STANDARD OPERATING PROCEDURES (SOP) FOR WORKING WITH PYROPHORIC CHEMICALS AT AMHERST COLLEGE

General Information

Pyrophoric Chemicals are solid, liquid, or gas compounds that, when exposed to air or moisture at or below 54°C (130°F), can spontaneously ignite.

Examples of Pyrophoric chemicals used at Amherst College Laboratories include: sodium hydride, zinc powder, and Grignard reagents. See the "Appendix" page below for a full list of Pyrophoric Chemicals.

Pyrophoric chemicals are often used as catalysts in chemical reactions or as reducing and deprotonating agents in organic chemistry.

Note that Pyrophoric chemicals may also be characterized by other hazards, hence, users of these chemicals may also need to refer to other SOPs that cover other hazards. In addition, each individual chemical's Safety Data Sheet (SDS) should be consulted before they are used.

Personal Protective Equipment

When working with Pyrophoric Chemicals, the following personal protective equipment (PPE) **must** be worn, at a minimum. Depending on the specific chemical, other forms of protection might be required. Consult the SDS for each chemical before use:

Splash goggles

Lab coat (Fire resistant lab coat highly recommended)

Long pants

Close toed shoes

Gloves – Nitrile gloves adequate for accidental contact with small quantities. However, the use of fire resistant Nomex/ Leather Pilot's gloves is highly recommended

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Safety Devices

All work with Pyrophoric chemicals must be done in a glove box, vacuum manifold, or any enclosed inert environment. If work must be done in a fume hood, ensure that the hood sash is in the lowest feasible position.

A blast shield may also be employed to provide an additional level of protection in cases where the potential for an explosion or a high thermal reaction exists

Identify the location of all the safety devices in the room before starting your procedure (particularly, the Class D fire extinguisher / Met-L-X , and sand) and familiarize yourself with all the possible means of egress.

Specific Health Hazards

The Permissible Exposure Limits (PEL) for Pyrophoric Chemicals are specific to each individual chemical. Review the SDS before using each chemical.

Pictogram: 

All Pyrophoric Chemicals are flammable. However, some of these chemicals might also be characterized by additional hazards.

Consult the SDS for more information about a specific chemical

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Possible Routes of Entry

Inhalation, eye/skin contact, ingestion

If *any part of your body* comes in contact with Pyrophoric Chemicals, call the Amherst College Emergency phone number 413-542-2111. Also call this number if you begin to feel ill after working with or in the vicinity of Pyrophoric Chemicals

Inhalation

If inhaled, move to fresh air and get help. if you begin to feel ill during / after working with Pyrophoric Chemicals, Call the Amherst College Police Department (ACDP) at x2111 to report it

Eye contact

Use eyewash to flush eyes with water for at least 15 minutes

Skin Contact

Wash skin with plenty of water for 15 minutes. Use safety shower, if needed.

Ingestion

Do not induce vomiting

Storage and Special Handling

Store Pyrophoric chemicals in the original shipping can, if possible

Store in an inert gas atmosphere, such as in a glove box or under appropriate liquid (eg. Oil)

Store away from other flammable materials, oxidizers, heat sources, ignition sources, open flames, strong acids, strong bases, liquid chemicals, water sources, normal atmospheric environments

Do not store on shelf or in a refrigerator/freezer

If you have Pyrophoric chemicals that have expired or that you no longer need, please contact Jason Williams (x2736) for disposal

Special Handling

Post a sign on the fume hood when a process involving Pyrophoric chemicals is unattended

Remove all other flammable materials in the immediate area when working with Pyrophoric chemicals

Take note of any printed expiration dates on the container label and dispose of them as required. **Many Pyrophoric reagents become unstable or more dangerous with age**

It is highly recommended that transportation of Pyrophoric materials throughout the building be done in a container with sand

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Spill clean up

Do not attempt to clean up Pyrophoric Chemicals, regardless of the size of the spill

If a spill occurs:

Call Jason Williams (Chemical Hygiene Officer) or The Amherst College emergency number (x2111) to report it.

Alert everyone in the area

Leave the room and close the door behind you

Call Jason Williams (Chemical Hygiene Officer) or The Amherst College emergency number (x2111) to report it.

Disposal

Waste or waste-like Pyrophoric chemicals should not be placed into Satellite Accumulation Areas. Contact the Chemical Hygiene Officer or Environmental Health and Safety as soon as waste or waste-like Pyrophoric chemicals are generated.

Reaction mixtures containing these materials must be completely quenched before being picked up as waste. Consult your Principal Investigator or Chemical Hygiene Officer if you are unsure about quenching procedures

Syringes, “empty” bottles, and all other materials that come in contact with Pyrophoric materials can lead to a fire if not handled appropriately. These materials must also be quenched before being removed from their inert environments.

If you have Pyrophoric Chemicals that you no longer need, contact the Chemical Hygiene officer

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Questions

Contact Jason Williams or Environmental Health and Safety if you have any questions about this SOP or this compound.

APPENDIX

List of Pyrophoric Chemicals

Phase: solid, liquid or gas

Liquids: examples

Alkylaluminum reagents (Neat or in hydrocarbon solvents) (Neat reagents are VERY pyrophoric)
Alkyllithium reagents (Typically in hydrocarbon solvents) (Tert-butyllithium is VERY pyrophoric)
Alkenyllithium and Aryllithium reagents (Typically in hydrocarbon solvents)
Alkynyllithium reagents (Typically in hydrocarbon solvents)
Alkylzinc reagents (Neat reagents are pyrophoric)
Boranes (Neat reagents are pyrophoric)
Grignard Reagents (RMgX) (Typically in hydrocarbon solvents)
Partially or fully alkylated derivatives of metal and nonmetal hydrides (diethylaluminium hydride,diisobutylaluminum hydride, dichloro(methyl)silane) (Usually in liquid form or in solution.)
Alkylated metals (butyllithium, triethylboron, trimethylaluminum) (Usually in liquid form or in solution.)
Non-metal alkyls: R3B, R3P, R3As; Tetramethylsilane, Tributylphosphine"
Metal alkyls and aryls, such as RLi, RNa, R3Al, R2Zn
UCLA

Solids:

Alkali metals (lithium, sodium, potassium, especially sodium potassium alloy – NaK, and even more dangerous are cesium and rubidium)
Alkylated metal alkoxides or halides (dimethylaluminum chloride, diethylethoxyaluminium)
Finely divided metals (bismuth, calcium, hafnium, iron, magnesium, titanium, uranium, zirconium) Al, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr
Low valent metals (titanium dichloride)
Metal hydrides (potassium hydride, sodium hydride, lithium aluminum hydride, uranium trihydride NaH, LiAlH4)
Nonmetals (white phosphorous)
Metal carbonyls (dicobalt octacarbonyl, nickel carbonyl) Ni(CO)4, Fe(CO)5, Co2(CO)8
Used hydrogenation catalysts, e.g. Raney Ni, are especially hazardous due to adsorbed hydrogen gas
Copper fuel cell catalysts, e.g. Cu/ZnO/Al2O3 Methanetellurol (CH3TeH)
Finely divided Iron sulfides (FeS, FeS2, Fe3S4), Potassium sulfide (K2S), Aluminum phosphide (AlP)" UCLA

Gases:

Nonmetal hydrides (arsine, boranes, germane, phosphine, silane) (Most of these are actually gases.)
B2H6 and other boranes, PH3, AsH3

Index to Pyrophoric Chemicals

acetic acid bromide
acetic acid chloride
acetyl bromide
acetyl chloride
acetyl peroxide
aluminum
aluminum aminoborohydride
aluminum borohydride
aluminum borohydride
aluminum borohydride mixture
aluminum hydride
aluminum phosphide
aluminum sesquibromide ethylate
amyl trichlorosilane
anisic acid chloride
anisoyl chloride
antimony pentachloride
antimony triethyl
antimony trimethyl
arsenic trichloride
arsenic triethyl
arsenic trimethyl
azido thallium
barium
barium azide
barium carbide
barium hydride
barium peroxide
barium sulfide
benzene, 1,2-epoxyethyl
benzoyl chloride
benzyl silane
benzyl sodium
beryllium
beryllium borohydride
beryllium hydride
bis(ethylamino) siloxene
bis-cyclopentadienyl manganese
bis-dimethylstibine oxide
bismuth

bismuth ethyl chloride
bis-trifluoromethyl chlorophosphine
bis-trifluoromethyl cyanophosphine
bis-trifluoromethyl phosphine
boron
boron arsenotribromide
boron chloride tetramer
boron tribromide
boron triethyl
boron trimethyl
bromine pentafluoride
bromoacetylene
bromoethyne
bromosilane
butadiene
butyl boron dichloride
butyl boron difluoride
butyl lithium
cacodyl
cacodyl arsine
cacodyl chloride
cacodyl dioxide
cacodyl fluoride
cacodyl iodide
cacodyl sulfide
cadmium
cadmium amide
cadmium nitride
calcium
calcium carbide
calcium hydride
calcium hypochlorite
calcium nitride
calcium phosphide
calcium sulfide
carbon disulfide
carbon hexachloride
carbon trichloride
cerium
cerium aluminohydride
cerium amalgam
cerium hydride
cerium hydride amalgam

cerium nitride
cerium-indium alloys
cesium
cesium amide
cesium arsenic alloy
cesium bismuth alloy
cesium hydride
cesium oxide
cesium phosphide
cesium silicide
cesium-antimony alloy
charcoal
chlorine trifluoride
chloroacetylene
chlorodimethyl arsine
chloroethyne
chlorosulfonic acid
chromium
chromium-cobalt alloy
chromium monoxide
chromyl chloride
cobalt
cobalt abietate
cobalt amalgam
cobalt nitride
cobaltous resinate
cobalt triphosphine
copper
copper aluminohydride
copper hydride
cupric phosphide
decaborane
deuterium
diacetylene
diamidophosphorous acid
diazirine
diborane
dibromo borine phosphine
dibutyl boron chloride
dibutyl chloroborine
dibutyl magnesium
di-chloroacetylene
diethoxy siloxene

diethyl aluminum bromide
diethyl aluminum chloride
diethyl aluminum hydride
diethyl arsine
diethyl beryllium
diethyl bismuth chloride
diethyl boron chloride
diethyl cadmium
diethyl dichlorosilane
diethyldiethyl amino-3-propyl alumine
diethyl 4-ethoxybutylamine
diethyl phosphine
1,2-diethyl tetraiodo dialumene
diethyl zinc
difluorourea
digermane
dihydrohexaborane
diisobutyl aluminum chloride
diisobutyl aluminum hydride
diisopropylberyllium
dimethyl allyl arsine
dimethyl arsine
dimethyl beryllium
dimethyl cadmium
dimethylchloroarsine
dimethyl dichlorosilane
dimethyl dimethyl phosphoramidate
dimethyl magnesium
dimethyl manganese
dimethyl phosphine
di- n -propyl zinc
di- n -propylaluminum hydride
diphosphine
dipotassium aci -nitroacetate
dipropyl chloroborine
disilane
disilyamino diborane
disilyamino dichloroborine
disulfur dinitride
divanadium dodecacarbonyl
divinyl zinc
ethanoyl bromide
ethanoyl chloride

ethylaluminum dichloride
ethyl aluminum sesquichloride
ethyl boron dichloride
ethyl dichloroalumine
2-ethylhexaldehyde
ethyl lithium
ethyl methyl arsine
ethyl nitrite
ethyl pentaborane
ethyl sodium
ethyl trichlorosilane
europium
ferrous oxide
gallium hydride
germanium hydride
germanium tetrahydride
hafnium
hafnium borohydride
HEF-2
hexaamminecalcium
hexaborane
hexachloroethane mixture
hydrogen phosphide
indium monoxide
iron
iron amalgam
iron hydroxide
iron pentacarbonyl
iron sulfide
isobutyl titanium trichloride
isopropylaluminum
lanthanum-antimony alloy
lead
lead imide
lithium
lithium aluminum deuteride
lithium aluminum hydride
lithium aluminum tri- tert -butoxyhydride
lithium amide
lithium borohydride
lithium dimethylamide
lithium hydride
lithium hypochlorite

lithium phosphide
lithium phosphorus alloy
lithium silicide
lithium tetramethyl borate
magnesium
magnesium cyanide
magnesium diamide
magnesium diethyl
magnesium diphenyl
magnesium hydride
magnesium phosphide
manganese
manganese aluminohydride
manganese heptoxide
manganese-bismuth alloy
methyl aluminum sesquibromide
methyl aluminum sesquichloride
N-methyl N,N-bis(diethylborinic)imide
methyl copper
methylene dilithium
methylene magnesium
methylethyliodoarsine
methyl lithium
methyl phosphine
methyl sodium
methyl trichlorosilane
(methyl sily)amino diborane
molybdenum
molybdenum dioxide
molybdenum trioxide
monochlorodiborane
monomethylhydrazine
nickel
nickel carbonyl
nickel-iron alloy
nickel lanthanum
nitrosilane
nitroso chloride of α -methylstyrene
p -nitrosophenol
O,O-dimethyl thiophosphoryl chloride
oleum
oxodisilane
oxosilane

pentaborane
pentamethyl aluminum hydride
pentamethyl dialumene
perchloroethane
phenyl cacodyl
phenyl cyclotetramethylene borine
phenyldiazosulfide
phenyl dicyclopentadienylvanadium
phenyldimethyl antimony
phenyl lithium
phenyloxiran
phenylsilver
phosphine
phosphorus
phosphorus oxychloride
phosphorus pentachloride
phosphorus pentasulfide
phosphorus sesquisulfide
phosphorus trichloride
phosphorus trioxide
plutonium
plutonium hydride
potassium
potassium-antimony alloy
potassium arsenic alloy
potassium carbide
potassium carbonyl
potassium chlorate
potassium graphite
potassium hydride
potassium nitride
potassium nitromethane
potassium peroxide
potassium phosphide
potassium-phosphorus alloy
potassium silicide
potassium sulfide
n -propyl lithium
propyl silane
prosiloxane
3-pyridine-diazonium fluoroborate
pyridinium perchlorate
rosin

rubidium
rubidium-antimony alloy
rubidium-arsenic alloy
rubidium-bismuth alloy
rubidium hydride
rubidium phosphide
rubidium silicide
silane
silicocyn
silicon
silicon carbide
silicon hexachloride
silicon hydride
silicon monoxide
siloxane
silver
silyl phosphine
sodium
sodium acetate
sodium aluminum hydride
sodium amalgam
sodium amide
sodium carbide
sodium carbonyl
sodium hydrazide
sodium hydride
sodium hydrosulfite
sodium hydroxylamine
sodium hypochlorite
sodium lead alloy
sodium methylate
sodium nitromethane
sodium phosphamide
sodium phosphide
sodium silicide
sodium sulfide
sodium-potassium alloy
stannic phosphide
stearic acid
strontium
strontium azide
strontium hydride
styrene oxide

sulfur
sulfur trioxide
sulfuryl chloride
tetraborane
tetrabromosilane
tetrabutyl diborinyl oxyethane
tetrachlorodiborane
1,1,2,2-tetramethyl dialumene
tetramethyl diarsine
tetramethyl diarsine
tetramethyl diborane
tetramethyl diborane
tetramethyl digalline
tetramethyl distibine
tetramethyl silane
tetramethyldiarsyl
tetraphenyl diarsine
thiophosphoryl fluoride
thorium
thorium hydride
thorium nitride
thorium oxysulfide
thorium silver alloy
tin
tin tetrachloride
titanium boride
titanium carbide
titanium dibromide
titanium dichloride
titanium diiodide
titanium monoxide
titanium tetrachloride
titanium trichloride
triazido borine
tribromo borine arsine
tribromosilane
tributyl phosphine
tri-chloroacetylene
trichlorosilane
trichlorotrimethylborazole
tridecanal
tridecyl aldehyde
triethyl alumine diethyl ether

triethyl aluminum
triethyl aluminum etherate
triethyl aluminum triethyl boron
triethyl antimony sulfate
triethyl bismuth
triethyl borine
triethyl diborane
1,1,3-triethyl ethoxy diphosphinyl oxide
triethyl gallium
triethyl indium
triethyl stibine
triethyl tellurium
1,1,1-triethyl trichlorodialumene
trifluoromethyl phosphine
trigermane
tri-iso-butylaluminum
trimethyl alumine dimethyl ether
trimethyl alumine diethyl ether
trimethyl aluminum
trimethyl aluminum bromide
trimethyl aluminum dimethyl ether complex
trimethyl aluminum hydride
trimethyl antimony sulfate
trimethyl arsine
trimethyl bismuth
trimethyl borine
trimethyl boron
trimethyl chlorosilane
1,1,2-trimethyl dialumene
1,1,2-trimethyl diborane
trimethyl gallium
trimethyl indium
trimethyl phosphine
trimethyl thallium
trimethylbismuthine
tri- n -butylaluminum
tri- n -butylborane
triphenyl aluminum
triphenyl tungsten-tris(phenyl lithium)-tris(diethyl ether)
tripropyl antimony
tripropyl boron
tripropyl indium
tripropylaluminum

tripropylaluminum
1,1,1-trimethyl tribromo dialumene
trisilane
trisilicylamine
trisilyl arsine
trisilyl phosphine
trisilylamine
tris-trifluoromethyl phosphine
tris(trimethyl silyl) phosphine
trisulfur dinitrogen dioxide
tritium
trivinyl bismuth
trivinyl stibine
tungsten
unsymmetrical dimethyl hydrazine
uranium
uranium-bismuth alloy
uranium borohydride
uranium carbide
uranium hydride
uranium hydride
uranium monocarbide
uranium nitride
uranium oxide
vanadium sesquioxide
vanadyl chloride
vinyl trichlorosilane
vinylmethyl tetrazole triborane
zinc
zinc dimethyl
zinc isoamyl
zinc isobutyl
zirconium
zirconium borohydride
zirconium carbide
zirconium carbonitride
zirconium dibromide