Existing Standards for Multifunction Powered Air Purifying Respirators

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Multifunction PAPR Approach

- Existing Standards
- Perceived Importance
- Respirator Wearability
- User Characteristics
Performance & Protection
Standards Categories

- Respiration
- Vision
- Hearing
- Head
- Human factors
- Intrinsic safety
Standards Review

- Reviewed existing domestic and international standards
- Identified applicable standards
- Identified need for new standards
Respiratory Protection Standards
42 CFR 84
Respiratory Protective Devices (NIOSH)

- Procedures for NIOSH approval
- Certification for respirators meeting construction, performance, and respiratory protection requirements
- Inspection, examination and testing methods
Respirator Configuration

- Breathing tubes
- Harnesses
- Facepieces
- Weight requirement
- Head and neck protection
- Air velocity and noise levels
- End-of-service-life indicator
Respiratory Protection

- Minimum requirements
- Testing procedures
29 CFR 1910 Subpart I

Personal Protective Equipment (OSHA)

- Respirator selection
- Fit testing
- User seal check
Domestic Standards
ANSI Z88.2
Respiratory Protection

- Guidance for proper selection, use, and care of respirators

- Requirements for establishing and regulating respirator programs
ANSI Z88.4

Safety guide for respiratory protection against coal mine dust

- Respiratory protection against coal mine dust
- Coal dust concentration standard
  - Federal Register, Subpart O, Part 70, Mandatory Health Standards-Underground Coal Mines
Color coding of air-purifying respirator canisters, cartridges, and filters

- Color coding if air-purifying respirator canisters, cartridges, and filters
- Rapid identification
- Color consistency among manufacturers
<table>
<thead>
<tr>
<th>Fit test method</th>
<th>Test</th>
<th>Chemical agent</th>
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<tbody>
<tr>
<td>Smell</td>
<td>Odor test</td>
<td>isoamyl acetate</td>
</tr>
<tr>
<td>Taste</td>
<td>Sweetener aerosol</td>
<td>sodium saccharine</td>
</tr>
<tr>
<td></td>
<td>Bitter aerosol</td>
<td>denatonium benzoate</td>
</tr>
<tr>
<td>Feeling</td>
<td>Irritating aerosol</td>
<td>stannic chloride</td>
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</table>
## International Standards

<table>
<thead>
<tr>
<th>BS EN 136</th>
<th>BS EN 143</th>
<th>BS EN 12941</th>
<th>JIS T 8157</th>
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</thead>
<tbody>
<tr>
<td>Respiratory protective devices – Full face masks – Requirements, testing, marking</td>
<td>Particle filters used in respiratory protective equipment</td>
<td>Respiratory protective devices incorporating a helmet or hood – Requirements, testing, marking</td>
<td>Powered air purifying respirators (PAPR)</td>
</tr>
</tbody>
</table>
Vision Protection Standards
29 CFR 1910 Subpart I

Personal Protective Equipment (OSHA)

- Protection from eye and face hazards
- Side protection from flying objects
- Prescription lenses required
- Shade against radiation
- Manufacturer identification marking
29 CFR 1910 requires compliance with ANSI Z87.1
ANSI Z87.1

Practice for occupational and educational eye and face protection

- Minimum requirements for eye and face protective devices
- Guidance for selection, use, and maintenance
High Velocity Impact Test

- Low mass projectiles
- High velocity
- 20 trials tested
High Mass Impact Test

- High mass projectile
- Low velocity
- 4 trials tested
Flammability Resistance Test

- Apply and remove flame
- Check for continued burning after 5 sec
Other Tests

- Drop ball impact test
- Corrosion resistance test for metal parts
- Penetration tests for plastic lenses and windows
- Optical tests for prismatic power, refractive power, astigmatism, definition, prism balance, haze, and transmittance
<table>
<thead>
<tr>
<th>International Standards</th>
<th>AS/NZS 1337</th>
<th>DIN/BS EN 166</th>
<th>DIN/BS EN 167</th>
<th>DIN/BS EN 168</th>
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<tr>
<td>Ind. eye &amp; face protection</td>
<td>Specifications</td>
<td>Optical test methods</td>
<td>Non-optical test methods</td>
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</table>
International Standards

- ISO 4849  Personal eye-protectors – Specifications
- ISO 4854  Personal eye-protectors – Optical test methods
- ISO 4855  Personal eye-protectors – Non-optical test methods
- ISO 4856  Personal eye-protectors – Synoptic tables of requirements for oculars and eye protectors
DIN/BS EN 168
Resistance to Fogging of Oculars

- Eyepiece suspended above a hot water bath
- Transmittance is measured continuously
- Time to 20% reduction in transmittance is recorded
Head Protection Standards
29 CFR 1910 Subpart I
Personal Protective Equipment (OSHA)

- Protective helmet required when potential for injury from falling objects
- Reduce electrical shock hazard
29 CFR 1910 requires compliance with ANSI Z89.1
ANSI Z89.1

Industrial Head Protection

- Types and classes
- Materials
- Physical requirements
- Performance requirements
- Testing methods
Force Transmission Test

- Helmet preconditioning
- Impact test
- Force transmission recorded
Apex Penetration Test

- Helmet preconditioning
- Impact test on apex of helmet
- Penetration recorded
Off-Center Penetration Test

- Helmet preconditioning
- Impact test past the dynamic test line of helmet
- Penetration recorded
Other Tests

- Impact energy attenuation
- Flammability
- Chin strap retention
- Electrical insulation
International Standards

- AS/NZS 1801: Occupational protective helmets
- BS EN 397: Specifications for industrial safety helmets
- ISO 3873: Industrial safety helmets
Hearing Protection Standards
29 CFR 1910 Subpart G (OSHA)
Occupational Health and Environmental Control

- Noise exposure computation based on an 8 hour time weighted average
- Methods for measuring the adequacy of hearing protector attenuation
- Noise reduction ratio method
Domestic Standards

■ ANSI S12.6 Measurement of real-ear attenuation of hearing protectors

■ ANSI S12.19 Measurement of occupational noise exposure

■ ANSI S12.42 Microphone-in-real-ear and acoustic test fixture methods for the measurement of insertion loss of circumaural hearing protection devices
International Standards

- AS / NZS 1270
- CSA Z94.2
- DIN EN 352-3

Acoustics – Hearing protectors
Hearing protective devices – Performance, selection, care, and use
Hearing protectors – Safety requirements and testing
Part 3: Ear muffs attached to an industrial safety helmet
Acoustics – Hearing protectors
Part 1: Subjective method for the measurement of sound attenuation

Acoustics – Hearing protectors
Part 4: Measurement of effective sound pressure levels for level-dependent sound-reduction ear muffs
Human Factors

Standards
ANSI S3.2
Method for measuring the intelligibility of speech over communication systems

Phonetically balanced, monosyllabic word lists
Test for trained speakers and listeners
Intrinsic Safety Standards
30 CFR 18.68

Tests for Intrinsic Safety (MSHA)

Component requirements:

- Back-up current limiting components
- Stability against shock and vibration
- Amply sized circuitry parts
- Electrolytic capacitors tested with 1,500 volts
Circuit is considered *intrinsically safe* if *no ignitions* occur in testing
Summary

- Performance certification
  - New standards may be necessary
  - Focus on user

- Protection certification
  - Existing standards may be used
  - Focus on mask
Consultations and Acknowledgements

- NIOSH
- MSHA
- Delmarva Safety Association
- NAVAIR
- Noise Pollution Clearinghouse
- OSHA
- SBCCCOM
- SEA