FREQUENTLY ASKED QUESTIONS RELATED TO PHEAF PERFORMANCE TESTING

National Institutes of Health • Office of Research Services (ORS) • Division of Occupational Health and Safety (DOHS) • Technical Assistance Branch (TAB)

- **What is a PHEAF device?**

The portable high efficiency air filtration (PHEAF) device is an engineering control used to capture particulate matter (PM) during environmental remediation projects; likewise units have been deployed to control dust generated during indoor construction-related activities. The essence of the PHEAF device's performance is the high efficiency particulate air (HEPA) filter. The PHEAF device is also known as negative air machine (NAM), air scrubber, and air handling unit (AHU). (Figure)

PURPOSE AND APPLICABILITY:

- **What is the purpose of assessing the performance of PHEAF devices?**

Filtration is a simple and economical engineering control for collecting PM, but its prominence for air cleaning is not indicative of performance. Testing of HEPA filters at the time of manufacture establishes performance parameters; however, filtration effectiveness should not be assumed. Studies exploring the performance of the HEPA filter itself and installed filtration systems have provided cause for concern. These studies have shown capture effectiveness may not be as expected because of manufacturer defects, damage that incurred during shipping and handling of the HEPA filter, or improper installation of the filter in the filtration system. For this reason, performance testing is conducted on the PHEAF device to assess capture effectiveness.

- **What units are subject to testing?**

PHEAF devices used for remediation projects performed on the NIH-Bethesda campus are subject to visual inspection and performance testing.

LOGISTICS:

- **Where and when will the testing occur?**

PHEAF devices used for abatement of asbestos-containing materials (ACM) must be tested for each project at the project site. These units will be tested within the containment at the project prior to commencing abatement. PHEAF devices used during remediation projects not involving ACM must have successfully passed a performance test within the previous 3-months. PHEAF devices must pass a visual inspection prior to each project.

The NIH Industrial Hygienist, or representative, may require a subsequent performance test if the PHEAF device is relocated during the project or if the PHEAF device appears to have incurred damage since the last performance test.

- **Is visual inspection and/or performance testing necessary if the PHEAF device is configured to exhaust outside the building envelope? Can a PHEAF device which fails visual inspection and/or performance test be used if exhausted outside of the building?**

One could argue that units exhausted outside of the building envelope do not require testing since occupants would not be exposed to contaminated air. However, NIH's mission is to promote health and well-being. For this reason, all PHEAF devices must pass inspection and performance testing.

- **What if the test administrators are not immediately available (e.g., are conducting testing at another site?) Since there is only one set of testing equipment, when multiple projects are taking place, how is testing priority determined?**

NIH does not have the resources to simultaneously test multiple PHEAF devices. The owner or operator of the PHEAF device should contact the NIH test administrator to determine personnel/equipment availability prior to selecting your project start date. In the event multiple projects are scheduled for the same date, priority will be given on a first come, first serve basis.

EXHAUSTING PHEAF DEVICE INSIDE BUILDING ENVELOPE

- **What options are available if the PHEAF device cannot be exhausted outside of the building envelope due to the room configuration/sealed windows/location of project, etc.? Can the exhaust of the PHEAF device be vented indoors?**

Exhaust air from the PHEAF device shall be vented outside of the building. Exceptions to this practice shall be considered if the NIH industrial hygienist, or representative, determines a low risk to occupants. In no case shall exhaust air be discharged directly into occupied areas. If exhausted within the building envelope, an additional PHEAF device shall be operated in sequence (i.e., piggyback serial configuration). When PHEAF devices are used in sequence, an appropriate connection between the units shall be maintained to ensure an air tight seal.

VISUAL INSPECTION AND PERFORMANCE TESTING

- **What is the minimum capture efficiency for passing the performance test?**

Capture effectiveness is determined by injecting a known concentration of aerosol upstream of the HEPA filter and measuring the percent of aerosol penetrating through the PHEAF device. PHEAF units are classified (i.e., pass/fail) based on their overall capture effectiveness, which is an average of measurements collected consecutively from a 9-sector grid superimposed on the PHEAF device's intake location. A "pass" value is assigned if the overall capture efficiency ≥ 99.0%.

- **Can a PHEAF device fail the visual inspection?**

Each PHEAF device will undergo a visual inspection by the NIH industrial hygienist, or representative, before assessing the unit's capture effectiveness. Damage to the HEPA media, corrugated aluminum separators, or housing can affect the efficacy of the filter. HEPA filters damaged or otherwise judged to be defective must be replaced before conducting the performance test. (Figure)

- **What documentation must be maintained by the contractor?**

Documentation of the last filter change date must accompany the PHEAF device. When requested the operator of the PHEAF device must present an operating procedure indicating preventative maintenance, technician training, criteria to determine filter change out, and methods employed to prevent cross-contamination while replacing the contaminated filter.

- **What can I do to improve the capture effectiveness of the PHEAF device?**

A PHEAF device may fail the performance test for a variety of reasons, including bypass leakage, damaged HEPA media, and off-square cabinet. Damage to the PHEAF device's cabinet can cause the HEPA filter to become misaligned in the filter mount frame. Damage which appears to distort the squareness of the cabinet or otherwise prevent proper seating of the HEPA filter is unacceptable.

Consideration should be given to the quality of the filtration media and filter construction. Producing a filter using HEPA filter media does not qualify the filter as conforming to HEPA performance criteria. When purchasing, ensure the HEPA filter has been certified. The filter's certification can be verified by a manufacturer's label adhered to the filter's frame. The label identifies the HEPA filter's penetration rate (i.e., capture efficiency) and rated pressure drop. The HEPA filter's rated volumetric flow rate should be equal to and/or greater than the PHEAF device's measured flow rate.

Improper handling can cause the HEPA filter to jar loose from its mount. Filters not properly seated in the mount enable bypass leakage. The HEPA filter's retaining brackets must be securely tightened. Loose brackets can allow a gap between the filter gasket and the filter mount. A better seal should minimize bypass air between the filter gasket and filter mount, thereby improving the PHEAF device's capture efficiency.

The pre-filter and HEPA filter shall be replaced according to the manufacturer's recommendation. A trained technician is responsible for the filter replacement.

- **What if the PHEAF device fails visual inspection or the performance tests? Can we adjust or modify/fix the unit on site?**

The NIH industrial hygienist, or representative, will inform the PHEAF device owner of the deficiency resulting in the failed visual inspection. The performance test will be conducted once the contractor corrects the deficiency. Repairs can be performed on the spot if the repair time is reasonable and does not delay the project or testing of the other PHEAF devices. (Figure)

After performing repairs, the PHEAF device can be retested. The PHEAF device will be marked or otherwise "tagged" after each performance test. Contractors are encouraged to have spare units immediately available to substitute PHEAF units which fail visual inspection or the performance test.

- **What does "three consecutive failures" mean?**

A performance test can be immediately repeated upon failure assuming some corrective action occurred to improve the test outcome. Units failing three consecutive performance tests without successfully passing a test is deemed a risk to occupant health and prohibited from future use.

COST CONSIDERATIONS:

- **How much time is required to complete the capture effectiveness test?**

Visual inspection and testing of the PHEAF device's capture effectiveness takes approximately 20 minutes to complete.

- **Can I bill/charge the government for labor hours required to participate in the performance test?**

A company's demonstration of its equipment meeting contractual (or regulatory) performance expectations and does not present an occupational risk to the community is a business requirement; therefore, repairs and maintenance of the PHEAF device is considered an indirect cost to the contractor and shall not be charged to the government.

SPECIAL CIRCUMSTANCES:

- **What if the work is emergency-based, do we have to wait for the "performance test"?**

The PHEAF device must pass the visual inspection and performance test at the project site if the work involves ACM. PHEAF devices deployed for projects not involving ACM must have successfully passed a performance test within the previous 3-months. PHEAF devices will be exempted from testing during emergency projects at the discretion of the Division of Occupational Health and Safety program manager.

- **How do we know that testing equipment is reliable?**

The PHEAF device's capture effectiveness is measured using the aerosol photometer technique, which is considered the "gold standard" for testing stationary HEPA systems. All instruments are serviced and calibrated every 12-months by the equipment's manufacturer. Industrial hygienists performing the test are trained to ensure consistent and proper measurement technique.