Personal Protective Equipment

Presented by:
Samar Khalil, Environmental & Chemical Safety Officer
• What are Personal Protective Equipment (PPE)?
• What type of PPE do you use most frequently?
• How do you select your PPE?
• Do you feel protected when you are wearing PPE?
• For you, what is the biggest challenge (problem) in using personal protective equipment?
• What are the biggest mistakes that you think healthcare workers make when wearing PPE?
Dr. Wetterhahn died at age 48. She was a chemistry professor at Dartmouth University. She wore her PPE, but it was the wrong choice.

- Conducting heavy metals research at Dartmouth in 1997 – spilled a tiny drop of a common metal on a gloved hand.
- Symptoms: tingling in hands, nausea, weight loss, stumbling, gradual loss of sight and hearing
- Six months later she slipped into a coma
- In ten months she was gone....
Case Study

Researcher Fatality
(Dr. Karen Wetterhahn, 1948 -1997)

What heavy metal caused this fatality?

One drop of dimethyl mercury, which was absorbed through her latex glove and intact skin.
Case Study
Researcher Fatality

*What could the researcher do to work in a safe manner?*

- Review Material Safety Data Sheet (MSDS)
- Plan out work and account for likely hazards
- Ensure adequate controls (Isolation, ventilation)
- Training
- Personal protective equipment
What is a Personal Protective Equipment (PPE)?

PPE is an equipment worn by an employee and which is designed to prevent injury or illness from a specific hazard.
Identifying and assessing the hazards will help us select the proper PPE for that hazard.
PPE Selection

PPE Should Be Considered Only After Administrative and Engineering Controls Have Been Applied.
Hierarchy of Hazard Control

- Elimination
- Substitution
- Engineering
- Administrative
- PPEs

Lab Hoods, Snorkels, Gas Cabinets, etc.

Limiting exposure time, Rotating employees, Attention to susceptible employees, etc.
OSHA (29 CFR.1910.132) requires:

• Hazard assessments *before* worker assignment
• Selection of appropriate equipment
• Communicate selection decision to employees
• Train in use and limitations of PPE
• Employer to supply PPE
Hazard Sources

• Sources of motion:
  Machines, personnel in motion.

• Sources of extreme temperatures:
  Thermal or freezer burns, ignition of PPE

• Types of chemical exposures:
  Chemicals handling, leaks

• Sources of harmful dust:
  Welding of metals, asbestos or other dusts

• Sources of light radiation:
  Welding, cutting, high intensity light
• Sources of falling objects or potential for dropping objects:
  Dropping of heavy objects

• Sources of sharp objects:
  Needles, glass

• Sources or rolling or pinching objects:
  Machines, door hinges (any thing that crushes feet/hands)

• Layout of workplace and location of co workers:
  Due to their presence or their operation

• Electrical hazards
Types of PPEs

- Head Protection
- Hearing Protection
- Eye/Face Protection
- Breathing Protection
- Visibility
- Fall/Absrt Protection
- Hand Protection
- Foot Protection
- Other Protection (as needed)
Head Protection
Types of Hard Hats

- Standard hardhats must be able to withstand a **40 foot-pound impact**, which is the equivalent of a one pound hammer falling 40 feet.

- To do this a hardhat consists of two parts: the **outer shell** and the **inner suspension system**.

- The suspension system is designed to absorb the impact of a striking object. The effectiveness of the suspension system is reduced if objects are placed between it and the outer-shell.

- Type I are designed to protect against a direct impact to the top of the hardhat.

- Hardhats rated Type II are designed to protect against both top and side impacts.
Types of Hard Hats

- **Class G hard hats** provide impact and penetration resistance along with limited voltage protection (up to 2,200 volts).

- **Class E hard hats** provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying/falling objects.

- **Class C hard hats** provide lightweight comfort and impact protection but offer no protection from electrical hazards.
Eye Protection

Your eye sight is priceless
Once it is lost! all the money in the world can not bring it back
Types of Eye Protection

- Non-Prescription safety glasses.
- Prescription safety glasses.
  - Employees that wear prescription (Rx) lenses can use non-prescription eye protection worn over prescription lenses as long as it does not compromise the fit of either piece of eyewear.
- All eye protection must be ANSI Z87 approved.
Types of Eye Protection

- Goggles
  - Chemical
  - Laser

- Chemical goggles protect your eyes, eye sockets, and the facial area immediately surrounding the eyes from impact, dust, and splashes.
- Chemical goggles are generally stronger than safety glasses and are used for higher impact, particle and chemical splash protection.
- Laser goggles protect the eyes from harmful light.

- All eye protection must be ANSI Z87 approved.
Face PPE

• Needed when work presents the potential of causing facial injury from physical, chemical, or radiation agents.

• Examples of hazards:
  • Contents under pressure
  • Splash hazard
  • Flying objects / particles

• Safety goggles or goggles must always be worn under a face shield.
• Once goggles are in place, position face shield over face and secure on brow with headband.

• Adjust to fit comfortably.
Proper Fit Use of Eye PPE’s

• All eye and face protection must
  – Be adequate for the hazard
  – Fit snugly
  – Not interfere with your movements
  – Be durable, easy to clean and disinfect
  – Be Kept in good shape
Hand Protection
Hand Hazard Categories

• Chemical, e.g., irritants, allergens corrosives, dermal toxins systemic toxins, cancer causing agents.

• Physical, e.g., trauma producing, thermal hazards (hot/cold), fire, vibration, radiation.

• Biological, e.g., human, animal, or environmental pathogens.
Hand Hazard Categories

Various categories are available based on hazard intensity and severity on exposure to hazard

- Electrician gloves
- Chemical gloves / gaunlets
- Cut resistant gloves
- Pierce resistant gloves
- Anti impact gloves
- Anti vibration gloves
- Welders hand gloves
- Heat resistant gloves
- Insulation [cold resistant] gloves
Gloves & Protective Clothing

factors to consider

• Degradation
  – Harmful change in one or more physical properties of a protective material when subjected to a chemical

• Penetration
  – The flow of chemicals through closures, zippers, seams, pinholes, etc.

• Permeation
  – Movement of a chemical through a protective material
Factors to Consider (continued)

• Permeation rate
  – The amount (mass) of chemical per unit time for an area of material once steady state has been achieved. Units are usually expressed as mg of chemical per square meter of material per minute (or second).
  – Permeation tests are usually conducted for up to 8 hours. If no breakthrough, usually expressed as BT > 480 min.

• Breakthrough time
  • Time for a chemical to pass through a protective material
Gloves Selection

- Chemical toxicity
- Permeation parameters for chemical/glove
- Nature of exposure
- Physical factors associated with job
  - Cut resistance and tearing
  - Manual dexterity and flexibility
  - Temperature extremes
- Cost
# General Guidance on Protective Gloves for Work with Chemicals

<table>
<thead>
<tr>
<th>Type of Chemical</th>
<th>Natural Rubber</th>
<th>Nitrile</th>
<th>Neoprene</th>
<th>PVC</th>
<th>Butyl</th>
<th>Viton</th>
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<tbody>
<tr>
<td>Water miscible substances, weak acids/alkalis</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
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<tr>
<td>Oils</td>
<td></td>
<td>X</td>
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<tr>
<td>Chlorinated Hydrocarbons</td>
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<tr>
<td>Aromatic Solvents</td>
<td></td>
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<td></td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Aliphatic solvents</td>
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<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Strong acids</td>
<td></td>
<td></td>
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<td></td>
<td>X</td>
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<tr>
<td>Strong alkalis</td>
<td></td>
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<tr>
<td>PCBs</td>
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<td>X</td>
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</tbody>
</table>
Best Manufacturing Company (http://www.showabestglove.com/site/chemrest/default.aspx)

Ansell's SpecWare (http://www.ansellpro.com/specware/)


Honeywell (http://www.honeywellsafety.com/USA/Product_Catalog/Gloves.aspx)

Microflex (http://www.microflex.com/Products/Wizard.aspx#Wizard)

Chemrest (http://www.chemrest.com/)
DEMONSTRATION
Wearing & Removing Gloves
Removing Gloves
Foot Protection
Feet PPE

- Needed when work presents hazards that have potential to cause a foot injury:

- Examples of hazards:
  - Falling objects
  - Rolling objects
  - Piercing/cutting injuries
  - Electrical work
  - Chemical exposure
Types of Foot Protection

- Impact and compression protection for toes
- Metatarsal protection
- Electrical hazard protection (600 volts or less under dry conditions)
- Conductive protection (minimize static electricity)
- Protection against punctures and penetration
- Must be ANSI Z41 or ASTM F2413-05 approved.
Body Protection
Body PPE

• Needed when work presents a potential for contamination or injury to other parts of the body such as legs, arms, back, chest.

• Examples of hazards:
  • Heat
  • Splashes
  • Hot/cold metals and liquids
  • Impacts
  • Sharp objects
  • Chemicals
  • Radiation
Types of Body Protection

- Laboratory coats
- Laboratory gowns
- Laboratory aprons
- Coveralls
Fall Protection
A Personal Fall Arrest System is comprised of three (3) key components – anchorage connector; body wear; and connecting device.

Remember: A, B, & C

A = Anchorage/Anchorage Connector (Ex: I-beam, scaffolding, lifeline, etc.)

B = Body Wear (e.g. Full body harness)

C = Connecting Device (e.g. a shock-absorbing lanyard or self-retracting lifeline)
Hearing Protection
Hearing Protection

• Sound/Noise is measured in dB

• Any loud noise will affect your hearing

• You may start loosing your hearing if you are exposed to sound levels exceeding 85 dBA over an 8 hrs consecutive shift (without hearing protection)

• Hearing loss from Noise can be temporary or permanent.
## Hearing Protection

<table>
<thead>
<tr>
<th>Safe Exposure Duration (hrs)</th>
<th>Sound Level (dB)</th>
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<tbody>
<tr>
<td>24</td>
<td>80</td>
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<tr>
<td>16</td>
<td>82</td>
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<td>8</td>
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<td>88</td>
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<td>91</td>
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<td>1</td>
<td>94</td>
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<tr>
<td>0.5</td>
<td>97</td>
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<tr>
<td>0.25</td>
<td>100</td>
</tr>
</tbody>
</table>
• Ear plug
• Ear muffs
• Combination muffs and plugs
Hearing Protection

• Hearing Protection effectively reduce noise by 25-30 dBA

• Above 120 dBA conduction of noise to the inner ear starts to defeat plugs, muffs, etc.
Respiratory Protection
Respiratory Protection

OSHA’s general policy on respirator use:

• Where engineering or administrative controls are not feasible or insufficient

• During the time when engineering or administrative controls are being implemented (depending on the TLV)

• For emergency response situations
Types of Respirators

Air-purifying respirators

- Filters (for particulates)
- Cartridges (for gases or vapors) - may have filters, too
- Canisters (used with “gas masks”, large capacity)
- Oxygen must be > 19.5%

Atmosphere supplying respirators

- SCBA’s
- Supplied air respirators
- Combinations of SCBA’s and SAR’s
Air Purifying Respirators

**Particulate respirators**
- capture particles in the air, such as dusts, mists, and fumes
- do not protect against gases or vapors
- generally become more effective as particles accumulate on the filter and plug spaces between the fibers
- filters should be replaced when user finds it difficult to breath through them

**Combination respirators**
- used in atmospheres that contain hazards of both particulates and gases
- have both particulate filters and gas/vapor filters
- may be heavier

**Gas & vapor respirators**
- Used only for protection against specific hazardous gases and vapors
- use chemical filters (called cartridges or canisters) to remove dangerous gases or vapors
- do not protect against airborne particles
- provide protection only as long as the filter's absorbing capacity is not depleted
Particulate Filters

- 3 levels of filter efficiency:
  - 95% (called “95”)
  - 99% (called “99”)
  - 99.97% (called “100”)

- 3 categories of resistance to filter efficiency degradation:
  - N (Not resistant to oil)
  - R (Resistant to oil)
  - P (oil Proof)

Choose filter efficiency (95%, 99%, 99.97%)

Does the aerosol contain oil?

- Yes/unknown
  - Will the filter be used for more than 8 hrs?
    - Yes
      - Use P-series filters
    - No
      - Use R-series or P-series filters
  - No
    - Use N-series or R-series or P-series filters
Service Life of Cartridges or Canisters

Depends on:

– Quality and amount of absorbent
– Packing uniformity and density
– Exposure conditions, breathing rate
– Relative humidity
– Temperature
– Contaminant concentration
– Affinity of the gas or vapor for the absorbent
– Presence of other gases and vapors
Air Purifying Respirators

Air Line Respirators
- makes use of a hose to deliver clean, safe air from a stationary source of compressed air
- provides clean air for long periods of time and are lightweight for the user
- limits the range of user-mobility and may fail due to hose damage
- used when extended work periods are required in atmospheres that are not immediately dangerous to life and health (IDLH)

Combination Respirators
- have an auxiliary self-contained air supply that can be used if the primary supply fails
- the self-contained portion can be small since it only needs to supply enough air for escape
- can be used for entry into confined spaces
- used when extended work periods are required in atmospheres that are or may be immediately dangerous to life and health (IDLH)

Self Contained Breathing Apparatus
- consists of a wearable, clean-air supply pack
- do not restrict movement with a hose connection
- the closed-circuit type can provide air up to 4 hours
- the open-circuit type only provide air for 30 - 60 minutes
- used when there is a short-time need to enter and escape from atmospheres which are or may be immediately dangerous to life and health (IDLH)
Not Everyone Can Wear A Respirator

• A respirator can not be worn with:
  – Contact lenses
  – Glasses with temple pieces
  – A beard, mustache, or sideburns

• A respirator can not be worn if you have:
  – Breathing problems, asthma
  – Heart condition
  – Claustrophobia
  – Heat sensitive
• Even a tiny gap between the respirator and your face could let in the contaminated air

• A respirator must fit well or it will not work

• Fit testing:

  Quantitative:
  Computerized means of detecting face seal leakage

  Qualitative
  Relies on wearer’s subjective response to taste, odor or irritation
• Check prior to each use for cuts, cracks or discoloration.
• Replace as necessary.
• Discard single use PPEs after use.
• PPE must be kept clean and sanitary. Clean PPE with mild soap and water. Some PPE may require special cleaning, in these cases use the manufacturer’s recommendations.
• If PPE is contaminated and cannot be decontaminated safely, it may need to be disposed of in a special manner to protect other employees from exposure to the hazard.
• PPE shall be stored in such a way that it will not become contaminated such as plastic bags, lockers, closet, drawers.
Exercise: Case Study

- An electrician is working on a construction site. He is using a drill to install electrical appliances. Moreover, he will be testing electrical connections and will be working at height.
- Identify hazards and appropriate PPEs to protect this worker.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>PPE</th>
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</table>
Exercise: Case Study

• An electrician is working on a construction site. He is using a drill to install electrical appliances. Moreover, he will be testing electrical connections and will be working at height on a scaffold.

• Identify hazards and appropriate PPEs to protect this worker.

<table>
<thead>
<tr>
<th>Hazard</th>
<th>PPE</th>
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<tbody>
<tr>
<td>Noise</td>
<td>Ear plugs and ear muffs</td>
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<tr>
<td>Electrical hazard</td>
<td>Isolated gloves, shoes, clothing</td>
</tr>
<tr>
<td>Flying objects, fragments</td>
<td>Safety glasses</td>
</tr>
<tr>
<td>Working at height</td>
<td>Full body harness and lanyard</td>
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<tr>
<td>Dust</td>
<td>Dust mask</td>
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</table>
As long as a face shield covers your eyes, you aren’t required to wear eye protection.

Sandals and running shoes provide protection from most workplace hazards.

There is no single work glove that is effective for all tasks.

Class E hardhat is rated for up to 20,000 volts of electricity.
Questions?
Thank you