



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

Procedure No. RCT-ASR-STP-0134	Revision: 1.1	Date: 26 September 2005
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DETERMINATION OF GASOLINE PERMEATION TEST ON BREATHING BAGS, CLOSED-CIRCUIT, 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 breathing bag requirements on Closed-Circuit, Self-Contained Breathing Apparatus (SCBA) 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 H, Section 84.85(a)(b)(c), and 84.88(a)(b)(c)(d); Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Gasoline Permeation Test on Breathing Bags, Closed-Circuit, 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. Mechanical Breather with 622 Kg-m/min. cam as per U.S. BOM Drawings C-1748 (3/17/69) Breathing Machine and B-1198 (3/6/69) Breathing Cam.

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level
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3.1.2. Electric Timer, calibrated to hundredths of a minute (Precision Scientific Co.) or equivalent.



3.1.3. Matheson Toxic Gas Detector - Model 8014KA or equivalent.



3.1.4. Large container or tub, (14" deep x 22" W x 22" L) approximately 20 to 30 gallon capacity or equivalent.

3.1.5. A plastic cover for top and tray for the tub to set in.



3.1.6. Large test subject 10' x 12' gas tight chamber.

3.1.7. Gasoline (Amoco premium unleaded or equivalent).



3.1.8. General Electric 1/10 h. pump or equivalent.



3.1.9. Infrared Analyzer Gas Analyzer (Miran/A) or equivalent.

3.1.10. Calibration Vapors.

3.1.11. Kitagawa gasoline detector tubes.

- a. Pentane/Technical-Eastman Kodak (Fisher Scientific) or equivalent.
- b. Carbon tetrachloride-Certified ACSC-199 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 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 at all times.
 - 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.

4.4. Mandatory Safety Requirements.

The following practices are to be fully complied with during this testing:

- 4.4.1. The only people allowed in the Lab are personnel running the test.
- 4.4.2. A fire extinguisher and telephone will be present and available during testing. Personnel present will know the door combination and the guard's telephone number.
- 4.4.3. All wrist watches, rings, pens, etc and particularly any aluminum objects are not to be taken into the chamber at any time. If rings can't be removed then gloves are required to be worn.
- 4.4.4. The following sequence is mandatory during test set-up, test, and equipment breakdown:
 - a. A minimum of three wire plugs must be pulled and the exhaust plug inside the chamber removed. The exhaust ventilation must be checked by mechanical means before test set up.
 - b. The electric light in the chamber must not be used.
 - c. All combination doors will be kept shut.
 - d. A sign will be placed on hallway door to indicate "test is in progress".
 - e. The test tub holding the gasoline must have a secondary containment in order to guard against accidental discharge.
 - f. Gasoline will be transferred only with the chamber.
 - g. The tub must be covered immediately with plastic after pouring the gasoline. This should be accomplished in a minimum amount of time and all personnel must leave the chamber immediately afterwards.
 - h. At test conclusion: The cover must be removed and personnel must leave the chamber immediately. After the chamber has exhausted for a minimum of fifteen minutes the gasoline must be poured into the safety can. The chamber must be ventilated for one hour before the test set up can be dismantled.

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. Set up breathing machine with a 622 Kg-m/min. cam and set for 24 respirations per minute giving a 40 L/minute volume. The breathing machine is to be stationed outside of the large man test gas chamber.
- 5.2. Place a large tub (20-30 gallon capacity) inside the chamber next to the wall port where breathing machine connections will be made.
- 5.3. Suspend the breathing bag 6 to 8 inches above the bottom of the tub. (Use ring stands, clamps, etc.).
- 5.4. Make all necessary connections between the breathing machine and breathing bag thru the chamber wall port. Extend all connections, if possible, outside the tub to minimize vapor contamination.
- 5.5. Connect a length of Tygon tubing to a port of the breathing bag and extend outside chamber connecting to a "T" containing a pump in line and pinch-off on other side of "T". This serves as the sampling line.
- 5.6. Check all connections for tightness and secure with hose clamps, wire, tape, etc. Make final tightness test by injecting air thru sampling line until there is 6 to 8 inches of positive pressure and allow to sit for one-half hour. If pressure holds, proceed.
- 5.7. Fill bag to desired test capacity with fresh air (approximately 4 to 5 liters) with the breathing cam in position to start inhalation cycle.
- 5.8. Start breathing machine and take an initial sample to use as a blank.
- 5.9. Turn on chamber ventilation - follow safety guidelines listed under Mandatory Safety Requirements.
- 5.10. Pour a shallow layer of gasoline approximately one-half inch deep on bottom of tub; then, cover bag and top of tub with a plastic cover to allow vapor saturation of the test atmosphere. Take care not to allow any liquid gasoline to contact the breathing bag while pouring gasoline into the tub.
- 5.11. Take periodic samples at intervals listed on test/data sheet using gasoline detector tubes. Compare stain in detector tube to scale inscribed on surface of stain tube. Record results on test data sheet. If bag begins to totally collapse when breathing machine inhales then use pump to add fresh air. Care must be taken not to add too much.
- 5.12. At the conclusion of the test, take a sample over the gasoline to check detector tube. Shut off breathing machine and put the test gasoline into an approved gasoline safety can and leave stored in the flammable cabinet.

Note: If tube shows more than 50ppm during the test period, then it is necessary to rerun test using a calibrated IR for quantitative determination. For calibration use Pentane which comes off at a wave length of 3.4 microns and is representative of the Aliphatics; and use

carbon tetrachloride which comes off at a wave length of 12.6 microns and is representative of the aromatics.

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, Section 84.85(a)(b)(c), and 84.88(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.

84.85 Breathing bags; minimum requirements.

(a) Breathing bags shall have sufficient volume to prevent gas waste during exhalation and to provide an adequate reserve for inhalation.

(b) Breathing bags shall be constructed of materials which are flexible and resistant to gasoline vapors.

(c) Breathing bags shall be installed in a location which will protect them from damage or collapse by external forces, except on apparatus classified for escape only.

84.88 Breathing bag test.

(a) Breathing bags will be tested in an air atmosphere saturated with gasoline vapor at room temperature (24-30 °C./75-85 °F.) for a continuous period of twice the rated time of the apparatus (except for apparatus for escape only where the test period shall be the rated time of the apparatus).

(b) The bag will be operated during this test by a breathing machine with 24 respirations per minute and a minute-volume of 40 liters.

(c) A breathing machine cam with a work rate of 622 kp.-m./min. will be used. The dimensions of a suitable breathing machine cam are available from the Institute upon request.

(d) The air within the bag(s) shall not contain more than 100 parts per million of gasoline vapor at the end of the test.

7. RECORDS\TEST SHEETS

- 7.1. All test data will be recorded on the GASOLINE PERMEATION - BREATHING BAG TEST, CLOSED-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.

**GASOLINE PERMEATION - BREATHING BAG TEST, CLOSED-CIRCUIT,
SELF-CONTAINED BREATHING APPARATUS**

Project No : _____ Date: _____

Company : _____

Respirator Type: _____

Reference: 42 CFR, Part 84, Subpart H, Section 84.85(a)(b)(c), and 84.88(a)(b)(c)(d).

Requirement: 84.85 Breathing bags; minimum requirements.

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Results:

PENETRATION

Time	Stain	Total HC Analyzer	Remarks
0			
5			
15			
30			
45			
60			
90			
120			
150			
180			
210			
240			
270			
300			
330			
360			
390			
420			
450			
480			

Comments:

Test Engineer: _____

Pass: _____ Fail: _____





Revision History

Revision	Date	Reason for Revision
1.0	22 August 2000	Historic document
1.1	26 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method