# University of Arizona

## Flammable Gases Standard Operating Procedure

*[This is a template. Fill in all necessary blanks and delete all highlighted areas when complete. Add any sections necessary for your laboratory. This will be appended to your Laboratory Chemical Hygiene Plan.]*

**Title:**  **Click here to enter the title of your SOP.**

**Approval Holder (AH):** Click here to enter text **Approval #:** Click here to enter text

**Approval Holder Phone Number(s):** Click here to enter text

**Approval Safety Coordinator (ASC):** Click here to enter text

**Approval Safety Coordinator Phone Number(s):** Click here to enter text

**Department:** Click here to enter text

1. **Purpose**

This standard operating procedure (SOP) is intended to provide guidance on how to safely store, handle, use, and dispose of flammable gases in Enter AH’s name’s laboratory. Laboratory personnel should review this SOP, as well as the appropriate Safety Data Sheet(s) (SDSs), before Describe the procedure or process this SOP will address. If you have questions concerning the requirements within this SOP, contact your Approval Holder (AH) or Approval Safety Coordinator (ASC).

1. **Scope**

*[Describe when this SOP applies and to whom this SOP applies.]*

1. **Hazard Description**

*[Describe the hazards presented by the procedure or process this SOP addresses. What makes it hazardous? Provide an example, if applicable.]*



Flammable gases are gases which are ignitable at a concentration in air of ≤13% (v/v), or have a flammable range in air of at least 12 percentage points regardless of the lower flammable limit, at 20 °C and 1 atm. Examples of flammable gases include hydrogen and methane.

1. **Process & Hazard Controls**

*[Describe the steps needed to set up and complete the procedure or process in safe manner following the* [*hierarchy of controls*](https://www.cdc.gov/niosh/topics/hierarchy/default.html)*. Use as much detail as is necessary to ensure all laboratory workers can complete the procedure or experiment safely.]*

* 1. **Elimination/Substitution**

*[Describe any eliminations of hazardous chemicals or processes; alternatively, any substitutions with less hazardous alternatives that could be used to accomplish the task.]*

* 1. **Engineering Controls**

*[Describe any engineering controls (e.g. fume hoods, gas cabinets, local exhausts, blast shields, etc.) that are used to safely accomplish the task.]*

**Fume Hood:** If your protocol does not permit the handling of these materials in a fume hood, contact UA RLSS to determine whether alternative engineering controls are warranted.

**Fume hoods or other RLSS approved local exhaust ventilation are required for flammable gases.**

* 1. **Work Practices**

*[Describe any work practices (e.g. staggering schedules, additional cleaning measures for particulates, etc.) that are used to safely accomplish the task.]*

* Flammable gases must be kept 20 ft or more away from oxidizing gases/oxygen cylinders.
* Mixing of flammable gases and oxygen in secondary containers or in processes is prohibited.
* Purchase flammable gases in lecture bottle or smallest feasible size to reduce the potential hazard.
* Check connections and hoses regularly for leaks using a specific monitoring instrument or soapy water (or equivalent).
  + Gas lines can be tested before use with tools using hydrogen gas to leak test or the bubble method.
  + Never use flames or other means to test for gas leaks in lines or at regulator.
* Only use compatible materials for the gas line: <https://www.mathesongas.com/pdfs/products/Materials-Compatibility-Guide.pdf>
* Replace valve caps when cylinders are not in use or before moving.
* Remove damaged or defective cylinders from service (contact the cylinder vendor for assistance).
* Potential need to use blast shields depending on the process
  1. **Personal Protective Equipment**

*[Describe the personal protective equipment needed to adequately protect laboratory workers when performing the process or procedure addressed by this SOP. Ensure to specify any personal protective equipment beyond the minimum (i.e. safety glasses, lab coat, gloves, long pants and closed-toed shoes).]*

* **Hand and Arm Protection**: Insulated gloves and leather gloves work best, but 100% cotton would also be acceptable.
* **Face and Eye Protection**: Safety glasses are a minimum protection; the use of a face shield with eye protection is strongly recommended to protect both the eyes and face from splashes.
* **Body Protection**: A 100% cotton lab coat is minimal protection; flame-resistant lab coat should be used and is preferred.
  1. **Transportation and Storage**

*[Describe how to safely transport and/or store (e.g. ventilated cabinet, flammable cabinet, under inert blanket, etc.) the hazardous chemical(s) or processes.]*

* Store flammable gases away from combustible materials, oxidizing substances, and ignition sources.
* Flammable cylinders in storage be separated from oxidizing gas cylinders by a minimum distance of 20 feet or by a noncombustible barrier at least five feet high and with a fire resistance rating of least one-half hour.
* Compressed gas cylinders should be double chained to a stable structure such as a wall with no more than three cylinders of equal size secured with a single set of chains. The first chain should be 1/3 from the bottom of the cylinder and the second chain should be 1/3 from the top of the cylinder. Alternatively, use a cylindrical casing to secure the cylinder to the floor next to your experimental setup. Refer to American Society of Mechanical Engineers code for Process Piping, ASME B31.3, to select compliant piping.
* **What not to do:**
  + Do not use table/bench clamps for securing cylinders.
  + Never store cylinders on transportation carts.
  + Remove regulators from cylinders when not in use and replace with the safety cap. Never use a cylinder without a regulator.
  + Never permit the gas to enter the regulator suddenly.
  + Never try to stop a leak between a cylinder such as an flammable gas cylinder.
  + Never strike an electric arc on the cylinder.

1. **Spills, Cleanup & Disposal**

*[Describe how to safely end the procedure or process, clean up the process or spills, and/or dispose of any waste generated.]*

**Spills**

Spill response should always follow the [University Chemical Hygiene Plan](https://rgw.arizona.edu/sites/default/files/cs-univeristy_chemical_hygiene_plan.pdf) Section 8.2. Please find general guidance below:

* Do not attempt to clean up a spill and evacuate the area and follow the procedures in the University Chemical Hygiene Plan section on major chemical spills.
* **Release:** Immediately notify others in the area of the release and evacuate the room. If your lab is equipped with an emergency electrical shutoff, activate it as you exit (Note: this does **NOT** include a circuit breaker, which can arc when switched). Notify your supervisor and call 911 from any campus phone. Report any exposure to UA RLSS 520-626-8620. Remain on-site (at a safe distance) to provide detailed information to first responders.

**Exposure Response** (may vary slightly based on the metal in use; consult SDS prior to use)

|  |  |  |  |
| --- | --- | --- | --- |
| **Inhalation** | **Ingestion** | **Skin Contact** | **Eye Contact** |
| Remove victim to fresh air and keep at rest in a position comfortable for breathing. | Rinse mouth. DO NOT induce vomiting. | Take off immediately all contaminated clothing. Rinse skin with water/shower Wash contaminated clothing before reuse Brush off loose particles from skin. Immerse in cool water/wrap with wet bandages. | Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. |

**Disposal**

* Do not attempt to “empty” or “bleed” a gas cylinder either in the open air, or in a fume hood. Describe person responsible for ensuring full cylinders are ordered and used cylinders are returned promptly to Airgas.
* NOTE: All compressed gas cylinders must be returned to UA Cryogenics when empty or no longer in use. Lecture bottles will be disposed as hazardous waste through UA Risk Management Services hazardous waste.

1. **Enter Additional Section Title**

*[Add as many sections as necessary to adequately describe how to safely perform the procedure or process addressed by this SOP.]*

1. **References:**

* <https://ehs.stanford.edu/wp-content/uploads/sops/Compressed-Gasses.pdf>
* <https://ehs.unl.edu/sop/s-hazards_flam_gases_liq_aeros_risk_min.pdf>
* <https://ehrs.upenn.edu/sites/default/files/2018-02/Acetylene%20Fact%20Sheet.pdf>
* <https://rgw.arizona.edu/sites/default/files/cs-univeristy_chemical_hygiene_plan.pdf>