



National Institute for Occupational Safety and Health
National Personal Protective Technology Laboratory
P.O. Box 18070
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Procedure No. RCT-ASR-STP-0122	Revision: 1.1	Date: 21 September 2005
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DETERMINATION OF EXHALATION BREATHING RESISTANCE - OPEN-CIRCUIT, DEMAND AND PRESSURE-DEMAND, SELF-CONTAINED BREATHING APPARATUS STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedures for ensuring that the level of protection provided by the exhalation breathing resistance requirements on Open-Circuit, Demand and Pressure-Demand, Self-Contained Breathing Apparatus (SCBA) submitted for Approval, Extension of Approval, or examined during Approved Product audits meet the certification standards set forth in 42 CFR, Part 84, Subpart G, Section 84.63(a)(c)(d), Subpart H, Section 84.91(a)(b)(c)(d) Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Exhalation Breathing Resistance - Open-Circuit, Demand and Pressure-Demand, Self-Contained Breathing Apparatus 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 follows:



3.1.1. Dwyer Slant Manometer 0-3", F. W. Dwyer Manufacturing Co., Michigan City, Indiana or equivalent.

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level
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- 3.1.2. ISI Anthropometric Test heads with tube for measuring breathing resistance and air flows - Model SR-085 or equivalent.



- 3.1.3. Positive pressure source calibrated at a flow of 85 lpm. (Lead fume chamber) or equivalent. (See Figure 1.)

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. The compressed gas cylinder must meet all applicable Department of Transportation requirements for cylinder approval as well as for retesting/requalification.
- 4.3. Normal laboratory safety practices must be observed. This includes all safety precautions described in the current ALOSH Facility Laboratory Safety Manual.
- 4.3.1. Safety glasses, lab coats, and hard-toe shoes must be worn during all testing.
- 4.3.2. Work benches must be maintained free of clutter and non-essential test equipment.
- 4.3.3. 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. Assemble unit as per manufacturer's instructions.
- 5.2. Mount facepiece on an anthropometric head and check for leakage. Block outlet of head with rubber stopper.
- 5.3. Turn on cylinder then connect resistance port to slant manometer. Allow two minutes for reading to stabilize. This reading is the static pressure.
- 5.4. Turn off positive-flow controller on front panel of lead fume chamber (Figure 1).
- 5.5. Turn on chamber main line air supply.
- 5.6. To measure exhalation resistance, adjust positive air flow until the bottom of the meniscus is level with the top of the calibrated 85 lpm mark.
- 5.7. Read the exhalation resistance in inches of water directly from the slant manometer.
- 5.8. Data Analysis.
 - 5.8.1. Take exhalation resistance and static pressure readings directly from the slant manometer scale.
 - 5.8.2. Record readings on test data sheets.
 - 5.8.3. The exhalation resistance shall not exceed 1.0 inches of water column height for demand units.
 - 5.8.4. The exhalation resistance shall not exceed the static pressure by more than 2.0 inches of water column height.

Note: This test should be done on a minimum of two respirators, or more if additional testing is required (42 CFR, Part 84, Sections 84.12, 84.30, and 84.60).

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 H, Section 84.91(a)(b)(c)(d), 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.

84.91 Breathing resistance test; exhalation.

(a) Resistance to exhalation airflow will be measured in the facepiece or mouthpiece of open-circuit apparatus with air flowing at a continuous rate of 85 liters per minute.

(b) The exhalation resistance of demand apparatus shall not exceed 25 mm. (1 inch) water-column height.

(c) The exhalation resistance of pressure-demand apparatus shall not exceed the static pressure in the facepiece by more than 51 mm. (2 inches) water-column height.

(d) The static pressure (at zero flow) in the facepiece shall not exceed 38 mm. (1.5 inches) water-column height.

6.3. See Test Procedure RCT-ASR-STP-0113 for additional requirements for SCBA with hoods.

7. RECORDS\TEST SHEETS

7.1. All test data will be recorded on the BREATHING RESISTANCE TEST - EXHALATION, OPEN-CIRCUIT, SELF-CONTAINED BREATHING APPARATUS test data sheet.

7.2. All videotapes and photographs of the actual test being performed, or of the test 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.

**BREATHING RESISTANCE TEST - EXHALATION, OPEN-CIRCUIT,
SELF-CONTAINED BREATHING APPARATUS**

Project No.: _____ Date: _____

Company : _____

Respirator Type: _____

Reference: 42 CFR, Part 84, Subpart H, Section 84.91(a)(b)(c)(d) - Exhalation Resistance.

Requirements: 84.91(a) Resistance to exhalation airflow will be measured in the facepiece or mouthpiece of open-circuit apparatus with air flowing at a continuous rate of 85 liters per minute.

84.91(b) The exhalation resistance of demand apparatus shall not exceed 25 mm. (1 inch) water-column height.

84.91(c) The exhalation resistance of pressure-demand apparatus shall not exceed the static pressure in the facepiece by more than 51 mm. (2 inches) water-column height.

84.91(d) The static pressure (at zero flow) in the facepiece shall not exceed 38 mm. (1.5 inches) water-column height.

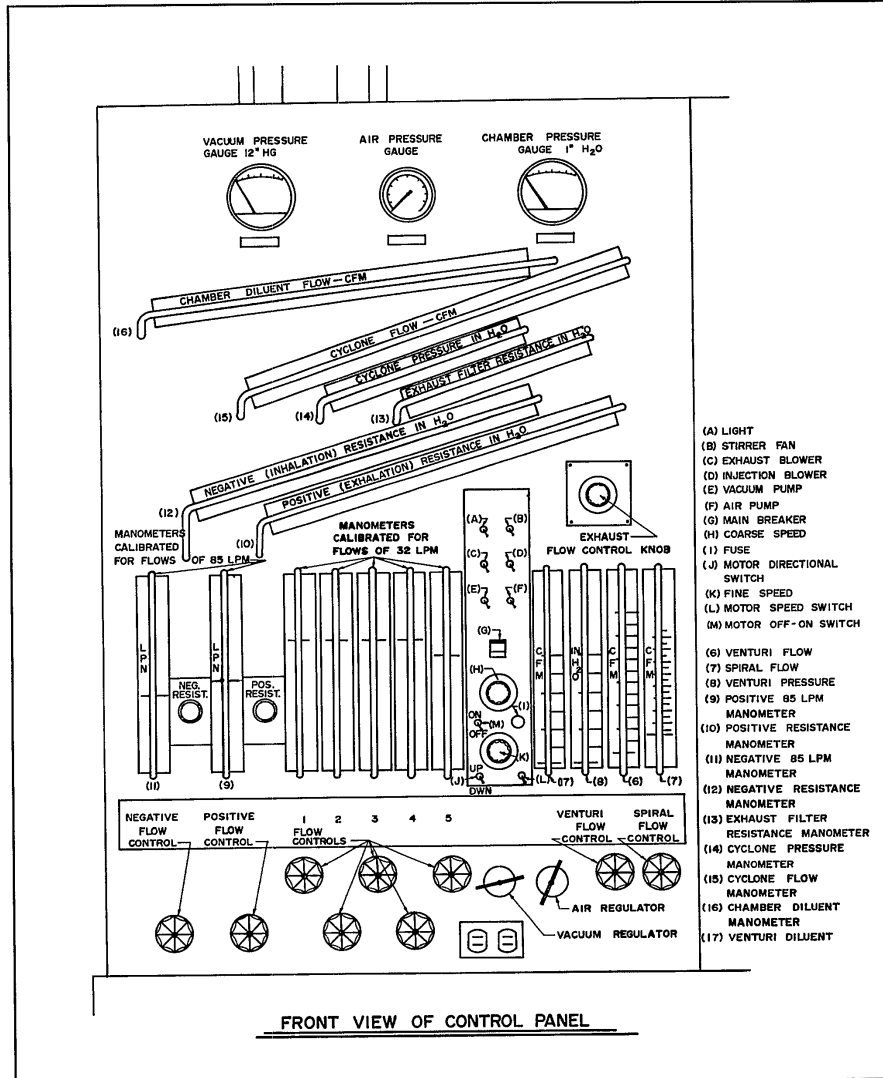
Results:

DEMAND UNIT	<u>Unit 1 "H₂O</u>	<u>Unit 2 "H₂O</u>
84.91(b) - Exhalation:	_____	_____
PRESSURE-DEMAND UNIT	<u>Unit 1 "H₂O</u>	<u>Unit 2 "H₂O</u>
84.91(c) - Exhalation:	_____	_____
84.91(d) - Static:	_____	_____

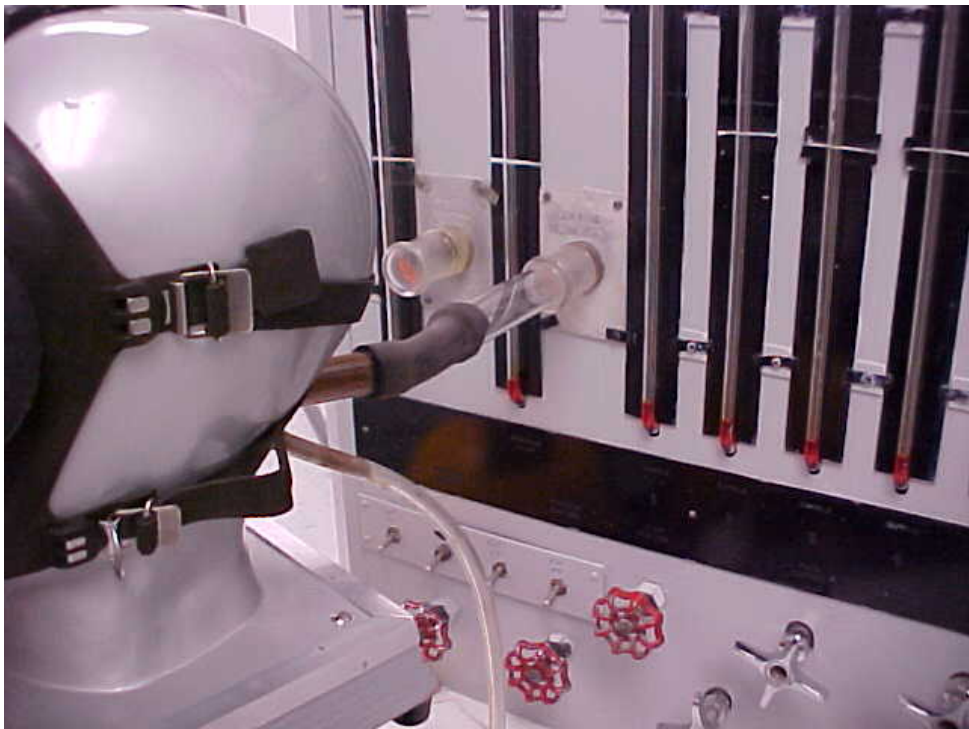
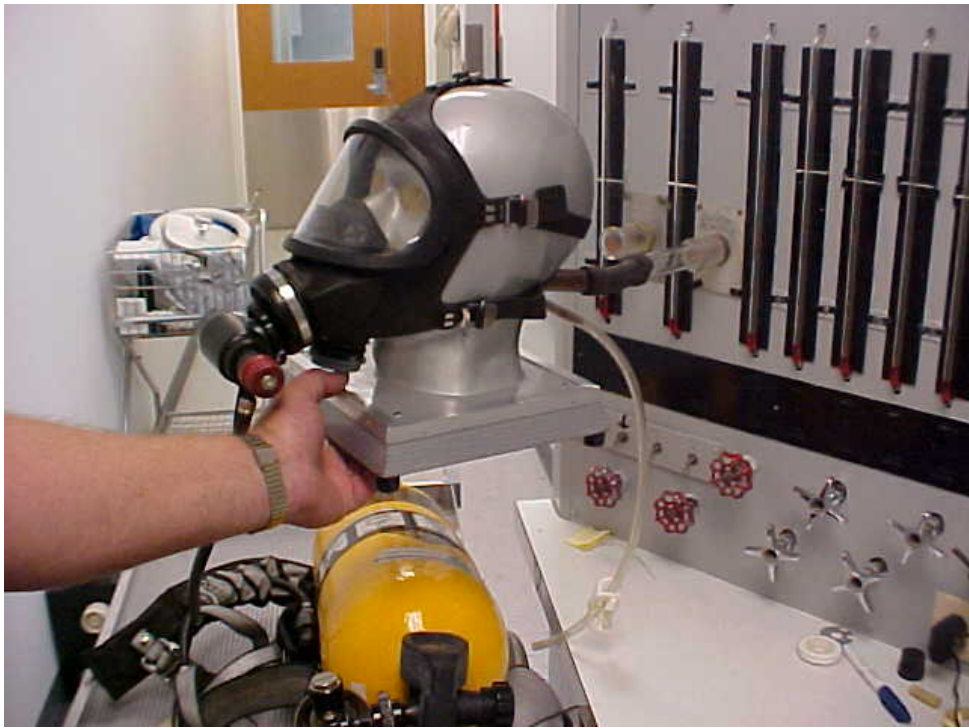
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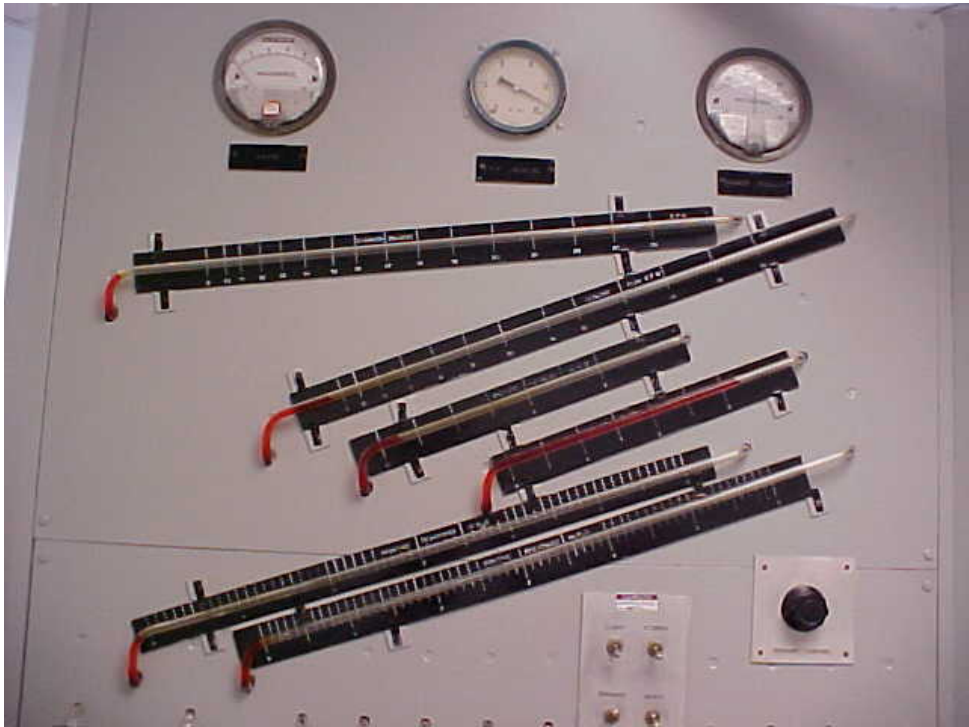
Test Engineer: _____ Pass _____ Fail _____

Figure 1



- (A) LIGHT
- (B) STIRRER FAN
- (C) INJECTION BLOWER
- (D) VACUUM PUMP
- (E) AIR PUMP
- (F) MAIN BREAKER
- (G) COARSE SPEED
- (H) FUSE
- (J) MOTOR DIRECTIONAL SWITCH
- (K) FINE SPEED
- (L) MOTOR SPEED SWITCH
- (M) MOTOR OFF-ON SWITCH
- (6) VENTURI FLOW
- (7) SPIRAL FLOW
- (8) VENTURI PRESSURE
- (9) POSITIVE 85 LPM MANOMETER
- (10) POSITIVE RESISTANCE MANOMETER
- (11) NEGATIVE 85 LPM MANOMETER
- (12) NEGATIVE RESISTANCE MANOMETER
- (13) EXHAUST FILTER RESISTANCE MANOMETER
- (14) CYCLONE PRESSURE MANOMETER
- (15) CYCLONE FLOW MANOMETER
- (16) CHAMBER DILUENT MANOMETER
- (17) VENTURI DILUENT







Revision History

Revision	Date	Reason for Revision
1.0	26 May 2000	Historic document
1.1	21 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method