UC SANTA BARBARA

Toxic, Corrosive and Pyrophoric Gas Program

Table of Contents

Overview

Toxic, corrosive, and pyrophoric compressed gases present an elevated risk of health, fire, explosion and other adverse effects in the case of accidental release. As such, they require the establishment of rigorous protocols to protect people and property, including standard operating procedures (SOPs) for handling and storage, training, engineering controls such as gas cabinets and monitors, and established emergency response procedures. The purpose of this program is to aid researchers in developing these protocols, thereby facilitating this campus' diverse research efforts.

Scope

The Toxic Gas Program applies to the purchase, on-campus transportation, use, storage and disposal of all toxic, corrosive, and pyrophoric compressed gases in campus laboratories, facilities, and storage areas. This does NOT include areas defined as semiconductor fabrication facilities, as these areas have distinct regulatory requirements: at our campus this consists of the clean rooms in Elings Hall and the Engineering Science Building. All gases in this program also need to comply with the relevant sections of the Chemical Hygiene plan, specifically those concerned with compressed gases.

All program elements described in this document assume that the amount of toxic, pyrophoric and/or compressed gases contained in a control area remain below the California Fire Code Maximum Allowable Quantity (MAQ) threshold. Exceeding these thresholds triggers regulatory requirements far in excess of those described here. If these thresholds are exceeded, EH&S and the Fire Marshal will consult with the material owners and discuss plans to either reduce quantities or comply with these requirements.

Dilute toxic gases may be exempt from this program if their mixture composition is below the Cal/OSHA Permissible Exposure Limit (PEL).

Definitions

Acutely Toxic Gas (as defined by the Globally Harmonized System, GHS): A gas for which a single or short-term inhalation exposure causes serious health effects. They are differentiated into five categories, with Category 1 being the most toxic. The categories are defined by ranges in LC_{50} values (see Table 1). The GHS H-Codes that apply to acutely toxic gases are

H280: Contains gas under pressure; may explode if heated

Plus one of the following:

H330, Category 1: Fatal if inhaled
H330, Category 2: Fatal if inhaled
H331, Category 3: Toxic if Inhaled
H332, Category 4: Harmful if inhaled
H333, Category 5: May be harmful if inhaled

California Fire Code (CFC): California Code of Regulations, Title 24, Part 9, California Fire Code, 2019.

Ceiling Limit: The maximum exposure limit which cannot be exceeded for any length of time.

Compressed Gas: A material that is stored and shipped in a compressed gas cylinder, and acts as a gas upon release at normal temperature and pressure (NTP). The material may be liquefied or non-liquified gas before release from the cylinder.

Control Area (per CFC): Spaces within a building where quantities of hazardous materials not exceeding the maximum allowable quantities per control area (MAQ) are stored, dispensed, used or handled. These areas are defined by building construction and the assessment of the Campus Fire Marshal.

Corrosive (as defined by the CFC): A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the point of contact. A chemical shall be considered corrosive if, when tested on the intact skin of albino rabbits by the method described in DOT 49 CFR 173.137, such chemical destroys or changes irreversibly the structure of the tissue at the point of contact following an exposure of 4 hours. This term does not refer to action on inanimate surfaces.

Exhausted Enclosure: A piece of equipment that consists of a top, back, and not less than two sides providing a means of local exhaust for capturing gases, fumes, vapors and mists. A laboratory fume hood is one example of an exhausted enclosure.

Gas Cabinet: A fully enclosed, ventilated, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage or use.

GHS: Globally Harmonized System of Classification and Labelling of Chemicals (8^{th} edition), United Nations, 2019. This system is adopted by reference per California Code of Regulations, Title 8, Section 5194 (the Hazard Communication Standard).

Highly Toxic Gas (as defined by the CFC): A gas that has an LC_{50} of 200 ppm or less by volume in air when administered by continuous inhalation for one hour or less to albino rats weighing between 200-300 grams each.

Immediately Dangerous to Life and Health (IDLH): An atmospheric concentration of any toxic, corrosive, or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere. IDLH's are established by Cal/OSHA (California Code of Regulations, Title 8, Section 5192).

Lethal Concentration 50% (LC_{50}): The airborne concentration of a toxic gas that kills 50% of test animals during a 1-hour exposure period. It is a measure of acute toxicity via inhalation exposure.

Maximum Allowable Quantity (MAQ): The maximum amount of a hazardous material to be stored within an indoor or outdoor control area, as defined by the California Fire Code (CFC).

Permissible Exposure Limit (PEL): The maximum concentration of an airborne contaminant to which a worker may be exposed for an 8-hour shift, as determined by a time-weighted average. PELs are established and enforced by Cal/OSHA. A complete list of published PELs is found here.

Pyrophoric Gas: The GHS H-Codes that apply to pyrophoric gases are

H280: Contains gas under pressure; may explode if heated

Plus one of the following:

H220: Extremely flammable gas.

H232: May ignite spontaneously if exposed to air.

Shall: Signifies that a program element that is required by federal, state or local regulation.

Should: Signifies that a program element is considered Best Practice, and is strongly recommended.

Short Term Exposure Limit (STEL): The maximum concentration of an airborne contaminant to which a worker may be exposed for a 15 minute period, as determined by a time-weighted average. STELs are established and enforced by Cal/OSHA.

Toxic Gas (as defined by the CFC): A gas that has an LC_{50} between 201 and 2,000 ppm by volume in air when administered by continuous inhalation for one hour or less to albino rats weighing between 200-300 grams each.

Roles and Responsibilities

Principal Investigator/Laboratory Manager: Carries the primary responsibility for ensuring that all operations involving toxic and pyrophoric gasses are conducted safely and in compliance with the toxic gas program. This includes:

- Creating standard operating procedures (SOPs) for any toxic or pyrophoric gases in the laboratory.
- Ensuring that all laboratory personnel working in their space is fully trained on
    - The Fundamentals of Laboratory Safety class, live or online
    - The Chemical Hygiene Plan
    - Laboratory-specific standard operating procedures (SOPs), including any SOPs related to toxic or pyrophoric gases.
- Ensuring that all SOPs are compliant with the toxic gas program elements, and are being followed by laboratory personnel.
- Providing and maintaining gas equipment and devices in good working order.
- Arranging the return or disposal of gas cylinders when gas use is complete.

Office of Environmental Health and Safety: Carries the responsibility of aiding researchers in developing toxic and pyrophoric gas SOPs that are in full compliance with federal, state and local regulations. EH&S also manages the campus-wide tracking and reporting of these materials. This includes:

- Reviewing all toxic and pyrophoric gas purchases, and contacting principal investigators to conduct a hazard analysis, assess necessary engineering controls and develop an SOP for the material.
- Conducting annual follow-up evaluations to ensure requirements of the toxic gas program are being met.
- Enforcing the California Fire Code (CFC) for toxic and pyrophoric gases.

- Acting as the primary campus contact for regulatory agency inspections.

Toxic, Corrosive and Pyrophoric Gas Users: The end users of toxic and pyrophoric gas are responsible for ensuring that they are fully trained in their safe handling and storage. This includes

- Ensuring that they are fully trained on
    - The Fundamentals of Laboratory Safety class, live or online
    - The Chemical Hygiene Plan
    - Laboratory-specific standard operating procedures (SOPs), including any SOPs related to toxic or pyrophoric gases.
- Labeling all areas, gas lines and equipment in the lab involving toxic and pyrophoric gases.
- Understanding all engineering controlled associated with these gases including gas cabinets, gas monitors, alarms, etc.
- Understanding all emergency shutoff and evacuation procedures.

Program Elements

The following sections detail the basic requirements for the development of compliant standard operating procedures (SOPs) for the use of toxic and pyrophoric gases. An SOP template is included at the end of this document.

Purchase Approval Process

Purchases of all compressed gases shall be flagged in the Gateway purchasing system by the Departmental Purchaser per campus policy, as these items are on the UCSB restricted items list. EH&S will reach out to purchasers of toxic, corrosive and pyrophoric gases to ensure that the below program elements are in place, or to assist in developing a Standard Operating Procedure (SOP) and implementing controls in the case of first-time purchasers.

Training Requirements

Training for use of toxic and pyrophoric gas use and storage starts with general lab safety training followed by training specific to the laboratory, the gas in question, the experimental apparatus in which the gas is being used. The training elements are outlined below:

- **The Fundamentals of Laboratory Safety** class, live or online: This class is required before access is permitted to any UC Santa Barbara laboratory space. The live class is offered for all incoming first year graduate students every fall, and then every two months throughout the year. The online class is available on the UC Santa Barbara Learning Center.

- **The Chemical Hygiene Plan**: All researchers must read and sign this document upon joining a new research group. This document includes a lab-specific portion, which includes standard operating procedures covering operations and their associated hazards that occur in that lab. It also includes a more general UCSB Policies and Procedures that is applicable to all laboratories on campus.

- **Laboratory-specific standard operating procedures (SOPs)**, including any SOPs related to toxic or pyrophoric gases: These are the SOPs contained in the laboratory-specific section of the Chemical Hygiene Plan. These SOPs are created by the research group using the EH&S SOP Template Library, and approved by the Principal Investigator. They can be specific to a chemical like a specific toxic gas, or they could cover the process in which the gas is being used, or both. These SOPs must be read and understood thoroughly by the researcher, and be followed up by hands-on training for first time users. A blank SOP template is also located in the Appendix of this document.

Transport, Use and Storage

Proper storage, handling and transport for compressed gases in general is covered in the UCSB Chemical Hygiene Plan Section II: Handling pp 16-17. Storage and transport pp 50-53. For toxic, corrosive and pyrophoric gases, these additional requirements are in place:

Receiving: The vendor shall deliver the cylinder(s) directly to the laboratory for which it is intended, or to a well-ventilated temporary area that is secured or monitored at all times. *Highly toxic gases (LC_{50} of 200 ppm or less) shall not be delivered to temporary storage areas, unless that area is equipped with gas cabinets or exhausted enclosures with a minimum air velocity of 200 feet per minute average in which to store them*. *Pyrophoric gases shall not be delivered to temporary storage areas, unless that area is equipped with a fire sprinkler system.*

Storage: Indoor storage of toxic, corrosive and pyrophoric gases shall be in a mechanically ventilated area that is secured or monitored at all times: never store or handle in environmental rooms (cold or warm) as these rooms have minimal ventilation. *Highly toxic gases (LC_{50} of 200 ppm or less) shall be stored in a gas cabinet or exhausted enclosure with a minimum air velocity of 200 feet per minute average*. *Pyrophoric gases shall be stored in areas that are equipped with a fire sprinkler system.* Clear labeling with the full name and the hazard information is required for the cylinder, the gas cabinet or ventilated enclosure if used, and the room entrance. Additionally:

- Store away from high traffic areas and emergency exits.
- Oxidizing gases must be separated from flammable gases by 20 feet or by a non-combustible partition no less than 18" above and to the sides of the cylinders, and no less than 5 feet high, whichever is greater.
- Oxidizing gases should never be stored near combustible materials.
- Flammable gases should not be stored near electrical connections, heat sources or fire extinguishers.
- Corrosive gases should not be stored longer than 6 months, due to the risk of cylinder corrosion/failure.
- Visually inspect stored cylinders regularly for signs of corrosion or leakage.
- Add the material to the online chemical inventory (UC Chemicals)

Outdoor storage of toxic, corrosive and pyrophoric gases may be approved by the campus Fire Marshal on a case-by-case basis.

The security of the storage area should be assessed to mitigate any risk of theft or unauthorized use. Laboratory doors, gas rooms and gas cages should be securely locked when unattended. Storage areas that are not regularly occupied should be visually inspected on a regular basis. Notify EH&S and/or campus police if any cylinders of toxic, corrosive or pyrophoric gas become unaccounted for or show signs of tampering.

Gas Regulators, Piping and Exhaust: All regulators, valves, and piping shall be compatible with the gases being used. Pressurized gas systems must be leak tested immediately after assembly and before each use. Piping and tubing used for toxic, highly toxic and corrosive gases shall have welded, threaded or flanged connections throughout, except when piping is located exclusively within exhausted enclosures. Supply piping should be designed with a minimum number of fittings. All piping, regulators, and equipment shall be rated for the planned experimental pressure. Piping pressurized to more than 15 psig may require additional controls, such as leak detection, emergency shut-off or excess flow control. Additionally, compressed gas systems conveying pyrophoric gases shall be provided with:

- An automatic emergency shutoff valve installed on the supply piping at the cylinder or bulk source.
- A manual or automatic emergency shutoff valve installed on the supply piping at the point of use.

All lines or ducts carrying purged or exhausted emissions of toxic, corrosive or pyrophoric gases shall be connected to an exhaust system installed in compliance with the California Mechanical Code. Exhaust duct materials shall be chemically compatible with the gas in use.

Toxic or corrosive gases emitted to exhaust systems at a high concentration (defined by the IDLH concentration of the gas in question) shall require a treatment system capable of reducing the concentration at the point of discharge to at least ½ the IDLH concentration for that gas. If these emissions still pose health risks to rooftop workers, then locked gates, doors, or other means shall be used to prevent worker access to stack discharge areas, and warning signs shall be clearly placed in the vicinity.

Gas cabinets/exhausted enclosures and fume hoods: Highly toxic gases (LC_{50} of 200 ppm or less) shall be stored in a gas cabinet or exhausted enclosure with a minimum air velocity of 200 feet per minute average. Ideally, all toxic, pyrophoric or corrosive gas cylinders should be kept in ventilate enclosures during storage and use. Outside of the highly toxic category, these exhausted enclosures may have flow rates as low as 100 feet per minute average. Equipment connected to these cylinders should also be in exhausted enclosures. If this is impractical due to the size or location of the equipment, alternate engineering controls should be used, such as gas detection alarms and automatic shut-offs.

A ventilation monitor is required and is present on all certified fume hoods. Any gas cabinet or exhausted enclosure where toxic, corrosive, or pyrophoric gases are used and stored should also be equipped with a ventilation monitor. These monitors should indicate that the enclosure is being ventilated at an acceptable flow rate via audible and visual alarms, magnehelic gauges, digital readout, etc. For highly toxic or pyrophoric gases, an interlock between an automatic shutoff valve and the ventilation monitoring device should be considered.

Toxic and Pyrophoric Gas Monitors: Gas monitors which include a detection device and a linked alarm system should be considered if:

- Gases are being used in large quantities.
- Gases have poor physiological warning properties, such as an odor threshold above the PEL.
- Gases are being used outside of an exhausted enclosure due to the size or location of the equipment.
- Gases in permanent or long-term use.

These systems should go into alarm at or below the PEL for toxic and corrosive gases, and at 25% LEL (Lower Explosive Limit) for pyrophoric gases. There should audible and visible alarms in the gas supply location, the gas use or operator room, and outside of the gas use or storage area (e.g. the hallway). The alarms should be distinct from the fire alarm, and should be labeled with the identity of the gas and any emergency procedures. Ideally, gas monitors and alarms should be connected to an emergency power source. For highly toxic or pyrophoric gases, an interlock between an automatic shutoff valve and the gas monitoring device should be considered.

Emergency Response

Emergency response procedures for each toxic, corrosive, and pyrophoric gas being used must be developed and written into the SOP. This should include any aspects of the response that are in addition to those describes in Chapter 4 of the UC Santa Barbara Chemical Hygiene Plan Section II. In general:

- The fire alarm must be activated and the building evacuated.
- Any doors to the area of the release should be closed.
- 911 shall be called from a safe location.
- The SDS for the gas in question should be obtained and referenced.
- **Only trained emergency response personnel with proper PPE including respiratory protection, and gas monitoring instruments shall be allowed to enter the release area.**

In the case of personnel exposure, follow the First Aid Measures section of the relevant SDS. If medical attention is required, provide a copy of the SDS to the health care provider.

References

California Code of Regulations, Title 8, Section 5155, Airborne Contaminants

California Code of Regulations, Title 8, Section 5194, Hazard Communication, Register 2018, No 39

California Code of Regulations, Title 24, Part 2, California Building Code (CBC), 2019

California Code of Regulations, Title 24, Part 4, California Mechanical Code (CMC), 2019

California Code of Regulations, Title 24, Part 9, California Fire Code (CFC), 2019

Department of Transportation (DOTn), Code of Federal Regulations, Title 49, Part 173.179, 2009.

Globally Harmonized System of Classification and Labelling of Chemicals (8th edition), Chapter 3.1 (Acute Toxicity), United Nations, 2019

IDLH values published by National Institute for Occupational Safety and Health (NIOSH), 2017

TLV from American Conference of Governmental Industrial Hygienists, 7th edition, 2019

United States Department of Labor, Occupational Safety and Health Administration (OSHA), Code of Federal Regulations, Title 29, Section 1910.1000, Air Contaminants

Appendix

Table of Toxic, Corrosive and Pyrophoric Gases

Gas and Formula	CAS and UN or NA No.	CFC Class[1]	IDLH[2]	LC50[3]	PEL[4]
Ammonia – NH_3	7664–41–7, UN1005	Corrosive[5,6], flammable	300 ppm	4000 ppm	50 ppm
Arsine – AsH_3	7784–42–1, UN2188	Highly toxic, flammable	3 ppm	20 ppm	0.05 ppm
Boron Tribromide – Bbr_3	10294–33–4, UN2692	Toxic	50 ppm	380 ppm	1 ppm[4(C)]
Boron Trichloride – BCl_3	10294–34–5, UN1741	Corrosive[5]	25 ppm[7]	2541 ppm	5 ppm
Boron Trifluoride – BF_3	7637–07–2, UN1008	Toxic	25 ppm	806 ppm	1 ppm[4(C)]
Bromine – Br_2	7726–95–6, UN1744	Highly toxic, corrosive, oxidizer	3 ppm	113 ppm	0.1 ppm
Carbon Monoxide – CO	630–08–0, UN1016	Flammable[5]	1200 ppm	3760 ppm	50 ppm
Chlorine – Cl_2	7782–50–5, UN1017	Toxic, corrosive, oxidizer	10 ppm	293 ppm	1 ppm[4(C)]
Chlorine Dioxide – ClO_2	10049–04–4, NA9191	Toxic, oxidizer	5 ppm	250 ppm	0.1 ppm
Chlorine Trifluoride – ClF_3	7790–91–2, UN1749	Toxic, oxidizer	20 ppm	299 ppm	0.1 ppm[4(C)]
Diborane – B_2H_6	19278–45–7, UN1911	Highly toxic, flammable	15 ppm	80 ppm	0.1 ppm

Gas and Formula	CAS and UN or NA No.	CFC Class[1]	IDLH[2]	LC50[3]	PEL[4]
Dichlorosilane – SiH_2Cl_2 (HCl)	4109–96–0, UN2189	Toxic, corrosive, flammable	50 ppm	314 ppm	5 ppm[4(C)]
Ethylene Oxide – C_2H_40	75–21–8, UN1040	Flammable[5]	800 ppm	4350 ppm	1 ppm
Fluorine – F_2	7782–41–4, UN1045	Highly toxic, oxidizer	25 ppm	185 ppm	0.1 ppm
Germane – GeH_4	7782–65–2, UN2192	Toxic, flammable	6 ppm[7]	622 ppm	0.2 ppm[8]
Hydrogen Bromide – HBr	10035–10–6, UN1048	Corrosive[5]	30 ppm	2860 ppm	3 ppm
Hydrogen Chloride – HCl	7647–01–0, UN1050	Corrosive[5]	50 ppm	2810 ppm	5 ppm[4(C)]
Hydrogen Cyanide – HCN	74–90–8, UN1051	Highly toxic, flammable	50 ppm	40 ppm	10 ppm
Hydrogen Fluoride – HF	7664–39–3, UN1052	Toxic	30 ppm	1300 ppm	3 ppm
Hydrogen Selenide – H_2Se	7783–07–5, UN2202	Highly toxic, flammable	1 ppm	2 ppm	0.05 ppm
Hydrogen Sulfide – H_2S	7783–06–4, UN1053	Toxic, flammable	100 ppm	712 ppm	20 ppm
Methyl Bromide – CH_3Br	74–83–9, UN1062	Toxic, flammable	250 ppm	1007 ppm	20 ppm[4(C)]
Methylisocyanate – CH_3NCO	624–83–9, UN2480	Highly toxic, flammable	3 ppm	22 ppm	0.02 ppm
Methyl Mercaptan – CH_3SH	74–93–1, UN1064	Toxic, flammable	150 ppm	1350 ppm	10 ppm[4(C)]
Nickel Carbonyl – $Ni(CO)_4$	13463–39–3, UN1259	Highly toxic, flammable	2 ppm	18 ppm	0.001 ppm
Nitric Oxide – NO	10102–43–9, UN1660	Highly toxic, oxidizer	100 ppm	115 ppm	25 ppm
Nitrogen Dioxide – NO_2	10102–44–0, UN1067	Highly toxic, oxidizer	20 ppm	115 ppm	5 ppm[4(C)]

Gas and Formula	CAS and UN or NA No.	CFC Class[1]	IDLH[2]	LC50[3]	PEL[4]
Phosgene – $COCl_2$	75–44–5, UN1076	Highly toxic	2 ppm	5 ppm	0.1 ppm
Phosphine – PH_3	7803–51–2, UN2199	Highly toxic, pyrophoric	50 ppm	20 ppm	0.3 ppm
Phosphorus Oxychloride – $POCl_3$	10025–87–3, UN1810	Highly toxic	0.96 ppm[7]	96 ppm	0.1 ppm[8]
Phosphorus Pentafluoride – PF_5	7647–19–0, UN2198	Toxic, oxidizer	2.6 ppm[7]	260 ppm	3 ppm
Phosphorus Trichloride – PCl_3	7719–12–2, UN1809	Toxic, oxidizer	25 ppm	208 ppm	0.5 ppm
Selenium Hexafluoride – SeF_6	7783–79–1, UN2194	Highly toxic	2 ppm	50 ppm	0.05 ppm (as Se)
Silicon Tetrachloride – $SiCl_4$ (HCl)	10026–04–7, UN1818	Toxic, corrosive	50 ppm	750 ppm	5 ppm[4(C)]
Silicon Tetrafluoride – SiF_4 (HF)	7783–61–1, UN1859	Toxic	30 ppm	450 ppm	0.1 ppm
Stibine – SbH_3	7803–52–3, UN2676	Highly toxic, flammable	5 ppm	20 ppm	0.1 ppm
Sulfur Dioxide – SO_2	7446–09–5, UN1079	Corrosive[5]	100 ppm	2520 ppm	5 ppm
Sulfuryl Fluoride – SO_2F_2	2699–79–8, UN2191	Corrosive[5]	200 ppm	3020 ppm	5 ppm
Tellurium Hexafluoride – TeF_6	7783–80–4, UN2195	Highly toxic	1 ppm	25 ppm	0.02 ppm (as Te)
Titanium Tetrachloride – $TiCl_4$	7550–45–0, UN1838	Highly toxic, corrosive	1.3 ppm	119 ppm	—
Tungsten Hexafluoride – WF_6 (HF)	7783–82–6, UN2196	Toxic, corrosive	30 ppm	217 ppm	0.1 ppm

(Table adapted from Santa Clara County's Hazardous Gas Table.)

Footnotes:

1. **Gases listed as either toxic or highly toxic require a gas-specific SOP**
    a. Class as defined in CFC:

        i. Highly toxic = < 200 LC_{50}
        ii. Toxic = 201–2000 LC_{50}
    b. Physical hazards per CFC Standard 7903.
2. **IDLH (Immediately Dangerous to Life and Health)** values published in 1994 by the National Institute for Occupational Safety and Health (NIOSH).
3. **LC50 data (Lethal concentration 50%):** Lowest reported value, 1 hour adjusted, taken from Dept. of Transportation, Compressed Gas Association, Registry of Toxic Effects of Chemical Substances.
4. **PEL (Permissible Exposure Limit)** values published by Occupational Safety & Health Administration (OSHA). OSHA values used if available; otherwise, Threshold Limit Values (TLV) from ACGIH. (C) = TLV-ceiling limit, an exposure limit not to be exceeded under any circumstances.
5. Moderately toxic per cities of San Jose, Santa Clara, and Milpitas: LC50 = 2,000–5000.
6. When used as a refrigerant, Uniform Building Code Class does not apply.
7. IDLH determined by 0.01 of LC50.
8. Cal/OSHA PEL, Title 8, Section 5155, 9/1/95

Blank SOP template

This document is an addendum to the UC Santa Barbara Chemical Hygiene Plan, and covers additional information on the safe handling and storage of the materials described beyond the practices described therein. Users must be familiar with the UC Santa Barbara Chemical Hygiene Plan before utilizing this SOP.

Standard Operating Procedure (SOP)

Blank Template Instructions

Standard Operating Procedures (SOP) are written safety and health guidelines for laboratory work with hazardous chemicals and are required as a part of a laboratory-specific Chemical Hygiene Plan per Cal-OSHA.

Standard Operating Procedures can be written in one or more of the following ways:

1. By process (e.g. distillation, peptide synthesis, or glove box use).
2. By hazardous chemical (e.g. benzene, perchloric acid, chloroform).
3. By class of hazardous chemicals (e.g. organic solvents or peroxidizable chemicals. SOPs for most hazard classes are already provided in the UCSB SOP Library).

PROCESS SOP Guidance:

In the Overview section, describe the process or type of process that this SOP is to cover in terms of its associated hazards. If specific hazardous chemicals are involved, list those and their associated hazards. The SDS is a good source of information for this. Physical hazards such as temperature extremes, pressure/vacuum, moving parts, etc. should also be described here. This should be written such that the primary danger of the material is observable at a glance. (For example: This operation is run at **high temperature and pressure**, and therefore carries a risk of explosion.)

HAZARDOUS CHEMICAL/HAZARDOUS CHEMICAL CLASS SOP Guidance:

In the Overview section, describe the known hazards of the chemical or class of chemicals. This should be written such that the primary danger of the material is observable at a glance. (For example: *tert*-butyllithium is **extremely pyrophoric**, so all exposure to air and moisture must be avoided.)

Cal/OSHA does not have specific guidelines or requirements for content of Standard Operating Procedures. For Principal Investigators and laboratory supervisors desiring guidance, EH&S recommends that the elements shown by the headings below be included in Standard Operating Procedures. The information given should focus on practices that are in addition to those already described in the Chemical Hygiene Plan. EH&S Laboratory Safety is happy to assist in this effort. Contact Hector Acuna < hector.acuna@ucsb.edu> or Alex Moretto amoretto@ucsb.edu.

Standard Operating Procedure

[HAZARD]

Overview

Special Handling and Storage Concerns

Personal Protective Equipment

Special Storage Requirements

Engineering Controls

Special Handling Considerations

Decontamination

Waste Management

First Aid and Emergencies

Spill

Fire

Personnel Exposure

Laboratory Specific Information

Prior Approval Required

- ☐ **NO**
- ☐ **YES (describe):**

Designated Area

- ☐ **Entire Laboratory Area**
- ☐ **Other (describe):**

Experimental Conditions of Use

Temperature Range:

Pressure Range:

Scale Range:

Other Relevant Details: