



Hydrogen

Product Stewardship Summary

Hydrogen is the most abundant element in the universe, primarily in the form of stars and clouds of gas. It is a component of water, minerals and acids, and it makes up a fundamental part of all hydrocarbons. Hydrogen has many commercial uses. It is used by power generation utilities and manufacturing processes for producing chemicals, foods and electronics. Its role in modifying hydrocarbons makes it critical in chemical and fuel refining processes. Hydrogen is also used as a fuel for space vehicles, rockets and for fuel cell applications.

Chemical Identity

- *Chemical Formula: H₂*
- *Other names: hydrogen gas, gaseous hydrogen, liquid hydrogen*

Uses and Benefits

Hydrogen is used to make a wide variety of products. Oil refineries use hydrogen to convert heavy crude oils into cleaner-burning gasoline and low-sulfur diesel fuels. This use of hydrogen reduces air pollution. It also enables the oil industry to use lower-grade raw materials that may become critical energy sources in the future.

Metal processors and heat treaters use hydrogen to help create bright and shiny stainless steel, which helps them improve product quality and reduce waste. The chemical industry uses hydrogen to make ammonia and other products, and the electronics industry uses it in the process of manufacturing integrated circuits.

Hydrogen fuels space vehicles, and someday hydrogen might fuel your car. Hydrogen offers

advantages as an alternative for today's fossil fuels. It is renewable, abundant, efficient and clean. Hydrogen fuel has no carbon, so it does not emit carbon dioxide or other greenhouse gases. Vehicles can use hydrogen in two ways. One option is to use hydrogen, either alone or in combination with another fuel source, such as compressed natural gas, in an internal combustion engine like the ones we use today. The cleanest option is to use hydrogen to produce electricity in a fuel cell that powers the vehicle. Hydrogen fuel cells produce zero emissions. Numerous fleets of passenger cars, buses, and forklifts are already using fuel cells powered by hydrogen in demonstration fleets around the world.

Physical and Chemical Properties

At standard temperature and pressure, hydrogen exists as a gas. Hydrogen is the lightest of all gases and is 14 times lighter than air. It has no color, odor or taste. It is nontoxic and non-irritating.

Hydrogen is flammable and can burn at concentrations from 4 percent to 75 percent in air. Ignition can occur if hydrogen mixes with

oxygen or air. Hydrogen burns with an almost invisible pale blue flame. Because hydrogen is lighter than air, it disperses rapidly.

We sometimes cool and compress hydrogen into liquid form so it is easier to store and transport. Hydrogen turns to liquid at $-423^{\circ}\text{F}/-253^{\circ}\text{C}$. Next to liquid helium, it is the coldest known fluid.

Health Effects

The primary health effect associated with hydrogen is the possibility that it could displace air in a poorly ventilated or confined space, resulting in asphyxiation. However, because it is flammable at only 4 percent in air, the most important concern is the flammability hazard.

Liquid hydrogen is so cold that contact with skin can result in severe frostbite, skin burns and other tissue damage.

Environmental Effects

We can manufacture and use hydrogen safely without harming the environment. The most economical way to produce hydrogen is by steam reforming natural gas. At high temperatures, steam (water vapor) reacts with the methane in natural gas to produce hydrogen and carbon monoxide. Generating hydrogen from natural gas and using it in a fuel cell can reduce greenhouse gas emissions by over 50 percent compared to gasoline.

Hydrogen is nontoxic, and when released to the environment, it has no detrimental effects. It does not produce harmful emissions or pollute soil or groundwater resources.

Exposure Potential and Risk Management Measures

Industrial Use

We ship hydrogen through pipelines as well as over the road as a high-pressure gas or a cold liquid.

Depending on how much our customer uses, we provide the gas in high-pressure cylinders or tube trailers. Industry guidelines cover the storage and handling of compressed gas cylinders. Workers should use sturdy work gloves, safety glasses with side shields, flame-retardant clothing and safety shoes when handling compressed hydrogen gas cylinders.

We ship liquid hydrogen in vacuum-insulated tanker trailers. Due to the low temperature of liquid hydrogen, transfer lines must also be vacuum-insulated to minimize product lost

through vaporization or the formation of liquid air. Air can be condensed to a liquid at the low temperatures of liquid hydrogen, and this liquid air can be oxygen-enriched. Oxygen enrichment creates a fire hazard since oxygen supports combustion. Insulating the lines avoids the potential cold burns that can occur with even short contact with frosted lines, liquid air condensation or vapor leaks. For workers who handle liquid hydrogen, it is important to wear a full face-shield over safety glasses to protect the eyes and face. Workers should also wear clean, loose-fitting, insulated gloves; fire-retardant clothing; pants without cuffs; and safety shoes.

Exposure Potential and Risk Management Measures (continued)

To lower the risk of fire or explosion and prevent suffocation, it is important to have good ventilation when working with hydrogen. Hydrogen systems should be periodically checked for leaks with leak detection solutions or handheld flammable gas monitors. Other precautions include purging equipment with helium or nitrogen to prevent creating a flammable atmosphere or explosive mixtures of air and hydrogen. In fact, many codes and industry standards require the presence of a purge system when hydrogen is in use.

Consumer Use

Hydrogen is used to produce many consumer products; we generally sell it to industrial manufacturers not to the public. Hydrogen is being considered as a viable alternative fuel for the future. As with any flammable material, care must be taken to reduce the fire risks associated with this unique fuel source.

Regulatory Information

Several regulations govern the manufacture, sale, transportation, use and disposal of hydrogen. These laws vary by country and geographic region. You can find general regulatory information in the Material Safety Data Sheet.

Sources for Additional Information

- [Air Products - MSDS](#)
- [Compressed Gas Association](#)
- [National Fire Protection Association](#)
- [Air Products Safetygrams](#)

Conclusion

A wide variety of industries use hydrogen, and it may someday replace today's fossil fuels. Users can handle hydrogen safely without harming the environment when they follow industry and company guidelines.



Contact Information

Emergency Response System

- Tel 1-800-523-9374
(Continental U.S. and Puerto Rico)
- Tel 1-610-481-7711 (other locations)
- 24 hours a day, 7 days a week
- For assistance involving Air Products and Chemicals, Inc. gases and equipment

Technical Information Center

- Tel 1-800-752-1597 (U.S.)
- Tel 1-610-481-8565 (other locations)
- Fax 1-610-481-8690
- E-mail gasinfo@airproducts.com
- Monday–Friday, 8:00 a.m.–5:00 p.m. EST

We developed this Product Stewardship Summary to give you a general overview of the chemical. This Summary is not meant to provide emergency response or medical treatment information. You can find in-depth safety and health information on the [Material Safety Data Sheet](#) for the product.

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