

# Laboratory PPE Selection Guide



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## Introduction

This guide is a resource for Principal Investigators and Lab Supervisors to choose Personal Protective Equipment (PPE) that is appropriate for lab workers.

**Hazardous materials, such as chemicals, biological agents, and radioactive materials, can enter the body in four different ways:**

- Absorption through the skin
- Inhalation
- Ingestion (eating and drinking)
- Injection (needles or sharp pieces of glass, metal, or plastic)

**Whether or not exposure will lead to illness or injury depends on:**

- Exposure frequency
- Exposure duration
- Individual factors (age, sex, and genetics)

**First, access the risk by asking these questions:**

- What are the hazards?
- What is the worst that could happen?
- What can be done to prevent this from happening?
- What should be done if something goes wrong?

**Exposure risk can be minimized using these control factors (in order from most effective to least effective):**

- Elimination of hazard
- Substitution of less hazardous materials
- Engineering controls (fume hoods, biosafety cabinets, blast shields, snorkels)
- Administrative controls (Safety Operating Procedures, training)
- Personal protective equipment

\*Note that PPE is your last line of defense. Apply other controls FIRST before selecting PPE. PPE is not a substitute for proper lab attire. Clothing such as shorts or short skirts, sandals, or open-toed shoes are not appropriate for the laboratory.

### How to use this guide

Survey your laboratory for hazards. Divide them up by category such as Chemical, Biological, Physical, and Radiological. Review the tables below and check off each activity as it applies to your lab. Use the blank spaces at the end to fill in any activities that are not listed. Make note of any deviations from the suggested PPE, explain the need for the change, and how protection will be assured.

<b>Chemical Hazards</b> (see below for explanation of CSL Levels)					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Small volumes of mildly corrosive liquids pH>2 or <12.5 CSL 2-3	Eye or skin damage Lung damage from inhalation	Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S)	Basic written procedure, Safety Data Sheets (SDS), Research-specific training, and EH&S Lab and Research training	<ul style="list-style-type: none"> <li>•Safety glasses or chemical splash goggles</li> <li>•Light chemical resistant gloves (disposable nitrile, latex). See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used</li> <li>•Lab coat</li> </ul>
<input type="checkbox"/>	Large volumes of highly corrosive liquids pH<2 or >12.5 Work where there is a splash hazard CSL 4	Extensive eye or skin damage Lung damage from inhalation	Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S)	<p>Peer-reviewed SOP, SDS, Research-specific training, and EH&amp;S Lab and Research training</p> <p>Purchase pre-diluted corrosive solutions</p>	<ul style="list-style-type: none"> <li>•Chemical splash goggles</li> <li>•Face shield</li> <li>•Heavy chemical resistant gloves (neoprene or butyl), especially if hands will be immersed. See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used</li> <li>•Lab coat</li> <li>•Chemical resistant apron</li> </ul>
<input type="checkbox"/>	Acutely toxic corrosive liquids Any volume of hydrofluoric acid Any concentration	Extensive eye or skin damage Lung damage from inhalation Poisoning through skin contact	Acid resistant fume hood	<p>Peer-reviewed SOP, SDS, Research-specific training, and EH&amp;S Lab and Research training</p> <p>Purchase pre-diluted corrosive solutions</p>	<ul style="list-style-type: none"> <li>•Chemical splash goggles</li> <li>•Face shield</li> <li>•Heavy chemical resistant gloves (neoprene or butyl)</li> </ul> <p>See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical</p>

	of perchloric acid CSL 4			Practice before working with live material	being used •Lab coat •Chemical resistant apron
<input type="checkbox"/>	Small volumes of organic solvents, flammable organic compounds, or oxidizers Flash point at or above 73°F (22.8°C) but less than 100°F (37.8°C). CSL 2,3	Eye or skin damage Poisoning through skin contact	Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S)	SOP, Research-specific training, and EH&S training  Purchase prepared solutions	•Safety glasses or chemical splash goggles •Light chemical resistant gloves (nitrile, latex). See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used •Lab coat
<input type="checkbox"/>	Large volumes of organic solvents, flammable organic compounds, or oxidizers Flash point below 73°F (22.8°C) and boiling point below 100°F. CSL 4	Extensive eye or skin damage Lung damage from inhalation Poisoning through skin contact Fire	Certified chemical fume hood	Peer-reviewed SOP, Research-specific training, and EH&S training  Do not store large volumes Handle in areas free of ignition sources Do not heat with open flame (use steam bath, water bath, heating mantle, hot air bath) Bond and ground metal equipment to avoid static sparks	•Chemical splash goggles •Face shield •Heavy chemical resistant gloves (neoprene or butyl) , especially if hands will be immersed. See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used •Flame resistant lab coat •Chemical resistant apron
<input type="checkbox"/>	Pyrophoric liquids, air	Extensive eye or skin damage	Certified chemical fume hood	Peer-reviewed SOP, Research-specific	•Chemical splash goggles •Face shield

	and/or water reactive liquids in any quantity CSL 4	Lung damage from inhalation Poisoning through skin contact Fire	Inert atmosphere glove bag or glove box	training, and EH&S training  Practice before working with live material	<ul style="list-style-type: none"> <li>•Heavy chemical resistant gloves (neoprene, butyl, or flame resistant). See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used</li> <li>•Flame resistant lab coat</li> <li>•Chemical resistant apron</li> </ul>
<input type="checkbox"/>	Acutely toxic or hazardous chemicals, including organic mercury compounds CSL 4	Extensive eye or skin damage Poisoning through skin contact	Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S) Inert atmosphere Trap or condense gases, vapors, and aerosols to avoid contaminating vacuum pumps or discharging large quantities to fume hood exhaust air Use designated area	Peer-reviewed SOP, Research-specific training, and EH&S training Medical surveillance may be required depending on quantity, toxicity, and frequency of exposure  Practice before working with live material  Inform nearby persons with a sign: "Toxic Compounds Use Area"	<ul style="list-style-type: none"> <li>•Chemical splash goggles</li> <li>•Heavy chemical resistant gloves (neoprene or butyl). See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used</li> <li>•Lab coat or gown</li> </ul>
<input type="checkbox"/>	Pressurized apparatus CSL 3,4	Eye or skin damage (lacerations due to shrapnel)	Chemical fume hood with sash lowered as much as possible Lexan or blast resistant shield	SOP, Research-specific training, and EH&S training	<ul style="list-style-type: none"> <li>•Safety glasses or chemical splash goggles</li> <li>•Face shield (high risk)</li> <li>•Light chemical resistant and/or abrasion/puncture resistant gloves</li> <li>•Lab coat</li> </ul>
<input type="checkbox"/>	Potentially explosive materials,	Eye or skin damage (lacerations due to shrapnel or burns)	Chemical fume hood with sash lowered as much as possible	Peer-reviewed SOP, Research-specific training, and EH&S	<ul style="list-style-type: none"> <li>•Chemical splash goggles</li> <li>•Face shield</li> <li>•Heavy chemical resistant gloves</li> </ul>

	time sensitive, temperature sensitive, light sensitive, acid/base sensitive, metal ion sensitive, shock sensitive, or peroxide formers CSL 4	Fire	Lexan or blast resistant shield (when more than 0.5g of explosive reactants are produced or 0.1g of explosive product is produced) Use Teflon-coated instead of ground glass fixtures for shock or friction sensitive materials	training  Inform nearby persons with a sign: "Potentially Explosive Compounds Use Area"  Practice before working with live material	(neoprene, butyl, or flame resistant) or leather work gloves/welding gauntlets that extend past the wrist See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used •Heavy work apron •Flame resistant lab coat
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## Chemical Safety Levels (CSLs)

Assessment of the risk of chemical exposure may be accomplished using the concept of Chemical Safety Levels (CSLs). Similar to Biosafety Levels (BSLs), which have been well established in laboratories where there is a risk from a biological hazard, Chemical Safety Levels help to establish safety guidelines depending on the types of hazards present. The tables below illustrate how chemicals can be divided into Chemical Safety Levels. Refer Appendix 1 to see what precautions to take depending on the Chemical Safety Level present in your lab. For some chemicals, the Chemical Safety Level designation is dependent not just on the type of chemical present, but also on the quantity present, its concentration, and how it is used.

Chemical Safety Level 4 (High Risk)	
Hazard Description	Examples
<p><i>Health</i> Regulated, confirmed, probable, or suspected human carcinogens, mutagens, or teratogens Toxicity: LD<sub>50</sub>&lt;50mg/kg, LC<sub>50</sub>&lt;2g dust or 200ppm vapor OEL &lt; 1ppm Irreversible toxicities require use of designated areas Lachrymators, potent irritants, or stenches</p> <p>Highly toxic compounds</p> <p>Cryogenic materials Environmental Hazard</p>	<p>Acrylamide, benzene, benzidine, ethylene oxide, formaldehyde, chromium VI Acrolein, bromine, sodium azide, potassium cyanide, lead, phosgene (GHS: H304; H334; H340-H373)</p> <p>acetic anhydride, capsaicin, ethanethiol (GHS: H290; H314; H318; H302; H312; H315; H317; H319; H332; H335; H336)</p> <p>acrolein, abrin, bromine, diacetoxyscirpenol,, diazomethane, dimethylmercury, shigatoxin, sodium azide, sodium cyanide, toluene diisocyanate, ethidium bromide, hydrofluoric acid (GHS:H300; H301; H310; H311; H330; H331)</p> <p>Argon, Helium, Hydrogen, Nitrogen, Oxygen, Methane Iodine, Zinc sulfate, Copper sulfate (GHS: H400-H420)</p>
<p><i>Corrosivity</i> Highly corrosive chemicals</p>	<p>Hydrogen fluoride, hydrofluoric acid, sodium hydroxide</p>
<p><i>Reactivity</i> Can explode or decompose violently at normal temperature and pressure. Can undergo a violent self-accelerating exothermic reaction with common materials by itself. May be sensitive to mechanical or local thermal shock at normal</p>	<p>Light sensitive: Hydrogen and chlorine Acid/Base sensitive: Acrolein, epichlorohydrin Metal ion sensitive: Hydrogen peroxide Shock sensitive: Acetylides, azides, nitrogen triiodide, organic nitrates, nitro compounds (picric acid), perchlorate salts, organic peroxides, and</p>

<p>temperature and pressure. Easily forms dangerous peroxide levels High hazard reactions in use Explosive chemicals that can cause a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.</p> <p>Pyrophorics or flammable solids. Materials that spontaneously ignite when exposed to air.</p> <p>Water Reactives. May produce heat and flammable hydrogen gas, which can ignite or combine explosively with atmospheric oxygen May produce toxic gas</p> <p>Strong oxidizing agents Readily yield oxygen to increase the rate of combustion during a fire</p>	<p>compounds containing diazo, halamine, nitroso, and ozonide functional groups Chemicals that autooxidize to form organic hydroperoxides and /or peroxides: Ethers (especially cyclic ethers or those with primary and secondary alkyl groups), aldehydes, compounds containing benzylic hydrogens or allylic hydrogens, vinyl and vinylidene compounds, compounds containing a tertiary C-H group like decalin and 2,5-dimethylhexane (GHS:H200-H205; H240;H241) Many finely divided metals Many reducing agents (metal hydrides, alloys of reactive metals, low-valent metal salts, iron sulfides) trimethylaluminum, trimethylphosphine (GHS: H242; H250) Alkali metals(lithium, sodium, potassium), Organometallic compounds, and some hydrides Some anhydrous metal halides (aluminum bromide) Some oxides (calcium oxide) Some nonmetal oxides (sulfur trioxide) Some halides (phosphorous pentachloride) thionyl chloride Gases: fluorine, chlorine, ozone, nitrous oxide, steam, oxygen Liquids: hydrogen peroxide, nitric acid, perchloric acid, bromine, sulfuric acid, water Solids: nitrites, nitrates, perchlorates, peroxides, chromates, dichromates, picrates, permanganate, hypochlorites, bromates, iodates, chlorites, chlorates (GHS:H271; H272)</p>
<p><i>Flammability</i> NFPA rating of 4 Flash point below 73°F (22.8°C) and boiling point below 100°F. Flammable gases</p>	<p>Acetaldehyde, diethyl ether, hydrogen sulfide, acetone, carbon disulfide, hexane Acetylene, ammonia, hydrogen, propane, propylene and methane (GHS: H220-H226, H281)</p>

Chemical Safety Level 3 (Moderate Risk)	
Hazard Description	Examples
<p><i>Health</i></p> <p>Unknown toxicities or OEL &lt; 10ppm            Specific target organs or irreversible effects probable            Possible human carcinogens, mutagens, or teratogens            Irritants</p>	t-butanol, butyl acetate, sodium sulfide, isopropanol, amyl acetate, cyclohexanone, sodium hydroxide, formamide
<p><i>Corrosivity</i></p>	See CSL 4 above, in small quantities or low concentrations.
<p><i>Reactivity</i></p> <p>Can detonate or explode but requires a strong initiating force or confined heating before initiation. Readily promotes oxidation with combustible materials and may cause fires. Is sensitive to thermal or mechanical shock at elevated temperatures. May react explosively with water without requiring heat or confinement.            Chemicals being used have known reactions or contamination hazards</p>	See CSL 4 above, in small quantities or low concentrations.
<p><i>Flammability</i></p> <p>Flammables solvents and gases. Vaporizes readily and can be ignited under almost all ambient conditions. May form explosive mixtures with or burn rapidly in air. May burn rapidly due to self-contained oxygen.            Flash point at or above 73°F (22.8°C) but less than 100°F (37.8°C).  <b>Expected concentration &gt;10% LEL</b></p>	acetone, ethanol, hexane, methanol, xylene, 2-butanol

Chemical Safety Level 2 (Low Risk)	Chemical Safety Level 1 (Minimal Risk)
<p><i>Health</i>            Toxicity is known and 10ppm &lt; OELs &lt; 500ppm Specific target organs or irreversible effects suspected            Water soluble alcohols (Lower alcohols)            Solid salts            Compressed gases are simple asphyxiants</p>	<p><i>Health</i>            No suspected human carcinogens            All chemicals have known toxicities and OELs &gt; 500ppm            Consumer products in consumer packaging, unopened            Instrumental labs</p>
<p><i>Corrosivity</i>            Low concentration acids or bases            pH less than 2 or greater than 10.5</p>	<p><i>Corrosivity</i>            Chemicals with hazardous characteristics are not present or are in small capped vials, sampled with a pipette or syringe            2 &lt; pH &lt; 10.5</p>
<p><i>Reactivity</i>            All chemicals being used are compatible. Limited quantities (&lt;1L, or 0.5kg) of CSL 3 chemicals. No CSL 4 chemicals.</p>	<p><i>Reactivity</i>            No chemical changes expected in the process            Normally stable, does not react with water, can become unstable at high temperature and pressure</p>
<p><i>Flammability</i>            Flashpoint near ambient  <b>Expected concentration &lt;10% LEL</b>             Examples: gasoline, antifreeze</p>	<p><i>Flammability</i>            Slightly combustible, will burn in air when exposed at 1500°F (815.5°C) for 5 minutes            Noncombustible, will not burn in air when exposed at 1500°F (815.5°C) for 5 minutes            Flashpoint above ambient temperature (140°F)            Examples: Lysol, 6% Hydrogen peroxide (hair bleaching)</p>

<b>Biological Hazards</b>					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Working with human blood, body fluids, tissues, or bloodborne pathogens (BBP), animal specimens (preserved and unpreserved), or recombinant DNA Work with agents that are not known to consistently cause diseases in healthy adults. (BSL-1)	Exposure to infectious material or preservatives. Eye or skin irritation.	Lab bench, sink	Follow standard microbiological practices EH&S Lab & Research Safety course, Biosafety Core course	<ul style="list-style-type: none"> <li>•Lab coats</li> <li>•Nitrile gloves</li> <li>•Safety glasses</li> <li>•Use goggles for splash protection.</li> <li>•Select glove protection for preserved specimens according to type of preservative used</li> </ul>
<input type="checkbox"/>	Agents associated with human disease (BSL-2)	Exposure to infectious material Routes of transmission include percutaneous injury, ingestion, mucous membrane exposure	Bio Safety Cabinets or other physical containments devices used for all manipulations of agents that can cause splashes or aerosols of infectious materials.	EH&S Lab & Research Safety course, Biosafety Core course Limited access, biohazard warning signs “Sharps” precautions, Biosafety manual defining any needed waste Decontamination	<ul style="list-style-type: none"> <li>•Lab coats</li> <li>•Nitrile gloves</li> <li>•Face and eye protection, as needed</li> </ul>

				or medical surveillance policies Autoclave must be available	
<input type="checkbox"/>	Indigenous or exotic agents (BSL-3)	Exposure to infectious material May cause serious or potentially lethal disease through the inhalation route exposure	Bio Safety Cabinets or other physical containments devices used for all manipulations of agents that can cause splashes or aerosols of infectious materials. Facility requirements: •Physical separation from access corridors •Self-closing, double-door access •Exhausted air not recirculated •Negative airflow into laboratory •Entry through airlock or anteroom	EHS lab & research safety course, Contact USF Biosafety Officer Hand washing sink near laboratory exit	<ul style="list-style-type: none"> <li>•Lab coats</li> <li>•Nitrile gloves</li> <li>•Face and eye protection, as needed</li> </ul>

<b>Physical Hazards</b>					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Working with cryogenics	Major skin, tissue, or eye damage	Store and work with material in a laboratory or laboratory support areas with adequate air exchanges.	<ul style="list-style-type: none"> <li>• Oxygen monitor if greater than 60 gallons of liquid nitrogen present.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety glasses or goggles for large volumes</li> <li>• Heavy impermeable insulated gloves; lab coat</li> <li>• Consider a face shield</li> </ul>
<input type="checkbox"/>	Working with very cold equipment or dry ice	Frostbite, Hypothermia	<ul style="list-style-type: none"> <li>• Work with material or equipment in a laboratory or laboratory support areas with adequate air exchanges.</li> <li>• Allow dry ice to sublimate in certified fume hood or glove box</li> </ul>	<ul style="list-style-type: none"> <li>• Develop &amp; follow task specific SOPs</li> <li>• Do not store dry ice in cold rooms</li> </ul>	<ul style="list-style-type: none"> <li>• Safety glasses or goggles for large volumes</li> <li>• Insulated gloves (possibly warm clothing)</li> <li>• Lab coat</li> </ul>
<input type="checkbox"/>	Working with hot liquids, equipment, or open flames (autoclave, Bunsen burners, water or oil bath)	Burns resulting in skin or eye damage	Work with material in a laboratory or laboratory support areas with adequate air exchanges.	<ul style="list-style-type: none"> <li>• Develop &amp; follow task specific SOPs</li> <li>• Use &amp; maintain equipment as per manufactures guide</li> <li>• Do not use mercury containing thermometers</li> <li>• Do not heat liquids above flash point.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety glasses or goggles for large volumes</li> <li>• Insulated gloves (impermeable insulated gloves for liquids, steam)</li> <li>• Lab coat</li> </ul>
<input type="checkbox"/>	Extreme heat during field activities	Sunburn, heat stroke, dehydration	<ul style="list-style-type: none"> <li>• If possible, perform work in shaded areas or use pop-up tents or umbrellas</li> <li>• Drink plenty of fluids</li> </ul>	<ul style="list-style-type: none"> <li>• Develop &amp; follow task specific SOPs</li> </ul>	<ul style="list-style-type: none"> <li>• Protective clothing (long sleeves, pants)</li> <li>• Sunscreen</li> </ul>

□	Working with compressed gas cylinders	Uncontrolled pressure release can cause personal injury or property damage	<ul style="list-style-type: none"> <li>• Store and work with material in a laboratory or laboratory support areas with adequate air exchanges</li> <li>• Secure compressed gas cylinders to a wall or bench by using a mounting bracket.</li> </ul>	<ul style="list-style-type: none"> <li>• Keep regulators in good condition; cap cylinders that are not in use or attached to equipment; keep upright</li> </ul>	<ul style="list-style-type: none"> <li>• Safety glasses should be worn when operating a regulator or when using compressed air for cleaning/dusting</li> </ul>
□	Working with hazardous compressed gas cylinders (flammable, toxic, highly toxic, corrosive, air reactive, pyrophoric, those without good physiological warning properties)	Uncontrolled pressure release can cause personal injury or property damage; Fire or explosion; poisoning; severe respiratory, eye, and skin irritation	<ul style="list-style-type: none"> <li>• Store and work with material in a laboratory or laboratory support areas with adequate air exchanges.</li> <li>• Secure compressed gas cylinders to a wall or bench mounted bracket.</li> <li>• Use and store in a certified chemical fume hood or vented gas cabinet.</li> </ul>	<ul style="list-style-type: none"> <li>• Purchase the lowest concentration of the gas as possible</li> <li>• Keep flammable gases away from ignition sources</li> <li>• Keep regulators in good condition</li> <li>• Cap cylinders that are not in use or attached to equipment; keep upright.</li> <li>• Use a gas detection and alarm system.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety glasses should be worn when operating a regulator or when using compressed air for cleaning/dusting</li> </ul>
□	Working with loud equipment, noises, sounds, or alarms, etc.	Potential ear damage and hearing loss	<ul style="list-style-type: none"> <li>• Lubricate machinery and equipment</li> <li>• Place a barrier between the noise source and employee (i.e. sound walls or curtains)</li> <li>• Consider vibration isolation system.</li> </ul>	<ul style="list-style-type: none"> <li>• Develop &amp; follow task specific SOPs</li> <li>• Limit workers' exposures through techniques such as using job-rotation schedules that reduce the time an individual may be exposed.</li> <li>• Operating noisy machines during shifts</li> </ul>	<ul style="list-style-type: none"> <li>• Earplugs or ear muffs in consultation with EH&amp;S Occupational Safety</li> </ul>

				when fewer people are exposed. <ul style="list-style-type: none"> <li>Restricting worker presence to a suitable distance away from noisy equipment.</li> </ul>	
<input type="checkbox"/>	Glassware washing, handling broken glass or sharps	Laceration, injection, exposure		<ul style="list-style-type: none"> <li>Develop &amp; follow task specific SOPs</li> <li>Use plastic disposable ware when possible</li> </ul>	<ul style="list-style-type: none"> <li>Heavy rubber gloves for glassware washing</li> <li>Cut-resistant gloves when handling sharps</li> <li>Lab coat</li> </ul>
<input type="checkbox"/>	Working with electrical equipment (exposed electrical conductors, high voltage circuits, energized equipment)	Electrical shock		<ul style="list-style-type: none"> <li>Develop &amp; follow task specific SOPs</li> <li>Signs and postings notifying others of the hazard present</li> <li>Inspect power cords prior to use</li> </ul>	<ul style="list-style-type: none"> <li>Safety glasses</li> <li>Protective gloves</li> </ul>
<input type="checkbox"/>	Harmful dusts, fumes, mists or vapors	Inhalation, lung damage, eye irritation	<ul style="list-style-type: none"> <li>Work with material or equipment in a laboratory or laboratory support areas with adequate air exchanges</li> <li>Local exhaust ventilation</li> </ul>		<ul style="list-style-type: none"> <li>Safety goggles</li> <li>Respirator after consultation with EH&amp;S Industrial Hygiene</li> </ul>
<input type="checkbox"/>	Manipulation of large objects (lifting)	Back injury		<ul style="list-style-type: none"> <li>EH&amp;S Back Safety Training</li> <li>Proper lifting technique; bend knees</li> </ul>	

<b>Radiological Hazards</b>					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Working with any radioactive materials requires prior approval by USF's radiation safety officer – 813-974-1194	Cell damage, potential spread of radioactive materials	Contact USF Radiation Safety Officer	Contact USF Radiation Safety Officer	Contact USF Radiation Safety Officer
<input type="checkbox"/>	Working with radiation producing equipment (X-ray devices) requires prior approval by USF's radiation safety officer – 813-974-1194	Cell damage.	Contact USF Radiation Safety Officer	Contact USF Radiation Safety Officer	Contact USF Radiation Safety Officer
<input type="checkbox"/>	Working with ultraviolet radiation	Skin cancer, conjunctivitis, corneal damage, skin redness	Enclosures, screens or filters used to contain the UV radiation. Devices such as interlocks to allow safe temporary access to a hazardous area. Surfaces should be painted in a dark, dull color.	SOP, Research-specific Training, EHS training, 4 hour training course, Warning Signs, limited access and exposure time. Complete application for use	<ul style="list-style-type: none"> <li>•Safety glasses or chemical splash goggles</li> <li>•UV face shield</li> <li>•Lab coat</li> </ul>
<input type="checkbox"/>	Working with infrared emitting equipment (i.e. glass blowing)	Cataracts, burns to cornea	Adequate Ventilation	SOP, Research-specific Training, EHS training, 4 hour training course, Warning Signs, limited access and exposure time. Complete application for use	<ul style="list-style-type: none"> <li>•Appropriate shaded safety goggles</li> <li>•Lab coat</li> </ul>

<b>Laser Hazards</b>					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Performing alignment, troubleshooting or maintenance that requires working with an open beam and/or defeating the interlock(s) on any Class 3 or Class 4 laser system All class 3b and 4 lasers must be registered with USF's laser safety officer 813-974-1194	Eye and/or skin damage	Enclosures to limit access to laser beam	Follow requirements in the USF Laser Safety Program – available on-line. Warning Signs, limited access and exposure time.	<ul style="list-style-type: none"> <li>•Proper Laser Safety glasses</li> <li>•impermeable gloves</li> <li>•Lab coat</li> </ul>
<input type="checkbox"/>	Viewing a Class 3R laser beam with magnifying optics (including eyeglasses)	Eye damage	Enclosures to limit access to laser beam	Follow requirements in the USF Laser Safety Program – available on-line. Warning Signs, limited access and exposure time.	Proper Laser Safety glasses

<b>Laser System Non-Beam Hazards</b>					
<input type="checkbox"/>	Handling dye and other laser-related materials such as chemicals and solvents.	Adverse health effects due to toxicity from inhalation or skin absorption, explosion, fire	Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S).	SOP, Research-specific Training, EHS training, 4 hour training course, Warning Signs, limited access and exposure time. Complete application	<ul style="list-style-type: none"> <li>•Appropriate shaded safety goggles</li> <li>•Lab coat</li> </ul>

				for use	
<input type="checkbox"/>	Laser high voltage supplies	Electrocution	Make sure area is dry. Connect to power last.	SOP, Research-specific Training, EHS training, 4 hour training course, Warning Signs, limited access and exposure time. Complete application for use	<ul style="list-style-type: none"> <li>• Use properly grounded equipment and tools</li> <li>• remove metal from body</li> </ul>
<input type="checkbox"/>	Laser systems used to cut or etch materials. These lasers may have potential to generate a fire hazard. Laser beam may generate air contaminants.	Adverse health effects due to toxicity from inhalation explosion, fire	Ventilation/exhaust at laser work area, follow fire safety – access to fire extinguisher	SOP, Research-specific Training, EHS training, 4 hour training course, Warning Signs, limited access and exposure time. Complete application for use	<ul style="list-style-type: none"> <li>• Use properly grounded equipment and tools</li> <li>• remove metal from body</li> </ul>

<b>Nanomaterial Hazards</b>					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Handling nanomaterial in a bound substrate or matrix; water-based liquid suspensions or gels. Non-destructive handling of nanomaterial. No potential for airborne release when handling.	Inhalation, ingestion, ocular, and dermal exposure are possible. Acute irritation and chronic respiratory illness are possible.	<ul style="list-style-type: none"> <li>• Local exhaust ventilation</li> <li>• Certified chemical hood (with HEPA-filtered exhaust)</li> <li>• HEPA-filtered exhausted enclosure (Glove box)</li> <li>• Biological safety cabinet class II type A1, A2, vented via thimble connection, or B1 or B2</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain a clean work area by using wet wiping method or vacuum with HEPA filtration after each use.</li> <li>• Limit workers' exposures through techniques such as using job-rotation schedules that reduce the time an individual may be exposed.</li> <li>• Develop and follow task specific SOP.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety glasses with side shields</li> <li>• Laboratory coat</li> <li>• Disposable gloves to match any associated chemical hazards</li> </ul>
<input type="checkbox"/>	Handling nanomaterial in powder or pellet form, in volatile liquid suspensions or gels. Heating materials, stirring or agitating liquid suspensions or gels, weighing or transferring powders or	Inhalation, ingestion, ocular, and dermal exposure are possible. Acute irritation and chronic respiratory illness are possible.	<ul style="list-style-type: none"> <li>• Local exhaust ventilation</li> <li>• Certified chemical hood (with HEPA-filtered exhaust)</li> <li>• HEPA-filtered exhausted enclosure (Glove box)</li> <li>• Biological safety cabinet class II type A1, A2, vented via thimble connection, or B1 or B2</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain a clean work area by using wet wiping method or vacuum with HEPA filtration after each use.</li> <li>• Limit workers' exposures through techniques such as using job-rotation schedules that reduce the time an individual may be exposed.</li> <li>• Develop and follow task specific SOP.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety goggles</li> <li>• Laboratory coat made from non-woven fibers</li> <li>• Disposable shoe covers</li> <li>• Disposable gloves to match any associated chemical hazards</li> </ul>

	pellets. Moderate potential for release into air during handling.				
<input type="checkbox"/>	Generation or manipulation nanomaterial in a powder or gaseous phase with high potential for airborne release.	Inhalation, ingestion, ocular, and dermal exposure are possible. Acute irritation and chronic respiratory illness are possible.	<ul style="list-style-type: none"> <li>• Glove box or other sealed enclosure with HEPA-filtered exhaust.</li> <li>• Appropriate equipment for monitoring toxic gas (e.g., CO)</li> </ul>	<ul style="list-style-type: none"> <li>• Maintain clean work area use wet wiping method or vacuum with HEPA filtration after each use.</li> <li>• Limit workers' exposures through techniques use job-rotation schedules that reduce the time an individual may be exposed.</li> <li>• Develop and follow task specific SOP.</li> </ul>	<ul style="list-style-type: none"> <li>• Safety goggles</li> <li>• Laboratory coat made from non-woven fibers</li> <li>• Disposable shoe covers</li> <li>• Disposable gloves to match any associated chemical hazards</li> </ul>

<b>Shop Hazards</b>					
Check if applicable	Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE
<input type="checkbox"/>	Machinery with components which transmit energy to the part of the machine performing work. These components include flywheels, pulleys, belts, connecting rods, couplings, cam, spindles, chains, cranks and gears.	Entrapment and/or entanglement hazard. Damage to eyes due to flying debris	Use machine guarding and locate emergency stop	<ul style="list-style-type: none"> <li>Loose hair, jewelry, ID badges and loose clothing must be secured to prevent entanglement</li> </ul>	<ul style="list-style-type: none"> <li>PPE that is form fitting - no work gloves</li> <li>Eye protection, hearing protection where necessary</li> </ul>
	All parts of the machine move while the machine is in operation. This can include reciprocating, rotating & transverse moving parts, as well as feed mechanisms	Entanglement and/or entrapment hazard	Use machine guarding and locate emergency stop	<ul style="list-style-type: none"> <li>Loose hair, jewelry, ID badges and loose clothing must be secured to prevent entanglement</li> </ul>	<ul style="list-style-type: none"> <li>PPE that is form fitting - no work gloves</li> <li>Eye protection, hearing protection where necessary</li> </ul>

	and auxiliary parts of the machine.				
	Powered hand tools, such as drill or hand saw.	Laceration hazard; electrical hazard; potential eye damage due to flying debris or tool parts.	Use safety shields	<ul style="list-style-type: none"><li>• Inspect power cord prior to use</li><li>• Power off when changing bits and blades</li></ul>	<ul style="list-style-type: none"><li>• Protective eyewear</li></ul>

**Blank PPE Selection Worksheet**

Activity	Potential Hazard	Engineering Controls	Administrative Controls	Recommended PPE

## References

- American Chemical Society. Identifying and Evaluating Hazards in Research Laboratories.: Guidelines Developed by the Hazards Identification and Evaluation Task Force of the American Chemical Society's Committee on Chemical Safety. 2013
- Hill, R. H. Jr.; Gaunce, J.A.; Whitehead, P. *Chemical Health and Safety* 1999, Jul-Aug, 7-14.
- National Research Council. *Prudent Practices in the Laboratory: Evaluating Hazards and Assessing Risks in the Laboratory*, National Academy Press: Washington DC, 1995.
- Univeristy of Arizona. Laboratory Chemical Safety Manual. Section 5. Particularly Hazardous Chemicals. (<https://orcbs.arizona.edu/files/forms/Laboratory%20Chemical%20Safety%20Manual.pdf>) Accessed 3/6/2015.
- University of California. Laboratory Hazard Assessment Tool.( <https://ucla.app.box.com/ehs-ppe-selection-guide>) Accessed 3/18/2015

## **Appendix 1: Establishing Chemical Safety Levels (American Chemical Society)**

Table 8-1 is designed to help you determine a chemical safety level (CSL) appropriate to the chemical activities in a laboratory. This CSL provides general guidance for best chemical safety practices appropriate to the chemical hazards of the laboratory.

In order to use this table, start with the “Conceptual Hazard Level” row and work across the row, thinking about the type of hazards present in the lab room, lab group, or process and match the hazard to the Chemical Safety Level, across the top of the table. Compare the tentative Chemical Safety Level to the “Chemicals Used” row, to confirm proper assignment. Once the Chemical Safety Level is assigned, go down the table to identify the various safety measures appropriate to the lab room, lab group or process. Remember that these recommendations may be over-ridden by local factors; document the reasons for these variations as they occur.

Table 8-1 Suggested Approach for Establishing Chemical Safety Levels				
DESCRIPTOR OR CONTROL	CHEMICAL SAFETY LEVEL 1	CHEMICAL SAFETY LEVEL 2	CHEMICAL SAFETY LEVEL 3	CHEMICAL SAFETY LEVEL 4
Scope of Assessment Possibilities				
Driving Consideration				
<b>CONCEPTUAL HAZARD LEVEL</b> <i>(overview of risk level)</i>	Laboratory hazards equivalent to typical household	Laboratory hazards equivalent to teaching lab settings (restricted hazardous chemical inventory; well-established procedures in place)	Moderate or varying laboratory hazards within a narrow range (open hazardous chemical inventory; evolving procedures)	Novel hazards or severe established hazards (high hazard chemicals or processes with well established procedures)
Flexible				
Context Dependent				
<b>CHEMICALS USED</b> <i>(types or characteristics of chemicals used)</i>	Consumer products in consumer packaging; may receive but not open chemical packages	Low concentration acids/bases, lower alcohols, solid salts, simple asphyxiant compressed gases	Typical chemical inventory for a research laboratory - flammable solvents, corrosives, inorganic salts, toxics, flammable gases. No air/water reactive, pyrophoric materials	Air/water reactive, pyrophoric materials or gases. Explosives or potentially explosive compounds, highly toxic materials (in any state of matter)
Lab Room				
None identified				
<b>TRAINING REQUIREMENTS</b> <i>(prerequisites for people working in the lab)</i>	Observe label and warning signs	General lab safety training in addition to warning labels and signs	Laboratory hazards require laboratory specific safety training	Laboratory access restricted to people accompanied by experienced personnel
Lab group				
Based on highest lab hazard rating				
<b>SUPERVISION REQUIREMENTS</b> <i>(safety responsibilities of lab leader(s))</i>	Awareness of work being conducted	Constant supervision or working alone based on specific restrictions	Peer presence or working alone based on specific restrictions	Peer presence
Lab room				
Based on highest active lab hazard process				

Table 8-1 Suggested Approach for Establishing Chemical Safety Levels				
DESCRIPTOR OR CONTROL	CHEMICAL SAFETY LEVEL 1	CHEMICAL SAFETY LEVEL 2	CHEMICAL SAFETY LEVEL 3	CHEMICAL SAFETY LEVEL 4
Scope of Assessment Possibilities				
Driving Consideration				
<b>OVERSIGHT REQUIREMENTS</b> <i>(expectations for institutional review of lab operations)</i>	*Weekly self-inspections; **self-audits three times per year	*Weekly self-inspections; **self-audits three times per year	*Weekly self-inspections; ***monthly drop bys; **self-audits three times per year; ‡risk-based institutional review schedule	*Daily self-inspections; ***monthly drop bys; **self-audits three times per year; †risk-based institutional review schedule
Lab group				
Based on highest lab hazard rating				
<b>PLANNING REQUIREMENTS</b> <i>(specific requirements for planning of work)</i>	Process specific plans written and the presence of other chemicals prohibited	Written procedures including safety protocols	Written procedures including safety protocols must be peer reviewed	Written procedures including safety protocols must be supervisor reviewed
Process specific				
Based on highest rated chemical involved				
<b>GENERAL PPE REQUIREMENTS (EYE AND SKIN EXPOSURE)</b> <i>(protection requirements to enter the room)</i>	Coverage of legs and feet	Above plus eye protection	Above plus lab coat	Above plus flame resistant lab coat
Lab room				
Primarily based on physical ratings				
<b>SPECIFIC PPE REQUIREMENTS (HAND AND RESPIRATORY PROTECTION)</b> <i>(protection requirements to conduct work)</i>	No gloves	Activity-specific gloves - thin nitrile, vinyl, or latex disposable gloves would be typical	Activity-specific gloves - thin nitrile, vinyl, or latex disposable gloves would be acceptable for an incidental small quantity splash. Neoprene or butyl rubber may be needed for immersion in solvents, or similar	Activity-specific gloves - flame resistant if using pyrophoric liquids, neoprene if using large quantities.
Process specific				
Primarily based on physical ratings				
<b>GENERAL VENTILATION REQUIREMENTS</b> <i>(facility support requirements)</i>	None or low ventilation specifications	‡ Moderate ventilation, as defined by laboratory ventilation management plan	‡ High ventilation, as defined by laboratory ventilation management plan	Ventilation designed specifically for this operation
Lab room				
Primarily based on health rating				

Table 8-1 Suggested Approach for Establishing Chemical Safety Levels				
DESCRIPTOR OR CONTROL	CHEMICAL SAFETY LEVEL 1	CHEMICAL SAFETY LEVEL 2	CHEMICAL SAFETY LEVEL 3	CHEMICAL SAFETY LEVEL 4
Scope of Assessment Possibilities				
Driving Consideration				
<b>OTHER ENGINEERING CONTROLS</b>		Local exhaust ventilation (snorkel)	Fume hood, local exhaust ventilation (snorkel)	Fume hood, local exhaust ventilation (snorkel), glove/dry box, enclosed reactor
Based on exposure risk				
<b>EMERGENCY RESPONSE PROTOCOL</b> <i>(expectations for response to potential hazmat emergencies)</i>	Institutional-specific response protocol	Institutional-specific response protocol; people with knowledge of incident have responsibility to provide information to responders	Institutional-specific response protocol; may have advanced lab response protocol to make the situation safe while evacuating	Institutional-specific response protocol; specific pre-planning required
Lab room				
Primarily based on physical and mechanical ratings				
<p>* Self-Inspections: quick look at physical surroundings - may or may not use a formal checklist  ** Self-Audits: more comprehensive review of the CSL and other documentation; uses a checklist  *** Drop-by: informal review, consult, check-in, friendly visit by an institutional representative  † Risk-based Institutional Review: formal review of lab by an institutional representative; uses a checklist, documents issues for correction, escalates issues to upper management as necessary  ‡ Contact facilities for details about the laboratory ventilation plan.</p>				





Laboratory Safety Training

Hazardous Waste Refresher

Biomedical Waste Refresher

Hazardous Communication

Personal Protective Equipment

Slips, Trips, and Falls

Hearing Conservation

Golf Cart Training

Asbestos Awareness Training

Fire Prevention Safety Training



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