

PPE Selection Training

University Police and Safety Office

Course Introduction

This training is intended to provide a basic understanding of selecting personal protective equipment for the laboratory. Additional laboratory specific training(s) should be provided by a principal investigator or laboratory supervisor.

Who is required to attend?

- Any NDSU student (undergraduate and graduate), staff, faculty, or other personnel who use and/or select PPE in the laboratory

When do you need to complete PPE Selection Training?

- Before beginning laboratory duties.

PPE Selection Training is recommended annually.

Personal Protective Equipment (PPE)

Personal Protective Equipment (PPE) is worn to minimize the risk of hazards that can cause injury or illness.

PPE Can Include:

- Gloves
- Safety glasses or splash goggles
- Hearing protection (e.g., ear plugs)
- Lab coats
- Hard hats
- And, much more...

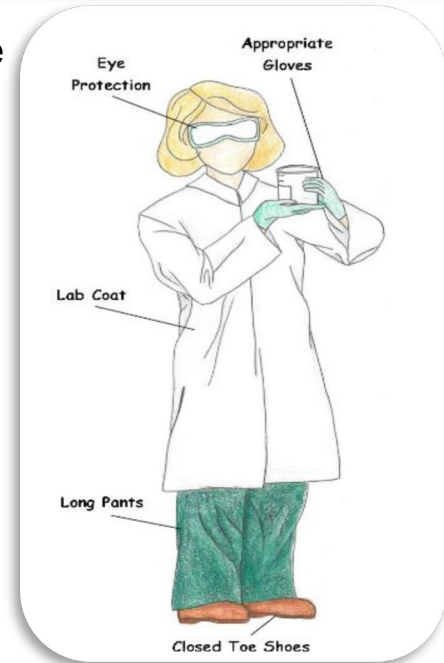


Image: Example of a typical lab worker's required PPE.

Personal Protective Equipment (PPE)

Biological, chemical, physical, and radiological hazards may be present in NDSU laboratories and other work areas on campus. Selecting the most appropriate personal protective equipment (PPE) to reduce exposure to hazards is critical for laboratory and workplace safety.

Personal Protective Equipment:

- The PPE you are required to wear will depend on the activities and hazards in your laboratory.
- Appropriate PPE should be worn whenever there is a potential for exposure to a hazard in the lab.



The Safety Office is Available 24/7
Phone: 701-231-7759

Hierarchy of Controls

The **Hierarchy of Controls** is the effective order of control measures that are used to minimize or eliminate hazards in the lab.

Hierarchy of Controls:

- Do not rely on PPE alone when other control measures are available.
- Engineering controls like chemical fume hoods and biosafety cabinets are effective controls in the laboratory.
- PPE is your last line of protection from laboratory hazards, and the least effective control used in the laboratory.

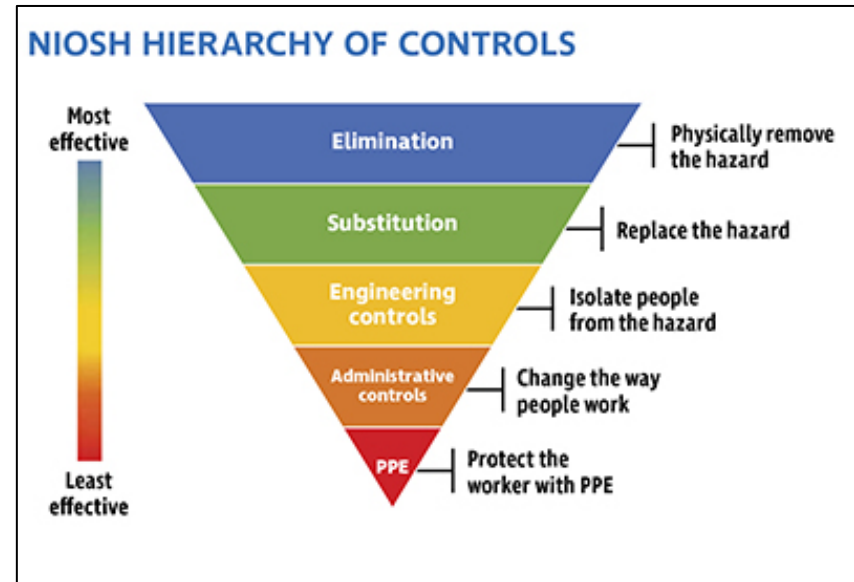


Figure: Hierarchy of Controls. Figure from NIOSH.

Hierarchy of Controls Example

EXAMPLE: In your laboratory, you are planning to use a chemical that is flammable and toxic. How would you use the Hierarchy of Controls to select the appropriate control measures to minimize risk?

Minimizing Risk:

Step 1 (Most Effective): Eliminate/Substitute the Hazard

- Identify if it is possible use non-hazardous or less hazardous chemicals for the experiment.

Step 2: Use Engineering Controls

- Conduct the experiment in a laboratory fume hood to minimize inhalation hazards.

Step 3: Implement Administrative Controls

- Follow an approved SOP for your experiment, and ensure you are thoroughly trained and follow all general lab safety practices.

Step 4 (Least Effective): Wear your PPE

- Chemical resistant gloves, splash goggles, long pants, closed toe shoes, and a flame-resistant lab coat would be recommended for working with flammable and toxic chemicals.

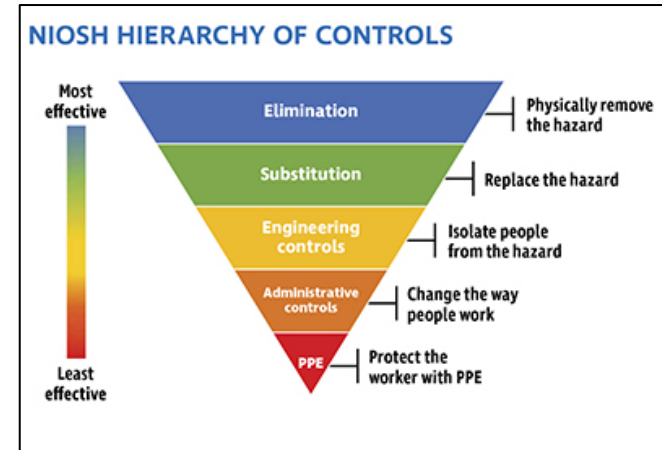


Figure: Hierarchy of Controls. Figure from NIOSH.

Hazard Assessments

To determine the appropriate PPE required for the work area, the principal investigator or supervisor must identify all of the potential hazards in the laboratory or work area. For each hazard, identify the hazard controls and/or PPE required to eliminate or minimize the hazard to a safe level. Hazard assessments should be completed before conducting work and reevaluated regularly and whenever a new hazard is identified.

Consider the Following Hazards During a Hazard Assessment:

- Chemical Hazards
- Biological Hazards
- Atmospheric Hazards
- Electrical Hazards
- Physical Hazards
- Radiological (ionizing and non-ionizing) Hazards
- Thermal (extreme hot or cold) Hazards
- Noise Hazards

The Safety Office is available to assist with hazard assessments in your area.

Phone: 701-231-7759

PPE Training Requirements

The principal investigator or lab supervisor must provide PPE Training to all laboratory personnel who are required to wear PPE.

PPE Training Must Include:

- How to properly wear PPE.
- The uses and limitations of PPE.
- When PPE must be worn in the lab.
- Maintenance, inspection, storage, and care of PPE.
- Proper removal, disposal, and replacement procedures for damaged PPE.



IMPORTANT:

The PI or laboratory supervisor must maintain training records for laboratory personnel.

Minimum Laboratory PPE Requirements

Workers in labs that handle hazardous or biological materials must wear the minimum laboratory PPE.

Minimum Laboratory PPE Requirements:

- Safety glasses
- Gloves (disposable nitrile or other appropriate glove)
- Lab coat
- Long pants, skirt, or other leg covering
- Closed-toe shoes

Other Laboratory Attire Guidelines:

- Tie back long hair and remove any dangling jewelry.
- Do not wear shorts, short skirts, or sandals.

REMEMBER:

Additional PPE may be required for certain laboratory hazards or activities!

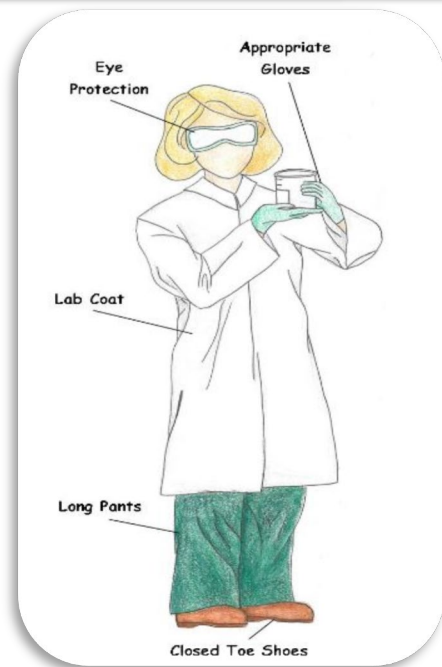


Image: Example of a typical lab worker's required PPE.

Eye and Face Protection

Eye protection can protect you from the risk of exposure to chemical or biological splashes, dangerous light radiation, and impact hazards (e.g., flying debris).

Types of Eye/Face Protection:

- Safety Glasses
- Goggles
- Face Shield
- Laser Safety Glasses
- Welding Goggles/Helmet



Image: Safety glasses prevent shrapnel and flying debris from damaging your eyes.

Comparing Eye and Face Protection (1 of 2)



SAFETY GLASSES

Uses and Limitations:

- Minimum level of eye protection that must be worn in the lab.
- Offer protection against dust and flying objects.
- Less effective at protecting the eyes from splashes.

Required when:

- An impact hazard exists (flying debris, dust, chips).
- Working with low hazard chemicals, or BSL-1 biological materials.

SPLASH GOGGLES

Uses and Limitations:

- Form a liquid-proof seal around the eyes to provide better eye protection in the case of splashes.

Required when:

- Potential for chemical fumes, splashes, mists, sprays, or dust exposure to the eyes, or when working with BSL-2 or BSL-3 biological hazards.

FACE SHIELD

Uses and Limitations:

- Highest level of face and eye protection for impact hazards, and chemical and biohazard splashes.
- Must always be used in combination with safety glasses or splash goggles.

Required when:

- Working with large quantities of hazardous materials, particularly hazardous chemicals, and/or a high probability of face or eye exposure exists.

Comparing Eye and Face Protection (2 of 2)



LASER SAFETY EYEWEAR

Uses and Limitations:

- Provide protection against exposure to lasers.
- Must be selected based on wavelength and energy/power of laser.
- Contact the Radiation Safety Officer for assistance: 701-231-7759

Required when:

- Working with Class 3 or Class 4 lasers where irradiation of the eye is possible.

WELDING HELMET

Uses and Limitations:

- Protects eyes and face from sparks, flying debris, and harmful UV and IR radiation.

Required when:

- Performing and/or observing welding or cutting activities.

Gloves

Gloves can be worn to minimize the risk of exposure to many chemical and physical hazards.

Chemical Hazard Gloves

- Common glove materials are nitrile, butyl, natural rubber, and latex.
- Available in different thicknesses.
- Different kinds of glove materials are resistant to different kinds of chemicals.
- Use a *Glove Compatibility Chart* and a chemical's safety data sheet to select the correct gloves.
- No single glove type protects against all chemicals. Glove selection must be based on the specific chemical, concentration, task, contact time, and manufacturer compatibility data.

Physical Hazard Gloves

- May protect you from physical hazards like sharp edges and extreme temperatures.



Image (upper left/upper right): A variety of chemical resistant gloves.

Image (bottom left/bottom right): Physical hazard gloves.

Chemical Hazard Glove Properties

Understanding chemical hazard glove properties can help you select the appropriate glove for your laboratory activities.

When selecting a glove, consider:

- **Degradation:** changes in the physical properties of a glove (e.g., hardening, swelling, shrinking, or cracking) caused by contact with a chemical.
- **Breakthrough time:** the amount of time between contact with a chemical and detection of the chemical on the inside of the glove.
- **Permeation rate:** the rate at which a chemical passes through the glove once breakthrough has occurred.



Glove Materials

When working with chemicals an appropriate glove material must be selected based on the specific chemicals and tasks in the laboratory.

GLOVE MATERIAL	GENERAL USES
Butyl	High resistance to permeation by most gases and water vapor. Suitable for work with esters and ketones.
Natural Rubber	Resistance to a wide variety of acids, caustics, salts, and alcohols.
Neoprene	Moderate resistance to abrasion, but good tensile strength and heat resistance. Compatible with many acids, caustics, and oils.
Nitrile	Protection from many solvents, oils, and some corrosives. Excellent general duty glove.
PVC	Protection against abrasion and use with fats, acids, and petroleum products.
PVA	Highly impermeable to gases. Excellent protection against aromatic and chlorinated solvents.
Viton	Excellent resistance to chlorinated and aromatic solvents.
Silver Shield	Resists wide variety of toxic and hazardous chemicals. Highest level of overall chemical resistance.

Glove Compatibility Chart

Most glove manufacturers provide glove compatibility charts for their gloves.

Glove Compatibility Charts:

- Enable you to compare degradation, breakthrough times, and permeation rates of a chemical for different glove materials.

IMPORTANT:

Safety data sheets (SDS) provide glove selection recommendations in *Section 8: Exposure Controls/Personal Protection*.



CHEMICAL	LAMINATE FILM BARRIER™			NITRILE SOL-VEX®			UNSUPPORTED NEOPRENE 29-SERIES		
	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
1. Acetaldehyde	■	380	E	P	—	—	F	10	F
2. Acetic Acid, Glacial, 99.7%	■	150	—	G	158	—	F	390	—
3. Acetone	▲	>480	E	NR	—	—	G	10	F
4. Acetonitrile	▲	>480	E	F	30	F	E	20	VG
5. Acrylic Acid	—	—	—	G	120	—	E	395	—
6. Acrylonitrile	▲	>480	E	—	—	—	—	—	—
7. Allyl Alcohol	▲	>480	E	F	140	F	E	140	VG
8. Ammonia Gas	■	19	E	▲	>480	E	▲	>480	—

Physical Hazard Gloves

Physical hazard gloves can protect you from sharp edges and extreme temperatures.



Autoclave Gloves

Description:

- Heat resistant.
- Made of terrycloth cotton.
- Not waterproof and should not be used to handle dry ice.

Recommended Uses:

- Working with hot liquids or equipment.

Cryogen Insulated Gloves

Description:

- Protection against dry ice and ultra-cold environments.
- Lightweight and waterproof.

Recommended Uses:

- Working with liquid nitrogen, other liquid cryogens, and dry ice.

Cut Resistant Gloves

Description:

- May be made of leather, wire mesh, or Kevlar.
- Protect against cuts or laceration from sharp objects.

Recommended Uses:

- Working with sharp objects like knives.

Other Glove Considerations

In addition to glove material, there are several other considerations when selecting the appropriate glove.

Dexterity

- Different glove materials will impact hand and finger dexterity.

Glove Size

- Be sure to wear gloves that fit snugly and provide the highest level of dexterity, but not too tight to cause discomfort or fatigue.

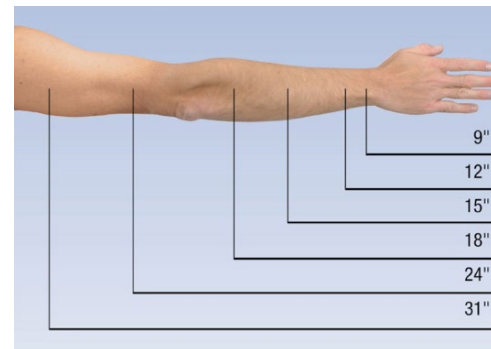
Glove Thickness

- Thinner gloves offer better touch sensitivity and flexibility, but usually provide shorter breakthrough times than thicker gloves.

Glove Length

- Select a glove length based on the risk of wrist or arm exposure to the chemical hazard. Gloves longer than 14 inches provide extra wrist and arm protection.

GLOVE SIZING CHART



Lab Coats and Body Protection

Lab coats and chemical aprons may be required when working in the laboratory.

Lab Coats:

- Provide protection of skin and personal clothing from incidental contact and small spills.
- Provide a removable barrier in the event of an incident involving a spill or splash of hazardous substances.
- Should always be removed before leaving the lab to prevent the spread of contamination.



Types of Lab Coats and Body Protection

Lab coats are worn over your clothing and may protect you from certain lab hazards depending on the type of lab coat.

Types of Lab Coats and Body Protection:

- Traditional Lab Coat
- Flame Resistant Lab Coat
- Barrier Lab Coat
- Chemical Apron



Comparison of Lab Coats and Body Protection



Type of Lab Coat	Traditional Lab Coat	Flame-Resistant Lab Coat	Barrier Lab Coat	Chemical Resistant Apron
Material	Cotton/Poly Blend	Nomex	Polyester	Nitrile, Butyl, etc.
Uses	General chemical or biological lab work.	Highly flammable and reactive chemicals.	High risk biological lab work.	Working with highly toxic, or large quantities of corrosives.
Limitations	Provides only moderate protection from splashes and burns readily.	Flame resistant. Provides only moderate protection from splashes.	Fluid resistant. Does not offer chemical or flame resistance.	Worn over a lab coat. Ensure the apron is resistant to the chemicals in the laboratory.

Respiratory Protection

Respirators are a form of personal protective equipment (PPE) worn to protect the wearer from inhaling hazardous atmospheres.

Respirators shall only be used to protect employees from inhalation hazards in the following circumstances:

- (1)When other options for hazard control (i.e., use of engineering controls or substitution of less toxic materials) are infeasible,
- (2)While engineering controls are being installed or repaired, or
- (3)During emergencies.

The use of required respiratory protection equipment at NDSU is strictly limited to employees who:

- Have a documented need to utilize such equipment,
- Pass and maintain an appropriate medical evaluation,
- Attend annual training, and
- Complete annual fit-testing.

Additional information is available on the [Respirator Information webpage!](#)



Half-Face
Respirator



N95 Respirator



Full-Face
Respirator

Other Types of PPE

Depending on the hazards in your lab or work area, you may be required to wear additional types of PPE.



Hard Hat

Description:

- Provide head protection from falling objects and head impacts.
- May provide protection from electrical hazards.

Recommended Uses:

- Whenever there is a potential for head trauma.

Hearing Protection

Description:

- Protection against noise.

Recommended Uses:

- Whenever there is risk for noise exposure above permissible exposure limits for noise.
- Contact the Safety Office for a noise assessment.

High-Vis Vest

Description:

- Made of reflective materials to provide visibility in low light.

Recommended Uses:

- Working around moving vehicles or machinery.

Safety Footwear

Description:

- May have steel toe caps.
- May be slip or chemical resistant.
- Insulated or waterproof for electrical hazards.

Recommended Uses:

- Wide variety of applications.

PPE Selection Resources

NDSU Safety Office

- Website: https://www.ndsu.edu/police_safety/
- Phone: 701-231-7759

PPE Selection Links

- [NDSU Chemical Safety Webpage](#)

Contact the Safety Office for assistance with hazard assessments, PPE selection, or laboratory-specific safety requirements.

701-231-7759