FPST 2023 – Industrial and Occupational Safety
Personal Protective Equipment (PPE)

OSHA PPE website

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1. Introduction of PPE

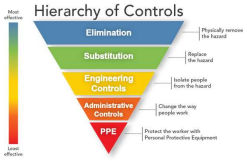
Purpose: Protecting employees from workplace hazards

Employers have a duty to protect workers from recognized hazards

Employers must:

(1) Use all feasible engineering and administrative controls to eliminate or mitigate hazards

(2) Use appropriate PPE if these controls do not eliminate the hazards.



Remember, PPE is the last level of control!

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Payment for PPE

- When PPE is required to protect employees, it must be **provided by the employer at no cost** to employees, except for specific items, such as:
  - Safety-toe footwear
  - Prescription safety eyewear
  - Weather-related gear
  - Logging boots

General work clothes not considered to be PPE (pants, shirts)

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Establishing a PPE Program

- Determine if hazards are present, or are likely to be present in workplaces
- Set out procedures for selecting, providing and using PPE as part of an employer's routine operation
- Once the proper PPE has been selected, the employer must provide training to each employee who is required to use PPE

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Training

Employees required to use PPE must be trained to know at least the following:

- When PPE is necessary
- What type of PPE is necessary
- How to properly put on, take off, and adjust
- Limitations of the PPE
- Proper care, maintenance, disposal

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PPE Examples

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2. Head Protection

ANSI Z89.1 – Head Protection
NFPA 1971 – Firefighting Equipment
NFPA 1951 – Technical Rescue

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Classes of Hard Hats

Class G

- General service (e.g., mining, building construction)
- Good impact protection but limited voltage protection

Class E

- Utility service (e.g., electrical work)
- Protect against falling objects, high-voltage shock/burns

Class C

- Special service, designed for comfort
- Protects heads that may bump against fixed objects, but do not protect against falling objects or electrical shock

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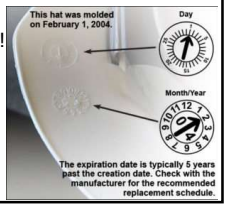
Maintenance of Head Protection

- Never use paint or stickers on a helmet that could affect the protective nature
  - hide signs of deterioration in the hard hat shell
  - weaken the shell of the hard hat
  - eliminate electrical resistance

- Do not wear helmets backwards!
- Hard Hats have a service life



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3. Eye and Face Protection

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Causes of Eye Injuries

- Dust and other flying particles, such as metal shavings or sawdust
- Molten metal that might splash
- Acids and other caustic liquid chemicals that might splash
- Blood and other potentially infectious body fluids that might splash or spray
- Intense light such as that created by welding and lasers

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Selection of Eyewear

- ANSI Z87.1-1989
  The eye and face protection standard

- Acid and chemicals
- Laser beam
- Welding

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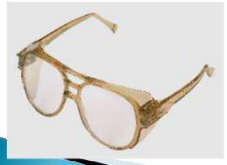
Safety Glasses

- Made with metal/plastic safety frames
- Most operations require **side shields**
- Used for moderate impact from particles produced by such jobs as carpentry, woodworking, grinding, and scaling



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Goggles

- Protect eyes, eye sockets, and the facial area immediately surrounding the eyes from **impact, dust, and splashes**
- Some goggles fit over **corrective lenses**

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Welding Shields

Protect eyes from burns caused by infrared or intense radiant light, and protect face and eyes from flying sparks, metal spatter, and slag chips produced during welding, brazing, soldering, and cutting

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Filter Lenses for Protection Against Radiant Energy			
Operations	**Electrode Size 1/32 in.**	**Arc Current**	**Minimum* Protective Shade**
Shielded metal arc welding	Less than 3	Less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11
Gas metal arc welding and flux cored arc welding		less than 60	7
		60-160	10
		160-250	10
		250-500	10
Gas Tungsten arc welding		less than 50	8
		50-150	8
		150-500	10
Air carbon	(Light)	less than 500	10
Arc cutting	(Heavy)	500-1000	11
Plasma arc welding		less than 20	6
		20-100	8
		100-400	10
		400-800	11
Plasma arc cutting	(light)**	less than 300	8
	(medium)**	300-400	9
	(heavy)**	400-800	10
Torch brazing			3
Torch soldering			2
Carbon arc welding			14

Filter Lenses for Protection Against Radiant Energy			
Operations	**Plate thickness-inches**	**Plate thickness-mm**	**Minimum* Protective Shade**
Gas Welding:			
Light	Under 1/8	Under 3.2	4
Medium	1/8 to 1/2	3.2 to 12.7	5
Heavy	Over 1/2	Over 12.7	6
Oxygen cutting:			
Light	Under 1	Under 25	3
Medium	1 to 6	25 to 150	4
Heavy	Over 6	Over 150	5

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Laser Safety Goggles

Protect eyes from **intense concentrations of light** produced by lasers.

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Face Shields

- Protect the face from nuisance dusts and potential **splashes** or sprays of **hazardous liquids**
- Do not protect employees from **impact hazards**
- To obtain the level of protection, **face shields** must be combined with basic eye protection

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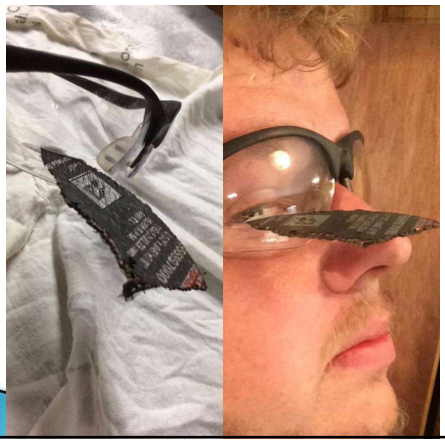

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4. Hearing Protection

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29 CFR 1910.95
Permissible Noise Exposure

Noise Level	Exposure Limit
90 dBA	8.0 hours
92 dBA	6.0 hours
95 dBA	4.0 hours
97 dBA	3.0 hours
100 dbA	2.0 hours
102 dBA	1.5 hours
105 dBA	1.0 hours
110 dBA	30 minutes
115 dBA	15 minutes

Table 1. OSHA's Permissible Noise Exposure Limits.

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Examples of Hearing Protectors

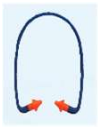
Earmuffs

NRR 30 DB

Earplugs

NRR 33 DB

Canal Caps



NRR 27 DB

Custom Molded

NRR 31 DB

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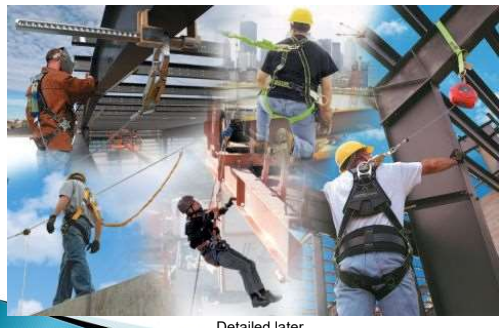
5. Fall Protection



Detailed later

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6. Respiratory Protection

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Respiratory Protection

- Protection against **airborne contaminants**
- **Hazardous Atmospheres**
  - **IDLH**
    - Immediately Dangerous to Life or Health
    - A single acute exposure is expected to result in irreversible damage to health
      - for example: hydrogen fluoride gas and cadmium vapor can cause possibly fatal collapse 12 to 72 hours after exposure

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Respiratory Protection

- A well-planned program
  - proper selection of the respirators
  - fit testing
  - regular maintenance
  - employee training
- Responsibility of the employer and S&H manager to make sure equipment used properly
- Classification
  - Air-purifying devices
  - Atmosphere-supplying devices

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Air Purifying Respirators

Quarter Mask

Half Mask

Full Facepiece

Mouthpiece/Nose Clamp
(no fit test required)

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Dusk Mask

- The most popular respirator but frequently misused
- Used for preventing of particulates (suspended solids), not for most painting and welding hazards
- Limitation:
  - used for preventing irritant dusts
  - fit problem, more than 20% leakage
- Advantages:
  - inexpensive
  - sanitary
  - easy disposal

Air-purifying devices

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Half Mask

- Fit underneath the chin and extends to the bridge of the nose
- Have four suspension points, two on each side of the mask connected to rubber or elastic about the head

Air-purifying devices

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Full-Face Mask

- Canisters contain granular sorbents that filter the air by adsorption, absorption, or chemical reaction

Air-purifying devices

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Atmosphere Supplying Respirators

Air Line Respirator

Self Contained Breathing Apparatus SCBA

Combination Respirator

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Air Line Respirator

- The air line respirator is an atmosphere-supplying respirator and derives its name from the way in which air is supplied to the respirator mask
- Hose: a small-diameter less than 300 feet long
- Air supply: cylinders or compressors
- Types:
  - continuous flow
  - pressure demand flow

Atmosphere-supplying respirators

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Continuous Flow Air Line Respirator

- The air line respirator receives fresh air without any action on the part of the user
- Minimum air flow: 6 ft^3/min
- Advantage
  - permit use of a leaky, loose-fitting hood or face piece
  - the positive pressure differential preventing toxic agent entry
- Need a compressor for the unlimited supply of air

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Loose-Fitting Coverings

Hood

Helmet

Loose-Fitting Facepiece

Full Body Suit

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Pressure Demand Flow Air Line Respirator

- Air doesn't flow until a valve opens, caused by a negative pressure created when the user inhales
- Advantage:
  - uses less air
- Disadvantage:
  - need a tight-fitting facepiece
  - the inhalation valve can fail to open if the facepiece is too leaky

Atmosphere-supplying respirators

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Self-Contained Breathing Apparatus

- The user carries all of the apparatus on the back
- Advantage:
  - increasing the distance the user
- Disadvantage:
  - the large pack on the back may restrict the passage of the user through a manhole or vessel entry
  - many fatalities have occurred when rescue breathing packs were rendered useless, because the rescuer was unable to enter the vessel

Atmosphere-supplying respirators

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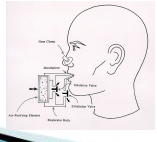
Mouthpiece Respirator

- Enable the user to prepared to escape during an emergency
- Breathing is accomplished through the mouth by means of a stem held inside the teeth
- A nose clip must be used to prevent inhaling through the nose
- The effectiveness is greatly dependent on the knowledge and skill of the user



Air-purifying devices

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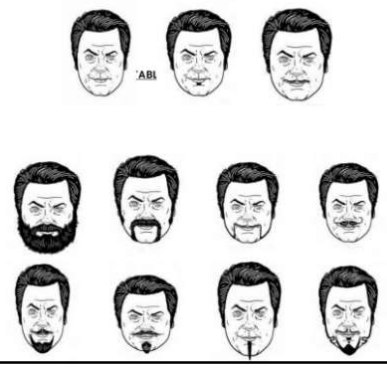
Facial Hair and Respirators



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7. Hand and Arm Protection

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Types of Gloves

Norfoil laminate resists permeation and breakthrough by a number of toxic/hazardous chemicals.

Butyl provides the highest permeation resistance to gas or water vapors; frequently used for ketones (M.E.K., Acetone) and esters (Amyl Acetate, Ethyl Acetate).

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Types of Gloves (cont'd)

Viton is highly resistant to permeation by chlorinated and aromatic solvents.

Nitrile provides protection against a wide variety of solvents, harsh chemicals, fats and petroleum products and also provides excellent resistance to cuts, snags, punctures and abrasions.

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Types of Gloves (cont'd)

Kevlar protects against cuts, slashes, and abrasion.

Stainless steel mesh protects against cuts and lacerations.

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Ansell Permeation Tables

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PPE Selection Guide

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Anti – Impact Gloves

- Dense Thermal Plastic or Rubber pads
- Padded palms
- Molded knuckles

- No testing

- No glove is invincible
- Protect from glancing blows, but not full impact.

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8. Foot Protection

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Causes of Foot Injuries

- Heavy objects such as barrels or tools that might roll onto or fall on employees' feet
- Sharp objects such as nails or spikes that might pierce the soles or uppers of ordinary shoes
- Molten metal that might splash on feet
- Slippery, hot, or wet surfaces

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Safety Shoes

- Have impact-resistant toes and heat-resistant soles that protect against hot surfaces common in roofing, paving, and hot metal industries
- Some have metal insoles to protect against puncture wounds
- May be designed to be electrically conductive for use in explosive atmospheres

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9. Body Protection

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Causes of Body Injuries

- Intense heat
- Splashes of hot metals and other hot liquids
- Impacts from tools, machinery, and materials
- Cuts
- Hazardous chemicals
- Contact with potentially infectious materials, like blood
- Radiation

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Body Protection

Cooling Vest

Sleeves and Apron

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Body Protection

Coveralls

Encapsulating Suit

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10. Summary

Employers must implement a PPE program

- Assess the workplace for hazards
- Use engineering and work practice controls to eliminate or reduce hazards before using PPE
- Select and provide appropriate PPE at no cost to employees to protect them from hazards that cannot be eliminated
- Train employees how to use and care for their PPE and how to recognize deterioration and failure
- Require employees to wear PPE in the workplace