Chemical Disposal Guidelines
Department of Natural Sciences

UNT Dallas™

Natural Sciences

Updated: 7/1/2025 ICP Created: 2024 ICP

1. Introduction

Whether participating in a laboratory course or conducting research, the faculty, staff, and students at the University of North Texas at Dallas must be properly informed on the handling of chemical waste. To keep those who handle chemical waste safe, this guide will outline the procedures associated with waste characterization/designation, storage, and ultimate disposal to off-campus handlers. Details in the event of an emergency spill will also be covered. Our goal is to maintain a safe environment for everyone affiliated with our university and the community surrounding it through proper handling of potentially hazardous materials.

1.1. Generator Status

Currently, the University of North Texas at Dallas is classified as a Very Small Quantity Generator (VSQG). To meet the requirements for this class, an institution must not generate more than 100 kg (220 lbs) of hazardous waste and 1 kg (2.2 lbs) of acute hazardous waste per month. At the point of waste generation, the hazardous waste determination must be made for each solid waste. A list of exclusions is available under 40 CFR 261.4 and must be taken into consideration during the determination process. The person must then determine if the waste demonstrates any hazardous characteristics or falls into any designated lists, which will be covered in the following section. If the labs experience an episodic event (a planned or unplanned activity resulting in an increase in generation of waste that exceeds generator's usual category), the generator may retain its generator status under conditions detailed in subpart L.

1.2. Subpart K

Subpart K is an alternative and optional set of hazardous waste rules specifically designed for academic laboratories. It was created to give more flexibility to institutions when making hazardous waste designations. In subpart K, hazardous waste determination can be made in the laboratory, at the Central Accumulation Area (CAA) within 4 days, or at the Treatment, Storage and Disposal (TSD) facility within 4 days. While typically there is no limit for how long a VSQG can hold chemical waste, subpart K requires that accumulation time be no longer than 6 months. Training is required for both lab workers and students under this modification and a Laboratory Management Plan (LMP) must be created/maintained. A helpful comparison can be found on the EPA website (https://www.epa.gov/sites/default/files/2014-12/documents/saa-vs-alr.pdf). If an entity would like to opt into following Subpart K requirements, they must notify the EPA in writing.

2. Definitions and Designations

For reference in hazardous waste literature, solid waste refers to "any garbage, refuse, sludge from a waste treatment plant, water supply treatment plant or air pollution

control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material resulting from industrial, municipal, commercial, mining, and agricultural operations, and from community and institutional activities" (30 Texas Administrative Code (TAC) §335.1). Prior to consolidating any waste, it is important to understand four characteristics of chemical waste (ignitibility, corrosivity, reactivity, and toxicity) as classified by the Resource Conservation and Recovery Act (RCRA). Note that while a substance could fall into more than one of these categories, it only needs to demonstrate one of these qualities to be considered hazardous.

2.1. Flammable/Ignitable

Denoted by the pictogram of a flame, chemicals of this classification are characterized by having a flashpoint below 60 °C (140 °F). While this category encompasses most common organic solvents, it also includes solids that ignite under chemical or physical changes as well as some compressed gases. Oxidizers also fall under this classification.

2.2. Corrosive

Corrosive chemicals should be marked with the pictogram of a chemical spill on a solid and on a hand. These chemicals can be aqueous solutions with a pH that is less than or equal to 2 or greater than or equal to 12.5. Additionally, this classification includes liquids that can corrode steel, with a rate faster than 6.35 mm (0.25 in) per year at 55 °C (130 °F).

2.3. Reactive

Chemicals that fall into the reactive category are often denoted by a pictogram of an explosion. These chemicals are often violently reactive when exposed to air or water but there are instances where some have the potential to detonate under standard temperature and pressure. This category often includes common oxidizers as well, such as peroxides but separate labeling should still be used to designate these cases. Chemicals that can generate toxic fumes, usually cyanides and sulfides, also fall under this hazard classification.

2.4. Toxicity

Toxic chemicals, represented by a skull and crossbones pictogram, pose a threat to the health and safety of the lab and safety personnel and the environment if not properly handled. The list below details the 40 chemicals determined to be toxic based on the EPA. A Toxic Characteristic Leaching Procedure (TCLP) is used to detect the presence of these chemicals in waste. Heavy metals are highlighted orange while organic chemicals are highlighted blue.

EPA HW No.	Contaminant	CAS No.	Regulatory Level (mg/L)
D004	arsenic	7440-38-2	5.0
D005	barium	7440-39-3	100.0

D018	benzene	71-43-2	0.5
D006	cadmium	7440-43-9	1.0
D019	carbon tetrachloride	56-23-5	0.5
D020	chlordane	57-74-9	0.03
D021	chlorobenzene	108-90-7	100.0
D022	chloroform	67-66-3	6.0
D007	chromium	7440-47-3	5.0
D023	*o*-cresol	95-48-7	200.0
D024	*m*-cresol	108-39-4	200.0
D025	*p*-cresol	106-44-5	200.0
D026	cresol	1319-77-3	200.0
D016	2,4-dichlorophenoxyacetic acid	94-75-7	10.0
D027	1,4-dichlorobenzene	106-46-7	7.5
D028	1,2-dichloroethane	107-06-2	0.5
D029	1,1-dichloroethylene	75-35-4	0.7
D030	2,4-dinitrotoluene	121-14-2	0.13
D012	endrin	72-20-8	0.02
D031	heptachlor (and its epoxide)	76-44-8	0.008
D032	hexachlorobenzene	118-74-1	0.13
D033	hexachlorobutadiene	87-68-3	0.5
D034	hexachloroethane	67-72-1	3.0
D008	lead	7439-92-1	5.0
D013	lindane	58-89-9	0.4
D009	mercury	7439-97-6	0.2
D014	methoxychlor	72-43-5	10.0
D035	methyl ethyl ketone	78-93-3	200.0
D036	nitrobenzene	98-95-3	2.0
D037	pentachlorophenol	87-86-5	100.0
D038	pyridine	110-86-1	5.0
D010	selenium	7782-49-2	1.0
D011	silver	7440-22-4	5.0
D039	tetrachloroethylene	127-18-4	0.7
D015	toxaphene	8001-35-2	0.5
D040	trichloroethylene	79-01-6	0.5
D041	2,4,5-trichlorophenol	95-95-4	400.0
D042	2,4,6-trichlorophenol	88-06-2	2.0
D017	2,4,5-TP (Silvex)	93-72-1	1.0
D043	vinyl chloride	75-01-4	0.2

There are also several lists (F, K, P, and U) designated by the EPA which can be used in conjunction with the known categorized hazards mentioned above to segregate waste.

2.5. The F List

F-listed chemicals stem from manufacturing and industrial processes and are not tied to a specific industrial sector, deeming their source non-specific. These

chemicals can fall into the following groups, as defined in the Code of Federal Regulations.

- Spent solvent wastes
- Wood preserving wastes
- Electroplating and other metal finishing wastes
- Chlorinated aliphatic hydrocarbons production
- Dioxin-bearing wastes
- Petroleum refinery wastewater treatment sludges
- Multisource leachate

2.6. The K List

Chemicals in the K list are considered wastes that are source-specific, coming from specific sectors of industry and manufacturing. This waste must (1) belong to one of the 13 industry categories below and (2) match a waste description designated by the EPA (40 CFR section 261.32).

- Organic chemicals manufacturing
- Inorganic chemicals manufacturing
- Wood preservation
- Pesticides manufacturing
- Iron and steel production
- Explosives manufacturing
- Primary aluminum production
- Inorganic pigment manufacturing
- Petroleum refining
- Veterinary pharmaceuticals manufacturing
- Secondary lead processing
- Ink formulation
- Producing coke from coal processing

2.7. The P List

P-listed chemicals are defined as acute hazardous wastes that arise from commercial chemical products. This chemical must be either completely pure, technical grade, or the sole active ingredient. Additionally, P-listed chemicals must be unused. A list of these chemicals can be found in 40 CFR section 261.33.

2.8. The U List

The U list consists of hazardous chemical waste that stems from discarded chemical products. Similarly to chemicals on the P list, U-listed chemicals must be either completely pure, technical grade, or the sole active ingredient and must be unused. A list of these chemicals can be found in 40 CFR section 261.33.

There is a search feature on the EPA website which can be useful in determining wastes that are F-, K-, P-, or U-listed as well as any additional hazard code the chemical is associated with (https://www.epa.gov/hw/defining-hazardous-waste-listed-characteristic-and-mixed-radiological-wastes#:~:text=The%20F%2Dlist%2C%20found%20at,wastes%20from%20non%2Dspecific%20sources.).

3. Labeling and Storage

Once the hazards of a specific container of waste have been identified, it is important to properly label and store these contents for eventual departure from the facility. Keep in mind that many individuals of various backgrounds may handle this waste which is why it is important to use proper labeling as well as consider every detail, such as container choice (size, composition, etc.) and storage location.

3.1. Labeling Waste

The specifics of waste labeling are dependent on the regulations that an institution follows (e.g. subpart K). Under the standard hazardous waste regulations set by the EPA, containers of hazardous waste should be labeled with at least one of the following:

- The words “hazardous waste”
- A description or list that helps identify the contents of the container

This varies with subpart K, as the hazardous waste determination can occur later in the waste’s life cycle. To ensure proper safety and precautions during transport and storage, waste should be labelled with the following information:

- The words “unwanted materials” or similar verbiage
- Identification of contents (e.g. the chemical name – not chemical formula)
- Information sufficient to make a hazardous waste determination (hazard characteristics, composition distribution, molarity, etc.)
- Accumulation start date

Though there is no specific mention of labeling when the waste container was filled, this additional piece of labeling may aid in inventory or other reporting events.

The first two pieces of information under subpart K must be securely attached to the container whereas the latter two can be maintained in a spreadsheet, a logbook, or an online barcoding system.

3.2. Hazardous Waste Determination

An important distinction to note is the difference between when the hazardous waste distinction is made, and which personnel are responsible for this. Under

normal EPA standards, the generator must make the determination at the time and place of generation. Under this definition, a student could be considered a generator.

Under subpart K, the academic institution can decide when and where the hazardous waste determination is made (in the laboratory, at the Central Accumulation Area (CAA), or at the Treatment, Storage, or Disposal Facility (TSDF). ***Regardless, a "trained professional" must make this determination.*** Under the definitions of subpart K (40 CFR section 262.200) a trained professional at a VSQG institution is any person that is "knowledgeable about normal operations and emergencies in accordance with § 262.16(b)(9)(iii)". This definition changes once an institution reaches SQG or LQG status. Once this distinction is made, the container of waste must be labeled with the words "hazardous waste" as well as the appropriate hazardous waste codes.

3.3. Storage of Waste

For the duration of the time spent at the institution's Central Accumulation Area (CAA), chemical waste should be properly contained, and adequate logs should be kept up to date.

Not all chemicals are compatible with one another. This is an important note to keep in mind when consolidating waste or determining waste location in the Central Accumulation Area (CAA). Here are a few key points to remember:

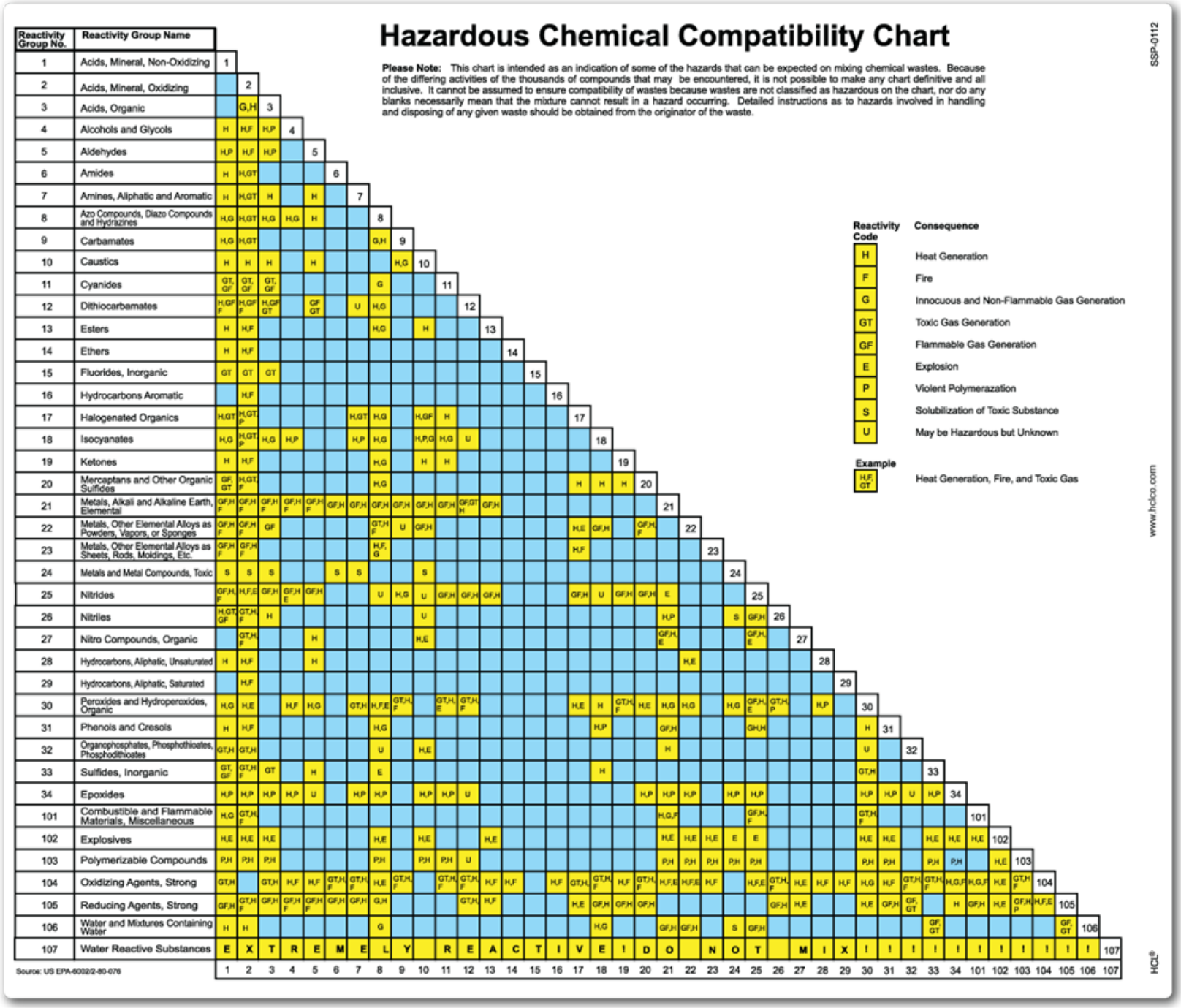
- Waste that contains flammable chemicals (e.g. waste from organic chemistry) must be kept in a flammables cabinet
- Acids – both organic and inorganic – should not be stored on metal shelves
- Keep organic acids separate from inorganic acids
- Peroxide-forming chemicals (e.g. tetrahydrofuran, ether, etc.) should be dated upon opening and tested for peroxides about every 6 months
- Oxidizers and reductants should be kept separate

Regardless of the material or composition inside, all waste should have some form of secondary containment in case of a spill or leak. This is often a container or tray placed under the primary waste container(s). Make sure to choose an appropriately sized form of secondary containment that is sufficient to catch the entirety of the waste if a major breach were to occur.

A useful chart and depiction of proper storage management can be found online from the University of Chicago (https://d3qi0qp55mx5f5.cloudfront.net/safety/i/basic_pages/Segregation.pdf?mtime=1526050773). Additionally, a comprehensive graphic depicting chemical compatibility can be found below. For further information, the Utah State

University website also includes some helpful incompatibility summaries (https://research.usu.edu/ehs/training-and-resources/incompatible-chemicals).

In general, waste containers must be sealed at all times. Exceptions to this rule apply when adding or removing material, during an active lab, or when venting is necessary (e.g. for operation of equipment, to prevent pressure build-up, etc.).



Hazardous Chemical Compatibility Chart

Please Note: This chart is intended as an indication of some of the hazards that can be expected on mixing chemical wastes. Because of the differing activities of the thousands of compounds that may be encountered, it is not possible to make any chart definitive and all inclusive. It cannot be assumed to ensure compatibility of wastes because wastes are not classified as hazardous on the chart, nor do any blanks necessarily mean that the mixture cannot result in a hazard occurring. Detailed instructions as to hazards involved in handling and disposing of any given waste should be obtained from the originator of the waste.

Reactivity Code	Consequence
H	Heat Generation
F	Fire
G	Innocuous and Non-Flammable Gas Generation
GT	Toxic Gas Generation
GF	Flammable Gas Generation
E	Explosion
P	Violent Polymerazation
S	Solubilization of Toxic Substance
U	May be Hazardous but Unknown

Example: H,F, GT — Heat Generation, Fire, and Toxic Gas

Reactivity Group No.	Reactivity Group Name
1	Acids, Mineral, Non-Oxidizing
2	Acids, Mineral, Oxidizing
3	Acids, Organic
4	Alcohols and Glycols
5	Aldehydes
6	Amides
7	Amines, Aliphatic and Aromatic
8	Azo Compounds, Diazo Compounds and Hydrazines
9	Carbamates
10	Caustics
11	Cyanides
12	Dithiocarbamates
13	Esters
14	Ethers
15	Fluorides, Inorganic
16	Hydrocarbons Aromatic
17	Halogenated Organics
18	Isocyanates
19	Ketones
20	Mercaptans and Other Organic Sulfides
21	Metals, Alkali and Alkaline Earth, Elemental
22	Metals, Other Elemental Alloys as Powders, Vapors, or Sponges
23	Metals, Other Elemental Alloys as Sheets, Rods, Moldings, Etc.
24	Metals and Metal Compounds, Toxic
25	Nitrides
26	Nitriles
27	Nitro Compounds, Organic
28	Hydrocarbons, Aliphatic, Unsaturated
29	Hydrocarbons, Aliphatic, Saturated
30	Peroxides and Hydroperoxides, Organic
31	Phenols and Cresols
32	Organophosphates, Phosphothioates, Phosphodithioates
33	Sulfides, Inorganic
34	Epoxides
101	Combustible and Flammable Materials, Miscellaneous
102	Explosives
103	Polymerizable Compounds
104	Oxidizing Agents, Strong
105	Reducing Agents, Strong
106	Water and Mixtures Containing Water
107	Water Reactive Substances

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	101	102	103	104	105	106	107
E	X	T	R	E	M	E	L	Y		R	E	A	C	T	I	V	E	I	D	O		N	O	T		M	I	X	!	!	!	!	!	!	!	!	!	!	!	!

Source: US EPA-6002/2-80-076

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A trained professional must be present during the movement of unwanted waste from the laboratories to the CAA. Ensure that waste has secondary containment and is secure before attempting to transport it. Once at the designated CAA, the waste should remain here until a pickup from an approved Treatment, Storage, or Disposal Facility (TSDF) is scheduled.

As a quick note, there can be locations designated as Satellite Accumulation Areas (SAAs). A Satellite Accumulation Area must be located near the point of generation and can hold up to 55 gallons of non-acute hazardous waste and/or 1 qt (or 1 kg) of acute hazardous waste. The regulations associated with these locations, however, only legally apply to small and large quantity generators.

4. Training and Responsibilities

Under the normal EPA regulations, VSQGs are not required to receive or administer training; regardless, it is best practice to provide it to all personnel involved in chemical waste handling. SQGs and LQGs must comply with the emergency preparedness and personnel training requirements outlined by the EPA. LQGs are also subject to annual reviews. Additionally, the institution is not required to have or make a Laboratory Management Plan (LMP) regardless of generator status and only LQGs must prepare a detailed contingency plan.

If an institution has opted into Subpart K, these rules and requirements are different. For all laboratory personnel, including laboratory workers and students, there must be training available that is “commensurate with duties”. These can be formatted as professor/lab management instruction before/during an experiment, formal in-person training, electronic/written training, on-the-job training, or a written/oral exam. A trained professional whether inside or outside the lab must also have the appropriate training, which changes depending on the generator status of the institution. For a Large Quantity Generator, this person must complete RCRA training requirements. For Small and Very Small Quantity Generators, this person just needs to be “knowledgeable about normal operations and emergencies” associated with the workplace and tasks. Unlike under normal regulations, all institutions following Subpart K must create and maintain a Laboratory Management Plan.

5. Non-Hazardous Waste Handling

Up to this point, the focus has been on hazardous waste, however, a major portion of lab-produced waste is not considered hazardous. This non-hazardous waste can be treated as normal trash, but care must be taken to ensure that it is truly non-hazardous. Below are listed the conditions by which waste can be disposed of either in the trash or down the drain.

5.1. Trash

To dispose of items in the trash, they must be non-radioactive and non-biohazardous. Additionally, they must not meet any of the definitions/characteristics of hazardous waste listed in section 2 and cannot be listed on the F, K, P, or U lists. Before disposing, ensure that the material will not be detrimental to human health or the well-being of the environment.

5.2. Drain

For an item to qualify for drain disposal, it must first meet all qualifications for non-hazardous trash. The liquid to be disposed must not be a strongly acidic or basic, having a pH between 5.5 and 10.5. Aside from strong bases and acids, combinations of common cations and anions are typically safe for drain disposal. These common cations and anions are listed in the graphic below: