

UNIVERSITY OF KANSAS
LAWRENCE CAMPUS

LABORATORY SAFETY
MANUAL

PART II

Chemical Hygiene/Safety Plan

November 2000 Revision

PART II

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1) Introduction to Chemical Hygiene/Safety

1.1) Elements of the KU Chemical Hygiene/Safety Plan (CHSP)

The KU Chemical Hygiene/Safety Plan consists of the following components:

1.1.1) The requirements, conditions and procedures of the "University's Safety and Health Manual" apply to all university laboratory users/occupants/visitors and are, therefore, part of the Chemical Hygiene/Safety Plan. See the Kansas University (Lawrence) Safety Program.

1.1.2) The requirements, conditions and procedures of Part I of this Laboratory Safety Manual apply to all university laboratory users/occupants/visitors and are, therefore, part of the Chemical Hygiene/Safety Plan.

1.1.3) The requirements, conditions, and procedures of this part (Part II) apply to all university laboratory users/occupants/visitors in laboratories with chemicals. For Chemical Safety Levels III and IV (see Glossary) additional requirements, conditions, and procedures based upon the characteristics of the EHS Safety Authorization-Requiring Hazardous Chemicals will be specified in the Laboratory-Specific Safety Plan(s) required for the use of such materials. See section 3.9.3 of this part for chemicals specified as EHS Safety Authorization-Requiring Hazardous Chemicals.

1.1.4) This Part II in conjunction with the items specified in 1.1.1, 1.1.2, and 1.1.3, above, make up the University's Chemical Hygiene Plan as required under the OSHA Lab Standard (29 CFR 1910.1450). (See Part I: Chapter 1-Section 1.1.1 for further details.)

1.2) Chemical Considerations

Since exposure by hazardous chemicals may be by skin or eye contact, absorption through skin or mucous membranes, ingestion, injection by puncture, or inhalation, the safety procedures and engineered safeguards implemented in the lab must address protection against these modes of exposure. Because the same modes of exposure apply to biological and radioactive materials, the "universal" safety procedures and safeguards are covered in Part I of this Laboratory Safety Manual. When animals are used, the behavior of the animals, in addition to the vectors they may carry, must also be considered in establishing safety procedures and safeguards.

Note: If animals are used, the Biosafety Plan is automatically applicable and Authorized Users shall be trained in both components.

1.3) Organization of Part II

1.3.1) Chemical Hygiene/Safety-specific operating procedures and/or emphasized universal safety operating procedures (Standard Operating Procedures) are addressed in Chapter 2.

1.3.2) Chemical Hygiene/Safety-specific aspects of hazard communication and control are addressed in Chapter 3.

1.3.3) How to obtain EHS Safety Authorizations for work at Chemical Hygiene/Safety Levels III and IV is described in Chapter 3.

1.3.4) Chemical Hygiene/Safety-specific information and training requirements are outlined in Chapter 4.

1.3.5) Medical factors that may need to be considered for Chemical Hygiene/Safety are listed in Chapter 5.

1.3.6) Specific procedures for the safe disposal of hazardous chemical waste are addressed in Chapter 6.

1.3.7) Chemical Hygiene/Safety-specific recordkeeping is addressed in Chapter 7.

1.3.8) Appendices for the various chapters in this Chemical Hygiene/Safety Plan are provided in Chapter 8.

2) Standard Operating Procedures and Practices for Laboratories Using Chemicals

2.1) General Principles for Working Safely with Laboratory Chemicals

All individuals (authorized users, and authorized laboratory supervisors) using chemicals in a laboratory shall:

- 2.1.1) Pursue the goal of minimizing all chemical exposures to a level “as low as reasonably achievable.”
- 2.1.2) Avoid underestimation of chemical risks.
- 2.1.3) Establish and maintain adequate ventilation when working with chemicals.
- 2.1.4) Observe established Action Levels, Permissible Exposure Limits, and Threshold Limit Values for chemicals and keep exposures below them.
- 2.1.5) Comply with the Requirements of this KU Chemical Hygiene/Safety Plan.

2.2) Review of Universal Standard Operating Procedures for Chemicals

Note: This section provides references back to the Universal Standard Operating Procedures in Laboratories with Hazardous Materials provided in Part I, as applicable for achieving Chemical Hygiene/Safety. References to Part I are given.

All individuals (authorized users, and authorized laboratory supervisors) using chemicals in the laboratory shall:

- 2.2.1) Responsibilities under SOPs
 - 2.2.1.1) Fulfill their responsibilities as identified under SOPs in Part I: Section 2.1 (specifically 2.1.1 through 2.1.4).
- 2.2.2) Procurement of Chemicals
 - 2.2.2.1) Procure chemicals in accordance with the SOPs identified in Part I: Section 2.2.

2.2.3) Chemical Receipt and Distribution

2.2.3.1) Receive and distribute chemicals in accordance with the SOPs identified in Part I: Section 2.3.

2.2.4) Chemical Storage

2.2.4.1) Store chemicals in accordance with the SOPs identified in Part I: Section 2.4.

2.2.5) General Lab Safety Practices/Conduct with Chemicals

2.2.5.1) Comply with and enforce the access restrictions applicable to visitors and/or non-laboratory authorized occupants in rooms with chemicals as identified in Part I: Section 2.5.1.

2.2.5.2) Comply with and enforce the access restrictions applicable to individuals who are Authorized Occupants in rooms with chemicals as identified in Part I: Section 2.5.2.

2.2.5.3) Follow the general lab safety practices identified in Part I: Section 2.5.3. when working with chemicals.

2.2.6) Specialized Safe Laboratory Practices/Conduct

2.2.6.1) Adhere to each of the specialized safe laboratory practices/conduct when working with chemicals, as applicable. These are identified in Part I: Section 2.6 (specifically 2.6.1 through 2.6.15).

2.2.7) Hazard Specific Safety Procedures

2.2.7.1) Follow hazard-specific laboratory safety procedures as identified in Part I: Section 2.7.

2.2.7.2) Follow chemical hazard-specific safety procedures as identified in Part II: Section 2.3

2.2.8) Laboratory-Specific SOPs

2.2.8.1) Develop and implement laboratory-specific SOPs in accordance with Part I: Section 2.8.

2.2.9) Emergency Procedures

2.2.9.1) Adhere to the general emergency procedures identified in Part I: Section 2.9.

2.3) Chemical Hygiene/Safety-Standard Procedures

2.3.1) Restricted or controlled access to Laboratory during chemical operations

The Authorized Laboratory Supervisor (ALS) shall:

2.3.1.1) Evaluate the need for restrictions on access to the laboratory during critical chemical operations within the laboratory, instruct the Authorized Users and Authorized Occupants concerning the nature of those restrictions and include those instructions in the laboratory-specific Standard Operating Procedures.

Note: This includes an evaluation of the need to inform visitors, authorized occupants, and even authorized users of special risk factors. Some individuals may be susceptible to allergic reactions to chemicals and other materials in the laboratory. All of these factors may need to be considered in establishing the level of control that is needed.

2.3.1.2) Implement any/all access restrictions specifically required by EHS-approved Laboratory-Specific Safety Plans.

Authorized Users and Authorized Occupants shall:

2.3.1.3) Follow the instructions given by the Authorized Laboratory Supervisor concerning access restrictions.

2.3.2) Chemical Decontamination or Clean-up Techniques

The Authorized Laboratory Supervisor shall:

2.3.2.1) Establish effective decontamination procedures for the chemicals used in the laboratory.

NOTE: Appropriate procedures to be used for decontaminating equipment, instruments, glassware, and laboratory benches, etc., must be developed as part of the laboratory-specific standard operating procedures.

2.3.2.2) Train Authorized Users in these procedures and provide these in writing as part of the laboratory-specific procedures.

2.3.2.3) Enforce the use of such procedures by Authorized Users.

Authorized Users shall:

2.3.2.4) Isolate equipment and glassware potentially contaminated with hazardous chemicals and appropriately mark/label such materials until decontamination is accomplished.

NOTE: This means that such equipment and glassware must be kept in a “reserved area that is appropriately labeled” and in appropriate containers.

2.3.2.5) Decontaminate equipment/glassware in an expedient fashion using the procedure stipulated in the laboratory-specific Standard Operating Procedures.

a) Use appropriate protective clothing and equipment in handling chemically contaminated items.

2.3.2.6) Clean work areas at the end of an experiment or the end of the day, whichever comes first, using the laboratory-specific decontamination procedures. (Note: This is the minimum frequency. Judgment is to be used in deciding whether the frequency should be greater.)

2.3.2.7) Clean work areas after any known chemical contamination episode or suspected episode.

2.3.3) Storage Containers for Chemicals

The Authorized Users shall:

2.3.3.1) Collect, handle, process and store all chemicals in accordance with requirements previously identified in section 2.2.4 of this Part II. Containers used to store chemicals shall be compatible with the materials being stored, leak-proof, and corrosion resistant.

2.3.3.2) Label each container in accordance with the requirements specified in section 3.4.3 of this Part II.

2.3.4) Chemical Waste

Authorized Users and Authorized Laboratory Supervisors shall:

2.3.4.1) Comply with the requirements identified in Part II: Chapter 6 for safe disposal of all chemicals.

2.3.5) Shipping and Transporting Hazardous Chemicals

Authorized Users and Authorized Laboratory Supervisors shall:

2.3.5.1) Not ship or transport chemicals off campus via postal or private express services without prior consultation with EHS concerning applicable federal and state regulations that must be satisfied.

2.3.5.2) Not transport chemicals across or off campus in personal vehicles.

2.3.5.3) Not transport chemicals across or off campus in University-owned vehicles without prior consultation with EHS concerning applicable federal and state regulations that must be satisfied.

NOTE: Only someone with the appropriate training in these regulations may prepare and send shipments of chemicals or transport them.

2.3.5.4) Contact EHS for assistance in determining appropriate procedures and protocols to be followed when needing to ship samples of synthesized or unknown compounds across or off campus.

2.4) Specific Procedures for Working with Flammable/Combustible Liquids & Gases

These are materials that, under standard conditions, can generate sufficient vapor to cause a fire when in the presence of an ignition source. Liquids that have a flash point below 100°F (38°C) are considered "flammable liquids." Liquids that have flash points at or above 100°F (38°C) are considered to be "combustible liquids." Fires may result when the invisible vapors from these materials come in contact with an ignition source, creating a flashback; or direct contact with an ignition source will cause these liquids to burn. Also, fire can result from reactions between flammable or combustible liquids and other compounds (e.g., oxidizers).

The National Fire Protection Agency (NFPA) places flammable and combustible liquids into the following classes:

	Flash Point	Boiling Point
Flammable Liquids		
Class IA	<73°F (22.8°C)	<100°F (37.8°C)
Class IB	<73°F (22.8°C)	>=100°F (37.8°C)
Class IC	>=73°F (22.8°C)	
Combustible Liquids		
Class II	>=100°F (37.8°C)&<140°F (60°C)	
Class IIIA	>=140°F (60°C)&<200°F (93°C)	
Class IIIB	>=200°F (93°C)	

NFPA and OSHA specify the maximum allowable container size for point of use storage in a laboratory:

Container Type	IA	IB	IC	II	III
Glass	1 pint	1 quart	1 quart	1 gallon	1 gallon
Metal or Approved Plastic	1 gallon	5 gallon	5 gallon	5 gallon	5 gallon
Safety Containers	2 gallon	5 gallon	5 gallon	5 gallon	5 gallon

(Exception): Glass containers as large as 1 gallon (3.785 L) may be used if the required liquid purity would be adversely affected by storage in a metal or an approved plastic container, or if the liquid would cause excessive corrosion or degradation of a metal or approved plastic container.

(Prohibition): Laboratories are not allowed to have containers of flammable or combustible liquids greater than 5 gallons in size in the lab without special EHS-approved Laboratory-Specific Safety Plans.

NFPA and OSHA regulate the maximum quantity of flammable/combustible liquids and gases that may be present in a laboratory. The limits are dependent upon the size of the lab, class of materials, and whether or not the materials are stored outside of an approved storage cabinet. Therefore, the following limits are set to identify levels that require Laboratory-Specific Safety Plans and the related Safety Authorization from the EHS:

Flammable/Combustible Liquids

Storage Type	EHS Level III LSSP Required
1) Unapproved Cabinets, Shelf or open storage/use	>30 gallons total (all classes)
a) Glass, plastic, or metal cans	>10 gallons total (all classes)
b) Approved Safety Containers	>20 gallons total (all classes)
c) Any single container (drum, tank, etc.)	> 5 gallons in size (any class)
2) Storage in Approved Safety Cabinets	>1 cabinet per lab
a) Class I liquids	> 30 gallons per cabinet
b) Class I, II, & III combined	> 60 gallons per cabinet

Flammable Gases

Type	EHS Level III LSSP Required
1) Flammable Gas Cylinders > Lecture size	>2 cylinders total
a) Hydrogen	>1 cylinder
2) Flammable Gas Cylinders - Lecture size	>5 lecture cylinders total

Some specific procedures for safe handling/usage of Flammable/Combustible Liquids & Gases are provided below. They are not intended to be all inclusive, but serve as minimum safety procedures to be followed when handling and using these materials. Specific safety instructions may be obtained from the Material Safety Data Sheet, container label, or by contacting the EHS Dept.

The Authorized Laboratory Supervisor shall:

2.4.1) Obtain the necessary EHS Safety Authorization with the associated LSSPs if the lab is or needs to store quantities in excess of those identified above. (See also Part I; EHS 3.9 and Part II: Section 3.9.)

2.4.2) Establish and maintain flammable and combustible liquids & gases storage and usage in the lab in accordance with the requirements above and procedures below. Provide adequate fire safety equipment as necessary.

2.4.3) Train and inform authorized users on flammable/combustible liquids & gases hazards, the safety procedures of this section, the appropriate action to take in the event of an emergency in the lab, and any provisions imposed by an applicable EHS-approved Laboratory-Specific Safety Plan (LSSP).

The Authorized User shall:

- 2.4.4) Eliminate ignition sources (open flames, smoking materials, hot surfaces, sparks from welding/cutting, electrical equipment, and static electricity) from areas where flammable/combustible liquids and gases are used or stored.
 - 2.4.5) Minimize the quantity of these materials within the work area.
 - 2.4.6) Store such materials in accordance with the container type size and storage type quantity limitations stated previously in this section and these procedures in 2.4.4 - 2.4.13.
 - 2.4.7) Segregate flammable/combustible liquids and gases away from oxidizers and other incompatible materials.
 - 2.4.8) Not store flammable liquids (flashpoint < 100°F (38°C)) in glass containers that exceed 1 liter in capacity. EXCEPTION: If chemical purity is a necessity and justifiable, then 4-liter glass containers are permissible as long as they are stored in an approved safety cabinet.
 - 2.4.9) Not store flammable/combustible liquids in Non-explosion-proof refrigerators/freezers.
 - 2.4.10) Establish and maintain proper bonding and grounding when transferring or dispensing flammable liquids from a larger containers into smaller ones.
 - 2.4.11) Establish and maintain appropriate sprinkler systems or fire extinguishers where flammable/combustible liquids or gases are used or stored.
- Note: Although the provision for these is the responsibility of the Authorized Laboratory Supervisor, the Authorized User shall not perform these procedures at any location for which these are not available.
- 2.4.12) Be familiar with the hazards of the flammable/combustible liquid & gases being used and the appropriate action to take in the event of a flammable/combustible liquids or gases emergency in the lab.
 - 2.4.13) Comply with all provisions required by an applicable EHS-approved Laboratory-Specific Safety Plan if one has been established for the lab.

2.5) Specific Procedures for Working with Corrosives

These materials are health hazards and chemically react at the point of contact to cause immediate, acute erosive effects (often visible burn-like damage) to tissues. Examples of corrosives include:

Strong Acids

Organic Acids such as: Glacial Acetic Acid, Acetic Anhydride, Chloroacetic Acid, Formic Acid, Phenol, Trichloroacetic Acid & etc.

Inorganic Acids such as: Hydrochloric, Hydrobromic, Hydroiodic, Hydrofluoric, Sulfuric, Nitric, Phosphoric, Perchloric, Chromic, Chromerge, No-Chromix, and etc.

Strong Alkali

Organic Bases such as: Amines, Diamines, Imines, Hydrazines, & etc.

Inorganic Bases such as: Metal (sodium, potassium, calcium-, etc.) Hydroxides, Metal Hydrides, Ammonia, Ammonium Hydroxide & Sulfide, Hydrazine, & etc.

Organic & Inorganic Halides

Various materials with anions of fluoride, chloride, bromide, iodide, sulfide, oxide, silane, etc., may be corrosive, especially when put into solution. This can include compounds such as: Aluminum Trichloride, Ammonium Bifluoride, Antimony Trichloride, Calcium Fluoride, Ferric Chloride, Sulfuryl Chloride, Thionyl Chloride, Phosphorous Pentachloride, Phosphorous Pentoxide, Sodium Bisulfate, Tin Chloride, Acetyl Chloride, Benzyl Chloride, Chlorotrimethylsilane, Dichlorodimethylsilane, etc.

Elemental Halogens

Compounds such as: Fluorine, Chlorine, Bromine, Iodine, Phosphorus

Corrosive Compounds	EHS Level III LSSP Required
Perchloric Acid (70% or greater concentration)	Any Quantity when being heated >100°F
Chlorine (gas)	>= 5 lbs total
Fluorine (gas)	>= 5 lbs total
Corrosive Liquids	>10 gallons total volume present
Corrosive Solids	>100 pounds total mass of all present
Corrosive Gases	Any cylinder > lecture size
Multiple Corrosive Lecture Cylinders	5 or more lecture cylinders

Some general procedures for safe handling/usage of Corrosives are provided below. They are not intended to be all inclusive, but serve as minimum safety procedures to be followed when handling and using corrosives. Specific safety instructions may be obtained from the Material Safety Data Sheet, container label, or by contacting the EHS Dept.

The Authorized Laboratory Supervisor shall:

- 2.5.1) Obtain the necessary EHS Safety Authorization if the lab is using/storing corrosives at quantities in excess of those identified above. (also see Part I: Section 3.9 and Part II: Section 3.9).
- 2.5.2) Establish and maintain corrosives storage and usage in the lab in accordance with the requirements above and procedures below. Provide adequate personal protective and safety equipment as necessary.
- 2.5.3) Train and inform authorized users specifically on corrosives hazards, the safety procedures of this section, the appropriate action to take in the event of a corrosives emergency in the lab, and any provisions imposed by an EHS-approved Laboratory-Specific Safety Plan.

Authorized User shall:

- 2.5.4) Wear eye protection (chemical safety goggles) and rubber gloves, as a minimum, when handling or using corrosives. A face shield, rubber apron, rubber boots, or other appropriate personal protective equipment may be necessary depending upon the work being performed.
 - 2.5.5) Always add acid to water (never the reverse) to avoid violent reaction and splattering.
 - 2.5.6) Establish and maintain an appropriate eyewash within the lab and a readily accessible safety shower within 100 ft of areas where corrosives are used and stored.
- Note: Although the provision for these is the responsibility of the Authorized Laboratory Supervisor, the Authorized User shall not perform these procedures at any location for which these are not available.
- 2.5.7) In the event of skin or eye contact with corrosives, immediately flush the affected area with cool water for at least 15 minutes. Remove contaminated clothing and get medical help immediately.
 - 2.5.8) Comply with all provisions required by any applicable EHS-approved Laboratory Safety Plan if one has been established for the lab.

2.6) Specific Procedures for Working with Reactives

Any solid, liquid, or gaseous chemical substances that are flammable solids, or have the potential to react rapidly so as to release relatively large amounts of energy and/or dangerous by-products (e.g., a toxic gas) are termed reactives.

Reactive Compounds	EHS Level III LSSP Required
All solid/liquid Reactives	=>1 pound of any single reactive compound
All solid/liquid Reactives	=>10 pounds total combined reactives in lab
Reactive Gases	Any cylinder > lecture size
Multiple Reactive Lecture Cylinders	5 or more lecture cylinders

Several groups of such substances are listed below with some simple precautions to be followed when handling them. They are not intended to be all inclusive, but serve as minimum safety procedures to be followed when handling and using reactives. Specific safety instructions may be obtained from the Material Safety Data Sheet, container label, or by contacting the EHS Dept. Refer to Part II: Appendix 8.2.6 for information on reactive chemical hazards. Appendix 8.2.6.1-Chemical Incompatibilities; Appendix 8.2.6.2 -Peroxidizable Compounds.

The Authorized Laboratory Supervisor shall:

2.6.1) Obtain the necessary EHS Safety Authorization if the lab is using/storing reactives at quantities in excess of those identified above. (also see Part I: Section 3.9 and Part II: Section 3.9).

2.6.2) Establish and maintain reactives storage and usage in the lab in accordance with the requirements above and procedures below. Provide adequate personal protective and safety equipment as necessary.

2.6.3) Train and inform authorized users specifically on reactives hazards, the safety procedures of this section, the appropriate action to take in the event of a reactives emergency in the lab, and any provisions imposed by an applicable Laboratory-Specific Safety Plan

The Authorized User shall:

2.6.4) Obtain prior review and approval by the laboratory supervisor before using or initiating any procedures with reactive compounds.

2.6.5) Comply with all provisions required by any applicable EHS-approved Laboratory-Specific Safety Plan if one has been established for the lab.

Flammable Solids (ignite readily, can burn vigorously and persistently)

2.6.6) Store and use minimal amounts. Keep away from ignition sources or protect from actions that can cause ignition.

Oxidizers (can react vigorously with organic materials or reducing agents)

2.6.7) Store and use minimal amounts. Keep these materials away from organic compounds, reducing agents, and flammable materials.

Peroxidizables (react with oxygen to form potentially explosive peroxides)

2.6.8) Keep quantities limited and consume materials before expiration date. Routinely check for the presence of peroxides before handling, especially after storage of six months or more. If bottles contain visible crystalline material, (do not touch these containers) put up a warning sign and notify EHS as soon as possible.

Air Reactives (Pyrophorics -can undergo spontaneous combustion)

2.6.9) Store and use minimal amounts. Actual materials should be stored and used in an inert atmosphere: (e.g., glove bag, dry box, Schlenk apparatus). Limit quantities to as small as possible.

Water Reactives (react violently with water to produce a flammable or toxic gas or other hazardous condition)

2.6.10) Store and use minimal amounts. Keep these materials away from water sources and they should be stored/used in well-ventilated areas (to help disperse flammable or toxic gases if there is an accident). Have dry sand or a Type D fire extinguisher available for emergencies.

2.7) Specific Procedures for Working with Explosive Compounds

Explosives are solid, liquid, or gaseous chemicals that can cause a sudden, almost instantaneous release of pressure, gas, and heat when subjected to shock, pressure, or high temperature. These compounds present the greatest, immediate danger to individuals in comparison to any other chemical compounds. Their acquisition, storage and use is highly regulated (some even require a federal license or permit) and demands the utmost in safety protection. Highly secure storage provisions and special safety practices are necessary. Because of this, any storage/use of regulated explosive compounds at any quantity requires an EHS Safety Authorization with the included Laboratory-Specific Safety Plan prior to the introduction of these materials in the lab.

Explosive Compounds	EHS-approved LSSP Required
Any ATF identified explosive compound(s)	any quantity requires a Level IV LSSP
Any DOT identified explosive compound(s)	any quantity requires a Level III LSSP
Potentially Explosive Compounds	See limits for Reactives (Section 2.6)

Several compounds are specifically identified as explosives, while many others are labeled “potential” explosives. Extreme care must be taken when working with any of the compounds identified as explosives or potential explosives. The fact that an explosive compound has been reported to have been prepared without incident is not adequate evidence that it is safe. Refer to Part II: Appendix 8.2.7 for further information on explosive chemicals. Appendix 8.2.6.1- Chemical Incompatibilities; Appendix 8.2.7.1- Potentially Explosive Compounds; Appendix 8.2.7.2-ATF & DOT Identified Explosives.

Some general procedures for safe handling/usage of explosive compounds are provided below. They are not intended to be all inclusive, but serve as minimum safety procedures to be followed when handling and using explosive compounds. Specific safety instructions may be obtained from the Material Safety Data Sheet, container label, or by contacting the EHS Dept.

The Authorized Laboratory Supervisor shall:

2.7.1) Obtain the necessary EHS Safety Authorization if the lab is using/storing any regulated (DOT or ATF) explosive compounds at any quantity. (See also Part I: Section 3.9 and Part II: Section3.)

2.7.2) Establish and maintain explosives storage and usage in the lab in accordance with the requirements above, procedures below, and any EHS-approved Laboratory-Specific Safety Plan . Provide adequate personal protective and safety equipment as necessary.

2.7.3) Train and inform authorized users specifically on explosives hazards, the safety procedures of this section, the appropriate action to take in the event of an explosives emergency in the lab, and any provisions imposed by an EHS-approved LSSP.

The Authorized User shall:

2.7.4) Obtain prior review and approval from Authorized Laboratory Supervisor before using or initiating any procedures with explosive compounds.

2.7.5) Heat such compounds only with a carefully controlled water or oil bath and shall NOT mix or grind them in the dry state.

2.7.6) Perform all operations involving the explosive compound behind a safety shield, wear a face shield and a long-sleeve laboratory coat, with appropriate protective gloves. Corresponding care must be observed in the storage of such compounds as well.

2.7.7) Never initiate or carry out reactions involving explosive compounds without:

2.7.7.1) Warning all other individuals in the lab;

2.7.7.2) Having at least one other person present in the area who is knowledgeable of the experiment and on stand-by to obtain assistance in the event of an emergency.

The Authorized User should:

2.7.8) Restrict the scale of the experiment involving the compound as a reactant or product to as small a mass as possible, preferably 1 gram or less.

2.8) Specific Procedures for Working with Particularly Toxic Chemicals

This section pertains to Select Carcinogens, Reproductive Toxins, and Chemicals with High Acute Toxicity, or Moderate to High Chronic Toxicity as identified by the following:

OSHA Listed Carcinogens (See Part II: Chapter 8 - Appendix 8.2.8.1.)

OSHA Regulated Substances (See Part II: Chapter 8 - Appendix 8.2.8.1.)

The National Toxicology Program (NTP) “Known or Reasonably Anticipated to be Carcinogens” List (See Part II: Chapter 8 - Appendix 8.2.8.2.)

The International Agency for Research on Cancer (IARC) “Carcinogenic or Probably Carcinogenic to Humans” List (See Part II: Chapter 8 - Appendix 8.2.8.3.)

Particularly Toxic Compounds	LSSP Required
OSHA Listed Carcinogens	Any Quantity - Level IV LSSP
OSHA Regulated Substances (EHS Group A)	Any Quantity - Level III LSSP
NTP “Known Carcinogens”- Group 1	Any Quantity - Level III LSSP
IARC “Group 1 Carcinogens”	Any Quantity - Level III LSSP
OSHA Regulated Substances (EHS Group B)	Any Quantity - Level II Notification
NTP “Reasonably Anticipated Carcinogens” - Group 2	Any Quantity - Level II Notification
IARC “Group 2A or 2B Carcinogens”	Any Quantity - Level II Notification

Compliance with the universal and chemical hygiene/safety standard operating procedures previously identified in this Part II will assist in assuring that chemical exposure of laboratory users/occupants/visitors is minimized or prevented. However, because of the high toxicity hazards of the compounds identified above, it is necessary for the laboratory to implement the following additional protective operating procedures when working with any of the compounds identified above:

Authorized Laboratory Supervisors shall:

2.8.1) Obtain the appropriate EHS Safety Authorization for procurement and use of these materials as required in Part I: Section 3.9 and Part II: -Section 3.9. The proposed Laboratory-Specific Safety Plan will need to provide specific operating procedures and hazard controls to be implemented for working with the compounds identified above and will specifically address in greater details the requirements below.

2.8.1.1) Establish a designated area for the storage and use of these materials, including access restrictions and proper hazard identification through warning signage. Assure that all laboratory users/occupants with access are aware of necessary safety precautions.

2.8.1.2) Provide proper containment devices such as hoods, glove boxes, work surfaces, etc. and personal protective equipment for protecting lab laboratory users/occupants from exposure. Enforce their use.

2.8.1.3) Develop and implement appropriate decontamination procedures and require compliance with those procedures.

2.8.1.4) See that all contaminated wastes are collected and removed in accordance with the procedures identified in Part II: Chapter 6 as well as any special waste conditions established in the Laboratory-Specific Safety Plan.

2.8.1.5) Inform and train all laboratory users/occupants in accordance with the chemical hygiene/safety requirements established in Part II: Chapter 4, as well as on all procedures, practices, and safety measures mandated by all applicable Laboratory-Specific Safety Plans and hazard information specific to the compound they are using.

Authorized Users shall:

2.8.2) Comply with all requirements set forth in applicable Laboratory-Specific Safety Plans for working with these compounds and the instructions/SOPs provided by the authorized laboratory supervisor.

3) Chemical Hygiene/Safety - Hazard Communication & Control

This chapter provides guidance on meeting the hazard communication and hazard control requirements of Chapter 3 of Part I and further detailed procedures for laboratories working with chemicals. This chapter should be used together with Chapter 3 of Part I.

3.1) General Chemical Hazard Control

The Authorized Laboratory Supervisor or Authorized User shall:

- 3.1.1) Utilize and comply with the general hazard control methods specified in Part I: Chapter 3 - Section 3.1 for addressing chemical hazards in his/her lab.
- 3.1.2) Not conduct any chemical activity in the lab for which it has not been properly designed, nor where appropriate engineering controls, personal protective equipment and/or safety equipment are not available.

3.2) Chemicals Hazard Control Responsibilities

- 3.2.1) The general hazard control responsibilities specified in Part I: Chapter 3 - Section 3.2 are applicable for addressing chemical hygiene/safety.

3.3) Lab Hazard Registration/Safety Authorization Application

The Authorized Laboratory Supervisor (ALS) shall:

3.3.1) For each lab under his/her jurisdiction, perform an assessment to identify chemical hazards present in their lab in accordance with Part I: Chapter 3 - Section 3.3.

3.3.2) Complete the LHRSA form and submit to EHS in accordance with the procedures identified in Part I: Chapter 3 - Section 3.3.

3.3.2.1) Attach a copy of the laboratory's chemical inventory list to the LHRSA form.

(Note: This information will be used by EHS to determine the laboratory's chemical safety hazard level (I, II, III or IV), fulfill emergency response information needs, and to prepare laboratory entrance postings.)

3.3.3) Update the LHRSA information whenever conditions change significantly and as required under Part I: Chapter 3 - Section 3.3 & Section 3.8.

3.3.4) Appropriately train and inform all Authorized Users and Authorized Occupants with respect to the hazards identified on this form.

3.3.5) A copy of the appropriate LHRSA form is available in Part I: Chapter 8 - Appendix 8.3.1.

3.4) Communication of Chemical Hazards in the Laboratory

3.4.1) Inventory of Hazardous Chemicals (Use with Part I-3.4.1)

The Authorized Laboratory Supervisor shall:

3.4.1.1) Establish and maintain an up-to-date inventory of all chemicals being used in the laboratory.

a) Include the following minimum information in the inventory:

- Identity of Chemical - (Product name or Chemical Name)
- Chemical's Manufacturer
- Location Information - (Building, Department, and Room# or Area)
- Quantity of Chemical Present - (Maximum Daily Amount)

b) Not introduce a new chemical into the laboratory unless it has been added to the inventory and all Authorized Users and Authorized Occupants have been appropriately trained and informed with respect to the new chemical.

3.4.1.2) Keep the inventory list readily available to any person entering the laboratory should they request to see it. (Repeat of Part I-3.4.1.3)

3.4.1.3) Submit a copy of the chemical inventory list to EHS a minimum of annually.

3.4.2) Material Safety Data Sheets for Hazardous Chemicals

Chemical manufacturers, importers, and distributors are required to send a Material Safety Data Sheet (MSDS) with the initial shipment of a chemical, or when MSDS information is updated. The MSDS contains detailed information about the chemical such as: product identity, chemical and common name(s), physical and chemical characteristics, physical and health hazards, employee exposure information, general precautions for safe handling and use, generally applicable control measures, emergency and first-aid procedures, and other pertinent information.

Federal and State regulations require the University to maintain in the work-place copies of the required MSDSs for each hazardous chemical present, and require that they are readily accessible to laboratory users/occupants (no barriers to immediate access by them) during each work-shift when they are in their work-areas. In order to achieve this, the following measures must be implemented:

The Authorized Laboratory Supervisor shall:

3.4.2.1) Make or verify that a Material Safety Data Sheet for each hazardous chemical present in the work-area is readily available to laboratory users/occupants within their work-area. An MSDS must be available for each chemical on the chemical inventory list.

(Note: Either a copy of the Material Safety Data Sheet must be physically present and readily available within the individual's workarea; or this information may be made available electronically (computer, campus ethernet, or Internet -- see www.ehs.ukans.edu/MSDS Links) via a computer readily accessible to laboratory users/occupants in their work-area.)

3.4.2.2) Initiate and document efforts undertaken to obtain the appropriate Material Safety Data Sheet if one is not available in the work area, or has not been received. Contact EHS for assistance in obtaining them.

Note: If a new compound is synthesized for which a Material Safety Data Sheet is not available, the Authorized Laboratory Supervisor shall create a Safety Data Sheet that furnishes comparable information based upon the best information available to the Supervisor about the properties of the compound--using comparisons with similar types of compounds, etc.

3.4.2.3) Include the information on the Material Safety Data Sheets or Safety Data Sheets in training laboratory users/occupants to become Authorized Users and Authorized Occupants.

The Authorized Laboratory Supervisor should (is encouraged to):

3.4.2.5) Keep a photocopy and forward original copies of Material Safety Data Sheets received by them to the EHS Office for inclusion in a centralized, campus repository. EHS currently has about 10,000 MSDSs on file.

Note: An example of a blank Material Safety Data Sheet may be found in Part II - Appendix 8.3.4.1.

3.4.3) Chemical Labeling

Chemical manufacturers, importers, and/or distributors are required to label, tag, or mark each container of hazardous chemical(s) leaving their workplace with the following information:

- Identity of the Hazardous Chemical,
- Appropriate Hazard Warning,
- Name and Address of the chemical manufacturer, importer, or other responsible party.

Various Federal and State regulations stipulate that labels on incoming containers of hazardous materials shall not be removed and that each container with chemicals in the work area shall be properly labeled so that laboratory users/occupants can immediately identify what chemical is present. In order to achieve this, the following measures must be implemented:

The Authorized Laboratory Supervisor shall:

- 3.4.3.1) Implement and maintain these container labeling requirements in their laboratories.

Authorized Users shall:

- 3.4.3.2) Not remove or deface the original label from incoming containers unless they immediately replace it with a label that provides the following required information:

- a) Identity of the Chemical,
- b) Appropriate Hazard Warning,
- c) Name and Address of the chemical manufacturer, importer, or other responsible party.

Note: Authorized Occupants shall not handle containers with hazardous chemicals for which they have not received the necessary training to become AUs and, therefore, shall not remove labels under any circumstances..

Note: The AU shall remove or obliterate labels only on empty containers that have no hazards associated with them. The AU shall not dispose of empty containers with hazardous warning labels in normal trash.

3.4.3.3) Place and maintain, at all times, a label, tag or mark on each non-original container of chemical stored, handled, and used in or by the laboratory with the following minimum information:

- a) Identity of the Chemical,
- b) Appropriate Hazard Warning

3.4.3.4) All container labels shall be legible, in English (as a minimum), and prominently displayed on the container.

Note 1: Clarification – It is understood that in some instances it may be virtually impossible to adequately label non-original chemical containers often used in the laboratory (such as test tubes, sample vials, beakers, flasks, etc.) with the information required above because of their relatively small size. Regulations do allow for the use of signs, placards, process sheets, batch tickets, SOPs, or other such written materials in lieu of affixing labels to individual containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required above in 3.4.3.3. The alternative written materials shall be readily accessible to the all lab laboratory users/occupants in their work area throughout each shift.

Note 2: Exception – Although prudent practice would dictate that all containers of chemicals should be labeled at all times, regulations do allow the following exception for chemical container labeling: “The employer (laboratory) is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee (lab person) who performs the transfer.” The unlabeled chemical container must be under the direct control of the individual at all times. If the chemicals will not be immediately used or are going to be left in the portable container unattended, the container must be labeled in accordance with 3.4.3.3 above.

Warning: The discovery of "orphan" (unknown and unclaimed) containers with any hazardous materials, which is inclusive of hazardous chemicals, is clear non-compliance with the safety requirements of this Laboratory Safety Manual!

3.4.4) Chemical Hazard Warning Signs

The Authorized Laboratory Supervisor shall:

3.4.4.1) For other than chemical containers, post, as required and/or necessary, the appropriate hazard warning signs identifying areas where chemical hazards are present inside the laboratory.

(Note: Regulations require that areas where certain compounds or chemical hazards are present be identified by warning signs, tags, etc. Contact EHS for assistance in identifying appropriate signage. For labs requiring Laboratory-Specific Safety Plans, this issue will be addressed as part of that LSSP.)

The Authorized User shall:

3.4.4.2) Post the appropriate hazard warning signs before initiating any operation or activity inside the lab that may present a chemical hazard.

3.4.5) Laboratory Entrance Posting

The Authorized Laboratory Supervisor shall:

3.4.5.1) Assist EHS in establishing the appropriate laboratory entrance posting(s) that identifies the chemical hazards present in the lab. This will be done in accordance with the procedures identified in Part I: Section 3.4.6.

a) This will consist of submittal of LHRSA form, chemical inventory list and consultation with EHS to determine chemical hazard levels.

3.4.5.2) Maintain readily visible laboratory entrance postings with up-to-date chemical hazard warning information.

3.4.5.3) Post Appropriate Access Restrictions.

Guidance Note: Access restrictions are to be evaluated by the Authorized Laboratory Supervisor for any Chemical Safety Level I or II Laboratories. Access might be restricted only during certain specifically identified procedures within the laboratory. In this case, temporary signs may need to be used which forbid entrance during those times. In other cases, access might be restricted just as it is for Levels III and IV.

3.4.5.4) Post requirements for any required medical status: exclusion of or special protection for persons with special susceptibilities--might include allergy sensitivities, etc.

3.5) Engineering Controls for Chemical Hygiene/Safety

The Authorized Laboratory Supervisor and Authorized Users shall:

3.5.1) Utilize and comply with the engineering control measures specified in Part I: Chapter 3 - Section 3.5 when working with chemicals. This includes:

3.5.1.1) Process Modifications (Part I: Section 3.5.1)

3.5.1.2) Physical Isolation/Containment (Part I: Section 3.5.2)

3.5.1.3) General Exhaust Ventilation (Part I: Section 3.5.3)

3.5.1.4) Laboratory Fume Hoods (Part I: Section 3.5.4)

3.5.1.5) Biological Safety Cabinets (Part I: Section 3.5.5)

3.5.1.6) Gloveboxes/Containment Devices (Part I: Section 3.5.6)

3.6) Personal Protective Equipment for Chemical Hygiene/Safety

The Authorized Laboratory Supervisor and Authorized Users shall:

3.6.1) Adhere to the personal protective equipment control measures specified in Part I: Chapter 3 - Section 3.6 when working with chemicals. This includes:

3.6.1.1) General PPE Measures (Part I: Section 3.6.1)

3.6.1.2) Head Protection Measures (Part I: Section 3.6.2)

3.6.1.3) Eye & Face Protection Measures (Part I: Section 3.6.3)

3.6.1.4) Hand & Body Protection Measures (Part I: Section 3.6.4)

3.6.1.5) Foot Protection Measures (Part I: Section 3.6.5)

3.6.1.6) Hearing Protection Measures (Part I: Section 3.6.6)

3.6.1.7) Respiratory Protection Measures (Part I: Section 3.6.7)

3.7) Safety Equipment for Chemical Hygiene/Safety

The Authorized Laboratory Supervisor and Authorized Users shall:

3.7.1) Adhere to the safety equipment control measures specified in Part I: Chapter 3 - Section 3.7 when working with chemicals. This includes:

3.7.1.1) Safety Shields/Containment (Part I: Section 3.7.1)

3.7.1.2) Safety Showers (Part I: Section 3.7.2)

3.7.1.3) Eye Wash Fountains (Part I: Section 3.7.3)

3.7.1.4) Fire Extinguishers (Part I: Section 3.7.4)

3.7.1.5) First Aid Kits (Part I: Section 3.7.5)

3.7.1.6) Storage Cabinets (Part I: Section 3.7.6)

3.7.1.7) Spill Control Kits (Part I: Section 3.7.7)

3.8) Laboratory Inspections/ Reviews for Chemical Hygiene/Safety

3.8.1) Laboratory Inspections/Reviews shall be conducted as specified in Part I: Chapter 3 - Section 3.8.1.

3.8.2) Deficiencies, Violations and Corrective Actions shall be handled in accordance with Part I: Chapter 3 - Section 3.8.3.

3.9) Safety Levels for the Chemical Hygiene/Safety Plan

Note: In this section, LSSP will be used for Laboratory-Specific Safety Plan

3.9.1) Introduction

Federal and State regulations require that the University's chemical hygiene/safety plan shall contain provisions for the proper protection of laboratory users/occupants from exposure to hazardous chemicals. This includes certain elements and specific measures for identifying the circumstances under which a particular laboratory operation, procedure or activity shall require prior approval by the University before implementation. There are also several regulations that either limit or require the University to report the types, amounts, and hazards of chemicals present. Some even require the University to seek special permits for procurement, storage, and use. Therefore, the following procedures have been developed to address compliance with these requirements and to provide safety for laboratory users/occupants.

3.9.2) Chemical Hygiene/Safety Levels

The following Chemical Hygiene/Safety Levels have been established to identify the severity of chemical hazards present in the lab and facilitate registration of hazards, approvals and establishment of Laboratory-Specific Safety Plans when needed.

3.9.2.1) Chemical Hygiene/Safety Level I

- a) No to minimal chemical hazards present, mostly non-hazardous chemicals. No known or only minimal chemical risks to laboratory users/occupants.
- b) No chemicals present that require a written EHS Safety Authorization.
- c) Authorized supervisor must approve all chemical users. This can be accomplished by meeting the chemicals safety-specific information and training requirements in Part II: Chapter 4 - Section 4.2 and 4.3.
- d) Authorized Supervisor must provide LHRSA and Chemical Inventory to EHS.

3.9.2.2) Chemical Hygiene/Safety Level II

- a) Slight to moderate chemical hazards present. Slight risk to laboratory users/occupants.
- b) No chemicals present that require a written EHS Safety Authorization.
- c) No chemicals present in a quantity that requires regulatory reporting.
- d) Authorized supervisor must approve all chemical users. This can be accomplished by meeting the chemicals safety-specific information and training requirements in Part II: Chapter 4 - Section 4.2 and 4.3.
- e) Authorized Supervisor must provide LHRSA and Chemical Inventory to EHS.

3.9.2.3) Chemical Hygiene/Safety Level III

- a) Severe chemical hazards present. Substantial risk to lab laboratory users/occupants.
- b) Chemicals present that require an EHS Safety Authorization and a written LSSP as described in Part I: Chapter 3 - Section 3.9.
- c) Chemicals present in a quantity that requires regulatory reporting.
- d) EHS will require all chemical users to have chemical safety-specific information and training in accordance with Part II: Chapter 4 - Sections 4.2 & 4.3 and may require additional training.

3.9.2.4) Chemical Hygiene/Safety Level IV

- a) Extreme chemical hazards present. High risk to laboratory users/occupants.
- b) Chemicals present that require an EHS Safety Authorization and a written LSSP as described in Part I: Chapter 3 - Section 3.9.
- c) Chemicals present in a quantity or type that requires regulatory reporting or a regulatory agency permit.

3.9.3) Chemical Hazards Present That Require an EHS Safety Authorization

Any laboratory meeting the criteria established for Chemical Hygiene/Safety Level III or IV must obtain an EHS Safety Authorization before it can initiate any Level III/IV laboratory activities. Identified below are the chemical hazard conditions or chemicals that require such Safety Authorizations.

3.9.3.1) Chemical Hygiene/Safety Level III

- a) Types and quantities of chemicals present that present a severe hazard and substantial risk to laboratory users/occupants.
- b) Type and quantity of chemicals present that require reporting to a Federal, State, or local regulatory agency.
- c) Flammable/Combustible Liquids or Flammable Gases present at or above the quantities below:

Flammable/Combustible Liquids

Storage Type	Level III LSSP Required
1) Unapproved Cabinets, Shelf or open storage/use	>30 gallons total (all classes)
a) Glass, plastic, or metal cans	>10 gallons total (all classes)
b) Approved Safety Containers	>20 gallons total (all classes)
c) Any single container (drum, tank, etc.)	> 5 gallons in size (any class)
2) Storage in Approved Safety Cabinets	>1 cabinet per lab
a) Class I liquids	> 30 gallons per cabinet
b) Class I, II, & III combined	> 60 gallons per cabinet

Flammable Gases

Type	Level III LSSP Required
1) Flammable Gas Cylinders > Lecture Size	>2 cylinders total
a) Hydrogen	>1 cylinder
2) Flammable Gas Cylinders - Lecture Size	>5 lecture cylinders total

d) Corrosive Liquids, Solids, or Gases present at or above the quantities below:

Corrosive Compounds	Level III LSSP Required
Perchloric Acid (70% or greater concentration)	Any Quantity when being heated
Chlorine (gas)	>5 lbs total
Fluorine (gas)	> 5 lbs total
Corrosive Liquids	>10 gallons total volume present
Corrosive Solids	>100 pounds total mass of all present
Corrosive Gases	Any cylinder > lecture size
Multiple Corrosive Lecture Cylinders	> 5 lecture cylinders total

e) Reactive Liquids, Solids, or Gases present at or above the quantities below:

Reactive Compounds	Level III LSSP Required
All solid or liquid reactives	=>1 pound of any single reactive compound
All solid or liquid reactives	=>10 pounds total combined reactives in lab
Reactive Gases	Any cylinder > lecture size
Multiple Reactive Lecture Cylinders	5 or more lecture cylinders

f) Potentially Explosive Compounds present at or above the quantities below:

Potentially Explosive Compounds	Level III LSSP Required
All Potentially Explosive Compounds	Same limits as Reactives above

g) Explosive Compounds present at or above quantities below:

Explosive Compounds	Level III LSSP Required
Any DOT identified explosive compound(s)	any quantity

h) Particularly Toxic Compounds at or above quantities below:

Particularly Toxic Compounds	Level III LSSP Required
OSHA Listed Carcinogen - Formaldehyde	Any Quantity
NTP Known Carcinogens - Group 1	Any Quantity
IARC Group 1 Carcinogens	Any Quantity
NTP "Reasonably Anticipated Carcinogens"-Group 2	Any Quantity - Level II Registration
IARC Listed "Group 2A or 2B Carcinogens"	Any Quantity - Level II Registration

3.9.3.2) Chemical Hygiene/Safety Level IV

- a) Types and quantities of chemicals present that present an extreme hazard and high risk to laboratory users/occupants.
- b) Type and quantity of chemicals present that require reporting to and a permit from a Federal, State, or Local regulatory agency.
- c) Explosive compounds present at or above the quantities below:

Explosive Compounds	Level IV LSSP Required
Any ATF identified explosive compound(s)	any quantity

- d) Particularly toxic chemicals present at or above the quantities below:

Particularly Toxic Compounds	Level IV LSSP Required
OSHA Listed Carcinogens (except Formaldehyde)	Any quantity

3.9.4) Process for Obtaining an EHS Safety Authorization

Go to section 3.9 of Part I and follow the procedures specified in 3.9.3.

Note: That section describes how an LSSP is to be developed including how the appropriate approvals may be obtained for the proposed LSSP. After the LSSP has been approved, EHS will perform an inspection to verify that all conditions of the LSSP have been met. After that verification, EHS will provide a written Safety Authorization that will permit the Laboratory Supervisor to begin use of the HM.

4) Chemical Safety-Specific Information & Training

Federal and State regulations, as well as “Prudent Practice,” require the University to provide all faculty, staff, students, and visitors with information concerning the chemical hazards present in their University environments, and sufficient training to enable them to perform their tasks safely and protect themselves from potential chemical exposure.

4.1) Review of Universal (Part I) Information & Training Requirements

Note: This section provides references back to the universal laboratory safety information and training requirements provided in Part I - Chapter 4, as applicable for achieving chemical hygiene/safety. References to Part I are given.

All individuals (authorized users, and authorized laboratory supervisors) using chemicals in a laboratory shall:

4.1.1) Responsibilities

4.1.1.1) Fulfill their responsibilities for universal laboratory safety information and complete training as identified in Part I - Chapter 4: Section 4.1 (Specifically 4.1.1 through 4.1.4)

4.1.2) Required Information

4.1.2.1) Be familiar with and make the required information specified in Part I - Chapter 4: Section 4.2 (specifically 4.2.1 through 4.2.4) available.

4.1.3) Required Training

4.1.3.1) Comply with the required training specified in Part I - Chapter 4 (specifically sections 4.3 through 4.5).

4.1.4) Frequency of Information & Training

4.1.4.1) Comply with the information and training frequency requirements specified in Part I - Chapter 4: Section 4.6.

4.1.5) Documentation of Information & Training

4.1.5.1) Comply with the information and training documentation requirements specified in Part I - Chapter 4: Section 4.7.

4.2) Chemical Hygiene/Safety-Specific Information

Authorized Laboratory Supervisors shall:

4.2.1) General Chemical Safety Information

4.2.1.1) Inform all users of chemicals in their labs with the information required under Part I - Chapter 4: Section 4.2.1.

4.2.2) Specific Chemical Safety Information

4.2.2.1) Review the Laboratory Hazard Registration and Safety Authorization (LHRSAA) form for their lab with all chemical users. (See Part II: Section 3.3 for details.)

4.2.2.2) Review the Inventory of Chemicals present in the lab with all chemical users. (See Part II: Section 3.4.1 for details.)

4.2.2.3) Inform all users of chemicals in their lab as to the location and accessibility of Material Safety Data Sheets for chemicals present in the lab. (See Part II: Section 3.4.2.)

4.2.2.4) Inform all users of chemicals in their labs as to specific areas inside the lab that have been marked with Chemical Hazard Warning Signs.

4.3) Chemical Hygiene/Safety-Specific Training

Authorized Laboratory Supervisors shall:

4.3.1) General Chemical Safety Training

4.3.1.1) Provide all users of chemicals and occupants in their labs with the initial lab safety training specified in Part I - Chapter 4: Section 4.7.1.

4.3.1.2) Train all users of chemicals in their labs on all of the following Standard Operating Procedures and Practices for Laboratories Using Chemicals found in Part II-Chapter 2: Sections 2.1 through 2.3. This includes:

- Section 2.1 - General Principles for Working Safely with Chemicals
- Section 2.2 - Universal SOPs for Chemical Hygiene/Safety
- Section 2.3 - Chemical Hygiene/Safety-Specific Procedures/Practices

4.3.2) Specific Chemical Safety Information

4.3.2.1) Train any chemical user who is working with a compound that falls under any of the specific chemical hazard class work procedures/practices identified in Part II-Chapter 2: Sections 2.4 through 2.8. This includes:

- Section 2.4 - Flammable/Combustible Liquids
- Section 2.5 - Corrosives
- Section 2.6 - Reactives
- Section 2.7 - Explosive Compounds
- Section 2.8 - Particularly Toxic Compounds

4.3.2.2) Train all users of chemicals in their labs on the Hazard Communication Procedures found in Part II-Chapter 3: Sections 3.1 through 3.3. This includes:

- Section 3.3 - Laboratory Hazard Registration & Safety Authorization Application (LHRSAA)
- Section 3.4.1 - Inventory of Hazardous Chemicals
- Section 3.4.2 - Materials Safety Data Sheets for Chemicals
- Section 3.4.3 - Chemical Container Labeling
- Section 3.4.4 - Chemical Hazard Warning Signs
- Section 3.4.5 - Laboratory Entrance Posting

4.3.2.3) Train all users of chemicals in their labs on the Special Requirements for Laboratory Facilities with Hazardous Chemicals found in Part II- Section 3.5 through Section 3.7. This includes the following hazard control procedures:

Section 3.5 - Engineering Controls (training must also include the references to procedures found Part I: Section 3.5, especially section 3.5.4 which addresses fume hoods).

Section 3.6 - Personal Protective Equipment (training must also include the references to procedures found Part I: Section 3.6, especially section 3.6.3, which addresses the State Mandate for wearing eye/face protection).

Section 3.7 - Safety Equipment (training on safety equipment that is present in the lab or readily available. Must also include the references made back to procedures found Part I: Section 3.7.)

4.3.2.4) Train all users of chemicals in their labs on any special requirements imposed upon the lab by an EHS-approved Laboratory-Specific Safety Plan (Refer to Part I: Section 3.9 and Part II: Section 3.9 and the actual LSSP itself).

4.3.2.5) Train all users of chemicals in their labs on Medical Factors to Consider for Chemical Safety provided in Part II - Chapter 5.

4.3.2.6) Train all users of chemicals in their labs on the Safe Disposal of Hazardous Chemical Waste Procedures found in Part II - Chapter 6.

4.3.2.7) Train all users of chemicals in their labs on any laboratory-specific chemical safety procedures which have been implemented by the laboratory supervisor that are above and beyond those identified in Part II of this manual.

4.4) Chemical Hygiene/Safety - Information & Training Frequency

Authorized Laboratory Supervisor shall:

4.4.1) Provide all users of chemicals in his/her labs with information and training at a frequency that is in accordance with that specified in Part I - Chapter 4:Section 4.6.

4.5 Chemical Hygiene/Safety - Information & Training Documentation

Authorized Laboratory Supervisor shall:

4.5.1) Document the training of all chemical users in his/her labs in accordance with the procedures specified in Part I - Chapter 4: Section 4.7.

5) Medical Factors to Consider in Chemical Safety

5.1) Introduction

This chapter identifies a number of medical factors (not necessarily complete) that may need to be considered in the establishment of laboratory-specific safety requirements and/or procedures when hazardous chemicals are being used. This chapter should be used together with Chapter 5 of Part I on exposure assessment and medical surveillance.

5.2) Medical Factors in Evaluating Access Restriction

The Authorized Laboratory Supervisor shall:

5.2.1) Individuals with allergies or chemical sensitivities

5.2.1.1) Determine whether there are any individuals within their lab(s) who may be allergic or sensitive to chemical products that are utilized and may become airborne in the laboratory. If there are, then laboratory-specific operating procedures shall be developed to protect these individuals from exposure. This may include providing special respiratory protection to such individuals if evaluation of the working conditions indicates the need for such protection.

5.3) Medical Care

The Authorized Laboratory Supervisor shall:

5.3.1) Emergency Response to Exposure to Hazardous Chemicals

5.3.1.1) Add laboratory-specific procedures to the general emergency procedures described in I-2.9 and I-5.3 that address any actions that need to be taken very quickly in order to reduce the magnitude of the medical consequences of the emergency if an evaluation indicates the need. The responding and attending medical services personnel need to know to what hazardous chemical(s) the person was exposed.

For example: these might include specific actions that can be taken immediately if an individual self-inoculates the chemicals through an accident with sharps; or is contaminated by a spill.

Note: There may be no action other than obtaining medical assistance as soon as possible but the possibility that there are actions that could be taken needs to be explored.

5.3.2) Effects of Chronic Exposure

5.3.2.1) Evaluate the risk of long-term adverse health effects subject to on-going exposure to the chemicals being used. If there are unique symptoms that need to be monitored or if there are medical tests that can monitor the status of exposure, appropriate provisions for such monitoring must be included in the Laboratory Standard Operating Procedures if the level of risk requires it.

5.3.3) Effects of Acute Exposure

5.3.3.1) Evaluate the risk associated with potential acute exposure (skin contamination, ingestion, or inhalation) to the chemicals agents in the laboratory and determine whether procedures need to be in place for responding to individuals who develop symptoms associated with such exposure.

5.3.4) Public Health Issues

5.3.4.1) Evaluate the potential for a public health risk associated with the use of the chemicals and the need for procedures that would minimize the risk of public health problems.

Note: Hopefully, in most cases, the evaluation will show that there is little cause for concern. The Authorized Laboratory Supervisor is responsible for having thoroughly researched and identified what is known concerning the risks associated with the chemicals the Authorized Laboratory Supervisor proposes to use.

5.4) Chemicals Requiring Mandatory Medical Surveillance

Federal regulations (29 CFR 1910 Subpart Z) identify several specific chemical compounds for which medical surveillance is mandated for individuals who are working with or in areas containing these compounds. Some are required just because of the chemical type, while others require medical surveillance only if the individual will be exposed at or above an action level that has been specified for the compound.

5.4.1) Medical Surveillance Due to Chemical Type

The Authorized Laboratory Supervisor shall:

5.4.1.1) Immediately contact EHS to determine the appropriate medical surveillance protocols if any of the following compounds are present in his/her laboratory:

OSHA Listed Carcinogens & Substances

4-Nitrobiphenyl	a-Naphthylamine
Methyl Chloromethyl Ether	3,3'-Dichlorobenzidine
bis-Chloromethyl Ether	b-Naphthylamine
Benzidine	4-Aminodiphenyl
Ethyleneimine	b-Propiolactone
2-Acetylaminofluorene	4-Dimethylaminoazo-benzene
N-Nitrosodimethylamine	1,2-Dibromo-3-Chloropropane

5.4.2) Medical Surveillance Based On Action Levels

The Authorized Laboratory Supervisor shall:

5.4.2.1) Immediately contact EHS to determine the appropriate medical surveillance protocols if any of the following compounds are present in his/her laboratory and laboratory users/occupants may be exposed at or above the identified action level for each compound.

Compound	Action Level (Airborne Exposure)
Acrylonitrile	1.0 ppm
Asbestos	0.1 fiber/cc
Benzene	0.5 ppm
Cadmium	2.5 ug/m ³
Ethylene Oxide	0.5 ppm
Formaldehyde	0.5 ppm
Inorganic Arsenic	5.0 ug/m ³
Lead	30.0 ug/m ³
Methylenedianiline	5.0 ppb
Vinyl Chloride	0.5 ppm

5.4.2.2) Contact EHS to have the appropriate exposure assessments performed in order to determine airborne concentrations of chemicals identified above.

5.4.3) Medical Surveillance for Other Chemical Exposures

The Authorized Laboratory Supervisor and other laboratory users/occupants who are exposed to chemicals shall:

5.4.3.1) Comply with the Medical Surveillance requirements specified in Chapter 5 of Part 1 of this manual.

6) Safe Disposal of Hazardous Chemical Waste

6.1) Introduction

Hazardous chemicals must be properly disposed in order to protect human health, safety and the environment. A vast number of the chemicals being used at the University present some type of physical or health hazard (Ignitability, Corrosivity, Reactivity, Toxicity) and require specific disposal procedures to be implemented. Therefore, all chemicals being used by a laboratory or laboratory-related unit shall be disposed in accordance with the University of Kansas Hazardous Materials Waste Management Program. The applicable portions of Part I: Chapter 6 shall be followed by all laboratory users/occupants in the handling of Hazardous Chemical waste. The conditions and requirements of this Part II: Chapter 6 are in addition to the previously mentioned reference and are specific for chemicals.

All individuals (authorized users and authorized laboratory supervisors) using chemicals shall:

6.1.1) Hazardous Materials Waste Management Program Policy

6.1.1.1) Be familiar with and uphold the hazardous materials waste management program policy stated in Part I: Chapter 6 - Section 6.1.1.

6.1.2) Hazardous Materials Waste Management Program Responsibilities

6.1.2.1) Fulfill their hazardous materials waste management program responsibilities as identified in Part I: Chapter 6 - Section 6.1.2.

6.1.3) Hazardous Materials Waste Management Program Philosophy

6.1.3.1) Adhere to the hazardous materials waste management program philosophy presented in Part I: Chapter 6 - Section 6.1.3.

6.1.4) Pollution Prevention, Waste Minimization & Reduction

6.1.4.1) Where feasible, make pollution prevention, waste minimization and reduction an integral part of the chemical process, experiment, or activities being conducted in their lab(s) in accordance with the procedures provided in Part I: Chapter 6-Section 6.4.

6.2) Hazardous Chemical Waste Identification

The following procedures are to be used in the identification of a spent, used, unwanted, waste, or surplus chemicals in order to determine whether it should be collected by the user for special disposal by EHS. It is recommended that users of chemicals contact EHS prior to performing experimentation, research, or work in order to determine the proper disposal method for the chemicals being used.

6.2.1) Non-Hazardous Chemical Disposal

All individuals (authorized users, and authorized laboratory supervisors) using chemicals shall:

6.2.1.1) Refer to Part I: Chapter 6 - Section 6.2.1 for procedures identifying the requirements for disposal of non-hazardous materials such as normal solid waste, empty containers, sharps, broken glass, etc.

6.2.1.2) (May) dispose of Non-Hazardous Chemical Solids by collecting them into an appropriate secondary container (trash bag or box), sealing the container, and delivering it to the nearest building dumpster.

NOTE: Non-Hazardous Chemical Solid is one that does not meet the definition of a hazardous chemical and the waste material is not defined as a hazardous waste.

6.2.1.3) (May) dispose of Non-Hazardous Chemical Liquids by discharging down a laboratory sink drain with water.

NOTE: Non-Hazardous Chemical Liquid is one that does not meet the definition of a hazardous chemical, the waste solution is not defined as a hazardous waste, and the material is not prohibited from discharge into the sanitary sewer system.

6.2.1.4) Not place Non-Hazardous Chemical Solids or Liquids in a normal trash wastebasket. For safety reasons, it is not housekeeping's responsibility to remove and dispose of any (non-hazardous or hazardous) chemicals.

6.2.2) Chemicals Prohibited From Disposal Into The Sanitary Sewer System

All individuals (authorized users, and authorized laboratory supervisors) using chemicals shall:

6.2.2.1) Refer to Part I: Chapter 6 - Section 6.2.2 to determine what materials (chemicals) are prohibited from being discharged into the sanitary sewer system by the City of Lawrence Wastewater Discharge Pretreatment Ordinance. Below is a brief summary for types of chemicals prohibited from Sanitary Sewer Disposal:

- a) Any combustible, flammable, or explosive liquids, solids, or gases.
- b) Any noxious or malodorous liquids, solids, or gases.
- c) Any solid or viscous substance that may cause obstruction to the flow in the sewer system.
- d) Any wastewater having $\text{pH} < 5$ or > 10 , or having corrosive properties capable of causing damage.
- e) Any wastewater containing toxic pollutants in sufficient quantity to injure or interfere with the POTW's process.
- f) Any wastewater having objectionable color not capable of being removed by the POTW.
- g) Any wastewater containing fats, wax, grease, or oils in excess of 100 mg/l, or containing substances that may solidify.
- h) Any wastewater containing contaminants above the City's specified pollutant limitations. This includes: Antimony, Arsenic, Beryllium, Cadmium, Copper, Cyanide, Lead, Mercury, Nickel, Selenium, Silver, Total Chromium, Thallium, Zinc, Organic Priority Pollutants, Total Organic Halogens, and Phenolic compounds. Contact EHS for specific pollutant limits.

6.2.3) Hazardous Chemicals Requiring Special Disposal By EHS

All individuals (authorized users and authorized laboratory supervisors) using chemicals shall collect for special disposal by EHS any spent, used, unwanted, waste, or surplus chemicals that: 1) cannot be disposed as non-hazardous materials (see Part II: Section 6.2.1 above), 2) are prohibited from disposal into the sanitary sewer system (see Part II: Section 6.2.2 above), or 3) meet any of the criteria below:

6.2.3.1) Hazardous Chemicals

Any chemicals/materials that meet the definition of a hazardous chemical (see glossary) require special disposal by EHS. This includes:

Chemicals which are/present physical hazards - Combustible liquids, explosives, flammable liquids, flammable solids, oxidizers, organic peroxides, pyrophorics (air reactives), water reactives, and unstable reactives.

Chemicals which are/present health hazards - Carcinogens, corrosives, irritants, hepatotoxins, nephrotoxins, neurotoxins, reproductive toxins, hematopoietic system agents, sensitizers, toxic or poisonous agents, and any agent that can damage the lungs, skin, eyes, or mucous membranes.

6.2.3.2) Hazardous Waste

Any chemicals/materials that exhibit the characteristics of a hazardous waste as identified in 40 CFR 261 Subpart C or are listed as a hazardous waste in 40 CFR 261 Subpart D. This includes:

Characteristic Hazardous Waste - (See Part II: Appendix 8.6.1.)

Listed Hazardous Waste - (See Part II: Appendix 8.6.2.)

6.2.3.3) Biohazard Materials/Waste Disposal

Refer to Part III: Chapter 6 for biohazard waste disposal procedures.

6.2.3.4) Radioactive Materials/Waste Disposal

Refer to Part IV: for radioactive waste disposal procedures.

6.2.3.5) Any other materials/chemicals that may not be identified previously, but that the user believes pose some danger to human health, safety or the environment.

6.3) Hazardous Chemicals/Materials Collection Procedures

The proper collection of excess, spent, used, unwanted, waste or surplus chemicals/materials by individuals and units is the most critical part of the KU Hazardous Materials Waste Management Program. All chemicals/materials identified as hazardous in Part II: Chapter 6 - Section 6.2.3 must be collected and given to EHS for evaluation as to their potential reuse, redistribution, reclamation, recycling, or need for off-campus hazardous waste disposal.

6.3.1) Collection Procedures for Hazardous Chemicals/Materials

All individuals (authorized users and authorized laboratory supervisors) shall collect chemicals/materials identified as needing special disposal by EHS in accordance with the procedures provided in this section:

6.3.1.1) Containers should be triple-rinsed and all previous labels removed before they are used for collection of materials.

6.3.1.2) Containers used for collection shall be compatible with the materials being collected.

6.3.1.3) Solvent wastes (HPLC, LC, Peptide Synthesis, and other solutions containing solvents) shall be collected into either 2.5 or 5.0 gallon reusable, approved flammable liquids waste safety containers.

a) Glass containers are not acceptable for collection of solvent wastes and will not be picked up.

b) The laboratory is responsible for purchasing the correct container(s) as recommended by EHS. These containers will be returned to the lab after they are emptied by EHS.

6.3.1.4) Each container of collected material shall be labeled in ENGLISH as to its specific chemical content and specific chemical volume, weight, or percentage. Structural formulas or abbreviations are not acceptable. Example of the required chemical waste container label can be found in Part II: Appendix 8.6.3

6.3.1.5) Containers shall be kept tightly closed at all times, except when filling with materials.

6.3.1.6) It is important to collect different or incompatible chemicals into separate containers. The mixing of incompatible substances could cause a serious hazard to laboratory users/occupants. Use the following protocols:

- a) Where possible, collect separately organic materials from inorganic materials.
- b) Collect separately, peroxidizable materials separately from other materials.
- c) Where possible, collect separately all known or suspected carcinogens.
- d) Where possible, do not mix aqueous material with organic material.
- e) Where possible, collect solvents separately as either halogenated or non-halogenated.

6.3.1.7) Acids or bases should be neutralized to a pH of 5-10 so they can be disposed into the sanitary sewer as long as they contain no other toxic materials. Corrosive materials that may generate dangerous fumes or products when neutralized, and for which the lab does not have the appropriate safety devices or capability to perform the neutralization, should be left corrosive and placed into glass or plastic containers for pickup by EHS.

- a) Any precipitates that are generated during neutralization that are or may be hazardous shall be filtered out and collected for disposal by EHS.
- b) Do not collect highly acidic or alkaline materials into metal containers.

6.3.1.8) Used photographic fixers are to be collected separately and given to EHS for silver recovery.

6.3.1.9) Chemicals/materials containing any of the following heavy metals should be collected separately, where possible:

- a) Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver.

6.3.1.10) Collect separately; pesticides and/or pesticide products.

6.3.2) Collection Procedures for Specialty Items

6.3.2.1) Unknowns - Containers of unknown contents shall not be picked up from the user by EHS personnel until the chemicals in the container have been identified. EHS can arrange for the analysis of unknowns, but the unit will be responsible for payment of the analytical costs.

6.3.2.2) Used Oil - Used Oils (pump, lubricating, etc.) shall be collected separately and given to EHS for recycling or disposal.

6.3.2.3) Metallic Mercury - Dirty metallic mercury should be collected by the unit for temporary storage and shipment for redistillation, or it may be given to EHS for handling.

6.3.2.4) Gas Cylinders - It is the user's responsibility to ship unwanted or empty cylinders of compressed or liquefied gases back to the supplier with the screw-on shipping cap in place. Small leaking cylinders should be placed into a functioning lab hood and EHS should be contacted for handling and disposal assistance.

6.3.2.5) Batteries - Batteries should be collected and recycled in accordance with the following procedures:

- a) Lead-Acid - collect separately and contact EHS for pickup.
- b) Nickel-Cadmium - collect separately and contact EHS for pickup.
- c) Mercury-Containing Alkaline - collect separately and contact EHS for pickup.
- d) Non-Mercury Alkaline - currently may be disposed of in trash.
- e) Other Batteries - check with EHS for disposal procedures.

6.4) Hazardous Chemicals/Materials Pickup & Removal Procedures

All excess, spent, used, unwanted, waste, or surplus chemicals/materials that have been collected by a lab in accordance with the procedures identified in sections 6.3.1 & 6.3.2 above are to be picked-up and removed by EHS. These materials will be taken back to Burt Hall for evaluation as to their potential reuse, redistribution, reclamation, recycling, or need for off-campus hazardous waste disposal.

All individuals (authorized users, and authorized laboratory supervisors) shall comply with the following procedures for pickup and removal of hazardous chemicals/materials from their lab by EHS.

6.4.1) Contact For Pickup

6.4.1.1) To arrange for pickup of hazardous chemicals or hazardous materials, Contact EHS at (864-4089) and be prepared to provide the following information:

- Contact Person
- Contact Person Phone #
- Building & Room #
- Department
- Type of chemicals to be picked up
- Number & size of containers.

6.4.1.2) You may also request pickups by Email. Go to EHS website at WWW.EHS.UKANS.EDU and click on "Hazardous Materials/Environmental Protection Office" and follow directions for requesting chemical pickups.

6.4.1.3) Information will be placed onto EHS Pickup Schedule List that is organized on a "first requested-first served" basis. Priority is usually given to solvent materials, but emergency situations, types of chemicals, and availability of EHS personnel are also considered.

6.4.2) Container Preparations

6.4.2.1) Containers shall have been prepared in accordance with the proper collection procedures as identified in sections 6.3.1 & 6.3.2.

6.4.3) Removal Exceptions

6.4.3.1) Any containers found to be unsuitable in the judgement of EHS personnel, or that have not been prepared, labeled, or packaged in accordance with the previous procedures, shall not be removed from the user's location until compliance is achieved.

6.4.3.2) Containers of unknown contents shall not be removed, until the chemicals in the container have been identified, by analysis if necessary. It is the user's responsibility to correctly label all containers and to identify each specific component in a container; otherwise, it will not be removed from your area.

6.4.4) Laboratory Clean-out Procedures

It is important that prior planning and a cooperative effort be established between laboratory users and EHS in order to facilitate the clean-out/close-out of areas containing large numbers of hazardous chemicals/materials.

6.4.4.1) A typewritten inventory list of chemicals/materials to be removed shall be provided by the lab supervisor to EHS at least 30 days in advance of close-out/clean-out deadline. Once the inventory list has been received and reviewed by EHS, a pickup date will be scheduled. The typewritten inventory list shall include the following minimum information:

- a) Chemical Name, Container Size & Chemical Quantity.
- b) This information is necessary so that EHS personnel can review the list to identify appropriate safety precautions, potential items for redistribution or reuse, and schedule sufficient time for the clean-out.

6.4.4.2) All containers shall be in accordance with the collection procedures as identified in sections 6.3.1 & 6.3.2.

6.4.4.3) The Container Removal Exceptions identified in section 6.4.3 are applicable for all close-outs and inventory clean-outs.

6.5) Pollution Prevention, Waste Minimization & Reduction

Federal and State laws require the University to certify that it has a program in place to prevent, minimize, and reduce the amount of hazardous waste that it generates. This especially includes hazardous chemical waste.

All individuals (authorized users, and authorized laboratory supervisors using chemicals shall:

6.5.1) Chemical Waste Minimization & Reduction

6.5.1.1) Where feasible, make pollution prevention, waste minimization and reduction an integral part of the chemical process, experiment, or activities being conducted in their lab(s) in accordance with the procedures provided in Part I: Chapter 6 - Section 6.4. This includes:

- a) Chemical Redistribution & Reuse
- b) Source Reduction through substitutions or process modifications
- c) Source Reduction through Chemical Inventory Management
- d) Waste Reduction through Chemical Reclamation
- e) Waste Reduction through Chemical Treatment Procedures

6.5.2) Contact EHS for assistance in developing and implementing pollution prevention, waste minimization and reduction activities in the lab.

7) Chemical Hygiene/Safety-Specific Recordkeeping

7.1) Auditable Records

Authorized Laboratory Supervisors and/or Unit Safety Coordinators shall:

7.1.1) Establish and maintain auditable records in accordance with the requirements of Part I: Chapter 7 - Section 7.1.

7.2) Identification and Dating of Records

Authorized Laboratory Supervisors and/or Unit Safety Coordinators shall:

7.2.1) Identify and date records in accordance with the requirements of Part I: Chapter 7 - Section 7.2.

7.3) Retention of Records

Authorized Laboratory Supervisors and/or Unit Safety Coordinators shall:

7.3.1) Retain records in accordance with the requirements of Part I: Chapter 7 - Section 7.3.

7.4) EHS Records

EHS shall:

7.4.1) Establish and maintain the appropriate records in accordance with the requirements of Part I: Chapter 7 - Section 7.4.

8) Part II - Appendices

8.1) Appendices for Part II - Chapter 1

None - Reserved

8.2) Appendices for Part II - Chapter 2

Appendix 8.2.6.1 - Chemical Incompatibilities

Appendix 8.2.6.2 - Peroxidizable Compounds

Appendix 8.2.7.1 - Potentially Explosive Functional Groups

Appendix 8.2.7.2 - ATF & DOT Identified Explosives

Appendix 8.2.8.1 - OSHA Listed Carcinogens & Regulated Substances

Appendix 8.2.8.2 - NTP Listed Carcinogens

Appendix 8.2.8.3 - IARC listed Carcinogens

8.3) Appendices for Part II - Chapter 3

Appendix 8.3.4.1 - Example of a Blank MSDS

Appendix 8.3.9.1 - EHS Safety Authorization-Requiring Hazardous Chemicals

8.4) Appendices for Part II - Chapter 4

None - Reserved

8.5) Appendices for Part II - Chapter 5

None - Reserved

8.6) Appendices for Part II - Chapter 6

Appendix 8.6.1 - Characteristic Hazardous Waste

Appendix 8.6.2 - Listed Hazardous Waste

Appendix 8.6.2.1 - U List

Appendix 8.6.2.2 - P List

Appendix 8.6.2.3 - F List

Appendix 8.6.2.4 - K List

Appendix 8.6.3 - KU-EHS Hazardous Material Waste Container Label

8.7) Appendices for Part II - Chapter 7

None - Reserved

Appendix 8.2.6.1 - Chemical Incompatibilities (Partial List)

These listings were taken from 'Prudent Practices in the Laboratory, 2nd edition.'
They are not considered to be exhaustive.

CHEMICAL	INCOMPATIBLE CHEMICAL(S)
Acetic acid	aldehyde, bases, chromic acid, carbonates, hydroxides, metals, oxidizers, nitric acid, peroxides, permanganates, phosphates, xylene
Acetic anhydride	Hydroxyl-containing compounds such as ethylene glycol, perchloric acid
Acetylene	halogens (chlorine, fluorine, etc.), mercury, potassium, oxidizers, silver
Acetone	acids, amines, oxidizers, plastics
Alkali and alkaline earth metals	acids, carbon dioxide, carbon tetrachloride, chlorinated hydrocarbons, chromium, ethylene, halogens, hydrogen, mercury, nitrogen, oxidizers, plastics, sodium chloride, sulfur
Ammonia (anhydrous)	acids, aldehydes, amides, bromine, calcium hypochlorite, chlorine, halogens, heavy metals, hydrogen fluoride, iodine, mercury, oxidizers, plastics, sulfur
Ammonium nitrate	acids, alkalis, chlorates, combustible materials, metals, organic materials, phosphorous, reducing agents, urea
Aniline	acids, aluminum, dibenzoyl peroxide, oxidizers, plastics
Azides	acids, heavy metals, oxidizers
Bromine	ammonia, acetaldehyde, acetylene, alcohols, alkalis, amines, benzene, butadiene, butane, combustible materials, ethylene, fluorine, hydrogen, ketones (acetone, carbonyls, etc.), metals, sodium carbide, sulfur
Calcium oxide	acids, ethanol, fluorine, organic materials, water
Carbon (activated)	alkali metals, calcium hypochlorite, halogens, oxidizers

Appendix 8.2.6.1 - Chemical Incompatibilities (Partial List) - continued

CHEMICAL	INCOMPATIBLE CHEMICAL(S)
Carbon tetrachloride	benzoyl peroxide, ethylene, fluorine, metals, oxygen, plastics, silanes
Chlorates	ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromates	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Chromic acid and Chromium trioxide	acetic acid, acetone, alcohols, alkalis, ammonia, bases benzene, combustible materials, hydrocarbons, metals, organic materials, phosphorous, plastics
Chlorine	alcohols, ammonia, benzene, combustible materials, flammable compounds (hydrazine), hydrocarbons (acetylene, ethylene, etc.), hydrogen peroxide, iodine, metals, nitrogen, oxygen, sodium hydroxide
Chlorine dioxide	ammonia, hydrogen, mercury, organic materials, phosphorous, potassium hydroxide, sulfur
Copper	acetylene, calcium, hydrocarbons, oxidizers
Cyanides	acids, alkaloids, aluminum, iodine, oxidizers, strong bases
Dichromates	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Flammable liquids	ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Isolate from everything.
Halogens and Halogenating agents	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Hydrazine	Hydrogen peroxide, nitric acid, other oxidants

Appendix 8.2.6.1 - Chemical Incompatibilities (Partial List) - continued

CHEMICAL	INCOMPATIBLE CHEMICAL(S)
Hydrocarbons (Such as butane, propane, benzene, turpentine, etc.)	acids, bases, halogens, oxidizers, peroxides, plastics
Hydrocyanic acid	Nitric acid, alkalis
Hydrofluoric acid	ammonia, metals, organic materials, plastics, silica (glass), (anhydrous) sodium
Hydrogen peroxide	acetaldehyde, acetic acid, acetone, alcohol's carboxylic acid, combustible materials, metals, nitric acid, organic compounds, phosphorous, sulfuric acid, sodium, aniline
Hydrogen sulfide	acetaldehyde, metals, nitric acid, oxidizers, sodium
Hypochlorites	acids, activated carbon
Iodine	acetaldehyde, acetylene, ammonia, metals, sodium
Mercury	acetylene, aluminum, amines, ammonia, calcium, fulminic acid, lithium, oxidizers, sodium
Nitrates	acids, nitrites, metals, reducing agents, sulfur, sulfuric acid
Nitric acid	acetic acid, acetonitrile, alcohols, amines, (concentrated) ammonia, aniline, bases, benzene, cumene, formic acid, ketones, metals, organic materials, plastics, sodium, toluene
Nitrites	Acids, oxidizing agents
Nitroparaffins	Inorganic bases, amines
Organic compounds	Oxidizing agents
Organic acyl halides	Bases, organic hydroxyl and amino compounds
Organic anhydrides	Bases, organic hydroxyl and amino compounds

Appendix 8.2.6.1 - Chemical Incompatibilities (Partial List) - continued

CHEMICAL	INCOMPATIBLE CHEMICAL(S)
Organic halogen compounds	Group IA and IIA metals, aluminum
Organic nitro compounds	Strong bases
Oxidizing agents	reducing agents, organic compounds
Oxalic acid	mercury and silver and their salts, oxidizers, sodium chlorite
Oxygen	acetaldehyde, secondary alcohols, alkalis and alkalines, ammonia, carbon monoxide, combustible materials, ethers, flammable materials, grease, hydrogen, hydrocarbons, metals, oils, phosphorous, polymers
Perchlorates	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Perchloric acid	acetic acid, acetic anhydride, alcohols, aniline, bismuth and its alloys, combustible materials, dehydrating agents, ethyl benzene, grease, hydroiodic acid, hydrochloric acid, iodides, ketones, organic materials, oils, oxidizers, paper, pyridine, wood
Permanganates	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Peroxides	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Peroxides, organic	acids (organic or mineral), avoid friction, store cold
Persulfates	ammonia, carbon, metals, metal hydrides, nitrites, organic compounds, phosphorous, silicon, sulfur
Phosphorus (white)	oxygen (pure and in air), alkalis
Phosphorous pentoxide	alcohols, strong bases, water
Potassium	acetylene, acids, alcohols, halogens, hydrazine, mercury, oxidizers, selenium, sulfur, water

Appendix 8.2.6.1 - Chemical Incompatibilities (Partial List) - continued

CHEMICAL	INCOMPATIBLE CHEMICAL(S)
Potassium chlorate	acids, ammonia, combustible materials, fluorine, hydrocarbons, metals, organic materials, sugars
Potassium perchlorate (also see chlorates)	alcohols, combustible materials, fluorine, hydrazine, metals, organic matter, reducing agents, sulfuric acid
Potassium permanganate	benzaldehyde, ethylene glycol, glycerol, sulfuric acid
Reducing agents	arsenates, arsenites, oxidizing agents, phosphorous, selenates, selenites, tellurium salts and oxides.
Silver and salts	acetylene, ammonia, fulminic acid, oxalic acid, oxidizers, ozonides, peroxyformic acid, tartaric acid,
Sodium	acids, hydrazine, metals, oxidizers, water
Sodium nitrate	acetic anhydride, acids, metals, organic matter, peroxyformic acid, reducing agents
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	any oxidizable substance; acetic acid, acetic anhydride, alcohols, benzaldehyde, benzene, carbon disulfide, ethyl acetate, ethylene glycol, furfural, glycerol, hydrogen sulfide metals, methyl acetate, oxidizers, peroxyformic acid, phosphorous, reducers, sugars, water
Sulfides	acids
Sulfuric acid	potassium chlorates, potassium perchlorate, potassium permanganate

Appendix 8.2.6.2 - Peroxidizable Compounds

These listings were taken from 'Prudent Practices in the Laboratory, 2nd edition.'
They are not considered to be exhaustive.

Types of Compounds Known to Auto-oxidize to Form Peroxides

Aldehydes

Ethers - especially cyclic ethers and those containing primary and secondary alkyl groups
(never distill an ether before it has been shown to be free of peroxide)

Compounds containing benzylic hydrogens

Compounds containing allylic hydrogens (C=C-CH), including most alkenes, vinyl and vinylidene compounds

Compounds containing a tertiary C-H group (e.g., decalin and 2,5-dimethylhexane)

Appendix 8.2.6.2 - Peroxidizable Compounds - Continued

These listings were taken from 'Prudent Practices in the Laboratory, 2nd edition.'
They are not considered to be exhaustive.

Classes of Chemicals that can Form Peroxides upon Aging

Class I: Unsaturated materials, especially those of low molecular weight, may polymerize violently and hazardously due to peroxide initiation.

Acrylic acid	Tetrafluoroethylene
Acrylonitrile	Vinyl acetate
Butadiene	Vinyl acetylene
Chlorobutadiene (Chloroprene)	Vinyl chloride
Chlorotrifluoroethylene	Vinyl pyridine
Methyl methacrylate	Vinylidene chloride
Styrene	

Class II: The following chemicals are a peroxide hazard upon concentration (distillation and or evaporation). A test for peroxide should be performed if concentration is intended or suspected.

Acetal	Dioxane (p-dioxane)
Cumene	Ethylene glycol dimethyl ether (glyme)
Cyclohexane	Furan
Cyclooctene	Methyl acetylene
Cyclopentane	Methyl cyclopentane
Diacetylene	Methyl-i-butyl-ketone
Dicyclopentadiene	Tetrahydrofuran
Diehtylene glycol dimethyl ether (diglyme)	Tetrahydronaphthalene
Diethyl ether	Vinyl ethers

Class III: Peroxides derived from the following compounds may explode without concentration

Organic	Inorganic
Divinyl ether	Potassium metal
Divinyl acetylene	Potassium amide
Isopropyl ether	Sodium amide (sodamide)
Vinylidene chloride	

Appendix 8.2.7.1 - Potentially Explosive Compounds

These listings were taken from 'Prudent Practices in the Laboratory, 2nd edition.'
They are not considered to be exhaustive.

Potentially Explosive Functional Groups in Some Compounds

Structural Feature	Compound
$-\text{C} \equiv \text{C}-$	Acetylenic compound
$-\text{C} \equiv \text{C}-\text{M}$	Metal acetylide or carbide
$-\text{C} \equiv \text{C}-\text{X}$	Haloacetylide
$\diagup \text{CN}_2$	Diazo compounds
$\diagup \text{C}-\text{N}=\text{O}$	Nitroso compounds
$\diagup \text{C}-\text{NO}_2$	Nitroalkanes, C-nitro and polynitroaryl compounds, polynitroalkyl compounds, trinitroethyl compounds
$\text{C}-\text{O}-\text{N}=\text{O}$	Acyl or Alkyl nitrites
$\text{C}-\text{O}-\text{NO}_2$	Acyl or alkyl nitrates
$\text{C}-\text{O}-\text{O}-\text{C}$	Alkyl or acyl peroxides
$\diagup \text{C}-\text{O}-\text{O}-\text{H}$	Alkyl hydroperoxides
$\diagup \text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{O}-\text{O}-\text{C} \diagdown$	Dialkyl peroxy carbonates
$\text{CNO}-\text{M}$	Metal fulminates or aci-nitro salts, oximates
$-\text{N}_3$	Organic azides, acyl azides, metal azides, metal azide complexes
$\text{M}(\text{CO})_n$	Transition metal-carbonyl compounds
$-\text{C} \equiv \text{N}$	Metal cyanides, organic nitriles, cyanogen halides

Appendix 8.2.7.1 - Potentially Explosive Compounds - continued

These listings were taken from 'Prudent Practices in the Laboratory, 2nd edition.'
They are not considered to be exhaustive.

Listing of Potentially Explosive Compounds/Classes (many are shock/heat/friction sensitive)

Acetylenic compounds	Difluoroamino compounds
aci-Nitro salts	Dinitroacetonitrile
Acyl azides	Dinitrobenzene (ortho)
Acyl Nitrates	1,2-Epoxides
Alkylhydroperoxides	Ethyl methyl ketone peroxide
Alkyl nitrates	Ethyl nitrate
Alkyl and acyl nitrites	Fluorodintromethyl compounds
Alkyl perchlorates	Fulminates
Amine perchlorates	Haloacetylenes and derivatives
Amminechromiumperoxo complexes	Halo-Aryl metals
Amminemetal oxosalts	Halogen azides
Ammonium perchlorate	N-Halogen compounds
Ammonium permanganate	Halogen oxides
Arenediazoates	N-Haloimides
Arenediazo Aryl sulfides	Heavy metal acetylenes
bis-Arenediazo oxides	Heavy metal picrates
bis-Arenediazo sulfides	Hydrazinium salts
Arenediazoniumolates	Hydrogen Peroxide >30%
Azides	Hydroperoxides
Azo compounds	Hydroxylamine
Butyl hydroperoxide	Hydroxylammonium salts
t-Butyl peroxyacetate	Hypohalites
Butyl perbenzoate	Lead picrate
Chlorite salts of metals	Mercury chlorite
1-Chloro-2,4-dinitrobenzene	Mercury picrate
Copper picrate	Metal acetylides
Cumene hydroperoxide	Metal azides
Cyclic peroxides	N-Metal derivatives
Diacetyl peroxide	Metal fulminates
Diacyl peroxides	Metal perchlorates
Dialkyl peroxides	Metal peroxides
Diazirenes	Nickel picrate
Diazo compounds	Nitric amide
Diazonium carboxylates and salts	N-Nitro compounds
Diazonium salts	N-nitromethylamine
Diazonium sulfides	Nitroalkanes,
Dibenzoyl peroxide	Nitrocellulose

Appendix 8.2.7.1 - Potentially Explosive Compounds - continued

These listings were taken from 'Prudent Practices in the Laboratory, 2nd edition.'
They are not considered to be exhaustive.

Listing of Potentially Explosive Compounds/Classes (many are shock/heat/friction sensitive)

Nitroglycerine	Picric acid
Nitroguanidine	Polyacetylenes
Nitroso compounds	Polyol nitrates
Nitrourea	Polynitroalkyl compounds
Nonmetal azides	Polynitro amines
Nonmetal perchlorates	Polynitroaromatic compounds
Organic azides	Polynitroaryl compounds
Oxo salts of nitrogenous bases	Polynitro hydrocarbons
Ozonides	Polynitro phenols
Perchlorate salts	Silver chlorite
Perchloric acid (anhydrous)	Silver fulminate
Perchloryl compounds	Tetranitromethane
Peroxides and hydroperoxides	Tetrazoles
Peroxides - transition metal salts	Transition metal picrates
Peroxoacids and salts	Triazenes
Peroxyacetic acid	N,N,N-trifluoroalkylamidines
Peroxy acids	Trinitrobenzene
Peroxy esters	Trinitrotoluene
Picrates	Zinc picrate

Appendix 8.2.7.2 - ATF & DOT Identified Explosives

Acetylides of heavy metals ^(ATF)	Aluminum containing polymeric propellant ^(ATF)
Aluminum ophorite explosive ^(ATF)	Amatex ^(ATF)
Amatol ^(ATF)	Ammonal ^(ATF)
Ammonium nitrate	Ammonium nitrate-fuel oil mixture ^(ATF)
Ammonium perchlorate	Ammonium picrate
Ammonium salt lattice with isomorphously substituted inorganic salts ^(ATF)	Articles, explosive
Ammunition	Barium Azide
Baratol ^(ATF)	Baronol ^(ATF)
Barium Styphnate	Blasting agents, nitro-carbo-nitrates ^(ATF)
BEAF [1, 2-bis (2, 2-difluoro-2-nitroacetoxyethane)] ^(ATF)	Blasting gelatin ^(ATF)
Black powder ^(ATF)	BTNEC [bis (trinitroethyl) carbonate] ^(ATF)
Blasting caps ^(ATF)	BTNEN [bis (trinitroethyl) nitramine] ^(ATF)
Blasting powder ^(ATF)	Butyl tetryl ^(ATF)
Bulk salutes ^(ATF)	Cartridges (Ammunition)
BTTN [1,2,4 butanetriol trinitrate] ^(ATF)	Charges
Calcium nitrate explosive mixture ^(ATF)	Components, explosive
Cellulose hexanitrate explosive mixture ^(ATF)	Composition B and variations ^(ATF)
Chlorate explosive mixtures ^(ATF)	Copper acetylide ^(ATF)
Composition A and variations ^(ATF)	Cyclotetramethylenetrinitramine ^(ATF)
Composition C and variations ^(ATF)	Cyclotrimethylenetrinitramine [RDX] ^(ATF)
Cyanuric triazide ^(ATF)	Cyclotol ^(ATF)
Cyclotetramethylenetrinitramine [HMX] ^(ATF)	DDNP [diazodinitrophenol] ^(ATF)
Cyclonite [RDX] ^(ATF)	Detonating cord ^(ATF)
DATB [diaminotrinitrobenzene] ^(ATF)	Diazodinitrophenol
Deflagrating metal salts of aromatic nitro derivatives	Dinitroethyleneurea ^(ATF)
DEGDN [diethyleneglycol dinitrate] ^(ATF)	Dinitrophenols ^(ATF)
Detonators ^(ATF)	Dinitrophenyl hydrazine ^(ATF)
Dimethylol dimethyl methane dinitrate composition ^(ATF)	Dinitrosobenzene
Dinitroethyleneurea ^(ATF)	Dipicryl sulfide
Dinitroglycoluril	Dipicrylamine ^(ATF)
Dinitrophenolates ^(ATF)	DNPD [dinitropentano nitrile] ^(ATF)
Dinitroresorcinol ^(ATF)	Dynamite ^(ATF)
Dinitrotoluene-sodium nitrate explosive mixtures ^(ATF)	EDNA ^(ATF)
DIPAM ^(ATF)	EDNP [ethyl 4,4-dinitropentanoate] ^(ATF)
Dipicryl sulfone ^(ATF)	Esters of nitro-substituted alcohols ^(ATF)
Display fireworks ^(ATF)	
DNPA [2,2-dinitropropyl acrylate] ^(ATF)	
EDDN [ethylene diamine dinitrate] ^(ATF)	
Ednatol ^(ATF)	
Erythritol tetranitrate explosives ^(ATF)	

Appendix 8.2.7.2 - ATF & DOT Identified Explosives - continued

EGDN [ethylene glycol dinitrate] ^(ATF) Ethyl-tetryl ^(ATF)
Explosive conitrates ^(ATF) Explosive gelatins ^(ATF)
Explosive mixtures containing oxygen releasing inorganic salts and hydrocarbons ^(ATF)
Explosive mixtures containing oxygen releasing inorganic salts and nitro bodies ^(ATF)
Explosive mixtures containing oxygen releasing inorganic salts and water insoluble fuels ^(ATF)
Explosive mixtures containing oxygen releasing inorganic salts and water soluble fuels ^(ATF)
Explosive mixtures containing sensitized nitromethane ^(ATF)
Explosive mixtures containing tetranitromethane (nitroform) ^(ATF)
Explosive nitro compounds of aromatic hydrocarbons ^(ATF)
Explosive organic nitrate mixtures ^(ATF) Explosive liquids ^(ATF)
Explosive powders ^(ATF) Explosives
Fireworks Flares
Flash powder ^(ATF) Fulminate of mercury ^(ATF)
Fulminate of silver ^(ATF) Fulminating gold ^(ATF)
Fulminating mercury ^(ATF) Fulminating platinum ^(ATF)
Fulminating silver ^(ATF) Fuse
Gelatinized nitrocellulose ^(ATF) Gem-dinitro aliphatic explosive mixtures ^(ATF)
Grenades Guanyl nitrosaminoguanilydene hydrazine ^(ATF)
Guanyl nitrosaminoguanilytetrazene ^(ATF) Guncotton ^(ATF)
Heavy metal azides ^(ATF) Hexanite ^(ATF)
Hexanitrodiphenylamine ^(ATF) Hexanitrostilbene ^(ATF)
Hexogen (RDX) ^(ATF)
Hexogene or octogene and a nitrated N-methylaniline ^(ATF)
Hexolites ^(ATF) Hexotonal
HMX [cyclo-1,3,5,7-tetramethylene 2,4,6,8-tetranitramine; Octogen] ^(ATF)
Hydrazinium nitrate/hydrazine/aluminum explosive system ^(ATF)
Hydrazoic acid ^(ATF) Igniter cord ^(ATF)
Igniters ^(ATF) Initiating tube systems ^(ATF)
KDNBF [potassium dinitrobenzofuroxane] ^(ATF) Lead azide ^(ATF)
Lead mannite ^(ATF) Lead mononitroresorcinate ^(ATF)
Lead picrate ^(ATF) Lead salts, explosive ^(ATF)
Lead styphnate [styphnate of lead, lead trinitroresorcinate] ^(ATF)
Liquid nitrated polyol and trimethylolethane ^(ATF) Liquid oxygen explosives ^(ATF)
Magnesium ophorite explosives ^(ATF) Mannitol hexanitate ^(ATF)
MDNP [methyl 4,4-dinitropentanoate] ^(ATF) MEAN [monoethanolamine nitrate] ^(ATF)
5-Mercaptotetrazol-1-acetic acid Mercuric fulminate ^(ATF)
Mercury oxalate ^(ATF) Mercury tartrate ^(ATF)
Metriol trinitrate ^(ATF) Mines
Minol-2 [40% TNT, 40% ammonium nitrate, 20% aluminum] ^(ATF)
MMAN [monomethylamine nitrate]; methylamine nitrate ^(ATF)

Appendix 8.2.7.2 - ATF & DOT Identified Explosives - continued

Mononitrotoluene-nitroglycerin mixture ^(ATF)	Monopropellants ^(ATF)
NIBTN [nitroisobutametrial trinitrate] ^(ATF)	Nitrate sensitized with gelled nitroparaffin ^(ATF)
Nitrated carbohydrate explosive ^(ATF)	Nitrated glucoside explosive ^(ATF)
Nitrated polyhydric alcohol explosives ^(ATF)	Nitrates of soda explosive mixtures ^(ATF)
Nitric acid and a nitro aromatic compound explosive ^(ATF)	Nitric acid explosive mixtures ^(ATF)
Nitric acid and carboxylic fuel explosive ^(ATF)	5-Nitrobenzotriazol
Nitro aromatic explosive mixtures ^(ATF)	Nitroderivative of urea explosive mixture ^(ATF)
Nitro compounds of furane explosive mixtures ^(ATF)	Nitrogen trichloride ^(ATF)
Nitrocellulose ^(ATF)	Nitrourea ^(ATF)
Nitrogelatin explosive ^(ATF)	Nitroguanidine ^(ATF)
Nitrogen tri-iodide ^(ATF)	
Nitroglycerine [NG, RNG, nitro, glyceryltrinitrate, trinitroglycerine] ^(ATF)	
Nitroglycide ^(ATF)	
Nitroglycol (ethylene glycol dinitrate, EGDN) ^(ATF)	
Nitroparaffins Explosive Grade and ammonium nitrate mixtures ^(ATF)	
Nitronium perchlorate propellant mixtures ^(ATF)	Nitrostarch ^(ATF)
Nitro-substituted carboxylic acids ^(ATF)	Nitrotriazolone
Octogen [HMX] ^(ATF)	Octol [75 percent HMX, 25 percent TNT] ^(ATF)
Octolite	Octonal
Organic amine nitrates ^(ATF)	Organic nitramines ^(ATF)
PBX [RDX and plasticizer] ^(ATF)	Pellet powder ^(ATF)
Penthrinite composition ^(ATF)	Pentolite ^(ATF)
Perchlorate explosive mixtures ^(ATF)	Peroxide based explosive mixtures ^(ATF)
PETN [nitropentaerythrite, pentaerythrite tetranitrate, pentaerythritol tetranitrate] ^(ATF)	
Picramic acid and its salts ^(ATF)	Picramide ^(ATF)
Picrate of potassium explosive mixtures ^(ATF)	Picratol ^(ATF)
Picric acid (manufactured as an explosive) ^(ATF)	Picric Acid (other uses)
Picryl chloride ^(ATF)	Picryl fluoride ^(ATF)
PLX [95% nitromethane, 5% ethylenediamine] ^(ATF)	
Polynitro aliphatic compounds ^(ATF)	
Polyolpolynitrate-nitrocellulose explosive gels ^(ATF)	
Potassium chlorate and lead sulfocyanate explosive ^(ATF)	
Potassium nitrate explosive mixtures ^(ATF)	Potassium nitroaminotetrazole ^(ATF)
Potassium salts of aromatic nitro derivatives	Powder Cake
Primers	Projectiles
Propellant, (liquid or solid)	Pyrotechnic compositions ^(ATF)
PYX (2,6-bis(picrylamino))-3,5- dinitropyridine ^(ATF)	
RDX [cyclonite, hexogen, T4, cyclo-1,3,5,-trimethylene-2,4,6,-trinitramine; hexahydro-1,3,5-trinitro-S-triazine] ^(ATF)	
Rockets	Rocket motors

Appendix 8.2.7.2 - ATF & DOT Identified Explosives - continued

Safety fuse ^(ATF)	Salutes, (bulk) ^(ATF)
Salts of organic amino sulfonic acid explosive mixture ^(ATF)	
Silver acetylide ^(ATF)	Silver azide ^(ATF)
Silver fulminate ^(ATF)	Silver oxalate explosive mixtures ^(ATF)
Silver styphnate ^(ATF)	Silver tartrate explosive mixtures ^(ATF)
Silver tetrazene ^(ATF)	
Slurried explosive mixtures of water, inorganic oxidizing salt, gelling agent, fuel and sensitizer ^(ATF) (cap sensitive)	
Smokeless powder ^(ATF)	Smoke Signals
Sodatol ^(ATF)	Sodium amatol ^(ATF)
Sodium azide explosive mixture ^(ATF)	Sodium dinitro-ortho-cresolate ^(ATF)
Sodium nitrate-potassium nitrate explosive mixture ^(ATF)	
Sodium picramate ^(ATF)	Sodium salts of aromatic nitro derivatives
Sounding devices, explosive	Special fireworks ^(ATF)
Squibs ^(ATF)	Styphnic acid explosives ^(ATF)
Tacot [tetranitro-2,3,5,6-dibenzo-1,3a,4,6a tetrazapentalene] ^(ATF)	
TATB [triaminotrinitrobenzene] ^(ATF)	TEGDN [triethylene glycol dinitrate] ^(ATF)
Tetrazene [tetracene, tetrazine, 1(5-tetrazolyl)-4-guanyl tetrazene hydrate] ^(ATF)	
Tetranitrocarbazole ^(ATF)	Tetranitroaniline
Tetrazol-1-acetic acid	Tetryl [2,4,6 tetranitro-N-methylaniline] ^(ATF)
Tetrytol ^(ATF)	TMETN [trimethylolethane trinitrate] ^(ATF)
TNEF [trinitroethyl formal] ^(ATF)	TNEOC [trinitroethylorthocarbonate] ^(ATF)
TNEOF [trinitroethylorthoformate] ^(ATF)	TNT [trinitrotoluene, trotyl, trilitite, triton] ^(ATF)
Torpedoes	Torpex ^(ATF)
Tracers for ammunition	Tridite ^(ATF)
Trimethylol ethyl methane trinitrate composition ^(ATF)	
Trimethylolthane trinitrate-nitrocellulose ^(ATF)	Trimonite ^(ATF)
Trinitroaniline	Trinitroanisole ^(ATF)
Trinitrobenzene ^(ATF)	Trinitrobenzenesulfonic acid
Trinitrobenzoic acid ^(ATF)	Trinitrochlorobenzene
Trinitrocresol ^(ATF)	Trinitro-meta-cresol ^(ATF)
Trinitrofluorenone	Trinitronaphthalene ^(ATF)
Trinitrophenetol ^(ATF)	Trinitrophenol
Trinitrophenylmethylnitramine	Trinitrophenylmethylnitramine ^(ATF)
Trinitroresorcinol ^(ATF)	Trinitrotoluene ^(ATF)
Tritonal ^(ATF)	Urea nitrate ^(ATF)
Water-in-oil emulsion explosive compositions ^(ATF)	
Xanthamomas hydrophilic colloid explosive mixture. ^(ATF)	
Zirconium picramate	

Appendix 8.2.8.1 - OSHA Listed Carcinogens & Regulated Substances

 OSHA Listed Carcinogens

2-Acetylaminofluorene	Methyl chloromethyl ether
4-Aminodiphenyl	a-Naphthylamine
Benzidine	b-Naphthylamine
bis-Chloromethyl ether	4-Nitrobiphenyl
3,3'-Dichlorobenzidine (and salts)	N-Nitrosodimethylamine
4-Dimethylaminoazobenzene	b-Propiolactone
Ethyleneimine	

 OSHA Regulated Substances (EHS Group A)

Acrylonitrile	Ethylene Oxide
Asbestos	Formaldehyde
Benzene	Methylenedianiline
1,3-Butadiene	Vinyl Chloride
1,2-dibromo-3-Chloropropane	

 OSHA Regulated Substances (EHS Group B)

Arsenic (inorganic)
 Cadmium
 Lead
 Methylene Chloride

Appendix 8.2.8.2 - NTP Listed Carcinogens

Copied from National Toxicology Program report
(Part of the U.S. Dept. of Health & Human Services)

Group Identification:

Class 1 -- Known human carcinogen

Class 2 -- Reasonably anticipated human carcinogen

Chemical Name	Group
Acetaldehyde	2
2-Acetylaminofluorene	2
Acrylamide	2
Adriamycin	2
Aflatoxins	2
2-Aminoanthraquinone	2
ortho-Aminoazotoluene	2
4-Aminobiphenyl	1
1-Amino-2-methylantraquinone	2
Amitrole	2
Analgesic mixtures containing phenacetin	1
ortho-Anisidine hydrochloride	2
Arsenic and arsenic compounds	1
Asbestos	1
Azathioprine	1
Benzene	1
Benzidine	1
Benz[a] anthracene	2
Benzo[b] fluoranthene	2
Benzo[j] fluoranthene	2
Benzo[k] fluoranthene	2
Benzo[a] pyrene	2
Benzotrichloride	2
Beryllium & beryllium compounds	2
Bis(chloromethyl) nitrosourea (BCNU)	2
Bis(chloromethyl) ether and chloromethyl methyl ether (Technical Grade)	2
Bromodichloromethane	2
1,3-Butadiene	2
1,4-butanediol dimethanesulfonate (Myleran)	1
Butylated hydroxyanisole (BHA)	2
Cadmium and cadmium compounds	2
Carbon Tetrachloride	2
Ceramic fibers (respirable size)	2

Appendix 8.2.8.2 - NTP Listed Carcinogens - continued

Chemical Name	Group
Chlorambucil	1
Chlorendic acid	2
Chlorinated paraffins	2
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	2
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU)	1
Chloroform	2
3-Chloro-2-methylpropene	2
4-Chloro-ortho-phenylenediamine	2
Chromium compounds, hexavalent	1
C.I. basic red 9 monohydrochloride	2
Coke oven emissions	1
para-Cresidine	2
Cupferron	2
Cyclophosphamide	1
Dacarbazine	2
DDT	2
2,4-Diaminoanisole sulfate	2
2,4-Diaminotoluene	2
Dibenz (a,h) acridine	2
Dibenz (a,j) acridine	2
Dibenz (a,h) anthracene	2
7H-Dibenzo(c,g) carbazole	2
Dibenzo(a,e) pyrene	2
Dibenzo(a,h) pyrene	2
Dibenzo(a,i) pyrene	2
Dibenzo(a,l) pyrene	2
1,2-Dibromo-3-chloropropane	2
1,2-Dibromoethane (EBD)	2
1,4-Dichlorobenzene	2
3,3'-Dichlorobenzidine & 3,3'- Dichlorobenzidine dihydrochloride	2
1,2-Dichloroethane	2
Dichloromethane (Methylene chloride)	2
1,3-Dichloropropene (technical grade)	2
Diepoxybutane	2
Diethyl sulfate	2
Di(2-ethylhexyl) phthalate	2
Diethylstilboestrol	1
Diglycidyl resorcinol ether	2
3,3'-Dimethoxybenzidine (ortho-dianisidine)	2
3,3'-Dimethoxybenzidine dihydrochloride	2

Appendix 8.2.8.2 - NTP Listed Carcinogens - continued

Chemical Name	Group
3,3'-Dimethylbenzidine (ortho-tolidine)	2
Dimethylcarbamoyl chloride	2
1,1-Dimethylhydrazine	2
Dimethyl sulfate	2
1,4-Dioxane	2
Direct black 36	2
Direct blue 6	2
Epichlorohydrin	2
Erionite	1
Estrogens (conjugated)	2
Estrogens (not conjugated) estradiol-17 beta	2
Estrogens (not conjugated) estrone	2
Estrogens (not conjugated) ethinylestradiol	2
Estrogens (not conjugated) mestranol	2
Ethyl acrylate	2
Ethyl methanesulfonate	2
Ethylene dibromide	2
Ethylene oxide	2
Ethylene thiourea	2
Glycidol	2
Hexachlorobenzene	2
Hexachloroethane	2
Hexamethylphosphoramide	2
Hydrazine & hydrazine sulfate	2
Hydrazobenzene	2
Iron-dextran complex	2
Kepone (chlordecone)	2
Lead & lead compounds, inorganic	2
Lindane & other hexachlorocyclohexane isomers	2
Melphalan	1
Methoxsalen with ultraviolet A therapy (PUVA)	1
Methyl methanesulfonate	2
2-Methylaziridine (Propyleneimine)	2
4,4'Methylene bis (2-chloroaniline) (MBOCA)(MOCA)	2
4,4'Methylene bis (N,N-dimethylbenzenamine)	2
4,4'Methylenedianiline & its dihydrochloride	2
N-Methyl-N'nitro-N-nitrosoguanidine (MNNG)	2
Metronidazole	2
Michler's ketone	2
Mirex	2

Appendix 8.2.8.2 - NTP Listed Carcinogens - continued

Chemical Name	Group
Mustard gas (sulfur mustard)	1
2-Naphthylamine	1
Nickel & nickel compounds	2
Nitrilotriacetic acid and its salts	2
Nitrofen (Technical-grade)	2
Nitrogen mustard hydrochloride	2
2-Nitropropane	2
N-Nitrosodi-n-butylamine	2
N-Nitrosodi-n-propylamine	2
N-Nitrosodiethanolamine	2
N-Nitrosodiethylamine	2
N-Nitrosodimethylamine	2
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)	1
N-Nitrosomethylethylamine	2
N-Nitrosomethylvinylamine	2
N-Nitrosomorpholine	2
N'-Nitrosornicotine	2
N-Nitrosopiperidine	2
N-Nitrosopyrrolidine	2
N-Nitrososarcosine	2
Norethisterone	2
Ochratoxin A	2
4,4'-Oxydianiline	2
Oxymetholone	2
Phenacetin	2
Phenazopyridine hydrochloride	2
Phenoxybenzamine hydrochloride	2
Phenytoin	2
Polybrominated biphenyls	2
Polychlorinated biphenyls	2
Polycyclic aromatic hydrocarbons, 15 Listings NTP	2
Benz (a) anthracene	2
Benzo (b) fluoranthene	2
Benzo (j) fluoranthene	2
Benzo (k) fluoranthene	2
Benzo (a) pyrene	2
Dibenz (a,h) acridine	2
Dibenz (a,j) acridine	2
Dibenz (a,h) anthracene	2
7H-Dibenzo (c,g) carbazole	2

Appendix 8.2.8.2 - NTP Listed Carcinogens - continued

Chemical Name	Group
Dibenzo (a,e) pyrene	2
Dibenzo (a,h) pyrene	2
Dibenzo (a,i) pyrene	2
Dibenzo (a,l) pyrene	2
Indeno (1,2,3-cd) pyrene	2
5-Methylchrysene	2
Procarbazine hydrochloride	2
Progesterone	2
1,3-Propane sultone	2
beta-Propiolactone	2
Propylene oxide	2
Propylthiouracil	2
Radon	1
Reserpine	2
Saccharin	2
Safrole	2
Selenium sulfide	2
Silica, crystalline (respirable size)	2
Cristobalite	2
Quartz	2
Tridymite	2
Soots, tars and mineral oils	1
Streptozotocin	1
Sulfallate	2
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)	2
Tetrachloroethylene (Perchloroethylene)	2
Tetranitromethane	2
Thioacetimide	2
Thiourea	2
Thorium Dioxide	2
Toluene diisocyanates	2
ortho-Toluidine & ortho-toluidine hydro-chloride	2
2,4,6-Trichlorophenol	2
Tris (1-aziridinyl)phosphine sulfide(thiotepa)	2
Tris (2,3-dibromopropyl)phosphate	2
Urethane	2
Vinyl chloride	1
4-Vinyl-1-cyclohexene diepoxide	2
Zinc chromate (VI) hydroxide	1

Appendix 8.2.8.3 - IARC listed Carcinogens

Copied from International Agency for Research on Cancer
(Part of the U.N. World Health Organization)

Group Identification: Class 1 -- Known human carcinogen
Class 2A -- Probable human carcinogen
Class 2B -- Possible human carcinogen

Chemical Name	Group
A-alpha-C(2-amino-9H-pyrido(2,3-beta)indole)	2B
Acetaldehyde	2B
Acetamide	2B
Acrylamide	2A
Acrylonitrile	2A
Actinomycin D	2B
Adriamycin	2A
AF-2(2-(2-furyl)-3-(5-nitro-2-furyl)acrylamide)	2B
Aflatoxins	1
Aflatoxin M1	2B
para-Aminoazobenzene	2B
ortho-Aminoazotoluene	2B
4-Aminodiphenyl	1
2-Amino-1-methyl-6-phenylimidazo-[4,5-b]pyridine (PhIP)	2B
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole	2B
Amitrole	2B
Analgesic mixtures containing phenacetin	1
Androgenic (Anabolic) steroids	2A
ortho-Anisidine	2B
Antimony trioxide	2B
Aramite	2B
Arsanilic acid	1
Arsenic and arsenic compounds	1
Asbestos	1
Atrazine	2B
Auramine (Manufacture of)	1
Auramine (Technical Grade)	2B
Azactidine	2A
Azaserine	2B
Azathioprine	1
Benzene	1
Benzidine	1
Benzidine-based dyes	2A

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
Benzofuran	2B
Benz[a] anthracene	2A
Benzo[b] fluoranthene	2B
Benzo[j] fluoranthene	2B
Benzo[k] fluoranthene	2B
Benzo[a] pyrene	2A
Benzotrichloride	2B
Benzyl violet 4B	2B
Beryllium & beryllium compounds	1
N,N-Bis(2-chloroethyl)-2-naphthylamine(Chlornaphazine)	1
Bischloroethyl nitrosourea (BCNU)	2A
Bis(chloromethyl) ether and chloromethyl methyl ether (Technical Grade)	1
Bitumens, extracts of steam-refined and air-refined	2B
Bleomycins	2B
Bracken fern	2B
Bromodichloromethane	2B
1,3-Butadiene	2A
1,4-butanediol dimethanesulfonate (Myleran)	1
Butylated hydroxyanisole (BHA)	2B
B-Butyrolactone	2B
Cadmium and cadmium compounds	1
Caffeic acid	2B
Captafol	2A
Carbon-black extracts	2B
Carbon Tetrachloride	2B
Carrageenan, degraded	2B
Ceramic fibers (respirable size)	2B
Chlorambucil	1
Chloramphenicol	2A
para-Chloroaniline	2B
Chlordane	2B
Chlordecone (Kepone)	2B
Chlorendic acid	2B
Chlorinated paraffins	2B
alpha-Chlorinated toluenes	2B
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	2A
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU)	1
Chloroform	2B
1-Chloro-2-methylpropene	2B
3-Chloro-2-methylpropene	2B

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
Chlorophenols	2B
Chlorophenoxy herbicides	2B
4-Chloro-ortho-phenylenediamine	2B
para-Chloro-ortho-toluidine & its strong acids	2A
Chlorozotocin	2A
Chromium compounds, hexavalent	1
C.I. acid red 114	2B
C.I. basic red 9 monohydrochloride	2B
C.I. direct blue 15	2B
C.I. disperse blue	2B
Ciclosporin (Cylcoporin A)	1
Cisplatin	2A
Citrus red no. 2	2B
Clonorchis sinensis (infection with)	2A
Coal-tar	1
Coal-tar pitch volatiles	1
Cobalt and cobalt compounds	2B
Creosotes	2A
para-Cresidine	2B
Cycasin	2B
Cyclophosphamide	1
Dacarbazine	2B
Dantron (chryszin;1,8-dihydroxyantraquinone)	2B
Daunomycin	2B
DDT	2B
N,N' Diacetylbenzidine	2B
2,4-Diaminoanisole	2B
4,4'-Diaminodiphenyl ether	2B
2,4-Diaminotoluene	2B
Dibenz (a,h) acridine	2B
Dibenz (a,j) acridine	2B
Dibenz (a,h) anthracene	2A
7H-Dibenzo(c,g) carbazole	2B
Dibenzo(a,e) pyrene	2B
Dibenzo(a,h) pyrene	2B
Dibenzo(a,i) pyrene	2B
Dibenzo(a,l) pyrene	2B
1,2-Dibromo-3-chloropropane	2B
1,2-Dibromoethane (EBD)	2B
para-Dichlorobenzene	2B

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
ortho-Dichlorobenzene	2B
3,3'-Dichlorobenzidine & 3,3'-Dichlorobenzidine dihydrochloride	2B
3,3' Dichloro-4,4'diaminodiphenyl ether	2B
1,2-Dichloroethane	2B
Dichloromethane (Methylene chloride)	2B
1,3-Dichloropropene (technical grade)	2B
Dichlorvos	2B
Dienoestrol	1
Diepoxybutane	2B
Diesel fuel (marine)	2B
Diethyl sulfate	2A
Di(2-ethylhexyl) phthalate	2B
1,2-Diethylhydrazine	2B
Diethylstilboestrol	1
Diglycidyl resorcinol ether	2B
Dihydrosafrole	2B
Diisopropyl sulfate	2B
3,3'-Dimethoxybenzidine (ortho-dianisidine)	2B
para-Dimethylaminoazobenzene	2B
trans-2-[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)-vinyl]-1,3,4-oxadiazole	2B
2,6-Dimethylaniline (2,6-xylidine)	2B
3,3'-Dimethylbenzidine (ortho-tolidine)	2B
Dimethylcarbamoyl chloride	2A
Dimethylformamide	2B
1,1-Dimethylhydrazine	2B
1,2-Dimethylhydrazine	2B
Dimethyl sulfate	2A
1,6-Dinitropyrene	2B
1,8-Dinitropyrene	2B
1,4-Dioxane	2B
Disperse blue 1	2B
Epichlorohydrin	2A
Erionite	1
Estrogens (not conjugated) ethinylestradiol	1
Estrogens (not conjugated) mestranol	1
Ethanol (Oral)	1
Ethyl acrylate	2B
Ethyl methanesulfonate	2B
Ethylene dibromide	2A
Ethylene oxide	1

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
Ethylene thiourea	2B
N-Ethyl-N-nitrosourea	2A
Formaldehyde	2A
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl) thiazole	2B
Fumonisin B1 & fumonisin B2	2B
Furan	2B
Fusarin C	2B
Gasoline (unleaded automobile)	2B
Glass wool (respirable size)	2B
Glu-P-1(2-amino-6-methyldipyrido(1,2-a:3',2'-d)imidazole)	2B
Glu-P-2(2-aminodipyrido(1,2-a:3',2'-d)imidazole)	2B
Glycidaldehyde	2B
Griseofulvin	2B
HC blue no. 1	2B
Helicobacter pylori (infection with)	1
Hepatitis B virus (chronic infection with)	1
Hepatitis C virus (chronic infection with)	1
Heptachlor	2B
Hexachlorobenzene	2B
Hexachlorocyclohexanes (lindane)	2B
Hexamethylphosphoramide	2B
Hydrazine & hydrazine sulfate	2B
IQ (2-Amino-3-methylimidazo[4,5-f]quinoline)	2A
Iron-dextran complex	2B
Insecticides, nonarsenical (spraying & application)	2A
Isoprene	2B
Isopropyl alcohol manufacture, strong-acid process	1
Kepone (chlordecone)	2B
Lasiocarpine	2B
Lead & lead compounds, inorganic	2B
Lead arsenate	1
Magenta	2B
Magenta, manufacture of	1
MeA-alpha-C [2-amino-3-methyl-9H-pyrido(2,3-beta)indole]	2B
Medroxyprogesterone acetate	2B
MeIQ (2-Amino-3,4-dimethylimidazo[4,5-f]quinoline)	2B
MeIQx (2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline)	2B
Melphalan	1
Merphalan	2B
Methoxsalen with ultraviolet A therapy (PUVA)	1

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
5-Methoxypsoralen	2A
8-Methoxypsoralen (methoxsalen) plus ultraviolet A radiation	1
Methyl methanesulfonate	2B
2-Methylaziridine (Propyleneimine)	2B
Methylazoxymethanol and its acetate	2B
5-Methylchrysene	2B
4,4'Methylene bis (2-chloroaniline) (MBOCA)(MOCA)	2A
4,4'Methylene bis (2-methylaniline)	2B
4,4'Methylenedianiline & its dihydrochloride	2B
Methylmercury compound	2B
2-Methyl-1-nitroanthraquinone (uncertain purity)	2B
N-Methyl-N'nitro-N-nitrosoguanidine (MNNG)	2A
N-Methyl-N-nitrosourea	2A
N-Methyl-N-nitrosourethane	2B
Methylthiouracil	2B
Metronidazole	2B
Mineral oils, untreated and mildly-treated	1
Mirex	2B
Mitomycin C	2B
Monocrotaline	2B
MOPP (Combined therapy with nitrogen mustard, vincristine, procarbazine, prednisone) and other combined chemotherapy including alkylating agents	1
5-(Morpholinomethyl)-3-[(5-nitrofurfurylidene) amino]-2-oxazolidinone	2B
Mustard gas (sulfur mustard)	1
Nafenopin	2B
2-Naphthylamine	1
Nickel & nickel compounds	1
Nickel, metallic	2B
Niridazole	2B
Nitrilotriacetic acid and its salts	2B
5-Nitroacenaphthene	2B
Nitroarenes:	
1,6-Dinitropyrene	2B
1,8-Dinitropyrene	2B
6-Nitrochrysene	2B
1-Nitropyrene	2B
4-Nitropyrene	2B
6-Nitrochrysene	2B
Nitrofen (Technical-grade)	2B

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
2-Nitrofluorene	2B
1-[(5-Nitrofurfurylidene)amino]-2-imidazolidinone	2B
N-(4-(5-Nitro-2-furyl)-2-thiazolyl)acetamide	2B
Nitrogen mustard	2A
Nitrogen mustard N-oxide	2B
2-Nitropropane	2B
1-Nitropyrene	2B
4-Nitropyrene	2B
N-Nitrosodi-n-butylamine	2B
N-Nitrosodi-n-propylamine	2B
N-Nitrosodiethanolamine	2B
N-Nitrosodiethylamine	2A
N-Nitrosodimethylamine	2A
3-(N-Nitrosomethylamino)propionitrile	2B
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK)	2B
N-Nitrosomethylethylamine	2B
N-Nitrosomethylvinylamine	2B
N-Nitrosomorpholine	2B
N'-Nitrosornicotine	2B
N-Nitrosopiperidine	2B
N-Nitrosopyrrolidine	2B
N-Nitrososarcosine	2B
Nonsteroidal Oestrogens	1
Norethisterone	2B
Ochratoxin A	2B
Oestradiol - 17 beta	1
Oestrogen replacement therapy	1
Oestrogens, nonsteroidal	1
Oestrogens, steroidal	1
Oil orange SS	2B
Opisthorchis viverrini (infection with)	1
Oxazepam	2B
Oxymetholone	2A
Panfuran S (containing dihydroxymethyl-furatrizine)	2B
Pentachlorophenol	2B
Phenacetin	2A
Phenazopyridine hydrochloride	2B
Phenobarbital	2B
Phenoxyacetic acid herbicides	2B
Phenoxybenzamine hydrochloride	2B

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
Phenyl glycidyl ether	2B
Phenytoin	2B
PhIP	2B
Polybrominated biphenyls	2B
Polychlorinated biphenyls	2A
Polycyclic aromatic hydrocarbons, 15 Listings	
Benz (a) anthracene	2A
Benzo (b) fluoranthene	2B
Benzo (j) fluoranthene	2B
Benzo (k) fluoranthene	2B
Benzo (a) pyrene	2A
Dibenz (a,h) acridine	2B
Dibenz (a,j) acridine	2B
Dibenz (a,h) anthracene	2A
7H-Dibenzo (c,g) carbazole	2B
Dibenzo (a,e) pyrene	2B
Dibenzo (a,h) pyrene	2B
Dibenzo (a,i) pyrene	2B
Dibenzo (a,l) pyrene	2B
Indeno (1,2,3-cd) pyrene	2B
5-Methylchrysene	2B
Ponceau MX	2B
Ponceau 3R	2B
Potassium bromate	2B
Potassium chromate and dichromate	1
Procarbazine hydrochloride	2A
Progesterone	2B
Progestins	2B
1,3-Propane sultone	2B
beta-Propiolactone	2B
Propylene oxide	2B
Propylthiouracil	2B
Radon	1
Rockwool	2B
Saccharin	2B
Safrole	2B
Schistosoma haematobium (infection with)	1
Schistosoma japonicum (infection with)	1
Shale-oils	1
Silica, crystalline (respirable size)	2A

Appendix 8.2.8.3 - IARC listed Carcinogens - continued

Chemical Name	Group
Slagwool	2B
Sodium ortho-phenylphenate	2B
Soots, tars and mineral oils	1
Sterigmatocystin	2B
Steroid Oestrogens	1
Streptozotocin	2B
Styrene	2B
Styrene oxide	2A
Sulfallate	2B
Sulfuric acid, strong inorganic acid mists containing	1
Talc containing asbestiform fibers	1
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)	2B
Tetrachloroethylene (Perchloroethylene)	2A
Thioacetamide	2B
4,4'-Thiodianiline	2B
Thiotepa	1
Thiourea	2B
Tobacco products, smokeless	1
Tobacco smoke	1
Toluene diisocyanates	2B
ortho-Toluidine & ortho-toluidine hydro-chloride	2B
Toxaphene (polychlorinated camphenes) Treosulfan	1
Trichloroethylene	2A
Trichlormethine (trimustine hydrochloride)	2B
2,4,6-Trichlorophenol	2B
1,2,3-Trichloropropane	2A
Tris (1-aziridinyl)phosphine sulfide(thiotepa)	1
Tris (2,3-dibromopropyl)phosphate	2A
Trp-P-1 [3-amino-1,4-dimethyl-5H-pyrido(4,3-b)indole]	2B
Trp-P-2 (3-amino-1-methyl-5H-pyrido[4,3-b]indole)	2B
Trypan blue	2B
Uracil mustard	2B
Urethane	2B
Vinyl acetate	2B
Vinyl bromide	2A
Vinyl chloride	1
4-Vinylcyclohexene	2B
4-Vinyl-1-cyclohexene diepoxide	2B
Vinyl fluoride	2A
Welding fumes	2B
Wood Dust	1

Appendix 8.3.4.1 - Example of a Blank MSDS - continued

OSHA MSDS Form - Page 2

Section V -- Reactivity Data			
Stability	Unstable	Conditions to Avoid	
	Stable		
Incompatibility (Materials to Avoid)			
Hazardous Decomposition or Byproducts			
Hazardous Polymerization	May Occur	Conditions to Avoid	
	Will Not Occur		
Section VI -- Health Hazard Data			
Route(s) of Entry: Inhalation? Skin? Ingestion?			
Health Hazards (Acute and Chronic)			
Carcinogenicity: NTP? IARC Monographs? OSHA Regulated?			
Signs and Symptoms of Exposure			
Medical Conditions Generally Aggravated by Exposure			
Emergency and First Aid Procedures			
Section VII -- Precautions for Safe Handling and Use			
Steps to Be Taken in Case Material is Released or Spilled			
Waste Disposal Method			
Precautions to Be Taken in Handling and Storage			
Other Precautions			
Section VIII -- Control Measures			
Respiratory Protection (Specify Type)			
Ventilation	Local Exhaust	Special	
	Mechanical (General)	Other	
Protective Gloves		Eye Protection	
Other Protective Clothing or Equipment			
Work-Hygiene Practices			

Appendix 8.3.9.1 - EHS Safety Authorization-Requiring Hazardous Chemicals

Hazardous Chemicals Requiring EHS Safety Authorization/ Level III LSSP

Flammable/Combustible Liquids Storage in unapproved cabinets/containers

- Unapproved Cabinets, Shelf or open storage/use >30 gallons total (all classes)

- Glass, plastic, or metal cans >10 gallons total (all classes)

- Approved Safety Containers >20 gallons total (all classes)

- Any single container (drum, tank, etc.) > 5 gallons in size (any class)

Flammable/Combustible Liquids Storage in Approved Safety Cabinets

- Storage in Approved Safety Cabinets >1 cabinet per lab

- Class I liquids > 30 gallons per approved safety cabinet

- Class I, II, & III combined > 60 gallons per approved safety cabinet

Flammable Gases

- Flammable Gas Cylinders > Lecture Size >2 cylinders total

 - Hydrogen > Lecture Size >1 cylinder

- Flammable Gas Cylinders = Lecture Size >5 Lecture cylinders total

Corrosive Compounds

- Perchloric Acid (70% or greater concentration)

- Chlorine (gas) >5 lbs total

- Fluorine (gas) > 5 lbs total

- Corrosive Liquids >10 gallons total volume of all present

- Corrosive Solids >100 pounds total mass of all present

- Corrosive Gases - any cylinder > lecture size

- Multiple Corrosive Lecture Cylinders > 5 lecture cylinders total

Reactive Compounds

- All solid or liquid reactives \geq 1 pound of any single reactive compound

- All solid or liquid reactives \geq 10 pounds total combined reactives in lab

- Reactive Gases - any cylinder > lecture size

- Multiple Reactive Lecture Cylinders - 5 or more lecture cylinders

Potentially Explosive Compounds

- \geq 1 pound of any single potentially explosive compound

- \geq 10 pounds total combined of potentially explosive compounds in lab

- Any size gas cylinder of potentially explosive compounds

Explosive Compounds

- Any DOT identified explosive compound(s)

Appendix 8.3.9.1 - EHS Safety Authorization-Requiring Hazardous Chemicals - continued

 Hazardous Chemicals Requiring EHS Safety Authorization/ Level III LSSP

Particularly Toxic Compounds

NTP Known Carcinogens (Group 1)

IARC Group 1 Carcinogens

NTP "Reasonably Anticipated Carcinogens" Group 2 - EHS notification

IARC Listed "Group 2A or 2B Carcinogens" - EHS notification

OSHA Regulated Substances Requiring EHS Approval - Any Quantity

Acrylonitrile

Ethylene Oxide

Asbestos

Formaldehyde

Benzene

Methylenedianiline

1,3-butadiene

Vinyl Chloride

1,2-dibromo-3-chloropropane

OSHA Regulated Substances Requiring EHS notification - Any Quantity

Arsenic (inorganic)

Lead

Cadmium__

Methylene Chloride

Highly Toxic Substances

LD50-oral < 50 mg/Kg

LD50-skin < 200 mg/Kg

LC50-inh <200 ppm or < 2mg/l)

 Hazardous Chemicals Requiring EHS Safety Authorization/ Level IV LSSP

Explosive Compounds

ATF regulated explosive compounds

Particularly Toxic Chemicals - OSHA Regulated Carcinogens

4-Nitrobiphenyl

a-Naphthylamine

Methyl chloromethyl ether

b-Naphthylamine

3,3'-Dichlorobenzidine (and salts)

bis-Chloromethyl ether

Benzidine

4-Aminodiphenyl

Ethyleneimine

b-Propiolactone

2-Dimethylaninoazobenzene

N-Nitrosodimethylamine

2-Acetylaminofluorene

Appendix 8.6.1 - Characteristic Hazardous Waste

Ignitability Characteristics EPA ID# D001

Liquid with Flash Point < 141°F, or
Flammable Solid, or
Ignitable Compressed Gas, or
Oxidizer.

Corrosivity Characteristics EPA ID# D002

Aqueous material with pH <= 2, or
Aqueous Material with pH >= 12.5, or
Liquid capable of corroding SAE 1020 steel at a rate of > 0.25 inches per year at a test temperature of 130° F.

Reactivity Characteristics EPA ID# D003

Unstable & undergoes Violent Change without Detonating, or
Reacts Violently with Water, or
Potentially Explosive Mixtures with Water, or
Toxic Gases, Vapors, or Fumes when mixed with Water
Cyanide or Sulfide Bearing Waste when exposed to pH 2-12.5, can give off toxic gases, vapors, or fumes, or
Capable of Detonation or Explosion when subjected to Strong Initiating Source or if Heated under Confinement, or
Capable of Detonation, Explosive Decomposition or Reaction at STP, or
DOT Forbidden Explosive, Class A or B Explosive.

Toxicity Characteristics EPA ID# D004 through D034

Exhibits Toxic Characteristics > Allowable Maximum Concentration after analysis by EPA Toxicity Characteristic Leaching Procedure (TCLP)
Includes 8 Heavy Metals, 4 Insecticides, 2 Herbicides, and 26 Organic Toxic Constituents.
(See Table A on next page)

Appendix 8.6.1 - Characteristic Hazardous Waste - continued

Table A - Toxicity Characteristic Wastes - Constituents and Regulatory Levels

EPA HW#	Contaminant	Regulatory Level (mg/L or ppm)
D004	Arsenic	5.0
D005	Barium	100.0
D018	Benzene	0.5
D006	Cadmium	1.0
D019	Carbon Tetrachloride	0.5
D020	Chlordane	0.03
D021	Chlorobenzene	100.0
D022	Chloroform	6.0
D007	Chromium	5.0
D023	o-Cresol	200.0
D024	m-Cresol	200.0
D025	p-Cresol	200.0
D026	Total Cresol	200.0
D016	2,4-D (Dichlorophenoxyacetic acid)	10.0
D027	1,4-Dichlorobenzene	7.5
D028	1,2-Dichloroethane	0.5
D029	1,1-Dichloroethylene	0.7
D030	2,4-Dinitrotoluene	0.13
D012	Endrin	0.02
D031	Heptachlor (and its epoxides)	0.008
D032	Hexachlorobenzene	0.13
D033	Hexachlorobutadiene	0.5
D034	Hexachloroethane	3.0
D008	Lead	5.0
D013	Lindane	0.4
D009	Mercury	0.2
D014	Methoxychlor	10.0
D035	Methyl Ethyl Ketone	200.0
D036	Nitrobenzene	2.0
D037	Pentachlorophenol	100.0
D038	Pyridine	5.0
D010	Selenium	1.0
D011	Silver	5.0
D039	Tetrachloroethylene	0.7
D015	Toxaphene	0.5
D040	Trichloroethylene	0.5
D041	2,4,5-Trichlorophenol	400.0
D042	2,4,6-Trichlorophenol	2.0
D017	2,4,5-TP (Trichlorophenoxyacetic acid - "Silvex")	1.0
D043	Vinyl Chloride	0.2

Appendix 8.6.2 - Listed Hazardous Waste

Appendix 8.6.2.1: U-LIST Hazardous Wastes

- Commercial Chemical Products
- Manufacturing Chemical Intermediates
- Off-Specification Commercial Chemical Products
- Container Residues
- Spill Residues
- 456 Listings

Appendix 8.6.2.2: P-LIST Acutely Hazardous Wastes

- Discarded Commercial Chemical Products
- Manufacturing Chemical Intermediates
- Off-Specification Commercial Chemical Products
- Container Residues
- Spill Residues
- 198 Listings

Appendix 8.6.2.3: F-LIST Hazardous Wastes

- Hazardous Waste from Non-Specific Sources
- 21 Listings

Appendix 8.6.2.4: K-LIST Hazardous Wastes

- Hazardous Waste from Specific Sources
- 85 Listings covering 12 Manufacturing Classes

Appendix 8.6.2.1: U-LIST Hazardous Wastes

This list includes discarded commercial chemical products, off-specification species, container residues, and spill residues that are identified as being hazardous waste. The primary hazardous properties of the material is indicated by the letters: (T-toxic), (R-reactive), (I-ignitable), (C-corrosive).

EPA ID#	Substance
U001	Acetaldehyde (I)
U034	Acetaldehyde, trichloro-
U187	Acetamide, N-(4-ethoxyphenyl)-
U005	Acetamide, N-9H-fluoren-2-yl-
U240	Acetic Acid, (2,4-dichlorophenoxy)-, Salts & ethers
U112	Acetic Acid Ethyl Ester (I)
U144	Acetic Acid, lead(2+) salt
U214	Acetic Acid, thallium(1+) salt
See F027	Acetic Acid, (2,4,5-trichlorophenoxy)-
U002	Acetone (I)
U003	Acetonitrile (I,T)
U004	Acetophenone
U005	2-Acetylaminofluorene
U006	Acetyl Chloride (C,R,T)
U007	Acrylamide
U008	Acrylic Acid (I)
U009	Acrylonitrile
U011	Amitrole
U012	Aniline (I,T)
U136	Arsinic Acid, dimethyl-
U014	Auramine
U015	Azaserine
U010	Azirino[2',3',3,4]pyrrolo[1,2-a]indole-4,7-dione,6-amino-8- {[aminocarbonyl]oxy}methyl]-1,1a,2,8,8a,8b-hexahydro-8a-methoxy-5-methyl-,[1aS-(1aalpha,8beta,8aalpha,8balpha)]-
U157	Benz[j]aceanthrylene, 1,2-dihydro-3-methyl-
U016	Benz[c]acridine
U017	Benzal Chloride
U192	Benzamide, 3,5-dichloro-N-(1,1-dimethyl-2-propynyl)-
U018	Benz[a]anthracene
U094	Benz[a]anthracene, 7,12-dimethyl-
U012	Benzenamine (I,T)
U014	Benzenamine, 4,4'-carbonimidoylbis[N,N-dimethyl-
U049	Benzenamine, 4-chloro-2-methyl-, hydrochloride
U093	Benzenamine, N,N-dimethyl-4-(phenylazo)-
U328	Benzenamine, 2-methyl-
U353	Benzenamine, 4-methyl-
U158	Benzenamine, 4,4'-methylenebis[2-chloro-
U222	Benzenamine, 2-methyl-, hydrochloride
U181	Benzenamine, 2-methyl-050nitro-
U019	Benzene (I,T)
U038	Benzeneacetic Acid,4-chloro-alpha-(4-chlorophenyl)-alpha-hydroxy-,ethyl ester
U030	Benzene, 1-bromo-4-phenoxy-

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U035	Benzenebutanoic Acid, 4-[bis(2-chloroethyl)amino]-
U037	Benzene, chloro-
U221	Benzenediamine, ar-methyl-
U028	1,2-Benzenedicarboxylic Acid, bis(2-ethylhexyl) ester
U069	1,2-Benzenedicarboxylic Acid, dibutyl ester
U088	1,2-Benzenedicarboxylic Acid, diethyl ester
U102	1,2-Benzenedicarboxylic Acid, dimethyl ester
U107	1,2-Benzenedicarboxylic Acid, dioctyl ester
U070	Benzene, 1,2-dichloro-
U071	Benzene, 1,3-dichloro-
U072	Benzene, 1,4-dichloro-
U060	Benzene, 1,1'-(2,2-dichloroethylidene)bis[4-chloro-
U017	Benzene, (dichloromethyl)-
U223	Benzene, 1,3-diisocyanatomethyl- (R,T)
U239	Benzene, dimethyl- (I,T)
U201	1,3-Benzenediol
U127	Benzene, hexachloro-
U056	Benzene, hexahydro-
U220	Benzene, methyl-
U105	Benzene, 1-methyl-2,4-dinitro-
U106	Benzene, 2-methyl-1,3-dinitro-
U055	Benzene, (1-methylethyl)- (I)
U169	Benzene, nitro-
U183	Benzene, pentachloro-
U185	Benzene, pentachlornitro-
U020	Benzenesulfonic acid chloride (C,R)
U020	Benzenesulfonyl chloride (C,R)
U207	Benzene, 1,2,4,5-tetrachloro-
U061	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-chloro-
U247	Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-
U023	Benzene, (trichloromethyl)-
U234	Benzene, 1,3,5-trinitro-
U021	Benzdine
U202	1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide & salts
U203	1,3-Benzodioxole, 5-(2-propenyl)-
U141	1,3-benzodioxole, 5-(1-propenyl)-
U090	1,3-Benzodioxole, 5-propyl-
U064	Benzo[rs]pentaphene
U248	2H-1-Benzopyran-2-one,4-hydroxy-3-(3-oxo-1-phenyl-butyl)-, & salts
U022	Benzo[a]pyrene
U197	p-Benzoquinone
U023	Benzotrichloride (C,R,T)
U085	2,2'-Bioxirane
U021	[1,1'-Biphenyl]-4,4'-diamine
U073	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dichloro-
U091	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethoxy-
U095	[1,1'-Biphenyl]-4,4'-diamine, 3,3'-dimethyl-
U225	Bromoform

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U030	4-Bromophenyl phenyl ether
U128	1,3-Butadiene, 1,1,2,3,4,4-hexachloro-
U172	1-Butanamine, N-butyl-N-nitroso-
U031	1-Butanol (I)
U159	2-Butanone (I,T)
U160	2-Butanone, peroxide (R,T)
U053	2-Butenal
U074	2-Butene, 1,4-dichloro- (I,T)
U143	2-Butanoic Acid, 2-methyl-, 7[[[2,3-dihydroxy-2-(1-methoxyethyl)- 3-methyl-1- oxobutoxy]methyl]- [1S-[1alpha(Z),7(2S',3R'),7alpha]]-
U031	n-Butyl Alcohol (I)
U136	Cacodylic Acid
U032	Calcium Chromate
U238	Carbamic Acid, ethyl ester
U178	Carbamic Acid, methylnitroso-, ethyl ester
U097	Carbamic Chloride, dimethyl-
U114	Carbamodithioic acid, 1,2-ethanediybis-, salts & esters
U062	Carbamothioic Acid, bis(1-methylethyl)- S-(2,3-dichloro-2-propenyl) ester
U215	Carbonic Acid, dithallium(1+) salt
U033	Carbonic Difluoride
U211	Carbon Tetrachloride
U034	Chloral
U035	Chlorambucil
U036	Chlordane, alpha & gamma isomers
U026	Chlornaphazin
U037	Chlorobenzene
U038	Chlorobenzilate
U039	p-Chloro-m-cresol
U042	2-Chlorethyl vinyl ether
U044	Chloroform
U046	Chloromethyl Methyl Ether
U047	beta-Chloronaphthalene
U048	o-Chlorophenol
U049	4-Chloro-o-toluidine, hydrochloride
U032	Chromic Acid, H ₂ CrO ₄ , Calcium Salt
U050	Chrysene
U051	Creosote
U052	Cresol (Cresylic Acid)
U053	Crotonaldehyde
U055	Cumene (I)
U246	Cyanogen Bromide (CN)Br
U197	2,5-Cyclohexadiene-1,4-dione
U056	Cyclohexane
U129	Cyclohexane, 1,2,3,4,5,6-hexachloro-(1alpha,2alpha,3beta,4alpha,5alpha,6beta)-
U057	Cyclohexanone (I)
U130	1,3-Cyclopentadiene, 1,2,3,4,5,5-hexachloro
U058	Cyclophosphamide
U240	2,4-D, salts & esters

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U059	Daunomycin
U060	DDD
U061	DDT
U062	Diallate
U063	Dibenz[a,h]anthracene
U064	Dibenzo[a,i]pyrene
U066	1,2-Dibromo-3-chloropropane
U069	Dibutyl Phthalate
U070	o-Dichlorobenzene
U071	m-Dichlorobenzene
U072	p-Dichlorobenzene
U073	3,3'-Dichlorobenzidine
U074	1,4-Dichloro-2-butene (I,T)
U075	Dichlorodifluoromethane
U078	1,1-Dichloroethylene
U079	1,2-Dichloroethylene
U025	Dichloroethyl Ether
U027	Dichloroisopropyl Ether
U024	Dichloromethoxy Ethane
U081	2,4-Dichlorophenol
U082	2,6-Dichlorophenol
U084	1,3-Dichloropropene
U085	1,2,3,4-Diepoxybutane (I,T)
U108	1,4-Diethyleneoxide
U028	Diethylhexyl Phthalate
U086	N,N'-Diethylhydrazine
U087	O,O-Diethyl S-methyl dithiophosphate
U088	Diethyl Phthalate
U089	Diethylstilbesterol
U090	Dihydrosafrole
U091	3,3'-Dimethoxybenzidine
U092	Dimethylamine (I)
U093	p-Dimethylaminoazobenzene
U094	7,12- Dimethylbenz[a]anthracene
U095	3,3'-Dimethylbenzidine
U096	alpha,alpha-Dimethylbenzylhydroperoxide (R)
U097	Dimethylcarbamoyl Chloride
U098	1,1-Dimethylhydrazine
U099	1,2-Dimethylhydrazine
U101	2,4-Dimethylphenol
U102	Dimethyl Phthalate
U103	Dimethyl Sulfate
U105	2,4-Dinitrotoluene
U106	2,6-Dinitrotoluene
U107	Di-n-octyl phthalate
U108	1,4-Dioxane
U109	1,2-Diphenylhydrazine
U110	Dipropylamine

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U111	Di-n-propylnitrosamine
U041	Epichlorohydrin
U001	Ethanal
U174	Ethanamine, N-ethyl-N-nitroso
U155	1,2-Ethanediamine, N,N-dimethyl-N'-2-pyridinyl-N'-(2-thienylmethyl)-
U067	Ethane, 1,2-dibromo-
U076	Ethane, 1,1-dichloro-
U077	Ethane, 1,2-dichloro-
U131	Ethane, hexachloro-
U024	Ethane, 1,1'-[methylenebis(oxy)]bis[2-chloro-
U117	Ethane, 1,1'-oxybis- (I)
U025	Ethane, 1,1'-oxybis[2-chloro-
U184	Ethane, pentachloro-
U208	Ethane, 1,1,1,2-tetrachloro-
U209	Ethane, 1,1,2,2-tetrachloro-
U218	Ethanethioamide
U226	Ethane, 1,1,1-trichloro-
U227	Ethane, 1,1,2-trichloro-
U359	Ethanol, 2-ethoxy-
U173	Ethanol, 2,2'-(nitrosoimino)bis-
U004	Ethanone, 1-phenyl-
U043	Ethene, chloro-
U042	Ethene, (2-chloroethoxy)-
U078	Ethene, 1,1-dichloro-
U079	Ethene, 1,2-dichloro- (E)
U210	Ethene, tetrachloro-
U228	Ethene, trichloro-
U112	Ethyl Acetate (I)
U113	Ethyl Acrylate (I)
U238	Ethyl Carbamate (urethane)
U117	Ethyl Ether (I)
U114	Ethylenebisdithiocarbamic Acid, salts & esters
U067	Ethylene dibromide
U077	Ethylene dichloride
U359	Ethylene glycol monoethyl ether
U115	Ethylene Oxide (I,T)
U116	Ethylenethiourea
U076	Ethylidene dichloride
U118	Ethyl Methacrylate
U119	Ethyl methanesulfonate
U120	Fluoranthene
U122	Formaldehyde
U123	Formic Acid (C,T)
U124	Furan (I)
U125	2-Furancarboxaldehyde (I)
U147	2,5-Furandione
U213	Furan, tetrahydro- (I)
U125	Furfural (I)

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U124	Furfuran (I)
U206	Glucopyranose, 2-deoxy-2-(3-methyl-nitrosoureido)-,D-
U206	D-Glucose, 2-deoxy-2-[[methylnitrosoamino]-carbonyl]amino]-
U126	Glycidylaldehyde
U163	Guanidine, N-methyl-N'-nitro-N-nitroso-
U127	Hexachlorobenzene
U128	Hexachlorobutadiene
U130	Hexachlorocyclopentadiene
U131	Hexachloroethane
U132	Hexachlorophene
U243	Hexachloropropene
U133	Hydrazine (R,T)
U086	Hydrazine, 1,2-diethyl-
U098	Hydrazine, 1,1-dimethyl-
U099	Hydrazine, 1,2-dimethyl-
U109	Hydrazine, 1,2-diphenyl
U134	Hydrofluoric Acid (C,T)
U134	Hydrogen Fluoride (C,T)
U135	Hydrogen Sulfide
U135	Hydrogen Sulfide H ₂ S
U096	Hydroperoxide, 1-methyl-1-phenylethyl- (R)
U116	2-Imidazolidinethione
U137	Indeno[1,2,3-cd]pyrene
U190	1,3-Isobenzofurandione
U140	Isobutyl Alcohol (I,T)
U141	Isosafrole
U142	Kepone
U143	Lasiocarpine
U144	Lead Acetate
U146	Lead, bis(acetato-O)tetrahydroxytri-
U145	Lead Phosphate
U146	Lead Subacetate
U129	Lindane
U163	MNNG
U147	Maleic Anhydride
U148	Maleic Hydrazide
U149	Malononitrile
U150	Melphalan
U151	Mercury
U152	Methacrylonitrile (I,T)
U092	Methanamine, N-methyl- (I)
U029	Methane, bromo-
U045	Methane, chloro- (I,T)
U046	Methane, chloromethoxy-
U068	Methane, dibromo-
U080	Methane, dichloro-
U075	Methane, dichlorodifluoro-
U138	Methane, iodo-

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U119	Methanesulfonic Acid, ethyl ester
U211	Methane, tetrachloro-
U153	Methanethiol (I,T)
U225	Methane, tribromo-
U044	Methane, trichloro-
U121	Methane, trichlorofluoro-
U036	4,7-Methano-1H-indene,1,2,4,5,6,7,8,8-octachloro-2,3,3a,4,7,7a,hexahydro-
U154	Methanol (I)
U155	Methapyrilene
U142	1,3,4-Metheno-2H-cyclobuta[cd]pentalen-2-one, 1,1a,3,3a,4,5,5,5a,5b,6-decachlorooctahydro-
U247	Methoxychlor
U154	Methyl Alcohol (I)
U029	Methyl Bromide
U186	1-Methylbutadiene (I)
U045	Methyl Chloride (I,T)
U156	Methyl chlorocarbonate (I,T)
U226	Methyl Chloroform
U157	3-Methylcholanthrene
U158	4,4'-Methylenebis(2-chloroaniline)-
U068	Methylene bromide
U080	Methylene Chloride
U159	Methyl Ethyl Ketone (MEK) (I,T)
U160	Methyl Ethyl Ketone peroxide (R,T)
U138	Methyl iodide
U161	Methyl Isobutyl Ketone (I)
U162	Methyl methacrylate (I,T)
U161	4-Methyl-2-pentanone (I)
U164	Methylthiouracil
U010	Mitomycin C
U059	5,12-Naphthacenedione,8-acetyl-10-[(3-amino-2,3,6-trideoxy)-alpha-L-lyxo-hexopyranosyl)oxy]-7,8,9,10-tetrahydro-6,8,11-trihydroxy-1-methoxy-,(8S-cis)-
U167	1-Naphthalenamine
U168	2-Naphthalenamine
U026	Naphthalenamine, N,N'-bis(2-chloroethyl)-
U165	Naphthalene
U047	Naphthalene, 2-chloro-
U166	1,4-Naphthalenedione
U236	2,7-naphthalenedisulfonic Acid,3,3'-[(3,3'-dimethyl[1,1'-biphenyl]-4,4'-diyl)bis[5-amino-4-hydroxy]- , tetrasodium
U166	1,4-Naphthoquinone
U167	a-Naphthylamine
U168	b-Naphthylamine
U217	Nitric Acid, thallium(1+) salt
U169	Nitrobenzene (I,T)
U170	p-Nitrophenol
U171	2-Nitropropane (I)
U172	N-Nitrosodi-n-butylamine
U173	N-Nitrosodiethanolamine

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U174	N-Nitrosodiethylamine
U176	N-Nitroso-N-ethylurea
U177	N-Nitroso-N-methylurea
U178	N-Nitroso-N-methylurethane
U179	N-Nitrosopiperidine
U180	N-Nitrosopyrrolidine
U181	5-Nitro-o-toluidine
U193	1,2-Oxathiolane, 2,2-dioxide
U058	2H-1,3,2-Oxazaphosphorin-2-amine, N,N-bis(2-chloroethyl)tetrahydro-, 2-oxide
U115	Oxirane (I,T)
U126	Oxiranecarboxaldehyde
U041	Oxirane, (chloromethyl)-
U182	Paraldehyde
U183	Pentachlorobenzene
U184	Pentachloroethane
U185	Pentachloronitrobenzene (PCNB)
See F027	Pentachlorophenol
U161	Pentanol, 4-methyl-
U186	1,3-Pentadiene (I)
U187	Phenacetin
U188	Phenol
U048	Phenol, 2-chloro-
U039	Phenol, 4-chloro-3-methyl-
U081	Phenol, 2,4-dichloro-
U082	Phenol, 2,6-dichloro-
U089	Phenol, 4,4'-(1,2-diethyl-1,2-ethenediy)bis-, (E)
U101	Phenol, 2,4-dimethyl-
U052	Phenol, methyl-
U132	Phenol, 2,2'-methylenebis[3,4,6-trichloro-
U170	Phenol, 4-nitro-
See F027	Phenol, pentachloro-
See F027	Phenol, 2,3,4,6-tetrachloro-
See F027	Phenol, 2,4,5-trichloro-
See F027	Phenol, 2,4,6-trichloro-
U150	L-Phenylalanine, 4-[bis(3-chloroethyl)amino]-,
U145	Phosphoric Acid, lead(2+) salt (2:3)
U087	Phosphorodithioic Acid, O,O-diethyl S-methyl ester
U189	Phosphorous Sulfide (R)
U190	Phthalic Anhydride
U191	2-Picoline
U179	Piperidine, 1-nitroso-
U192	Propanamide
U194	1-Propanamine (I,T)
U111	1-Propanamine, N-nitroso-N-propyl-
U110	1-Propanamine, N-propyl- (I)
U066	Propane, 1,2-dibromo-3-chloro-
U083	Propane, 1,2-dichloro-
U149	Propanedinitrile

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U171	Propane, 2-nitro- (I,T)
U027	Propane, 2,2'-oxybis[2-chloro-
U193	1,3-Propane Sultone
See F027	Propanoic Acid, 2-(2,4,5-trichlorophenoxy)-
U235	1-Propanol, 2,3-dibromo-, phosphate (3:1)
U140	1-Propanol, 2-methyl-, (I,T)
U002	2-Propanone (I)
U007	2-Propenamide
U084	1-Propene, 1,3-dichloro-
U243	1-Propene, 1,1,2,3,3,3-hexachloro-
U009	2-Propenenitrile
U152	2-Propenenitrile,2-methyl- (I,T)
U008	2-Propenoic Acid (I)
U113	2-Propenoic Acid, ethyl ester (I)
U118	2-Propenoic Acid, 2-methyl, ethyl ester
U162	2-Propenoic Acid, 2-methyl, methyl ester (I,T)
U194	n-Propylamine (I,T)
U083	Propylene dichloride
U148	3,6-Pyridazinedione, 1,2-dihydro-
U196	Pyridine
U191	Pyridine, 2-methyl-
U237	2,4-(1H,3H)-Pyrimidinedione, 5-[bis(2-chloroethyl)amino]-
U164	4(1H)-Pyrimidinone, 2,3-dihydro-6-methyl-2-thioxo-
U180	Pyrrolidine, 1-nitroso-
U200	Reserpine
U201	Resorcinol
U202	Saccharin & salts
U203	Safrole
U204	Selenious Acid
U204	Selenium dioxide
U205	Selenium sulfide
U205	Selenium sulfide SeS ₂ (R,T)
U015	L-Serine, diazoacetate (ester)
See F027	Silvex (2,4,5-TP)
U206	Streptozotocin
U103	Sulfuric Acid, dimethyl ester
U189	Sulfur Phosphide (R)
See F027	2,4,5-T
U207	1,2,4,5-Tetrachlorobenzene
U208	1,1,1,2-Tetrachloroethane
U209	1,1,2,2-Tetrachloroethane
U210	Tetrachloroethylene
See F027	2,3,4,6-Tetrachlorophenol
U213	Tetrahydrofuran
U214	Thallium(I) Acetate
U215	Thallium(I) Carbonate
U216	Thallium(I) Chloride
U216	Thallium Chloride TlCl

Appendix 8.6.2.1: U-LIST Hazardous Wastes - continued

EPA ID#	Substance
U217	Thallium(I) Nitrate
U218	Thioacetamide
U153	Thiomethanol (I,T)
U244	Thioperoxydicarbonic diamide $[(H_2N)C(S)]_2$, tetramethyl
U219	Thiourea
U244	Thiram
U220	Toluene
U221	Toluenediamine
U223	Toluene diisocyanate (R,T)
U328	o-Toluidine
U353	p-Toluidine
U222	o-Toluidine hydrochloride
U011	1H-1,2,4-Triazol-3-amine
U227	1,1,2-Trichloroethane
U228	Trichloroethylene
U121	Trichloromonofluoromethane
See F027	2,4,5-Trichlorophenol
See F027	2,4,6-Trichlorophenol
U234	1,3,5-Trinitrobenzene (R,T)
U182	1,3,5-Trioxane, 2,4,6-trimethyl-
U235	Tris(2,3-dibromopropyl) phosphate
U236	Trypan blue
U237	Uracil mustard
U176	Urea, N-ethyl-N-nitroso-
U177	Urea, N-methyl-N-nitroso-
U043	Vinyl Chloride
U248	Warfarin & salts, when present at concentrations of 0.3% or less
U239	Xylene (I)
U200	Yohimban-16-carboxylic Acid,11,17-dimethoxy-18-[(3,4,5-trimethoxybenzoyl)oxy]-methyl ester, (3beta,16beta,17alpha,18beta,20alpha)-
U249	Zinc Phosphide (Zn_3P_2) when present at concentrations of 10% or less

Appendix 8.6.2.2: P-LIST Acutely Hazardous Wastes

This list includes discarded commercial chemical products, off-specification species, container residues, and spill residues that are identified as being acutely hazardous waste. The primary hazardous properties of the material is indicated by the letters: (T-toxic), (R-reactive), (I-ignitable), (C-corrosive).

EPA ID#	Substance
P023	Acetaldehyde, chloro-
P002	Acetamide, N-(aminothioxomethyl)-
P057	Acetamide, 2-fluoro-
P058	Acetic Acid, fluoro-, sodium salt
P002	1-Acetyl-2-thiourea
P003	Acrolein
P070	Aldicarb
P004	Aldrin
P005	Allyl Alcohol
P006	Aluminum phosphide (R,T)
P007	5-(Aminomethyl)-3-isoxazolol
P008	4-Aminopyridine
P009	Ammonium Picrate (R)
P119	Ammonium Vanadate
P099	Argentate(1-),bis(cyano-C)-, potassium
P010	Arsenic Acid, H ₃ AsO ₄
P012	Arsenic Oxide, As ₂ O ₃
P011	Arsenic Oxide, As ₂ O ₅
P011	Arsenic Pentoxide
P012	Arsenic trioxide
P038	Arsine, diethyl-
P036	Arsonous dichloride, phenyl-
P054	Aziridine
P067	Aziridine, 2-methyl-
P013	Barium Cyanide
P024	Benzenamine, 4-chloro-
P077	Benzenamine, 4-nitro-
P028	Benzene, (chloromethyl)-
P042	1,2 Benzenediol, 4-[1-hydroxy-2-(methylamino)ethyl]-, (R)
P046	Benzeneethanamine, a,a-dimethyl-
P014	Benzenethiol
P001	2H-1-benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts
P028	Benzyl Chloride
P015	Beryllium
P017	Bromoacetone
P018	Brucine
P045	2-Butanone, 3,3-dimethyl-1-(methylthio)-, O-[(methylamino)carbonyl] oxime
P021	Calcium Cyanide
P022	Carbon Disulfide

Appendix 8.6.2.2: P-LIST Acutely Hazardous Wastes - continued

EPA ID#	Substance
P095	Carbon Dichloride
P023	Chloroacetaldehyde
P024	p-Chloroaniline
P026	1-(o-Chlorophenyl)thiourea
P027	3-Chloropropionitrile
P029	Copper Cyanide
P030	Cyanides (soluble cyanide salts not otherwise specified)
P031	Cyanogen
P033	Cyanogen Chloride
P034	2-Cyclohexyl-4,6-dinitrophenol
P016	Dichloromethyl ether
P036	Dichlorophenylarsine
P037	Dieldrin
P038	Diethylarsine
P041	Diethyl-p-nitrophenyl phosphate
P040	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	Diisopropylfluorophosphate (DFP)
P004	1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,- hexahydro(1 alpha,4alpha,4abeta,5alpha,8alpha,8abeta)-
P060	1,4,5,8-Dimethanonaphthalene,1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,- hexahydro(1 alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P037	2,7:3,6-Dimethanonaphth[2,3-b]oxirene,3,4,5,6,9,9-hexachloro-1 a,2,2a,3,6,6a,7,7a-octahydro-, (1 aalpha,2beta,2aalpha,3beta,6beta,6aalpha,7beta,7aalpha)-
P051	2,7:3,6-Dimethanonaphth[2,3-b]oxirene,3,4,5,6,9,9-hexachloro-1 a,2,2a,3,6,6a,7,7a-octahydro-, (1 aalpha,2beta,2abeta,3alpha,6alpha,6abeta,7beta,7aalpha)- & metabolites
P044	Dimethoate
P046	alpha,alpha-Dimethylphenethylamine
P047	4,6-Dinitro-o-cresol, & salts
P048	2,4-Dinitrophenol
P020	Dinoseb
P085	Diphosphoramidate,octamethyl-
P111	Diphosphoric Acid, tetraethyl ester
P039	Disulfoton
P049	Dithiobiuret
P050	Endosulfan
P088	Endothall
P051	Endrin
P051	Endrin, & metabolites
P042	Epinephrine
P031	Ethanedinitrile
P066	Ethanimidothioic acid, N-[[[(methylamino)carbonyl]oxy]-, methyl ester
P101	Ethyl Cyanide
P054	Ethyleneimine
P097	Famphur
P056	Fluorine
P057	Fluoroacetamide
P058	Fluoroacetic Acid, Sodium salt
P065	Fulminic acid, mercury(2+)salt (R,T)

Appendix 8.6.2.2: P-LIST Acutely Hazardous Wastes - continued

EPA ID#	Substance
P059	Heptachlor
P062	Hexaethyl tetraphosphate
P116	Hydrazinecarbothioamide
P068	Hydrazine, methyl-
P063	Hydrocyanic Acid
P063	Hydrogen Cyanide
P096	Hydrogen Phosphide
P060	Isodrin
P007	3(2H)-Isoxazolone, 5-(aminomethyl)-
P092	Mercury, (acetato-O)phenyl-
P065	Mercury Fulminate (R,T)
P082	Methanamine, N-methyl-N-nitroso-
P064	Methane, isocyanato-
P016	Methane, oxybis[chloro-
P112	Methane, tetranitro- (R)
P118	Methanethiol, trichloro-
P050	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10-hexachloro- 1,5,5a,6,9,9a-hexahydro-,3-oxide
P059	4,7-Methano-1H-indene, 1,4,5,6,7,7,8-heptachloro- 3a,4,7,7a-tetrahydro-
P066	Methomyl
P068	Methyl Hydrazine
P064	Methyl Isocyanate
P069	2-methylactonitrile
P071	Methyl Parathion
P072	alpha-Naphthylthiourea
P073	Nickel Carbonyl
P073	Nickel Carbonyl Ni(CO) ₄ , (T-4)-
P074	Nickel Cyanide
P075	Nicotine & salts
P076	Nitric Oxide
P077	p-Nitroaniline
P078	Nitrogen Dioxide
P076	Nitrogen Oxide NO
P078	Nitrogen Oxide NO ₂
P081	Nitroglycerine (R)
P082	N-Nitrosodimethylamine
P084	N-Nitrosomethylvinylamine
P085	Octamethylpyrophosphoramide
P087	Osmium Oxide, OsO ₄ , (T-4)-
P087	Osmium Tetroxide
P088	7-Oxabicyclo[2.2.1]heptane-2,3-dicarboxylic acid
P089	Parathion
P034	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	Phenol, 2,4-dinitro-
P047	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	Phenol, 2,4,6-trinitro-, ammonium salt, (R)
P092	Phenylmercury Acetate

Appendix 8.6.2.2: P-LIST Acutely Hazardous Wastes - continued

EPA ID#	Substance
P093	Phenylthiourea
P094	Phorate
P095	Phosgene
P096	Phosphine
P041	Phosphoric Acid, diethyl 4-nitrophenyl ester
P039	Phosphorodithioic Acid, O,O-diethyl S-[(ethylthio)ethyl] ester
P094	Phosphorodithioic Acid, O,O-diethyl S-[(ethylthio)methyl] ester
P044	Phosphorodithioic Acid, O,O-dimethyl S-[2-(methylamino)-2-oxoethyl] ester
P043	Phosphorofluoridic Acid, bis(1-methylethyl) ester
P089	Phosphorothioic Acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	Phosphorothioic Acid, O,O-diethyl O-pyrazinyl ester
P097	Phosphorothioic Acid, O-{4-[(dimethylamino)sulfonyl]phenyl} O,O-dimethyl ester
P071	Phosphorothioic Acid, O,O-dimethyl O-(4-nitrophenyl) ester
P110	Plumbane, tetraethyl-
P098	Potassium Cyanide
P098	Potassium Cyanide K(CN)
P099	Potassium Silver Cyanide
P070	Propanal, 2-methyl-2-(methylthio)-O-[(methylamino)carbonyl]oxime
P101	Propanenitrile
P027	Propanenitrile, 3-chloro-
P069	Propanenitrile, 2-hydroxy-2-methyl-
P081	1,2,3-Propanetriol, trinitrate (R)
P017	2-Propanone, 1-bromo-
P102	Propargyl Alcohol
P003	2-Propenal
P005	2-propen-1-ol
P067	1,2-Propylenimine
P102	2-Propyn-1-ol
P008	4-Pyridinamine
P075	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-, (S)-, & salts
P114	Selenious Acid, dithallium(1+) salt
P103	Selenourea
P104	Silver Cyanide
P104	Silver Cyanide, Ag(CN)
P105	Sodium Azide
P106	Sodium Cyanide
P106	Sodium Cyanide, Na(CN)
P107	Strontium Sulfide, SrS
P108	Strychnidin-10-one, & salts
P018	Strychnidin-10-one, 2,3-dimethoxy-
P108	Strychnine & salts
P115	Sulfuric Acid, dithallium(1+) salt
P109	Tetraethyldithiopyrophosphate
P110	Tetraethyl Lead
P111	Tetraethyl Pyrophosphate
P112	Tetranitromethane (R)
P062	Tetrakisphosphoric Acid, hexaethyl ester
P113	Thallic Oxide

Appendix 8.6.2.2: P-LIST Acutely Hazardous Wastes - continued

EPA ID#	Substance
P113	Thallium Oxide, Tl_2O_3
P114	Thallium Selenite
P115	Thallium Sulfate
P109	Thiodiphosphoric Acid, tetraethyl ester
P045	Thiofanox
P049	Thioimidodicarbonic Diamide $[(H_2N)C(S)]_2NH$
P014	Thiophenol
P116	Thiosemicarbazide
P026	Thiourea, (2-chlorophenyl)-
P072	Thiourea, 1-naphthalenyl-
P093	Thiourea, phenyl-
P123	Toxaphene
P118	Trichloromethanethiol
P119	Vanadic Acid, ammonium salt
P120	Vanadium Oxide, V_2O_5
P120	Vanadium Pentoxide
P084	Vinylamine, N-methyl-N-nitroso-
P001	Warfarin, & salts, when present at concentrations > 0.3%
P121	Zinc Cyanide
P121	Zinc Cyanide, $Zn(CN)_2$
P122	Zinc Phosphide (Zn_3P_2), when present at concentrations > 10% (R,T)

Appendix 8.6.2.3: F-LIST Hazardous Wastes

This list includes hazardous wastes from non-specific sources. The primary hazardous properties of the material is indicated by the letters: (I-ignitable), (W-corrosive), (R-reactive), (E-toxicity), (H-acutely hazardous), (T-toxic).

EPA ID#	Hazardous Waste
F001	The following spent halogenated solvents used in degreasing: Tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10% or more (by volume) of one or more of the above halogenated solvents, or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.(T)
F002	The following spent halogenated solvents: Tetrachloroethylene, methylene trichloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, o-dichlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.(T)
F003	The following spent non-halogenated solvents: Xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and a total of 10% or more (by volume) of one or more of those solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures. (I)
F004	The following spent non-halogenated solvents: Cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above listed solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures. (T)
F005	The following spent non-halogenated solvents: Toluene, Methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures. (I,T)
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum, (2) Tin plating on carbon steel, (3) Zinc plating (segregated basis) on carbon steel, (4) Aluminum or zinc-aluminum plating on carbon steel, (5) Cleaning or stripping associated with tin, zinc and aluminum plating on carbon steel, and (6) Chemical etching and milling of aluminum. (T)
F007	Spent cyanide plating bath solutions from electroplating operations. (R,T)

Appendix 8.6.2.3: F-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
F008	Plating bath residues from the bottom of plating baths from electroplating operations where cyanides are used in the process. (R,T)
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process. (R,T)
F010	Quenching bath residues from oil baths from metal heat treating operations where cyanides are used in the process. (R,T)
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations. (R,T)
F012	Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process. (T)
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum. (T)
F020	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as A reactant, chemical intermediate, or component in the formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of Hexachlorophene from highly purified 2,4,5-trichlorophenol. (H)
F021	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in the formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.(H)
F022	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzenes under alkaline conditions. (H)
F023	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (this listing does not include wastes from equipment used only for the production or use of Hexachlorophene from highly purified 2,4,5-trichlorophenol.) (H)
F024	Wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes from the production of chlorinated aliphatic hydrocarbons, having carbon content from one to five, utilizing free radical catalyzed processes. (this listing does not include light ends, spent filters and filter aids, spent dessicants, wastewater, wastewater treatment sludges, spent catalysts, and waste listed in 261.32. (T)

Appendix 8.6.2.3: F-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
F025	Condensed light ends, spent filters, and filter aids, and spent dessicant wastes from the production of certain chlorinated aliphatic hydrocarbons, by free radical catalyzed processes. Thses chlorinated aliphatic hydrocarbons are those having carbon chain lengths ranging from one to and including five, with varying amounts and positions of chlorine substitution. (T)
F026	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions.
F027	Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing Hexachlorophene synthesized from prepurified 2,4,5-trichlorophenol as the sole component). (H)
F028	Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F024, and F027. (T)
F032	Wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations (except potentially cross-contaminated wastes that have had the F032 waste code deleted in accordance with 40 CFR 261.35 and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol. (T)
F034	Wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use creosote formulations. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.
F035	Wastewaters, process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that use inorganic preservatives containing arsenic or chromium. This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol. (T)

Appendix 8.6.2.3: F-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
F037	<p>Petroleum refinery primary oil/water/solids separation sludge- Any sludge generated from the gravitational separation of oil/water/solids during the storage or treatment of process wastewaters and oily cooling wastewaters from petroleum refineries. Such sludges include, but are not limited to, those generated in: oil/water/solids separators; tanks and impoundments; ditches and other conveyances; sumps; and stormwater units receiving dry weather flow. Sludge generated in storm water units that do not receive dry weather flow, sludges generated from non-contact once through cooling waters segregated for treatment from other process or oily cooling waters, sludges generated in aggressive biological treatment units as defined in 40 CFR 261.31(b)(2) (including sludges generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and K051 wastes are not included in this listing. (T)</p>
F038	<p>Petroleum refinery secondary (emulsified) oil/water/solids separation sludge-Any sludge and/or float generated from the physical and/or chemical separation of oil/water/solids in process wastewaters and oily cooling wastewaters from petroleum refineries. Such waste include, but are not limited to, all sludges and floats generated in: induced air flotation units, tanks and impoundments, and all sludges generated in DAF units. Sludges generated in stormwater units that do not receive dry weather flow, sludges generated from non-contact once through cooling waters segregated for treatment from other process or oily cooling waters, sludges and floats generated in aggressive biological treatment units as defined in 40 CFR 261.31(b)(2) (including sludges and floats generated in one or more additional units after wastewaters have been treated in aggressive biological treatment units) and F037, K048, and K051 wastes are not included in this listing. (T)</p>
F039	<p>Leachate (liquids that have percolated through land disposal wastes) resulting from the disposal of more than one restricted waste classified as hazardous under 40 CFR 261 Subpart D. (Leachate resulting from the disposal of one or more of the following EPA Hazardous Wastes and no other hazardous waste retains its EPA ID number: F020, F021, F022, F026, F027, F028. (T)</p>

Appendix 8.6.2.4: K-LIST Hazardous Wastes

This list includes hazardous wastes from specific sources. The primary hazardous properties of the material is indicated by the letters: (I-ignitable), (W-corrosive), (R-reactive), (E-toxicity), (H-acutely hazardous), (T-toxic).

EPA ID#	Hazardous Waste
Wood Preservation	
K001	Bottom sediment sludge from the treatment of wastewaters from preserving processes that use creosote and/or pentachlorophenol. (T)
Inorganic Pigments	
K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments. (T)
K003	Wastewater treatment sludge from the production of molybdate orange pigments. (T)
K004	Wastewater treatment sludge from the production of zinc yellow pigments. (T)
K005	Wastewater treatment sludge from the production of chrome green pigments. (T)
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated).
K007	Wastewater treatment sludge from the production of iron blue pigments (T)
K008	Oven residue from the production of chrome green pigments. (T)
Organic Chemicals	
K009	Distillation bottoms from the production of acetaldehyde from ethylene. (T)
K010	Distillation side cuts from the production of acetaldehyde from ethylene. (T)
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile. (T)
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile. (T)
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile. (T)
K015	Still bottoms from the distillation of benzoyl chloride. (T)
K016	Heavy ends or distillation residues from the production of carbon tetrachloride. (T)
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin. (T)
K018	Heavy ends from the fractionation column in ethyl chloride production. (T)
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production. (T)

Appendix 8.6.2.4: K-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
K020	Heavy ends from the distillation of vinyl chloride monomer production. (T)
K021	Aqueous spent antimony catalyst waste from fluoromethanes production. (T)
K022	Distillation bottom tars from the production of phenol/acetone from cumene. (T)
K023	Distillation light ends from the production of phthalic anhydride from naphthalene. (T)
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene. (T)
K093	Distillation light ends from the production of phthalic anhydride from ortho-xylene. (T)
K094	Distillation bottoms from the production of phthalic anhydride from ortho-xylene. (T)
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene. (T)
K026	Stripping still tails from the production of methyl ethyl pyridines. (T)
K027	Centrifuge and distillation residues from toluene diisocyanate production. (T)
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane. (T)
K029	Waste from the product steam stripper in the production of 1,1,1-trichloroethane. (T)
K095	Distillation bottoms from the production of 1,1,1-trichloroethane. (T)
K096	Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane. (T)
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene. (T)
K083	Distillation bottoms from aniline production. (T)
K103	Process residues from aniline extraction from the production of aniline. (T)
K104	Combined wastewater streams generated from nitrobenzene / aniline production. (T)
K085	Distillation or fractionation column bottoms from the production of chlorobenzene. (T)
K105	Separated aqueous stream from the reactor product washing step in the production of chlorobenzene. (T)
K107	Column bottoms from product separation from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazines. (C,T)

Appendix 8.6.2.4: K-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
K108	Condensed column overheads from the product separation and condensed reactor vent gases from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazides. (I,T)
K109	Spent filter cartridges from product purification from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazides. (T)
K110	Condensed column overheads from intermediate separation from the production of 1,1-dimethylhydrazine from carboxylic acid hydrazines. (T)
K111	Product washwaters from the production of dinitrotoluene via nitration of toluene.(C,T)
K112	Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene.(T)
K113	Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene.(T)
K114	Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene. (T)
K115	Heavy ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene. (T)
K116	Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine. (T)
K117	Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene.
K118	Spent adsorbent solids from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene. (T)
K136	Still bottoms from the purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene. (T)
Inorganic Chemicals	
K071	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used. (T)
K073	Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production. (T)
K106	Wastewater treatment sludge from the mercury cell process in chlorine production. (T)

Appendix 8.6.2.4: K-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
Pesticides	
K031	By-product salts generated in the production of MSMA and cacodylic acid. (T)
K032	Wastewater treatment sludge from the production of chlordane. (T)
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane. (T)
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane. (T)
K097	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane. (T)
K035	Wastewater treatment sludges generated in the production of creosote. (T)
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton. (T)
K037	Wastewater treatment sludges from the production of disulfoton. (T)
K038	Wastewater from the washing and stripping of phorate production. (T)
K039	Filter cake from the filtration of diethylphosphorodithioic acid in the production of phorate. (T)
K040	Wastewater treatment sludge from the production of phorate. (T)
K041	Wastewater treatment sludge from the production of toxaphene. (T)
K098	Untreated process water from the production of toxaphene. (T)
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T. (T)
K043	2,6-Dichlorophenol waste from the production of 2,4-D. (T)
K099	Untreated wastewater from the production of 2,4-D. (T)
K123	Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salts. (T)
K124	Reactor vent scrubber water from the production of ethylenebisdithiocarbamic acid and its salts. (C,T)

Appendix 8.6.2.4: K-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
K125	Filtration, evaporation, and centrifugation solids from the production of ethylenebisdithiocarbamic acid and its salts. (T)
K126	Baghouse dust and floor sweepings in milling and packaging operations from the production or formulation of ethylenebisdithiocarbamic acid and its salt. (T)
K131	Wastewater from the reactor and spent sulfuric acid from the acid dryer from the production of methyl bromide. (C,T)
K132	Spent absorbent and wastewater treatment separator solids from the production of Methyl Bromide. (T)
Explosives	
K044	Wastewater treatment sludges from the manufacturing and processing of explosives. (R)
K045	Spent carbon from the treatment of wastewater containing explosives. (R)
K046	Wastewater treatment sludges from the manufacturing, formulation, and loading of lead-based initiating compounds. (T)
K047	Pink/red water from TNT operations. (R)
Petroleum Refining	
K048	Dissolved air flotation float from the petroleum refining industry. (T)
K049	Slop oil emulsion solids from the petroleum refining industry. (T)
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry. (T)
K051	API separator sludge from the petroleum refining industry. (T)
K052	Tank bottoms (leaded) from the petroleum refining industry. (T)
Iron & Steel	
K061	Emission control dust/sludge from the primary production of steel in electric furnaces. (T)
K062	Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry. (C,T)
Primary Copper	
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production. (T)

Appendix 8.6.2.4: K-LIST Hazardous Wastes - continued

EPA ID#	Hazardous Waste
Primary Lead	
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities. (T)
Primary Zinc	
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production. (T)
Primary Aluminum	
K088	Spent potliners from primary aluminum reduction. (T)
Ferroalloys	
K090	Emission control dust or sludge from ferrochromium silicon production. (T)
K091	Emission control dust or sludge from ferrochromium production. (T)
Secondary Lead	
K069	Emission control dust/sludge from secondary lead smelting. (T)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting. (T)
Veterinary Chemicals	
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds. (T)
K101	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds. (T)
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds. (T)
Ink Formulation	
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium or lead. (T)
Coking	
K060	Ammonia still lime sludge from coking operations. (T)
K087	Decanter tank tar sludge from coking operations. (T)

Appendix 8.6.3 - Waste Hazardous Material Container Label

Go to the EHS website to see and download the latest version of the waste hazardous material container label. Follow the link below:

www.ehs.ukans.edu/hazmat/lable.html