

Safety Data Sheet E-4604

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

Date of issue: 10-15-1979 Revision date: 03-04-2023 Supersedes: 01-01-2021 Version: 1.0

SECTION 1: Identification

1.1. Product identifier

Product form : Substance
Substance name : Hydrogen
Chemical name : Hydrogen
CAS No : 1333-74-0
Formula : H2

Other means of identification : Dihydrogen, parahydrogen, refrigerant gas R702, water gas

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. 500 — 5015 Spectrum Way Mississauga - Canada L4W 0E4 T 1-905-803-1600 - F 1-905-803-1682 www.lindecanada.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

Flammable gases, Category 1 H220 Gases under pressure : Compressed gas H280

Simple Asphyxiant

2.2. GHS Label elements, including precautionary statements

GHS-CA labelling

Hazard pictograms





IS02 GHS04

Signal word : DANGER

Hazard statements : EXTREMELY FLAMMABLE GAS

CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION

BURNS WITH INVISIBLE FLAME.

MAY FORM EXPLOSIVE MIXTURES WITH AIR.

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.

LEAKING GAS FIRE: Do not extinguish, unless leak can be stopped safely.

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In case of leakage, eliminate all ignition sources
Use and store only outdoors or in a well-ventilated place.
Use a back flow preventive device in the piping.
Use only with equipment rated for cylinder pressure.
Close valve after each use and when empty.

Protect from sunlight when ambient temperature exceeds 52°C (125°F).

2.3. Other hazards

Other hazards which do not result in classification

: None. Asphyxiant in high concentrations.

2.4. Unknown acute toxicity (GHS CA)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substances

 Name
 : Hydrogen

 CAS No
 : 1333-74-0

 EC no
 : 215-605-7

 EC index no
 : 001-001-00-9

Name	CAS No.	% (Vol.)	Common Name (synonyms)
Hydrogen	(CAS No) 1333-74-0	99.5 – 100	Hydrogen, compressed / Hydrogen molecule H2

3.2. Mixtures

Not applicable

SECTION 4: First-aid measures

4.1. Description of first aid measures

First-aid measures after inhalation : Remo

: Remove to fresh air and keep at rest in a position comfortable for breathing. If not breathing, give artificial respiration. If breathing is difficult, trained personnel should give oxygen. Call a

physician.

First-aid measures after skin contact

: Adverse effects not expected from this product.

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. Immediately flush eyes thoroughly with water for at least 15 minutes.

First-aid measures after ingestion : Ingestion is not considered a potential route of exposure.

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

Symptoms/injuries : No additional information available
Most Important Symptoms/Effects : Asphyxiant in high concentrations.

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 powder, water spray, fog. Carbon dioxide, Dry chemical, Water spray or fog. Use extinguishing media appropriate for surrounding fire.

5.2. Unsuitable extinguishing media

No additional information available

5.3. Specific hazards arising from the hazardous product

Fire hazard : EXTREME

: **EXTREMELY FLAMMABLE 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 exidizing agents. **EXTREMELY ELAMMABLE GAS**

oxidizing agents. **EXTREMELY FLAMMABLE GAS**.

Explosion hazard : EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents.

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Reactivity

: No reactivity hazard other than the effects described below.

Reactivity in case of fire

: No reactivity hazard other than the effects described in sub-sections below.

5.4. Special protective equipment and precautions for fire-fighters

Firefighting instructions

: 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.

Protection during firefighting

Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen. **DANGER! FLAMMABLE**, **HIGH PRESSURE GAS**..

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.

Stop flow of product if safe to do so.

Use water spray or fog to knock down fire fumes if possible.

Other information

 Containers are equipped with a pressure relief device. (Exceptions may exist where authorized.).

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures

General measures

DANGER: EXTREMELY FLAMMABLE GAS. Forms explosive mixtures with air and oxidizing agents. See section 5. Evacuate personnel to a safe area. Appropriate self-contained breathing apparatus may be required. Approach suspected leak area with caution. Remove all sources of ignition. if safe to do so. Reduce gas with fog or fine water spray. Stop flow of product if safe to do so. Ventilate area or move container to a well-ventilated area. Flammable gas may spread from leak. Before entering the area, especially a confined area, check the atmosphere with an appropriate device. 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.

Personal Precautions, Protective Equipment and Emergency Procedures

General measures: Ensure adequate ventilation. Personal Precautions, Protective Equipment and Emergency Procedures: EVACUATE ALL PERSONNEL FROM AFFECTED AREA. Use appropriate protective equipment. If leak is on user's equipment, be certain to purge piping before attempting repairs. If leak is on a container or container valve contact the closest Linde Canada location.

6.2. Methods and materials for containment and cleaning up

For containment

: Try to stop release if safe to do so.

Methods for cleaning up

 $: \ \, \text{Dispose of contents/container in accordance with local/regional/national/international} \\$

regulations. Contact supplier for any special requirements.

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SECTION 7: Handling and storage

7.1. Precautions for safe handling

Precautions for safe handling

: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Use only non-sparking tools. Use only explosion-proof equipment.

Wear leather safety gloves and safety shoes when handling cylinders. Protect cylinders from physical damage; do not drag, roll, slide or drop. While moving cylinder, always keep in place removable valve cover. Never attempt to lift a cylinder by its cap; the cap is intended solely to protect the valve. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. Never insert an object (e.g, wrench, screwdriver, pry bar) into cap openings; doing so may damage the valve and cause a leak. Use an adjustable strap wrench to remove over-tight or rusted caps. Slowly open the valve. If the valve is hard to open, discontinue use and contact your supplier. Close the container valve after each use; keep closed even when empty. Never apply flame or localized heat directly to any part of the container. High temperatures may damage the container and could cause the pressure relief device to fail prematurely, venting the container contents. For other precautions in using this product, see section 16.

7.2. Conditions for safe storage, including any incompatibilities

Storage conditions

Store only where temperature will not exceed 52 °C (125 °F). 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.: CSA, TSSA, or NFPA Codes), or according to the provincial 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.

OTHER PRECAUTIONS FOR HANDLING, STORAGE, AND USE: When handling product under pressure, use piping and equipment adequately designed to withstand the pressures to be encountered. Never work on a pressurized system. Use a back flow preventive device in the piping. Gases can cause rapid suffocation because of oxygen deficiency; store and use with adequate ventilation. If a leak occurs, close the container valve and blow down the system in a safe and environmentally correct manner in compliance with all international, federal/national, state/provincial, and local laws; then repair the leak. Never place a container where it may become part of an electrical circuit.

Store in a cool, well-ventilated place. Store and use with adequate ventilation. Store only where temperature will not exceed 52 °C (125 °F). Firmly secure containers upright to keep them from falling or being knocked over. Install valve protection cap firmly in place by hand. Store full and empty containers separately. Use a first-in, first-out inventory system to prevent storing full containers for long periods.

Store only where temperature will not exceed 52 °C (125 °F). 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.: CSA, TSSA, or NFPA Codes), or according to the provincial 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

Hydrogen (1333-74-0)	ydrogen (1333-74-0)		
USA - ACGIH	Remark (ACGIH)	Simple asphyxiant	

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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. Provide adequate general and local exhaust ventilation. Ensure exposure is below occupational exposure limits (where available).

8.3. Individual protection measures/Personal protective equipment

Personal protective equipment : Safety glasses. Face shield. 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. Wear safety glasses with side shields. Select in accordance with the current CSA standard Z94.3, "Industrial Eye and Face Protection", and any provincial regulations, local bylaws or guidelines. Safety eye wear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or

dusts. 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 OEL (if applicable). 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 when transfilling or breaking transfer connections. None necessary.

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

(a) Physical state : Gas

(b) Colour : Colourless. (c) Odour : Odourless.

Odour threshold : No data available

(d) Melting point : -259.2 °C (-434.56°F)

Freezing point : No data available

(e) Boiling point : -252.9 °C (-422.97°F)

(f) Flammability : FLAMMABLE GAS, Flammable

(g) Flammability (solid, gas) : 4 - 75 vol % (h) Flash point : No data available (i) Auto-ignition temperature 566 °C (1051°F) (j) Decomposition temperature : No data available (k) pH : Not applicable. (I) Viscosity, kinematic : Not applicable. : Water: 1.6 mg/l (m) Solubility (n) Partition coefficient - n-octanol/water [log : Not applicable.

Pow/log Kow]

(o) Vapour pressure : Not applicable.

(p) Density : 0.089 g/l (0.0056 lb/ft3) (at STP = 0°C and 1atm)

Relative gas density : 0.07

(r) Particle characteristics : No data available

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(s) Molecular mass : 2 g/mol

(t) Critical temperature : -239.9 °C (-399.82°F)

(v) Oxidizing properties : None.

(w) Relative evaporation rate (butylacetate=1) : No data availableRelative evaporation rate (ether=1) : Not applicable.

9.2. Other information

Gas group : Compressed gas

Additional information : BURNS WITH INVISIBLE FLAME.

SECTION 10: Stability and reactivity

Reactivity : No reactivity hazard other than the effects described 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 : Oxidizing agents. 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 Likely routes of exposure : Inhalation

11.2 Symptoms related to the physical, chemical, and toxicological characteristics

: No additional information available

11.3 Delayed and immediate effects and chronic effects

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

exposure)

Aspiration hazard : Not classified

11.4 Toxicity

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Hydrogen (\f)1333-74-0		
LC50 inhalation rat (ppm)	> 15000 ppm/1h	

SECTION 12: Ecological information

12.1. Toxicity

Ecology - general : No ecological damage caused by this product.

12.2. Persistence and degradability

Hydrogen (1333-74-0)		
Persistence and degradability	No ecological damage caused by this product.	
Hydrogen (1333-74-0)		
Persistence and degradability	No ecological damage caused by this product.	

12.3. Bioaccumulative potential

lydrogen (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.
Hydrogen (1333-74-0)	
BCF - Fish [1]	(no bioaccumulation expected)

Hydrogen (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

ydrogen (1333-74-0)	
Mobility in soil	No data available.
Log Pow	Not applicable.
Log Kow	Not applicable.
Ecology - soil	No ecological damage caused by this product.
Hydrogen (1333-74-0)	
Mobility in soil	No data available.
Log Pow	Not applicable.

No ecological damage caused by this product.

Not applicable.

12.5. Other adverse effects

Log Kow

Ecology - soil

Effect on the ozone layer : None.

Effect on global warming : No known effects from this product.

SECTION 13: Disposal considerations

Product/Packaging disposal recommendations

Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

SECTION 14: Transport information

14.1. Basic shipping description

In accordance with TDG

TDG

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UN-No. (TDG) : UN1049

TDG Primary Hazard Classes : 2.1 - Class 2.1 - Flammable Gases : HYDROGEN, COMPRESSED Proper shipping name

ERAP Index : 3 000 Explosive Limit and Limited Quantity Index : 0.125 L Passenger Carrying Ship Index : Forbidden Passenger Carrying Road Vehicle or Passenger : Forbidden

Carrying Railway Vehicle Index

Air and sea transport

IMDG

UN-No. (IMDG) : 1049

Proper Shipping Name (IMDG) : HYDROGEN, COMPRESSED

Class (IMDG) : 2 - Gases MFAG-No : 115

IATA

UN-No. (IATA) : 1049

Proper Shipping Name (IATA) : Hydrogen, compressed

Class (IATA) : 2 - Gases

SECTION 15: Regulatory information

15.1. National regulations

Hydrogen (1333-74-0)

Listed on the Canadian DSL (Domestic Substances List)

Hydrogen (1333-74-0)

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15.2. International regulations

Hydrogen (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)

Hydrogen (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)

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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)

SECTION 16: Other information

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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.

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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 Canada 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.

NFPA health hazard

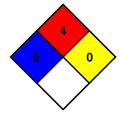
NFPA fire hazard

NFPA instability

: 0 - Exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials.

 4 - Will rapidly or completely vaporize at normal pressure and temperature, or is readily dispersed in air and will burn readily.

: 0 - Normally stable, even under fire exposure conditions, and are not reactive with water.



HMIS III Rating

Health

Flammability

Physical

: 0 Minimal Hazard - No significant risk to health

: 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)

: 3 Serious Hazard - Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion

SDS Canada (GHS) - Linde NEW

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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