## Standard Operating Procedure

# **Vacuum Systems**

## Overview

Systems under vacuum and their associated equipment have a variety of hazards associated with them, including:

* Implosion and the associated flying debris, splattering chemicals and possibly fire.
* Condensation of liquid oxygen into a cold trap using liquid nitrogen as coolant. Liquid oxygen is an explosion hazard when warmed in a closed system, and when it comes in contact with organic material.
* Pinching extremities or catching clothing in the vacuum pump belt system.
* Exposure to hazardous material due to improper venting of pump exhaust.

These systems are typically quite complicated and require extensive hands-on training prior to use.

Related SOP: [ADDLINK]

* Cryogens

## Special Handling and Storage Concerns

**Personal Protective Equipment**

ANSI Z87.1-compliant safety glasses or goggles. A face shield is recommended if the system is made of glass or other breakable material, and is not behind a fume hood sash or blast shield.

**Engineering Controls**

**Special Handling Considerations**

*General Concerns*

* Understand the type of vacuum pump being used, and ensure that it is appropriate for the application (e.g. evaporation of solvents vs. high vacuum).
* Prepare for power outages. Some valves close upon loss of power, some open. Understand the effects that a series of valve openings and closings will have upon the system's integrity.
* Always replace the pump belt guard to prevent catching fingers or clothing in the mechanism.
* Glass vessels that are evacuated should be round-bottomed and/or thick-walled and designed for low-pressure work. They should be regularly checked for star cracks and scratches.

*Traps and Venting*

* Mechanical vacuum pumps should be protected by cold traps – generally liquid nitrogen based. Cold traps are dangerous due to their ability to condense liquid oxygen. Therefore, operation of low these traps must be thoroughly understood. Both the cooling and warming phases deserve undivided attention, and the system tested for leaks regularly.
* If hazardous materials are used with the vacuum system they should be located in, and **vented** to, a fume hood.
* Dewar flasks are insulated by being under high vacuum and are therefore subject to implosion. They should be wrapped in tape or plastic sheathing and generally come that way.

Turning ON a High Vacuum System:

* Make sure all valves are closed.
* Turn on vacuum pump.
* Place Dewar around trap flask
* Submerge trap flask in liquid nitrogen. Make sure system is under vacuum before cooling trap to avoid condensation of liquid oxygen.

Turning OFF a High Vacuum System

* Remove all samples and experiments from vacuum line.
* Remove trap flask from Dewar. Allow to warm to room temperature
* Open vacuum system to atmosphere. Do not do this while trap is cold to avoid condensation of liquid oxygen.
* Turn off pump.

*Chemical Hazards*

* Mechanical pump oil can become contaminated with hazardous materials. During maintenance, proper protective equipment must be employed. A ventilated area should be used for changing pump oil, as harmful vapors may be released. Clean or contaminated pump oil must be disposed of as hazardous waste via EH&S.
* Mechanical pump exhaust may require suitable scrubbing for volatile highly toxic materials. This may involve a relatively simple filter or liquid bubbler.

**Decontamination**

Please see Large [Laboratory Equipment Decontamination SOP](https://www.ehs.ucsb.edu/sites/www.ehs.ucsb.edu/files/docs/chp/sop/UCSB_Large_Equipment_Decontamination_SOPv2018.pdf) for guidance on how to decontaminate vacuum pumps for repair or disposal

## 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:**