

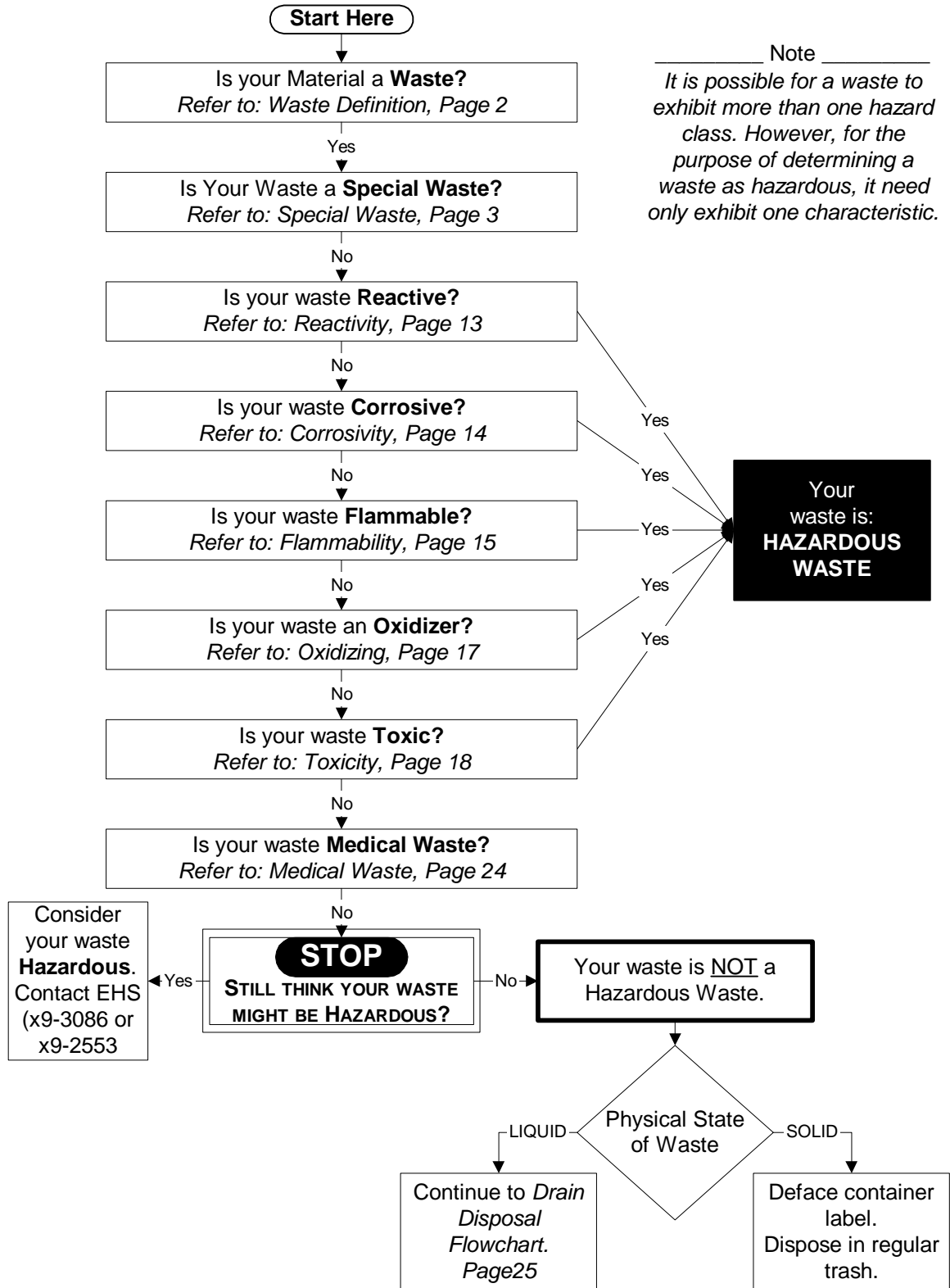
Hazardous Waste Determination and Classification Guidelines



A publication of:
U.C. Santa Cruz
Environmental Health and Safety
October 2002 revision

MASTER FLOWCHART

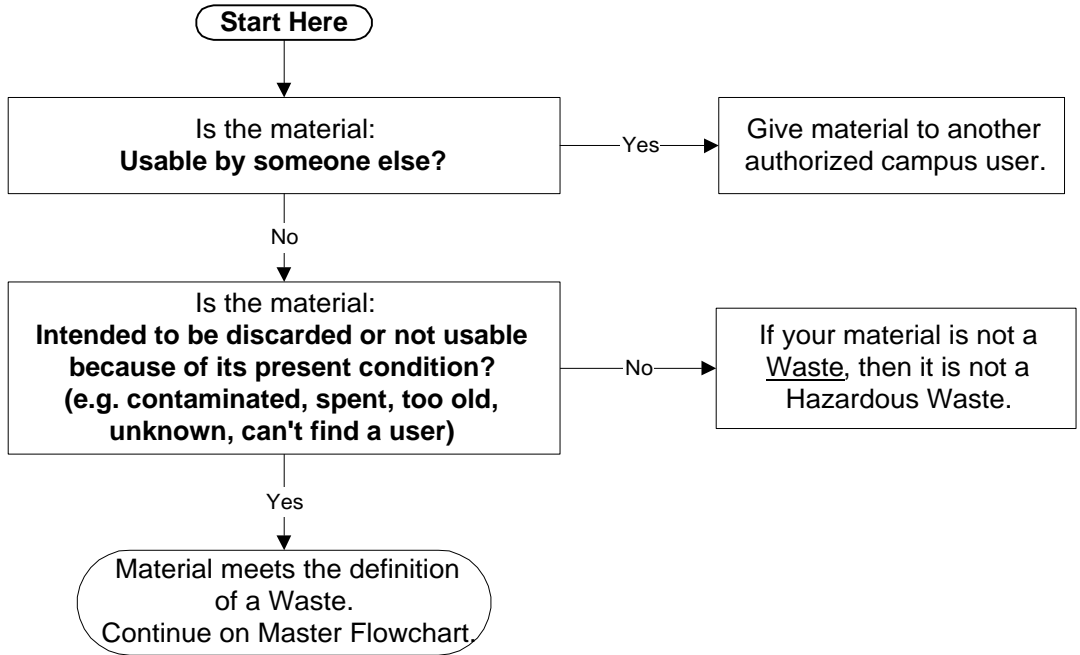
IN ORDER TO ASSIGN THE PROPER HAZARD CLASS IT IS IMPORTANT TO FOLLOW THE STEPS OUTLINED IN THE ORDER THEY APPEAR.



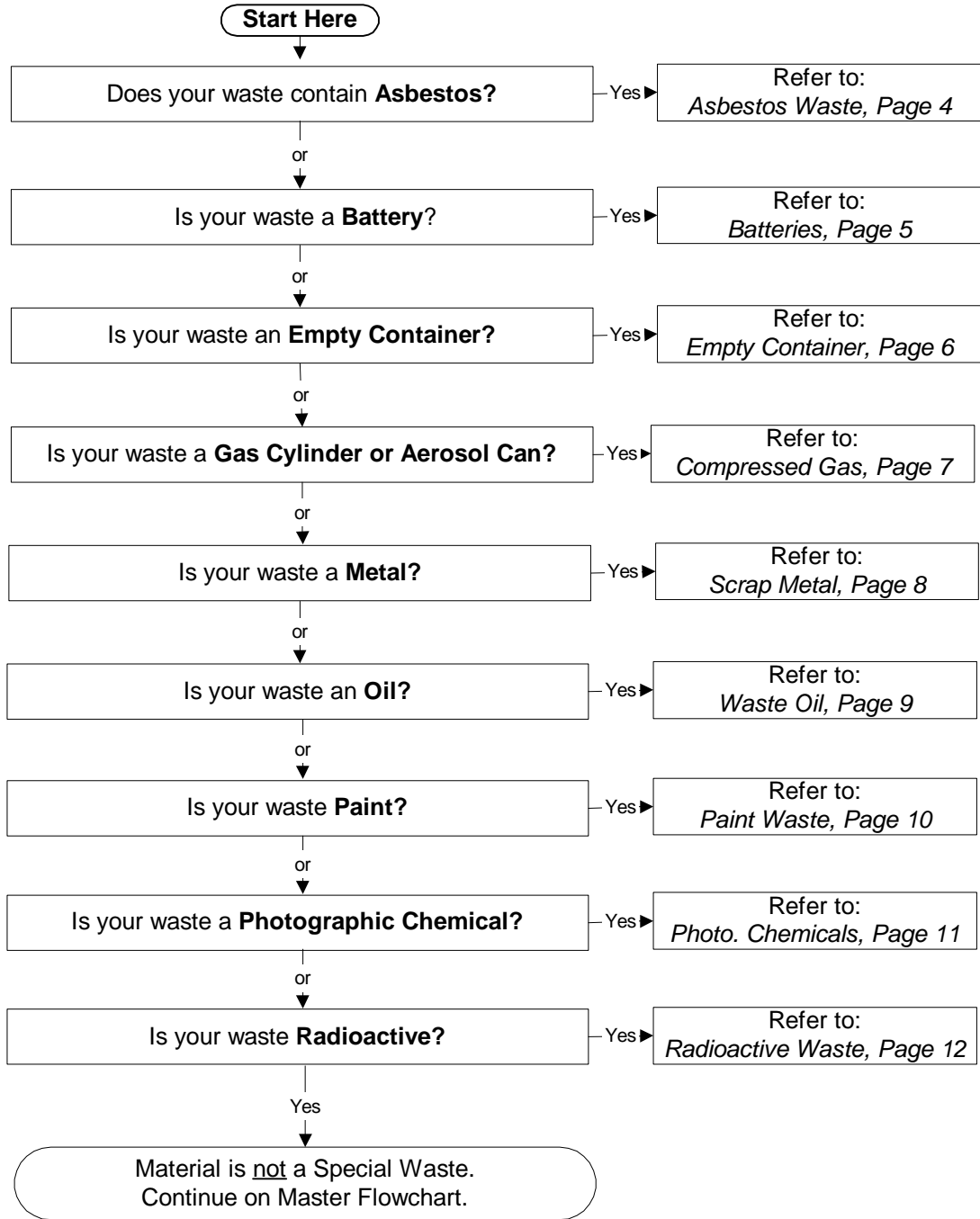
 Note
It is possible for a waste to exhibit more than one hazard class. However, for the purpose of determining a waste as hazardous, it need only exhibit one characteristic.

WASTE DEFINITION

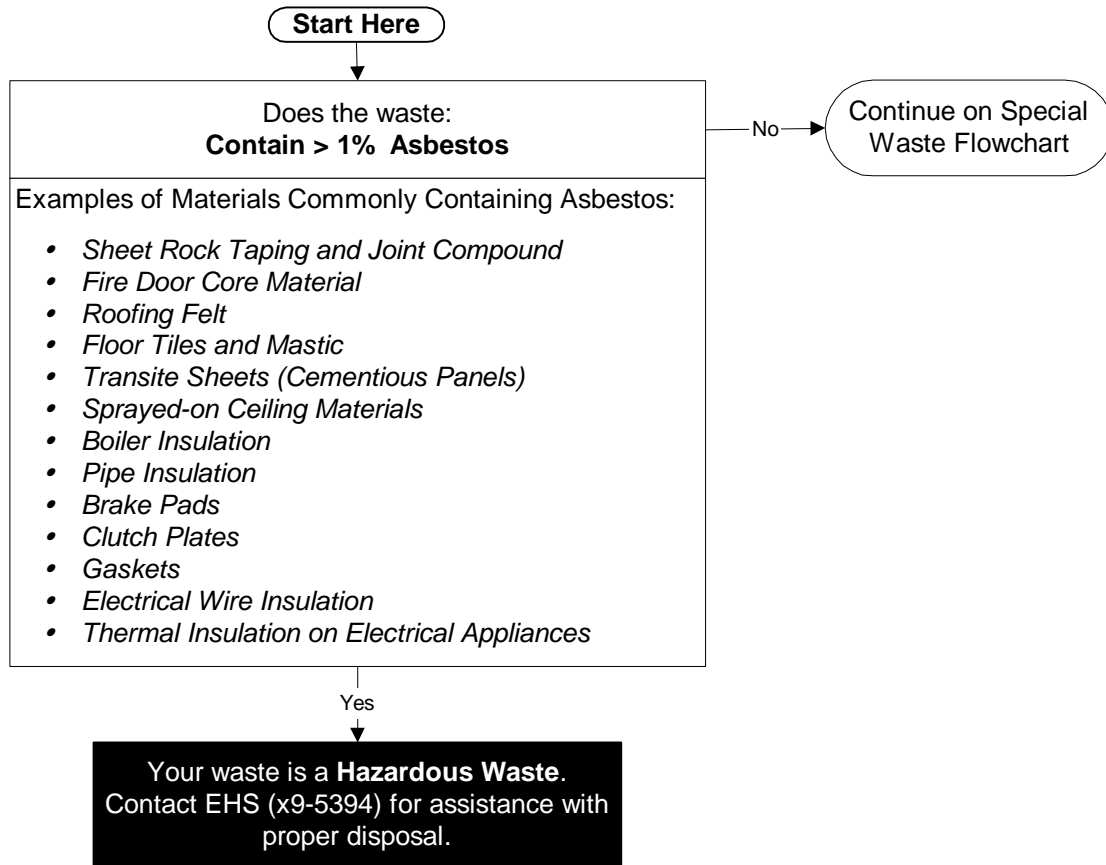
The average cost for disposal is 7-10 times the purchase cost of a material; generators are strongly encouraged to find recycling alternatives. If you would like assistance with waste reduction alternatives, contact EHS (x9-3086 or x9-2553).



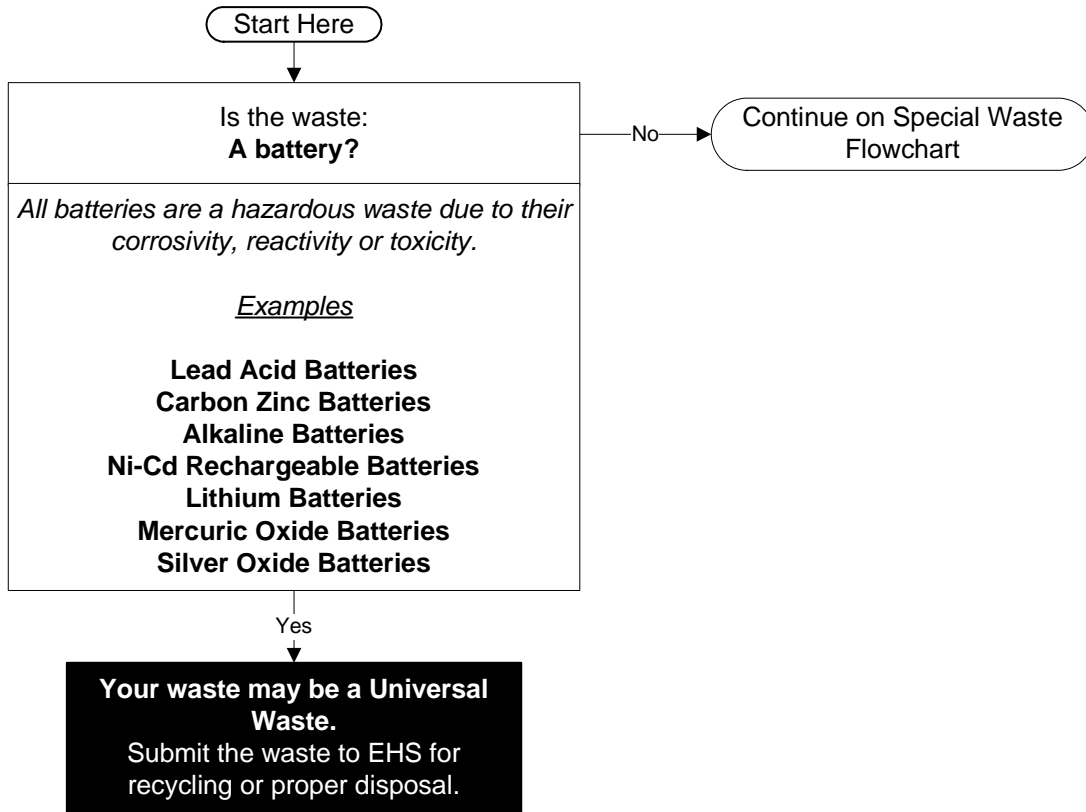
SPECIAL WASTE



ASBESTOS WASTE

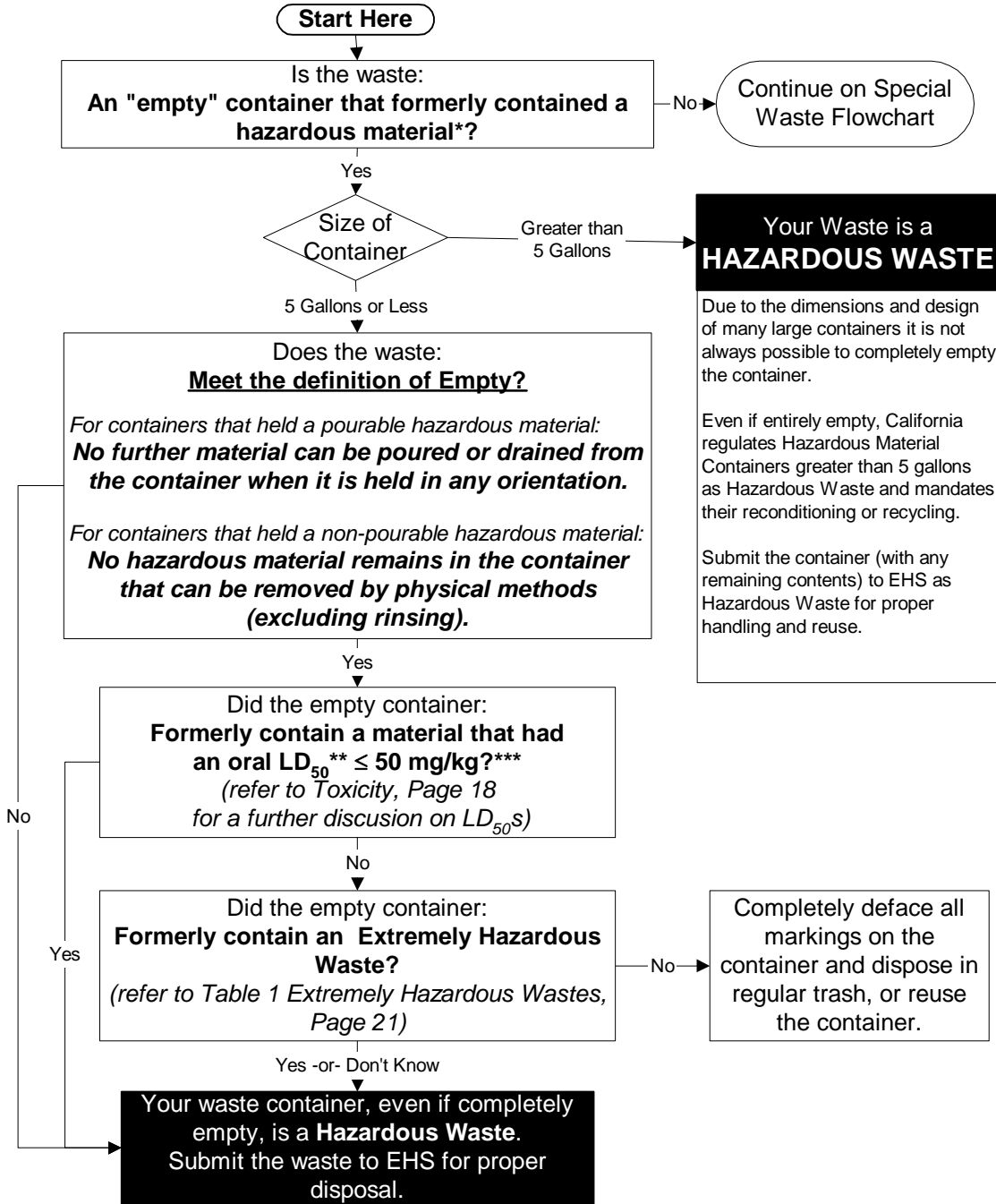


BATTERIES



EMPTY CONTAINERS

Containers that once held hazardous substances* are considered potential hazardous wastes due to the residues of hazardous contents that may persist.



* Use Pages 13-24 of this Guide to assist in determining if the containers former contents were hazardous.

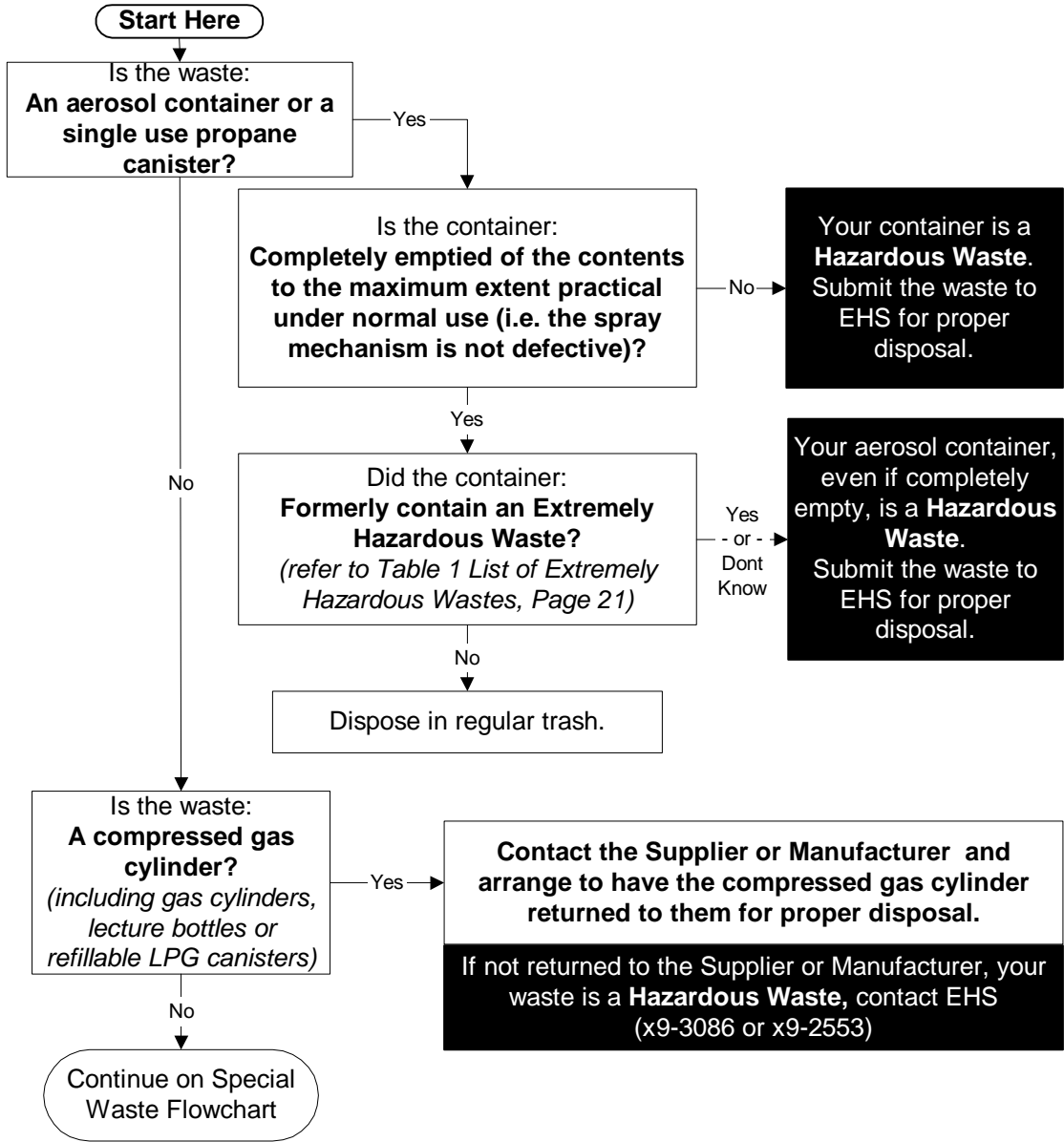
** LD₅₀ - The dose that has been determined to be lethal to 50% of the test population.

*** Toxicity regulations include, in addition to the oral LD₅₀, criteria for dermal LD₅₀ as well as inhalation LD₅₀. For the sake of simplicity, these criteria are not presented here. If you think one of these criteria may be important in classifying your waste, contact EHS (x9-3086 or x9-2553).

COMPRESSED GASSES

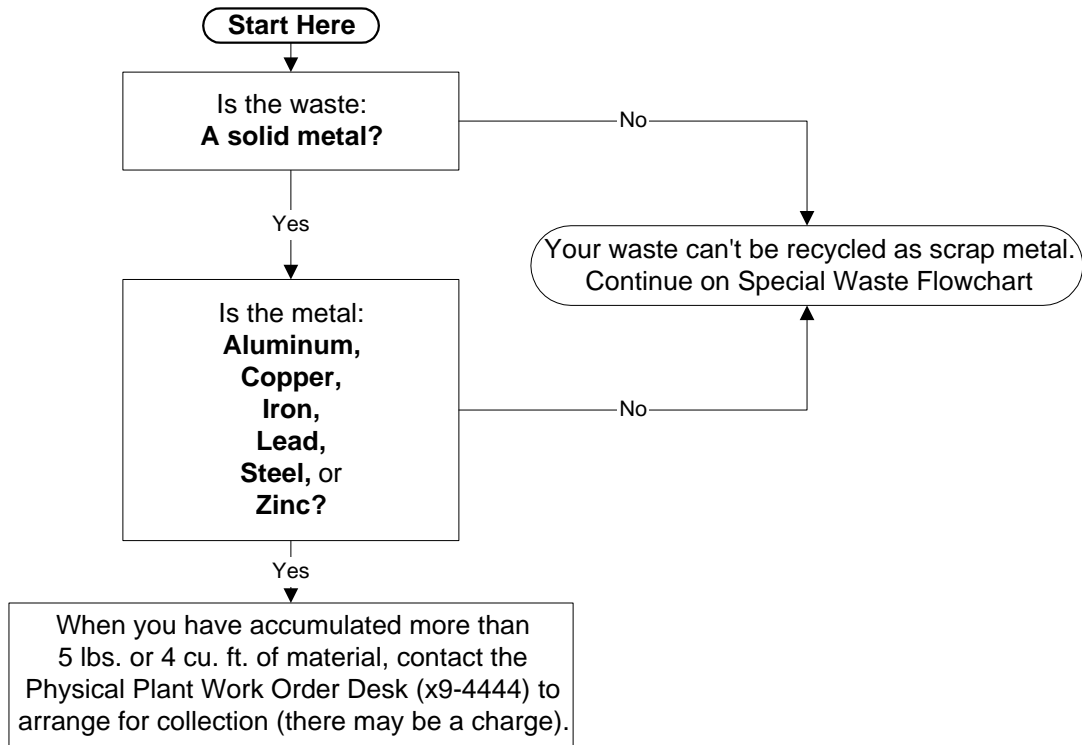
Due to the astronomically high cost of disposal for compressed gas cylinders, it is University Policy to only purchase gas in cylinders that are returnable to the vendor.

If you would like further information contact EHS (x9-3086 or x9-2553)

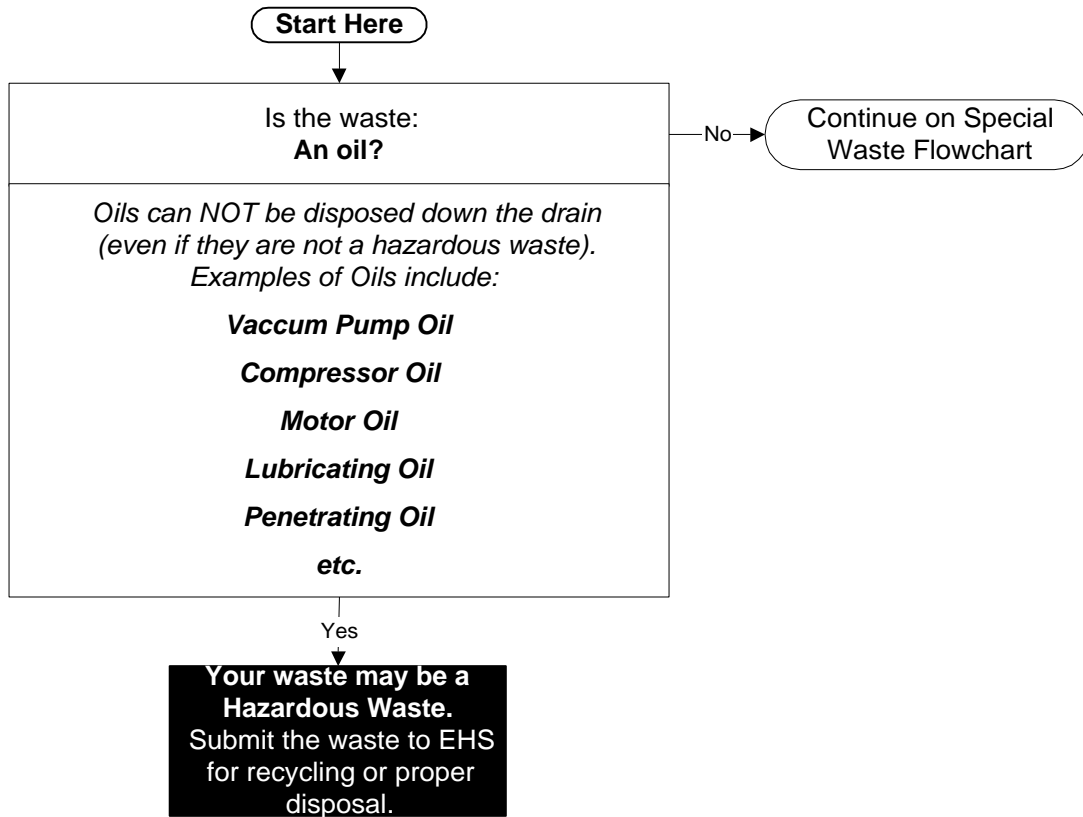


SCRAP METAL

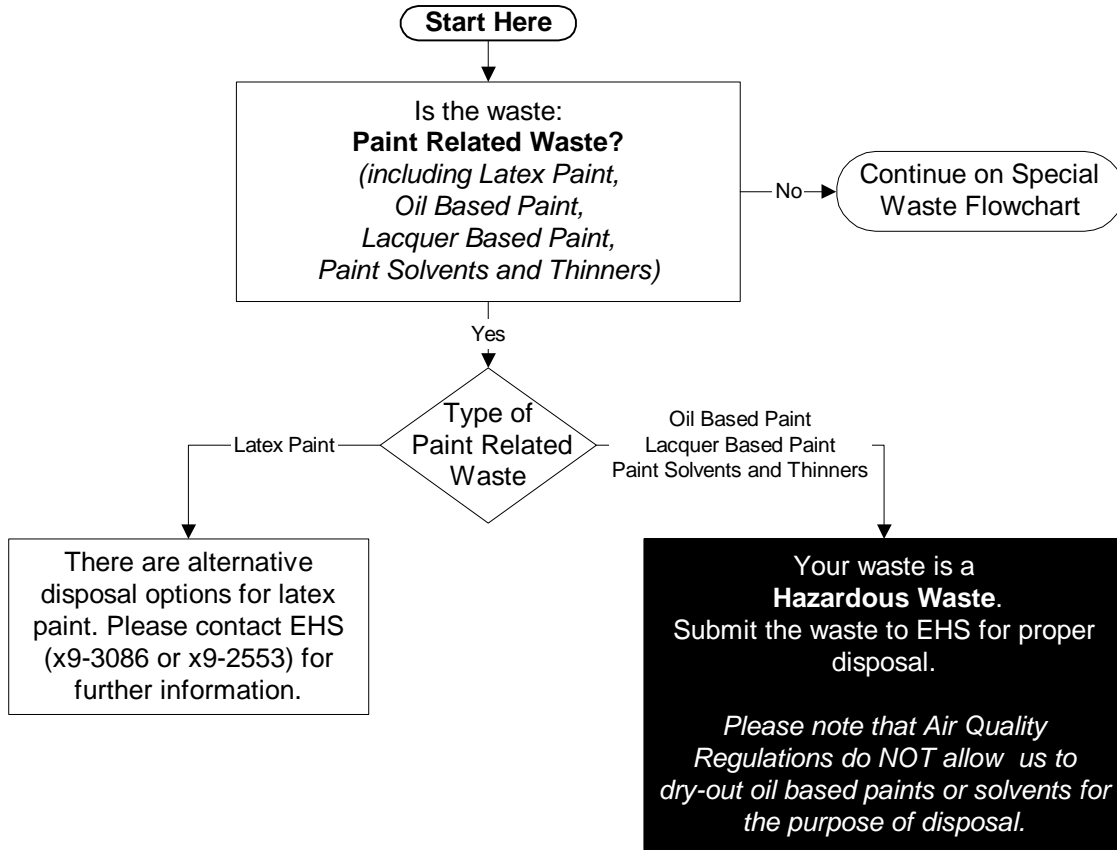
Reusable scrap metals can be reclaimed and recycled



WASTE OIL

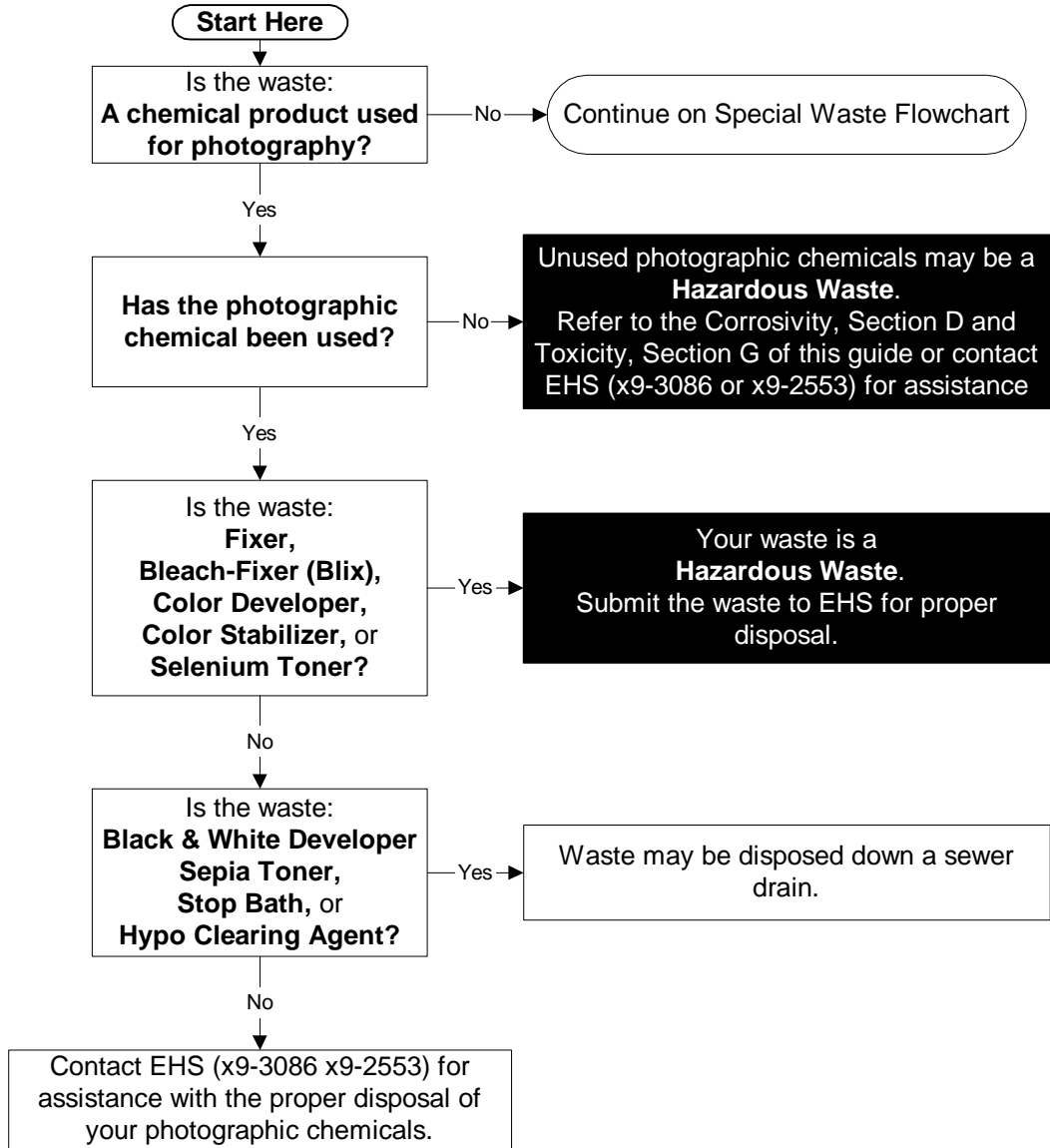


PAINT WASTE

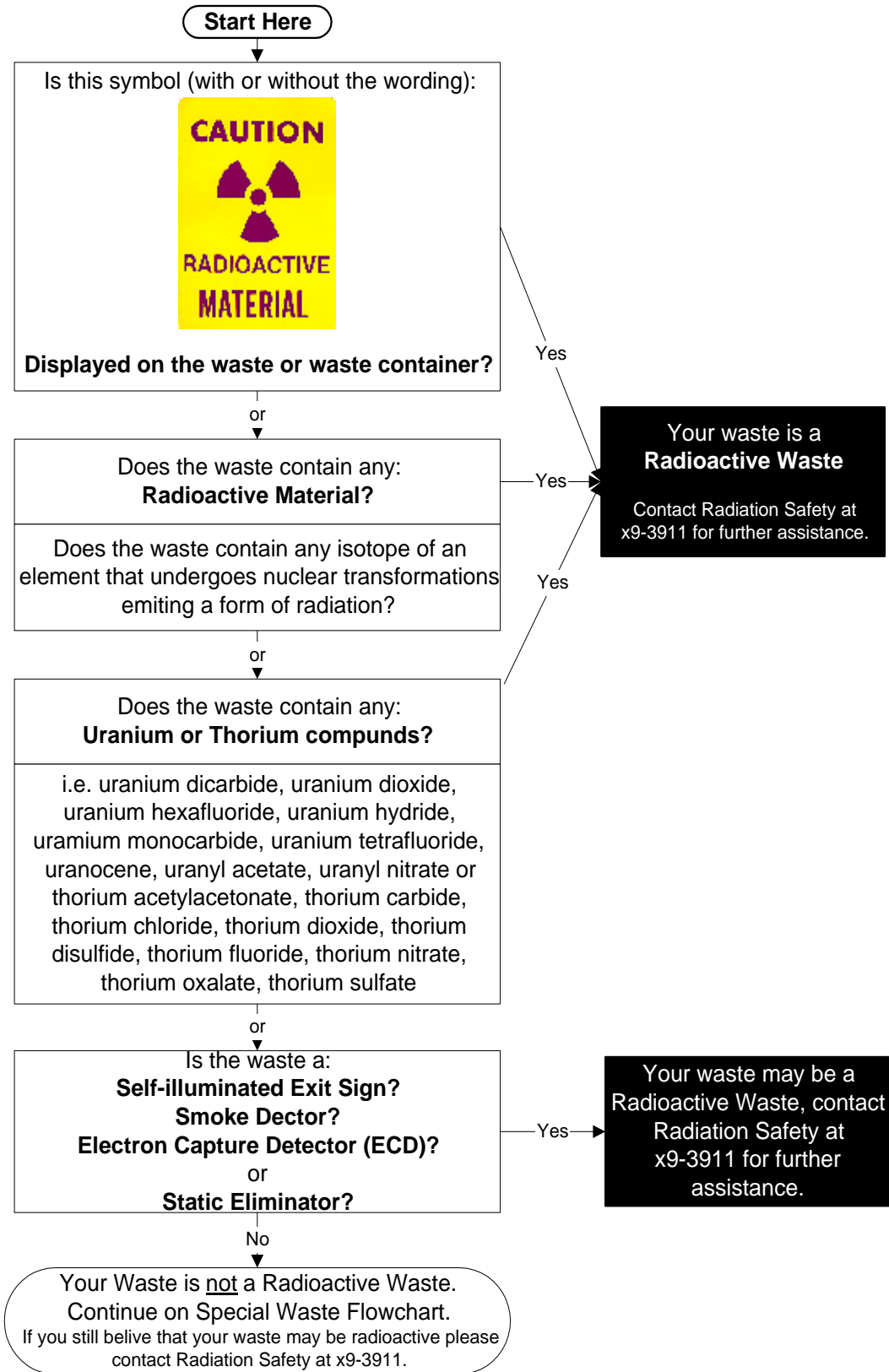


PHOTOGRAPHIC CHEMICALS

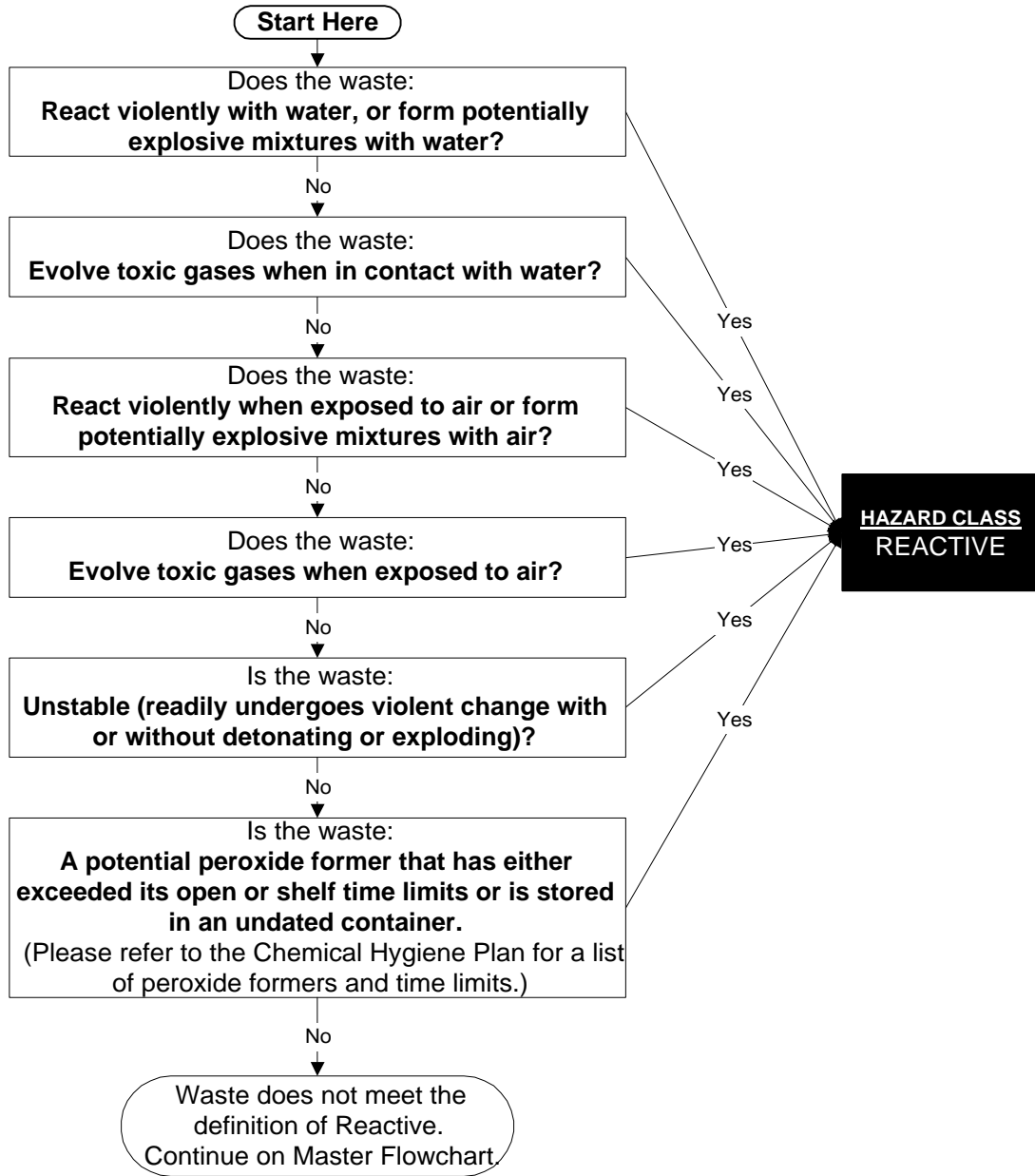
Some photographic chemicals have properties that make them a hazardous waste in their own right. Other photographic chemicals become hazardous with use (fixer accumulates the exposed silver, which is a toxic metal).



RADIOACTIVE WASTE



REACTIVITY



CORROSIVITY

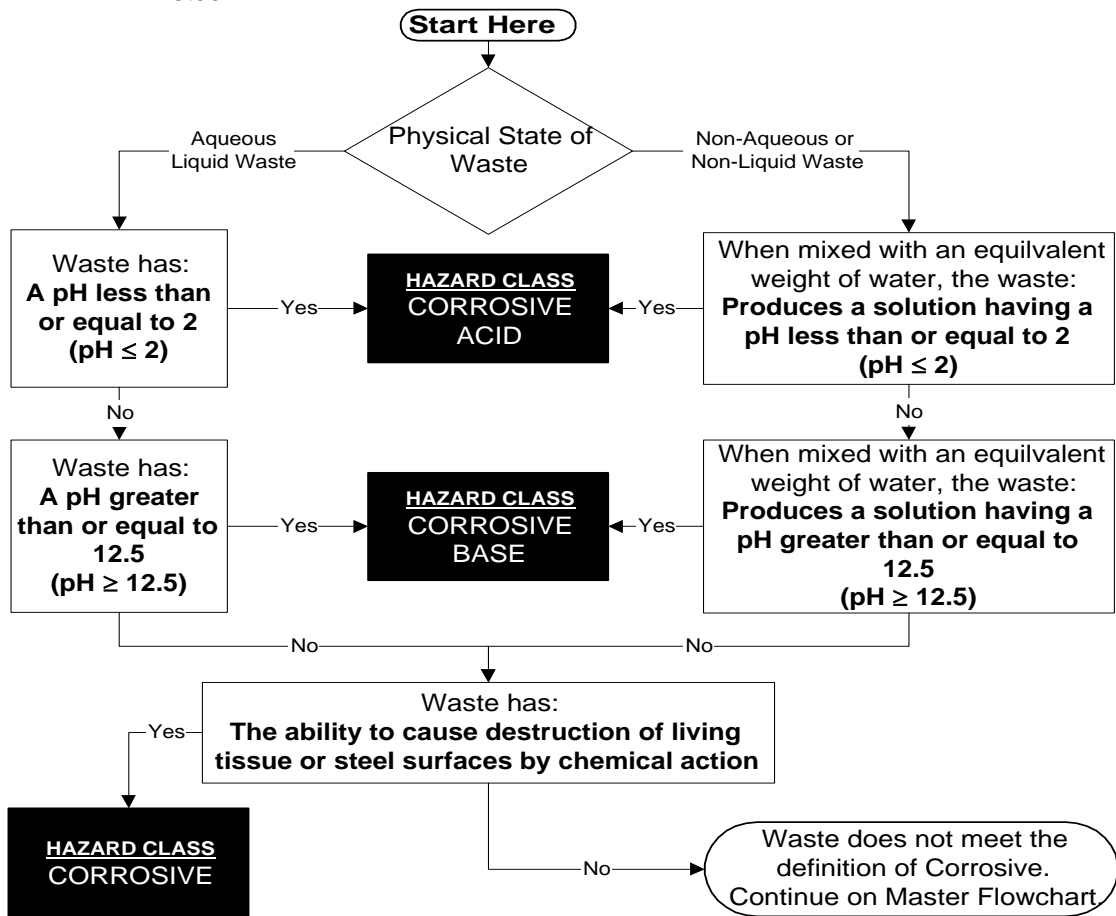
Characteristics

A liquid that:

- is aqueous and has a pH less than or equal to 2 ($\text{pH} \leq 2$) or greater than or equal to 12.5 ($\text{pH} \geq 12.5$), or
- corrodes steel, or
- causes destruction of living tissue

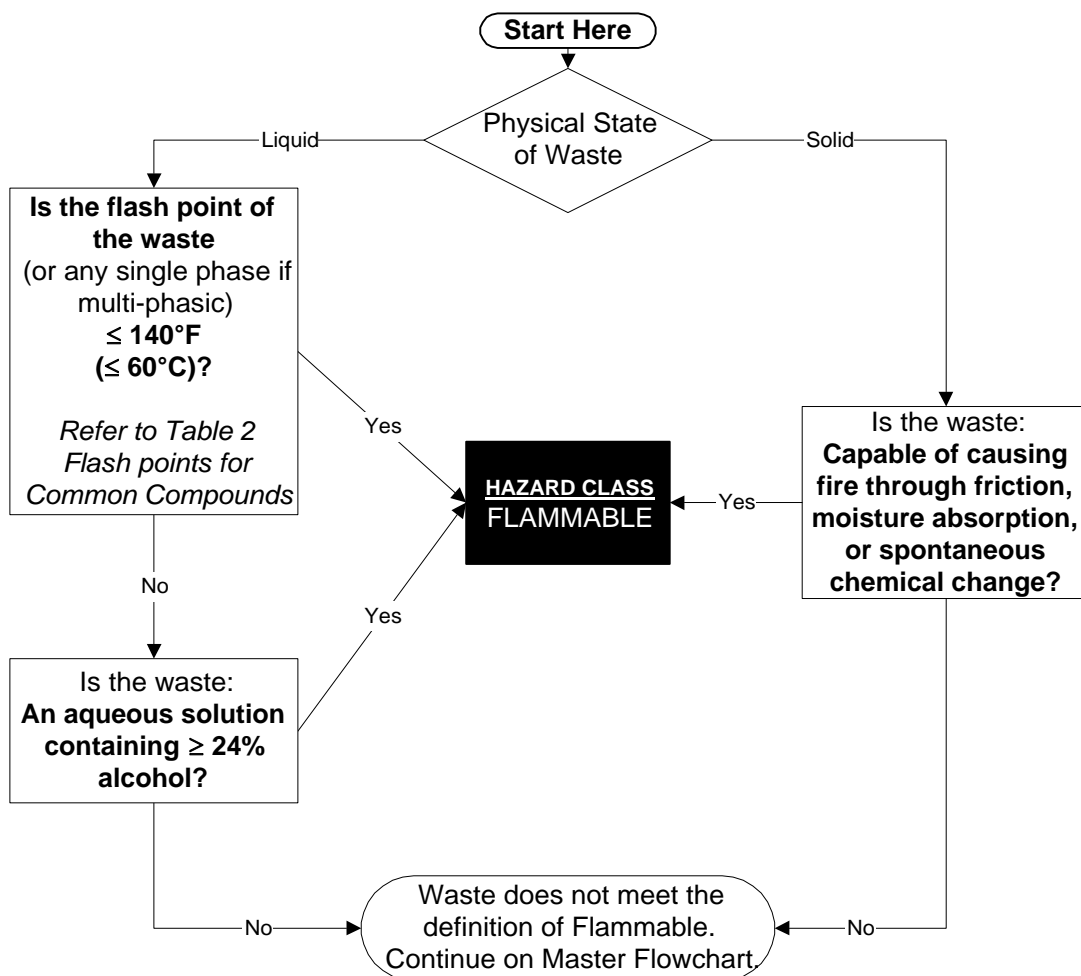
A non-aqueous or non-liquid waste that:

- when mixed with an equivalent weight of water, produces a solution having a pH less than or equal to 2 ($\text{pH} \leq 2$) or greater than or equal to 12.5 ($\text{pH} \geq 12.5$)
- when mixed with an equivalent weight of water, produces a liquid that corrodes steel



FLAMMABILITY**Characteristics**

A flammable material is any material “which will ignite easily and burn rapidly.”¹



¹ Lewis, Hawley's Condensed Chemical Dictionary 12th Edition, New York

Hazardous Waste Determination and Classification Guidelines

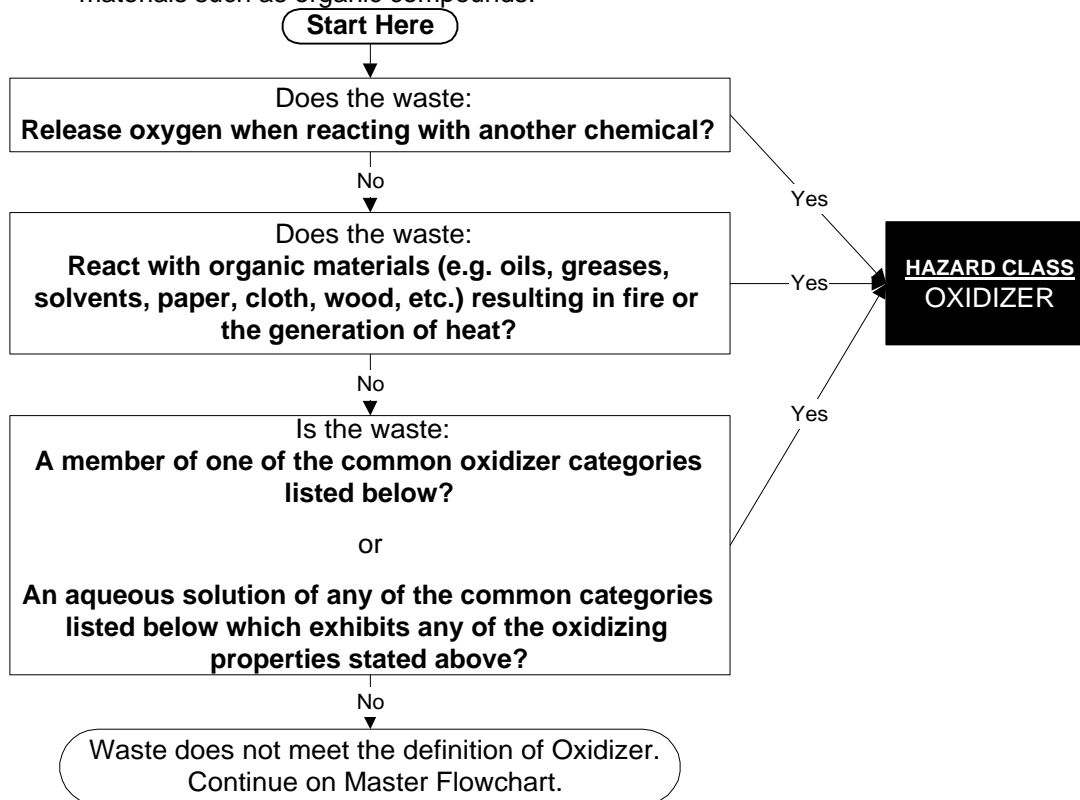
Table 2 FLASH POINTS FOR COMMON COMPOUNDS

Chemical	° F	° C
Acetic Acid	103	39
Acetone	-4	-20
Acetonitrile	42	6
Acetyl acetone (2,4-pentanedione)	93	34
Benzene	12	-11
1-Butanol	98	37
2-Butanol (sec butanol)	75	24
tert-Butyl alcohol	52	11
Bromopropene (allyl bromide)	30	-1
Carbon disulfide	-22	-30
Carbon tetrachloride	N/A	
Chloroform	N/A	
Cyclohexane	-4	-20
1,2-Dichlorobenzene	150	66
1,2-Dichloroethylene	36	2
Diethylamine	-9	-23
DMF (dimethylformamide)	136	58
DMSO (dimethyl sulfoxide)	203	95
1,4-Dioxane	54	12
Ethanol - 30%, aqueous	85	29
Ethanol - 50%, aqueous	75	24
Ethanol - 95%, aqueous	63	17
Ethanol - 100%	55	13
Ethyl acetate	24	-4
Ethyl ether	-49	-45
Ethylene dichloride (1,2-dichloroethane)	56	13
Formalin	122	50
Hexane	-7	-22
Isopropanol	53	12
Isopropyl ether	-18	-28
MEK (methyl ethyl ketone)	156-170	69-77
Mercaptoethanol	165	74
Methylene chloride	N/A	N/A
Methanol	52	11
Morpholine	98	37
Mineral oil	380	193
Nitrobenzene	190	88
Nitromethane	95	35
p-Dioxane	54	12
Pentane	<-40	<-40
Petroleum ether	<0	<-18
Phenol	175	79
Piperidine	61	16
Propanol	74	23
Propylene carbonate	275	135
Pyridine	68	20
Sulfolane	350	177
THF (tetrahydrofuran)	6	-14
Toluene	40	4
Xylenes	81-90	27-32

Note: For dilute solutions and mono-phasic mixtures, consider the waste to be flammable if **ANY ONE COMPONENT**, in its pure form, has a flash point $\leq 140^{\circ}\text{F}$ (60°C), unless you are confident that the mixture's flash point does not meet the criteria.

OXIDIZING**Definition**

An oxidizing material is “any compound that spontaneously evolves oxygen either at room temperature or under slight heating. The term includes such chemicals as peroxides, chlorates, perchlorates, nitrates and permanganates. These can react vigorously at ambient temperatures when stored near or in contact with reducing materials such as organic compounds.”²

**Examples****SOLIDS**

Bismuthates	Ferric chloride	Perborates
Bromates	Ferric trioxide	Perchlorates
Ferric sulfate	Ferricyanides	Periodic acid
Chlorates	Hypochlorites	Permanganates
Chlorites	Iodates	Permanganic acid
Chromates	Iodine	Peroxides
Chromium trioxide	Manganese dioxide	Persulfates
Dichromates	Nitrates	

LIQUIDS

Bromine	Hydrogen peroxide	Perchloric acid (pH > 2) *
Chromic acid (pH > 2) *	Nitric acid (pH > 2) *	Sulfuric acid (pH > 2) *

* Oxidizing mixtures having a pH ≤ 2 are classified as corrosive.

² Sax and Lewis, Hawley's Condensed Chemical Dictionary 11th Edition, New York

TOXICITY

The determination of a waste as a hazardous waste due to its toxicity is a process that is complicated by many lists and many different criteria. In an attempt to provide guidelines that are relatively straightforward, only the lists and criteria of general applicability are summarized in these guidelines. Before determining that a questionable waste is not toxic, please check with EHS (x9-3086 or x9-5394) so we can look at the complete regulatory requirements.

Rule Of Thumb: If you're reluctant to eat, drink or wear your waste, California probably considers it to be a toxic hazardous waste

Characteristics

Acute Lethal Dose Assessment *

- **Acute oral LD₅₀** < 2,500 mg/kg is a toxic hazardous waste**

While the regulations do not specify the organism to be used in determining the LD₅₀, convention dictates the use of rat oral LD₅₀ information when available.

** Toxicity regulations include, in addition to the oral LD₅₀, criteria for dermal LD₅₀, inhalation LD₅₀ as well as aquatic LD₅₀. For the sake of simplicity, these criteria are not presented here. If you think one of these criteria may be important in classifying your waste, contact EHS (x9-3086).*

Calculating LD₅₀s

The LD₅₀ for a simple solution of a single toxic material can be calculated using the solution's dilution factor. A 10% solution of a toxic material (a 10-fold dilution) would have an LD₅₀ 10 times greater than the pure substance.

The LD₅₀ for a mixture of toxic materials can be calculated from the sum of the individual component LD₅₀s as weighed by each component's proportional abundance in the mixture. EHS (x9-3086 or x9-2553) can provide assistance in calculating LD₅₀s.

Example acute oral LD₅₀s (rat):

Example	LD ₅₀ (mg/kg)
Citric acid (solid)	3,000
10% Citric acid Soln.	30,000
Acetone	5,800
Benzoic acid	1,700
Caffeine	192

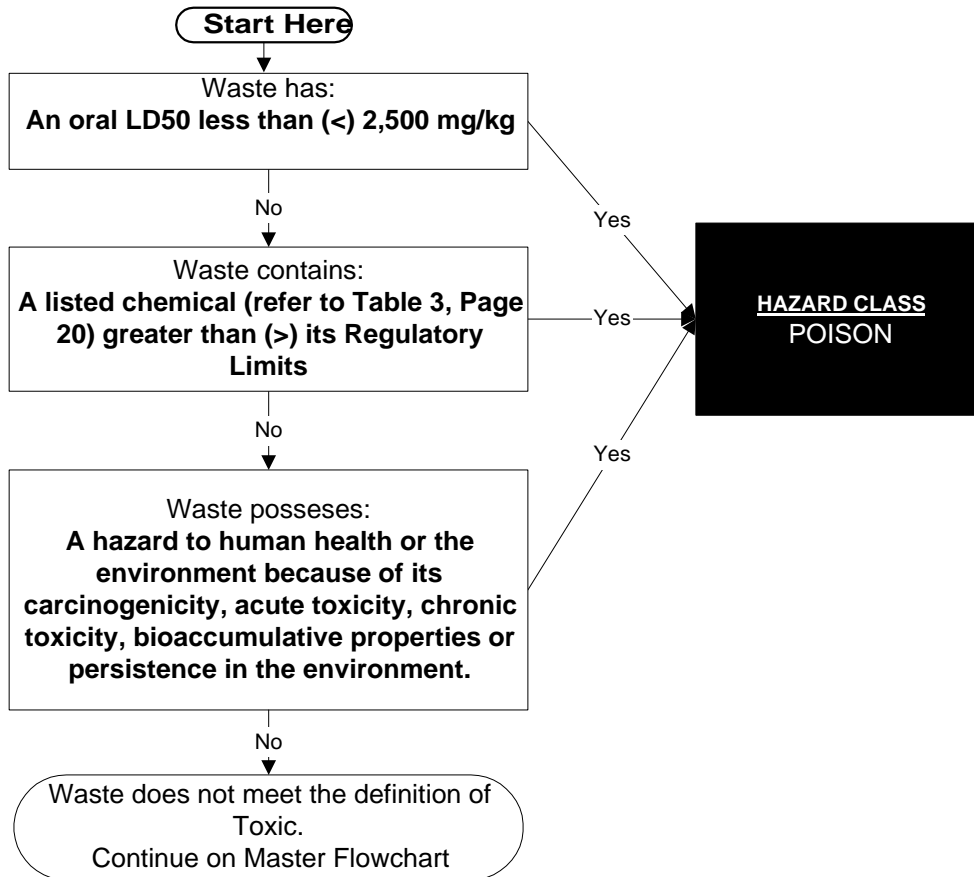
Toxic Constituent Assessment

The hazardous waste regulations include several lists of toxic constituents (or contaminants) and concentrations of these materials that would automatically make a waste a hazardous waste. Some lists include concentration limits for constituents in liquids or for the leachable portion of the constituent. Other lists include limits for the total portion of toxic constituent (soluble and insoluble).

Table 3 summarizes the more commonly encountered constituents and their established regulatory limits. Please keep in mind that this table is a non-inclusive summary and is meant to serve as a guideline in characterizing toxic waste, not as a definitive yardstick.

** LD₅₀ - The dose that has been determined to be lethal to 50% of the test population.

Toxicity Determination Flowchart



**TOXIC CHEMICAL WASTE
NON-INCLUSIVE LIST
MAXIMUM CONSTITUENT THRESHOLDS**

Table 3 Constituent	REGULATORY LIMITS *		
	Liquids	Solids	
	Concentration mg/L	Soluble Portion mg/Kg	Total Portion (soluble & insoluble) mg/Kg
Acrylonitrile	---	---	10
Antimony	15	15	500
Arsenic	5.0	5.0	500
Barium	100	100	10,000
Benzene	0.5	0.5	---
Benzidine	---	---	10
Beryllium	0.75	0.75	75
Cadmium	1.0	1.0	100
Carbon tetrachloride	0.5	0.5	---
Chlorobenzene	100	100	---
Chloroform	6.0	6.0	---
Chromium(VI)	5.0	5.0	500
Chromium(III)	5.0	5.0	2,500
Cobalt	80	80	8,000
Copper	25	25	2,500
Cresol (o,m,p,mix)	200	200	---
p Dichlorobenzene	7.5	7.5	---
1,2-Dichloroethane	0.5	0.5	---
1,1-Dichloroethylene	0.7	0.7	---
4-Dimethylaminoazobenzene (DAB)	---	---	10
2,4-Dinitrotoluene	0.13	0.13	---
Dioxin	0.001	0.001	0.01
Ethyleneimine	---	---	10
Fluoride salts	180	180	18,000
Lead	5.0	5.0	1,000
(organic lead compounds)	(5.0)	(5.0)	(13)
Mercury	0.2	0.2	20
Methyl ethyl ketone	200	200	---
Molybdenum	350	350	3,500
Naphthylamine	---	---	10
Nickel	20	20	2,000
Nitrobenzene	2	2	---
N-Nitrosodimethylamine (DMN)	---	---	10
Pentachlorophenol	1.7	1.7	17
Pesticides (varies)	0.1	0.1	1.0
Pyridine	5.0	5.0	---
Selenium	1.0	1.0	100
Silver	5.0	5.0	500
Tetrachloroethylene	0.7	0.7	---
Thallium	7.0	7.0	700
Trichloroethylene	0.5	0.5	2040
Vanadium	24	24	2,400
Zinc	250	250	5,000

* For compounds containing listed elements, concentration of the element (not the compound)
1 mg/kg = 1 ppm = 0.0001%

Table 1: EXTREMELY HAZARDOUS WASTE

Definition

A waste or material is extremely hazardous if human exposure may result in death, disabling personal injury or serious illness because of its carcinogenicity, high acute toxicity, chronic toxicity, bioaccumulative properties, or persistence in the environment.

Accumulation Time

Quantities of up to a quart of extremely hazardous waste may be accumulated at one time. Once this threshold is reached the waste must be removed within 72 hours. Please submit your waste pickup request and flag the waste for immediate pickup.

The chemicals listed below are presumed to be extremely hazardous wastes. The list is **NOT** definitive and every generator should evaluate their waste with regard to the above definition of extremely hazardous waste.

General categories of listed chemicals

Arsenic and arsenic compounds
 Beryllium and beryllium compounds
 Boranes (BxHy)
 Cadmium and cadmium compounds
 Cyanide, cyanide salts and cyano compounds
 Dioxin compounds
 Halogenated silanes
 Hypochlorite compounds
 Lead and organo-lead compounds
 Mercury and mercury compounds
 Metal hydrides
 Pesticides
 Platinum compounds
 Polychlorinated Biphenyls (PCBs)
 Selenium and selenium compounds
 Thallium and thallium compounds

antimony pentachloride
 antimony pentafluoride
 arsenic and arsenic compounds
 aziridine
 benzene hexachloride
 benzenephosphorous dichloride
 benzenethiol
 benzidine and salts
 1,4-benzoquinone
 benzotrifluoride
 benzoyl chloride
 benzyl chloride
 benzyl chlorocarbonate
 benzyl chloroformate
 beryllium and beryllium compounds
 biphenyl
 boranes
 boron trichloride
 boron trifluoride
 bromine
 bromine pentafluoride
 bromine trifluoride
 3-bromo-1-propyne
 1-bromo-2-propanone
 bromoacetone
 bromomethane
 brucine
 2-butenal
 n-butyllithium and isomers
 cacodylic acid, esters and salts
 cadmium and cadmium compounds
 calcium
 calcium carbide
 calcium hydride
 calcium hypochlorite
 calcium oxychloride
 calcium phosphide
 carbon disulfide
 carbonic dichloride
 carbonyl chloride
 chlorine
 chlorine dioxide
 chlorine pentafluoride

Specifically listed Chemicals

acetyl chloride
 acetyl thiourea
 2-acetylaminofluorene
 acrolein
 acrylonitrile
 adiponitrile
 alkyl aluminum compounds
 allyl alcohol
 allyl trichlorosilane
 aluminum chloride (anhydrous)
 aluminum diethyl monochloride
 aluminum phosphide
 4-aminodiphenyl
 5-(aminomethyl)-3-isoxazol
 5-(aminomethyl)-3-isoxazolone
 aminopyridine (2- and 4-)
 N-(aminothioxomethyl) acetamide
 ammonium bifluoride
 ammonium picrate
 ammonium vanadate

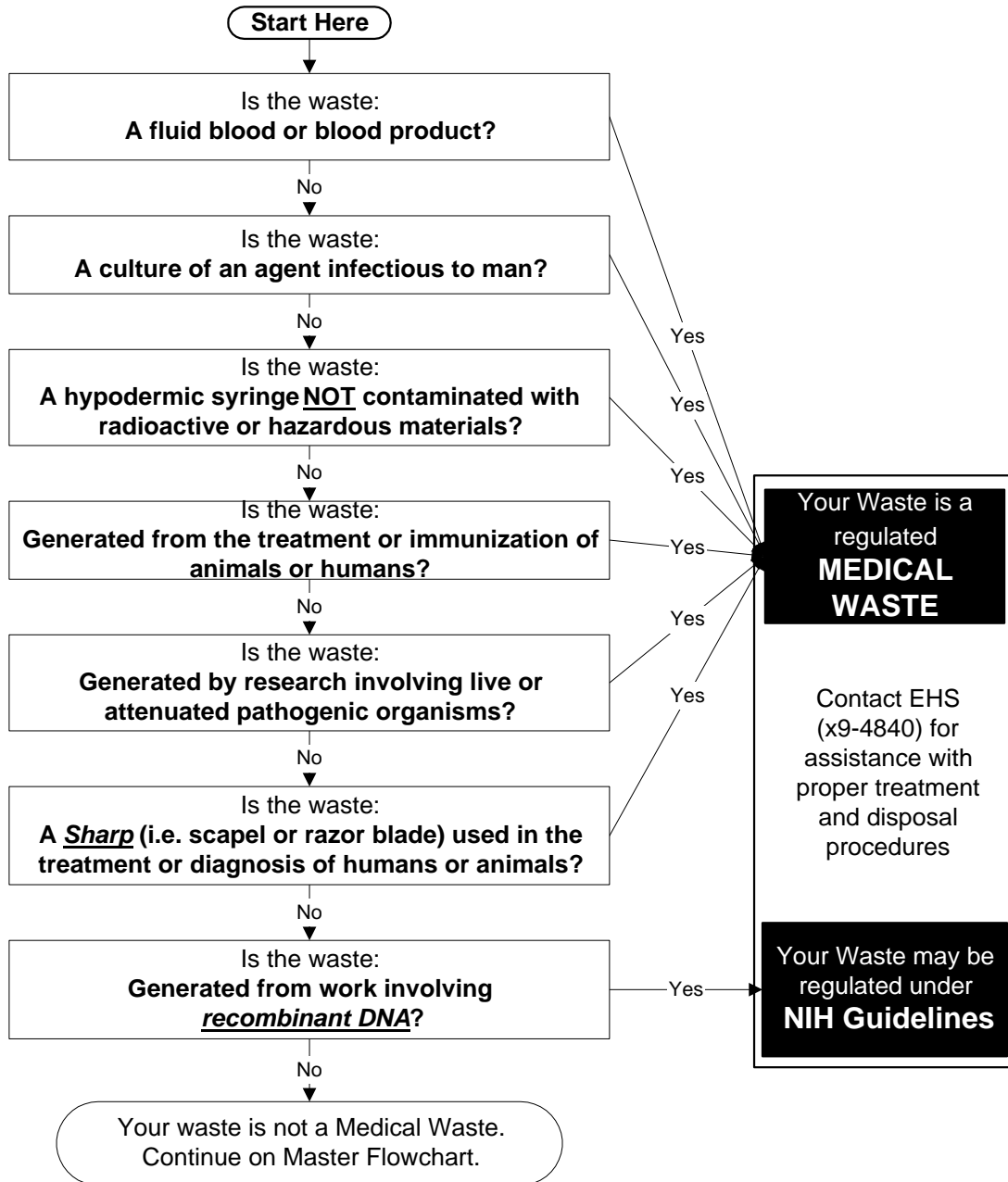
Hazardous Waste Determination and Classification Guidelines

chlorine trifluoride	hydrofluoric acid
chloroacetaldehyde	hydrogen phosphide
α -chloroacetophenone	hydrogen sulfide
chloroacetyl chloride	hydroiodic acid
<i>p</i> -chloroaniline	2-hydroxy-2-methylpropaneitrile
4-chlorobenzenamine	hypochlorite compounds
<i>o</i> -chlorobenzylidene malonitrile	<i>O</i> -isopropyl methyl phosphoryl fluoride
chlorochromic anhydride	lead, lead compounds and organo-lead compounds
chloromethylbenzene	lithium
<i>bis</i> (chloromethyl) ether	lithium aluminum hydride
<i>o</i> -chlorophenyl thioiurea	lithium amide
chloropicrin	lithium ferrosilicon
3-chloropropionitrile	lithium hydride
chlorosulfonic acid	lithium hypochlorite
chromyl chloride	magnesium
cyanide, cyanide salts	maleic anhydride
cyano compounds	mercury and mercury compounds
cycloheximide	metal hydrides
2-cyclohexyl-4,6-dinitrophenol	methyl acrolein
3,3-dichlorobenzidine and salts	methylaluminium sesquibromide
dichloromethyl ether	methylaluminium sesquichloride
2,4-dichlorophenoxyacetic acid	2-methylacetoneitrile
<i>O,O</i> -diethyl- <i>O</i> -pyrazinyl phosphorothioate	2-methylaziridine
diethyl- <i>p</i> -nitrophenyl phosphate	methyl bromide
<i>O,O</i> -diethyl- <i>S</i> - (isopropylthilmethyl)phosphorodithioate	methyl chlorocarbonate
diethylaluminum chloride	methyl chloroformate
diethylzinc	methyl chloromethyl ether
difluorophosphoric acid	2-methyl-4,6-dinitrophenol and salts
diglycidyl ether	4,4-methylene bis(2-chloroaniline)
diisopropylfluorophosphate	methyl hydrazine
α,α -dimethyl benzeneethanamine	methyl isocyanate
dimethylaminoazobenzene	methylmagnesium bromide
dimethylhydrazine	methylmagnesium chloride
dimethyl nitrosoamine	methylmagnesium iodide
α,α -dimethylphenethylamine	<i>N</i> -methyl- <i>N</i> -nitrosomethanamine
dimethyl sulfate	<i>N</i> -methyl- <i>N</i> -nitrosovinylamine
dimethyl sulfide	2-(1-methylpropyl)-4,6-dinitrophenol
dinitrobenzene	methyl yellow
4,6-dinitro cresol and salts	1-naphthalenylthiourea
dinitrophenol	naphthylamine (α and β)
dioxin compounds	α -naphthylthiourea
diphenyl	nickel carbonyl
diphosphoric acid, tetraethylester	nicotine and salts
disulfuryl chloride	nitric oxide
epinephrine	<i>p</i> -nitroaniline
<i>bis</i> (2,3-epoxypropyl) ether	4-nitrobenzenamine
ethanedinitrile	nitrobenzene
ethylchlorocarbonate	nitrobenzol
ethylchloroformate	4-nitrobiphenyl
ethyleneimine	nitrochloroform
ethylmercaptan	nitrogen dioxide
ethylzinc	nitroglycerine
fluorine	nitrophenol (<i>o,m,p</i>)
2-fluoroacetamide	<i>N</i> -nitrosodimethylamine
fluoroacetanilide	<i>N</i> -nitrosomethylvinylamine
fluoroacetic acid and salts	nitrotrichloromethane
fluoroboric acid	octamethyl-diphosphoramide
fluorosulfonic acid	octamethylpyrophosphoramide
fuming sulfuric acid	oleum (fuming sulfuric acid)
halogenated silanes	osmium tetroxide
hexaethyl tetraphosphate	oxy <i>bis</i> (chloromethane)
hydrazine	oxygen difluoride
hydrazinecarbothioamide	perchloromethyl mercaptan
hydrobromic acid	pesticides
hydrochloric acid	phenylbenzene
hydrocyanic acid	phenylthiourea
	phosgene

Hazardous Waste Determination and Classification Guidelines

phosphine
phosphoric acid, diethyl-4-nitrophenyl ester
phosphoric chloride
phosphoric sulfide
phosphorofluoridic acid, bis(1-methylethyl) ester
phosphorus (white or yellow)
phosphorus oxybromide
phosphorus oxychloride
phosphorus pentachloride
phosphorus pentasulfide
phosphorus sesquisulfide
phosphorous tribromide
phosphorous trichloride
phosphoryl bromide
phosphoryl chloride
platinum compounds
polychlorinated biphenyls
potassium
potassium bifluoride
potassium hydride
propanenitrile
1,2,3-propanetriol, trinitrate
propargyl alcohol
propargyl bromide
2-propen-1-ol
2-propenal
 β -propiolactone
1,2-propylenimine
2-propyn-1-ol
4-pyridinamine
pyrosulfuryl chloride
quinone
selenium and selenium compounds
silicon chlorides
silver acetylde
sodium
sodium aluminum hydride
sodium amide
sodium azide
sodium bifluoride
sodium cacodylate
sodium fluoroacetate
sodium hydride
sodium hypochlorite (chlorine bleach)
sodium methoxide
sodium methylate
sodium peroxide
sodium potassium alloy
strychnine and salts
sulfonyl chloride
sulfonyl fluoride
sulfur chloride
sulfur mustard
sulfur oxychloride
sulfur pentafluoride
sulfuryl chloride
sulfuryl fluoride
tellurium hexafluoride
tetraethyldithiopyrophosphate
tetraethyl pyrophosphate
tetramethyl succinonitrile
tetranitromethane
tetraphosphorus trisulfide
thallium and thallium compounds
thiocarbonyl chloride
thionyl chloride
thiophenol
thiophosgene
thiosemicarbazide
titanium tetrachloride
toluene-2,4-diisocyanate
trichloroborane
trichloromethanethiol
trichloromethylsulfenylchloride
trichloronitromethane
trifluoromethylbenzene
2,4,6-trinitrophenol, ammonium salt
vanadium oxides
vinyl chloride
zinc phosphide
zirconium chlorides

MEDICAL WASTE



LIQUID WASTE DISPOSAL FLOWCHART

