USC UNIVERSITY OF SOUTHERN CALIFORNIA

STANDARD OPERATING PROCEDURE

Reactive and Explosive Materials

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1.0 PURPOSE

The purpose of this standard is to provide guidelines for the safe handling of reactive and explosive materials. Consult the MSDS for specific information about a particular reactive or explosive material.

2.0 DEFINITIONS

Explosive materials are chemical compounds or mechanical mixtures that, when subjected to heat, impact, friction, detonation, or other suitable initiation, undergoes rapid chemical change. It evolves large volumes of highly heated gases that exert pressure on the surrounding medium. The term applies to materials that either detonate or deflagrate. Heat, light, mechanical shock, and certain catalysts initiate explosive reactions. Examples include organic peroxides, perchloric and picric acids (dry state), and metal azides.

Organic peroxide formers react with oxygen to form peroxy compounds (usually hydroperoxides) that are very unstable and decompose continuously. These organic peroxides are sensitive to light, heat, friction, and impact, as well as to strong oxidizing and reducing agents, and they are extremely flammable. There are four main groups of peroxide formers:

a. Ethers with primary and/or secondary alkyl groups attached to the oxygen, including open chain and cyclic ethers, acetals, and ketals.
b. Hydrocarbons with allylic, benzylic, or propargylic hydrogens.
c. Conjugated dienes, eneynes, and diynes.
d. Saturated hydrocarbons with exposed tertiary hydrogens.

Pyrophoric materials ignite spontaneously when exposed to air at a temperature of 130 deg. F (54.4 deg. C) or below. Reaction by-products are toxic fumes or gases and liberation of heat. Many pyrophoric materials are water reactive as well. Examples include white phosphorus, many finely divided metals, some metal hydrides, and certain silanes.

Reactive (unstable) materials are chemicals that will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

Water reactive materials react violently with water to produce toxic, corrosive, or flammable gases and the liberation of heat. Some examples are listed.

Alkali metals	Non-metal Halides (e.g. BCl_3, BF_3, $BPCl_3$, $SiCl_4$, S_2Cl_2)
Alkali metal hydrides	Inorganic acid halides (e.g. $POCl_3$, $SOCl_2$, SO_2Cl_2)
Alkali metal nitrides	Anhydrous metal halides (e.g. $AlCl_3$, $TiCl_4$, $ZrCl_4$, $SnCl_4$)
Calcium carbide	Organic acid halides and anhydrides of low molecular weight
Phosphorus pentoxide	Metal and non-metal hydrides (borane, $LiAlH_4$)

3.0 EXPOSURE HAZARDS

3.1 Contact/Absorption

Contact with eyes may cause irritation, corneal damage; skin: may cause burns, or deep penetrating ulcers. Chronic exposure may lead to anemia and digestive tract effects.

3.2 Inhalation

Inhalation may cause:

1. Respiratory tract irritation, sore throat, and possible burns.
2. Central nervous system effects such as nausea and headache.
3. Shortness of breath, coughing.
4. Delayed pulmonary edema.

3.3 Ingestion

Ingestion may cause the following:

1. Severe gastrointestinal tract irritation with nausea and possible burns.
2. Severe and permanent damage to the digestive tract.
3. Heart, liver, and kidney damage.
4. Death.

4.0 PERSONAL PROTECTIVE EQUIPMENT

Use chemical splash goggles for eye protection in combination with a full-length face shield to fully protect the face and throat. Heavy, non-reactive gloves should be worn when handling reactive compounds or in the event it is necessary to reach behind a shielded area while a hazardous experiment is in progress. Check glove manufacturer for recommendations on a suitable glove for the specific chemical.

Wear a lab coat and closed-toed shoes (non-fabric) with non-slip soles.

If a respirator is needed, then user must follow guidelines of the Respiratory Protection Program.

5.0 ENGINEERING AND VENTILATION CONTROLS

All procedures involving reactive materials must be conducted in a fume hood to protect against runaway reactions and hazardous exposure.

6.0 SPECIAL HANDLING PROCEDURES

1. CONDUCT PROCEDURES IN A FUME HOOD.
2. Use a blast shield in combination with the hood sash to protect personnel and equipment from injury or damage from a possible explosion or fire.
3. Minimize the quantity of reactive (unstable) materials used and stored in the work area.
4. Label incoming containers with the date of receipt. Do not use reactive materials past their expiration date.
5. Exercise due care when handling peroxide formers. Visually inspect bottle cap and threads of container (without handling) for presence of organic peroxide crystals. If present, evacuate area and deny entry. Contact EH&S, Laboratory Safety, and DPS. If container appears free of encrustation, test for peroxides using the methods below. If peroxides are detected, contact EH&S for disposal. NOTE: Test should be conducted semi-annually.
   a. Add 1 to 3 milliliters (mL) of the liquid to be tested to an equal amount of acetic acid, add a few drops of 5% aqueous potassium iodide solution, and shake. The appearance of a yellow to brown color indicates the presence of peroxides. Alternatively, addition of 1 mL of a freshly prepared 10% solution of potassium iodide to 10 mL of an organic liquid in a 25-mL glass cylinder should produce a yellow color if peroxides are present.
   b. Add 0.5 mL of the liquid to be tested to a mixture of 1 mL of 10% aqueous potassium iodide solution and 0.5 mL of dilute hydrochloric acid to which has been added a few drops of starch solution just prior to the test. The appearance of a blue or blue-black color within a minute indicates the presence of peroxides.
   c. Use commercially available peroxide test strips.

7.0 LABELING REQUIREMENTS

1. Label storage cabinets or areas with appropriate descriptor: **WATER REACTIVE, PYROPHORIC, OR EXPLOSIVE.**
2. Label all incoming containers with the date of receipt.

8.0 STORAGE REQUIREMENTS

1. Minimize the amount of reactive materials used and stored.
2. Store peroxide formers in tightly sealed metal containers in areas away from oxidizers.
3. Do not return unused material to the original container.

9.0 FIRST AID

See CHP 7.9.2 Chemical Exposure.

10.0 SPILL AND ACCIDENT PROCEDURES

See CHP 7.9.1 Chemical Spill Clean Up.

11.0 WASTE DISPOSAL

See Hazardous Waste Management and Disposal.

12.0 PROGRAM APPROVAL AND REVIEW

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