

Voltaix, Inc.

Material Safety Data Sheet for Hydrogen (H₂)

Reference: Voltaix, Inc. MSDS Document Number -H000 (revision dated 03 Sept 96)

IN AN EMERGENCY, CALL CHEMTREC at 800-424-9300 (US toll free) or 703-527-3887

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Section 1: *Chemical Product and Company Identification*

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Material Name: Hydrogen.

Chemical Formula: H₂

Synonyms: Protium.

Note: This Material Safety Data Sheet addresses the compressed, gaseous form of this substance, not the refrigerated liquid.

Manufacturer: Voltaix, Inc.:

Post Office Box 5357, North Branch, New Jersey 08876-5357, USA

Voice: 908-231-9060 or 800-VOLTAIX, Facsimile: 908-231-9063

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Section 2: *Composition/Information on Ingredients*

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Component	CAS Registry Number	Molar (volume) concentration	Exposure Guidelines
Hydrogen	1333-74-0	100%	Simple Asphyxiant

Section 3: *Hazards Identification*

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Emergency Overview

Hydrogen is a colorless gas with no odor. It is not toxic; the immediate health hazard is that it may cause thermal burns. It is flammable and may form mixtures with air that are flammable or explosive.

Hydrogen may react violently if combined with oxidizers, such as air, oxygen, and halogens. Hydrogen is an asphyxiant and may displace oxygen in a workplace atmosphere. The concentrations at which flammable or explosive mixtures form are much lower than the concentration at which asphyxiation risk is significant.

NFPA 704 Rating (determined by Voltaix, Inc.):

Health	0
Flammability	4
Reactivity	0
Special	None

Potential Health Effects

Routes of Exposure: Hydrogen is not toxic by any route. Asphyxia may result if the oxygen concentration is reduced to below 18% by displacement.

Lengths of Exposure: None of the available data indicate toxicity for exposures of any duration.

Severity of Effect: No effect identified.

Target Organs: None identified.

Type of Effect: No effect identified.

Signs and Symptoms of Exposure: None identified.

Medical Conditions that may be Aggravated by Exposure: None identified.

Reported Carcinogenic and Reproductive Effects: None known to Voltaix, Inc.

Section 4: *First Aid Measures*

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Asphyxiation

This is the primary health risk.

1. Remove the affected person from the gas source or contaminated area. Note: Personal Protective

Equipment (PPE), including positive pressure, self contained breathing apparatus, may be required to assure the safety of the rescuer. The concentration required for asphyxiation is above the upper flammable limit. A boundary region, in the flammable range, may exist between contaminated and uncontaminated areas. Take appropriate precaution against ignition of the atmosphere in this region.

2. If the affected person is not breathing spontaneously, administer rescue breathing.
3. If the affected person does not have a pulse, administer CPR.
4. If medical oxygen and appropriately trained personnel are available, administer 100% oxygen to the affected person.
5. Summon an emergency ambulance. If an ambulance is not available, contact a physician, hospital, or poison control center for instruction.
6. Keep the affected person warm, comfortable, and at rest while awaiting professional medical care. *Monitor the breathing and pulse continuously.* Administer rescue breathing or CPR if necessary.

Skin Contact

No detrimental effect of skin contact has been reported. Treat thermal burns by assuring that affected area is cool by flushing with cool water, then apply dry sterile dressings. If the patient is burned on the face, neck, head, or chest, assume that the airway may also have been burned and obtain professional medical assistance immediately.

Eye Contact

No detrimental effect of eye contact has been reported.

Ingestion

Ingestion is not an observed route of exposure to gaseous hazardous materials.

Chronic Effects

None is known to Voltaix, Inc.

Note to Physicians:

The combustion product of hydrogen and air is water.

Section 5: Fire Fighting Measures

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Flammability and Explosivity

Flash Point: Not applicable, this material is a gas.

Flammability Limits in Air: 4.0% to 75.0%.

Autoignition Temperature: 500 deg. C (932 deg. F).

Flammability Classification (per 29 CFR 1910.1200): Flammable gas.

Known or Anticipated Hazardous Products of Combustion: None.

Properties that may Initiate or Intensify Fire: Heating cylinder to the point of activation of the pressure relief device.

Reactions that Release Flammable Gases: None known to Voltaix, Inc.

Extinguishing Media

None

Fire Fighting Instructions

The only safe way to extinguish a flammable gas fire is to stop the flow of gas. If the flow cannot be stopped, allow the entire contents of the cylinder to burn. Cool the cylinder and surroundings with water from a suitable distance. Extinguishing the fire without stopping the flow of gas may permit the formation of ignitable or explosive mixtures with air. These mixtures may propagate to a source of ignition.

Excessive pressure may develop in gas cylinders exposed to fire, which may result in explosion, regardless of the cylinder's content. Cylinders with pressure relief devices (PRD's) may release their contents through such devices if the cylinder is exposed to fire. Cylinders without PRD's have no provision for controlled release and are therefore more likely to explode if exposed to fire.

Positive pressure, self-contained breathing apparatus is required for all fire fighting involving hazardous materials. Full structural fire fighting (bunker) gear is the *minimum* acceptable attire. The need for proximity, entry, and flashover protection and special protective clothing should be determined for each incident by a competent fire fighting safety professional.

Section 6: Accidental Release Measures

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Containment

As hydrogen is a gas at atmospheric conditions, the only means of containment is the enclosure of the space into which it is released. Containment is described in [Section 7](#).

Clean Up

Clean up consists of passing the entire gas volume of the enclosure through appropriate exhaust gas treatment equipment (EGTE). Purge the enclosure with a non-reactive gas, such as nitrogen, through the EGTE until an acceptably low level of contamination remains. The primary consideration is flammability.

Evacuation

If the release is not contained in an appropriate device or system, all personnel not appropriately protected (see Section 8) must evacuate the contaminated spaces. Consider evacuation of additional areas, as a precaution against the spread of the release or subsequent explosion or fire.

Special Instructions

None.

Section 7: Handling and Storage

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Handling

Handle this material only in sealed, purged systems. The design of handling systems for hazardous materials is beyond the scope of this MSDS, and should be performed by a competent, experienced professional. Consider the use of doubly-contained piping; diaphragm or bellows sealed, soft seat valves; backflow prevention devices; flash arrestors; and flow monitoring or limiting devices. Gas cabinets, with appropriate exhaust treatment, are recommended, as is automatic monitoring of the secondary enclosures and work areas for release.

Handle sealed gas cylinders in accordance with CGA P-1, *Safe Handling of Compressed Gases in Containers*.

Some material may have accumulated behind the outlet plug. Face the outlet away from you and wear appropriate protective equipment when removing the plug to connect the cylinder to your system.

Never introduce any substance into a gas cylinder. If you believe your cylinder may have been contaminated, notify Voltaix, Inc. immediately. Provide as much information as possible on the nature and quantity of contamination.

Storage

Store cylinders in accordance with CGA P-1, *Safe Handling of Compressed Gases in Containers*, local building and fire codes and other relevant regulations. Materials should be segregated by the hazards they comprise for storage.

Protect the cylinders from direct sunlight, precipitation, mechanical damage, and temperatures above 55°C (130°F).

Ship and store cylinders with the outlet plug and valve protective cap in place.

Section 8: Exposure Control/Personal Protection

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Engineering Controls

Local exhaust is required. Secondary containment, with appropriate exhaust gas treatment, is strongly encouraged and is required in some jurisdictions.

Monitor the work area and the secondary containment continuously for release of the material. Automatic alerting of personnel and automatic shutdown of flow are appropriate in most applications and are required in some jurisdictions.

Purge all primary containment systems with a nonreactive gas, such as nitrogen, before introducing hydrogen.

Personal Protective Equipment (PPE)

Respiratory Protection: Positive pressure, full face, air supplied breathing apparatus should be used for work within the secondary containment equipment if a leak is suspected or the primary containment is to be opened, *e.g.*, for a cylinder change. Air supplied breathing apparatus is required for response to demonstrated or suspected releases from the primary containment.

Eye/Face Protection: When using respiratory protection as described above, use a face mask that provides splash and impact protection for the face and eyes. Otherwise, wear safety glasses.

Skin Protection: Wear appropriate gloves when handling sealed cylinders. Use gloves and other skin protection, as assigned by a competent safety professional, when working within the secondary enclosure with the primary enclosure compromised, *e.g.*, cylinder changing, to protect both from exposure to the material and from fire that may result from its release to the air.

Other Protection: Wear appropriate protective footwear when moving cylinders.

Exposure Guidelines

As hydrogen is a simple asphyxiant, no TLV (ACGIH), PEL (OSHA), or REL (NIOSH) has been established. Workplace concentrations should be controlled to be below the lower flammable limit.

Section 9: Physical and Chemical Properties

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Notes: 1) "N/A" means not applicable.

2) Unless otherwise specified, properties are reported at 0°C (32°F) and 1 atmosphere (1.0 bar, 14.7 psia).

Property	Hydrogen
Appearance	colorless
Odor	none
Physical state	gas
PH	N/A
Vapor Pressure	N/A
Vapor Density	0.082 g/L
Boiling point	-252.9 deg. C (-423 deg. F)
Melting point	N/A
Solubility in water (v/v, at 20 deg C)	0.0182
Specific gravity (liquid)	N/A
Molecular weight	2.02

Section 10: *Stability and Reactivity*

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Chemical Stability: Hydrogen is stable.

Conditions to Avoid: Sources of ignition, exposure to air.

Incompatibility with Other Materials: Oxidizers, including air, oxygen and halogens.

Hazardous Decomposition, Reaction and Oxidation (other than burning) Products: None.

Hazardous Polymerization: Has not been observed.

Section 11: *Toxicological Information*

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Acute Data (by route): None, hydrogen is a simple asphyxiant.

Chronic and Subchronic Data: Hydrogen is listed in RTECS, but no information on its carcinogenicity or other effects is included.

Special Studies: None known.

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Ecotoxicity: None known to Voltaix, Inc.

Environmental Fate: None known to Voltaix, Inc.

Section 13: *Disposal Considerations*

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Classification under RCRA, 40 CFR 261: This material is not listed.

US EPA waste number and descriptions: D001 (ignitability).

Special Instructions and Limitations: Treat process and other exhaust streams appropriately before release to the atmosphere.

Notice: The information above is derived from Voltaix, Inc.'s interpretation of the US federal laws, regulations and policies concerning the material, as shipped by Voltaix, Inc., at the time this MSDS was prepared. Federal controls are subject to change and state and local controls may also apply. Proper waste disposal is the responsibility of the owner of the waste. The user is encouraged to consult with appropriate experts in developing a disposal plan.

Section 14: *Transport Information*

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Basic Description: Hydrogen, Compressed, Division 2.1 (Flammable Gas), UN 1049.

Additional Information for shipment by water: IMDG Page Number 2148.

Additional Information for shipment by air: Transportation by air is permitted in Cargo Aircraft Only.

Section 15: *Regulatory Information*

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TSCA Status: This material is listed on the Inventory of Chemical Substances.

CERCLA Reportable Quantity (40CFR302.40): This material is not listed. The Reportable Quantity (RQ) for "Unlisted Hazardous Wastes Characteristic of Ignitability" (D001) of 45.4 kg (100 lbs.)

therefore applies.

SARA Title III Status (Section 302 (40CFR355), Section 311/312, Section 313 (40CFR372)): No Threshold Planning Quantities (TPQ's) or Reportable Quantities (RQ's) are listed for these substances. The default federal MSDS submission and inventory requirement filing threshold of 4,540 kg (10,000 lbs.) therefore applies.

Note: State and local requirements may be more stringent.

Section 16: *Other Information*

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References

Book of SEMI Standards, Facilities Standards and Safety Guidelines. Mountain View, CA: Semiconductor Equipment and Materials International, 1993.

Borak, Jonathan, M.D., Michael Callan and William Abbott, *Hazardous Materials Exposure: Emergency Response and Patient Care.* Englewood Cliffs, NJ: Prentice-Hall, Inc., 1991.

Braker, William and Allen L. Mossman, *Matheson Gas Data Book (Sixth Edition).* Lyndhurst, NJ: Matheson, 1980.

Documentation of TLV's and BEI's. Cincinnati, Ohio: American Conference of Government Industrial Hygienists, 1992.

Fire Protection Guide on Hazardous Materials. Quincy, MA: National Fire Protection Association, 1993.

Material Safety Data Sheet: Hydrogen. Irvington, NJ: Spectra Gases, Inc., 1992.

Safe Handling of Compressed Gases in Containers (Pamphlet P-1). Arlington, VA: Compressed Gas Association, Inc., 1991.

Revision Indication

International telephone number for Chemtrec revised.

Disclaimer

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