EACC
PERFORMANCE LEAK TESTING GUIDELINE FOR HEPA FILTERED EQUIPMENT 2021

Environmental Abatement Council of Canada
Canadian Chapter of the EIA

FOREWORD

The guideline promotes industry standards for training, equipment, and methodologies for HEPA filtration integrity testing of negative air units including construction air handling units (CAHU) in CAN/CSA Z317-13 *Infection control during construction, renovation, and maintenance of health care facilities*, vacuums and any other HEPA filtered equipment on abatement and remediation projects as well as health care facility construction, renovation and maintenance projects. This guideline is considered a recommended industry standard procedure that can be utilized for testing the filtration integrity of HEPA filtered equipment used in the control of hazardous materials and limited infectious agents (i.e. aspergillus, legionella).

DISCLAIMER

EACC disclaims any liability or risk resulting from the use of the work practices and recommendations discussed in the guideline. It is the user's responsibility to ensure that these apply to the specific workplaces and health care facilities (as defined by CAN/CSA Z317.13) and to ensure compliance with all other applicable federal, provincial and local acts, regulations, codes, standards and guidelines.

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2021

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SECTION A: GENERAL POINTS AND LIMITATIONS

1. This document has been designed to address the Canadian Hazardous Materials Abatement industry standards regarding filtration integrity of HEPA filtered negative air units and vacuums as well as Construction Air Handling Units (CAHU) in Canadian health care settings as per CAN/CSA Z317-13 *Infection control during construction, renovation, and maintenance of health care facilities,* vacuums and any other HEPA filtered equipment used on-site to control hazardous airborne particulate during abatement, remediation and construction projects as well as health care facility construction, renovation and maintenance projects.

2. This guideline will assist:

   - Hazardous material abatement supervisors in meeting the requirements of various provincial regulations and industry guidelines relating to the containment and abatement of hazardous materials.
   - Responsible parties involved in health care facility construction, renovation, and maintenance projects meet the requirements of HEPA filtration verification as it applies to construction-related infection control preventive measures including those specified in CAN/CSA Z317-13 *Infection control during construction, renovation, and maintenance of health care facilities*.

3. Below is a summary of recommended frequency based on current industry standards of acceptance:

   NEGATIVE AIR UNITS/CONSTRUCTION AIR HANDLING UNITS

   Units should be tested:

   - For each project on-site where the exhaust from the units is vented indoors or near exterior HVAC systems and/or intakes.
   - A minimum of every 12 months regardless of location of exhausting and frequency of use.
   - Whenever maintenance work is conducted such as changing or repair of HEPA filters, working on motors or any other maintenance that will affect the seal or integrity of the unit.
   - Whenever the unit suffers trauma which could affect the integrity of the unit.
   - In the case of hazardous material (e.g. asbestos, lead) abatement activities where equipment is transient every 3 months.

VACUUMS

Vacuums should be tested**:**

- A minimum of every 12 months regardless of location of exhausting and frequency of use.
- Whenever maintenance work is conducted such as changing or repair of HEPA filters, working on motors or any other maintenance that will affect the seal or integrity of the vacuum.
- In the case of hazardous material (e.g. asbestos, lead) abatement activities where equipment is transient every 3 months.

4. Contractors and service providers are to keep records of all maintenance related work.

5. Currently, the only known acceptable testing equipment is manufactured by ATI (Air Techniques International) and TEC Services Inc (TEC). ATI and TEC manufactures acceptable and widely used aerosol generators and photometers. Please refer to ATI's website, www.atitest.com and TEC's website, www.tecservicesinc.com for additional information. Ensure your service provider follows all requirements as outlined in the manufacturer's specifications.

6. In order to check the accuracy of the Performance Leak Testing Procedure, it is imperative that the service providers calibrate the equipment used for the procedures at least yearly and/or as recommended by the manufacturer. Service providers should provide records of calibration on a regular basis when conducting testing.

   In order to ensure the effectiveness of the Performance Leak Testing Procedure, it is recommended that the service providers provide documentation to demonstrate that their field technicians have received training in the use of the testing equipment and the required procedures for field testing noted in this guideline. In-house training may be provided by a competent or qualified person as defined by the federal or provincial health and safety legislation. The following training and certifications are recognized as acceptable:
   - National Environmental Balancing Bureau (NEBB) Clean room performance testing CPCPT
   - National Sanitation Foundation NSF-49 Biological Cabinet Certifiers
   - Controlled Environment Testing Association Clean room testing

The following training organizations are recognized as providing acceptable training for cabinet and clean room filtration performance testing:

- Eagleson Institute Sanford ME - Testing of HEPA Filtered Systems and Pharmaceutical Cleanrooms
- Air Techniques International - HEPA Filter Testing (ISO 14644-3 Photometry)

7. Service providers should have adequate insurance for conducting Performance Leak Testing Procedure and should be updated on a regular basis as required.

SECTION B: DEFINITIONS

Abatement	Procedures involving the removal, containment, control, or treatment of hazardous materials.
Aerosol Challenge	Challenging of a filter or an installed filter system by test aerosol.
Competent or Qualified Person	As defined by federal, provincial, or territorial health and safety legislation that has jurisdiction in the workplace/project.
Construction Air Handling Unit (CAHU)	A machine used to move HEPA filtered air into or out of a construction site.
DOP	DOP or dioctyl phthalate is an organic compound used as a poly-dispersed test aerosol, to generate sub-micron particles, to challenge (evaluate integrity of) of HEPA filters.
Hazardous Materials	Any material that, because of its quantity, concentration, or physical or chemical characteristics, may pose a real hazard to human health or the environment.
HEPA	High Efficiency Particulate Arresting filter that is at least 99.97% efficient in collecting a 0.3 micrometer aerosol. HEPA filters to be pre-certified by the filter manufacturer and labeled. Filters shall be certified by the IEST standard.
HEPA Filtered Equipment	Any form of equipment or device fitted with a 99.97% (@0.3 micrometer) high efficiency particulate arresting filter removal system.

HEPA Filtered Exhaust Fan	Exhaust fan in a sealed cabinet equipped with HEPA filtration used to exhaust filtered air out of an enclosed hazardous materials abatement work area for the purpose of establishing and maintaining a Negative Pressure in the hazardous materials Abatement work area with respect to surrounding areas, and also to provide general ventilation of the abatement area.
HEPA Filtered Vacuum	A vacuum device fitted with a 99.97% (@ 0.3 micrometer) high efficiency particulate arresting filter removal system.
Infectious Agents	Organisms that are capable of producing infection or infectious disease (e.g. aspergillus, legionella, Histoplasma capsulatum, etc.)
Installed Filter Leakage Test	Test performed to confirm that the final filters are properly installed by verifying there is absence of bypass leakage in the installation, and the filters and system are free of defects and leakage.
Mixing Chamber	A compartment placed in front of the negative air unit that assists in ensuring that the aerosol uniformly challenge the in-place HEPA filter, unit housing and HEPA filter seals. For example, see Illustration #2 and #3.
Negative Air Unit	A machine used to create negative pressure by removing HEPA filtered air from within a hazardous materials abatement work area.
Negative Pressure	A reduced pressure established within a hazardous materials abatement enclosure relative to the area outside the enclosure by extracting air directly from the Abatement area and discharging this air outside the work area.
PAO	PAO or Poly Alfa Olefin is a monomer used as a poly-dispersed test aerosol, to generate sub-micron particles, to challenge (evaluate integrity of) of HEPA filters.
SDS	Safety Data Sheet, required by Workplace Hazardous Materials Information System (WHMIS) legislation that is aligned with the Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Gives information on hazardous materials, including properties, hazards, first-aid, emergency response, and personal protection.

SECTION C: STEP-BY-STEP PROCEDURE

STEP 1 The equipment being tested must be visually inspected to see that no major deficiencies can be detected, such as, cracked frame, holes from screws or rivets, damage to controls, etc. Visually check to see that the HEPA filter is properly installed prior to activating equipment. Turn equipment on to check that it is operating properly. If possible, locate the test label from the factory to check that the HEPA filter is certified as HEPA by IEST and meets or exceeds airflow, velocity and resistance of equipment utilizing the HEPA filter. The contractor should also have this information recorded in the contractor's maintenance logbook for reference and inspection. The prefilters shall be removed prior to performing the leakage testing. See Illustration # 5 for example of pre-filters and HEPA filters.

STEP 2 Set-up a mixing chamber in front of and attached to the unit. The purpose of the mixing chamber is to ensure the aerosol challenge solution is mixed properly and challenge the HEPA filter uniformly. See Illustration #2. The mixing chamber should be connected to a sufficiently length of flexible ducting or similar device with a 180 degree turn for particle mixing.

STEP 3 Calculate the number of Laskin nozzles required in the aerosol generator for a minimum of 10 ug/1 based on the unit's air flow volume. Use the manufacturer's rated air volume to calculate the approximate concentration. Turn on the aerosol generator. Check that the unit has reached the correct temperature and pressure as per the manufacturer's guidelines. (DOP 138 kpa [20 psi] - PAO 159 kpa [23 psi]) before using so that the correct aerosol size will be generated in accordance with the manufacturer's specifications.

STEP 4 Initialize the aerosol generator and commence production of aerosol. Direct DOP/PAO aerosol at the inlet/filter side of the equipment to permit the equipment to draw the aerosol through the filter and blower (if testing HEPA Vacuums proceed to Step 7). The test aerosol should be introduced into the system to challenge the HEPA filter and seals on the upstream side of the filter. This can be achieved with the aerosol passing through the mixing chamber, creating adequate mixing of the aerosol with the airflow in the duct or by directing the generated particles over entire filter media and around filter edges to test seal. See Illustration #2 and #3.

STEP 5 A sample of the DOP/PAO aerosol/air mixture shall be taken from the upstream side, close to the filters under test to verify the necessary upstream challenge. This sample shall also be used to set the 100% baseline. The 0% baseline is then set by the photometer using particle-free air supplied by the photometer internal ULPA (Ultra Low Penetration Air) filter. The instrument is now ready to detect and quantify leaks on the downstream side of the filter. See Illustration #4.

STEP 6 The leak test/scanning test is performed using the handheld scanning probe or sample tube. The probe is held or attached to the air exhaust of the unit. The Photometer display indicates the percent of leakage through or around the filter. For this test method the percentage of leakage shall be less than 0.005%. See Illustration # 4.

STEP 7 The air volume of vacuums is very low and special procedures are required to verify leakage of the HEPA filters. A test injection device is required to ensure the proper injection of aerosol and that it is evenly dispersed prior to the measurement of the upstream concentration of the photometer. The test injection device can be constructed using a 4" U-shaped ABS pipe with an open end for the aerosol injection and with the alternate open end attached to the vacuum suction port. The photometer will sample the vacuum exhaust at the outlet. On vacuums that exhaust from multiple openings, the vacuum shall be placed in a sealed container and the exhaust from the opening in the container shall be sampled.

STEP 8 The leak/scanning test is performed where and when the filter face is accessible using the handheld scanning probe. The entire exhaust area is sampled by passing the probe in overlapping strokes across the face and perimeter of the exhaust. The end of the probe should be held within 25mm (one inch) of the exhaust and scanned at a traverse rate of no more than 50 mm per second (2 inches per second). The photometer display indicates the percent of leakage through or around the filter or exhaust canister. The leakage acceptance for this method is less than 0.01%

STEP 9 For equipment that passes the performance leak test at the time of the testing shall have a "Passed" label applied in a conspicuous location on the equipment. Hard copy documentation must be completed and provided to customer as noted in Appendix I.

STEP 10 For equipment that fails the performance leak test and shall not be repaired and retested to a satisfactory pass at the time of the testing shall have a "Failed" label applied in a conspicuous location on the equipment and the failure and deficiencies shall be reported to the site supervisor.

STEP 11 Deficiencies may be corrected on-site and the unit re-tested.

General: follow the manufacturers' specifications for the operation of the aerosol generator and photometer.

APPENDIX I

MINIMUM REPORTING REQUIREMENTS

1. Documentation of performance leak testing should consist of the following;

    a. Certificate of Testing (the paper copy documentation), and
    b. Certificate Label (the sticker that is attached to tested equipment).

2. Documentation of performance leak testing shall be written in a clear and concise manner and provided at completion of testing. Certificates of Testing should be generated in duplicate paper forms; one copy should be available at the project location for comparison to Certificate Labels that are attached to tested equipment.

3. Certificate Labels shall be attached to the specific piece of tested equipment.

4. Information to be included on a Certificate of Testing should contain the following, at a minimum.
    a) General Information:
        i. Testing company name and contact information.
        ii. Certificate or Test number.
        iii. Equipment calibration test number and date.
        iv. Date of testing.
        v. Technician name and signature.
        vi. Testing standard
    b) Equipment Owner information:
        i. Equipment owner company name and contact information.
        ii. Location of equipment testing (civic address with description as necessary).
        iii. Equipment owner contact name.
    c) Information of tested equipment:
        i. Manufacturer.
        ii. Make/Model.
        iii. Serial Number and/or Contractor's in-house tracking numbers.
        iv. Condition of equipment (e.g. Good or Damaged). Provide details where the condition of equipment is not reported as good.
    d) Performance leak test information for each piece of equipment:
        i. Maximum leakage rate % as tested.
        ii. Maximum leakage rate allowed (0.005% or 0.01%)
        iii. Volume used for calculations and number of Laskin nozzles.
        iv. Test result (i.e. Pass or Fail).
        v. Test date in a DD/MMM/YYYY format (e.g. 15-DEC-2021).

5. Information to be included on a performance leak test Certificate Label (that is attached to tested equipment) shall be consistent with information recorded on the Certificate of Testing and should contain the following, at a minimum.
    a) Testing company name and contact information.
    b) Certificate or Test number.
    c) Date of testing. In a DD/MMM/YYYY format (e.g. 5-Jan-2021).
    d) Location of equipment testing.
    e) Information of Tested Equipment including,
        i. Manufacturer.
        ii. Make/Model.
        iii. Serial Number.
    f) Maximum leakage rate %.
    g) Test result (i.e. Pass, Fail).
    h) Technician name and signature.

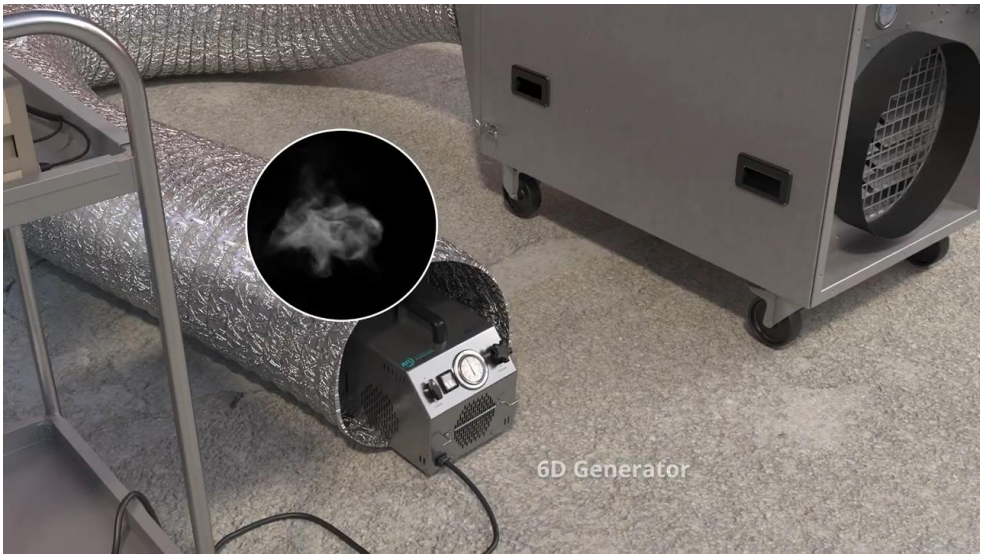
APPENDIX II
CONTRACT SPECIFICATION NOTE FOR CONSULTING MEMBERS

1. Performance leak testing of negative air units, construction air handling units, vacuums and any other HEPA filtered equipment used on abatement and construction-related infection control projects shall be completed in accordance with the Environmental Abatement Council of Canada (EACC) document, “Performance Leak Testing Guideline for HEPA Filtered Equipment”, 2021, or a similar standard.

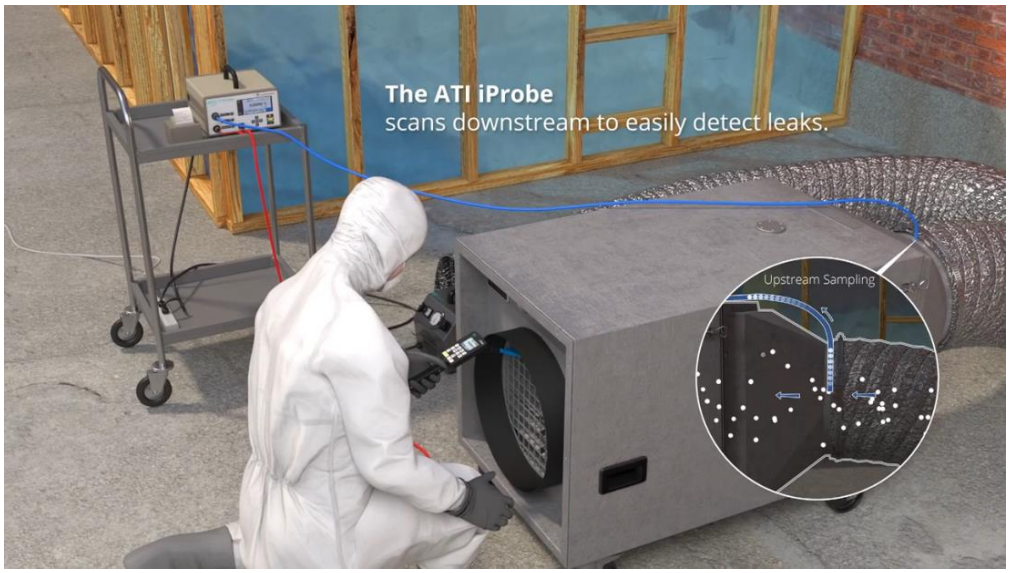
APPENDIX III
ILLUSTRATIONS

1	Example of aerosol generator and photometer required to conduct performance leak testing.

2	Negative air unit set-up to be performance leak tested with mixing chamber.



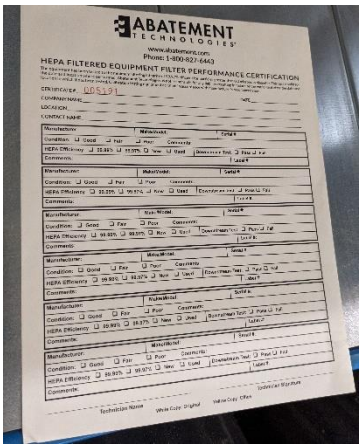
3	Aerosol generating and introducing challenge aerosol into mixing chamber.



4	Field technician testing for leakage through the HEPA filter as part of the performance leak testing.

5	Example of pre-filters and HEPA filters found as part of the unit filtering.

P1	Photo of unit label.



P2	Photo of technical report.

P3	Photo of unit label.

P4	Photo of unit label.

6	Examples of performance leak testing labels and reports.

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