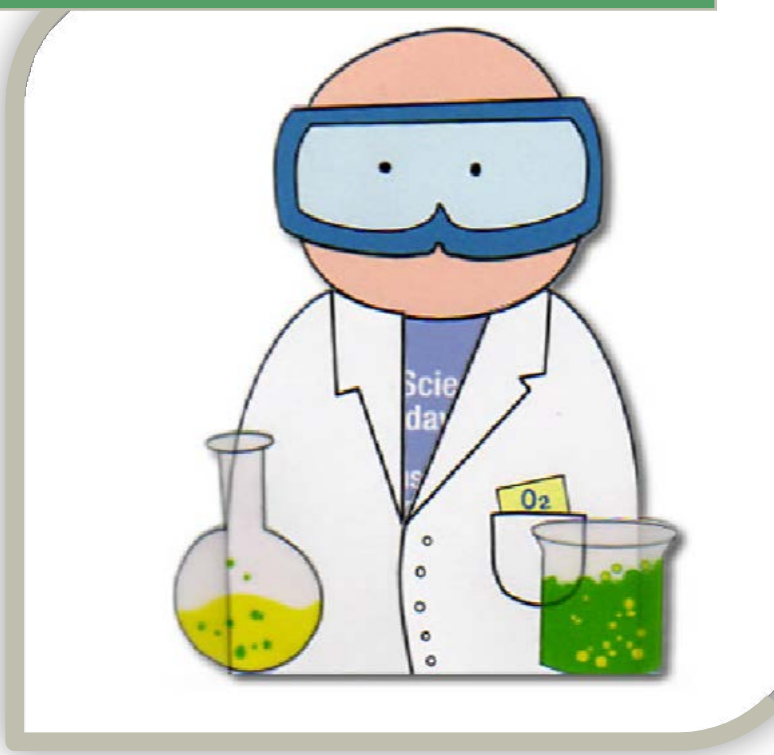
# Hazard Control & PPE Selection Guide

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# Introduction

This guide is a resource for Principal Investigators and Lab/Shop/Studio Supervisors to evaluate and control hazards and choose Personal Protective Equipment (PPE) that is appropriate for 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 workspace 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.

## Chemical Hazards (see below for explanation of CSL Levels)

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | Small volumes of mildly corrosive liquids<br>pH>2 or <12.5<br>CSL 2-3 | • Eye or skin damage<br>• Lung damage from inhalation | Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S) | • Written procedure (SOP)<br>• Safety Data Sheets (SDS)<br>• Job-specific training<br>• EH&S Lab and Research training | •Safety glasses or chemical splash goggles<br>•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<br>•Lab coat |
| ☐ | Large volumes of highly corrosive liquids<br>pH<2 or >12.5<br>Work where there is a splash hazard<br>CSL 4 | • Extensive eye or skin damage<br>• Lung damage from inhalation | Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S) | • Peer-reviewed written procedure (SOP)<br>• Safety Data Sheets (SDS)<br>• Job-specific training<br>• EH&S Lab and Research training<br>• Consider pre-diluted corrosive solutions | •Chemical splash goggles<br>•Face shield<br>•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<br>•Lab coat<br>•Chemical resistant apron |
| ☐ | Acutely toxic corrosive liquids<br>Any volume of hydrofluoric acid<br>Any concentration | • Extensive eye or skin damage<br>• Lung damage from inhalation<br>Poisoning through skin contact | Acid resistant fume hood | • Peer-reviewed written procedure (SOP)<br>• Safety Data Sheets (SDS)<br>• Job-specific training<br>• EH&S Lab and Research training<br>Consider pre-diluted corrosive solutions | •Chemical splash goggles<br>•Face shield<br>•Heavy chemical resistant gloves (neoprene or butyl)<br>See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical |

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

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| | and/or water reactive liquids in any quantity<br>CSL 4 | Lung damage from inhalation<br>Poisoning through skin contact<br>Fire | Inert atmosphere glove bag or glove box | training, and EH&S training<br><br>Practice before working with live material | •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<br>•Flame resistant lab coat<br>•Chemical resistant apron |
| ☐ | Acutely toxic or hazardous chemicals, including organic mercury compounds<br>CSL 4 | Extensive eye or skin damage<br>Poisoning through skin contact | Adequate ventilation, chemical fume hood, or local exhaust. If unavailable, a respirator may be required (contact EH&S)<br>Inert atmosphere<br>Trap or condense gases, vapors, and aerosols to avoid contaminating vacuum pumps or discharging large quantities to fume hood exhaust air<br>Use designated area | Peer-reviewed SOP, Research-specific training, and EH&S training<br>Medical surveillance may be required depending on quantity, toxicity, and frequency of exposure<br><br>Practice before working with live material<br><br>Inform nearby persons with a sign: “Toxic Compounds Use Area” | •Chemical splash goggles<br>•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<br>•Lab coat or gown |
| ☐ | Pressurized apparatus<br>CSL 3,4 | Eye or skin damage (lacerations due to shrapnel) | Chemical fume hood with sash lowered as much as possible<br>Lexan or blast resistant shield | SOP, Research-specific training, and EH&S training | •Safety glasses or chemical splash goggles<br>•Face shield (high risk)<br>•Light chemical resistant and/or abrasion/puncture resistant gloves<br>•Lab coat |
| ☐ | 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 | •Chemical splash goggles<br>•Face shield<br>•Heavy chemical resistant gloves |

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| | time sensitive, temperature sensitive, light sensitive, acid/base sensitive, metal ion sensitive, shock sensitive, or peroxide formers<br>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)<br>Use Teflon-coated instead of ground glass fixtures for shock or friction sensitive materials | training<br><br>Inform nearby persons with a sign: "Potentially Explosive Compounds Use Area"<br><br>Practice before working with live material | (neoprene, butyl, or flame resistant) or leather work gloves/welding gauntlets that extend past the wrist<br>See the chemical glove compatibility chart to choose appropriate chemical resistant gloves specific to the chemical being used<br>•Heavy work apron<br>•Flame resistant lab coat |

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

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

| Chemical Safety Level 3 (Moderate Risk) | |
|---|---|
| Hazard Description | Examples |
| *Health*<br>Unknown toxicities or OEL < 10ppm<br>Specific target organs or irreversible effects probable<br>Possible human carcinogens, mutagens, or teratogens<br>Irritants | t-butanol, butyl acetate, sodium sulfide, isopropanol, amyl acetate, cyclohexanone, sodium hydroxide, formamide |
| *Corrosivity* | See CSL 4 above, in small quantities or low concentrations. |
| *Reactivity*<br>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.<br>Chemicals being used have known reactions or contamination hazards | See CSL 4 above, in small quantities or low concentrations. |
| *Flammability*<br>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.<br>Flash point at or above 73°F (22.8°C) but less than 100°F (37.8°C).<br>**Expected concentration >10% LEL** | acetone, ethanol, hexane, methanol, xylene, 2-butanol |

| Chemical Safety Level 2 (Low Risk) | Chemical Safety Level 1 (Minimal Risk) |
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| *Health*<br>Toxicity is known and10ppm < OELs <500ppmSpecific target organs or irreversible effects suspected<br>Water soluble alcohols (Lower alcohols)<br>Solid salts<br>Compressed gases are simple asphyxiants | *Health*<br>No suspected human carcinogens<br>All chemicals have known toxicities and OELs > 500ppm<br>Consumer products in consumer packaging, unopened<br>Instrumental labs |
| *Corrosivity*<br>Low concentration acids or bases<br>pH less than 2 or greater than 10.5 | *Corrosivity*<br>Chemicals with hazardous characteristics are not present or are in small capped vials, sampled with a pipette or syringe<br>2<pH<10.5 |
| *Reactivity*<br>All chemicals being used are compatible. Limited quantities (<1L, or 0.5kg) of CSL 3 chemicals. No CSL 4 chemicals. | *Reactivity*<br>No chemical changes expected in the process<br>Normally stable, does not react with water, can become unstable at high temperature and pressure |
| *Flammability*<br>Flashpoint near ambient<br>**Expected concentration <10% LEL**<br><br>Examples: gasoline, antifreeze | *Flammability*<br>Slightly combustible, will burn in air when exposed at 1500°F (815.5°C) for 5 minutes<br>Noncombustible, will not burn in air when exposed at 1500°F (815.5°C) for 5 minutes<br>Flashpoint above ambient temperature (140°F)<br>Examples: Lysol, 6% Hydrogen peroxide (hair bleaching) |

## Biological Hazards

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | Working with human blood, body fluids, tissues, or bloodborne pathogens (BBP), animal specimens (preserved and unpreserved), or recombinant DNA<br>Work with agents that are not known to consistently cause diseases in healthy adults.<br>(BSL-1) | Exposure to infectious material or preservatives.<br>Eye or skin irritation. | Lab bench, sink | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab & Research Safety Training<br>• Biosafety Core Course<br>• Follow standard microbiological practices | •Lab coats<br>•Nitrile gloves<br>•Safety glasses<br>•Use goggles for splash protection.<br>•Select glove protection for preserved specimens according to type of preservative used |
| ☐ | Agents associated with human disease (BSL-2) | Exposure to infectious material<br>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. | Peer-reviewed written procedure (SOP)<br>Job-specific training<br>EH&S Lab & Research Safety Training<br>Biosafety Core Course<br>Limited access, biohazard warning signs<br>Sharps precautions | •Lab coats<br>•Nitrile gloves<br>•Face and eye protection, as needed |

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| | | | | Medical surveillance policies<br>Autoclave must be available | |
| ☐ | Indigenous or exotic agents (BSL-3) | Exposure to infectious material<br>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.<br>Facility requirements:<br>•Physical separation from access corridors<br>•Self-closing, double-door access<br>•Exhausted air not recirculated<br>•Negative airflow into laboratory<br>•Entry through airlock or anteroom | EHS lab & research safety course, Contact USF Biosafety Officer<br>Hand washing sink near laboratory exit | •Lab coats<br>•Nitrile gloves<br>•Face and eye protection, as needed |

## Physical Hazards

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | 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. | • Peer-reviewed written procedure (SOP)<br>• Safety Data Sheets (SDS)<br>• Job-specific training<br>• EH&S Lab and Research training<br>• Oxygen monitor if greater than 60 gallons of liquid nitrogen | • Safety glasses or goggles for large volumes<br>• Heavy impermeable insulated gloves; lab coat<br>• Consider a face shield |
| ☐ | Working with very cold equipment or dry ice | Frostbite, Hypotherm ia | • Work with material or equipment in a laboratory or laboratory support areas with adequate air exchanges.<br>• Allow dry ice to sublimate in certified fume hood or glove box | • Peer-reviewed written procedure (SOP)<br>• Safety Data Sheets (SDS)<br>• Job-specific training<br>• EH&S Lab and Research training<br>• Do not store dry ice in cold rooms | • Safety glasses or goggles for large volumes<br>• Insulated gloves (possibly warm clothing)<br>• Lab coat |
| ☐ | 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. | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab and Research training<br>• Use & maintain equipment as per manufactures guide<br>• Do not use mercury containing thermometers | • Safety glasses or goggles for large volumes<br>• Insulated gloves (impermeable insulated gloves for liquids, steam)<br>• Lab coat |

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| ☐ | Extreme temperature during field activities | • Sunburn, heat stroke, dehydration<br>• Hypothermia, frostbite | • Provide air-conditioned/ heated area for rest breaks<br>• Consider fans, tents, umbrellas, chemical heat packs<br>• Always have fluids available | • Peer-reviewed written procedure (SOP) | • Provide air-conditioned/ heated area for rest breaks<br>• Consider fans, tents, umbrellas, chemical heat packs<br>• Always have fluids available |
| ☐ | Nonhazardous material compressed gas cylinders | Uncontrolled pressure release can cause personal injury or property damage | • Store and work with material in a laboratory or laboratory support areas with adequate air exchanges<br>• Secure compressed gas cylinders to a wall or bench by using a mounting bracket | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab and Research training<br>• Keep regulators in good condition<br>• Cap cylinders that are not in use or attached to equipment<br>• Keep upright | Safety glasses should be worn when operating a regulator or when using compressed air for cleaning/dusting |

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| ☐ | 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 | • Store and work with material in a laboratory or laboratory support areas with adequate air exchanges.<br>• Secure compressed gas cylinders to a wall or bench mounted bracket.<br>• Use and store in a certified chemical fume hood or vented gas cabinet. | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab and Research training<br>• Keep regulators in good condition<br>• Cap cylinders that are not in use or attached to equipment<br>• Use a gas detection and alarm system<br>• Purchase the lowest concentration of the gas as possible | Safety glasses should be worn when operating a regulator or when using compressed air for cleaning/dusting |
| ☐ | Working with loud equipment, noises, sounds, or alarms, etc. | Potential ear damage and hearing loss | • Lubricate machinery and equipment<br>• Place a barrier between the noise source and employee (i.e. sound walls or curtains)<br>• Consider vibration isolation system. | Peer-reviewed written procedure (SOP)<br>Job-specific training<br>EH&S Hearing Conservation Training<br>Limit workers' exposures through techniques such as job-rotation<br>Operate noisy machines during times when fewer people are exposed<br>Restrict worker presence to a suitable distance | Earplugs or ear muffs in consultation with EH&S Occupational Safety |

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| ☐ | Glassware, needles, sharp metal or plastic edges | Laceration, injection, exposure | • Use rubber mats in sinks to protect glassware<br>• Use "safer" sharps | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• Use plastic disposables | • Heavy rubber gloves for glassware washing<br>• Cut-resistant gloves when handling sharps<br>• Lab coat |
| ☐ | Working with electrical equipment (exposed electrical conductors, high voltage circuits, energized equipment) | Electrical shock | | • Develop & follow task specific SOPs<br>• Signs and postings notifying others of the hazard present<br>• Inspect power cords prior to use | • Safety glasses<br>• Protective gloves |
| ☐ | Harmful dusts, fumes, mists or vapors | Inhalation, lung damage, eye irritation | • Work with material or equipment in a laboratory or laboratory support areas with adequate air exchanges<br>• Local exhaust ventilation | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab and Research training or EH&S Shop Safety or EH&S Safety and Compliance in the Arts | • Safety goggles<br>• Respirator after consultation with EH&S Industrial Hygiene |
| ☐ | Manipulation of large objects (lifting) | Back injury<br>Crush injury | • Use carts and mechanical hoists<br>• Install conveyor belts and machines that move objects | • EH&S Back Safety Training<br>• Proper lifting technique; bend knees | Back support |

## Radiological Hazards

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | 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 |
| ☐ | 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 |
| ☐ | 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 | •Safety glasses or chemical splash goggles<br>•UV face shield<br>•Lab coat |
| ☐ | 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 | •Appropriate shaded safety goggles<br>•Lab coat |

## Laser Hazards

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | Performing alignment, trouble-shooting or maintenance that requires working with an open beam and/or defeating the interlock(s) on any Class 3 of Class 4 laser system<br>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. | •Proper Laser Safety glasses<br>•impermeable gloves<br>•Lab coat |
| ☐ | 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 |

## Laser System Non-Beam Hazards

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| ☐ | 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). | • Follow requirements in the USF Laser Safety Program - available online<br>• EH&S Lab and Research Safety training<br>• Warning signs | •Appropriate shaded safety goggles<br>•Lab coat |

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| | | | | for use | |
| ☐ | Laser high voltage supplies | Electrocution | Use properly grounded equipment and tools | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• USF Laser Safety Training<br>• Make sure area is dry<br>• Connect to power last<br>• Warning signs<br>• Limited access and exposure time | Remove metal watches and jewelry |
| ☐ | 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 | •Use properly grounded equipment and tools<br>• remove metal from body |

## Nanomaterial Hazards

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | 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. | • Local exhaust ventilation<br>• Certified chemical hood (with HEPA-filtered exhaust)<br>• HEPA-filtered exhausted enclosure (Glove box)<br>• Biological safety cabinet class II type A1, A2, vented via thimble connection, or B1 or B2 | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab & Research Safety Training<br>• Maintain a clean work area by using wet wiping method or vacuum with HEPA filtration after each use<br>• Limit workers' exposures by using job-rotation schedules | • Safety glasses with side shields<br>• Laboratory coat<br>• Disposable gloves to match any associated chemical hazards |
| ☐ | Handling nanomaterial in powder of 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. | • Local exhaust ventilation<br>• Certified chemical hood (with HEPA-filtered exhaust)<br>• HEPA-filtered exhausted enclosure (Glove box)<br>• Biological safety cabinet class II type A1, A2, vented via thimble connection, or B1 or B2 | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab & Research Safety Training<br>• Maintain a clean work area by using wet wiping method or vacuum with HEPA filtration after each use<br>• Limit workers' | • Safety goggles<br>• Laboratory coat made from non-woven fibers<br>• Disposable shoe covers<br>• Disposable gloves to match any associated chemical hazards |

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| | pellets. Moderate potential for release into air during handling. | | | exposures by using job-rotation schedules | |
| ☐ | 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. | • Glove box or other sealed enclosure with HEPA-filtered exhaust.<br>• Appropriate equipment for monitoring toxic gas (e.g., CO) | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Lab & Research Safety Training<br>• Maintain a clean work area by using wet wiping method or vacuum with HEPA filtration after each use<br>• Limit workers' exposures by using job-rotation schedules | • Safety goggles<br>• Laboratory coat made from non-woven fibers<br>• Disposable shoe covers<br>• Disposable gloves to match any associated chemical hazards<br>• Respirator after consultation with EH&S Industrial Hygiene |

## Shop/Studio Hazards

| Check if applicable | Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|---|
| ☐ | Machinery (wood and/or metalworking) | Entrapment and/or entanglement hazard. Damage to eyes due to flying debris | Use machine guarding and locate emergency stop | • Loose hair, jewelry, ID badges and loose clothing must be secured to prevent entanglement | • PPE that is form fitting - no work gloves<br>• Eye protection, hearing protection where necessary |
| ☐ | 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 | • Inspect power cord prior to use<br>• Power off when changing bits and blades | • Protective eyewear |
| ☐ | Painting, printmaking, and/or photography | Poisoning<br>Fire<br>Skin/eye/lung damage | Adequate ventilation, chemical fume hood, or local exhaust; if unavailable, a respirator may be required (contact EH&S) | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Safety and Compliance in the Arts<br>• Purchase pre-mixed paints and solutions | • Full length smock, coveralls, or apron<br>• Safety glasses or chemical splash goggles<br>• 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 |

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|---|---|---|---|---|---|
| ☐ | Clay modeling, sculpting | • Laceration hazard<br>• Metal poisoning<br>• Respiratory system damage<br>• Skin irritation<br>• Potential eye damage due to flying debris | Vent kilns to the outside | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Shop Safety Training or EH&S Safety and Compliance in the Arts | • Eye protection (for flying debris or shaded) or splash goggles<br>• Apron<br>• 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 |
| ☐ | Hot work (soldering, brazing, welding, plasma cutting) | • Burns<br>• Fire<br>• Metal poisoning<br>• Respiratory system damage from fumes<br>• Hearing damage<br>• Electric shock | • Adequate ventilation or local exhaust (if unavailable, a respirator may be required (contact EH&S)<br>• Welding curtains to reduce reflectivity<br>• Noncombustible welding screens or booths<br>• Gas cylinder restraints | • Peer-reviewed written procedure (SOP)<br>• Job-specific training<br>• EH&S Shop Safety Training or EH&S Safety and Compliance in the Arts<br>• EH&S Hearing Conservation<br>• EH&S Fire Safety and Prevention<br>• Warning signs | • Eye protection (for flying debris or shaded) or splash goggles<br>• Heavy protective apron<br>• Welding helmets with filter lenses<br>• Flame-resistant gloves<br>• Hearing protection |

## Blank Hazard Control Worksheet

| Activity | Potential Hazard | Engineering Controls | Administrative Controls | Recommended PPE |
|---|---|---|---|---|
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## 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**<br>Scope of Assessment Possibilities<br>Driving Consideration | **CHEMICAL SAFETY LEVEL 1** | **CHEMICAL SAFETY LEVEL 2** | **CHEMICAL SAFETY LEVEL 3** | **CHEMICAL SAFETY LEVEL 4** |
|---|---|---|---|---|
| **CONCEPTUAL HAZARD LEVEL** *(overview of risk level)*<br>Flexible<br>Context Dependent | 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) |
| **CHEMICALS USED** *(types or characteristics of chemicals used)*<br>Lab Room<br>None identified | 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) |
| **TRAINING REQUIREMENTS** *(prerequisites for people working in the lab)*<br>Lab group<br>Based on highest lab hazard rating | 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 |
| **SUPERVISION REQUIREMENTS** *(safety responsibilities of lab leader(s))*<br>Lab room<br>Based on highest active lab hazard process | 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 |

| Table 8-1 Suggested Approach for Establishing Chemical Safety Levels | | | | |
|---|---|---|---|---|
| **DESCRIPTOR OR CONTROL**<br>Scope of Assessment Possibilities<br>Driving Consideration | **CHEMICAL SAFETY LEVEL 1** | **CHEMICAL SAFETY LEVEL 2** | **CHEMICAL SAFETY LEVEL 3** | **CHEMICAL SAFETY LEVEL 4** |
| **OVERSIGHT REQUIREMENTS** *(expectations for institutional review of lab operations)*<br>Lab group<br>Based on highest lab hazard rating | *Weekly self-inspections;<br>**self-audits three times per year | *Weekly self-inspections;<br>**self-audits three times per year | *Weekly self-inspections;<br>***monthly drop bys;<br>**self-audits three times per year;<br>‡risk-based institutional review schedule | *Daily self-inspections;<br>***monthly drop bys;<br>**self-audits three times per year;<br>†risk-based institutional review schedule |
| **PLANNING REQUIREMENTS** *(specific requirements for planning of work)*<br>Process specific<br>Based on highest rated chemical involved | 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 |
| **GENERAL PPE REQUIREMENTS (EYE AND SKIN EXPOSURE)** *(protection requirements to enter the room)*<br>Lab room<br>Primarily based on physical ratings | Coverage of legs and feet | Above plus eye protection | Above plus lab coat | Above plus flame resistant lab coat |
| **SPECIFIC PPE REQUIREMENTS (HAND AND RESPIRATORY PROTECTION)** *(protection requirements to conduct work)*<br>Process specific<br>Primarily based on physical ratings | 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. |
| **GENERAL VENTILATION REQUIREMENTS** *(facility support requirements)*<br>Lab room<br>Primarily based on health rating | 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 |

| Table 8-1 Suggested Approach for Establishing Chemical Safety Levels | | | | |
|---|---|---|---|---|
| **DESCRIPTOR OR CONTROL**<br>Scope of Assessment Possibilities<br>Driving Consideration | **CHEMICAL SAFETY LEVEL 1** | **CHEMICAL SAFETY LEVEL 2** | **CHEMICAL SAFETY LEVEL 3** | **CHEMICAL SAFETY LEVEL 4** |
| **OTHER ENGINEERING CONTROLS**<br><br>Based on exposure risk | | Local exhaust ventilation (snorkel) | Fume hood, local exhaust ventilation (snorkel) | Fume hood, local exhaust ventilation (snorkel), glove/dry box, enclosed reactor |
| **EMERGENCY RESPONSE PROTOCOL** *(expectations for response to potential hazmat emergencies)*<br>Lab room<br>Primarily based on physical and mechanical ratings | 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 |

* 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.

NOTES

- 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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