DETERMINATION OF INSTANTANEOUS FILTER EFFICIENCY LEVEL TEST, PAPR SERIES HE, PAPR100N, AND PAPR100-P FILTRATION POWERED AIR-PURIFYING RESPIRATOR FILTERS STANDARD TESTING PROCEDURE

1. PURPOSE

This document establishes the procedure for ensuring that the level of protection provided by powered air-purifying respirator (PAPR) filters submitted for Approval, Extension of Approval, or examined during Certified Product Audits, meet the filter penetration requirements set forth in 42 CFR, Part 84, Subpart G, Section 84.63 and Subpart K, Section 84.175.

2. GENERAL

This standard testing procedure (STP) describes the named procedure 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, and create a record of those results, reporting the measurements obtained in a preestablished, standard format.

3. EQUIPMENT/MATERIALS

3.1. Automated filter tester: TSI, model 8130A, or equivalent. Accuracy is 2 percent (%) of full scale for air flow and pressure. Penetration can be measured to 0.001%, efficiencies to 99.999%.

3.2. Electronic balance with a resolution of 0.0001 grams (g) and capacity of 120 g, or better.

3.3. Dioctyl phthalate (DOP), di(2-ethylhexyl) phthalate. 98% purity, or better.

3.4. Test fixture: Shall be compatible with the automated filter tester. The test fixture is a respirator filter holder, specific for each respirator.

3.5. Data acquisition system: Generic thermal printer or digital equivalent, compatible with automated filter tester.

3.6. “Green Line” filter paper: TSI, part number 813010, or equivalent. Lot number must be included on each box. Each lot number must include a “Penetration vs. Resistance” graph.

4. TESTING REQUIREMENTS AND CONDITIONS

4.1. Equipment shall be operated and calibrated in accordance with the testing laboratory’s operation and calibration procedure(s) or the manufacturer’s operation and maintenance manual(s). All measuring equipment utilized for this testing should have been calibrated using a method traceable to the National Institute of Standards and Technology (NIST), when available.

4.2. Normal laboratory safety practices must be observed. Refer to Safety Data Sheets (SDS) for the proper protection and care in handling, storing, and disposing of the chemicals and gases used in this procedure. All applicable local, state, and federal regulations for the safe handling and use of hazardous substances shall be followed.

5. PROCEDURE

5.1. Respirator filters will be challenged by a neat cold-nebulized DOP aerosol at 25 ± 5 degrees Celsius (°C) that has been neutralized to the Boltzmann equilibrium state. The particle size distribution will be a count median diameter of 0.185 ± 0.020 micrometer (μm) and a geometric standard deviation not exceeding 1.6. Each respirator filter unit will be challenged with an aerosol concentration of 100 ± 10 mg/m^3.

5.2. The DOP particle size distribution shall be verified using green line filter paper with a known penetration range. Graphs of penetration vs. resistance for two sheets and five sheets of stacked filter discs are supplied with each lot of filter paper. The graphs show central, upper, and lower lines, representing the expected penetration range at a given resistance. The test data should fall within the acceptance zone, with boundaries defined by the upper and lower lines on the graphs. The DOP particle size distribution shall be verified using both 2 sheets and 5 sheets at least once in each 8-hour test period to verify that the aerosol distribution is within the acceptance zone.

5.3. Filters shall be configured as follows:

5.3.1. The filter, including the filter holder(s) and gasket(s), shall be tested for DOP 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 which are not separable from cartridges, canisters, or respirators, and odd or unusually shaped filters, may be tested on a text fixture provided by the applicant. NOTE: NIOSH will not be obligated to use applicant supplied test fixtures for approval testing. Applicant supplied test fixtures must be correlated with the NIOSH test method.

5.4. Filters shall be mounted and sealed on the test fixture to prevent leakage around the fixture interface. PAPRs are normally designed to use from one to four filters. Filters shall be tested using a single filter regardless of the number of filters used on the unit. Adjustment is made to the flow rate of the test by dividing the specified flow rate for the test, which is based on the minimum required air flow of 115 LPM for tight-fitting PAPRs and 170 LPM for loose-fitting PAPRs, by the number of filters used. Table 1 specifies the test flow rate based on the type of PAPR and the number of filters employed. NOTE: The highest obtainable air flow for the TSI 8130A automated filter tester is approximately 105 LPM. For a PAPR that employs a single filter, the automated filter tester shall be set to the maximum flow rate of the instrument, to be no less than 105 LPM and no greater than the values shown in Table 1.

Table 1: Test Flow Rates

	PAPR Filter Test – Flow Rate (LPM)	
Number of Filters	Tight-Fitting Facepiece	Loose-Fitting Facepiece
1	115 ± 5	170 ± 5
2	57 ± 3	85 ± 4
3	38 ± 2	57 ± 3
4	29 ± 2	43 ± 2

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

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

5.5.1. 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.

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

6. PASS/FAIL CRITERIA

6.1. The basis for passing this test is set forth in 42 CFR, Part 84, Subpart K, Section 84.175(d).

6.2. A failure occurs when the total leakage for the connector and filter exceeds 0.03 percent of the ambient DOP concentration for any test sample.

7. LIST OF ABBREVIATIONS AND ACRONYMS

Table 2: List of Abbreviations and Acronyms Used Within This Document

Abbreviation or Acronym	Definition
°C	degrees Celsius
%	percent
CFR	Code of Federal Regulations
DOP	dioctyl phthalate
g	gram(s)
LPM	liters per minute
µm	micrometer
NIOSH	National Institute for Occupational Safety and Health
NIST	National Institute of Standard and Technology
NPPTL	National Personal Protective Technology Laboratory
PAPR	powered air-purifying respirator
RH	relative humidity
SDS	safety data sheet
STP	standard testing procedure

8. RECORDS/TEST SHEETS

8.1. Record the test data in a format that shall be stored and retrievable. Data should be reported similar to Attachment A: Sample Test Data Sheet.

9. ATTACHMENTS

9.1. Attachment A: Sample Test Data Sheet

Attachment A: Sample Test Data Sheet

National Institute for Occupational Safety and Health

Test Data Sheet

Task Number:

Test: **STP No.:**

Manufacturer:

Item Tested:

Filter	Flow Rate	Maximum Allowable Percent Leakage	Actual Percent Leakage	Result

Overall Result:

Comments:

Was all equipment verified to be in calibration throughout all testing? ◉ Yes ◉ No

Signature: **Date:** _____

Test Administrator

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	
2.0	14 April 2008	Section	Change
		3.2.	List of Work Instructions added
		4.	Requirements and data for precision and accuracy added
		5.	Editorial changes to clarify procedures
		5.1.2.	Example calculation for challenge concentration added
		5.4.	Clarifications to test flow in light of the maximum total test flow of 96 LPM. A table of appropriate flow values is added.
		All	Editorial changes to improve clarity throughout
3.0	18 August 2025	Editorial rewrite of the document. Pictures and work instructions removed. Equipment model numbers updated. Update of the maximum total test flow to 105 LPM.	