NJIT New Jersey Institute of Technology

POTENTIALLY EXPLOSIVE CHEMICALS (PEC)

STANDARD OPERATING PROCEDURE

Type of SOP: ☐ Process ☐ Hazardous Chemical ☐ Hazard Class

Department: _____ **Building:** _____ **Room #:**_____

Principal Investigator: _____ **Phone #:**_____

Prepared By: _____ **Email:** _____ **Date:** _____

1. HAZARD OVERVIEW

PECs are chemicals (or combinations thereof) that may cause a sudden release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature. Materials having these general properties are termed "explosive" throughout this document in the commonly-used sense of the word. However, the technical definition of an **explosive** is a material that meets certain criteria for the speed of the chemical reaction. **Deflagration** is another term sometimes used for explosive reactions of slower speed. **Unstable reactive** is another term used to describe some of these materials.

This SOP describes how to safely handle these types of chemical compounds in general. SOP's covering specific chemicals/chemical classes in greater detail should be appended to this SOP if their use is routine in the laboratory.

Explosive chemicals can release tremendous amounts of destructive energy rapidly. If not handled properly, these chemicals can pose a serious threat to the health and safety of laboratory personnel, emergency responders, building occupants, chemical waste handlers, etc.

There are two classes of explosive chemicals:

- **Known Explosive Chemicals** that are designed and produced for use as an explosive *(e.g., TNT, explosive bolts, bullets, blasting caps, and fireworks)*.
- **Potentially Explosive Chemicals (PECs)** are chemicals that can oxidize, become contaminated, dry out, or otherwise destabilize over time to become PECs *(e.g., isopropyl ether, sodium amide, and picric acid)*. Most chemicals that are used in research and teaching laboratories are stable and non-explosive at the time of purchase.

2. PERSONAL PROTECTIVE EQUIPMENT (PPE)

At minimum, safety glasses, lab coats, and gloves are required. However, the use of face shields and heavy leather gloves is advised when handling genuinely explosive materials. Additional or more protective PPE may be required. Please refer to the NJIT Chemical Hygiene Guide and Hazard Assessment Form to determine the proper PPE for handling corrosive materials.

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3. ENGINEERING/VENTILATION CONTROLS

- Heavy transparent plastic safety shielding shall be used for any operation having the potential for explosion, including the following situations:
  - When a reaction is attempted for the first time *(small quantities of reactants should be used to minimize hazards)*;
  - When a familiar reaction is carried out on a larger than usual scale *(i.e., 5-10 times more material)*; or
  - When operations are carried out under non-ambient conditions.
- Shields must be placed so that all personnel in the area are protected from hazard.
- All operations involving PECs and dilutions should be carried out in a certified chemical fume hood to keep airborne level below recommended exposure limits. Sash should be kept in down position to act as additional shielding. **NOTE:** A hood sash is not a good substitute for a genuine safety shield.
- Chemical fume hoods used as containment areas for particularly hazardous chemicals must have a face velocity of 100 lfm, averaged over the face of the hood and must be inspected annually by EHS.
- Laboratory rooms must be at negative pressure with respect to the corridors and external environment. The laboratory/room door must be kept closed at all times.
- The experimental set-up should be designed such that the reaction vessel can easily be immersed in a cold bath or other cooling device in case of a run-away exothermic reaction.

Please review the NJIT Chemical Hygiene Guide and the Safe Chemical Fume Hood Use Guide for information on the proper use of a chemical fume hood and criteria for implementing engineering controls.

☐ Chemical Fume Hood ☐ Glovebox ☐ Biological Safety Cabinet ☐ Other _____

Room Location of Unit(s): _____

4. SPECIAL HANDLING PROCEDURES AND STORAGE REQUIREMENTS

- Be sure to review the Safety Data Sheet (SDS) for all chemicals to be used in the experiment. General information on working with PECs can also be found in Prudent Practices in the Laboratory, see Secs. 4.D.3 and 6.G.
- A risk assessment by or including Faculty/PI shall be carried out before new work with PECs begins. EHS shall receive a copy of the risk assessment, and be notified of any new work, increase in volume, or experimental changes involving with PECs.
- **Do not** work alone with these high hazard substances. At least one other person **must** be present in the same laboratory when any work involving hazardous chemicals is being done.
- Eliminate hazard materials or substitute it for a less hazardous material when possible.
- Design your experiment to use the least amount of material possible to achieve the desired result. Consult with the Faculty/PI and EHS if the work involves procedure scale-up or other large quantities, or if there are any questions regarding appropriate safety procedures.

- Verify your experimental set-up and procedure prior to use. Be familiar with the Safety Data Sheets for all chemicals in use. Assess the hazards to ensure that appropriate controls are in place to minimize risk and address emergency shut-down procedures as appropriate.
- Areas in which longer-term experiments containing PECs should be labeled as “EXPLOSION RISK”.

Explosion risk

Hazard Class-Specific Practices:

It is important that chemical users track and dispose of chemicals before they become a problem. Proper inventory management systems can help mitigate risk to personnel and avert higher than normal disposal costs.

- Identify all explosive and potentially explosive chemicals in your inventory. **Never store unlabeled chemicals.** Before they can be shipped to a disposal site, unknown chemicals require special testing to determine which hazardous properties they possess.
- Record the opening date and the date the chemical should be discarded on the label of chemicals that may degrade to become potentially explosive.
- Keep explosive chemicals away from all ignition sources such as open flames, hot surfaces, spark sources, and direct sunlight.
- Consider designating a special area for explosive chemical use.
- Periodically check containers of chemicals that could become over-pressurized, like highly concentrated formic acid. **NOTE:** Release the pressure by unscrewing the cap, using protective heavy-duty gloves, chemically resistant coveralls, safety glasses, face shield, and a safety glass screen between you and the container.
- Make sure everyone who uses chemicals that are explosive or could become potentially explosive are thoroughly trained in safe storage methods, conditions to avoid (e.g., contamination), the hazards of the chemical, and disposal procedures.
- Chemically reactive substances are stored in designated cabinets in secondary containment and segregated away from incompatibles.

Most explosions occur while purifying or distilling mixtures. Therefore, use extreme caution before concentrating or purifying any mixture that may contain an explosive chemical *(e.g. a peroxide forming chemical or perchlorate)*.

5. INCIDENTS AND ACCIDENTS

Prevent the spill from spreading be applying sand, earth or other non-combustible material if it is safe to do so. Contact NJIT Public Safety to activate emergency response.

Laboratory personnel are to report all occupational injuries or illnesses to Faculty/PI as soon as practical. The Faculty/PI and laboratory personnel must submit the required paperwork to NJIT EHS Department. See the the Emergency Response Guidelines posted in the laboratory or Emergency Procedures section of the NJIT CHG for proper procedures involving an injury, exposure, fire, or release/spill of a hazardous material.

In the event of an emergency, DIAL 9-1-1 to activate emergency response personnel.

6. SPILL AND DECONTAMINATION

Wear proper PPE. Please review the SDS, verify with the manufacturer, or contact EHS for appropriate decontamination procedures. Dispose of all used contaminated disposables in the appropriate waste stream following the Waste Disposal Section of the NJIT CHG.

Decontamination Solution(s): _____

Additional Spill / Decontamination Requirements:

7. WASTE DISPOSAL

Follow the practices and procedures in accordance with the NJIT Laboratory Waste Management Program to properly dispose of waste.

Additional Waste Disposal Requirements:

8. PRIOR APPROVAL/REVIEW

9. DESIGNATED USE AREA

Designated Use Area Location(s): _____

10. SAFETY DATA SHEETS

Location of SDS: _____

11. LAB-SPECIFIC INFORMATION (required) *(Examples of appropriate content)*

Appendix – List of Potentially Explosive Chemicals (PEC)

A. PEC - Lab Chemicals

Acetyl peroxide
Acetylene
Ammonium nitrate
Ammonium perchlorate
Ammonium picrate
Ba/Pb/Hg azide (heavy metal azides)
Li/K/Na azide
Organic azides
Bromopropyne
Butanone peroxide
Cumene peroxide
Diazodinitrophenol
Dinitrophenol
Dinitrophenylhydrazine
Dinitroresorcinol
Dipicryl amine
Dipicryl sulphide
Dodecanoyl peroxide
Ethylene oxide
Lauric peroxide
MEK peroxide
Mercury fulminate, Silver fulminate
Nitrocellulose
Nitrogen trifluoride
Nitrogen triiodide
Nitroglycerine
Nitroguanidine
Nitromethane
Nitrourea
Picramide
Picric acid (trinitrophenol)
Picryl chloride
Picryl sulphonic acid
Propargyl bromide (neat)
Sodium dinitrophenate
Succinic peroxide
Tetranitroaniline
Trinitroaniline
Trinitroanisole
Trinitrobenzene
Trinitrobenzenesulphonic acid
Trinitrobenzoic acid
Trinitrocresol
Trinitronaphthalene
Trinitrophenol (picric acid)
Trinitroresorcinol
Trinitrotoluene
Urea nitrate

B. PEC - Compound Classes

Acetylene (-C=C-)
Acyl hypohalites (RCO-OX)
Azide Organic (R-N3)
Azide Metal (M-N3)
Azo (-N=N-)
Diazo (=N=N)
Diazosulphide (-N=N-S-N=N-)
Diazonium salts (R-N2+)
Fulminate (-CNO)
Halogen Amine (=N-X)
Nitrate (-ONO2)
Nitro (-NO2)
Aromatic or Aliphatic Nitramine (=N-NO2) (-NH-NO2)
Nitrite (-ONO)
Nitroso (-NO)
Ozonides
Peracids (-CO-O-O-H)
Peroxide (-O-O-)
Hydroperoxide (-O-O-H)
Metal peroxide (M-O-O-M)

C. PEC - Explosive Salts

Bromate salts (BrO3-)
Chlorate salts (ClO3-)
Chlorite salts (Cl02-)
Perchlorate salts (Cl04-)
Picrate salts (2,4,6-trinitrophenoxide)
Picramate salts
(2-amino-4,6-dinitrophenoxide)
Hypohalite salts (XO-)
Iodate salts (IO3-)

D. PEC - Chemicals That May Rupture their Container Due to Over-pressurization

Aluminum chloride
Aluminum lithium hydride
Ammonia solution
Ammonium hydroxide
Ammonium persulfate
Anisyl chloride
Aqua regia
Benzenesulphonyl chloride
Bleach
Bleaching powder
Calcium carbide
Calcium hydride
Calcium hypochlorite
Chloroform
Chromic acid
Cumene hydroperoxide
Cyclohexne
Diethyl pyrocarbonate
Dimethylamine
Formic Acid
Hydrogen peroxide
Lauroyl peroxide
Lithium aluminum hydride
Lithium hydride
Nitric acid
Nitrosoguanidine
Peracetic acid
Phenol
Phosphorus trichloride
Potassium Persulphate
Silicon tetrachloride
Sodium borohydride
Sodium dithionite
Sodium hydride
Sodium hydrosulphite
Sodium hypochlorite
Sodium peroxide