Osmium Tetroxide

Standard Operating Procedure

Revision Date: 12/07/22

Laboratory Director (LD) Approval is Required Prior to Performing this Procedure

This standard operating procedure (SOP) outlines the handling and use of osmium tetroxide. Review this document and supply the information required in order to make it specific to your laboratory. In accordance with this document, laboratories should use appropriate controls, personal protective equipment, and disposal techniques when handling osmium tetroxide. All laboratory workers must read and understand the [*Laboratory Emergencies SOP*](https://ehs.umich.edu/wp-content/uploads/2022/05/LaboratoryEmergencyProceduresSOP.docx) prior to commencing any work in a laboratory.

# Description [Provide additional information as it pertains to your research protocol]

Osmium tetroxide is a colorless to pale yellow solid with a strong, unpleasant, acrid, chlorine-like odor. It is used as a catalyst in chemical reactions as well as for microscope tissue staining activities.

## Process [Write the steps for using the chemical in your research protocol]

# Potential Hazards [Provide additional information as it pertains to your research protocol]

**Consult the safety data sheet (SDS)** and the [Laboratory Chemical Safety Summary for Osmium Tetroxide](https://www.nap.edu/read/4911/chapter/14#364) from Prudent Practices in the Laboratory (The National Academies Press).

Be aware of these specific hazards:

* Osmium tetroxide is a strong oxidizer that will sublime (pass directly from solid to vapor and back to solid) readily at room temperature and significantly when refrigerated.
* It is highly toxic (LD50 oral [rat] 14 mg/kg) – ingesting very small amounts can cause death. It is also a severe eye and respiratory irritant – acute exposure can cause severe eye damage, even blindness, or chemical burns to the respiratory tract. It can also cause dermatitis or lung or kidney damage.
* The MIOSHA Permissible Exposure Limit is 0.002 mg/m3 over 8 hours. The ACGIH Threshold Limit Value is 0.0002 ppm over 8 hours or 0.0006 ppm over 15 minutes.
* Chronic exposure to osmium tetroxide can result in accumulation of osmium compounds in the liver and kidney and damage to these organs. Osmium tetroxide has been reported to cause reproductive toxicity in animals; this substance has not been shown to be carcinogenic or to show reproductive or developmental toxicity in humans.

# Engineering Controls [Provide additional information as it pertains to your research protocol]

* Always work with osmium tetroxide in a chemical fume hood – never on an open benchtop.
* Use of a Biological Safety Cabinet for working with osmium tetroxide is not appropriate because it sublimes and the BSC is not designed to prevent exposure to vapors.
* Consult Environment, Health & Safety (EHS) at (734) 647-1143 if you need to work with osmium tetroxide and do not have a chemical fume hood available.
* An eyewash-drench hose must be available in the immediate area. A safety shower is highly recommended – please contact EHS at (734) 647-1143 for consultation if a safety shower is not currently available in your area.

# Work Practice Controls [Provide additional information as it pertains to your research protocol]

* Use a less dangerous product than osmium tetroxide if possible, or purchase in dilute solution.
* Purchase a minimal amount of osmium tetroxide to do your work.
* Purchase in liquid form if possible.
* Keep corn oil on hand to use for decontamination and in case of a spill – it deactivates osmium tetroxide. A 2% solution of osmium tetroxide can be fully neutralized by twice its volume of corn oil. Aqueous solutions contaminated with osmium tetroxide can be fully neutralized by adding sodium sulfide or sodium sulfite to reduce osmium tetroxide to less hazardous forms.
* Set up a designated area for work with osmium tetroxide and suspensions thereof, and label it with the following wording: DANGER: Osmium Tetroxide in use. Oxidizing Agent, Severe Irritant, Causes Eye Damage, Toxic to Liver and Kidney, Authorized Personnel Only.
* Line work surfaces with plastic-backed absorbent pads.
* Keep containers closed ~~as much as possible~~ when not in use.
* If weighing osmium tetroxide powder and the balance cannot be located in a chemical fume hood, tare a container then add the powdered osmium tetroxide to the container in a chemical fume hood (NOT a Biological Safety Cabinet) and seal the container before returning to the balance to weigh the powder.
* Change gloves regularly (at least every two hours) and wash hands at the time of the glove change.
* Wash hands thoroughly immediately after working with any concentration of osmium tetroxide.
* Contaminated containers and equipment may be decontaminated by dipping in corn oil before removing from the hood. The corn oil will turn black. Paper soaked with corn oil may be used to test if the osmium tetroxide is fully neutralized – if the paper blackens, osmium tetroxide is still present and more corn oil should be added.
* Contaminated work surfaces may be decontaminated with corn oil or an aqueous solution of sodium sulfite, followed by a cleaning with detergent and water.

# Personal Protective Equipment [Provide additional information as it pertains to your research protocol]

* Two pairs of standard nitrile laboratory gloves and a fully buttoned lab coat with sleeves extending to the wrists must be worn when handling osmium tetroxide. Chemical-protective sleeves or wrist guards, or extended-cuff gloves are recommended.
* Wear chemical splash goggles (safety glasses are not sufficient). If there is risk of splash, also wear a face shield.
* In cases where the arms or torso may be exposed to liquid suspensions or dry particles, wear chemical-protective sleeves or gowns.

# Transportation and Storage [Provide additional information as it pertains to your research protocol]

* Dry powders and concentrated solutions must be in sealed shatter-resistant containers, within secondary containment, during storage and transportation.
* Osmium tetroxide powder and concentrated solutions should be stored in a secure location (no unauthorized access).
* Osmium tetroxide can penetrate plastic, so it should be stored in a sealed glass container (such as a vacuum-type blood collection tube), and placed inside a secondary container.
* Osmium tetroxide should be kept in a refrigerator, and should be stored separately from hydrochloric acid as well as other acids, bases, organic materials, metals, strong reducing agents, and strong oxidizing agents.

# Waste Disposal [Provide additional information as it pertains to your research protocol]

Unwanted osmium tetroxide (solid and solutions) must be disposed of following your laboratory-specific chemical hygiene plan. Because most spent, unused, and expired chemicals/materials are considered hazardous wastes, they must be properly disposed of. **Do not dispose of chemical wastes by dumping them down a sink, flushing in a toilet or discarding in regular trash containers, unless authorized by EHS Hazardous Materials Management (HMM)**. Contact EHS-HMM at (734) 763-4568 for waste containers, labels, manifests, waste collection and for any questions regarding proper waste disposal. Also, refer to the EHS [Hazardous Waste](http://ehs.umich.edu/haz-waste/) Web page for more information.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when handling osmium tetroxide.

# Certification

I have read and understand the above SOP. I have received approval from my Lab Director to perform this procedure. I agree to contact my Lab Director if I plan to modify this procedure.

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### Major Revisions (Tracking purposes only -- Do not print as part of SOP)

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| Date | Revision |
| 09-19-18 | Updated EHS name and logo and format and revised the Exposure/unintended contact section (AKJ) |
| 02-25-19 | Updated links (DML) |
| 12-07-22 | Reviewed and updated links (SW) |