* **Standard Operating Procedure**

for work(*ing*) with *Phosgene (75-44-5).*

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| **PI:** | **Building(s):** |
| **PI Signature:** | **Room Number(s):** |
| **Date:** | **Designated Work Area:** |
| **OESO Approval?** | **Yes** |[ ]  **No** |[ ]  **OESO Signature:** |
| **Departmental Approval?** | **Yes** |[ ]  **No** |[ ]  **Departmental Signature:** |

1. **Circumstances of Use:**

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| This SOP must be customized for each lab using phosgene. *Use this section to describe the circumstances of use, including concentration and quantity (i.e., for gas cylinders: size and number).* |

1. **Potential Hazards:**

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| Phosgene is a non-flammable colorless gas with a hay-like odor at lower levels, pungent at higher levels; detectable at 0.1 to 5.7 ppm. The OSHA PEL is 0.1 ppm as an 8 hour time-weighted average, and the ACGIH TLV is 0.02 ppm as a Ceiling Limit.  * Phosgene is Particularly Hazardous and High Risk, Action A. It is Fatal by inhalation, category 1 and corrosive to the eyes, skin and respiratory tract. Short-term (acute) inhalation exposure can cause severe respiratory effects, including pulmonary edema, pulmonary emphysema, and possibly death1.
* Phosgene is severely irritating and corrosive to all body tissues. It reacts with water to form hydrochloric acid and carbon dioxide. It can cause severe skin burns, eye damage, and destruction to the tissue of the mucous membranes and upper respiratory tract.
* May be harmful if absorbed through the skin2.
* Chronic (long-term) inhalation exposure may cause irreversible pulmonary changes of emphysema and fibrosis1.
* As with any compressed gas cylinder, the large amount of potential energy contained makes these cylinders a potential rocket or bomb if the pressure is released through rupture of the valve or container failure.

For more safety information, refer to the [Laboratory Chemical Safety Summary for Phosgene](https://pubchem.ncbi.nlm.nih.gov/compound/6371#datasheet=LCSS) on PubChem. |

1. **Engineering Controls:**

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| The minimum acceptable engineering controls for phosgene use are a chemical fume hood in a negative pressure room, secure cylinder storage (via chains, cylinder stand, or gas cabinet), and regulators and valves approved for use with phosgene. Depending on the amount, concentration, and other properties of the gas, some of the following controls may be required: * + - * Exhausted gas cabinet for cylinder(s).
			* Electronic safety shut-off valve attached to cylinder with a negative pressure sensor inside the fume hood exhaust system. In the event of a fume hood exhaust system failure, this valve will respond by closing off all gas flow from the cylinder.
			* Phosgene sensor/detector with or without alarm.
			* Restrictive flow orifices that limit the flow of gas.
			* Scrubbed exhaust.
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1. **Work Practice Controls:**

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| * *Specific written procedures, approved in advance by the Principal Investigator and OESO (as a High Risk Procedure), are required. These must cover all sections of this template.*
* Purchase phosgene in the lowest concentration and in the smallest cylinder that makes sense for the lab. Concentration must be **less than** 0.17% (1700ppm).
* All work with phosgene must be conducted by at least two trained individuals at all times.
* Gas outlet must be inside chemical fume hood or other engineering control device.
* All exhaust gas must be routed through a dual trap system, with the first trap empty and the second trap containing an aqueous sodium hydroxide solution (8% by weight) to quench the phosgene. Phosgene is converted to sodium chloride, sodium bicarbonate and water. A third trap containing water with a colorimetric indicator for acid can be used after the sodium hydroxide in some instances.
	+ - * Phosgene levels in exposure chambers can be determined using a phosgene gas detector.
* Cylinders, fittings, and fume hood should be visually inspected for leaks on a routine basis for any indication of leakage or other problems.
* Keep valve closed and valve cover in place when gas is not in use.
* Post warning signs indicating the presence of phosgene on doors and on fume hood (and gas cabinet, if used).
* All compressed gas cylinders shall be legibly marked by stenciling or stamping with at least the chemical name or commonly accepted name of the material contained. In addition, cylinders should bear the approved markings of the Department of Transportation stamped in the metal at the top of the cylinder.
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1. **Personal protective equipment (PPE):**

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| Engineering controls will provide the primary means of minimizing employee exposure to toxic gases, but in some cases emergency respirators may be advised. Contact OESO Occupational Hygiene and Safety at 919-684-5996 for advice on respiratory protection.As with all lab work, wear a fully buttoned lab coat, safety glasses, standard nitrile laboratory gloves, clothing covering the legs, and closed-toed shoes. |

1. **Transportation and Storage:**

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| * Cylinders (full or empty) shall be secured by chains, straps, or other sturdy tie downs during storage and transport.
* Full cylinders shall be separated from empty cylinders within the storage area.
* Cylinders shall not be stored at temperatures above 125 °F or in direct sunlight, or outside of the temperature range specified by the manufacturer.
* Cylinder valves shall be kept closed when not in use.
* Removable caps shall be kept on cylinders at all times, except when cylinders are in use.
* Cylinders shall be protected against tampering and damage.
* Cylinders shall not be stored near combustible materials or incompatible chemicals.
* Cylinders shall not be refilled.
* Cylinders shall not be used or stored in cold rooms or other unventilated enclosures.
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1. **Waste Disposal:**

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| All empty gas cylinders, including any unused gas, should be returned to the vendor from which the cylinder was purchased. OESO Environmental Programs should also be contacted at 919-684-2794 to determine if the gas can be exhausted or if scrubbers are needed. |

1. **Exposures/Unintended contact:**

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| Contact Employee Occupational Health and Wellness (EOHW) at 919-684-3136 for medical advice on occupational chemical exposures. For an actual chemical exposure:* Remove all persons from the contaminated area. (It may be necessary to go outside.)
* Call 911 from a campus phone or 919-684-2444 from any phone to request assistance if needed. Contact Employee Occupational Health and Wellness at 919-684-8115 for exposure-related advice.
* **Eye Contact**: Immediately flush eyes at an eyewash station for at least 15 minutes. Get medical attention immediately. Continue rinsing eyes during transport to hospital.
* **Skin Contact**: Take off contaminated clothing and shoes immediately and wash off with soap and plenty of water. Get medical attention immediately.
* **Inhalation**: Moved exposed person to fresh air. If not breathing, give artificial respiration. Get medical attention immediately.
* Within 24 hours, complete the work-related injury or illness report found at: <http://www.hr.duke.edu/benefits/medical/workcomp/report.php>.
* Follow-up medical attention should be sought through Duke Employee Occupational Health and Wellness (919-684-3136).
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1. **Emergency/Release Procedure:**

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| On the Durham campus, any uncontained release of toxic gases must be referred to the OESO spill response team by calling Duke Police at 911 from a campus phone or 919-684-2444 from any phone. |

1. **Training of personnel:**

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| * All personnel are required to complete the online General Lab Safety session thru the OESO website. This session includes an introduction to general chemical safety.
* Training on **phosgene**-specific procedures must be performed by the PI or knowledgeable designee for all personnel working with **phosgene**, and must be documented (topics covered, date, employee names and signatures).
* All personnel shall read and fully adhere to this SOP for **phosgene gas**, and shall document that they have read it by signing and dating the SOP.
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References:

1[Phosgene - EPA Air Toxic Web Site](http://www.epa.gov/ttnatw01/hlthef/phosgene.html)

2Sigma-Aldrich SDS product#79372

3EPA-450/4-84-007i\_1985\_pg.21

**“I have read and understand this SOP. I agree to fully adhere to its requirements.”**

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| **Last** | **First** | **Duke ID** | **Signature** | **Date** |
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