

## Fact Sheet for the Handling and Dispensing of Hazardous Gases.

### Definitions

Hazardous gases: For the purposes of these guidelines gases that are flammable, toxic, corrosive, pyrophoric or oxidizing are considered hazardous gases.

CGA: Compressed Gas Association. A trade organization that promotes industry standards for manufacture, storage, transportation and use of compressed gases. The CGA sets standards for cylinder valve outlet connections.

Two stage regulator: A device that reduces the higher pressure in the gas cylinder to a lower working pressure. Two stage regulators control pressure in two steps allowing precise control of pressure.

Needle valve: A flow regulating device that allows fine control of gas flow and provides a secondary means of gas shut off.

Purge assembly: A valving system that permits the flushing of the regulator and delivery tubing with inert gas.

Flow restricting orifice: A flow limiting devices that restricts the maximum flow out of a compressed gas regulator. These devices are typically critical orifices.

### Procedures and Practices

The use of hazardous gases by University of Pennsylvania Faculty, Students and Staff requires adherence to the following in addition to the Standard Operating Procedures in Appendix F of the Chemical Hygiene Plan.

*EHRS approval:* Use of hazardous gases requires EHRS approval prior to purchase and a final approval of the experimental set up prior to the start of work. Notification is also required if there are significant changes in procedures or amounts of material hazardous gases used.

*Ventilation:* Proper ventilation is required in laboratories using hazardous compressed gases. The presence of a fume hood is mandatory (except for oxygen use) unless a gas cabinet and special local exhaust system or filtering system is used. Contact EHRS to determine if your lab has a ventilation system appropriate for hazardous gas use before purchasing the gas.

*Cylinder Size:* Use lecture sphere or bottle size hazardous gas sources in a returnable cylinder when small volumes are needed. While the initial purchase cost per cubic foot may be lower when hazardous gases are purchased in full sized cylinders the over all cost of experimental setup which may require local ventilation, gas cabinets, stainless steel

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piping and purging systems may offset the apparent saving from buying hazardous gases in full sized cylinders

*Cylinder holders:* All compressed gas cylinders, regardless of size, must be properly secured. Use floor or bench clamps or secure gases to the wall with chains installed by Facilities Services. A single floor or bench clamp may not be used to secure multiple cylinders unless it is designed for multiple cylinder support.

*Regulators:* Gases from full sized gas cylinders must be dispensed using a two stage regulator that is both compatible with the gas and the intended use. The maximum pressure of the second stage of the regulator should be as low as is practical for the intended experimental work. Do not select or reuse existing regulators with very high second stage pressure ranges unless needed since this will require the entire experimental setup (tubing, connections) to be engineered to withstand high pressures.

*Flow control valves:* A mechanical flow control valve (needle valve) that is compatible and properly cleaned for the hazardous gas must be attached directly to the gas out port of the gas regulator. This is required even if other flow control devices are present in the experimental device. Flow control must not be attempted through use of the gas regulator.

*Flow restricting orifices:* Where feasible flow restricting devices must be installed after the regulator. Select the appropriate flow restricting orifice based on gas used and the flow rate required for the research.

*Tubing and piping:* Hazardous gases must be dispensed using systems that are properly cleaned and compatible with the gas in use. Burst pressure of tubing and piping must be twice the maximum pressure on the second stage regulator. Exceptions to this requirement may be made for short sections of tubing when it and the compressed gas cylinder are completely enclosed in a fume hood and low pressures and flow rates are used.

*Purge assembly:* Required for all hazardous gas systems that are not used in a fume hood or other ventilated enclosure. Purge assemblies must exhaust into a fume hood or other approved exhaust system. Exceptions may be made for laser systems that contain small quantities of hazardous gas that will be effectively filtered when exhausted. Exemptions must be approved by EHRS.

*Vacuum pumps:* Hydrocarbon based vacuum pump oil is incompatible with strongly oxidizing and many reactive gases. New vacuum pumps that have inert lubricants such as DuPont Krytox and never contained oil-based lubricants must be used with oxidizing and reactive gases. Vacuum pumps must be securely vented to a fume hood or other approved exhaust system with tubing that is compatible with the gases used. Exhaust lines must be as short as feasible. Vented enclosures may be required for vacuum pumps depending on the toxicity of the gases used.

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*Leak testing:* Hazardous gas systems must be leak tested using inert gas and leak detection solutions such as Snoop(TM) before use.