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National Personal Protective Technology Laboratory

Concept Standard for CBRN, Full Facepiece, Closed Circuit, Self-Contained Breathing Apparatus (SCBA)

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CBRN Respirator Standards

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Purpose

- **To discuss the Special Requirements and updates of the Concept Standard:**
 - Chemical warfare agent permeation and penetration resistance requirement
 - Laboratory respiratory protection level (LRPL) test requirement

Requirements from Relevant Sections of NFPA 1981, 2002 Edition and Updates

- Environmental temperature operational performance
- Vibration endurance
- Fabric flame resistance
- Fabric heat resistance
- Thread heat resistance
- Accelerated corrosion resistance
- Particulate resistance
- Facepiece lens haze, luminous transmittance & abrasion
- Communication performance
- Heat and flame operational performance

Environmental temperature operational performance requirement

- **Requirement update:**
 - Waive the Wet-bulb temperature breathing gas requirement of ≤ 50 °C in Table 1.
- **Test method:**
 - Test conditions the same
- **Rationale:**
 - Extended temperature soaking periods and test temperatures of the CC-SCBA

Vibration endurance requirement

- **Requirement :**

- Updated requirement changed the vibration profile from the U.S. Highway Truck Vibration profile to the vibration profile specified in NFPA 1981, 2002 Edition

- **Test method update:**

- Updated method changed to use applicable sections NFPA 1981, 2002 Edition, Section 8.3

- **Rationale:**

- Require the same Rough Handling Requirement for both Open and Closed Circuit SCBAs

Fabric flame resistance requirement

- **Requirement the same:**
 - Fabric average char length \leq 4 inches
 - Fabric average after flame \leq 2 seconds
- **Test method update:**
 - Updated method to use ASTM D 6413, Standard Test method for Flame Resistance of Textiles (Vertical Test)
- **Rationale:**
 - Federal Test Method Standard 191A Method 5903.1; Flame Resistance of Cloth is being phased out and replaced by ASTM D 6413

Fabric heat resistance requirement

- **Requirement the same:**
 - Fabric shall not melt or ignite
- **Test method update:**
 - Updated method to use NFPA 1981, 2002 Edition Section 8.5.
- **Rationale:**
 - Same test but better defined by specifying NFPA 1981; in addition, Federal Test Method 191A is being phased out

Thread heat resistance requirement

- **Requirement the same:**
 - Thread shall not melt or ignite
- **Test method update:**
 - Updated method to use NFPA 1981, 2002 Edition Section 8.6.
- **Rationale:**
 - Same test but better defined by specifying NFPA 1981; in addition, Federal Test Method 191A is being phased out

Accelerated corrosion resistance requirement

- **Requirement the Same**

- Required to meet the operational performance requirements of Section 3.1 after being subjected to accelerated corrosion

- **Test method the same**

- MIL-STD 810F, Environmental Test Methods, Method 509.4, Salt Fog
 - 24-hours at 5% \pm 1% salt fog
 - 24-hours in drying chamber set at 35°C \pm 2°C
 - Run 2-cycles

Particulate resistance requirement

- **Requirement the same**

- Required to meet the operational performance requirements of Section 3.1 while being subjected to particular dust

- **Test method the same**

- Note: During Bench-mark testing, the following slight modifications were made to the test procedure:

Apparatus and components were not mounted on a mannequin and the facepiece was mounted on a head-form in one position to minimize the ABMS trachea breathing tube length. (Details will be explained later in the Bench-mark presentation)

Facepiece lens haze, luminous transmittance and abrasion resistance requirement

- Requirement the same:
 - Change in haze $\leq 14\%$
- Test method the same:
 - NFPA 1981, 2002 Edition; Section 8.9.

Communications performance requirement

- **Requirement the same:**
 - Average calculated value $\geq 72\%$

- **Test method the same:**
 - NFPA 1981, 2002 Edition; Section 8.10.

Heat and flame operational performance Requirement

- **Requirement Update:**

- Waive the Wet-bulb temperature breathing gas requirement of ≤ 50 °C in Table 1.

- **Test method the same:**

- Applicable Sections of NFPA 1981, 2002 Edition; Section 8.11
- Technical Challenges: Can't test with loaded O₂, ABMS
Trachea Tube is too long, hard to test in most realistic condition

- **Rationale:**

- Extended temperature soaking periods and test temperatures

Chemical Warfare Agent (CWA) Penetration and Permeation Resistance CWA Test Parameters

- Sarin (GB) and sulfur mustard (HD) challenge vapor concentrations are equivalent to the NIOSH CBRN SCBA Open Circuit Standard
- SMARTMAN upper-torso manikin connected to a NIOSH automated breathing and metabolic simulator (ABMS)

CWA Test Parameters

- **Sarin (GB):**
 - Vapor challenge – 2,000 mg/m³
 - Maximum Breakthrough
 - 0.087 mg/m³ (Fails at 3 Consecutive Peak Readings)
 - 2.1 mg•min/m³ Ct
 - Time agent generated = First 30 minutes
 - Total test time = Applicant's identified duration plus 1 hour (*changed from 6 hours*)
 - Breathing rates = 30 Lpm Standard Temperature and Pressure Dry; 0 °C and 760 mm-Hg (STPD) (*changed from 100 Lpm and 40 Lpm*)

CWA Test Parameters

- **Mustard (HD):**
 - Vapor challenge 300 mg/m³
 - Liquid challenge 0.86 ml
 - Maximum Breakthrough
 - 0.60 mg/m³ (Fails at 3 Consecutive Peak Readings)
 - 6.0 mg•min/m³ Ct
 - Vapor challenge = First 30 minutes
 - Liquid challenge = Applicant's identified duration plus 1 hour (Minimum Service Life)
 - Total test time = Minimum Service Life
 - Breathing rates = 30 Lpm (STPD)

Laboratory Respirator Protection Level (LRPL)

- **Description – Fit-factor corn oil aerosol test**
- **Purpose – Establishes a benchmark level of protection under laboratory conditions**
- **Not intended as an indication of protection in an actual response scenario**

Laboratory Respirator Protection Level (LRPL) Pass / Fail Level

- LRPL \geq 10,000 for each human subject (System)
- LRPL \geq 500 for each human subject (Facepiece)
- Tested with CC-SCBA operating
- Change:
 - Added the Facepiece Test to meet Los Alamos Panel
 - Increased System Test up to a total of 8 SCBA systems: must fit 2 small, 4 medium and 2 large facial sizes

Laboratory Respirator Protection Level (LRPL) Subject Exercises

- 1) Normal breathing
- 2) Deep breathing
- 3) Turn head side to side
- 4) Move head up and down
- 5) Recite the rainbow reading passage or equivalent
- + 6) Sight a mock rifle
- 7) Reach for the floor and ceiling
- + 8) On hands and knees, look side to side
- 9) Facial grimace
- + 10) Climb stairs at a regular pace
- 11) Normal breathing

+ Emergency response exercises

Questions

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