
Existing Standards for Multifunction Powered Air Purifying Respirators

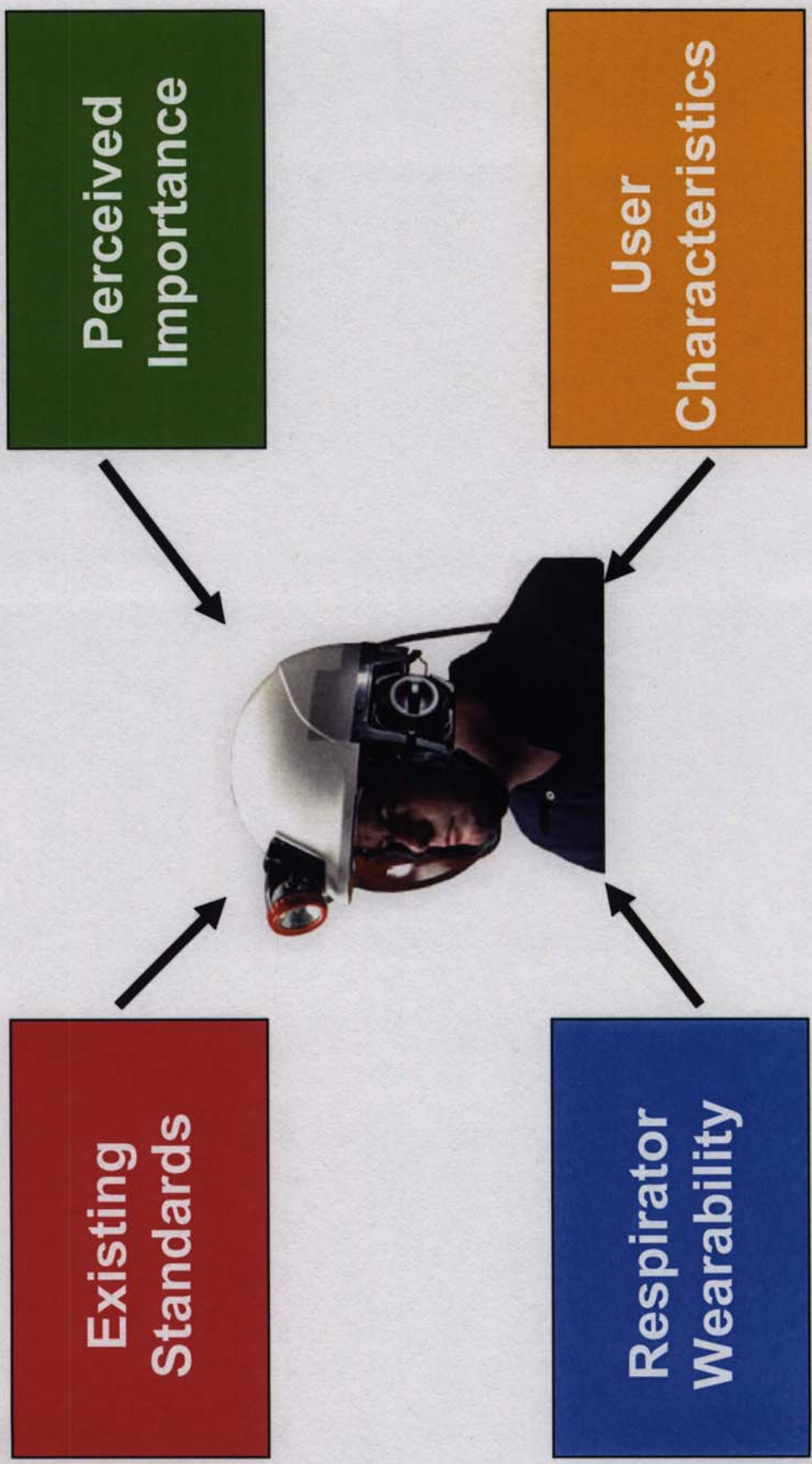
Arthur T Johnson Ph.D., P.E.
Katherine R. M. Mackey

Biological Resources Engineering
University of Maryland, College Park



10 April 2003 • Under funding from NIOSH Contract #200200200531

Multifunction PAPR Approach



Performance & Protection

The Code of Federal Regulations

and other *standards*

give protection guidelines

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)

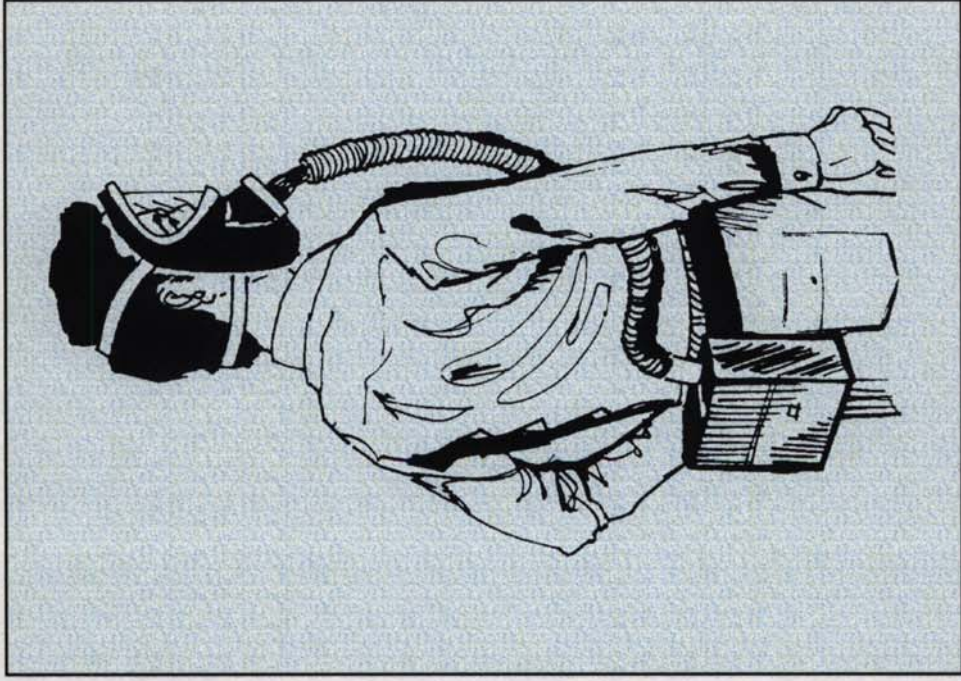
- **Procedures** for NIOSH approval
 - **Certification** for respirators meeting construction, performance, and respiratory protection requirements
 - **Inspection, examination and testing methods**
-

Respirator Configuration

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

Respiratory Protection

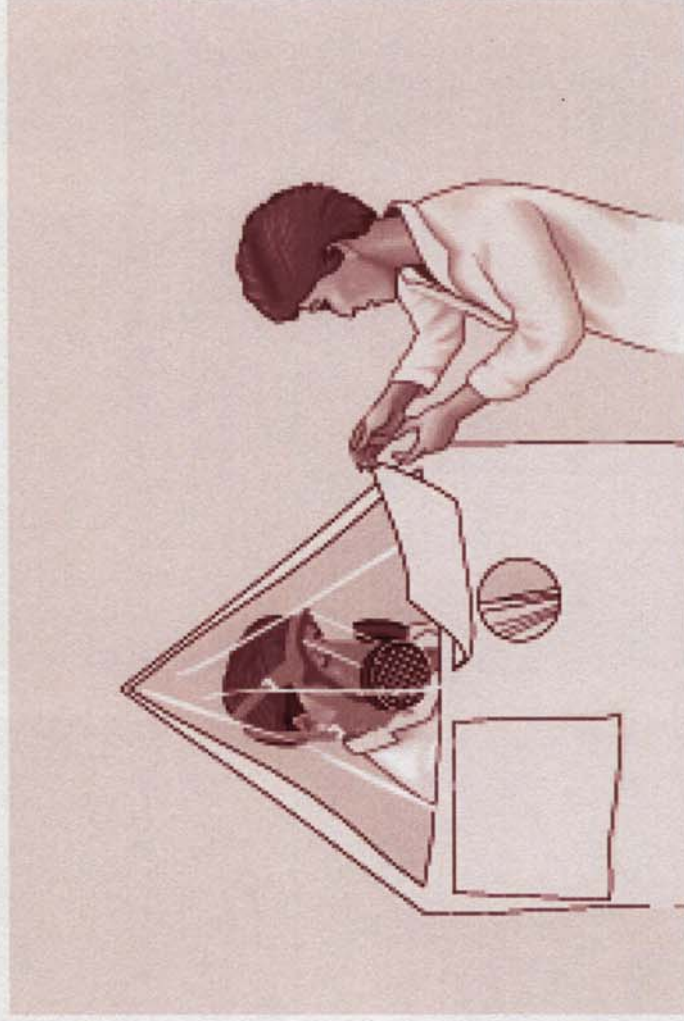
- Minimum requirements
- Testing procedures



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
-

ANSI Z88.7

Color coding of air-purifying respirator canisters, cartridges, and filters

- **Color coding of air-purifying respirator canisters, cartridges, and filters**
 - **Rapid identification**
 - **Color consistency among manufacturers**
-

ANSI Z88.10

Respirator fit testing methods

Fit test method	Test	Chemical agent
Smell	Odor test	isoamyl acetate
Taste	Sweetener aerosol	sodium saccharine
	Bitter aerosol	denatonium benzoate
Feeling	Irritating aerosol	stannic chloride

International Standards

- **BS EN 136** Respiratory protective devices – Full face masks – Requirements, testing, marking
 - **BS EN 143** Particle filters used in respiratory protective equipment
 - **BS EN 12941** Respiratory protective devices – Powered filtering devices incorporating a helmet or hood – Requirements, testing, marking
 - **JIS T 8157** Powered air purifying respirators (PAPR)
-

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

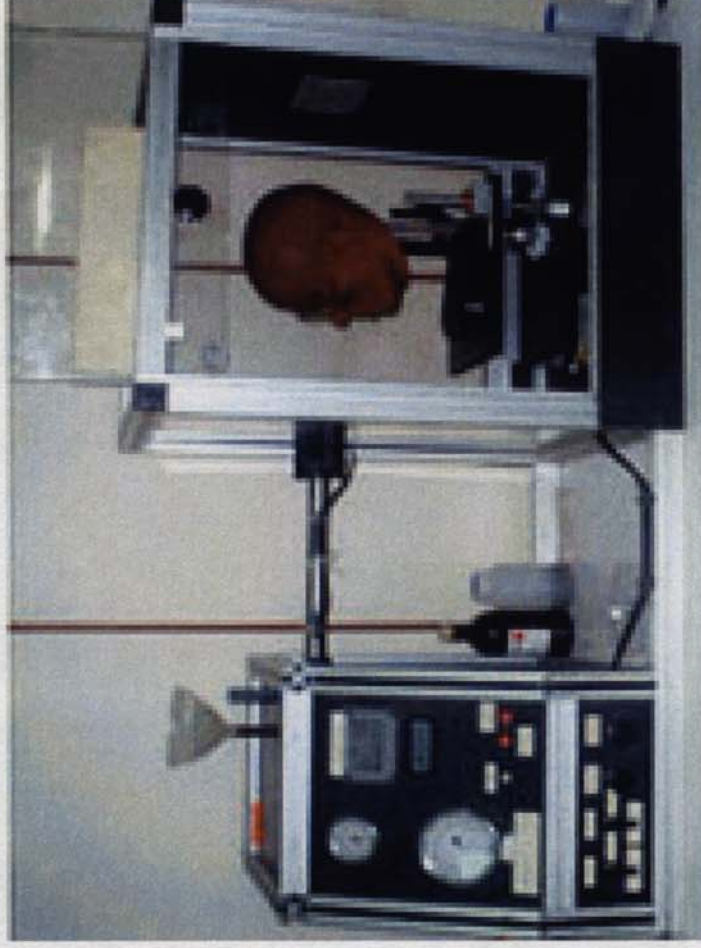
ANSI Z87.1

*Practice for occupational and educational
eye and face protection*

- Minimum requirements for eye and face protective devices
 - Guidance for selection, use, and maintenance
-

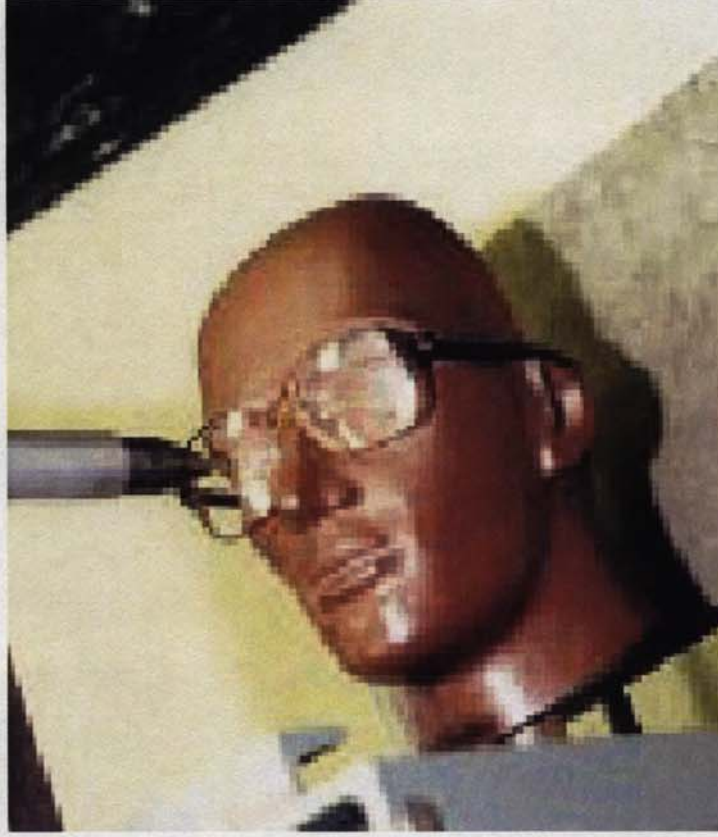
High Velocity Impact Test

- Low mass projectiles
- High velocity
- 20 trials tested



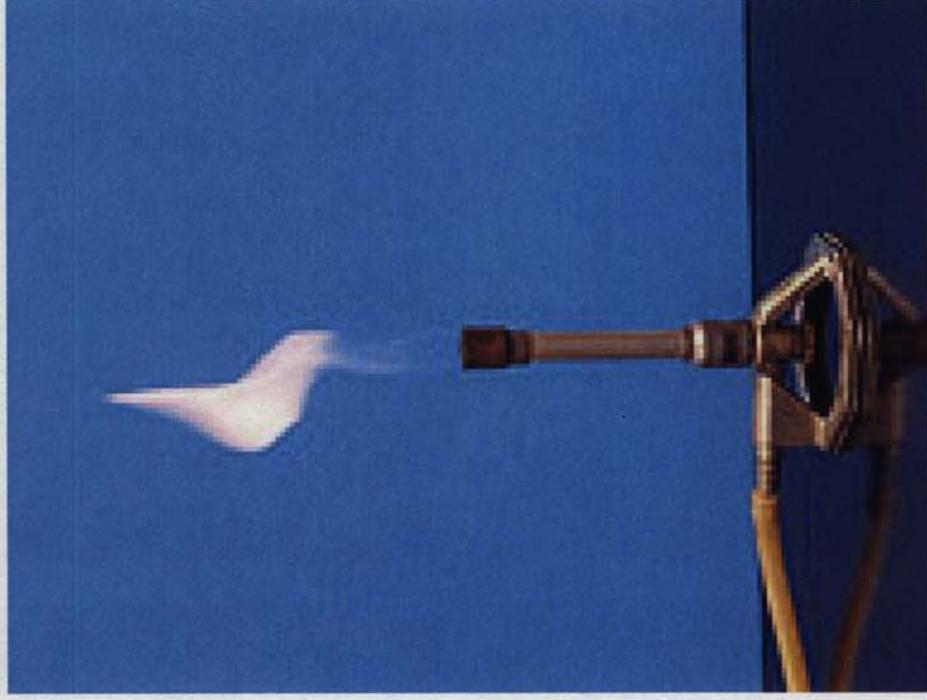
High Mass Impact Test

- 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
-

International Standards

- AS/NZS 1337
Industrial eye and face protection
 - DIN/BS EN 166
Personal eye-protection -
Specifications
 - DIN/BS EN 167
Personal eye-protection -
Optical test methods
 - DIN/BS EN 168
Personal eye-protection -
Non-optical test methods
-

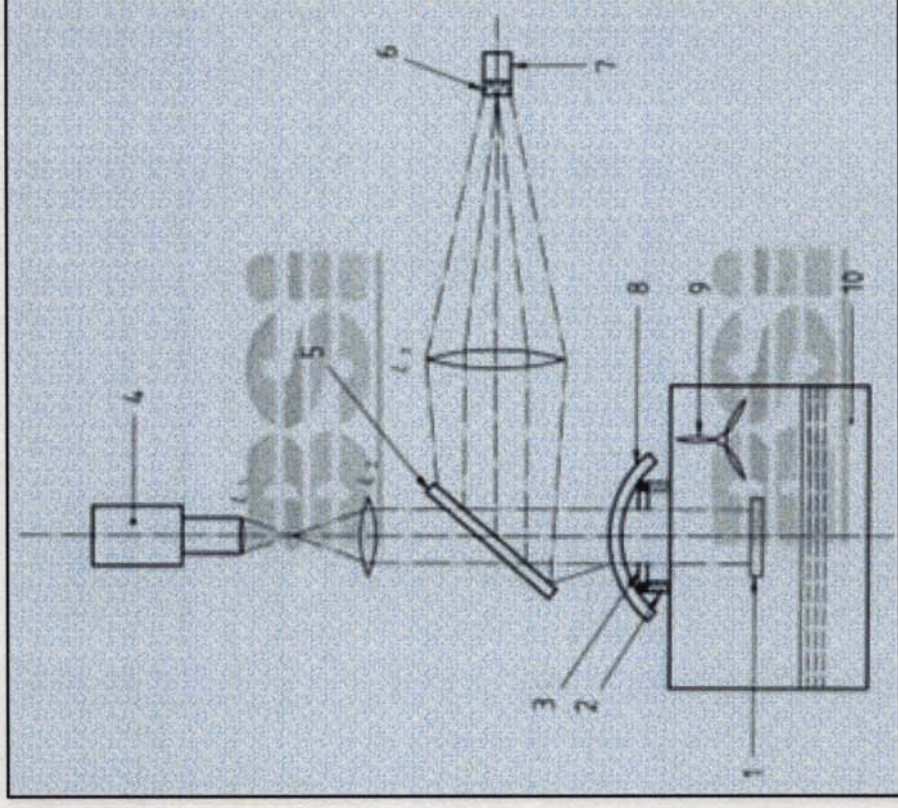
International Standards

- 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

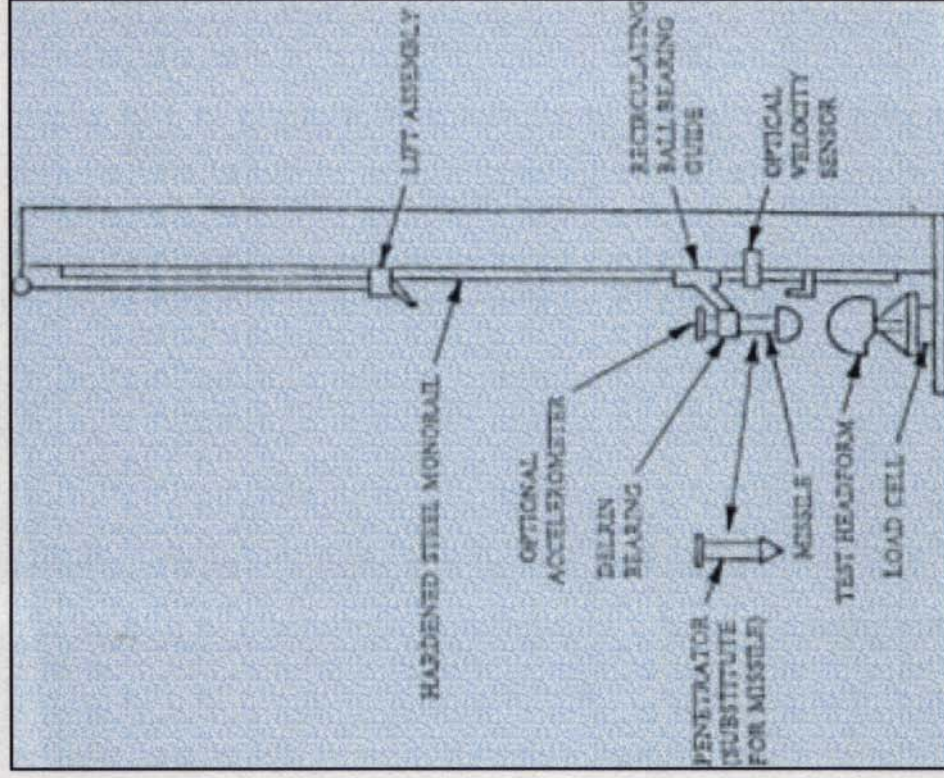
ANSI Z89.1

Industrial Head Protection

- Types and classes
 - Materials
 - Physical requirements
 - Performance requirements
 - Testing methods
-

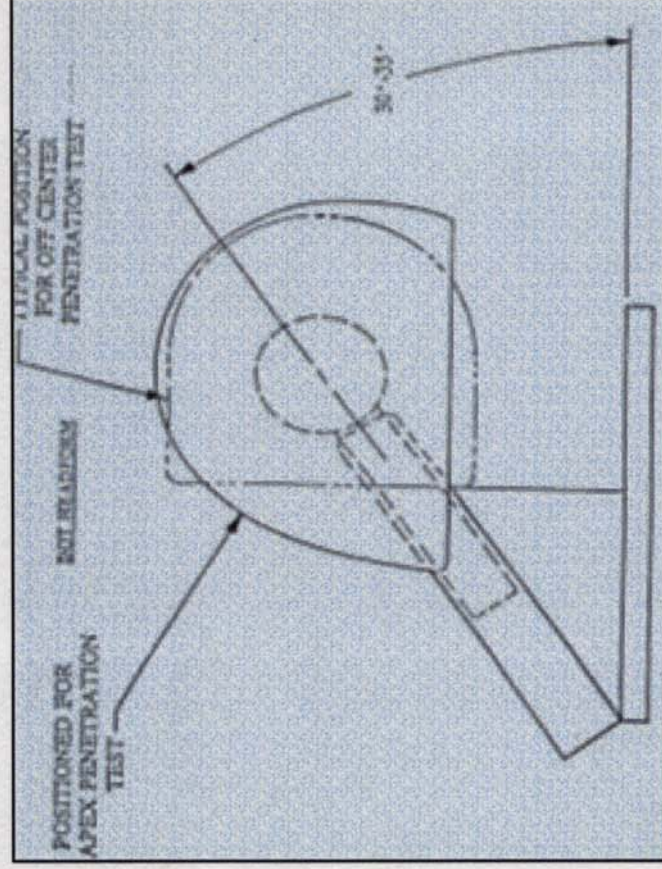
Force Transmission Test

- Helmet preconditioning
- Impact test
- Force transmission recorded



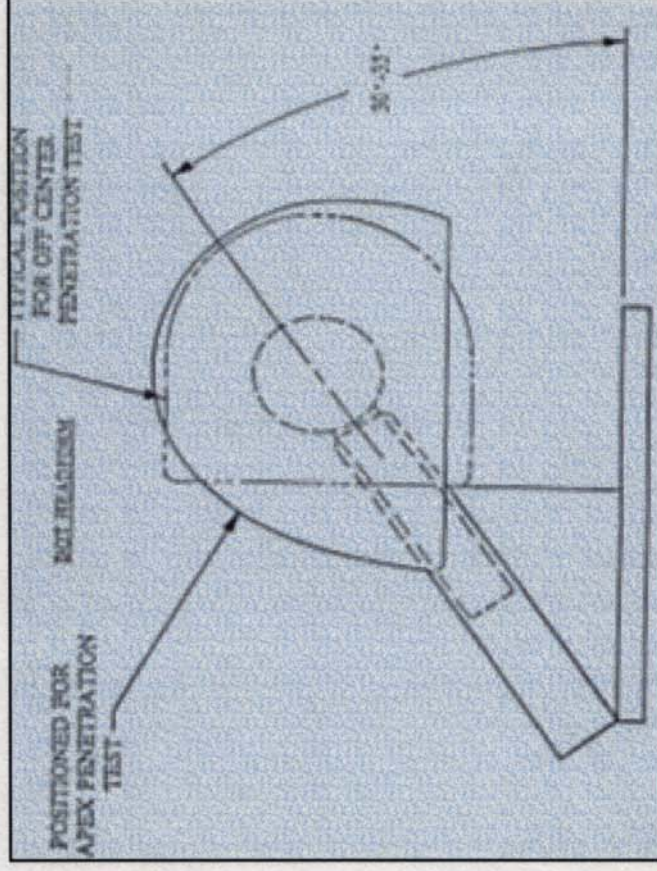
Apex Penetration Test

- 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
Acoustics – Hearing protectors
 - CSA Z94.2
Hearing protective devices –
Performance, selection, care, and use
 - DIN EN 352-3
Hearing protectors – Safety
requirements and testing
Part 3: Ear muffs attached to an
industrial safety helmet
-

International Standards

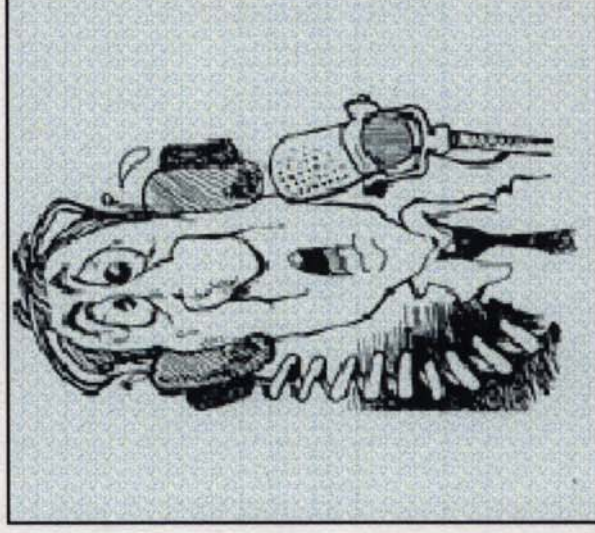
- ISO 4869-1
Acoustics – Hearing protectors
Part 1: Subjective method for the measurement of sound attenuation
 - ISO / TR 4869-4
Acoustics – Hearing protectors
Part 4: Measurement of effective sound pressure levels for level-dependent sound-restoration ear muffs
-

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
 - SBCCOM
 - SEA
-