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	REVISION Final Rev 1
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1.0 Purpose/Scope This procedure documents recommendations by the SHSD Industrial Hygiene Group for health and safety protection during mercury vacuum cleaner repair and filter replacement. This procedure is not intended to measure the environmental consequences or determine the status of environmental compliance during vacuum cleaner maintenance.

2.0 Responsibilities This procedure [can](#) be implemented [by](#) organizations that own and/or service vacuum cleaners. Only persons who thoroughly understand this procedure and are competent to operate the detection equipment should conduct work following the recommendations [in Attachment 91](#).

3.0 Definitions

Mercury Vacuum Cleaner: a mechanism that pulls air into the apparatus and collects mercury by one of several methods including filtration, adsorption on activated carbon cartridge, or collection in a jar attachment. Once [a vacuum cleaner is](#) used, all interior components of the vacuum are potentially contaminated with mercury.

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4.0 Prerequisites

4.1 **Hazard Assessment of area:** See Attachment 9.1 for details. The task of opening a vacuum cleaner **can** pose significant employee health risks. Do not perform maintenance work until a competent individual has assessed the impact of opening the vacuum in **an** area. Appropriate protection and spill containment mechanisms must be in place prior to work.

4.2 **Personal Protective Equipment:** See Attachment 9.1 for specific requirements.

4.3 **Work Planning:** All requirements of work permits and work planning system reviews must be met in performing this procedure.

4.4 **Environmental Impact and Waste Disposal:** Parts, bags, debris, and other items removed from the vacuum cleaner may have adverse impact on the environment or create waste for disposal. All items from the vacuum cleaner must be handled, transported and disposed of in accordance with BNL Environmental and Waste Management Services Division requirements.

5.0 Precautions

Verify that personnel will not be exposed to hazardous airborne levels of the mercury by testing the breathing air and the source with direct reading instrumentation. Test the source in a manner that does not place the tester's breathing zone in **close** vicinity with a source, i.e. approach with meter in front of the employee. Move slowly to allow the meter to respond to mercury vapors. Use appropriate respiratory protection **if** indicated by the airborne vapor levels measurements. See Attachment 9.1 for specific details.

6.0 **Procedure:** [Follow the steps in Attachment 9.1](#)

7.0 Implementation and Training

The only official copy is on-line at the SHSD IH Group website.
 Before using a printed copy, verify that it is current by checking the document issue date on the website.

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- 7.1 Only persons who thoroughly understand the hazards of mercury and have documented training in Hazard Communication or Laboratory Standard should conduct work using these recommendations.
- 7.2 Only persons who have qualified on the procedures for atmosphere testing and meter operation should conduct the exposure assessment portion of these recommendations.

8.0 References none

9.0 Attachments

9.1 *Health and Safety Protection during Mercury Vacuum Repair and Filter Replacement*

10.0 Documentation

Document Development and Revision Control Tracking		
PREPARED BY: <i>(Signature and date on file)</i> R. Selvey, Certified Industrial Hygienist Date 08/21/04	REVIEWED BY: <i>(Signature and date on file)</i> J. Peters, SHSD IH Group Date 08/22/04	APPROVED BY: <i>(Signature and date on file)</i> R. Selvey, SHSD IH Group Leader Date 08/24/04
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
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Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input type="checkbox"/> Clarify/enhance procedural controls		
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Section/page and Description of change: Minor text changed in procedure and Attachment 9.1 (marked). Removed Step 7.1 as it was un-necessary. Added new format for Section 10.		
<i>R. Selvey 02/21/08 (signature on file)</i> SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:

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Attachment 9.1

HEALTH AND SAFETY PROTECTION DURING MERCURY VACUUM REPAIR AND FILTER REPLACEMENT

This procedure is written for elemental mercury and is not considered appropriate for organic mercury compounds.

1. Pre Work Checks

- a. Check the maintenance log for previous service and manufacturer's recommendations for part replacement/life expectancy.
- b. Ensure proper training and qualifications of involved workers in clean-up procedure, hazards, PPE and respiratory protection.
- c. Contact waste management representative to determine procedures for hazard identification of the waste stream and proper label requirements.
- d. Establish emergency procedures for cleanup of spills (ie. The vacuum tips over after being opened, a waste bag rips, protective flooring rips, etc.).
- e. Establish emergency procedures for personnel decontamination.
- f. Establish emergency procedures for other incidents such as collapse of a worker (eg. heart attack, heat exhaustion), physical injury, etc.

2. Area Preparation

- a. Conduct work with two workers and an industrial hygienist as a monitor. One worker can maintain clean gloves and be responsible for only touching exterior vacuum surfaces.
- b. The monitor will be exposed near the unit and should be fully dressed out with respiratory protection the same as the workers.
- c. Conduct the work in a secure area. The area should be minimized but large enough for all personnel and equipment without crowding.
- d. An outdoor location would be acceptable in an area where the wind will not cause increased exposure or drift into occupied areas. If an interior space is necessary ventilation should be provided as long as the exhaust does not create exposure to others.
- e. Do not allow the unit to become hot (eg. sit in direct sunlight) as this would increase the volatility of any mercury present.

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- f. When using an outdoor location, ensure protection from adverse weather conditions.
- g. Protect the work area with double plastic sheeting (or tear resistant sheeting), caution tape with warning signs.
- h. Provide nearby wash facilities and eyewash station to allow for quick personal decontamination if skin/eye exposure occurs and personal decontamination prior to leaving the site after job completion.
- i. Prepare a protected staging area for clean materials.
- j. Prepare receptacles for receiving waste: vacuum, wipes and the PPE/respirator cartridges.

3. Personal Protective Equipment PPE

Appropriate personal protective equipment to protect the person handling the vacuum cleaner and debris are:

- **Hand:** Use disposable gloves. Exam-style, splash gloves are acceptable. Acceptable elastomers are: Nitrile, PVC, and Natural Rubber. Wear two pair of nitrile disposable gloves; inner gloves taped to sleeve. Remove and dispose of the gloves immediately after work. Don a second pair of gloves to further handle equipment.
- **Body:** Wear disposable suits with booties and hood. Acceptable CPC materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as mercury waste if contact with contamination has occurred. If personal clothing items become contaminated, they must be surrendered for BNL cleaning or disposal.
- **Foot:** If contact of the feet is anticipated with contaminated surfaces, disposable shoe coverings, boots or booties should be used. Acceptable CPC material include: Tyvek®, KleenGuard®, and rubber. If personal shoes become contaminated, they must be surrendered for BNL cleaning or disposal.
- **Respiratory:** Wear full face APR with mercury cartridges (need end of service life indicator). Respiratory protection may be not required if the work is not conducted under local exhaust ventilation. If mercury levels in the area exceed (as indicated by the direct reading meter) or are likely to exceed the OSHA, ACGIH, or DOE standards, respirators are required. A half face or full face APR or PAPR respirator with mercury cartridge or an air line respirator may be used up to the assigned protection factor listed in the [SHSD's Respiratory Protection Selection procedure SOP IH7220](#).
- **Eye:** Safety Glasses with side shields are required in all laboratories, construction, and general industry work areas. If exposure is above the Occupational Exposure Limit (PEL/TLV), vapor-proof goggles or full-face respirator must be used.

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4. Monitoring

- a. Conduct mercury monitoring with direct reading mercury vapor meter and personal breathing zone samples beginning prior to set up until conclusion of all tasks. Provide consideration for the ACGIH TLV (0.025 mg/m^3) as well as the OSHA Ceiling (0.1 mg/m^3).
- b. Log all monitoring data and activities for review by IH after work completion.
- c. Monitor exterior of unit (within approximately 1 foot) initially as the unit is opened then the interior. Ensure levels are acceptable prior to allowing work to begin. Interior levels may be high as long as the worker breathing zone is within acceptable limits. If the breathing zone is at or above the TLV ensure that any ancillary personnel (outside the secured area) are not exposed.
- d. Conduct continuous breathing zone monitoring with the direct reading mercury vapor meter during the dismantling and replacement procedure. The IH should also document interior levels periodically as dismantling occurs.

5. Conducting the Work

- a. Change the outer gloves frequently to avoid cross contamination of vacuum surfaces. Prohibit touching the exterior surfaces of the vacuum with contaminated gloves.
- b. Remove, seal and replace the droplet collector bottle in accordance with the manufacturer's instructions.
- c. Remove interior components in accordance with the manufacturer's instructions. As filters or other components are removed for replacement immediately place in sealable disposal bags (or wrap in plastic and tape) then put into the waste disposal bags. If possible, a bag may be placed over the filter prior to removal and sealed immediately upon removal to minimize dust disturbance.
- d. Clean any visible debris within the unit with another, mercury vacuum and/or wipe/wrap with a moist cloth with a solution specific for mercury cleanup (eg. Mercon or Hg-x) and place in a waste container.
- e. Using a new pair of outside gloves, reassemble the unit in accordance with the manufacturer's instructions.
- f. Decontaminate the entire exterior of the unit with a solution specific for mercury cleanup (eg. Mercon or Hg-x) and place wipes in waste containers.
- g. The exterior of the unit should receive a final wipe and this checked with the direct reading mercury vapor monitor to ensure no residual contamination.
- h. Remove unit from secure area.
 - i. Step onto step-off pad.
 - j. Fold plastic sheeting inward to trap any debris and place in waste container.

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6. Clean up

- a. Seal containerized waste: HEPA filter, rags, etc.
- b. Remove and containerize PPE and step off pad.
- c. Don new pair of gloves and wipe outer surface of respirator. Dispose of wipe in PPE waste container.
- d. Remove respirator. Place cartridges in waste container. Place respirator in bag and seal.
- e. Remove caution tape, place in waste container and seal.

7. Final Testing

- a. After a visual check of the vacuum turn the unit on and test the exhaust air for mercury vapor. Any level of mercury detected should be considered unacceptable.
- b. Test the vacuum in accordance with the BNL HEPA vacuum surveillance testing protocol (SOP IH 62350: HEPA Filter Vacuum Cleaner Testing) or [equivalent](#).
- c. Failure of the testing protocol requires reopening the unit under controlled conditions to assess the reason for failure and repair of the unit prior to re-testing.

8. Additional Recommendations

- a. Update maintenance log with tasks accomplished and status of HEPA testing.
- b. When the vacuum is used for spill cleanup test the exhaust prior to using and during use with a direct reading mercury vapor meter to ensure mercury vapor is not being disseminated with the exhaust air.