Pressure and Vacuum Systems

Standard Operating Procedure

Revision Date: 6/30/2022

This standard operating procedure (SOP) outlines hazards and controls when working with systems under pressure or vacuum. 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 working with systems under pressure or vacuum.

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

Working under pressures that are higher or lower than normal pressure conditions can be hazardous. High-pressure conditions can result in explosions and low-pressure conditions can result in implosions. If a piece of pressure equipment malfunctions or breaks, it can be extremely dangerous. Only perform high-pressure operations within pressure vessels that are appropriate.

All vacuum systems pose implosion hazards. Vacuum operations should be performed behind a shield or within a fume hood.

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

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

Experiments carried out at pressures above one atmosphere can lead to explosion from equipment failure. Systems under vacuum pose a potential for flying glass, exposure to toxic chemicals contained in the vacuum system and fire from solvent release.

Exposure to cryogenic liquids poses a hazard with vacuum lines that require cold traps between the pumps and the vacuum line. Cold traps need to be checked frequently to make sure they do not become plugged with frozen material. Cold traps in a reduced-pressure system should be taped or placed in a metal can filled with vermiculite.

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

* Make sure the container you are using will withstand the pressure/vacuum and set up the operation to minimize the hazards of a container failure.
* Whenever possible, metal reactors with glass liners should be used instead of sealed glass tubes.
* Use suitable shielding to prevent injury from flying glass or from corrosive or toxic reactants.
* Glass tubes with high-pressure sealers should be no more than three-quarters full.
* For vacuum filtering applications, use a heavy walled filtering flask conforming to ASTM E1406. Coated glass flasks or Nalgene flasks will be less likely to produce flying sharps than plain glass filtering flasks.
* Examine newly fabricated or repaired glass equipment for flaws and strains using polarized light.
* For work with compressed gas cylinders, see the [SOP for compressed gases](http://ehs.umich.edu/wp-content/uploads/2016/02/CompressedGases.docx).
* Pressurized apparatus shall have an appropriate pressure-relief device, which needs to be inspected and replaced periodically.
* Work in a chemical fume hood if a pressure-relief device will discharge toxic, corrosive, flammable, or otherwise hazardous or noxious materials.

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

In planning the research steps for work in a closed system, consider the effects of heat (including exothermic reactions) and cooling and ensure that the laboratory apparatus is designed to withstand the pressure or vacuum that may be created.

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

Wear PPE that will provide protection if the container fails. Minimum PPE would be safety glasses, lab coat, and standard laboratory gloves. A full face shield is recommended if work is not done inside a chemical fume hood.

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

Plan ahead if it is necessary to transport containers under pressure or vacuum. Use a safety cart and/or secondary containment.

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

If your process that is done under pressure or vacuum generates any hazardous waste, contact Environment, Health & Safety (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 webpage](http://oseh.umich.edu/hazardous-waste/) for more information.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when working with equipment under pressure or vacuum.

# Certification

I have read and understand the above SOP. 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 and formatting (DML). |
| 06-30-22 | Content review, Removed emergency info (JMW) |