

WORKING WITH COMPRESSED GASES

1. **Chemical Hazards of Compressed Gases** - Compressed gases expose the worker to both chemical and physical hazards. Safe storage, monitoring for leaks, and proper labeling are essential for the prudent use of compressed gases. If the gas is flammable, flash points lower than room temperature compounded by rapid diffusion throughout the laboratory present the danger of fire or explosion. Additional hazards can arise from the reactivity and toxicity of the gas, and asphyxiation can be caused by high concentrations of even inert gases such as nitrogen. An additional risk of simple asphyxiants is head injury resulting from falls following rapid loss of oxygen from the brain. Death can also occur after asphyxiation if oxygen levels remain too low to sustain life. Finally, the large amount of potential energy resulting from the compression of the gas makes a highly compressed gas cylinder a potential rocket or fragmentation bomb. On-site chemical generation of a gas should be considered as an alternative to use of a compressed gas if relatively small amounts are needed. Monitoring compressed gas inventories and disposal or return of gases not in current or likely future use are advisable to avoid the development of hazardous situations.
2. **Specific Chemical Hazards of Select Gases** - Certain hazardous substances that may be supplied as compressed gases are listed below:
 - a. **Boron halides** are powerful Lewis acids and hydrolyze to strong protonic acids. *Boron trichloride* (BCl_3) reacts with water to give HCl, and its fumes are corrosive, toxic, and irritating to the eyes and mucous membranes.
 - b. **Chlorine trifluoride** (ClF_3) in liquid form is corrosive and very toxic. It is a potential source of explosion and causes deep, penetrating burns on contact with the body. The effect may be delayed and progressive, as in the case of burns caused by hydrogen fluoride. Chlorine trifluoride reacts vigorously with water and most oxidizable substances at room temperature, frequently with immediate ignition. It reacts with most metals and metal oxides at elevated temperatures. In addition, it reacts with silicon-containing compounds and thus can support the continued combustion of glass, asbestos, and other such materials. Chlorine trifluoride forms explosive mixtures with water vapor, ammonia, hydrogen, and most organic vapors. The substance resembles elemental fluorine in many of its chemical properties and handling procedures, which include precautionary steps to prevent accidents.
 - c. **Hydrogen selenide** (H_2Se) is a colorless gas with an offensive odor. It is a dangerous fire and explosion risk and reacts violently with oxidizing materials. It may flow to ignition sources. Hydrogen selenide is an irritant to eyes, mucous membranes, and pulmonary system. Acute exposures can

- d. cause symptoms such as pulmonary edema, severe bronchitis, and bronchial pneumonia. Symptoms also include gastrointestinal distress, dizziness, increased fatigue, and a metallic taste in the mouth.
- e. **Methyl chloride** (CH_3Cl) has a slight, not unpleasant odor that is not irritating and may pass unnoticed unless a warning agent has been added. Exposure to excessive concentrations of CH_3Cl is indicated by symptoms similar to those of alcohol intoxication, that is, drowsiness, mental confusion, nausea, and possibly vomiting. Methyl chloride may, under certain conditions, react with aluminum or magnesium to form materials that ignite or fume spontaneously with air, and contact with these metals should be avoided.
- f. **Phosphine** (PH_3) is a spontaneously flammable, explosive, poisonous, colorless gas with the foul odor of decaying fish. The liquid can cause frostbite. Phosphine is a dangerous fire hazard and ignites in the presence of air and oxidizers. It reacts with water, acids, and halogens. If heated, it will form hydrogen phosphides, which are explosive and toxic. There may be a delay between exposure and the appearance of symptoms.
- g. **Silane** (SiH_4) is a pyrophoric, colorless gas that ignites spontaneously in air. It is incompatible with water, bases, oxidizers, and halogens. The gas has a choking, repulsive odor.
- h. **Silyl halides** are toxic, colorless gases with a pungent odor that are corrosive irritants to the skin, eyes, and mucous membranes. When silyl halides are heated, toxic fumes can be emitted.