Standard Operating Procedure

Trimethylaluminum (TMA)

**This is an SOP template and is not complete until: 1) lab specific information is entered into the box below 2) lab specific protocol/procedure is added to the protocol/procedure section and
3) SOP has been signed and dated by the PI and relevant lab personnel.**

Print a copy and insert into your *Lab-Specific Chemical Hygiene Plan*.

**Section 1 – Lab-Specific Information**

| **Building/Room(s) covered by this SOP:** | Click here to enter text. |
| --- | --- |
| **Department:** | Click here to enter a date. |
| **Principal Investigator Name:** | Click here to enter text. |
| **Principal Investigator Signature:** | Click here to enter text. |

**Section 2 – Hazards**

**Signal Word: Danger**

Trimethylaluminum (TMA) is a highly pyrophoric (flammable corrosive) liquid and vapor. Pyrophoric materials spontaneously ignite when exposed to air. Additional hazards include corrosivity, water reactivity, peroxide formation, toxicity, damage to the liver, kidneys and central nervous system.



**Section 3 – Personal Protective Equipment (PPE) and Engineering Controls**

**Skin and Body Protection:** Flame resistant laboratory coats must be worn and be appropriately sized for the individual and buttoned to their full length. Personnel must also wear full length pants, or equivalent, and close-toed shoes. Full length pants and close-toed shoes must be worn at all times by all individuals that are occupying the laboratory area. The area of skin between the shoe and ankle must not be exposed. If working with large quantities of material, a chemical-resistant apron must be worn over the fire-resistant lab coat.

**Engineering Controls:**

Use of the chemical TMA must be conducted and transferred in a properly functioning chemical fume hood with the sash at the certified position or lower. The chemical fume hood with sash must be approved and certified by REM and have a face velocity between 0.3 to 0.5 m/s. The hood flow alarm should be checked to be operating correctly prior to using the hood.

Efforts to prevent ignition of open TMA may include utilizing a glove box with an inert gas or ensuring that the TMA doesn’t come into contact with the atmosphere through a properly designed, rated, and approved reactor, such as an atomic layer deposition reactor.

**Hygiene Measures:** Wash thoroughly and immediately after handling. Remove any contaminated clothing and wash before reuse.

**Hand Protection:**

Hand protection requirements for the use of solid pyrophoric chemicals outside an inert glove box include wearing/donning the appropriate chemical resistant out gloves (Neoprene) and fire resistant (FR) inner gloves/liners. Gloved or glove liners composed of the tight weave, inherently flame-resistant materials Kevlar, Nomex, Kerinel, or PBI, or blend of those materials, of sufficient thickness to prevent or minimize burn injuries to the extent feasible. Gloves or glove liners meeting MIL-DTL-81188C are also acceptable.

Gloves must be worn. Nitrile gloves are recommended and have been shown to provide excellent protection against trimethylaluminum. The user should wear two pairs of gloves as a precautionary measure. **NOTE:** Consult with your preferred glove manufacturer to ensure that the gloves you plan on using are compatible with the specific chemical being used.

**Eye Protection:** ANSI Z.87.1-1989 standard approved properly fitting safety glasses or chemical splash goggles are required whenever handling pyrophoric chemicals. A face shield may also be appropriate (8-inch minimum). A face shield is required any time there is a risk of explosion, large splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals with this risk should occur in a fume hood with a sash in the lowest feasible position.

**Skin and Body Protection:**

A flame-resistant lab coat must be worn and be appropriately sized for the individual and buttoned to their full length. Laboratory coat sleeves must be of sufficient length to prevent skin exposure while wearing gloves. Personnel must also wear full length pants, or equivalent, and close-toed shoes. Full length pants and close-toed shoes must be worn at all times by all individuals that are occupying the laboratory area. The area of skin between the shoe and ankle must not be exposed. A chemical-resistant apron worn over the lab coat is required for working with large quantities.

**Respiratory Protection:** If TMA is being used outside of a chemical fume hood, respiratory protection may be required. If this activity is necessary, contact REM (4-6371) so a respiratory protection analysis can be performed. Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ADEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

**Section 4 – Special Handling and Storage Requirements**

As TMA’s most dangerous property is its pyrophoric nature, the information regarding safe handling and storage requirements listed below will mainly cover how to handle pyrophoric materials like TMA. Extra care must also be given as TMA is a known corrosive and toxic if ingested. **Note: TMA will ignite violently upon exposure to atmosphere.**

**Special Handling**

* A “dry run” of the entire experiment should be preformed with low-hazard chemicals, such as water, if appropriate.
* If possible only handle under inert gas, a glove box, so that it isn’t exposed to air.
* Ensure that both your skin and eyes are fully covered when handling TMA.
* Limit the amount of TMA purchased so there is no accumulation within the lab.
* A Standard Operating Procedure (SOP) should be made and reviewed for the entire process from extracting the TMA, preforming the experiment, to finally re-storing it.
* The SDS for TMA must be reviewed by everyone working in the lab with you.
* Always work with at least one other person when handling TMA.
* All glassware used must be oven-dried to eliminate moisture.
* Secure all containers with TMA upright.
* All expired TMA should be immediately disposed as hazardous waste. **Don’t attempt to use it in an experiment.**
* Never try to return excess chemical to original container as there may be impurities.
* Before starting the experiment review the location of safety shower, eyewash, telephone, and fire extinguisher.

**Storage Requirements**

* TMA should be kept under an inert atmosphere of inert gas a cool as its air sensitive.
* It should be kept in a dry place away from other incompatible chemicals like flammables, water, or other oxidizers.
* Avoid storing in areas of heat/flames.
* TMA should be kept in a tightly sealed container that is upright
* All containers with TMA must be labeled with original manufacturer’s label with the: the chemical name, hazard labels, and pictograms.

**Section 5 – Spill and Accident Procedures**

If the spill is manageable (i.e. a small spill within a glove box under inert atmosphere or in fume hood with no secondary fires), evacuate all persons from the lab not wearing protective equipment. Remove ignition sources from point of spill. Coat spill with dry lime, sand or soda ash and place in a container for disposal. Ventilate area after clean-up. Treat cleanup materials as hazardous waste. DO NOT use water to clean up spill.

Contact REM at 49-40121 (M-F, 7AM – 4PM) for spill cleanup assistance, or 911 for after hours.

If the spill is large or there is a resulting fire from the spill, immediately evacuate the area, warn others, and pull a fire alarm and **dial 911**. If personnel have become exposed and require medical assistance, **dial 911**.

**Section 6 – Waste Disposal Procedures**

Hazardous waste should be stored in closed, labeled containers in a designated area, away from incompatible materials including aqueous solutions. A flammable cabinet is recommended.

Small remainders of unused TMA must be destroyed by careful quenching in an inert atmosphere. Transfer the small amount of material to a designated reaction flask. Dilute the pyrophoric compound in an unreactive solvent such as heptane or toluene and cool with dry ice. Slowly add isopropanol then methanol to ensure complete quenching. Finally, add a small volume of water dropwise to ensure the TMA is fully quenched.

Double bag dry waste from a spill in transparent bags and dispose with hazardous waste.

Cylinders originally containing TMA must be rinsed 3 times with an inert dry solvent, which must resultingly be quenched and treated as hazardous waste.

To arrange for disposal by REM, complete a Chemical Waste Pickup Request Form: <http://www.purdue.edu/ehps/rem/hmm/chemwaste.htm>.

**Section 7 – Protocol/Procedure (Add lab specific Protocol/Procedure here)**

**NOTE:** Any deviation from this SOP requires approval from Principal Investigator.

**Section 8 – Documentation of Training (signature of all users is required)**

Prior to conducting any work with pyrophoric material, the Principal Investigator must ensure that all laboratory personnel receive training on the content of this SOP.

**I have read and understand the content of this SOP:**

| **Name** | **Signature** | **Date** |
| --- | --- | --- |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
| Click here to enter text. |  | Click here to enter a date. |