



## Notional Test Protocols

**Methods:** Combination of Unmanned Test Platforms & Human Wear Trials Resulting in a Current Negative Pressure Operational Focus

**Procedures:** Select blend of enhanced and/or actual tests from NIOSH, EN, NFPA, ANSI, ASTM, & Mil-Specs.

### 8 CBRN APR Human Factors:

- ◆ Breathing Resistance
- ◆ Communications
- ◆ Field of View
- ◆ Lens/Visor Optics
- ◆ LRPL/Donning (Systems Test)
- ◆ Lens/Visor Fogging
- ◆ Carbon Dioxide (*as needed*)
- ◆ Hydration (*as needed*)

**Test Agencies:** NIOSH, SBCCOM, & Certified Contract Facilities.



## Breathing Resistance: Notional Protocol

Methods: Per 42 CFR 84.122, 84.203, RCT-APR-STP-0004

Procedure:

- ◆ Headform tests with continuous air flow rate of 85 L/min.

Requirements:

- ◆ Inhalation Resistance w/Mechanical Particulate Filter (P100):

	<u>Face mounted</u>	<u>Non-face mounted</u>
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Initial:	65 mm H <sub>2</sub> O	70 mm H <sub>2</sub> O
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Final:	80 mm H <sub>2</sub> O	85 mm H <sub>2</sub> O
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- ◆ Exhalation : **20 - 26 mm H<sub>2</sub>O** **20-26 mm H<sub>2</sub>O**, 26mm is proposed



## Communications: Notional Test Protocol

Method: Modified NFPA 1981 & ANSI

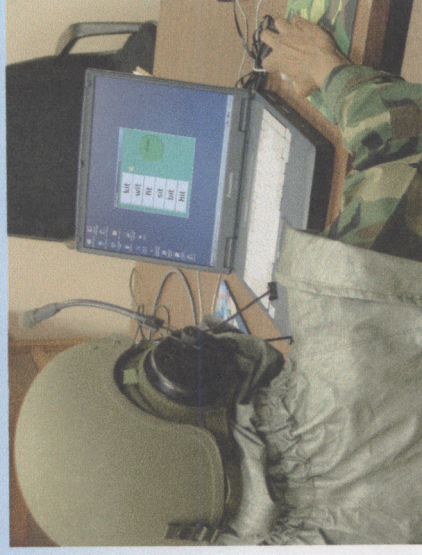
Conditions:

- ◆ Masked and unmasked (control) trials
- ◆ Constant background noise of 60 dB(A)

No. of Test Participants: 3 Listeners & 5 Speakers

Procedure:

- ◆ Modified Rhyme Test (MRT) – phonetically balanced speech intelligibility test.
- ◆ One speaker and 3 listeners per MRT trial (50 stimulus words).
- ◆ Data obtained with and without respirator wear for both speakers and listeners.
- ◆ 10 MRT trials (2 x 5) required to complete test matrix.





## Communications: Notional Test Protocol

### Data Analysis:

- ◆ Listener performance calculated for each MRT trial
  - ◆ % Correct = (# correct – (# incorrect / 5)) x 2
  - ◆ Average individual listener's MRT scores for their masked and unmasked conditions.
  - ◆ Calculate **Performance Rating** scores for each listener

$$\text{Performance Rating} = \frac{\text{Ave MRT Score}_{\text{masked}}}{\text{Ave MRT Score}_{\text{unmasked}}} \times 100$$

- ◆ Average performance ratings of all 3 listeners.

Proposed Requirement: Average **Performance Rating**  $\geq 70\%$

## Vision Testing: Notional Test Protocol

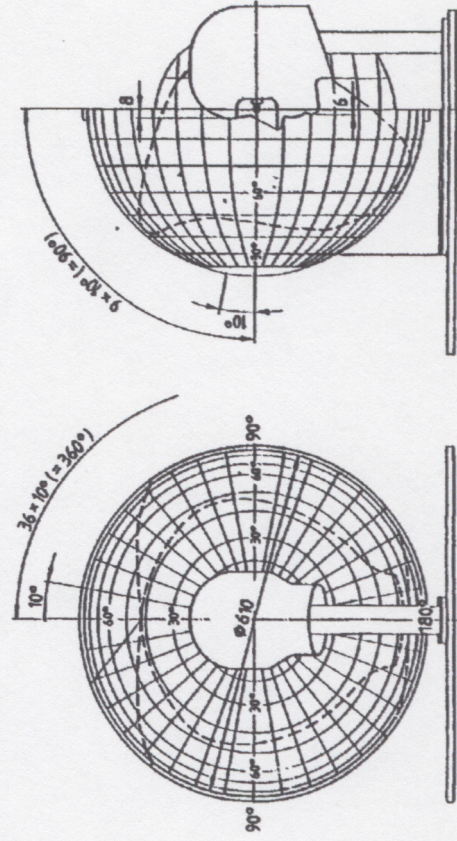
**Methods:** Objective measure of Field of view (FOV)

**Procedure:**

- ♦ Adaptation of EN136, “Full face masks for respiratory protective devices.”
- ♦ FOV assessed methods equivalent to EN136, section 5.8.
- ♦ Express results as a percentage of the area of the ‘natural’ field of vision.

**Proposed Requirement:** EN136, 4.13.3

- ♦ **Visor:** Overall FOV  $\geq 70\%$   
Overlapped FOV  $\geq 80\%$
- ♦ **Dual-lens:** Overall FOV  $\geq 70\%$   
Overlapped FOV  $\geq 20\%$





## Lens Abrasion and Optical Haze: Notional Test

Methods: Per NFPA 1981 6.9, *Facepiece Lens Abrasion Test*

Procedure:

- ◆ Haze tested in accordance with ASTM D1003, *Standard Test Method for Haze and Luminance Transmittance of Transparent Plastics*, with additions.
- ◆ Haze testing of multiple lens samples before and after abrasion.

Requirements:

- ◆ Average delta haze value of all samples  $\leq 14\%$  or  $10\%$ .

## Lens/Visor Fogging: Notional Test Protocol

Method: Human wear trials

Conditions:

- ◆ Cold: minus 21 °C (- 6 °F)
- ◆ Cool & humid: 15.5 °C (60 °F) at 75% RH

No. of Test Participants: 2 per test condition

Procedure:

- ◆ Baseline visual acuity (Snellen eye charts or equivalent)
- ◆ 4 hour respirator environmental conditioning.
- ◆ Respirator donning followed by test of visual acuity.
- ◆ 5 min walk (4.8 km/hr (3 mph)): 2 min rest: 5 min walk: rest
- ◆ Measure visual acuity during rest periods. Outserts evaluated.





## Lens/Visor Fogging: Notional Test Protocol

### Data Analysis:

- ◆ Calculate **Performance Rating** scores for each visual acuity measure obtained during respirator testing.

$$\text{Performance Rating} = \frac{VA_{\text{masked}}}{VA_{\text{unmasked}}} \times 100$$

- ◆ Average performance ratings for each individual subject.

$$\text{Ave PR}_{TP1} = \frac{PR_{\text{don}} + PR_{\text{rest1}} + PR_{\text{rest2}}}{3}$$

Proposed requirement: Average **Performance Rating**  $\geq$  70% or 90% minimum for each environmental condition for each subject.





## Carbon Dioxide Retention: Notional Test

Methods: Per 42 CFR 84.97, RCT-APR-STP-0064, dated 4/26/2001.

Procedure: OPTIONAL Based on Configuration of Application.

- ◆ Adaptation of open-circuit SCBA test for CO<sub>2</sub> in inspired gas.
- ◆ APR headform mounted; CO<sub>2</sub> measured at mouth during inhalation for 3 respiratory cycles. Oxygen concentration  $\geq 19.5\%$ .
- ◆ Exhaled air contains approximately 5% CO<sub>2</sub> concentration.
- ◆ Applicable to secondary neck dam or shrouded neck piece on a non-powered “gas” mask with a tight fitting neck “seal.”

Requirements:

- ◆ Maximum allowable average inhaled CO<sub>2</sub> concentration  $\leq 2\%$  or 4%.
- ◆ Linear deflection plot generated from testing three (3) respirators.



Methods: NIOSH RCT-APR-STP-0014

and US Army CAT Method(s)

Procedures: **OPTIONAL**, Based on Configuration of Application

- Analyze drinking tube leakage on dry drinking tube valves, seats and seals.
- Analyze contamination levels in water over a 24 hour period.
- Dry Drinking device analyzed separately under GB/HD SMARTMAN Systems Testing.
- NIOSH method: 75 mm of H<sub>2</sub>O via Gilibrator Bubbler under STP – 0014.
- CAT method: GB and HD contaminate a drinking device surface, water samples are taken at defined time intervals and analyzed by GC for agent concentrations.

Requirements:

- 9 Trials, 3 Trials per respirator.
- Leakage between valve and valve seat shall not exceed 30ml per min.



## Notional Test Protocol Summary

- ◆ Maximum 8 HF tests / minimum of 6
- ◆ 6 Basic Human Factors (HF) tests (5 + LRPL)
- ◆ 2 Optional HF tests
- ◆ Verification testing IAW NIOSH Test Matrix
- ◆ HF Testing is Coupled with Systems and Environmental Testing
- ◆ Exhalation Resistance: 26 mm H<sub>2</sub>O
- ◆ Communications and Fogging Performance Ratings: 70% or 90%
- ◆ Hydration: **Optional**, Examines Leakage, H<sub>2</sub>O Analysis & LAT
- ◆ CO<sub>2</sub> Test : **Optional** based on Application Configuration
- ◆ LRPL Passage Rate of 100% and 1,000 or 2,000 or 3,000 LRPL FF.

