



National Institute for Occupational Safety and Health
 National Personal Protective Technology Laboratory
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STANDARD OPERATING PROCEDURE (SOP) FOR ENVIRONMENTAL TREATMENTS ON
 CLOSED-CIRCUIT ESCAPE RESPIRATORS (CCER)

1. PURPOSE

This procedure specifies the environmental treatments set forth in 42 CFR, Part 84, Subpart O, Section 84.307 for Closed-circuit Escape Respirator (CCER) submitted for Approval, Extension of Approval, or examined during Certified Product Audits as part of ensuring that the level of protection provided by capacity and performance, meet the minimum certification standards set forth in Section 84.304 and 84.305 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

This document describes the process for environmental treatments including extreme temperatures, physical shock, and vibration of the closed-circuit escape respirator (CCER) in sufficient detail that a person knowledgeable in the appropriate technical field can select equipment with the necessary characteristics and conduct the treatments in accordance with the requirements of this procedure.

3. EQUIPMENT AND MATERIALS

3.1. Treatment with extreme temperatures:

- 3.1.1. Russells Technical Products Temp/Humidity Chamber, model RDV100-705 or equivalent
- 3.1.2. Research, Inc. Micristar Controller model 828E or equivalent
- 3.1.3. Envirotronics Temp/Humidity Chamber model EVH-100-2-705 S/N 04911590 or equivalent
- 3.1.4. Research, Inc. Micristar Controller model 828-E11 S/N 11522 or equivalent
- 3.1.5. Honeywell Truline Chart Recorder model 910-80714 or equivalent

3.2. Treatment with shock:

- 3.2.1. Measure tape or stick with one (1.0) meter graduation or equivalent.

Approvals: First Level	Second Level	Third Level	Fourth Level

3.2.2. Bare concrete floor with no paint, tile or carpeting or equivalent.

3.3. Treatment with vibration:

3.3.1. Unholtz-Dickie Corp. Vibration Test System, Electrodynamic, with Accessories Model 289 or equivalent

3.3.2. Spectral Dynamics Vibration Control System on Sun Sparc Station 4 model 2550 or equivalent

3.3.3. Ling Dynamic Systems Vibration System with components Model V-964LS or equivalent

3.3.4. PCB Accelerometers model 308B or equivalent

3.3.5. Unit attachment fixture is not necessarily a commercial item but must achieve the requirements given in the §4.3 of the following section.

3.3.5.1. The fixture may use by any combination of clamping, strapping, shimming, etc. to achieve the requirements.

4. 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. The CCER unit will be in the condition to be deployed in the field according to manufacturer instructions.

4.5. The same axes (as illustrated in figure 1 below) will be used for both physical shock and vibration treatments.

4.6. The procedure for vibration requires attaching the CCER unit to the table of the vibration test system.

- 4.6.1. The CCER must be attached to allow full transfer of the applied energy to the unit. The fixture results in the table and attached unit behaving as a rigid object. This allows the unit to vibrate at the same frequency as the table.
- 4.6.2. Attachment with the fixture must not result in any damage or distortion of the unit.
- 4.7. Timing:
 - 4.7.1. The elapsed time between the three procedures can be varied to accommodate laboratory scheduling.
 - 4.7.2. The elapsed time between the environmental treatments and subsequent test procedures can be varied to accommodate laboratory scheduling.
 - 4.7.3. The elapsed time between phases of a single treatment (for example storage at extreme temperature, and vibration along each axis) can be varied to accommodate laboratory scheduling.
 - 4.7.4. The duration times specified in table 1 for intervals 2, 4 and 6 are minimum values.

5. PROCEDURES

- 5.1. A minimum of four (4) units will be subjected to the environmental treatments. Each unit will be subjected to all treatments in the following order: Extreme temperature, physical shock and vibration.
 - 5.1.1. Initially note the presence and condition of any indicators *e.g.* thermal exposure, chemical bed physical integrity, moisture damage, etc. in the test record.
 - 5.1.2. Subsequently, observe the status of indicators after each phase of environmental treatment and note any change and when it occurred in the test record.
- 5.2. Extreme temperature:
 - 5.2.1. The unit will initially be stored for 16 hours at a temperature of -45°C.
 - 5.2.2. The unit will then be stored at a temperature of 25°C for 1 hour.
 - 5.2.3. Then the unit will be stored for 48 hours at a temperature of 71°C.
 - 5.2.4. The unit will then be stored at a temperature of 25°C for 1 hour.
 - 5.2.5. The maximum rate of temperature change shall not exceed 3°C per minute.
 - 5.2.6. All temperatures shall be maintained within $\pm 2^\circ\text{C}$ of specified value.

Table 1 - Summary of Conditions for Storage and Transition Intervals for Extreme Temperature Treatment

Order	Conditions	
	Temperature (°C)	Duration (hours)
1	25	1
2	rate of change $\leq 3/\text{minute}$	≥ 0.39
3	-45	16
4	rate of change $\leq 3/\text{minute}$	≥ 0.39
5	25	1
6	rate of change $\leq 3/\text{minute}$	≥ 0.25
7	71	48
8	rate of change $\leq 3/\text{minute}$	≥ 0.25
9	25	1

5.3. Physical shock:

5.3.1. The CCER will be manually dropped six times from a height of 1 meter onto a concrete surface.

5.3.2. Two drops will be made with the unit oriented along each major axis as shown in Figure 1.

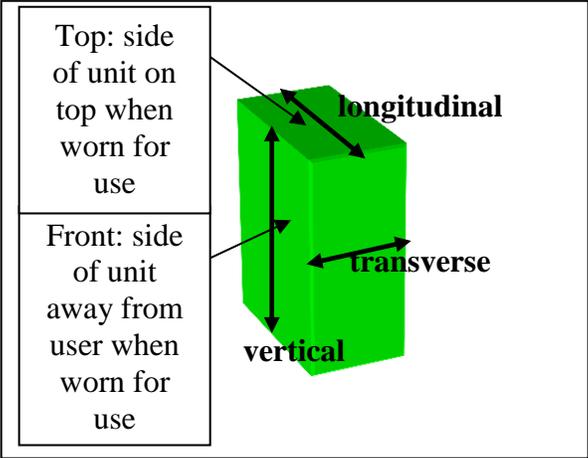
5.3.2.1. In the second drop (along a major axis) the unit will be oriented upside down from the orientation of the first drop.

5.3.2.1.1. For example if the first drop along the vertical axis was with the side of unit on top when worn for use facing upward, the second drop is performed with the side of unit on top when worn for use facing downward.

5.3.2.2. The 1 meter height will be from the floor to the lowest component of the unit in each orientation.

5.3.2.3. The same axes are used for physical shock and vibration treatments.

Figure 1. Three Major Axes of CCER unit shown with double-headed arrows



- 5.4. Vibration:
 - 5.4.1. The unit will be vibrated one axis at a time along each of the three axes, longitudinal, vertical and transverse, as shown in Figure 1.
 - 5.4.2. The unit will first be firmly attached to the shaker table.
 - 5.4.3. The attached unit will then be vibrated with motion applied along a single axis.
 - 5.4.4. The vibration frequency regimen applied to the axis will consist of the sequence of elements listed in Table 2 over twenty minutes.
 - 5.4.5. The sequence will be continuously repeated until the total duration of vibration along the axis totals 180 minutes (three hours);
 - 5.4.6. Steps 5.4.2 through 5.4.5 will then be repeated for each of the remaining axes.
 - 5.4.6.1. As a result, each unit will have been vibrated along the three major axes for a **total** duration of 540 minutes (nine hours).

Table 2: Conditions for Vibration Treatment Elements

Element	Frequency (Hertz)	Acceleration g (± peak)
1	5 – 92	2.5
2	92 – 500	3.5
3	500 – 2000	1.5

6. PASS/FAIL CRITERIA

- 6.1. None

6.2. A minimum of four (4) CCER units are subjected to environmental treatments using this procedure.

6.2.1. Two (2) CCERs will be tested for capacity test requirements as indicated in 42 CFR, Part 84, Subpart O, Section 84.304(a)(2). Refer to Standard test procedure (STP) for capacity of as-received and environmentally treated closed-circuit escape respirators (CCER).

6.2.2. The number of CCERs needed to complete two performance tests (2) will be tested as indicated in 84.305(a)(2) for Performance test requirements. Refer to Standard test procedure (STP) for performance of as-received and environmentally treated closed-circuit escape respirators (CCER).

7. RECORDS AND TEST SHEETS

ENVIRONMENTAL TREATMENT RECORD

General Information:

NIOSH Application Number _____

Manufacturer _____

CCER Name/Model _____ Serial Number _____

Date Recieved _____

Appearance including indicators and their status and any specific physical anomalies _____

Treatment dates:

Extreme Temperatures: Start Date and Time _____; End Date and Time _____

Notes* _____

Physical Shock: Start Date and Time _____; End Date and Time _____

Indicate order of drop orientations:

Vertical: top side up _____ top side down _____

Longitudinal: front side up _____ front side down _____

Transverse: left side up _____ left side down _____

Notes* _____

Vibration: Start Date and Time _____; End Date and Time _____

Indicate order of axes vibrated:

Vertical _____ Longitudinal _____ Transverse _____

Notes* _____

Signatures:

Technician _____ Date _____

Supervisor _____ Date _____

*Additional notes below and attach as needed.

8. ATTACHMENTS

None

Revision History

Revision	Date	Reason for Revision
4.0	16 November 2011	Administrative change – Document number changed
5.0	28 March 2012	Administrative changes were made to include information from the release of the proposed rule.
		Former document number - STP-00001-PSDB-0005
0.0	7 April 2014	New document number to reflect numbering in the approval library, normalization of format. Edits to sections 5.1. and 6.2.2. clarify the fact that more than 4 samples may need to be conditioned depending upon the number of CCERs required to complete the performance test. Some additional grammatical changes have been made, but there are no changes to procedure from historical document.