Right to Know

Hazardous Substance Fact Sheet

Common Name: **HYDROGEN**

Synonyms: Molecular Hydrogen; Protium

Chemical Name: Hydrogen

Date: August 2010 Revision: July 2016

CAS Number: 1333-74-0

RTK Substance Number: 1010

DOT Number: UN 1049 (Compressed)
UN 1966 (Refrigerated liquid)

Description and Use

Hydrogen is a colorless, odorless, and tasteless gas that is lighter than air. It is used in making other chemicals, for processing fats and oils, and in welding and cutting metals. *Liquefied* **Hydrogen** is used as a rocket fuel and propellant.

Reasons for Citation

- **Hydrogen** is on the Right to Know Hazardous Substance List because it is cited by ACGIH, DOT, DEP, NFPA and EPA.
- This chemical is on the Special Health Hazard Substance List.

SEE GLOSSARY ON PAGE 5.

FIRST AID

Eye Contact

- Immediately flush with large amounts of water for at least 30 minutes, lifting upper and lower lids. Remove contact lenses, if worn, while flushing. Seek medical attention immediately.

Skin Contact

- Immerse affected part in warm water. Seek medical attention.

Inhalation

- Remove the person from exposure.
- Begin rescue breathing (using universal precautions) if breathing has stopped and CPR if heart action has stopped.
- Transfer promptly to a medical facility.

EMERGENCY NUMBERS

Poison Control: 1-800-222-1222

CHEMTREC: 1-800-424-9300

NJDEP Hotline: 1-877-927-6337

National Response Center: 1-800-424-8802

EMERGENCY RESPONDERS >>>> SEE LAST PAGE

Hazard Summary

Hazard Rating	NJDHSS	NFPA
HEALTH	-	3
FLAMMABILITY	-	4
REACTIVITY	-	0

FLAMMABLE
CONTAINERS MAY EXPLODE IN FIRE
BURNS WITH AN INVISIBLE FLAME

Hazard Rating Key: 0=minimal; 1=slight; 2=moderate; 3=serious; 4=severe

- **Hydrogen** can affect you when inhaled.
- Contact with *liquefied* **Hydrogen** can cause severe burns and frostbite to the skin and eyes.
- Very high levels of **Hydrogen** can decrease the amount of *Oxygen* in the air and cause suffocation with symptoms of headache, dizziness, weakness, loss of coordination and judgment, loss of consciousness and death.
- **Hydrogen** is a FLAMMABLE LIQUID and GAS and a DANGEROUS FIRE HAZARD.

Workplace Exposure Limits

No occupational exposure limits have been established for **Hydrogen**. However, it may pose a health risk. Always follow safe work practices.

- **Hydrogen** decreases the amount of available *Oxygen*. Routinely measure *Oxygen* content to make sure it is at least 19.5% by volume.

Determining Your Exposure

- Read the product manufacturer's Material Safety Data Sheet (MSDS) and the label to determine product ingredients and important safety and health information about the product mixture.
- For each individual hazardous ingredient, read the New Jersey Department of Health and Senior Services Hazardous Substance Fact Sheet, available on the RTK Program website (http://www.state.nj.us/health/workplacehealthandsafety/right-to-know/) or in your facility's RTK Central File or Hazard Communication Standard file.
- You have a right to this information under the New Jersey Worker and Community Right to Know Act and the Public Employees Occupational Safety and Health (PEOSH) Act if you are a public worker in New Jersey, and under the federal Occupational Safety and Health Act (OSHA) if you are a private worker.
- The New Jersey Right to Know Act requires most employers to label chemicals in the workplace and requires public employers to provide their employees with information concerning chemical hazards and controls. The federal OSHA Hazard Communication Standard (29 CFR 1910.1200) and the PEOSH Hazard Communication Standard (N.J.A.C. 12:100-7) require employers to provide similar information and training to their employees.

This Fact Sheet is a summary of available information regarding the health hazards that may result from exposure. Duration of exposure, concentration of the substance and other factors will affect your susceptibility to any of the potential effects described below.

Health Hazard Information

Acute Health Effects
The following acute (short-term) health effects may occur immediately or shortly after exposure to **Hydrogen**:

- Contact with *liquefied* **Hydrogen** can cause severe burns and frostbite to the skin and eyes.
- Very high levels of **Hydrogen** can decrease the amount of *Oxygen* in the air and cause suffocation with symptoms of headache, dizziness, weakness, nausea, vomiting, loss of coordination and judgment, increased breathing rate, loss of consciousness and death.

Chronic Health Effects
The following chronic (long-term) health effects can occur at some time after exposure to **Hydrogen** and can last for months or years:

Cancer Hazard
- According to the information presently available to the New Jersey Department of Health and Senior Services, **Hydrogen** has not been tested for its ability to cause cancer in animals.

Reproductive Hazard
- According to the information presently available to the New Jersey Department of Health and Senior Services, **Hydrogen** has not been tested for its ability to affect reproduction.

Other Effects
- No chronic (long-term) health effects are known at this time.

Medical

Medical Testing
There is no special test for this chemical. However, seek medical attention if illness occurs or overexposure is suspected.

Any evaluation should include a careful history of past and present symptoms with an exam. Medical tests that look for damage already done are not a substitute for controlling exposure.

Request copies of your medical testing. You have a legal right to this information under the OSHA Access to Employee Exposure and Medical Records Standard (29 CFR 1910.1020).

Workplace Controls and Practices

Very toxic chemicals, or those that are reproductive hazards or sensitizers, require expert advice on control measures if a less toxic chemical cannot be substituted. Control measures include: (1) enclosing chemical processes for severely irritating and corrosive chemicals, (2) using local exhaust ventilation for chemicals that may be harmful with a single exposure, and (3) using general ventilation to control exposures to skin and eye irritants. For further information on workplace controls, consult the NIOSH document on Control Banding at www.cdc.gov/niosh/topics/ctrlbanding/.

The following work practices are also recommended:

- Label process containers.
- Provide employees with hazard information and training.
- Monitor airborne chemical concentrations.
- Use engineering controls if concentrations exceed recommended exposure levels.
- Provide eye wash fountains and emergency showers.
- Wash or shower if skin comes in contact with a hazardous material.
- Always wash at the end of the workshift.
- Change into clean clothing if clothing becomes contaminated.
- Do not take contaminated clothing home.
- Get special training to wash contaminated clothing.
- Do not eat, smoke, or drink in areas where chemicals are being handled, processed or stored.
- Wash hands carefully before eating, smoking, drinking, applying cosmetics or using the toilet.

In addition, the following may be useful or required:

- Specific actions are required for this chemical by OSHA. Refer to the OSHA **Hydrogen** Standard (29 CFR 1910.103).
- Before entering a confined space where **Hydrogen** is present, check to make sure sufficient *Oxygen* (19.5%) exists.
- Before entering a confined space where **Hydrogen** may be present, check to make sure that an explosive concentration does not exist.
- Transfer **Hydrogen** from a tanker, tank or cylinder in a closed system, with proper safety relief devices.
- Electrically ground and bond all equipment.
- Purge **Hydrogen** systems with an *inert gas* (such as *Helium*) to remove AIR, OXYGEN, GREASE and/or OILS before **Hydrogen** enters the system.

Personal Protective Equipment

The OSHA Personal Protective Equipment Standard (29 CFR 1910.132) requires employers to determine the appropriate personal protective equipment for each hazard and to train employees on how and when to use protective equipment.

The following recommendations are only guidelines and may not apply to every situation.

Gloves and Clothing

- Avoid skin contact with **Hydrogen**. Wear personal protective equipment made from material which can not be permeated or degraded by this substance. Safety equipment suppliers and manufacturers can provide recommendations on the most protective glove and clothing material for your operation.
- Where exposure to cold equipment, vapors, or liquid may occur, employees should be provided with *insulated* gloves and special clothing designed to prevent the freezing of body tissues.
- Wear protective clothing made of material that does not generate static electricity.
- All protective clothing (suits, gloves, footwear, headgear) should be clean, available each day, and put on before work.

Eye Protection

- Wear non-vented, impact resistant goggles when working with fumes, gases, or vapors.
- Wear a face shield along with goggles when working with corrosive, highly irritating or toxic substances.
- Do not wear contact lenses when working with this substance.

Respiratory Protection

Improper use of respirators is dangerous. Respirators should only be used if the employer has implemented a written program that takes into account workplace conditions, requirements for worker training, respirator fit testing, and medical exams, as described in the OSHA Respiratory Protection Standard (29 CFR 1910.134).

- Exposure to **Hydrogen** is dangerous because it can replace *Oxygen* and lead to suffocation. Only NIOSH approved self-contained breathing apparatus with a full facepiece operated in the positive pressure mode should be used in *Oxygen* deficient environments.

Fire Hazards

If employees are expected to fight fires, they must be trained and equipped as stated in the OSHA Fire Brigades Standard (29 CFR 1910.156).

- **Hydrogen** is a FLAMMABLE LIQUID and GAS that burns with an almost INVISIBLE FLAME.
- **Hydrogen** *fires* can be detected by carefully approaching the area with an outstretched straw broom to make the flame visible.
- Stop flow of gas or use a dry powder extinguisher to get to the place where the flow of **Hydrogen** can be shut off. Allow fire to burn out.
- CONTAINERS MAY EXPLODE IN FIRE.
- Use water spray to keep fire-exposed containers cool.
- **Hydrogen** *gas* is lighter than air and can accumulate in the upper sections of enclosed spaces.
- **Hydrogen** may form an ignitable vapor/air mixture in closed tanks or containers.

Spills and Emergencies

If employees are required to clean-up spills, they must be properly trained and equipped. The OSHA Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120) may apply.

If **Hydrogen** is leaked, take the following steps:

- Evacuate personnel and secure and control entrance to the area.
- Eliminate ignition sources.
- Ventilate area of leak to disperse the gas.
- Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.
- Keep **Hydrogen** out of confined spaces, such as sewers, because of the possibility of an explosion.
- Use water spray to keep containers cool.
- Conduct air monitoring to determine that *Oxygen* levels are above 19.5%.
- It may be necessary to contain and dispose of **Hydrogen** as a HAZARDOUS WASTE. Contact your state Department of Environmental Protection (DEP) or your regional office of the federal Environmental Protection Agency (EPA) for specific recommendations.

Handling and Storage

Prior to working with **Hydrogen** you should be trained on its proper handling and storage.

- **Hydrogen** is extremely FLAMMABLE and can be ignited by the cylinder valve being opened to AIR and by HEAT, SPARKS and STATIC ELECTRICITY.
- **Hydrogen** reacts violently and explosively when mixed with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); ACETYLENE; ETHYLENE; and OXYGEN.
- **Hydrogen** is not compatible with METALS; METAL OXIDES; and METAL SALTS.
- Store under an *inert gas* (such as *Helium*) in a cool, well-ventilated area away from COMBUSTIBLES and protect from temperatures above 122ºF (50ºC).
- Sources of ignition, such as smoking and open flames, are prohibited where **Hydrogen** is used, handled, or stored.
- Metal containers involving the transfer of **Hydrogen** should be grounded and bonded.
- Use explosion-proof electrical equipment and fittings wherever **Hydrogen** is used, handled, manufactured, or stored.
- Use only non-sparking tools and equipment, especially when opening and closing containers of **Hydrogen**.
- **Hydrogen** may accumulate static electricity.
- Protect cylinders from physical damage and do not drag, roll, slide or drop.

Occupational Health Information Resources

The New Jersey Department of Health and Senior Services, Occupational Health Service, offers multiple services in occupational health. These services include providing informational resources, educational materials, public presentations, and industrial hygiene and medical investigations and evaluations.

For more information, please contact:

New Jersey Department of Health & Senior Services
Right to Know Program
PO Box 368
Trenton, NJ 08625-0368
Phone: 609-984-2202
Fax: 609-984-7407
E-mail: rtk@doh.nj.gov
Web address:
http://www.state.nj.us/health/workplacehealthandsafety/right-to-know/

GLOSSARY

ACGIH is the American Conference of Governmental Industrial Hygienists. They publish guidelines called Threshold Limit Values (TLVs) for exposure to workplace chemicals.

Acute Exposure Guideline Levels (AEGLs) are established by the EPA. They describe the risk to humans resulting from once-in-a lifetime, or rare, exposure to airborne chemicals.

Boiling point is the temperature at which a substance can change its physical state from a liquid to a gas.

A **carcinogen** is a substance that causes cancer.

The **CAS number** is unique, identifying number, assigned by the Chemical Abstracts Service, to a specific chemical.

CFR is the Code of Federal Regulations, which are the regulations of the United States government.

A **combustible** substance is a solid, liquid or gas that will burn.

A **corrosive** substance is a gas, liquid or solid that causes destruction of human skin or severe corrosion of containers.

The **critical temperature** is the temperature above which a gas cannot be liquefied, regardless of the pressure applied.

DEP is the New Jersey Department of Environmental Protection.

DOT is the Department of Transportation, the federal agency that regulates the transportation of chemicals.

EPA is the Environmental Protection Agency, the federal agency responsible for regulating environmental hazards.

ERG is the Emergency Response Guidebook. It is a guide for emergency responders for transportation emergencies involving hazardous substances.

Emergency Response Planning Guideline (ERPG) values provide estimates of concentration ranges where one reasonably might anticipate observing adverse effects.

A **fetus** is an unborn human or animal.

A **flammable** substance is a solid, liquid, vapor or gas that will ignite easily and burn rapidly.

The **flash point** is the temperature at which a liquid or solid gives off vapor that can form a flammable mixture with air.

IARC is the International Agency for Research on Cancer, a scientific group.

Ionization Potential is the amount of energy needed to remove an electron from an atom or molecule. It is measured in electron volts.

IRIS is the Integrated Risk Information System database on human health effects that may result from exposure to various chemicals, maintained by federal EPA.

LEL or **Lower Explosive Limit**, is the lowest concentration of a combustible substance (gas or vapor) in the air capable of continuing an explosion.

mg/m^3 means milligrams of a chemical in a cubic meter of air. It is a measure of concentration (weight/volume).

A **mutagen** is a substance that causes mutations. A **mutation** is a change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

NFPA is the National Fire Protection Association. It classifies substances according to their fire and explosion hazard.

NIOSH is the National Institute for Occupational Safety and Health. It tests equipment, evaluates and approves respirators, conducts studies of workplace hazards, and proposes standards to OSHA.

NTP is the National Toxicology Program which tests chemicals and reviews evidence for cancer.

OSHA is the federal Occupational Safety and Health Administration, which adopts and enforces health and safety standards.

PEOSHA is the New Jersey Public Employees Occupational Safety and Health Act, which adopts and enforces health and safety standards in public workplaces.

Permeated is the movement of chemicals through protective materials.

ppm means parts of a substance per million parts of air. It is a measure of concentration by volume in air.

Protective Action Criteria (PAC) are values established by the Department of Energy and are based on AEGLs and ERPGs. They are used for emergency planning of chemical release events.

A **reactive** substance is a solid, liquid or gas that releases energy under certain conditions.

STEL is a Short Term Exposure Limit which is usually a 15-minute exposure that should not be exceeded at any time during a work day.

A **teratogen** is a substance that causes birth defects by damaging the fetus.

UEL or **Upper Explosive Limit** is the highest concentration in air above which there is too much fuel (gas or vapor) to begin a reaction or explosion.

Vapor Density is the ratio of the weight of a given volume of one gas to the weight of another (usually *Air*), at the same temperature and pressure.

The **vapor pressure** is a force exerted by the vapor in equilibrium with the solid or liquid phase of the same substance. The higher the vapor pressure the higher concentration of the substance in air.

Right to Know Hazardous Substance Fact Sheet

Emergency Responders Quick Reference

Common Name: **HYDROGEN**

Synonyms: Molecular Hydrogen; Protium
CAS No: 1333-74-0
Molecular Formula: H_2
RTK Substance No: 1010
Description: Colorless, odorless gas that is lighter than air

HAZARD DATA

Hazard Rating	Firefighting	Reactivity
3 - Health **4 - Fire** **0 - Reactivity** **DOT#:** UN 1049 (Compressed) UN 1966 (Refrigerated Liquid) **ERG Guide #:** 115 **Hazard Class:** 2.1 (Flammable gas)	**Hydrogen** is a FLAMMABLE LIQUID and GAS that burns with an almost INVISIBLE FLAME. **Hydrogen** *fires* can be detected by carefully approaching the area with an outstretched straw broom to make the flame visible. Stop flow of gas or use a dry powder extinguisher to get to the place where the flow of **Hydrogen** can be shut off. Allow fire to burn out. CONTAINERS MAY EXPLODE IN FIRE. Use water spray to keep fire-exposed containers cool. **Hydrogen** *gas* is lighter than air and can accumulate in the upper sections of enclosed spaces. **Hydrogen** may form an ignitable vapor/air mixture in closed tanks or containers.	**Hydrogen** is extremely FLAMMABLE and can be ignited by the cylinder valve being opened to AIR and by HEAT, SPARKS and STATIC ELECTRICITY. **Hydrogen** reacts violently and explosively when mixed with OXIDIZING AGENTS (such as PERCHLORATES, PEROXIDES, PERMANGANATES, CHLORATES, NITRATES, CHLORINE, BROMINE and FLUORINE); ACETYLENE; ETHYLENE; and OXYGEN. **Hydrogen** is not compatible with METALS; METAL OXIDES; and METAL SALTS. Protect cylinders from physical damage and do not drag, roll, slide or drop.

SPILL/LEAKS

Isolation Distance:

Spill: 100 meters (330 feet)

Fire: 1,600 meters (1 mile)

Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.

Use only non-sparking tools and equipment, especially when opening and closing containers of **Hydrogen**.

Metal containers involving the transfer of **Hydrogen** should be grounded and bonded.

Keep **Hydrogen** out of confined spaces, such as sewers, because of the possibility of an explosion.

Conduct air monitoring to determine that Oxygen levels are above 19.5% and that the LEL is not being exceeded.

PHYSICAL PROPERTIES

Odor Threshold:	Odorless
Flash Point:	Flammable gas
LEL:	4%
UEL:	75%
Auto Ignition Temp:	932º to 1,060ºF (500º to 571ºC)
Vapor Density:	0.069 (air = 1)
Vapor Pressure:	1.24 x 10^6 mm Hg at 77ºF (25ºC)
Specific Gravity:	0.07 (water = 1)
Water Solubility:	Very slightly soluble
Boiling Point:	-423ºF (-253ºC)
Freezing Point:	-434ºF (-259ºC)
Molecular Weight:	2.02
Critical Temp:	-400ºF (-239.9ºC)
Expansion Ratio:	1 to 848 (liquid to gas)

EXPOSURE LIMITS

Hydrogen is a simple asphyxiant. Oxygen levels should be 19.5%.

The Protective Action Criteria values are:

PAC-1 = 65,000 ppm PAC-2 = 230,000 ppm

PAC-3 = 400,000 ppm

PROTECTIVE EQUIPMENT

Gloves: Insulated Rubber and Leather

Coveralls: >10% of the LEL use flash protection or turn out gear

Respirator: < *19.5% Oxygen* - SCBA

HEALTH EFFECTS

Eyes: Contact with *liquefied* gas can cause frostbite

Skin: Contact with *liquefied* gas can cause frostbite

Inhalation: Headache, dizziness, weakness, loss of consciousness and death

FIRST AID AND DECONTAMINATION

Remove the person from exposure.

Flush eyes with large amounts of water for at least 30 minutes. Remove contact lenses if worn. Seek medical attention immediately.

Immerse affected part in warm water. Seek medical attention.

Begin artificial respiration if breathing has stopped and CPR if necessary.

Transfer promptly to a medical facility.