

Safety Data Sheet

Version 1.12

Revision Date 08/01/2016

SDS Number 300000000075

Print Date 12/16/2017

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Hydrogen (Refrigerated)

Chemical formula : H₂

Synonyms : Hydrogen (refrigerated), Cryogenic Liquid Hydrogen, Liquid Hydrogen

Product Use Description : General Industrial

Manufacturer/Importer/Distributor : Versum Materials US, LLC
8555 South River Parkway
Tempe, AZ 85284
Exporter EIN No.475632014
www.versummaterials.com

Telephone : (602)282-1000

Emergency telephone number (24h) : 800-523-9374 USA
+1 610 481 7711 International

2. HAZARDS IDENTIFICATION

GHS classification

Flammable gases - Category 1
Gases under pressure - Refrigerated liquefied gas

GHS label elements

Hazard pictograms/symbols



Signal Word: Danger

Hazard Statements:

H220:Extremely flammable gas.

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H281:Contains refrigerated gas; may cause cryogenic burns or injury.
May displace oxygen and cause rapid suffocation.
May form explosive mixtures in air.
Burns with invisible flame.

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 :Eliminate all ignition sources if safe to do so.

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

Hazards not otherwise classified

Burns with an invisible flame.
Can ignite on contact with air.
Extremely cold liquid and gas under pressure.
Extremely flammable liquefied gas.
Vapors may spread long distances and ignite.
Direct contact with liquid can cause frostbite.
Avoid breathing gas.
Can cause rapid suffocation.
Self contained breathing apparatus (SCBA) may be required.
High concentrations that can cause rapid suffocation are within the flammable range and should not be entered.
Immediate fire and explosion hazard exists when mixed with air at concentrations exceeding the lower flammability limit (LFL).

100 % of mixture consists of ingredients of unknown acute toxicity

3. COMPOSITION/INFORMATION ON INGREDIENTS

Components	CAS Number	Concentration (Volume)
Hydrogen	1333-74-0	100 %

Concentration is nominal. For the exact product composition, please refer to technical specifications.

4. FIRST AID MEASURES

General advice : Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped.

Eye contact : In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.
Keep eye wide open while rinsing. Seek medical advice.

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- Skin contact : In case of frostbite, obtain medical treatment immediately. Wash frost-bitten areas with plenty of water. Do not remove clothing. Cover wound with sterile dressing. Do not rub frozen parts as tissue damage may result. As soon as practical, place the affected area in a warm water bath- which has a temperature not to exceed 40 °C (105 °F).
- Ingestion : Ingestion is not considered a potential route of exposure.
- Inhalation : Move to fresh air. In case of shortness of breath, give oxygen. If breathing has stopped or is labored, give assisted respirations. Supplemental oxygen may be indicated. If the heart has stopped, trained personnel should begin cardiopulmonary resuscitation immediately.
- Most important symptoms/effects - acute and delayed : Exposure to oxygen deficient atmosphere may cause the following symptoms: Dizziness. Salivation. Nausea. Vomiting. Loss of mobility/consciousness.

Immediate Medical Attention and Special Treatment

- Treatment : If exposed or concerned: Get medical attention/advice.

5. FIRE-FIGHTING MEASURES

- Suitable extinguishing media : All known extinguishing media can be used.
- Specific hazards : Ignitable by static electricity. Burns with an invisible flame. Gas is lighter than air and can accumulate in the upper sections of enclosed spaces. Spill will rapidly vaporize and create an immediate flammable atmosphere. Keep area evacuated and free from ignition sources until any spilled liquid has evaporated. (Ground free from frost). Move away from container and cool with water from a protected position. Keep containers and surroundings cool with water spray. Do not direct water spray at container vent. Do not extinguish a leaking gas flame unless absolutely necessary. Spontaneous/explosive re-ignition may occur. Extinguish any other fire. If possible, shut off the source of gas and allow the fire to burn itself out. Vapor cloud may obscure visibility.
- Special protective equipment for fire-fighters : Wear self contained breathing apparatus for fire fighting if necessary.
- Further information : The presence of a hydrogen flame can be detected by approaching cautiously with an outstretched straw broom to make the flame visible.

6. ACCIDENTAL RELEASE MEASURES

- Personal Precautions, Protective Equipment, and Emergency Procedures : Evacuate personnel to safe areas. Approach suspected leak areas with caution. Remove all sources of ignition. Ventilate the area. Never enter a confined space or other area where the flammable gas concentration is greater the 10% of its lower flammable limit.
- Environmental precautions : Prevent further leakage or spillage if safe to do so. Prevent from entering sewers, basements and workpits, or any place where its accumulation can be dangerous. Do not discharge into any place where its accumulation could be

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dangerous.

- Methods for cleaning up : Ventilate the area. Do not spray water directly at leak.
- Additional advice : If possible, stop flow of product. Increase ventilation to the release area and monitor concentrations. Do not direct water spray at container vent. Liquid spillages can cause embrittlement of structural materials. If leak is from cylinder or cylinder valve, call the emergency telephone number. If the leak is in the user's system, close the cylinder valve, safely vent the pressure, and purge with an inert gas before attempting repairs.

7. HANDLING AND STORAGE

Handling

May ignite if valve is opened to air. Know and understand the properties and hazards of the product before use. Before using the product, determine its identity by reading the label. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Do not remove or interchange connections. Only transfer lines designed for cryogenic liquids shall be used. Do not smoke while handling product or cylinders. Ensure the complete gas system has been checked for leaks before use. Prevent entrapment of cryogenic liquid in closed systems not protected with relief device. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Do not subject containers to abnormal mechanical shock. Remove all sources of ignition. All piped systems and associated equipment must be grounded.

Storage

Do not change or force fit connections. Always keep container in upright position. Use a back flow preventative device in the piping. Use insulated hose and piping to prevent condensation of oxygen-rich liquid air. Open/close valve slowly. Close when not in use. Wear Safety Eye Protection. Check Safety Data Sheet before use. Do not allow storage temperature to exceed 50°C (122°F). Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Do not store in a confined space. Full containers should be stored so that oldest stock is used first. Full and empty cylinders should be segregated. Store containers in location free from fire risk and away from sources of heat and ignition. Return empty containers in a timely manner. Stored containers should be periodically checked for general condition and leakage. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. All vents should be piped to the exterior of the building. Cryogenic containers are equipped with pressure relief devices to control internal pressure. Under normal conditions these containers will periodically vent product. Display "No Smoking or Open Flames" signs in the storage areas. Flammable storage areas should be separated from oxygen and other oxidizers by a minimum distance of 20 ft. (6.1 m.) or by a barrier of non-combustible material at least 5 ft. (1.5 m.) high, having a fire resistance rating of at least 1/2 hour. All electrical equipment should be explosion-proof in the storage areas. Smoking should be prohibited within storage areas or while handling product or containers. Observe all regulations and local requirements regarding storage of containers.

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8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures

Provide natural or explosion-proof ventilation that is adequate to ensure flammable gas does not reach its lower explosive limit.

Use explosion-proof equipment.

Keep self contained breathing apparatus readily available for emergency use.

Personal protective equipment

- Respiratory protection : High concentrations that can cause rapid suffocation are within the flammable range and should not be entered. Users of breathing apparatus must be trained. Self contained breathing apparatus (SCBA) or positive pressure airline with mask are to be used in oxygen-deficient atmosphere.
- Hand protection : Wear working gloves when handling gas containers.
Loose fitting thermal insulated or leather gloves.
Chemical-resistant, impervious gloves complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.
- Eye protection : Safety glasses recommended when handling cylinders.
Wear goggles and a face shield when transfilling or breaking transfer connections.
- Skin and body protection : Safety shoes are recommended when handling cylinders.
Flame retardant protective clothing.
Never allow any unprotected part of the body to touch uninsulated pipes or vessels which contain cryogenic fluids. The extremely cold metal will cause the flesh to stick fast and tear when one attempts to withdraw from it.
- Special instructions for protection and hygiene : Ensure adequate ventilation, especially in confined areas.

9. PHYSICAL AND CHEMICAL PROPERTIES

- Appearance : Liquefied gas. Colorless.
- Odor : None.
- Odor threshold : No data available.
- pH : Not applicable.
- Melting point/range : -434 °F (-259 °C)

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Boiling point/range	: -423 °F (-253 °C)
Flash point	: Not applicable.
Evaporation rate	: Not applicable.
Flammability (solid, gas)	: Refer to product classification in Section 2
Upper/lower explosion/flammability limit	: 75 %(V) / 4 %(V)
Vapor pressure	: Not applicable.
Water solubility	: 0.0016 g/l
Relative vapor density	: 0.07 (air = 1) Lighter or similar to air.
Relative density	: 0.07 (water = 1)
Partition coefficient (n-octanol/water)	: Not applicable.
Auto-ignition temperature	: 560 °C
Decomposition temperature	: No data available.
Viscosity	: Not applicable.
Molecular Weight	: 2 g/mol

10. STABILITY AND REACTIVITY

Chemical Stability	: Stable under normal conditions.
Conditions to avoid	: Heat, flames and sparks.
Materials to avoid	: Oxygen. Oxidizing agents. Carbon steel.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.
Possibility of hazardous Reactions/Reactivity	: No data available.

11. TOXICOLOGICAL INFORMATION

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11.1. Information on toxicological effects

Likely routes of exposure

- Effects on Eye : Contact with liquid may cause cold burns/frostbite.
- Effects on Skin : Contact with liquid may cause cold burns/frostbite. May cause severe frostbite.
- Inhalation Effects : In high concentrations may cause asphyxiation. Symptoms may include loss of mobility/consciousness. Victim may not be aware of asphyxiation. Asphyxiation may bring about unconsciousness without warning and so rapidly that victim may be unable to protect themselves.
- Ingestion Effects : Ingestion is not considered a potential route of exposure.
- Symptoms : Exposure to oxygen deficient atmosphere may cause the following symptoms: Dizziness. Salivation. Nausea. Vomiting. Loss of mobility/consciousness.

Acute toxicity

- Acute Oral Toxicity : No data is available on the product itself.
- Inhalation : No data is available on the product itself.
- Acute Dermal Toxicity : No data is available on the product itself.
- Skin corrosion/irritation : No data available.
- Serious eye damage/eye irritation : No data available.
- Sensitization. : No data available.

Chronic toxicity or effects from long term exposures

- Carcinogenicity : No data available.
- Reproductive toxicity : No data is available on the product itself.
- Germ cell mutagenicity : No data is available on the product itself.
- Specific target organ systemic toxicity (single exposure) : No data available.
- Specific target organ systemic toxicity (repeated exposure) : No data available.
- Aspiration hazard : No data available.

Delayed and Immediate Effects and Chronic Effects from Short and Long Term Exposure

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None. Not applicable.

12. ECOLOGICAL INFORMATION

Ecotoxicity effects

Aquatic toxicity : Not applicable.

Toxicity to other organisms : Not applicable.

Persistence and degradability

Biodegradability : No data is available on the product itself.

Mobility : Because of its high volatility, the product is unlikely to cause ground pollution.

Bioaccumulation : Refer to Section 9 "Partition Coefficient (n-octanol/water)".

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products : Return unused product in original cylinder to supplier. Contact supplier if guidance is required. Do not discharge into areas where there is a risk of forming an explosive mixture with air. Waste gas should be flared through a suitable burner with flash back arrestor.

Contaminated packaging : Return cylinder to supplier.

14. TRANSPORT INFORMATION

DOT

UN/ID No. : UN1966
Proper shipping name : Hydrogen, refrigerated liquid
Class or Division : 2.1
Label(s) : 2.1
Marine Pollutant : No

IATA

Transport Forbidden

IMDG

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UN/ID No. : UN1966
Proper shipping name : HYDROGEN, REFRIGERATED LIQUID
Class or Division : 2.1
Label(s) : 2.1
Marine Pollutant : No

TDG

UN/ID No. : UN1966
Proper shipping name : HYDROGEN, REFRIGERATED LIQUID
Class or Division : 2.1
Label(s) : 2.1
Marine Pollutant : No

Further Information

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. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

15. REGULATORY INFORMATION

Toxic Substance Control Act (TSCA) 12(b) Component(s):

None.

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.
Japan	ENCS	Included on Inventory.

EPA SARA Title III Section 312 (40 CFR 370) Hazard Classification

Fire Hazard. Sudden Release of Pressure Hazard.

US. California Safe Drinking Water & Toxic Enforcement Act (Proposition 65)

This product does not contain any chemicals known to State of California to cause cancer, birth defects or any other harm.

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16. OTHER INFORMATION

NFPA Rating

Health : 3
Fire : 4
Instability : 0

HMIS Rating

Health : 3
Flammability : 4
Physical hazard : 1

Prepared by : Versum Materials, Product Regulatory Department

Telephone : (602)282-1000

Preparation Date : 12/16/2017

For additional information, please visit our Versum Materials' Product Stewardship web site.
<http://www.versummaterials.com/productstewardship/>
