GUIDELINES FOR THE SAFE USE OF PYROPHORIC LIQUID REAGENTS

Pyrophoric liquid reagents are substances that spontaneously ignite when exposed to air and/or moisture. These reagents are commonly utilized in chemical synthesis and catalysis. Pyrophoric liquid reagents include, but are not limited to:

- Alkylaluminum reagents
- Alkylmagnesium reagents (Grignard reagents)
- Alkyl-, alkenyl-, alkynyl-, and aryllithium reagents
- Alkylzinc reagents

Due to high reactivity with air and water, pyrophoric liquid reagents are often stored in organic solvents (e.g. hexane, heptane, toluene, ethyl ether, tetrahydrofuran). Extreme caution must be used when handling pyrophoric liquid reagents, and exposure to oxygen and moisture must be avoided. This information is intended to provide basic guidance for the safe use of pyrophoric liquid reagents. Review of specific Safety Data Sheets, review of intended use, and documented proficiency in the safe use of pyrophoric liquid reagents are also essential.

1. Hazards

Pyrophoric liquids are highly reactive, and exposure to pyrophoric liquid reagents can be potentially fatal. Flammability, corrosivity, toxicity, and peroxide formation are also hazards that are associated with pyrophoric liquids.

Health hazards during exposure may include (but are not limited to):

1.1 Severe skin corrosion and eye damage

1.2 Drowsiness and/or dizziness

1.3 Kidney, liver, and central nervous system damage from prolonged or repeated exposure

1.4 Potential damage to fertility or unborn child

2. Safety Precautions

2.1 Employees who work with pyrophoric liquid reagents must receive training on the associated hazards and what to do in the event of an exposure or a spill. A Safety Data Sheet (SDS) should be kept in the immediate work area where pyrophoric liquid reagents are used. The SDS, along with this Guideline and the specific experimental procedure, should be used for training employees on the hazards of pyrophoric substances.

2.2 Work with pyrophoric liquid reagents should always be performed inside a certified chemical fume hood or approved glove box. Care must be taken to clear the working area of aqueous solutions, oxidizers, and other incompatible substances.

2.3 Safety glasses (or chemical splash goggles) along with a face shield must be worn when handling pyrophoric liquid reagents. The use of a face shield provides added splash protection in the event of an unintended release during handling or transfer.

2.4 A flame-resistant lab coat is required when handling pyrophoric liquid reagents, and a chemical-resistant and flame-resistant apron is required to be worn over the lab coat when working with large quantities. Consult EH&S (412-624-9505) for lab coat and apron selection. Strict adherence to the University's Lab Attire Guidelines (EH&S Guideline # 03-001) is necessary when handling pyrophoric liquid reagents. Never wear shorts, skirts above the knee or open-toed shoes when handling pyrophoric liquid reagents or other laboratory chemicals.

2.5 Compatible gloves are recommended when working with pyrophoric liquid reagents in small quantities. Depending on reagent quantity and/or the type of solvent, heavier gloves may be required. Consult the specific reagent SDS for proper glove selection. If you have any questions about glove selection, contact EH&S.

2.6 If gloves become contaminated with pyrophoric reagents, remove them immediately (do not place the gloves near any combustible materials), thoroughly wash your hands, and check your hands for any sign of contamination.

2.7 An eyewash and safety shower must be nearby and accessible when handling pyrophoric liquid reagents. If exposure to a pyrophoric liquid reagent occurs, immediately rinse the exposed area for at least 15 minutes. Seek additional medical attention immediately after the water rinse. Call Pitt Police at 412-624-2121.

2.8 The handling and transfer of pyrophoric liquid reagents must be conducted using a published setup under an inert atmosphere of nitrogen. If handling these reagents in a fume hood, a Schlenk line (vacuum gas manifold) setup is recommended. Refer to Sigma-Aldrich Technical Bulletins AL-134, AL-136, and AL-164[1] for specific guidance on the preparation, handling, and transfer of pyrophoric liquid reagents.

2.9 Training in the proper handling and transfer of pyrophoric liquid reagents should be conducted and documented by the Principal Investigator.

2.10 Pyrophoric liquid reagent usage is not permitted in a laboratory when personnel are working alone per University Guidelines (EH&S Guideline # 03-020).

3. Spill Response

3.1 Small spills of pyrophoric liquid reagents should be handled with extreme care as spontaneous ignition of the reagent and flammable vapor may occur. Immediately move away from the spill, and if possible, move all nearby combustible materials away from the spill. The spill should then be completely covered with dry calcium oxide (lime) or sand followed by a slow quenching with isopropanol. Once the material has been completely quenched and all reactions have ceased, the mixture should be placed in a sealed container for disposal via the chemical waste program.

3.2 If a large spill occurs, evacuate the area, close the doors, and contact Pitt Police at 412-624-2121.

4. Storage

4.1 Pyrophoric liquid reagents should always be stored in their original manufacturer's containers.

4.2 If the reagent requires refrigeration, store the reagent in a refrigerator that is approved for flammable liquid storage. Parafilm should be placed over the septum and around the cap to prevent moisture from coming in contact with the reagent. Additionally, the use of a secondary container or desiccator is highly recommended.

4.3 Storage in an approved glove box under an inert atmosphere is permitted. As with all chemicals being stored/used in a glove box, the specific pyrophoric liquid reagent(s) must be listed on the glovebox chemical inventory. The inventory must be posted on the outside of the glovebox.

4.4 Store pyrophoric liquid reagents away from incompatible materials such as oxidizing materials, aqueous solutions, acids, and combustible materials. Consult the specific reagent SDS for incompatibility information.

5. Waste Disposal

5.1 Unused pyrophoric liquid reagents should be kept in the original manufacturer's container and must be disposed via the University's chemical waste program. Do not transfer pyrophoric liquid reagents to another container.

5.2 Pyrophoric liquid reagents in secondary containers or flasks must be properly quenched prior to disposal via the University's chemical waste program. Quenching should be conducted under an inert atmosphere, and only small amounts of reagent should be quenched at a time. The following procedures should be utilized during the quenching process*:

5.2.1 The reagent is transferred to an appropriate reaction flask for hydrolysis and/or neutralization.

5.2.2 The reagent is diluted significantly using an unreactive solvent such as toluene or heptane, and the flask is immediately placed in an ice water bath.

5.2.3 Isopropanol is added slowly to quench the pyrophoric liquid reagent.

5.2.4 Methanol (a more reactive quenching agent) is slowly added to ensure completion.

5.2.5 Water is added drop-wise to ensure that no pockets of reactive material remain.

5.2.6 The resulting solution is disposed via the University's chemical waste program.

* As specified in the UCLA Procedures for Safe Handling of Pyrophoric Liquid Reagents http://www.chemistry.ucla.edu/sites/default/files/safety/sop/SOP_Pyrophoric_Liquid_Reagents.pdf

5.3 Pyrophoric liquid reagent waste must never be combined with incompatible chemicals such as aqueous solutions, combustible materials, and acids. Contact with incompatible chemicals will cause the rapid generation of flammable gas and the potential for spontaneous ignition and/or explosion.

5.4 Contact EH&S (412-624-9505) with any questions regarding the disposal of pyrophoric liquid reagent wastes.

[1] Aldrich® Technical Bulletins (AL-134, AL-136, AL-164): http://www.sigmaaldrich.com/chemistry/chemical-synthesis/learning-center/technical-bulletins.html.

UCLA Procedures for Safe Use of Pyrophoric Liquid Reagents: http://www.chemistry.ucla.edu/sites/default/files/safety/sop/SOP_Pyrophoric_Liquid_Reagents.pdf.

EMERGENCY PROCEDURES FOR PYROPHORIC LIQUID REAGENT EXPOSURES

Individuals that are exposed to pyrophoric liquid reagents should receive immediate first aid and a medical evaluation.

Skin contact

1. Immediately proceed to the nearest eyewash/shower and wash affected area for a minimum of 15 minutes.
2. While washing the affected area, have someone call for emergency medical assistance – **PITT POLICE 412-624-2121.**
3. Remove all contaminated clothing.
4. After 15 minute rinse, immediately obtain emergency medical attention.

Eye contact

1. Immediately proceed to the nearest eyewash station.
2. Wash eyes with water for at least 15 minutes while holding eyelids open.
3. While washing eyes, have someone call for emergency medical assistance – **PITT POLICE 412-624-2121**.
4. After 15 minute rinse, immediately obtain emergency medical attention.