



Hydrogen, Refrigerated Liquid

Safety Data Sheet E-4603

according to the Hazardous Products Regulation (February 11, 2015)

Date of issue: 10-15-1979

Revision date: 01-01-2021

Supersedes: 03-19-2018

SECTION 1: Identification

1.1. Product identifier

Product form : Substance
Substance name : Hydrogen, Refrigerated Liquid
CAS No : 1333-74-0
Formula : H₂
Other means of identification : Hydrogen (cryogenic liquid), para-Hydrogen
Product group : Core Products

1.2. Recommended use and restrictions on use

Recommended uses and restrictions : Industrial use
Use as directed.

1.3. Supplier

Linde Canada inc.
1200 – 1 City Centre Drive
Mississauga - Canada L5B 1M2
T 1-905-803-1600 - F 1-905-803-1682
www.lindecana.ca

1.4. Emergency telephone number

Emergency number : 1-800-363-0042
Call emergency number 24 hours a day only for spills, leaks, fire, exposure, or accidents involving this product.
For routine information, contact your supplier or Linde sales representative.

SECTION 2: Hazard identification

2.1. Classification of the substance or mixture

GHS-CA classification

Simple asphyxiant H380
Flam. Gas 1 H220
Refrigerated liquefied gas H281

2.2. GHS Label elements, including precautionary statements

GHS-CA labelling

Hazard pictograms :



GHS02

GHS04

Signal word : DANGER

Hazard statements : **EXTREMELY FLAMMABLE GAS**
CONTAINS REFRIGERATED GAS; MAY CAUSE CRYOGENIC BURNS OR INJURY
MAY FORM EXPLOSIVE MIXTURES WITH AIR.
BURNS WITH INVISIBLE FLAME.
MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.

Precautionary statements : Do not handle until all safety precautions have been read and understood
Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
Wear cold insulating gloves and either face shield or eye protection
Thaw frosted parts with lukewarm water. Do not rub affected area. Get immediate medical advice/attention

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LEAKING GAS FIRE: Do not extinguish, unless leak can be stopped safely.
In case of leakage, eliminate all ignition sources
Use and store only outdoors or in a well-ventilated place.

2.3. Other hazards

Other hazards not contributing to the classification : Contact with liquid may cause cold burns/frostbite. Asphyxiant in high concentrations.

2.4. Unknown acute toxicity (GHS CA)

No data available

SECTION 3: Composition/information on ingredients

3.1. Substances

Name	CAS No.	% (Vol.)	Common Name (synonyms)
Hydrogen, Refrigerated Liquid (Main constituent)	(CAS No) 1333-74-0	100	Hydrogen, compressed / Hydrogen molecule H ₂

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

- First-aid measures after inhalation : Remove victim to uncontaminated area wearing self contained breathing apparatus. Keep victim warm and rested. Call a doctor. Apply artificial respiration if breathing stopped. If not breathing, give artificial respiration, with supplemental oxygen given by qualified personnel. If breathing is difficult, qualified personnel should give oxygen. Call a physician.
- First-aid measures after skin contact : The liquid may cause frostbite. For exposure to liquid, immediately warm frostbite area with warm water not to exceed 105°F (41°C). Water temperature should be tolerable to normal skin. Maintain skin warming for at least 15 minutes or until normal coloring and sensation have returned to the affected area. In case of massive exposure, remove clothing while showering with warm water. Seek medical evaluation and treatment as soon as possible.
- First-aid measures after eye contact : Immediately flush eyes thoroughly with water for at least 15 minutes. Hold the eyelids open and away from the eyeballs to ensure that all surfaces are flushed thoroughly. Contact an ophthalmologist immediately. Get immediate medical attention.
- First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

4.2. Most important symptoms and effects (acute and delayed)

No additional information available

4.3. Immediate medical attention and special treatment, if necessary

Other medical advice or treatment : None.

SECTION 5: Fire-fighting measures

5.1. Suitable extinguishing media

Suitable extinguishing media : Carbon dioxide, Dry chemical, Water spray or fog.

5.2. Unsuitable extinguishing media

No additional information available

5.3. Specific hazards arising from the hazardous product

- Fire hazard : **EXTREMELY FLAMMABLE, EXTREMELY COLD CRYOGENIC LIQUID AND GAS.** The hydrogen flame is nearly invisible. Hydrogen has a low ignition energy; escaping hydrogen gas may ignite spontaneously. A fireball forms if the gas cloud ignites immediately after release. Hydrogen forms explosive mixtures with air and oxidizing agents.
- Explosion hazard : **EXTREMELY FLAMMABLE GAS.** Forms explosive mixtures with air and oxidizing agents.
- Reactivity : No reactivity hazard other than the effects described in sub-sections below.
- Reactivity in case of fire : No reactivity hazard other than the effects described in sub-sections below.

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5.4. Special protective equipment and precautions for fire-fighters

- Firefighting instructions : DANGER! Extremely cold, flammable liquefied gas. Take care not to direct spray onto vents on top of container. Do not discharge sprays into liquid hydrogen. Liquid hydrogen can freeze water rapidly. If flames are accidentally extinguished, explosive re-ignition may occur. All personnel, including fire and rescue workers, should leave the area immediately. Re-approach with extreme caution. When containers have cooled, move them away from fire area if safe to do so.
- If venting or leaking gas catches fire, do not extinguish flames. Flammable vapors may spread from leak, creating an explosive reignition hazard. Vapors can be ignited by pilot lights, other flames, smoking, sparks, heaters, electrical equipment, static discharge, or other ignition sources at locations distant from product handling point. Explosive atmospheres may linger. Before entering an area, especially a confined area, check the atmosphere with an appropriate device.
- Evacuate all personnel from the danger area. Use self-contained breathing apparatus (SCBA) and protective clothing. Immediately cool containers with water from maximum distance. Stop flow of gas if safe to do so, while continuing cooling water spray. Remove ignition sources if safe to do so. Remove containers from area of fire if safe to do so. On-site fire brigades must comply with their provincial and local fire code regulations.
- Special protective equipment for fire fighters : Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters.
- Specific methods : Use fire control measures appropriate for the surrounding fire. Exposure to fire and heat radiation may cause gas containers to rupture. Cool endangered containers with water spray jet from a protected position. Prevent water used in emergency cases from entering sewers and drainage systems.
- Other information : Cryogenic liquid causes severe frostbite, a burn-like injury. Heat of fire can build pressure in a closed container and cause it to rupture. Venting vapors may obscure visibility. Air will condense on surfaces such as vaporizers or piping exposed to liquid or cold gas. Nitrogen, which has a lower boiling point than oxygen, evaporates first, leaving an oxygen-enriched condensate.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

- General measures : EXTREMELY COLD, FLAMMABLE LIQUEFIED GAS. FORMS EXPLOSIVE MIXTURES WITH AIR. (See section 5.) Immediately evacuate all personnel from danger area. Liquid hydrogen will condense moisture in the atmosphere, producing a vapor cloud. The zone of flammability may extend beyond this cloud, so personnel should be evacuated well beyond any visible moisture. Avoid contact with cold liquid, vapor, or frosty condensation. Liquid hydrogen can freeze air, oxygen, and other gases. Contact with liquid or solid gases can cause severe frostbite, a burn-like injury. (See section 2.) Flammable gas may spread from leak. Approach suspected leak area with caution. Before entering area, especially confined areas, check atmosphere with an appropriate device. Self-contained breathing apparatus and protective clothing may be required by rescue workers. Remove all sources of ignition if without risk. Reduce gas with fog or fine water spray. Shut off flow if without risk. Ventilate area or move container to a well-ventilated area.

6.2. Methods and materials for containment and cleaning up

6.3. Reference to other sections

For further information refer to section 8: Exposure controls/personal protection



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SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling

: **PRECAUTIONS TO BE TAKEN IN HANDLING:** Do not get liquid in eyes, on skin, or on clothing. Keep away from heat, flame, and sparks. Never allow any unprotected part of your body to touch uninsulated pipes or vessels containing cryogenic fluids. Flesh will stick to the extremely cold metal and will tear when you try to pull free. For liquid withdrawal, wear face shield and cryogenic gloves (see section 8). Air will condense on exposed liquid or cold-gas surfaces such as vaporizers and piping. Nitrogen, which has a lower boiling point than oxygen, will evaporate first, leaving oxygen-enriched condensation on the surface. To prevent possible ignition of grease, oil, or other combustibles, keep all areas of potential condensation free of these substances. Use only spark-proof tools and explosion-proof equipment.

Use a suitable hand truck for container movement. Cryogenic containers must be handled and stored in an upright position. Do not drop or tip containers, or roll them on their sides. Hydrogen is the lightest known gas. It may leak out of systems that are air-tight for other gases and may collect in poorly ventilated upper reaches of buildings. All piped hydrogen systems and associated equipment must be grounded. Electrical equipment must be non-sparking or explosion-proof. Leak check system with soapy water; never use a flame. If valve is hard to open, discontinue use and contact your supplier. For other precautions in using hydrogen, see section 16.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions

: Store only where temperature will not exceed 125°F (52°C). Post "No Smoking/No Open Flames" signs in storage and use areas. There must be no sources of ignition. Separate packages and protect against potential fire and/or explosion damage following appropriate codes and requirements (e.g. NFPA 30, NFPA 55, NFPA 70, and/or NFPA 221 in the U.S.) or according to requirements determined by the Authority Having Jurisdiction (AHJ). Always secure containers upright to keep them from falling or being knocked over. Install valve protection cap, if provided, firmly in place by hand when the container is not in use. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods. For other precautions in using this product, see section 16.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

No additional information available

8.2. Appropriate engineering controls

Appropriate engineering controls

: Use an explosion-proof local exhaust system. Local exhaust and general ventilation must be adequate to meet exposure standards. **MECHANICAL (GENERAL): Inadequate - Use only in a closed system.** Use explosion proof equipment and lighting.

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment

: Safety glasses. Face shield. Insulated gloves.



Hand protection

: Wear work gloves when handling containers. Wear heavy rubber gloves where contact with product may occur.

Eye protection

: Wear goggles and a face shield when transfilling or breaking transfer connections. Select in accordance with the current CSA standard Z94.3, "Industrial Eye and Face Protection", and any provincial regulations, local bylaws or guidelines.

Respiratory protection

: **Respiratory protection:** Use air supplied respirator when working in confined space or where local exhaust or ventilation does not keep exposure below TLV. Select in accordance with provincial regulations, local bylaws or guidelines. Respirators should also be approved by NIOSH and MSHA. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

Thermal hazard protection

: Wear cold insulating gloves. Wear cold insulating gloves when transfilling or breaking transfer connections.

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Environmental exposure controls	: The substance is not classified for human health hazards or for environment effects and it is not PBT or vPvB so that no exposure assessment or risk characterisation is required. For tasks where the intervention of workers is required, the substance must be handled in accordance with good industrial hygiene and safety procedures.
Other information	: Other protection : Safety shoes for general handling at customer sites. Metatarsal shoes and cuffless trousers for cylinder handling at packaging and filling plants. Select in accordance with the current CSA standard Z195, "Protective Foot Wear", and any provincial regulations, local bylaws or guidelines. For working with flammable and oxidizing materials, consider the use of flame resistant anti-static safety clothing.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

Physical state	: Gas
Appearance	: Colourless gas.
Molecular mass	: 2 g/mol
Colour	: Colourless.
Odour	: Odourless.
Odour threshold	: No data available
pH	: Not applicable.
pH solution	: No data available
Relative evaporation rate (butylacetate=1)	: No data available
Relative evaporation rate (ether=1)	: Not applicable.
Melting point	: -259 °C
Freezing point	: No data available
Boiling point	: -252.9 °C
Flash point	: Not available
Critical temperature	: -239.9 °C
Auto-ignition temperature	: 566 °C
Decomposition temperature	: No data available
Vapour pressure	: Not applicable.
Vapour pressure at 50 °C	: No data available
Critical pressure	: 1293 kPa
Relative vapour density at 20 °C	: No data available
Relative density	: 0.07
Relative density of saturated gas/air mixture	: No data available
Density	: 70.96 kg/m ³
Relative gas density	: 0.07
Solubility	: Water: 1.6 mg/l
Log Pow	: Not applicable.
Log Kow	: Not applicable.
Viscosity, kinematic	: Not applicable.
Viscosity, dynamic	: Not applicable.
Viscosity, kinematic (calculated value) (40 °C)	: No data available
Explosive properties	: Not applicable.
Oxidizing properties	: None.
Flammability (solid, gas)	: 4 - 75 vol %

9.2. Other information

Gas group	: Refrigerated liquefied gas
Additional information	: BURNS WITH INVISIBLE FLAME.

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SECTION 10: Stability and reactivity

10.1. Reactivity

Reactivity	: No reactivity hazard other than the effects described in sub-sections below.
Chemical stability	: Stable under normal conditions.
Possibility of hazardous reactions	: Can form explosive mixture with air. May react violently with oxidants.
Conditions to avoid	: Keep away from heat/sparks/open flames/hot surfaces. – No smoking.
Incompatible materials	: Oxidizer. Lithium. Halogens.
Hazardous decomposition products	: Under normal conditions of storage and use, hazardous decomposition products should not be produced.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Acute toxicity (oral)	: Not classified
Acute toxicity (dermal)	: Not classified
Acute toxicity (inhalation)	: Not classified

Hydrogen, Refrigerated Liquid (f)1333-74-0

LC50 inhalation rat (ppm)	> 15000 ppm/1h
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Skin corrosion/irritation	: Not classified pH: Not applicable.
Serious eye damage/irritation	: Not classified pH: Not applicable.
Respiratory or skin sensitization	: Not classified
Germ cell mutagenicity	: Not classified
Carcinogenicity	: Not classified
Reproductive toxicity	: Not classified
Specific target organ toxicity (single exposure)	: Not classified
Specific target organ toxicity (repeated exposure)	: Not classified
Aspiration hazard	: Not classified

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general	: No ecological damage caused by this product.
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12.2. Persistence and degradability

Hydrogen, Refrigerated Liquid (1333-74-0)

Persistence and degradability	No ecological damage caused by this product.
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12.3. Bioaccumulative potential

Hydrogen, Refrigerated Liquid (1333-74-0)

BCF fish 1	(no bioaccumulation expected)
Log Pow	Not applicable.
Log Kow	Not applicable.
Bioaccumulative potential	No ecological damage caused by this product.

12.4. Mobility in soil

Hydrogen, Refrigerated Liquid (1333-74-0)

Mobility in soil	No data available.
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Log Pow	Not applicable.
Log Kow	Not applicable.
Ecology - soil	No ecological damage caused by this product.

12.5. Other adverse effects

Other adverse effects	: Can cause frost damage to vegetation.
Effect on the ozone layer	: None.
Effect on global warming	: No known effects from this product.

SECTION 13: Disposal considerations

13.1. Disposal methods

Product/Packaging disposal recommendations : Do not attempt to dispose of residual or unused quantities. Return container to supplier.

SECTION 14: Transport information

14.1. Basic shipping description

In accordance with TDG

TDG

UN-No. (TDG)	: UN1966
TDG Primary Hazard Classes	: 2.1 - Class 2.1 - Flammable Gas.
Proper shipping name	: HYDROGEN, REFRIGERATED LIQUID

ERAP Index	: 3 000
Explosive Limit and Limited Quantity Index	: 0
Passenger Carrying Ship Index	: Forbidden
Passenger Carrying Road Vehicle or Passenger Carrying Railway Vehicle Index	: Forbidden

14.3. Air and sea transport

IMDG

UN-No. (IMDG)	: 1966
Proper Shipping Name (IMDG)	: HYDROGEN, REFRIGERATED LIQUID
Class (IMDG)	: 2 - Gases
MFAG-No	: 115

IATA

UN-No. (IATA)	: 1966
Proper Shipping Name (IATA)	: Hydrogen, refrigerated liquid
Class (IATA)	: 2

SECTION 15: Regulatory information

15.1. National regulations

Hydrogen, Refrigerated Liquid (1333-74-0)

Listed on the Canadian DSL (Domestic Substances List)

15.2. International regulations

Hydrogen, Refrigerated Liquid (1333-74-0)

Listed on the AICS (Australian Inventory of Chemical Substances)
Listed on IECSC (Inventory of Existing Chemical Substances Produced or Imported in China)
Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)
Listed on the Korean ECL (Existing Chemicals List)
Listed on NZIoC (New Zealand Inventory of Chemicals)
Listed on PICCS (Philippines Inventory of Chemicals and Chemical Substances)
Listed on the United States TSCA (Toxic Substances Control Act) inventory
Listed on INSQ (Mexican National Inventory of Chemical Substances)

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SECTION 16: Other information

Date of issue : 15/10/1979
Revision date : 01/01/2021
Supersedes : 19/03/2018

Indication of changes:

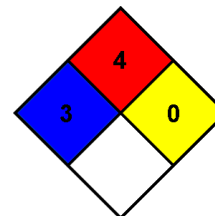
Training advice : The hazard of asphyxiation is often overlooked and must be stressed during operator training. Ensure operators understand the flammability hazard. Receptacle under pressure.

Other information : When you mix two or more chemicals, you can create additional, unexpected hazards. Obtain and evaluate the safety information for each component before you produce the mixture. Consult an industrial hygienist or other trained person when you evaluate the end product. Before using any plastics, confirm their compatibility with this product.

Linde asks users of this product to study this SDS and become aware of the product hazards and safety information. To promote safe use of this product, a user should (1) notify employees, agents, and contractors of the information in this SDS and of any other known product hazards and safety information, (2) furnish this information to each purchaser of the product, and (3) ask each purchaser to notify its employees and customers of the product hazards and safety information.

The opinions expressed herein are those of qualified experts within Linde Canada Inc. We believe that the information contained herein is current as of the date of this Safety Data Sheet. Since the use of this information and the conditions of use are not within the control of Linde Canada Inc, it is the user's obligation to determine the conditions of safe use of the product. Linde Canada Inc, SDSs are furnished on sale or delivery by Linde Canada Inc, or the independent distributors and suppliers who package and sell our products. To obtain current SDSs for these products, contact your Linde sales representative, local distributor, or supplier, or download from www.lindecanada.ca. If you have questions regarding Linde SDSs, would like the document number and date of the latest SDS, or would like the names of the Linde suppliers in your area, phone or write Linde Canada Inc, (Phone: 1-888-257-5149; Address: Linde Canada Inc, 1 City Centre Drive, Suite 1200, Mississauga, Ontario, L5B 1M2).

NFPA health hazard : 3 - Short exposure could cause serious temporary or residual injury even though prompt medical attention was given.
NFPA fire hazard : 4 - Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.
NFPA instability : 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health : 3 Serious Hazard - Major injury likely unless prompt action is taken and medical treatment is given
Flammability : 4 Severe Hazard - Flammable gases, or very volatile flammable liquids with flash points below 73 F, and boiling points below 100 F. Materials may ignite spontaneously with air. (Class IA)
Physical : 1 Slight Hazard - Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors.

SDS Canada (GHS) - Linde

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.

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