Indian Institute of Science

Office of Laboratory Safety and Environmental Health

OLSEH/PPE/GUI/22-01

General Guidance on Personal Protective Equipment

1 Some Common Hazard Classes

This document provides generic guidelines for the use of personal protective equipment (PPE) when working in laboratories at IISc with one or more of the following occupational hazards.

i) Chemical hazards such as labs having chemicals or gases with NFPA rating >0;
ii) Laser radiation hazard;
iii) Electrical hazards such as high-voltages;
iv) Radiation hazards such as X-rays and/or radio-active material.
v) Biological hazards such as infectious molecules/organisms, blood samples, etc.
vi) Mechanical hazards such asin a mechanical workshop that involves material machiningprocesses including turning, milling, drilling, etc.

2 Minimum Laboratory PPE

When working In laboratories with at least one of the hazards listed in Section 1, OLSEH recommends that the following minimum PPE be worn at all times.

1. **Eyes:** Safety Glasses
2. **Hands:** Disposable thin-nitrile gloves. Avoid latex since it is permeable and allergic.
3. **Body:** Long pants or equivalent leg covering (no shorts). Synthetic clothing **not** allowed when working with any fire hazard.
4. **Close-toed shoes**: Laboratory footwear should fully cover the feet. **No sandals or flip flops**. **The common practice of removing footwear outside the lab is not allowed unless lab-specific footwear is provided.**
5. **Tied hair:** No loose long-hair anytime. All long beard and hair should be properly tied or covered.

3 Additional PPE for Specialized Laboratories

In sections 4 to 10, PPE for specialized laboratories and/or situtations are listed out with respect to certain common tasks expected in laboratories at IISc. The PPE prescribed in sections 4 to 10 is in addition to the minimum PPE suggested in section 2. Any task that is not listed here does not necessarily mean that it is safe to perform without PPE. When in doubt, users are encouraged to use their judgement and follow best practices. Always err on more PPE!

4 PPE for General Safety

	Task	Potential Consequence	AdditionalPPE
1.	Working with equipment that directly exposes the user topressures>2 bar or 14 psig or a vacuum of <400 mm of Hg. Examples include working with pressurized gas nozzles.	1. Skin damage 2. Eye damage 3. Implosion	1. Face: Face shield if no other implosion/explosion barrier exists. (also see section 7 on compressed gas safety for more specific guidelines)
2.	Working with high temperature equipment or objects	1. Burns 2. Fire 3. Splash	1. Hands: Gloves that are suitable for the working temperature. 2. Extra set of thermal gloves are required when directly handling hot objects at temperatures >50 °C. 3. Body: Lab coat or apron suitable for the working temperature
3.	Working with inert cryogens (He, N2, etc.)	1. Frostbite 2. Eye damage 3. Hypoxia in confined spaces	**For ≤ 10Liters** 1. Body: Lab coat or apron 2. Eyes: Safety goggles 3. Hands: Inner disposable nitrile gloves + outerinsulated cryogenic gloves, when directly handling objects exposed to cryogens. **For ≥ 10 liters** 4. Eyes: Safety goggles 5. Face: Face shield 6. Hands: Inner disposable nitrile gloves + outerinsulated cryogenic gloves 7. Body: Lab coat or cryogenic apron. 8. Note: Use only in well-ventilated area.
4.	Woriking with reactive cryogens (H2, O2, etc.)	1. Frostbite 2. Eye damage 3. Hypoxia in confined spaces	**Talk to OLSEH. Special permission and protocols required.**

	Task	Potential Consequence	AdditionalPPE
5.	Working at elevated locations such as for example loading samples in an overhead sample loading dock.	1. Fall and subsequent injury	**≤ 3m** 1. Use ladders with a stable base. Adhocplatforms, stools and chairs are not allowed. **> 3m** 1. Safety harness 2. Hard safety hat. 3. Hard-toed safety shoes
6.	Possibility of falling objects such as in construction sites	1. Serious or fatal injuries to head and other body parts.	1. Hard safety hat. 2. Hard-toed safety shoes
7.	High-speed machinery	1. Entangled hair. 2. Possibility of flying scrap or high speed particles	1. Tie long hair in a bun or use hair-nets. 2. Hard-toed safety shoes 3. Eyes: Safety Goggles

5 PPE for Chemical Safety

	Task	Potential Consequence	AdditionalPPE
1.	Working with solids of low hazard (NFPA 704 rating 0-1 in all quadrants)	1. Skin damage 2. Eye damage	Minimum PPE as described in section 2
2.	Working with moderate hazard chemicals (NFPA 704 rating ≤2 in all quadrants), small volumes (<100 ml.).	1. Skin damage 2. Eye damage	Minimum PPE as described in section 2
3.	Working with moderate hazard chemicals (NFPA 704 rating ≤2 in all quadrants), moderate volumes (<4000 ml.).	1. Skin damage 2. Eye damage	1. Eyes: Safety goggles 2. Body: Chemical resistant apron or Lab Coat.
4.	Working with moderate hazard chemicals (NFPA 704 rating ≤2 in all quadrants),large volumes (>4 litres).	1. Skin damage 2. Eye damage 3. Splash	1. Eyes: Safety goggles 2. Face: Face shield 3. Hands: Disposable chemical resistant gloves (thick) as a second glove 4. Body: Chemical resistant apron or Lab Coat.
5.	Working with high hazard chemicals (NFPA 704 rating >2 in	1. Skin damage 2. Eye damage	1. Eyes: Safety goggles 2. Face: Face shield (if quantity is >4 lit or splash hazard)

	Task	Potential Consequence	AdditionalPPE
	any quadrant). E.g.,corrosive (acids or caustics) or hazardous materials that may splash.	3. Splash 4. Toxic 5. Inhalation	3. Hands: Disposable chemical resistant gloves (thick) as a second glove 4. Body: Chemical resistant apron 5. Inhalation: Suitable face mask (if quantity is >4 lit. or materials is noxious)
6.	Working with volatile solvents. E.g. • Ethanol, Isopropanol • Propylene • Oxide Xylene • Methanol • Chloroform • Phenol	1. Skin damage 2. Eye damage 3. Fire	1. Eyes: Safety goggles 2. Hands: Suitable chemical resistant gloves (thin) 3. Face: Face shield (if quantity is >4 lit or splash hazard) 4. Body: Lab coat or apron. 5. Gloves: a. Nitrile for alcohol b. Butyl for propylene oxide and Xylene. 6. Inhalation: Suitable face mask (if quantity is >4 lit. or materials is noxious)
7.	Working with chemicals of acute toxicity (NFPA 704 Health rating =4) e.g., hydrogen fluoride, hydrogen cyanide.	1. Inhalation 2. Skin damage 3. Eye damage 4. Toxic by skin contact	1. Eyes: Safety goggles 2. Face: Face shield (if quantity is >4 lit or splash hazard) 3. Hands: Chemical resistant gloves (thick) as a second glove. Special gloves designed for that specific hazard are highly recommended. 4. Body: Chemical-resistant apron 5. Inhalation: Suitable face mask (if quantity is >1 lit/kg or if the material is noxious).
8.	Working with explosive chemicals (NFPA 704 Instability rating =4)	1. Detonation 2. Flying debris 3. Skin damage 4. Eye damage 5. Fire	Talk to OLSEH. Need special permission and protocols.
9.	Working with long-term toxins like carcinogens, mutagens, nanoparticles, etc. (Example: agarose gels and ethidium bromide)	1. Inhalation 2. Skin damage 3. Eye damage 4. Toxic by skin contact	1. Eyes: Safety goggles 2. Hands: Appropriate chemical resistant gloves 3. Body: Chemical-resistant apron 4. Face: Face shield (if quantity is >1 lit/kg or splash hazard) 5. Inhalation: Suitable face mask (if quantity is >1 lit/kg

	Task	Potential Consequence	AdditionalPPE
			or if materialis noxious)
10.	Working with air or water-reactive chemicals that form hazardous by products, or react violently.	1. The sudden release of gases or energy 2. Chemical hazards associated with by-products.	PPE appropriate for the by-products. Face shield if there is a chance of splash or splatter.

6 PPE for Biosafety

	Task	Potential Consequence	Additional PPE
1.	Working with human blood, body fluids, cell lines (primary or established), tissues, or blood borne pathogens (BBP).	1. Exposure to infectious material	1. Face: Face mask or sheild 2. Body: Lab coat or disposable gown/apron
2.	Working with animal and/or human specimens preserved in fixative (such as formalin or Para formaldehyde solution) Preserving animal and/or human specimens with fixative (such as formalin or Paraformaldehyde solution)	2. Exposure to fixative used to preserve the specimen. 3. If tissue is fixed, there is no longer exposure to infectious material.	1. Eye: Safety goggles 2. Hand: Impermeable glove for preserved specimens that is chemical-resistant to fixative use 3. Face: Face mask 4. Body: Lab coat or Disposable gown

	Task	Potential Consequence	Additional PPE
3.	Working with radioactive human blood, body fluids, or blood borne pathogens (BBP).	1. Exposure to infectious material 2. Cell damage 3. The potential spread of radioactive contaminants.	1. Eye: Safety googles 2. Face: Face mask +Face shield 3. Body: Lab coat or disposable gown
4.	Manipulation of recombinant DNA, cell lines, viruses, bacteria, or other organisms classified as Risk Group 2 and requiring Biosafety Level 2 (BSL-2). Perform aerosol-generating procedure: Vortex, sonicate, pipette, tissue harvest.	Biological agents that pose a moderate potential for infection by injection, skin exposure, ingestion, or inhalation.	1. Eye: Safety googles 2. Hand: Nitrile gloves 3. Face: Face mask 4. Body: Lab coat orDisposable gown
5.	Manipulation of infectious materials classified as Risk Group 3 but manipulated in a BSL 2 facility with BSL-3 practices (BSL 2+).	Biological agents that pose a moderate/ serious potential for infection by injection, skin exposure, ingestion, or inhalation.	1. Eye: Safety goggles 2. Hands: Nitrile gloves (double) 3. Body: Lab coat + disposable gown that ties in back 4. Inhalation: Respiratory protection like N95 mask
6.	Manipulation of infectious materials classified as Risk Group 3 and requiring Biosafety Level 3 (BLS-3) containment.	Biological agents that pose a serious or lethal potential for infection via injection, skin exposure, ingestion, or inhalation.	1. Eye: Safety goggles 2. Hands: Nitrile gloves (double) 3. Body: Full disposable coverall suit + headcover 4. Foot: Shoe cover 5. Face: N95or other triple-layered mask + Face shield.

	Task	Potential Consequence	Additional PPE
7.	Working with live animals, e.g.mice and rats& chicken eggs:	1. Animal bites. 2. Exposure to animal allergens. 3. PotentialStaph &Strep exposure.	1. Animal bites: Restraints or bite-resistant gloves 2. Animal allergen: N95 respirator. 3. Eye: Safety goggles 4. Body: Lab coat or apron, Hair bonnet + gown 5. Foot: Shoe covers

7 PPE for Radiation Hazards

Radiation safety is managed by AERB, a governmental regulatory agency. AERB appoints safety officers (outside OLSEH). All radiation-realted work must be done under rules of AERB and with permission from AERBsafety officers.

	Task	Potential Consequence	Additional PPE
1.	Working with sealed sources	1. Exposure	1. Minimum PPE unless the dosage is above safe limits 2. TLD badges, if mandated by AERB safety officer
2.	Working with solid radioactive material or solid radioactive waste.	1. Cell damage 2. The potential spread of radioactive	1. Hands: Disposable nitrile or other impermeable gloves (double) 2. Face: N95 mask 3. Body: Lab coat or apron 4. TLD badges, if mandated by AERB safety officer
3.	Working with liquid radioactive material (in corrosives, flammables, aqueous liquids – including liquid radioactive waste) or radioactive powders.	1. Cell damage 2. The potential spread of radioactive contamination 3. Hazards presented by the specific chemical	1. Eyes: Safety goggles 2. Hands: Disposable nitrile or other impermeable gloves (double) 3. Face: N95 mask 4. Body: Lab coat or apron 5. TLD badges, if mandated by AERB safety officer
4.	Usage of open-beam X-ray sources that are not enclosed or interlocked	1. Cell damage 2. The potential spread of radioactive contamination 3. Hazards presented by the specific chemical	Talk to OLSEH. Special permission and protocols required.

8 PPE for Lasers and Intense Light Sources

	Task	Potential Consequence	AddtionalPPE
1.	Using an open-beam	1. Eye damage	1. Eye: Appropriate laser safety

	Task	Potential Consequence	AddtionalPPE
	laser of Class 3 or above in a setup that is not fully contained or interlocked.	2. Skin damage	goggles/glasses with optical density based on individual beam parameters. 2. Skin: Fully covered arms and feet. Flame-resistance clothing. Avoid synthetics. 3. Avoid reflective jewelry.
3.	Troubleshooting or maintenance of a laser system in a way that defeats the interlock(s) of a laser of Class 3 and exposes optical cavity.	1. Eye damage 2. Explosionof glass components 3. Electrocution	1. Eye: Appropriate laser safety goggles/glasses with optical density based on individual beam parameters. 2. Skin: Fully covered arms and feet. Flame-resistance clothing. Avoid synthetics. 3. Hands: Electrically Insulated gloves 4. Avoid reflective jewelry. This is a specialized activity. PPE above assumesthe personel is trained.
4.	Working with intenselight sources, infrared-emitting equipment, UV sources (<400 nm)	1. Eye damage 2. Skin-burn	1. Eye: Appropriate laser safety goggles/glasses with optical density based on individual beam parameters. 2. Skin: Fully covered arms and feet. Flame-resistance clothing. Avoid synthetics.

9 PPE for Compressed Gas Cylinders& Cryogens

	Task	Potential Consequences	Additional PPE
1.	Transport or handling of inert gas cylinders (NFPA 704 rating of <2 in all quadrants)	1. Cylinder falling over 2. Breaking off the valves	1. Hand: Wear mechanically resistant-gloves when handling cylinders. 2. Foot: Closed-toed shoes
2.	Transport of handling of flammable gases with NFPA 704 flammability rating of ≥3	1. Cylinder falling over 2. Breaking off the valves 3. Fire or explosion due to a sudden release	1. Skin: Flame resistant antistatic safety clothing. 2. Hand: Wear mechanically resistant-gloves when handling cylinders 3. Foot: Closed-toed shoes.
3.	Toxic gases with NFPA 704 health rating of ≥3	1. Cylinder falling over 2. Breaking off the valves 3. Poisoning	Respiratory protection-Toxic gas mask or self-contained breathing apparatus

10 PPE for Electrical Safety

	Tasks	Potential Hazards	Additional PPE

1.	Maintenance and repairing electrically powered equipment	1. Electrocution	1. Hands: Insulated electrical gloves. 2. Foot: Electrical safety shoes. 3. Electric works to be undertaken by trained electrical technicians ONLY.
2.	High Voltage (> 400 V)	1. Electrocution 2. Arc flash	1. Body: Arc flash clothing. Switching suits available from low level to high-level protection. Arc clothing is made from flame-resistant material such as a cotton and nylon blend. 2. Electrical rated gloves and steel toe cap boots with rubber, designed for protection against high voltage. 3. Electrical-rated safety helmet. 4. To use specified Electrical standard tools, switch OFF Mains/incoming supply during maintenance/repair work.