

Hydrogen Gas Safety Overview



The information presented in this overview is intended to provide general guidance regarding the hazards associated with Hydrogen gas. It is not intended to be a specific written safety procedure for your lab. Specific written procedures are the responsibility of the Principal Investigator. If you have any questions concerning the applicability of any items listed in this overview, contact Risk Management and Safety (RMS at 334-740-9711, or the Principal Investigator (PI) of your laboratory.

Hydrogen is a colorless, odorless, tasteless, flammable nontoxic gas which is flammable over a wide range of concentrations. Some of the unique hydrogen properties that contribute to potential hazards (flammability and explosivity) are:

- Hydrogen is combustible over a wide range of concentrations. At atmospheric pressure, hydrogen is combustible at concentrations from 4% to 74.2% by volume.
- Hydrogen has very low ignition energy.
- Hydrogen burns with a nonluminous flame which can be invisible under bright light.
- Due to its small molecular size, Hydrogen can easily pass through porous materials and has the ability to be absorbed by some containment materials. This can eventually result in loss of ductility or embrittlement (this reduces performance of some containment and piping materials such as carbon steel). Loss of ductility/embrittlement is accelerated at elevated temperatures.

General Precautions When Handling Hydrogen Gas

- Always use regulators that have been designed to be used with hydrogen. Never attempt to repair a regulator or force connections that do not readily fit together. Avoid cracking hydrogen cylinder valves to remove dust or dirt from fittings as this practice (though acceptable for other gases) could result to self-ignition.
- Hydrogen gas cylinders must be secured in an upright position to avoid being knocked over.
- Use leak-checking equipment to periodically check for hydrogen leaks, eliminate from your lab as many ignition sources as possible (e.g. open flames, devices that can spark, sources of static electricity) during manipulation of hydrogen gas.
- Before moving Hydrogen gas cylinders from their secured location, replace regulators with protective valve caps. Never roll, drop or lift cylinders by their protective caps.
- Hydrogen gas cylinders must be separated from oxidizing gases during storage and use by a distance of at least 20 ft (NFPA). Protect cylinders against heat and direct sunlight.
- Hydrogen can leak from apertures through which other gases cannot pass due to its small molecular size. Always ensure that there is adequate ventilation to handle the largest anticipated hydrogen leaks or spills. Ventilation with large quantities of air will dilute small hydrogen leaks to below the lower flammable limit of 4% in air.
- Use of flammable gas detection alarm systems is recommended, place alarms in close vicinity to areas of anticipated leakage. Alarms will be triggered if a specified concentration of Hydrogen

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gas is exceeded providing early warning for possible leaks. Ensure that alarms / flammable gas detection systems are calibrated regularly as per manufacturer's recommendations.

- A flammable gas detector alarm system does not prevent leaks from occurring or indicate what actions to take, lab personnel must be trained by their PI on safe work practices and proper emergence response actions.

Emergency Response

PIs should train individuals using hydrogen in labs to recognize different mechanisms by which hydrogen leaks, how accumulation can occur, and the emergency procedures when there is a suspected or known hydrogen gas leak. AU Emergency and Spill Response Procedures can be found [here](#). The laboratory procedures should address as a minimum the following:

- Know who to Contact - (911, RMS, and the Principal investigator of the laboratory including evening phone number)
- If a leak is detected:
 - Evacuate the immediate area of all non-essential personnel
 - Immediately shut off the hydrogen source and increase indoor ventilation with emergency explosion-proof exhaust fans if possible
 - Notify PI immediately
 - To detect a small local hydrogen fire (the flame is nearly invisible), use a piece of tissue paper on a stick, the paper will readily ignite upon contact with the flame.
- In case of fire:
 - Shut off the hydrogen source if safe to do so
 - Let the fire burn itself out (If the flame is snuffed out, it may reignite and cause greater damage).
 - You may use a water fire extinguisher if you have been trained and if it is safe to do so. You may also use water spray to thermally protect people and equipment if necessary. Note that a venting hydrogen flame cannot be extinguished with water.
 - Execute the emergency plan immediately; this includes calling 911, notifying the PI and other required emergency contacts.

Lessons Learned: Incidents /Near Misses

[Hydrogen Explosion in University Biochemistry Laboratory](#)

[Hydrogen Cylinder Fire in Laboratory](#)

[Hydrogen Cylinder Leak](#)

[Hydrogen Explosion in Microbiological Anaerobic Chamber](#)

[Pressurization of Anhydrous Hydrogen Fluoride Cylinder](#)

[Hydrogen Gas Leak from Compressed Gas Cylinder](#)