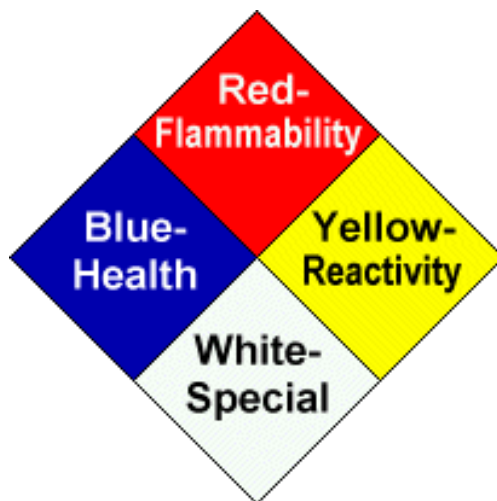




NEW YORK UNIVERSITY

Lab Safety Handbook



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New York University continually strives to provide a learning, teaching, and research environment free from recognized hazards. Pursuant to **Occupational Safety and Health Administration** Regulations (**29 CFR 1910.1450 and 1910.132**) the University established this Laboratory Safety Handbook to protect employees and students from potential health hazards associated with the handling, use, and storage of hazardous chemicals in laboratories. The Chemical Safety Officer for New York University is the Associate Vice President of Operational Risk Management.

Scope

The Laboratory Safety Handbook applies to all laboratories at New York University, including the Dental Center research laboratories and clinics. This handbook is designed to be a template for laboratories to personalize to their own needs. This document is intended to be a working document where items are added to the Lab Safety Handbook.

The safe storage, use and disposal of chemicals in the laboratory require policies for the protection of students, employees, and the environment. Chemicals, which include reagent grade materials through trade name products and wastes, are the focus of increased regulatory actions by federal, state and local governments. The purpose of this Laboratory Safety Handbook is to provide the chemical user with basic safety information regarding the use of chemicals. This Laboratory Safety Handbook forms the foundation of the safe use of chemicals in the laboratory.

The Handbook is not intended as an encyclopedia of chemicals and their hazards. Although numerous chemicals may be mentioned, for the most part they will serve as illustrations for broad categories of hazards, except in the case of chemical incompatibility charts or listings. The Laboratory Safety Handbook must be used in conjunction with the MSDS of the chemicals in your lab.

In addition, EH&S has a biosafety manual developed to address biosafety concerns such as Regulated Medical Waste, Select Agents, biosafety cabinets, rDNA, and shipping biological material. The EH&S Biosafety program goals are to minimize the health risk of those who are involved in research using biohazardous materials (i.e. infectious agents, rDNA, biological toxins, and Select Agents/Toxins); minimize the risk to the NYU community and environment; and meet regulatory requirements. Please refer to the Biosafety Manual in your area, or contact EH&S for a copy.

Section II

Responsibilities

A. Department Chairpersons are responsible for ensuring that the work and learning environment are maintained in accordance with the guidance set forth in the Laboratory Safety Handbook.

B. Principal Investigators (PI's), Professors of teaching labs, Lab Managers, Clinic Managers and TA's supervising teaching labs have the primary responsibility for the activities of their staff and for conditions in the rooms and areas under their control. It is the responsibility for principal investigators and supervisory personnel to:

- acquire knowledge and information needed to provide safe working conditions for all laboratory personnel;
- continually educate all laboratory personnel on the potential hazards associated with a specific task and the precautionary measures (laboratory practices, engineering controls, and personal protective equipment) appropriate for the hazards;
- monitor staff to ensure safe work practices are followed;
- advise and assist in improvement/development of safe work practices;
- investigate accidents and initiate corrective actions which ensure safe working conditions;
- implement new work practices or policies recommended by the Office of Environment, Health & Safety;
- meet the legal requirements of governmental legislation for occupational health and safety;
- decide who is responsible for the collection and maintenance of the material safety data sheets (MSDSs);
- keep abreast of chemical storage procedures including chemical segregation, and waste disposal in the laboratory as advised by the Office of Environmental Health & Safety;
- provide procedures to lab personnel for working with particularly hazardous chemicals (select carcinogens, reproductive toxins, substances with a high degree of toxicity).

C. Individual laboratory workers, students in teaching labs, and clinic workers are responsible for:

1. Planning and conducting each operation in accordance with the standard operating procedures (SOP) outlined in this Laboratory Safety Handbook;
2. Wearing a lab coat and safety glasses in the laboratory;
3. Developing good laboratory hygiene habits;
4. Reporting unsafe acts or conditions to their principal investigator or Environmental Health and Safety.

D. The Office of Environmental Health and Safety (EH&S) is responsible for assisting departments, principal investigators, and supervisory personnel in:

- identifying safety hazards in the laboratory during annual inspections;
- providing technical guidance on matters of laboratory safety;
- developing and conducting training or informational programs for laboratory personnel on health and safety issues;
- developing and improving safe work practices and policies; investigating accidents and developing corrective actions which ensure safe working conditions;
- meeting the legal requirements of governmental legislation for occupational health and safety, and waste disposal in laboratories;
- Conducting Lab Safety and Hazardous Waste trainings

Section III

Toxicology

Chemical Toxicity

Toxicology is the study of the nature and action of poisons. Toxicity is the ability of a chemical molecule or compound to produce injury once it reaches a susceptible site in or on the body. Toxicity hazard is the probability that injury will occur considering the manner in which the substance is used.

Dose-Response Relationships

The potential toxicity (harmful action) inherent in a substance manifests only when that substance comes in contact with a living biological system. A chemical normally thought of as "harmless" will provoke a toxic response if added to a biological system in sufficient amount. The toxic potency of a chemical is defined by the relationship between the dose (the amount) of the chemical and the response that is produced in a biological system.

Routes of Entry into the Body

There are three main routes by which hazardous chemicals enter the body:

- absorption via the **respiratory tract** through inhalation. This is most important in terms of severity;
- absorption or injection (by sharp object) through the **skin* or eyes**;
- absorption through the **digestive tract**. This can occur by eating or smoking with contaminated hands or in contaminated work areas.

Most exposure standards, Threshold Limit Values (TLVs) and Permissible Exposure Limits (PELs), are calculated using the inhalation route of exposure. They are normally expressed in terms of either parts per million (ppm) or milligrams per cubic meter (mg/m³) concentration in air.

If a significant route of exposure for a substance is through skin contact, the MSDS will have a "skin" notation. Examples include: pesticides, carbon disulfide, phenol, carbon tetrachloride, dioxane, mercury, thallium compounds, xylene, hydrogen cyanide.

Other Factors Affecting Toxicity

Rate of entry and route of exposure; that is, how fast is the toxic dose delivered and by what means. Age can affect the capacity to repair tissue damage. Previous exposures can lead to tolerance, increased sensitivity or make no difference.

State of health, physical condition and life style can affect the toxic response. Preexisting disease can result in increased sensitivity.

Environmental factors such as temperature and pressure may also affect the exposed individual as well as host factors including genetic predisposition and the sex of the exposed individual.

Section IV

Hazardous Chemicals

General

A Hazardous chemical is a chemical for which there is statistically significant evidence (based on at least one study conducted according to established scientific principles), that acute or chronic health effects may occur in exposed employees, or if it is listed in any of the following:

- OSHA, 29 CFR 1910 Subpart Z, Toxic and Hazardous Substances
- "Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment", ACGIH (latest edition)
- "The Registry of Toxic Effects of Chemical Substances", NIOSH (latest edition)

In most cases, the label will indicate if the chemical is hazardous. Look for key words like caution, hazardous, toxic, dangerous, corrosive, irritant, or carcinogen. Old containers of hazardous chemicals (pre 1985) may not contain hazard warnings.

If you are not sure a chemical you are using is hazardous, review the Material Safety Data Sheet (MSDS) or contact your supervisor, instructor, or the Office of Environmental Health.

Types of Hazards

Irritants are materials that cause inflammation of the body surface they come into contact. The inflammation results from concentrations far below those needed to cause corrosion. Common irritants include substances such as:

- ammonia
- alkaline dusts and mists
- hydrogen chloride
- hydrogen fluoride*
- halogens
- ozone
- phosgene*
- nitrogen dioxide
- phosphorus chloride
- arsenic trichloride

* these materials also have other hazardous properties.

Irritants can also cause changes in the mechanics of respiration and lung function. These include:

- sulfur dioxide
- acetic acid
- formaldehyde*
- formic acid
- sulfuric acid
- acrolein
- halogens

* these materials also have other hazardous properties, please refer to their individual Material Safety Data Sheets.

Long term exposure to irritants can result in increased mucous secretions and chronic bronchitis.

A *primary irritant* exerts no systemic toxic action, either because the products formed on the tissue of the respiratory tract are non-toxic or because the irritant action is more severe than any systemic toxic action. Example: hydrogen chloride.

A *secondary irritant's* effect on mucous membranes is overshadowed by a systemic effect resulting from absorption. These include:

- hydrogen sulfide
- aromatic hydrocarbons

Exposure to a secondary irritant can result in pulmonary edema, hemorrhage and tissue necrosis.

Simple Asphyxiants deprive the tissue of oxygen. Simple asphyxiants are inert gases that displace oxygen. These include:

- nitrogen
- nitrous oxide
- carbon dioxide
- helium

Chemical asphyxiants render the body incapable of maintaining an adequate oxygen supply. They are active at very low concentrations (few ppm). These include:

- carbon monoxide
- cyanides

Primary anesthetics have a depressant effect upon the central nervous system, particularly the brain. These include:

- halogenated hydrocarbons
- alcohols

Hepatotoxic agents cause damage to the liver. These include:

- carbon tetrachloride
- tetrachloroethane
- nitrosamines

Nephrotoxic agents damage the kidneys. These include:

- halogenated hydrocarbons
- uranium compounds

Neurotoxic agents damage the nervous system. The nervous system is especially sensitive to organometallic compounds and certain sulfide compounds. These include:

- trialkyl tin compounds
- tetraethyl lead
- methyl mercury
- carbon disulfide
- organic phosphorus insecticides
- manganese

- thallium

Some toxic agents act on the blood or *hematopoietic* system. The blood cells can be directly affected or the bone marrow can be damaged. These include:

- nitrites
- aniline
- toluidine
- nitrobenzene
- benzene

There are toxic agents that produce damage of the pulmonary tissue (lungs) but not by immediate irritant action. *Fibrotic* changes can be caused by free silica and asbestos. Other dusts can cause a restrictive disease called pneumoconiosis.

The term *carcinogen* describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material. A listing of carcinogenic materials can be found in appendix C. Carcinogens commonly used in large quantities at the University include formaldehyde, benzene, ethylene amine, ethylene oxide, and chloroform. **Please see Appendix C: Carcinogen List**

Select carcinogen is any substance that meets one of the following criteria:

- It is regulated by OSHA as a carcinogen
- It is listed under the category, "known to be carcinogens" in the National Toxicology Program (NTP), "Annual Report of Carcinogens" (latest edition)
- It is listed under Group 1, "carcinogenic to humans" by the International Agency for Research on Cancer Monographs (IARC)
- It is listed under Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals according to any of the following criteria:

Reproductive hazards are chemicals that affect the reproductive capabilities including chromosomal damage (mutagens) and effects on the fetus (teratogens). Please see Appendix A

A *mutagen* affects the chromosome chains of exposed cells. The effect is hereditary and becomes part of the genetic pool passed on to future generations.

A *teratogen* (embryotoxic or fetotoxic agent) is an agent that interferes with normal embryonic development without damage to the mother or lethal effects on the fetus. Effects are not hereditary.

A *sensitizer* causes a majority of the exposed population to develop an allergic reaction in normal tissue after repeated exposure to the chemical. The reaction may be as mild as a rash (contact dermatitis) or as serious as anaphylactic shock.

A list of reproductive hazards can be found in Appendix A of this Handbook.

A list of acutely toxic chemicals can be found in Appendix B of this Handbook.

Extremely toxic chemicals are substances that cause irreversible neurological damage or death with extremely small doses. Substances in this class include many organic mercury compounds such as dimethyl mercury and MPTP (1-methyl-4-phenyl-1, 2, 3, 6-tetrahydropyridine) which can cause irreversible Parkinsonian syndrome. Lab work with these materials requires review by EH&S and typically includes chemical resistant gloves and protective clothing.

Section V

Handling of Chemicals

General

Know the physical and health hazards associated with the chemicals you are using. Carefully read the chemical's label and material safety data sheet (MSDS) before using a chemical for the first time. Also review the appropriate Standard Operating Procedures. These documents will provide any special handling information that you may need. After the potential hazards associated with the chemicals and the experimental processes are evaluated you can modify work procedures so that laboratory hazards are minimized or eliminated.

Keep the following guidelines in mind when handling chemicals:

- Do not work alone in the laboratory. If you do need to work alone notify someone.
- Use required personal protective equipment.
- Label all containers with chemical content.
- Wear disposable nitrile gloves to prevent skin exposure
- Keep your hands and face clean. Wash thoroughly with soap and water after handling any chemical and whenever you leave the lab.
- Avoid direct contact with any chemical. Always wear a laboratory coat.
- Keep chemicals off your hands, face and clothing, including shoes.
- Never smell, inhale or taste a chemical.
- **Smoking, drinking, eating and the application of cosmetics is forbidden in areas where hazardous chemicals are used or stored.**
- Always use chemicals with adequate ventilation or in a chemical fume hood. Refer to the MSDS and the standard operating procedure to determine what type of ventilation is needed.
- Use hazardous chemicals only as directed and for their intended purpose.
- Inspect equipment or apparatus for damage before adding a hazardous chemical. Do not use damaged equipment.
- Never use mouth suction to fill a pipette. Use a pipette bulb or other pipette filling device. (See the Biosafety Manual for more on pipetting.)
- Electrically ground and bond containers using approved methods before transferring or dispensing a flammable liquid from a large container.

For specific information regarding chemical handling, contact your supervisor, instructor or EH&S.

Section VI

Laboratory Fumehoods

Local exhaust ventilation is one of the best engineering methods available to reduce the health hazard risk associated with the use of hazardous chemicals in the laboratory. Laboratory fume hoods* are the most common local exhaust ventilation devices found in the laboratory. Fume hoods are used to prevent hazardous, offensive, or flammable gases and vapors from mixing with the general room air. A hood, especially with the sash down, acts as a physical barrier between the laboratory workers and chemical reactions. The hood can also contain accidental spills of chemicals.

* Note that laboratory fume hoods and biosafety cabinets, although similar in appearance, are extremely different devices. Biosafety cabinets are used for protection against exposure to biological materials and should not be used with chemicals unless properly vented. If you are uncertain about the type of hood in your laboratory check with the principal investigator.

Check the MSDS, appropriate *Standard Operating Procedure*, or chemical label for special ventilation requirements, such as:

- Use with adequate ventilation
- Use in a fume hood
- Avoidance of Vapor Inhalation
- Use of local ventilation

Ventilation recommendations must be adapted to the work site and the specific process.

If the hood is not functioning properly the building manager will place a *Hood out of order sign* on the sash of the hood. A hood must never be used when this *Hood out of order sign* is present. A mechanic will evaluate the hood and make the necessary repairs. Once the hood is repaired it will be flow tested by EH&S. Once repairs are completed, contact EH&S in order to have a quick turn around of fume hood certification. **Persistent problems with fume hoods or repair delays longer than 5 working days should be reported to EH&S.**

To be effective, laboratory fume hoods must be installed and used correctly. The National Research Council in *Prudent Practices for Handling Hazardous Chemicals in Laboratories*; (1981) recommends that the following factors be remembered in the daily use of hoods:

1. Hoods should be considered as backup safety devices that can contain and exhaust toxic, offensive, or flammable materials, when the design of an experiment fails. Hoods should not be used as a means for disposing of chemicals. Thus, apparatus used in hoods should be fitted with condensers, traps, or scrubbers to contain and collect waste solvents, toxic vapors or dusts.
2. Hoods should be evaluated before use to ensure adequate face velocities (typically 80-150 fpm) and the absence of excessive turbulence. Further, some continuous monitoring device for adequate hood performance should be present and should be checked before each hood is used. If inadequate hood performance is suspected, it should be established that the hood is functioning properly before it is used. Call your building manager to report inoperable hoods.
3. Except when adjustments of apparatus within the hood are being made, the hood should be kept closed: vertical sashes down and horizontal sashes closed. Sliding sashes should not be removed from horizontal sliding-sash hoods. Keeping the face opening of the hood small improves the overall performance of the hood.
4. The airflow pattern, and thus the performance of a hood, depends on such factors as placement of equipment in the hood, room drafts from open doors or windows, persons walking by, or even the presence of a user in front of the hood. For example, the placement of equipment in the hood can have a dramatic effect on its performance. Moving an apparatus 5-10 cm back from the front edge into the hood can reduce the vapor concentration at the user's face by 90%.

5. Hoods are not intended to be a primary storage unit for chemicals. Materials stored in them should be kept to a minimum. Stored chemicals should not block vents or alter airflow patterns. Whenever practical, chemicals should be moved from hoods into cabinets for storage.
6. Solid objects and materials (such as paper) should not be permitted to enter the exhaust ducts of hoods as they can lodge in the ducts or fans and adversely affect their operation.
7. An emergency plan should always be prepared for the event of ventilation failure (power failure, for example) or other unexpected occurrence such as fire or explosion in the hood.

Section VII

Personal Protective Equipment

Lab workers must, at a minimum, wear lab coats and safety glasses in the laboratory. Additional protective equipment may also be required. Open toed shoes **must not** be worn into the lab.

Personal protective devices are to be used only where engineering and administrative controls cannot be used or made adequate, or while controls are being instituted.

Engineering and administrative controls to reduce or eliminate exposures to hazardous chemicals include:

- **substitution** of a less hazardous substance
- **substitution** of less hazardous equipment or process (e.g., safety cans for glass bottles)
- **isolation** of the operator or the process
- **use of fume hood**
- **hazard education**
- **job rotation**

The MSDS and University *Standard Operating Procedure* will list the personal protective equipment recommended for use with the chemical. The MSDS addresses "worst case" conditions. Therefore, not all of the equipment shown may be needed for a specific job.

The employer must provide appropriate personal protective equipment to employees.

Eye Protection

Eye and face protection must be worn whenever its use will reduce or eliminate injury. It is recommended that eye protection be worn in the laboratory whenever chemicals are in use.

The need for adequate eye protection is fundamental to the use of chemicals, including housekeeping materials such as wax strippers, detergent and toilet bowl cleaners, and operations such as grinding, drilling, and sawing with power tools. Eye protection, and at times face protection is required wherever the potential for eye injury exists. Areas where eye protection must be worn are laboratories, glass cleaning and glassblowing shops, and machine shops or any area where active or automated work with chemicals is conducted. Eye protection is required for all personnel and visitors in these areas. No personnel may enter laboratories where chemicals are being handled or automated processes are in operation without eye protection.

Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87.1 1989) and must be equipped with side shields.

However, safety glasses with side shields do not provide adequate protection from splashes, therefore, when the potential for a splash hazard exists, other eye protection and/or face protection must be worn.

Splash goggles (acid goggles) with splash proof sides or a face shield must be used when protection from a chemical splash is needed.

Face shields afford protection to the face and neck. Face shields must be worn if there is an explosion or implosion (pressure or vacuum) hazard and when transferring cryogenic liquids.

Special eye protection is available for protection against laser, ultraviolet (UV), welding and brazing, or intense light sources.

Managers, supervisors, and principal investigators should refer to the appropriate University Standard Operating Procedure to determine the type(s) of eye and/or face protection necessary.

Eye protection must be made available to employees, students and visitors, **at no cost to them**, when the potential for eye injury exists.

If you have any questions regarding the selection of appropriate face protection, call Environmental Health and Safety at 212-998-1450

Clothing

Protective and appropriate clothing is required when a potential exists for chemical or biohazard splashes, fire, extreme heat or cold, excessive moisture, or radiation.

Lab supervisors and directors are responsible for setting requirements for their use.

Protective clothing that should be readily available to laboratory personnel include:

- Lab Coats (Lab workers must wear lab coats while in a lab where chemicals are being handled. Lab coats should not be worn outside of the lab)
- Shoes or shoe covers (no open toe or sandals permitted)
- Guanlets/Lab aprons
- Jump suits/coveralls
- Gloves (gloves shall not be worn outside of the lab unless transporting chemicals safely in transit, however, do not touch doorknobs, elevator buttons, etc. with gloves on)

Glove Selection

Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. These gloves provide a non-chemical resistant barrier between the worker's hand and the reagent. Lab workers who contaminate their gloves should immediately remove them, wash their hands and obtain a fresh pair. Gloves should not be worn outside of the lab. Latex gloves are not recommended for laboratory use.

Lab workers should contact EH&S for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated. The selection of the proper glove requires knowledge of the health and physical hazards of the chemical that is used; familiarity with the glove manufacturer's test data (permeation rate and breakthrough time) and the length of the hand exposure. Lab workers should not select chemical resistant gloves based on data from generic selection charts.

Use of Respirators

If your work requires the use of a respirator, you must complete a medical questionnaire that will be evaluated by student health, and you must complete the required respirator training from EH&S. Do not use respiratory protective equipment until you have received proper training.

Respirators are designed to protect only against specific types of substances and in certain concentration ranges, depending on the type of equipment used. Never use a respirator unless you have been assigned one and have been trained and fit tested by the Office of Environmental Health and Safety.

Respirator selection is based on the hazard and the protection factor required.

Types of respiratory protective equipment include:

- particle-removing air purifying respirators (N95, N100)
- gas and vapor-removing air purifying respirators

- air supplied respirators

You should familiarize yourself with the limitations of each type of respiratory protective equipment used and the signals for respirator failure (odor breakthrough, filter clogging, etc.).

Respirators are not to be used except in conjunction with a written respiratory protection program. See Safety Policy #109 for further information on respiratory protection.

Protection of Body (other than hands)

Skin and body contact should not occur during routine lab operations that involve small quantities of laboratory chemicals. Any lab activity that is anticipated to result in body contact must be evaluated by EH&S.

Lab staff must wear lab coats when handling hazardous chemicals to prevent against body contact that may result from accidental spills and splashes.

Chemical protective clothing in the form of disposable work suits should be provided for the rare instances where body contact is anticipated or when extremely toxic chemicals are handled. Special attention must be given to sealing all openings in the clothing. Duct tape can be used for this purpose. Caps should be worn to protect hair from contamination. Selection of the protective clothing shall be made by EH&S.

Section VIII

Chemical Storage

General Considerations for Chemical Storage

Carefully read the label before storing a hazardous chemical. The MSDS will also provide any special storage information and incompatibilities.

Do Not Store Chemicals Alphabetically, except within a hazard class. Hazard classes that should be stored separately include:

- radioactive materials
- pyrophoric materials
- flammable materials
- oxidizing materials
- water reactive substances
- oxidizing acids
- inorganic acids
- organic acids
- caustics (bases)
- poisons (general laboratory reagents separated into organic and inorganic groups)

Provide physical segregation (sills, curbs, trays) or separation between hazard classes.

Keep flammable materials by themselves in approved storage cans, cabinets, or rooms. Store oxidizers well away from flammable materials.

Please refer to Appendix E for an example Chemical Compatibility Chart

Segregation

Do not store unsegregated chemicals in alphabetical order or incompatible chemicals in close proximity to each other. The amount of space that can be placed between different chemical classes depends on the amount of storage area available in the lab suite. Do not segregate chemical classes into separate rooms unless they will only be used in that room. Segregation that disrupts normal work flow or requires more frequent transport of chemicals between labs will increase the probability of a chemical spill. Use common sense in planning chemical storage areas.

Store dry reagents, liquids reagents and solutions and compressed gases in separate areas. Within each of these chemical forms segregate into hazard classes.

Segregate dry reagents as follows:

- oxidizing solids
- flammable solids
- water reactive solids
- all others solids

Segregate liquid reagents and solutions as follows:

- acid liquids
- caustic liquids
- oxidizing liquids
- perchloric acid solutions
- flammable or combustible liquids
- all other liquids

Segregate compressed gases as follows:

- toxic gases
- flammable gases
- oxidizing and inert gases

Once separated into hazard classes, chemicals may be stored alphabetically.

Use approved storage containers and safety cans for flammable liquids. Use spill trays under containers of strong corrosive reagents. Do not store liquids above eye level.

Dispose of old chemicals promptly. See waste disposal section of this Handbook.

Ensure that all containers are properly labeled. For more information on chemical storage, contact your supervisor, instructor, or EH&S. A Chemical Compatibility Chart is attached as Appendix E

Flammable and Combustible Liquid Storage

The storage of flammable and combustible liquids in a laboratory, shop, or building area must be kept to the minimum needed for research and operations. When large quantities of flammable liquids are present in a lab they must be stored in a flammable-liquids storage cabinet. Flammable-liquids storage cabinets are not intended for the storage of highly toxic materials, acids, bases, compressed gases or pyrolytic chemicals.

Chemical Stability

Stability refers to the susceptibility of the chemical to dangerously decompose. Ethers and olefins form peroxides upon exposure to air and light. Since these chemicals are packaged in an air atmosphere, peroxides can form even though the containers have not been opened. Write the date received and date opened on all containers of ether.

Unless an inhibitor was added by the manufacturer, closed containers of ether should be discarded after 1 year.

The label and MSDS will indicate if a chemical is unstable.

The following are examples of materials that may form explosive peroxides:

acetal	cyclohexene
decahydronaphthalene	diacetylene
dicyclopentadiene	diethyl ether
diethylene glycol	dimethyl ether
dioxane	divinyl acetylene
ethyl ether	terahydronaphthalene
isopropyl ether	methyl acetylene
tetrahydrofuran	vinylidene chloride
vinyl ether	ethylene glycoldimethylether (glyme)

For additional information on chemical stability, contact your supervisor, instructor or EH&S.

Shock Sensitive Chemicals

Shock sensitive refers to the susceptibility of the chemical to rapidly decompose or explode when struck, vibrated or otherwise agitated.

Some chemicals become increasingly shock sensitive with age. Write the date received and date opened on all containers of shock sensitive chemicals. Unless an inhibitor was added by the manufacturer, closed containers of shock sensitive materials should be discarded after 1 year. Open containers of shock sensitive materials should be discarded within 6 months of opening.

The label and MSDS will indicate if a chemical is shock sensitive. Wear appropriate personal protective equipment when handling shock sensitive chemicals.

Table 1 lists materials that can be shock sensitive.

Table 1 Shock Sensitive Chemicals*

acetylides of heavy metals ammonium perchlorate copper acetylide dinitroglycerine dipicryl sulfone fulminate of silver germane hexite hyrazoic acid lead salts mercury tartrate nitrated polyhydric alcohol nitroglycol organic amine nitrates picratol potassium nitroaminotetrazole sodatol syphnic acid trinitroanisole trinitronaphthalene tritonal	aluminum ophorite explosive ammonium picrate cyanuric triazide dinitrophenol dipicylamine fulminating gold guanyl nitrosamino guanyltetrazene hexanitrodiphenyl- amine lead azide lead styphnate mononitrotoluene nitrogen trichloride nitroguanidine organic nitramines picric acid silver acetylide sodium amatol tetrazene trinitrobenzene trinitrophenetol urea nitrate	amatol ammonium salt lattice cyclotrimethylenetrinitramine dinitrophenolates erythritol tetranitrates fulminating mercury guanyl nitrosamino guanylidene hydrazine hexanitrostilbene lead mannite magnesium ophorite nitroaminotetrozole nitrogen tri-iodide nitroparaffins organic peroxides picryl chloride silver azide sodium dinitro-ortho-cresolate tetranitrocarbazole trinitrobenzoic acid trinitrophloro-glucinol
ammonal butyl tetryl cyclotetramethylenetrinitramine dinitrophenyl hydrazine explosive mixtures fulminating platinum guanylidene hexogen lead mononitro-resorcinate mannitol hexanitrate nitrated carbohydrate nitroglycerin nitronium perchlorate picramic acid picryl fluoride silver styphnate sodium nitrate-potassium explosive mixtures tetrytol trinitrocresol trinitrotoluene	ammonium nitrate calcium nitrate dinitroethyleneurea dinitrotoluene fulminate of mercury compounds gelatinized nitrocellulose heavy metal azides hydrazinium nitrate lead picrate mercury oxalate nitrated glucoside nitroglycide nitrourea picramide polynitro aliphatic compounds silver tetrazene sodium picramate trimonite trimethylolethane	

	trinitroresorcinol	
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* This list is not all inclusive. Review the material safety data sheet for reactivity information concerning the chemicals you use.

Compressed Gases

Carefully read the label before using or storing compressed gas. The MSDS will provide any special hazard information. Always use the minimum size cylinder required to perform the work.

Cylinders of compressed gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders. Compressed gas cylinders pose a crush hazard to hands and feet.

Do not expose cylinders to temperature extremes.

Do not store cylinders or lecture bottles with the regulator in place. If the regulator fails, the entire contents of the gas cylinder may be discharged.

Always use the correct regulator. Do not use a regulator adapter. Oil or grease on the high pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator.

Cylinders of toxic, flammable or reactive gases should be stored and used in a fume hood or with local ventilation.

Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out.

Always wear safety glasses when handling compressed gases.

For more information, contact your supervisor, instructor, or EH&S.

Section IX

Hazardous Waste

Hazardous Waste Characteristics

A Hazardous Waste, as defined by EPA, is any waste that exhibits **one or more** of the following hazard characteristics: **Ignitability**, **Corrosivity**, **Reactivity**, or **Toxicity**, or is a **Listed Waste**. Such a waste is subject to all EPA hazardous waste labeling, storage and disposal regulations.

Ignitability (Flammability) (40 CFR 261.21)

An ignitable or flammable waste is one that:

- Has a **flash point** of less than 140 degrees F.
- Is a non-liquid capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture, or spontaneous chemical changes, and, when ignited, burns vigorously and persistently.
- Is an ignitable compressed gas.
- Is an oxidizing substance.

Flash point - the minimum temperature at which a liquid can give off vapors that can ignite.

Corrosivity (40 CFR 261.22)

A corrosive waste is one that:

- Can destroy or burn skin tissue
- Is capable of corroding steel at a rate greater than 0.25 inches per year.
- Has a pH of less than 2.0 or greater than or equal to 12.5.

Reactivity (40 CFR 261.23)

A reactive waste is one that:

- Is normally unstable and can readily undergo violent change without detonating.
- Can explode or react violently with water or other wastes; or can become unstable.
- When mixed with water, generates toxic gases, vapors, or fumes, in a quantity sufficient to present a danger to human health or the environment.
- Is capable of detonation or explosive reaction if subjected to a strong initiating source (impact) or if heated under confinement.
- A cyanide or sulfide solution that generates a toxic gas between pH of 2 and 12.5.

Toxicity (40 CFR 261.24)

A toxic waste is one that is dangerous to humans, animals, aquatic life or the environment.

Containers & Labels

Hazardous Materials and Hazardous Wastes must be managed in a way that prevents a spill or release. Regulated hazardous waste must be labeled, collected and stored in approved containers.

Containers must be:

- Compatible with the waste being stored.
- Leak-proof, in good condition, and capable of being sealed tightly.
- Closed at all times during accumulation except when it adding waste.
- Properly labeled.

Labels must:

- Have the words "Hazardous Waste"
- The **chemical composition** of the waste. If a mixture, all components must be listed and their approximate percentage (totaling 100%)
- The primary hazard (ignitable, corrosive, reactive, or toxic).
- The location where the waste was generated and a contact name.
- The date the container becomes full and is ready for disposal or removal to the waste room.

The **NYU Hazardous Waste Label** should be used for all waste chemicals, particularly mixtures. It is designed so that it can be either printed directly off the website using Avery Shipping Labels #6878, or downloaded and filled in electronically before printing.

If you are disposing of pure material that is still in its original container and the manufacturer's label is in tact and legible, then you do not need to complete a full NYU Hazardous Waste Label. However, you still must label the container as follows:

- The words "Hazardous Waste",
- The primary hazard (ignitable, corrosive, reactive, or toxic), and
- The date of removal to waste room (if located in the Main Complex) or the date you called to request a pick-up, if located elsewhere on campus.

Storage

Hazardous waste must be located at or near the point of generation and under the control of the person generating the waste.

To ensure safe and compliant storage, segregate incompatible materials (incompatibility charts) and store chemicals or waste in secondary containment, in accordance with EPA and FDNY requirements.

Disposal

Hazardous waste must be disposed of through Environmental Health & Safety. Environmental Health & Safety maintains a contract with an outside contractor for the compliant disposal of hazardous waste.

Wastes generated within the Silver Complex (Silver, Brown or Waverly buildings) should be brought to the Waste Room during regular waste room hours. Hazardous Waste can be brought to the Waste Room (Brown 1158) every **Wednesday and Friday from 2:15pm - 3:15pm**. All waste must be properly labeled and dated prior to bringing it to the waste room and those transporting the waste must have received the **Annual Hazardous Waste Training** within the previous year.

Drain Disposal

Solids, oil and other viscous substances SHALL NOT be discarded down the drain or into the sewer system. Only water-soluble, non-hazardous laboratory chemicals, and urine or fecal homogenates, which meet the following criteria, may be flushed, with large volumes of water, into the New York City sewer system:

- **NON-flammable**
- **NON-corrosive** (5 < pH > 9.5)
- **NON-toxic**
- **NON-explosive**
- **NON-reactive**
- **NON-malodorous**

If unsure whether the substance meets the above criteria, consult the substance's MSDS or call Environmental Health & Safety.

Potentially Explosive Materials

Potentially Explosive Materials are **reactive** chemicals or substances that can explode or enter violent reactions releasing large amounts of light, heat, and/or gases. Reactive Materials are defined by the following four categories:

- **Explosives** are substances that can detonate or decompose rapidly and violently at room temperatures. Gentle heat, light, mild shock, and chemical action can initiate these explosive reactions. Potential peroxide-forming chemicals such as Tetrahydrofuran, ethers, Acetaldehyde, Picric Acid, and 1,4-dioxane are a few examples of Explosive Materials.
- **Strong Oxidizing Agents** are capable of detonation or explosive decomposition under conditions of strong heat, confinement, or a strong shock. Perchlorates, inorganic nitrates, chlorates, chromates and the halogens are examples of some strong oxidizing agent groups.
- **Water Reactives** are chemicals that combine with water or moisture in the air to produce heat, flammable explosive or toxic gases. These chemicals present a severe fire hazard because sufficient heat is often released to self ignite the chemical or ignite nearby combustibles. In addition, contact with the skin can cause severe thermal and alkali burns. Examples of some water reactive groups are strong acids and bases, alkali metals (sodium & potassium, hydrides, & carbides).
- **Air Reactives** ignite spontaneously in air at temperatures below 130 degrees F (54.5 degrees Celsius). Finely divided metal powders that do not have a protective oxide coat may ignite when a specific surface area is exceeded. The degree of reaction depends on the size of the particle, its distribution, and surface area. Examples of some air reactive chemicals are white phosphorus, fine zirconium powder and activated zinc.

According to FDNY requirements (RCNY 10-01), it shall be the duty and responsibility of the laboratory permit applicant or designee, to clearly record on the container, in indelible ink, the opening date of the following chemical groups (failure to do so will result in a written violation):

- Picrics originating at less than 10% hydration;
- Perchlorates;
- Peroxides; (arrange to have these chemicals tested at least once every six months)
- Potential peroxide-forming materials;
- Polymerizing chemicals that react violently in polymerization or become hazardous after polymerization; and
- Any other material stored or used which are known to deteriorate or to become unstable or reactive.

Dispose within one year of opening.

Non-Hazardous Chemical Waste

If the waste material does not meet any of the criteria of the **hazardous waste characteristics** then the waste is not hazardous. However, that does not mean that it is not regulated.

Solid Wastes That May Be Hazardous

Any solid wastes, including but not limited to aerosol cans, paint cans, metal filings, painted, stained or treated woods and dusts, paper towels, absorbent materials, used gloves or any other solid wastes that could be potentially contaminated with hazardous materials, must be characterized prior to disposal, to determine if they exhibit any of the **hazardous waste characteristics**.

Areas where hazardous materials are used, such as laboratories, art studios and workshops, photo-developing areas, and maintenance areas must evaluate the solid wastes generated in their areas and determine if any may be contaminated with hazardous substances. Those wastes that may be contaminated must be evaluated and a hazardous waste characterization made prior to disposal.

Spill Cleanup Material

All materials (paper towels, absorbent materials, PPE, etc.) used to clean up a chemical or waste spill should be considered to exhibit the same characteristics as would the chemical or waste that was spilled. If the substance spilled was a hazardous chemical or waste, the cleanup materials would be considered a hazardous waste and must be handled as such and disposed of through Environmental Health & Safety. Any oil spill cleanup material shall also be collected, labeled and disposed of as Non Hazardous Waste through Environmental Health & Safety. See the procedures above for **Disposal**.

Disposal of DEA Controlled Substances

A controlled substance or DEA drug is any substance listed in the Controlled Substances Act, in the Code of Federal Regulations (21 CFR, Part 1300) and is outdated, possessed in excess or is no longer intended for use is regulated. Disposal also refers to a controlled substance that is residual (often referred to as waste) or has been contaminated through use or spills.

Please refer to the EHS Website for more information at:
<http://www.nyu.edu/ehs/waste.disposal/chemical.waste.html>

Section X

Laboratory Chemical Waste Management Guidelines

Introduction

Excellence in research, education and environmental health and safety is of primary importance to New York University. In support of this activity, Environmental Health and Safety (EH&S) provides for the proper disposal of hazardous waste.

The University has zero tolerance for non-compliance with Environmental Regulations. The enclosed procedures must be followed to comply with rules from the U.S. Environmental Protection Agency (EPA) and the New York State Department of Environmental Conservation (NYSDEC) and the New York City Department of Environmental Protection (NYCDEP) which regulate the disposal of hazardous wastes in a cradle-to-grave fashion.

General Guidelines

Potentially Hazardous chemicals must be disposed of in accordance with federal, state and city regulations and procedures established by EH&S. Your department may also have procedures that you are required to follow. Contact your supervisor, instructor or EH&S before discarding any potentially hazardous chemical.

The following guidelines will assist waste collection:

- Unless you have written approval from EH&S, disposal of chemicals by way of the sanitary sewer system is prohibited.
- To determine if the chemical you want removed from your laboratory or work area is a regulated hazardous waste, contact EH&S or consult the EPA regulation 40 CFR 261-Identification and Listing of Hazardous Waste.
- All lab personnel must be familiar with the location and composition of all wastes produced in the lab.
- Waste containers must remain closed except when actually adding waste. Open containers violate state and federal waste regulations.
- For disposal information, call x81450
- To request a pickup, submit an online request at <http://www.nyu.edu/ehs/pdf/hwpickupform.pdf>
- Waste chemicals must **not** be placed or left for removal in hallways.
- There is no charge for routine chemical waste collection and disposal unless a lab or clinic is being renovated or relocated.
- EH&S does not pick up sharps or other infectious waste. Contact your building manager or the FCM helpdesk at x81001.
- Disposal of radioactive materials require special procedures. Contact NYU Radiation Safety Officer (212.998.8480) before proceeding.

Satellite Accumulation Areas

These are locations within laboratories where chemical waste is collected and properly stored until it is picked up by EH&S.

Section XI

Labels

General

A label is any written, printed, or graphic material displayed on, or affixed to, containers of chemicals.

Labels or other forms of hazard warnings, such as tags or placards, provide immediate warning of potential danger. They are used to warn of a variety of potential physical hazards or health hazards.

The **Occupational Safety and Health Administration's Hazard Communication Standard** established minimum labeling requirements for most chemical containers in the workplace. All chemical containers at the university shall be labeled according to these OSHA requirements. The container shall be labeled with:

- the contents of the container (i.e. common name of the chemical). Chemical formulas and structural formulas are not acceptable except for small quantities of compounds synthesized in the laboratory;
- the name and address of the manufacturer;
- the physical and health hazards;
- the recommended protective equipment.

Existing labels on new containers of chemicals or containers in storage shall not be removed or defaced.

Employees and students should not work with any chemical from an unlabeled container. However, portable containers intended for the immediate use by the employee or student performing the transfer do not need to be labeled. This labeling requirement also does not apply to students assigned unknown chemicals for analysis.

However, any chemicals made in the lab and stored in a temporary container (i.e. beaker, nalgene spray bottle, etc) must have the following information on the container:

- Initials of person who made the solution;
- Contents of solution;
- Date solution was made.

Carefully read all the information on the label. If you do not understand something, contact your supervisor or instructor for an explanation or request the MSDS.

Special Labeling Requirements

All containers that hold carcinogens, reproductive hazards or acutely toxic reagents must be properly labeled concerning the health hazard posed by the chemical. Most new reagent containers will have the chemical hazards clearly displayed on the label. However older reagents and containers of solutions that are mixed in the lab must be properly labeled by the laboratory worker. The laboratory worker may write the hazard class (e.g. carcinogen, etc.) on the container.

Section XII

Material Safety Data Sheets

The material safety data sheet (MSDS) is the hazard communication tool that provides details on all important aspects of chemical use, handling, and storage. Review both the appropriate Standard Operating Procedure and the MSDS when working with a chemical for the first time or when training staff. All laboratories should have MSDS organized alphabetically in a binder or on the computer for all chemicals in the lab

The OSHA Hazard Communication standard (29 CFR 1910.1200) requires manufacturers to provide MSDSs at no cost. Information is divided into ten sections.

Section I of the MSDS lists information identifying the manufacturer and the product. It includes:

- manufacturer's name, address and telephone number
- number to call in case of emergency
- chemical name and synonyms
- trade name and synonyms
- chemical family and formula
- Chemical Abstract Service (CAS) number that is a unique identification number for chemical reagents.
- Date of preparation.

If your work requires an understanding of this chemical information, contact your supervisor or EH&S.

Section II describes the hazardous ingredient(s) contained in the product, the percentages of ingredient(s), and exposure limits when appropriate. This section will identify all hazardous chemicals that comprise 1% or greater of the mixture. Carcinogens must be listed if the concentrations are 0.1% or greater.

Section III describes the physical properties of the material. Physical properties include:

- boiling point
- specific gravity
- vapor pressure
- percent volatile
- vapor density
- evaporation rate
- solubility in water
- appearance and odor

Section IV describes the fire and explosion hazard data for the material and other fire and explosion data. The appropriate extinguishing agent for fires involving the material will be listed. Special fire fighting procedures may also be listed.

Section V describes the known health hazard data for the material and exposure limits. Symptoms or the health effects of an overexposure are listed. This information will help the user and medical personnel recognize if an overexposure has occurred.

- threshold limit value (TLV)
- existing medical conditions that may be aggravated by exposure
- effects of overexposure (e.g., headache, nausea, narcosis, eye irritation, weakness, skin rashes, etc.)
- primary routes of exposure (i.e., inhalation, skin, ingestion)

- cancer or other special health hazards
- emergency and first aid procedures

Section VI describes reactivity data; that is, the material's ability to react and release energy or heat under special conditions or when it comes in contact with certain substances.

Section VII gives instructions for the steps to be taken in case of an accidental release or spill. The steps normally include information on containment, evacuation procedures, and waste disposal. The statements on the MSDS are general; more specific information is available from the appropriate Standard Operating Procedure.

Section VIII describes the protective equipment for the individual who might have to work with the substance. This section normally describes worst case conditions; therefore, the extent to which personal protective equipment is required is task dependent. Always review the appropriate Standard Operating Procedure. Equipment may include:

- respiratory equipment
- ventilation
- protective gloves
- eye protection
- other protective equipment (i.e., special clothing).

Section IX describes handling and storage procedures to be taken with the material. Information may include statements such as: keep container closed; store in a cool, dry, well ventilated area; keep refrigerated; avoid exposure to sunlight.

Section X describes any special precautions or miscellaneous information regarding the material. In some cases, manufacturers may choose to withhold certain information on a MSDS provided the information is a trade secret. Regardless of the existence of trade secrets, the MSDS must still contain all relevant hazard, protection, and health information.

Some MSDSs may not contain all ten sections or the information may be in a slightly different order. However, the basic information described above must be provided.

Some MSDSs are more complete than others. Do not assume everything you need to know is contained on the MSDS. Do not assume if a section is left blank that there is no risk.

Section XIII

Training Requirements

Principal investigators should assure that all laboratory workers are provided with information and training to ensure that they are apprised of the hazards of chemicals present in their work area. This training is mandated by OSHA. In fulfillment of part of this training requirement, the principal investigator shall assure that all new laboratory workers attend Laboratory Safety Training at NYU provided by Environmental Health and Safety. Lab personnel are only required to attend Lab Safety Training at initial start of work.

There is also a Hazardous Waste training required by the EPA to be taken annually by all lab personnel and clinic workers.

Additional training provided by the principal investigator should be as specific to the activities conducted in the laboratory as possible. It should include:

1. Health risks (both chemical and physical) posed by the experimental procedures conducted in their lab;
2. The existence and location of all designated areas in the laboratory;
3. The selection and use of personal protective equipment appropriate for laboratory tasks. See section for VII additional information on personal protective equipment.

Please contact EH&S at 212-998-1450 for date and location of trainings.

Section XIV

Standard Operating Procedures

Standard operating procedures (SOP) are intended to provide you with general guidance on how to safely work with hazardous chemicals. While SOPs provide only general guidance, observance of all the safety practices listed in them is mandatory. If compliance with all the requirements of a specific standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

SOPs at minimum should include step by step instructions of the task with emphasis on safety controls, (i.e. Personal Protective equipment, use of fumehoods, trainings.) They should also state the type of personnel authorized to perform the task.

In order to provide flexibility, standard operating procedures are generic in nature. They address the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for specific chemicals. If you have questions concerning the applicability of any item listed in this procedure contact the Office of Environmental Health and Safety 212-998-1440 or the Principal Investigator of your laboratory.

Please insert a copy of all SOPs for the laboratory at the end of this manual.

Section XV

Chemical Spills

Response Activities

Response to chemical spills varies depending on the type of spill. In very broad terms, spills are classified into Minor and Major, depending on the material and its hazards, the quantity, and the extent of the clean-up person's familiarity with the material. Minor and Major Spills are further defined and described below.

Laboratory personnel or other chemical users are responsible for cleaning up minor spills of the chemicals they commonly use as part of proper chemical management. EH&S will provide consultation or assistance in the case of minor spills, as requested.

Please complete the Operational Risk Management Spill Questionnaire in Appendix D. Please keep all completed forms at the end of the manual. EH&S will inspect the manuals and completed forms during their periodic inspections.

For major spills, EH&S should always be notified and will coordinate cleanup with a hazardous waste contractor or the FDNY Hazmat Unit.

Minor Chemical Spill

- A Minor Chemical Spill is a small quantity spill of a known material that laboratory personnel or chemical users are capable of handling safely without the assistance of EH&S or other emergency response personnel.

Major Chemical Spill

A Major Chemical Spill is one that:

1. Is a material that is unknown or unfamiliar to the person who discovered the spill.
2. Has caused, or is likely to cause, injury to personnel.
3. Is of a volume that is not easily cleaned up by the chemical user.
4. Is uncontained and spreading out of the immediate area endangering other areas.
5. Has the potential to cause a fire.

When a call comes in about a spill complete the Operational Risk Management Spill Questionnaire or if mercury is spilled, complete the Mercury Spill Questionnaire in Forms. See **Appendix D**

Cleanup of a Minor Spill

These actions should be conducted by the laboratory personnel/chemical user when possible, or by Operational Risk Management when requested or necessary.

1. Alert personnel in affected area.
2. Wear appropriate personal protective equipment(PPE): safety goggles, gloves, and long sleeve lab coat.
3. Locate source of spill and confine to a small area or a container.
4. Avoid breathing vapors from spill.
5. For inorganic acids and bases, use appropriate spill kit, such as sodium bicarbonate or Acid Spill Kit to neutralize and absorb the spilled material.
6. For Mercury, use a special mercury spill kit. See below for more detailed instructions on the cleanup of mercury spills.
7. For Formaldehyde spills see below for more detailed instructions.

8. For other chemicals, use appropriate spill kit or absorb spill with vermiculite, dry sand, kitty litter or diatomaceous earth. All such materials should be available at the location where the chemical is used or stored. If not, get required materials from the Emergency Response Room at Brown 155.
9. Collect residue and spill cleanup material, place in a hazardous waste labeled container or bag, and properly dispose of as hazardous waste.
10. Clean spill area with water, if appropriate
11. Ventilate room.

Response to a Major Spill

If someone has been seriously injured or is unconscious, call 911 (or 9-911 from an internal NYU phone). This is the fastest way to get help. The FDNY is the primary responder for major chemical spills.

1. Alert personnel in affected area and advise them to evacuate.
2. Avoid breathing vapors from spill.
3. If spill has caused a fire, pull fire alarm and evacuate, closing the door and windows behind you if possible. If no fire, do NOT pull fire alarm.
4. Attend to injured or contaminated individuals and remove them from exposure ONLY if possible. If unable, call 911 (or 9-911 from an internal NYU phone). The FDNY is the primary responder for major chemical spills involving injured personnel.
5. If spilled material is flammable, turn off ignition and/or heat sources ONLY if possible and safe to do so.
6. Close doors and windows to affected area.
7. Contact Public Safety at x 82222.
8. Call EH&S at X81450. They will coordinate with NYU hazardous waste contractor.
9. Have person knowledgeable of incident and facility meet and assist emergency response personnel.

Mercury Spill

1. Cordon off, ventilate by opening windows and evacuate the area.
2. Wear appropriate PPE.
3. Mercury spill kits are available for use by response personnel in Brown Room 155.
4. Most small mercury spills (i.e., thermometers, etc.) can be placed in an airtight container, labeled with the appropriate content and volume information.
5. Large volume liquid mercury spills should be vacuumed to assure complete cleanup. To accomplish this, the mercury vacuum located in Brown 155 will be brought to the spill area.
6. The spill area should be cordoned off, ventilated by opening windows and evacuated until clean up activities are completed.

Formaldehyde Spill

1. Cordon off, ventilate by opening windows and evacuate the area.
2. Wear appropriate PPE
3. Sprinkle spill area with sodium bisulfite.
4. Scoop absorbed material into an airtight container for disposal.
5. If area is still wet with spilled material, repeat steps 3 & 4 above.
6. The area should be well ventilated and remain vacant until the spill is completely dry.
7. After drying, clean area with soap and water.

Recovery Activities

1. Conduct a final inspection of the affected area.
2. If all clear advise personnel that they may reenter the area and resume normal activities. Collect, store and dispose of all spill material in accordance with local, state and federal regulations and guidelines.

Section XVI

Personal Contamination

General Information

Do what is necessary to protect life. Remain calm. The MSDS for the chemical will contain special first aid information.

Do not move an injured person unless they are in further danger. A blanket should be used immediately to protect the victim from shock and exposure. Get medical attention promptly by calling:

- Call 911
- University Public Safety at X 82222 or 212-998-2222

For specific instruction regarding personal contamination, contact your supervisor, instructor, or EH&S.

Chemical Spilled over Large Portion of Body

Quickly remove all contaminated clothing while using the safety shower or other available source of water. Immediately flood the affected body area in cold water for at least 15 minutes. Remove contaminated clothing or jewelry at once. Make sure chemical has not accumulated in shoes. Wash off chemical with water but do not use neutralizing chemicals, unguents, creams, lotions, or salves.

Clean scrubs should be stored in the lab at all times so that in the event of a major spill incident the individual can redress in temporary clothes so they can either be transported to a medical facility or head home after the incident.

Get medical attention promptly.

Chemicals on the Skin in Confined Areas

Immediately flush with cold water. If there is no visible burn, scrub area with warm water and soap. Remove all jewelry to facilitate removal of any residual material.

If a delayed action is noted (often the next day), report immediately for medical attention and explain carefully what chemicals were involved.

If the incident involves **Hydrofluoric acid (HF)**, seek immediate medical attention.

If there is any doubt, seek immediate medical attention.

Chemicals in the Eyes

Use Eyewash or Irrigate with plenty of cool water for at least 15 minutes. Simultaneously, check for and remove contact lenses.

Get medical attention promptly.

Smoke and Fumes

Anyone overcome with smoke or chemical fumes should be removed to uncontaminated air and treated for shock. If certified, follow standard CPR protocols. Get medical attention promptly.

Do not enter the area if a life threatening condition still exists, such as the presence of:

- oxygen depletion

- explosive vapors
- cyanide gas, hydrogen sulfide
- nitrogen oxides, carbon monoxide

Burning Clothing

Extinguish burning clothing by dousing it with cold water, using the safety shower and/or the drop-and-roll technique. Remove contaminated clothing. If possible, send clothing with the victim. Wrap injured person to prevent shock.

Get medical attention promptly.

Ingestion of Hazardous Chemicals

Identify the chemical ingested and Call 911 and University Public Safety X82222 or 212-998-2222. Wrap injured person to prevent shock.

Provide the ambulance crew and physician the chemical name and any other relevant information.

Do not reenter the building until directed to do so. Follow any special procedures established for your unit.

Section XVII

Medical Consultation

On-campus medical emergencies requiring an ambulance:

Do not move a seriously injured person unless they are in further danger. Dial X82222 or 212-998-2222. Tell the dispatcher the location and nature of the emergency. Public Safety will coordinate the ambulance or transportation to either the Student Health Center or local Hospital.

Employees and students must notify their immediate supervisor or instructor of all illnesses and injuries related to exposure to hazardous chemicals. Contact your supervisor, instructor, or EH&S if you have any questions regarding the procedure for treating a non-serious injury or illness.

Section XVIII

Fire and Fire Related Emergencies

If you discover a fire or fire-related emergency, such as abnormal heating of material, hazardous gas leaks, hazardous material or flammable liquid spill, smoke, or odor of burning, immediately follow these procedures:

Activate the building alarm (fire pull station); if not available or operational, verbally notify persons in the building.

Call 911.

Notify Public Safety X 8222 or 212-998-8222 from a safe location.

Isolate the area and evacuate the building:

- Shut down equipment in the immediate area (if possible).
- Close doors to isolate the area.
- use a portable fire extinguisher to: assist oneself or another to evacuate, or control a small fire, if possible.

Identify yourself as the person who notified Public Safety and provide the fire or police teams with the details of the problem upon their arrival. Special hazard information you may know is essential. If the fire alarms are ringing in your building:

- evacuate the building.
- move away from the building to a designated area.
- stay clear of driveways, sidewalks and other means of access to the building.

If you are a supervisor, account for your employees and report any missing persons to the emergency personnel at the scene. Assist emergency personnel as requested.

FDNY INSPECTION LIST FOR CHEMICAL LABORATORIES

Permit – It is unlawful to operate a laboratory or storage room in which flammable liquids, flammable solids, flammable gases, oxidizing materials, explosive materials, unstable or reactive chemicals, are used in testing, research, experimental or instructional work, without a permit from the FDNY Fire Commissioner.

Guidelines Requiring a Fire Permit for Laboratories

(One or more of the following criteria will warrant a Permit)

- 32 ounces or greater of a flammable liquid
- ½ pound or greater of a solid oxidizing agent
- A flammable gas cylinder that is at least 20 inches in height or 6 inches in diameter
- 10 gallons or greater of a combustible liquid
- 15 gallons or greater of an acid

LABORATORY SAFETY

Certificate of Fitness (Type C-14) - In all locations where there are laboratories in operation, at least one person per floor must have obtained a Certificate of Fitness (Type C-14) from the FDNY. This CoF must be posted at all times in all laboratories. Information can be obtained by calling 718.999.1986 or by going to:

http://www.nyc.gov/html/fdny/html/c_of_f/cof_study_materials.shtml

Labeling of Containers – Chemical containers and gases in all chemical laboratories and storage rooms shall be clearly and properly labeled to include the containers contents and any special conditions required to maintain safe storage of the container.

Potentially Explosive/Reactive Chemicals – It shall be the duty and responsibility of the permit applicant or designee, to clearly record on the container, in indelible ink, the opening date of the following chemical groups:

- Picrics originating at less than 10% hydration;
- Perchlorates;
- Peroxides; (arrange to have these chemicals tested at least once every six months)
- Peroxidizable materials;
- Polymerizers that react violently in polymerization or become hazardous after polymerization; and
- Any other material stored or used which are known to deteriorate or to become unstable or reactive.

Dispose of all within one year of opening date.

Spill Kits – Neutralizing or absorbing agents shall be provided at all areas used for the storage of acids. (All labs have a spill kit)

Fire Extinguisher – Provide one approved workable fire extinguisher, Type ABC in each lab.

Safety Shower/Eye Wash – Where more than 5 gallons of corrosive acids or 5 gallons of flammable liquids are stored or used (fixed or flexible) shall be provided within 25 feet of the laboratory door – unobstructed.

Compressed Gas Cylinders – Properly secure all cylinders with a chain or other suitable holder. Cylinders shall have a stamped-on date which certifies that the cylinder has been hydrostatically tested within the past 10 years. Return empty or non-conforming cylinders to the manufacturer. Dispose of lecture bottles through EHS.

Fume Hoods – Fume Hoods shall be inspected annually so that a maximum average face velocity of 120 feet per minute, with minimum face velocity at any point not less than 80 feet per minute, is provided. (EHS to arrange for annual inspections)

Material Safety Data Sheets (MSDS) – Shall be maintained in accordance with “OSHA General Industry Standards – Hazard Communication” and be readily available to lab staff and emergency personnel.

STORAGE OF CHEMICALS

Storage of chemical amounts for use in individual laboratories – Please refer to the bottom of your lab’s Fire Permit. Next to the lab room number there is a “Lab Type” followed by a Roman Numeral. Each lab or lab type has a maximum storage limit, refer to the following table for your lab’s chemical storage limits:

Lab Type	Max. Flammable Liquids	Max. Flammable Solids	Max. Oxidizing Materials	Max. Unstable Reactives
I	30 gallons	15 pounds	50 pounds	12 pounds
II	25 gallons	10 pounds	40 pounds	6 pounds
III	20 gallons	6 pounds	30 pounds	3 pounds
IV	15 gallons	3 pounds	20 pounds	2 pounds

Corrosive Acids – Secondary containment or corrosive-resistant trays must be used in areas where corrosives are stored on or come in contact with metal shelving. Please call EHS to obtain secondary containment for acids.

Water-Reactives – Water-reactive chemicals shall be stored in suitable receptacles or enclosures, properly identified as to contents, to protect them from contact with water.

Temperature-Sensitive Flammable Liquids – Shall be stored only in approved explosion-proof or spark-proof refrigerators.

Disposal of old, surplus, unwanted, contaminated or unidentified chemicals - Material which is in danger of decomposition or of changing characteristics so as to present a danger or explosion or fire, or which is unidentified, shall be promptly removed or disposed of through EHS.

Proper Chemical Segregation – Do not store flammables with oxidizers or keep flammables near ignition sources

SIGNS AND WARNING PLACARDS

No Smoking – Smoking is prohibited within laboratories. A sign shall be conspicuously posted at the exterior of entrances to storage and laboratory areas and within such areas.

Store No Flammables – Shall be posted on all non-explosion proof refrigerators (provided by EHS).

Laboratory – Potentially Hazardous Substances – Shall be posted on exterior entrances to laboratory areas (provided by EHS).

Section XIX

Laser Safety

Introduction

Lasers are used for various research applications at NYU. The Physics and Chemistry departments are the main users of lasers on campus. The emerging field of nanotechnology (which physics and chemistry are a part of) rely on the use of lasers in their work.

Lasers pose a number of potentially serious health hazards. Lasers can cause physical injury to the eyes to anyone who looks directly into the beam or specular reflections. In addition, diffuse reflection of a high-power laser beam can burn exposed skin, ignite flammable materials, and activate toxic chemicals that can release hazardous fumes, gases, debris, and radiation. High powered lasers increase risks of electrical and fire hazards in the lab. The use of lasers can emit noxious airborne exposures depending on the substrates being used. High pressure systems used in the functioning of lasers can create explosion hazards.

The term laser is an acronym for *Light Amplification by Stimulated Emission of Radiation*. A laser is an electronic optical device which produces a coherent, directional beam of energy in the visible, infrared, ultraviolet, and far infrared regions of the electromagnetic spectrum.

Responsible Parties

The Laser Safety Officer will be responsible for:

- Suspending, restricting or terminating the operation of a laser or laser system without adequate hazard controls;
- Maintaining an inventory of all Class 3b and Class 4 lasers and ensuring appropriate classification if necessary;
- Reviewing and commenting on standard operating procedures (SOP), alignment procedures and other control measures, before initial use of laser systems;
- Periodically inspecting Class 3b and Class 4 lasers to assess compliance with NYU safety requirements;
- Providing assistance in evaluating and controlling hazards;
- Participating in accident investigations involving lasers.

The Principal Investigator is responsible for:

- Notifying EH&S of the intent to purchase or construct a laser, and providing required information for registration and a safety assessment for lasers. The laser user registration form can be found on the EH&S website;
- Providing specific laser training and the SOP to all laser operators;
- Ensuring each laser is operated safely and in accordance with applicable manufacturer and ANSI requirements;
- Ensuring that each laser is stored securely and safely when not in use so that it is not usable by unauthorized personnel or under unauthorized conditions;
- Writing and maintaining written SOPs for Class 3b and all Class 4 lasers and ensuring laser use is commensurate with the requirements of the SOP;
- Providing copies of written SOPs to the Laser Safety Officer for review and comment;
- Informing EH&S prior to receiving a laser, transferring a laser to another user, sending a laser to another site off-campus, or disposal of a laser or laser system;
- Reporting any known or suspected accidents to the Laser Safety Officer;
- Ensuring that a hazard assessment for personal protective equipment (PPE) use and specific PPE training is provided for all laser users for whom PPE will be required.

The laser operator is responsible for:

- Completing all applicable requirements including training, before operating a laser;
- Operating lasers safely and in a manner consistent with safe laser practices, requirements and standard operating procedures (SOPs). This includes the use of personal protective equipment as applicable;
- Maintaining a safe environment/area during the operation of a laser.

Laser Safety Requirements and Registration

NYU has adopted the *American National Standard for Safe Use of Lasers Z136.1 – 2007* as the minimum standard for laser safety. ANSI Z136.1 – 2007 is recognized as the primary consensus standard for laser safety.

These provisions apply to all NYU personnel who use Class 3b and 4 lasers.

All Class 3b and Class 4 lasers at NYU must be registered with Environmental Health & Safety (EH&S). Please contact EH&S prior to receiving laser equipment so that the unit can be registered and the procedures and safety controls can be evaluated. The Laser User Registration Form can be found on the EH&S website.

Class I, II, and IIIa lasers or laser systems are exempt from all requirements of this section of the handbook. Class IIIb or IV lasers are sometimes embedded in devices of a lower class, however. Modification or service of Class I or II or IIIa lasers or laser devices which results in access to laser radiation of a higher class laser will require compliance with requirements for the embedded lasers.

Hazard Classification

Commercial lasers are classified and certified by the manufacturer. When a commercial laser is modified or when a new laser is constructed in the laboratory, it is the responsibility of the principal investigator to classify and label the laser per the ANSI Standard. EH&S can assist in determining the appropriate classification. On a periodic basis the Laser Safety Officer will inspect laser safety control measures to assure appropriate measures are in place.

Laser Safety Hazards

There are several parameters which dictate the types of injuries that laser beam hazards can inflict. These factors include wavelength, energy of the beam, divergence and exposure duration. For pulsed lasers, parameters also include the pulse length, pulse repetition frequency and pulse train characteristics. The ANSI standard has established Maximum Permissible Exposure (MPE) limits for laser radiation. The MPE must be determined for each specific laser so that a Nominal Hazard Zone (NHZ) can be established. The NHZ is the area directly around a laser in which the applicable MPE is exceeded. During alignment and adjustments laser systems should be powered down to avoid over exposure above the MPE. The LSO can assist in determining MPEs and NHZs. When the MPE is exceeded, damage can occur to the skin, retina, lens, cornea, and conjunctival tissue surrounding the eye. Lasers over 500 mW of power can ignite flammable materials when the beam is crossed and cause a fire.

Standard Operating Procedures should detail procedures that require adjustments of laser systems while the system is energized.

Thermal burns to the retina may occur from a laser beam in the near ultraviolet (UV), visible and near infrared (IR) spectral regions between 400 nm – 1400 nm. When a laser beam enters the eye and is focused on the retina damage occurs. The laser energy is absorbed by the tissue in the form of heat and can destroy sensitive retinal tissue. Retinal tissue does not regenerate so direct laser exposure to the eye can create permanent damage, which may result in the loss of sight.

Depending on the procedure high power lasers can emit fumes and vapors when a laser beam makes contact with certain substrates and materials. Appropriate ventilation must be considered when planning an experiment where laser beams may release airborne material into the lab.

Laser User Qualification and Training

All staff and students that will be using laser equipment must read through this section of the lab safety handbook before using any laser equipment. Only a qualified and authorized person is permitted to operate a laser. The

Principal Investigator determines the employee's or student's operational qualification from departmental or technical training or other acceptable learning experience.

Before operating a Class 3b or Class 4 laser system a person must:

- Review the Laser Safety section of the Lab Safety Handbook;
- Receive from the lab supervisor or Principle Investigator a thorough review of the laser equipment to be used and the administrative, alignment and standard operating procedures (SOP);
- Review the operating and safety instructions furnished by the manufacturer.

Laser safety training can also be provided by the LSO when new employees or new procedures are implemented that require more involvement from EH&S. The need for this training will be determined by the LSO and the managing PI in the applicable department.

Laser Safety Engineering Controls

All Class 3b and Class 4 lasers must be equipped with the following engineering safety features:

- Protective housing interlock system that prevent emission of laser radiation when the housing is open;
- Viewing portals in the protective housing must be equipped with filters and attenuators that keep escaping light below the Maximum Permissible Exposure (MPE) limit;
- Optical instruments for viewing the laser system must be equipped with filters and attenuators and interlocks to keep exposures below the MPE limit for all conditions of operation and maintenance.

These features are standard for commercially purchased lasers and should be incorporated into custom built lasers. If these engineering controls are considered a burden on research a written SOP and written explanation of alternative control measures must be forwarded to the LSO for consideration.

Another useful control measure is the master key switch which should be used with Class 4 lasers. The laser should not be operable when the master key is removed.

Requirements for labs housing lasers:

Required items for Class 3b laser areas:

- Appropriate warning sign(s) posted;
- Only operated by qualified and authorized employees or personnel;
- During operation, direct supervision of an individual knowledgeable in laser safety and operations;
- Only diffuse reflective materials in or near the beam path, where feasible;
- Personnel within the controlled area need to be provided with appropriate eye protection if there is any possibility of viewing the direct or reflected beams;
- The laser needs to be secured so that the beam is not at eye level of any person standing or seated;
- There must be secure storage of a disabling device such as a master key switch so that when the laser is not in use no unauthorized individuals can energize the laser system.

Class 4 laser areas require, in addition to the items listed for Class 3b:

- For emergencies there shall be a clearly marked "Panic Button" that can deactivate the laser or substantially reduce the output to the appropriate MPE levels;
- Entryway safety control to deactivate the laser in the event of unexpected entry into laser area;
- These additional safety control shut off systems can be discussed with the LSO to determine the number and extent of such emergency shut off systems on a case by case basis.

Personal Protective Equipment

Laser safety eye protection suitable to the specific laser type must be provided and worn within laser operating areas if there is a potential for exceeding the MPE limit if the beam is viewed. Eye protection can include goggles, face shields, or safety glasses with the appropriate filters and reflective coatings. Exceptions may be approved if the eye

protection produces a greater hazard to the laser users or greatly hinders the procedures being proposed if the written SOP is sent to the LSO for review and approval.

Depending on the type of laser in use varying types of laser safety glasses are needed. When purchasing laser safety glasses or goggles the laser type, wavelength, active medium, and filter Optical Density (OD) must be considered. In addition the maximum power should be a factor in the decision process. These important components of laser safety eyewear should be clearly marked on the safety equipment purchased. The protective eyewear should be inspected periodically to ensure no pitting, cracking, scratches or other damage is found in the equipment.

When making decisions on the purchase of laser safety glasses any questions or concerns should be forwarded to the Laser Safety Officer at 8-1450.

Exposure Incidence

In the event of an accident involving laser radiation and eye damage both the Student Health Service and EH&S should be contacted as soon as possible. The personnel involved will be evaluated and/or referred for ophthalmologic assessment if the reviewing doctor deems it necessary. In the event of an after hours accident involving the eye NYU Public Safety and/or 911 should be contacted in order to receive immediate medical attention.

Section XX

Laboratory and Clinical Equipment Decontamination

Preparing Equipment for Service or Disposal

Clinical and Laboratory equipment may potentially be contaminated with biological and chemical materials, or radioisotopes. The equipment must be cleaned or decontaminated to protect workers servicing the equipment, protect the environment if disposing the equipment or the public if purchasing surplus equipment.

Examples of equipment which may need to be decontaminated or obtain assurance of the removal of hazardous materials prior to servicing or disposal include (but are not limited to):

Centrifuges	Incubators	Fume Hoods
Cryostats	Ovens	Refrigerators
Freezers	Sinks	Warm Rooms*
Tanks*	Biological Safety Cabinets	Walk-in Refrigeration Units
X-Ray Units	Photo Processing Units	Lab Benches (grossly contaminated)
Other storage cabinets, lockers, bins used to store hazardous materials		

*potential confined space

The exact decontamination procedure will be dependent upon the equipment. Decontamination can be performed by the clinic, lab or department preparing for service or disposing of equipment. If there is ever a question of the hazard, please call the Environmental Health & Safety (EH&S) Office at 212.998.1450.

Some equipment can contain materials which present or contain hazards to repair personnel and/or the environment when disposing of it. Examples include equipment that may contain ballasts (possible PCB-containing), thermometers (possible mercury-containing); oil reservoirs, lead sheeting, radioisotopes, CFCs (chlorofluorocarbons) and attachments such as gas cylinders.

It is the laboratory, clinic and/or department's responsibility to assure that the equipment is cleaned or does not pose a risk. If there presents a risk that cannot or should not be mitigated by the laboratory, clinic or department personnel, contact EH&S.

Once the equipment has been decontaminated of hazards or does not present a hazard, please fill out and attach the **"Notice of Equipment Decontamination"** Label. An employee knowledgeable of the hazardous materials used in the equipment/fume hood must complete the label and attach it to the equipment or face of the fume hood prior to calling Asset Management. Then follow the steps in the Asset Management Policy and Procedures:

<http://www.nyu.edu/asset/>

REQUIREMENTS FOR EQUIPMENT DECONTAMINATION

Equipment Used to Process or Store Biological Material

Remove biological material from the equipment. Clean the equipment with warm, soapy water and scrub as necessary. Sanitize with a 1:10 bleach solution. After 10 minutes contact time, rinse metal surfaces as bleach is corrosive. If you have questions, contact the EH&S office at 212.998.1450.

For decontamination of biological safety cabinets, call 212.998.1440.

Other Uses of Equipment, Contact and Decontamination Information

- Radiation Safety

Contact the NYU Radiation Safety Officer (212.998.8480) prior to servicing or removing equipment containing sealed radiation sources (gas chromatographs, liquid scintillation counters, etc), x-ray equipment, lasers, or equipment producing non-ionizing radiation (UV radiation).

*Again, if any of this equipment does not contain a radiation hazard or the hazard has been removed, please fill out and attach the "Notice of Equipment Decontamination" Label.

- Chemical Safety

Contact the Department EH&S (212.998.1450) prior to servicing or removing equipment/instruments containing mercury (thermometers, blood pressure devices, etc.), gas cylinders, equipment containing capacitors, small transformers containing PCBs, fluorescent light ballasts or pressurized containers and vessels. The EH&S office can also provide information on decontamination of equipment used to store or process chemicals.

For fume hood liner, oven and older counter tops decontamination or removal, please contact the Department of EH&S (212.998.1450).

- Occupational Safety

Prior to sanitizing large tanks, walk-in refrigeration/freezer units or warm rooms which have failed, it is also important to call the Department of EH&S as these units can potentially be confined spaces.

Please attach the "Notice of Equipment Decontamination" Label to the equipment indicating that the equipment is free, to the best of your knowledge, of potential hazards (go to EHS Website at:

<http://www.nyu.edu/ehs/waste.disposal/lab.waste.html>

REQUIREMENTS FOR EQUIPMENT DECONTAMINATION

Equipment Used to Process or Store Radioisotopes

For potentially radioactive material, the following should be performed:

- Thoroughly decontaminate all surfaces;
- Perform wipe tests and document the test in the Radiation Safety handbook for possible future inspection;
- Remove all radioactive labels and signs.

Equipment Used to Process or Store Chemicals

Safely remove, drain, or discharge chemicals from the equipment. Collect the material for reuse or for hazardous waste disposal. If applicable, use an inert gas or liquid to purge or rinse out chemical residues. In some cases, rinsate will need to be disposed of as hazardous waste if what you are decontaminating is considered a hazardous material.

- Contaminated Refrigerators or Ovens

Contaminated refrigerators, ovens and other equipment with non-permeable surfaces must be decontaminated by scrubbing with warm soapy water.

- Fume Hoods

When maintenance personnel must enter the inside of a fume hood, the fume hood user must remove all containers and thoroughly wash interior surfaces with warm soapy water (fume hood areas that are within arms reach). Call EH&S if a full decontamination of the fume hood is required or needed (up into the HVAC duct work).

Appendix A

Reproductive Hazards

Appendix B

Acutely Toxic Chemicals

Appendix C

Carcinogen List

Appendix D

Spill Questionnaire

Appendix E

**Chemical Compatibility
Chart**

Appendix A

Reproductive Hazards

This list is provided as a guide and is not all inclusive. Review material safety data sheet.

Name	CAS#	Name	CAS#
Acetaldehyde	75-07-0	Hydrazine(s)	302-01-2
Arsenic	7440-38-2	Hexafluoroacetone	684-16-2
Aniline	62-53-3	Halothane	151-67-7
Aflatoxins		Karathane	131-72-6
Benzene	71-43-2	Lead (inorganic compounds)	7439-92-1
Benzo(a)pyrene	50-32-8	2-Methoxyethanol	109-86-4
Carbon disulfide	75-15-0	2-Methoxyethyl acetate	110-49-6
Chloroform	67-66-3	Methyl chloride	74-87-3
Chloroprene	126-99-8	N-Methyl-2-pyrrolidone	872-50-4
Dimethyl formamide	68-12-2	Propylene glycol monomethyl ether	107-98-2
Di-sec-octyl-phthalate	117-81-7	Propylene glycol monomethyl ether acetate	108-65-6
Dinitrooctyl phenol	63149-81-5	Propylene oxide	75-56-9
Dithane	111-54-6	Trichloroethylene	79-01-6
2-Ethoxy ethanol	110-80-5	RH-7592	
2-Ethoxyethyl acetate	111-15-9v	Systhane/RH-3866	88671-89-0
Ethylene thiourea	96-45-7	TOK (herbicide)	1836-75-5
2-Ethyhexanol	104-76-7	Toluene	108-88-3
Glycol ethers		Vinyl chloride	75-01-4

Appendix B

Acutely Toxic Chemicals

This list is provided as a guide and is not all inclusive. Review material safety data sheet.

Acrolein	Acrylyl chloride	2-Aminopyridine
Benzyl chloride	Bromine	Chlorine dioxide
Chlorine trifluoride	Chlorpicrin	Cyanogen chloride
Cyanuric fluoride	Decaborane	Dichloro acetylene
Dimethyl disulfide	Dimethylsulfate	Dimethylsulfide
Ethylene chlorohydrin	Ethylene fluorohydrin	Hexamethylene diisocyanate
Hexamethyl phosphoramidate	Iodine	Iron pentacarbonyl
Isopropyl formate	Methacryloyl chloride	Methacryloxyethyl isocyanate
Methyl acrylonitrile	Methyl chloroformate	Methylene biphenyl isocyanate
Methyl fluoroacetate	Methyl fluorosulfate	Methyl hydrazine
Methyl Mercury (and other organic forms)	Methyltrichlorosilane	Methyl vinyl ketone
Nickel carbonyl	Nitrogen tetroxide	Nitrogen trioxide
Organo Tin compounds	Osmium tetroxide	Oxygen difluoride
Ozone	Pentaborane	Perchloromethyl mercaptan
Phosphorus oxychloride	Phosphorus trichloride	Sarin
	Select Agents	
Sulfur monochloride	Sulfur pentafluoride	Sulfuryl chloride
Tellurium hexafluoride	Tetramethyl succinonitrile	Tetranitromethane
Thionyl chloride	Toluene-2,4-diisocyanate	Trichloro (chloromethyl) silane

Appendix C

Carcinogen List

Table C-1 Basis of OSHA Carcinogen Listing for Individual Chemicals

Chemical	IARC	NTP	OSHA-Z	Chemical	IARC	NTP	OSHA-Z
Acetaldehyde	2B	P	-	Catechol	2B	-	-
Acetamide	2B	-	-	Chlordane	2B	-	-
2-Acetylaminofluorene	-	P	Z	Chlorendic acid	2B	P	-
Acrylamide	2A	P	-	p-Chloroaniline	2B	-	-
Acrylonitrile	2B	P	Z	Chloroform	2B	P	-
2-Aminoanthraquinone	-	P	-	Chloromethyl methyl ether	1	K	Z
4-Aminoazobenzene	2B	-	-	β-Chloro-2-methyl-1-propene	-	P	-
4-Aminobiphenyl	1	K	Z	Chlorophenols	2B	-	-
1-Amino-2-methylantraquinone	-	P	-	Chloroprene***	2B	P	-
Amitrole	2B	P	-	Chlorothalonil	2B	-	-
o-Anisidine	2B	-	-	p-Chloro-o-toluidine	2A	P	-
o-Anisidine hydrochloride	-	P	-	Chromium (VI) compounds	1	K	-
Arsenic and inorganic arsenic compounds	1	K*	Z	Cobalt and cobalt compounds	2B	-	-
Asbestos (friable)	1	K	Z	Creosote	2A	K	-
Atrazine**	-	-	-	p-Cresidine	2B	P	-
Benzene	1	K	Z	Cupferron	-	P	-
Benzidine	1	K	Z	2,4-D****	2B	-	-
Benzoic trichloride	2B	P	-	2,4-D butoxyethyl ester****	2B	-	-
Beryllium and beryllium compounds	1	P*	-	2,4-D butyl ester****	2B	-	-
Bis(chloromethyl)ether	1	K	Z	2,4-D chlorocrotyl ester****	2B	-	-
1,3-Butadiene	2A	K	-	2,4-D 2-ethylhexyl ester****	2B	-	-
1,2-Butylene oxide	2B	-	-	2,4-D 2-ethyl-4-methylpentyl ester****	2B	-	-
C.I. Acid Red 114	2B	-	-	2,4-Diaminoanisole	2B	-	-
C.I. Direct Black 38	2A	K	-	2,4-Diaminoanisole sulfate	-	P	-
C.I. Direct Blue 6	2A	K	-	4,4'-Diaminodiphenyl ether	2B	-	-
C.I. Direct Brown 95	2A	-	-	2,4-Diaminotoluene	2B	P	-
C.I. Food Red 5	2B	-	-	Diaminotoluene (mixed isomers)	2B	P	-
C.I. Solvent Yellow 3 (o-aminoazotoluene)	2B	P	-	1,2-Dibromo-3-chloropropane	2B	P	Z
C.I. Solvent Yellow 34 (Auramine)	2B	-	-	1,2-Dibromoethane	2A	P	-
Cadmium and cadmium compounds	1	K*	-	1,4-Dichlorobenzene	2B	P	-
Carbon tetrachloride	2B	P	-	Dichlorobenzene (mixed isomers)	2B	P	-

Note: The list of TRI chemicals meeting the OSHA carcinogen standard and, therefore, reported when in a mixture at a concentration level below the de minimus level of 0.1% has been updated, and this list reflects the update.

IARC: 1-The chemical is carcinogenic to humans; 2A-The chemical is probably carcinogenic to humans; 2B-The chemical is possibly carcinogenic to humans.

NTP: K-The chemical is known to be carcinogenic; P-The chemical may reasonably be anticipated to be carcinogenic.

OSHA: Z-The chemical appears at 29 CFR part 1910 Subpart Z.

*Certain compounds.

**IARC classification was recently downgraded and the chemical no longer meets the OSHA carcinogen criteria (effective for the 2000 reporting year).

***NTP classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

****Chlorophenoxy herbicides (IARC 2B).

*****IARC classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

Table C-1 Basis of OSHA Carcinogen Listing for Individual Chemicals (continued)

Chemical	IARC	NTP	OSHA-Z	Chemical	IARC	NTP	OSHA-Z
3,3'-Dichlorobenzidine	2B	P	Z	2,4-D propylene glycol butyl ether ester****	2B	-	-
3,3'-Dichlorobenzidine dihydrochloride	2B	P	-	2,4-D sodium salt****	2B	-	-
3,3'-Dichlorobenzidine sulfate	2B	P	-	Epichlorohydrin	2A	P	-
Dichlorobromomethane	2B	P	-	Ethyl acrylate	2B	-	-
1,2-Dichloroethane	2B	P	-	Ethyl benzene****	2B	-	-
Dichloromethane	2B	P	-	Ethyleneimine	-	-	Z
trans-1,3-Dichloropropene	2B	-	-	Ethylene oxide	1	K	Z
1,3-Dichloropropylene	2B	P	-	Ethylene thiourea	2B	P	-
Dichlorvos	2B	-	-	Formaldehyde	2A	P	Z
Diepoxybutane	2B	P	-	Heptachlor	2B	-	-
Di-(2-ethylhexyl)phthalate	-	P	-	Hexachlorobenzene	2B	P	-
Diethyl sulfate	2A	P	-	alpha-Hexachlorocyclohexane	2B	P	-
Diglycidyl resorcinol ether	2B	P	-	Hexachloroethane	2B	P	-
Dihydrosafrole	2B	-	-	Hexamethylphosphoramide	2B	P	-
3,3'-Dimethoxybenzidine	2B	P	-	Hydrazine	2B	P	-
3,3'-Dimethoxybenzidine dihydrochloride	2B	P	-	Hydrazine sulfate	-	P	-
3,3'-Dimethoxybenzidine hydrochloride	2B	P	-	Lead and inorganic lead compounds	2B	-	Z
4-Dimethylaminocazobenzene	2B	P	Z	Lindane	2B	P	-
3,3'-Dimethylbenzidine	2B	P	-	Mecoprop****	2B	-	-
3,3'-Dimethylbenzidine dihydrochloride	2B	P	-	Methoxone****	2B	-	-
3,3'-Dimethylbenzidine dihydrofluoride	2B	P	-	Methoxone sodium salt****	2B	-	-
Dimethylcarbonyl chloride	2A	P	-	4,4'-Methylenebis (2-chloroaniline)	2A	P	-
N,N-Dimethylformamide**	-	-	-	4,4'-Methylenebis (N,N-dimethyl) benzeneamine	2B	P	-
1,1-Dimethylhydrazine	2B	P	-	4,4'-Methylenedianiline	2B	P	Z
Dimethyl sulfate	2A	P	-	Michler's ketone	-	P	-
2,4-Dinitrotoluene	2B	-	-	Mustard gas	1	K	-
2,6-Dinitrotoluene	2B	-	-	alpha-Naphthylamine	-	-	Z
1,4-Dioxane	2B	P	-	beta-Naphthylamine	1	K	Z
1,2-Diphenylhydrazine	-	P	-	Nickel	2B	P	-
2,4-D isopropyl ester****	2B	-	-	Nickel compounds	1	P*	-
2,4-DP****	2B	-	-	Nitrotriacetic acid	-	P	-

Note: The list of TRI chemicals meeting the OSHA carcinogen standard and, therefore, reported when in a mixture at a concentration level below the de minimus level of 0.1% has been updated, and this list reflects the update.

IARC: 1-The chemical is carcinogenic to humans; 2A-The chemical is probably carcinogenic to humans; 2B-The chemical is possibly carcinogenic to humans.

NTP: K-The chemical is known to be carcinogenic; P-The chemical may reasonably be anticipated to be carcinogenic.

OSHA: Z-The chemical appears at 29 CFR part 1910 Subpart Z.

*Certain compounds.

**IARC classification was recently downgraded and the chemical no longer meets the OSHA carcinogen criteria (effective for the 2000 reporting year).

***NTP classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

****Chlorophenoxy herbicides (IARC 2B).

*****IARC classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

Table C-1 Basis of OSHA Carcinogen Listing for Individual Chemicals (continued)

Chemical	IARC	NTP	OSHA-Z	Chemical	IARC	NTP	OSHA-Z
Nitrobenzene	2B	-	-	7,12-Dimethylbenz(a)anthracene	2B	-	-
4-Nitrobiphenyl	-	-	Z	Indeno[1,2,3-cd]pyrene	2B	P	-
Nitrofen	2B	P	-	5-Methylchrysene	2B	P	-
Nitrogen mustard	2A	-	-	1-Nitropyrene	2B	P	-
2-Nitropropane	2B	P	-	Potassium bromate	2B	-	-
N-Nitrosodi-n-butylamine	2B	P	-	Propane sultone	2B	P	-
N-Nitrosodiethylamine	2A	P	-	beta-Propiolactone	2B	P	Z
N-Nitrosodimethylamine	2A	P	Z	Propyleneimine	2B	P	-
N-Nitrosodi-n-propylamine	2B	P	-	Propylene oxide	2B	P	-
N-Nitroso-N-ethylurea	2A	P	-	Saccharin (manufacturing)**	-	-	-
N-Nitroso-N-methylurea	2A	P	-	Safrole	2B	P	-
N-Nitrosomethylvinylamine	2B	P	-	Sodium o-phenylphenoxide	2B	-	-
N-Nitrosomorpholine	2B	P	-	Styrene	2B	-	-
N-Nitrosornicotine	2B	P	-	Styrene oxide	2A	-	-
N-Nitrosopiperidine	2B	P	-	Tetrachloroethylene	2B	P	-
Pentachlorophenol	2B	-	-	Thioacetamide	2B	P	-
Phenytoin	2B	P	-	4,4'-Thiodianiline	2B	-	-
Polychlorinated alkanes (C12, 60% chlorinated)	-	P	-	Thiourea	2B	P	-
Polybrominated biphenyls (PBBs)	2B	P	-	Toluene-2,4-diisocyanate	2B	P	-
Polychlorinated biphenyls (PCBs)	2A	P	-	Toluene-2,6-diisocyanate	2B	P	-
Polycyclic aromatic compounds (PACs):				Toluene diisocyanate (mixed isomers)	2B	P	-
Benz(a)anthracene	2A	P	-	o-Toluidine	2A	P	-
Benzo(b)fluoranthene	2B	P	-	o-Toluidine hydrochloride	-	P	-
Benzo(j)fluoranthene	2B	P	-	Toxaphene	2B	P	-
Benzo(k)fluoranthene	2B	P	-	Trichloroethylene	2A	P	-
Benzo(rst)pentaphene	2B	-	-	2,4,6-Trichlorophenol	2B	P	-
Benzo(a)pyrene	2A	P	-	1,2,3-Trichloropropane	2A	P	-
Dibenz(a,h)acridine	2A	P	-	Tris(2,3-dibromopropyl) phosphate	2A	P	-
Dibenz(a,j)acridine	2B	P	-	Trypan blue	2B	-	-
Dibenzo(a,h)anthracene	2B	P	-	Urethane	2B	P	-
7H-Dibenzo(c,g)carbazole	2B	P	-	Vinyl acetate	2B	-	-
Dibenzo(a,e)pyrene	2B	P	-	Vinyl bromide	2A	-	-
Dibenzo(a,h)pyrene	2B	P	-	Vinyl chloride	1	K	Z
Dibenzo(a,l)pyrene	2B	P	-	2,6-Xylidine	2B	-	-

Note: The list of TRI chemicals meeting the OSHA carcinogen standard and, therefore, reported when in a mixture at a concentration level below the de minimus level of 0.1% has been updated, and this list reflects the update.

IARC: 1-The chemical is carcinogenic to humans; 2A-The chemical is probably carcinogenic to humans; 2B-The chemical is possibly carcinogenic to humans.

NTP: K-The chemical is known to be carcinogenic; P-The chemical may reasonably be anticipated to be carcinogenic.

OSHA: Z-The chemical appears at 29 CFR part 1910 Subpart Z.

*Certain compounds.

**IARC classification was recently downgraded and the chemical no longer meets the OSHA carcinogen criteria (effective for the 2000 reporting year).

***NTP classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

****Chlorophenoxy herbicides (IARC 2B).

*****IARC classification meets OSHA carcinogen criteria (effective for the 2001 reporting year)

Appendix D

OPERATIONAL RISK MANAGEMENT SPILL QUESTIONNAIRE

DATE OF NOTIFICATION:	WHERE:	
TIME:	ROOM:	
CALLER'S NAME & PHONE #:	IS SPILL CONTAINED, DOOR CLOSED, AND PERSONNEL NOTIFIED/PREVENTED FROM ENTERING?	
SECTION 1		
Do you know the chemical? If yes, continue to Section 2, if not go to Section 1 below		IF YES
MAJOR SPILL = YES TO ANY OF THE FOLLOWING 3 QUESTIONS		
Has the spill caused serious injury (including unconsciousness) to personnel or is likely to cause injury (MAKE CALL, THEN GET NAMES OF INJURED)?		Call 9-911 then Call x82222
Uncontained and spreading out of the immediate area endangering other labs?		Call 9-911 then Call x82222
Has the potential to cause a fire?		Call 9-911 then Call x82222
Is this a major Radiation Spill?		Call Radiation Safety Officer @ x88480 then Call x82222
SECTION 2		
If the caller can answer YES to all 4 questions below, it is safe for them to clean up the spill		IF NO TO ANY OF THESE
Do you know what chemical was spilled? (WHAT & QUANTITY)		
Do you have a chemical spill kit?		↑
Do you know the hazards of the spilled chemical? (WHAT)		↑
Can you protect yourself from these hazards?		↑
SECTION 3		
Was there a release to the air/water?		
Do you have MSDS available?		If yes, have them fax it to x54932
Names of those injured or exposed		Call Public Safety X82222
NAME	INJURY/EXPOSURE	

OPERATIONAL RISK MANAGEMENT SPILL QUESTIONNAIRE Cont.

SECTION 4	
WHO IS INVOLVED?	
NAME:	POSITION:
PHONE:	EMAIL:
NAME:	POSITION:
PHONE:	EMAIL:
SECTION 5	
SPILL INFORMATION	IF NO TO ANY OF THESE
TYPE OF SPILL	APPROX AMOUNT:
THERMOMETER/MANOMETER	OTHER
WHERE SPILL OCCURED	
ON SMOOTH SURFACE	POUROUS SURFACE
IN OVEN INCUBATOR, HOT WATER BATH, OR ANY OTHER ELEVATED TEMPERATURE SITUATION	

Appendix E

Chemical Compatibility Chart

Below is a chart adapted from the CRC Laboratory Handbook which groups various chemicals into 23 sections with examples and incompatible chemical groups. This chart is by no means complete but it will aid in making decisions about storage. For more complete information please refer to the MSDS for the specific chemical.

Incompatible Chemicals Table

Group	Name	Example	Incompatible Groups
1	Inorganic Acids	Hydrochloric acid Hydrofluoric acid Hydrogen chloride Hydrogen fluoride Nitric acid Sulfuric acid Phosphoric acid	2,3,4,5,6,7,8,10,13,14,16,17,18,19,21,22,23
2	Organic acids	Acetic acid Butyric acid Formic acid Propionic acid	1,3,4,7,14,16,17,18,19,22
3	Caustics	Sodium hydroxide Ammonium hydroxide solution	1,2,6,7,8,13,14,15,16,17,18,20,23
4	Amines and Alkanolamines	Aminoethylethanolamine Aniline Diethanolamine Diethylamine Dimethylamine Ethylenediamine 2-Methyl-5-ethylpyridine Monoethanolamine	1,2,5,7,8,13,14,15,16,17,18,23

		Pyridine Triethanolamine Triethylamine Triethylenetetramine	
5	Halogenated Compounds	Allyl chloride Carbon tetrachloride Chlorobenzene Chloroform Methylene chloride Monochlorodifluoromethane 1,2,4-Trichlorobenzene 1,1,1-Trichloroethane Trichloroethylene Trichlorofluoromethane	1,3,4,11,14,17
6	Alcohols Glycols Glycol Ether	1,4-Butanediol Butanol (iso, n, sec, tert) Diethylene glycol Ethyl alcohol Ethyl butanol Ethylene glycol Furfuryl alcohol Isoamyl alcohol Methyl alcohol Methylamyl alcohol Propylene glycol	1,7,14,16,20,23
7	Aldehydes Acetaldehyde	Acrolein Butyraldehyde Crotonaldehyde Formaldehyde Furfural Paraformaldehyde Propionaldehyde	1,2,3,4,6,8,15,16,17,19,20,23
8	Ketones	Acetone	1,3,4,7,19,20

		Acetophenone Diisobutyl ketone Methyl ethyl ketone	
9	Saturated Hydrocarbons	Butane Cyclohexane Ethane Heptane Paraffins Paraffin wax Pentane Petroleum ether	20
10	Aromatic Hydrocarbons	Benzene Cumene Ethyl benzene Naphtha Naphthalene Toluene Xylene	1,20
11	Olefins	Butylene 1-Decene 1-Dodecene Ethylene Turpentine	1,5,20
12	Petroleum Oils	Gasoline Mineral Oil	20
13	Esters	Amyl acetate Butyl acetates Castor oil Dimethyl sulfite Ethyl acetate	1,3,4,19,20
14	Monomers Polymerizable Esters	Acrylic acid Acrylonitrile Butadiene	1,2,3,4,5,6,15,16,19,20,21,23

		Acrylates	
15	Phenols	Carbolic acid Cresote Cresols Phenol	3,4,7,14,16,19,20
16	Alkylene Oxides	Ethylene oxide Propylene oxid	1,2,3,4,6,7,14,15,17,18,19,23
17	Cyanohydrins	Acetone cyanohydrin Ethylene cyanohydrin	1,2,3,4,5,7,16,19,23
18	Nitriles	Acetonitrile Adiponitrile	1,2,3,4,16,23
19	Ammonia	Ammonium Hydroxide Ammonium Gas	1,2,7,8,13,14,15,16,17,20,23
20	Halogens	Chlorine Fluorine	3,6,7,8,9,10,11,12,13,14,15,19,21,22
21	Ethers	Diethyl Ether THF	1,14,20
22	Phosphorus	Phosphorus, Elemental	1,2,3,20
23	Acid Anhydrides	Acetic anhydride Propionic anhydride	1,3,4,6,7,14,16,17,18,19