

Standard Operating Procedure

Tetrahydrofuran (THF)

This SOP is not complete until it has been signed and dated by the PI and relevant lab personnel.

Print a copy and insert into your
Laboratory Safety Manual and Chemical Hygiene Plan.
Refer to instructions for assistance.

Department:	Chemistry & Biochemistry - Chemical Engineering
Date SOP was written:	December 14, 2012
Date SOP was approved by PI/lab supervisor:	January 18, 2013
Principal Investigator:	Prof. Susannah Scott
Internal Lab Safety Coordinator/Lab Manager:	Stephanie Goubert-Renaudin
Lab Phone:	805-893-8941
Office Phone:	805-893-7403
Emergency Contact:	EHS 24 hour line: 805-893-3194 (Name and Phone Number)
Location(s) covered by this SOP:	ESB 3324 and 3328 (Building/Room Number)

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

Purpose

Tetrahydrofuran is a flammable liquid that is also an irritant, and should be treated with care by researchers. It is also a peroxide forming chemical and care should be taken when handling it as it may become shock sensitive. It is generally used as a reaction solvent. This compound should be inspected prior to use for peroxide crystals that may have collected around the cap, on the inside, or on the outside of the bottle.

Physical & Chemical Properties/Definition of Chemical Group

CAS#: 109-99-9

Class: **Peroxide Former, Irritant, Flammable**

Molecular Formula: C₄H₈O

Form (physical state): Liquid

Color: Colorless

Boiling point: 65.0 - 67.0 °C

Flash Point: -17.0 °C (closed cup)

Potential Hazards/Toxicity

Inhalation May be harmful if inhaled. Causes respiratory tract irritation. Vapors may cause drowsiness and dizziness.

Skin Harmful if absorbed through skin. Causes skin irritation.

Eyes Causes eye irritation.

Ingestion Harmful if swallowed.

Acute toxicity

Oral LD50

LD50 Oral - rat - 1,650 mg/kg

LD50 Oral - guinea pig - 2,300 mg/kg

Inhalation LC50

LC50 Inhalation - rat - 3 h - 21000 ppm

Remarks: Drowsiness Lungs, Thorax, or Respiration: Respiratory stimulation. Ingestion may cause gastrointestinal irritation, nausea, vomiting and diarrhea.

Dermal LD50

LD50 Dermal - rat - > 2,000 mg/kg

CalOSHA Permissible Exposure Limit (PEL): 200 ppm, 250 ppm STEL

Skin corrosion/irritation

Skin - rabbit - Mild skin irritation - Draize Test

Serious eye damage/eye irritation

Eyes - rabbit - Risk of serious damage to eyes. - Draize Test

Specific target organ toxicity - single exposure (Globally Harmonized System)

Inhalation - May cause respiratory irritation.

May cause drowsiness or dizziness. - Nervous system

Specific target organ toxicity - repeated exposure (Globally Harmonized System)

The substance or mixture is not classified as specific target organ toxicant, repeated exposure.

Personal Protective Equipment (PPE)

NOTE: Lab-specific information on PPE selection may be included in the Protocol/Procedure section.

Respiratory protection

Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU). Refer to 8 CCR 5144 for selection of respirators. A respiratory protection program that meets 8 CCR 5144 must be followed whenever workplace conditions warrant use of a respirator.

Respirators should be used only under any of the following circumstances:

- As a last line of defense (i.e., after engineering and administrative controls have been exhausted).
- When Permissible Exposure Limit (PEL) has exceeded or when there is a possibility that PEL will be exceeded.
- Regulations require the use of a respirator.
- An employer requires the use of a respirator.
- There is potential for harmful exposure due to an atmospheric contaminant (in the absence of PEL)
- As PPE in the event of a chemical spill clean-up process

NOTE: Lab personnel intending to use/wear a respirator mask must be trained and fit-tested by EH&S. This is a regulatory requirement.

Hand Protection

Handle with gloves. [Nitrile or laminate film gloves \(Ansell Barrier\)](#) gloves are recommended. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

Refer to glove selection chart from the links below:

http://www.ansellpro.com/download/Ansell_8thEditionChemicalResistanceGuide.pdf

OR

<http://www.allsafetyproducts.biz/page/74172>

OR

<http://www.showabestglove.com/site/default.aspx>

OR

<http://www.mapaglove.com/>

Eye Protection

Safety glasses with side shields or tightly fitting safety goggles.

Skin and Body Protection

Long pants, closed-toed and closed-heeled shoes, and lab coat must be worn.

Hygiene Measures

Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Engineering Controls

NOTE: Lab-specific information on engineering controls may be included in the Protocol/Procedure section.

Work with tetrahydrofuran should be conducted in a fume hood unless other controls are designated in the Protocol/Procedure section. Sash height should be kept low to avoid escaping fumes and provide explosion barrier. Use supplemental explosion protective equipment like a blast shield where appropriate to protect from explosions in the case of peroxide detonation.

First Aid Procedures

Notify supervisor and EH&S immediately.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact

Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed

Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

Special Handling and Storage Requirements

NOTE: Laboratory-specific information on handling and storage may be included in the Protocol/Procedure section.

Working alone Certain extremely hazardous operations should not be performed if the PI or Lab Safety Contact(s) are not present. Never work alone with extremely hazardous materials/operations. See the Protocol/Procedure section below for specific prohibitions (if any) on working alone.

Precautions for safe handling Avoid contact with skin and eyes. Avoid inhalation of vapor or mist. Use explosion-proof equipment. Keep away from sources of ignition - No smoking. Take measures to prevent the buildup of electrostatic charge.

Conditions for safe storage

If not in use, tetrahydrofuran containers have to be safely stored in the ventilated flammable storage cabinets.

Store and transport THF containers in secondary containment (for example polyethylene bottle carrier).

Keep storage container closed (air tight) when not in use.

Maintain the smallest amount necessary for ongoing work. Use in the smallest practical quantities for the experiment being performed.

Purchase THF with inhibitors added (for peroxide-forming) when possible.

Due to its peroxide-forming hazard, THF containers must be dated upon receipt and at the time they are opened (mark the date on the bottle). If tested, note the date it was tested on the bottle.

Test open THF containers with peroxide test strips every 3 months.

An opened container can be stored for a maximum of 6 months. Dispose of unused amounts after that period of time has passed (or if peroxides are found to be present by testing).

Degassed tetrahydrofuran may be stored in resealable Schlenk flasks under an atmosphere of argon or nitrogen, or stored in closed containers in a glove box with a nitrogen or argon atmosphere.

Spill and Accident Procedure

Chemical Spill Dial **9-911** and EH&S (805-893-3194)

Spill – Assess the extent of danger. Help contaminated or injured persons. Evacuate the spill area. Avoid breathing vapors. If possible, confine the spill to a small area using a spill kit or absorbent material. Keep others from entering contaminated area (e.g., use caution tape, barriers, etc.).

Small (<1 L) – If you have training, you may assist in the clean-up effort. Use appropriate personal protective equipment and clean-up material for chemical spilled. Double bag spill waste in clear plastic bags, label and take to the next chemical waste pick-up.

Large (>1 L) – Dial **9-911** from campus phones (**and 805-893-3446 from a cell phone**) and EH&S (893-3194) for assistance.

Chemical Spill on Body or Clothes – Remove clothing and rinse body thoroughly in emergency shower for at least 15 minutes. Seek medical attention. *Notify supervisor and EH&S immediately.*

Chemical Splash Into Eyes – Immediately rinse eyeball and inner surface of eyelid with water from the emergency eyewash station for 15 minutes by forcibly holding the eye open. Seek medical attention. *Notify supervisor and EH&S immediately.*

Medical Emergency Dial **9-911**

Life Threatening Emergency, After Hours, Weekends and Holidays – Dial **9-911** (or **805-893-3446** from a cell phone) or go to the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411) *Note: All Serious injuries must be reported to EH&S within 8 hours.*

Non-Life Threatening Emergency – Go to the Student Health Building, Building 588 (phone number: 893-5361, hours: M, T, R, F 8am-4.30pm, W 9am - 4.30pm, R 5pm to 7pm by appointment). After hours go to the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411) *Note: All serious injuries must be reported to EH&S within 8 hours.*

Needle stick/puncture exposure (as applicable to chemical handling procedure) – Wash the affected area with antiseptic soap and warm water for 15 minutes. For mucous membrane exposure, flush the affected area for 15 minutes using an eyewash station. Page the needle stick nurse \ and then enter your extension. After hours go to the nearest emergency room: the Emergency Room of Goleta Valley Cottage Hospital at 351 South Patterson Avenue, Goleta (Phone number: 805-967-3411). *Note: All needle stick/puncture exposures must be reported to EH&S within 8 hours.*

Decontamination/Waste Disposal Procedure

Wearing proper PPE, please decontaminate equipment and bench tops. Call EH&S (805-893-3194) if assistance is needed. Please dispose of the used tetrahydrofuran in the appropriate organic waste container and disposables contaminated with it as hazardous waste.

Waste disposal guidelines:

Label Waste

- Affix an hazardous waste tag on all waste as soon as the first drop of waste is added to the container

Store Waste

- Store hazardous waste in closed containers, in secondary containment and in a designated location

Dispose of Waste

- Dispose of regularly generated chemical waste within 90 days
- Call EH&S for questions (**893-3194**)
- Empty Containers
 - Rinse off the empty containers with a low boiling point solvent, dry and dispose capped in the glassware container

Safety Data Sheet (SDS) Location

SDS can be found online: <http://ehs.ucsb.edu/units/labsfty/labrsc/chemistry/lischemmsdsacc.htm>

Protocol/Procedure

In our laboratory, tetrahydrofuran is used as a solvent.

Tetrahydrofuran containers are stored in a ventilated cabinet and are kept sealed at all times when not in use. THF is also dispensed via the glass contour solvent purification system which can be used in connection with the glove box.

Personal protective equipment, including a lab coat, closed shoes, safety goggles, long pants, nitrile or laminate film gloves (Ansell Barrier) gloves should be used when working with tetrahydrofuran. Because tetrahydrofuran and tetrahydrofuran solutions penetrate most common lab gloves rapidly, and skin absorption can occur, gloves have to be changed as soon as contaminated.

When not handled in the glove box, tetrahydrofuran has to be used within the ventilated fume hood at all times, on a cleared space and away from any ignition source as THF is flammable.

Pressure can be built up when tetrahydrofuran is used in reactions, extractions or being heated. Adequate ventilation (pressure bubbler on Schlenk manifold, opening the valve during extraction) has to be used to prevent over pressurization

Tetrahydrofuran containers, including reaction vessel, have to be cap-sealed/closed when moved out of the fume hood or glove box. Glassware having contained THF has to be rinsed with acetone prior to being moved out of the fume hood. Tetrahydrofuran has to be disposed as hazardous waste in the appropriate organic waste container, which has to be kept closed at all times.

THF is a peroxide generator and can form peroxide upon contact with air. Peroxides can be contact explosive. As a consequence, it should not be stored longer than 6 months after opening, or one year

after purchase. Date the containers upon delivery AND upon opening. Disposal as hazardous waste has to be then organized.

THF should be tested every 3 months with peroxide test strips. If the test is positive, it has to be disposed. Do not evaporate to dryness. If peroxide crystals are observed on the containers, do not touch the crystals, do not move the container due to explosion risk. Immediately contact the Lab manager and/or EHS for waste disposal.

For the glass contour solvent purification system, when refilling the reusable container with THF, rinse thoroughly the keg with water to eliminate any potential peroxide before pouring fresh THF.

NOTE: Any deviation from this SOP requires approval from PI.

Documentation of Training (signature of all users is required)

- Prior to conducting any work with tetrahydrofuran, designated personnel, i.e. approved users listed below, must provide training to laboratory personnel specific to the hazards involved in working with this substance, work area decontamination, and emergency procedures.
- The Principal Investigator must provide his/her laboratory personnel with a copy of this SOP and a copy of the SDS provided by the manufacturer.
- The Principal Investigator must ensure that his/her laboratory personnel have attended appropriate laboratory safety training or refresher training as required by EH&S.

I have read and understand the content of this SOP:

Name	Signature	Trainer	Date
Prof. Susannah Scott			
Stephanie Goubert-Renaudin			
Gary Kwanyi Ng			
Alessandro Gallo			
Anthony Crisci			
Haibo Yu			
Taeho Hwang			
Bethany Wigington			

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