

National Personal Protective Technology Laboratory

Benchmark Testing for CBRN, Full-Facepiece, Closed-Circuit, Self-Contained Breathing Apparatus (SCBA)

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CBRN Respirator Standards

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Benchmark Tests Conducted

- Laboratory Respiratory Protection Level (LRPL)
- Heat and Flame
- Accelerated Corrosion Resistance
- Particulate Resistance



Laboratory Respiratory Protection Level (LRPL)

- **Procedures**

- Existing NIOSH CBRN LRPL Tests (RB-CET-STP-CBRN-0352)
- Tests conducted by US Army Edgewood Chemical Biological Center
- Used equipment from 2 manufacturers
- 8-Subjects / 2-Trials
 - 2 each - Manufacturer A's apparatus
 - 2 each - Manufacturer A's face piece w/ filter adapter
 - 2 each – Manufacturer B's apparatus
 - 2 each- Manufacturer B's face piece w/ filter adapter



LRPL

- **Pass/Fail Criteria**
 - Full System $\geq 10,000$
 - w/ Filter adapter ≥ 500
- **Exercises (1-minute each)**
 - Normal breathing
 - Deep breathing
 - Turn head side to side
 - Move head up and down
 - Recite the rainbow passage or equivalent
 - Sight a mock rifle
 - Reach for floor and ceiling
 - On hands and knees, look side to side
 - Facial grimace
 - Climb stairs at regular pace
 - Normal breathing



LRPL

- **Results**

- One subject with the filter adapter did not pass the LRPL of 500 because their hairline was in the periphery. It was a one size fits all mask so no resizing could be done.

- **Conclusions**

- Current CC-SCBAs pass existing LRPL tests.



Heat and Flame Resistance

- **Treatment**

- Section 8.11.5 of NFPA 1981, 2002 Edition
 - Exposed to 95°C for 15-minutes
 - Exposed to direct flame contact for 10-seconds
 - Raised 150 mm and dropped freely
 - Note: Tests conducted without live oxygen cylinder
- Tests conducted at Intertek Testing Services
- Used equipment from 2 manufacturers
- 2 CC-SCBAs were tested



Heat and Flame Resistance

- **Problems noted**
 - After flame beyond 2.2 seconds at:
 - Hose
 - Harness
 - Facepiece hose connector
 - Hole burnt through the hose
 - Hole burnt through the facepiece hose connector
 - Backpack fell off the mannequin
 - Bypass valve was fused shut
 - Oxygen bottle strap was burnt through
- **Note: Existing CC-SCBAs were used but were not hardened for heat or flame test. We anticipated problems and that is why live oxygen cylinders were not used.**



Heat and Flame Resistance

- **ABMS Testing Results after retrofitting CC-SCBAs:**
 - Unit #1
 - No difference from untreated units.
 - Test terminated at 240 minutes, empty.
 - Unit #2
 - No difference from untreated units.
 - Test terminated at 167 minutes, empty.
 - Conclusions: Heat and flame treatment did not adversely affect the performance.



Accelerated Corrosion Resistance

- **Treatment**
 - MIL-STD 810F, Environmental Test Methods, Method 509.4, Salt Fog
- **Test Conditions**
 - 24-hours at 5% \pm 1% salt fog
 - 24-hours in drying chamber set at 35°C \pm 2°C
 - Run 2-cycles
 - 2 CC-SCBAs (from different manufacturers) were tested



Accelerated Corrosion Resistance

- **Results**

- No damage to the control and operating features.
- ABMS Test Protocol – no difference from untreated units.



Particulate Resistance

- **Treatment**

- MIL-STD-810F, Method 510.4, Procedure 1 – Blowing Dust with modified NPFA 1981 Test Procedures:

- CC-SCBA was not rotated during the test because it was attached to a headform in lieu of the torso or mannequin. This was done to minimize the trachea tube length between ABMS and CC-SCBA.

- **Test Conditions**

- Air velocity: $533.4\text{m/min} \pm 76.2\text{ m/min}$
 - Temperature: $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$
 - Operated ABMS at Workload B – 40 liters/minute (Table 2.a in Concept Paper)
 - 2 CC-SCBAs (from different manufacturers) were tested



Particulate Resistance

- **Results**
 - No difference from untreated units.



Remaining Benchmark Testing

- Chemical Agent Permeation and Penetration Resistance Against HD and GB
- Environmental Temperature Operational Performance
- Vibration Endurance
- Communications Performance
- Facepiece Lens Haze, Luminous Transmittance and Abrasion Resistance
- Fabric Flame Resistance
- Fabric Heat Resistance
- Thread Heat Resistance



Questions

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