Water Reactive Materials and Strong Reducing Agents

H260 H261

Examples: lithium, sodium, cesium, lithium aluminum hydride, calcium hydride, potassium hydride

Department:	Chemistry
Date SOP was written:	March 23, 2015
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Location(s) covered by this SOP:	834, 836, 837, 838, 839, 842, 844, 847, 849, 907

1. Purpose

This SOP covers the precautions and safe handling procedures for the use of Water Reactive Chemicals, which include the following chemicals and their uses:
Note: A * next to chemical indicates that it is also an Acutely Toxic Chemical.
Note: A ** next to a chemical indicates that it is also a Peroxide Forming Chemical.

CasNumber	Chemical_Name	Procedure	Exhibit
16940-66-2	sodium borohydride (powder)	2	Exhibit 1
16853-85-3	Lithium aluminum hydride	2	Exhibit 1
7439-93-2	Li Wire	1	Exhibit 1
16940-66-2	sodium borohydride	2	Exhibit 1
7439-93-2	Lithium	1	Exhibit 1
7440-23-5	Sodium	1	Exhibit 1
7440-23-5	sodium in kerosene	1	Exhibit 1
16940-66-2	Sodium borohydride pellets	2	Exhibit 1
7440-23-5	Sodium pieces in mineral oil	1	Exhibit 1

7440-23-5	sodium metal	1	Exhibit 1
7439-93-2	lithium wire	1	Exhibit 1
7782-92-5	sodium amide**	2	Exhibit 1
77299-63-9	Lithium diisobutyl-tert-butoxyaluminum hydride solution*	4	
2428-06-0	2-chloro-5,5-dimethyl-1,3,2-dioxaphosphorinane	3	
7782-89-0	Lithium amide	2	
5565-32-2	Chlorotris(trimethylsilyl)silane	3	
4301-14-8	ethynylmagnesium bromide	4	
25015-63-8	4,4,5.5-tetramethyl-1,3,2-dioxaborolane (1 M in THF)	4	
109704-53-2	tetramethylammonium triacetoxyborohydride	2	
19172-47-5	2,4-bis(4-methoxyphenyl)-1,3,2,4-dithiadiphosphetane-2,4-disul	3	
19172-47-5	Lawesson's Reagent	3	
6867-30-7	Lithium acetylide-ethylene diamine complex	2	
694-53-1	Phenylsilane	4	
67969-82-8	Tetrafluoroboric acid diethyl ether complex	4	
75-16-1	Methylmagnesium Bromide Solution	4	
75-16-1	Methylmagnesium bromide 3M in ether	4	
75-16-1	Methylmagnesium bromide	4	
13289-97-9	N,N-diethylaniline borane complex	4	
75-77-4	Chlorotrimethylsilane	3	
21969-32-4	1-methyl-2-propenylmagnesium chloride, 0.5 M soln in THF	4	
7440-19-9	Samarium powder	2	
7440-19-9	Samarium	2	
3536-96-7	vinylmagnesium chloride, 0.56 m in thf	4	
37342-97-5	bis(cyclopentadienyl)zirconium chloride hydride	3	
37342-97-5	bis(cyclopentadienyl)zirconium hydride	3	
37342-97-5	Bis(cyclopentadienyl)zirconium(IV) chloride hydride	3	
37342-97-5	Zirconocene Chloride Hydride	3	
92390-26-6	CHLORO(1,5-CYCLOOCTADIENE)	4	
925-90-6	Ethylmagnesium bromide	4	
925-90-6	Ethylmagnesium bromide 3.0 M	4	
107149-56-4	Chlorodiethylisopropylsilane	3	
1068-55-9	Isopropylmagnesium chloride solution	4	
1068-55-9	isopropylmagnesium chloride	4	
1068-55-9	isopropyl magnesium chloride	4	

56553-60-7	Sodium triacetoxyborohydride	2	
11110-52-4	sodium mercury amalgam*	2	
22722-98-1	Vitride(R) T reducing agent*	4	
22722-98-1	Red-Al*	4	
917-65-7	methylaluminum dichloride (1M in hexanes)*	4	
280-64-8	9-Borabicyclo3.3.1nonane solution *	4	
88-68-6	Anthranilamide*	2	
54575-49-4	Potassium tri-sec-butylborohydride	2	
11135-81-2	Potassium-Sodium alloy	1	
1826-67-1	Vinylmagensium bromide, 0.7M solution in THF	4	
1826-67-1	Vinylmagnesium Bromide	4	
1826-67-1	Vinylmagnesium bromide, 1.0M solution in THF	4	
26134-62-3	Lithium nitride	2	
17476-04-9	lithium tri-tert-butoxyaluminohydride	2	
7789-78-8	calcium hydride	2	
7580-67-8	Lithium hydride	2	
7693-26-7	Potassium hydride	2	
7439-96-5	Manganese Metal	2	
7439-96-5	Manganese	2	
693-04-9	butylmagnesium chloride (2.0M in THF)	4	
1314-80-3	Diphosphorous pentasulfide	4	
4984-82-1	Sodium cyclopentadienide	2	
22560-16-3	Super-Hydride solution1.0 M lithium triethylborohydride in THF	4	
22560-16-3	Lithium triethylborohydride	2	
13292-87-0	Borane-methylsulfide complex	4	
13292-87-0	Borane-methyl sulfide complex	4	
13291-18-4	Isopropenylmagnesium bromide, 0.5 M solution in THF	4	
15681-89-7	Sodium borodeuteride	2	
1066-35-9	N-Cyclohexyl-N-(2-morpholinoethyl)carbodiimide chlorodimethyls	3	
1730-25-2	Allylmagnesium bromide 1.0 M in Diethyl Ether	4	
14044-65-6	borane 1M THF	4	
14044-65-6	Borane tetrahydrofuran complex solution (1.0 M in THF)	4	
14128-54-2	Lithium aluminum deuteride	2	
16949-15-8	Lithium borohydride	2	

If you have questions concerning the applicability of any recommendation or requirement listed in this procedure, contact the Principal Investigator/Laboratory Supervisor of your laboratory or Environment, Health and Safety (EH&S).

2. Water Reactive Chemicals Information

Water reactive materials are chemicals that can react violently with water to produce a flammable gas and heat. This classification for "Water Reactive" follows the definitions of Global Harmonization System (GHS) of Classification and Labeling of Chemicals. The risks associated with a specific water reactive chemical depend on its reactivity and the nature of the gaseous product (flammable, toxic, or both). Prior to working with a water reactive chemical, identify the gas to be formed when exposed to water, learn the risks associated with this gas, and develop plans to minimize the risks of handling that material. "Water" can include moisture in the atmosphere, therefore water reactive are usually used under air-free conditions.

3. Potential Hazards/Toxicity

Water reactive substances are **dangerous when wet** because they can undergo a chemical reaction with water. This reaction may release a gas that can be flammable and/or toxic. In addition, the heat generated when water contacts such materials is often enough to spontaneously combust or explode.
When quenching WR materials, the hazards of the mixture, the WR chemical and the solvent, should be considered together and procedures for safe quenching should reflect the hazard properties of both solvent and solute.
As defined by the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), WR materials are defined as "**substances and mixtures which, in contact with water, emit flammable gases**" and are designated by one or more of the following H codes:

H260 In contact with water releases flammable gases which may ignite spontaneously
H261 In contact with water releases flammable gases

4. Engineering Controls

The following is the set of engineering controls that are required when quenching WR chemicals:

- Use a clean fume hood, preferably with the sliding sash windows or a glove box.
- 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 a vertical sliding sash, keep the sash as low as possible.
- Remove any flammables (squirt bottles, solvents, oil bath) and combustibles (Kimwipes, paper towels) from the area that will be used for the quenching.

5. Personal Protective Equipment

At a minimum, the following PPE must be worn at all times.

Eye Protection

A. ANSI Z87.1-compliant safety glasses with side shields or chemical splash goggles.
   - Ordinary prescription glasses will NOT provide adequate protection unless they also meet ANSI standard and have compliant side shields.

B. If the potential for explosion/splashing exists, and adequate coverage is not provided by the hood sash, a face shield should be worn.

Skin Protection

A. Flame-resistant lab coat (Nomex IIIA, NFPA 2112) should be worn when working with water-reactive materials.
B. Gloves are required when handling hazardous materials. Refer to the specific chemical SDS for information on glove selection.
C. Long pants, closed-toe/closed-heel shoes, covered legs, and ankles. Cotton-based, non-synthetic clothing should be worn.

6. First Aid Procedures and Medical Emergencies

In the event of an injury, notify your supervisor immediately and EH&S within 8 hours. Follow up with a call to 510-642-6060 to report the incident.

Go to the Occupational Health Facility (Tang Health Center, on campus); if after hours, go to the nearest emergency room (Alta Bates, 2450 Ashby Ave in Berkeley); or

Call 911 (from a cell phone: 510-642-3333) if:

- ***it is a life threatening emergency; or***
- ***you not are confident in your ability to fully assess the conditions of the environment and/or the condition of the contaminated/injured person, or you cannot be assured of your own safety; or***
- ***the contaminated/injured person is not breathing or is unconscious.***

Please remember to provide a copy of the appropriate manufacturer SDS (if available) to the emergency responders or physician. At a minimum, be ready to provide the identity/name of any hazardous materials involved.

In case of skin contact

If skin contact occurs, and/or skin or clothing are on fire, immediately drench in the safety shower with copious amounts of water for no less than 15 minutes.

If possible to do so without further injury, remove any remaining jewelry or clothing.

In case of eye contact

Rinse thoroughly with plenty of water using an eyewash station for at least 15 minutes, occasionally lifting the upper and lower eyelids. Remove contact lenses if possible.

If swallowed

Do NOT induce vomiting unless directed otherwise by the SDS. Never give anything by mouth to an unconscious person. Rinse mouth with water.

Needle stick/puncture exposure

Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure such as eyes, mouth and/or nose, flush the affected area for 15 minutes using an eyewash station.

If inhaled

Move into fresh air.

7. Special Handling and Storage Requirements

WR chemicals can be handled and stored safely as long as all exposure to moisture or other incompatible chemicals is minimized. Never leave a container with a residue of a WR material open to the atmosphere.

Lab-specific information on handling and storage may be included in Section 12 - Protocol/Procedure section.

Working Alone

- The UC Berkeley Office of Environmental Health and Safety specifies not to work with WR chemicals alone or during off hours, when there are few people around to help**.**

Handling Water Reactive Materials

- Only use if the area is properly equipped with a properly operating eye wash/safety shower within ten seconds of travel.
- Work away from any water sources or where there is the potential of water splash.

Storage of Water Reactive Materials

- Store under dry inert gas (Nitrogen or Argon).
- Store in a location separated from bases, oxidizing and other incompatible materials.
- Never allow product to get in contact with water or water-based compounds during storage. Keep in a dry place (such as a desiccator or a dry box or glove box) free of moisture/humidity and away from sources of heat.
- Store in a separate secondary container and label the material clearly. Hazard communication label on the container must read "*Water Reactive,* ~~W~~"
- Do not leave the container near a lab sink, emergency eyewash, or safety shower or on the bench top - even momentarily.
- At the end of each project, thoroughly inspect the area for residual reactive material.

Disposal of Water Reactive Chemicals

- Any unused or unwanted water reactive materials must be destroyed by following the Quenching of Water Reactive Chemicals SOP. If you have large quantities of unreacted water reactive reagent material contact EH&S for guidance on disposal options.
- The empty container should be rinsed three times with an inert dry COMPATIBLE solvent; this rinse solvent must also be neutralized or hydrolyzed.
- After the empty container is triple-rinsed, it should be left open in back of a hood or ambient atmosphere at a safe location for about a week.
- The empty container, solvent rinses, and water rinse should be disposed of as hazardous waste and should not be mixed with incompatible waste streams.

8. Chemical Spill and Managing Any Subsequent Fire

Water-Reactive Spill Response

- In the case of a spill, announce the situation loudly in the immediate area and have any nearby persons move to a safe location.
- Immediately eliminate/remove all nearby ignition sources.
- If spill occurs in a fume hood, cover with Met-L-X, dry sand, or other non-combustible material, close the hood sash and if present, press the red purge button.
- If a spill occurs outside a fume hood, cover with Met-L-X, dry sand, or other non-combustible material, and stand away from the spill.
- Locate and have a proper fire extinguisher (dry chemical-based) ready in case of ignition/fire.

- Use clean, non-sparking tools to collect absorbed material and place into loosely-covered metal or plastic containers ready for disposal.
- Do not use combustible materials (paper or cloth towels) to clean up a spill, as these may increase the risk of igniting the reactive compound.
- If you cannot assess the situation well enough to be sure of your own safety, do not approach the spill.
- Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).
- Report the spill to 510-642-3073.

Water-Reactive Fire Response

- Call **911** (from a cell phone: **510-642-3333**) for emergency assistance and for assistance with all fires, even if extinguished.
- If the spill ignites, and if you are trained and you feel comfortable to do so, consider extinguishing the fire with an appropriate fire extinguisher. Only dry chemical fire extinguishers should be used (classes ABC or D).
- A can of Met-L-X or **dry** sand in the work area, within arm's reach, might be helpful to extinguish any small fire as it can smother the flames.
- Do not use water to extinguish a WR chemical fire as it may enhance the intensity of the fire. An exception to this would be in the case of skin contact or ignited clothing/skin. In these cases rinsing any unreacted chemical off is of primary importance.

Be AWARE: Small flames at the tip of the needles can be produced – always expect this to occur, and do not panic. The can of Met-L-X/sand is in the hood to quickly extinguish those small flames.

9. Cleaning and Decontamination

Lab-specific information on decontamination may be included in the Protocol/Procedure section.

- Wearing proper PPE, laboratory work surfaces should be cleaned at the end of each work day.
- Dispose of contaminated materials in accordance with hazardous waste disposal guidelines referenced below.
- Clean all equipment before removing from a designated area.

10. Hazardous Waste Disposal

Label Waste

Label all waste containers. See the EH&S Fact Sheet, "Hazardous Waste Management" for general instructions on procedures for disposing of hazardous waste.

Dispose of Waste

- Dispose of regularly generated chemical waste within 6 months.
- Call EH&S with questions.

11. Safety Data Sheet (SDS) Location

SDS can be accessed online at http://ucmsds.com

12. Protocol/Procedure for Water Reactive Chemicals

Preparation	*List any other particular preparation requirements needs for this procedure (e.g., location of spill kit or keep water or ignition sources away from procedure area)* • Know the location of the nearest fire extinguisher, eyewash, and safety shower before beginning work. • Have a small beaker or can of Met-L-X or DRY sand in the work area, within arm's reach. • Solvents must be dry. • Glassware must be dry before using. Either "flame" dry or dry in an oven at a minimum temperature of 100˚C for about 2 hours. • Remove all other flammable materials from the hood to reduce the hazard in case of a fire. • Make adjacent lab workers aware that you will be working with WR chemicals.
Procedure	
1	Removal of oil from Li/Na/K prior to use in reactions
2	Sodium Hydride, Calcium Hydride, and Lithium Hydride are used as bases/ reducers in organic chemical reactions
3	Using Water Reactive Chemical (WRC) as reactant. Procedure includes WRCs that liberate toxic but not flammable product(s) when in contact with water. These are mostly halides and acid halides of organics, metals, and non-metals
4	Transferring of liquid water reactive chemicals
Appendix	Comprehensive List of Water Reactive Chemicals.

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
1. Removal of oil from Li/Na/K prior to use in reactions	This procedure is to be used for up to **40 g** of WR material as supplied by manufacturer. The uses of these WR materials in amounts greater than 40 g at a time are not permitted.	Conduct in a clean fume hood with the sash closed, or an inert atmosphere glove box.	**Eye Protection:** Wear tight-fitting safety goggles or safety glasses with side shields. **Face Protection:** Face shields are to be used when there is no protection from the hood sash or when the hood sash is in open position. **Hand Protection:** Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Wash and dry hands after use. Hand Protection for indirect contact with WR material (closed-system procedures such as transfers via syringe or cannula): Use nitrile gloves of at least 10 mil thickness (double-glove if 5 mil thickness). Hand Protection for direct contact with WR material (open system procedures such as spill handling, wiping of residual WR chemical)**:** Provide for adequate employee hand protection by evaluating any additional risks via a hazard assessment and provide the appropriate hand protection. Consider the use of fire resistant (FR) gloves or liners. **Clothing:** Wear Nomex IIIA (NFPA 2112) lab coat; cotton based clothing; full length pants or	General Procedure: Pieces (~5 g) are transferred to a beaker containing hexanes that covers the metal fully. Pieces are then washed with more hexanes to remove the oil and transferred to a second beaker containing more hexanes. The pieces are flattened in the beaker containing hexanes then removed, washed with hexanes and transferred to the reaction vessel containing solvent. After reaction has been completed, quench (see below) the residual metal. Quenching requires the cooling of the vessel with a cold bath and slow addition of the quencher.

			equivalent; and close-toed and close-heeled shoes.	
Notes	Any deviation from this SOP requires approval from PI.			

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
2. Sodium Hydride, Calcium Hydride, and Lithium Hydride are used as bases/ reducers in organic chemical reactions	This procedure is to be used for up to **40 g** of WR material as supplied by manufacturer. The uses of these WR materials in amounts greater than 40 g at a time are not permitted.	Conduct in an inert atmosphere glove box or in the fume hood. The hydrogen gas evolved here is very flammable, if an ignition source is found, but is not spontaneously flammable.	**Eye Protection:** Wear tight-fitting safety goggles or safety glasses with side shields. **Face Protection:** Face shields are to be used when there is no protection from the hood sash or when the hood sash is in open position. **Hand Protection:** Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Wash and dry hands after use. Hand Protection for indirect contact with WR material (closed-system procedures such as transfers via syringe or cannula): Use nitrile gloves of at least 10 mil thickness (double-glove if 5 mil thickness). Hand Protection for direct contact with WR material (open system procedures such as spill handling, wiping of residual WR chemical)**:** Provide for adequate employee hand protection by evaluating any additional risks via a hazard assessment and provide the appropriate hand protection. Consider the use of fire resistant (FR) gloves or liners. **Clothing:** Wear Nomex IIIA (NFPA 2112) lab coat; cotton based	General Procedure: Add hydride reagents to reactions in a slow and controlled manner. Monitor reactions for the formation of H_2 gas. Avoid vigorous or exothermic reactions and the buildup of pressure within a reaction vessel. Cool if necessary. Adequate ventilation (pressure bubbler on Schlenk manifold or an equilibrating balloon) has to be used to prevent dangerous over pressurization. Quenching of reactions (see below) require the cooling of the vessel with a cold bath and slow addition of the quencher.

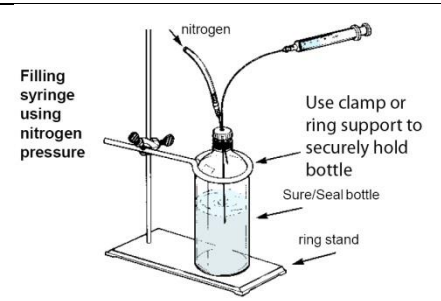
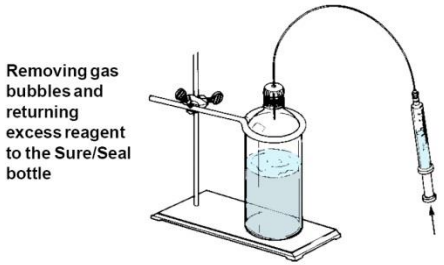
			clothing; full length pants or equivalent; and close-toed and close-heeled shoes.	
Notes	Any deviation from this SOP requires approval from PI.			

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
3. Using Water Reactive Chemical (WRC) as reactant. Procedure includes WRCs that liberate toxic but not flammable product(s) when in contact with water. These are mostly halides and acid halides of organics, metals, and non-metals	This procedure is to be used for up to **40 g** of WR material as supplied by manufacturer. The uses of these WR materials in amounts greater than 40 g at a time are not permitted.	Conduct in an inert atmosphere glove box or in the fume hood. For halide-based WRCs consider the need to provide a scrubber at the exit point of the vessel to absorb any toxic gases, such as HCl, that could formed. For hydrides and complex hydrides, the hydrogen gas evolved during the reaction is very flammable, if an ignition source is found, but is not spontaneously flammable.	**Eye Protection:** Wear tight-fitting safety goggles or safety glasses with side shields. **Face Protection:** Face shields are to be used when there is no protection from the hood sash or when the hood sash is in open position. **Hand Protection:** Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Wash and dry hands after use. Hand Protection for indirect contact with WR material (closed-system procedures such as transfers via syringe or cannula): Use nitrile gloves of at least 10 mil thickness (double-glove if 5 mil thickness). Hand Protection for direct contact with WR material (open system procedures such as spill handling, wiping of residual WR chemical)**:** Provide for adequate employee hand protection by evaluating any additional risks via a hazard assessment and provide the appropriate hand protection. Consider the use of fire resistant (FR) gloves or liners. **Clothing:** Wear Nomex IIIA (NFPA 2112) lab coat; cotton based clothing; full length pants or	General Procedure: Add these WRC reagents to reactions in a slow and controlled manner. Monitor reactions for the formation of gas (such as HCl), which could be indicative of water intrusion. Avoid vigorous or exothermic reactions and the buildup of pressure within a reaction vessel. Cool if necessary. Adequate ventilation (pressure bubbler on Schlenk manifold or an equilibrating balloon) has to be used to prevent dangerous over pressurization. Quenching of reactions (see below) require the cooling of the vessel with a cold bath and slow addition of the quencher.

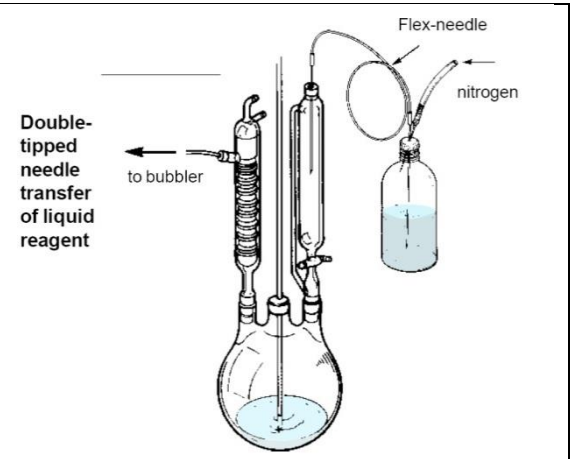
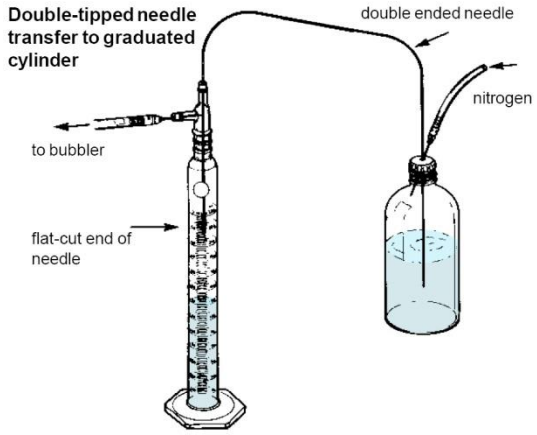
			equivalent; and close-toed and close-heeled shoes.	
Notes	Any deviation from this SOP requires approval from PI.			

Procedure/Use	Scale	Engineering Controls/Equipment	PPE (eye, face, gloves, clothing)	Procedure Steps and Special Precautions for this Procedure
4. Transferring of liquid water reactive chemicals .	This procedure is to be used for up to **150 mL** of WR material as supplied in the reagent bottle. The reaction vessel can hold more than 150mL of total solution (up to 3 L) but no more than 150mL of liquid WR as supplied in the reagent bottle.	Conduct in an inert atmosphere glove box, or in a clean fume hood with the sash closed using the Schlenk techniques. If using outside an inert atmosphere glove box, ensure the receiving vessel has been purged with an inert gas prior to transfer of the water reactive chemical. Also, a blanket of inert gas needs to be kept over the air sensitive chemicals. When dispensing more than 10 mL of liquid use a cannula system with a volumetric addition funnel. Reagent containers need to have a Sure/Seal or equivalent closure system	**Eye Protection:** Wear tight-fitting safety goggles or safety glasses with side shields. **Face Protection:** Face shields are to be used when there is no protection from the hood sash or when the hood sash is in open position. **Hand Protection:** Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Wash and dry hands after use. Hand Protection for indirect contact with WR material (closed-system procedures such as transfers via syringe or cannula): Use nitrile gloves of at least 10 mil thickness (double-glove if 5 mil thickness). Hand Protection for direct contact with WR material (open system procedures such as spill handling, wiping of residual WR chemical)**:** Provide for adequate employee hand protection by evaluating any additional risks via a hazard assessment and provide the appropriate hand protection. Consider the use of fire resistant (FR) gloves or liners.	General Considerations: The reagent can be dispensed using a syringe for small quantities (<20 mL) or double-tipped needle - cannula method for larger quantities (≥20 mL). The needle should be no larger than 16 gauge, inserted through the hole in the metal cap. It is recommended to use the plastic syringes and needles only once; the rubber gasket of a plastic syringe may swell up leading to a jammed syringe. The plastic cap on the reagent container is to be replaced after each use. Draw the syringe plunger slowly, checking for leaks. If the syringe is pulled too hard, the water-reactive liquid can come out the back of the syringe onto the researcher. Orient the syringe in such a way that an accidental spill will be directed away from you. Never overfill the syringe; fill the syringe half full, even if you need to make multiple transfers. The pressure in bottles of air sensitive chemicals must be tightly controlled. Draw out water reactive liquid only in the presence of a flow of inert gas to prevent air from entering the reagent container. For extended storage of unused reagents, use the solid plastic cap, or equip the bottle with an Oxford Sure/Seal valve or equivalent. Use a long flexible needle that is one to two feet long to transfer liquid via the cannula method. Clamp the reagent bottle to prevent it from moving. Clamp/secure the receiving vessel too.

			Clothing: Wear Nomex IIIA (NFPA 2112) lab coat; cotton based clothing; full length pants or equivalent; and close-toed and close-heeled shoes.	**- Reagent Transfer with Syringe -** The syringe transfer of liquid reagents is readily accomplished by first pressurizing the Sure/Seal™ reagent bottle with inert gas followed by filling the syringe. The inert gas pressure is used to slowly fill the syringe with the desired volume plus a slight excess (to compensate for gas bubbles) of the reagent. Note the inert gas pressure pushes the plunger back as the reagent enters the syringe. The plunger should not be pulled back as this tends to cause leaks and creates gas bubbles. The excess reagent along with any gas bubbles is forced back into the reagent bottle. The accurately measured volume of reagent in the syringe is quickly transferred to the reaction apparatus by puncturing a rubber septum on the reaction flask or addition funnel. Following its use, a syringe contains amount of residual reagent. It is advisable to rinse out the reactive reagent by first placing a few milliliters of the same solvent that was used for the reaction in a small Erlenmeyer flask in the hood. Keeping the needle tip under the solvent at all times, no more than half the solvent is then drawn into the syringe. The solvent plus dissolved residual reagent is ejected from the syringe back into the same Erlenmeyer flask. Repeat this rinse treatment at least three times. The wash solution can be safely combined with other waste solvents and the syringe may be further cleaned with water and acetone.

				  **- Reagent Transfer with Cannula (Double-Tipped Needle) -** Use a long flexible needle that is one to two feet long to transfer liquid via the cannula method. The double-tipped needle technique is recommended when transferring 20 mL or more. Pressurize the Sure/Seal bottle with nitrogen and then insert the double-tipped needle through the septum into the headspace above the reagent. Nitrogen will pass through the needle. Insert the other end through the septum at the calibrated addition funnel on the reaction apparatus. Push the needle into the liquid in the Sure/Seal reagent bottle and transfer the desired volume.

				Then withdraw the needle to above the liquid level. Allow nitrogen to flush the needle. Remove the needle first from the reaction apparatus and then from the reagent bottle. For an exact measured transfer, convey from the Sure/Seal bottle to a dry nitrogen flushed graduated cylinder fitted with a double-inlet adapter. Transfer the desired quantity and then remove the needle from the Sure/Seal bottle and insert it through the septum on the reaction apparatus. Apply nitrogen pressure as before and the measured quantity of reagent is added to the reaction flask. After use, the double-tipped needle is flushed free of reagent with nitrogen in the transfer system, and then immediately removed and placed in a clean sink. With water running in the sink and in the complete absence of flammable solvents and vapors, the double-tipped needle can be rinsed with water. When no activity in the rinse water is observed, acetone from a squeeze bottle can be flushed through the needle.

				 
Notes	Any deviation from this SOP requires approval from PI.			

Documentation of Training (signature of all users is required)

- Prior to conducting any work with water reactive chemicals, designated personnel must provide training to his/her laboratory personnel specific to the hazards involved in working with the substance(s), work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.

I have read and understand the content of this SOP:

Name	Signature	Initials	Identification	Date

Appendix: Water Reactive Chemical Listed in Settlement Agreement, July 25, 2012.

Aluminum alkyls
Aluminum alkyl halides
Aluminum alkyl hydrides
Aluminum borohydride or Aluminum borohydride in devices
Aluminum Carbide
Aluminum ferrosilicon powder
Aluminum hydride
Aluminum phosphide
Aluminum powder, uncoated
Aluminum silicon powder, Uncoated
Barium
Boron trifluoride dimethyl etherate
Calcium
Calcium carbide
Calcium cyanamide with more than 0.1percent of calcium carbide
Calcium hydride
Calcium manganese silicon
Calcium phosphide
Calcium silicide
Cells, containing sodium
Cerium, turnings or gritty powder
Cesium or Caesium
Dimethylzinc
Diethylzinc
Ethyldichlorosilane
Ferrosilicon, with 30 percent or more but less than 90 percent silicon
Hexyllithium
Lithium
Lithium alkyls
Lithium aluminum hydride
Lithium aluminum hydride, ethereal
Lithium borohydride
Lithium ferrosilicon
Lithium hydride
Lithium hydride, fused solid
Lithium nitride
Lithium silicon
Magnesium alkyls
Magnesium aluminum phosphide
Magnesium granules, coated, particle size not less than 149 microns
Magnesium hydride

Magnesium phosphide
Magnesium silicide
Magnesium, powder or Magnesium alloys, powder
Maneb or Maneb preparations with not less than 60 percent Maneb
Methyl magnesium bromide, in ethyl ether
Methyldichlorosilane
Phosphorus pentasulfide, free from yellow or white phosphorus
Potassium
Potassium borohydride
Potassium phosphide
Potassium sodium alloys
Potassium, metal alloys
Rubidium
Sodium
Sodium aluminum hydride
Sodium borohydride
Sodium hydride
Sodium phosphide
Stannic phosphide
Strontium phosphide
Trichlorosilane
Zinc ashes
Zinc phosphide
Rubidium
Sodium
Sodium aluminum hydride
Sodium borohydride
Sodium hydride
Sodium phosphide
Stannic phosphide
Strontium phosphide
Trichlorosilane
Zinc ashes
Zinc phosphide