National Personal Protective Technology Laboratory

Supplied-Air Respirator (SAR) Conceptual Standard

Policy and Standards Development Branch

Jeff Palcic

September 17, 2009
083A Docket Comments

- All comments received were reviewed and considered
  - Comments accepted have been incorporated into the current SAR proposed draft
  - Comments related to issues such as airsource systems, and pneumatic tool takeoff were not adjusted pending additional stakeholder input
Organization of SAR Proposed Standard

SAR Base Requirements
- Respiratory
- Non-Respiratory
- Airsource Blower/Air Compressor / Air Supply Hose

SAR Enhanced Combination SAR/SCBA Requirements (IDLH)

SAR Enhanced CBRN Requirements
SAR Required Technical Actions

- **Revise the Draft Standard**
  - Continue internal technical reviews
  - Post SAR draft standard on NIOSH web for public comment
  - Review additional docket comments and revise draft as required

- **Update Standard Test Procedures (STP)**
  - Eliminate obsolete STP
  - Modify existing STP
  - Develop new STP

- **Evaluate, Acquire, and Secure Test Capabilities**
  - Evaluate current test capabilities with regard to new standard
  - Purchase and install new test equipment
  - Validate test equipment and procedures
Overview of Technical Aspects Specific to Proposed Subpart J

- SAR will remain subpart J
- Subpart will contain optional requirements for both IDLH and CBRN applications
- SAR will continue to meet the requirements of Subparts A - G of 42 CFR Part 84
Highlights of Proposed Technical Updates for Subpart J

Descriptions

Airline Type

- Air supply line and respiratory inlet covering with coupling for connection to Grade D or better breathing gas source

Optional Airsource Type

- Portable blower/air compressor with air supply line and respiratory inlet covering certified as a complete system
### Highlights of Proposed Technical Updates for Subpart J Base Requirements Respiratory

<table>
<thead>
<tr>
<th>Airline Type Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eliminate, Type A – hose mask respirator with large diameter breathing hose that draws inspired air by means of hand or motor-driven blower</td>
</tr>
<tr>
<td>Eliminated, Type AE – Type A with protection from rebounding abrasive materials</td>
</tr>
<tr>
<td>Eliminated, Type B – hose mask respirator with large diameter hose that draws inspired air by means of the users lungs</td>
</tr>
<tr>
<td>Eliminated, Type BE – Type B with protection from rebounding abrasive materials</td>
</tr>
<tr>
<td>Re-designate C and CE as “Airline Type”</td>
</tr>
<tr>
<td>Eliminate demand-type apparatus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Airline Breathing Air</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remain unchanged with CGA G-7.1 updated</td>
</tr>
</tbody>
</table>
### Highlights of Proposed Technical Updates for Subpart J Base Requirements Respiratory (Cont.)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhalation Valve Leakage</td>
<td>- Modified maximum valve leakage from 30 to 15 ml per minute based on current equipment capabilities</td>
</tr>
<tr>
<td>Carbon Dioxide Limit</td>
<td>- Included to insure acceptable CO₂ level (dead space test)</td>
</tr>
<tr>
<td>Human Subject Testing</td>
<td>- Included to determine the inhaled carbon dioxide (≤ 2.0%) and oxygen (≥ 19.5%) levels in the breathing zone during tests performed with subjects standing and walking at 3.5 miles per hour</td>
</tr>
<tr>
<td>Assess Fitting Characteristics</td>
<td>- Total Inward Leakage (TIL) Test based on benchmark testing to finalize values</td>
</tr>
</tbody>
</table>
Highlights of Proposed Technical Updates for Subpart J Base Requirements

Respiratory (Cont.)

Air Flow Rates

- Manufacturer specified air flow rates at which positive pressure is maintained in the breathing zone based on a sinusoidal breathing profile

- Replaces flow rates of 115 and 170 Lpm for tight and loose fitting respiratory inlet coverings

- Addition of the very high air flow rate based on stakeholder comments

<table>
<thead>
<tr>
<th>NIOSH Proposed Air Flow Rates</th>
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</thead>
<tbody>
<tr>
<td><strong>Air Flow Rate</strong></td>
</tr>
<tr>
<td>Low</td>
</tr>
<tr>
<td>Moderate</td>
</tr>
<tr>
<td>High</td>
</tr>
<tr>
<td>Very High</td>
</tr>
</tbody>
</table>
## Highlights of Proposed Technical Updates for Subpart J Base Requirements
### Non-Respiratory

**Required Components**
- Airline: Respiratory inlet covering, air supply valve or orifice, air supply hose, detachable couplings, flexible breathing tube, and harness

**General Construction**
- Shall meet requirements in subpart G of 42 CFR Part 84
- Connections and couplings are required to prevent unintentional disconnection
Highlights of Proposed Technical Updates for Subpart J Base Requirements
Non-Respiratory (Cont.)

Harness Tests

- Shoulder strap test increased to a 300lb pull for 30 min
- Belts and rings increased to a 500lb pull for 30 min
- Hose attachment to harness remains at 250 lb pull for 30 min
- Life lines or safety harness shall meet ANSI Z359.1 or NFPA 1983
- Total length of hose (heaviest configuration) shall permit dragging over a concrete floor without compromising the harness
<table>
<thead>
<tr>
<th>Highlights of Proposed Technical Updates for Subpart J Base Requirements Non-Respiratory (Cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visors/Lenses</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Noise Level</td>
</tr>
<tr>
<td>Failure Mode Effects Analysis</td>
</tr>
</tbody>
</table>
### Highlights of Proposed Technical Updates for Subpart J Base Requirements

**Air Supply Hose**

<table>
<thead>
<tr>
<th>Section</th>
<th>Updates</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hose Length</strong></td>
<td>Air-supply hose length will be manufacturer specified</td>
</tr>
<tr>
<td><strong>Hose Labeling</strong></td>
<td>All breathing air hoses must be labeled “breathing air only” (not in current SAR draft)</td>
</tr>
<tr>
<td><strong>Hose Permeation</strong></td>
<td>Addition of permeation tests using kerosene and MEK/toluene.</td>
</tr>
</tbody>
</table>
Highlights of Proposed Technical Updates for Subpart J Enhanced Requirements for IDLH Combination SAR/SCBA

Escape Cylinder

- Airline SAR/SCBA will incorporate a 5 or 10 min. duration SCBA escape air cylinder
- A 15 minute or longer duration SCBA air cylinder allows 20% capacity for entry
- Automatic switch from supplied air to air cylinder
- Alarm will notify user when the system is on cylinder air
- Requires tight fitting full facepiece
Highlights of Proposed Technical Updates for Subpart J Enhanced Requirements for IDLH Combination SAR/SCBA (Cont.)

Visor/Lenses
- Haze, luminous transmittance and abrasion
- Impact and penetration resistance
- Low temperature/fogging

Communication
- Modified Rhyme Test (MRT)
Highlights of Proposed Technical Updates for Subpart J Enhanced Requirements Optional CBRN Protections

- Meet base and combination SAR/SCBA requirements
- 15 minute or longer duration escape air cylinder
- Automatic switch from supplied air to air cylinder
- Alarm will notify user when the system is on cylinder air
- Criteria which have been established for CBRN SCBA respirators will be applied to combination SAR/SCBA
  - Requires tight fitting full facepiece
  - Durability conditioning
  - Agent testing
Highlights of Proposed Technical Updates for Subpart J Requirements for Options

**Hydration**
- Drink tube valves and valve seats shall not exceed 30 ml per minute of leakage at 75 mm H$_2$O vacuum

**Pneumatic Tool Take-Off**
- Requirements for check valve and filter at the take-off point to prevent any back flow or contamination to the respirator
- Maintain positive pressure in the breathing zone at the manufacturers highest specified air flow rate regardless of occurrence with the pneumatic tool line such as blockage or free flow
Benchmark
Live Agent Testing

- Test setup will be similar to the open circuit self-contained breathing apparatus (SCBA) but will include the hose and hose connection
- Draft standard test procedure has been developed
- Test will be conducted at the current open circuit SCBA challenge concentrations for Sarin (GB) and Sulfur Mustard (HD)
Benchmark (Cont.)

Breathing Gas, carbon dioxide (CO₂) machine test
- Will be conducted on the new CO₂ dead space test system

Breathing Gas Concentration, human subject generated
- Required equipment has been purchased and installation started

Total Inward Leakage
- Sample respirator equipment has been purchased, pending installation of test equipment
Benchmark (Cont.)

Hose Permeation Testing

- Development of new test apparatus, and finalization of test challenge agents

Positive Pressure Determination

- Existing breathing systems will be tested at all four proposed breathing rates to develop procedures and evaluate general performance
Highlights of proposed technical updates for Subpart J
Standard Test Procedures

New Procedures

- New STP or those derived from existing procedures for other respiratory protective devices

Procedures Requiring Revision

- STP already existing for SAR but requiring modification to test to the new performance standards

Obsolete Procedures

- Eliminated due to changes in the performance requirements and evaluation methods
Projected Timeline

August 09: Post SAR Concept Standard on the NIOSH Web

September 09: Hold Public Meeting and Discuss Concept

November 09: Revise SAR Concept Standard
Supplied-Air Respirator (SAR)
NIOSH Docket # 083B

Stakeholder Input can be submitted by

- Mail:
  NIOSH Docket Office
  Robert A. Taft Laboratories, M/S C 34
  Supplied Air Respirators (SAR) – NIOSH Docket # 083B
  4676 Columbia Parkway
  Cincinnati, OH 45226

- Email: nioshdocket@cdc.gov

- Fax: (513) 533-8285

- Phone: (513) 533-8303
Optional approval

Presently neither NIOSH nor OSHA evaluate portable air supply systems

Inclusion of cylinder carts in Airsource systems

NIOSH approves systems, when SAR are offered as Airsource systems they should be tested in that configuration
## Discussion Slide
### Total Inward Leakage

<table>
<thead>
<tr>
<th>Respiratory inlet covering</th>
<th>Maximum TIL value, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant flow half mask</td>
<td>0.2%</td>
</tr>
<tr>
<td>Constant flow full facepiece or neck dam</td>
<td>0.01%</td>
</tr>
<tr>
<td>Constant flow hood, helmet, or loose fitting facepiece</td>
<td>0.01%</td>
</tr>
<tr>
<td>Pressure demand half mask</td>
<td>0.01%</td>
</tr>
<tr>
<td>Pressure demand full facepiece</td>
<td>0.01%</td>
</tr>
<tr>
<td>Any IDLH or CBRN SAR</td>
<td>0.01%</td>
</tr>
<tr>
<td>Any combination with one of the above</td>
<td>The unit must meet or exceed the minimum TIL of each type when tested in that mode.</td>
</tr>
</tbody>
</table>
Discussion Slide
Helmet Requirements

- Should NIOSH require marking helmets that do not meet the mechanical compliance test as “not impact and penetration resistant?”
- The current SAR draft standard only requires ANSI Z89.1-2003 Type I or Type II protective cap standards
Discussion Slide
Lens Requirements

- Should NIOSH require marking lenses that do not meet the mechanical compliance test as “not impact resistant?”
- The current SAR draft standard only requires ANSI Z87.1-2003 impact and penetration tests
- To be marked ANSI Z87.1-2003 the lens would need to pass all of the ANSI 87.1-2003 tests
## Discussion Slide
Manufacturer Specified Air Flow Rates

<table>
<thead>
<tr>
<th>Air Flow Rate</th>
<th>Minute Volume</th>
<th>Tidal Volume and Respirations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>25 Lpm</td>
<td>1.30 liters @19.2 respirations per minute</td>
</tr>
<tr>
<td>Moderate</td>
<td>40 Lpm</td>
<td>1.67 liters @ 24 respirations per minute</td>
</tr>
<tr>
<td>High</td>
<td>57 Lpm</td>
<td>1.95 liters @ 29.1 respirations per minute</td>
</tr>
<tr>
<td>Very High</td>
<td>78 Lpm</td>
<td>2.00 liters @ 39 respirations per minute</td>
</tr>
</tbody>
</table>
Discussion Slide
Hose Permeation Tests

- Develop a new sealed test apparatus and test procedure that can be conducted in a laboratory environment under controlled conditions
- Proposed permeation tests include gasoline, kerosene, and MEK/toluene
- Can all three tests be replaced with one custom blend?
Discussion Slide
Live Agent Testing

- Should we have two available levels of protection as is being considered with the PAPR standard?
  - Higher challenge concentration same as the Open Circuit SCBA
  - Lower challenge concentration for perimeter support activities