

Syracuse University

Laboratory Guidance Document

Toxic Gases

This Laboratory Guidance Document was created by Syracuse University Environmental Health & Safety Services (EHSS) to assist researchers in developing laboratory specific standard operating procedures for the storage and handling of toxic gases.

Potential Hazards:

Exposure to a toxic gas can cause damage to living tissue, the central nervous system, severe illness, and/or death.

- Some toxic gases are not visible, cannot be smelled, have no immediate physiological effects, and therefore are only detected with sensing instruments.
- Some toxic gases will also be flammable, pyrophoric, corrosive, or water reactive. Safe use requires assessing all potential hazards.
- Common laboratory examples of toxic gases include: carbon monoxide, chlorine, nitrogen dioxide and phosgene.

Toxicological Properties:

The following properties should be taken into consideration when handling toxic gases:

1. The **LC₅₀ (lethal concentration)** is the concentration of a chemical or mixture in air as a gas, vapor, or mist that kills 50% of the test animals via inhalation during the observation period. LC₅₀ values are expressed in parts per million (ppm).
NOTE: The LC₅₀ and other toxicology information is found in *Section 11* of the chemical's Safety Data Sheet (SDS).
2. A **Toxic Gas** is any gas that has a median LC₅₀ between 201 and 2,000 ppm by volume in air when administered by continuous inhalation for one hour or less to test animal populations.
3. A **Highly Toxic Gas** is any gas that has a median LC₅₀ between 0 and 200 ppm by volume in air when administered by continuous inhalation for one hour or less to test animal populations.

General Precautions:

Working with any substances of high toxicity requires thorough planning and the consistent application of good work practices and skills to control the hazard while achieving the goal of the experiment.

1. **Training**
The Principal Investigator is responsible for ensuring all personnel under their supervision are aware of the hazards associated with toxic gases, have received appropriate hands-on training, adhere to the laboratory standard operating procedures, and are provided with the appropriate personal protective equipment.
2. **Containment**

All work with toxic gases must be done in a designated area of a laboratory inside of a properly functioning chemical fume hood or with a dedicated exhaust that does not recirculate within the building. Please contact EHSS (315-443-4132 or ehss@syr.edu) for assistance with determining ventilation requirements.

3. Hazard Communication

Clearly label all lines, tubing, vessels, cylinders, and all associated experimental apparatus with the name of the toxic gas that is in use. Post signage to warn laboratory personnel and visitors of the areas or equipment that contain toxic gas.

Personal Protective Equipment (PPE):

In addition to the standard laboratory attire (i.e., long pants and closed toe shoes), the following PPE is recommended:

- ANSI certified (Z87) chemical splash goggles
- Knee-length lab coat
NOTE: A flame resistant (FR) lab coat should be worn when working with toxic gases that are also flammable.
- Nitrile gloves

Best Practices for the Safe Handling of Toxic Gases:

1. Review the Safety Data Sheet (SDS), laboratory standard operating procedure (SOP), and emergency procedures before starting any work requiring a toxic gas.
2. Post a hazard warning label (available from EHSS) and emergency response procedure in all storage and use areas.
3. Leak test toxic gas cylinders upon receipt.
4. Store toxic gas cylinders in a ventilated gas cabinet or fume hood.
5. Conduct experiments requiring the use of a toxic gas inside a fume hood.
6. For operations that cannot be contained inside a fume hood, toxic gas detection alarms may be necessary. Consult with EHSS for more information.
7. Due to their toxic and/or corrosive nature, certain toxic gases require a specialized regulator and supply piping. Consult with the toxic gas supplier for more information.
8. Conduct an apparatus test-run using an inert and non-toxic gas before attaching a toxic gas cylinder.
9. Disconnect the regulator and return the valve protection cap to the cylinder when not in use. Be sure to purge the all lines and the regulator with inert gas prior to disconnecting.

Storage Considerations:

Federal, State, and Local regulations restrict the number of toxic gas cylinders that can be stored in a laboratory. Contact EHSS (315-443-4132 or ehss@syr.edu) for more information.

- Procure and store only the smallest practical quantities for the experiment performed.
- Store toxic gas cylinders in a dry, secure, and well-ventilated area away from ignition and combustion sources.
- Store all cylinders (empty and full) upright and secured by chains, straps, or in racks to prevent tipping/falling.

- Segregate full and empty cylinders and use follow the “first in, first out” inventory control method.
- Store cylinders away from heavily traveled areas and emergency exits.
- Visually inspect stored cylinders on a routine basis; look for indication of leakage and cylinder defects.
- Never attempt to fully empty or “bleed” a compressed cylinder, even inside a fume hood.
- Promptly return empty cylinders to the vendor. Do not purchase non-returnable cylinders.

Disposal and Waste Management:

Liquid or solid hazardous waste byproducts of reactions with toxic gases must be disposed of as hazardous waste.

- Ensure the waste container is fitted with a proper screw cap.
- Place the waste container in the satellite accumulation area in secondary containment and notify the EHSS Hazardous Waste Group at 315.443.9132 for disposal.

First Aid:

The chemical’s SDS should be readily available and used as a reference for determining appropriate first aid measures. The following information provides typical first aid measures recommended for chemical exposures.

1. **Skin Contact:** Remove all contaminated clothing and rinse affected area with water for at least 15 minutes.
2. **Eye Contact:** Flush with water at an emergency eyewash station for at least 15 minutes.
3. **Ingestion:** Seek medical attention immediately.
4. **Inhalation:** Move to fresh air and seek medical attention immediately.

Incident Response:

All laboratory emergencies must be reported to the Department of Public Safety at 315-443-2224.

Additional Resources:

1. United States Department of Labor: [OSHA Health and Safety Topics - Chemical Hazards and Toxic Substances](#)