Northwestern University
Office for Research Safety

Hazardous Waste Management Program
http://www.research.northwestern.edu/ors/

Hazardous Waste Disposal Guide

Revised: November 2013

NORTHWESTERN UNIVERSITY – EMERGENCY CONTACT LIST		
EMERGENCY COORDINATORS		
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Alternate Emergency Coordinator Andrea Hall, Ph.D. – ORS Chicago Director	Office: (312) 503-1932 24-hour pager: (312) 250-0467	Cell: (708) 341-4025 Home: (815) 886-5691
Alternate Emergency Coordinator Antonio Triventi – Radiation & Laser Safety Officer	Office: (847) 467-0634 24-hour pager: (312) 661-3858	Cell 708 668 8042
INTERNAL RESPONSE CONTACTS		
Northwestern University Police[1]	**911** or 456	
ORS Office – Evanston Campus	(847) 491-5581	
ORS Office – Chicago Campus	(312) 503-8300	
ORS Emergency Pager System – All contacts	(312) 661-3227	
EXTERNAL RESPONSE CONTACTS (City/State/Federal Agencies)		
Evanston Fire Department / LEPC	(847) 448-4311	
Evanston Police Department	(847) 866-5000	
Chicago Fire Department	(312) 745-3705	
Chicago Police Department	(312) 744-4000	
Chicago LEPC (Mr. William Schatz - Dept. of Envir.)	(312) 746-6430	
LOCAL HOSPITAL		
Northwestern Memorial Hospital (Chicago)	(312) 926-2000	
Northshore University Health System (Evanston)	(847) 570-2000	
STATE AND LOCAL AGENCIES		
Metropolitan Water Reclamation District (MWRD)	(312) 787-3575 (Emergency) (312) 751-5600 (Non-emergency)	
Chicago Department of Water Management	(312) 744-4420	
Illinois Environmental Protection Agency	(217) 782-3637 (Administrative)	
Illinois Emergency Management Agency (IEMA)	(800) 782-7860 (24-hour response)	
Illinois Radiological Assistance Team	(217) 785-0600	
Hazardous Waste Dump Hotline	(800) 332-3867	
Illinois State Police District Chicago	(847) 294-4400 (for non-business hours only)	
FEDERAL AGENCIES		
National Response Center	(800) 424-8802	
EPA Region 5	(800) 572-2515 Environmental Hotline (312) 886-9296 Water Division	
SPILL RESPONSE CONTRACTORS - for Major Spill Response		
Clean Harbors, Inc.	(800) 645-8265 (off hours) (773) 892-9616 (Hemang Rana–InSite Program Manager) (414) 336-1893 (Joe Sutton – Evanston Campus) (773) 892-7818 (Marcelo Mesina-Chicago Campus)	

[1] Northwestern University Police (UP) is responsible for responding to all 911 emergencies. In the event of an emergency where outside resources are deemed necessary (i.e., Chicago or Evanston fire and/or police department(s)). UP will make the necessary emergency calls and lead the coordination efforts with outside resources.

Reporting Inappropriate Disposal of Potentially Hazardous Chemicals

The inappropriate disposal of potentially hazardous chemicals is illegal and can have serious repercussions.

Northwestern University is firmly committed to the safe and proper disposal of all its hazardous wastes. Moreover, the University is committed to promoting waste minimization and pollution prevention in all aspects of its activities.

Under no circumstances should hazardous wastes be discharged into the environment in an effort to "save money," as a matter of "convenience," or due to carelessness in planning, preparation, operations or design. Assistance in preventing or resolving such issues is always available from the Office for Research Safety (ORS).

If you suspect or have knowledge of the inappropriate disposal of potentially hazardous materials or deviations from the advice and guidance set forth in this guide, you should immediately report these concerns to the Executive Director ORS.

No employee of Northwestern University shall be discriminated against or be subject to any reprisal for reporting suspected violations of the University's policies on the disposal of potentially hazardous materials.

Michael S. Blayney, Ph.D. Executive Director

[See also NU Policy: Hazardous Waste Management Plan]

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DEFINITION OF CHEMICAL WASTE

Any chemical that exhibits hazardous characteristics as defined by federal and Illinois rules and regulations, is unusable or unwanted in any way and poses a potential hazard to individuals, the environment or public health is a hazardous chemical waste.

Examples:

- Waste and opened surplus chemicals
- Expired or off-specification chemicals
- Carcinogens and cytotoxic (antineoplastic) agents
- Prescription drugs and controlled substances
- Empty chemical drums and other chemical containers with a capacity of 10 gallons and greater
- Thermometers and other items containing mercury
- Non-returnable gas cylinders and lecture bottles or pressurized chemicals
- Residue of spill clean-up materials-contaminated rags and absorbents
- Non-radioactive lead shielding and lead scrap
- Photographic film processing solutions
- Used oil --- motor, vacuum pump, lubricating
- Pesticides
- Used solvents
- Batteries
- Paint, paint thinners, brush cleaners, linseed oil, thinner contaminated rags
- Heavy metal containing waste or products (arsenic, barium, cadmium, chromium, lead, mercury, selenium and silver)

The definitions and disposal procedures for radioactive waste can be found in the ORS Radiation Safety Handbook. (http://www.research.northwestern.edu/ors/forms/radiation-safety-handbook.pdf)

Naturally-Occurring-Radioactive-Materials (NORM) for example uranium, thorium, samarium compounds must be disposed of through the radioactive waste program.

The definitions and disposal procedures for potentially infectious waste can be found on the ORS website under “Biological/Infectious Waste” (http://www.research.northwestern.edu/ors/safety/biological/waste/)

WASTE MINIMIZATION

The Environmental Protection Agency's (EPA's) policy for hazardous waste management places the highest priority on waste minimization. The University must annually report to the government on efforts it has made to reduce hazardous wastes.

Waste minimization is any action that:

- Decreases the amount of hazardous waste generated;
- Reduces the inherent toxicity of the waste.

The costs associated with the proper disposal of chemical wastes and the safe storage of chemicals in the research laboratory are inextricably linked. Researchers are encouraged to limit the amount of chemicals purchased. It is easier to order additional chemicals than to dispose of unwanted or unused surplus chemicals. **REMEMBER: The disposal cost can exceed ten times the cost of the chemical.**

In some cases, there are no acceptable waste disposal options.

Rethink how you purchase, handle and store laboratory chemicals to control the increasing costs of proper chemical waste disposal and the inherent hazards of storing and working with hazardous chemicals.

Waste minimization benefits you, the university and the environment by:

- Significantly lowering costs;
- Reducing potential health hazards;
- Reducing potential long-term liabilities for disposal;
- Promoting environmental ethics; and
- Preventing pollution.

It is the responsibility of every investigator who generates waste to incorporate the principles of waste minimization into experimental design. See the ORS website for specific methods to reduce waste and waste minimization.

SOURCE REDUCTION AND WASTE MINIMIZATION TIPS

- Clearly mark the contents of all chemical containers to prevent the generation of unknowns.
- Actively manage the inventory of all hazardous materials used in your laboratory or work location.
- When planning experiments or demonstrations, examine all wastes generated and ask if they could be minimized and how.

- Substitute less hazardous chemicals whenever possible.
- Ask others in your department if they could use your unwanted chemicals.
- Reduce the scale of processes so that less waste is generated.
- Neutralize, quench or destroy hazardous by-products as the last step in experiments.
- Minimize the volume of waste solutions containing mercury and heavy metals.
- Separate halogenated from non-halogenated solvents. The non-halogenated solvent waste may be shipped for fuel blending.
- Separate aqueous and solvent wastes if possible.

When in doubt, call the Office for Research Safety for assistance.

CHEMICAL WASTE MANAGEMENT TRAINING

Lab workers must complete the Chemical Waste Management Training module in ISIS.

CHEMICAL WASTE DISPOSAL OVERVIEW

1) Collect Chemical Waste in sturdy leak-proof containers for disposal through ORS.

- Do not use the sinks or surrounding areas for handling, storing, or disposing of hazardous chemicals.
- Do not dispose of hazardous chemicals via the sink, in the trash with/as Biological Waste or with/as Radioactive Waste.
- Evaporation is not an acceptable waste disposal method. Only insignificant, residual amounts of liquid associated with labware or containers can be treated in this way.
- Separate aqueous mixtures, halogenated solvents and non-halogenated solvents (See Appendix B: Solvents).
- Do not mix radioactive materials with chemical waste.

2) Label and seal chemical waste containers at all times.

- All chemical waste containers must be properly labeled. Complete and attach an ORS Hazardous Waste Label (as seen in Appendix A) for any unlabeled waste containers.
- Always enter a start date.

- On the waste label, identify lawfully required constituents by chemical name. No abbreviations, trade names, or chemical formulas!

- The label must contain the amount or concentration of constituents.

3) Store waste containers properly.

- Caps must be tight. No open funnels or filling aids may be left in containers.

- During waste collection, process waste containers (i.e., HPLC) must have a cap with tight fitting hole for the fill tube.

- Never store flammables with oxidizers or acids with caustics.

- Labs must use bins for segregation and secondary containment.

- Flammable wastes are best stored in a fire rated cabinet.

- As a last step of a research project quench potassium or pyrophoric potassium alloys (NaK) in the lab. Let etch and cleaning solutions (i.e., piranha, aqua regia).cool down to room temperature and provide a vented cap.

4) **Request a waste container pick up in 60 days or when container is ¾ full.**

- Fill out and submit a *Hazardous Waste Pickup Request* online via the Integrated Safety Information System (ISIS) at https://www.isis.northwestern.edu/Login.aspx. Once a request has been submitted, pick up will occur within three (3) business days.

- Never abandon chemicals. Contact ORS immediately for proper disposal.

- For non-science areas email hazardous-waste@northwestern.edu for pick up.

Other Reminders

Always wear eye/face protection, lab coat and gloves when working with hazardous chemicals.

Consult Safety Data Sheets (SDS) for more information on hazardous chemicals you may work with at Northwestern University. SDS sheets can be accessed through the ORS Homepage.

CHEMICAL WASTE COLLECTION AREAS

Regulations define any location where small amounts of chemical waste are temporarily stored prior to pick up by ORS as a "Satellite Accumulation Area" or SAA. To be considered a SAA, waste must be stored at or near the point where the waste is generated.

These areas must not contain *greater than 25 gallons of chemical waste*. Keep waste volumes to a minimum – request routine waste pickups. ORS inspects laboratories annually. Random inspections are also performed.

SATELLITE ACCUMULATION AREA SETUP

SAAs may be located inside a chemical fume hood or on a laboratory bench top. If neither of these locations can be utilized, the SAA must be set up in an area with minimal traffic.

NOTE: Waste handling and SAAs may not be near open sink or floor drains!!

SAAs must be posted with a sign (provided by ORS). See example sign provided in *Appendix A.*

SAAs must be provided with secondary containment. Use gray plastic bins provided by ORS.

Incompatible wastes must be separated by storing wastes in separate containment bins, or if appropriate, in separate areas within the lab. Contact ORS if you have any questions regarding incompatibility of waste streams, especially waste containing nitric acid and etching solutions.

The SAA must be under the control of the PI or lab director and must contain a spill kit.

CHEMICAL WASTE COLLECTION CONTAINERS:

Waste collection container material must be compatible with the chemicals to be collected.

Appropriately size waste containers! At the start of using a waste container, enter a start date on the label. Request a pick up after 60days or when ¾ full, whichever comes first.

All chemical waste containers must be:

- Properly labeled (See example label in Appendix A.) Package small containers so a fully completed label is securely attached.
- Closed and sealed except when adding contents;
- Liquids must be stored in secondary containment bins; and
- Segregated from incompatible chemicals or materials.

OPTION A: ORIGINAL CONTAINER

If a surplus chemical is to be discarded in the original container, print "HAZARDOUS WASTE" on the label in large, easily recognizable letters and add the date.

OPTION B: CONTAINER OTHER THAN ORIGINAL CONTAINER

Deface existing label or mark "XXX" through the existing label. Attach a completed ORS Hazardous Waste Label as shown in *Appendix A*.

OPTION C: CHEMICALLY CONTAMINATED SOLID WASTE

1. Obtain a five-gallon plastic pail with lid from VWR. Label the outside of the pail with a completed ORS Hazardous Waste Label.

2. Line the pail with a clear plastic bag. The lid must be on the pail except when adding contents to the bag.

3. When bag is ¾ full, close bag with tape or zip tie. Complete and attach an ORS Hazardous Waste Label to the bag.

NOTE: Never use black plastic or biohazard bags to collect chemical wastes!

OPTION D: CHEMICALLY CONTAMINATED SHARPS

Chemically contaminated broken glass, pipette tips, needles, blades and sharps must be disposed of in a labeled puncture-proof container.

OPTION E: SOLVENTS

Separately collect mercury or other heavy metals containing solvents. Separate solvent waste from aqueous waste. Use separate containers for different solvents and mixtures. Separate aqueous waste, halogenated and non-halogenated solvents.

1. Solvents must be collected in compatible and right-sized containers.

2. Complete and attach an ORS Hazardous Waste Label to the container. Each time you add waste to the container, note this on the waste tag. Use pencil as ink will smudge. Hazardous Waste Labels can also be created and printed through ISIS.

3. Fill container no more than ¾ full.  **DO NOT OVERFILL.**

OPTION F: DISPOSAL OF EMPTY CHEMICAL CONTAINERS

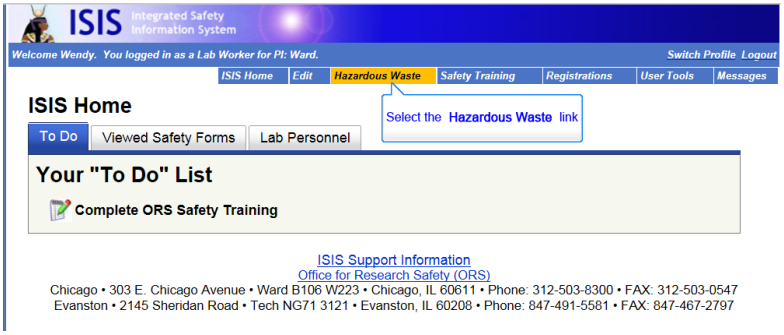
1. Thoroughly empty all contents. Only *de minimis*[2] amounts of the chemical may remain before rinsing. Collect all rinsate as hazardous waste.
2. Obliterate, remove or thoroughly deface labels before disposal.
3. Place rinsed and dried glass in the containers designated for glass disposal.

If the chemical containers has a capacity of >10 gallons, or solids or sludge remain, dispose of as hazardous waste see OPTION A.

[2] The mixture rule at 40 CFR 261.3(a)(2)(iv) states that if you mix a solid waste with any listed waste, the entire mixture is listed hazardous waste. Discarded, unused, commercial chemical products arising from what are known as de minimis losses are exempt from the mixture rule when they are discharged through a wastewater treatment system regulated by the Clean Water Act.

De minimis losses include spills from unloading or transfer of materials, leaks from process equipment, leaks from well-maintained pump packings and seals, sample purgings, relief device discharges, safety shower discharges, rinsing and cleaning of personal safety equipment, and rinsate from emptying containers.

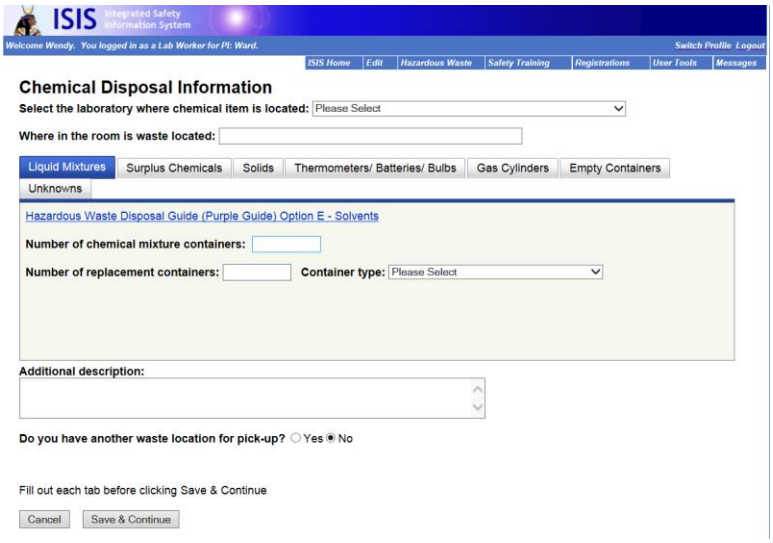
HOW TO USE THE ISIS HAZARDOUS WASTE MODULE



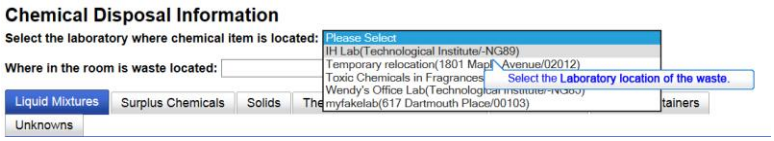
Log into ISIS. From the ISIS Home page, select Hazardous Waste from the menu bar.

Select the Add new Waste Pickup Request link.

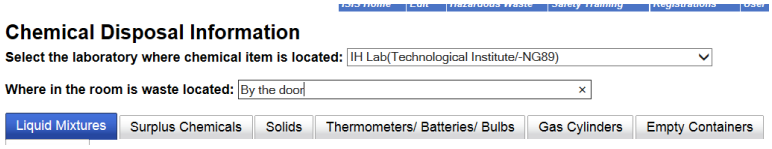
Select the type of hazardous waste you wish to include in your pickup request. You may add other types to this request later in the process.



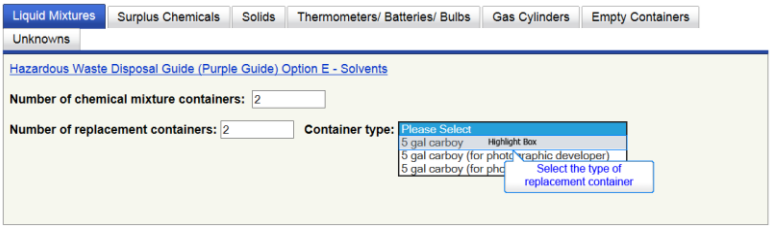
The Chemical Disposal Information page appears. Select the correct Tab for your purpose.



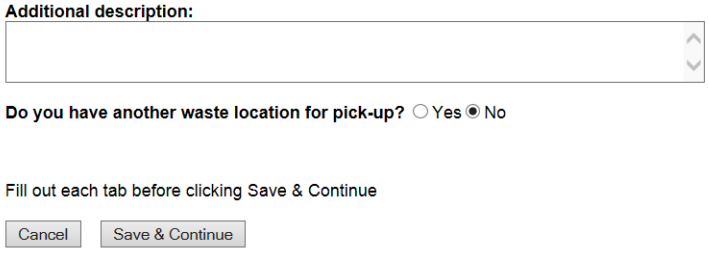
Select the laboratory from your drop-down list.



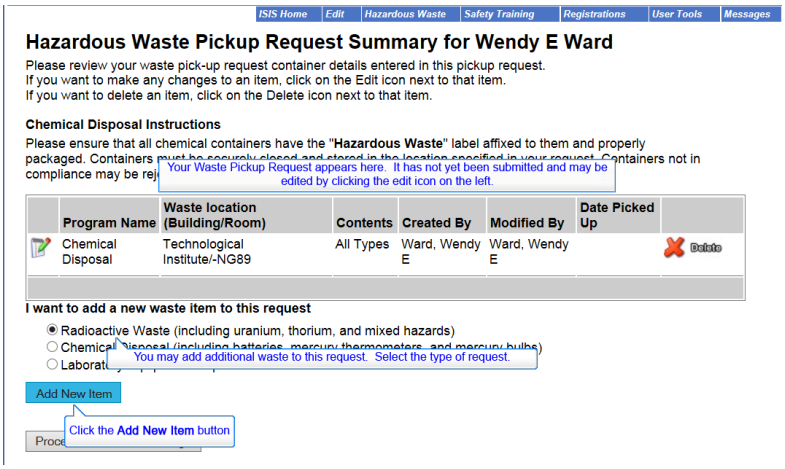
Type in the more-specific location information.



Enter the number of containers to be picked up, the number of replacement containers, and the type of container.



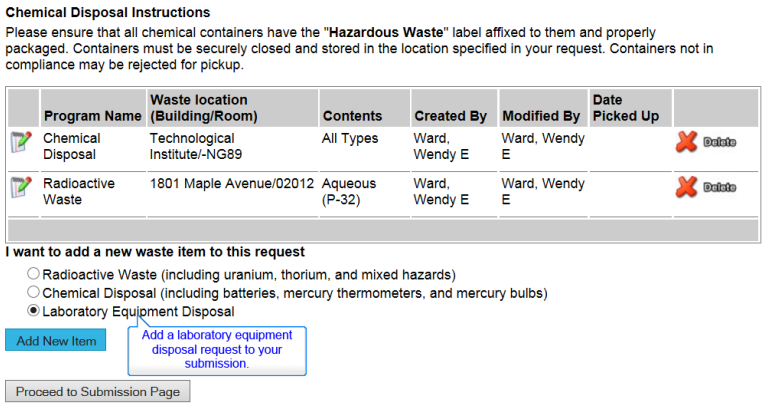
Add any additional description information, and when ready, click Save and Continue.



This will take you to the Hazardous Waste Pickup Request Summary page. Your request has not yet been submitted. You may Delete it or Edit it until it has been submitted. You may also add new waste to this request by selecting the waste type and clicking Add New Item.

Add Radioactive waste to your request by completing the Radioactive Waste Information page.

Click the Save & Continue button.

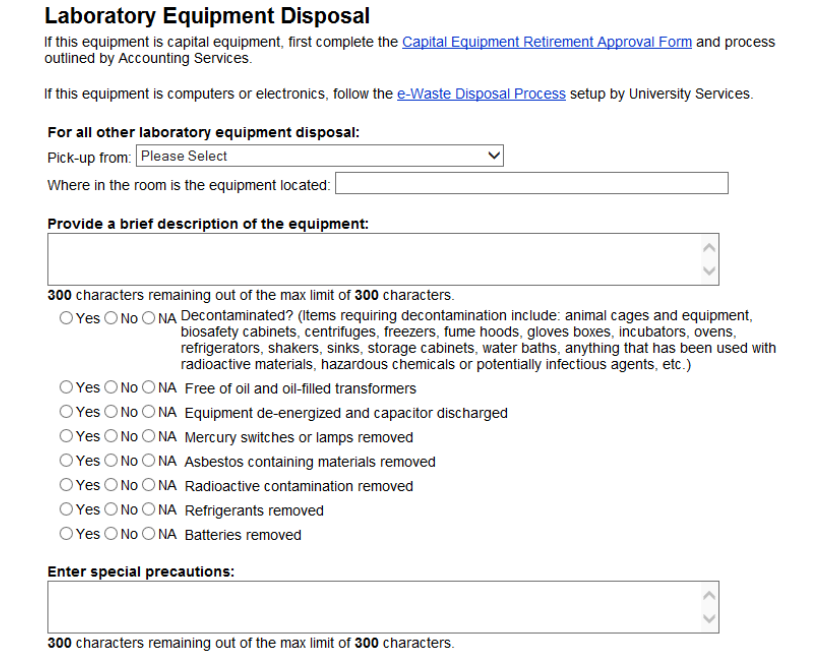


Add a Laboratory Equipment Disposal to your request.

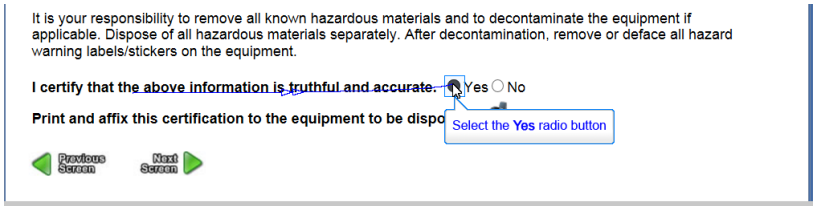
Note that there may be some cleanup/prep-work required before requesting an equipment disposal as

shown on the next screen.

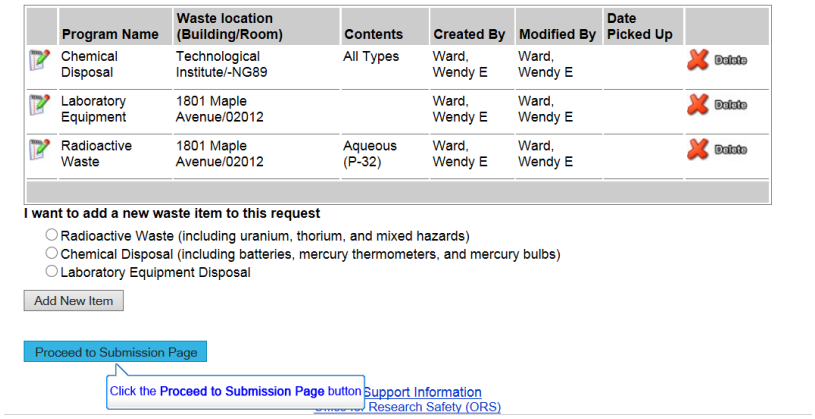
Complete the location information, and provide a description of the equipment (i.e., freezer, oven, incubator, etc.).



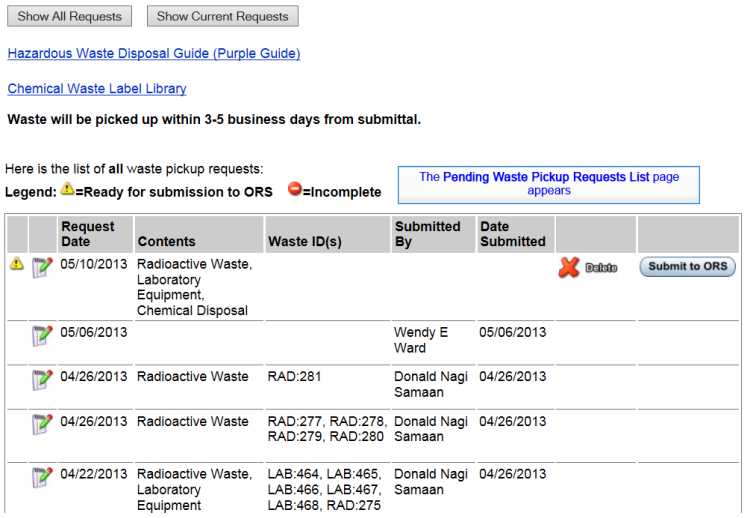
Answer all of questions pertaining to the state of the equipment, and enter any special precautions pertaining to the safe removal of the equipment.



Certify that you have made every effort to make the equipment safe for removal and disposal, and click Next.

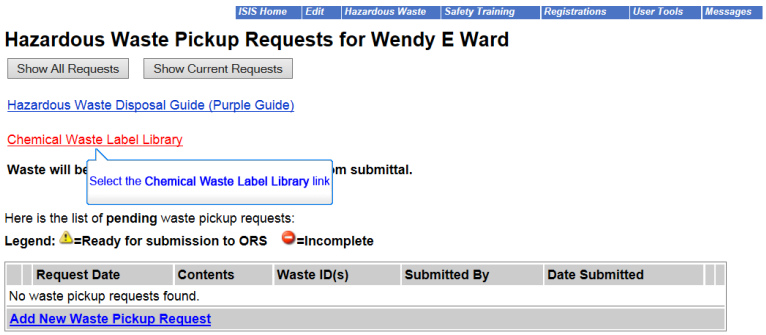


If your waste pickup request is complete, you must now click Proceed to Submission Page.

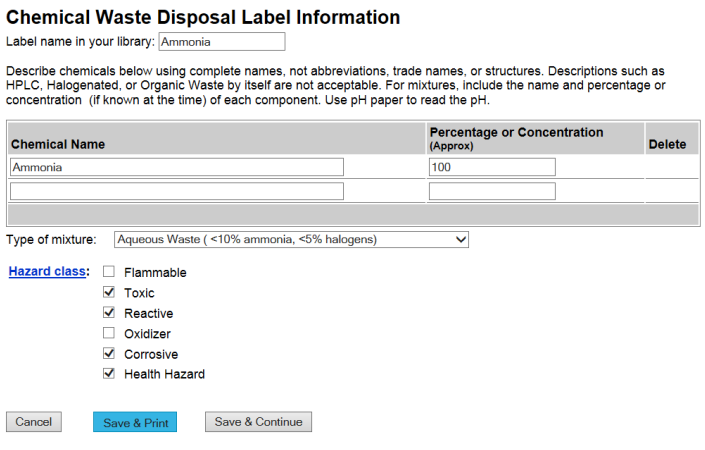


Here you can see all of your pending waste pickup requests. Those that have been submitted will not have the Delete or Submit to ORS buttons available. They are waiting to be picked up. To submit your request, click the Submit to ORS button, and you are finished.

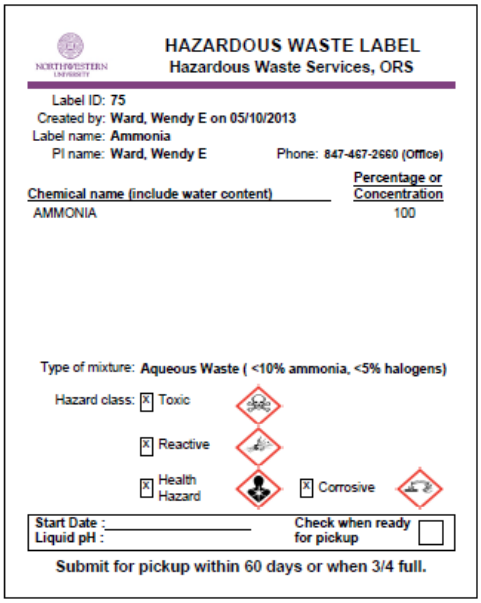
HOW TO CREATE A CHEMICAL WASTE LABEL LIBRARY



From the Hazardous Waste Pickup Requests page, you can create labels and save them for future use. Click the Chemical Waste Label Library link.



Enter a name for your label that will help you identify this specific label for future use. Enter the chemical information and the hazard class. Click Save and Print.



HAZARDOUS WASTE LABEL
Hazardous Waste Services, ORS

Label ID: 75
Created by: Ward, Wendy E on 05/10/2013
Label name: Ammonia
PI name: Ward, Wendy E Phone: 847-467-2660 (Office)

Chemical name (include water content)	Percentage or Concentration
AMMONIA	100

Type of mixture: Aqueous Waste (<10% ammonia, <5% halogens)

Hazard class: [X] Toxic
[X] Reactive
[X] Health Hazard
[X] Corrosive

Start Date :
Liquid pH :
Check when ready for pickup

Submit for pickup within 60 days or when 3/4 full.

Your label will be prepared for printing and saved to your library. Plastic sleeves will be provided by the Office for Research Safety for the paper labels.

To retrieve a label previously saved to your label library, from the Hazardous Waste Pickup Requests page, click the Chemical Waste Label Library link.

ISIS Home | Edit | Hazardous Waste | Safety Training | Registrations | User Tools | Messages

Hazardous Chemical Waste Label Library

Create, save and print hazardous chemical waste labels.

Search for Chemical Waste Label

Search by Label name: AMMONIA
Search by Type of Mixture: Aqueous Waste (<10% ammonia, <5% halogens) Search

Search Results

	Created Date	Created By	Label Name	Type of Mixture		
	05/10/2013	Wendy E Ward	Ammonia	Aqueous Waste		Delete

Add New Hazardous Chemical Waste Label

ISIS Support Information
Office for Research Safety (ORS)
Chicago • 303 E. Chicago Avenue • Ward B106 W223 • Chicago, IL 60611 • Phone: 312-503-8300 • FAX: 312-503-0547
Evanston • 2145 Sheridan Road • Tech NG71 3121 • Evanston, IL 60208 • Phone: 847-491-5581 • FAX: 847-467-2797

From here, you can search for you label by the name you saved it as. Then click the printer icon to print a new label.

STORAGE OF HAZARDOUS CHEMICALS IN TEACHING AND RESEARCH LABORATORIES

In the laboratory, hazardous chemicals can be divided into four general categories - corrosives, flammables, reactives and toxics. In most cases, it is the immediate or obvious hazard that determines which category a particular chemical is classified. See the Laboratory Safety and Chemical Hygiene Plan for further definitions.

Note*: Highly toxic gases and select agents are restricted commodities requiring approval from ORS.*

Below are some general principles to follow when handling and storing chemicals:

GENERAL PRINCIPLES FOR MANAGING LABORATORY CHEMICALS

- **Less is better**. Purchase small amounts that you will use up within a year. Whereas the per-unit cost may be greater—significant savings are realized in reduced disposal costs and safer storage.
- Buy pre-made molar and normal solutions, thereby reducing the likelihood of waste.
- Obtain access to a SDS for each chemical, and consult the SDS before using a chemical.
- Read labels. Handling and storage information is on the manufacturer's label.
- Purchase chemicals in plastic containers to minimize potential breakage. If this is not possible, purchase shatter-resistant plastic coated bottles.
- Manage first-in, first-out! **Indicate the date received and the date opened.** Pay particular attention to expiration dates.
- Dispose of open, partially used or expired chemicals.
- Peroxide-forming compounds require frequent testing or disposal.
- Keep all chemical containers off floors, carts and electrical equipment.
- Physically segregate your chemicals according to compatibility.
- Label the secondary storage containers or areas in which particularly hazardous chemicals may be used. These substances must be kept in a Designated Area.
- Store hazardous chemicals **below** eye level. This simple task greatly reduces the likelihood of something falling from above and breaking.

- Cabinets with doors are safer locations than open shelves for hazardous chemicals.

- Safely transport any hazardous chemical. Place in secondary containment such as a bottle carrier.

- Avoid placing any chemical container in direct sunlight, underneath a sink or near heat sources.

- Place volatile or flammable chemicals only in specially designed refrigerators.

-  DO NOT STORE HAZARDOUS CHEMICALS IN COLD ROOMS.

- Be especially careful with reactive chemicals. Obtain and read the SDS for each reactive chemical that you may have or may work near.

- Label all containers in the laboratory with the following information (this includes any stock or working solutions):

  Name of chemical or stock solution
  Date started
  Your initials
  Hazard warning (i.e., flammable, toxic, corrosive, reactive)

- Store chemical by hazard class. Do not store merely by alphabetical order.

- Use and manage your chemical fume hood, wisely. Too many chemical containers or equipment block the air slots and compromise the containment performance.

- Follow all waste disposal guidelines provided by ORS.

STORAGE OF FLAMMABLE LIQUIDS

- Limit the amount of flammable liquids in use to the smallest practical volume. Work with flammable liquids inside a chemical fume hood. At the end of the day, return all flammable liquids to an approved flammable storage cabinet. The doors to flammable storage cabinets must close securely. Self-closing doors are best. Contact ORS for assistance in ordering flammable storage cabinets.

- The maximum quantity of flammable and combustible liquids that can be stored openly or **within** an approved flammable storage cabinet is defined for each campus. See the *Laboratory Safety and Chemical Hygiene Plan*

- The purchase of 5-gallon containers of flammable liquids is strongly discouraged. All transfers of flammable liquids from containers of five gallons or more must be

performed inside a fume hood. These containers also must be stored in a flammable storage cabinet.

- Segregate flammables from oxidizers and oxidizing acids.

- Most refrigerators/freezers purchased by the labs are designed for non-hazardous materials. Refrigerators and freezers suitable for flammable material storage are specially labeled "Explosion safe" of "Explosion proof."

STORAGE OF GAS CYLINDERS

- In general, only keep cylinders in your lab that are in current use or waiting for immediate use.

- Large toxic gas cylinders must be in an approved gas cylinder cabinet.

- Maximum allowable storage quantities for cylinders is defined in the ORS *Compressed or Liquified Gas Cylinders in Laboratories* policy. A summary table is available online at http://www.research.northwestern.edu/ors/safety/chemical/hazard-groups/gas-cylinders.html

- All cylinders **not** attached to a regulator must have a valve protection cap in place.

- For vertical storage, cylinders must be secured (at a minimum) in their upper third by a tight fitting chain or belt secured to the wall or non-movable casework. This applies to all cylinders.

- One cylinder per chain or web belt.

- Horizontal storage of cylinders is only allowed in racks designed for the purpose. Cylinders must be chained to the rack.

- Cylinders must not be kept in corridors, hallways, stairways or cold rooms (or any other area with limited ventilation). Exceptions must be approved by ORS.

HANDLING CRYOGENIC FLUIDS

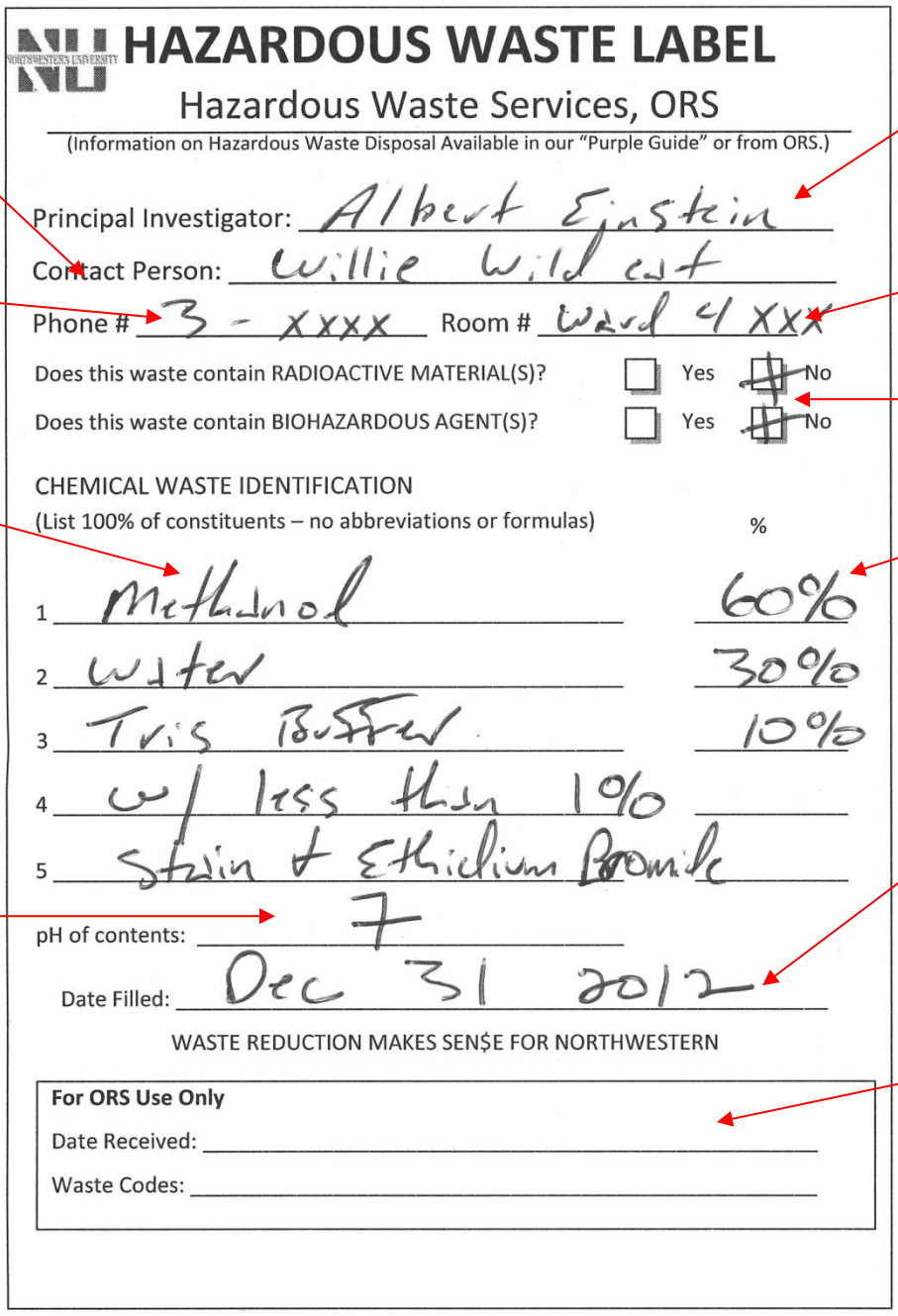
- Cryogenic liquids, such as liquid nitrogen, must be handled only in containers designed for that purpose.

- Full face protection including safety glasses and goggles as well as insulated gloves must be worn when handling cryogenic liquids.

- When transferring liquid from one container to another, the receiving container must be cooled gradually.

APPENDIX A - LABEL FORMATS

Adhere the completed label, securely to the container.



Hazardous waste container labels can also be created in the ISIS Hazardous Waste module.

Example of a labeled SAA below.

APPENDIX B - DISPOSAL PROCEDURES FOR SPECIFIC WASTE STREAMS

Northwestern University laboratories utilize and generate a wide variety of hazardous substances. ***Appendix B*** contains a comprehensive list of some of the more common waste streams generated by the University. Refer to the following list for specific information:

ACIDS AND BASES

1. Collect concentrated acids and bases in original containers whenever possible. This includes nitric, hydrofluoric, sulfuric, glacial acetic, hydrochloric, sodium hydroxide, ammonium hydroxide. Hydrofluoric acid etches glass and must be collected in plastic containers.
2. Dilute acid and base solutions may be disposed of down a lab sink with copious amounts of water **provided they are treated as follows**:
   - Slowly stir acid in a large amount of an ice-water-to dilute to about 5%.
   - Prepare a base solution of one of the following: sodium carbonate (soda ash), calcium hydroxide (slaked lime), or sodium hydroxide. The base concentration should be 5 to 10 % for nitric and perchloric acids. A one-molar solution is about 4% (4 grams per 100 ml).
   - Slowly stir diluted acid into the base solution until the pH is at least 5 but not greater than 10[3].
   - Slowly pour the neutralized solution down the drain with large amounts of water.
3. No solvent or metal contamination is permitted for drain disposal.

   NOTE: *The use of **chromic acid or Chromerge®** is strongly discouraged by ORS. If used, these cleaning solutions must be collected through the third rinse. Contact ORS for recommendations on possible alternatives.*

ACRYLAMIDE

1. Unused/unwanted acrylamide powder or opened liquid must be disposed of through ORS using Container Option A.

2. For the collection of acrylamide gels that contain ethidium bromide, dispose of in a five-gallon plastic pail (See Container Option C.).

   NOTE: *Only small amounts of liquid can be placed in these plastic pails. For large amounts of unpolymerized acrylamide liquid see Container Option B.*

AEROSOL CANS

If completely empty, aerosol cans may be disposed of as non-hazardous waste. If contents or pressure remains, dispose through ORS.

[3] The pH of solutions poured down the drain shall be between 5 and 10 to avoid violating local, state, or federal regulations.

BATTERIES

There are many types of batteries on campus: lead-acid (automotive), mercury, lithium containing, ordinary household and rechargeable. Dispose of **all** battery types through ORS. There is no charge for the disposal of batteries.

CHEMICAL CARCINOGENS AND MUTAGENS

If original containers are to be discarded, use Container Option A. For associated contaminated disposable labware, use Container Option C or Option D. Triple rinse empty containers and collect all rinsate as hazardous waste or present to ORS for cleaning.

CONTAMINATED GLASSWARE

Chemically contaminated glass ware, pipette tips, needles, blades and sharps are collected in a puncture proof container using Option D.

Broken glass ware not contaminated with hazardous chemicals can be put in a card board container, sealed and picked up as trash.

CYANIDES

Cyanides, nitrites and sulfides are among the most toxic and rapidly acting substances found in a chemical lab. Symptoms of toxicity occur if these materials are swallowed, inhaled or absorbed through the skin. Keep stored in locked and secure locations. Always use secondary containers to help prevent breaks or spills. Use Container Option A or B for disposal.

DIOXANE

Dioxane (1,4-Dioxane) is a highly flammable liquid and can form potentially explosive peroxides upon long exposure to air. Containers of dioxane must be dated when opened and tested periodically for the presence of peroxides. Dioxane must be collected using Container Option A or E. If old, undated dioxane is found, do not open and contact ORS immediately.

DRAIN DISPOSAL

The range of substances that can be potentially hazardous is enormous. Almost any substance can be a hazardous waste if it is disposed of in large quantities or in high concentrations. Federal and state hazardous waste laws permit laboratories to dispose of small amounts of some chemicals in quantities that do not pose a hazard to human health or the environment. It is the policy of Northwestern University to prohibit the drain disposal of all potentially hazardous chemicals and take a more conservative approach when confronted with a less defined disposal situation.

Suitable for Drain Disposal (See Appendix C)

NOT Suitable for Drain Disposal

1. Inherently toxic, malodorous or lachrymatory chemicals

2. Solutions containing heavy metals
3. Flammable liquids (flash point < 140◦F) of any type.
4. Organic solvents—methanol, acetone, hexane, chloroform
5. Paint and paint thinner
6. Poisons, carcinogens, teratogens or embryotoxins
7. Toxic dyes and stains
8. Sodium azide
9. Strong acids and bases (either in pH extremes/concentration)
10. Chromic/sulfuric acid cleaning solutions
11. Photographic fixer
12. Motor oil, gasoline, degreasing solutions, antifreeze or other automotive fluid
13. Pesticides

DRUGS AND CONTROLLED SUBSTANCES

See Pharmaceuticals

ETHER

Ether is a highly flammable liquid and can form potentially explosive peroxides over time. Containers of ether must be dated when opened and tested periodically for the presence of peroxides. Ether must be collected using Container Option A and E. Ether cans have expiration dates on the label. Dispose before they expire. If old, undated ether is found, do not open and contact ORS immediately.

ETHIDIUM BROMIDE (ETBR) & PROPIDIUM IODIDE

Ethidium bromide staining and running buffer solutions must be disposed using Container Option B. For the collection of acrylamide gels that contain ethidium bromide, dispose of in a five-gallon plastic pail (See Container Option C.)

Never use bleach to treat EtBr wastes. This actually increases toxicity.

NOTE: *SYBR Safe® is sold as a safer alternative to Ethidium Bromide. It is less toxic and the stain and gels can be disposed as regular waste. SYBR Safe can be used in the same manner as solutions of EtBr. Tests indicate that it is just as, if not more sensitive than EtBr. It can also be read in the same manner with a standard UV or visible light trans-illuminator, or laser based scanner. SYBR Safe is provided ready to use as a concentrate, it can be cast directly in the gel or used as a post stain. It may*

also be used to stain RNA in gels. Recommended storage time is six months at room temperature.

FORMALIN/FORMALDEHYDE/GLUTARALDEHYDE/ PARAFORMALDEHYDE

1. Unwanted or unused formalin or formaldehyde must be disposed through ORS using Container Option A.

2. If you have a large number of specimens preserved in formalin that you wish to dispose of, contact ORS to discuss disposal options.

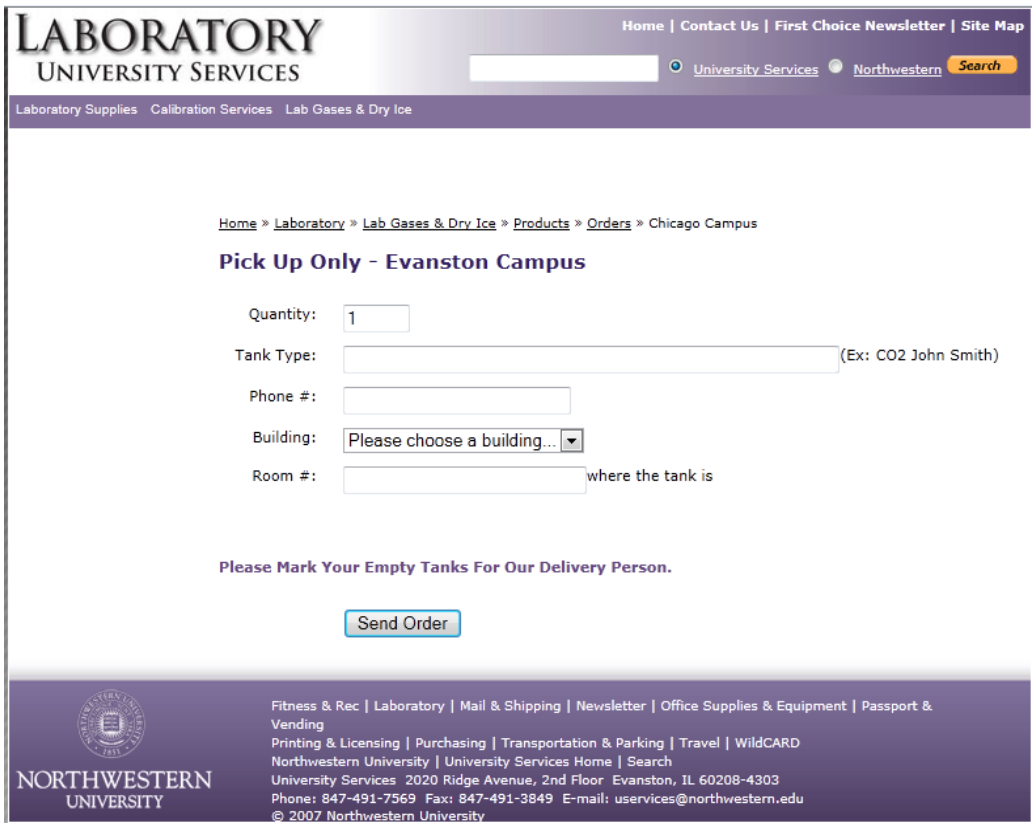
NOTE: *The use of so-called "cold sterilants" such as Cidex® or other higher molecular weight aldehydes such as glutaraldehyde is strongly discouraged for both occupational and environmental reasons.*

FORMAMIDE

Formamide must be collected using Container Option B. If radioactive, attach an ORS Radioactive Waste Label and dispose of as radioactive waste.

GAS CYLINDERS

Compressed gases are among the most problematic wastes to handle and dispose. Avoid buying gas cylinders if at all possible. Buy only what you need, use all you buy and return cylinders to the gas vendors if empty or not routinely used. Lecture bottles can be a serious disposal problem. If at all possible, return these to the manufacturer or supplier for reuse. If not, dispose of through ORS. Label integrity is essential. Ensure that the label on each cylinder is legible. Keep the valve protection cap on the cylinder when not in use. When the cylinder is in use, keep this valve cap near the cylinder so that it does not get misplaced. Attach an ORS Hazardous Waste Label when the cylinder is to be disposed. Return gas cylinders to University Services using the online tool at http://labservicesorders.com/PickUpsEv.asp.



NOTE: *Never dispose of the contents of a compressed gas cylinder by releasing outdoors or in a fume hood.*

GLOVES, PAPERS, CARDBOARD

Gloves, papers, or cardboard that are grossly contaminated or were immersed in hazardous chemicals are disposed of using Container Option C.

Gloves, papers or cardboard that are not contaminated with hazardous chemicals, radioactive materials or potentially infectious agents are disposed of as trash.

LABORATORY EQUIPMENT

See http://www.research.northwestern.edu/ors/forms/index.html or enter a pick-up request through the ISIS Hazardous Waste Disposal.

MERCURY

Mercury and mercury compounds are especially hazardous. If spilled, elemental mercury in cracks of lab benches or floor tiles may pose an exposure hazard for years. Few hazardous waste facilities accept mercury. Therefore, it is essential that the use of mercury be avoided. Substitute mercury thermometers with non-mercury alternatives (available through VWR) or electronic devices to measure temperature and pressure.

All mercury compounds and materials must be disposed through ORS. For mercury spills, contact ORS.

NATURALLY OCCURING RADIOACTIVE MATERIALS (NORM)

NORM refers to all radioactive elements found in the environment where human activities have increased the potential for exposure compared with unaltered situation.

Chemical compounds containing NORM are mostly purchased as staining agents for electron microscopy. Common compounds contain long-lived radionuclides such as uranium and thorium. Typical commercial forms include uranium oxide, uranium fluoride, uranium nitrate, uranium acetate, thorium oxide, thorium fluoride, thorium nitrate and thorium acetate.

In general, all chemical compounds containing NORM must be collected and disposed of as radioactive waste. Uranium nitrate and thorium nitrate are considered radioactive and oxidizers, and are treated as "mixed waste".

Important note on "Mixed Waste": Never mix aqueous uranyl acetate with other staining compounds such as lead citrate or other heavy metals, solvents and other hazardous chemicals.

All liquid and solid radioactive waste must be accumulated in proper containers provided by ORS- Health Physics Services.

NITRIC ACID

Many reported waste container ruptures and explosions in laboratories involve the accidental mixing of nitric acid with reducing agents (e.g., organic compounds). Avoid creating nitric acid waste mixtures with acetone, acetic acid, acetic anhydride, alkali metals, cyanides, aldehydes, powdered metals organic materials, ammonia, acetonitrile, alcohols, acrylonitrile and organic matter. Nitric acid is a powerful oxidant and reacts violently, sometimes explosively with liberation of toxic nitrogen oxides. Oxidation is invariably accompanied by more or less gas evolution, usually capable of rupturing closed vessels.

OILS

Uncontaminated instrument and machine oils such as centrifuge, diffusion pump and vacuum pump oils must be collected in plastic containers and labeled with an ORS Hazardous Waste Label. Oils found in X-Ray machines and other similar devices may contain PCB's (polychlorinated biphenyls), especially if the equipment is old. DO NOT MIX PCB CONTAMINATED OIL WITH OTHER OILS. Contact ORS if you suspect you have PCB oil.

NOTE: *All vacuum pumps must be emptied of oil prior to disposal. If sending them out or to the shop for service, they must be rinsed and purged with clean oil. Collect rinse oil for disposal through ORS.*

ORGANIC MERCURY (ALKYL AND ARYL) COMPOUNDS

Organic mercury compounds pose special hazards in the laboratory. Under *all* circumstances, these compounds must be handled according to the Laboratory Safety and Chemical Hygiene Plan. Alkyl mercury compounds require prior approval from ORS before purchase or use. Contact ORS for assistance in planning, use and disposal before using these compounds.

OSMIUM TETROXIDE

Osmium tetroxide solutions must be disposed of using Container Option A or B. The osmium tetroxide can be converted to a less volatile (safer) form by adding corn oil to the solution and shaking. This method takes advantage of the double bonds of the unsaturated oil to form a cyclic osmic ester. The reaction may be slow because corn oil is not readily miscible in water, but it's easy and it works.

Osmium tetroxide contaminated labware must be disposed of by using Container Option C or D.

PAINT

Paint can be a significant potential source of pollution in landfills. Dispose of **all oil based paints** through ORS. Old, unwanted full cans of **latex paints** must be disposed of through ORS. Opened, nearly empty cans of **latex paint** can be allowed to air dry until solid then be disposed in the trash as non-hazardous waste. This must be waste generated at Northwestern University. *You may not bring personal wastes from home for disposal through Northwestern University.*

PAINT THINNERS, RELATED CHEMICALS, CONTAMINATED RAGS

Chemicals associated with the use of paint thinner, brush cleaners, linseed oil, etc. must be collected for disposal by ORS. Rags and paper towels contaminated with paint thinner or related chemicals are hazardous waste. Contact ORS for more information on collection options and disposal.

PERCHLORIC ACID

Perchloric acid reacts violently with many oxidizable substances. The anhydrous (dehydrated) acid presents a serious explosion hazard. It is unstable and can decompose explosively at ordinary temperatures or in contact with many organic compounds. Amounts in labs must be limited to *1 pound or less*. Any work with

perchloric acid heated above ambient temperature requires ORS approval. Special wash-down hoods may be required. Use Waste Collection Option A or B for disposal.

Many heavy metal perchlorates and organic perchlorate salts are extremely sensitive explosives; the ammonium, alkali metal and alkali earth perchlorates are somewhat less hazardous. Mixtures of perchlorates with many oxidizable substances are explosive. Cold 70% perchloric acid is a strong acid but is not considered to be a strong oxidizing agent; however more concentrated solutions are good oxidizers. Work with >85% perchloric acid requires special precautions and should be carried out only by specially trained personnel and in specially designed fume hoods.

PEROXIDE FORMING COMPOUNDS

Certain chemicals such as isopropyl ether, diethyl ether, dioxane, 2-butanol, tetrahydrofuran can form organic peroxides if they are exposed to air, become more concentrated or age. These compounds may violently explode when combined with certain other compounds (i.e., metals or by heat, shock, friction or static discharge).

Never move or open a container if crusty deposits formed on the material or its container, an oily, viscous layer appeared, or there are solids on the bottom. Immediately contact ORS if rusted, damaged, undated or suspicious looking containers of peroxide forming materials are found.

- Clearly and explicitly label chemicals known to form peroxides.
- Always date the container when received and when opened.
- Limit the on-hand stock to a three (3) month supply or less.
- Air dry empty containers under the hood, flush with water, deface the label and put containers in the glass disposal container.
- Store away from heat and light.
- Protect from ignition sources, physical damage, contact with strong reducing agents or oxidizers, or other contamination.
- Ensure air-tight closures on containers, purge head space with nitrogen when possible.
- Keep a minimal working inventory.
- Never store in a freezer. Use explosion-proof or explosion-safe refrigerators, as needed.
- Never store in glass bottles with glass stoppers.

- Never attempt to clean containers that were used to store peroxide forming compounds by scraping or rubbing, especially if an oily deposit or crusty residue is present.

- Prevention of unwanted peroxides is paramount. Stabilization and disposal can cost up to $3,000 per container.

PESTICIDES

If old pesticides are found, please contact ORS.

PHARMACEUTICALS

Keep Drug Enforcement Administration (DEA) regulated drugs under lock and key security until time of pick up. Any drugs provided by the Center for Comparative Medicine (CCM) must be disposed of through CCM - contact h-fletcher@northwestern.edu . Dispose otherwise acquired drug as hazardous waste via ORS. Enter a pick up request in ISIS or send an email to hazardous-waste@northwestern.edu . Ensure that your ORS pickup request communicates that DEA Controlled Substances are included.

PHENOL/CHLOROFORM

1. Collect liquid mixtures using Container Option E. Indicate percentages on the label.

2. Phenol/Chloroform contaminated labware such as pipette tips and eppendorf tubes with small volumes of liquid must be collected using Container Option D. See also under SMALL VIALS

It is not acceptable to throw this type of waste into general trash containers, autoclave in biohazard bags, or dispose of as biological waste.

PHOTOGRAPHIC SOLUTIONS

All darkrooms must be registered in ISIS with the Office for Research Safety.

Used Fixer (Black & White, Color, Bleach, Microfilm, X-ray): Fixers pick up unexposed silver during photo processing. Due to this, used fixer solutions are classified as a hazardous waste and are prohibited from drain disposal. Used fixer must be collected using Container Option A or B.

Stabilizers and Activators: Some activators and stabilizers pick up unexposed silver during photo processing. Use Container Option A or B.

Indicator Stop Bath or Acetic Acid: If Indicator Stop Bath has changed color, the solution is neutral and can be drain disposed. If Stop Bath does not have an indicator, check the pH. Adjust the pH to between 5-10 before drain disposal. Use Container Option A or B to dispose of used Indicator Stop Bath or acetic acid solutions that do not meet either of these conditions.

Developers - Black & White: In general, these solutions can be drain disposed. Identify the chemical constituents from the product's SDS and call ORS for disposal information.

Developers - Color: Some color developers contain hazardous constituents and others have a pH that prohibits them from being drain disposed. Identify the chemical constituents from the product's SDS and call ORS for disposal information and assistance.

Hypo Clearing Agent: These solutions can be drain disposed.

Mixtures: Certain photo processing operations do not allow for the collection of fixer separate from other photochemicals. These mixtures **cannot** be discharged to the sewer. All silver bearing solutions MUST be collected using Container Option A or B.

NOTE: *All silver recovery systems must be approved and registered with the Office for Research Safety. All automated film processors must be equipped with silver recovery systems and registered with ORS.*

PIRANHA SOLUTION

Piranha solutions are highly reactive and incompatible with HDPE plastic containers. The best waste container choice is a safety coated glass container with a vented cap.

REACTIVES

Chemicals that are considered reactive can react violently with air, water or other substances and also have the potential to explode. These chemicals include picric acid, sodium cyanide and sodium azide.

- Segregate oxidizers from flammable and combustible materials, organic material and reducers;
- Pyrophoric chemicals ignite spontaneously on contact with air. Store breakable glass bottles inside a plastic bottle carrier. Keep these chemicals in a glove box.
- Shock-sensitive and/or explosive materials (benzoyl peroxide) can spontaneously release large amounts of energy when struck, shaken, dropped or agitated. Some chemicals become increasingly shock sensitive with age. Inspect these regularly for degradation and dispose of promptly. Consult the Safety Data Sheet (SDS) before working with reactives**.**
- Never contaminate reactive chemicals with heavy metals or incompatibles.

SMALL VIALS

Small vials filled with compatible chemicals may be collected in wide mouth quart and gallon jars or 5gal buckets with lids. Separate containers are required for the collection of mercury containing liquids, reactive, oxidizing and acutely toxic liquids.

Label the outside of the collection container with all chemical contents. Choose the container size according to expected waste volumes so the container can be filled and picked up in less than 60 days.

SODIUM AZIDE

Sodium azide is commonly used in low concentrations as a microbiocide to preserve samples. If used as a microbiocide, purchase sodium azide in solution. Avoid exposure to the pure material. Avoid weighing the solid by adding solvent to the material and diluting to working concentrations. Take care not to contaminate pure sodium azide with metals or foreign materials as this can lead to the formation of explosive metal azides. Azide solutions can also form explosive metal azides in drain pipes. Collect solutions and pure material for disposal through ORS.

SOLVENTS

All solvents must be collected using Container Option E. Aqueous, halogenated and non-halogenated waste streams should be separated if possible. Halogenated solvents include methylene chloride and chloroform. Non-halogenated solvents include methanol, acetone and xylene. List **all** chemical constituents on the waste label. This includes any metals. The pH also is very important to note on the waste label. No excess solids or debris is allowed. For laboratories using large volumes of certain solvents, it may be possible to distill or purify these solvents for reuse. Please contact ORS for more information on solvent recycling.

STAINING SOLUTIONS

Staining solutions such as Wright's, eosin, iodine and methylene blue stains must be in Container Option A or B. You must list the solvent concentrations on the waste label (i.e., water, glacial acetic acid, methanol).

SCIENTIFIC EQUIPMENT- SURPLUS, REPAIR OR DISPOSAL

Any piece of scientific equipment must be carefully surveyed and decontaminated when it may have been in contact with potentially hazardous biological, chemical or radioactive materials. It is the responsibility of lab personnel to do this. All equipment that may have contained radioactivity must be cleared by the Radiation Safety Officer prior to being surplused, sent out for repair or for disposal. This includes refrigerators, freezers, incubators, centrifuges and counters (beta scintillation and gamma counters). Vacuum pumps must have oil removed prior to disposal and rinsed with clean oil if sent out for repair. Enter a pick up request in ISIS or send an email to hazardous-waste@northwestern.edu.

THINNERS

See Paint Thinner.

UNIVERSAL WASTES

Universal waste is "universally generated." It is defined as a hazardous waste but has low risk relative to other hazardous wastes. Types of universal wastes recognized in Illinois are batteries, fluorescent light bulbs, mercury containing devices, used

automotive antifreeze, certain pesticides and color cathode ray tubes. Due to the large volume, Northwestern University collects and recycles batteries, bulbs and cathode ray tubes.

You may not bring personal wastes from home for disposal through Northwestern University.

UNKNOWNS

Analysis and disposal of material for which the identity is not known can be expensive, from $300 to $1500 or more per unknown. If unknowns are found, consult with other workers who may have an idea as to the identity of the material. Even a general chemical classification (such as "aromatic sulfur compound") can be very helpful. A phone call to a colleague who has left will pay for itself several times over.

To prevent unknowns, remember to label all your containers regardless of size. Labeling of stock solutions is essential. All labels must include the commonly accepted name (**NO CHEMICAL FORMULAS**), special warnings, individual responsible and the date made. When scientists plan to leave the University, contact ORS to help you clean out the laboratory so that unknowns can be identified.

Researchers must make every effort to identify the contents and to avoid the generation of these materials. List unknown materials on the Hazardous Waste Pickup Request in ISIS. It is helpful to include the color and physical state of these materials on the form and any other information that may help in identification.

When unknowns are found in the laboratory, exercise caution as these materials may be old and unstable. If you suspect unknowns are reactive, call ORS prior to moving these materials.

APPENDIX C - SANITARY SEWER OR ORDINARY REFUSE DISPOSAL

Only dilute solutions of non-toxic materials shall be disposed of in the sanitary sewer system. This includes most normal biological metabolites and nontoxic cellular constituents (proteins, nucleic acids, carbohydrates, soluble fats, and their precursors and catabolites, common sugars, amino acids, non-toxic common salts (NaCl, MgCl2, etc) and biological buffers with pH between 5-10. (Phosphate buffers, saline, Tris, etc.).

Note that acid or base solutions containing organic or inorganic impurities (e.g. base baths or acidic solutions used to clean glassware) must not be flushed down the drain even if neutralized. These solutions must be collected for hazardous waste disposal by ORS.

In general, only the following non-hazardous laboratory chemicals may be placed into the ordinary refuse (garbage) for disposal. Non-hazardous materials in aqueous solution may be poured down the drain with the exception of >2% slurries of sand-, earth-, gypsum-, cement or other insoluble material.

Acids, pH>5	Calcium oxide	L-cysteine	Sephadex
Actin	Calcium phosphate	L-glutamic acid	Silica Gel
Agar	Calcium sulfate	L-histidine	Sodium borate
Agarose	Citric acid	L-leucine	Sodium bicarbonate
Alcohol <24%	Collagen	Lactose monohydrate	Sodium carbonate
Alanine	Dextrin	Lysine hydrochloride	Sodium chloride
Albumin, bovine	EDTA (acid free)	Maltose	Sodium citrate
Alumina	EDTA disodium salt	Manganese chloride	Sodium phosphate
Aluminum oxide	Egg albumin	Manganese sulfate monohydrate	Sodium sulfate
Ammonium acetate	Ferric citrate	Mannitol	Sorbitol
Ammonium phosphate dibasic	Ferric oxide	Magnesium borate	Stannic oxide
Ammonium sulfate	Ferrous sulfate hexahydrate	Magnesium carbonate	Stannous oxide
Amylase	Fetal bovine serum	Magnesium chloride	Starch
Amylose	Folic acid	Magnesium oxide	Sugars
Antifoam E Emulsion	Fructose	Magnesium phosphate	Tetraethylammonium chloride monohydrate
Asparagine	Gelatin	Magnesium sulfate	Thiamine hydrochloride
Aspartic acid	Glucose	Niacin	Tin
Bases, pH <10	Glutamic acid	Pectin	Titanium oxide
Boric Acid	Glycerol	Potassium borate	Tris base
Calcium acetate	Glycine	Potassium carbonate	Trypsin
Calcium borate	Glycogen	Potassium chloride	Yeast extract
Calcium carbonate	Inositol	Potassium phosphate	Zinc oxide
Calcium chloride	Iron	Potassium sulfate	
Calcium citrate	Iron oxide	Riboflavin	

Materials that do not appear on these lists **MUST** be collected for disposal by ORS

NOTE THAT LIQUID NITROGEN OR DRY ICE MUST *NEVER* BE PLACED IN THE SINKS, AS THEY CAN CRACK THE SINK AND CAUSE DAMAGE TO THE PLUMBING.