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National Personal Protective Technology Laboratory
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Procedure No. CET-APRS-STP-CBRN-0411	Revision: 1.1	Date: 23 December 2005
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DURABILITY CONDITIONING PROCESS FOR ENVIRONMENTAL, TRANSPORTATION AND ROUGH HANDLING USE CONDITIONS ON CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR (CBRN) (AIR-PURIFYING OR SELF-CONTAINED) ESCAPE RESPIRATORS STANDARD TEST PROCEDURE (STP)

1. PURPOSE

- 1.1. This procedure establishes the actions required for the Durability Conditioning Process for Environmental, Transportation and Rough Handling Conditions on the chemical, biological, radiological, and nuclear (CBRN) (air-purifying or self-contained) escape respirators.
- 1.2. The purpose of this test is to subject the CBRN escape respirator (ER) to a series of environmental, transportation, and rough handling conditions in order to test the items for durability. The anticipated primary application of CBRN ER is use by the general worker population exiting from an enclosed contaminated atmosphere such as an office building following a CBRN terrorist attack. Another anticipated user group is the multidiscipline emergency responders including emergency medical technicians, law enforcement officers and ambulance crews who will most likely store the CBRN ER in vehicle compartments. The environmental and transportation challenge tests represent conditions that a CBRN ER may experience from the point of issue that is induced by the user. The conditioning procedures described herein are not intended to assess manufacturers' packaging, handling and shipping practices but to test the CBRN ER for design and unit packaging integrity and to ensure that the user receives a durable product that will provide adequate respiratory protection. Because of the one-time use application and thus the inability of the users to perform annual inspections on the CBRN ER, it is imperative to ensure that integrity is integral to the design and unit packaging of the CBRN ER.

2. GENERAL

- 2.1. This STP describes the Durability Conditioning Process for Environmental, Transportation and Rough Handling Conditions (Drop Test) of the Chemical, Biological, Radiological, and Nuclear (CBRN) (air-purifying or self-contained) Escape Respirator in sufficient detail that a person knowledgeable in the appropriate technical field and MIL-STD-810 (E or F) can select equipment with the necessary resolution and conduct the conditioning in accordance with the requirements of this procedure and MIL-STD-810 (E or F).

Approvals:	<u>1st</u> Level	<u>2nd</u> Level	<u>3rd</u> Level
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3. EQUIPMENT AND MATERIALS

3.1. Test Equipment

3.1.1. Environmental and Transportation Conditions

3.1.1.1. High Temperature: The test facility shall comply with the requirements stated in *MIL-STD-810F, Method 501.4*, Section 4.1. or equivalent.

3.1.1.2. Low Temperature: The test facility shall comply with the requirements stated in *MIL-STD-810F, Method 502.4*, Section 4.1. or equivalent.

3.1.1.3. Humidity: The test facility shall comply with the requirements stated in *MIL-STD-810E, Method 507.3*, Section II-1.1. or equivalent.

3.1.1.4. Vibration: The test facility shall comply with the requirements stated in *MIL-STD-810F, Method 514.5*, Section 4.1. or equivalent. The vibration test surface shall have a wood containment fixture with adjustable wooden slats or separator fencing to keep the items individually contained and from falling off the test surface. A mechanical drawing is provided in Appendix A, illustrating one such possible design of the containment fixture. There shall be a minimum of 1.27 cm (0.5 in) space between the test items and the separator fencing.

3.1.2. Rough Handling Drop Test

3.1.2.1 Tape measure graduated in specific increments.

3.1.2.2 Bare concrete floor (no tile or carpeting).

3.1.3. Figures 1, 2 and 3 illustrate a temperature humidity chamber that can be used for the high temperature, low temperature and humidity environmental challenge tests. Figure 4 illustrates a vibration control system. Both of these systems meet the requirements of *MIL-STD-810(E or F)*. Contained in Appendix B: Environmental and Vibration Challenge Test Equipment List, is a list indicating test equipment, model numbers, and manufacturers; however, other test equipment and sources may be used provided the equipment meets the requirements of *MIL-STD-810*.



Figure 1. Temperature humidity chamber (storage area)



Figure 2. Temperature humidity chamber and control panel



Figure 3. Control panel for temperature humidity chamber



Figure 4. Vibration control system with 4 x 4 foot vibration table

3.2. Required CBRN ER Test Items

- 3.2.1. If the CBRN ER is an air-purifying type, 125 ER are required for this test with a minimum of 6 ER that anatomically fit the medium head size of the SMARTMAN manikin (manufactured by ILC Dover, Frederica, DE).
- 3.2.2. If the CBRN ER is a self-contained type, six (6) medium size ER that anatomically fit the medium head size of the SMARTMAN manikin (Manufactured by ILC Dover; Frederica, DE) are required for this test.

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. Prior to beginning any testing, all test facilities, equipment and conditions must comply with the requirements of *MIL-STD-810 (E or F)* or equivalent.
- 4.3. Normal laboratory safety practices must be observed. This includes safety precautions described in the current *Centers for Disease Control and Prevention (CDC) General Laboratory Health and Safety Manual* or site-specific procedures that are applicable to the health and safety requirements.
 - 4.3.1. Safety glasses, lab coats, and hard-toe shoes must be worn at all times.
 - 4.3.2. All test equipment shall be in a safe operating condition, and the test administrators shall comply with all equipment safety operating procedures.

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. This procedure describes the conditioning sequence that the CBRN ER must undergo before conducting the performance tests required by *42 CFR Part 84*, the *Statement of Standard for Chemical, Biological, Radiological and Nuclear (CBRN) Air-Purifying Escape Respirator*, September 30, 2003 and the *Statement of Standard for Chemical, Biological, Radiological and Nuclear (CBRN) Self- Contained Escape Respirator*, September 30, 2003. This STP outlines the sample size, *MIL-STD-810(F or E) Test Method*, duration, sequence and package configuration for testing the CBRN ER. The CBRN ER shall be subjected to the high temperature, low temperature, humidity, vibration and drop tests in the unit Minimum Packaging Configuration as recommended by the manufacturer.

5.2. Minimum Packaging Configuration

The applicant shall submit either 125 CBRN air-purifying ER or 6 CBRN self-contained ER (see Section 3.2. for respirator size requirements) for the laboratory durability conditioning process test. The ER submitted for this test by the applicants shall be exposed sequentially to high temperature, low temperature, humidity, vibration and drop tests. The CBRN ER shall be tested in the individual package Minimum Packaging Configuration. The tests represent environmental, transportation and rough handling conditions that the items may be subjected to while in the possession of the user. The manufacturer will provide the CBRN ER in their unit packaging, in their Minimum Packaging Configuration. The Minimum Packaging Configuration is the operational packaging state prior to use, such that immediately upon opening allows the user to don the respirator.

5.3. Test Items

Indicate on the General Information Data Sheet contained in Appendix C: Durability Test Data Sheets, the following information about the applicant and their CBRN ER system:

- NIOSH application number:
- Name of manufacturer:
- Model number of CBRN ER:
- Type of CBRN ER (air-purifying or self-contained):
- Date arrived:
- Date of Test:
- General condition of packaging:
- Appearance of CBRN ER:
- Any specific physical anomalies:
- Type of test being conducted:

The Appendix C: Durability Test Data Sheets consists of the following three sections: General Information, Test Incident Report, and Environmental and Transportation

Conditioning and Rough Handling Data Sheets. The General Information Data Sheet is to document basic information about the applicant and their CBRN ER system and to indicate test initiation and termination dates and times. The purpose of the Test Incident Report is to document any equipment failure or alteration to the procedure resulting from an unforeseen, external event such as an electrical power outage, storm, etc. and to document the corrective action taken. The purpose of the Environmental and Transportation Conditioning and Rough Handling Data Sheet is to document the condition of the test item after subjecting the item to each durability test challenge.

5.4. Number Test Items

All test items shall be individually numbered with an indelible pen in 2 places or a single tag in a sequence so that the number can be traced to the NIOSH application number, manufacturer, model number and the test items can be tracked throughout the series of tests. For example, the ER can be ER1A1, ER2A1, ER3A1 meaning escape respirator applicant 1, escape respirator applicant 2, etc.

5.5. Environmental, Vibration and Rough Handling Conditioning

Test initiation and termination dates and times shall be recorded on the General Information Data Sheet for all test conditions and test items: high temperature, low temperature, humidity, vibration and drop tests. After each of the environmental challenges, vibration challenges and drop tests, the condition of the test items shall be indicated on the Environmental and Transportation Conditioning and Rough Handling Data Sheet.

5.5.1. For the environmental conditioning, the test facility controls and testing procedures shall be in compliance with *MIL-STD-810F*. The temperature and humidity tests conducted in the environmental conditioning shall be conducted in accordance with the procedures classified under storage.

5.5.2. High Temperature, *MIL-STD-810F*, *Method 501.4*

5.5.2.1. Place the required quantity (See Section 3.2.) of CBRN ER per application, in the high temperature chamber.

5.5.2.2. Adjust the chamber settings to 71°C (160°F) constant high temperature exposure per *MIL-STD-810F*, *Method 501.4*. The rate of temperature change shall not be greater than 3°C (6°F) per minute to prevent thermal shock to the test items. Humidity control is not necessary for this particular high temperature test.

5.5.2.3. Once the chamber has stabilized to 71°C (160°F), test items shall remain exposed for 5 weeks.

5.5.2.4. At the completion of the 5 week storage period, adjust the chamber air temperature to controlled ambient conditions and maintain until temperature stabilization of the test item has been achieved.

- 5.5.2.5. Conduct a complete visual checkout of the test items and record results and any specific physical anomalies on the Environmental and Transportation Conditioning and Rough Handling Data Sheets.
- 5.5.2.6. Next the items will be subjected to low temperature storage.
- 5.5.3. Low Temperature, *MIL-STD-810F, Method 502.4*
 - 5.5.3.1. Place the CBRN ER in the low temperature test chamber per application.
 - 5.5.3.2. Adjust the chamber temperature setting to -31°C (-24°F) constant temperature exposure per *MIL-STD-810F, Method 502.4, Basic Cold (CI)*. The rate of temperature change shall not be greater than 3°C (6°F) per minute to prevent thermal shock to the test items.
 - 5.5.3.3. Once the temperature has stabilized, test items shall remain exposed to -31°C (-24°F) for 72 hours.
 - 5.5.3.4. At the completion of the last cycle, adjust the chamber air temperature to controlled ambient conditions and maintain until temperature stabilization of the test item has been achieved.
 - 5.5.3.5. Conduct a complete visual checkout of the test items and record results and any specific physical anomalies on the Environmental and Transportation Conditioning and Rough Handling Data Sheets.
 - 5.5.3.6. Next the items will be subjected to humidity storage.
- 5.5.4. Humidity, *MIL-STD-810E, Method 507.3*
 - 5.5.4.1. Place CBRN ER in the humidity test chamber per application.
 - 5.5.4.2. Adjust the chamber temperature setting to replicate the temperature and humidity conditions of a natural diurnal humidity cycle per *MIL-STD-810E, Method 507.3, Table 507.3-I, Natural, Hot-Humid, (Cycle 1)*. The rate of temperature change shall not be greater than 3°C (6°F) per minute to prevent thermal shock to the test items.
 - 5.5.4.3. Once temperature and humidity has stabilized as defined by the natural diurnal humidity cycle per *MIL-STD-810E, Method 507.3, Table 507.3-I, Natural, Hot-Humid (Cycle 1)*, the test items shall remain exposed for 5 days as defined in Table 507.3-II, Natural, Cycle 1, Quick Look.
 - 5.5.4.4. At the completion of the last cycle, adjust the chamber air temperature and relative humidity to controlled ambient conditions and maintain until temperature and humidity stabilization of the test item has been achieved.

5.5.4.5. Conduct a complete visual checkout of the test items and record results and any specific physical anomalies on the Environmental and Transportation Conditioning and Rough Handling Data Sheets.

5.5.4.6. Next the items will be subjected to vibration conditioning.

5.5.5. Vibration Conditioning, *MIL-STD-810F, Method 514.5*

5.5.5.1. For the vibration conditioning, the vibration control system shall use a containment fixture illustrated in Appendix A to segregate the test items from one another. The testing procedures shall be in compliance with *MIL-STD-810F, Method 514.5*.

5.5.5.2. Fasten the containment fixture on the vibration table of the vibration control system.

5.5.5.3. The items shall be vibrated along the transverse, longitudinal and vertical axes. It may be necessary to orientate the test items in order to test all three of the axes. Figure 5 is an illustration of the axes of vibration.

5.5.5.4. Place the CBRN ER in the transverse position in the individual compartments of the containment fixture. Adjust the sideboards and dowel-rods of the containment fixture if necessary so there is a minimum of 1.27 cm (0.5 inch) space around the perimeter of the test item.

5.5.5.5. Adjust the setting of the vibration machine to replicate the vibration to be in accordance with *MIL-STD-810F, Method 514.5, Annex A, Category 4, Section 2.2.1.c.1, Truck Transportation Over U.S. Highways*.

5.5.5.6. The test items shall be vibrated for 12 hours in the transverse position.

5.5.5.7. When the items have been vibrated for 12 hours in the transverse position, rotate the items to the longitudinal position. Adjust the sideboards and dowel-rods of the containment fixture if necessary so there is a minimum of 1.27 cm (0.5 inch) space around the perimeter of the test item.

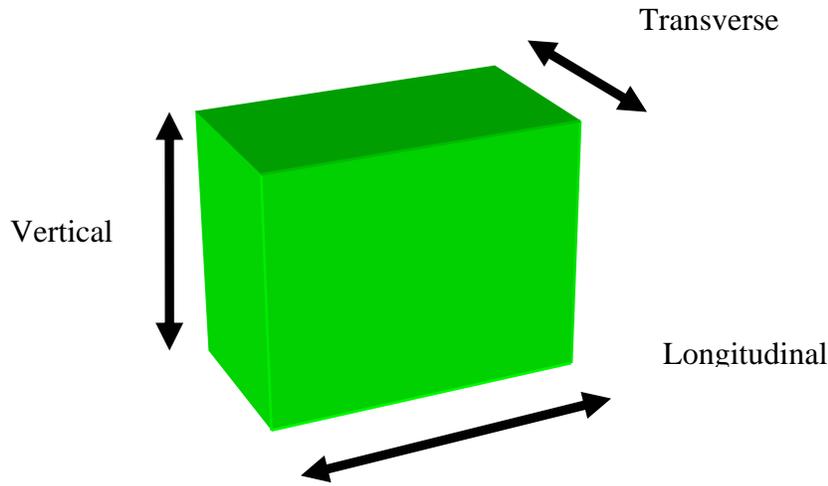


Figure 5. Axes of vibration

- 5.5.5.8. Adjust the setting of the vibration machine to replicate the vibration to be in accordance with *MIL-STD-810F, Method 514.5, Annex A, Category 4, Section 2.2.1.c.1, Truck Transportation Over U.S. Highways*.
- 5.5.5.9. The test items shall be vibrated for 12 hours in the longitudinal position.
- 5.5.5.10. When the items have been vibrated for 12 hours in the longitudinal position, rotate the items to the vertical position. Adjust the sideboards and dowel-rods of the containment fixture if necessary so there is a minimum of 1.27 cm (0.5 inch) space around the perimeter of the test item.
- 5.5.5.11. Adjust the setting of the vibration machine to replicate the vibration to be in accordance with *MIL-STD-810F, Method 514.5, Annex A, Category 4, Section 2.2.1.c.1, Truck Transportation Over U.S. Highways*.
- 5.5.5.12. The test items shall be vibrated for 12 hours in the vertical position.
- 5.5.5.13. Conduct a complete visual checkout of the test items and record results of any specific physical anomalies on the Environmental and Transportation Conditioning Data Sheets.
- 5.5.5.14. Next perform the rough handling drop test on the CBRN ER.
- 5.5.5.14.1. If the rough handling drop test is going to be performed at a different location, adequately package the CBRN ER test

items so shipping does not induce any damage and deliver them to the specified address for additional testing.

5.6. Rough Handling Drop Test

- 5.6.1. The rough handling drop test shall be performed on the CBRN ER test items that were previously subjected to the environmental and vibration conditions. The CBRN ER shall be drop tested in their individual packaging container. The rough handling drop test consists of dropping each test item on all three axes one time. The rough handling drop test initiation and termination dates and times for all test items shall be recorded on the General Information Data Sheet. After each CBRN ER is dropped, the orientation of drop, location of impact on the package and resulting condition shall be documented on the Environmental and Transportation Conditioning and Rough Handling Data Sheet for each of the 3 axes. The three axes of drop for each test item is illustrated in Figure 6.

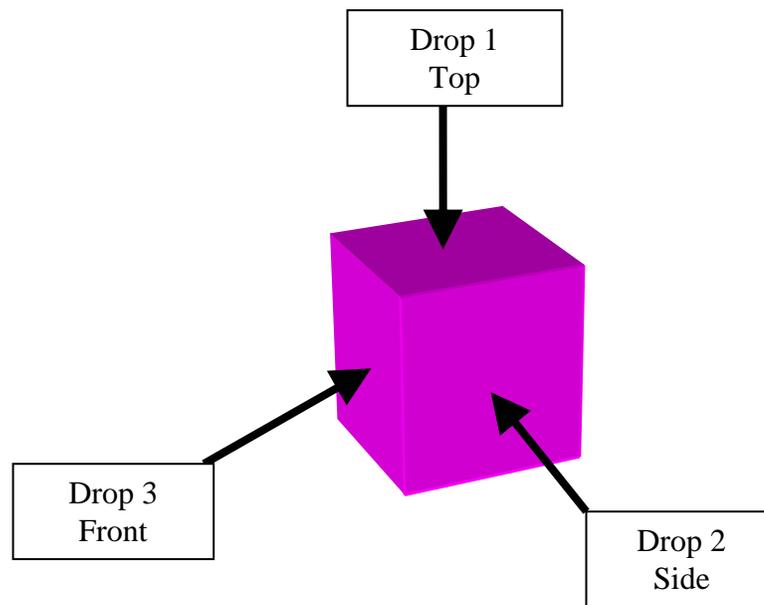


Figure 6. Axes of Impact

NOTE: If the CBRN ER are in a nontransparent packaging container, mark the location of Drop 1, Drop 2 and Drop 3 on the unit packaging and the Environmental and Transportation Conditioning Data Sheets.

- 5.6.2. Each CBRN ER test items shall be dropped on the 3 axes as illustrated in Figure 6 from a height of 0.9144 meters (3 feet).
- 5.6.3. For Drop 1, orientate a CBRN ER test item so the top surface will impact the concrete surface while positioning it so the lowest point of the test item is at the 0.9144 meters (3 feet) elevation mark; in other words, maximize the height of the test item.

- 5.6.4. Release the test item and after impact, conduct a complete visual checkout of the test item. Record on Environmental and Transportation Conditioning Data Sheets the test item number, impact surface (top) and any specific physical anomalies. The next step is to conduct drop 2 on the same test item.
- 5.6.5. For drop 2, orientate a CBRN ER test item so the side surface will impact the concrete surface while positioning it so the lowest point of the test item is at the 0.9144 meters (3 feet) elevation mark; in other words, maximize the height of the test item.
- 5.6.6. Release the test item and after impact, conduct a complete visual checkout of the test item. Record on Environmental and Transportation Conditioning Data Sheets the impact surface (side) and any specific physical anomalies. The next step is to conduct drop 3 on the same test item.
- 5.6.7. For drop 3, orientate a CBRN ER test item so the front surface will impact the concrete surface while positioning it so the lowest point of the test item is at the 0.9144 meters (3 feet) elevation mark; in other words, maximize the height of the test item.
- 5.6.8. Release the test item and after impact, conduct a complete visual checkout of the test item. Record on Environmental and Transportation Conditioning Data Sheets impact surface (front) and any specific physical anomalies.
- 5.6.9. Drop test the remainder of the CBRN ER test items by repeating steps indicated in Sections 5.6.3. through 5.6.8 of this STP.
- 5.6.10. Adequately package the drop-tested CBRN ER in multiple over-pack boxes so shipping does not induce any damage to the test items and deliver them to the specified address. The point of contact in the NIOSH, National Personal Protective Technology Laboratory Division, Respirator Branch, Certification, Evaluation, and Testing (CET) Section will provide the shipping address at the appropriate time.

6 PASS OR 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)*.
- 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.

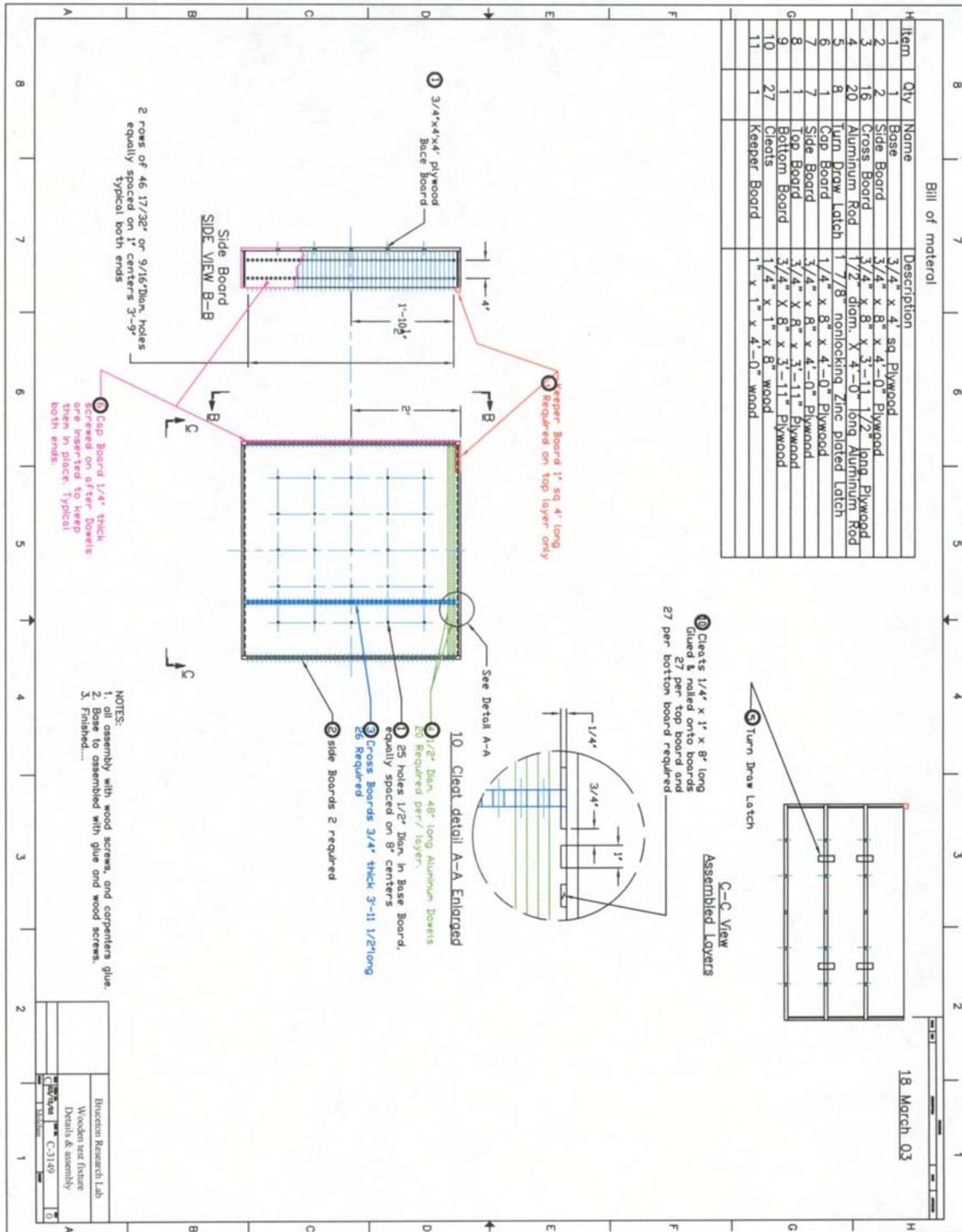
The ready-to-use configuration CBRN ER shall be subjected to additional NIOSH performance tests described in *Title 42 Code of Federal Regulations (CFR) Part 84, the Statement of Standard for Chemical, Biological, Radiological and Nuclear (CBRN) Air-Purifying Escape Respirator*, September 30, 2003 and the *Statement of Standard for Chemical, Biological, Radiological and Nuclear (CBRN) Self-Contained Escape Respirator*, September 30, 2003. The pass or fail criteria for these test items have been established in the applicable *Title 42 CFR 84, the Statement of Standard for Chemical, Biological, Radiological and Nuclear (CBRN) Air-Purifying Escape Respirator*, September 30, 2003 and the *Statement of Standard for Chemical, Biological, Radiological and Nuclear (CBRN) Self-Contained Escape Respirator*, September 30, 2003.

7. RECORDS AND TEST DATA SHEETS

- 7.1. All test data shall be recorded on the Environmental and Transportation Conditioning Data Sheets.
- 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 CET Section Team 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 the Test Operator and the CET Section Team 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 Respirator Branch Chief or designee, following the standard operating procedures outlined in the *Procedure for Scheduling, and Processing Post-Certification Product Audits, RB-SOP-0005-00*

APPENDIX A

Containment Fixture Drawing



APPENDIX B**Environmental and Vibration Challenge Test Equipment List**

<u>ITEM</u>	<u>MDL #</u>	<u>S/N</u>	<u>DATE CALIBRATED</u>
Unholtz-Dickie Corp. Vibration Test System, Electrodynamic, with Accessories	289		
Russells Technical Products Temp/Humidity Chamber with Research, Inc. Micristar Controller	RDV100-705 828E		
Spectral Dynamics Vibration Control System on Sun Sparc Station 4	2550		
Ling Dynamic Systems Vibration System W/ components	V-964LS		
Envirotronics Temp/ Humidity Chamber w/Research, Inc. Micristar Controller/ Honeywell Truline Chart Recorder	EVH-100-2-705 828-E11 910-80714		
Spectral Dynamics Vibration Control	2550		
System on Sun Sparc Station 4	386		
Elliott Williams Chamber W/Systems Plus Controller And Honeywell Truline Chart Recorder (Walkin6)	91428414-		
PCB Accelerometer	308B		
PCB Accelerometer	308B		

APPENDIX C
Durability Test Data Sheets

General Information Data Sheet

NIOSH application number: _____

Name of manufacturer: _____

Model number of CBRN ER: _____

Type of CBRN ER: (air purifying or self-contained): _____

Date arrived: _____

Test Date: _____

General condition of packaging: _____

Appearance of CBRN ER and canisters (if applicable): _____

Any specific physical anomalies: _____

Type of test being conducted: _____

Test operator signature: _____
Date: _____

Laboratory Supervisor signature: _____
Date: _____

**ENVIRONMENTAL/TRANSPORTATION/ROUGH HANDLING:
TEST DATES AND TIMES**

High Temp: Start Date and Time _____; End Date and Time _____
Items Tested: _____

(If Applicable: In case 2 sets of Test Items are Tested at Different Times)
High Temp: Start Date and Time _____; End Date and Time _____
Items Tested: _____

Low Temp: Start Date and Time _____; End Date and Time _____
Items Tested: _____

(If Applicable; In case 2 sets of Test Items are Tested at Different Times)
Low Temp: Start Date and Time _____; End Date and Time _____
Items Tested: _____

Humidity: Start Date and Time _____; End Date and Time _____
Items Tested: _____

(If Applicable; Incase 2 sets of Test Items are Tested at Different Times)
Humidity: Start Date and Time _____; End Date and Time _____
Items Tested: _____

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

(If Applicable; Incase 2 sets of Test Items are Tested at Different Times)
Vibration: Start Date and Time _____; End Date and Time _____
Items Tested: _____

Drop: Start Date and Time _____; End Date and Time _____
Items Tested: _____

(If Applicable; Incase 2 sets of Test Items are Tested at Different Times)
Drop: Start Date and Time _____; End Date and Time _____
Items Tested: _____

Test Incident Report			
DATE:	TIME:	TIR #:	UNIT #:
TEST NAME:			
TEST LOCATION:			
TEST ENGINEER ON SITE:			
DESCRIBE TEST INCIDENT:			
STATE CORRECTIVE ACTION:			
DAMAGE TO EQUIPMENT (IF ANY)			
NAME:	COMPANY:		
TELEPHONE#/FAX OR EMAIL:	DATE/TIME NOTICE SENT:		
NAME:	COMPANY:		
TELEPHONE#/FAX OR EMAIL:	DATE/TIME NOTICE SENT:		

Revision History

Revision	Date	Reason for Revision
0	20 September 2004	Historic document
1.1	12 December 2005	Update header and format No changes to method