

May 2022

EHS Document Binder

THIS IS A **MANDATORY** SUPPLEMENT TO THE UNIVERSITY OF MICHIGAN CHEMICAL HYGIENE PLAN

CHP Documents

# **EHS Document binder**

**CHP DOCUMENTS**

The University of Michigan Chemical Hygiene Plan (CHP) establishes a written program in accordance with the requirements of the Michigan Occupational Safety and Health Act (MIOSHA) Part 431 Hazardous Work in Laboratories. The Plan is available for all employees to view on the EHS website.

**U-M Chemical Hygiene Plan is located at:**

[**http://ehs.umich.edu/research-clinical/chemical/**](http://ehs.umich.edu/research-clinical/chemical/)

Complete the following documents in this section as applicable, maintain them in the EHS Document Binder and review/update annually. The LD / Lab Manager or CHO can use the form below to document their annual review.

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| **Reviewer** | **Date** | **Reviewer** | **Date** |
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**Laboratory Director (LD): \_**

**Lab Manager or Chemical Hygiene Officer (CHO, when other than the LD):**

List building and room information for the above mentioned LD/research facility:

**Building:**  **Building:**

**Rooms:**  **Rooms:**

**Building:**  **Building:**

**Rooms:**  **Rooms:**

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## Section 1 – Emergency Information and Instructions

The CHP contains standard laboratory emergency information and instructions. In addition to this, each laboratory must develop emergency plans for hazards requiring additional protective measures not included in the CHP. These additional safety procedures will be kept in this section.

***Enter your department's safety program key personnel below***. Also refer to Section 9.0 *Emergency Response* of the CHP for additional information.

***In Case of Emergency: 911 (With a campus phone.)***

**U-M Environment, Health & Safety (EHS) Phone**

EHS Director (734) 647-2253

U-M Radiation Safety Officer (734) 764-6200

U-M Biological Safety Officer (734) 647-3133

U-M Chemical Hygiene Officer (734) 647-3133

U-M Hazardous Materials Manager (734) 763-4568

**Laboratory Contact Information**

LD: Work Phone #: Home/Cell Phone #:

Lab CHO: Work Phone #:

*(When other than LD)*

Home/Cell Phone #:

Lab Manager: \_\_\_\_\_\_ Work Phone #:

Home/Cell Phone #:

**Laboratory Emergencies**

Standard Operating Procedure

Rev. 05/05/22

This Standard Operating Procedure outlines emergency response guidelines for laboratories that handle, store, or are potentially exposed to hazardous chemicals. Laboratories that handle other hazardous materials including biohazardous materials or radioisotopes should consult the [U-M Biosafety Manual](https://ehs.umich.edu/wp-content/uploads/2018/08/bsm.pdf)1 or the [Radiation Safety Services SOP](https://ehs.umich.edu/wp-content/uploads/2016/04/RSS_Spill-EmerProc.pdf)2 for emergency information prior to working with those specific hazards.

# **Emergency Reporting**

Report all emergencies, suspicious activity, injuries, spills, and fires to the University of Michigan Division of Public Safety and Security (DPSS) by calling 9-1-1 or texting 377911. Register with the [University of Michigan Emergency Alert System](http://dpss.umich.edu/emergency-management/alert/)3 via Wolverine Access.

# **Emergency evacuation and utility outages**

In the event there is an emergency evacuation or a utility outage (electrical, gas, ventilation or water) that affects your laboratory space, it is important to ensure the safety of the laboratory’s occupants as well as others who may respond to assist. Prior to leaving the lab and only if safe to do so, secure the laboratory:

* Stop all reactions, chemical processes, etc.
* Cover and seal all chemical, biological, radioactive materials and hazardous waste containers
* Unplug or turn off non-essential electrical equipment (including ovens & hot plates)
* Shut off research gasses & water
* Fully close all fume hoods & biological safety cabinets
* Securely close all refrigerators and freezers

Vacate and inform emergency responders of any processes, experiments or equipment still in operation that may pose a threat to health, property or the environment. Report utility outages to the building’s Facilities contact or to the Facilities Service Center (FSC) at (734) 647-2059.

# **Fire**

* Familiarize yourself with locations of fire alarm pull stations, fire extinguishers, egress stairways, and emergency exits in your building(s)
* Activate the fire alarm system if you see smoke or fire
* Evacuate the building immediately using the nearest marked exit
* Use stairs, do not use elevators
* Encourage those around you to evacuate as well
* Assist those with disabilities or those who cannot safely evacuate the building by getting them to a safe rescue location and notifying emergency responders of their location as soon as possible
* Keep building exits and fire lanes clear
* Meet at designated assembly areas
* Re-enter only when directed by authorities

All fires and unintentional ignition events, even those that do not activate alarms or require emergency services, **must** be immediately reported to the University of Michigan Division of Public Safety and Security (DPSS) by dialing 9-1-1. DPSS will perform an investigation and complete an after action report necessary for U-M Risk Management to deal with insurance recovery for damages.

In the event a fire extinguisher is discharged, you **must** contact the Environment Health & Safety (EHS) Fire Safety Service at (734) 647-1143. EHS **must** be notified because depending on the type of building involved, notification **must** be made to the State of Michigan Bureau of Fire Safety. To replace the discharged extinguishers, contact the FSC at (734) 647-2059.

# **Chemical Spill or Release**

A minor chemical spill is one that the laboratory staff is capable of cleaning up safely without the assistance of EHS and emergency personnel.

**NOTE**: For **major** spills or significant areas of contamination, call **9-1-1**.

**Resources**

In the event of a spill, consult the following documents for information about spill and emergency response:

* Chemical’s Safety Data Sheet
* Process-specific standard operating procedure

**Spill Kits**

Stock the area with spill cleanup kits to clean up minor spills of commonly used chemicals. The kits contain:

* Instructions for use
* Absorbents
* Reactants
* Protective equipment
* Waste receptacle and labels

Kits are available through laboratory safety supply vendors or can be assembled from separate materials.

**Procedure: Responding to a Minor Chemical Spill**

1. Notify all individuals in the general vicinity that a spill has occurred.
2. Isolate the area and keep other personnel out of the contaminated area.
3. If spilled material is flammable, turn off ignition and heat sources. WARNING: Do not light Bunsen burners or turn on/off other switches or lights. Turning on/off switches may cause an electrical charge that could create a spark.
4. Avoid breathing vapors from the spill; if possible, open outside windows.
5. Do you have the training and equipment to clean up the spill?
   1. If NO, call 9-1-1 and go to step 13.
   2. If YES, then go to the next step.
6. Put on protective equipment, including:
   1. Safety goggles
   2. Gloves
   3. Long-sleeve lab coat
7. Confine spill to as small an area as possible.
   1. **CAUTION**: Do NOT wash spilled materials down the drain.
   2. Avoid walking through spilled materials.
8. Use appropriate spill kits or sorbents to neutralize corrosives, absorb the spill, or both.

**NOTE**: For powdered chemicals, use one of the following methods to clean up the spill:

* 1. Sweep carefully to avoid generation of dust
  2. If appropriate, use moist sorbent pads

1. Collect contaminated materials and place them in a waste container.
2. Clean the spill area with water, and place any materials used for cleaning into the waste container with the contaminated materials.
3. Label and manifest the waste.
4. Request a waste collection from EHS Hazardous Materials Management (HMM) using one of the following methods:
   1. Call HMM at (734) 763-4568
   2. Complete the online [Waste and Supply Request](https://docs.google.com/a/umich.edu/forms/d/1HaA2TRYfSesVxPdIaz72UPGcXnuFkdMO4eVHD2FSaOk/viewform?edit_requested=true)4 form
5. Notify area supervisor.
6. For **all** incidents and near misses, complete and submit the EHS [Incident and Near Miss Report](https://ehsa.oseh.umich.edu/EHSA/public/injuryillnesssubmit/injuryillnessinitialedit)5

# **Hazardous Material Exposures, Injuries or Illnesses**



***If the employee is in need of emergency medical attention, call 911 immediately.*** 

|  |  |  |
| --- | --- | --- |
| **Injury type** | **Action** | **Notes** |
| Exposure-Eyes | 1. Immediately rinse eyes with copious amounts of water for at least 15 minutes, while occasionally lifting upper and lower lids. 2. Promptly seek medical attention. |  |
| Exposure-Skin | 1. Immediately remove contaminated clothing and shoes. 2. Rinse with water for at least 15 minutes. |  |
| Inhalation (including spills of powder outside of a chemical fume hood) | 1. Move the person to fresh air immediately. 2. Seek medical attention. |  |
| Ingestion | 1. Seek medical attention immediately. |  |
| **NOTE**: If an ambulance is needed, call DPSS at 9-1-1 to request assistance. | | |

## Treatment Facilities

**Severe illness or injury requiring immediate care**

**Michigan Medicine Emergency Department or Call 9-1-1**  
1500 East Medical Center Drive, Ann Arbor (734) 936-6666

**Non-urgent conditions**

**Campus Employees, Fellows and student workers**U-M Occupational Health Services

Mon-Fri 7:00 am - 4:30 pm  
C380 Med Inn building  
1500 East Medical Center Drive, Ann Arbor (734) 764-8021

**Non-employee or guest of U-M**

Go to an urgent care clinic in Ann Arbor

**Report all work related accidents, injuries, illnesses or exposures to Work Connections *within 24* hours by completing and submitting the**[**Illness and Injury Report Form**](http://www.workconnections.umich.edu/employees/work-related-illness-injury/step-one/)**6**

**For all incidents, complete and submit the EHS** [**Incident and Near Miss Report**](https://ehsa.oseh.umich.edu/EHSA/public/injuryillnesssubmit/injuryillnessinitialedit)**5**

Contact EHS for assistance in performing an exposure assessment.

# **Training of Personnel**

* All personnel shall read and fully adhere to this SOP when working with hazardous chemicals.
* All relevant employees should understand how to operate and where to find emergency response equipment, including:

1. Emergency eyewash and shower
2. Fire extinguishers - contact EHS for training opportunities. Do not use a fire extinguisher if you have not been trained on its use.
3. Spill kits
4. PPE needed for spill cleanup
5. Specific antidotes when applicable, e.g. calcium gluconate for hydrofluoric acid exposures

Additional online training courses are available through [EHS MyLinc](http://ehs.umich.edu/education/)7.

# **External Links and References**

1 U-M Biosafety Manual: <https://ehs.umich.edu/wp-content/uploads/2018/08/bsm.pdf>

2 Radiation Safety Services Preventing or Reducing Dispersal of Radioactive Contamination Following a Spill Standard Operating Procedure:

<https://ehs.umich.edu/wp-content/uploads/2016/04/RSS_Spill-EmerProc.pdf>

3U-M Emergency Alert System:

<https://dpss.umich.edu/content/emergency-preparedness/emergency-alerts/>

4EHS HMM Waste and Supply Request Form: <https://docs.google.com/forms/d/e/1FAIpQLSf_y_KGJN_utudrRwBZX9Yx9qPg7IyF9xchinD6Ae7Karnocg/viewform>

5EHS Incident and Near Miss Report Form (for Lab, shop, and studio incidents): <https://ehsa.oseh.umich.edu/EHSA/public/injuryillnesssubmit/injuryillnessinitialedit>

6Work Connections Work-Related Injury or Illness Report Form: <https://www.workconnections.umich.edu/employees/work-related-illness-injury/step-one/>

7EHS MyLinc <http://ehs.umich.edu/education/>

## Section 2 – Chemical Inventory

This section contains information on the Chemical List/Inventory, as described in CHP Section 6.4 *Chemical Inventory*.

The Chemical Inventory can be accomplished by using **either** of the following options. Please **select** the system your laboratory uses:

*□* 1. Using EHS’s web-based inventory tracking system MI Safety Portal (MISP) (<http://ehs.umich.edu/research-clinical/mi-safety-portal/>).

*□* 2. Use of the Earth and Environmental Sciences or Department of Chemistry’s (Vertére) Inventory system or the Lurie Nanofabrication inventory.

All labs, except those taking part in the Earth and Environmental Sciences or Chemistry Department’s chemical tracking system or the Lurie Nanofabrication program, will be required to transition to MISP. Chemical Lists already in Excel, Access, or other systems can be uploaded into the system by contacting EHS.

The chemical inventory ***must be updated immediately when new chemicals arrive*** into the laboratory. At a minimum, the chemical inventory must be reviewed on an annual basis. Certification of the annual review is accomplished by clicking on the “Chemical Inventory Review Statement” link within MI Safety Portal and submitting the acknowledgement.

## Section 3 - Safety Data Sheets (SDS)

Most SDS can be quickly found using the Chemwatch Gold FFX SDS (<http://ehs.umich.edu/research-clinical/chemical/safety-data-sheets/>) system on the EHS website. Each lab is responsible for obtaining and maintaining copies of SDS received with incoming shipments of hazardous chemicals and making sure they are readily accessible to laboratory employees. ***Place received SDS in this section***. EHS can assist in obtaining SDS that may be difficult to find.

## Section 4 – Training Records

Employee ***training is documented*** in this section of the binder.

**4.1** Each person working in a laboratory must take the online Chemical Laboratory Safety course (**EHS\_BLS025w\_TAB**) noted in chapter 2 of the CHP. Records of training completion are maintained in MyLinc.

**4.2** Each person will review the U-M CHP and the documents in the EHS Document Binder. They will also receive training on lab-specific procedures identified in Part 2: Lab-Specific Training Acknowledgement and sign the form.

**4.3** Any additional laboratory-specific training is recorded on the documentation sheets in this section.

**NOTE:** Training on specific SOPs is documented on each SOP located in Section 5 of this document.

4.2: Lab-Specific Training Acknowledgement – Sign below to acknowledge having reviewed or received training on the following information. Any questions relating to this material will be directed to the LD or other designated lab authority.

|  |  |
| --- | --- |
| * U-M Chemical Hygiene Plan (CHP) | * Working after hours |
| * EHS Document Binder (Blue Binder) | * Chemical procurement, distribution, and storage |
| * Specific areas for food consumption | * Compressed gas cylinders |
| * Chemical Inventory – Ensure access to MISP | * Protective Apparel and Equipment |
| * Location of Safety Data Sheets (SDS) | * Housekeeping, Maintenance, and Inspections |
| * Emergency Procedures: Spills, Injury, Reporting | * Maintenance of scientific equipment |
| * Radiological safety practices (If working with   radioactive materials) | * Environmental monitoring: PELs and TLVs   for chemicals |
| * Biosafety Manual (If working with recombinant   DNA or infectious agents) | * Fume hoods, biological safety cabinets or other   local exhaust – proper use and functioning |
| * Exposure Control Plan (If working with human   blood or other potentially infectious materials) | * Medical surveillance (Respirator, Heat Stress,   Noise, etc) |
|  | * Waste Handling: Labeling, Packaging, Pick-ups |

**LABORATORY-SPECIFIC TRAINING ACKNOWLEDGEMENT**

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| --- | --- | --- | --- |
| **Name** | **U-M ID No.** | **Signature** | **Date of Training** |
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|  |  |
| --- | --- |
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| * EHS Document Binder (Blue Binder) | * Chemical procurement, distribution, and storage |
| * Specific areas for food consumption | * Compressed gas cylinders |
| * Chemical Inventory – Ensure access to MISP | * Protective Apparel and Equipment |
| * Location of Safety Data Sheets (SDS) | * Housekeeping, Maintenance, and Inspections |
| * Emergency Procedures: Spills, Injury, Reporting | * Maintenance of scientific equipment |
| * Radiological safety practices (If working with   radioactive materials) | * Environmental monitoring: PELs and TLVs   for chemicals |
| * Biosafety Manual (If working with recombinant   DNA or infectious agents) | * Fume hoods, biological safety cabinets or other   local exhaust – proper use and functioning |
| * Exposure Control Plan (If working with human   blood or other potentially infectious materials) | * Medical surveillance (Respirator, Heat Stress,   Noise, etc) |
|  | * Waste Handling: Labeling, Packaging, Pick-ups |

**LABORATORY-SPECIFIC TRAINING ACKNOWLEDGEMENT**

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| **Name** | **U-M ID No.** | **Signature** | **Date of Training** |
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4.3: Additional Lab Specific Training – Record any safety training beyond that covered in the previous parts and within the SOP section.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Training Type** | **Employee Name** | **U-M ID No.** | **Initials** | **Trainer** | **Date** |
| *i.e. Glove box use* | *John Doe* | *55551212* | *JD* | *Dr. Smith* | *1-1-2022* |
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4.3: Additional Lab Specific Training – Record any safety training beyond that covered in the previous parts and within the SOP section.

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| --- | --- | --- | --- | --- | --- |
| **Training Type** | **Employee Name** | **U-M ID No.** | **Initials** | **Trainer** | **Date** |
| *i.e. Glove box use* | *John Doe* | *55551212* | *JD* | *Dr. Smith* | *1-1-2022* |
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## Section 5 – Standard Operating Procedures (SOPs)

Each laboratory working with hazardous chemicals should include applicable SOPs in this section *or indicate where they are maintained – ex: DropBox, MISP, etc*. The CHP provides information and guidelines on best practices in laboratory health and safety. In addition, EHS has developed SOPs for many specific chemicals and classes of chemicals used in the laboratory. An SOP **must** be developed for hazardous chemicals or procedures **not** included in EHS’s list of SOPs.

Laboratory employees working with a particularly hazardous chemical or hazardous procedure must receive the applicable SOP training from their LD/Laboratory Supervisor.

*When developing SOPs for working with hazardous chemicals in your laboratory, follow these steps:*

* Download and print, *or save electronically*, applicable [SOP](http://ehs.umich.edu/research-clinical/chemical/) from the EHS website. These SOPs may be modified if necessary to reflect laboratory-specific information. Employees will be trained on applicable SOPs by their LD/Laboratory Supervisor. Once training is complete, employees will certify training with a signature in *Training of Personnel* section of SOP.
* Develop an SOP for any hazardous chemical or procedure **not** included in EHS’s list of SOPs. Use the [EHS SOP template](http://ehs.umich.edu/research-clinical/chemical/) to develop the SOPs. Once SOP training has been given by the LD/Laboratory Supervisor, employees will certify with signature in *Training of Personnel* section of SOP.
* Please note that there are restricted chemicals (found in CHP Section 5.2 *Restricted Chemicals Requiring Prior Approval),* and chemicals with a hazard ranking of 4 in any [ChemWatch GoldFFX](http://ehs.umich.edu/research-clinical/chemical/safety-data-sheets/) rating for Flammability, Toxicity, Body Contact, Reactivity or Chronic. When developing an SOP for these chemicals, use the [EHS SOP Template LD Approval](http://ehs.umich.edu/research-clinical/chemical/).

## Section 6 – Additional Documentation

The following items must be saved in this section, or indicate where they are maintained – ex: DropBox, MISP, etc.:

* **Hazard Assessment Worksheet(s) and Risk Assessment(s):** Maintain the Hazard Assessment Worksheet(s) for the lab, as well as any Risk Assessments, in this section.

The MIOSHA standard regarding PPE requires an assessment to determine the hazards in the workplace, PPE selection and training. A documented Hazard Assessment is required to be maintained in the EHS Document Binder. Lab Directors are also responsible for determining if there are areas in the lab where PPE is not required and are encouraged to work with EHS to assess risks. *If the Lab Director or PI wishes to designate areas in the lab where PPE is not required - i.e. when seated at a desk - then they must also complete and document a risk assessment.*

* **EHS Correspondence:** Copies of correspondence to the LD/Laboratory Supervisor from EHS, safety-related memos within laboratory groups, requests for safety information, and other correspondence that may be important to safety management.
* **EHS Exposure Monitoring Information:** Maintain a copy of personal exposure monitoring information in this section.
* **Incident/Near-Miss Information:** Laboratory incident and near miss report forms are located online: <http://ehs.umich.edu/research-clinical/reporting-incidents/>.

***Please note, a Work Connections Injury or Illness Report Form***

***must also be completed for all workplace injuries and illnesses***:

[***https://www.workconnections.umich.edu/employees/work-related-illness-injury/step-one/***](https://www.workconnections.umich.edu/employees/work-related-illness-injury/step-one/)

* **EHS Safety Findings for Animal Use Protocols:** Maintain copies of EHS recommendations for proper protective measures, including any need for special medical monitoring, based on risk assessments in animal use protocols.

**HAZARD ASSESSMENT WORKSHEET**

NOTES:

Minimum PPE to work with hazardous materials, equipment, or processes is a lab coat, appropriate gloves, safety glasses and appropriate lab attire (closed toe shoes, long pants, etc.).

Always consult the U-M SOP in addition to lab-specific SOP for more information. Always consult a material’s SDS for additional PPE guidance and use engineering and/or administrative controls.

|  |  |
| --- | --- |
| Date: | Employee(s) Covered: |
| Lab Director/PI: | Location: |

**Use the table below to list and identify the tasks conducted in your research space:**

* **Copy and paste any rows from Table 1 (beginning on the next page) that apply to your research**
* **Include additional rows for tasks, potential hazards and recommended PPE that are specific to your research**

| **Tasks & Materials** | **Potential Hazard(s)** | **PPE Required** |
| --- | --- | --- |
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**PPE Hazard Assessment & PPE Recommendations**

NOTES:

Minimum PPE to work with hazardous materials, equipment, or processes is a lab coat, appropriate gloves, safety glasses and appropriate lab attire (closed toe shoes, long pants, etc.). Refer to Tables 1 & 2 below for additional eye and face protection guidance

Always consult the U-M SOP in addition to lab-specific SOP for more information. Always consult a material’s SDS for additional PPE guidance and use engineering and/or administrative controls.

| **Tasks & Materials** | **Potential Hazard(s)** | **PPE Required** |
| --- | --- | --- |
| Working with small (< 1 Liter) volumes of **corrosive liquids** | * Splash hazards * Skin and eye damage | * Safety goggles * Chemical resistant gloves ([refer to Corrosives SOP](http://ehs.umich.edu/research-clinical/chemical/)) |
| Working with large (> 1 Liter) volumes of **corrosive liquids**, **acutely toxic corrosives** or work which may create a **splash hazard** | * Large surface area skin and eye damage * Poisoning * Great potential for eye and skin damage | * Safety goggles * Face shield * Chemical resistant gloves ([refer to Corrosives SOP](http://ehs.umich.edu/research-clinical/chemical/)) * Chemical resistant apron |
| Working with **Hydrofluoric (HF) Acid** | * Major skin damage * Major eye damage * Potential poisoning through skin absorption | * Safety goggles * Chemical resistant gloves ([refer to HF SOP](http://ehs.umich.edu/research-clinical/chemical/)) * Chemical resistant apron   *\*\* Have unexpired Calcium Gluconate on-hand \*\** |
| Working with small (< 1 Liter) volumes of **organic solvents** | * Skin damage * Eye Damage * Slight poisoning potential through skin absorption | * Safety goggles (*if splash hazard*) * Chemical resistant gloves ([refer to Glove Compatibility Charts](https://ehs.umich.edu/research-clinical/planning-safe-research/glove-compatibility-chart/) & SDS) |
| Working with large (> 1 Liter) volumes of organic solvents, very dangerous organic solvents or work which may create a splash hazard | * Major skin damage * Major eye damage * Poisoning through skin absorption | * Safety goggles * Face shield * Chemical resistant apron * Chemical resistant gloves ([refer to Glove Compatibility Charts](https://ehs.umich.edu/research-clinical/planning-safe-research/glove-compatibility-chart/) & SDS) |
| Working with pyrophoric materials | * Body damage from burns * Fires | * Fire resistant (FR) lab coat * Safety goggles * Fire/chemical resistant gloves ([refer to Pyrophoric SOP](http://ehs.umich.edu/research-clinical/chemical/))   *\*\* No synthetic clothing allowed \*\** |
| Working with small (< 1 Liter) volumes of human blood, body fluids or other Bloodborne Pathogens (BBP) | * Acquire an infectious disease (BBP) * Spread of infectious disease | * Light latex or nitrile gloves |

Table 1

| **Tasks & Materials** | **Potential Hazard(s)** | **PPE Required** |
| --- | --- | --- |
| Working with large (> 1 Liter) volumes of human blood, body fluids or other Bloodborne Pathogens (BBP) and/or splash hazards | * Greater risk of acquiring an infectious disease (BBP) * Greater risk of spreading an infectious disease | * Light latex or nitrile gloves * Safety goggles * Face shield * Foot covers (*as applicable*) * N-95 respirator (*as applicable*) |
| Working with hazardous powders | * Skin damage * Eye damage * Poisoning through skin absorption | * Safety goggles for large quantities * Light chemical resistant gloves ([refer to Glove Compatibility Charts](https://ehs.umich.edu/research-clinical/planning-safe-research/glove-compatibility-chart/)) |
| Working with acutely toxic hazardous powders | * Greater risk for skin damage * Greater risk for eye damage * Greater risk for poisoning through skin absorption | * Safety goggles * Heavy chemical resistant gloves * Chemical resistant apron * Booties (*as applicable*) * Also refer to [Highly Toxic Chemicals SOP](http://ehs.umich.edu/research-clinical/chemical/) |
| Working with radioactive materials | * Cellular damage * Spread of radioactive materials | * Safety goggles (*if splash hazard*) * Light latex or nitrile gloves |
| Working with radioactive chemicals, e.g., corrosives, solvents, powders, etc. | * Refer to appropriate chemical sections above * Cellular damage * Spread of radioactive materials | * Safety goggles (*if splash hazard*) * Light chemical resistant gloves * Use PPE for applicable tasks above |
| Working with radioactive human blood, body fluids or other BBPs | * Cellular damage * Spread of radioactive materials * Risk of acquiring an infectious disease (BBP) | * Safety goggles (*if splash hazard*) * Light latex or nitrile gloves |
| Working with cryogenic liquids | * Major skin damage * Major tissue damage * Major eye damage | * Safety goggles for large volumes or splash hazards * Thicker insulated gloves * Also refer to [Cryogenic Materials SOP](http://ehs.umich.edu/research-clinical/chemical/) |
| Working with very cold materials and equipment, e.g., freezers, dry ice | * Skin damage | * Insulated gloves * Also refer to [Environmental Rooms SOP](http://ehs.umich.edu/research-clinical/chemical/) |
| Working in cold environments, e.g., walk-in cold rooms or freezers | * Frostbite * Hypothermia | * Insulated gloves and warm clothing * Also refer to [Environmental Rooms SOP](http://ehs.umich.edu/research-clinical/chemical/) |
| Working with hot liquids, equipment and/or open flames, e.g., autoclave, Bunsen burner, waterbath, oil bath | * Skin damage * Eye damage | * Safety goggles for large volumes or splash hazards * Insulated gloves |
| Working with large volumes of hot, cold, or cryogenic liquids | * Major skin and eye damage   Frozen or **burned** body tissues | * Safety goggles * Face shield * Heavy insulated gloves * Chemical apron * Also refer to [Cryogenic Materials SOP](http://ehs.umich.edu/research-clinical/chemical/) |

| **Tasks & Materials** | **Potential Hazard(s)** | **PPE Required** |
| --- | --- | --- |
| Working with Ultraviolet (UV) Radiation | * Conjunctivitis * Corneal eye damage * Erythema | * UV face shield * Safety goggles * Also refer to [UV Radiation SOP](http://ehs.umich.edu/research-clinical/chemical/) |
| Working with LASER radiation | * Retinal eye damage * Skin damage | * Appropriate shaded goggles with optical density based on individual beam parameters. * Also refer to the [EHS LASER Guideline](https://ehs.umich.edu/research-clinical/lasers/)   *\*\* No jewelry or reflective items allowed \*\** |
| Working with Infrared (IR) emitting equipment, e.g., glass blowing | * Cataracts and flash burns to cornea | * Appropriate shaded goggles |
| Arc/TIG welding | * Conjunctivitis * Corneal eye damage * Erythema | * Appropriate shaded goggles and face shield * Work gloves |
| Instrument or equipment repair/service | * Eye damage from foreign objects | * Safety glasses with side shields or safety goggles   *\*\* No loose clothing or jewelry \*\** |
| Metalworking/Woodworking shop | * Eye damage from foreign objects | * Safety glasses with side shields or safety goggles   *\*\* No loose clothing or jewelry \*\** |
| Glassware washing | * Skin lacerations | * Safety glasses with side shields or safety goggles * Heavy rubber gloves |
| Working in Industrial lab with potential injury from falling equipment or tools, e.g., Earthquake lab, Structural Engineering lab, etc. | * Head injury * Foot injury | * Hard-hat * Steel toe boots |
| Spill clean-up | * See potential hazards for applicable task section | *See applicable individual task section* |
| Changing Cryostat knife blade | * Skin lacerations * Risk of acquiring an infectious disease (BBP) | * Steel mesh glove |

**Table I. Eye and Face Protection Selection Chart**

*(To be used as a guide to select the proper* ***eye*** *and* ***face*** *protection.)*

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Type** | **Hazard(s)** | [ASSESSMENT](#Notes)  [SEE NOTE (1)](#Notes) | **PROTECTOR**  **TYPE**  ***(refer to graphic below)*** | **PROTECTORS** | | **LIMITATIONS** | **NOT RECOMMENDED** |
| **I**  **M**  **P**  **A**  **C**  **T** | Chipping, grinding, machining, masonry, work, riveting, and sanding | Flying fragments, objects, large chips, particles, sand, dirt, etc. | B, C, D, E, F, G, H, I, J, K, L, N | Spectacles, goggles, face shields  **SEE NOTE (1) (3) (5) (6) (10)**  For severe exposures add N. | | Protective devices do not provide unlimited protection.  **SEE NOTE (7)** | Protectors that do not provide protection from side exposure  **SEE NOTE (10)**  Filter or tinted lenses that restrict light transmittance, unless it is determined that a glare hazard exists. **Refer to OPTICAL RADIATION** |
| **H**  **E**  **A**  **T** | Furnace operations, pouring, casting, hot dipping, gas cutting, and welding | Hot sparks | B, C, D, E, F, G, H, I, J, K, L, N | Face shields, goggles, spectacles  \*For severe exposure  add N.  **SEE NOTE (2) (3)** | | Spectacles, cup and cover type goggles not provide unlimited protection.  **SEE NOTE (2)** | Protectors that do not provide protection from side exposure |
| Splash from molten metals | \*N | \*Face shields worn over goggles H, K | | --- |
| High temperature exposure | N | Screen face shields, reflective face shields  **SEE NOTE (2) (3)** | | **SEE NOTE (3)** |
| **C**  **H**  **E**  **M**  **I**  **C**  **A**  **L** | Acid & chemicals handling, degreasing, plating | Splash | G, H, K,  \*N | Goggles, eyecup, and cover types  \* For severe exposure, add N. | | Ventilation should be adequate but well protected from splash entry. | < None > |
| Irritating mists | G | Special purpose goggles | | **SEE NOTE (3)** |
| **D**  **U**  **S**  **T** | Woodworking, buffing, general dusty conditions | Nuisance dust | G, H, K | Goggles, eyecup, and cover types | | Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleaning may be required. | < None > |
| **O**  **P**  **T**  **I**  **C**  **A**  **L**  **R**  **A**  **D**  **I**  **A**  **T**  **I**  **O**  **N** | Welding: Electric Arc | | O, P, Q | **Typical Filter Lens**  **Shade** | **Protectors** | Protection from optical radiation is directly related to filter lens density.  **SEE NOTE (4)**  Select the darkest shade that allows adequate task performance. | Protectors that do not provide protection from optical radiation.  **SEE NOTE (4)** |
| 10 – 14 | Welding Helmets or Welding Shields |
| **SEE NOTE (9)** | |
| Welding:  Gas  Cutting  Torch Brazing | | J, K, L, M, N, O, P, Q | 4 – 8  3 – 6  3 – 4 | Welding Goggles  or  Welding Shields | **SEE NOTE (3)** | < None > |
| Torch Soldering | | B, C, D, E, F, N | 1.5 – 3 | Spectacles  or  Welding Face shield |
| Glare | | A, B | Spectacle  **SEE NOTE (9) (10)** | | Shaded or special Purpose lenses as suitable  **SEE NOTE (8)** |

**Notes to Table I (above) Eye and Face Protection Selection Chart:**

(1) Care should be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards should be provided. Protective devices do not provide unlimited protection.

(2) Operations involving heat may also involve light radiation. As required by the standard, protection from both hazards must be provided.

(3) Face shields should only be worn over primary eye protection (spectacles or goggles).

(4) As required by the standard, filter lenses must meet the requirements for shade designations in [Table II](#Table_2). Tinted and shaded lenses are not filter lenses unless they are marked or identified as such.

(5) As required by the standard, persons whose vision requires the use of prescription (Rx) lenses must wear either protective devices fitted with prescription (Rx) lenses or protective devices designed to be worn over regular prescription (Rx) eyewear.

(6) Wearers of contact lenses must also wear appropriate eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments might represent an additional hazard to contact lens wearers.

(7) Caution should be exercised in the use of metal frame protective devices in electrical hazard areas.

(8) Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleansing may be necessary.

(9) Welding helmets or face shields should be used only over primary eye protection (spectacles or goggles).

(10) Non‑side shield spectacles are available for frontal protection only, but are not acceptable eye protection for the sources and operations listed for "impact."

(11) Ventilation should be adequate, but well protected from splash entry. Eye and face protection should be designed and used so that it provides both adequate ventilation and protects the wearer from splash entry.

(12) Protection from light radiation is directly related to filter lens density. See note (4). Select the darkest shade that allows task performance.

**Protector Types (from Table 1 above):**

**Table II. Filter Lenses for Protection Against Radiant Energy**

(Listing of appropriate shade numbers for various operations.)

|  |  |  |  |
| --- | --- | --- | --- |
| **Operations** | **Electric Size 1/32 in.** | **Arc Current(amps)** | **Minimum\* Protective Shade** |
| Shielded metal  Arc welding | Less than 3 | Less than 60 | 7 |
| 3 - 5 | 60 - 160 | 8 |
| more than 5 to 8 | 161 - 250 | 10 |
| more than 8 | 251 - 550 | 11 |
| Gas metal arc welding and flux | cored arc welding | Less than 60 | 7 |
| 60 - 160 | 10 |
| 161 - 250 | 10 |
| 251 - 500 | 10 |
| Gas Tungsten arc | welding | Less than 50 | 8 |
| 50 - 150 | 8 |
| 151 - 500 | 10 |
| Air carbon | Light | Less than 500 | 10 |
| Arc cutting | Heavy | 500 – 1,000 | 11 |
| Plasma arc welding | --- | Less than 20 | 6 |
| 20 - 100 | 8 |
| 101 - 400 | 10 |
| 401 - 800 | 11 |
| Plasma arc cutting | Light\*\* | Less than 300 | 8 |
| Medium\*\* | 300 - 400 | 9 |
| Heavy\*\* | 401 - 800 | 10 |
| Torch soldering | --- | --- | 2 |
| Torch brazing | --- | --- | 3 |
| Carbon arc welding | --- | --- | 14 |
| **Operations** | **Plate Thickness(inches)** | **Plate Thickness(mm)** | **Minimum\* Protective Shade** |
| **Gas Welding**: | --- | --- | --- |
| Light | Under 1/8 | Under 3.2 | 4 |
| Medium | 1/8 to 1/2 | 3.2 to 12.7 | 5 |
| Heavy | Over 1/2 | Over 12.7 | 6 |
| **Oxygen Cutting**: | --- | --- | --- |
| Light | Under 1 | Under 25 | 3 |
| Medium | 1 to 6 | 25 to 150 | 4 |
| Heavy | Over 6 | Over 150 | 5 |

\* As a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade, which gives sufficient view of the weld zone without going below the minimum. In oxyfuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.

\*\* These values apply where the actual arc is clearly seen. Experience has shown that lighter filters may be used when the arc is hidden by the work piece.

**Performing a Risk Assessment**

If a lab wishes to designate specific areas within the lab where PPE may be removed, a risk assessment is **required** to ensure the hazards have been identified and the risks posed by those hazards have been controlled in that area. Options include removing hazardous work when possible or redesigning spaces to isolate hazardous from non-hazardous work. Physical modifications to the laboratory, including the addition of barriers, require approval to ensure codes, regulations and guidelines are met. EHS can assist in determining which U-M entities need to be involved to review proposed modifications. ***It is expected that these areas will be the exception and not the rule in labs where hazardous materials and/or equipment are present and work is conducted with chemical, biological and/or radiological materials.***

In order to understand the process of completing a risk assessment, a few definitions are essential:

**Hazard:** The potential for harm; cannot be changed. A chemical with a low or high pH will always be corrosive, a burning flame will always be hot, etc.

**Risk:** The probability or likelihood that the hazard will cause harm. For instance, the hazard of a chemical with a low or high pH, i.e. a corrosive liquid, is that any living tissue exposed to it will be burned. The risk of working with a corrosive liquid can be controlled through the use of controls – engineering, administrative and PPE – to prevent exposure of living tissue.

**Risk assessment:** Performed to identify hazards and ways to eliminate or reduce the hazards. It involves a detailed review of equipment, processes, chemicals and the work environment and requires substantial time and effort to properly and thoroughly complete.

When performing a risk assessment, the following questions must be addressed:

1. What can happen and under what circumstances?
2. How likely are the possible consequences to occur? ***Do not underestimate***.
3. Is the risk controlled effectively?

**Step 1 - Start by making a list of the operations/procedures/tasks done in the lab that include:**

* All procedures involving hazardous materials (solvents, acids, bases, toxics, chemical gases or vapors), biological materials, potentially dangerous equipment, intermediate chemicals, waste products, etc.
* All procedures with potential for physical hazards – container or vessel pressurization, moving parts, heat from thermal energy, cold from cryogenic liquids, etc.

Use the following checklists to aid in thinking through tasks that include any of the following:

*Physical Hazards of Chemicals*

☐ Compressed gases ☐ Cryogens ☐ Explosives ☐ Flammables ☐ Organic peroxides ☐ Oxidizers ☐ Peroxide formers ☐ Pyrophorics ☐ Self-heating substances ☐ Self-reactive substances

☐ Substances which, in contact with water, emit flammable gases

*Health Hazards of Chemicals*

☐ Acute toxicity ☐ Carcinogens ☐ Eye damage/irritation ☐ Germ cell mutagens

☐ Nanomaterials ☐ Reproductive toxins ☐ Respiratory or skin sensitization

☐ Simple asphyxiant ☐ Skin corrosion/irritation ☐ Specific target organ toxicity

☐ Hazards not otherwise classified (specify)

*Biohazards*

☐ BSL-2 Biological agents ☐ BSL-3 Biological agents ☐ Human cells, blood, BBP

☐ NHPs/cells/blood ☐ Non-exempt rDNA ☐ Animal work ☐ High risk animals (RC1)

*Reaction Hazards*

☐ Explosive ☐ Exothermic, with potential for fire, excessive heat, or runaway reaction

☐ Endothermic, with potential for freezing solvents, decreased solubility or heterogeneous mixtures

☐ Gases produced ☐ Hazardous reaction intermediates/products ☐ Hazardous side reactions

*Hazardous Processes*

☐ Generation of air contaminants (gases, aerosols, or particulates) ☐ Heating chemicals

☐ Large mass or volume ☐ Pressure > atmospheric ☐ Pressure < atmospheric

☐ Scale-up of reaction

*Other Hazards*

☐ Hand/power tools ☐ Moving equipment/parts ☐ Electrical ☐ Noise > 80 dBA

☐ Heat/hot surfaces ☐ Ergonomic hazards ☐ Needles/sharps ☐ Other (list):

**Step 2 – Using the Risk Assessment Table below, for each operation/procedure/task identified, list the hazards of concern (Column 1) and describe the consequence(s) of an incident occurring (Column 2).**

**For a Chemical Process, Consider:**

* Reactions, including side reactions. Think through reactants, intermediates, and products in terms of flammability, toxicity, and reactivity hazards.
* Does it decompose, and if so, how rapidly and to what products?
* What is its stability on exposure to heat, light, water, metals, etc.?
* Is it impact sensitive?
* How violent will the reaction be?
* What is the effect of catalysts or inhibitors?
* How will air affect the reaction?
* Are any incompatible materials near the reaction?
* Determine the quantity and the rate of evolution of heat and gases that may be released during the reaction. Use the thermodynamic and kinetic data from the reaction chemistry.
* Are the chemicals compatible with containers and equipment?
* Will the experiment be conducted at temperatures or pressures above normal?
* Are there other hazards to be aware of such as noise, electrical, radiation, biological, or machinery?

**Step 3 –Determine the probability (Column 3) and severity (Column 4) of that incident or failure occurring. Information on probability and severity is provided in a Risk Matrix that follows the Risk Assessment table and the example provided. Do not underestimate the probability! Consider:**

* + Prior incidents – even if not in your lab
  + *Human error* due to inexperience/incomplete understanding of the process, failure to follow standard operating procedure, fatigue, inattention, etc. resulting in improper chemicals/amounts of chemicals being used; inadvertent addition of heat to a process on a heat/stir plate;
  + Electric power failure
  + Cooling system failure
  + Exhaust system failure
  + Over-pressurization
  + Water leaks into system
  + Air leaks into system
  + Fire (Is the appropriate extinguishing agent nearby?)
  + Container breakage
  + Chemical spill

**Step 4 – Determine the Risk (column 5), which is the intersection of Probability (P) and Severity (S) in the Risk Matrix Table. When considering the possibility of eye injuries, there is *no* acceptable risk. If there is any risk of injury, eye protection must be worn.**

**Step 5 - Identify all controls and risk mitigation strategies for each hazard or potential failure point.** Use the controls listed below and add this information to the column 6 in the risk assessment table.

|  |  |  |
| --- | --- | --- |
| **Engineering Controls** | **Administrative Controls** | **Personal Protective Equipment (PPE)** |
| * Ventilation (fume hood, snorkel, biological safety cabinet) * Containment (glove box, reaction vessel, sealed containers, barriers) * Substitution/Elimination (consider less hazardous alternative materials) * Process controls (safety valves, gauges, temperature sensor, regulators, alarms, monitors, electrical grounding and bonding, glassware preparation). | * Reduce scale of process (micro-scale experiments) * Reduce time of personal exposure to process * Provide training on proper techniques to reduce exposure and mitigate hazards * Chemical expiration and testing * Equipment maintenance and certification (pressure vessel testing) | * Eye and face protection (Safety glasses, safety goggles, laser eyewear, face shield) * Body protection (Lab coat, apron, close-toed shoes, pants, hearing protection) * Hand protection (thermal, mechanical, chemical) * Respiratory protection (contact your EHS rep) |

**RISK ASSESSMENT TABLE**

Adapted from [Identifying and Evaluating Hazards in Research Laboratories](https://www.acs.org/content/dam/acsorg/about/governance/committees/chemicalsafety/publications/identifying-and-evaluating-hazards-in-research-laboratories.pdf)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Operation Name and Purpose**:  **Date of Risk Assessment**:  **Person Conducting Risk Assessment**: | | | | | |
| 1  Describe Hazard(s) of Concern | 2  Describe the Consequence(s) of an Incident Occurring | 3  What is the Probability\* of Occurrence (P)? **Do Not Underestimate** | 4  How Severe\* is the Consequence (S ) of an Incident? | 5  Risk (Intersection of P and S from table) | 6  Describe Controls/Risk Mitigation Strategies |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

**\*Use the Risk Matrix on the next page to determine the probability and severity**

**EXAMPLE RISK ASSESSMENT TABLE:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Operation Name and Purpose**: Use of Bunsen burner: Bunsen burners are used to sterilize inoculation loops when plating bacteria  **Date of Risk Assessment**: January 17, 2022  **Person Conducting Risk Assessment**: Dr. R. Searcher | | | | | |
| 1  Describe Hazard(s) of Concern | 2  Describe the Consequence(s) of an Incident Occurring | 3  What is the Probability\* (P) of Occurrence? **Do Not Underestimate** | 4  How Severe\* (S) is the Consequence of an Incident? | 5  Risk (Intersection of P and S from table) | 6  Describe Controls/Risk Mitigation Strategies |
| Use of an open flame | Ignition of ethanol vapor  Ignition of clothing  Ignition of nearby combustible materials | Possible | Moderate – Severe | High | **Engineering Controls:** N/A  **Administrative Controls:**  1 - Train all Bunsen burner users on use  2 - Restrict areas of use to east end of bench  3 – Locate combustible materials and flammable liquids at least 3 feet away from Bunsen burner when in use  4 – Prohibit use of ethanol spray on gloves prior to flaming the loop  **PPE:** Lab coat, gloves, safety glasses |
| **Possible Substitutions:**  1 - Purchase sterile inoculating loops that do not require flaming  2 – Replace Bunsen burners with hot glass beads for sterilization | | | | | |

**RISK MATRIX: SEVERITY OF CONSEQUENCE(S) X PROBABILITY OF OCCURRENCE**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **PROBABILITY** | | | | |
| **SEVERITY** | **Rare** | **Unlikely** | **Possible** | **Likely** | **Almost Certain** |
| **NO RISK:**  No injuries  Minor property damage  No impact to reputation | **LOW** | **LOW** | **LOW** | **LOW** | **LOW** |
| **MINOR:**  Minor injuries  Moderate property damage  Potential damage to reputation | **LOW** | **LOW** | **MEDIUM** | **MEDIUM** | **HIGH** |
| **MODERATE:**  Moderate to life-impacting injuries  Substantial property damage  Damaged reputation | **LOW** | **MEDIUM** | **HIGH** | **HIGH** | **CRITICAL** |
| **HIGH:**  Life-threatening injuries  Severe property damage  Loss of confidence to reputation | **MEDIUM** | **HIGH** | **CRITICAL** | **CRITICAL** | **CRITICAL** |

**Low** = Acceptable risk level. Implement appropriate engineering and administrative controls and PPE. Monitor and manage.

**Medium** = Tolerable risk level. Implement appropriate engineering and administrative controls and PPE. Monitor and manage.

**High** = Tolerable risk level with strict controls, routine monitoring and oversight. Contact EHS for assistance.

**Critical** = Intolerable risk level. Engage higher levels of management.

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Engineering Controls** | **Administrative Controls** | **Personal Protective Equipment (PPE)** |
|  | * Ventilation (fume hood, snorkel, biological safety cabinet) * Containment (glove box, reaction vessel, sealed containers, barriers) * Substitution/Elimination (consider less hazardous alternative materials) * Process controls (safety valves, gauges, temperature sensor, regulators, alarms, monitors, electrical grounding and bonding, glassware preparation). | * Reduce scale of process (micro-scale experiments) * Reduce time of personal exposure to process * Provide training on proper techniques to reduce exposure and mitigate hazards * Chemical expiration and testing * Equipment maintenance and certification (pressure vessel testing) | * Eye and face protection (Safety glasses, safety goggles, laser eyewear, face shield) * Body protection (Lab coat, apron, close-toed shoes, pants, hearing protection) * Hand protection (thermal, mechanical, chemical) * Respiratory protection (contact your EHS rep) |
|  |
|  |
|  |  |

According to the hazards and risks identified above please provide the areas/locations that do not require the use of personal protective equipment (PPE) based on the assessment of risk and mitigation activities (e.g. relocation of equipment, reagents, or research procedures.)

|  |  |  |  |
| --- | --- | --- | --- |
| Building | Room/Lab Space | Specific Area in Lab | PPE That May Be Removed |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

**Description of Risk Mitigation:**

*Attach the completed Risk Assessment(s). Specify the hazards and describe what is in place to protect against the hazards in the PPE Free Area e.g. barriers to protect from splash, relocation of hazards to remove them from the area, etc.*

|  |  |  |
| --- | --- | --- |
| **PROCESS** | **HAZARD(S)** | **RISK MITIGATION** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

X\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Lab Director/Principal Investigator (PI) / Date