National Institute for Occupational Safety and Health National Personal Protective Technology Laboratory P.O. Box 18070 Pittsburgh, PA 15236		
Procedure No. RCT-APR-STP-0001	Revision: 1.1	Date: 1 June 2005

DETERMINATION OF PARTICULATE FILTER PENETRATION TEST
POWERED AIR-PURIFYING RESPIRATOR FILTERS
STANDARD TESTING PROCEDURE (STP)

l. PURPOSE

This test establishes the procedure for ensuring that the level of protection provided by the particulate filter penetration requirements on powered air-purifying respirator filters submitted for Approval, Extension of Approval, or examined during Certified Product Audits, meet the minimum certification standards set forth in 42 CFR, Part 84, Subpart G, Section 84.63(a)(c)(d) and Subpart KK, Section 84.1151(a)(c); Volume 60, Number 110, June 8, 1995, except that the flow requirements of Section 84.1151(a)(c) are not used. In their place, flow requirements specified in Section 84.1156(c)(2) are applied. This is done as provided in Section 84.63(a)(c)(d) so that PAPR filters are tested, to the extent possible, at the flow rate of the PAPR.

2. GENERAL

This STP describes the Determination of Particulate Filter Penetration Test Powered Air-purifying Respirator Filters test in sufficient detail that a person knowledgeable in the appropriate technical field can select equipment with the necessary resolution, conduct the test, and determine whether or not the product passes the test.

3. EQUIPMENT/MATERIALS

3.1. The list of necessary test equipment and materials is as follows:

3.1.1. TSI Model 8110, 8130, or equivalent filter test instrument with a forward light scattering detector.

3.1.2. Particle sizing instrument (such as a Scanning or Differential Mobility Particle Sizer) capable of determining submicron particles according to a count median diameter (CMD).

3.1.3. Microbalance accurate to 0.0001 grams (g).

3.1.4. Gelman 102 mm, type A/E glass filters or equivalent high efficiency filters with a 1 micron pore size.

Approvals:	1st Level	2nd Level	3rd Level

3.1.5. Neat Dioctyl phthalate (DOP)

3.1.6. Virtis JM-8000 Photometer or equivalent

3.1.7. Customized respirator filter holder for a specific manufacturer filter design which is compatible with the TSI filter tester or equivalent tester. Note: NIOSH is not obligated to use any filter holder for certification testing.

3.1.8. Optional data acquisition system.

4. TESTING REQUIREMENTS AND CONDITIONS

4.1. Prior to beginning any testing, all measuring equipment to be used must have been calibrated in accordance with the manufacturer's calibration procedure and schedule. At a minimum, all measuring equipment utilized for this testing must have been calibrated within the preceding 12 months using a method traceable to the National Institute of Standards and Technology (NIST).

4.2. Normal laboratory safety practices must be observed. This includes safety precautions described in the current ALOSH Facility Laboratory Safety Manual.

4.2.1. Safety glasses, lab coats, and hard-toe shoes must be worn at all times.

4.2.2. Work benches must be maintained free of clutter and non-essential test equipment.

4.2.3. When handling any glass laboratory equipment, lab technicians and personnel must wear special gloves which protect against lacerations or punctures.

5. PROCEDURE

Note: Reference Section 3 for equipment, model numbers and manufacturers. For calibration purposes use those described in the manufacturer's operation and maintenance manuals.

5.1 The following procedure shall be routinely employed to insure that the DOP particle size distribution has a count median diameter of 0.185 ± 0.020 micrometers with a geometric standard deviation of less than 1.6.

5.1.1 A standard filter instantaneous penetration shall be determined using DOP aerosol. The standard filter test shall be run two times each day (at the start and half or more of the way through each work day) during testing to verify that the aerosol distribution is optimized and has not changed.

5.1.2 If the instantaneous filter penetration has changed, testing shall be aborted and the aerosol particle size shall be brought into specification.

5.2. The DOP aerosol concentration shall be determined daily by the gravimetric method described below and calculated as milligrams per cubic meter (mg/m^3).

5.2.1. A Gelman 102 mm filter shall be weighed to the nearest 0.0001 g, mounted in the gravimetric filter holder, subjected to the generated aerosol, and re-weighed. Pre- and post-weights, time, and average flow rate shall be recorded and the aerosol concentration shall be calculated in mg/m^3. The weight change should be a significant value over the pre-weight.

5.2.2. The DOP aerosol concentration can be monitored by a calibrated photometer placed in line on the mixing chamber exhaust.

5.2.3 The DOP particle size shall be monitored routinely with an appropriate particle sizing instrument to ensure the particle size distribution count median diameter remains in the range of 0.185 ± 0.020 micrometers with a geometric standard deviation of not more than 1.6.

5.3 Filters shall be tested as follows:

5.3.1. The filter, including the filter holders and gaskets, shall be tested for particle penetration. When the filtering element is not separable from the cartridge or canister, the complete component shall be tested.

5.3.2. When filters are not separable from the respirator body, any exhalation valves shall be sealed to ensure that any leakage due to an exhalation valve is not included in the filter penetration measurement.

5.3.3. Filters not separable from cartridges, canisters, respirators, and odd or unusually shaped filters may be tested on a headform assembly or an assembly provided by manufacturer. Note: NIOSH is not obligated to use the headform assembly or any assembly provided by the manufacturer for certification testing.

5.4. Filters shall be mounted and sealed on holders to prevent leakage around the filter holder. Filters used singularly on a PAPR shall be tested at a challenge flow rate of 115 Lpm ± 5Lpm. Filters used as pairs on a PAPR shall be tested using a single filter of the pair at 57 Lpm ± 3 LPM for tight fitting PAPRS and 85 Lpm ± 4 LPM for loose fitting hoods or helmets. Filters used in sets of 3 on a PAPR shall be tested using a single filter at 38 ± 2 LPM for tight fitting PAPRS and 57 ± 3 LPM for loose fitting hoods or helmets. Filters used in sets of 4 on PAPRS shall be tested using a single filter 29 ± 2 LPM for tight fitting PAPRS and 43 ± 2 LPM for loose fitting hoods or helmets.

5.4.1. The challenge flow rate shall be checked for stability for at least 30 seconds prior to testing.

5.4.2 If using a TSI 8130 tester, the tester rise time shall be set at 10 seconds, the tester sample time shall be set at 10 seconds, and the tester purge time shall be set at 9 seconds.

5.5. Filters shall be challenged by a neat neutralized liquid DOP aerosol at 25 ± 5°C. The particle size distribution shall be a count median diameter of 0.185 ± 0.020 micrometers

with a geometric standard deviation not exceeding 1.6. Each filter shall be challenged with a DOP aerosol concentration of 100 $\pm$10 mg/m^3

5.6. A total of 3 filters shall be tested against the DOP liquid aerosol. Each filter shall be instantaneously loaded and evaluated.

5.6.1. Any filter that exceeds the specified limit shall be remounted and retested to ensure that leakage was not caused by a mounting leak. If retesting eliminates the leakage, that filter shall be considered an invalid sample and another filter shall be tested in its place.

5.7. The penetration of the 3 filters shall be measured and recorded.

6. PASS/FAIL CRITERIA

6.1. The criterion for passing this test is set forth in 42 CFR, Part 84, Subpart G, Section 84.63(a)(c)(d) and Subpart KK, Section 84.1151(a)(c); Volume 60, Number 110, June 8, 1995, except that the flow requirements of Section 84.1151(a)(c) are not used. In their place, flow requirements specified in Section 84.1156(c)(2) are applied.

6.2. This test establishes the standard procedure for ensuring that:

84.63 Test requirements; general.

(a) Each respirator and respirator component shall when tested by the applicant and by the Institute, meet the applicable requirements set forth in subparts H through L of this part.

(c) In addition to the minimum requirements set forth in subparts H through L of this part, the Institute reserves the right to require, as a further condition of approval, any additional requirements deemed necessary to establish the quality, effectiveness, and safety of any respirator used as protection against hazardous atmospheres.

(d) Where it is determined after receipt of an application that additional requirements will be required for approval, the Institute will notify the applicant in writing of these additional requirements, and necessary examinations, inspections, or tests, stating generally the reasons for such requirements, examinations, inspections, or tests.

84.1151 DOP filter test; respirators designed as respiratory protection against dusts, fumes, and mists having an air contamination level less than 0.05 milligram per cubic meter and against radio nuclides; minimum requirements.

(a) All single air-purifying respirator filter units will be tested in an atmosphere concentration of 100 micrograms of DOP per liter of air at continuous flow rates of 32 and 85 liters per minute for a period of 5 to 10 seconds.

(c) The filter will be mounted on a connector in the same manner as used on the respirator, and the total leakage for the connector and filter shall not exceed 0.03 percent of the ambient DOP concentration at either flow rate.

84.1156 Pesticide respirators; performance requirements; general.

(c)(2) Continuous airflow through the respirator will be 32 liters per minute for front-mounted, back-mounted, and chin-style gas mask pesticide respirators and chemical cartridge pesticide respirators, and not less than 115 (4 cubic feet) liters per minute to tight-fitting facepieces and 170 liters (6 cubic feet) per minute to loose-fitting hoods and helmets of powered air-purifying respirators.

7. RECORDS/TEST SHEETS

7.1. All test data will be recorded on the PARTICULATE FILTER PENETRATION PROCEDURE TO TEST POWERED AIR-PURIFYING RESPIRATOR FILTERS test data sheet.

7.2. All videotapes and photographs of the actual test being performed, or of the tested equipment shall be maintained in the task file as part of the permanent record.

7.3. All equipment failing any portion of this test will be handled as follows:

7.3.1. If the failure occurs on a new certification application, or extension of approval application, send a test report to the RCT Leader and prepare the hardware for return to the manufacturer.

7.3.2. If the failure occurs on hardware examined under an Off-the-Shelf Audit the hardware will be examined by a technician and the RCT Leader for cause. All equipment failing any portion of this test may be sent to the manufacturer for examination and then returned to NIOSH. However, the hardware tested shall be held at the testing laboratory until authorized for release by the RCT Leader, or his designee, following the standard operating procedures outlined in Procedure for Scheduling, and Processing Post-Certification Product Audits, RB-SOP-0005-00.

National Institute for Occupational Safety and Health
Respirator Branch
Test Data Sheet

NIOSH

Task Number: Reference No.:
Test: STP No.:
Manufacturer:
Item Tested:

Filter	Flow Rate	Maximum Allowable Percent Leakage	Actual Percent Leakage	Result

Overall Result:

Signature: Date: _____

Engineering Technician

Revision History

Revision	Date	Reason for Revision
1.0	7 March 2004	Historic document
1.1	1 June 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method