National Institute for Occupational Safety and Health National Personal Protective Technology Laboratory P.O. Box 18070 Pittsburgh, PA 15236		
Procedure No. RCT-ASR-STP-0155	Revision: 1.1	Date: 12 September 2005

MAN TEST NUMBER 6 SELF-CONTAINED BREATHING APPARATUS USING LIQUIFIED GAS STANDARD TESTING PROCEDURE (STP)

1. PURPOSE

This test establishes the procedures for ensuring that the level of protection provided by the Man Test Number 6 requirements on Self-Contained Breathing Apparatus (SCBA) using liquified gas 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, Sections 84.79, 84.102, and 84.103(a)(b), Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Man Test Number 6 Self-Contained Breathing Apparatus Using Liquified Gas 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. Electric time, calibrated to hundredths of a minute (Precision Scientific) or equivalent.

Approvals:	1st Level	2nd Level	3rd Level

3.1.2. Multiple-outlet box with 6 receptacles.

3.1.3. Applied Electrochemistry CO_2 Analyzer - Model CD-3A or equivalent.

3.1.4. Applied Electrochemistry Oxygen Analyzer - Model S-3A or equivalent.

3.1.5. Two test subjects meeting requirements of the NIOSH Human Subject Review Board (HSRB) approved Protocol. Refer to HSRB-73-DSR-01, "Protocol for the Testing of Respiratory Protective Devices" for the proper consent form and complete details on the use of human test subjects in respirator certification testing.

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 liquid gas cylinder or dewar must meet all applicable Department of Transportation Requirements for cylinder or dewar 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, and cryogenic liquid.

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. Put a full charge of the liquified gas into the unit.

5.2. Install the carbon dioxide and oxygen probes into the breathing tube for constant measuring. (Samples should be recirculated into the SCBA).

5.3. A subject will then don the unit as per the manufacturer's instructions.

5.4. The subject will lie face downward and the timer will be started.

5.5. The carbon dioxide and oxygen analyzers will be monitored constantly with readings being noted on the test sheet every 5 minutes. If at any time during the test the carbon dioxide is high or the oxygen is low; stop the test immediately. (See data analysis).

5.6. The subject will remain in this position for one-fourth of the rated-service time.

5.7. The unit will then be bled down until one-fourth of a full charge of the liquified gas is left.

5.8. Steps 5.2 through 5.6 will then be repeated.

5.9. Steps 5.1 through 5.8 will be repeated, except the subject will lie on his back during the test.

5.10. Steps 5.1 through 5.8 will be repeated, except the subject will lie on his right side during the test.

5.11. Steps 5.1 through 5.8 will be repeated, except the subject will lie on his left side during the test.

5.12. All comments will be noted on the test sheet.

5.13. Data Analysis

5.13.1. The percent of carbon dioxide cannot exceed 0.5% at any time during the test.

5.13.2. No less than 19.5 volume percent of oxygen will be allowed at anytime during the test to meet the minimum requirements in 42 CFR 84.79.

5.13.3. The liquid oxygen or liquified breathing air must meet the requirements of 42 CFR, Part 84, 84.79, paragraph B and D.

5.13.4. The apparatus shall satisfy the respiratory requirements of the wearer during the test to meet the minimum requirement in 42 CFR, 84.103.

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, Sections 84.79, 84.102, and 84.103(a)(b), 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.

84.79 Breathing gas; minimum requirements.

(a) Breathing gas used to supply apparatus shall be respirable and contain no less than 19.5 (dry atmosphere) volume percent of oxygen.

(b) Oxygen, including liquid oxygen, shall contain not less than 99.0 percent, by volume, of pure O_2, not more than 0.03%, by volume, carbon dioxide, and not more than 0.001%,

by volume, carbon monoxide. Methods for making these determinations can be found in the U.S. Pharmacopeia National Formulary. Containers used for oxygen must not be treated with any toxic, sleep-inducing, narcosis-producing, or respiratory tract irritating compounds.

(c) Compressed, gaseous breathing air shall meet the applicable minimum grade requirements for Type I gaseous air set forth in the Compressed Gas Association Commodity Specification for Air, G-7.1, 1966 (Grade D or higher quality). G-7.1 is incorporated by reference and has been approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018. Copies may be inspected at the NIOSH, Respirator Branch, 1095 Willowdale Road, Morgantown, WV 26505-2888, or at the Office of the Federal Register, 800 North Capitol Street, NW, suite 700, Washington, DC.

(d) Compressed, liquefied breathing air shall meet the applicable minimum grade requirements for Type II liquid air set forth in the Compressed Gas Association Commodity Specification for Air, G-7.1, 1966 (Grade B or higher quality). G-7.1 is incorporated by reference and has been approved by the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51. Copies may be obtained from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018. Copies may be inspected at the NIOSH, Respirator Branch, 1095 Willowdale Road, Morgantown, WV 26505-2888, or at the Office of the Federal Register, 800 North Capitol Street, NW, suite 700, Washington, DC.

84.102 Man test 6; requirements.

(a) Man test 6 will be conducted with respect to liquefied breathing gas apparatus only.

(b) This test will be conducted to evaluate operation of the apparatus in other than vertical positions.

(c) The wearer will lie face downward for one-fourth the service life of the apparatus with a full charge of liquefied breathing gas, and then a one-quarter full charge of liquefied breathing gas.

(d) The test will be repeated with the wearer lying on each side and on his back.

(e) The oxygen content of the gas supplied to the wearer by the apparatus will be continuously measured.

84.103 Man tests; performance requirements.

(a) The apparatus shall satisfy the respiratory requirements of the wearer for the classified service time.

(b) Fogging of the eyepiece shall not obscure the wearer's vision, and the wearer shall not experience undue discomfort because of fit or other characteristics of the apparatus.

7. RECORDS\TEST SHEETS

7.1. All test data will be recorded on the MAN TEST NO. 6, "SELF-CONTAINED BREATHING APPARATUS USING LIQUIFIED GAS", 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.

MAN TEST NO. 6, SELF-CONTAINED BREATHING APPARATUS USING LIQUIFIED GAS

Project No : _____ Date: _____

Company : _____

Respirator Type: _____

Reference: 42 CFR, Part 84, Subpart H, Sections 84.79, 84.102, and 84.103(a)(b).

Requirement: LOX or LAIR Only. The wearer will lie face downward for 1/4 of the service life of the apparatus with a full charge of liquified breathing gas, and then 1/4 full charge of liquified breathing gas.

The test will be repeated with the wearer lying on each side and on his back.

Results:

Test subject: _____

UNIT #1 FULL CHARGE

Position	Time/Min.	CO_2	O_2%	Remarks
Face Downward:	_____	____	____	_____
Back:	_____	____	____	_____
Left Side:	_____	____	____	_____
Right Side:	_____	____	____	_____

UNIT #1 QUARTER CHARGE

Position	Time/Min.	CO_2	O_2%	Remarks
Face Downward:	_____	____	____	_____
Back:	_____	____	____	_____
Left Side:	_____	____	____	_____
Right Side:	_____	____	____	_____

Test subject: _____

UNIT #2 FULL CHARGE

Position	Time/Min.	CO_2	O_2%	Remarks
Face Downward:	_____	____	____	_____
Back:	_____	____	____	_____
Left Side:	_____	____	____	_____
Right Side:	_____	____	____	_____

UNIT #2 QUARTER CHARGE

Position	Time/Min.	CO_2	O_2%	Remarks
Face Downward:	_____	____	____	_____
Back:	_____	____	____	_____
Left Side:	_____	____	____	_____
Right Side:	_____	____	____	_____

Comments :

_____

_____

_____

_____

_____

Test Engineer: _____ PASS_____ FAIL_____

Revision History

Revision	Date	Reason for Revision
1.0	2 February 2001	Historic document
1.1	12 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method