JOHNS HOPKINS BLOOMBERG SCHOOL of PUBLIC HEALTH

Personal Protective Equipment and Other Control Options

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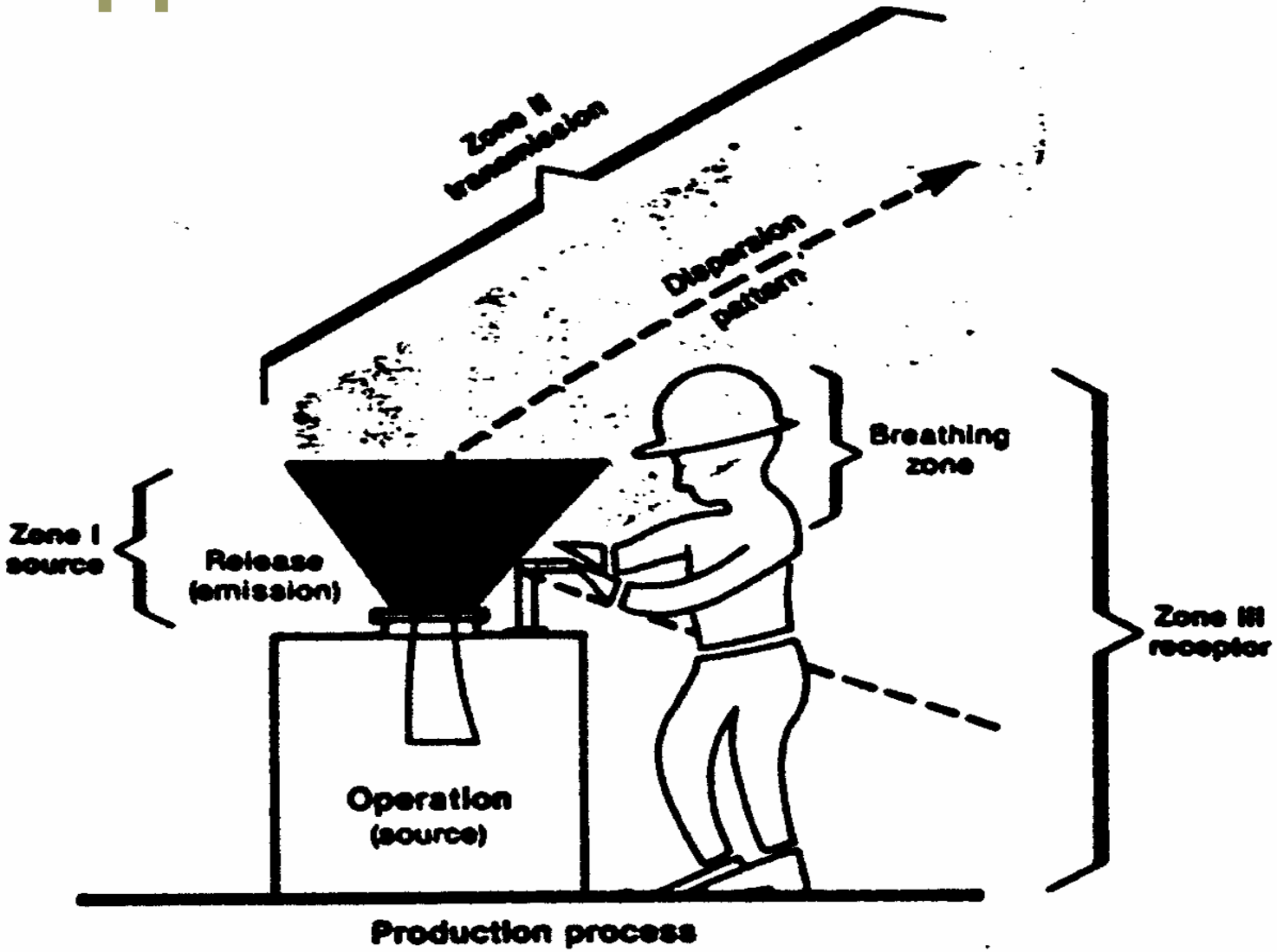
Section A

Introduction

Opportunities for Control



source - transmission - receptor

Source: Peter Lees

Personal Protective Equipment

- Many kinds
  - Respirators
  - Clothing
  - Hard hats
  - Safety shoes
  - Face shields
- Continued
  - Hearing protectors
  - Gloves
  - Safety glasses

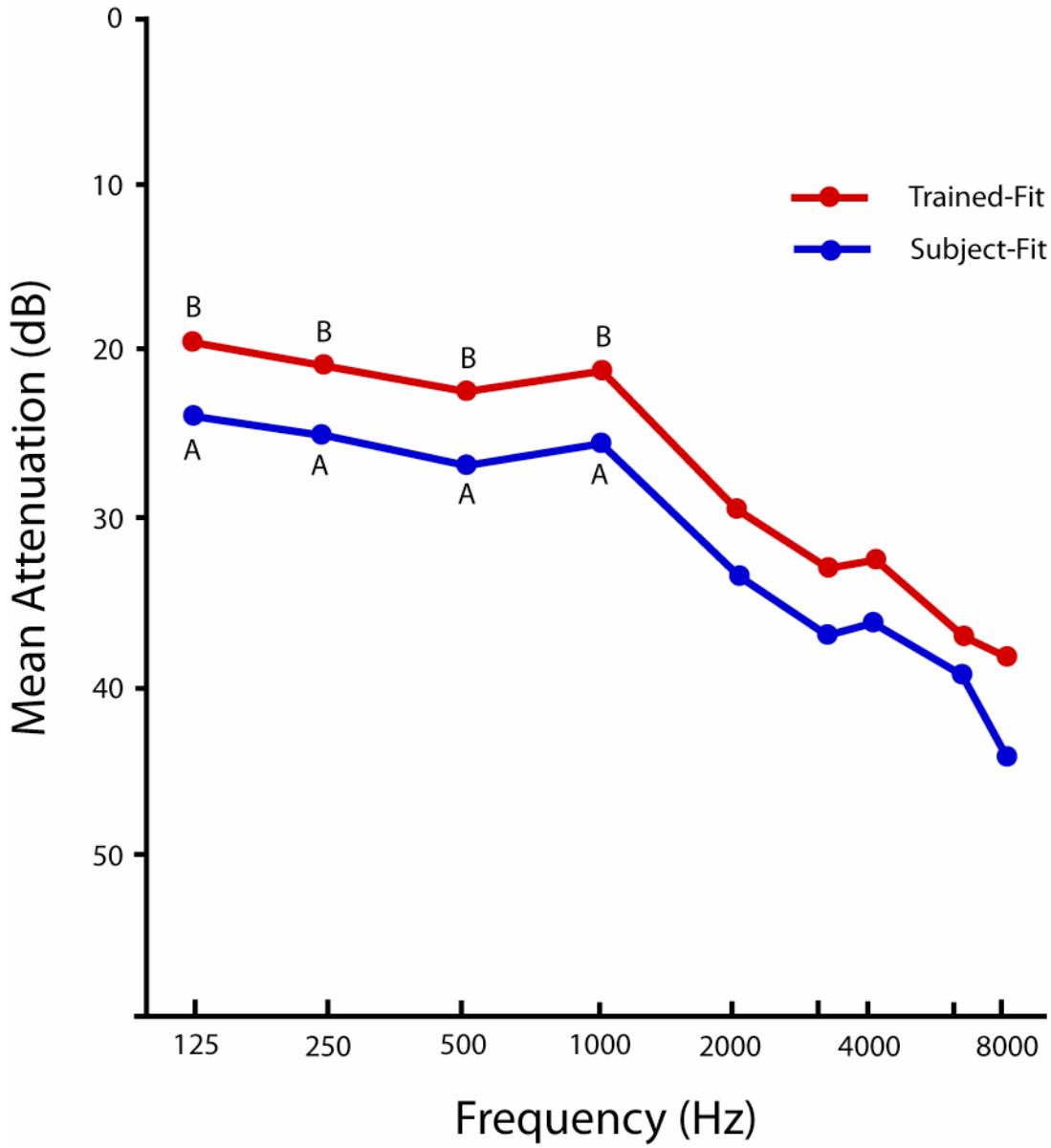
Use and Misuse of PPE

- Personal protective equipment is widely used
- Frequently inappropriate application or wrong equipment
- Specification of wrong PPE may result in higher exposure than use of no PPE
- Must know proper uses and limitations

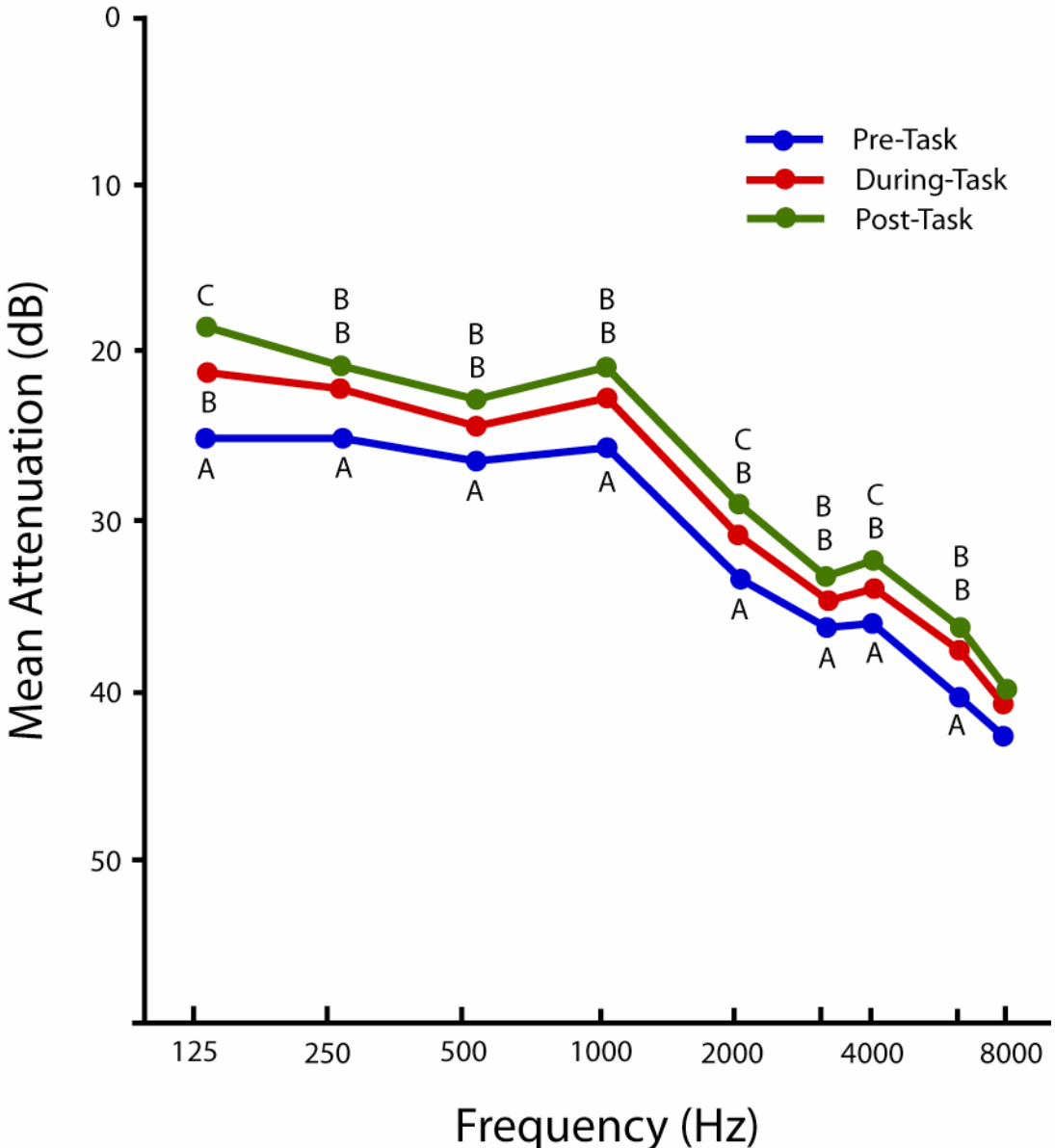
Time Required for Solvent to Penetrate 1/1000 inch of Material

Protective Material	1,2-dichloromethane
Butyl Rubber	6.4 min
Neoprene rubber latex	0.9 min
Nitrile rubber latex	0.3 min
Polyethylene	1.2 min
Surgical rubber latex	0.2 min
Viton	82 min

PPE and Training



PPE Performance over Time



PPE Certification Tests

- A primary influence on the design and performance of PPE is conformance with the requirements of the certification tests

Source: NIOSH

PPE in Laboratory Test vs. Field

Type of protector	Median noise reduction ratings[a]		Protection obtained by lowest 10% in field[b]
	laboratory	field	
All earplugs.....	28	13	—
Preformed types.....	29	7	0
Acoustic wool	26	10	3
Custom-molded[c]	20	14	3
Acoustic foam	36	20	3

[a]Measurements in dB.
[b]Average noise reduction achieved by the 10 percent of workers who obtained the poorest noise protection.
[c]In one plant, the custom-molded earplugs were fabricated by the plant nurse; in the other plant, they were fabricated by the manufacturer.

Source: U.S. Government

The *Real* Problem with PPE

Workers' reports of reasons for not wearing hard hats:

Total	852	
Thought it was not needed	216	25
Not available from employer	176	21
Not normally used or not practical	471	55
Uncomfortable, did not fit with other equipment, hard to work with it on, or in bad condition	163	19
Other	42	5

Source: U.S. Government

Summary of PPE Limitations

- Must match PPE to the hazard
- Actual performance is always less than that claimed by manufacturer or indicated by testing
  - Considerable variability among manufacturers
- Comfort and ease of use is important

Continued

Summary of PPE Limitations

- Training in proper use of PPE is required to achieve maximum possible protection
- PPE designed to pass certification test
  - Need to know limitations of tests
- If PPE isn’t used, it doesn’t work

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Section B

Respiratory Protection

Respiratory Protective Equipment

- Protect the respiratory system from inhalation of airborne contaminants by removing contaminants from the air before they are inhaled
- Supplying an independent source of “clean” air
- Viewed as control method of last resort in the hierarchy of controls

Legitimate Uses of Respiratory Protection

- Emergency situations
  - Spill clean-up
- Short-term solutions where engineering controls not feasible
  - Asbestos removal jobs
- While controls being installed

Types of Respirators

- Air-purifying respirators
  - Particulate-removing
    - Positive or negative pressure within the mask
  - Gas-and-vapor-removing
    - Positive or negative pressure within the mask
- Single or multiple use

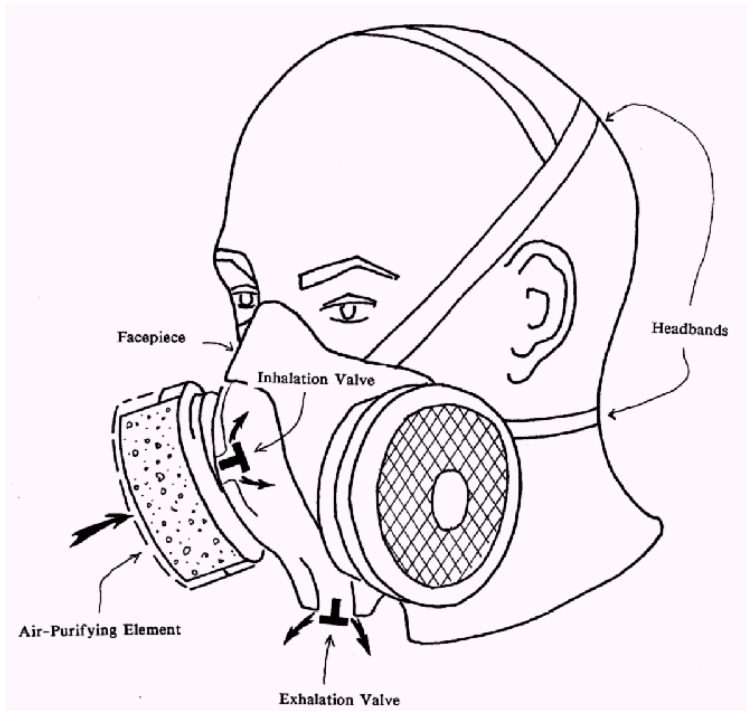
Continued

Types of Respirators

- Atmosphere-supplying respirator
  - Higher level of protection than air-purifying respirator
- Types
  - Hose mask
  - Air line
  - Self-contained breathing apparatus

Air-Purifying Respirator

- Air-purifying elements appropriate to contaminant (filter or adsorbent)
- Operates under negative pressure (seal/leaks)
- Determination of service life



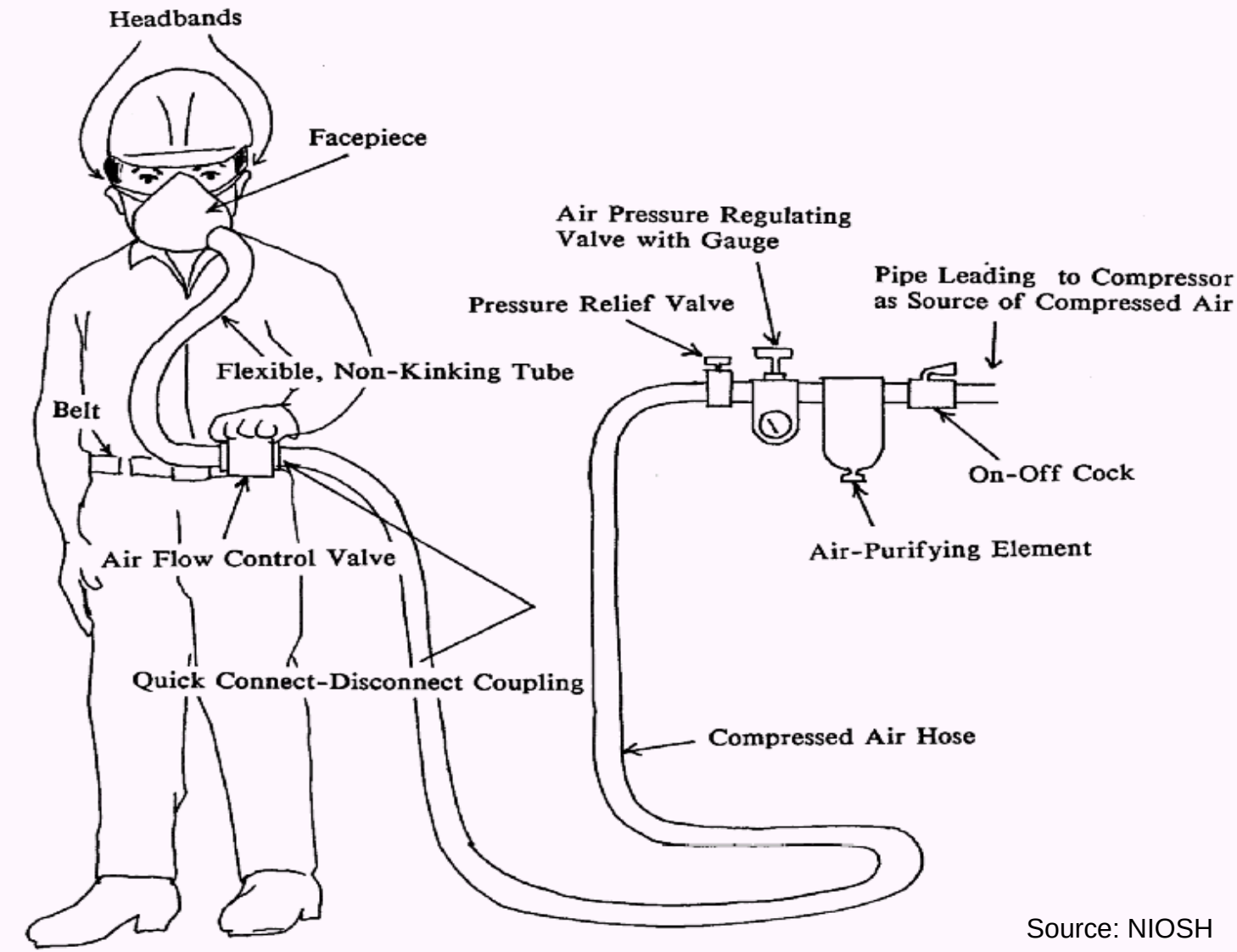
Source: NIOSH

Powered Air-Purifying Respirator

- Air-purifying elements appropriate to contaminant (filter or adsorbent)
- Operates under positive pressure (seal/leaks)
- Determination of service life (and associated limitations)

Source: NIOSH

Air Line Respirator



Source: NIOSH

Self-Contained Breathing Apparatus

- Flow regime
  - Demand
  - Pressure demand
  - Continuous flow

Protection Factors

- Respirator performance rated by protection factor
- Determined for respirator type

$$PF = \frac{[contaminant_{outside}]}{[contaminant_{inside}]}$$

Continued

Protection Factors

- Example
  - Workplace air concentration 50 ppm benzene
  - Inside respirator 2 ppm benzene

$$PF = \frac{50ppm}{2ppm} = 25$$

Comparison of Protection Factors

Respirator Type	PF
Half-mask air-purifying	10
Half-mask powered air-purifying	50
Half-mask air-line (demand)	10
Half-mask air-line (continuous flow)	50
Half-mask air-line (pressure demand)	1000
Full-face piece air line (pressure demand)	2000
SCBA (pressure demand)	10,000

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Section C

Respiratory Protection Programs

Respirator Programs

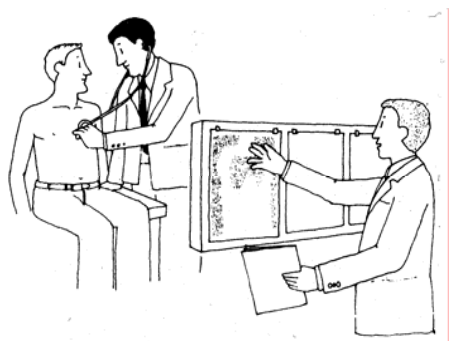
- OSHA requires written programs defining the procedures by which respiratory protective equipment is selected, stored, maintained, and repaired
- Procedures for determining if persons required to wear respiratory protective equipment are medically fit, trained in its use, and evaluated

Respirator Selection

- Select based on hazard
  - Implies identification of hazard and knowledge of its magnitude through investigation/measurement
- Use NIOSH-certified respirators
- Provide sufficient number of respirator models and sizes to fit users
- Respirator Decision Logic
  - www.cdc.gov/niosh/87-108.html

Medical Evaluation

- Required before RPE use
- Evaluation by physician or licensed health care professional
- Questionnaire or examination as specified in 29 CFR 1910.134(e)
- Mandatory exam for positive response to specified questions



Source: NIOSH

Fit Testing

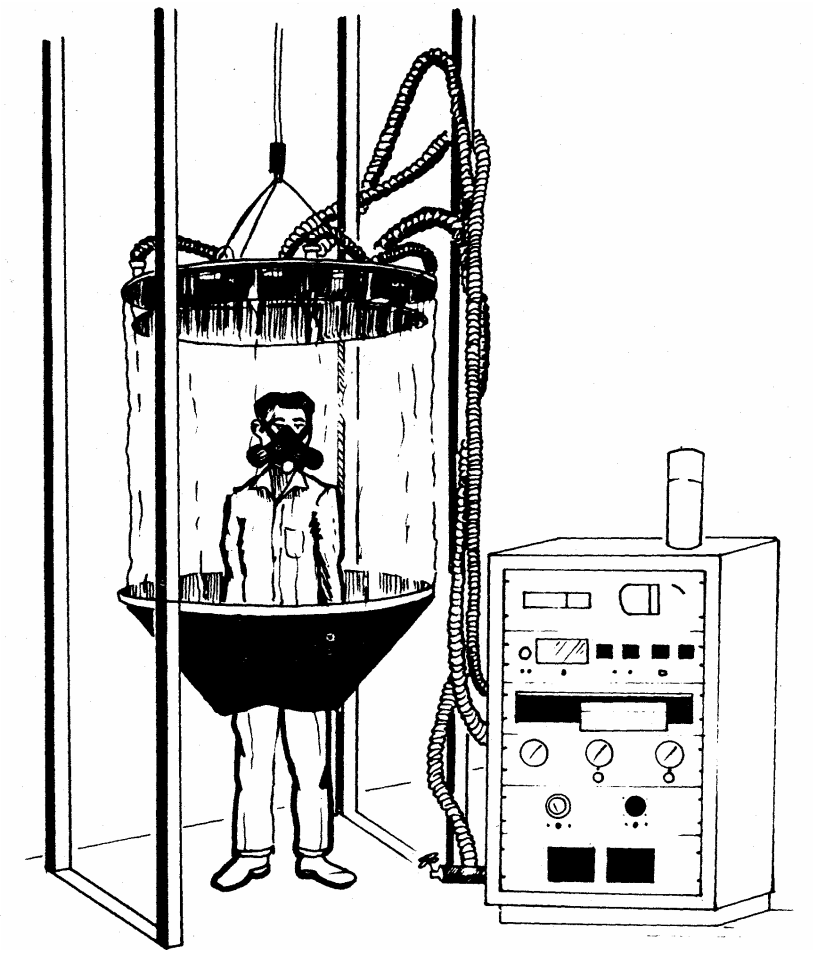
Source: NIOSH

- Qualitative fit tests
  - simple to conduct
  - For PF<100

Continued

Fit Testing

- Quantitative fit testing
  - Fit testing booth and associated equipment
  - For PF >100



Source: NIOSH

Training

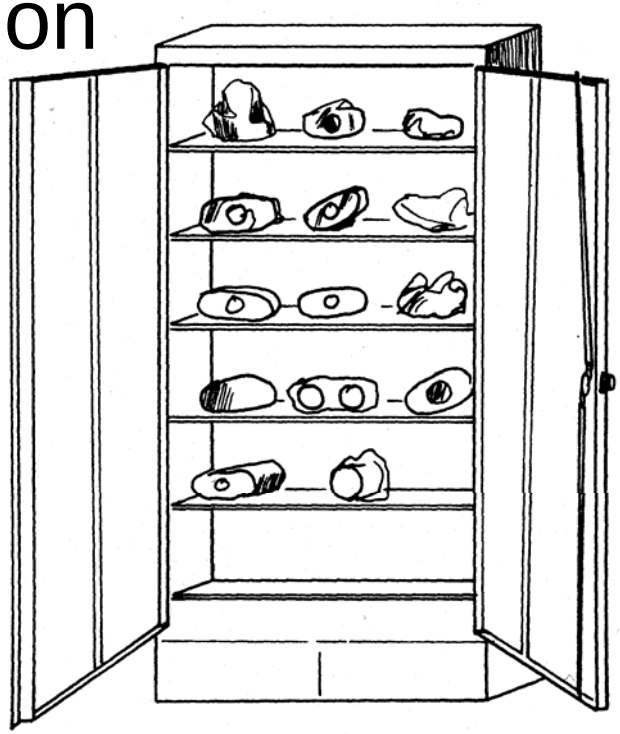
- Annual; “comprehensive and understandable”
- Selection of respirator
- Inspection of respirator
- Use of respirator
- Cleaning of respirator
- Storage of respirator

Source: NIOSH

Source: NIOSH

Maintenance and Care

- Cleaning and disinfection
- Storage
- Inspection
  - Emergency use
  - Routine use
- Repair



Source: NIOSH