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Level 1	Level 2	Level 3	Level 4

STANDARD TEST PROCEDURE (STP) FOR PERFORMANCE OF AS-RECEIVED AND ENVIRONMENTALLY TREATED CLOSED-CIRCUIT ESCAPE RESPIRATORS (CCER)

1. PURPOSE

1.1. This procedure establishes the test for ensuring that Closed-Circuit Escape Respirators (CCER) submitted for Approval, Extension of Approval, or examined during Certified Product Audits, meet the certification standards as set forth in Section 84.305 (a) (1) and (2), of Subpart O−Closed Circuit Escape Respirators updated requirements to 42 CFR, Part 84, Volume 60, Number 110, June 8, 1995 as published in Federal Register / Vol. 77, No. 46 / Thursday, March 8, 2012 / Rules and Regulations pp. 14168-14197.

2. GENERAL

2.1. This Standard Test Procedure describes the CCER performance test in sufficient detail such that a person knowledgeable in the appropriate technical field can conduct the test, and determine whether or not the product passes the test.

3. EQUIPMENT AND MATERIALS

3.1. The equipment and materials necessary to perform the following measurements are specified in Section 3 of Standard Operating Procedure for a Breathing and Metabolic Simulator when Performing Capacity and Performance Tests on Closed-Circuit Escape Respirators.

4. TEST REQUIREMENTS AND CONDITIONS

4.1. Prior to beginning any testing, all measuring equipment and instruments to be used must have been calibrated using a method traceable to the National Institute of Standards and Technology (NIST) in accordance with the manufacturer's calibration procedure and schedule.

4.2. Normal laboratory safety practices must be observed. These include safety precautions given in the current *NIOSH-Pittsburgh Health and Safety Manual*, Job Hazard Analysis (JHA), work instruction documents and test equipment manufacturer recommended practices.

4.3. Any laboratory using this procedure to supply certification test data to NPPTL will be subject to the provisions of the NPPTL Supplier Qualification Program (SQP). This program is based on the tenets of ISO/IEC 17025, the NIOSH Manual of Analytical Methods and other NIOSH guidelines. An initial complete quality system audit and follow on audits are requirements of the Program. Additional details of the Program and its requirements can be obtained directly from NPPTL.

4.4. Additional test requirements and conditions necessary to perform the following measurements are specified in Standard Operating Procedure for a Breathing and Metabolic Simulator when Performing Capacity and Performance Tests on Closed-Circuit Escape Respirators.

4.5. Prior to beginning the Capacity Test Procedure, the CCER will be opened and visually inspected using manufacturer's and NIOSH inspection criteria. This inspection will include:

4.5.1. Applying a -300mm H_2O vacuum to assess the integrity of the breathing tube and associated parts.

4.5.2. A phenolphthalein swab to detect alkaline chemicals present in the CCER user interface.

4.6. Performance Test Requirements and Conditions

4.6.1. Performance tests will continuously monitor the stressors listed in Table 1. The stressors will be measured at the interface between the CCER and the Breathing and Metabolic Simulator "mouth" by instruments capable of breath-by-breath measurement. Stressor measurements will be evaluated as one-minute averages. The operating (overall) averages of each stressor will be calculated upon the completion of each test as the average of the one-minute measurements of the stressor recorded during the test.

Table 1: Monitored Stressors and their Acceptable Ranges

Stressor	**Acceptable Range Operating Average**	**Acceptable Range Excursion**
Average inhaled CO_2	<1.5%	≤4%
Average inhaled O_2	>19.5%	≥15%
Peak Breathing Pressures	$\Delta P \leq 200$ mm H_2O	$-300 \leq \Delta P \leq 200$ mm H_2O
Wet-bulb temperature	<43˚C	≤50˚C

4.6.2. Performance testing of a CCER will conclude when the stored breathing gas supply has been fully expended.

4.6.3. The performance test is performed on at least five units submitted for approval, as follows:

4.6.3.1. Three units will be tested in the condition in which they are received from the applicant.

4.6.3.2. Two units will be tested after being subjected to the environmental treatments according to standard procedure for environmental treatments of closed-circuit escape respirators (CCER).

4.6.4. Each unit will be tested by application of a repeating cycle of work rates, according to the sequence and requirements in Table 3.

4.6.5. The performance test will begin with two exhalations into the unit at the specified ventilation rate to determine the design's susceptibility to hypoxia.

4.6.6. Testing of CCERs with less than 50 liters of capacity, as determined by the capacity testing under § 84.304 [refer to Standard test procedure (STP) for capacity of as-received and environmentally treated closed-circuit escape respirators (CCER)] will require the submission of additional test units to fully apply the work-rate test sequence and requirements specified in Table 3. The testing of each individual unit will complete the cycle specified in Table 3 until the breathing supply of the initial test unit is exhausted. This initial test unit will then be replaced by a second unit, which will continue the test cycle, beginning at the next work rate in the cycle.

Table 3: Performance Test Requirements for a cycle (All volumes are given at standard temperature (0°C) and pressure (760 mm Hg), dry)

Work-Rate Test Sequence	**Duration per cycle**	$\dot{V}O_2$ **(L/min)**	$\dot{V}CO_2$ **(L/min)**	$\dot{V}e$ **(L/min)**	**RF (breaths/min)**
1. Peak	5 min.	3.00	3.20	65.0	25
2. High	15 min.	2.00	1.80	44.0	20
3. Low	10 min.	0.50	0.40	20.0	12

$\dot{V}O_2$ = volume of oxygen consumed/min; $\dot{V}CO_2$ = volume of carbon dioxide produced/min

$\dot{V}e$ = ventilation rate; RF = respiratory frequency

5. PROCEDURES

5.1. Test with Breathing and Metabolic Simulator (BMS)

5.1.1. The procedure is specified in Section 5 of Standard Operating Procedure for a Breathing and Metabolic Simulator when Performing Capacity and Performance Tests on Closed-Circuit Escape Respirators.

5.2. Data analysis

5.2.1. Determine the completion time as the time elapsed from test start to when the gas supply is fully expended. Expended gas supply is usually indicated when either the breathing bag is empty, or (if present) the O_2 cylinder is empty, and (as a result) peak inhalation pressure begins to spike below -300 mm H_2O.

5.2.2. Calculate the overall average for each of the stressor measurements using the one-minute average values from the test start to when the gas supply is fully expended.

6. PASS/FAIL CRITERIA

6.1. The apparatus fails this test and certification if:

6.1.1. Any average stressor measurement (as the overall average from test start to when the gas supply is fully expended) is outside the acceptable operating average range shown in Table 1 (middle column).

6.1.2. If from the test start up to when the gas supply is fully expended any one-minute average stressor measurement is outside the acceptable excursion range shown in Table 1 (last column).

7. RECORDS AND TEST SHEETS

7.1. Test summary

Device ID	Test	Test date	Completion time	Comments
	As-received			
	As-received			
	As-received			
	Environmental treatments			
	Environmental treatments			

8. APPENDICES

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9. REVISION HISTORY

Revision	Date	Reason for Revision
00	14 October 2009	Initial Record
1.0	02 August 2011	Final Review
1.0	22 November 2011	Administrative changes – Document number changed
2.0	3 April 2012	Administrative changes were made to include information from the release of the proposed rule.