

STANDARD OPEARTING PROCEDURE FOR OXIDANTS



HAZARD AND CLASSIFICATION

Oxidizing agents (oxidants) are materials which have a propensity to donate electronegative atoms, most commonly oxygen, but sometimes fluorine or chlorine. The donated atoms are able to react with combustible (reducing) materials in an energetic manner. Oxidants intensify combustion, and oxidant-combustible mixtures may be violently reactive, intensely flammable, or explosive. Pyrotechnic reaction or explosion may occur immediately on mixing or spontaneously after a delay, or the mixture may be metastable and unexpectedly ignite or explode on heating, shock, or friction.

Oxidizing agents are relatively common laboratory materials. Examples which may be found in labs include the following:

- Oxidizing gases: Oxygen, fluorine, chlorine, nitrous oxide, nitrogen dioxide
- Oxidizing liquids: Perchloric acid, nitric acid, hydrogen peroxide, tetranitromethane, dinitrogen tetroxide
- Oxidizing solids: Silver(I) oxide, lead dioxide, chromium trioxide, trichloroisocyanuric acid; salts of the following anions: Chromate, dichromate, permanganate, nitrite, nitrate, chlorite, chlorate, perchlorate, bromate, iodate, periodate, peroxide, superoxide; peroxydisulfate (persulfate)

OSHA/GHS classification of oxidizing agents is covered in detail in Section 6 of the CHP, and in the table referenced in the [CHP](#) appendices. All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 6 of the CHP. In short, oxidizing liquids and solids are assigned into Categories 1-3, where the lower number indicates the more severe hazard. Oxidizing gases are not divided into categories.

HAZARD IDENTIFICATION

For purchased chemicals, identification as oxidizing should be made by assessing the hazard information given in the safety data sheet (SDS). In section 2 of the SDS, look out for the GHS hazard classes of Oxidizing Solid/Liquid/Gas and the numeric category (except for oxidizing gases which are not subdivided into categories). Also look for the following Hazard Codes:

- H270 May cause or intensify fire; oxidizer
- H271 May cause fire or explosion; strong oxidizer
- H272 May intensify fire; oxidizer

Synthesized chemicals should be assumed oxidizing if they contain halogen-halogen bonds, halogen-oxygen bonds, halogen-nitrogen bonds, oxygen-oxygen bonds, or known oxidizing anions (nitrite, nitrate, permanganate, etc). High oxidation state metal oxides and fluorides may also be hazardously oxidizing.

BROMINE AND IODINE

Bromine and iodine are not categorized as oxidants by OSHA/GHS, as they do not increase the burning rate of typical organic materials. However, bromine and iodine are powerfully oxidizing towards stronger reductants such as powdered metals and should be handled accordingly.

INCOMPATIBLES

Oxidizing agents are evidently hazardous if mixed with flammable or combustible materials, e.g. organic substances. However, other oxidizable substances not necessarily thought of as combustible may also produce violently flammable or explosive pyrotechnic mixtures with oxidants. Oxidizable substances incompatible with oxidants include: Sulfur, phosphorus, arsenic, carbon (e.g. charcoal), boron powder, silicon powder, metal powders (e.g. iron, zinc, aluminum, titanium, zirconium), sulfides, thiosulfates, dithionites, hypophosphites, azides, cyanides, thiocyanates, hexacyanoferrate(II)/(III), carboxylate salts (e.g. acetates), ammonium salts, amine salts, all organic materials, all non-perfluorinated polymers including silicone resins.

Please refer to [CHP](#) Section 8, subsection Potentially Explosive Substances, for more information on incompatible mixtures.

SPECIAL HAZARDS

Due to potential reactive/explosive hazards, **personnel of limited chemistry knowledge or experience shall NOT attempt to synthesize potentially oxidizing compounds without adequate training, supervision, and oversight from the PI or from an appropriately knowledgeable person delegated by the PI.**

Do NOT synthesize compounds containing both oxidizing and reducible moieties as they are likely to be explosive. For example, perchlorate or nitrate salts of metal anions bearing organic ligands are usually powerfully explosive, as are many nitrate esters, nitro compounds, organic peroxides, and all perchlorate esters. Perchlorate or nitrate salts of metal anions bearing hydrazine ligands are explosive.

Do NOT allow aqueous solutions of oxidants (e.g. potassium nitrate solution) to soak into porous combustible material (e.g. paper) and subsequently dry out. On drying, oxidant will crystallize throughout the combustible matrix, resulting in a potentially violently flammable or explosive pyrotechnic mixture.

Do NOT allow aqueous solutions containing both oxidant (e.g. potassium nitrate) and reductant (e.g. potassium hexacyanoferrate(II/III)) to dry out as this may result in deposition of a potentially violently flammable or explosive pyrotechnic mixture of crystals.

NH₃/NH₄⁺ WITH OXIDANTS

Ammonia and ammonium cation are oxidizable. Ammonium nitrate, ammonium perchlorate, ammonium chromate/dichromate, and ammonium iodate are all metastable towards energetic decomposition but are safe for laboratory use given appropriate precautions, e.g. not heating or mixing with combustibles. The ammonium salts of other oxidizing anions (e.g. nitrite, chlorate, permanganate) may be unstable, violently explosive, or even spontaneously explosive. **Do NOT mix ammonium salts with nitrites, chlorites, chlorates, or permanganates.**

Do NOT mix ammonia or ammonium salts with halogen-donating oxidants (including elemental halogens) as violently explosive shock-sensitive nitrogen halides may be formed.

PREPARATION

- Wear all appropriate PPE (Safety Goggles, Face Shield for operations with splash hazard, Two layers of rubber gloves).
- Do not wear contact lens (Contact lens are not permitted in the cleanroom).
- Identify the locations of safety equipment (Eyewash and Shower station, Emergency buttons, and phones, Hazardous Waste Container, Fire Extinguisher, Manual Pull Fire Alarms).
- Save DPS emergency line 213-740-4321 into personal phone.
- Read the Material Safety Data Sheet for specific Oxidants intended for use.
- Ensure an adequate supply of clean-up material is within reach in case of spills.
- Ensure an appropriate waste container is accessible to dispose contaminated clean-up material.
- Minimize the quantity of oxidants in the work area (oxidants must be handled under a fume hood).
- Keep oxidants away from combustible materials (e.g., wood, paper, metal powders and sulfur) to prevent violent reactions.
- Exercise due care when mixing oxidizing agents and combustible materials. Use very small amounts to reduce heat.
- Clearly label all containers with any chemicals, including containers with water. Place containers with Oxidants into secondary polypropylene container while not in use.
- Labels must include User Name, Group (PI) Name, Contact Email or Phone Number, Chemical Name, and Chemical Formula.

WASTE DISPOSAL

- Wash all beakers and cylinders used in handling.
- Wipe down and dry all surfaces.
- Store waste in containers labelled "CHEMICAL/HAZARDOUS WASTE FOR DISPOSAL."

SKIN AND EYE EXPOSURE

- For skin exposure, immediately flush with cool water for a minimum of 15 minutes. Remove contaminated clothing and footwear while rinsing.
- For eye exposure, forcibly hold eyes open and flush for at least 15 minutes. Continue flushing area with water if pain continues.
- Do not use neutralizing chemicals, creams, abrasives, or lotions.
- Contact DPS and alert cleanroom staff.

INHALATION EXPOSURE

- Move to location with fresh air.
- Obtain medical attention immediately if symptoms develop (coughing, shortness of breath, wheezing, burning in mouth or throat, or chest pain).
- Alert cleanroom staff and call DPS for medical assistance.

INGESTION

- Alert cleanroom staff and call DPS for medical assistance.

- If possible, determine what material was ingested by victim.
- If victim begins to vomit, turn head or entire body to one side to avoid choking.
- Do not induce the victim to vomit or drink any beverage unless instructed to by qualified medical personnel.

ACCIDENTAL SPILLS

- Minor spills can be cleaned with a spill kit or simple items like wipes or absorbent pads.
- For all spill emergencies, contact DPS and alert cleanroom staff.
- Evacuate personnel from spill area and deny entry.

UNATTENDED EXPERIMENTS

- Chemicals may not be left unattended for more than 15 minutes.
- For unattended experiments longer than 15 minutes, notify cleanroom staff to get permission.
- The maximum time for unattended chemicals is one hour.
- Unattended chemicals require displayed signage at fume hood.
- The sign must contain the hazards of the experiment, the experimenter's name and contact information, responsible PI's name and contact information, expected date and time of disposal.
- For more information on unattended hazardous experiments, please refer to the [Unattended Hazardous Operations Fact Sheet](#).

EMERGENCY NOTIFICATION

- Notify the Department of Public Safety (DPS) at (213) 740-4321 or (323) 442-1000. For a non-emergency, dial (213) 740-6000.
- State the nature of the emergency (e.g., injury, hazardous materials or biohazards spill, fire) and provide details.
 - a) Location of injury/incident
 - b) Name(s) of injured and name(s) of witness(es)
 - c) Contact information (your name and call-back number)
 - d) Injury/incident summary
- Notify EH&S immediately at (323) 442-2200 or injuryprevention@usc.edu to report the injury/incident.
- Notify the cleanroom staff and your supervisor.

References

- [Chemical Hygiene Plan](#)
- [SOP – Oxidants | USC Environmental Health & Safety](#)

Contributors	Revised Date
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