

Safety Data Sheet

**Section 1: Identification of the Substance/Mixture and of the Company/Undertaking****1.1 Product identifier**

Product Name	• Hydrogen
CAS Number	• 1333-74-0
Product Code	• 10050
EC Number	• 215-605-7

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

Relevant identified use(s)	• Semiconductor Use
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1.3 Details of the supplier of the safety data sheet

Manufacturer	• Air Liquide 2700 Post Oak Blvd. Houston, TX 77056 United States www.us.airliquide.com sds@airliquide.com
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Telephone (Technical) • 713-896-2896

Telephone (Technical) • 800-819-1704

1.4 Emergency telephone number

Manufacturer	• 800-424-9300 - CHEMTREC
Manufacturer	• +1 703-527-3887 - Outside United States

Section 2: Hazards Identification**EU/EEC**

According to Regulation (EC) No 1272/2008 (CLP)/REACH 1907/2006 [amended by 453/2010]
According to EU Directive 67/548/EEC (DSD) or 1999/45/EC (DPD)

2.1 Classification of the substance or mixture

CLP	• Flammable Gases 1 - H220 Compressed Gas - H280
DSD/DPD	• Extremely Flammable (F+) R12

2.2 Label Elements

CLP

DANGER



- Hazard statements**
- H220 - Extremely flammable gas
 - H280 - Contains gas under pressure; may explode if heated

Precautionary statements

- Prevention**
- P210 - Keep away from heat, sparks, open flames and/or hot surfaces. - No smoking.
- Response**
- P377 - Leaking gas fire: Do not extinguish, unless leak can be stopped safely.
 - P381 - Eliminate all ignition sources if safe to do so.
- Storage/Disposal**
- P403 - Store in a well-ventilated place.

DSD/DPD



- Risk phrases**
- R12 - Extremely flammable.
- Safety phrases**
- S9 - Keep container in a well ventilated place
 - S16 - Keep away from sources of ignition - No Smoking.

2.3 Other Hazards

- CLP**
- This material is a simple asphyxiant. May displace or reduce oxygen available for breathing especially in confined spaces. According to Regulation (EC) No. 1272/2008 (CLP) this material is considered hazardous.

- DSD/DPD**
- This material is a simple asphyxiant. May displace or reduce oxygen available for breathing especially in confined spaces. This product is considered dangerous according to the European Directive 67/548/EEC.

United States (US)

According to OSHA 29 CFR 1910.1200 HCS

2.1 Classification of the substance or mixture

- OSHA HCS 2012**
- Flammable Gases 1 - H220
 - Compressed Gas - H280
 - Simple Asphyxiant

2.2 Label elements

OSHA HCS 2012

DANGER



- Hazard statements**
- Extremely flammable gas - H220
 - Contains gas under pressure; may explode if heated - H280
 - May displace oxygen and cause rapid suffocation.

Precautionary statements

- Prevention**
- Keep away from heat, sparks, open flames and/or hot surfaces. - No smoking. - P210
- Response**
- Leaking gas fire: Do not extinguish, unless leak can be stopped safely. - P377
 - Eliminate all ignition sources if safe to do so. - P381
- Storage/Disposal**
- Store in a well-ventilated place. - P403

2.3 Other hazards

- OSHA HCS 2012**
- Under United States Regulations (29 CFR 1910.1200 - Hazard Communication Standard), this product is considered hazardous.

Canada

According to WHMIS

2.1 Classification of the substance or mixture

WHMIS

- Compressed Gas - A
- Flammable Gases - B1

2.2 Label elements

WHMIS



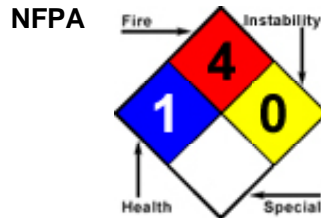
- Compressed Gas - A
- Flammable Gases - B1

2.3 Other hazards

WHMIS

- This material is a simple asphyxiant. May displace or reduce oxygen available for breathing especially in confined spaces.
In Canada, the product mentioned above is considered hazardous under the Workplace Hazardous Materials Information System (WHMIS).

2.4 Other information



Section 3 - Composition/Information on Ingredients

3.1 Substances

Composition					
Chemical Name	Identifiers	%	LD50/LC50	Classifications According to Regulation/Directive	Comments
Hydrogen	CAS:1333-74-0 EC Number:215-605-7	> 99%	NDA	EU DSD/DPD: Annex I - F+; R12 EU CLP: Annex VI - Flam. Gas 1, H220; Press. Gas - Comp., H280 OSHA HCS 2012: Flam. Gas 1, Press. Gas - Comp.; Simp. Asphyx.	NDA

3.2 Mixtures

- Material does not meet the criteria of a mixture in accordance with Regulation (EC) No 1272/2008.

Section 4 - First Aid Measures

4.1 Description of first aid measures

Inhalation

- IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for

breathing. Administer oxygen if breathing is difficult. Give artificial respiration if victim is not breathing. If signs/symptoms continue, get medical attention.

- Skin**
- Although exposure is unlikely, in case of contact immediately flush skin with running water. If skin irritation develops get medical advice/attention.
- Eye**
- First aid is not expected to be necessary if material is used under ordinary conditions and as recommended. Get medical attention immediately if symptoms occur. Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first five minutes, then continue rinsing eye.
- Ingestion**
- First aid is not expected to be necessary if material is used under ordinary conditions and as recommended. Never give anything by mouth to an unconscious person. Do NOT induce vomiting.

4.2 Most important symptoms and effects, both acute and delayed

- Refer to Section 11 - Toxicological Information.

4.3 Indication of any immediate medical attention and special treatment needed

Notes to Physician

- All treatments should be based on observed signs and symptoms of distress in the patient. Consideration should be given to the possibility that overexposure to materials other than this product may have occurred.

4.4 Other information

- Ensure that medical personnel are aware of the material(s) involved and take precautions to protect themselves. RESCUERS SHOULD NOT ATTEMPT TO RETRIEVE VICTIMS OF EXPOSURE TO GASES WITHOUT ADEQUATE PERSONAL PROTECTIVE EQUIPMENT. At a minimum, Self-Contained Breathing Apparatus must be worn. Victim(s) who experience any adverse effect after over-exposure to this gas mixture must be taken for medical attention. Rescuers should be taken for medical attention if necessary. Take a copy of the label and the MSDS to physician or other health professional with victim(s).

Section 5 - Firefighting Measures

5.1 Extinguishing media

Suitable Extinguishing Media

- SMALL FIRES: Dry chemical or CO₂.
LARGE FIRES: Water spray or fog.

Unsuitable Extinguishing Media

- No data available

5.2 Special hazards arising from the substance or mixture

Unusual Fire and Explosion Hazards

- EXTREMELY FLAMMABLE
Will form explosive mixtures with air.
Vapors may travel to source of ignition and flash back.
Cylinders exposed to fire may vent and release flammable gas through pressure relief devices.
Containers may explode when heated.
Ruptured cylinders may rocket.

Hazardous Combustion Products

- None known.

5.3 Advice for firefighters

- Structural firefighters' protective clothing provides limited protection in fire situations ONLY; it is not effective in spill situations where direct contact with the substance is possible.
Always wear thermal protective clothing when handling refrigerated/cryogenic liquids. Wear positive pressure self-contained breathing apparatus (SCBA).
DO NOT EXTINGUISH A LEAKING GAS FIRE UNLESS LEAK CAN BE STOPPED
Move containers from fire area if you can do it without risk.
FIRE: If tank, rail car or tank truck is involved in a fire, ISOLATE for 1600 meters (1 mile) in all directions; also, consider initial evacuation for 1600 meters (1 mile) in all directions.
FIRE INVOLVING TANKS: ALWAYS stay away from tanks engulfed in fire.

FIRE INVOLVING TANKS: Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
 FIRE INVOLVING TANKS: Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
 FIRE INVOLVING TANKS: Cool containers with flooding quantities of water until well after fire is out.
 FIRE INVOLVING TANKS: Do not direct water at source of leak or safety devices; icing may occur.
 FIRE INVOLVING TANKS: For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

Section 6 - Accidental Release Measures

6.1 Personal precautions, protective equipment and emergency procedures

Personal Precautions

- Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Do not touch or walk through spilled material. Ventilate the area before entry.

Emergency Procedures

- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). As an immediate precautionary measure, isolate spill or leak area for at least 100 meters (330 feet) in all directions. Stop leak if you can do it without risk. Keep unauthorized personnel away. Keep out of low areas. Stay upwind. LARGE SPILL: Consider initial downwind evacuation for at least 800 meters (1/2 mile)

6.2 Environmental precautions

- Prevent spreading of vapors through sewers, ventilation systems and confined areas.

6.3 Methods and material for containment and cleaning up

Containment/Clean-up Measures

- All equipment used when handling the product must be grounded. Stop leak if you can do it without risk. If possible, turn leaking containers so that gas escapes rather than liquid. Use water spray to reduce vapors; do not put water directly on leak, spill area or inside container. Do not direct water at spill or source of leak. Isolate area until gas has dispersed.

6.4 Reference to other sections

- Refer to Section 8 - Exposure Controls/Personal Protection and Section 13 - Disposal Considerations.

Section 7 - Handling and Storage

7.1 Precautions for safe handling

Handling

- Keep away from heat and ignition sources – No Smoking. Take precautionary measures against static charges. All equipment used when handling the product must be grounded. Use only non-sparking tools. Use only with adequate ventilation. Ventilate closed spaces before entering. Be aware of any signs of dizziness or fatigue, especially if work is done in a poorly ventilated area; exposures to fatal concentrations of this gas mixture could occur without any significant warning symptoms, due to olfactory fatigue or oxygen deficiency. Cylinders should be firmly secured to prevent falling or being knocked-over. Use explosion-proof - electrical, ventilating and/or lighting equipment. Do not attempt to repair, adjust, or in any other way modify cylinders. If there is a malfunction or another type of operational problem, contact nearest distributor immediately. Empty containers retain product residue and can be hazardous. Do not cut, weld, puncture or incinerate container.

7.2 Conditions for safe storage, including any incompatibilities

Storage

- Cylinders should be stored in dry, well-ventilated areas away from sources of heat, ignition and direct sunlight. Do not allow area where cylinders are stored to exceed 52C (125F). Cylinders must be protected from the environment, and preferably kept at room temperature approximately 21C (70F). Protect cylinders against physical damage. Cylinders should be firmly secured to prevent falling or being knocked-over.

Store locked up.

7.3 Specific end use(s)

- Refer to Section 1.2 - Relevant identified uses.

Section 8 - Exposure Controls/Personal Protection

8.1 Control parameters

Exposure Limits/Guidelines • Currently there are no applicable exposure limits established for this material.

Exposure Control Notations

Portugal

•Hydrogen (1333-74-0): **Simple Asphyxiants:** (Simple Asphyxiant)

Canada Ontario

•Hydrogen (1333-74-0): **Simple Asphyxiants:** (Simple asphyxiant)

Canada Quebec

•Hydrogen (1333-74-0): **Simple Asphyxiants:** (Simple asphyxiant)

Ireland

•Hydrogen (1333-74-0): **Simple Asphyxiants:** (Asphyxiant)

Spain

•Hydrogen (1333-74-0): **Simple Asphyxiants:** (simple asphyxiant)

ACGIH

•Hydrogen (1333-74-0): **Simple Asphyxiants:** (Simple asphyxiant)

Exposure Limits Supplemental

ACGIH

•Hydrogen (1333-74-0): **TLV Basis - Critical Effects:** (asphyxia)

8.2 Exposure controls

Engineering Measures/Controls

- Good general ventilation should be used. Ventilation rates should be matched to conditions. If applicable, use process enclosures, local exhaust ventilation, or other engineering controls to maintain airborne levels below recommended exposure limits. If exposure limits have not been established, maintain airborne levels to an acceptable level. Use explosion-proof - electrical, ventilating and/or lighting equipment.

Personal Protective Equipment

Respiratory

- No data available

Eye/Face

- Wear safety glasses.

Skin/Body

- Wear leather gloves when handling cylinders.

Environmental Exposure Controls

- Follow best practice for site management and disposal of waste. Controls should be engineered to prevent release to the environment, including procedures to prevent spills, atmospheric release and release to waterways.

Section 9 - Physical and Chemical Properties

9.1 Information on Physical and Chemical Properties

Material Description			
Physical Form	Gas	Appearance/Description	Colorless compressed gas with no odor.
Color	Colorless	Odor	Odorless
Odor Threshold	Not relevant		
General Properties			
Boiling Point	-252 C(-421.6 F)	Melting Point	-259.2 C(-434.56 F)

Decomposition Temperature	Data lacking	pH	Not relevant
Specific Gravity/Relative Density	Data lacking	Water Solubility	1.82 % @ 20 C(68 F)
Viscosity	Data lacking	Explosive Properties	Data lacking
Oxidizing Properties:	Data lacking		
Volatility			
Vapor Pressure	79 hPa @ -259 C(-434.2 F)	Vapor Density	0.07 Air=1
Evaporation Rate	Data lacking		
Flammability			
Flash Point	Data lacking	UEL	75 %
LEL	4 %	Autoignition	500 C(932 F)
Flammability (solid, gas)	Flammable gas.		
Environmental			
Octanol/Water Partition coefficient	Data lacking		

9.2 Other Information

- No additional physical and chemical parameters noted.

Section 10: Stability and Reactivity

10.1 Reactivity

- No dangerous reaction known under conditions of normal use.

10.2 Chemical stability

- Stable under normal temperatures and pressures.

10.3 Possibility of hazardous reactions

- Hazardous polymerization will not occur.

10.4 Conditions to avoid

- No data available

10.5 Incompatible materials

- Oxidizing agents: hydrogen can react with some metals (i.e. hardened steel) to cause embrittlement, alkaline materials, halogens.

10.6 Hazardous decomposition products

- None

Section 11 - Toxicological Information

11.1 Information on toxicological effects

GHS Properties	Classification
Acute toxicity	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Aspiration Hazard	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Carcinogenicity	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met

Germ Cell Mutagenicity	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Skin corrosion/Irritation	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Skin sensitization	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
STOT-RE	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
STOT-SE	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Toxicity for Reproduction	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Respiratory sensitization	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met
Serious eye damage/Irritation	EU/CLP • Classification criteria not met OSHA HCS 2012 • Classification criteria not met

Potential Health Effects

Inhalation

- Acute (Immediate)**
 - This material is a simple asphyxiant. May displace or reduce oxygen available for breathing especially in confined spaces.
- Chronic (Delayed)**
 - No data available

Skin

- Acute (Immediate)**
 - Under normal conditions of use, no health effects are expected.
- Chronic (Delayed)**
 - No data available

Eye

- Acute (Immediate)**
 - Under normal conditions of use, no health effects are expected.
- Chronic (Delayed)**
 - No data available

Ingestion

- Acute (Immediate)**
 - Ingestion is not considered a potential route of exposure due to the physical form of this product.
- Chronic (Delayed)**
 - No data available

Section 12 - Ecological Information

12.1 Toxicity

- No data available

12.2 Persistence and degradability

- No data available

12.3 Bioaccumulative potential

- No data available

12.4 Mobility in Soil

- No data available

12.5 Results of PBT and vPvB assessment

- PBT and vPvB assessment has not been conducted for this material.

12.6 Other adverse effects

Section 13 - Disposal Considerations

13.1 Waste treatment methods

Product waste

- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Packaging waste

- Dispose of content and/or container in accordance with local, regional, national, and/or international regulations.

Section 14 - Transport Information

	14.1 UN number	14.2 UN proper shipping name	14.3 Transport hazard class(es)	14.4 Packing group	14.5 Environmental hazards
DOT	UN1049	Hydrogen, compressed	2.1	NDA	NDA
TDG	UN1049	HYDROGEN, COMPRESSED	2.1	NDA	NDA
IMO/IMDG	UN1049	HYDROGEN, COMPRESSED	2.1	NDA	NDA
IATA/ICAO	UN1049	Hydrogen, compressed	2.1	NDA	NDA

14.6 Special precautions for user

- Cylinders should be transported in a secure position, in a well-ventilated vehicle. The transportation of compressed gas cylinders in automobiles or in closed-body vehicles can present serious safety hazards. If transporting these cylinders in vehicles, ensure these cylinders are not exposed to extremely high temperatures (as may occur in an enclosed vehicle on a hot day). Additionally, the vehicle should be well-ventilated during transportation.

14.7 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

- Not relevant.

14.8 Other information

- Material is forbidden to be transported via Passenger Aircraft.

Section 15 - Regulatory Information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

SARA Hazard Classifications

- Acute, Fire, Pressure(Sudden Release of)

State Right To Know				
Component	CAS	MA	NJ	PA
Hydrogen	1333-74-0	Yes	Yes	Yes

Inventory						
Component	CAS	Canada DSL	Canada NDSL	China	EU EINECS	EU ELNICS
Hydrogen	1333-74-0	Yes	No	Yes	Yes	No

Inventory (Con't.)			
Component	CAS	Japan ENCS	TSCA
Hydrogen	1333-74-0	No	Yes

Canada

Labor

Canada - WHMIS - Classifications of Substances

• Hydrogen	1333-74-0	A, B1
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Canada - WHMIS - Ingredient Disclosure List

• Hydrogen	1333-74-0	Not Listed
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Environment

Canada - CEPA - Priority Substances List

• Hydrogen	1333-74-0	Not Listed
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China

Environment

China - Ozone Depleting Substances - First Schedule

• Hydrogen	1333-74-0	Not Listed
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China - Ozone Depleting Substances - Second Schedule

• Hydrogen	1333-74-0	Not Listed
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China - Ozone Depleting Substances - Third Schedule

• Hydrogen	1333-74-0	Not Listed
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Other

China - Annex I & II - Controlled Chemicals Lists

• Hydrogen	1333-74-0	Not Listed
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China - Dangerous Goods List

• Hydrogen	1333-74-0	UN1049; UN1966
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China - Export Control List - Part I Chemicals

• Hydrogen	1333-74-0	Not Listed
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Europe

Other

EU - CLP (1272/2008) - Annex VI - Table 3.2 - Classification

• Hydrogen	1333-74-0	F+; R12
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EU - CLP (1272/2008) - Annex VI - Table 3.2 - Concentration Limits

• Hydrogen	1333-74-0	Not Listed
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EU - CLP (1272/2008) - Annex VI - Table 3.2 - Labelling

• Hydrogen	1333-74-0	F+ R:12 S:(2)-9-16-33
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EU - CLP (1272/2008) - Annex VI - Table 3.2 - Notes - Substances and Preparations

• Hydrogen	1333-74-0	Not Listed
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EU - CLP (1272/2008) - Annex VI - Table 3.2 - Safety Phrases

• Hydrogen	1333-74-0	S:(2)-9-16-33
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Germany

Environment**Germany - TA Luft - Types and Classes**

• Hydrogen	1333-74-0	Not Listed
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Germany - Water Classification (VwVwS) - Annex 1

• Hydrogen	1333-74-0	ID Number 741, not considered hazardous to water
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Germany - Water Classification (VwVwS) - Annex 2 - Water Hazard Classes

• Hydrogen	1333-74-0	Not Listed
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Germany - Water Classification (VwVwS) - Annex 3

• Hydrogen	1333-74-0	Not Listed
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Other**Germany - Specifically Regulated Chemicals in TRGS**

• Hydrogen	1333-74-0	Not Listed
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Portugal**Other****Portugal - Prohibited Substances**

• Hydrogen	1333-74-0	Not Listed
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United Kingdom**Environment****United Kingdom - Pollution Inventory - Schedule 1 - Thresholds for Releases to Air**

• Hydrogen	1333-74-0	Not Listed
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United Kingdom - Substances Contained in Dangerous Substances or Preparations

• Hydrogen	1333-74-0	Not Listed
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Other**United Kingdom - Workplace Exposure Limits (WELs) - Substances in Review**

• Hydrogen	1333-74-0	Not Listed
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United Kingdom - The Red List - Dangerous Substances in Water

• Hydrogen	1333-74-0	Not Listed
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United States**Labor****U.S. - OSHA - Process Safety Management - Highly Hazardous Chemicals**

• Hydrogen	1333-74-0	Not Listed
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U.S. - OSHA - Specifically Regulated Chemicals

• Hydrogen	1333-74-0	Not Listed
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Environment**U.S. - CAA (Clean Air Act) - 1990 Hazardous Air Pollutants**

• Hydrogen	1333-74-0	Not Listed
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U.S. - CERCLA/SARA - Hazardous Substances and their Reportable Quantities

• Hydrogen	1333-74-0	Not Listed
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U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances EPCRA RQs • Hydrogen	1333-74-0	Not Listed
U.S. - CERCLA/SARA - Section 302 Extremely Hazardous Substances TPQs • Hydrogen	1333-74-0	Not Listed
U.S. - CERCLA/SARA - Section 313 - Emission Reporting • Hydrogen	1333-74-0	Not Listed
U.S. - CERCLA/SARA - Section 313 - PBT Chemical Listing • Hydrogen	1333-74-0	Not Listed
U.S. - RCRA (Resource Conservation & Recovery Act) - Basis for Listing - Appendix VII • Hydrogen	1333-74-0	Not Listed
U.S. - RCRA (Resource Conservation & Recovery Act) - Constituents for Detection Monitoring • Hydrogen	1333-74-0	Not Listed
U.S. - RCRA (Resource Conservation & Recovery Act) - List for Hazardous Constituents • Hydrogen	1333-74-0	Not Listed

United States - California

Environment		
U.S. - California - Proposition 65 - Carcinogens List • Hydrogen	1333-74-0	Not Listed
U.S. - California - Proposition 65 - Developmental Toxicity • Hydrogen	1333-74-0	Not Listed
U.S. - California - Proposition 65 - Reproductive Toxicity - Female • Hydrogen	1333-74-0	Not Listed
U.S. - California - Proposition 65 - Reproductive Toxicity - Male • Hydrogen	1333-74-0	Not Listed

United States - Pennsylvania

Labor		
U.S. - Pennsylvania - RTK (Right to Know) - Environmental Hazard List • Hydrogen	1333-74-0	Not Listed
U.S. - Pennsylvania - RTK (Right to Know) - Special Hazardous Substances • Hydrogen	1333-74-0	Not Listed

15.2 Chemical Safety Assessment

- No Chemical Safety Assessment has been carried out.

Section 16 - Other Information

Last Revision Date	• 07/October/2014
Preparation Date	• 07/October/2014
Disclaimer/Statement of	• To the best of Air Liquide's knowledge, the information contained herein is reliable and

Liability

accurate as of this date; however, accuracy, suitability or completeness are not guaranteed and no warranties of any type, either express or implied, are provided. The information contained herein relates only to this specific product. If this gas mixture is combined with other materials, all component properties must be considered. Data may be changed from time to time. Be sure to consult the latest edition.
