be released. Oxygen detectors should be used when asphyxiating gases may be released.

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.
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), this includes welder's glove and may include arm protectors, aprons, hats, and shoulder protection, as well as substantial clothing. Wear safety shoes while handling containers. ISO 20345 - Personal protective equipment - Safety footwear.
Respiratory protection	:	Use a NIOSH-approved self-contained breathing apparatus whenever exposure may exceed established Occupational Exposure Limit. In case of inadequate ventilation, oxygen deficient atmosphere, or when exposure levels are not known wear a self-contained breathing apparatus (SCBA).
Hygiene measures	:	Handle in accordance with good industrial hygiene and safety practice.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Appearance		
Physical state	:	Gas
Colour	:	Colourless.
Odour	:	Odourless.
Odour threshold	:	No data available.
pH	:	No data available.
Melting point	:	-159 °C (-254.2 °F)
Boiling point	:	-11.7 °C (10.94 °F)
Flash point	:	-83 °C (-117 °F -Closed cup).
Critical Temperature	:	135 °C (275 °F)
Flammability (solid, gas)	:	Extremely flammable gas.
Lower explosive limit	:	No data available.
Upper explosive limit	:	No data available.
Vapour pressure @ 20°C	:	No data available.
Relative density	:	No data available.

Specific gravity	:	No data available.
Molecular mass	:	58 g/mol
Solubility	:	Water 54 mg/l
Viscosity	:	No data available.
Partition coefficient: n-octanol/water	:	No data available.
Evaporation rate	:	No data available.
Decomposition temperature	:	No data available.
Autoignition temperature	:	No data available.

Section 10. Stability and reactivity

10.1 Reactivity

Hazardous reactions will not occur under normal conditions.

10.2 Chemical stability

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

10.3 Possibility of hazardous reactions

Hazardous polymerization will not occur.

10.4 Conditions to avoid

Direct sunlight, extremely high or low temperatures, open flames, source of ignition and incompatible materials.

10.5 Incompatible materials

Strong acid, strong bases, strong oxidizers.

10.6 Hazardous decomposition products

Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11. Toxicology information

11.1 Information on toxicological effects

No known effects from this product.

SECTION 12. Ecological information

12.1 Ecotoxicity

Not classified.

12.2 Persistence and degradability

Not established.

12.3 Bioaccumulative potential

Not established.

BCF Fish 1	1.57-1.97
Log Pow	2.88 (at 20 °C)

12.4 Mobility in soil

No additional information available.

SECTION 13. Disposal information

13.1 Disposal methods

Waste disposal recommendations : Dispose of content/container with local, regional, national and international regulations.
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 : Container may remain hazardous when empty. Continue to observe all precaution. Handle empty container with care because residual vapours are flammable. Do not puncture or incinerate container.

SECTION 14. Transport information

14.1 UN number

: UN1969

14.2 UN proper shipping name

: ISOBUTANE

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.

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

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 combability 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 ca be accepted.

End of Safety Data Sheet