Safety In Abrasive Blasting
Webinar
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Respiratory Hazards in Abrasive Blasting

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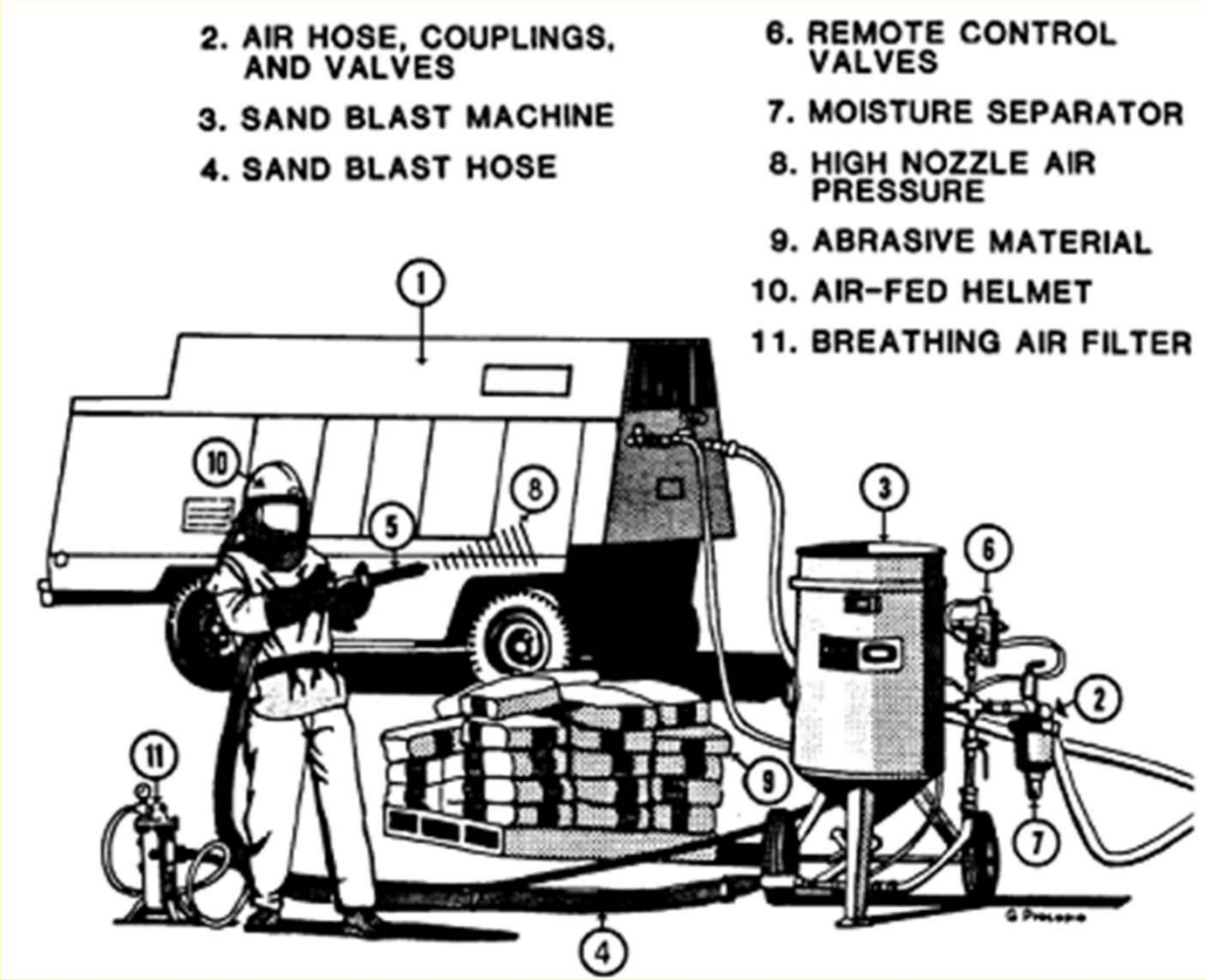
OUTLINE

1. Abrasive Blasting Introduction
2. Types of Media
3. Types of Potential Hazards
4. Respiratory Hazards
5. Respiratory System
6. Particulate deposition
7. Occupation Exposure Limits (OEL)
8. IH Hierarchy of Control
9. Types of Respiratory PPE
10. Respiratory Protection Program
11. Conclusions

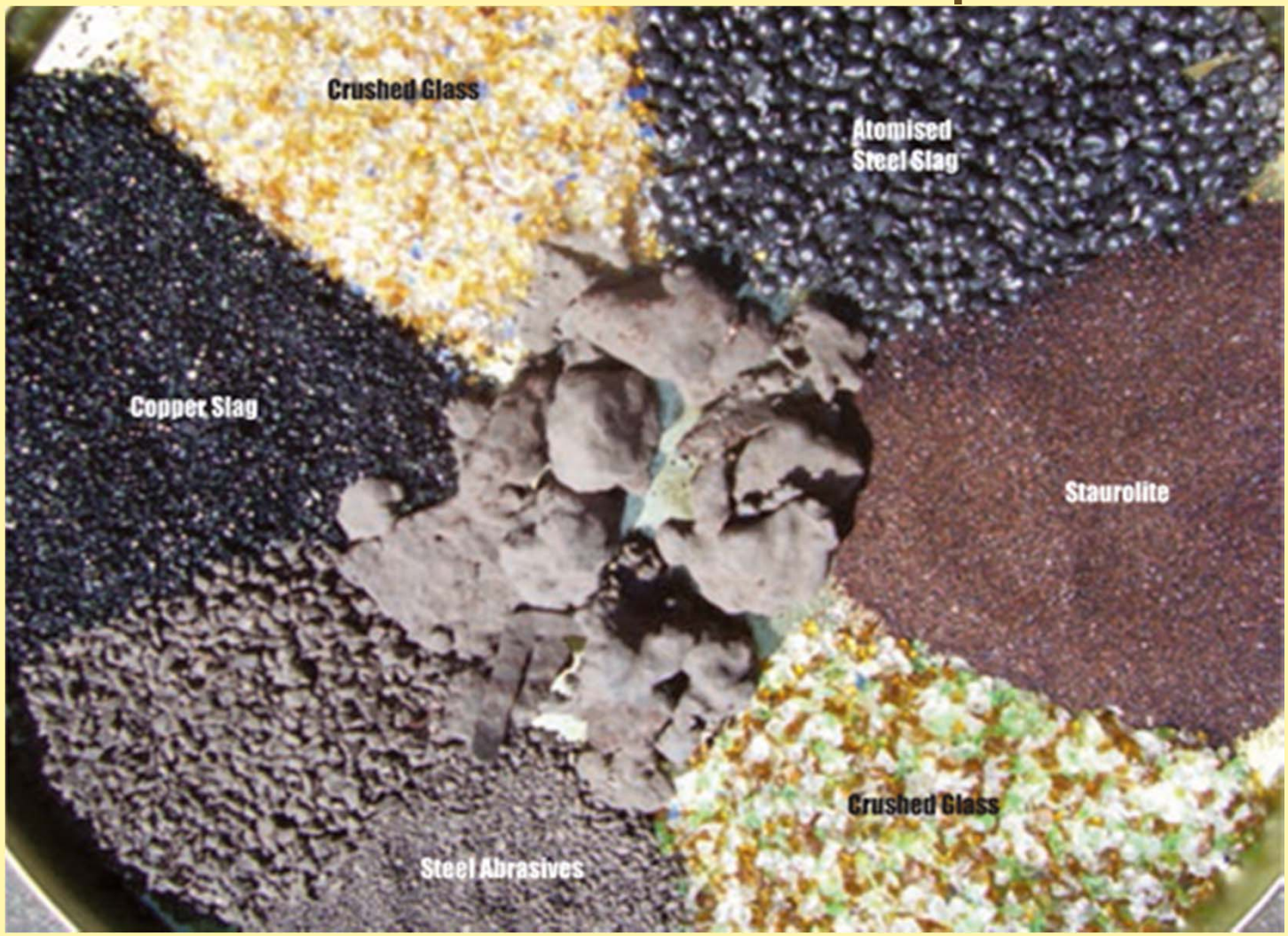
Abrasive Blasting

**The use of abrasive material surface cleaning, removal or preparation of a material*

- Energy transfer using:
  - Air pressure
  - Centrifugal wheels
  - Water pressure
    - Wet blasting
    - Hydroblasting
- Equipment depends upon:
  - Specific application
  - Type(s) of abrasive(s)
    - *e.g. "Sand Blasting"*



Abrasive Blasting Media Examples



NIOSH does not recommend use of sand containing >1% crystalline silica

Potential Hazards

- General Construction
  - Slips/trips
  - Falls (elevated locations)
  - Noise
  - Foot protection
- Physical
  - Temperature extremes
  - Ergonomic
  - Dermal
- Respiratory Hazards

Respiratory Hazards

- Particulate Matter (PM)
  - General
  - Particle size
  - Particle composition
- Confined Space
  - Oxygen (O_2) deficiency
  - Potential Toxicity
- Carbon Monoxide (CO)

Sources of Potential Air Contaminants

- Base Material
  - e.g., steel, aluminum, stainless steel, galvanized steel, copper-nickel and other copper alloys
- Surface Coatings
  - e.g., pre-construction primers, anticorrosive and antifouling paints
- Abrasive Blasting Media
  - e.g., coal slag, copper slag, nickel slag, glass, steel grit, garnet, silica sand

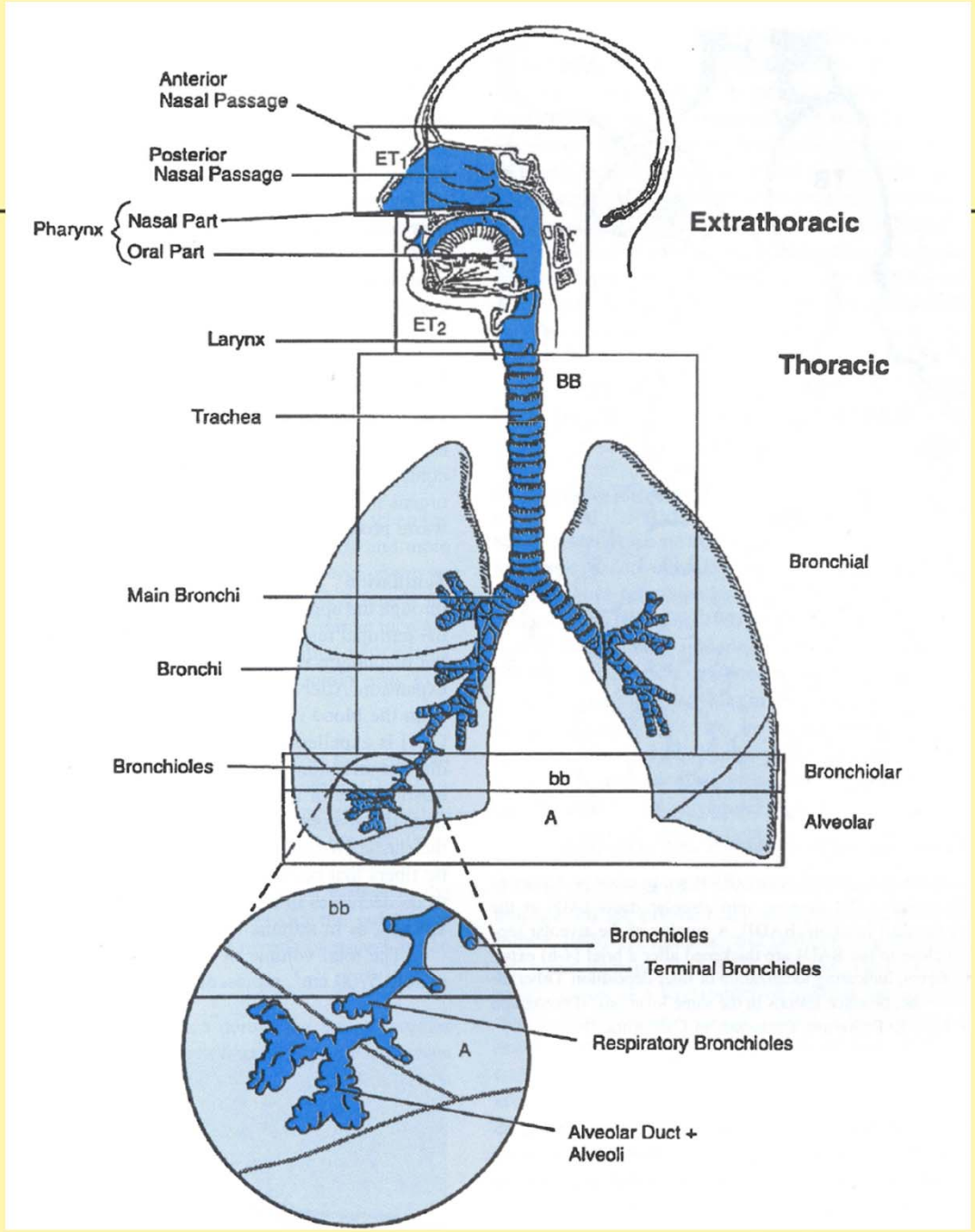
Example Surface Coating Concentrations

	Year 1	Year 2	Year 3
No. of Samples	4	11	4
Silica, crystalline	63,000	95,800	59,000
Arsenic	27.7	<23	<22
Beryllium	<0.44	<1.20	<0.89
Cadmium	7	3.58	1.16
Chromium	1,780	4,080	4,850
Chromium (VI)	0.36	7.36	3.39
Lead	135,000	172,000	175,000
Manganese	692	237	243
Nickel	48	14.5	10.6
Silver	<2.20	<6.3	<4.40
Titanium	128	64.6	558
Vanadium	8.56	9.95	10.7

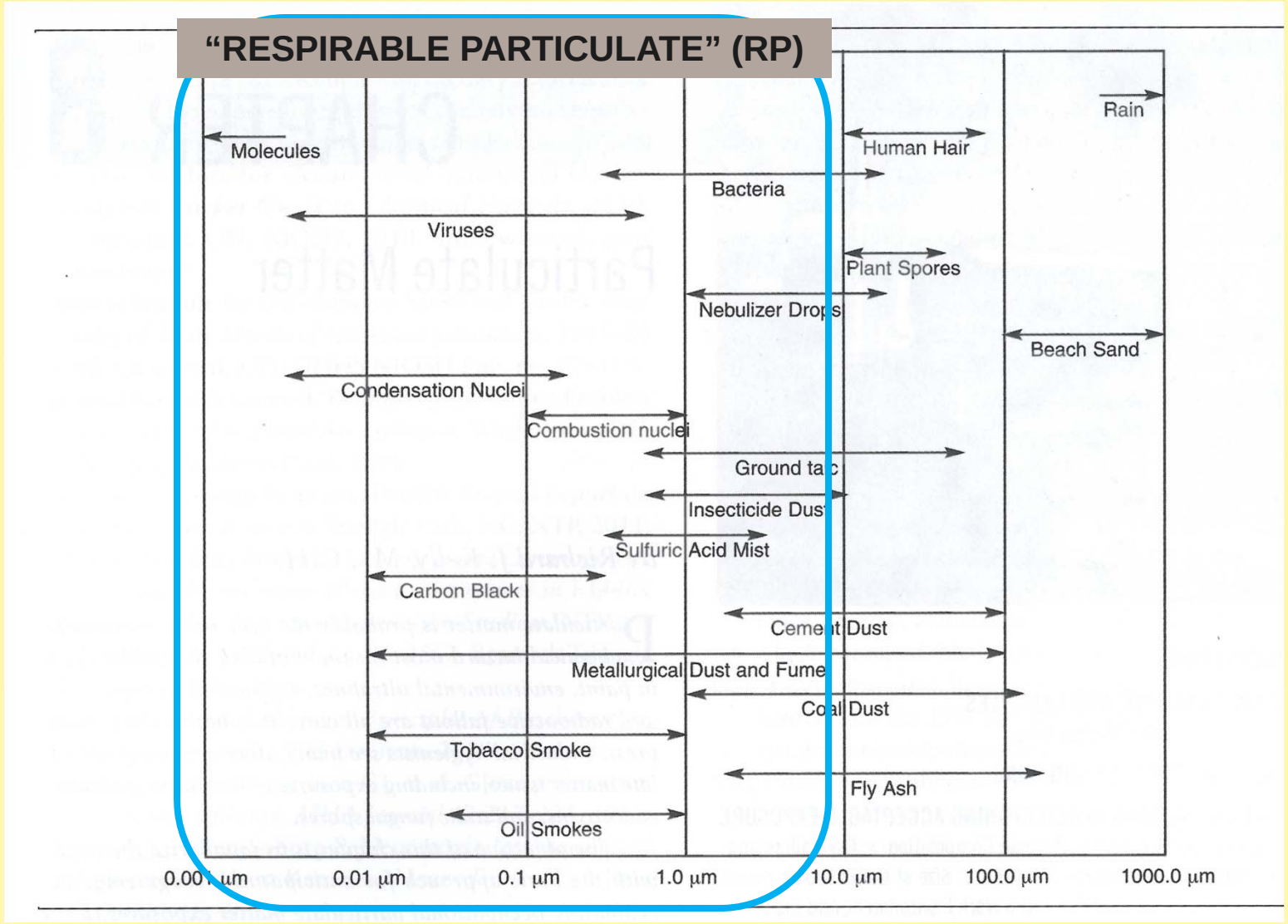
*All results are in ppm

Other potential components of concern:
Al, Ba, Co, Cu, Fe, Mg, Mo, P, Se, Na, Te, Tl , Y, Zn, Zr

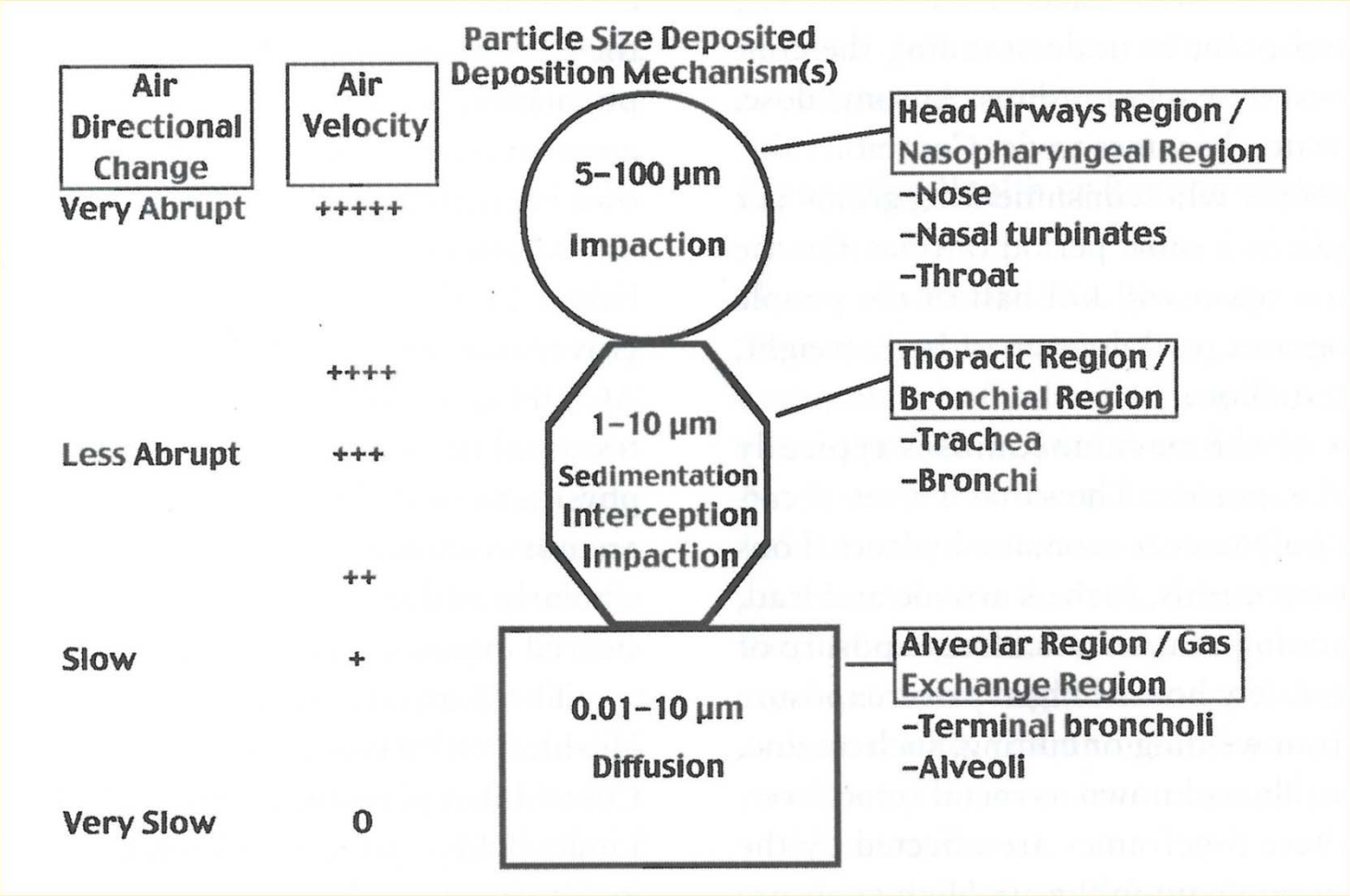
The Human Respiratory System



PM
Particle Size Ranges



Particle Deposition in Respiratory System



US Regulatory Issues

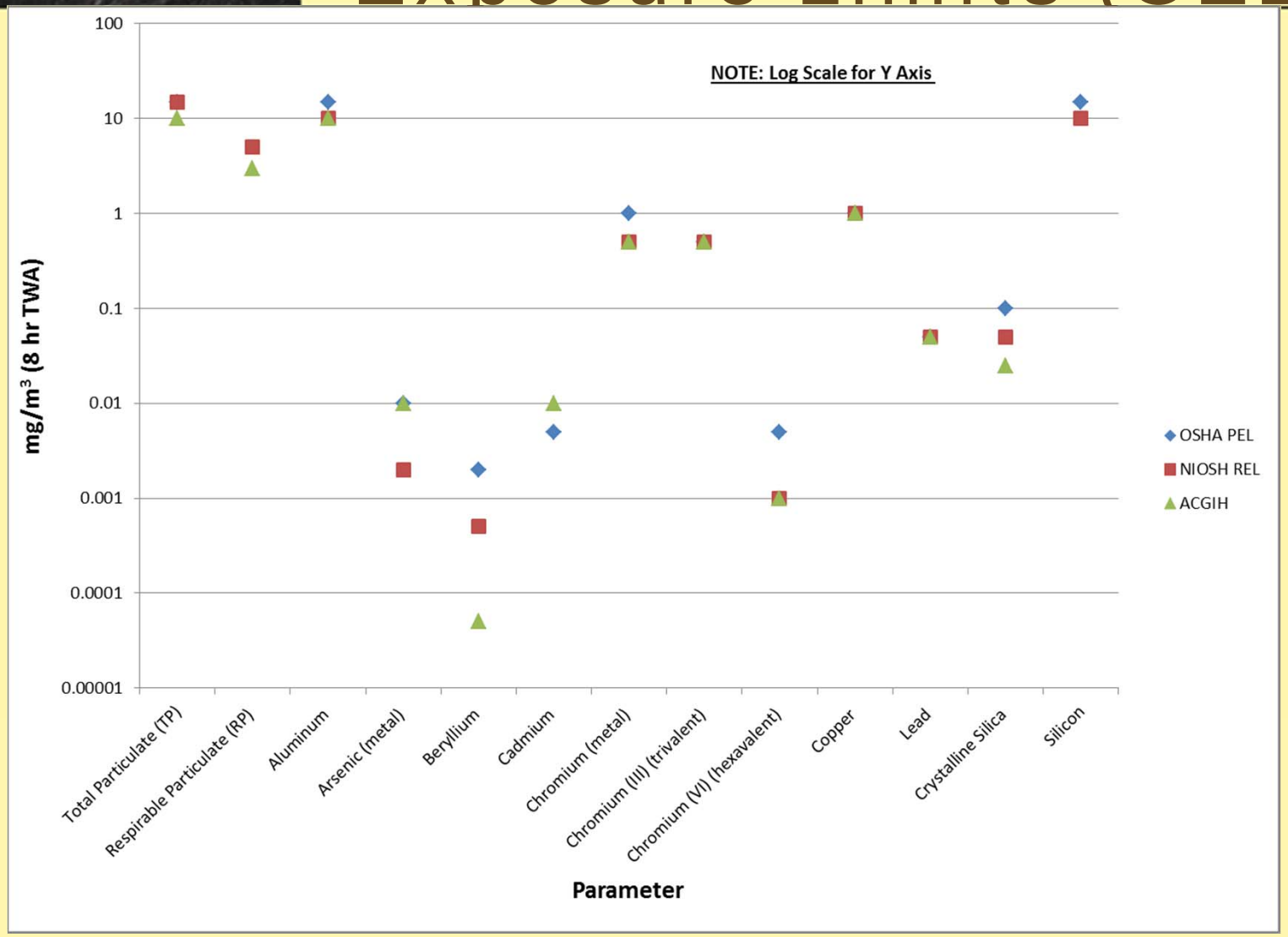
3 Primary OSHA Standards:

1. General Industry (29 CFR 1910)
2. Maritime (29 CFR 1915)
3. Construction (29 CFR 1926)

Other Examples:

- US EPA Regulations at 40 CFR
- State & Local Regulations & Codes

US Occupational Exposure Limits (OEL)



Factor of 300000 between TP and Be OELs

Determining Hazard Potential

- MSDS (now SDS)
  - Carcinogens listed (for >0.1% by weight)
  - ACGIH TLV also required to be listed
  - Respiratory protection
- Chemical Analysis:
  - Media
  - Coating
  - Substrate
- Scientific Literature
  - Journals
  - Government Agency Publications

Pneumoconioses

- A group of interstitial lung diseases that are caused by the inhalation of a range of organic and non-organic dusts/fumes which are then retained in the lungs. The disease is a result of the lung tissue's reaction to the dust.
- The principal cause of the pneumoconioses is work-place exposure
- Singular= *Pneumoconiosis*

Respirable Particulate Sampling Results

- 2013 Ceballos et al. JOEH
  - 100% of analyzable RP samples exceed PEL (5 mg/m^3)
  - Measured concentrations 75-25000 mg/m^3
- 2006 Meeker et al. JOEH
  - 100% of RP samples exceeded PEL
  - Measured concentrations 30-5652 mg/m^3

IH Hierarchy for Addressing Hazards

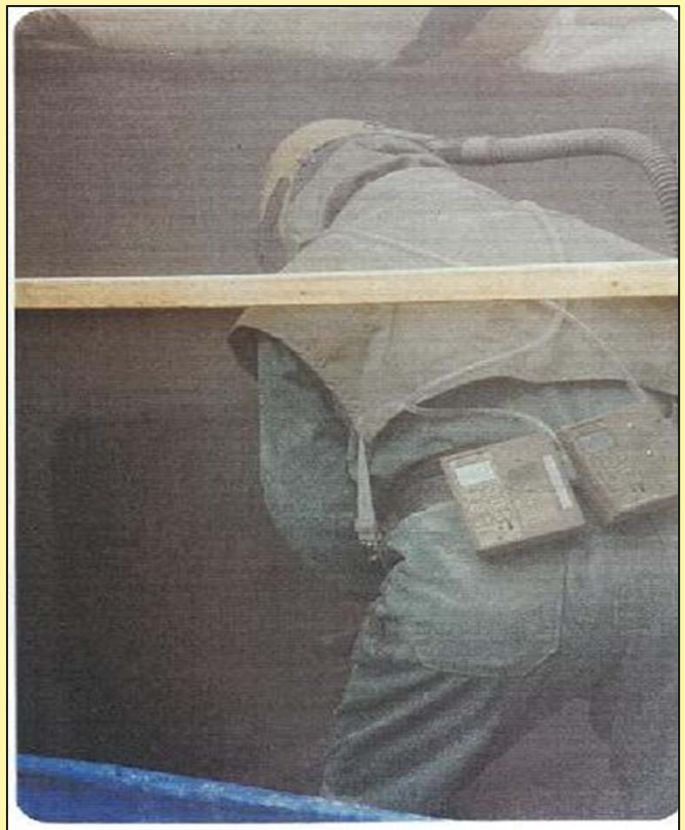
- Engineering Control examples
  - Material substitution
  - Enclosures
  - Remote or automated blasting
  - LEV
- Administrative Control examples
  - Restrictions on work time
  - Confined spaces entry protocols
- PPE

Respiratory PPE

1. If controls not feasible
2. Oxygen Deficient Atmosphere

Respiratory PPE :

- Properly selected based on task
- Individually fitted
- Properly maintained



PHOTOGRAPH NO. 8

Operator inside containment blast cleaning. Note personal sampling pumps on belt.

Do I need to wear a respirator ?

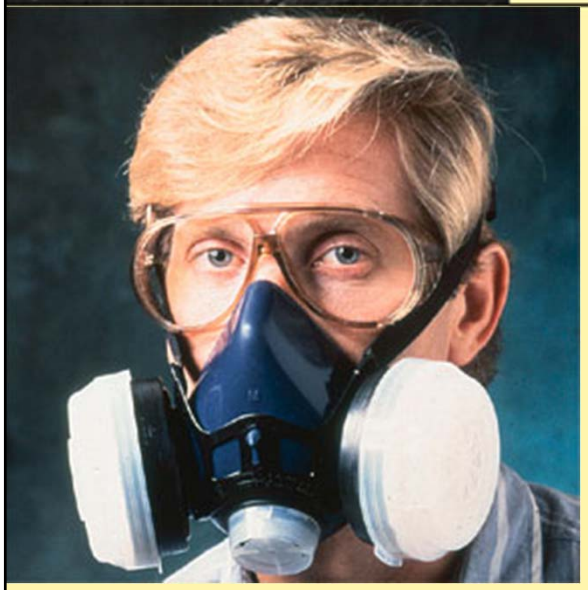
- What is the hazard?
- What is the degree of the hazard
  - What is expected range of concentrations?
  - What is relevant OEL?
- Work requirements
- The user

Types of Respirators

- Air Purifying Respirator (APR)
  - Non-powered APR
  - Powered Air Purifying Respiratory (PAPR)
- Atmosphere Supplying
  - Supplied Air Respirator (SAR)
  - Self Contained Breathing Apparatus (SCBA)
  - Combination

Also: Positive Pressure vs. Negative Pressure

APR/PAPR Examples



SAR & SCBA Examples

Assigned Protection Factor (APF)

- APFs and Maximum Use Concentrations (MUCs).

See: 29 CFR 1910.134

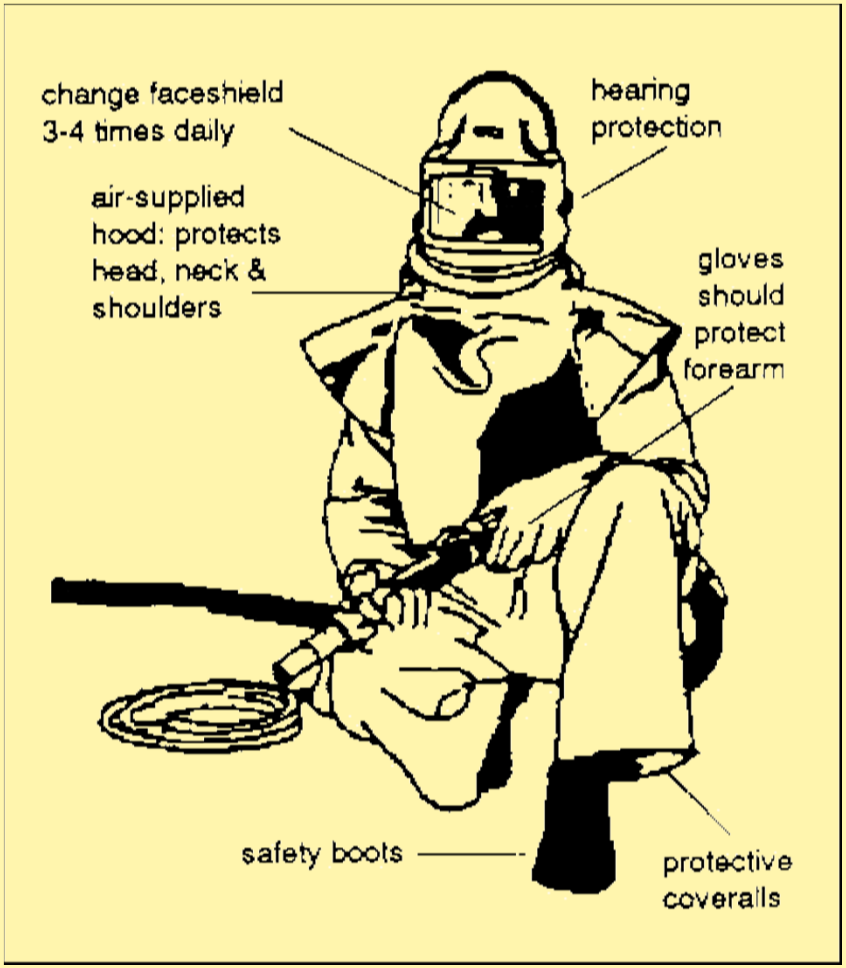
Assigned Protection Factors (APF)

Type of Respirator[1, 2]	Quarter mask	Half mask	Full facepiece	Helmet/Hood	Loose-fitting facepiece
1. Air-Purifying Respirator	5	10	50	—	—
2. Powered Air-Purifying Respirator (PAPR)	—	50	1,000	25/1,000[4]	25
3. Supplied-Air Respirator (SAR) or Airline Respirator					
• Demand mode	—	10	50	—	—
• Continuous flow mode	—	50	1,000	25/1,000	25
• Pressure-demand or other positive-pressure mode	—	50	1,000	—	—
4. Self-Contained Breathing Apparatus (SCBA)					
• Demand mode	—	10	50	50	—
• Pressure-demand or other positive-	—	—	10,000	10,000	—

OSHA Respirator Requirements- Abrasive Blasting

- "Abrasive-blasting respirator" or "Particulate-filter respirator" ("dust-filter respirator")
- Abrasive blasting respirators = NIOSH Type CE SAR
  - Required when:
    - working in enclosed or confined spaces; or
    - using abrasive media that contains more than one percent crystalline silica.
- For other situations, abrasive blasters must be protected with Type CE SAR or APR with HEPA (N-100) filters.

Abrasive Blasting PPE



NIOSH Type CE Respirator Approvals

30 models (total) currently approved by NIOSH

Approved Vendors

- MSA
- Clemco Industries Corp.
- E.D. Bullard Company
- Avon-International Safety Instruments, Inc.
- RPB Limited
- 3M Company

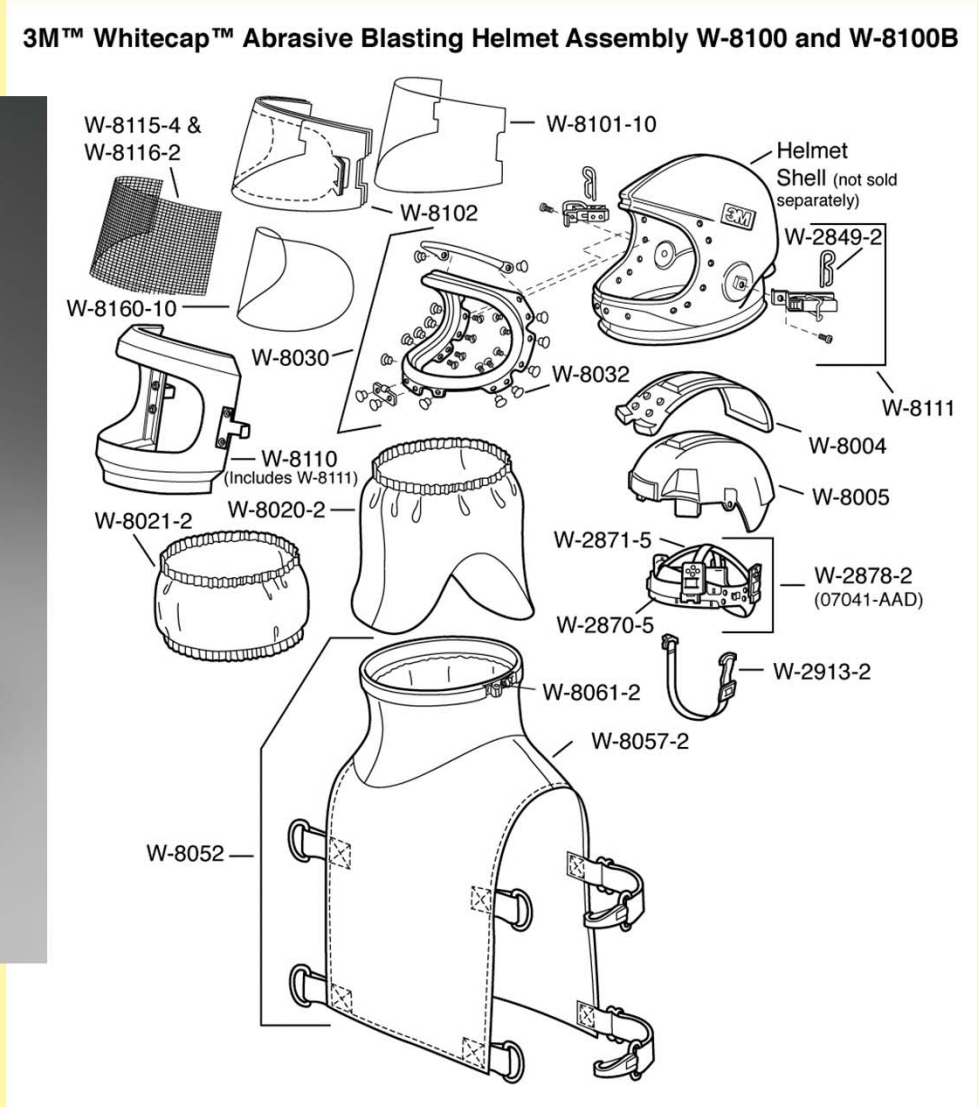
Note: loose fitting Type CE Abrasive Blasting Respirators (hoods, helmets) DO NOT need to be fit tested

Source: http://www2a.cdc.gov/drds/cel/cel_form_code.asp

Photos of CE Respirators-1

Photos of CE Respirators-2

Photos of CE Respirators-3



Photos of CE Respirators-4

Respiratory Protection Program

- OSHA 29 CFR 1910.134
  - Required whenever respirators are required to be worn
  - Written program is required
  - Additional program requirements

Elements of a Respiratory Protection Program

1. Procedures for selecting respirators
2. Medical evaluations
3. Fit testing procedures
4. Instructions on Use of respirators
5. Procedures for cleaning and maintaining respirators
6. Procedures to ensure adequate air quality/quantity
7. Training of employees in the potential respiratory hazards
8. Training of employees in the proper use of respirators
9. Procedures for regularly evaluating the effectiveness of the program.
10. Worksite Specific Procedures may be needed.

http://www.osha.gov/dts/osta/otm/otm_viii/otm_viii_2.html#4

Fit testing

- Loose fitting (hoods, helmets) Type CE Abrasive Blasting Respirators DO NOT need to be fit tested
- Tight fitting Type CE DO need to be fit tested
  - Quantitative
  - Qualitative

Examples of Improper Usage

- Facepiece seal leakage (not an issue with CE hood respirators)
- Removal of respirator at wrong time in hazardous atmosphere
- Improperly performing user seal checks
- Improperly repairing defective parts
- Improper air supply source (SAR)
- Improper air supply monitoring (SAR)

SAR air needs to be of

Alert: Abrasive Blaster Dies of Carbon Monoxide Poisoning

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Proper maintenance and use of compressor might have prevented this death

Hazard Summary:

A 43-year old, self-employed male sandblaster died of carbon monoxide poisoning at his outdoor work station.

Laborer Dies of Carbon Monoxide Poisoning During Sandblasting Operations in Virginia

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SUMMARY

A 46-year-old male laborer at an antique dealership was overcome by carbon monoxide while sandblasting wrought iron chairs. The victim had begun sandbl
working outdoors and was wearing an abrasive-blasting airline respirator. Air was supplied by a diesel-fueled air compressor which was later found to be

Grade D Breathing Air Required

- Compressed Gas Association (CGA) Specification

  Includes:

  – Air quality requirements

  – Monitoring requirements

- OSHA referenced requirement for SAR

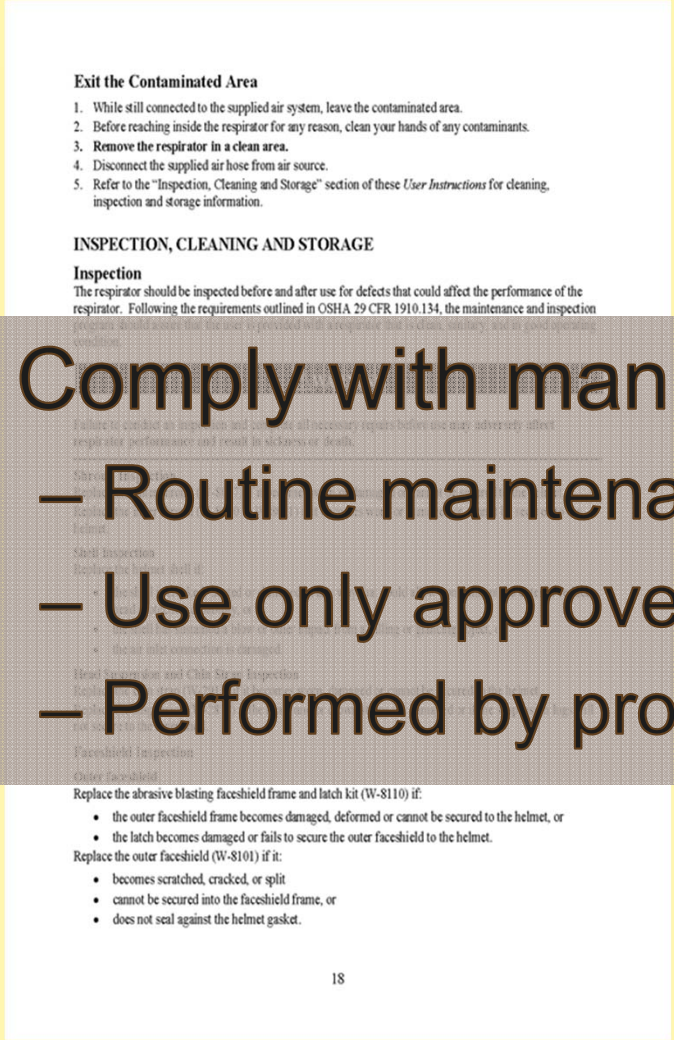
Temperature related issues

- Heat related illnesses of bigger concern in USA
- Emergency first aid training
- Prevention
  - Rest periods
  - Hydration
  - Fitness
  - Acclimatization
  - Climate control

Proper maintenance

- Quick pre-use inspection
  - By person using respirator
- Clean between use
  - Keep visibly cleaned
  - Wet cleaning better
  - Do not use air pressure blowing
  - Take care in choosing cleaning agents
    - Water and soap
    - Methanol or isopropanol impregnated wipes
  - May require vacuuming (with HEPA filtration)
  - Performed by person wearing respirator or another properly trained & authorized person

Follow Respirator User's Guide



Exit the Contaminated Area

1. While still connected to the supplied air system, leave the contaminated area.
2. Before reaching inside the respirator for any reason, clean your hands of any contaminants.
3. **Remove the respirator in a clean area.**
4. Disconnect the supplied air hose from air source.
5. Refer to the "Inspection, Cleaning and Storage" section of these *User Instructions* for cleaning, inspection and storage information.

INSPECTION, CLEANING AND STORAGE

Inspection

The respirator should be inspected before and after use for defects that could affect the performance of the respirator. Following the requirements outlined in OSHA 29 CFR 1910.134, the maintenance and inspection

Replace the abrasive blasting faceshield frame and latch kit (W-8110) if:

- the outer faceshield frame becomes damaged, deformed or cannot be secured to the helmet, or
- the latch becomes damaged or fails to secure the outer faceshield to the helmet.

Replace the outer faceshield (W-8101) if it:

- becomes scratched, cracked, or split
- cannot be secured into the faceshield frame, or
- does not seal against the helmet gasket.

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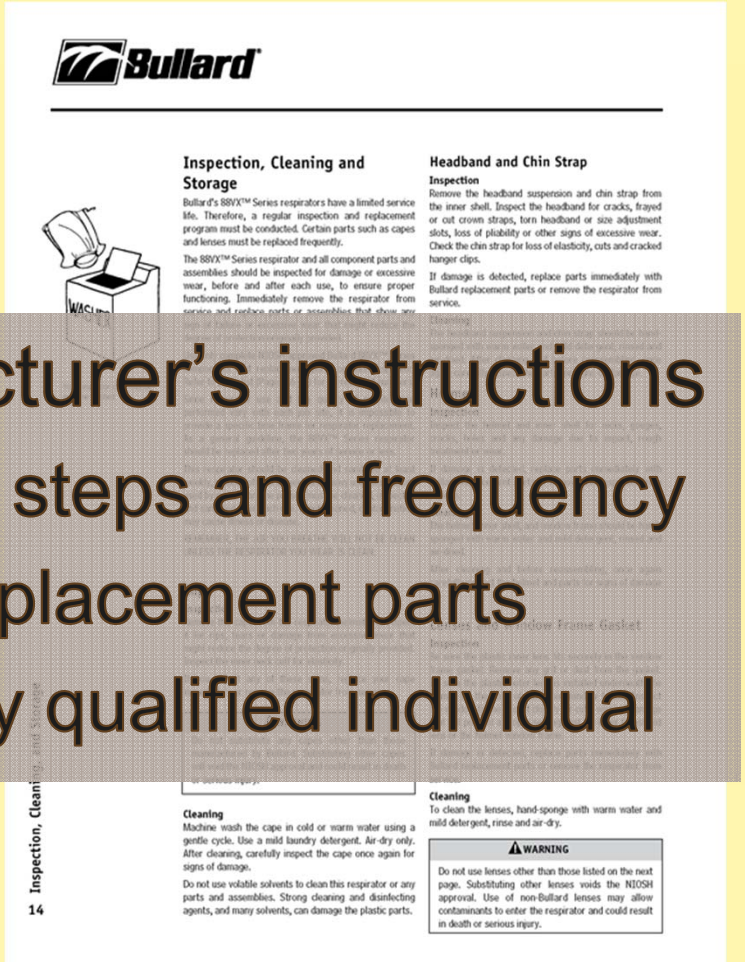

Bullard

Inspection, Cleaning and Storage

Bullard's 88VX™ Series respirators have a limited service life. Therefore, a regular inspection and replacement program must be conducted. Certain parts such as capes and lenses must be replaced frequently.

The 88VX™ Series respirator and all component parts and assemblies should be inspected for damage or excessive wear, before and after each use, to ensure proper functioning. Immediately remove the respirator from

Headband and Chin Strap

Inspection

Remove the headband suspension and chin strap from the inner shell. Inspect the headband for cracks, frayed or cut crown straps, torn headband or size adjustment slots, loss of pliability or other signs of excessive wear. Check the chin strap for loss of elasticity, cuts and cracked hanger clips.

If damage is detected, replace parts immediately with Bullard replacement parts or remove the respirator from service.

Cleaning

Machine wash the cape in cold or warm water using a gentle cycle. Use a mild laundry detergent. Air-dry only. After cleaning, carefully inspect the cape once again for signs of damage.

Do not use volatile solvents to clean this respirator or any parts and assemblies. Strong cleaning and disinfecting agents, and many solvents, can damage the plastic parts.

Cleaning

To clean the lenses, hand-sponge with warm water and mild detergent, rinse and air-dry.

WARNING

Do not use lenses other than those listed on the next page. Substituting other lenses voids the NIOSH approval. Use of non-Bullard lenses may allow contaminants to enter the respirator and could result in death or serious injury.

Inspection, Cleaning and Storage

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- Comply with manufacturer's instructions
  - Routine maintenance steps and frequency
  - Use only approved replacement parts
  - Performed by properly qualified individual

Conclusion

- Respiratory Hazards are due to
  - PM concentrations
  - Particle size
  - PM content
- Prevention is much better than Treatment
- PPE used only if controls not effective in reducing exposures
- APR N100 respirators of limited applicability
- Type CE respirators optimized for abrasive blasting
  - provide best combination of protection, ease of use and costs
- Respiratory Protection Program has specific required elements
- Protection from potential respiratory hazards is possible

Conclusion

- Respiratory Hazards are due to
  - PM concentrations
  - PM content
    - Media
    - Coatings
    - Substrates
- Prevention is much better than Treatment
- PPE used only if controls not effective in reducing exposures
- APR N100 respirators of limited applicability
- Type CE respirators optimized for abrasive blasting
  - Provide best combination of protection, ease of use and costs
- Respiratory Protection Program has specific required elements
- Protection is possible

Thank you for listening!

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