Lab Safety

Thursday Nov 9th, 2023

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Preparation

General Safety for Any Lab

Safety Data Sheets (SDS)

- Chemical identification
- Hazard identification
- First-Aid measures
- Fire-Fighting measures
- Accidental release measures
- Handling and storage
- Exposure control/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information

Non-mandatory Sections:

- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

Hazard Symbols

Safety Data Sheets (SDS)

Sigma-Aldrich.

www.sigmaaldrich.com

SAFETY DATA SHEET

Version 6.7
Revision Date 06/15/2023
Print Date 11/04/2023

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : *tert*-Butyllithium solution

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

GHS Classification in accordance with 29 CFR 1910 (OSHA HCS)

Flammable liquids (Category 2), H225
Pyrophoric liquids (Category 1), H250
Chemicals which, in contact with water, emit flammable gases (Category 1), H260
Skin corrosion (Category 1B), H314
Serious eye damage (Category 1), H318
Specific target organ toxicity - single exposure (Category 3), Central nervous system, H336
Aspiration hazard (Category 1), H304
Short-term (acute) aquatic hazard (Category 2), H401
Long-term (chronic) aquatic hazard (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

3.2 Mixtures

Synonyms : Lithium-2-methyl-2-propanide
t-BuLi

Formula : C_4H_9Li

Molecular weight : 64.06 g/mol

Component		Classification	Concentration
n-heptane			
CAS-No. EC-No. Index-No. Registration number	142-82-5 205-563-8 601-008-00-2 01-2119457603-38-XXXX	Flam. Liq. 2; Skin Irrit. 2; STOT SE 3; Asp. Tox. 1; Aquatic Acute 1; Aquatic Chronic 1; H225, H315, H336, H304, H400, H410 Concentration limits: 20 %: STOT SE 3, H336; M-Factor - Aquatic Acute: 1 - Aquatic Chronic: 1	>= 70 - < 90 %
lithium-tert-butylate			
CAS-No. EC-No.	594-19-4 209-831-5	Pyr. Liq. 1; Water-react 1; Skin Corr. 1B; Eye Dam. 1; H250, H260, H314, H318	>= 30 - < 50 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

Look for GHS Hazards, Accidental Release Measures, and PPE Requirements

GHS Hazard Classes

The GHS classification further divides health and physical hazards into separate classes such as toxicity, irritation, sensitization, flammability, etc. The severity of the hazard within each class is described by the category. Some classes have five categories; other classes have only one category. Category 1 or A always represents the highest hazard within that class. The higher the category number, the lower the hazard. The classes, their categories and pictograms are as follows:

Standard Operating Procedures (SOP's)

SOP BIO-003 FOR THE DISPOSAL OF SOLID BIOHAZARDOUS WASTE

SCOPE

This policy describes the management and disposal of biological and medical waste, as part of the UMass Lowell Biohazardous Waste Program, with the fundamental purpose to protect staff, faculty and students that could be at risk when working with biohazardous material.

This policy is in compliance with Massachusetts Department of Public Health regulations (such as the State Sanitary Code Title VIII and 105 CMR 480.00), and Mass Department of Environmental Protection regulations 310 CMR 19.000.

DEFINITIONS

Biohazardous Agents are any agents that are biological in nature, and have the capacity to produce harmful effects upon other biological organism. Biohazardous agents include, but are not limited to:

- Bacteria
- Fungi
- Viruses
- Rickettsia
- Chlamydia
- Parasites
- Recombinant products
- Allergens
- Human and non-human primate cell lines and the potentially biohazardous agents these cells may contain
- Clinical specimens
- Tissue from experimental animals
- Toxins of biological origin
- Other biohazardous agents like prions or as defined by State and Federal regulations.

DISPOSAL CONTAINERS FOR BIOLOGICAL WASTE

All contaminated lab ware (see above), must be disposed of in cardboard boxes lined with Red Biohazard plastic bags that can be decontaminated by autoclaving or by incineration.

IMPORTANT: Never over fill card boxes. They only should be filled until ¾ of the total volume.

USE OF THE AUTOCLAVE TO DECONTAMINATE AND DISPOSE OF SOLID WASTE

At UMass Lowell, only those autoclaves in laboratories that comply with the specifications of the 105 CMR 480.000 may be used to decontaminate biological or medical waste according to Bio-006 SOP. For any questions about autoclaving biological waste, contact EEM-EHS at biosafety@uml.edu or Ext. 4-2618.

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DISPOSAL OF THE AUTOCLAVED WASTE

1. Wait until the **Red Biohazard Plastic Bag** has cooled completely;
2. Transfer the cold red autoclaved bag to a regular **Black Plastic Bag;**
3. Close tightly and dispose of the black bag in the regular trash;
4. **Never** dispose of the autoclaved red bag directly in the regular trash.

https://www.uml.edu/docs/III%20Biosafety%20Standard%20Operating%20Procedures%20%28SOP%29%20_tcm18-269075.pdf

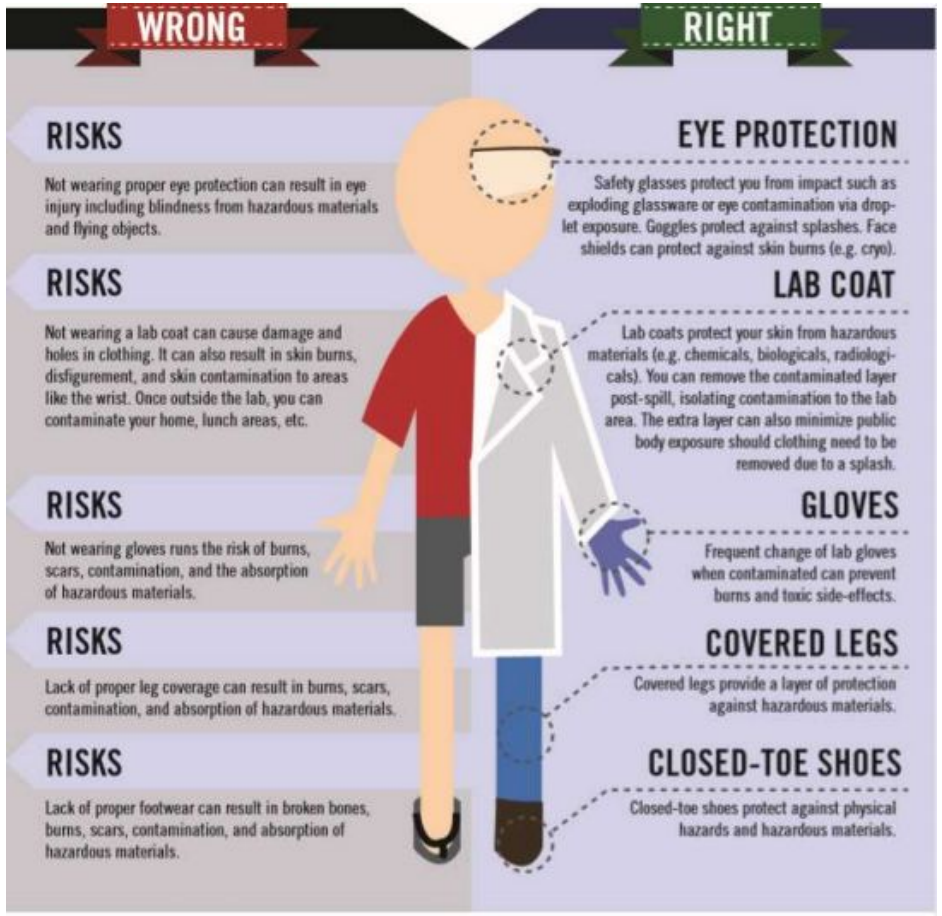
Personal Protective Equipment (PPE)

PPE should never be the first line of defense

Before considering PPE you should first consider:

- Engineering Controls
  (Use proper techniques)
- Administrative Controls
  (Adequate training)

- PPE functions as the last line of defense
- Always wear PPE when in the lab



PPE Is Not Universal

Impact Protection

Laser Protection Goggles

Splash Protection

Welding Goggles

Impact & UV Protection

Laser Protection Glasses

PPE Is Not Universal

POLYETHYLENE

Advantages:
- Excellent protection from common acids and bases
- Inexpensive

Disadvantages:
- Limited tear resistance

Good protection from:
- Acids
- Detergents
- Common dilute lab reagents

Poor protection from:
- Concentrated reagents and solvents

NEOPRENE

Advantages:
- High density
- Tear resistant

Disadvantages:
- Impaired dexterity

Good protection from:
- Peroxides
- Fuels
- Alcohols
- Organic acids and bases

Poor protection from:
- Halogenated compounds
- Aromatic compounds

NITRILE

Advantages:
- Flexible
- Sturdy
- Easy to see punctures

Disadvantages:
- Limited chemical protection

Good protection from:
- Oils and greases
- Acids, caustics
- Alcohols
- Chlorinated solvents

Poor protection from:
- Strong oxidizing agents
- Aromatic solvents
- Ketones
- Acetates

BUTYL

Advantages:
- Sturdy
- Reusable

Disadvantages:
- Limited sizes
- Impaired dexterity

Good protection from:
- Peroxides
- Strong acids and bases
- Alcohols
- Aldehydes
- Ketones
- Esters
- Nitro compounds

Poor protection from:
- Hydrocarbons (aliphatic, aromatic)
- Halogenated solvents

LAMINATE FILM

Advantages:
- Protection from a wide variety of chemicals
- Can be a liner under other gloves
- Good dexterity
- Good for hazmat work

Disadvantages:
- Not puncture-resistant

Good protection from:
- Alcohols
- Hydrocarbons (aliphatic, aromatic)
- Chlorines
- Ketones
- Esters

Poor protection from:
- Check manufacturer information

Cryogenic Gloves

High Temperature Gloves

PPE Is Not Universal

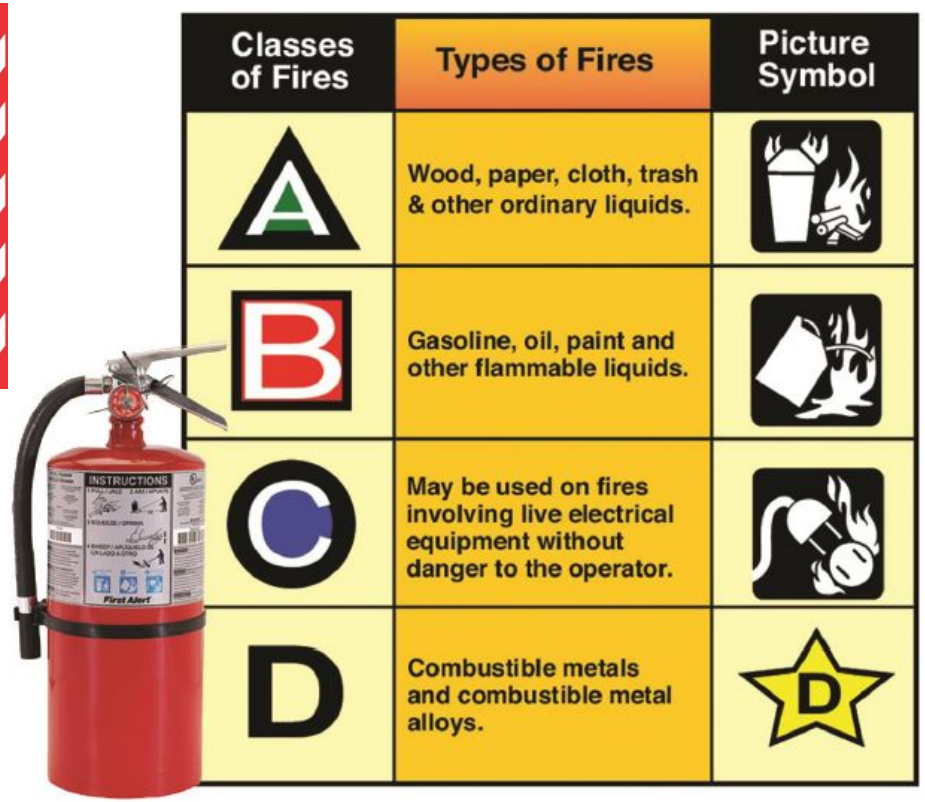
Standard
Lab Coat

Flame-Resistant
Lab Coat

Always Be Prepared

Know where everything is

- Fire extinguisher
- Eye wash stations and showers
- First aid kit
- Spill kit
- Antidotes



Lab Fire Extinguishers are CO_2 (Class ABC)

Be prepared for when things go sideways

Lab Injuries

- Call University Police (**9-911** or **5-2345**); identify yourself and give the location and nature of the injury
- Call departmental Business Office (**5-3335**) and report the injury.

Accidental Chemical Ingestion

- Immediately contact the Poison Control Center at **800-222-1222** for instructions.
- **Do not induce vomiting** unless directed to do so.

Accidental Chemical Injection

- Wash area with soap and water and seek medical attention.

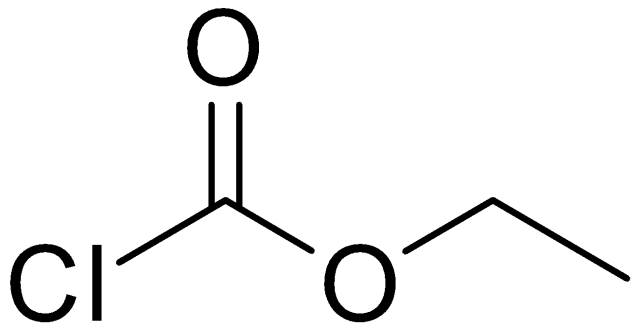
Know Your Reagents

Avoid Things Going Sideways

Importance of functional groups

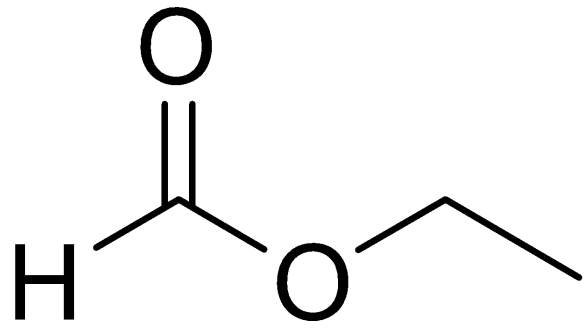
Ethyl chloroformate

- Highly toxic
- Causes severe burns when in contact with eyes &/or skin
- Can be fatal if swallowed or inhaled



Ethyl formate

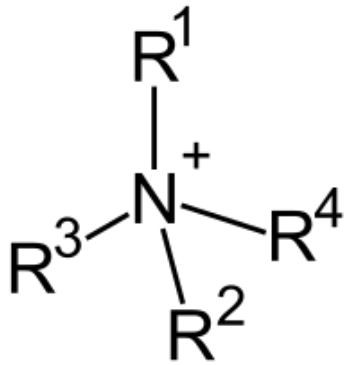
- Characteristic smell of rum
- Partially responsible for flavor of raspberries
- Safe by US Food and Drug Administration



Tetramethylammonium hydroxide

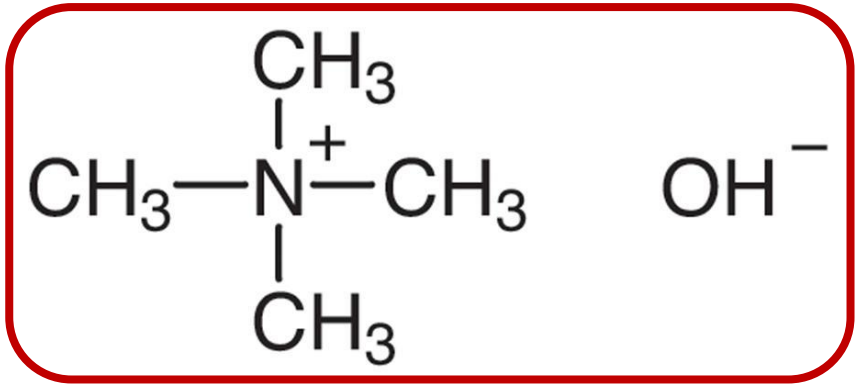
Quaternary ammonium salts

- Used in common disinfectants
- Fabric softeners
- Hair conditioner



Tetramethylammonium Hydroxide

- Can be fatal if inhaled, **absorbed through the skin**, or swallowed
- Affects nerves and muscles, can cause paralysis and death
- "Exposure to >1% TMAH solutions over a few percent of the body must be treated as a life-threatening event."

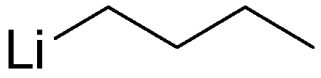


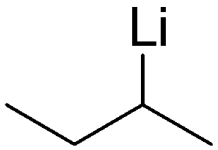
https://drs.illinois.edu/Page/SafetyLibrary/Tetramethyl

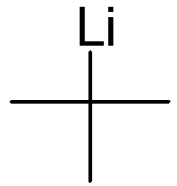
REAGENTS

- Pyrophoric
- Toxic
- Explosive

Butyllithium







Least Reactive

Most Reactive

1.6 M (<2M) solutions
not pyrophoric

- Sold as solution in alkanes
- Inert atmosphere
- Must quench syringes
  - Isopropyl alcohol/Toluene

REAGENTS

- Pyrophoric
- Toxic
- Explosive

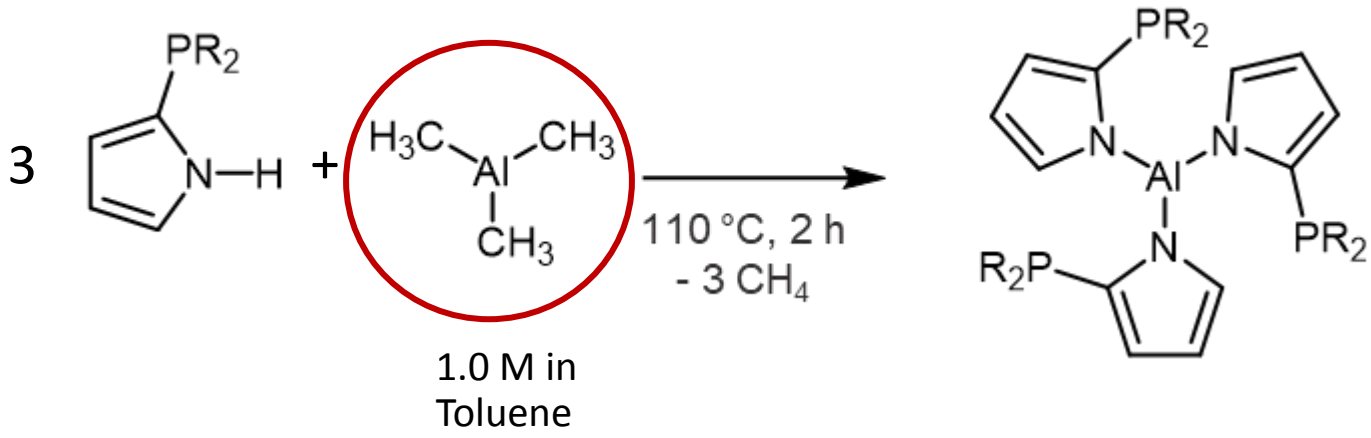
tert-Butyllithium

Sheri Sangji
UCLA 2008

REAGENTS

- Pyrophoric
- Toxic
- Explosive

Alkyl Aluminums



1.0 M in Toluene

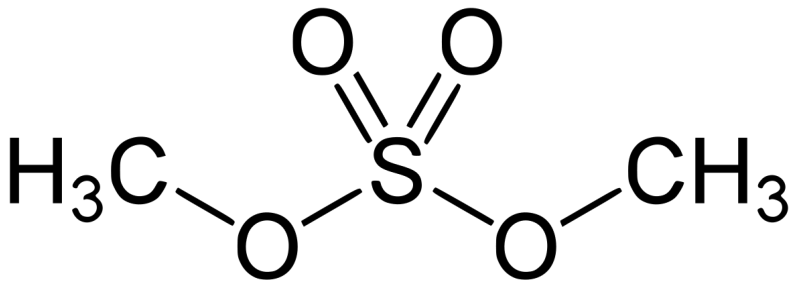
- Highly pyrophoric
- **Nap**hthyl aluminum is a component of **Nap**alm
- Set up in glovebox, use pressure safe flask

REAGENTS

- Pyrophoric
- Toxic
- Explosive

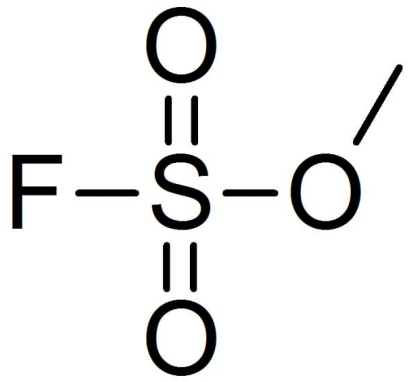
Methylating Agents

Attack DNA!



Dimethyl sulfate

- Inhalation Toxicity: 97 ppm
  Death in 10 min, human



Magic Methyl

- Inhalation Toxicity: 5 ppm

Potential Substitution Control: Use Methyl Triflate

REAGENTS

- Pyrophoric
- Toxic
- Explosive

Sodium Azide

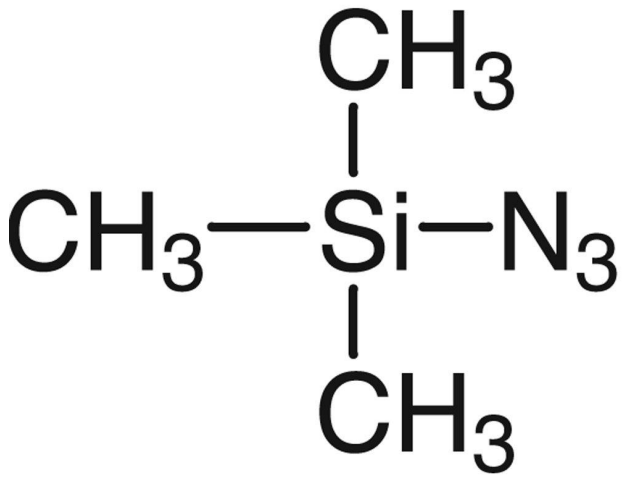
- Forms HN_3
- Absorbed through Respiratory system or skin
- Prevents body cells from using oxygen

- Wear PPE
- Weigh in a closed vial
- Quenched with $NaNO_2$

REAGENTS

- Pyrophoric
- Toxic
- Explosive

Trimethylsilyl Azide



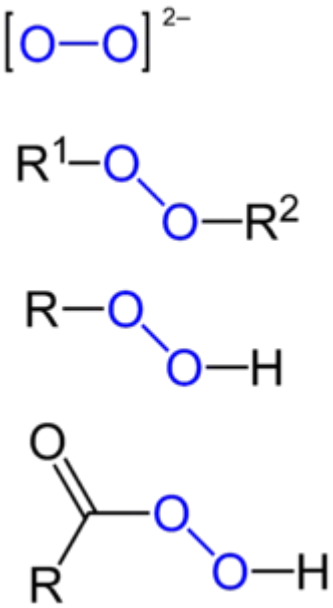
University of Minnesota

- Distillation pot spontaneously exploded
- 200 g scale vacuum distillation

REAGENTS

- Pyrophoric
- Toxic
- Explosive

Peroxides



High Peroxide Hazard (3 months)

- Butadiene, Divinyl Ether, Sodium Amide, Vinylidene Chloride

Medium Peroxide Hazard (12 months)

- Diethyl ether, Dioxane, THF, Secondary Alcohols, Cyclohexene, Benzyl Alcohol

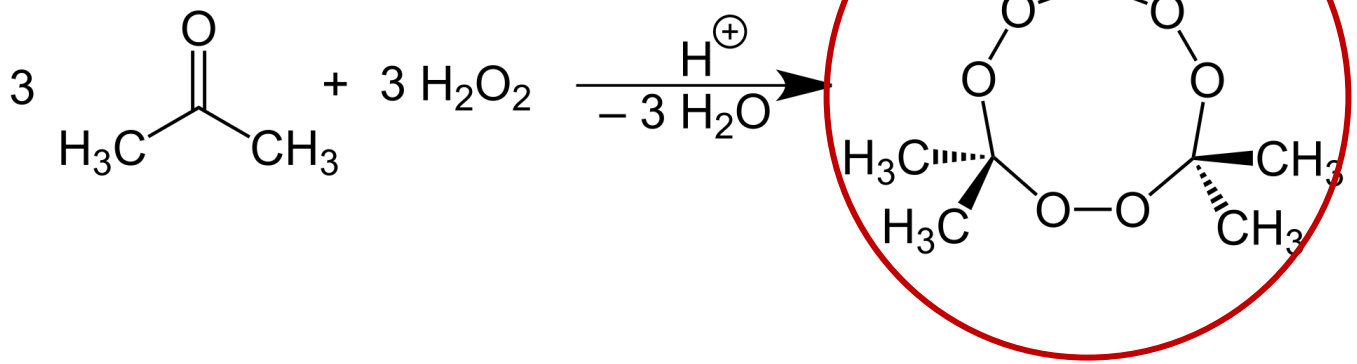
- Date solvent bottles
- Test with peroxide strips
- Peroxides are thermal and shock explosive hazards

REAGENTS

- Pyrophoric
- Toxic
- Explosive

Mixing of 2 common chemicals

Acetone & hydrogen peroxide



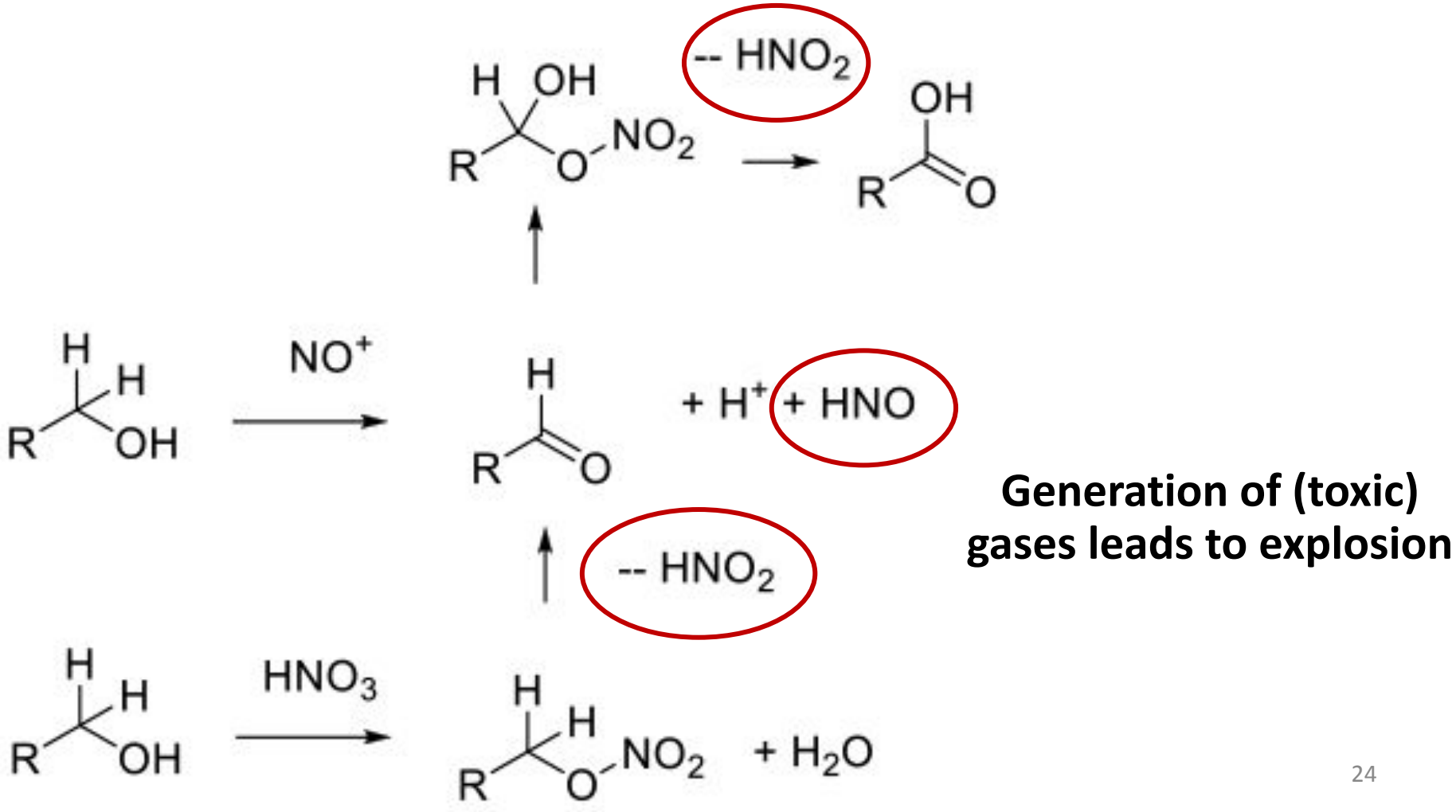
Shock sensitive explosive powder

REAGENTS

- Pyrophoric
- Toxic
- Explosive

Mixing of 2 common chemicals

Nitric Acid & Ethanol



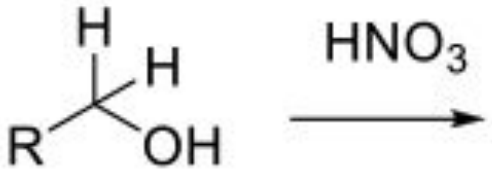
Generation of (toxic) gases leads to explosion

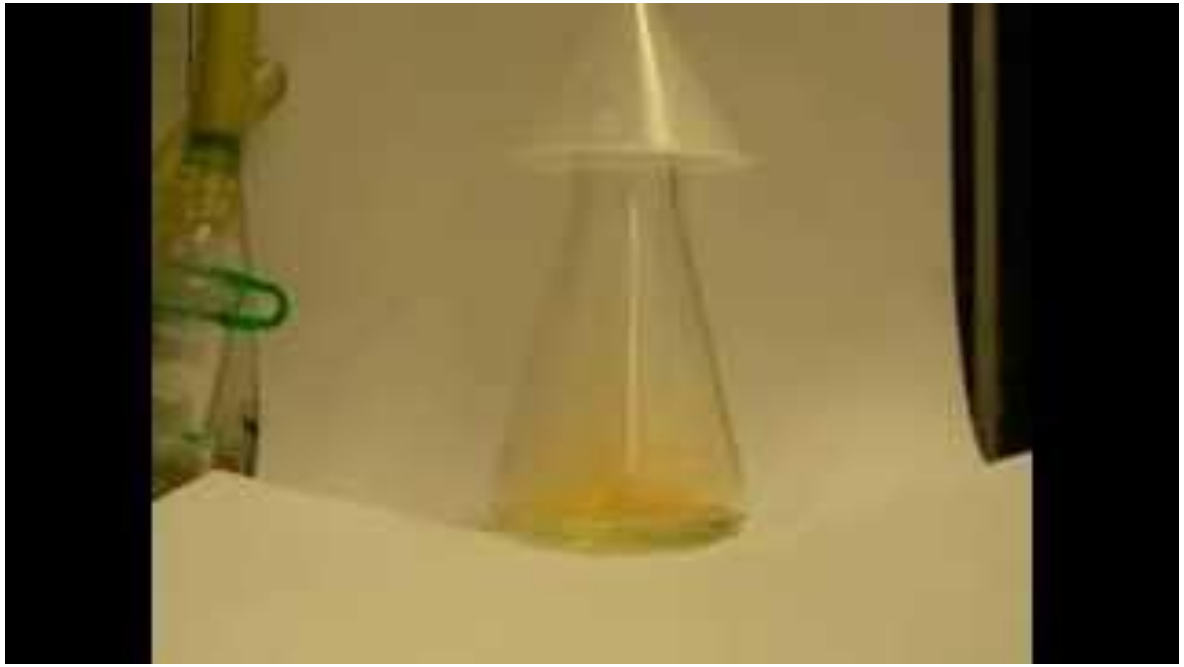
REAGENTS

- Pyrophoric
- Toxic
- Explosive

Mixing of 2 common chemicals

Nitric Acid & Ethanol





2 mL EtOH + 2 mL HNO_3 (conc.)

Hazards of Common Techniques

TECHNIQUE

- Base Bath
- Oil Baths
- Liquid N_2
- Needles
- Silica

Base bath

Base bath: Mixture of *i*PrOH and KOH for deep-cleaning glassware
Removes metals, silicone grease, fatty things

DONT's

- No Frits
- No Metal Spatulas
- Store Near Flame Risk

DO's

- **Eye protection**
- Use heavy gloves over nitrile gloves
- Recommended time: a few hours

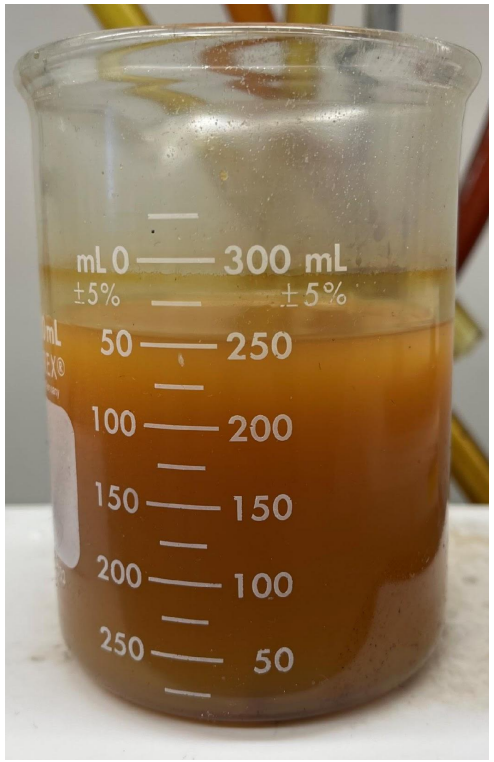
TECHNIQUE

- Base Bath
- Oil Baths
- Liquid N_2
- Needles
- Silica

Oil Bath

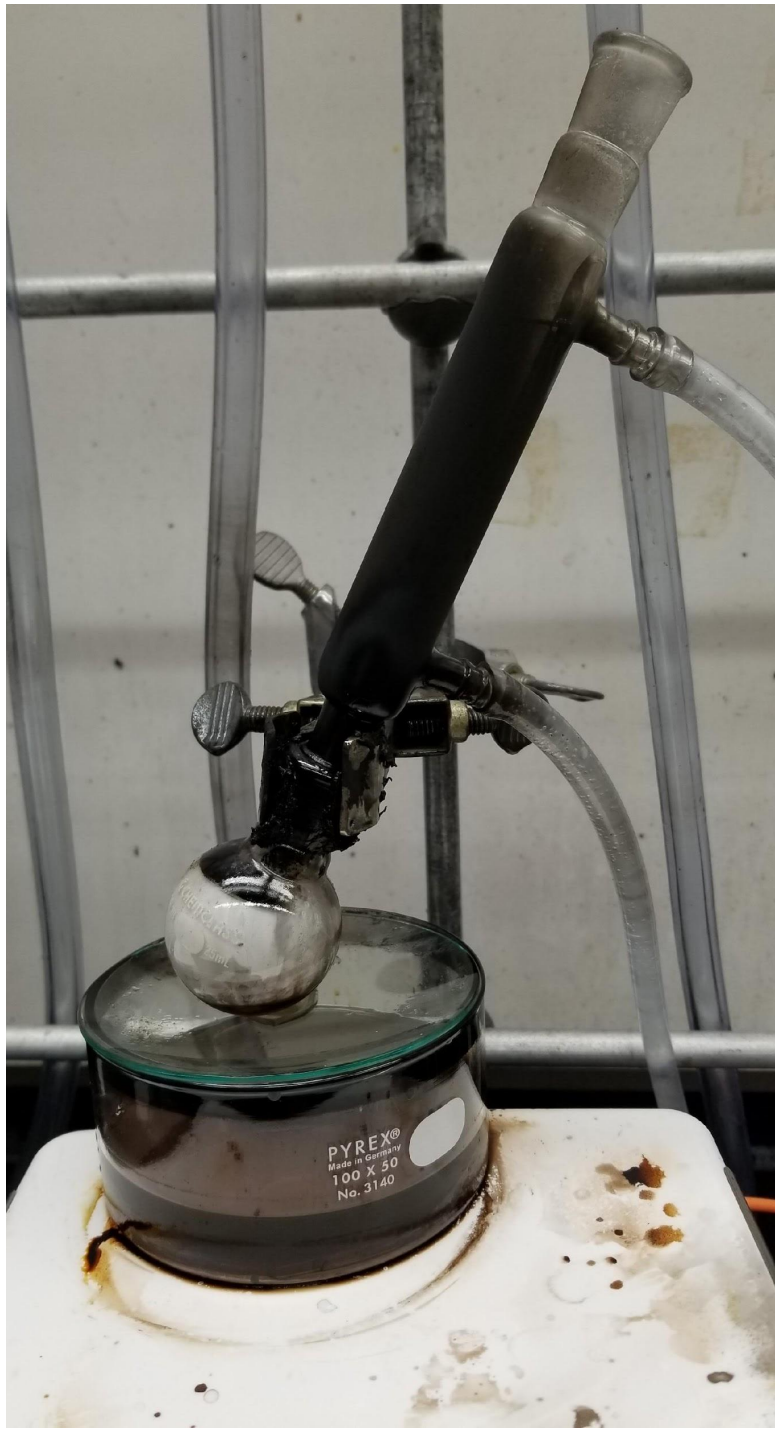
Oil Bath for Heating

- Should be Silicone Oil
  - Not all oil can be heated
  - Mineral Oil is for bubblers – don't mix!
- Max temp: ~200 °C
  - Oil will decompose at higher temperatures



Alternatives

- Sand (X00 ^{0}C) or Aluminum Beads (-80 – 180 ^{0}C)
- Thermometer placement and temp gradient



Double-Check the Undergrads!

- Incident was discussed at group meeting
- Advisor should be involved

TECHNIQUE

- Base Bath
- Oil Baths
- Liquid N_2
- Needles
- Silica

Liquid N_2

Liquid N_2 is colder than liquid O_2

- Do not pull air through your N_2 trap
  - No vacuum filtrations
  - Be vigilant
- Use a vacuum gauge
- If using an argon glovebox, can condense argon in the trap

Liquid O_2

https://news.mit.edu/1992/safety-0311

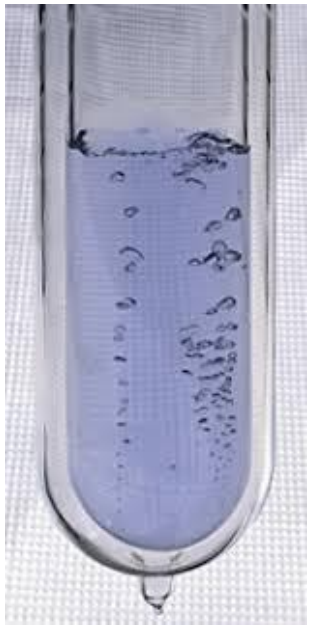
TECHNIQUE

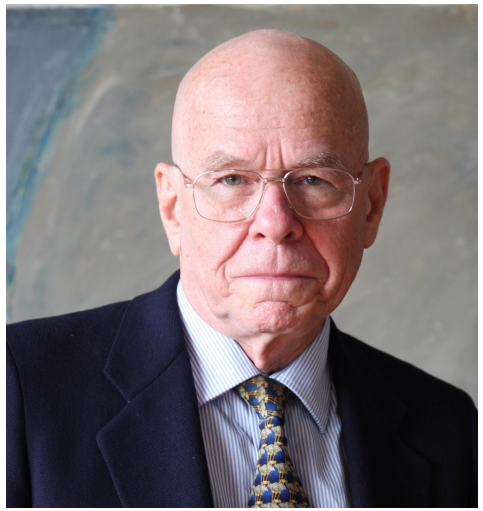
- Base Bath
- Oil Baths
- Liquid N_2
- Needles
- Silica

Liquid N_2

Liquid N_2 is colder than liquid O_2

- Do not pull air through your N_2 trap
  - No vacuum filtrations
  - Be vigilant
- Use a vacuum gauge
- If using an argon glovebox, can condense argon in the trap
- K. Barry Sharpless
  - Blind in one eye





https://news.mit.edu/1992/safety-0311

TECHNIQUE

- Base Bath
- Oil Baths
- Liquid N_2
- Needles
- Silica

Needles and Syringing

Do Not Recap Needles

- Recapping needles is dangerous
- Used needles go in needle waste
  - Filled with plaster or wax before disposal

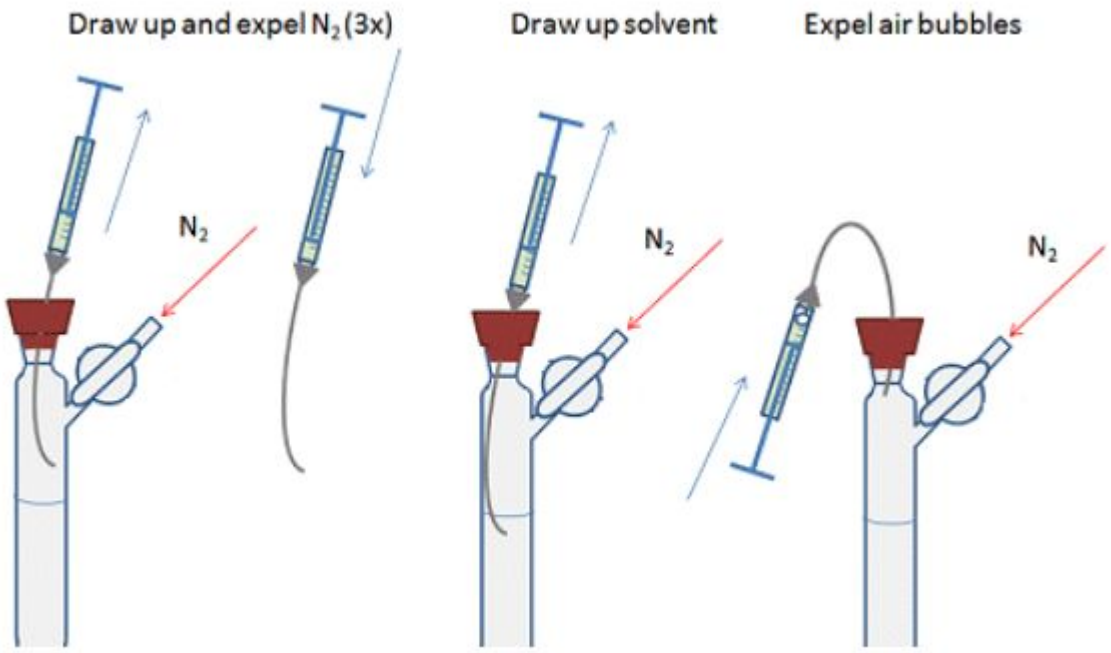
Early stages of necrosis by CH_2Cl_2

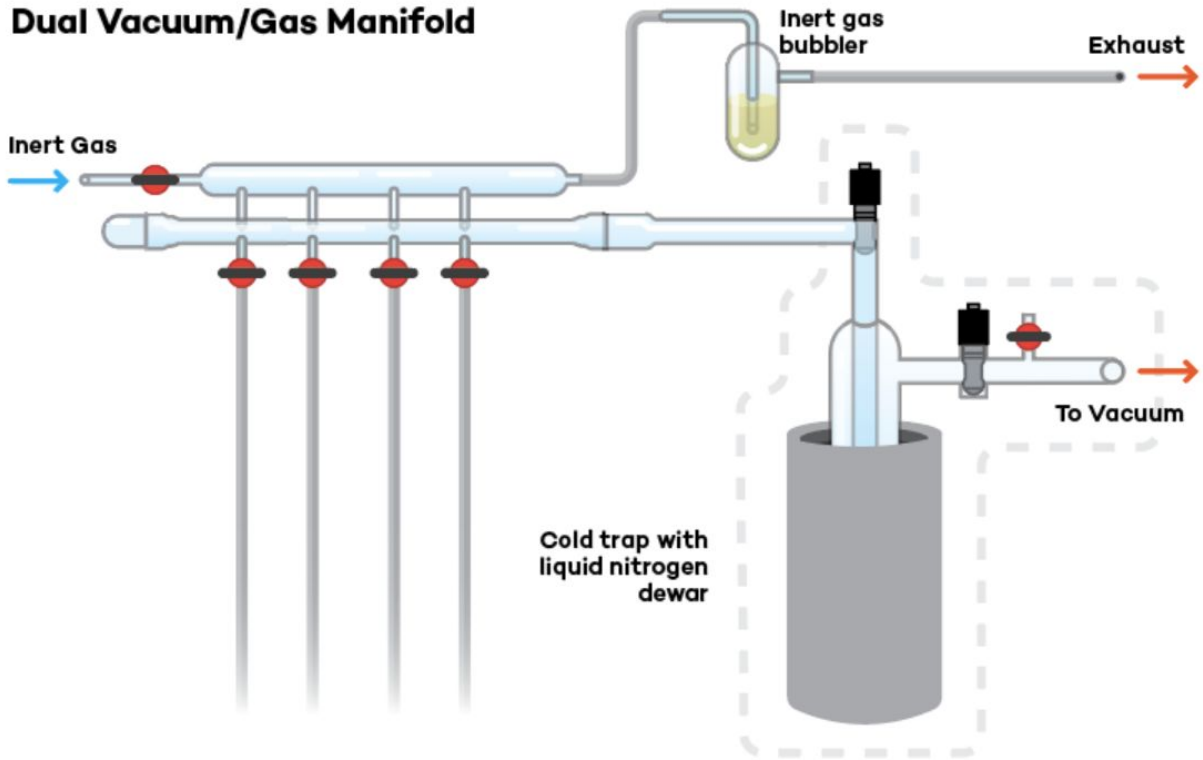
ACS Cent. Sci. **2020**, *6*, 83−86

Needles and Syringing

For pyrophorics:

- Draw up N_2 after proper volume is drawn**.**
- **Never** use more than half the syringe volume.





https://www.chemistryviews.org/details/education/4360441/Tips_and_Tricks_for_the_Lab_Air-Sensitive_Techniques_3/

TECHNIQUE

- Base Bath
- Oil Baths
- Liquid N_2
- Needles
- Silica

Silica and Celite

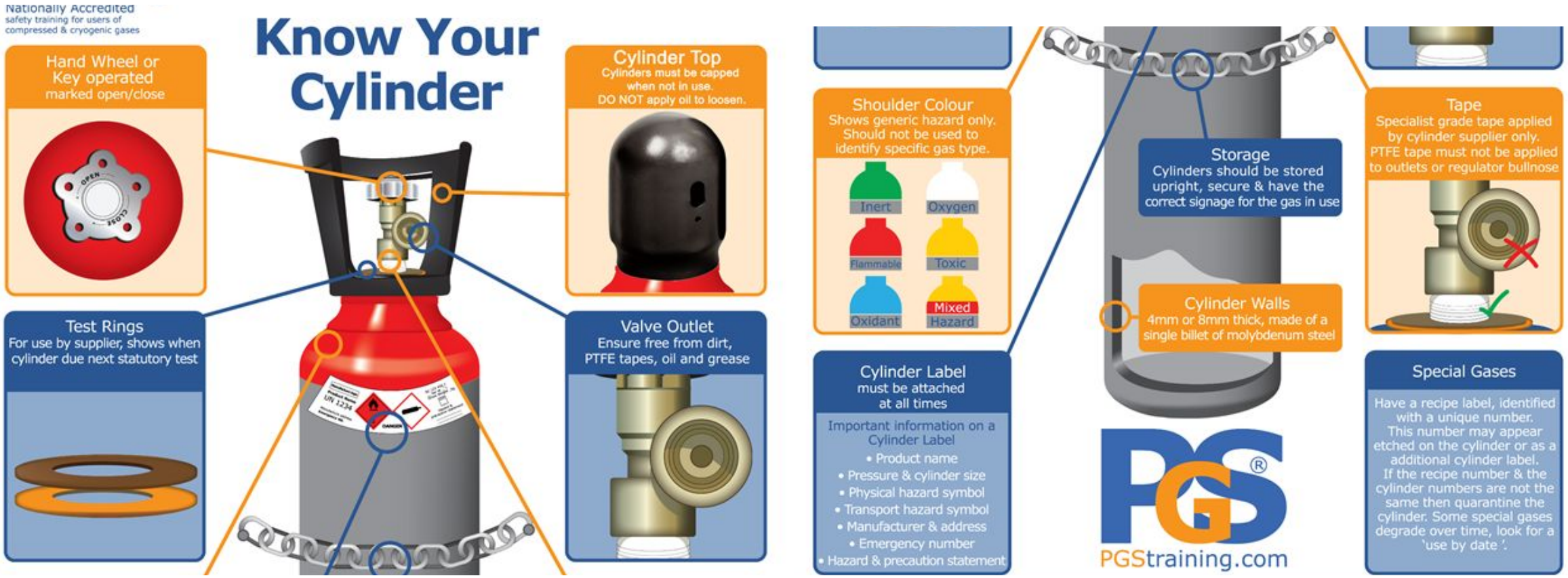
Inhalation Hazard

- Silica and Celite are abrasive and hazardous to the lungs
- Do not use without PPE (Face mask)
- Inhalation can cause Silicosis
- Silica vs asbestos

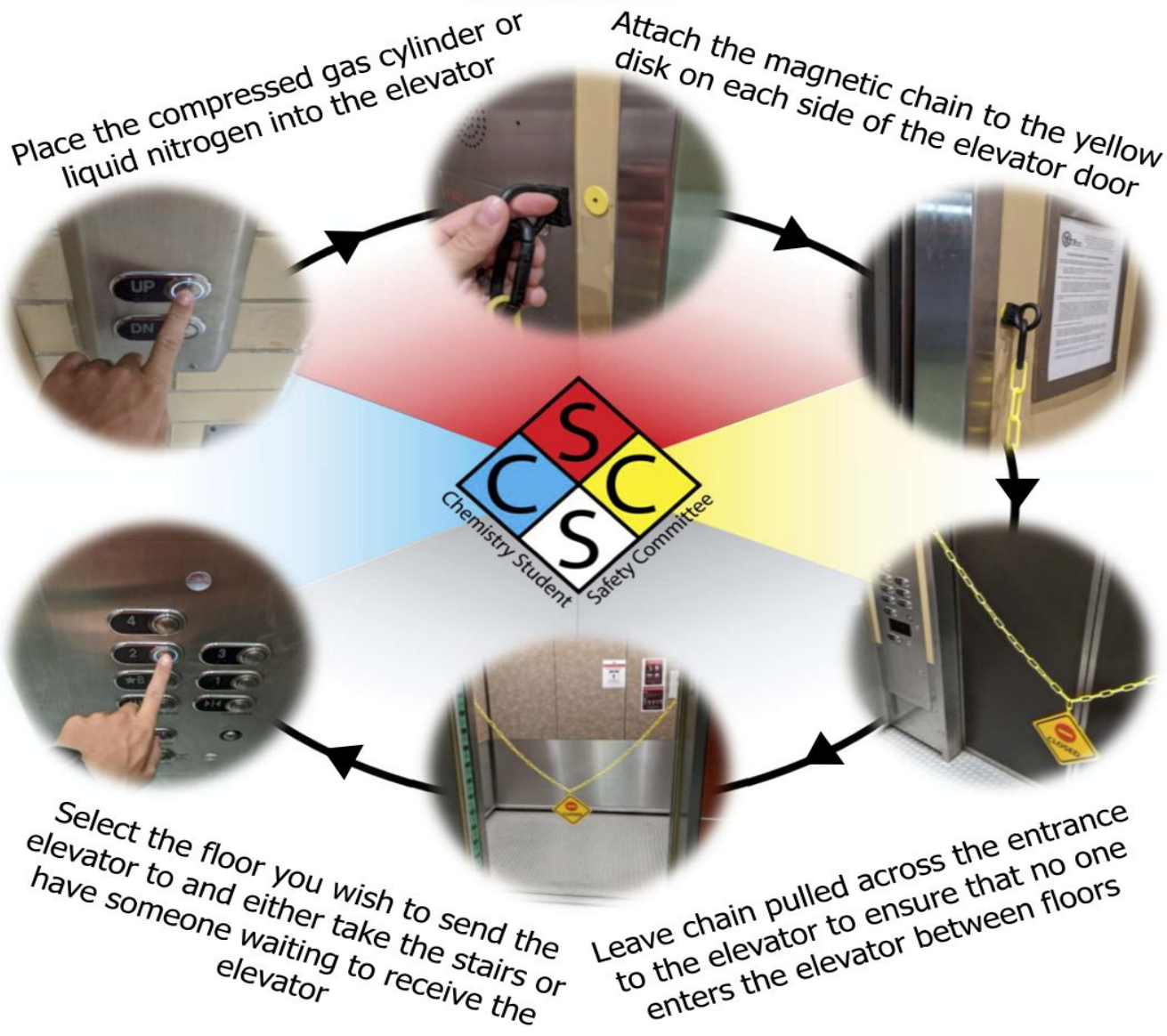
Asbestos

Silicosis

Gas Cylinders



Gas Cylinders



Resources

Chemical Waste Guide

Chemical Waste

The Chemical Waste Program collects and processes chemical waste from campus labs and shops in compliance with federal and state regulations. The waste is processed for disposal in the most environmentally sound and cost-effective method available.

Contact Information

Jason Ward

- 979-845-3498
- JSWard@tamu.edu

Jeff Truss

- 979-845-4029
- jctruss@tamu.edu

- Make a Report
- EHS News
- Hot Topics
- Training Opportunities
- Facebook
- Twitter
- Emergency Procedures
- Campus Safety Letter

How Do I

- How do I register or close out/decommission my laboratory?
- Dispose of Chemical Waste?

Documents

- Chemical Waste Disposal Informational
- Dakota Chemical Waste Tracking User Guide
- Chemical Waste Guide (website)
- Pollution Prevention Program
- Hazardous Chemical Waste Management Program
- Pollution Prevention Poster (1)
- Pollution Prevention Poster (2)

Links

- DakotaSoft
- Texas Commission on Environmental Quality
- Environmental Protection Agency

https://ehs.tamu.edu/programs/Chemical%20Waste.html

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TEXAS A&M UNIVERSITY

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Safety in Chemistry at Texas A&M

The Department of Chemistry strives continuously to provide a safe working environment in all of our instructional and research laboratories and support facilities. Despite the variety of potential hazards inherent in chemical laboratories, proper observance by all faculty, staff, and students of proper safety practices will minimize the possible risks and help to maintain an excellent safety record.

Safety Suggestions

The newly formed Chemistry Student Safety Committee (CSSC) is committed to a safe working envirmonemt. It's mission is to improve departmental safety culture through student-led initiatives. Please help us by giving your safety suggestions. We are looking for suggestions for future CSSC projects, lab experiences that may serve as safety learning moments, safety concerns you have observed and want to bring to our attention, feedback on how CSSC operates and ideas for improvements, and anyone who wants to learn more about safety culture. Suggestions are anonymous, unless you choose to identify yourself. Students, faculty, postdocs, staff, and visitors are all encouraged to provide feedback.

Upcoming Safety Events

Submit a Safety Suggestion

Safety Resources

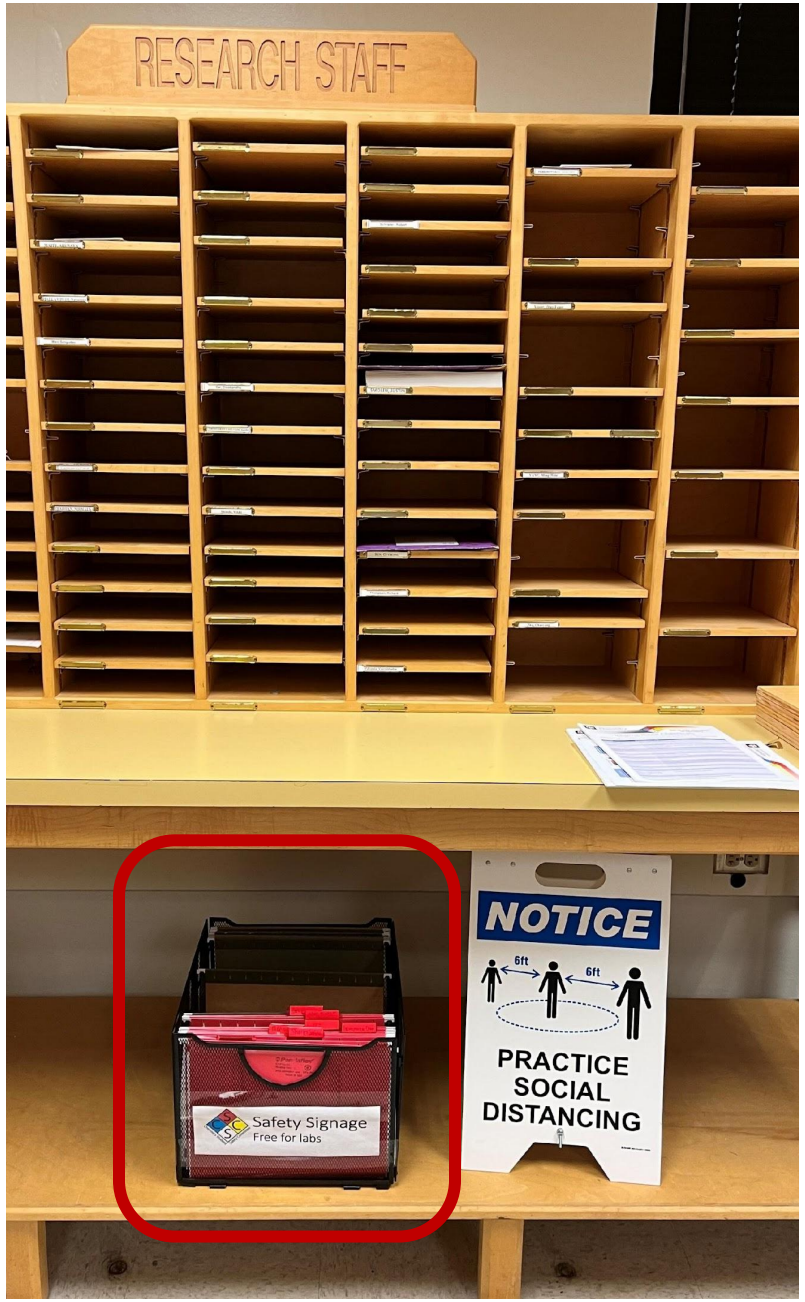
- Department Safety Guide
- Texas A&M Environmental Health and Safety
- Dow Safety Academy
- ACS Safety Zone
- Department Emergency Response Plan

CSSC Safety Improvement Projects

- Laboratory Signage Standardization
- Safety Resource Posters
- Safety Speaker Series
- Laboratory Upgrades

cssc@chem.tamu.edu
https://www.chem.tamu.edu/safety/

5th Annual Safety Symposium Coming February 2024



TEXAS A&M UNIVERSITY Chemistry

Tell us your thoughts!
tx.ag/safety

Safe Handling of Pyrophoric Materials

Pyrophoric materials ignite upon exposure to air or moisture

General Protocol

- Work under an inert atmosphere, glovebox (preferred) or in a fume hood with oven-dried glassware
- Remove all clutter and flammables (such as KimWipes) from working area
- Use the "buddy system" to avoid handling pyrophorics alone

SCAN FOR MORE THOROUGH INFORMATION AND EXPERIMENTAL SETUPS

- Use a long needle and a syringe that is twice the volume of liquid being transferred
- Large volumes of liquid should be transferred via cannula
- If exposed, seek the nearest safety shower, fire blanket, or fire extinguisher (ABC type)

Storage and Disposal

- Store under inert atmosphere or under kerosene as recommended in the MSDS; NEVER in a flammables cabinet
- Reactive materials must be quenched before disposal
- Storage containers should be rinsed with dry solvent and allowed to sit in a fume hood overnight
- Contact EHS for more detailed instructions

ENVIRONMENTAL HEALTH & SAFETY

Proper PPE

- Chemical Splash Goggles/Safety Glasses
- Flame Resistant (FR) Lab Coat
- *Neoprene Gloves
- Appropriate pants and shoes

*Nitrile gloves can be adequate but are combustible

Common Pyrophoric Chemicals

- Organolithiums
- Grignard reagents
- Organozincs
- Alkyl aluminums
- Metal hydrides (NaH, KH, $LiAlH_4$)
- Finely divided metal powders (bismuth, calcium, magnesium, titanium, etc.)
- Some silanes and phosphines

Note: this is a general list. More exhaustive lists can be found online.


lab Safety guide©: Are you stupid?! v2.0
Weee.
Ack!
My eyes!
Acid
Arf.
Bookbag
Fire
Where is the fire blanket, dudes?
Why is the stoner still broken?
mmmf.
feel anything yet?
Pipette
Dio
Sooper torch
Also Fire
Rave till dawn
Exit
Peace, geeks.
he-heh
duh de dum
YAAAAAAY!
WASTE
Broken glass
Shards of broken glass that will go on to stab some poor housekeeping personnel (or melanie or me).
WAY deadly e.coli