ENVIRONMENT, HEALTH & SAFETY
UNIVERSITY OF MICHIGAN

Proper Segregation and Disposal of Low-Level Radioactive Waste Procedures

Manual

Revision Date: 11/06/17

Applies To: University of Michigan personnel preparing low-level radioactive waste for collection.

Table of Contents

Table of Acceptable Segregation Categories for Low-Level Radioactive Waste

Use a separate container for each category. In some instances, Environment, Health & Safety may require further segregation as necessary for safe handling.

LONG-LIVED ISOTOPES (> 90 DAYS HALF-LIFE)	
Category A	H-3 and/or C-14
Category B	Na-22, Cl-36, Ca-45, Co-57, Co-58, Fe-59, Co-60, Ni-63, Sr-90, Tc-99, Sn-113, and/or Cs-137, etc. (excluding H-3 and C-14)
INTERMEDIATE-LIVED ISOTOPES (> 14 days - Less than or equal to 90 days half-life)	
Category C	S-35, P-33, Sc-46, Cr-51, Sr-85, Rb-86, Ru-103, and/or Ce-141, etc.
Category D	I-125, P-33, Sc-46, Cr-51, Sr-85, Rb-86, Ru-103, and/or Ce-141, etc.
SHORT-LIVED ISOTOPES (< 14 days half-life)	
Category E	P-32, C-11, F-18, Na-24, Br-82, Y-90, Nb-95, Tc-99m, In-111, I-131, and/ or Tl-201, etc.

Preparing Solid Low-Level Radioactive Waste for Collection

Solid low-level radioactive waste (LLRW) **must** be prepared for collection. Solid LLRW cannot be discarded as normal trash.

Solid LLRW includes dry contaminated laboratory materials, equipment, and supplies such as:

- Paper and absorbent pads
- Unbroken glass
- Plastic products

Do not use this procedure if this waste stream is:

- Non-LLRW (e.g., paper towels, boxes, etc), then follow the procedure Disposing of Uncontaminated Waste that Will Not Puncture the Skin.
- Liquid LLRW, then follow the procedure Preparing Liquid Low-Level Radioactive Waste for Collection.
- Liquid scintillation vials (empty or full), then follow the procedure Preparing Liquid Scintillation Vials for Collection.
- Sharps, then follow the procedure Preparing Sharps Low-Level Radioactive Waste for Collection.
- Stock vials, then follow the procedure Preparing Stock Vials for Collection.
- Animal. Carcasses, blood, tissue, organs, urine, feces, and bedding, then follow the procedure Preparing Animal Carcasses and Animal Tissues Contaminated with Radioactive Material for Collection.
- Lead pigs and leaded objects, then follow the procedure Preparing Lead- and Barium-Impregnated Pigs and Objects Impregnated with Lead or Barium for Collection.
- Large contaminated metal objects, then request a special collection

Supplies Available through Hazardous Materials Management

Hazardous Materials Management provides the following supplies. To order these supplies, call (734) 763-4568 or complete the online Waste and Supply Request form.

SUPPLY	DESCRIPTION
 *28 Gallon Large Drum and 7.5 Gallon Small Drum*	• Small (7.5 gallons) yellow fiber drums lined with a bag • Large (28 gallons) yellow fiber drums lined with a bag **NOTE**: Environment, Health & Safety (EHS) reuses the drums, so please refrain from writing or defacing the outside of them.
 	Low-Level Radioactive Waste (LLRW) Manifest
	Vinyl container labels

Using the Waste Container

1. Ensure the HMM supplied bag liner is installed properly in the drum prior to use.
2. Segregate solid LLRWs by isotopes(s).
3. Place solid LLRW into the solid waste drum.
4. Do **not** put any items containing liquids or unused stocks, any pathological waste, or any liquid scintillation vials in the drum.

Procedure: Preparing Solid LLRW for Collection

1. On the manifest, complete SEC A and the authorized user and location information.
2. Conduct a radioactive contamination survey for the following areas of the solid waste drum:
   - Lid
   - Sides
   - Bottom
3. Is there evidence of contamination?
   - If YES, decontaminate (clean) the outside of the drum and return to step 5.
   - If NO, go to the next step.
4. Make of copy of the manifest and radioactive contamination survey results for your records.
5. Staple a copy of the radioactive contamination survey results to the manifest.
6. Complete the container label and place at the Place Container Label Here location.
7. Place the manifest in a location where it is visible for collection and where it will **not** become contaminated.
8. Request a waste collection from HMM using one of the following methods:
   - Call HMM at (734) 763-4568
   - Complete the online Waste and Supply Request form

Preparing Liquid Low-Level Radioactive Waste for Collection

This procedure discusses how to:

- Keep the volume of liquid low-level radioactive waste (LLRW) generated as low as possible
- Manage liquid LLRW during research
- Prepare liquid LLRW for Hazardous Materials Management (HMM) for collection

Minimizing and Segregating Waste

Minimizing and segregating radioactive liquid waste prior to collection enhances safety and compliance, protects the environment, and reduces the costs to the University of Michigan (U-M) from the research and clinical use of radionuclides.

Mixed Waste

Waste containing both low-level radioactive material commingled in any manner (solutions, mixtures, alloys) with non-radioactive Environmental Protection Agency (EPA)-restricted chemicals or materials. Mixed waste is expensive and, in some rare cases, impossible to dispose of legally and safely.

NOTE: Contact EHS before generating possible mixed waste to obtain approvals, advice, and handling instructions.

Generating Mixed Waste

The EPA and the Michigan Department of Environmental Quality restrict the disposal of many chemicals, metals, and other materials based on properties of reactivity, flammability, corrosivity, or toxicity.

Hazardous Materials Management (HMM) or Radiation Safety Service (RSS) can help you determine if the chemicals you are using with radioactive materials are restricted and will result in mixed waste.

Examples of Chemicals Requiring Separate, Segregated Collection Containers

Waste processors **must** use special and additional handling and disposal methods for restricted chemicals resulting in substantially higher costs to U-M. Minimizing and segregating these wastes promotes safe, compliant disposal, and reduces costs. The following table provides examples of chemicals that may require a separate, segregated, collection container from other liquid LLRW.

NOTE: Consult with HMM and RSS when using chemicals listed below, or those with similar chemical properties.

CHEMICAL	EXAMPLES	
Organic solvents	• Ethanol • Methanol • Butanol • Acetonitrile • Toluene	• Acetone • Ether • Ethyl acetate • Isopropanol • Xylene
Halogenated compounds	• methylene chloride	• chloroform

Toxic compounds	• Phenol
	• Compounds of heavy metals such as:
	  ○ Arsenic
	  ○ Barium
	  ○ Cadmium
	  ○ Chromium
	  ○ Lead
	  ○ Mercury
	  ○ Selenium	

Strong acids	• Hydrochloric acid • Phosphoric acid • Trichloroacetic acid	• Any acid that will lower the pH to 2 or less
Strong bases	• Sodium hydroxide • Other hydroxides and amine compounds • Any base that will raise the pH to 12.5 or above	

Minimization and Segregation

To reduce, or minimize, the amount of liquid LLRW generated:

- Do **not** commingle non-LLRW with LLRW in the same waste container as a means of waste disposal.
- Use experimental protocols that isolate restricted chemicals from radioactive materials unless necessary and approved by EHS.
- If approved to use restricted chemicals with radioactive materials, you **must** minimize the volume of waste generated. Use only the amount of agents needed to perform the experiment and follow any special instructions from EHS.
- Do not combine mixed waste with non-mixed waste. "After-use mixing" of mixed and non-mixed waste renders the entire contents into a mixed waste and may make disposal of the contents extremely expensive.
- Never combine chemically incompatible waste. There is a risk of violent or toxic reaction. Refer to the Chemical Hygiene Plan, section 5.3 (for storage information go to pages 46-48; for chemical compatibility charts go to pages 48-50). You may also contact EHS if you are not sure about chemical compatibility.

Biological, Toxic, or Carcinogenic LLRW

Ensure biological (blood & urine), toxic or carcinogenic liquid LLRW are made innocuous (i.e. bleach, Lysol detergent, other methods), non-toxic, or otherwise neutralized prior to HMM collection.

NOTE: Special handling instructions or precautions should be given to HMM personnel when requesting waste collections containing biological, toxic, or carcinogenic material.

Volatility Controls: Radioiodines, Sulfur-35 Amino Acids, and Other Volatiles

- Unbound radioiodines (e.g. inorganic forms such as NaI of I-125 or I-131 or metabolized radioiodines in biological waste) are volatile. Acidity or oxidation enhances the volatile nature of these radiocompounds.
  NOTE: Do not add acids or strong oxidizers (e.g. bleach) to waste containing unbound radioiodines.
  TIP: A weak solution (0.1 M) of sodium thiosulfate (Na2S2O3) dissolved in sodium hydroxide can reduce volatility of radioiodines in waste.
- S-35 labeled amino acids (methionine and cysteine) have a propensity to radiolyse and release volatile products. Increased activity in the solution enhances this effect. Millicurie amounts collected in waste containers can accumulate volatile forms of S-35.
- A radiocompound has the same chemical properties as its equivalent unlabeled form including volatility. Contact -RSS for approval and instructions before acquiring and using any volatile radiolabeled compound.

Volatility Controls for Liquid LLRW Containers:

- Add about 500 ml of a 0.1 M sodium thiosulfate solution to 4-liter waste jugs before adding radioiodine waste to the jug.
- Always make sure waste containers holding volatile radiocompounds are capped when in storage.
- Only uncap waste containers and fill them in an operating EHS-certified exhaust hood (> 100 lfpm)

Collecting Labware Rinses and Washes

1. When washing reusable contaminated lab equipment, pour wash and rinse water from the first and second rinse into a liquid waste jug.
2. After the third wash and rinse take a 1 ml sample of the rinse water's count rate and compare to a 1 ml background sample of tap water. Is the count rate < 3 times of background?
   - If YES, discard the rinse water down the sanitary drain.
   - If NO, rinse, sample, and discard the rinse water into a waste jug until the count rate for the rinse water is < 3.

What NOT to Place in Waste Jugs

The addition of dissimilar material into a waste container complicates the efficient handling of the waste, may increase handling costs and may compromise the safety of all waste handlers. You **must** keep foreign matter and undissolved solids out of waste containers.

- Do **not** add:
  - Pipette tips
  - Needles
  - Filter paper
  - Precipitates or other undissolved solids
  - Biological material
- Collect liquid waste in liquid waste containers and collect solid waste material in its appropriate container

NOTE: Contact HMM for special handling or processing of acidic or caustic liquids.

Supplies Available through Hazardous Materials Management

Hazardous Materials Management provides the following supplies. To order these supplies, call (734) 763-4568 or complete the online Waste and Supply Request form.

SUPPLY	DESCRIPTION
 *20 Liter Jug and 4 Liter Jug*	• 20 liter plastic jugs • 4 liter plastic jugs **NOTE**: Obtain approval from HMM before using glass or other containers for waste.
 	Low-Level Radioactive Waste (LLRW) Manifest
	Vinyl container labels

Preparing Jugs for Collection

When preparing liquid waste jugs for collection, ensure:

- The liquid waste container is not filled above the inscribed line
  NOTE: If the container does not have a line, or if the line is faded, do not fill the container beyond the area of the jug where it begins to taper to the jug's mouth. An overfilled jug is more likely to lead to spillage and the spread of contamination.
- The waste jug is **not** leaking
- A radioactive contamination survey has been conducted to demonstrate the jug is free of external contamination
- The cap is securely tightened to prevent spillage from the container during collection and transportation.

Using the Waste Container

1. Use a funnel to decant liquid LLRW into jugs to prevent external contamination.
2. Segregate LLRW by isotope(s). Refer to Table of Acceptable Segregation Categories for Low-Level Radioactive Waste.

Procedure: Preparing liquid LLRW for Collection

1. Analyze 1 ml samples from the liquid LLRW jug in a liquid scintillation counter to ensure accurate reporting of radioisotope activity content.
2. Assign a number to each jug. Use 1-8 as preprinted on each manifest.
3. On the manifest, complete **SEC B** and the authorized user and location information.
4. Conduct a radioactive contamination survey for the following areas of the jugs:
   - Cap
   - Handle
   - Sides
   - Bottom
5. Is there evidence of contamination?
   - If YES, decontaminate (clean) the outside of the jug and return to step 4.
   - If NO, go to the next step.
6. Make of copy of the manifest and radioactive contamination survey results for your records.
7. Staple a copy of the radioactive contamination survey results to the manifest.
8. Complete the container label and insert it through the handle and affix the two adhesive ends together.
9. Place manifest in a location where it is visible for collection and where it will **not** become contaminated.
10. Request a waste collection from HMM using one of the following methods:
    - Call HMM at (734) 763-4568
    - Complete the online Waste and Supply Request form

Denying Waste Collection

EHS may choose **not** to collect waste jugs or may return jugs to the laboratory of origin for reprocessing if any of the following unacceptable conditions are noted:

- External contamination detected on jugs.
- Isotopes(s), activity, or chemical content in the waste jugs are inconsistent with those identified by the waste generator.
- Bi-phasic mixture of liquids in waste jug.
- Cap on jug is **not** an EHS– approved cap.
- Solid material discovered in jug (e.g. pipette tips, filter paper, needles, biological material, etc.).
- Jugs filled beyond scribed line.
- Jugs bloated (positive pressure) or crumpled (negative pressure).
- Writing or defacing noted on jug surface.

Preparing Sharps Low-Level Radioactive Waste for Collection

Sharps are those objects which represent a puncture or laceration hazard.

The following supplies are examples of this Waste Steam

- Needles
- Scalpels
- Intravenous tubing with needle attached
- Razor blades
- Capillary tubes and pipettes
- Xacto knife blades
- Sharp metal objects
- Broken glass objects

Supplies Available through Hazardous Materials Management

Hazardous Materials Management (HMM) provides sharps containers. To order sharps containers, call (734) 763-4568 or complete the online Waste and Supply Request form.

SUPPLY	DESCRIPTION
 *1 Gallon and 5 Gallon Sharps Containers*	• 1 gallon sharps pail • 5 gallon sharps pail

Denying Waste Collection

Sharps are **not** to be placed into the EHS yellow LLRW fiber drums for disposal. Sharp objects discovered in the yellow fiber drums will result in the fiber drum being returned to laboratory of origin for proper segregation and repackaging.

Using the Waste Container

1. Segregate sharps LLRW by isotope(s).
2. Securely close (i.e. snapped in place) the container to prevent radioactive material from leaking from conditions normally incident to transportation.

Procedure: Preparing Sharps LLRW for Collection

1. Assign a number to each pail or box. Use 1-8 as preprinted on each manifest.
2. On the manifest, complete **Sec D** and the authorized user and location information.
3. Conduct a radioactive contamination survey for the following places on the sharps pails or commercially-available approved containers:
   - Pail: Lid, handle, sides, and bottom
   - Commercially-available approved containers: All four sides, top, and bottom

4. Is there evidence of contamination?
    - If YES, decontaminate (clean) the outside of the pail or commercially-available approved container and return to step 5.
    - If NO, go to the next step.
5. Make of copy of the manifest and radioactive contamination survey results for your records.
6. Staple a copy of the radioactive contamination survey results to the manifest.
7. Place container label around handle of pail and affix the two adhesive ends together or on top of the commercially-available approved container.
8. Place the manifest in a location where it is visible for collection and where it will **not** become contaminated.
9. Request a waste collection from HMM using one of the following methods:
    - Call HMM at (734) 763-4568
    - Complete the online Waste and Supply Request form

Preparing Lead- and Barium-Impregnated Pigs & Objects Impregnated with Lead or Barium for Collection

Environment, Health & Safety collects lead pigs, bricks, sheets, and objects impregnated with lead or barium for disposal.

Packaging

Lead- and barium-impregnated pigs **must** be in a sturdy box, taped securely shut, and marked "LEAD PIGS" or "BARIUM PIGS."

Objects impregnated with lead or barium **must** also be in a sturdy box and taped securely shut.

Procedure: Preparing Lead- and Barium- Impregnated Pigs for Collection

1. Conduct a radioactive contamination survey for all sides or surfaces of the lead- or barium-impregnated pigs.
2. Is there evidence of contamination?
   - If YES, decontaminate (clean) the lead object and return to step 1.
   - If NO, go to the next step.
3. Place lead- or barium-impregnated pigs in sturdy box.
4. Seal box securely with lab, duct, or masking tape—not radioactive material tape.
5. On the manifest, complete **SEC D**--Pigs and the authorized user and location information.
6. Make of copy of the manifest and radioactive contamination survey results for your records.
7. Staple a copy of the radioactive contamination survey results to the manifest.
8. Place the manifest in a location where it is visible for collection and where it will NOT become contaminated.
9. Place the lead- or barium-impregnated pigs with the other radioactive material waste awaiting to be collected.
10. Request a waste collection from HMM using one of the following methods:
    - Call HMM at (734) 763-4568
    - Complete the online Waste and Supply Request form

Procedure: Preparing Objects Impregnated with Lead or Barium for Collection

1. Conduct a radioactive contamination survey for all sides or surfaces of the lead- or barium- objects.
2. Is there evidence of contamination?
   - If YES, decontaminate (clean) the lead or barium object and return to step 1.
   - If NO, go to the next step.
3. Place lead- or barium-impregnated objects in sturdy box.
4. Seal box securely with lab, duct, or masking tape—not radioactive material tape.
5. Place radioactive contamination survey results in a location where they are visible for collection and where they will **not** become contaminated.
   NOTE: Lead- and barium-impregnated objects do not need a manifest.
6. Place the lead or barium impregnated objects with the other LLRW waiting to be collected. For oversized items that cannot be boxed, contact HMM for packaging instructions.
7. Request a waste collection from HMM using one of the following methods:
   - Call HMM at (734) 763-4568
   - Complete the online Waste and Supply Request form

Preparing Animal Carcass & Animal Tissue Contaminated with Radioactive Material for Collection

Use this procedure to prepare animal carcasses and animal tissues contaminated with radioactive material for collection.

Examples of this Waste Stream include the following substances:

- Animal carcasses
- Blood
- Organs
- Tissues
- Body parts other than teeth
- Products of conception
- Urine/feces
- Bedding

Freezer

Animal carcasses and animal tissue waste **must** be completely frozen prior to collection. Place bags holding carcasses in a freezer designated for animals containing radioactive material.

Authorized users **must** notify Radiation Safety Services (RSS) in writing when planning to store radioactive pathological material in an animal freezer under the authorization of another individual or department.

NOTE: Contact RSS if a radioactive storage freezer is filled to capacity, breaks down, or otherwise becomes ineffective in completely freezing animal carcasses, blood, etc.

Biological Radioactive Waste Containing Other Hazards

Radioactive blood, tissue, urine, etc. **must** be made innocuous or rendered non-toxic prior to Environment, Health & Safety (EHS) collection (e.g. bleach, detergent, and other methods).

WARNING: Radioiodines or other volatile radionuclides may become airborne when bleach is added.

NOTE: Authorized users **must** have EHS approval to generate biohazardous, chemically toxic, or carcinogenic materials in animal tissue. Special handling instructions or precautions **must** be given to EHS when requesting waste collections containing pathological, toxic, or carcinogenic material.

Reducing Volatile Nature of Radioiodines

Acidic solutions or strong oxidizers (e.g. bleach) enhances the volatile nature of radioiodines (e.g. I-125, I-131).

To reduce the volatility of the radioiodines in fluids such as urine or blood place approximately 500 ml of sodium thiosulfate ($Na_2S_2O_3$) in waste jugs containing I -125 or I-131. The sodium thiosulfate binds free or volatile radioiodine and reduces volatility.

NOTE: Do **not** mix bleach with radioiodines. Bleach enhances volatile nature of radioiodines). Use other EPA-approved disinfectants (e.g. Lysol) to control odors and eliminate pathogens.

I-125 and I-131

Do **not** discard ≥ 5.0 of I-125, I-131, or both in a single bag or container of biological waste unless approved by EHS-RSS in advance.

Animal Cages

Plastic animal cages are **not** considered pathological waste. Follow the procedure Preparing Animal Waste and Bedding Contaminated with Radioactive Material for Collection, then decontaminate the cages.

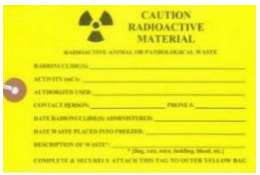
For more information about decontaminating cages, refer to Responsibilities to Decontaminate Animal Cages and Pens Used with Radioactive Materials.

Supplies Available through RSS

RSS provides the following supplies to collect radioactive animal carcasses, tissues and bedding. To order these supplies, call (734) 763-4568 or complete the online Waste and Supply Request form.

NOTE: Do not place radioactive animal carcasses and tissues into:

- Yellow fiber drums used for solid LLRW
- Glass containers

SUPPLY	DESCRIPTION
	Yellow opaque plastic bags (4 mil)
 	"CAUTION RADIOACTIVE MATERIAL" tag

Procedure: Preparing Animal Carcass and Animal Tissue Contaminated with Radioactive Material for Collection

To prepare animal carcasses and animal tissues contaminated with radioactive material for collection:

1. Remove all sharps (e.g. needles, razors, scalpels, etc) and metallic objects from carcasses.
2. Double-bag carcasses and tissues in 4 mil plastic bags.
3. Place carcass tissues in the leak-proof yellow plastic bag.
4. Seal the bag tightly with "Caution Radioactive Material" labeling tape.
5. Complete and attach the "CAUTION RADIOACTIVE MATERIAL: RADIOACTIVE ANIMAL OR PATHOLOGICAL WASTE" tag on the bag with the following information:
   - RADIONUCLIDE(S)
   - ACTIVITY (mCi)
   - AUTHORIZED USER/INVESTIGATOR'S NAME
   - CONTACT PERSON AND PHONE NUMBER
   - DATE RADIONUCLIDE(S) ADMINISTERED
   - DATE WASTE PLACED INTO FREEZER
   - DESCRIPTION OF WASTE (SUCH AS DOGS, RATS, MICE, BEDDING, BLOOD)
   - COMMENTS
6. Place the bag in a freezer designated for animals containing radioactive material.
7. Call RSS at (734) 764-6200 for collection.

Accepted Liquid Scintillation Fluids (Cocktails)

U-M approves which liquid scintillation cocktails can be used for research. Refer to the following table for a list of these liquid scintillation cocktails.

When ordering liquid scintillation cocktails verify the name of the liquid scintillation cocktail being ordered. Some manufacturers make a family of liquid scintillation cocktails with similar names, but with different properties; therefore, making one an approved liquid scintillation cocktail, but its cousin an unapproved liquid scintillation cocktail.

To use a liquid scintillation cocktail not in the table, contact RSS at (734)764-6200 or Hazardous Materials Management at (734) 763-4568. They will (may) grant temporary authorization to use a non-approved liquid scintillation cocktail. In addition, RSS and HMM may give special handling and processing instructions for the liquid scintillation cocktail.

COCKTAIL NAME	MANUFACTURER	COCKTAIL NAME	MANUFACTURER
Ready safe	Beckman	**Ecoscint H**	National Diagnostics
Scintisafe 30%	Fisher Scientific	**Ecoscint O**	National Diagnostics
Scintisafe Plus 50%	Fisher Scientific	**Beta Plate Scint**	Perkin Elmer (Wallac)
Scintisafe Econo F	Fisher Scientific	**Formula 989**	Perkin Elmer (Packard)
Scintisafe Econo 1	Fisher Scientific	**MicroScint O**	Perkin Elmer (Packard)
Scintisafe Econo 2	Fisher Scientific	**MicroScint 20**	Perkin Elmer (Packard)
Scintisafe Gel	Fisher Scientific	**Opti-fluor**	Perkin Elmer (Packard)
Scintiverse BD	Fisher Scientific	**Opti-fluor O**	Perkin Elmer (Packard)
BSC	GE Healthcare (Amersham)	**OptiPhase HiSafe 2**	Perkin Elmer (Packard)
In-Flow 2:1	IN/US Systems, Inc.	**OptiPhase Super Mix**	Perkin Elmer (Packard)
ProSafe FC+	Meridian Biotechnologies	**Ultima Gold**	Perkin Elmer (Packard)
ProSafe +	Meridian Biotechnologies	**Ultima AB**	Perkin Elmer (Packard)
ProSafe HC+	Meridian Biotechnologies	**Ultima Gold F**	Perkin Elmer (Packard)
ProSafe TS+	Meridian Biotechnologies	**Ultima Gold MV**	Perkin Elmer (Packard)
ProFlow G+	Meridian Biotechnologies	**Ultima Gold XR**	Perkin Elmer (Packard)
ProFlow P+	Meridian Biotechnologies	**Ultima Flo AF**	Perkin Elmer (Packard)
BetaMax ES	MP Biomedicals (ICN)	**Ultima Flo AP**	Perkin Elmer (Packard)
CytoScint ES	MP Biomedicals (ICN)	**Ultima Flo M**	Perkin Elmer (Packard)
Ecolite (+)	MP Biomedicals (ICN)	**Bio-Safe II**	Research Products Intl.
EcoLume	MP Biomedicals (ICN)	**Bio-Safe NA**	Research Products Intl.
UniverSol ES	MP Biomedicals (ICN)	**Econo-Safe**	Research Products Intl.

Preparing Liquid Scintillation Vials for Collection

Hazardous Material Management (HMM) will collect empty, filled, or partially-filled liquid scintillation vials containing EHS-approved non-hazardous or biodegradable scintillation fluid provided the vials are sorted, packaged, and prepared according to the methods described below.

Using Non-Approved Liquid Scintillation Fluids

To obtain approval to use a scintillation cocktail that is not on the approved list contact Radiation Safety Services (734) 764-6200 or HMM (734) 763-4568.

Temporary authorization may be granted to use a non-approved scintillation cocktail if there is a valid research need to use a specific product or type of LS fluid. Non-approved scintillation cocktails may require additional handling and packaging requirements such as decanting into specialty containers.

NOTE: Toluene and xylene-based scintillation fluids are prohibited from use at U-M unless authorization has been received from EHS. Contact HMM for specific collection instructions.

Segregating Liquid Scintillation Vials

To segregate liquid scintillation vials:

- Segregate vials by isotope content. Refer to the Table of Acceptable Segregation Categories for Low-Level Radioactive Waste
- Segregate glass and plastic vials of the same isotope content
- Use a separate tray and box for each isotope content and the type of container they are in

Improper Liquid Scintillation Vials Disposal

The following disposal methods are prohibited:

- Disposing of commercially prepared liquid scintillation standards with other scintillation vial wastes. **NOTE**: Contact EHS to request a special collection.
- Discarding scintillation fluid or isotopes down sanitary drains
- Discarding scintillation vials in with the solid waste

Boxes for Liquid Scintillation Vials

The boxes used to package liquid scintillation vials for disposal **must** be undamaged, sturdy, and properly sealed to prevent breakage or leakage of contents. Users will be asked to repackage boxes of scintillation vials saturated with or leaking scintillation fluid.

What NOT to Place in Boxes

The following items **must** NOT be placed in boxes containing the liquid scintillation vials:

- Other forms of LLRW (eg. gloves, syringes, paper, pads, etc.)
- Radiochemical stock vials

Procedure: Preparing Liquid Scintillation Vials for Collection

1. Segregate liquid scintillation vials by isotope(s).
2. Segregate vials of the same isotope by type of vial, glass or plastic.
3. Ensure scintillation vial caps are fastened securely and not leaking prior to packaging in trays and boxes.
   NOTE: Do NOT tape the tops of scintillation vials.
4. Did the vials come in a flat tray?
   - If YES, place the vials in a flat (tray).
   - If NO, place the vials in a plastic bag.
5. Place absorbent material in the bottom of the appropriate box:
   - If the vials are in a flat tray, place the absorbent pad in the original vial box
   - If the vials are in a plastic bag, box, place the absorbent pad in a sturdy box
6. Pack vial flats or plastic bag containing scintillation vials the appropriate box.
7. Seal box securely with lab, duct, or masking tape—not radioactive material tape.
8. Write on the top of the box whether the liquid scintillation vials are made of Plastic or Glass.
9. Assign a number to each box. Use 1-8 preprinted on each manifest.
10. On the manifest, complete SEC C and the authorized user and location information.
11. Conduct a radioactive contamination survey for the following areas for each box:
    - All four sides
    - Top
    - Bottom
12. Is there evidence of contamination?
    - If YES, decontaminate (clean) the outside of the box and return to step 11.
    - If NO, go to the next step.
13. Make of copy of the manifest and radioactive contamination survey results for your records.
14. Staple a copy of the radioactive contamination survey results to the manifest.
15. Complete the container label and affix it to the top of the box.
16. Place the manifest in a location where it is visible for collection and where it will NOT be contaminated.
17. Request a waste collection from HMM using one of the following methods:
    - Call HMM at (734) 763-4568
    - Complete the online Waste and Supply Request form

Preparing Stock Vials for Collection

This procedure explains how to package stock vials containing standing liquids or visible solid residues as waste and prepare it for collection. Empty stock vials with no visible residue can be disposed of in fiber drums as a solid waste.

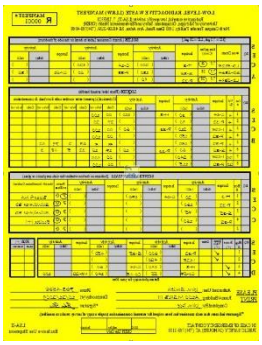
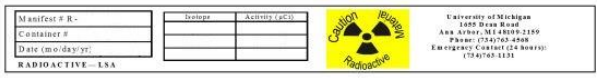
Containers

Place stock vial waste in a closeable container and that is sufficiently strong enough to hold the stock vial waste, such as a strong, durable carton or a pail with lid. Hazardous Materials Management (HMM) can supply plastic pails at no charge upon request.

Line the container with a plastic bag or place an absorbent plastic-backed pad (e.g. blue pads or Benchkote®) on the bottom of the container to contain or absorb any liquid that may leak.

Supplies Available through HMM

HMM provides the following supplies to collect stock vial waste. To order these supplies, call (734) 763-4568 or complete the online Waste and Supply Request form.

SUPPLY	DESCRIPTION
• 1 gallon pail • 5 gallon pail	----
 	Low-Level Radioactive Waste (LLRW) Manifest
	Vinyl container labels

Using the Waste Container

1. Segregate stock vials by isotope(s).
2. Line the container with plastic bag or place lined absorbent pads (blue pads or Benchkote®) on the bottom of the container.
3. Place stock vials in the container.

Procedure: Preparing Stock Vials for Collection

1. If using a box, seal it securely with lab, duct, or masking tape—not radioactive material tape.
2. Assign a number to each container. Use 1-4 as preprinted on each manifest.
3. On the manifest, complete SEC D and the authorized user and location information.

4. Conduct a radioactive contamination survey. Swipe the following areas for a:
    - Box: All four sides, top, and bottom
    - Pail: Lid, handle, sides, and bottom
5. Is there evidence of contamination?
    - If YES, decontaminate (clean) the outside of the container and return to step 4.
    - If NO, go to the next step.
6. Make of copy of the manifest and radioactive contamination survey results for your records.
7. Staple a copy of the radioactive contamination survey results to the manifest.
8. Complete the container label and affix it to the appropriate location:
    - Box: Affix on the top of the box
    - Pail: Place around the handle and affix the two adhesive ends together
9. Place manifest in a location where it is visible for collection and where it will NOT become contaminated.
10. Request a waste collection from HMM using one of the following methods:
    - Call HMM at (734) 763-4568
    - Complete the online Waste and Supply Request form

Completing the Low-Level Radioactive Waste Manifest

The Low-Level Radioactive Waste Manifest (manifest) provides a profile and a record of the types and quantities of low-level radioactive waste (LLRW) prepared for collection (solid, liquid, scintillation vials, sharps, and stock vials)

Procedure: Completing SEC A—SOLIDS

1. Record the assigned solid waste drum **Number** on each solid waste drum.
   NOTE: Solid waste drums have an assigned number, which is located on the side of the drum. Large drum numbers begin with "LD," small drum numbers begin with "SD."
2. Circle the applicable solid waste drum size:
   - Small solid waste drums= 7.5 or SD
   - Large solid waste drums = 28 or LD
3. Record the **Isotope(s)** and **Activity(s) (µCi)** of each isotope in the solid waste drum.
   The following illustration shows how the manifest looks when SEC A is completed:

[SD = 7.5 gal., LD = 28 gal.] SOLIDS (Attach Container Label to decal on the side of the drum)

SEC A	RQ	# on Drum	Size gallon (Circle)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)
		LD-5125	7.5 (28)	H-3		(200)	C-14		(120)			( )
		SD-5364	(7.5) 28	S-35		(130)	P-33		(50)	Cr-51		(35)
		LD-5894	7.5 (28)	P-32		(90)			( )			( )

4. Complete the next applicable section.

Procedure: Completing SEC B—LIQUIDS

1. In the **Vol (L)** box, indicate, using whole numbers, the volume of liquid in each individual liquid waste jug.
2. Record the **Isotope(s)** and corresponding **Activity(s) (µCi)** of the liquid waste within each liquid waste jug.
3. Refer to the back of the manifest and use the following table to describe the chemical constituents of the liquid contained within each liquid LLRW jug.

IF THE LIQUID LLRW…	THEN…
Contains a chemical listed on the back of the manifest	a. In the **Code** box, write the corresponding code. b. In the **% by vol** box, write the percentage of the corresponding chemical, then go to the next step.
Contains a chemical that is NOT listed on the back of the manifest	a. In the **Code** box, write **99**. b. In the **% by vol** box, write the percentage of that chemical contained in the liquid waste jug. c. On the back of the manifest, in **SEC E**, write the name of each chemical in the liquid waste jug NOT listed on the back of the manifest.
Does not contain ANY added chemicals	a. In the **Code** box, write **00**. b. In the **% by vol** box, write the percentage of water in the waste.

NOTE: Each container of liquid **must** be described by a code to ensure the liquid is profiled accurately and completely.
The following illustration shows how the manifest looks when SEC B is completed:

LIQUIDS (Place label around handle)

SEC B	RQ	Jug #	Vol (L)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	If chemical(s) present enter number code from back & concentration: Code	% by vol	Code	% by vol	Code	% by vol	Code	% by vol
		1	4	C-14		(30)	H-3		(110)	00	100						
		2	4	P-32		(90)			( )	27	20						
		3	4	I-125		(210)	P-33		(60)	00	100						
		4	4	P-32		(150)			( )	00	100						
		5	4	P-32		(150)			( )	51	5	68	2	79	10		
		6	4	S-35		(60)	P-33		(15)	17	15	32	5	48	3		
		7	20	I-125		(240)			( )	00	100						
		8	20	P-32		(115)			( )	00	100						

4. Complete the next applicable section.

Procedure: Completing Section C—Scintillation Vials

1. Record the **Isotope(s)** and corresponding **Activity(s) (µCi)** for each box scintillation vials
2. Circle the correct type of vials in the scintillation vials box:
   - If the vials are plastic, circle **P**.
   - If the vials are glass; circle **G**.
   - If a multi-well tray, write and circle a "**T**" between the "**P**" and "**G**."
3. In the **Identify Scintillation Cocktail** box, write the name of liquid scintillation cocktail that is in the vials.
   NOTE: Write Empty if no cocktail is used OR the vial once contained a cocktail, but the contents were decanted into another container.
   The following illustration shows how the manifest looks when SEC C is completed:

SCINTILLATION VIALS (Indicate on the box whether the vials are plastic or glass)

SEC	RQ	Box #	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Plastic or Glass	Identify Scintillation Cocktail
		1	H-3		(20)	C-14		(170)			( )	(P) G	Biosafe NA
		2	P-32		(160)			( )			( )	P (G)	Scintiverse BD
		3	S-35		(75)			( )			( )	P (G)	Scintiverse BD
		4	P-32		(160)			( )			( )	P (G)	Ecolite (+)
		5			( )			( )			( )	P G	

4. Complete the next applicable section.

Procedure: Completing Section D—Sharps, Stock Vials, Lead Pigs, Other Forms

1. Is the LLRW in the form of sharps or stock vials?
   - If YES, write a **checkmark** in the appropriate box, record the **Isotope(s)** and corresponding **Activity(s)** for each container.
   - If NO, go to the next step.
2. Is the waste in some other form?
   - IF YES, consult with Radiation Safety Services at 764-6200 or Hazardous Materials Management for more information about how to prepare the LLRW for collection.
   - If NO, go to the next step.
3. Does the waste consist of lead or barium "pigs" (small shields for vials)?
   - IF YES, and the pigs contain lead or barium, place a **checkmark** in the appropriate box, then go to the next step.
   - If NO, go to the next step.
   The following illustration shows how the manifest looks when SEC D is completed:

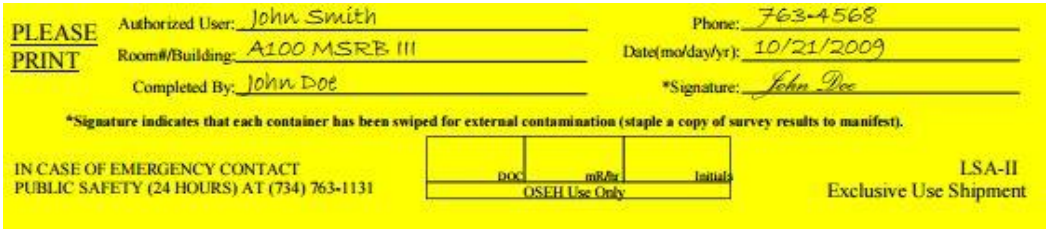
SEC	RQ	Pkg. #	Sharps (✓)	Stock Vials (✓)	Other	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	PIGS (✓) LEAD	PIGS (✓) BARIUM
S		1		✓		P-32		(600)	S-35		(450)					
E		2		✓		I-125		(420)			( )					
C		3	✓			H-3		(190)	C-14		(60)					
D		4	✓			Co-57		(55)	Ca-45		(140)	Na-22		100		

Retain photocopy for your files

4. Complete the next applicable section.

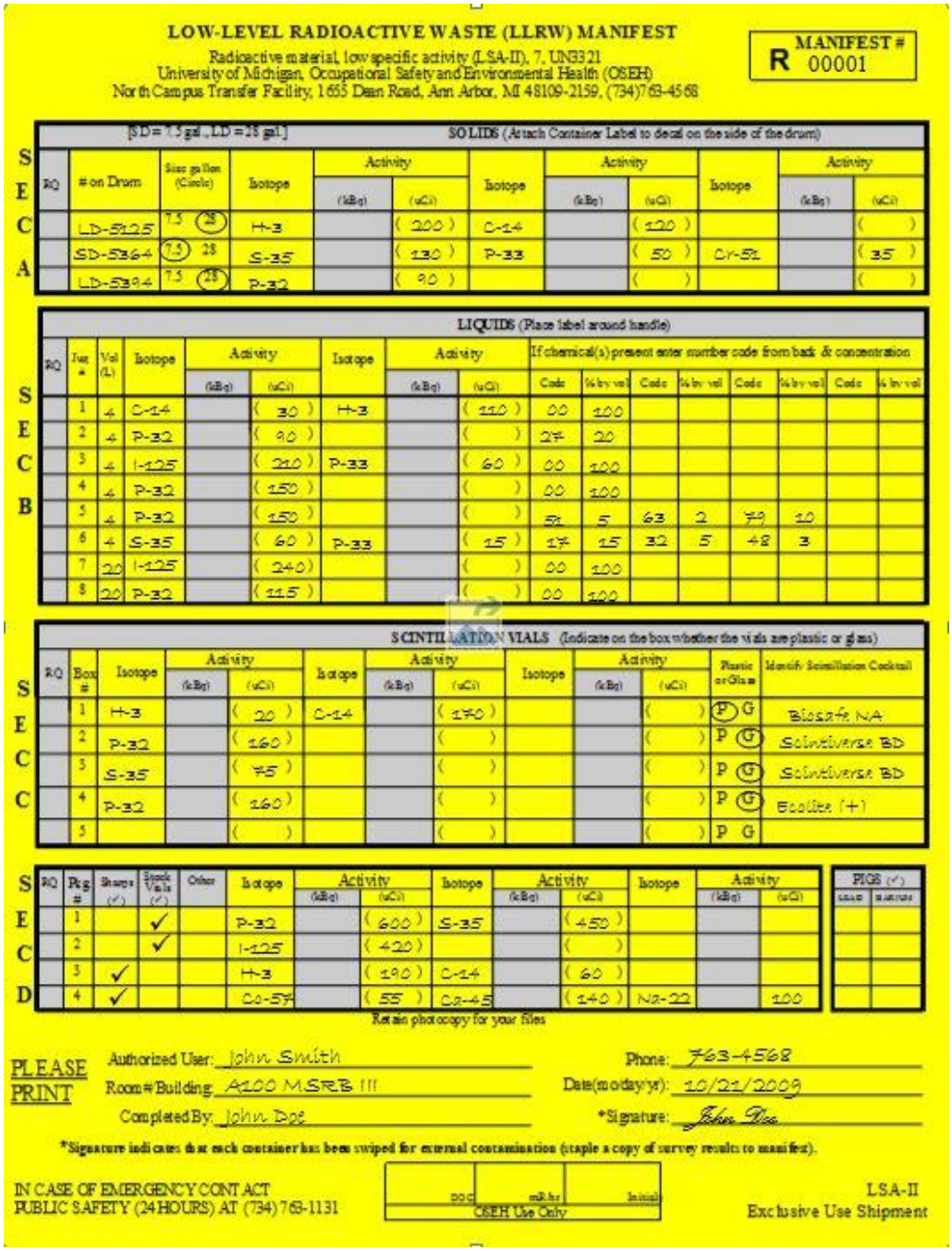
Procedure: Completing the Authorized User and Location Information

1. Complete the following contact information:
   - Authorized User: The RSS-approved authorized user
   - Phone: The telephone number of the laboratory
   - Room #/Building: The room number and building name
2. Write the date the manifest was prepared.
3. Print your name.
4. Sign the manifest attesting that each container has undergone a radioactive contamination survey and is free of external contamination.
   The following illustration shows how the manifest looks when the Authorized Use and location information is completed:


PLEASE PRINT
Authorized User: John Smith
Phone: 763-4568
Room#/Building: A100 MSRB III
Date(mo/day/yr): 10/21/2009
Completed By: John Doe
*Signature: John Doe
*Signature indicates that each container has been swiped for external contamination (staple a copy of survey results to manifest).
IN CASE OF EMERGENCY CONTACT
PUBLIC SAFETY (24 HOURS) AT (734) 763-1131
DOC
mR/hr
Initials
OSEH Use Only
LSA-II
Exclusive Use Shipment

5. Attach a copy of the radioactive contamination survey to the manifest.

Example of Completed Manifest



LOW-LEVEL RADIOACTIVE WASTE (LLRW) MANIFEST

Radioactive material, low specific activity (LSA-II), 7, UN3321
University of Michigan, Occupational Safety and Environmental Health (OSEH)
North Campus Transfer Facility, 1655 Dean Road, Ann Arbor, MI 48109-2159, (734) 763-4568

MANIFEST # R 00001

SECTION A — [SD = 7.5 gal, LD = 28 gal] — SOLIDS (Attach Container Label to decal on the side of the drum)

RQ	# on Drum	Size gallon (Circle)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)
	LD-5125	7.5 (28)	H-3		(200)	C-14		(120)			( )
	SD-5364	(7.5) 28	S-35		(130)	P-33		(50)	Cr-51		(35)
	LD-5394	7.5 (28)	P-32		(90)			( )			( )

SECTION B — LIQUIDS (Place label around handle)

RQ	Jug #	Vol (L)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	If chemical(s) present enter number code from back & concentration: Code	% by vol	Code	% by vol	Code	% by vol	Code	% by vol
	1	4	C-14		(30)	H-3		(110)	00	100						
	2	4	P-32		(90)			( )	27	20						
	3	4	I-125		(210)	P-33		(60)	00	100						
	4	4	P-32		(150)			( )	00	100						
	5	4	P-32		(150)			( )	51	5	63	2	29	10		
	6	4	S-35		(60)	P-33		(15)	17	15	32	5	48	3		
	7	20	I-125		(240)			( )	00	100						
	8	20	P-32		(115)			( )	00	100						

SECTION C — SCINTILLATION VIALS (Indicate on the box whether the vials are plastic or glass)

RQ	Box #	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Plastic or Glass	Identify Scintillation Cocktail
	1	H-3		(20)	C-14		(170)			( )	(P) G	Biosafe NA
	2	P-32		(160)			( )			( )	P (G)	Scintiverse BD
	3	S-35		(45)			( )			( )	P (G)	Scintiverse BD
	4	P-32		(160)			( )			( )	P (G)	Ecolite (+)
	5			( )			( )			( )	P G	

SECTION D

RQ	Pkg #	Sharps (✓)	Broken Vials (✓)	Other	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	Isotope	Activity (kBq)	Activity (uCi)	PIGS (✓) Lead	PIGS (✓) Tungsten
	1		✓		P-32		(600)	S-35		(450)					
	2		✓		I-125		(420)			( )					
	3	✓			H-3		(190)	C-14		(60)					
	4	✓			Co-57		(55)	Ca-45		(140)	Na-22		100		

Retain photocopy for your files

PLEASE PRINT

Authorized User: John Smith — Phone: 763-4568
Room # Building: A100 MSRB III — Date (mo/day/yr): 10/21/2009
Completed By: John Doe — *Signature: John Doe

*Signature indicates that each container has been swiped for external contamination (staple a copy of survey results to manifest).

IN CASE OF EMERGENCY CONTACT PUBLIC SAFETY (24 HOURS) AT (734) 763-1131

OSEH Use Only: dpm/cc | mR/hr | Initial

LSA-II
Exclusive Use Shipment

INSTRUCTIONS TO IDENTIFY CHEMICALS IN LIQUIDS

1 If chemical is listed below, please enter corresponding number code and approximate chemical concentration in % by volum in section B on the front side of the manifest.

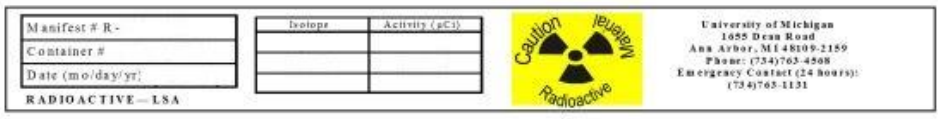
2 If chemical constituents are not listed below, Please enter number code 99 and approximate concentration in % by volume in section B on the front side of the manifest, and list chemical name(s) and concentration(s) in Section E below.

00 - Aqueous (water based with no added chemicals)
01 - acetamide
02 - acetic acid
100 - acetic anhydride
03 - acetone
04 - acetonitrile
05 - acrylamide
06 - aflatoxin
07 - ammonium compounds: (specify below)
08 - arsenic compounds: (specify below)
09 - barium compounds: (specify below)
10 - benzene
11 - benzo(a)pyrene
95 - blood
88 - boric acid
101 - bovine albumin
102 - bromophenol blue dye
12 - butanol
13 - cadmium compounds: (specify below)
103 - calcium chloride
104 - calcium sulfate
14 - carbon tetrachloride
15 - chloroamines
16 - chlorobenzene
17 - chloroform
18 - chlorophenol
105 - choline chloride
19 - chromium compounds:
106 - citric acid
107 - coomassie blue dye
20 - copper compounds:
96 - culture medium
21 - cyanide compounds: (specify below)
22 - cyclohexane
23 - DDD/DDT
108 - dextran sulfate
24 - dichlorobenzene
109 - DMEM media
25 - dimethyl sulfoxide (DMSO)
32 - ethylene diamine (EDTA)
33 - ethylene glycol-bis(B-amino ethyl ether)-tetraacetic acid (EGTA)
26 - epinephrine
29 - ethidium bromide (EtBr)
27 - ethanol
28 - ether
30 - ethyl acetate
34 - ethyl ether
31 - ethylbenzene
35 - ethylphenol
36 - formaldehyde
37 - formalin
38 - formamide
39 - formic acid
40 - glutaraldehyde
110 - glycine
111 - hams F12 media
112 - HEPES buffer
41 - heptane
113 - hexane
42 - HPLC Gels
43 - hydrochloric acid (HCl)
44 - hydroxybenzene
114 - isoamyl alcohol
45 - isobutane
46 - isobutanol
47 - isopropanol
48 - lead compounds: (specify below)
115 - magnesium chloride
97 - magnesium phosphate
116 - magnesium sulfate
49 - mercaptoethanol
50 - mercury compounds: (specify below)
51 - methanol
117 - methoxyethanol
52 - methyl benzene
53 - methyl bromide
55 - methyl ethyl ketone
56 - methyl iodide
57 - methyl phenol
54 - methylene chloride
58 - naphthalene
59 - nitric acid
60 - nitrobenzene
61 - osmium compounds: (specify below)
118 - perchloric acid
62 - perfluor
63 - phenol
64 - phosphoric acid
65 - phthalates
91 - potassium chloride
66 - potassium permanganate
119 - potassium phosphate
67 - propanoic acid
68 - pyridine
94 - saline sodium citrate (SSC)
69 - scintillation fluid: (specify below)
70 - selenium compounds: (specify below)
71 - silver compounds: (specify below)
120 - sodium acetate
72 - sodium azide
121 - sodium bicarbonate
122 - sodium carbonate
89 - sodium chloride
90 - sodium citrate
93 - sodium dodecyl sulfate (SDS)
73 - sodium hydroxide
74 - sodium hypochlorite
123 - sodium iodide
124 - sodium lauryl sulfate (SLS)
92 - sodium phosphate
125 - sodium Thiosulfate
126 - sucrose
75 - sulfuric acid
127 - taurine
79 - trichloroacetic acid (TCA)
76 - tetrachlorobenzene
77 - tetrachloroethene
128 - tetrahydrofuran
78 - toluene
80 - trichloroethylene
129 - trifluoracetic acid
87 - TRIS buffer
81 - uranyl acetate
82 - uranyl nitrate
83 - urea
84 - vinyl chloride
85 - xylene
130 - xylene cyanol
86 - zinc compounds: (specify below)
99 - OTHER: (SEE INSTRUCTIONS ABOVE)

	Jug #	CODE 99 CHEMICAL NAMES(S), % BY VOL.
S	1	
E	2	
C	3	
D	4	
	5	
	6	Lead acetate
	7	
	8	

The Container Label

Complete and attach an identification label to every container of low-level radioactive waste (LLRW) pending collection. The label associates the container to a Low-Level Radioactive Waste Manifest describing the contents of the container along with other information necessary for transportation and disposal.



Every container label **must** include the following information:

FIELD	WRITE…
Manifest number	The pre-printed number located on the upper-right corner of the LLRW manifest.
Container number	• A pre-designated number that can be found marked on the side of the drum. Large drum numbers begins with "LD," and small drum numbers begin with "SD." • For liquid waste, scintillation vials, sharps, and stock vials, the line number on the manifest corresponding to the container entry.
Date (month/day/year)	The date the manifest was prepared.
Isotope/Activity	Each isotope in the container and its activity (µCi). This **must** match the associated information on the manifest for the container.

Placement of the Container Label

CONTAINER	LOCATION
Solid waste drum	• Affix label where it says, "Place container label here" on the side of the drum
Liquid waste jug	• Insert label through handle and affix the two adhesive ends together
Scintillation vial box	• Affix label to the top of the box
Sharps container	• Pail: Place label around handle and affix the two adhesive ends together • Other commercially-available approved containers: Affix label to top of the container
Stock vial box	• Box: Affix label to the top of the box • Pail: Place label around handle and affix the two adhesive ends together

Storage and Labeling

Low-level radioactive waste (LLRW) ***must*** be stored in OSEH provided or approved containers. The containers **must** be:

- Sufficiently strong to hold the waste
- Handled in a manner to minimize breakage and spillage
- Identified as containing radioactive material according to Radiation Safety Service (RSS) guidelines

Proper Storage of Waste Containers

Waste containers ***must*** be stored in a safe, secure, and easily identifiable location within your laboratory room. OSEH will inspect containers and documentation prior to collection.

Store waste in an area that will limit laboratory personnel exposure. Also, use appropriate shielding. Contact RSS at (734) 764-6200 for recommended shielding methods.

Containers

EHS supplies specific types of containers for different types of LLRW at no cost. Use these containers for LLRW.

NOTE: All containers ***must*** be labeled with "Caution: Radioactive Material" tape.

TYPE OF LLRW	CONTAINER	AVAILABILITY
Solid	• Small Drum (7.5 gallon yellow fiber drum) • Large Drum (28 gallon yellow fiber drum)	EHS provides
Liquid	• 4 liter plastic jug (1 gallon) • 20 liter plastic jug (5 gallon)	EHS provides
Scintillation vials	• Boxes	Use the original box
Sharps	• 1 gallon and 5 gallon plastic pail • Other commercially-available approved container	EHS provides pail
Stock vials	• Box • 1 gallon and 5 gallon plastic pails	Any sturdy box or OSEH provided pail
Animals and related waste	• Yellow plastic bags (4 mil)	EHS provides the yellow opaque bag and identification tags

Ordering Containers

To order the containers, contact Hazardous Materials Management using one of the following methods:

- Call (734) 763-4568
- Complete the online Waste and Supply Request form

To order the yellow opaque bags and identification tags, call (734) 764-6200.