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Management of Broken Beryllium Windows and Equipment Contaminated with Beryllium Oxide

Section where used:

This procedure may be utilized at the APS beamlines or within a laboratory setting when managing the clean-up and disposal of either broken beryllium windows or equipment contaminated with beryllium oxide (BeO).

Changes made in this revision:

- Removed ASD Division Director as an approver

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Management of Broken Beryllium Windows and Equipment Contaminated with Beryllium Oxide

1 INTRODUCTION

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 ANL class 1 carcinogens.

Intact beryllium windows are considered "finished articles" and are exempt from the requirements of the ANL Chronic Beryllium Disease Prevention Program. Beryllium 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 beryllium window fragments.

Several years of beryllium monitoring at the APS has shown that broken beryllium windows typically result in fragments with little detectable concentration of beryllium observed from wipe sampling by ESQ-Industrial Hygiene. Furthermore, air monitoring following several window breakages have consistently shown no detectable airborne concentrations of beryllium (*ref. monitoring results on file in the Office of the APS Chemical Hygiene Officer*). Therefore, the APS has adopted the following procedure for managing broken beryllium windows based on clean-up recommendations provided by ESQ-Industrial Hygiene and prior monitoring results.

1.1 Purpose

To provide APS personnel and users with a step-by-step procedure that may be utilized at the APS beamlines or within a laboratory setting when managing the clean-up and disposal of broken beryllium windows. This policy defines the personnel allowed to initiate and perform the cleanup of a broken beryllium window and the logging requirements for the event.

1.2 Scope

Several research processes at the APS have the potential to create a situation in which a beryllium window may unexpectedly break. These processes include the following:

- A broken beryllium window on an X-ray detector
- A broken beryllium window under vacuum
- A broken beryllium window into an experimental station

1.3 Applicability

The use of this procedure is applicable to beamline personnel, engineers, APS Floor Coordinators, and other APS safety personnel.

1.4 References

Beryllium ([LMS-PROC-232](#))

“Hazard Communication for Chemicals” ([LMS-PROC-288](#))

[DOE G 440.1-7A](#) *Implementation Guide for use with 10 CFR Part 850, Chronic Beryllium Disease Prevention Program*

25 March, 2008 Memo from Steve Eagels to Tom Barkalow *Window clean-up procedure review* ([APS 1258059](#))

1.5 Type of Procedure

Clean-up & disposal

1.6 Hazard Controls

See “Management of Broken Beryllium Windows and Equipment Contaminated with Beryllium Oxide (APS_1191124)” ([WCD # 25673](#)).

2 PROCEDURE

Designated cleanup personnel – Only a trained APS Floor Coordinator, beamline personnel, or APS ESH Coordinator may perform the cleanup and disposal of a broken beryllium window following this procedure. This person will be designated as the Event Beryllium Coordinator (EBC) for the current event. A list of pre-designated, trained EBCs will be maintained by the APS Chemical Hygiene Officer (CHO). All logging of the event will be done by the APS CHO for reporting and tracking purposes. The event may be logged into the Floor Coordinator log only to serve as a reference to the event. The AES-UES group maintains a cleanup kit for Beryllium.

Types of Beryllium incidents:

1. **A Broken Beryllium Window on an X-ray Detector** - X-ray detectors are equipped with a thin beryllium window that is mounted on the end of the detector

probe by the manufacturer. Typically, the beryllium window breaks into the detector should the window rupture while under vacuum. In such instances, the level of beryllium contamination must be assessed prior to packaging and sending the detector back to the manufacturer for repair.

2. **A Broken Beryllium Window Under Vacuum** – On occasion, a beryllium window may rupture while under vacuum on the beamline due to an unanticipated overpressurization of the vacuum system. In such instances, fragments of the beryllium window have been known to travel as far upstream as the turbo pump.
3. **A Broken Beryllium Window Into An Experimental Station** – Sometimes a beryllium window that is mounted within a flange may break during initial installation within the experimental station or during other work downstream from the window that could create the potential for beryllium window fragments to rupture into normally occupied portions of the experimental station.

CAUTION: If any conditions are observed where there are unknown factors present such as a visible oxide, or undetermined residue has formed on any Be window fragments that appears to be potentially friable, (can easily crumble into a dust or powder), cleanup should be delayed until the industrial hygienist can be called to the location to conduct an evaluation. Avoid disturbing this material.

- The user or beamline personnel must contact the on-duty Floor Coordinator (2-0101) immediately if there is suspected BE contamination. Immediate actions to mark the area as being potentially contaminated in order to limit the spread of any potential Be particles should be taken.
- The Floor Coordinator will:
 - Immediately secure the area and post as **DANGER: Suspect Beryllium Contamination.**
 - Place a tacky-mat at the entrance to the experimental station.
 - Contact the APS Chemical Hygiene Officer (Paul Rossi 2-4192; 4-4492) and/or any APS ES&H Coordinator (Elroy Chang 2-6714; 4-1888, Jim Lang 2-7021; 4-1585 or Paul Rossi).
 - Contact ESQ-Industrial Hygiene to perform wipe sampling of the detector and surrounding areas.
 - If the CHO, an APS ES&H Coordinator, or ESQ-IH determine that a HEPA-filtered vacuum is needed follow the instructions for the vacuum below.
- The EBC will:
 - Don nitrile gloves, safety glasses, tyvek coat, and shoe covers
 - Pick up any noticeable beryllium fragments using small pieces of sticky tape and place into a small plastic Ziploc bag.
 - If the window was on a detector, remove contaminated detector and immediately place into a plastic bag.

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- Tape the bag and label as **DANGER: Contaminated with Beryllium. Do Not Remove Any Fragments by Blowing or Shaking. Cancer Hazard and Lung Disease Hazard.**
- Wipe down surrounding areas with solvent wipes.
- Place all used solvent wipes into a plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- Upon exiting the experimental station, remove all PPE and place into another plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- Place the used tacky-mat into a plastic bag and label as **DANGER: Suspect Beryllium Contamination.**
- The Floor Coordinator WILL NOT release the area unless instructed by the APS Chemical Hygiene Officer, APS ES&H Coordinator or ESQ-Industrial Hygiene.
- The APS CHO will then enter the contaminated equipment information (i.e., location used, model number, serial number) into the Be window log and update the log upon notification of the final status of the equipment by the equipment owner.
- Sampling results will typically be available from ESQ-Industrial Hygiene within 1-2 weeks. If the results show no detectable beryllium contamination, then all used PPE and tacky-mat may be disposed of in the regular trash and labels may be removed from any equipment identified as **DANGER: Suspect Beryllium Contamination Inside.** If sampling results show detectable beryllium contamination above the DOE threshold, then all used PPE and tacky-mat must be disposed of as chemical waste and all contaminated equipment must be relabeled as **DANGER: Contaminated with Beryllium. Do Not Remove Any Fragments by Blowing or Shaking. Cancer Hazard and Lung Disease Hazard.**
- Complete a WMO-197 Chemical Waste Requisition and dispose of the beryllium window fragments through ANL Waste Management Operations.

Notes:

If Be contaminated items are to be removed from the bag for decontamination:

- The EBC will immediately move the bagged items into a chemical fume hood that is rated for carcinogen use.
- The EBC will post the face of the hood as **DANGER: Cancer Hazard.**
- Note: The decontamination and/or replacement of such items while at the APS must then be handled under a separate carcinogen handling procedure.

If a piece of beryllium contaminated equipment is to be shipped back to the manufacturer:

- The Window Owner will:
 - Provide MSDS for beryllium and/or beryllium oxide when preparing equipment for shipment back to the manufacturer.

- Provide either the APS Chemical Hygiene Officer or any APS ES&H Coordinator with the ANL-126C Shipping Order number and shipping address so that he/she can send an email to the ANL Shipping Department to inform of the upcoming shipment. In some instances, he/she may also need to send a duplicate email to ANL Export Control for international shipments.
- Contact the ANL Shipping Department (2-5712 or 2-2934) to arrange for the old detector to be transported from the APS to Bldg. 46.

If preparing the contaminated items for disposal through ANL Waste Management Operations,

- The Beamline SWAA Owner will complete a WMO-197 Chemical Waste Requisition. The bagged Be waste is to be labeled and placed in the beamline SWAA to be made ready for WMO pickup.

HEPA-filtered vacuum procedure:

If the APS CHO, an APS ES&H Coordinator, or ESQ Industrial Hygiene determines that a HEPA-filtered vacuum is needed for the cleanup then:

- The EBC will:
 - Obtain a HEPA-filtered vacuum and the tools that may be necessary in order to disassemble any equipment or flanges in the cleanup process.
 - Enter into the HEPA-filtered vacuum logbook the date and location that the vacuum was used for beryllium clean-up.
- A second person must use the HEPA-filtered vacuum along the areas where the equipment is being breached prior to accessing any interior surfaces,
- Once the equipment is disassembled, ESQ-Industrial Hygiene will then perform wipe sampling of the interior surfaces to the extent that is physically practical.
- Any noticeable beryllium fragments may then be picked up using small pieces of sticky tape and placed into a small plastic Ziploc bag.
- Use the HEPA-filtered vacuum over the entire interior surfaces of the equipment to the extent that is physically possible.
- ESQ-Industrial Hygiene will then perform final wipe sampling of the interior surfaces of the equipment that was disassembled.
- Reassemble the vacuum chamber, beam pipe, or other equipment and temporarily label as **DANGER: Suspect Beryllium Contamination Inside**.
- If a vacuum pump was disassembled and is to be reassembled.
 - if the pump is an ion pump it may be reassembled for use and tagged as **DANGER: Suspect Beryllium Contamination Inside**
 - - OR -
 - If the pump is a turbo pump or other pump capable of dispersing Beryllium it may be bagged and tagged as **DANGER: Suspect Beryllium Contamination Inside** and replaced with a new pump.
 - Note: Any decontamination efforts of a beryllium contaminated vacuum pump while at the APS must then be handled under a separate carcinogen handling

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procedure. If preparing the contaminated vacuum pump for disposal through ANL Waste Management Operations, complete a WMO-197 Chemical Waste Requisition.

- Upon exiting the experimental station, remove all PPE and place into a plastic bag and label as **DANGER: Suspect Beryllium Contamination**.
- Note: Leave all tools and the HEPA-filtered vacuum inside the experimental station as well.
- ESQ-Industrial Hygiene will then perform final wipe samplings of the tools, HEPA-filtered vacuum, the floor and any horizontal surfaces per their discretion.

3 DOCUMENTATION REQUIRED

- Floor Coordinator Shift Log (for reference to the event).
- APS CHO Be Window Log
- WMO-197 Chemical Waste Requisition

4 DOCUMENTS/RECORDS CREATED BY THIS PROCEDURE

The documents/records listed below will be created in the execution of this procedure and must be retained as indicated.

Description of Document/Record (include ID number, if applicable)	Custodian	Storage Location and Medium	Retention Requirement
APS CHO Be Window Log	APS Chemical Hygiene Officer	Electronic Copy in APS ICMS system	75 years
Surface and Air monitoring reports from ESQ-Industrial Hygiene	APS Chemical Hygiene Officer	Electronic Copy in APS ICMS system	75 years

5 TRAINING AND ADDITIONAL REQUIREMENTS

To be designated as an Event Beryllium Coordinator:

- ESH 211, *Beryllium Awareness Training* (required)
- ESH 574, *Chemical Waste Generator* (required)
- ESH 456, *Chemical Waste Certifier* (needed for completing WMO-197 only)
- ESH 246, *Safe Handling of Carcinogens* (recommended)
- JHQ changed to reflect clean-up personnel as having the potential for low-level exposure to beryllium

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PPE required for cleanup: nitrile gloves, safety glasses, tyvek coat, and shoe covers.

DOE AL – Action Level = 0.2 micrograms/m³ of air

OSHA PEL – Permissible Exposure Limit = 2 micrograms/m³

DOE Surface Clearance Level for equipment = 0.2 micrograms/100 cm² of surface

Adherence to DOE levels is required for ANL operations.

6 FEEDBACK AND IMPROVEMENT

If you are using this procedure and have comments or suggested improvements for it, please go to the [APS Policies and Procedures Comment Form](#)* to submit your input to a Procedure Administrator. If you are reviewing this procedure in workflow, your input must be entered in the comment box when you approve or reject the procedure.

Instructions for execution-time modifications to a policy/procedure can be found in the following document: Field Modification of APS Policy/Procedure ([APS 1408152](#)).

* <https://www1.aps.anl.gov/Document-Central/APS-Policies-and-Procedures-Comment-Form>