C_001 - Chemical Safety Training

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LLE Chemical Hygiene Officer
About this training

• Description:
  - Review of UR’s Chemical Hygiene Program; Safe work practices; Hazard communication, Safety Data Sheets (SDS); Personal protective equipment (PPE), and Hazardous waste management

• Required participants:
  - Persons who work in a laboratory with chemicals, hazardous materials and solvents, or persons who handle, work with, store or dispense chemicals, hazardous materials and/or solvents

All persons taking this training for the first time must obtain the Chemical Safety Officer’s signature on their quiz.
Achieving and maintaining a safe working environment is everyone’s responsibility

**Administration**
- Establish safety guidelines and protocols
- Ensure regulatory compliance and employee safety

**Principal Investigators (PI), work area supervisors**
- Provide task-specific and material-specific training
- Promote safe working conditions and practices: 
  - lead by example

**Employees**
- Learn hazards before beginning experiments
- Follow safety protocols in every experiment
- Identify and report potentially hazardous situations to the appropriate PI, work area supervisor, or LLE Safety Officer
Training topics

• Identifying, classifying, and storing hazardous materials

• Hazard communication

• Exposure minimization

• Chemical emergencies

• Site specific safety procedures

• Hazardous waste
Examples of hazardous materials that pose significant physical or health risks under normal laboratory use

**Physical**

- Flammable
  - Acetone
- Combustible
  - Kerosene
- Corrosive
  - Hydrochloric acid
- Oxidizer
  - Chlorine bleach
- Explosive, unstable, reactive
  - perchlorates, lithium metal

**Health**

- Carcinogens, teratogens (birth defects), mutagens (genetic mutations)
  - Formaldehyde
- Toxic
  - Hydrogen cyanide
- Irritant
  - Ammonia
- Sensitizer
  - Beryllium dust
- Target organ effects
  - Chloroform

Radioactive Material Safety is covered in the R_002 Safety Training
OSHA standard 29 CFR 1910.106(a)(19) defines the terms *flash point, flammable and combustible*

- **Flash point** – the minimum temperature at which a liquid will produce a sufficient concentration of vapor within a test vessel to form an ignitable mixture with air near the liquid surface when a small flame is introduced.

- **Flammable** liquids have a flash point below 140°F (60°C).

- **Combustible** liquids have a flash point above 140°F (60°C)

![Flashpoint Diagram]

Organic peroxides undergo auto-accelerated thermal decomposition and are excluded from these flashpoint determinations
Explosion and fire are the two primary hazards associated with flammable and combustible liquids

- Many organic solvents are *highly flammable*
- Common organic solvents include (but are not limited to):
  - Acetonitrile
  - Benzene
  - Dichloromethane
  - Methyl ethyl ketone
  - Toluene
  - Ethyl Acetate

Always review safety information and work in a fume hood when using organic solvents
Hazardous materials must be stored in separate locations according to their *hazard class*.

**Hazard classes include:**

- Flammables
- Inorganic acids (nitric acid and perchloric acid are powerful oxidizers and are stored separately)
- Bases
- Organic acids (acetic acid, formic acid)
- Oxidizing agents
- Reducing agents
- High health hazard materials
  - carcinogens
  - teratogens
  - mutagens
  - acutely toxic
No more than 3 gallons* of flammable solvent may be stored in any room, outside an approved storage cabinet

* 3 gallons is a new reduced limit within LLE

- Both insulated and self-closing, air-tight doors provide high fire resistance

All flammable solvents in excess of the 3-gal. limit must be stored in approved flammable solvent storage cabinets
Storing items on top of a flammable storage cabinet is a violation of NYS Fire Code

**WARNING**

FIRE HAZARD

Storing items on top of flammable storage cabinet could increase fire risk
Do Not Place Anything On Top of This Cabinet

Ensure that the tops of all flammable storage cabinets remain clear of any items
Ethers and certain alcohols form **highly unstable peroxides** upon prolonged exposure to air and/or light

- Peroxides can be **explosive** if heated or allowed to evaporate to dryness!
- Solvents that generate peroxides include diethyl ether, tetrahydrofuran (THF), dioxane, butanol, and other secondary alcohols

- The lab supervisor must:
  - Test peroxide-forming materials every 6 months
  - Dispose of materials that exceed the peroxide threshold
  - Label containers with the date received, *and* dated test results
Supervisors and PI’s are responsible for ensuring that peroxide-forming materials stored in their areas are tested for peroxide content every 6 months.

1. Dip test strip into test solution for approximately 1 second:

2. Gently shake off excess liquid:

3. Wait 5 seconds:

4. Compare the test paper zone with the color scale:

5. Keep Dispose
Facility-wide chemical safety information at LLE is available both on-line.

**SDS Database**

*Example: Searching for physical properties and safety information*

Access is limited to users with an LLE computer account.
and in hard-copy format in the LLE Safety Library (Rm 1414)

- Safety Data Sheets (SDS)
- CHP binder
- National Fire Codes
- Chemical labels
- Reference texts
- Safety supplies
  - Eyewear
  - Hearing protection
  - Gloves
  - Lens cleaners
  - Sharps disposal
- Information and assistance
Each LLE laboratory or work area must have its own set of laboratory-specific materials safety data

- Safety documentation must be prominently displayed and rapidly accessible; these items include:
  - The Chemical Hygiene Plan (CHP) binder
    - CHP document
    - Chemical inventory
    - SDS’s (for laboratories with a small chemical inventory)
  - Safety Data Sheets (SDS) binder
    - one or more volumes for laboratories with a large chemical inventory

All employees must know the location of the CHP and Safety Data Sheet binders in their work areas
Chemical labeling follows the Globally Harmonized System (GHS) for hazard communication guidelines.

- **Product identifier**
- **Signal Word**
- **Hazard statements**
- **Precautionary statements**
- **Pictograms**

### PRODUCT IDENTIFIER

**Signal Word**

“Danger” implies a higher hazard level than does “Warning”

**Hazard statement**

Statements assigned to a hazard class and category that describes the nature and degree of the hazards

**Precautionary statements**

Phrases which describe recommended measures that should be taken to minimize or prevent adverse effects resulting from exposures to a hazardous product

Company Name, Street Address, City, State, Zip, Country Phone number

- **UN###**
- **CAS# XXXX-XX-X**
- **Pictograms**

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Chemical manufacturers must provide SDS documents in a standardized 16-section format

Safety Data Sheets (SDS)

GHS (OSHA HCS 2012)

Document format is *mandated*

Safety Data Sheets (SDS) must contain:

1. Product identification / name
2. Hazard identification
3. Composition / Information on ingredients
4. First aid measures
5. Fire fighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls / personal protection
9. Physical / chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transportation information
15. Regulatory information
16. Other information
Be aware of differences between GHS and NFPA labels

GHS Hazard Level (current)

Cat. 1 = Severe
Cat. 2 = Serious
Cat. 3 = Moderate
Cat. 4 = Slight
Cat. 5 = Minimal

NFPA Hazard Level (phasing out)

Cat. 4 = Deadly
Cat. 3 = Extreme Danger
Cat. 2 = Hazardous
Cat. 1 = Slightly Hazardous
Cat. 0 = Normal Material

GHS numeric hazard levels (1 = Severe; 5=Minimal) are the OPPOSITE of the NFPA numbering system
Flammables are separated into four categories according to their flash points and boiling points

Category 1 (extremely flammable):
- Flash point < 73.4°F (23°C)
- Boiling point ≤ 95°F (35°C)
  
  Ex: Diethyl ether

Category 2 (highly flammable):
- Flash point < 73.4°F (23°C)
- Boiling point > 95°F (35°C)
  
  Ex: Toluene, acetone

Category 3 (Flammable liquid and vapor):
- Flash point ≥ 73.4°F (23°C) and ≤ 140°F (60°C)
  
  Ex: Acetic acid, acetylacetone

Category 4 (Combustible liquid):
- Flash point ≥ 140°F (37.8°C) and ≤ 199.4 °F (93 °C)
  
  Ex. Kerosene, chloroform
**Pictograms** communicate chemical hazards

**Flame**
- Flammables
- Self-Heating
- Self Reactives
- Organic Peroxides
- Pyrophorics
- Emits Flammable Gas

**Exploding Bomb**
- Explosives
- Self Reactives
- Organic Peroxides

**Flame over Circle**
- Oxidizers

**Skull & Crossbones**
- Acute Toxicity (fatal or toxic)

**Health Hazard**
- Carcinogen
- Respiratory Sensitizer
- Reproductive Toxicity
- Target Organ Toxicity
- Mutagenicity
- Aspiration Toxicity

**Gas Cylinder**
- Gases Under Pressure

**Corrosion**
- Corrosives

**Exclamation Mark**
- Irritant
- Dermal Sensitizer
- Acute Toxicity (harmful)
- Narcotic Effects
- Respiratory Tract Irritant

**Environment**
- Acute Aquatic Toxicity
Chemical storage and container labeling follows the GHS format

- Container label:

- Cabinet label:
Labeling for secondary chemical containers must be *clearly legible and unambiguous*

- Re-used/ recycled chemical containers MUST have new labels provided with chemical name and associated hazards
  
- Preformatted blank labels are available in the Safety Library (Rm 1414)
Containers re-purposed for chemical storage must be properly cleaned and labeled before use

**RIGHT:**

- Previous labels removed
- Rinsed 3x with a suitable solvent* followed by tap water
- Labeling in accordance with GHS

**WRONG:**

- Non-GHS compliant label
- Old label not removed
- Rubber stopper
- No label
- Damaged or illegible labels

* Rinsate may or may not need to be collected as hazardous waste, see Chemical Hygiene Officer for guidance

Hazardous material storage in food containers is strictly prohibited
Hazardous materials may enter the body by four different routes of exposure

<table>
<thead>
<tr>
<th>High</th>
<th>Exposure probability</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
<td>Skin/eye contact</td>
<td>Injection</td>
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</table>

- **The level of exposure can have widely varying health effects for different people**

- **Exposures can be:**
  - **Acute:** brief, high concentration (e.g., cleaning up a spill)
  - **Chronic:** extended over days or weeks (e.g., cleaning parts with solvent)

- **Health effects from exposure can be reversible or irreversible, depending on the materials toxicology**

- **Individuals can respond differently to the same exposure (e.g., allergies)**
OSHA has established inhalation exposure levels below which adverse health effects normally do not occur

- **Permissible exposure limit (PEL)**\(^1\): the limit on the amount or concentration of a substance in the air based on an 8-hour time weighted average (TWA) exposure

- **Short-term exposure limit (STEL)**\(^2\): the acceptable average exposure over a short period of time, usually 15 minutes, as long as the TWA is not exceeded

- **Ceiling limit**\(^3\): the concentration of a chemical or material that no person should be exposed to for any period of time to prevent ill effects or death

\(^1\) [https://www.osha.gov/dsg/topics/pel/](https://www.osha.gov/dsg/topics/pel/)
Exposure minimization is the most effective means for preventing adverse health effects

Exposures are best prevented through a combination of:

- **Engineering controls**: the first line of defense in minimizing exposure potential. Both the work environment and the job should be designed to eliminate hazards or reduce exposure to hazards to the extent feasible.

- **Safe work practices**: include general workplace and other operation-specific rules.

- **Administrative controls**: aimed at reducing exposure to hazards.

- **Personal Protective Equipment (PPE)**: used when exposures cannot be mitigated by engineering and administrative controls.

For many hazardous materials, there are NO established exposure limits; personnel should use *maximum caution* when working with unknowns.
Engineering controls keep the concentration of hazardous contaminants within known OSHA exposure limits

- **Fume hoods** the primary control device for protecting laboratory personnel

- **Glove boxes** used when the substance poses too great a hazard for use in a fume hood

- Check regularly – leaks will contaminate the lab environment

Never work with hazardous materials in an open or uncontrolled environment
Proper fume hood use is essential in maintaining laboratory safety

- Make sure the sash is open to the proper operating level (indicated by arrow)
- Keep all materials inside the hood at least six inches from the sash opening
- Verify the inspection expiration date has not passed

Do NOT use fume hoods for long-term chemical storage
Proper fume hood use is essential in maintaining laboratory safety

• **Before using a fume hood:**
  - understand its functional controls and how they work
  - know the hazards of the chemical(s) that will be used
  - ensure the hood exhaust is on, functioning and the air flow is within the required range (above 100 linear ft/min)

• **When using the fume hood:**
  - never allow your head to enter the plane of the hood opening when experiments are in progress
  - always wear chemical safety eye wear
  - make sure nothing is blocking the air flow baffles at the rear of the hood

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Safe work practices are employed as an additional means of reducing exposure risk

- Exposures can still occur even when a hazard is contained
- Examples of safe work practices for specific OSHA standards include (but are not limited to):

  - **Respiratory protection** – all respirator users must be certified through the University Health Services (UHS) Respiratory Protection Program annually

  - **Lockout/Tagout (LOTO)** – prevents operation of equipment that could cause injury or equipment damage. LLE instructions 6300 defines LLE-specific LOTO procedures
The Chemical Hygiene Program promotes safe work practices by a number of different means:

- Provides standard operating procedures and control measures to reduce employee exposure to hazardous chemicals

- Classifies chemical hazards and mandates communication of these hazards to both employers and employees

- Requires a facility-wide chemical inventory to identify the locations and quantities of hazardous materials to aid in mitigation of accidents and spills
Safe Work Habits

Work habits make the single largest impact on both your safety and that of the people working around you.

The good ....
Poor work habits are one of the leading causes of laboratory accidents

the bad...
Ignorance of materials hazards and proper procedures can result in catastrophic accidents

... and the ugly

Supervisors and PI’s set the standard for safe working habits in their areas!
Operations involving large volumes and/or highly hazardous materials must undergo design/process safety reviews.

What is wrong with this picture?

- Outside fume hood
- Poor housekeeping
- Unstable apparatus
- No safety eyewear
- Unlabeled chemical containers
- No secondary containment

Experimental activities must be designed and conducted with exposure minimization and containment in mind.
The majority of chemical laboratory accidents are caused by **poor work practices**

**Incompatible Waste Incident**

- During an undergraduate organic chemistry lab class, a student poured a small quantity of waste material into a hazardous waste collection bottle.
- Moments after the student walked away, the container *exploded* in the hood.
- *Because the student had remembered to lower the hood sash, the explosion was contained and no one was injured.*
Incompatible Materials Use and Storage Incident

- A graduate student was slicing potassium metal in a toluene-filled dish next to a sink.
- A fragment of potassium fell into the damp sink.
- Hydrogen generated by reaction of potassium with water was ignited by heat of reaction, which then ignited the toluene.
- **The student received superficial first-degree facial burns, but no other injuries.**
Eating and drinking in laboratory and work areas is strictly prohibited

Food and drink consumption in laboratories and work areas greatly increases the risk of accidental ingestion of hazardous materials
PPE requirements are determined by both the hazards of the material and the process in which it is used

- PPE (goggles, gloves, facemasks, garments, etc.) is provided by LLE and usage is mandatory when indicated

- Work area supervisors and PI’s must:
  - provide appropriate PPE in their work areas
  - enforce wearing of required PPE

- PPE must:
  - fit properly and be inspected before each use for flaws, proper fit, and function
  - must meet ANSI standards

- Section 8 of the SDS provides guidance on each chemical’s PPE requirements

Inspection and care of PPE is the employee’s responsibility
Eye protection and gloves are mandatory for all chemical operations at LLE

Chemical safety eyewear must:

- bear the American National Standards Institute (ANSI) Z87 approval marking
- provide adequate protection against hazards
- fit snugly and not interfere with movements of the wearer
- have side shields
- be reasonably comfortable

Regular prescription glasses DO NOT provide adequate protection

Prescription safety eyewear can be ordered through the LLE if needed
The eyes can be rapidly and irreversibly damaged by even momentary contact with certain materials.

- Safety “glasses” are the minimum acceptable protection for working with chemicals.

- Safety goggles fit tightly around the eyes, and are secured with a strap that goes around the back of the head. They provide better protection against splashes and solvent vapor and are required for contact lens wearers.

- A full face shield is required when working with corrosive chemicals that can burn the skin.

- Safety eyewear is still necessary when wearing a face shield.
Selection of the proper glove material and thickness is critical for minimizing potential exposures

**Disposable gloves:**

- For incidental contact with low toxicity materials
  - nitrile rubber or chloroprene provide better protection
  - latex and PVC are NOT recommended

**Reusable gloves:**

- Discuss glove material with the Chemical Safety Officer before use
- For repeated and/or prolonged exposure with moderately toxic materials
  
  **Rinse thoroughly after each use**

**Insulated gloves:**

- For high temperature operations or when working with cryogenics

Inspect gloves carefully for holes or rips before each use
Proper donning and doffing of gloves is necessary to prevent cross-contamination

1. Pinch the outside of the glove near the wrist (careful not to touch exposed skin below)
2. Pull glove up slowly, turning the glove inside out
3. Ball up the used glove and grasp it with the gloved-hand
4. Using non-gloved hand, put finger inside cuff of glove
5. Pull glove up slowly, turning glove inside-out and encapsulating the balled glove
6. Finish removing glove and dispose of properly
Remove gloves before touching keyboards, telephones, door handles or leaving the work area.

Chemical burns, skin irritation, or other exposures can occur if contaminated gloves come in contact with the skin (i.e. scratching an itch).
Laboratory coats and aprons provide additional protection against splashes and spills

Laboratory coats made of 100% cotton (or disposable lab coats made of synthetic materials) provide secondary protection from minor exposures.

Rubber aprons may be needed for larger scale processes or highly corrosive materials.

Do not launder lab coats at home. LLE provides commercial laundry service!
Flame resistant (FR) lab coats are *required* where *pyrophoric* materials are used

- *Pyrophoric materials* can spontaneously ignite in air and will react vigorously with water or high humidity, often igniting upon contact

- Flame resistant lab coats:
  - must have FR label
  - be made with Nomex (fire resistant material)
  - polyester coats are NOT suitable

- Fires involving pyrophoric materials generally require a *Class D* fire extinguisher, which *must be* located near pyrophoric material use
In 2008, a research assistant died from injuries sustained in a chemical fire in a laboratory at UCLA

Inadequate Training Incident

• The researcher was working with tert-butyllithium (t-BuLi) when the syringe plunger came out of the barrel and the t-BuLi was exposed to the atmosphere

• The t-BuLi ignited and a nearby flask of hexane caught fire, igniting the workers clothes

• She was wearing safety glasses and nitrile gloves, *no lab coat and a polyester blouse*

• Her clothing from the waist up was largely burned and melted into the skin. Large blisters formed on her abdomen and hands - *She passed away 18 days later*
In 2008, a research assistant died from injuries sustained in a chemical fire in a laboratory at UCLA.

- OSHA concluded the accident was a result from safety lapses and inadequate training. Criminal charges were brought against both UCLA and the student’s supervisor.

- The supervisor settled out of court and paid $10,000 and was required to participate in community service.

- **What could have been done to prevent the incident?**
  - Safety and emergency training for laboratory personnel
  - Utilization of safety shower
  - Use smaller reagent volumes
  - Use of flame-resistant Nomex lab coat

The clothing you wear when working in the laboratory is an important part of your PPE - dress appropriately for the task at hand.
Respirators are deployed in special circumstances only and are NOT a substitute for engineering controls

All respirator users must be certified annually through the UR Respiratory Protection Program

<table>
<thead>
<tr>
<th>Initial certification</th>
<th>Annual re-certification</th>
</tr>
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<tbody>
<tr>
<td>• Medical history form</td>
<td>• Verify medical history</td>
</tr>
<tr>
<td>• Physical exam and spirometry test</td>
<td>• Repeat respirator fit test</td>
</tr>
<tr>
<td>• Respirator fit test</td>
<td></td>
</tr>
</tbody>
</table>

- The OMEGA and OMEGA EP target chambers are beryllium-regulated areas and require respiratory protection for entry

Report respiratory problems / issues in work areas to your supervisor or the Chemical Hygiene Officer
Eyewash and safety showers must be accessible near areas where hazardous chemicals are stored or used

Safety eyewashes and showers must:

• be located within 55 feet (10 sec), unobstructed from the hazard

• be flushed on a regular basis
  - eyewashes: 1x weekly for 3-5 min (laboratory personnel)
  - showers: 1x every 6 mos. for 3-5 min (assigned personnel)

• have a log with recorded flush dates near each unit

All personnel must know the location of the emergency units in or near work areas
Laboratory personnel are responsible for flushing eyewash stations in their areas

<table>
<thead>
<tr>
<th>Room:</th>
<th>Eyewash Log</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Time</td>
</tr>
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</table>

- Flush eyewash for 3-5 minutes weekly
- Verify:
  - The water is clear
  - The area around the station is clear of obstructions
- Record flushing information for safety verification
- The Chemical Safety Co-op provides new eyewash logs and archives full logs

In an emergency, hold eyes open and flush for at least 15 minutes
If a chemical spill or emergency occurs, contact the work area supervisor and a safety officer immediately.

**Minor spills**
- Clean up using a spill control kit
- Dispose of absorbed material as hazardous waste

**Major spills/ injuries/ emergencies**
- During *working* hours call LLE reception:
  - 55101 or 53941
  - 275-5101 or 275-3941 (cell)
- *After* hours:
  - 13 – for UR Public Safety
  - 275-3333 (cell)
  - 9-911 if no response on 13

**Emergency Numbers**
- During working hours: 55101 or 53941
- After hours:
  - 13 (UR Public Safety)
  - 275-3333 (cell)
  - 9-911 if no response on 13

**After hours protocols**
- Minimum of two people must be present when conducting any chemical processes (buddy system)
- Supervisor permission is *required for* anyone working after hours
Know what to do if a chemical exposure occurs

Touching, breathing or ingesting harmful chemicals can result in varying symptoms with different degrees of danger.

- Mild reactions can include tearing of the eyes, burning sensation of the throat, nose, chest, or skin
- Severe reactions can include coughing, wheezing, dizziness, and even death

For ingestion or other serious exposures, **immediately:**

- Alert the LLE Medical Response Team (by calling LLE reception)
- **And** call Poison Control 1-800-222-1222

For eye or skin exposure:

- Flush exposed area for 15 minutes

For inhalation exposure:

- Move victim to fresh air

*Report all chemical exposure incidents to the Chemical Safety Officer*
Repeated exposure to beryllium particles is a risk factor for both *Chronic Beryllium Disease (CBD)* and cancer

- CBD: is an irreversible lung disease produced by a sensitization (allergic) reaction to beryllium particles

- *Beryllium dust has been determined to cause cancer in humans*

- Beryllium is used at LLE for vacuum windows, x-ray filters, blast shields, and target supports

- LLE Instruction 6706 establishes procedures to insure safe handling and exposure minimization by:
  - *requiring beryllium to be purchased in article form*
  - *prohibiting any beryllium shaping processes that can generate dust* (sawing, drilling, abrading, laser cutting/engraving)
  - *allowing beryllium articles to only be shaped by wet crimp cutting*

Employees who work with beryllium must complete the LLE C_002 Beryllium Safety Training
Lead Safety

Lead dust can be harmful if inhaled or ingested

• Lead enters the body primarily through inhalation and ingestion

• When ingested or inhaled as dust, lead enters into the bloodstream where it can result in adverse health effects such as impaired cognitive function, impaired kidney function, high blood pressure, reproductive impairment, anemia and more.

• Lead soldering should be conducted in dedicated work stations
  – Away from areas where food will be consumed

• Wash hands, especially under fingernails, once soldering is complete

• For lead bricks: follow the steps in the Lead Encapsulation Procedure to reduce the risk of exposure
  • Drilling or machining of lead is prohibited at LLE

Lead bricks must be fully encapsulated and labeled
Exposure to hydrofluoric acid or buffered oxide etch can result in serious acute and chronic health effects

Hydrofluoric acid (HF) and ammonium bifluoride* (ABF) are primarily used at LLE to strip hard oxide coatings from optics and etch MLD gratings

*Ammonium bifluoride is also known as “ammonium hydrogen fluoride” or “Buffered Oxide Etch (BOE)”

HF or ABF exposure can have mild to serious consequences ranging from mild irritation to death!

**Use BOE in place of HF whenever possible**

LLE Employees are not permitted to work with HF or BOE until they have satisfactorily completed the C_006 HF Safety Training

Most exposure effects have a delayed response, if you think you may have been exposed, seek immediate medical assistance
Use of the LLE high pressure liquid nitrogen filling station (LN2) is limited to trained individuals

- The training process is “hands-on” and is conducted by either a certified fill station operator or the LLE Chemical Hygiene Officer (CHO)

- A “certified” fill station operator is one who has:
  - successfully demonstrated proficient operation of the fill station under the observation of the CHO
  - completed the LLE Mechanical Safety (M_001), Compressed Gas Safety (M_002), and Chemical Safety (C_001) trainings

This training is NOT required for filling open cryogenic containers from low-pressure LN2 storage tanks

Users must complete LLE C_004 High Pressure Liquid Nitrogen Fill Station Safety Training before operation
Hazardous chemical waste disposal is governed by EPA and NYSDEC regulations

- Hazardous chemical waste is defined as any chemical-containing product, item or material that is unwanted or has no further use and is:
  - **Ignitable**: solvents, oils, organic liquids, paint strippers
  - **Corrosive**: acids, bases, photoresist developers, metal etchants
  - **Toxic**: heavy metals, organometallics, cyanides, carcinogens, tetragons
  - **Reactive**: lithium, sodium, oxidizers, reducing agents, air-sensitive compounds and catalysts
  - **Unstable**: catalysts, peroxides, perchlorates
  - **Misc.**: batteries, sharps, E-waste, aerosol cans

- **Hazardous waste disposal information** can be found at the LLE Safety Zone (http://safety.lle.rochester.edu/530_chemical/disposal.php)

Other hazardous wastes (radioactive, biological) are covered by different regulatory agencies
Nearly everyone working at LLE handles or generates some form of hazardous chemical waste

- Many items commonly used in laboratories qualify as hazardous chemical waste under the EPA guidelines:
  - **batteries** *(toxic, corrosive, reactive)*: lead-acid, mercury, NiCd, NiMH, Li+, AgO - but *NOT* alkaline or carbon batteries
  - **“sharps”** *(toxic)*
  - **“universal wastes”** *(toxic)*: mercury-containing lamps, bulbs, switches, electronics
  - **“E-waste”** *(toxic)*: computers, power supplies, electronics
  - **beryllium, lead** and other powdered metals *(toxic, ignitable)*
  - **aerosol cans** *(ignitable, corrosive, toxic)*
Contact with chemically contaminated “sharps” can result in some of the most serious exposure injuries

- Syringe needles (new or used)
- Razor blades/scalpels
- Broken glass items (including optics)
- Microscope slides
- Pipettes

- Use approved sharps containers - *NEVER put sharps in the regular trash!*
Use non-biohazard sharps containers to dispose of chemically contaminated sharps*

*syringes, needles, razor blades, or other small sharp objects

Green or yellow containers are to be used for non-infectious sharps waste

Red containers are to be used for biohazard sharps only

Special containers can be requested for biohazard items
Syringe needles should *NEVER* be bent, sheared, or re-capped using two hands - either during use or before disposal

- **Serious or possibly fatal exposure could occur, depending on the material contained in the syringe or needle**

- **Alternative: one-handed “scoop” technique**
  - place needle cap on table
  - hold syringe only, guide needle into cap
  - lift syringe so that cap is sitting on needle hub
  - secure needle cap in place

- **Better: use a safety needle**
  - mechanism to blunt or cover the needle after use
  - one-handed operation
EPA mandates specific requirements for hazardous waste storage in laboratories and work areas

• Storage areas must be labeled as:

HAZARDOUS WASTE SATELLITE ACCUMULATION AREA

Ignitable, corrosive, reactive, toxic, and other noxious chemical wastes must be disposed of as directed by the Hazardous Waste Management Unit. EPA & Monroe County regulations prohibit drain disposal, trash disposal, or the intentional evaporation of such wastes. If you have any questions concerning the disposal of chemical wastes, contact the hazardous Waste Management Unit at x5-2056.

All Hazardous Waste Containers must be:

- Labeled “Hazardous Waste” and state the chemicals contained within the bottle. A running log of what is placed into the container with quantities must be attached to the container at all times.
- Free of old labels. All other labels on waste containers must be removed.
- Compatible with the wastes placed into them.
- Kept closed when not actually adding to their contents.
- Placed into secondary containment. Non-compatible wastes must be kept separate. Do not mix wastes. Waste containers may not be located in sinks.
- Clean. Remove chemical residue immediately from the outside of the containers.

Variations are unacceptable!

• Labels are available in the Safety Library (Rm. 1414)
Waste containers must be kept closed and stored in the labeled accumulation area except when being filled

- All containers must be triple-rinsed before being used for waste accumulation
- Secondary containment equal to 110% of the waste containers volume is required to control spills or container leaks

Incompatible wastes (i.e., oxidizers and organic liquids) must be segregated
Proper management and disposal of hazardous waste follows a multi-step process:

- **Date container, place in appropriate cabinet**
- **Is the waste hazardous?**
  - **Yes**
    - Select container
    - Triple rinse container
    - Label container, record contents
    - Generate Chematix tag
  - **No**
    - Transport to LLE main hazardous waste storage area
    - Sewer or landfill disposal as appropriate
Proper management and disposal of hazardous chemical wastes is the responsibility of those who generate them.

- **Disposal requirements:**
  - identify by name, quantity and composition  
    *NO UNKNOWNS* are permitted
  - collect according to *hazard class*

- *Drain disposal of chemicals requires special permits*

**List of hazardous materials:**
- Strong acids and bases
- Heavy metals
- Water-insoluble organics
- Volatile Organic Compounds (VOC’s)

UR Environmental Compliance / Hazardous Waste Office 275-2056
Container selection depends on both the physical properties and quantity of waste disposed.

Must be chemically compatible with leak-free closure

<table>
<thead>
<tr>
<th>Glass bottles</th>
<th>Heavy-walled plastic containers</th>
<th>Metal cans and drums</th>
</tr>
</thead>
<tbody>
<tr>
<td>All materials except HF (or BOE)</td>
<td>HF-containing materials, other corrosives, solids</td>
<td>Non-corrosive liquids and solids</td>
</tr>
</tbody>
</table>

Containers must be *triple-rinsed* before disposal or when re-used for hazardous waste storage.

* See slide 23 for rinsing details
Three UR graduate students were injured in an explosion on River Campus

Incompatible Waste Incident

- A glass container was being used to collect hazardous waste
- Residual organic material was present in the waste container
- Nitric acid waste was added to the container
- A chemical reaction created a rapid pressure build up, causing failure of the glass waste container
- Emergency crews recovered pieces of a container that contained a mixture of hydrochloric, nitric and sulfuric acids
- Nitric acid is a strong oxidizer and can react even with trace quantities of organic materials
Improper hazardous waste container labeling is one of EPA’s most frequently issued citations

- Use ONLY the pre-printed *Hazardous Waste Accumulation Record* labels for waste collection in the labs Hazardous Waste Satellite Accumulation areas:

![Image of hazardous waste container]

- Accumulation record labels are available:
  - LLE main hazardous waste storage area
  - Safety Library (Rm 1414)
  - LLE Safety Zone: [Hazardous Waste Accumulation Label](#)
Hazardous waste disposal tags must be generated for final disposal using the UR Chematix system. Instructions for use are located on the LLE SafetyZone:

- You may also request a one-on-one training when requesting account access.

Contact Karen Cera or the LLE Chemical Safety Co-op student (Rm 1414) to request access to the UR Chematix System.
Hazardous waste containers must be properly stored and labeled when ready for pick-up

All waste must:

• have an accumulation start date label affixed to the container

• be labeled with a Chematix Waste Tag

• **be stored in chemically compatible containers with a leak-free closure**

• be stored in secondary containment that is at least 110% of the volume of the waste container
Know the different uses of the waste labels

The Hazardous Waste Accumulation Record

- Must be used in the labs hazardous waste satellite accumulation area
- Can be left on the container when brought to the waste storage area for pick-up

Chematix Tag

- Must be used for final disposal

HAZARDOUS WASTE TAG
University Of Rochester - Environmental Compliance
Federal and State Law Prohibits Improper Disposal.
If Found, contact University of Rochester Public Safety
(585-275-3333, x5-3333, x13; ‘413 cell).

URW000HJX
Transport properly filled and labeled containers to the main LLE hazardous waste storage area for pickup by the UR Hazardous Waste Management Unit (HWMU).

Weekly waste pickups are scheduled for Thursday mornings.
All waste containers must be “date-stamped” before placing in the appropriate hazardous waste cabinets

- By law, all waste containers must be removed by HWMU within 90 days of the “accumulation date”

Accumulation date

Month/day/year

Accumulation start date labels are located in the red-box in the Hazardous Waste accumulation area

DO NOT leave empty containers* or those with unidentified contents in the cabinets!

*Consult Chemical Hygiene officer for proper disposal of empty containers
Any deficiencies in the disposal process will result in rejection of the waste by HWMU and require corrective action by the waste generator.
Summary

Achieving and maintaining a safe working environment is everyone’s responsibility!

- “Human Factors” are responsible for the majority of accidents involving hazardous materials

- Learn material-specific hazards before starting experiments

- Make exposure minimization and containment your “S.O.P.”

- Use proper-fitting PPE in every experiment every time

- Avoid risky, “quick and dirty” procedures to save time

- Know what to do and who to call when something goes wrong

When uncertain about proper procedure or operational safety: STOP and ASK!
You have completed the C_001 training – but there is still one more thing……

Complete the on-line quiz for **C_001** and follow instructions when you receive your grade by email.