General Use Standard Operating Procedure (SOP)

Water-Reactive Chemicals

Flammable

Globally Harmonized System pictogram Indicating a chemical is a flammable hazard.

*Globally Harmonized System Hazard Class: Substances and mixtures which in contact with water, emit flammable gases*

*Examples: Alkali metals (e.g. sodium, potassium, lithium), Alkali metal hydrides (e.g. lithium hydride, lithium aluminum hydride),* *Alkali metal amides (e.g. lithium amide, sodium amide),* *Metal alkyls (e.g. methyllithium, trimethylaluminum), alkaline earth metals (e.g. strontium, calcium, magnesium), Grignard reagents (e.g. ethylmagnesium chloride),* *Halides of nonmetals (e.g. phosphorus pentachloride, silicon tetrachloride),* *Phosphorus pentoxide, Calcium carbide*

**Note**: This SOP is intended to provide general guidance on how to safely work with water reactive chemicals and only addresses safety issues specific to water reactive chemicals. Other hazard classes may also apply. Review Safety Data Sheets (SDS) and refer to other general use SOPs relevant to the chemical you are working with. Contact the Principal Investigator/ Laboratory Supervisor or the WSU Chemical Hygiene Officer for questions concerning the applicability of any item listed in this SOP (OEHS: 313-577-1200).

**If the chemical of interest is a particularly hazardous substance or a high risk chemical a lab specific SOP is required.**

# Hazard Description

Water-reactive chemicals are solid or liquid chemicals which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. The flammable gases may form explosive mixtures with air which are easily ignited by ordinary sources of ignition, for example sparking tools or light bulbs. The resulting blast wave and flames may be hazardous to people and the environment. *(OSHA 1910.1200 App B Physical Hazard Criteria)*

* May ignite, react vigorously, or explosively on contact with water or moist air.
* May re-ignite after fire is extinguished.
* Inhalation or contact with vapors, substance or decomposition products may cause severe injury or death.
* Contact with water or fire may produce irritating, corrosive and/or toxic gases.

# Control of Hazards – General

* All Laboratory personnel who directly use water-reactive chemicals must be provided hands-on training by the Principal Investigator or a knowledgeable lab representative.
* Before working with these compounds, read the Safety Data Sheet (SDS) and other reference material carefully. Some manufacturers identify these hazards in section 2.3 of the Safety Data Sheet, after other hazard and precautionary statements. Look there for statements such as “Reacts violently with water” and/or “contact with water liberates flammable gas”.
* Purchase and use minimal amounts of water-reactive materials.
* Select less hazardous chemicals whenever possible.
* Examine storage containers frequently.
* Ensure sufficient protective solvent, oil, kerosene, or inert gas levels are maintained in the chemical container in which water reactive material is stored.
* Dispose containers that exhibits salt build up on its exterior.
* Prior to working with any water reactive chemicals, identify which gas may be formed in case of exposure to water and learn the risks associated with this gas.
* Work away from water sources or potential water splashes.
* If working with solvents, use a fresh supply of dry solvent.
* The reaction rate of solid material (and therefore heat and gas generation) depends on the material's surface area. Therefore, smaller particle size increases the hazards associated with these materials.
* Remove any flammables (squirt bottles, solvents, oil bath) and combustibles (Kimwipes, paper towels) from the area that will be used for the quenching.
* Before conducting the actual procedure, always perform a dry run (without the water reactive material) to identify and resolve possible safety hazards.
* Design a quenching scheme for residual materials prior to using water reactive chemicals. Refer to product SDS for quenching guidelines.
* **NEVER** return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.
* **NEVER** leave a container with a residue of water-reactive chemical open to the atmosphere.
* All material (e.g. needles, spatulas, wipes, and tools) that have been contaminated with water-reactive chemicals shall be stored in an inert atmosphere or shall be neutralized/quenched in accordance with the SDS guidelines and the laboratory-specific instructions.
* Work within sight and/or hearing of at least one other person who is familiar with the hazards and written procedures.
* **DO NOT** use water to put out fire; instead use a dry chemical extinguisher. Consult with OEHS
* Conduct a hazard assessment to identify proper use and handling techniques, fire safety, storage, and waste disposal issues specific to the chemical being used.

# Engineering/Ventilation Controls

* If at all possible, work under an inert atmosphere (e.g. argon, nitrogen), preferably in a glove box.
* If a glove box is unavailable or impractical, work in a clean chemical fume hood. For hoods with a horizontal sliding sash, position the sash all the way down, stand behind the sliding windows and reach around to perform the manipulations required. For hoods with vertical sliding sash, keep the sash as low as possible.
* Use a blast shield if available.
* A safety shower and eyewash must be available and accessible when working with water reactive chemicals.

# Personal Protective Equipment

In addition to proper street clothing (long pants or equivalent that cover legs and ankles, close-toed non-perforated shoes that completely cover the feet), wear the following Personal Protective Equipment (PPE) when performing lab operations/tasks:

* Safety glasses (If splash potential exists, use goggles + face shield instead)
* Lab coat.
  + Hazard assessment of procedures may indicate the need for a flame resistant lab coat, such as Nomex.
* Appropriate chemical‐resistant gloves. Refer to Section 8 “Exposure controls/personal protection” of SDS or a glove selection guide (e.g. [Ansell Chemical Protection Guide](https://www.ansellguardianpartner.com/chemical/home#hp)) to identify appropriate glove type.

# Special Handling Procedures and Storage Requirements

* There are two basic techniques to transfer liquid water reactive chemicals: the syringe and the cannula needle (overpressure transfer). The syringe must only be used for small quantities (less than 20 mL). To conveniently transfer 20 mL or more of reagent, the cannula technique must be used.
* Store upright & tightly closed in a desiccator, glove box, or some other dry place (in secondary container) away from water/humid environments, heat sources, and any other chemically incompatible material.
* Store alkali metals under mineral oil to prevent reaction with moisture in the air.
* Keep liquid water reactive chemicals under inert atmosphere when not in use.
* Many chemicals that fall within this class are incompatible with most other hazard classes so it is advisable to keep them segregated from all other chemicals.
* Do not store in the same room/cabinet as flammable liquids. (OSHA Standard 1910.106(d)(7)(iv)).
* These materials should not be stored near any water source such as a sink, safety shower, eyewash, or out in the open on a lab bench.
* Many water reactive chemicals will come from the manufacturer in plastic bags or metal cans; it is best to keep the reagents inside of these secondary containers even when these materials are designated for a hazardous waste pickup.

# Decontamination Procedures

* Avoid using water. Please review the chemical Safety Data Sheet for guidance on cleaning specific materials.

# Waste Disposal

After quenching/stabilizing the material, dispose IMMEDIATELY as chemical waste through OEHS.

Water-reactive chemicals must **NOT** be allowed to accumulate.

Do not dispose of waste by dumping down a drain or discarding in regular trash containers, unless authorized by OEHS. [Submit requests to OEHS](https://research.wayne.edu/oehs/forms/chem-waste) for waste containers, labels, and waste collection. Also, refer to the [OEHS Hazardous Waste Management web page](http://research.wayne.edu/oehs/hazardous/index.php) and [WSU Chemical Hygiene Plan](http://research.wayne.edu/oehs/pdf/chemical-hygiene-plan.pdf) for more information.

# Spill procedures

1. **Spills**

For hazardous material spills or releases which have impacted the environment (via the storm drain, soil, or air outside the building) or which cannot be cleaned up by local personnel due to size of spill, hazard level, or hazards are unknown:

* 1. Call WSU Police (313) 577-2222. Available 24 hours a day, 7 days a week.
  2. Evacuate the spill area
  3. Post someone or mark-off the hazardous area with tape and warning signs to keep other people from entering.
  4. Remain in the vicinity until emergency personnel arrive and provide them with information on the chemicals involved.

For additional information regarding spill response procedures, refer to the [OEHS chemical spill response guidelines](http://research.wayne.edu/oehs/chemical/spills), [WSU Chemical Hygiene Plan](http://research.wayne.edu/oehs/pdf/chemical-hygiene-plan.pdf) and [American Chemical Society (ACS) guide for chemical spill response](https://www.acs.org/content/acs/en/about/governance/committees/chemicalsafety/publications/guide-for-chemical-spill-response.html).

1. **Small Spills**

In the event of a minor spill or release that can be safely cleaned up by local personnel using readily available equipment (e.g. absorbent materials) and appropriate PPE:

* 1. Alert personnel in the immediate area of spill and restrict access.
  2. Eliminate all sources of ignition.
  3. Increase ventilation in area of spill (turn on fume hood and open sash, open windows). Vent vapors to outside of building only.
  4. Review the SDS for the spilled material, or use your knowledge, to assess the hazards and to determine the appropriate level of protection.
  5. **DO NOT** clean up spills requiring respiratory protection. Contact OEHS for help (313-577-1200)
  6. Choose appropriate personal protective equipment (e.g. goggles, face shield, chemical resistant gloves, lab coat or apron).
  7. Protect floor drains, sinks or other potential avenues of environmental release as much as possible. Make a dike around the outside edges of the spill using absorbent materials.
  8. **NEVER** use water to cover the spills of water reactive materials.
  9. Spill control and cleanup materials should be non-combustible and inert (will not react with the spilled water reactive chemical).
  10. For solid spills: Use a scoop and brush or other suitable non-combustible items to collect spilled material. Minimize dust generation.
  11. For liquid spills: Cover the liquid with appropriate non-combustible absorbent material (NO paper towel), working from the spill's outer edges toward the center.
  12. Collect spill cleanup materials using a scoop or other suitable items and place in a tightly closed hazardous waste container.
  13. After spilled material is removed, decontaminate surfaces with water or other appropriate solvent.
  14. Place all contaminated materials, including contaminated items such as gloves, in the hazardous waste container.
  15. Label waste container with completed hazardous waste tag (available from OEHS).
  16. Submit online [waste pickup request](https://research.wayne.edu/oehs/hazardous/chemical-waste.php) to OEHS.

# Emergency Procedures

**\*\*If medical attention required, call WSU police (313-577-2222) immediately\*\***

* **Fire Extinguishers** – Refer to section 5 of the SDS for chemical specific firefighting measures. Both ABC dry powder and carbon dioxide extinguishers are appropriate for most fires.
* **Eyewash/Safety Showers** – Depending on the chemical hazard type, an ANSI approved eyewash station and safety shower may be required, easily accessed, and available within 10 seconds travel time for emergency use. Instruct personnel on the locations of eyewashes and safety showers, and how to activate them, prior to an emergency. Refer to [MIOSHA Fact Sheet: Eyewashes and Safety Showers](https://www.michigan.gov/documents/lara/lara_miosha_cet0199_628109_7.doc) to determine if an eyewash/safety shower is required for your specific chemical.

Please note: Additional hazards present in the laboratory may require that an eyewash or safety shower be present. This emergency equipment is required for treating exposures to workplace hazards such as chemical splashes, biological agents, welding sparks, metal shavings, or fine particulates like dust, dirt and sand.

1. **Health Threatening Emergencies**
   1. **Fire, explosion, health threatening hazardous material spill or release, compressed gas leak, or valve failure.**
      1. Call WSU Police (313) 577-2222.
      2. Alert people in the vicinity and activate the local alarm systems.
      3. Evacuate the area and go to your Emergency Assembly Point.
      4. Remain nearby to advise emergency responders.
      5. Once personal safety is established, call OEHS at (313) 577-1200.

Note: For compressed gas leaks, shut off gas supply only if this can be done safely, without risk to personnel.

* 1. **Injuries and Exposures:** 
     1. Remove the injured/exposed individual from the area, unless it is unsafe to do so because of the medical condition of the victim or the potential hazard to rescuers.
     2. Call WSU Police (313) 577-2222.
     3. Administer first aid as appropriate.
        1. Eye contact: Promptly flush eyes with copious amounts of water for a prolonged period (at least 15 minutes). Seek medical attention.
        2. Ingestion: Seek medical attention IMMEDIATELY. See first aid section of chemical Safety Data Sheet.
        3. Skin contact: Remove any contaminated clothing. IMMEDIATELY flush contamination from skin using the nearest emergency shower for a minimum of 15 minutes. Seek medical attention.
        4. Inhalation: Get to a source of fresh air. Seek medical attention.
     4. Call OEHS (313) 577-1200, to report the exposure and complete [Report of Injury](https://risk.wayne.edu/files/rofi.pdf) form.
     5. Bring to the hospital copies of the Safety Data Sheets for all chemicals to which the victim was exposed.

1. **Non-Health Threatening Emergencies**
   1. **Injuries and Exposures**

For injuries and exposures that are not considered serious or a medical emergency, visit:

Henry Ford Occupational Health – Harbortown

3300 East Jefferson, Suite 100

Detroit MI 48207

(313) 656-1618

Monday – Friday 8:00 AM to 6:30 PM

If Henry Ford Occupational Health Center is closed or for serious injuries, visit:

Henry Ford Hospital – Emergency Room

2799 W. Grand Blvd.

Detroit MI 48202

(313) 916-8742

OR

Detroit Receiving Hospital - Emergency Room

4201 St. Antoine St, Detroit, MI 48201

Phone: (313) 745-3000

# Minimum Training Requirements

1. **General Training:**

* Online through the [Collaborative Institutional Training Initiative (CITI)](https://about.citiprogram.org/en/homepage/).
  + Laboratory Safety Training (general lab & chemical safety issues) and Hazard Communication
* [Fire Safety](https://risk.wayne.edu/fire-safety).

1. **Laboratory Specific Safety Training:**

* [Laboratory-Specific Safety Training](https://research.wayne.edu/oehs/docs/lab-safety-training-checklist.doc) checklist
* Review of SDS for chemicals involved in process/experiment.
* Review of this SOP.
* Review [WSU Hazardous Waste Management](https://research.wayne.edu/oehs/hazardous/chemical-waste) guidelines.
* Other: \_\_\_\_\_\_\_\_\_

# Laboratory Personnel Review

Prior to initiating work, lab personnel using these types of chemicals must complete the table below confirming that they have read and understood the above SOP and the associated hazards.

| **Name** | **Signature** | **Date** |
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