Beryllium Vacuum Windows

Standard Operating Procedure

Revision Date: 05/17/22

Laboratory Director (LD) Approval is Required Prior to Performing this Procedure

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

Beryllium (Be) windows are used for their high transmission of X-rays. The material exhibits higher transmission for thinner windows. Consequently, thin vacuum windows are often used for X-ray detection systems.

Intact Be windows are considered “finished articles”. Be windows broken as a result of unexpected breakage during beamline or other laboratory operations are NOT considered "finished articles" and precautionary measures **must** be adhered to in order to clean-up and dispose of broken Be window fragments.

A broken Be window may cause potential personal exposure to Be, damage to equipment and considerable downtime for the lab. Therefore, it is important to prevent failure of the Be window by calculating a maximum allowable working pressure (MAWP) for the equipment, and replacing the window prior to the end of its expected service life. The manufacturer of the Be window should be able to provide information to assist with establishing the MAWP and service life.

**Location**

Indicate in what room(s)/building(s)/equipment the Be windows are used.

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

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

Inhalation of beryllium dust and/or particles can cause chronic beryllium disease (CBD) or beryllium sensitization in exposed individuals. CBD is a chronic and sometimes fatal lung condition. Beryllium sensitization is a condition in which a person’s immune system may become highly responsive or allergic to the presence of any beryllium within the body. In the case of beryllium sensitization, the concentration of beryllium may be different for each individual person.

Other routes of entry that may attribute to these conditions also include ingestion and skin contact or absorption. Furthermore, both beryllium and beryllium compounds are considered to be class 1 carcinogens.

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

Under normal conditions of handling and use, no engineering controls are necessary for Be windows. Prior to subjecting a Be window to stress such as vacuum, calculate the MAWP. *Include the information in this section*.

An in-line filter should be used on the vacuum line to prevent contamination of the pump in case of window breakage.

If a window breaks under vacuum, dust is typically released into the vacuum. The vacuum pump needs to be shut down immediately, and the broken port should be covered with foil to contain the Be dust and pieces. Procedures for cleanup of the broken window, including required engineering controls, are detailed below.

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

Breakage of Be windows can be limited by using the smallest window possible in the given vacuum application, not exceeding the MAWP and replacing the window prior to the end of the expected service life.

In the event of a Be window breakage, the area **must** be immediately cleared of people and the University of Michigan Division of Public Safety and Security (DPSS) **must** be called at 911. Restrict access to the lab by posting signage or placing “Caution” tape across the door.

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

Under normal conditions, wear a lab coat and safety glasses in the lab. Use disposable nitrile gloves when handling Be windows and wash hands afterward.

PPE requirements for cleanup of Be fragments are provided below.

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

Describe where and how you will store Be windows in the lab. Describe transportation strategy (use of secondary containers, travel through low-traffic hallways).

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

There is no waste associated with the normal use of intact Be windows. A waste container should be available in the lab for disposal of Be contaminated items in the event of a window breakage. Obtain a waste container with cover that can be sealed, such as a plastic bucket or drum, from Environment, Health & Safety (EHS) Hazardous Materials Management (HMM).

Broken Be windows are considered hazardous waste and **must** be properly disposed of. ***Do not dispose of Be wastes by dumping down a sink, flushing in a toilet or discarding in regular trash containers.*** Contact EHS-HMM at (734) 763-4568 for waste containers, labels, manifests, waste collection and for any questions regarding proper waste disposal. Also refer to EHS’s [Hazardous Waste](http://ehs.umich.edu/haz-waste/) Web page for more information.

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

If a Be window breaks in equipment under vacuum, follow these steps:

* Immediately shut down the vacuum pump and cover the broken port with foil to contain the contamination inside the equipment.
* Leave the lab and call U-M DPSS at 911 with a contact name and phone number for someone with knowledge about the lab to report potential beryllium contamination in the lab.
* Post a sign at the entrance of the room “Danger: Suspect Beryllium Contamination Do Not Enter.”

U-M DPSS will contact EHS to advise them of the problem. **Do not do anything else until EHS has evaluated the situation and advised that you may proceed.**

EHS may collect wipe samples of the lab and surrounding areas and send them for analysis to determine the potential for contamination outside the chamber. *It will take a day or two to receive analytical results of the wipe samples. The lab will remain closed during this time until EHS grants approval to re-enter the lab to clean up the contamination.*

While waiting for the analytical results of the wipe sample, contact EHS-HMM at 763-4568 to obtain the following supplies for cleanup:

* Hazardous waste containers and waste labels
* Tyvek suits and shoe covers
* A dedicated HEPA filter vacuum

## Donning PPE for Clean Up

Place a tacky mat just inside the door of the lab. Position a waste container near the tacky mat to be used for contaminated PPE when finished with the cleanup, prior to exiting the lab. A clean area to place goggles when doffing PPE should be designated within reach of the tacky mat.

Don the following required PPE prior to entering the lab for cleanup:

* Disposable shoe covers
* Tyvek suit
* Two pair of disposable nitrile gloves
* N95 respirator

\*\*\*Respirator use requires employee participation in the Respiratory Protection Program, which involves medical clearance and annual fit testing and training\*\*\*

* Goggles or safety glasses with side shields

## Cleaning Up the Spill

* A dedicated HEPA filter vacuum may be used to suck out small chips and to vacuum out loose dust, but microscopic dust contamination may still pose a hazard.
**NOTE**: The vacuum will be considered contaminated and will need to be cleaned by EHS afterward. **Do not remove** the vacuum from the immediate area of the cleanup.
* Use water or alcohol-wetted wipes to wipe down all accessible surfaces. Place the used wipes in plastic bags and dispose of in the hazardous waste container to be removed by EHS-HMM.
* **Do not blow air onto any contaminated surfaces**.

## Removing PPE after Clean Up

Remove PPE **prior** to leaving the lab. It **must** be taken off in the following order:

1. Remove one shoe cover, place foot on tacky mat and discard the shoe cover in the labeled waste container. Repeat with the other foot.
2. Remove the **outer** **pair** of gloves. Place them in the waste container.
3. Remove the Tyvek suit by rolling it down, so the inner surface is on the outside as you roll. Place the suit in the waste container.
4. Remove goggles and place in pre-designated “clean” area.
5. Remove respirator and place in waste container.
6. Remove the **inner pair** of gloves and place in the waste container.

## Follow Up

After the surfaces of the chamber have been cleaned, contact EHS to complete a series of wipe tests to determine the highest accessible level of dust that remains.

# Training of Personnel

All personnel shall read and fully adhere to this SOP when working with beryllium windows.

# Certification

I have read and understand the above SOP. I have received approval from my Lab Director to perform this procedure. 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 |
| 09-13-18 | EHS name and logo were added, updated the formatting, and revised the content under Exposure/Unintended Content (AKJ). |
| 03-04-19 | Reviewed and updated. |
| 05-15-20 | Updated editing rights to headings (RSH) |
| 05-17-22 | Reviewed links and information. (WBD) |