HYDROGEN
Safety Data Sheet

1. IDENTIFICATION

Product identifier
Product Name HYDROGEN

Other means of identification
Safety data sheet number LIND-P066
UN / ID no. UN1049
Synonyms MAPAX® H, Normal Hydrogen; Hydrogen, Compressed

Recommended use of the chemical and restrictions on use
Recommended Use Industrial and professional use.
Uses advised against Consumer use

Details of the supplier of the safety data sheet
Linde Gas North America LLC - Linde Merchant Production Inc. - Linde LLC
200 Somerset Corporate Blvd, Suite 7000
Bridgewater, NJ 08807
Phone: 908-464-8100
www.lindeus.com

Linde Gas Puerto Rico, Inc.
Road 869, Km 1.8
Barrio Palmas, Catano, PR 00962
Phone: 787-641-7445
www.pr.lindegas.com

Linde Canada Limited
5860 Chedworth Way
Mississauga, Ontario L5R 0A2
Phone: 905-501-2500 / 905-501-1700
www.lindecanada.com

* May include subsidiaries or affiliate companies / divisions.

For additional product information contact your local customer service.

Emergency telephone number
Company Phone Number +1 800-232-4726 (Linde National Operations Center, US) 905-501-0802 (Canada)
CHEMTREC: 1-800-424-9300 (North America) +1-703-527-3887 (International)

2. HAZARDS IDENTIFICATION

Classification

OSHA Regulatory Status
This chemical is considered hazardous by the 2012 OSHA Hazard Communication Standard (29 CFR 1910.1200).

Flammable gases	Category 1
Gases under pressure	Compressed gas
Simple asphyxiants	Yes

Label elements

Signal word Danger

Hazard Statements
Extremely flammable gas
Contains gas under pressure; may explode if heated
May displace oxygen and cause rapid suffocation

May form explosive mixtures with air
Burns with invisible flame

Precautionary Statements - Prevention
Do not handle until all safety precautions have been read and understood
Keep away from heat, sparks, open flames, hot surfaces. — No smoking
Use and store only outdoors or in a well ventilated place
Use a backflow preventive device in piping
Use only with equipment rated for cylinder pressure
Do not open valve until connected to equipment prepared for use
Close valve after each use and when empty

Precautionary Statements - Response
IF INHALED: Remove person to fresh air and keep comfortable for breathing. Get medical attention / advice.
Leaking gas fire: do not extinguish, unless leak can be stopped safely
Eliminate all ignition sources if safe to do so

Precautionary Statements - Storage
Protect from sunlight when ambient temperature exceeds 52°C / 125°F

Hazards not otherwise classified (HNOC)
Not applicable

3. COMPOSITION/INFORMATION ON INGREDIENTS

Chemical Name	CAS No.	Volume %	Chemical Formula
Hydrogen	1333-74-0	100	H_2

4. FIRST AID MEASURES

Description of first aid measures

General advice — Show this safety data sheet to the doctor in attendance.

Inhalation — Remove to fresh air and keep comfortable for breathing. If breathing is difficult, give oxygen. If breathing has stopped, give artificial respiration. Get medical attention immediately.

Skin contact — None under normal use. Get medical attention if symptoms occur.

Eye contact — None under normal use. Get medical attention if symptoms occur.

Ingestion — Not an expected route of exposure.

Self-protection of the first aider — RESCUE PERSONNEL SHOULD BE EQUIPPED WITH SELF-CONTAINED BREATHING APPARATUS. Remove all sources of ignition.

Most important symptoms and effects, both acute and delayed

Symptoms — Simple asphyxiant. May cause suffocation by displacing the oxygen in the air. Exposure to oxygen-deficient atmosphere (<19.5%) may cause dizziness, drowsiness, nausea, vomiting, excess salivation, diminished mental alertness, loss of consciousness and death. Exposure to atmospheres containing 8-10% or less oxygen will bring about unconsciousness without warning and so quickly that the individuals cannot help or protect themselves. Lack of sufficient oxygen may cause serious injury or death.

Indication of any immediate medical attention and special treatment needed

Note to physicians — Treat symptomatically.

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media

Dry chemical or CO2. Water spray (fog). DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED.

Specific extinguishing methods

If possible, stop the flow of gas. Do not extinguish the fire until supply is shut off as otherwise an explosive-ignition may occur. If the fire is extinguished and the flow of gas continues, use increased ventilation to prevent build-up of explosive atmosphere. Ventilation fans must be explosion proof. Use non-sparking tools to close container valves.

Use water spray to cool surrounding containers. Be cautious of a Boiling Liquid Evaporating Vapor Explosion, BLEVE, if flame is impinging on surrounding containers. For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible withdraw from area and let fire burn. Damaged cylinders should be handled only by specialists.

Specific hazards arising from the chemical

Extremely flammable gas. May form explosive mixtures with air. Hydrogen is very light and may collect in the upper portions of storage areas. Hydrogen burns with an almost invisible flame. High pressure releases may ignite with no apparent ignition source possibly via static electricity. Vapors may travel to source of ignition and flash back. Cylinders may rupture under extreme heat.

Protective equipment and precautions for firefighters

As in any fire, wear self-contained breathing apparatus pressure-demand, NIOSH (approved or equivalent) and full protective gear. As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions, protective equipment and emergency procedures

Personal precautions: ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Evacuate personnel to safe areas. Ensure adequate ventilation, especially in confined areas. Monitor oxygen level. Consider the risk of potentially explosive atmospheres. All equipment used when handling the product must be grounded. Use non-sparking tools and equipment. Wear self-contained breathing apparatus when entering area unless atmosphere is proved to be safe.

Environmental precautions

Environmental precautions: Prevent spreading of vapors through sewers, ventilation systems and confined areas.

Methods and material for containment and cleaning up

Methods for containment: Stop the flow of gas or remove cylinder to outdoor location if this can be done without risk. If leak is in container or container valve, contact the appropriate emergency telephone number in Section 1 or call your closest Linde location.

Methods for cleaning up: Return cylinder to Linde or an authorized distributor.

7. HANDLING AND STORAGE

Precautions for safe handling

Advice on safe handling: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking. Ground and bond all lines and equipment associated with product system. All equipment should be non-sparking and explosion proof. Separate flammable gas cylinders from oxygen and other oxidizers by a minimum distance of 20 ft. or by a 5 ft. high barrier with a minimum fire resistance rating of a half an hour. "NO SMOKING" signs should be posted in storage and use areas. Hydrogen is non-corrosive. However hydrogen can interact with metals (hardened steels) to cause embrittlement.

Protect cylinders from physical damage; do not drag, roll, slide or drop. When moving cylinders, even for short distance, use a cart designed to transport cylinders. Never attempt to lift a cylinder by its valve protection cap. Never insert an object (e.g. wrench, screwdriver, pry bar,etc.) into valve cap openings. Doing so may damage valve, causing leak to occur. Use an adjustable strap wrench to remove over-tight or rusted caps. Use only with adequate ventilation. Use a backflow preventive device in piping. Use only with equipment rated for cylinder pressure. Close valve after each use and when empty. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Ensure the complete gas system has been checked for leaks before use.

Never put cylinders into trunks of cars or unventilated areas of passenger vehicles. Never attempt to refill a compressed gas cylinder without the owner's written consent. Never strike an arc on a compressed gas cylinder or make a cylinder a part of an electrical circuit.

Only experienced and properly instructed persons should handle gases under pressure. Always store and handle compressed gas cylinders in accordance with Compressed Gas Association, pamphlet CGA-P1, Safe Handling of Compressed Gases in Containers.

For additional recommendations, consult Compressed Gas Association's pamphlets P-1, G-5, G-5.3, G-5.5, P-6 and Safety Bulletin SB-2. NFPA 50A covers gaseous hydrogen at consumer sites.

Conditions for safe storage, including any incompatibilities

Storage Conditions: Store in cool, dry, well-ventilated area of non-combustible construction away from heavily trafficked areas and emergency exits. Keep at temperatures below 52°C / 125°F. Cylinders should

be stored upright with valve protection cap in place and firmly secured to prevent falling. Use a "first in-first out" inventory system to prevent full cylinders from being stored for excessive periods of time. Full and empty cylinders should be segregrated. Stored containers should be periodically checked for general condition and leakage. Outside or detached storage is preferred.

Incompatible materials: Oxidizing agents.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

Control parameters

Exposure Guidelines: This product, as supplied, does not contain any hazardous materials with occupational exposure limits established by the region specific regulatory bodies

Appropriate engineering controls

Engineering Controls: Explosion proof ventilation systems. Local exhaust ventilation to prevent accumulation of high concentrations and maintain air-oxygen levels at or above 19.5%. Oxygen detectors should be used when asphyxiating gases may be released. Systems under pressure should be regularly checked for leakages. Consider installation of leak detection systems in areas of use and storage.

Individual protection measures, such as personal protective equipment

Eye / face protection: Wear safety glasses with side shields (or goggles).

Skin and body protection: Work gloves and safety shoes are recommended when handling cylinders. Wear fire / flame resistant / retardant clothing. Take precautionary measures against static discharge.

Respiratory protection: Use positive pressure airline respirator with escape cylinder or self contained breathing apparatus for oxygen-deficient atmospheres (<19.5%).

General Hygiene Considerations: Handle in accordance with good industrial hygiene and safety practice.

9. PHYSICAL AND CHEMICAL PROPERTIES

Information on basic physical and chemical properties

Physical state	Compressed gas
Appearance	Colorless.
Odor	Odorless.
Odor threshold	No information available
pH	No data available
Melting point	-259.2 °C / -434.8 °F
Evaporation rate	Not applicable
Fire Hazard	Yes
Lower flammability limit:	4%
Upper flammability limit:	75%
Flash point	No information available
Autoignition temperature	570 °C / 1058 °F
Decomposition temperature	No data available
Water solubility	0.019 vol / vol @ 15.6°C
Partition coefficient	No data available
Kinematic viscosity	Not applicable

Chemical Name	Molecular weight	Boiling point	Vapor Pressure	Vapor density (air =1)	Gas Density kg / m^3@20°C	Critical Temperature
Hydrogen	1.00	-252.8 °C	Above critical temperature	0.07	0.083	-240 °C

10. STABILITY AND REACTIVITY

Reactivity
Not reactive under normal conditions

Chemical stability
Stable under normal conditions.

Explosion data

Sensitivity to Mechanical Impact	None.
Sensitivity to Static Discharge	Yes.

Possibility of Hazardous Reactions
May form explosive mixtures with air. May react violently with oxidizers.

Conditions to avoid
Heat, flames and sparks. Flammable or explosive when mixed with chlorine or other oxidizing materials. Fluorine and hydrogen react at -418°F (-250°C) when impurities are present. Chlorine / hydrogen mixtures explode if exposed to light. Lithium metal will burn in a hydrogen atmosphere.

Incompatible materials
Oxidizing agents.

Hazardous Decomposition Products
None known.

11. TOXICOLOGICAL INFORMATION

Information on likely routes of exposure

Inhalation	Product is a simple asphyxiant.
Skin contact	No data available.
Eye contact	No data available.
Ingestion	Not an expected route of exposure.

Information on toxicological effects

Symptoms	No information available.

Delayed and immediate effects as well as chronic effects from short and long-term exposure

Irritation	Not classified.
Sensitization	Not classified.
Germ cell mutagenicity	Not classified.
Carcinogenicity	This product does not contain any carcinogens or potential carcinogens listed by OSHA, IARC or NTP.
Reproductive toxicity	Not classified.
STOT - single exposure	Not classified.
STOT - repeated exposure	Not classified.
Chronic toxicity	None known.
Aspiration hazard	Not applicable.

Numerical measures of toxicity

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50	Inhalation LC50 (CGA P-20)
Hydrogen 1333-74-0	-	-	> 15000 ppm (Rat) 1 h	-

Product Information

Oral LD50	No information available
Dermal LD50	No information available.
Inhalation LC50	No information available

12. ECOLOGICAL INFORMATION

Ecotoxicity
No known acute aquatic toxicity.

Persistence and degradability
Not applicable.

Bioaccumulation
No information available

13. DISPOSAL CONSIDERATIONS

Waste treatment methods

Disposal of wastes: Do not attempt to dispose of residual waste or unused quantities. Return in the shipping container PROPERLY LABELED WITH ANY VALVE OUTLET PLUGS OR CAPS SECURED AND VALVE PROTECTION CAP IN PLACE to Linde for proper disposal.

14. TRANSPORT INFORMATION

DOT

UN / ID no.	UN1049
Proper shipping name	Hydrogen, compressed
Hazard Class	2.1
Special Provisions	N89
Description	UN1049, Hydrogen, compressed, 2.1
Emergency Response Guide Number	115

TDG

UN / ID no.	UN1049
Proper shipping name	Hydrogen, compressed
Hazard Class	2.1
Description	UN1049, Hydrogen, compressed, 2.1

MEX

UN / ID no.	UN1049
Proper shipping name	Hydrogen, compressed
Hazard Class	2.1
Description	UN1049, Hydrogen, compressed, 2.1

IATA

UN / ID no.	UN1049
Proper shipping name	Hydrogen, compressed
Hazard Class	2.1
ERG Code	10L
Special Provisions	A1

Description	UN1049, Hydrogen, compressed, 2.1

IMDG

UN / ID no.	UN1049
Proper shipping name	Hydrogen, compressed
Hazard Class	2.1
EmS-No.	F-D, S-U
Description	UN1049, Hydrogen, compressed, 2.1

ADR

UN / ID no.	UN1049
Proper shipping name	Hydrogen, compressed
Hazard Class	2.1
Classification code	1F
Tunnel restriction code	(B / D)
Description	UN1049, Hydrogen, compressed, 2.1, (B / D)

15. REGULATORY INFORMATION

International Inventories

TSCA	Complies
DSL / NDSL	Complies
EINECS / ELINCS	Complies

Legend:

TSCA - United States Toxic Substances Control Act Section 8(b) Inventory
DSL / NDSL - Canadian Domestic Substances List / Non-Domestic Substances List
EINECS / ELINCS - European Inventory of Existing Chemical Substances / European List of Notified Chemical Substances

US Federal Regulations

SARA 313

Section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA). This product does not contain any chemicals which are subject to the reporting requirements of the Act and Title 40 of the Code of Federal Regulations, Part 372.

SARA 311 / 312 Hazard Categories

Acute Health Hazard	No
Chronic Health Hazard	No
Fire Hazard	Yes
Sudden release of pressure hazard	Yes
Reactive Hazard	No

CERCLA

This material, as supplied, does not contain any substances regulated as hazardous substances under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) (40 CFR 302) or the Superfund Amendments and Reauthorization Act (SARA) (40 CFR 355). There may be specific reporting requirements at the local, regional, or state level pertaining to releases of this material.

Clean Air Act, Section 112 Hazardous Air Pollutants (HAPs) (see 40 CFR 61)

This product does not contain any substances regulated as hazardous air pollutants (HAPS) under Section 112 of the Clean Air Act Amendments of 1990.

CWA (Clean Water Act)

This product does not contain any substances regulated as pollutants pursuant to the Clean Water Act (40 CFR 122.21 and 40 CFR 122.42)

Risk and Process Safety Management Programs

This material, as supplied, contains one or more regulated substances with specified thresholds under 40 CFR Part 68 or regulated as a highly hazardous chemical pursuant to the 29 CFR Part 1910.110 with specified thresholds:

Chemical Name	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Toxic Substances	U.S. - CAA (Clean Air Act) - Accidental Release Prevention - Flammable Substances	U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals
Hydrogen		10000 lbs	

US State Regulations

California Proposition 65
This product does not contain any Proposition 65 chemicals

U.S. State Right-to-Know Regulations

Chemical Name	New Jersey	Massachusetts	Pennsylvania
Hydrogen 1333-74-0	X	X	X

16. OTHER INFORMATION

NFPA Health hazards 0 Flammability 4 Instability 0 Physical and Chemical Properties -

Note: Ratings were assigned in accordance with Compressed Gas Association (CGA) guidelines as published in CGA Pamphlet P-19-2009, CGA Recommended Hazard Ratings for Compressed Gases, 3rd Edition.

Issue Date	24-Feb-2015
Revision Date	12-Jul-2016
Revision Note	SDS sections updated; 1

General Disclaimer
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End of Safety Data Sheet