Hydrogen, compressed
Safety Data Sheet P-4604
Issue date: 01/01/1980 Revision date: 01/24/2022 Supersedes: 01/28/2021 Version: 2.1

SECTION: 1. Product and company identification
1.1. Product identifier
Product form: Substance
Trade name: Hydrogen
Chemical name: Hydrogen
CAS-No.: 1333-74-0
Formula: H2
Other means of identification: Dihydrogen, parahydrogen, refrigerant gas R702, water gas

1.2. Relevant identified uses of the substance or mixture and uses advised against
Use of the substance/mixture: Industrial use; Use as directed.

1.3. Details of the supplier of the safety data sheet
Linde Inc.
10 Riverview Drive
Danbury, CT 06810-6268, USA
www.lindeus.com
Linde Inc. 1-844-44LINDE (1-844-445-4633)

1.4. Emergency telephone number
Emergency number: Onsite Emergency: 1-800-645-4633
CHEMTREC, 24hr/day 7days/week
— Within USA: 1-800-424-9300, Outside USA: 001-703-527-3887
(collect calls accepted, Contract 17729)

SECTION 2: Hazard identification
2.1. Classification of the substance or mixture
GHS US classification
Simple asphyxiant SIAS
Flam. Gas 1 H220
Press. Gas (Comp.) H280

2.2. Label elements
GHS US labeling
Hazard pictograms (GHS US): 

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>GHS02</td>
<td>Flame fire</td>
</tr>
<tr>
<td>GHS04</td>
<td>Poison</td>
</tr>
</tbody>
</table>

Signal word (GHS US): Danger
Hazard statements (GHS US): H220 - EXTREMELY FLAMMABLE GAS
H280 - CONTAINS GAS UNDER PRESSURE; MAY EXPLODE IF HEATED
OSHA-H01 - MAY DISPLACE OXYGEN AND CAUSE RAPID SUFFOCATION.
CGA-HG04 - MAY FORM EXPLOSIVE MIXTURES WITH AIR
CGA-HG08 - BURNS WITH INVISIBLE FLAME.

Precautionary statements (GHS US): P202 - Do not handle until all safety precautions have been read and understood.
P210 - Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Heat, Open flames, Sparks, Hot surfaces
P271+P403 - Use and store only outdoors or in a well-ventilated place.
P377 - LEAKING GAS FIRE: Do not extinguish, unless leak can be stopped safely.
P381 - Eliminate all ignition sources if safe to do so.
P304, P340, P313 - IF INHALED: Remove person to fresh air and keep comfortable for

EN (English US) SDS ID: P-4604 1/10

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2.3. Other hazards
Other hazards which do not result in classification: None.

2.4. Unknown acute toxicity (GHS US)
No data available

SECTION 3: Composition/Information on ingredients

3.1. Substances
Name: Hydrogen, compressed
CAS-No.: 1333-74-0

<table>
<thead>
<tr>
<th>Name</th>
<th>Product identifier</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>(CAS-No.) 1333-74-0</td>
<td>99.5 – 100</td>
</tr>
</tbody>
</table>

3.2. Mixtures
Not applicable

SECTION 4: First aid measures

4.1. Description of first aid measures
First-aid measures after inhalation:
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.

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

4.2. Most important symptoms and effects, both acute and delayed
No additional information available

4.3. Indication of any immediate medical attention and special treatment needed
None.

SECTION 5: Firefighting measures

5.1. Extinguishing media
Suitable extinguishing media: Carbon dioxide, dry chemical powder, water spray, fog.

5.2. Special hazards arising from the substance or mixture
Fire hazard:
EXEMPLARY 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 oxidizing agents.

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

Reactivity:
No reactivity hazard other than the effects described below.
5.3. Advice for firefighters

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 OSHA 29 CFR 1910.156 and applicable standards under 29 CFR 1910 Subpart L—Fire Protection.

Protection during firefighting: Compressed gas: asphyxiant. Suffocation hazard by lack of oxygen.

Special protective equipment for fire fighters: Standard protective clothing and equipment (Self Contained Breathing Apparatus) for firefighters.

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.

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.

6.1.1. For non-emergency personnel

No additional information available

6.1.2. For emergency responders

No additional information available

6.2. Environmental precautions

Prevent waste from contaminating the surrounding environment. Prevent soil and water pollution. Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

6.3. Methods and material for containment and cleaning up

No additional information available

6.4. Reference to other sections

See also sections 8 and 13.
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 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.

7.3. Specific end use(s)
None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters
Hydrogen, compressed (1333-74-0)
<table>
<thead>
<tr>
<th>Source</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH</td>
<td>Not established</td>
</tr>
<tr>
<td>USA OSHA</td>
<td>Not established</td>
</tr>
</tbody>
</table>

Hydrogen (1333-74-0)
<table>
<thead>
<tr>
<th>Source</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACGIH</td>
<td>Remark (ACGIH)</td>
</tr>
<tr>
<td>USA OSHA</td>
<td>Not established</td>
</tr>
</tbody>
</table>

8.2. Exposure 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.
Eye protection: Wear safety glasses with side shields.
Respiratory protection: When workplace conditions warrant respirator use, follow a respiratory protection program that meets OSHA 29 CFR 1910.134, ANSI Z88.2, or MSHA 30 CFR 72.710 (where applicable). Use an air-supplied or air-purifying cartridge if the action level is exceeded. Ensure that the respirator has the appropriate protection factor for the exposure level. If cartridge type respirators are used, the cartridge must be appropriate for the chemical exposure. For emergencies or instances with unknown exposure levels, use a self-contained breathing apparatus (SCBA).

Thermal hazard protection: None necessary.

Other information: Consider the use of flame resistant anti-static safety clothing. Wear safety shoes while handling containers.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical state</td>
<td>Gas</td>
</tr>
<tr>
<td>Appearance</td>
<td>Colorless gas.</td>
</tr>
<tr>
<td>Molecular mass</td>
<td>2 g/mol</td>
</tr>
<tr>
<td>Color</td>
<td>Colorless.</td>
</tr>
<tr>
<td>Odor</td>
<td>Odorless.</td>
</tr>
<tr>
<td>Odor threshold</td>
<td>No data available</td>
</tr>
<tr>
<td>pH</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Relative evaporation rate (butyl acetate=1)</td>
<td>No data available</td>
</tr>
<tr>
<td>Relative evaporation rate (ether=1)</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Melting point</td>
<td>-259.2 °C (-434.56°F)</td>
</tr>
<tr>
<td>Freezing point</td>
<td>No data available</td>
</tr>
<tr>
<td>Boiling point</td>
<td>-252.9 °C (-422.97°F)</td>
</tr>
<tr>
<td>Flash point</td>
<td>No data available</td>
</tr>
<tr>
<td>Critical temperature</td>
<td>-239.9 °C (-399.82°F)</td>
</tr>
<tr>
<td>Auto-ignition temperature</td>
<td>566 °C (1051°F)</td>
</tr>
<tr>
<td>Decomposition temperature</td>
<td>No data available</td>
</tr>
<tr>
<td>Flammability (solid, gas)</td>
<td>No data available</td>
</tr>
<tr>
<td>Vapor pressure</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Relative vapor density at 20 °C</td>
<td>No data available</td>
</tr>
<tr>
<td>Relative density</td>
<td>No data available</td>
</tr>
<tr>
<td>Density</td>
<td>0.089 g/l (0.0056 lb/ft³) (at STP = 0°C and 1 atm)</td>
</tr>
<tr>
<td>Relative gas density</td>
<td>0.07</td>
</tr>
<tr>
<td>Solubility</td>
<td>Water: 1.6 mg/l</td>
</tr>
<tr>
<td>Partition coefficient n-octanol/water (Log Pow)</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Partition coefficient n-octanol/water (Log Kow)</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Viscosity, kinematic</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Viscosity, dynamic</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Explosive properties</td>
<td>Not applicable.</td>
</tr>
<tr>
<td>Oxidizing properties</td>
<td>None.</td>
</tr>
<tr>
<td>Explosion limits</td>
<td>4 – 77 vol %</td>
</tr>
</tbody>
</table>

9.2. Other information

Gas group: Compressed gas

Additional information: BURNS WITH INVISIBLE FLAME.

SECTION 10: Stability and reactivity

10.1. Reactivity

No reactivity hazard other than the effects described below.
10.2. Chemical stability
Stable under normal conditions.

10.3. Possibility of hazardous reactions
Can form explosive mixture with air. May react violently with oxidants.

10.4. Conditions to avoid
Keep away from heat/sparks/open flames/hot surfaces. – No smoking.

10.5. Incompatible materials

10.6. 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: Not classified

<table>
<thead>
<tr>
<th>Hydrogen, compressed (1333-74-0)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LC50 Inhalation - Rat [ppm]</td>
<td>&gt; 15000 ppm/1h</td>
</tr>
</tbody>
</table>

Skin corrosion/irritation: Not classified

pH: Not applicable.

Serious eye damage/irritation: Not classified

pH: Not applicable.

Respiratory or skin sensilization: Not classified

Germ cell mutagenicity: Not classified

Carcinogenicity: Not classified

Reproductive toxicity: Not classified

STOT-single exposure: Not classified

STOT-repeated exposure: Not classified

Aspiration hazard: Not classified

SECTION 12: Ecological information

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

12.2. Persistence and degradability

<table>
<thead>
<tr>
<th>Hydrogen, compressed (1333-74-0)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence and degradability</td>
<td>No ecological damage caused by this product.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hydrogen (1333-74-0)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence and degradability</td>
<td>No ecological damage caused by this product.</td>
</tr>
</tbody>
</table>

12.3. Bioaccumulative potential

<table>
<thead>
<tr>
<th>Hydrogen, compressed (1333-74-0)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BCF - Fish [1]</td>
<td>(no bioaccumulation expected)</td>
</tr>
</tbody>
</table>

| Partition coefficient n-octanol/water (Log Pow) | Not applicable. |

| Partition coefficient n-octanol/water (Log Kow) | Not applicable. |

| Bioaccumulative potential | No ecological damage caused by this product. |

<table>
<thead>
<tr>
<th>Hydrogen (1333-74-0)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BCF - Fish [1]</td>
<td>(no bioaccumulation expected)</td>
</tr>
</tbody>
</table>

| Partition coefficient n-octanol/water (Log Pow) | Not applicable. |
**Hydrogen, compressed**

**Safety Data Sheet**


**Issue date:** 01/01/1980    **Revision date:** 01/24/2022    **Supersedes:** 01/28/2021    **Version:** 2.1

| **Partition coefficient n-octanol/water (Log Kow)** | Not applicable. |
| **Bioaccumulative potential** | No ecological damage caused by this product. |

### 12.4. Mobility in soil

| **Mobility in soil** | No data available. |
| **Ecology - soil** | No ecological damage caused by this product. |

### 12.5. Other adverse effects

- **Effect on ozone layer:** None.
- **Effect on the global warming:** No known effects from this product.

### SECTION 13: Disposal considerations

#### 13.1. Waste treatment methods

**Product/Packaging disposal recommendations:** Dispose of contents/container in accordance with local/regional/national/international regulations. Contact supplier for any special requirements.

### SECTION 14: Transport information

**In accordance with DOT**

- **Transport document description (DOT):** UN1049 Hydrogen, compressed, 2.1
- **UN-No. (DOT):** UN1049
- **Proper Shipping Name (DOT):** Hydrogen, compressed
- **Class (DOT):** 2.1 - Class 2.1 - Flammable gas 49 CFR 173.115
- **Hazard labels (DOT):** 2.1 - Flammable gas

**DOT Special Provisions (49 CFR 172.102):** N89 - When steel UN pressure receptacles are used, only those bearing the “H” mark are authorized.

**Additional information**

- **Emergency Response Guide (ERG) Number:** 115 (UN1049)
- **Other information:** No supplementary information available.
- **Special transport precautions:** 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 cylinder 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.

**Transport by sea**

- **UN-No. (IMDG):** 1049
- **Proper Shipping Name (IMDG):** HYDROGEN, COMPRESSED
- **Class (IMDG):** 2 - Gases
- **Division (IMDG):** 2.1 - Flammable gases
- **MFAG-No:** 115

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Air transport

| UN-No. (IATA) | 1049 |
| Proper Shipping Name (IATA) | Hydrogen, compressed |
| Class (IATA) | 2 - Gases |
| Civil Aeronautics Law | Gases under pressure/Gases flammable under pressure |

**SECTION 15: Regulatory information**

### 15.1. US Federal regulations

**Hydrogen, compressed (1333-74-0)**

Listed on the United States TSCA (Toxic Substances Control Act) inventory

All components of this product are listed on the Toxic Substances Control Act (TSCA) inventory.

### 15.2. International regulations

**CANADA**

- **Hydrogen, compressed (1333-74-0)**
  - Listed on the Canadian DSL (Domestic Substances List)

- **Hydrogen (1333-74-0)**
  - Listed on the Canadian DSL (Domestic Substances List)

**EU-Regulations**

- **Hydrogen, compressed (1333-74-0)**
  - Listed on the EEC inventory EINECS (European Inventory of Existing Commercial Chemical Substances)

### 15.2.2. National regulations

**Hydrogen, compressed (1333-74-0)**

- Listed introduction on Australian Industrial Chemicals Introduction Scheme (AICIS Inventory)
- Listed on IECS (Inventory of Existing Chemical Substances Produced or Imported in China)
- Listed on KECL/KECI (Korean Existing Chemicals Inventory)
- Listed on NZIoC (New Zealand Inventory of Chemicals)
- Listed on PICCS (Philippine Inventory of Chemicals and Chemical Substances)
- Listed on INSQ (Mexican National Inventory of Chemical Substances)
- Listed on the TCSI (Taiwan Chemical Substance Inventory)

### 15.3. US State regulations

**Hydrogen, compressed (1333-74-0)**

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. - California - Proposition 65 - Carcinogens List</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>U.S. - California - Proposition 65 - Developmental Toxicity</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>U.S. - California - Proposition 65 - Reproductive Toxicity - Female</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>U.S. - California - Proposition 65 - Reproductive Toxicity - Male</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>State or local regulations</td>
<td>U.S. - Massachusetts - Right To Know List</td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S. - New Jersey - Right to Know Hazardous Substance List</td>
<td></td>
</tr>
<tr>
<td></td>
<td>U.S. - Pennsylvania - RTK (Right to Know) List</td>
<td></td>
</tr>
</tbody>
</table>

California Proposition 65 - This product does not contain any substances known to the state of California to cause cancer, developmental and/or reproductive harm.
## Hydrogen (1333-74-0)

<table>
<thead>
<tr>
<th>U.S. - California - Proposition 65 - Carcinogens List</th>
<th>U.S. - California - Proposition 65 - Developmental Toxicity</th>
<th>U.S. - California - Proposition 65 - Reproductive Toxicity - Female</th>
<th>U.S. - California - Proposition 65 - Reproductive Toxicity - Male</th>
<th>No significant risk level (NSRL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

## Hydrogen (1333-74-0)

<table>
<thead>
<tr>
<th>U.S. - Massachusetts - Right To Know List</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. - New Jersey - Right to Know Hazardous Substance List</td>
</tr>
<tr>
<td>U.S. - Pennsylvania - RTK (Right to Know) List</td>
</tr>
</tbody>
</table>
SECTION 16: Other information

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 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 Inc, it is the user’s obligation to determine the conditions of safe use of the product.

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Revision date: 01/24/2022

NFPA health hazard: 0 - Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.

NFPA fire hazard: 4 - Materials that rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and burn readily.

NFPA instability: 0 - Material that in themselves are normally stable, even under fire conditions.