

PERSONAL PROTECTIVE EQUIPMENT (PPE)



SCME Personal Protective Equipment Learning Module

Unit Overview

When manufacturing microsystems in a cleanroom environment there are many hazardous materials involved. This unit provides information on the Personal Protective Equipment (PPE) necessary to work with these materials.

- ❖ Why PPE is important in microsystems manufacturing
- ❖ Types of PPE used in microsystems manufacturing
- ❖ How to use the PPE appropriately

Objectives

- ❖ State why PPE should be used when handling hazardous materials.
- ❖ State the types of PPE commonly used in microsystems manufacturing.
- ❖ Describe the appropriate use of PPE for a specific situation.

Why Do You Need to Know About PPE?

- ❖ There are many chemical processes involved in the manufacturing of microsystems
- ❖ Large amounts of acids, bases, and solvents are used
- ❖ Chemical use can be dangerous
- ❖ When working with chemicals, PPE must be used

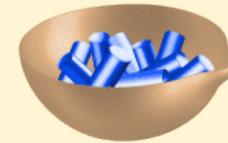


*PPE required for acids, corrosives
[Picture courtesy of Bob Willis]*

The Shape of Hazardous Materials

Hazardous materials can be in the following forms:

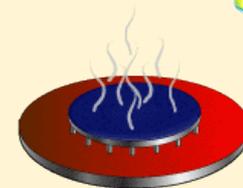
- ❖ Liquids
- ❖ Solids
- ❖ Gases
- ❖ Vapors
- ❖ Fumes
- ❖ Mists
- ❖ Fibers
- ❖ Dust



Metal Pellets



Liquid



Fumes

*Types of Hazardous Materials used in
Microsystems Fabrication*

Use the appropriate PPE when working with any hazardous chemical or equipment.

Hazards Present in Microsystems Manufacturing

Common hazards in a microsystems manufacturing environment:

- ❖ Health Hazard - Exposure to dangerous chemicals may cause acute or chronic health effects.
- ❖ Physical Hazard - A violent change occurs when subjected to external factors such as heat, vibration, or oxygen, or in some cases, normal temperature and pressure.
- ❖ Equipment Hazard - Exposure to dangerous equipment and/or equipment supplies or tools.

Specific Hazards

- ❖ What are some chemicals that could be a health hazard?
- ❖ What are some chemicals that create physical hazards?
- ❖ What are some types of equipment hazards?

Specific Hazards

- ❖ What are some types of chemicals that could be a health hazard?
 - ▣ Carcinogens, corrosives, poisons, irritants, teratogens
- ❖ What are some types of chemicals that create physical hazards?
 - ▣ Flammables, explosives, radioactive, oxidizers
- ❖ What are some types of equipment hazards?
 - ▣ Electrical, mechanical movement, radiation, hot surfaces

Routes of Entry

Hazardous chemicals may cause bodily damage by one or more of the following routes of entry:

- ❖ Inhalation - breathing it in
- ❖ Dermal (Absorption) - penetrating or irritating the skin or eye
- ❖ Ingestion - swallowing

Health Hazards

Common health effects caused by exposure to a hazardous chemical.

- ❖ Irritant - irritating effect
- ❖ Sensitizer - allergy developed over time
- ❖ Asphyxiant - suffocation
- ❖ Carcinogen - cancer causing
- ❖ Mutagen - changes genetic makeup
- ❖ Teratogen - affects developing fetus

Common PPE



PPE includes clothing and other accessories designed to protect against hazards during work and/or play. Here are some examples of PPE:

- ❖ Bullet proof vests
- ❖ Fire protective gear
- ❖ Oven mitts
- ❖ Helmets

PPE makes working and playing safer and more productive.

Your Turn



What are some common PPE that you use on a regular basis?

PPE Used in Microsystems Manufacturing

OSHA has PPE Standard

- ❖ PPE OSHA Standard - 29 CFR 1910.132-138
- ❖ Employers must establish and administer proper PPE, a PPE program and PPE training

PPE is available for the following parts of the body:

- ❖ Respiratory system
- ❖ Hands
- ❖ Eyes and face
- ❖ Feet
- ❖ Body

Atmospheric Hazards

Atmospheric hazards may exist in these forms:

- ❖ Fumes
- ❖ Gases
- ❖ Vapors
- ❖ Particles

Fumes

- ❖ Contain both gases (vapors) and dusts
- ❖ Require more careful attention than dusts or vapors
- ❖ Need to control the generation of fumes
- ❖ Use fume hoods and other engineering controls

PPE for the Respiratory System



*Air Purifying Respirator and Supplied Air Respirator
[Pictures courtesy of MATEC]*

What is a Respirator?

- ❖ A respirator is used when ventilation controls are not available
- ❖ A respirator is worn over the nose and mouth
- ❖ Two types of respirators which will be discussed:
- ❖ Air Purifying Respirators (left picture)
- ❖ Supplied Air Respirators (right picture)

How to Use a Respiratory

Concerns Before Using a Respirator

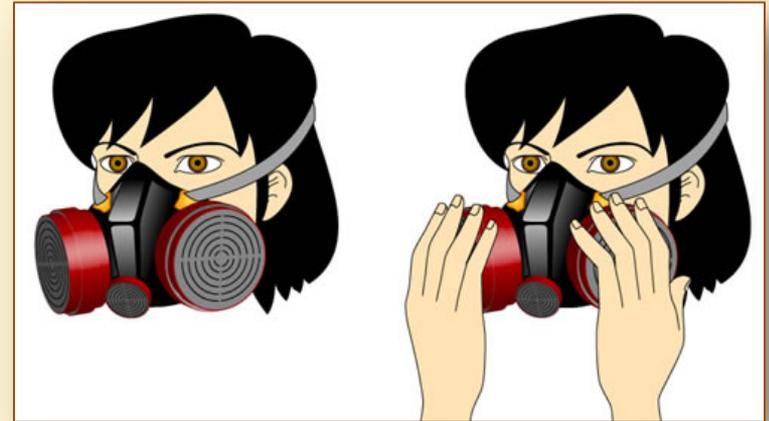
- ❖ Using a respirator requires the lungs and the heart to work harder
- ❖ If you have heart or lung conditions, a respirator may be dangerous
- ❖ Facial hair prevents the respirator from making a proper seal
- ❖ Shave any facial hair that touches the edge of the respirator

Properly Fitting a Respirator

- ❖ You must be fit-tested by a qualified person at least once a year
- ❖ A **seal check** must be performed every time a respirator is used

How to Perform a Seal Check

- ❖ Firmly cover the exhalation ports on the mask with the palms of your hands
- ❖ Inhale and exhale more strongly than usual
- ❖ If no air flows in or out of the respirator's seal is detected, then the respirator fits properly.



PPE for Hands



Acid Gloves and Solvent Gloves

Hand protection is required when handling acids or solvents. It is important to wear "acid gloves" when working with acids and "solvent gloves" when working with solvents.

Proper Use of Acid and Solvent Gloves

- ❖ Wear over cleanroom disposable gloves
- ❖ Acid gloves - thick rubber based composites (nitrile rubber, butyl rubber, natural rubber)
- ❖ Solvent gloves - commonly made of thick nitrile
- ❖ Make a 2" cuff to prevent chemical from running down the arm
- ❖ When removing, pull from the cuffs, turning the gloves inside out.
- ❖ Place into the respective acid or solvent waste container



Acid glove with 2" cuff



Proper glove removal

[Pictures courtesy of Bob Willis]

PPE for Hand (Continued)

Leak Test

Acid gloves and solvent gloves must be checked for holes or leaks

- ❖ Test Method 1: Seal the edges of the glove to your mouth with your hand, blow into it like a balloon. Listen for air leaks.
- ❖ Test Method 2: Inflate with nitrogen and submerge in water. Watch for bubbles.

If a leak is detected, dispose of the glove. Perform the leak test with a new pair of gloves. Repeat this process until no leaks are found.

PPE for Eyes

Safety Glasses and Eye Goggles

- ❖ Eye goggles and/or safety glasses are common gowning attire
- ❖ Safety glasses and goggles must have side shields
- ❖ Contact lenses are discouraged when working in a cleanroom; therefore, goggles or safety glasses are generally made to fit over eye glasses
- ❖ Eye goggles and safety glasses can be made with prescription lenses



PPE for Face

Face Shield

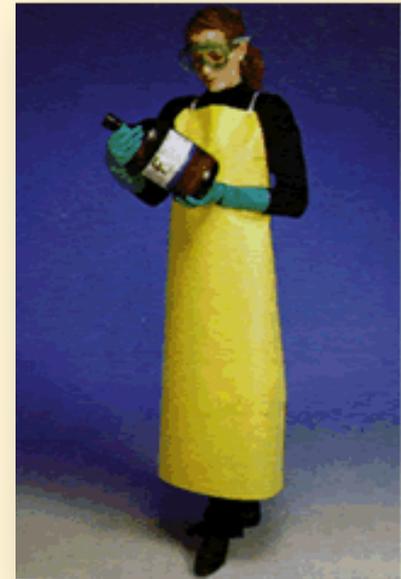
- ❖ A special face shield must be worn when working with acids and solvents
- ❖ Safety goggles or glasses must be worn to cover the eyes at all time
- ❖ The face shield is worn over the goggles or glasses



PPE for the body

Acid Aprons

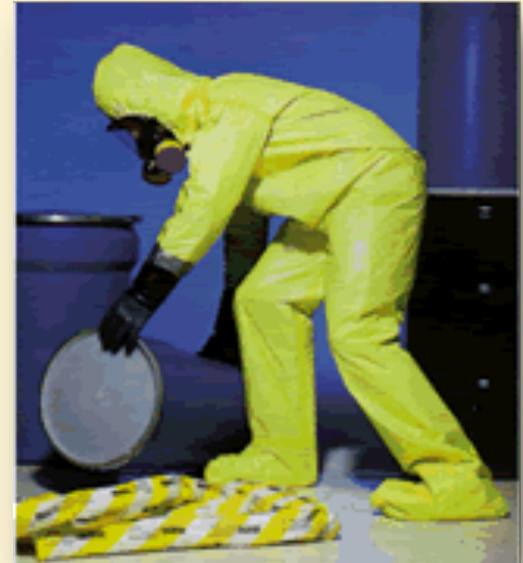
- ❖ Extra protection is required above and beyond a cleanroom smock or bunnysuit when using acids or solvents
- ❖ In the case of a splash or spill, acid aprons can be removed quicker than a bunnysuit or smock
- ❖ Acid aprons are commonly made from a rubber based composite
- ❖ Aprons should be removed carefully to prevent any chemicals on the aprons from contaminating other areas



More PPE for the Body

Chemical Resistant Splash Suits

- ❖ Chemical resistant splash suits offer a high degree of protection against a wide range of chemical contaminants
- ❖ They are commonly used when cleaning hazardous material spills
- ❖ They are commonly made from Neoprene or a rubber based composite



PPE for the Feet

- ❖ PPE protects the feet from chemical spills and dropped objects
- ❖ Cleanroom booties do not provide adequate protection
- ❖ Non-porous, closed toe shoes with a closed heel must be worn under the booties

Chemical Resistant Boots

- ❖ Worn when cleaning up hazardous chemical spills



Summary

- ❖ Manufacturing microsystems involves hazardous materials
- ❖ It is essential to understand the dangers involved and the proper PPE
- ❖ This SCO discussed the hazards in the workplace and the PPE needed to protect from any bodily injury
- ❖ When using PPE, it is also important to ensure that it is being used properly

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Acknowledgements

Made possible through grants from the National Science Foundation Department of Undergraduate Education #0830384, 0902411, and 1205138.

Any opinions, findings and conclusions or recommendations expressed in this material are those of the authors and creators, and do not necessarily reflect the views of the National Science Foundation.

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