Durability Testing of CBRN Powered Air-Purifying Respirators (PAPR)

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Durability Testing Includes:
Environmental, Transportation and Rough Handling

- Purpose/Goal
- Assumptions
- Types of Tests and Conditions of PAPR
  - Minimum Packaging Configuration (MPC)
  - Battery to undergo Environ & Trans in MPC
- Rationale for the Test
Purpose/Goal

**Purpose of Tests:** Perform environmental storage, transportation shock and drop tests on the CBRN PAPR to qualify durability and to detect any initial life cycle failures that may occur from typical use.

**Goal:** To ensure CBRN PAPR provides adequate respiratory protection after being subjected to normal environmental storage, transportation and rough handling conditions by the user.
Assumptions

- Tests represent conditions induced by the user that a CBRN PAPR may experience from the point of issue.
- Maintenance and inspection shall be performed IAW applicable Department of Labor, OSHA Title 29 CFR 1910.134(h).
- Non-industrial use scenario – for CBRN emergency use only.
Assumptions (Continued)

- Test conditions tailored to realistic U.S. meteorological weather conditions, U.S. roadway transportation conditions and typical first responder use rough handling conditions (i.e., not worst case).

- Potential for PAPR to experience these U.S. conditions by some users (i.e. car trunk vs. police station).

- Tests not intended to represent entire life cycle but rather to identify potential initial life cycle failures.

- Mil-Spec 810-F used as principle guidance document.
Types of Durability Tests

- PAPR, Battery and Canisters
  - High Temperature
  - Low Temperature
  - Humidity
  - Vibration

- Canisters only
  - Rough Handling/Drop Test

- IAW, CBRN PAPR Gas Service Life, Filtration (P100) and Filtration (P100) after Cyclohexane (OV)
  - IAW CBRN PAPR Performance Requirements
Test Conditions of PAPR

- CBRN PAPR and Canisters will be subjected to the test conditions in the Minimum Packaging Configuration (MPC) as recommended by the manufacturer in User Instructions.

- Batteries will be conditioned in the MPC:
  - Immediately after Durability in ambient conditions, conditioned batteries will be installed in PAPR and PAPR is required to be functional (No Time Limit).
  - Batteries will be Recharged/Replaced after functional testing and before performing the subsequent GB and HD testing.
Minimum Packaging Configuration

1. Minimum Packaging Configuration (MPC) is the protective packaging that *End User* shall store or maintain the PAPR and components inside after issue.

2. The User's Instructions (UI) shall identify the MPC and shall direct the *End User* how to store or maintain the PAPR and the components while in their possession.

3. The level of MPC, if any, is left to the discretion of PAPR manufacturer.

4. Over cases, packaging or shipping containers provided by Mfgrs over MPC will not be used in Durability Testing.
End User:

-- The person who will derive protection from the PAPR by wearing it
-- It is assumed the end user will be responsible for PAPR storage
Environmental Storage

1. High Temperature
   - Mil-Std-810F, Method 501.4, Table 501.4-II, Hot-Dry Diurnal Cycle, Hot-Induced Conditions 35°C (95°F) to 71°C (160°F), 24 Hour Cycle, 3 Weeks

2. Low Temperature
   - Mil-Std-810F, Method 502.4, Basic Cold, Constant Temperature at –31°C (–24°F), 3 Days (72 Hours)

3. Humidity
   - Mil-Std-810E, Method 507.3, Figure 507.3-I (cycle 1), Natural Diurnal Humidity Cycle, 5 Days
     ("quick look")
     (range 88°F @ 88% RH – 105°F @ 59% RH, 24 hr period)
Transportation

Vibration

MIL-STD-810F, Method 514.5, Vibration, Annex A, Category 4, Over U.S. Highways, 60 minutes per 1,000 miles of road travel per axis, 3 Axis, 12 Hours per axis (36 hours total = 12,000 miles), Unrestrained
Rough Handling: Drop Test (Canisters Only)

Drop 3 feet onto a concrete surface; Each canister dropped once; a canister is dropped once on one of the following axes:

1. Major axis vertical, air outlet port.
2. Major axis horizontal.
3. Major axis vertical, air inlet port.
Rationale for the Test

High Temperature: Simulates storage in trunk of vehicle; Induced conditions: solar loading/diurnal profile representative of southwest U.S. climates; Duration based on prior RDECOM (Formerly SBCCOM) experience with mask testing

Low Temperature: Representative of minimum temperature in U.S. intermediate zones per Mil-Std-810F (Basic Cold); Duration is minimum 810F recommended exposure period

Humidity: Represents natural temperature humidity profile in humid regions of U.S. per Mil-Std-810F; Duration is minimum Mil-Std-810F recommended exposure period

Vibration: Simulates vehicle transport of total of 12,000 miles on U.S. roadways in an unrestrained configuration

Rough Handling: Simulates drop or fall from vehicle or table-top
Durability Testing

Issues, Testing & Timelines

- Issues:
  - Battery Survivability
  - Containment Fixture Size
  - Test Procedures

- Testing:
  - Bench Mark Testing: 4 to 5 PAPR/ *Mfgr
  - Verification Test: 4 to 5 PAPR/ *Mfgr

- Timelines:
  - Complete Bench Mark Testing: Jul 2004
  - Complete Verification Testing: Oct 2004

- Minimum of 3 Manufacturers
## Durability Test Matrix

<table>
<thead>
<tr>
<th>Test Method</th>
<th>Test Condition</th>
<th>Duration</th>
<th>Pass/Fail Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIL-STD-810F 501.4</td>
<td>Hot Diurnal</td>
<td>3 Weeks</td>
<td>PAPR, Battery and Canisters</td>
</tr>
<tr>
<td>MIL-STD-810F 502.4</td>
<td>Cold Constant</td>
<td>3 Days</td>
<td>NIOSH CBRN PAPR Applicable</td>
</tr>
<tr>
<td>MIL-STD-810E 507.3</td>
<td>Humidity</td>
<td>5 Days &quot;quick look&quot;</td>
<td>NIOSH CBRN PAPR Applicable</td>
</tr>
<tr>
<td>MIL-STD-810E 514.5</td>
<td>Transportation Vibration</td>
<td>12 hours/axis, 3 Axes</td>
<td>Gas Service Life, Filtration (P100), and Filtration After OV Gas Life</td>
</tr>
</tbody>
</table>

### Test Conditions

- **Mil-Std-810F**
  - 501.4: Hot Diurnal
  - 502.4: Cold Constant
  - 507.3: Humidity
  - 514.5: Transportation Vibration

### Duration

- 3 Weeks Diurnal Cycle
- 24 Hour cycle
- Basic Cold, -32°C
- U.S. (range 88°F @ 59%RH, 24 hr period)
- U.S. Roadway Vibration, Unrestrained

### Pass/Fail Threshold

- PAPR, Battery and Canisters
- NIOSH CBRN PAPR Applicable

### NOTE:

Batteries in MFC as indicated by Users Instructions.