

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 | : H ₂ |
| Other means of identification | : MAPAX® H, Normal Hydrogen; Hydrogen, Compressed |

1.2. Relevant identified uses of the substance or mixture and uses advised against

| | |
|------------------------------|-----------------------------------|
| Use of the substance/mixture | : Industrial and professional use |
|------------------------------|-----------------------------------|

1.3. Details of the supplier of the safety data sheet

Linde Inc.
10 Riverview Drive
Danbury, CT 06810-6268, USA
www.lindeus.com

Electronics gas products 1-800-932-0624 or 1-908-329-9700
Linde Inc. 1-844-44LINDE (1-844-445-4633)

For additional product information contact your local customer service.

1.4. Emergency telephone number

| | |
|------------------|------------------------------------|
| Emergency number | : Onsite Emergency: 1-800-645-4633 |
|------------------|------------------------------------|

CHEMTREC, 24 hr/day 7 days/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 labelling

Hazard pictograms (GHS US)



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.
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.

CGA-PG05 - Use a back flow preventive device in the piping.
 CGA-PG10 - Use only with equipment rated for cylinder pressure.
 CGA-PG12 - Do not open valve until connected to equipment prepared for use.
 CGA-PG06 - Close valve after each use and when empty.
 CGA-PG02 - Protect from sunlight when ambient temperature exceeds 52°C (125°F).
 P304, P340, P313 - IF INHALED: Remove person to fresh air and keep comfortable for breathing. Get medical advice/attention.

2.3. Other hazards

Other hazards which do not result in classification : None.

2.4. Unknown acute toxicity (GHS US)

Not applicable

SECTION 3: Composition/information on ingredients

3.1. Substances

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

| Name | Product identifier | % |
|----------|---------------------|------------|
| Hydrogen | (CAS-No.) 1333-74-0 | 99.5 – 100 |

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. 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, 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 : **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 oxidizing agents.
 Explosion hazard : **EXTREMELY 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 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.

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 container supplier/owner instructions.

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 containers 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.

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.

7.3. Specific end use(s)

None.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

| Hydrogen, compressed (1333-74-0) | | |
|----------------------------------|-----------------|-------------------|
| ACGIH | Not established | |
| USA OSHA | Not established | |
| Hydrogen (1333-74-0) | | |
| ACGIH | Remark (ACGIH) | Simple asphyxiant |
| USA OSHA | Not established | |

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

: An air-supplied respirator must be used while working with this product in confined spaces. The respiratory protection used must conform with OSHA rules as specified in 29 CFR 1910.134. Select per OSHA 29 CFR 1910.134 and ANSI Z88.2.

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

| | |
|---|--|
| Physical state | : Gas |
| Appearance | : Colourless gas. |
| Molecular mass | : 2 g/mol |
| Colour | : Colourless. |
| Odour | : Odourless. |
| Odour threshold | : No data available |
| pH | : Not applicable. |
| Relative evaporation rate (butylacetate=1) | : No data available |
| Relative evaporation rate (ether=1) | : Not applicable. |
| Melting point | : -259.2 °C (-434.56°F) |
| Freezing point | : No data available |
| Boiling point | : -252.9 °C (-422.97°F) |
| Flash point | : No data available |
| Critical temperature | : -239.9 °C (-399.82°F) |
| Auto-ignition temperature | : 566 °C (1051°F) |
| Decomposition temperature | : No data available |
| Flammability (solid, gas) | : No data available |
| Vapour pressure | : Not applicable. |
| Relative vapour density at 20 °C | : No data available |
| Relative density | : No data available |
| Density | : 0.089 g/l (0.0056 lb/ft ³) (at STP = 0°C and 1atm) |
| Relative gas density | : 0.07 |
| Solubility | : Water: 1.6 mg/l |
| Partition coefficient n-octanol/water (Log Pow) | : Not applicable. |
| Partition coefficient n-octanol/water (Log Kow) | : Not applicable. |
| Viscosity, kinematic | : Not applicable. |
| Viscosity, dynamic | : Not applicable. |
| Explosive properties | : Not applicable. |
| Oxidizing properties | : None. |
| Explosive limits | : 4 – 77 vol % |

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

Oxidizing agents. Lithium. Halogens.

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

| Hydrogen, compressed (f)1333-74-0 | |
|-------------------------------------|----------------|
| LC50 Inhalation - Rat [ppm] | > 15000 ppm/1h |

Skin corrosion/irritation : Not classified
 pH: Not applicable.
 Serious eye damage/irritation : Not classified
 pH: Not applicable.
 Respiratory or skin sensitisation : 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

| Hydrogen, compressed (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

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

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

12.4. Mobility in soil

| Hydrogen, compressed (1333-74-0) | |
|----------------------------------|--|
| Mobility in soil | No data available. |
| Ecology - soil | No ecological damage caused by this product. |
| Hydrogen (1333-74-0) | |
| Mobility in soil | No data available. |
| Ecology - soil | No ecological damage caused by this product. |

12.5. Other adverse effects

| | |
|---------------------------|---------------------------------------|
| Effect on the ozone layer | : None. |
| Effect on 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 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 |
| EmS-No. (1) | : F-D |
| MFAG-No | : 115 |
| EmS-No. (2) | : S-U |

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(Hazardous materials notice Appended Table 1 Article 194 of the Enforcement Regulations) |

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, or excluded from listing, on the United States Environmental Protection Agency 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 IECSC (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 (Philippines 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)

| | |
|---|---|
| U.S. - California - Proposition 65 - Carcinogens List | No |
| U.S. - California - Proposition 65 - Developmental Toxicity | No |
| U.S. - California - Proposition 65 - Reproductive Toxicity - Female | No |
| U.S. - California - Proposition 65 - Reproductive Toxicity - Male | No |
| State or local regulations | U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List |

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, compressed

Safety Data Sheet LIND-P066

This SDS conforms to U.S. Code of Federal Regulations 29 CFR 1910.1200, Hazard Communication.

Issue date: 02/24/2015 Revision date: 03/24/2022 Supersedes: 02/02/2021 Version: 1.4

| Hydrogen (1333-74-0) | | | | |
|---|---|---|---|----------------------------------|
| U.S. - California - Proposition 65 - Carcinogens List | U.S. - California - Proposition 65 - Developmental Toxicity | U.S. - California - Proposition 65 - Reproductive Toxicity - Female | U.S. - California - Proposition 65 - Reproductive Toxicity - Male | No significant risk level (NSRL) |
| No | No | No | No | |
| Hydrogen (1333-74-0) | | | | |
| U.S. - Massachusetts - Right To Know List U.S. - New Jersey - Right to Know Hazardous Substance List U.S. - Pennsylvania - RTK (Right to Know) List | | | | |

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

: 03/24/2022

NFPA health hazard

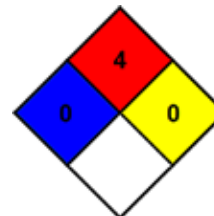
: 0 - Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.

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.



SDS US (GHS HazCom 2012) - Linde 2022

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.