Standard Operating Procedure (*SAMPLE)*

Before research use of highly toxic chemicals, please complete this form and have it approved by your supervisor. See the back of this form for instructions/information related to this form.

Name____________________ **Phone**_________________ **Bldg/Rm.**_______

1. Substance Information

Chemical Name	Tert Butyllithium in Pentane	
Estimated Rate of Use (e.g., g/month)		
SDS reviewed and readily available:		☒ Yes ☐ No

2. Hazards

Physical Characteristics/Hazards (See SDS)			**Health Hazards**
☐ Solid	☒ Liquid	☐ Gas	☐ Toxic, report LD50 = _446 (pentane, mouse/inject)_ mg/kg LC50 = __________ mg/kg
☐ Explosive	☒ Flammable		☐ Carcinogen ☐ Teratogen ☐ Embryotoxin ☐ Reproductive Toxin
☐ Oxidizer	☒ Corrosive		☐ Sensitizer ☐ Mutagen ☐ Unknown
☒ Reactive	☐ Temp./Light Sensitive		*Significant & Potential Route(s) of Exposure*
Stability Moderately stable		☒ Stable ☐ Unstable	☒ Inhalation Hazard ☐ Ingestion ☒ Skin Absorption ☐ Injection
Known incompatibilities Highly air and water reactive. Reacts exothermically with CO2. Other incompatibilities include halogenated hydrocarbons, ethers, alcohols, esters, nitriles and ketones.			☒ Splash to eyes/mucous membranes

3. Procedure (Briefly describe how material will be used & precautions for preparation of stock solutions & dilutions)

Administered to animals? ☐ Yes ☒ No. If yes, special precautions for excreta; are metabolites hazardous? (describe)

4. Location/Designated Area

Room: Building:	Storage Method/Precautions
Describe the area where substance(s) will be prepared.	☒ refrigerator/freezer ☐ fume hood ☐ flammable storage cabinet ☐ vented cabinet ☐ double containment (prevent spills) ☐ other, describe

5. Spills, Decontamination and Waste Disposal

Spill control materials readily available ☒ Yes ☐ No ☐ N/A		In-lab neutralization	☒ Yes	☐ No
Special personal protective equipment needed (e.g., respiratory protection, other PPE) ☒ Yes ☐ No	Describe Fire resistant gloves, lab coat. Lime or sand to extinguish fires. Dry chem extinguisher only.	Deactivation (describe product)	☒ Yes	☐ No
Decontamination method: Quench material using alcohol as necessary		Dispose as Hazardous	☒ Yes	☐ No

6. Exposure Controls for Research Laboratory Preparation and Use (NOTE: DLAR requirements for handling experimental animals may be different and will be noted on separate approval form and outside of animal room)

Personal Protective Equipment (PPE) (Check all that apply)	**Ventilation/Isolation**		
☐ Safety glasses ☒ Chemical splash goggles ☒ Face shield	Fume hood required	☒ Yes	☐ No
☒ Gloves(type) <u>Nitrile or Viton</u>____ ☒ Lab coat ☐ Disposable Lab Coat ☐ Disposable Tyvek Suit ☐ Apron	Face velocity operates at > 100 feet per minute	☒ Yes	☐ No
☐ Respirator Needed?** ☐ Disposable N-95 ☐ Reusable ½ mask ☐ Fullface ☐ PAPR	Biological Safety Cabinet Required	☐ Yes	☒ No
☒ Other, please describe , Fire Resistant lab coat necessary, long pants, closed toed shoes – RESEARCHERS MAY NOT WORK ALONE	**Glove box required**	☐ Yes	☐ No
	Designated Area of Use	☐ Yes	☒ No

**Note: Contact Environmental Health and Radiation Safety prior to use of respirator.

7. Authorization

All individuals working with Tert Butyllithium must undergo manipulation specific, documented, training by the Principal investigator/laboratory supervisor. Principal investigators/laboratory supervisors are responsible to ensure that any and all users have been adequately trained before manipulating Tert Butyllithium.

The principal investigator/supervisor has:

- Demonstrated appropriate manipulation techniques to researchers using lower risk agents
- Observed appropriate manipulation techniques by researchers using lower risk agents
- Ensured availability, demonstrated and observed appropriate use of PPE including:
    - Fire resistant lab coat (Nomex or similar)
    - Full length pants
    - Closed toed shoes
    - Safety goggles
    - Face shield (if a risk of spash to face exists)
- Identified location, availability and ensured functional status of the:
    - Safety shower
    - Eyewash
    - Bucket of lime
    - ABC (Dry Chem) fire extinguisher
    - Emergency telephone contacts

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Researcher Date

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Researcher Date

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Researcher Date

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Researcher Date

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Researcher Date

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Principal Investigator / Supervisor Date

3.6 Instructions for Using Form

Using This Form

For purposes of this form, a pyrophoric chemical is a chemical capable of igniting on contact with air or water. A more complete definition is included in the Institutional Chemical Hygiene Plan. Each researcher planning to use a pyrophoric chemical must receive task specific training from the Principal Investigator/Laboratory Supervisor, complete this form and have it approved by their Principal Investigator or supervisor and Chemical Hygiene Officer/Environmental Health and Radiation Safety prior to their initial use. Responsibility for determining whether a chemical is a pyrophoric chemical and completing this form rests jointly with the supervisor, principle investigator and individual seeking approval.

Substance Information:

Carcinogen: Not Classified

Reproductive toxin: Not Classified.

High Acute Toxicity: Not Classified

Hazards (Refer to *Physical Properties* section of SDS)
Flammable liquid: Material is pyrophoric (ignited upon exposure to air)

Corrosive: Material is highly corrosive to skin and mucous membranes

Reactive: Material is highly air and water reactive. Ignites with exposure to air/oxygen.

Temperature Sensitive: Not temperature sensitive, but keeps well at ~10c.

Unstable: Material is not noted as being unstable

Incompatibilities: Water, Air, Oxygen

Inhalation: Highly corrosive to mouth, nose and breathing tract.

Skin exposure: Highly corrosive to skin.

3.7. Best Practices Standard Operating Procedure

3.7.1 Storage of Tert Butyllithium Solutions

Tert butyllithium can be stored in its original container as shipped from the manufacturer provided that the reagent will be used in a reasonable period of time. These containers typically have a crimped top and rubber septum which can be punctured multiple times to allow for withdraw of the reagent. An example of this style of system is the sigma-aldrich sure seal. The sure seal cap should never be removed unless you are absolutely sure that the contents inside have been quenched completely. Tert Butyllithium benefits from refrigerated storage (Blakemore, P. R, 2009).

Fig 1: Sigma Aldrich Sure Seal

(photo credit (J, 2012)

Longer term storage of pyrophoric materials can be achieved using Teflon or glass stoppered specialty glassware.

Fig 2: Specialty glassware for storage of pyrophoric materials

(Credit Storage Bottle without Joints (Sigma-Aldrich, n.d.)

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3.7.2 Preparation of the chemical exhaust hood and laboratory glassware for pyrophoric manipulation

The chemical exhaust hood (fume hood) should be completely cleared of any excess materials. All flammable liquids should be tightly closed to avoid spillage in the event of an incident during manipulation of the Tert Butyllithium. Laboratory glassware must be completely dried and cooled in an inert atmosphere before using. An inert gas delivery system (optimally via manifold delivery) is critical for safe working conditions. The manifold must have at least one open bubbler protected vent to prevent over pressurization and potential explosion (Blakemore, P. R, 2009)

3.7.3 Syringe Transfer Techniques (Appropriate for transfers 10ml or less)

Syringe transfer is acceptable for small scale transfers of pyrophoric chemicals from reagent bottles to reaction vessels.

- Syringe Volume
    - It is critically important to utilize a syringe at least twice the volume of the anticipated transfer amount. An example is if your experiment requires 10 mL of Tert Butyllithium, then a syringe no smaller than 20 mL should be utilized for the transfer.
- Syringe Construction
    - Simple glass syringes are inappropriate for transfer due to poor seal, leading to air bubble formation, when withdrawing reagent. Plastic syringes are viewed as a better alternative. The optimal syringe construction is a glass syringe with a Teflon coated plunger.
- Needle
    - Syringes should have an appropriately gauged needle (larger gauge needle for larger volumes). Needle should be sufficiently long to allow the

needle to reach the bottom of the bottle while the syringe is inverted. Sigma Aldrich specifies a 1-2 foot needle is appropriate to achieve this (http://www.sigmaaldrich.com/content/dam/sigma-aldrich/docs/Aldrich/Bulletin/al_techbull_al134.pdf).

- Clamping reagent and reaction vessels
  - Both the reagent and reaction vessel should be clamped in place to avoid disruption, and accidental needle withdraw, during the transfer.
- Providing an inert gas source to the reagent bottle
  - After securing the reagent and reaction vessels, provide an inert gas source with a bubbler outlet (nitrogen or argon) to the reagent bottle keeping the gas supply needle above the liquid level. Equalize the pressure on in the reagent bottle. Do not use pressure generated via the compressed gas source to fill the syringe. This is a practice which can lead to overfilling of the syringe and blowing out the plunger which will create a pyrophoric spill and may result in serious fire.
- Flush the syringe with inert gas
  - Depress the plunger on the syringe fully, and then insert it into the reagent bottle keeping the needle tip above the liquid level. Draw inert gas into the syringe. Remove the syringe and evacuate the nitrogen or argon.
- Fill the syringe with reagent
  - Reinsert the syringe into the reagent container with the needle below the liquid level. Slowly and carefully draw the reagent into the syringe. Pulling too hard on the plunger can result in the introduction of air into the syringe via the plunger seal.
- Draw an inert headspace
  - Withdraw the needle until it is above the liquid level. Draw inert gas into the needle and syringe. This practice helps to prevent small needle tip fires and prevent clogging of the syringe with lithium solids.
- Introduce the reagent into the reaction vessel
  - Withdraw the needle from the reagent vessel and pierce the rubber septum of the reaction vessel. Transfer the pyrophoric reagent into the vessel.

Fig 3: Syringe transfer assembly equipped with inert gas source and bubbler outlet

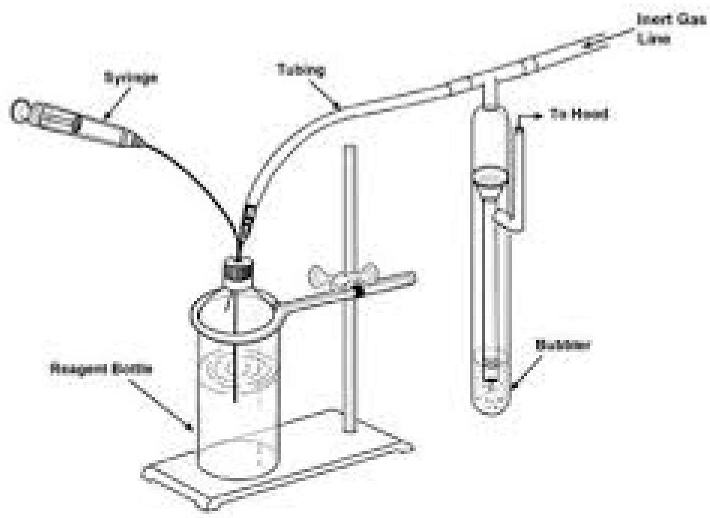


Diagram credit (Alnajjar, M. S, 2003)

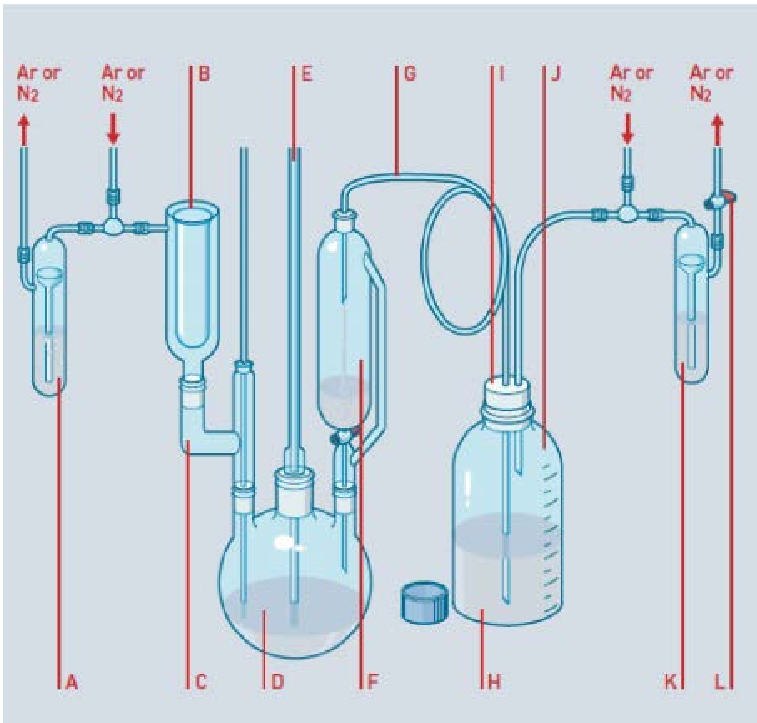
3.7.4 Cannula/Double Tipped Needle Transfer Techniques (appropriate for transfers greater than 10ml)

Cannula transfer techniques are appropriate for transfers of greater than 10ml of reagent.

- Double tipped needle
  - Utilize a double tipped needle of sufficient length to allow for safe transfer between the reagent and reaction vessel.
- Clamping reagent and reaction vessels
  - Both the reagent and reaction vessel should be clamped in place to avoid disruption, and accidental needle withdraw, during the transfer.
- Providing an inert gas source to the reagent bottle
  - After securing the reagent and reaction vessels, provide an inert gas source with a bubbler outlet (nitrogen or argon) to the reagent bottle keeping the gas supply needle above the liquid level. Slightly pressurize reagent bottle.
- Flush the needle
  - Insert the needle into the reagent bottle, keeping the needle above the liquid level allowing inert gas to flow through the needle.
- Connect to the calibrated addition funnel

- o Insert the other end of the double tipped needle into the calibrated addition funnel.
- Transfer reagent
  - o Push the reagent side needle below the liquid level. The pressure placed on the reagent by the inert gas source will push reagent into the calibrated addition funnel. When the desired amount of reagent has been transferred, withdraw the needle from the reagent bottle to a level above the liquid level allowing inert gas to flush the needle.

Fig 3.3 Cannula transfer apparatus



Key: A, mineral oil bubbler (outlet); B, dry ice condenser; C, Claisen adapter; D, three-neck round bottom fl ask; E, mechanical stir shaft; F, addition funnel; G, cannula; H, organolithium sample; I, septum; J, glass bottle; K, mineral oil bubbler (inlet); L, valve. Credit (FMC Lithium, 2005)

3.7.5 Cleaning needles and syringes

Needles and syringes must be cleaned immediately following transfer of tert butyllithium to avoid seizing.

3.7.5.1 Cleaning Syringes and associated needles

- Materials
  - o Gather reagent hexane and Isopropyl alcohol. Place a small amount of

hexane (30-50ml) into an open beaker and a small amount of isopropyl alcohol (30-50ml) into a second open beaker.

- Flush the remaining trace pyrophoric in the syringe/needle
    - Draw hexane into the syring and then evacuate the hexane from the syringe into the isopropyl alcohol.
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3.7.5.2 Cleaning cannula needles

- Materials
    - Gather a closed, rubber cocked container of hexane and an open beaker containing a small amount (30-50ml) of isopropyl alcohol.
- Apply inert gas pressure
    - Insert a needle supplying nitrogen or argon into the hexane reagent bottle, keeping the needle above the liquid level. Pressurize the hexane bottle slightly.
- Flush the remaining trace pyrophoric in the cannula
    - Insert the needle fully into the hexane and flow a small amount of hexane through the cannula directing it into the open beaker of isopropyl alcohol.
    -

3.7.5.3 Quench the remaining pyrophoric materials and cleaning solutions.

Deactivation is achieved by adding unwanted pyrophoric materials to a diluting solvent, and then quenching the pyrophoric in stages utilizing more reactive solvents.

- Materials
    - Gather a diluting solvent, such as Heptane or Toluene, Isopropyl alcohol, Methanol and a small amount of water.
- Dilute the pyrophoric material
    - Slowly add the unwanted pyrophoric materials to the heptane or toluene.
- Quench in a slightly more reactive environment
    - Add the Toluene or Heptane/pyrophoric solution to isopropyl alcohol.
- Quench in a slightly more reactive environment
    - Add methanol to the Toluene or Heptane/Pyrophoric/isopropyl alcohol.
- Conduct a final quench
    - Add a small amount of water (dropwise) to the Toluene or Heptane/Pyrophoric/Isopropyl alcohol/methanol solution to completely neutralize any pockets of pyrophoricity.

3.7.5.4 Waste management

Waste materials from this process, although no longer pyrophoric, must be managed as a hazardous waste material due to presence of solvents.

- Process
    - Using a funnel, transfer the waste into a suitable waste container and label it as “Hazardous Waste – Chemical Names”.
    - Contact EHRS to schedule a pickup.