|  |
| --- |
| Hazard Control Plan |

Potentially Explosive [and/or] Explosive Compounds - \_\_\_\_ Lab

**TEMPLATE INSTRUCTIONS: Some sections will require more or less detail depending on your procedure. Send completed HCPs to ehrslaba@ehrs.upenn.edu for upload to your lab’s document section in BioRAFT. EHRS will review HCPs on your request; however, the supervising faculty member is responsible for ensuring that a thorough hazard assessment has been performed. Replace red text with your text in this template. Delete this message when submitting your HCP.**

# Purpose

• • •

A Hazard Control Plan (HCP) is a standard operating procedure for a specific process performed in your laboratory or department. The HCP describes the hazardous materials or equipment in use and details the controls that will be put in place to minimize risk of exposure, injury, and other incidents. While the HCP may also include experimental procedures, its purpose is primarily to document the hazards and controls for the process. An HCP is typically written for procedures with particularly high hazards or when new hazards are introduced for the first time. A hazard assessment must be repeated, and the HCP amended whenever changes are made to the process.

Hazard Control Plan

Potentially Explosive [and/or] Explosive Compounds - \_\_\_\_ Lab

Date HCP Prepared: *[Date]*

HCP Prepared by:

|  |  |
| --- | --- |
| Name | *[Name]* |
| Position/title | *[Position/title]* |
| Email address | *[Email]* |
| Phone number | *[Phone number]* |
| Supervising Faculty Member | *[Faculty member’s name]* |
| Department | *[Department name]* |
| Contributors | *[Names]* |

Location of Process:

|  |  |
| --- | --- |
| Building | *[Building]* |
| Room number | *[Room]* |
| EHRS hood number (if applicable) | *[3-4 digit EHRS ID Hood Numbers]* |
| Other location information | *[Other location info, including storage, if applicable]* |

### References:

*[Insert literature or research notebook references for this procedure here. Specify which procedure in the* *paper is the one you will be following, e.g. “Method 3, page 1427”]*

*[Specify here if there are any parts of the procedure you will be modifying in your experiment, e.g. using a different solvent, a different substitution on a molecule, or different reaction conditions such as temp]*

*[Insert references/links to equipment manuals for any equipment you will be using in the procedure. We recommend uploading equipment manuals to your lab’s Documents section in BioRAFT and linking to that page for easy reference and access by lab members and EHRS.]*

# General Description

[Brief, General Description of Process Including Research Goal/Outcome.]

# Scope and Limitations

This Hazard Control Plan applies to the equipment, chemicals, and tasks described herein. Any deviation in materials, pressures, temperatures, or other operational parameters specified in this HCP must be evaluated for new potential hazards and necessary controls before implementation of the changes.

**Describe any limitations in scope that are specific or important to this hazard control plan (if applicable).**

# Hazard Identification

The following chemical and physical hazards have been identified for this process/equipment. [put “x” in box next to hazards]

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Chemical** |  | **Physical/Other** |
|  | Carcinogens |  | Ionizing radiation |
|  | Corrosive Liquids |  | Radioactive materials |
|  | Perchloric Acid |  | Lasers |
|  | Engineered Nano Materials |  | UV light sources |
|  | Flammable Chemicals |  | Inert compressed gases |
|  | Hazardous Gas (Flammable, Oxidizing, Corrosive, Toxic) |  | Electrical Hazards |
|  | Highly Toxic Chemicals |  | Heavy material handling equipment |
|  | Irritants |  | Working at Heights (4 foot or higher) |
| X | Explosive compounds |  | High heat |
|  | Peroxide formers |  | Open Flame |
|  | Pyrophoric chemicals |  | Lithium Batteries |
|  | Strong Oxidizers |  | Noise hazards |
|  | Water Reactive Chemicals |  | Particulates from machines and operations |
|  | Cryogens and Dry Ice |  | Pressure and Vacuum vessels |
|  | Teratogens and/or reproductive hazards |  | Robotic Machinery |
|  | Exothermic reaction/Other chemical reactivity hazards |  | Shop equipment |
|  |  |  | Biological Hazards |
|  |  |  | Exposed blades, needles, etc. |
|  |  |  | Acute/Chronic Aquatic Hazard |
|  |  |  |  |

# Training Requirements

*Training beyond the standard EHRS lab safety training is required for hazardous lab processes. Hands-on training by a senior lab member experienced in the use of [type of] reagents is required before new lab members can perform experiments with [type of] materials. All researchers conducting this experiment must read and understand the applicable SOPs and Fact Sheets in Penn’s Chemical Hygiene Plan.*

*After completing the training, the new lab member must obtain approval from the PI prior to commencing work. No researcher may work independently with the hazardous material described in this HCP until the Principal Investigator (or their designee) has ensured that the researcher:*

* *Has completed all required EHRS laboratory safety training programs.*
* *Understands the hazards of the materials and risks of the processes involved.*
* *Has read and understands the contents of the related SOP(s) and/or Fact Sheets on the hazard (available on* [*EHRS’s website*](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan#paragraph-1016)*) and this task-specific Hazard Control Plan.*
* *Demonstrates the ability to execute their work according to the requirements in the related SOP(s) and/or Fact Sheets on the hazard (available on* [*EHRS’s website*](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan#paragraph-1016)*) and this task-specific Hazard Control Plan*

# Tasks, Hazards, and Controls

Describe **each step of the procedure** that involves a hazardous material or procedure. **Replace the use of “should be/do” statements with “must be/do” statements as much as possible**; this reduces the risk of someone misinterpreting “should” statements as optional instructions.

(See Appendix B for an example task description)

***Hazard-Control Table Instructions: (Delete these instructions before submitting your draft)***

(See Appendix B at the end of this document for an example of a completed table)

* *Fill in the Hazard (e.g. Flammable Chemical, or Toxic Gas, etc.) in the top row.*
* *Enter the Risk (e.g. Fire, or Illness/Death due to inhalation).*
* *Enter the Risk Factors (e.g. For Fire: Strong oxidizers, open flames; For Illness/Death from inhalation: Leaks in tubing, inadequate post-reaction purge time).*
* *Define the likelihood and severity of the Risk.*
  + ***See Appendix A at the end of this document for definitions of Risk likelihood and severity levels (High(H), Medium(M), and Low(L)).***
* *Fill-in any hazard controls that are in place or will be put in place. (You do not need to enter a control for each category.)*
  + ***See Appendix B at the end of this document for an example of a completed Hazard Control Table.***
* *It is most efficient to group materials that have similar hazard controls in place, and/or quenching procedures. This way, the fewest number of tables must be written. (e.g. most flammable gases have the same controls, so it is best to create a “Flammable Gas” table).*
* *If a material has multiple hazards (e.g. Carbon Monoxide is toxic and flammable) and you have other materials that fit one or both hazards, writing tables for both hazards (e.g. “Toxic Gases” and “Flammable Gases”) is sufficient.*
* *If a material has multiple hazards (e.g. Carbon Monoxide is toxic and flammable) but no other materials fit one of the hazard types (e.g. Carbon Monoxide is your only toxic gas, you have other flammable gases), you may specify extra controls for that material in one hazard table, rather than writing another table (e.g. include “Use a handheld CO detector to detect leaks when working with CO” in your “Flammable Gases” table).*

***Duplicate the table as many times as is necessary for each hazard and risk of each step.***

1. **[Task Name]**

[Task Description/General Procedure]

[Photos]

|  |  |  |  |
| --- | --- | --- | --- |
| **Hazard: Explosive Reagents** | | | |
| **Risk** | **Likelihood** | **Severity** | **Risk Factors** |
| [Enter risk here] | H, M, or L | H, M, or L | [Enter risk factors here – conditions or actions that would increase risk] |
| **Controls** | | | |
| **Administrative [work practices]** | –All chemical compatibility must be thoroughly examined before performing a reaction using an explosive compound. Refer to the SDS of the compound, the relevant literature, and you and your colleagues’ chemical intuition for guidance.  –Never run a potentially explosive reaction in a sealed vessel.  –Minimize the manipulation of explosive compounds when setting up a reaction.  –If possible, avoid running reactions on days with ambient conditions that promote strong static discharge. Generally, this is when the air is very dry.  –Electrically ground yourself using the wrist strap attached to the grounding bar and anti-static mat while handling explosive material.  –Do not heat reactions using explosive compounds. Remove all heating equipment from the hood you’re going to work in.  –Remove all non-essential combustibles/flammables from your workspace before beginning the experiment.  –Work on as small of a scale as possible; we have found scales of [insert amount] of explosive reagent to be safe. Scale-ups from this must be addressed with the PI before continuing.  –Alert other researchers in the lab that you will be working with explosive materials. Do not handle explosive chemicals when working alone.  –Post a sign on the fume hood when a process involving potentially explosive compounds is unoccupied.  A template is available for download: [Unattended Operations](https://ehrs.upenn.edu/policies-resources/unattended-operations-sign-template) Sign Template | | |
| **Engineering** | –This procedure may only be done inside of a properly functioning chemical fume hood, or a grounded glove box. Keep the fume hood sash closed as much as feasible.  –Any fume hood used to facilitate work with explosive compounds must be equipped with a grounding bar and anti-static mat.  –Any glove box used to facilitate work with explosive compounds must be electrically grounded.  –Perform reactions using explosive compounds behind a blast shield to contain an explosion.  –Use plastic/ceramic spoons in place of metal tools to reduce static electricity. | | |
| **Personal Protective Equipment** | –Standard Lab attire including long pants, fully-enclosed shoes, etc.  –Safety glasses, 100% cotton or fire-resistant lab coat, solvent-appropriate gloves | | |
| **Other mitigating factors**  **(inherent risk reduction)** | Attempt to perform reactions that do not use explosive compounds but achieve the same result. | | |

**Link to Penn Chemical Hygiene Plan SOP for this hazard:**

[SOP: Explosive Compounds https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-explosive](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-explosive)

1. **[Task Name]**

[Task Description/General Procedure]

[Photos]

|  |  |  |  |
| --- | --- | --- | --- |
| **Hazard: [Name Hazard Here]** | | | |
| **Risk** | **Likelihood** | **Severity** | **Risk Factors** |
| [Enter risk here] | H, M, or L | H, M, or L | [Enter risk factors here – conditions or actions that would increase risk] |
| **Controls** | | | |
| **Administrative [work practices]** |  | | |
| **Engineering** |  | | |
| **Personal Protective Equipment** |  | | |
| **Other mitigating factors**  **(inherent risk reduction)** |  | | |

**Link to Penn Chemical Hygiene Plan SOP for this hazard:** [If applicable, include the link to the relevant [SOP](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-cryogens-and-dry) or [Fact Sheet](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets) from [Penn’s CHP](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan#paragraph-1016)]

***Continue adding tasks and hazard-control tables as necessary to describe all hazardous steps of the process.***

**Other Considerations**

**(Not specified elsewhere in this HCP)**

**Equipment Manual Safety Warnings**

*[Equipment manuals often come with a “Safety” or “Safety Messages” section that summarizes the “to-dos” and “not-to-dos” regarding the equipment. If a safety manual is available for a piece of equipment used in the procedure specified in this HCP, locate the “Safety” or “Safety Messages” section and copy the contents to here.]*

**[Storage and Transport](https://ehrs.upenn.edu/policies-resources/chemical-hygiene-plan" \l "paragraph-945)**

*Explosives as a whole do not necessitate a particular kind of storage cabinet or locations, but do often have additional storage requirements as noted by the manufacturer, and are often incompatible with many chemicals. [Refer to the SDS of the compound, the relevant literature, and you and your colleagues’ chemical intuition to develop instructions on where to store them. Write down your decisions here for reference. The next paragraph is meant as a starter.]*

*Explosive compounds in the [\_\_\_\_] Lab are stored in [location],* *separately from other non-explosive chemicals. The storage location must be kept free from clutter to avoid knocking a bottle over while removing another reagent. Use a secondary containment carrier when carrying explosive compounds between rooms.*

*All explosives must be stored in accordance with the requirements set forth in* [*Penn’s Explosives SOP*](https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/standard-operating-procedures/sop-explosive)*.*

**[Waste Disposal](https://ehrs.upenn.edu/health-safety/regulated-waste/chemical-waste)**

*[Indicate the waste disposal practices for the waste produced by this process.]*

*Always check for specific chemical incompatibilities before using or disposing of potentially explosive reagents. Potentially explosive waste streams must be segregated from other wastes and disposed of through EHRS as soon as possible. [Is explosive waste purposefully diluted in your lab before disposal?]*

*[INCLUDE IF QUENCHING IS APPLICABLE FOR YOUR HCP, DELETE OTHERWISE:]* *Quenching must only be done for:*

* *A sensitive explosive/residue in a container unsafe for transport.*
  + *e.g. Schlenk flasks, round-bottom flasks, and similar glassware can be quenched.*
  + *A container with a SureSeal (or equivalent stopper) must not be quenched.*
* *Equipment that needs to be reused.*
* *Contaminated debris/articles that could convey the pyrophoric hazard but can’t be safely packaged and transported.*
  + *e.g. contaminated Kimwipes, Pasteur pipettes.*
* *If you have a question about quenching/disposal, contact* [*chem\_waste@lists.upenn.edu*](mailto:chem_waste@lists.upenn.edu)*.*

*[Explicit quenching instructions (if applicable) must be included here;* *instructions from earlier in the document may be summarized.]*

*Collect the quenched material in a separate container from other wastes.* *Use a* *hazardous-waste tag to label the container with all of the constituents of the quenched mixture (e.g. For Grignard reagents: magnesium bromide, benzene, magnesium isopropoxide, etc), NOT just “Grignard quench” or “tolyl magnesium bromide, phenyl magnesium iodide, etc”. EHRS staff needs this information to avoid placing incompatible materials inside the same container.*

*Unwanted (full, used, or empty) reagent bottles in good condition can be removed from the refrigerator/freezer/glovebox/desiccator and stored in an empty fume hood while they warm up to room temperature/equilibrate with the atmosphere. After being left at room temperature for several hours without a reaction, reagent bottles can be directly removed by EHRS. Bottles of explosive material stored at room temperature can also be directly removed by EHRS. Label the container with a hazardous waste tag and request a waste pick-up.* ***Do not attempt to quench the residual material in the bottle.****If you are concerned that a reagent bottle will deflagrate/detonate/etc. if moved for waste pickup, contact* [*chem\_waste@lists.upenn.edu*](mailto:chem_waste@lists.upenn.edu) *for advice.*

[**Building/Lab Specific Emergency Procedures**](https://ehrs.upenn.edu/emergency-info)

*[Indicate where the* ***nearest eyewash and safety shower*** *are located. Refresh the lab group on the* ***emergency phone numbers*** *and* ***evacuation procedures****. Include any special* ***emergency response or spill clean-up instructions*** *for this particular process.]*

*[****Consider “what-if”*** *- is there something external that could fail, such as loss of running water, loss of fume hood exhaust, etc. impact the safety of your operation? How would you respond if you were mid reaction, or could not easily get to your reaction to stop it? Provide a brief overview of some relevant scenario(s).]*

*During a fire emergency, the University of Pennsylvania’s Division of Public Safety – Fire and Emergency Services (FES) emphasizes safe evacuation as top priority. While evacuating, shut the fume hood sash (if applicable) and close doors behind you. Notify emergency services of the fire and its location by either of the following methods:*

* ***Pulling the nearest fire alarm manual pull station*** *while you evacuate the building, or*
* *If on the* ***Philadelphia campus,****calling* ***215-573-3333, or 511****from a campus phone.*
* *If at* ***New Bolton Center or Morris Arboretum & Gardens calling 911****.*

*Incipient fires with a* ***mundane*** *fuel source (e.g. pure flammable solvents, nonhazardous lab trash) may be fought to assist oneself or another to evacuate, or to control a small fire. In case of a small, incipient fire of this nature, a [specify class] fire extinguisher can be found in [location]. Only fight such a fire if:*

* *You have received hands-on training at Penn on how to use a portable fire extinguisher.*
* *It is safe to do so, and the fire is not located between you and your exit.*
* *The fire is still contained to the original fuel source and has not begun to spread.*
* *You are not alone.*
* *The appropriate type of extinguisher is available.*

*Small incipient fires with an exotic fuel source (e.g. pyrophoric or explosive chemicals, reaction mixtures containing highly corrosive, toxic, or other hazardous chemicals) may be attempted to be immediately smothered using [a dry extinguishing agent, such as powdered lime or sand]. A dry extinguisher must be readily available where work is performed; the [Your Lab]’s sand is stored in [location], and a portion must be brought to the fume hood where work with explosives takes place. If using sand does not immediately put out the fire, do not continue fighting the fire; evacuate the area and notify emergency services as described above.*

*Do not feel compelled to fight a fire if you are not comfortable doing so. Evacuation is always an acceptable option.*

*After notifying emergency services of a fire, please notify EHRS of the fire at* ***215-898-4453****.*

*In case of an incident which causes life-threatening or otherwise severe injury in need of immediate medical care call 215-573-3333 or 511 from a Penn campus phone. For injuries that are not immediately life-threatening, or are otherwise minor, rinse any contaminated areas in safety shower for at least 15 minutes, then seek treatment at one of the following locations:*

***Faculty and Staff:***

***Go to Occupational Medicine:*** *HUP RAVDIN 2nd floor, 34th & Spruce Streets*

*Hours: 8:30am - 3:30 pm  
Phone: 215-662-2354*

*An appointment is not required for a new injury or exposure.*

***Go to Emergency Service at HUP or Penn Presbyterian after hours:***

*HUP:  Pavilion (1 Convention Avenue)*

*Penn Presbyterian: Myrin Building (51 N 39th St.)*

***Students:***

***Go to Student Wellness during hours:*** *3535 Market Street, Suite 100  
215-746-3535*

***Go to Emergency Service at HUP or Penn Presbyterian after hours:***

*HUP:  Pavilion (1 Convention Avenue)*

*Penn Presbyterian: Myrin Building (51 N 39th St.)*

***Do not hesitate to call EHRS for assistance with compressed gas leaks, spills, or exposure concerns. 24-hour EHRS on-call phone number: 215-898-4453***

***Contact Penn Police (511 from a Penn campus phone or 215-573-3333) if there is a fire, imminent risk of fire, an injury requiring an ambulance, or if there is a hazard that may affect others in the building.***

Optional attachments:

* Safety Data Sheets
* Operation Manuals for Equipment
* Experimental Procedure
* List of Individuals Trained and Authorized on this Procedure

**Appendix A: Definitions of Risk Likelihood and Severity Level**

**Likelihood**

**-------------------------------------------------------------------------**

**Low:**

To the best of your knowledge, this has not happened in the past with same or similar equipment/material/location.

*And*

This would not be expected to occur under normal operating conditions.

*And*

This would only be expected to occur in the event of a rare upset condition.

**-------------------------------------------------------------------------**

**Medium:**

To the best of your knowledge, this has not happened in the past with same or similar equipment/material/location.

*And*

This would not be expected to occur under normal operating conditions.

*And*

This would be expected to occur under reasonably anticipated upset conditions.

**-------------------------------------------------------------------------**

**High:**

This is known to have happened in the past with same or similar equipment/material/location.

*And/or*

This could occur under normal operating conditions.

*And/or*

This could occur under reasonably anticipated upset conditions.

**-------------------------------------------------------------------------**

**Severity**

**-------------------------------------------------------------------------**

**Low:**

This would not cause an injury or exposure that would require medical evaluation or treatment.

*And*

No permanent damage to equipment or facility would result.

*And*

Damages would not result in downtime of more than a few hour.

**-------------------------------------------------------------------------**

**Medium:**

Injuries or exposures would not exceed first-aid level treatment and would not result in any lost work days due to injury.

*And/or*

Minor equipment or facility damage would result.

*And/or*

Damages would result in downtime of a few hours or more.

*And/or*

A hazardous material spill clean-up would need to be done by the lab.

**-------------------------------------------------------------------------**

**High:**

Injuries or exposures would require medical treatment beyond first-aid and/or would result in lost work days due to injury.

*And/or*

Serious equipment or facility damage would result.

*And/or*

Damage to the facility would be beyond the lab/room of origin.

*And/or*

Damages would result in more than one day of downtime.

*And/or*

External hazmat team required for hazardous material spill clean-up.

**----------------------------------------------------------------------------**

# Appendix B: EXAMPLE TASK/HAZARDS/RISKS/CONTROLS

1. **Diluting hydrofluoric acid**

Hydrofluoric acid (49%) is poured from a 500-mL bottle through a plastic funnel into a 25-mL plastic graduated cylinder to the 11-mL mark. Any excess acid that was dispensed is poured from the graduated cylinder back into the bottle. The 11-mL of hydrofluoric acid are then poured into a 250-mL plastic beaker containing 50 mL of D.I. water.

Photo of Equipment/Process if available

(See Example Hazard-Control Table on Next Page)

EXAMPLE HAZARD-CONTROL TABLE

|  |  |  |  |
| --- | --- | --- | --- |
| **Hazard: Highly toxic and corrosive chemical (Hydrofluoric acid)** | | | |
| **Risk** | **Likelihood** | **Severity** | **Risk Factors** |
| Serious burns to eyes or skin from hydrofluoric acid exposure | M | H | Chemical spill/splash  Poor housekeeping practices/contaminated surfaces  Using funnels/vessels made of material incompatible with HF. |
| **Controls** | | | |
| **Administrative [work practices]** | -Label the area where HF is stored and used; a warning sign labelled “Hydrofluoric Acid Use in This Area” must be hung on the work space to let other group members stay alerted.  -Do not work with HF when alone in lab. Notify lab mates before working with HF.  -Use an appropriately sized funnel for the size of the graduated cylinder.  -Close HF bottle immediately after pouring chemical. Do not leave the bottle open.  -Wipe off the outside of bottle with a damp paper towel after use.  -Clean up all spills immediately. Ensure that no puddles or droplets are on the work surface when done.  -Remove gloves if they become contaminated. Change gloves immediately after completion of task.  -Wash hands immediately after completion of task.  -Thoroughly rinse all labware immediately after use.  -Do not perform any other procedures in the fume hood until all HF work is complete, the waste has been collected, and equipment and materials have been cleaned, properly discarded, or removed from the area. | | |
| **Engineering** | -Conduct this task only inside of a working chemical fume hood.  -Use the chemical fume hood sash as a barrier to shield your face and as much of your body as possible while performing this task.  -Use a metal clamp to secure the graduated cylinder from tipping during pour. | | |
| **Personal Protective Equipment** | Standard lab attire (long pants, fully-enclosed shoes) and  -Single 8-mil-thickness nitrile gloves, 100% cotton lab coat, an HF-resistant lab apron, and safety goggles must be worn properly **at minimum** when conducting the reaction.  -EHRS also strongly recommends working with a face shield, HF-resistant gloves, and HF-resistant arm sleeves (if not already a part of the glove) for all work with HF.  -Neoprene is a common HF-resistant material for PPE, but always check with the manufacturer for HF resistance before purchasing. | | |
| **Other mitigating factors**  **(inherent risk reduction)** | -An HF exposure kit with non-expired calcium gluconate gel is available in the lab near fume hood #### where HF is stored and used.  -Training is provided to all lab workers on the location and use of the kit.  -The lab will routinely check the expiration date of the calcium gluconate in the exposure kit and will replace the tube as needed. | | |

**Link to Penn Chemical Hygiene Plan SOP for this hazard:**

Fact Sheet: Hydrofluoric Acid|<https://ehrs.upenn.edu/health-safety/lab-safety/chemical-hygiene-plan/fact-sheets/fact-sheet-hydrofluoric-acid>