HEPA Filter Leak Testing/ Filtration Unit (IN-PLACE)

Standard Operating Procedure

1. Purpose/Scope

The purpose of this Standard Operating Procedure (SOP) is to establish uniform procedures pertaining to the leak testing of IN-PLACE HEPA filters.

The test in this SOP uses Emery 3004 (poly-alpha-olefin) as a challenge being injected into a HEPA filter system during testing on the upstream side. Penetration of this challenge through the filter is measured on the downstream side of the injection site and filter.

These tests are performed on High-efficiency particulate air (HEPA) filters. HEPA filters are important components of many air pollution control systems and clean air systems. These filters are normally very reliable and have a high level of performance. These filters are used in many applications, such as Biological Safety Cabinets and BSL3 labs for exhaust ventilation, laboratory fume hoods, glove box systems, laminar flow fume hoods, animal racks, and clean rooms.

HEPA filters are manufactured to remove ≥99.99% of the particles with a mean diameter of 0.3 µm from the air stream. This specification is evaluated at the manufacturing facility of these filters. Upon installation in the field a HEPA leak test must be performed again to verify performance. This second phase of evaluation is known as “in-place” testing and is designed to measure not only the particle removal efficiency of the HEPA filter but also of the associated filter housing, gasketing, and duct work if applicable.

2. Applicability

The procedures of the SOP are applicable to all personnel involved in leak testing of HEPA filters.

3. Precautions

HEPA exhaust filter systems are very likely to be contaminated with radiological, chemical or biological contaminates. Work will be evaluated for risk assessment. Measures should be taken to avoid inadvertent contamination of testing equipment and exposure to personnel. The photometer is only to be opened in areas where contamination can be contained and not result in surface contamination. Have equipment surveyed for radiological contamination before handling internal parts.

3.1 Hazard Determination:

3.1.10 By its very nature, a HEPA test may be done in places where biological, chemical, or radiation contamination is known or suspected to be present. Inhalation of

these contaminates can have significant health effects. These hazards must receive a hazard evaluation by a knowledgeable ESH professional.

3.1.11 The operation of this photometer involves exposure to a low hazard chemical (Emery 3004, test aerosol) that does not pose a high exposure risk.

3.1.12 PPE requirements may be needed to perform test. See section 3.2

3.2 Personal Protective Equipment:

3.2.10 Hand: Contact with aerosol liquid (Emery 3004) should be minimized but does not have a significant health risk. Use of this meter in areas of known or suspected contamination requires the use of disposable gloves. Exam-style, splash gloves are acceptable. Acceptable elastomers are: Nitrile, PVC, and Natural Rubber.

3.2.11 Body:

- If body contact is possible with known or suspected contaminated surfaces, a disposable suit is to be used. Acceptable materials include: Tyvek, KleenGuard, and cotton. Disposable garments must be discarded as hazardous waste if contact with contamination has occurred.
- If contact with contaminated surfaces are not expected, disposable body suit is optional.

3.2.12 Foot:

- If foot contact is possible with known or suspected contaminated surfaces, disposable shoe coverings, boots or booties are to be used. Acceptable materials include: Tyvek, KleenGuard, and rubber. Disposable shoe coverings must be discarded as hazardous waste if contact with contamination has occurred.
- If contact with contaminated surfaces are not expected, disposable shoe coverings is optional.

3.2.13 Respiratory: Under normal use, respiratory protection is not required. If chemical, radiological, or biological levels from contamination exceed the OSHA, ACGIH, or DOE standards, respirators are required. A full face APR or PAPR respirator with appropriate cartridge or an air line respirator may be used. Personnel wearing respiratory protection must have successfully passed a fit test for the protective respirator.

3.3 Environmental Management and Waste Disposal:

3.3.10 The operation converts all the Emery 3004 into an aerosol with compressed air. In a test of a passing filter, the aerosol is trapped in the filter. In a system with a leaking filter, some or all of the aerosol is discharged to the environment or if applicable up the exhaust stack. The concentration of aerosol in the exhaust air has very minimal environmental consequences.

3.3.11 The Emery 3004 purchased by Pure Air Testing, Inc. is used until it is all consumed in testing. If needed, the Emery 3004 is to be disposed of as a hazardous liquid.

4. **Procedure**

Summary: Filter efficiency is determined by challenging a HEPA filter with an aerosol and measuring the aerosol concentration both upstream and downstream to calculate the percentage of removed aerosol by the filter.

Equipment:

- Emery 3004 or equivalent approved alternative
- Aerosol generator
- Aerosol detector (photometer)
- Sampling train (tubing and probes)
- Source of air (compressed)

4.1 Prior to testing a ventilated HEPA filter system, contact the proper facilities person or persons to get approval and clearance to perform testing.

4.2 Identify the aerosol injection site and sampling locations. The upstream sampling point should be at least 10 duct diameters from the aerosol entry ping to provide a well mixed sample in the air mass. Similarly, the downstream sampling point should be located at least 10 duct diameters downstream for the filter housing. Where sampling points cannot be located at these parameters due to the physical construction or configuration of the ductwork, efforts should be made to maximize these distances to greatest possible extent. When testing HEPA filters where ventilation is not being used inject aerosol on upstream side of filter and sample the air for leakage on the downstream side of the filter.

4.3 Activate the ventilation system or otherwise verify that the ventilation system is in operation. Filter systems without ventilation should be verified to be in operation while performing test.

4.4 Attach sample collection tubing to detector and warm-up photometer in the "clear mode" until a stable reading is obtained. Self calibrate and zero the instrument according to the manufacturer's procedures. Insert sample probes into the duct centerline at both the upstream and downstream sampling points.

4.5 Assemble the aerosol generator system, i.e., ensure sufficient supply of aerosol-producing medium, attach inlet to regulator and gauge, and connect aerosol release nozzle. Insert generator nozzle into air stream, upstream of HEPA filter.

4.6 Attach the compressed air source to supply line (house air, compressed gas cylinder, or air compressor) to the generator inlet regulator. Ensure the compressed air source is on and the aerosol generator pressure valve is set to 20 PSI.

4.7 Inject aerosol into ventilation system until a stable measurement is obtained.

4.8 Measure upstream and downstream aerosol concentrations as follows:

- Record Static pressure drop across filter(s) if a gauge is present
- Measure upstream aerosol concentration
- Return to "clear" mode and re-zero instrument, if necessary
- Measure downstream aerosol concentration
- Record upstream and downstream concentrations

Where Cd= downstream aerosol concentration
Where Cu= upstream aerosol concentration

4.9 For filter systems where upstream challenge cannot be measured or isn't practical, the upstream concentration can be calculated as follows:

µg/L of Emery 3004 = 13,500 x number of nozzles/ft^3 of challenged air

4.10 Record data and findings on HEPA Filter Test Report form (see attachment 6.2)
4.11 Affix results sticker at test location, or appropriate location.
4.12 HEPA filter systems are to be tested to the frequency determined by facility-specifications or manufacturer suggestions.
4.13 Record-keeping: Provide a copy of the HEPA Filter Test Report to proper person or persons responsible for keeping test result and reports.
4.14 If the unit was used on a radiological exhaust system(s), at the end of sampling the equipment should be surveyed for radiological contamination.

5. References

5.1 National Sanitations Foundation (NSF) NSF 49 standard annex F revision 2008:*Testing HEPA filters.*
5.2 American National Standards Institute (ANSI) standard N510: *Testing of Nuclear Air Treatment Systems.*
5.3 American Conference of Governmental Industrial Hygienists (ACGIH). Industrial Ventilation: A Manual of Recommended Practice (current edition)
5.4 Institute of Environmental Sciences and Technology (IEST) IEST RP-CC034.2: *HEPA and ULPA filter leak tests*

6. Attachments

6.1 HEPA Filter System Test Results Sticker/Label
6.2 In-Place HEPA Filter Test Report