



National Institute for Occupational Safety and Health
National Personal Protective Technology Laboratory
P.O. Box 18070
Pittsburgh, PA 15236

Procedure No. RCT-APR-STP-0003	Revision: 1.1	Date: 3 June 2005
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DETERMINATION OF EXHALATION RESISTANCE TEST,
AIR-PURIFYING RESPIRATORS
STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedure for ensuring that the level of protection provided by the exhalation resistance requirements on chemical cartridge, particulate, gas masks, and tight fitting powered air-purifying respirators 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), Subpart I, Section 84.122, Subpart K, Section 84.180, Subpart L, Section 84.203 and Subpart KK, Section 84.1149 and Section 84.1157(a)(1)(2); Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Exhalation Resistance Test, Air-Purifying respirators 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/MATERIAL

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

- 3.1.1. An anthropometric headform or fixture on which to mount the complete respirator assembly in the configuration as worn by the user.
- 3.1.2. A means of connecting the headform or test fixture to the resistance tester. The respirator must be sealed to the fixture with no leaks.
- 3.1.3. Resistance tester consisting of an air source capable of delivering 85 liters per minute (lpm), a 6-inch slant manometer in inches of water increments, with a connection port for the test fixture with mounted respirator. The resistance tester currently being used is located on the silica dust chamber.
- 3.1.4. Hot melt glue gun and beeswax.
- 3.1.5. Heating plate, beaker, and small brush.

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level
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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. Follow individual instruction manuals for set up, calibration, and maintenance of equipment used in this procedure prior to beginning any testing. Malfunctioning equipment must be repaired or replaced and properly set up and calibrated before starting all tests.
- 5.2. Mount complete respirator assembly onto headform or test fixture. Seal respirator assembly onto headform or fixture by hot melt glue and/or melted beeswax around the sealing surface of the respirator.
- 5.3. Turn on resistance tester and adjust positive airflow to 85 lpm to calibrated mark on the manometer.
- 5.4. Adjust air pressure to 14 +/- .5.
- 5.5. Spiral flow should be set at 2 cfm.
- 5.6. Insert the connection of the headform or test fixture to the connection of the resistance tester.
- 5.7. Read resistance in inches of water on the positive resistance slant tube manometer.
- 5.8. Convert inches to millimeters by multiplying by 25.4.

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5.9. Record measurement.

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), Subpart I, Section 84.122, Subpart K, Section 84.180, Subpart L, Section 84.203 and Subpart KK, Section 84.1149 and Section 84.1157(a)(1)(2); Volume 60, Number 110, June 8, 1995.

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.

84.122 Breathing resistance test; minimum requirements.

(a) Resistance to airflow will be measured in the facepiece or mouthpiece of a gas mask mounted on a breathing machine both before and after each test conducted in accordance with 84.124, 84.125, and 84.126, with air flowing at a continuous rate of 85 liters per minute.

(b) The maximum allowable resistance requirements for gas masks are as follows:

Maximum Resistance
[mm. water-column height]

Type of gas mask	Inhalation		Exhalation
	Initial	Final ¹	
Front-mounted or back-mounted (without particulate filter)	60	75	20
Front-mounted or back-mounted (with approved particulate filter)	70	85	20
Chin-style (without particulate filter)	40	55	20
Chin-style (with approved particulate filter)	65	80	20
Escape (without particulate filter)	60	75	20
Escape (with approved particulate filter)	70	85	20

¹Measured at end of the service life specified in Tables 5, 6, and 7 of this subpart.

84.180 Airflow resistance tests.

(a) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a particulate respirator (complete respirator) mounted on a test fixture with air flowing at continuous rate of 85 ± 2 liters per minute, before each test conducted in accordance with 84.182.

(b) The resistances for particulate respirators upon initial inhalation shall not exceed 35 mm water column height pressure and upon initial exhalation shall not exceed 25 mm water column height pressure.

84.203 Breathing resistance test; minimum requirements.

(a) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a chemical cartridge respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with 84.206 through 84.207.

(b) The maximum allowable resistance requirements for chemical cartridge respirators are as follows:

Maximum Resistance
[Millimeter water column height]

Type of chemical-cartridge respirator	Inhalation		Exhalation
	Initial	Final ¹	
Other than single-use vinyl chloride respirators:			
For gases, vapors, or gases and vapors	40	45	20
For gases, vapors, or gases and vapors, and particulates	50	70	20
Single-use respirator with valves:			
For vinyl chloride	20	25	20
For vinyl chloride and particulates	30	45	20
Single-use respirator without valves:			
For vinyl chloride	15	20	(²)
For vinyl chloride and particulates	25	40	(²)

¹ Measured at end of service life specified in Table 11 of this subpart.

² Same as inhalation.

84.1149 Airflow resistance tests; all dust, fume, and mist respirators; minimum requirements.

(a) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a dust, fume, or mist respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with 84.1144 through 84.1147.

(b) The maximum allowable resistance requirements for dust, fume, and mist respirators are as follows:

Maximum Resistance
[mm. water-column height]

Type of respirator	Initial inhalation	Final inhalation	Exhalation
Pneumoconiosis- and fibrosis-producing dusts, or dusts and mists	12	15	15
Dust, fume, and mist, with single-use filter	30	50	20
Dust, fume, and mist, with reusable filter	20	40	20
Radon daughter	18	¹ 25	15
Asbestos dust and mist	18	25	15

¹ Measured after silica dust test described in 84.1144.

84.1157 Chemical cartridge respirators with particulate filters; performance requirements; general.

Chemical cartridge respirators with particulate filters and the individual components of each such device shall, as appropriate, meet the following minimum requirements for performance and protection:

(a) Breathing resistance test. (1) Resistance to airflow will be measured in the facepiece, mouthpiece, hood, or helmet of a chemical cartridge respirator mounted on a test fixture with air flowing at a continuous rate of 85 liters per minute, both before and after each test conducted in accordance with paragraphs (d) through (f) of this section

(2) The maximum allowable resistance requirements for chemical cartridge respirators are as follows:

Maximum Resistance
[mm. water-column height]

Type of chemical cartridge respirator	Inhalation		Exhalation
		Final ¹	
For gases, vapors, or gases and vapors, and dusts, fumes, and mists	50	70	20
For gases, vapors, or gases and vapors, and mists of paints, lacquers, and enamels	50	70	20

¹Measured at end of service life specified in Table 11 in subpart L of this part.

- 6.3. 20 mm. initial exhalation resistance, 20 mm. final exhalation resistance for all respirators except non powered particulate respirators.
- 6.4. 25 mm. initial exhalation resistance only for particulate non powered respirators except nonpowered particulate respirators. Final exhalation resistance is not performed on non powered particulate respirators.
- 6.5. The complete exhalation resistance criteria for other respirator assemblies not contained in the procedure can be found in 42 CFR 84.

7. RECORDS/TEST SHEETS

- 7.1. All test data collected will be recorded on the DETERMINATION OF EXHALATION RESISTANCE 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



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

Filter Type:

Overall Result:

Signature: _____ Date: _____
Engineering Technician

Revision History

Revision	Date	Reason for Revision
1.0	7 March 2004	Historic document
1.1	3 June 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method

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