



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

Procedure No. RCT-ASR-STP-0143	Revision: 1.1	Date: 12 September 2005
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DETERMINATION OF LOW TEMPERATURE OPERATION - MINIMUM PER MANUFACTURE,
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 low temperature 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 84.79(a), 84.97(d), and 84.98; Volume 60, Number 110, June 8, 1995.

2. GENERAL

This STP describes the Determination of Low Temperature Operation - Minimum Per Manufacture, 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. Environmental Room, Model D69 (Tenney Engineering, Inc.) or equivalent.

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level
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3.1.2. Applied Electrochemistry Oxygen Analyzer - Model S-3A or equivalent.



3.1.3. Applied Electrochemistry CO₂ Analyzer - Model CD-3A or equivalent.



3.1.4. One B-D Yale (2317 100YL) 100cc (Becton, Dickson and Co.) syringe "Luer-Lok", Becton Dickson & Company, Rutherford, NJ. or equivalent.



3.1.5. Electric Timer, calibrated to hundredths of a minute (Precision Scientific Co.) or equivalent.



- 3.1.6. Multiple outlet box with 6 receptacles.
- 3.1.7. 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.



- 3.1.8. A PHYSIO - Control Crash Cart - Model 800539 with current dated drugs and equipment at the test scene 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. The apparatus will be precooled at the specified minimum temperature for 4 hours.
- 5.2. The apparatus will be worn in the cold temperature chamber for 30 minutes or for the service time of the apparatus, whichever is less.
- 5.3. During the test period, alternate 1-minute periods of exercise and rest will be required with the exercise periods consisting of stepping onto and off a box 21.5 cm (8 1/2 inches) high at a rate of 30 cycles per minute.
- 5.4. The test subject shall be constantly monitored during the test to determine that the unit is functioning satisfactorily and that they are not experiencing undue discomfort because of air flow restrictions or other physical or chemical changes in the operation of the apparatus.
- 5.5. A sample of the unit atmosphere will be taken during the 1-minute rest periods. The sample will be taken immediately downstream of the carbon dioxide scrubber only during the inhalation portion of the test subject's breathing cycle.
- 5.6. The sample will be evaluated for its oxygen and carbon dioxide content using the respective analyses.
- 5.7. Data Analysis
 - 5.7.1. Record remarks concerning unit operation and test subject's comments on test data sheet.
 - 5.7.2. Oxygen concentration is obtained directly from analyzer and recorded on test data sheet.
 - 5.7.3. Carbon dioxide concentration is obtained directly from analyzer and recorded on test data sheet.

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, Section 84.79(a), 84.97(d), and 84.98; 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.

84.97 Test for carbon dioxide in inspired gas; open- and closed-circuit apparatus; maximum allowable limits.

(d) In addition to the test requirements for closed-circuit apparatus set forth in paragraph (b) of this section, gas samples will be taken during the course of the man tests described in Tables 1, 2, 3, and 4 of this subpart. These gas samples will be taken from the closed-circuit apparatus at a point downstream of the carbon dioxide sorbent, and they shall not contain more than 0.5 percent carbon dioxide at any time, except on apparatus for escape only, using a mouthpiece only, the sample shall not contain more than 1.5 percent carbon dioxide at any time.

84.98 Tests during low temperature operation:

(a) The applicant shall specify the minimum temperature for safe operation and two persons will perform the tests described in paragraphs (c) and (d) of this section wearing the apparatus according to applicant's directions. At the specified temperature, the apparatus shall meet all the requirements described in paragraph (e) of this section.

(b) The apparatus will be precooled at the specified minimum temperature for 4 hours.

(c) The apparatus will be worn in the low temperature chamber for 30 minutes, or for the service time of the apparatus, whichever is less.

(d) During the test period, alternate 1-minute periods of exercise and rest will be required with the exercise periods consisting of stepping onto and off a box 21.5 cm (8 1/2 inches) high at a rate of 30 cycles per minute.

- (e)
 - (1) The apparatus shall function satisfactorily at the specified minimum temperature on duplicate tests.
 - (2) The wearer shall have sufficient unobscured vision to perform the work.
 - (3) The wearer shall not experience undue discomfort because of air flow restriction or other physical or chemical changes in the operation of the apparatus.
 - (f) Auxiliary low-temperature parts which are commercially available to the user may be used on the apparatus to meet the requirements described in paragraph (e) of this section.
- 6.3
 - (1) Oxygen and carbon dioxide levels will be monitored if the unit being tested is a closed-circuit breathing apparatus.
 - (2) Oxygen levels shall be greater than 19.5%.
 - (3) Carbon dioxide levels shall not exceed 1.5% if the unit uses a mouthpiece and 0.5% if the unit utilizes a facepiece.

7. RECORDS\TEST SHEETS

- 7.1. All test data will be recorded on the COLD TEMPERATURE 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.

**COLD TEMPERATURE TEST, CLOSED-CIRCUIT,
SELF-CONTAINED BREATHING APPARATUS**

Project No : _____ Date: _____

Company : _____

Respirator Type: _____

Reference: 42 CFR, Part 84, Subpart H, Section 84.79(a), Section 84.97(d), and 84.98

Requirement: 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.

84.97 Test for carbon dioxide in inspired gas; open- and closed-circuit apparatus; maximum allowable limits.

(d) In addition to the test requirements for closed-circuit apparatus set forth in paragraph (b) of this section, gas samples will be taken during the course of the man tests described in Tables 1, 2, 3, and 4 of this subpart. These gas samples will be taken from the closed-circuit apparatus at a point downstream of the carbon dioxide sorbent, and they shall not contain more than 0.5 percent carbon dioxide at any time, except on apparatus for escape only, using a mouthpiece only, the sample shall not contain more than 1.5 percent carbon dioxide at any time.

84.98 Tests during low temperature operation:

(a) The applicant shall specify the minimum temperature for safe operation and two persons will perform the tests described in paragraphs (c) and (d) of this section, wearing the apparatus according to applicant's directions. At the specified temperature, the apparatus shall meet the requirements described in paragraph (e) of this section.

(b) The apparatus will be precooled at the specified minimum temperature for 4 hours.

(c) The apparatus will be worn in the low temperature chamber for 30 minutes, or for the service time of the apparatus, whichever is less.

(d) During the test period, alternate 1-min. periods of exercise and rest will be required with the exercise periods consisting of stepping onto and off a box 21.5 cm. (8 ½ inches) high at a rate of 30 cycles per minute.

(e) 1. The apparatus shall function satisfactorily at the specified minimum temperature on duplicate tests.

2. The wearer shall have sufficient unobscured vision to perform the work.

- 3. The wearer shall not experience undue discomfort because of airflow restriction or other physical or chemical changes in the operation of the apparatus.
- (f) Auxiliary low-temperature parts which are commercially available to the user may be used on the apparatus to meet the requirements described in paragraph (e) of this section.

O₂ shall be greater than 19.5%, CO₂ shall not exceed 0.5%.

Results:

1. Subject: _____ Chamber Temp. _____ °F

<u>Sample No.</u>	<u>O₂%</u>	<u>CO₂%</u>	<u>Remarks</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
11.	_____	_____	_____
12.	_____	_____	_____
13.	_____	_____	_____
14.	_____	_____	_____
15.	_____	_____	_____

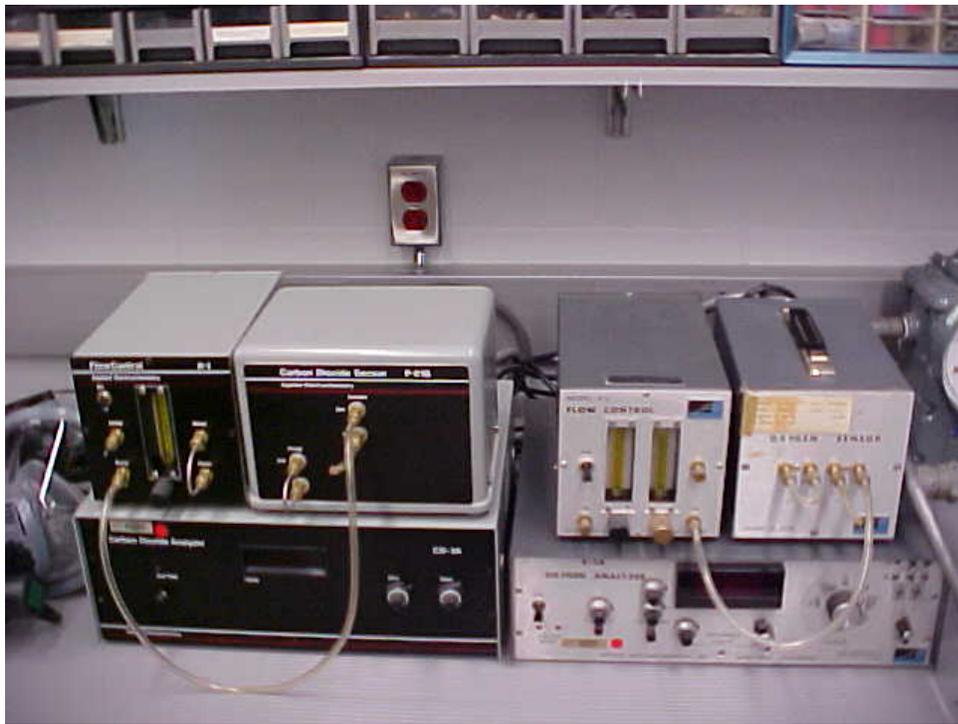
2. Subject: _____ Chamber Temp. _____ °F

<u>Sample No.</u>	<u>O₂%</u>	<u>CO₂%</u>	<u>Remarks</u>
1.	_____	_____	_____
2.	_____	_____	_____
3.	_____	_____	_____
4.	_____	_____	_____
5.	_____	_____	_____
6.	_____	_____	_____
7.	_____	_____	_____
8.	_____	_____	_____
9.	_____	_____	_____
10.	_____	_____	_____
11.	_____	_____	_____
12.	_____	_____	_____
13.	_____	_____	_____
14.	_____	_____	_____
15.	_____	_____	_____

Comments:

Test Engineer: _____ PASS _____ FAIL _____





Revision History

Revision	Date	Reason for Revision
1.0	23 May 2001	Historic document
1.1	12 September 2005	Update header and format to reflect lab move from Morgantown, WV No changes to method