



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

Procedure No. RCT-ASR-STP-0148	Revision: 1.1	Date: 12 September 2005
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**DETERMINATION OF REMOTE GAUGE LEAK FLOW TEST FOR OPEN-CIRCUIT, DEMAND AND PRESSURE-DEMAND, SELF-CONTAINED BREATHING APPARATUS STANDARD TESTING PROCEDURE (STP)**

**1. PURPOSE**

This test establishes the standard procedure for ensuring that the level of protection provided by the remote gauge leak flow test requirements on Open-Circuit, Demand and Pressure-Demand, Self-Contained Breathing Apparatus (SCBA) submitted for Approval, Extension of Approval, or examined during Post-Certification Product Audits meet the certification requirements set forth in 42 CFR, Part 84, Subpart G, Section 84.63(a)(c)(d), and Subpart H, 84.82(f)(g), Volume 60, Number 110, June 8, 1995.

**2. GENERAL**

This STP describes the Determination of Remote Gauge Leak Flow Test for 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. ISI Anthropometric Test heads with tube for measuring breathing resistance and air flows - Model SR-085 or equivalent.

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level



3.1.2. Electric timer, calibrated to hundredths of a minute (Precision Scientific Company) or equivalent.



3.1.3. Singer Dry Test Meter (Model 806) one cubic foot per revolution of proper rater or equivalent.



3.1.4. Two channel thermal tip recording system (Gould Model No. RS3200) with carrier amplifier (Model No. 13-4615-35) or equivalent.



3.1.5. Mechanical Breather with 622 Kg, m/min, Cam (as per U.S. BOM Drawings C-1748 (3/17/69) Breathing Machine and 8-1198 (3/6/69) Breathing Cam.



3.1.6. Temperature compensated pressure transducer (Validyne Engineering Model No. DP45) or equivalent.

#### 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. If unit has a shut-off valve for gauge and gauge line, charge cylinder to 1000 pounds per square inch. If unit does not have a shut-off valve, charge cylinder to 25% of its rated service pressure.
- 5.2. Remove remote pressure gauge from unit.
- 5.3. Attach gauge line to dry test meter.
- 5.4. Mount facepiece on anthropometric head, taking care not to block resistance port below

and left of nose, particularly if a noseclip is used. Make sure that the face seal is leak tight by blocking off inhalation port of facepiece and inhaling through the breathing tube port exiting back of head. After building up several inches of negative pressure hold breath several seconds, which will enable you to determine if a leak is present. If there is a leak, readjust headstraps and facepiece position and repeat leak test until a seal is obtained.

- 5.5. Connect regulator or breathing tube to facepiece. Do not connect head to breathing machine. Turn on breathing machine and use a timer to determine that the cam is operating at 24 rpm. (This will give a 40 lpm volume.)
- 5.6. Zero the recorder base-line to mid-point of chart paper. (while this is being done the transducer should be connected to the recorder, but the transducer should not have any load on it).
- 5.7. Connect head to breathing machine. Connect transducer to resistance port with a short length of tubing. Open main line valve full and make sure the by-pass valve is closed.
- 5.8. Simultaneously, open cylinder valve and start timer. Turn on breathing machine and recorder.
- 5.9. Operate recorder at 1 mm/sec. and set attenuator to a high value.
- 5.10. When the inhalation portion of the breathing curve falls below the minimum requirements shut off the breathing machine, timer, cylinder valve, and recorder.
- 5.11. Record number of revolutions on dry test meter and time on timer.
- 5.12. One revolution on dry test meter is equal to 28.32 liters per minute. Take number of revolutions recorded in Step 5.11. and multiply by 28.32. Divide this number by the time also recorded in Step 5.11. The flow obtained by doing this cannot exceed 70 liters per minute for a unit equipped with a shut off valve or 5% of service pressure at 25% of service pressure to end of rated service time, for a unit without a shut off valve to meet the minimum requirements of 42 CFR Part 84.
- 5.13. Data Analysis
  - 5.13.1. One revolution on dry test meter is equal to 28.32 liters per minute. Take number of revolutions recorded in step 5.11. and multiply by 28.32. Divide this number by the time also recorded in Step 5.11. The flow obtained by doing this cannot exceed 70 liters per minute for a unit equipped with a shut-off valve or 5% of service pressure at 25% of service pressure to end of rated service time, for a unit without a shut off valve to meet the minimum requirements of 42 CFR Part 84.

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), and Subpart H, 84.82(f)(g), 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.
- 84.82 Gas pressure gages; minimum requirements.
- (f) The loss of gas through a broken gage or severed gage connection shall not exceed 70 liters per minute when the cylinder pressure is  $6,900 \text{ kN/m}^2$  (1,000 pounds per square inch gage) or when the liquid level is at one-half.
- (g) Where gages are connected to the apparatus through a gage line, the gage and line shall be capable of being isolated from the apparatus except where the failure of the gage or line would not impair the performance or service life of the apparatus.
- 6.3. To determine impairment of self-contained breathing apparatus performance and service life, as the result of failure of a gage or gage line without shut-off valve, as required by 84.82, NIOSH requires that the remaining service-life indicator of the apparatus be set to operate at  $25 \pm 2\%$  of rated service time or pressure, and that the volume of gas escaping through the gauge or gauge line shall not exceed 5% of the full rated gas volume after failure of the gauge or gauge line, at 25% of service pressure to the end of the rated service time for the apparatus. In addition, the limiting orifice must be located on the reducer side of the gauge line.

## 7. RECORDS\TEST SHEETS

- 7.1. All test data will be recorded on the LOSS OF GAS THROUGH GAUGE, OPEN-CIRCUIT, SELF-CONTAINED BREATHING APPARATUS 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.

**LOSS OF GAS THROUGH GAUGE, OPEN-CIRCUIT,  
SELF-CONTAINED BREATHING APPARATUS**

Project No : \_\_\_\_\_ Date: \_\_\_\_\_

Company : \_\_\_\_\_

Respirator Type: \_\_\_\_\_

Reference: 42 CFR, Part 84, Subpart H, 84.82(f)(g).

Requirement: The loss of gas through a broken gage or severed gage connection shall not exceed 70 liters per minute when the cylinder pressure is 6,900 kN/m.<sup>2</sup> (1,000 pounds per square inch gage) or when the liquid level is at one-half.

Where gages are connected to the apparatus through a gage line, the gage and line shall be capable of being isolated from the apparatus except where the failure of the gage or line would not impair the performance or service life of the apparatus.

To determine impairment of self-contained breathing apparatus performance and service life, as the result of failure of a gage or gage line without shut-off valve, as required by 84.82, NIOSH requires that the remaining service-life indicator of the apparatus be set to operate at 25 ± 2% of rated service time or pressure, and that the volume of gas escaping through the gauge or gauge line shall not exceed 5% of the full rated gas volume after failure of the gauge or gauge line, at 25% of service pressure to the end of the rated service time for the apparatus. In addition, the limiting orifice must be located on the reducer side of the gauge line.

Results:

Event No.	Cylinder Pressure-psig	Flow/LPM
1.	_____	_____
2.	_____	_____
3.	_____	_____
4.	_____	_____
5.	_____	_____

Comments:

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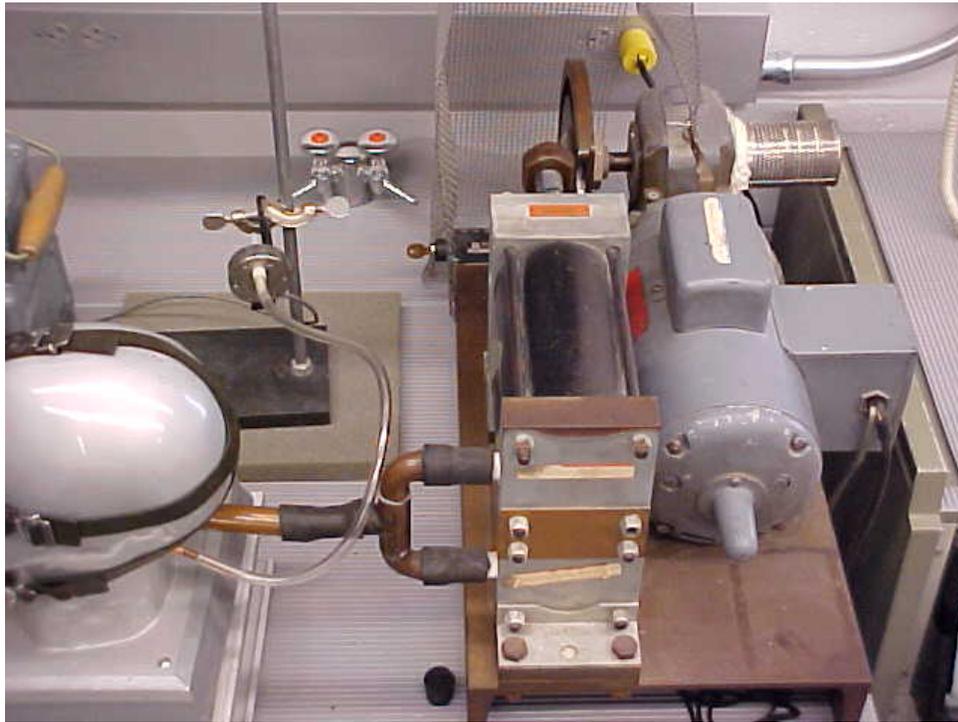
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Test Engineer: \_\_\_\_\_ PASS \_\_\_\_\_ FAIL \_\_\_\_\_





### Revision History

<b>Revision</b>	<b>Date</b>	<b>Reason for Revision</b>
1.0	21 February 2001	Historic document
1.1	12 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method