# University of Arizona

## Flammable and Combustible Metals 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 and combustible metals 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.]*



A combustible material is something that can combust (burn) in air. Flammable materials are combustible materials that ignite easily at ambient temperatures. In other words, a combustible material ignites with some effort and a flammable material catches fire immediately on exposure to flame.

A combustible metal is defined as any metal composed of distinct particles or pieces, regardless of shape, size or chemical composition that will burn. Water applied to alkali metals will result in hazardous decomposition, ignition or explosion. Alkali metals include lithium, sodium, potassium, rubidium, cesium and francium. Also unable to be extinguished normally which may pose hazards in the lab.

A combustible metal dust is a combustible particulate metal that presents a fire or explosion hazard when suspended in air or the process-specific oxidizing medium over a range of concentrations, regardless of particle size or shape. Certain metals undergo dangerous reactions with water, acids, and other chemicals. Some metals are subject to spontaneous heating and ignition. The hazards of an individual metal or alloy can vary widely depending on whether it is a bloc or powder, as well as the particle size and shape that is present. Thermal burns may also occur due to ignition of the metal and liberated hydrogen

The following is a list of elemental metals known to be combustible. Alkali metals such as cesium, francium, lithium, potassium, rubidium, sodium and alloys of:

* sodium
* potassium
* aluminum
* magnesium
* niobium
* tantalum
* titanium
* zirconium

Depending upon the type of metal, metal dust can cause a number of different health effects if it is inhaled, ingested, injected or comes in contact with the skin.

Health hazards associated with combustible metals include, but not limited to:

* Severe skin and eye burns upon contact
* Metals can react with moisture on the skin to produce corrosive hydroxides
* Vapors generated during burning are highly irritating to the skin, eye and mucous membranes

Turnings and chips of combustible metals can ignite and burn with intensity, especially if coated with a petroleum-based oil. With the exception of alkali metals, the larger the product, the smaller the likelihood of ignition. Metal fires caused by combustible dust are extremely dangerous because of the possibility of explosions if the dust becomes airborne and contacts an ignition source. Static electricity provides enough energy for ignition of some types of metal dusts. In addition, water in contact with burning combustible metal will result in an increase in burning intensity and possible explosion. Burning combustible metals can extract water from concrete, intensifying burning to cause spalling and explosion of the concrete.

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.]*

* Where possible, flammable chemicals should be replaced by safer, less flammable ones to reduce the risk of fires. Any substituted material should be stable, non-toxic and should either be nonflammable or have a high flashpoint.
  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.]*

* All operations involving flammable and combustible metals should be carried out in a certified chemical fume hood, glovebox, or a hard-ducted biosafety cabinet to keep airborne level below recommended exposure limits. The fume hood sash must be closed as much as possible.
* A blast shield must be used if there is a risk of explosion or reaction and the fume hood sash is not protective enough.

Contact RLSS for assistance in choosing the correct ventilated device and engineering controls for your specific application.

* 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.]*

* Regular surface cleaning to minimize accumulation of combustible dust is mandatory. The frequency of cleaning is dependent upon the amount of dust accumulated on surfaces. Use only conductive, non-sparking scoops, soft brooms or brushes with natural fiber bristles to sweep surfaces. Ensure cleaning is done on all equipment and in areas where dust accumulation is likely including crevices and joints between walls, ceilings and floors. Do not used compressed air to clean surfaces.
* Keep ordinary combustible materials such as paper and cardboard out of the work area. Maintain a 36” egress path to ensure safe evacuation in case of fire from areas where combustible metals are used.
* Hot work procedures must be followed when open flames, cutting or welding operations, propellant-actuated tools and spark-producing operations are performed in areas where combustible metals are produced, stored, handled or processed.
* Combustible material must be kept more than 10 feet away from any area where sodium or other flammable metals are being used or stored. This includes wads of paper towels, laboratory notebooks and especially flammable solvents.
* It should also be handled in a dry area away form any sinks or other sources of water. Unlike potassium, which usually stays in place when it ignites, sodium has a tendency to melt and blow apart when it reacts with water and starts fires in multiple places.
* Metals like sodium become more reactive as the surface area of the particles increases. Prudence dictates using the largest particle size consistent with the task at hand. For example, use of sodium ''balls" or cubes is preferable to use of sodium "sand" for drying solvents.
* All equipment used to cut or handle sodium must be bone dry and free of all water moisture before use. All equipment and work surfaces must be thoroughly cleaned and decontaminated with isopropanol before storage or reuse.
* Do not heat flammable chemicals with an open flame.
* For highly flammable chemicals, avoid static electricity or hot surfaces as they can serve as ignition sources.
* Do not use electrical devices with cracked or frayed electrical wiring.
* When transferring flammable liquid from a bulk container (generally greater than five gallons), the containers must be electrically bonded and grounded.
* Transfer flammable liquids from containers of five gallon-capacity or less inside a laboratory hood (or other area with similar ventilation) to prevent accumulation of flammable concentration of vapors.
* Keep the containers of flammable chemicals tightly closed at all times when not in use to prevent accumulation of flammable vapors.
* Ensure proper grounding. Be sure to ground metal containers when transferring flammable liquids.
* Do not pierce or burn pressurized containers of flammable aerosols, even after use.
  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**: Nitrile gloves are suitable to protect workers from dermal exposures. When potential exposure to air occurs while working with flammable metals, non-flammable work gloves should be utilized over clean, disposable nitrile gloves.
* **Eye and Face Protection:** Face shield and safety glasses must be used when working with flammable metals.
* **Body Protection**: 100% cotton at minimum; flame-resistant should always be used when working with flammable metal compounds.
* **Respiratory Protection**: Respiratory protection may be required if exposures are not able to be adequately controlled by the use of engineering controls or other means. All uses of respiratory protection require RLSS assessment and consultation (for assessment of work, selection of respirator and filtration, and OSHA-mandated medical clearance and fit testing).
  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.]*

* Sodium must be stored in a closed container under kerosene, toluene, or mineral oil.  
  Contact with water should be avoided because sodium reacts violently with water to form hydrogen (H2) with evolution of sufficient heat to cause ignition.
* Store away from water and moisture. Store away from oxidizing agents. Store away from halogens. Do not store with acids. Do not store near heat sources.

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

Major Spills require the laboratory to be evacuated; follow the [University Chemical Hygiene Plan](https://rgw.arizona.edu/sites/default/files/cs-univeristy_chemical_hygiene_plan.pdf) Section 8.2.

**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. |

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.]*

Reference:

* <https://www.ehs.pitt.edu/sites/default/files/docs/02-005CombustibleMetals.pdf>
* <https://rgw.arizona.edu/sites/default/files/cs-chemical_hazard_class_sop_for_flammables_0.pdf>
* <https://ehs.stonybrook.edu/Sodium%20Handling%20and%20Disposal.pdf>
* <https://ehs.unl.edu/sop/s-fire_safety.pdf>
* <https://ehs.stanford.edu/wp-content/uploads/sops/Flammable-and-Combustible-Liquids.pdf>
* <https://ehs.umich.edu>