Combustible Metals

Standard Operating Procedure

Revision Date: 02/20/23

# Description [Provide additional information as it pertains to your research protocol]

A combustible metal is defined as any metal composed of distinct particles or pieces, regardless of shape, size or chemical composition that will burn. 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. *All laboratory workers must read and understand the*[*Laboratory Emergencies SOP*](https://ehs.umich.edu/wp-content/uploads/2022/05/LaboratoryEmergencyProceduresSOP.docx)*prior to commencing any work in a laboratory.*

The following is a list of metals known to be combustible:

* Alkali metals: Cesium, Francium, Lithium, Potassium, Rubidium, Sodium and alloys of these metals such as
	+ NaK
	+ Aluminum
	+ Magnesium
	+ Niobium
	+ Tantalum
	+ Titanium
	+ Zirconium

## Process [Write the steps for using the chemical in your research protocol]

# Potential Hazards [Provide additional information as it pertains to your research protocol]

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. *Describe the potential hazards associated with exposure to the dust from the specific metal being used. State the route of exposure and when/how it might occur. Hazards will be found in the Safety Data Sheet (SDS). Look for information on whether the metal dust is corrosive, toxic, carcinogenic, pyrophoric, an irritant, etc.*

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.

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. Bars, ingots, heavy castings, thick plates and sheets are virtually impossible to ignite.

Burning combustible metals can extract water from concrete, intensifying burning to cause spalling and explosion of the concrete.

Water applied to alkali metals will result in hazardous decomposition, ignition or explosion. Alkali metals include lithium, sodium, potassium, rubidium, cesium and francium.

# Engineering Controls [Provide additional information as it pertains to your research protocol]

If possible, capture metal dust at the source as it is generated to avoid it becoming airborne and accumulating on surfaces. Any fan or blower associated with the local exhaust ventilation system must be spark-resistant, and the system must be bonded and grounded. Portable vacuum cleaners are not allowed to be used as a primary dust collection system.

Use spark-resistant tools such as spatulas or scoops in areas where combustible metals are used and will generate a fire hazard.

Ground and bond all permanently installed and moveable equipment used for combustible metals. Maintain equipment to minimize the potential for sparking from friction. People handling containers or vessels of combustible metals or dust may also need to be grounded.

Propellant-actuated tools are not allowed in any areas where a dust explosion can occur unless all machinery is shut down, and the area and machinery have been properly cleaned.

In the event of a metal fire, types A, B, and C fire extinguishing agents will react with combustible metals and make the fire worse. Therefore, unique agents such as potassium and sodium are used in type D fire extinguishers to put out fires with combustible metals. Type D fire extinguishers are yellow and have a five pointed star on them. Please call John Hirsch at (734) 647-2059 for an evaluation if you believe you may need this type of fire extinguisher.

In case of fire, activate the nearest fire alarm and proceed to the nearest exit. Use stairs, not elevators, and assist persons with disabilities or special needs. Once outside, meet at designated assembly areas and stay away from building entrance(s). Account for all individuals and re-enter the area only when directed by authorities. ***Note that all unplanned fires, regardless of magnitude, must be reported to U-M Division of Public Safety and Security (DPSS) at 911* *as soon as discovered.***

Only trained employees may extinguish an incipient-stage fire. An incipient-stage fire is defined as a fire that is in the initial or beginning stage and that can be controlled or extinguished by portable extinguishers or small amounts of dry extinguishing agents, without the need for protective clothing or breathing apparatus. To obtain fire extinguisher training, contact Environment, Health & Safety (EHS) Fire Safety Services (FSS) at (734) 647-1143.

State any additional safety equipment that must be used (ex. chemical fume hood, Biological Safety Cabinet (BSC), laminar flow hood, vented ovens, furnaces, glove boxes, etc.). If weighing powder and balance cannot be located in a fume hood or BSC, tare a container then add powder in the hood and cover before returning to the balance to weigh the powder. If this is a new process and the appropriate engineering controls do not seem to be available in the lab, discuss with lab staff whether the process can be done and how to obtain what is needed. If possible, purchase the metal in the smallest practical quantity to reduce the risk of exposure and minimize waste.

# Work Practice Controls [Provide additional information as it pertains to your research protocol]

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. Generally, if the color of the surface beneath the dust is not visible, cleaning is required. Use only conductive, non-sparking scoops, soft brooms or brushes with natural fiber bristles to sweep surfaces. Ensure cleaning is done on all machinery 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. Contact EHS-FSS at (734) 615-6764 regarding the Hot Work permit procedure.

# Personal Protective Equipment [Provide additional information as it pertains to your research protocol]

Primary PPE for performing work that generates combustible dust includes a flame-resistant lab coat, long pants preferably made of cotton or other organic material, closed-toe leather shoes, safety glasses with side shields and a face shield, and gloves made of heat-resistant fabric. Avoid wearing clothing made of wool, silk or synthetic fabrics as they can accumulate high static electric charges. Pant cuffs, sleeve cuffs and open pockets are not advised as they may trap combustible dust. The pant legs must be shingled over the tops of the shoes to prevent accumulation of dust inside them.

**NOTE**: Respirators are masks designed to protect the wearer from specific airborne hazards and are different from surgical masks, which protect the wearer only from splashes and are primarily intended to protect others from infectious aerosols exhaled by the wearer. Respirator use requires employee participation in the Respiratory Protection Program, which involves medical clearance and annual fit testing and training. Contact EHS for an evaluation of your process if there is a potential for inhalation of metal dust.

# Transportation and Storage [Provide additional information as it pertains to your research protocol]

Describe where will you store hazardous materials in the lab, e.g., solvent, acid, or base cabinet, refrigerator, etc. Be aware of incompatibility with other chemicals already in use in the lab. Chemical containers must be labeled with chemical name (& concentration, if diluted) and hazard warnings at a minimum. Describe transportation strategy (use of secondary containers, travel through low-traffic hallways). State chemical segregation strategies (list incompatibles).

# Waste Disposal [Provide additional information as it pertains to your research protocol]

All metal dust, chips, lathe turnings, etc. that are swept up must be placed into metal containers for disposal by EHS Hazardous Materials Management (EHS-HMM). To avoid a potential exothermic reaction, *do not dispose of anything other than the metal waste into the container*. Moisture combined with combustible metal dusts can produce hydrogen gas.

Because most spent, unused and expired chemicals/materials are considered hazardous wastes, they must be properly disposed of. ***Do not dispose of chemical wastes by dumping them down a sink, flushing in a toilet or discarding in regular trash containers, unless authorized by EHS-HMM.*** Contact EHS-HMM at (734) 763-4568 for waste containers, labels, manifests, waste collection and for any questions regarding proper waste disposal. Also refer to the EHS [Hazardous Waste](http://ehs.umich.edu/haz-waste/) Web page for more information.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when handling combustible metals.

# Certification

I have read and understand the above SOP. I agree to contact my Lab Director if I plan to modify this procedure.

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### Major Revisions (Tracking purposes only -- Do not print as part of SOP)

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| Date | Revision |
| 09-13-18 | EHS name and logo were added, updated the formatting, and revised the content under Exposure/Unintended Content (AKJ). |
| 03-04-19 | Reviewed and updated. |
| 02-20-23 | Removed emergency information sections, duplicate of new Laboratory Emergencies SOP. (DML) |