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Applicability: Hydrogen Gas Use and Storage in Laboratories

Program

Scope

This document provides a guideline identifying the safety requirements required by Lehigh University Environmental Health and Safety when using hydrogen gas in a laboratory.

Background

Hydrogen is a known flammable gas. Gas mixtures containing hydrogen can also be flammable. The LEL (Lower Explosive Limit) of hydrogen is 4% in air and the UEL (Upper Explosive Limit) is 75% in air.

The use of hydrogen gas in labs must follow the guidance of the Occupational Safety and Health Administration (OSHA) 1910.1450 and other sections related to the materials used in laboratory safety.

Hydrogen Gas Blends

Hydrogen gas mixtures may also require ventilation and gas monitoring depending on the gas it is mixed with and their concentrations.

A mixture of hydrogen gas with a concentration greater than 5 % in nitrogen shall be monitored and treated as a flammable gas.

A mixture of 3% of hydrogen in argon shall be considered flammable and require gas monitoring and ventilation.

A mixture of 4% in hydrogen in helium shall be considered flammable and require gas monitoring and ventilation.

The PEL (Permissible Exposure Limit) and STEL (Short Term Exposure Limit) should be used as setting for lower and upper alarm trigger points.

Ventilation and Gas Supply

When using high purity hydrogen gas, the cylinder will require a ventilated gas cabinet equipped with a gas sensor alarm system that will activate when a gas leak is detected. The gas cabinet will be ventilated and monitored 24/7 by a gas alarm.

Ensuring the gas monitoring system is calibrated and working properly is the responsibility of the PI and the department where the experimental process occurs.

Ventilating a flammable gas requires non-sparking exhaust equipment. The ventilation system should also be grounded.

Piping of hydrogen gas should be stainless steel with a minimum number of fittings (to reduce the chance of leaks).

Hydrogen gas sensor detectors should be located near and above the source.

Automatic shut off valves are to be incorporated on the hydrogen supply line.

If the scale of the experimental process is small enough to fit inside a ventilated hood, hydrogen gas may be used within the hood with a local alarm. In order for this to occur, the PI must be present during the experimental process and the ventilation system must be direct exhaust and non-sparking equipment.

Additional Safety Measures

The entire ventilation system should be bonded and grounded.

Anti- static mats are recommended in front of doorways and lab hoods.

Environmental Health and Safety must be notified if hydrogen gas will be used in the lab.

Only one gas cylinder is allowed for back up gases per laboratory. Back up cylinders containing flammable hydrogen gas must be stored in a ventilated cabinet or hood when in the lab and be must also be monitored by a gas sensor.

Emergency backup generators may be required to continue ventilation if power loss occurs.

Experimental processes where hydrogen is used should shut down if ventilation or continuous power is lost.

Note: The use of hydrogen generators in a lab may eliminate the need for gas monitoring and alarming as the units have internal alarms systems and automatic shutoff.

Maintenance of the Gas Monitoring System

The gas sensors are to be calibrated regularly per the manufacturer's instructions. Equipment is to be installed by trained professionals in the field. Maintenance and associated costs are the responsibility of the PI/department. Maintenance may be conducted by Lehigh personnel provided they are trained on how to conduct the proper maintenance.

Emergency Response

Hydrogen is a very ignitable gas. Hydrogen can ignite in concentrations as low as 4% in air by a spark not visible to the naked eye. Precautions should be taken to ensure non-sparking equipment is used in the

ventilation system. Efforts should be made to ground equipment in the lab. Anti-static mats are also advisable.

When a hydrogen alarm is activated, personnel in the laboratory are to evacuate immediately and follow all instructions documented in the laboratory's Emergency Response Plan. Hydrogen alarms are to be set at 50 PPM for the initial (low) warning and 100 PPM for the (secondary) high warning. (See Note).

Lehigh University Police should respond to any reported hydrogen alarm as the floor where the laboratory is located would need to be evacuated as a precaution.

Note:

Information on alarm settings taken from Industrial Scientific Alarm Setting
<https://www.indsci.com/en/training/general-gas-education/gas-detector-alarm-settings/>