Williams College
Chemical Hygiene Plan

2014

CONTENTS

1. Introduction 3
2. Standard Operating Procedures 4
    a. Procurement and distribution of chemicals 4
    b. Safety data sheets (SDS) 4
    c. Storage of chemicals 4
    d. Generally acceptable work practices 5
    e. Labeling 5
    f. Personal protective equipment 6
    g. Housekeeping 6
    h. Spills 7
    i. Emergency procedures 7
    j. Waste identification 7
3. Medical Consultation and Examinations 8
4. Special problems 8
    a. Potentially acutely hazardous procedures 8
    b. Select agents 8
    c. Particularly hazardous substances 8
    d. US EPA P-list 9

Appendix A: Laboratory Hazardous Waste Regulations 10

Appendix B: HHS Select Agents and Toxins 13

Appendix C: US EPA List of Acutely Hazardous Substances (P-list) 15

Appendix E: Chemical Compatibility and Storage Charts 19

Appendix F: Instructions for Cleaning Chemical Spills 21

Appendix G: GHS Pictograms and Hazard Statement Descriptions 23

1. INTRODUCTION

The preparation of a "Chemical Hygiene Plan" (CHP) has been mandated by OSHA as an extension of regulations governing worker protection. The original regulations were best suited to industrial situations, where workers are exposed to large amounts of a small variety of substances. In laboratories, there tends to be a wide variety of substances, and different hazards are involved. Implementation of the CHP is the responsibility of the Chemical Hygiene Officer (CHO), with the advice of the Safety Committee. The CHO for Williams College is Norman Bell, Science Center Coordinator: office Bronfman 026, phone x4829, (413) 662-4048 (home) or (617) 733-5954 (cell).

In the regulations, a "laboratory" is defined as a place where manipulations are carried out on laboratory scale (usually implying quantities manipulable by one person), where multiple procedures and chemicals are involved, and where the procedures are not part of a production process. Further, the range of procedures requires only what might be considered "normal" protective equipment (goggles, gloves, lab coats, fume hoods, fire extinguishers etc.).

These regulations are designed to apply to employees, including work-study students. There is no mechanism specifically covering students working in the lab as part of a research project, where no compensation is involved. Nor does it cover those who enter a lab only briefly, such as employees delivering a message. Williams College has chosen to define "employee" more broadly than OSHA with respect to application of safety procedures as it is only common sense to protect everyone to the maximum extent feasible. All workers, whether paid or not, should receive training in the materials and techniques in use in a given lab, and this CHP should be considered to apply to all people who work in a laboratory setting at Williams College in any capacity.

The CHO will provide annual training to all laboratory workers in general laboratory safety and hazardous waste protocols. Training in specific lab protocols is to be done by the supervisor. The CHO can provide assistance with regulatory information and assistance with waste removal protocols and materials. The CHO will also provide copies of this legislation, copies of EPA substance lists. Notes of training sessions, giving the name of the person(s) trained and the date should be sent to Norman Bell

In general, the standards of compliance are "performance" based; that is, if it can be shown that exposure is minimal, the government does not care how the level got that low. There are some existing health standards (Permissible Exposure Limits) which still apply, and all laboratory supervisors must be aware of certain substances for which eye and/or skin contact is prohibited.

The Chemical Hygiene Plan does not supersede the Hazard Communication Program set up in 1989. The latter is intended to ensure that employees are informed about their rights to know about risks they may encounter. The former is intended to ensure that they are trained how to reduce these risks by appropriate procedures in the laboratory. Copies of both documents must be made available in each lab.

In what follows, general procedures that should be in use campus-wide have been outlined. All laboratories should supplement this information with written lab-specific materials that detail, for example, which substances must be used in a fume hood, and what protective equipment is required for a given activity. Lab supervisors should take care to provide as detailed information as possible relating to specific hazards for specific procedures. Overall, the governing principle under this Chemical Hygiene Plan is that everyone should be alert to unsafe conditions, and should either correct them or alert others.

2. STANDARD OPERATING PROCEDURES

a. Procurement and Distribution of Chemicals

Each department must have clearly defined procedures for the ordering of chemicals. Records of substances ordered must be kept, and MSDS's copied and distributed to the lab supervisor, to the departmental file, and to the central safety office. All procurement and receiving personnel should receive training in interpreting DOT labels, and in handling of hazardous substances.

The method of distributing chemicals from receiving areas to stockrooms, and from stockrooms to laboratories must reflect the potential danger posed by the specific substance. Secondary containment of chemicals should be used to protect against breakage. Acids must be transported in shock-proof buckets; other dangerous substances particularly liquids (flammables, carcinogens) should also be carried in protective containers. Appropriate protective equipment should be worn when transporting hazardous material.

b. Safety Data Sheets

The United States has adopted the Globally Harmonized System (GHS) for safety data sheets. Over the next several years, all MSDS must be converted to the GHS format. The primary differences between the old MSDS and the new SDS are as follows:

- standardization of format
- Standardization of hazard pictograms
- Standardization of hazard statements
- Creation of universal hazard statement codes so that hazards can be evaluated if the language is not understood

Appendix G lists the nine GHS pictograms and the hazard codes and their definitions.

A copy of all safety data sheets (SDS) is stored in the office of the chemical hygiene officer. For SDS of all chemicals located at Williams College, Use the following link to the search engine for our database: https://msdsmanagement.msdsonline.com/company/fab9c599-a5d0-42fd-bb4b-18a6eeebff5b/ This link is also available through the Williams College Safety and Environmental Compliance webpage at http://sec.williams.edu/teaching-research/lab-safety/. A link to this website should be prominently placed on each laboratory computer.

c. Storage of Chemicals

The following general guidelines should be followed for routine chemical storage:

- Flammable materials (flash point < 100ºF/38ºC) should be stored in a flame resistant cabinet when not in use.
- Concentrated acids should be stored in an acid resistant cabinet when not in use
- All corrosives should be stored below eye level.
- Compressed gasses should be secured stably with a chain or strap and the cap must be in place when the cylinder is not in use, even if empty.
- Access to extremely hazardous materials should be restricted to only individuals who have been properly trained in their safe use. This includes, but is not necessarily limited to azides, cyanides, pyrophoric chemicals, shock sensitive materials, poisons, or any chemicals on the US EPA p-list (see appendix C)

- Air reactive and pyrophoric chemicals should be stored in an evacuated chamber or under an inert gas (argon, nitrogen etc.)

Non compatible chemical classes should be stored separately from each other (see appendix E). In particular, the following must be spatially separated:

- Concentrated acids and bases
- Cyanides and all acids
- Water reactive chemicals and all aqueous solutions
- Strong oxidizers and flammable chemicals
- Azides and heavy metals

Any questions regarding the safe storage of chemicals should be addressed to the Chemical Hygiene Officer.

d. Generally acceptable work practices

Every worker must know the safety rules and procedures that apply to the particular laboratory in which they work and the chemicals that they are expected to work with. This should include training in the use of Safety Data Sheets with emphasis on routes of potential exposure and target organs, risks of acute and chronic exposure. Workers should know how to recognize signs of chemical exposure. They should understand specific procedures in the event of an exposure or other emergency. Training should state specifically that when washing with water is appropriate, exposed eyes and/or skin should be washed for at least 15 minutes. Appropriate personal protective equipment must be made available to workers, and its use required. Long hair should be confined and loose clothing should be avoided while in the lab. Wash hands frequently and before leaving the lab.

There must be no eating, drinking or smoking in any laboratory or area where chemicals are stored. Very limited areas may be designated where food is allowed such as desks within labs. In such areas there must be no storage of chemicals and food must never be brought into the general lab. Food wrappers or containers should be disposed of outside of the lab area.

Avoid any contact with mucous membranes (eyes, mouth, etc.) while working with any chemicals. Do not pipet chemicals by mouth, or start a siphon by sucking on the tube.

No one should work alone in the laboratory outside of normal working hours without special arrangement. No one should work alone with chemicals of acute toxicity at any time. If operations must be left unattended, provisions should be made, where possible, for periodic inspection. The effect of potential disruptions such as electricity failure should be known. There should be provisions for containment in case of breakage. There must be signs on the door alerting security personnel to the fact that the equipment is running, and if possible laboratory lights should be left on. If alone in a laboratory, the door should remain unlocked.

All experiments that pose a hazard by virtue of the chemicals involved should be, where possible, tried first with less-hazardous substances, to determine the integrity of the equipment and procedures. Experiments should be appropriately scaled to minimize risk in the event of an accident.

e. Labeling

Proper labeling is critical. All user generated containers of chemicals should be labeled with the following at a minimum:

- Chemical name
- Concentration
- Date
- Users name/initials
- Hazard labels where appropriate

Workers should be familiar with how to read a GHS label including understanding pictograms and hazard statements (see Appendix G for GHS pictograms and hazard statements).

Hazard and warning labels on chemicals and equipment should be in good condition. Use equipment only for its designated purpose.

f. Personal protective equipment

i. **EYES**: Adequate eye protection must be made available to all laboratory workers. The choice of safety glasses, safety goggles or face shields should be made by the supervisor and be appropriate to the risk faced. In general, eye protection should be used for any work involving liquid handling. Full goggles offer better protection than safety glasses. For certain procedures (concentrated acids etc.) goggles or full face shields may be required. Eye protection should be comfortable and fit the wearers face closely with minimal spaces available for chemical infiltration. For hygienic reasons, protective eyewear should not be shared. If contact lenses are worn, safety glasses should also be worn. Additionally, specialty eye protection may be required for other lab hazards involving radiation (UV light, laser light).

   Locations of the nearest eyewash stations and how to operate them should be known to all laboratory workers. Eyewash baths are flushed at least every 6 months as part of regular inspections of laboratory-scale operations.

ii. **SKIN**: Exposure of skin to chemicals should be minimized. Individual labs should establish policies regarding glove use. Such policies should be as detailed as possible. This may be a policy where gloves must be worn for only certain procedures up to a policy where gloves are always worn when in the lab. The use of gloves when handling organic liquids (including alcohols) and hazardous substances is always recommended.

   Closed toe shoes (not sandals), must be worn in labs. Shorts and short dresses/skirts are discouraged in the lab. If such clothing is worn, a lab apron or lab coat should also be used.

   Location of the nearest safety shower and how to operate it should be known to all laboratory workers. Safety showers are tested annually as part of routine inspection of science facilities. If working with chemicals for which safety showers are not appropriate, this information must be specifically noted.

   When traveling in the hallways, only one glove should be worn, leaving an ungloved hand to open doors. If, for safety reasons, two gloves must be worn, a cart should be used to transport material or a second person should be brought to open doors.

iii. **INHALATION**: Fume hoods must be used for manipulations involving any volatile chemical with an 8 hour time weighted average (8-TWA) exposure limit less than 50 ppm. Additionally it is encouraged to use a fume hood when working with chemicals with a low odor threshold. Appendix D lists the 8-TWA and odor thresholds of common laboratory solvents. If unsure of the potential

hazard of a chemical, it should be opened in a fume hood first. Hoods should also be used when handling fine particulate chemicals. Hoods must be tested at least once a year, and labeled as to correct opening levels.

iv. **OTHER**: Fire extinguishers are inspected annually. If unsure of the proper operation of a fire extinguisher, do not attempt to use it. Training in the use of fire extinguishers is available through the office of Safety and Environmental Compliance.

g. Housekeeping

All laboratories must have an information card on the door noting the types of hazards to be found inside, and the name(s) of contacts in case of an emergency. The card must list all hazards present in the lab. Special hazards such as the presence of radioactive material, laser radiation, or biohazards require further signage.

Within the laboratory, chemicals and stored reaction mixtures should be labeled to identify any hazards. Equipment presenting a particular hazard (high voltage, laser light) should be appropriately labeled.

Work areas should be kept tidy while working and should be cleaned completely upon completion of work.

Do not block access to exits, emergency equipment, or equipment controls.

Keep equipment properly maintained. Safety equipment, such as guards, must always be used and should be inspected before any equipment is used.

h. Spills

All chemical spills must be cleaned up immediately. For general spill cleanup procedures please see Appendix F. All hazardous material cleaned up must be collected in an appropriate container, labeled as hazardous waste (see Appendix A) and moved to the main accumulation area within 3 days. Non-hazardous waste can be deposited in the trash. Any questions regarding chemical waste should be directed to the Chemical Hygiene Officer. Any cleaning material used to clean up hazardous material (gloves, paper towels, etc.) must also be collected as hazardous waste.

i. Emergency procedures

Every laboratory must post on the door the name and phone number of the person to be contacted in an emergency. In addition, emergency telephone numbers (fire, Security, medical help) must be posted prominently in each lab. Every lab should have a system for internal reporting of accidents, to prevent re-occurrence, even where such an accident does not result in injury. In the event of an accident causing injury, an accident report must be filed. Copies of accident reports should be sent to the Chemical Hygiene Officer, Human Resources and the Department of Health and Environmental Safety.

Each laboratory must have a plan for emergency evacuation. Evacuation routes must be posted near the exit and all exits must be kept clear. Workers should be made aware of Evacuation routes.

j. Waste Identification

Every laboratory worker should be aware of the waste characteristics of materials in use. All waste material deemed to be hazardous must be handled according to procedures laid out in Appendix A of this document. The following criteria apply for various categories:

i. Substances that are water soluble, have a pH between 5 and 9, and are neither toxic nor malodorous, may be disposed of down the drain. When in doubt, assume it is hazardous or consult the Chemical Hygiene Officer.

ii. Solid chemical wastes that are toxic, reactive or insoluble in water should be stored in containers with an approved waste label in the satellite accumulation area.

iii. Liquid chemical wastes not suitable for disposal down the sink should be collected in containers with an approved waste label and stored in the satellite accumulation area. **Halogenated and non-halogenated solvents should be segregated whenever possible**.

iv. **Great care should be taken to segregate non-compatible wastes**. See Appendix E for a more complete discussion of chemical compatibility.

v. When full, transfer waste containers to the main accumulation area within 3 days. Empty bottles can also be brought to the main accumulation area or they can be washed, de-labeled and recycled. **Non-labeled containers will not be accepted for disposal.**

3. MEDICAL CONSULTATION AND EXAMINATIONS

Williams College will provide medical attention and follow-up examinations to any worker who develops symptoms of overexposure, or who may have been exposed to a hazardous substance in excess of the Permissible Exposure Limit (PEL) either in the laboratory or as a result of a spill or leak in another campus location. In an emergency, workers should seek immediate assistance by calling 911 or (9-911 from a campus phone). Campus security (4444) should also be contacted after arrangements for medical care have been made. Any medical services will be performed without cost to the worker including lost pay. The College will provide medical professionals with information relating to the identity and extent of exposure. The physician will provide the College and the worker with the results of any examination and tests, and any recommendations for any follow-up treatment.

4. SPECIAL PROBLEMS

For most laboratories at Williams College, the preceding sections provide all necessary information for compliance with the OSHA Laboratory Standard. Labs affected by one or more of the following restrictions will need to supplement this Chemical Hygiene Plan with a detailed protocol enabling them to comply with the appropriate practices.

a. Potentially acutely hazardous procedures

Because of the potential dangers posed to the college community as a whole, certain procedures may require prior permission of the Safety Committee (analogous to the current situation with users of radioisotopes). No specific procedures have been designated by the legislation; rather, it is up to the College to decide what appropriate concerns are. The preamble to the legislation, which indicates the thinking of the regulators, lists two situations as possible examples: "...operations involving highly toxic non-carcinogenic material or highly volatile toxic material..." As the College responds to these and other suggestions, the Chemical Hygiene Plan will be revised accordingly. At present two such hazardous procedures have been identified on campus. Any experimentation involving the use of human blood or other potentially infectious material (as defined by the OSHA Bloodborne Pathogens Standard) must have approval from the Safety Committee before work can be done.

b. Select agents

The federal government requires registration of certain 'select agents', as defined in the Public Health Security and Bioterrorism Preparedness and Responses Act of 2002 (list in Appendix B). At this time, all select agents have been removed from the Williams College facilities. To enable Williams College to comply with this regulation, all researchers using any of these substances must inform this committee before bringing such material on campus.

c. Particularly hazardous substances

There are three classes of "Particularly hazardous substances". In all cases, work with such a substance must be confined to a designated area (this can be a particular bench, or hood, within a lab; it need not be physically restricted from other work areas), and use of containment devices must be specified. The procedures for waste removal and decontamination must also be specified in the supplemental material to this document, and are subject to review.

The first class is "Select Carcinogens". These are substances a) regulated by OSHA as a carcinogen; b) classified by NTP (National Toxicology Program) as "known to be a carcinogen", or "reasonably anticipated to be carcinogen"; or c) classified as IARC Group 1 ("carcinogenic to humans") or Group 2A ("limited human evidence") or 2B ("sufficient animal evidence; inadequate human data"), provided that the classification under a), b) or c) (for groups 2A and 2B) is based on one or more of the following conditions: inhalation exposure 6-7 hours/day, 5 days/week, for a significant portion of lifetime at doses less than 10 mg/m^3; repeated skin application of less than 300 mg/kg body weight/day; and/or oral doses of less than 50 mg/kg body weight/day. In other words, the intent is to identify substances which are likely to be carcinogens under conditions of long-term working usage. Ethyl alcohol, for example, is considered a carcinogen, but the level of potency is below the specified conditions. Information as to whether a particular substance meets one or more of these criteria is generally found on the MSDS, although by no means all of the substances noted as "Carcinogen" on the MSDS are "Select Carcinogens". Copies of the IARC list are available from Norm Bell or at *http://monographs.iarc.fr/ENG/Classification/ClassificationsAlphaOrder.pdf*.

The second class is "Reproductive Toxins". These are substances which affect reproductive capabilities, including genetic mutation and teratogenesis (i.e. damage to the developing fetus).

The third class is substances of "high acute toxicity". No definition of this class as a whole is given, but some examples, from which an idea of the criteria can be gained, are hydrogen cyanide, hydrogen sulfide and nitrogen dioxide. A suggested compilation is the DOT Class A Poison list, found in 49CFR172.101.

d. US EPA p-list

The US Environmental Protection Agency has compiled a list of particularly hazardous substances which can be found in Appendix C. This “P-list” originally included chemicals considered to be pesticides (thus “P” list), although the scope is now beyond simply that. Additionally the U-list (“unused”) contains a number of other chemicals of concern. Chemicals from these lists are generally more costly to dispose of and we are limited in the amount of items from the P-list that we can dispose of. Please limit the purchase of new material from this list until it is determined that there is insufficient material in stock.

Waste chemicals used in research from the p-list should be labeled as “spent” as only virgin material is counted toward our waste limit.

APPENDIX A

LABORATORY HAZARDOUS WASTE REGULATIONS

Determination of Hazardous Waste:

As mentioned previously, waste is characterized as hazardous if it is toxic, reactive, corrosive (pH>9.5 or <4.5), or flammable. To the extent possible, organic liquid waste should be segregated into halogenated and non-halogenated streams. A waste stream is considered halogenated if it contains >2% halogenated material. Similar waste streams can be combined together **provided all wastes are compatible (see Appendix E)**.

It is encouraged to add processes to lab protocols that reduce the quantity or hazardous quality of the waste stream. Once a material is classified as waste, our license does not allow us to alter it as this constitutes "waste treatment".

Satellite Accumulation Areas (SAA):

Each lab that handles chemicals is equipped with a SAA where hazardous waste is collected and temporarily stored. The SAA is the area most commonly inspected by regulatory agencies. Care should be taken to properly maintain the SAA. The following list includes guidelines for maintaining a lab SAA.

1. The SAA should be located in a clearly defined area in the lab, often in a portion of a fume hood or nearby cabinet. The SAA must be marked with signage and, if it is a portion of a larger space, must be clearly separated from non-SAA areas by tape, or similar demarcation. It is recommended that satellite accumulation areas be located outside of fume hoods if the properties of the waste warrant it.
2. All waste must be clearly labeled with the approved Hazardous Waste label Pictured in Figure 1. The label must be filled out with appropriate hazard box(es) checked, contact information, and the full name of each chemical in the container – **no abbreviations or chemical formulas are allowed**. A list may be appended to the container if there is insufficient space on the label. The container should only be dated when full. If additional labels are needed, contact the Chemical Hygiene Officer.
3. Waste labels should always face forward so that they can be read without handling the waste bottle.
4. Waste labels must be maintained in good readable condition. Labels should be refreshed if the writing becomes smeared.
5. Only one waste stream of a type may be present in the SAA. If a separate container is desired for remote collection of waste, it should be labeled as "spent solvent" or similar. It must not be labeled as "hazardous waste". The contents of such containers should be transferred to the appropriate waste container in the SAA at the end of each working day or after the experiment is finished.
6. Liquid waste should be placed within secondary containment large enough to contain the entire contents of the waste bottles in the event of breakage.
7. All hazardous waste must be contained within the SAA. Non-waste (virgin) material cannot be located within the SAA. Experiments should not be performed within the SAA.
8. Waste containers must be kept closed except when adding waste.
9. Users should use containers which are suitably sized such that they are filled in a reasonable amount of time. When a container is 90% full it should be dated and brought to the Waste Processing Room on the Morley Loading Dock (MSL G30A) within 3 days. Waste containers should not be allowed to become completely full to minimize risk of spill or overflow.
10. Any hazardous waste material that is collected as part of a spill cleanup should be properly contained and brought to MSL-G30A immediately. Do not store materials from a cleanup in the SAA.
11. Once per week, the SAA should be inspected to ensure compliance with the above rules.

Waste Processing Room:

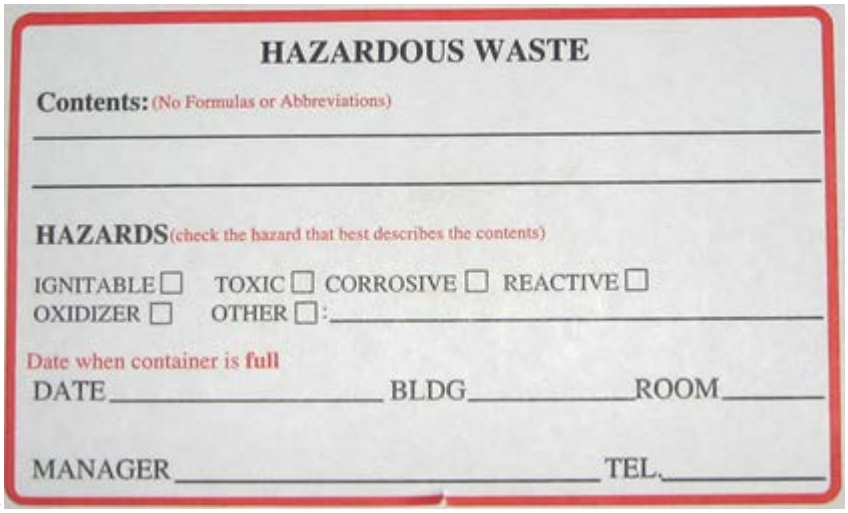
1. The Waste Processing Room is located in MSL-G30A on the Morley Science Labs loading dock.
2. Generators of waste are responsible for bringing their own waste bottles down to the processing room when they are full.
3. A logbook is provided to list all materials that are brought to MSL-G30A. People should record the date and the amount, quantity and type of material being dropped off.
4. All small waste containers (less than 5 gallons) should be left in the secondary containment bins on the bench to the left of the door as you enter. Containers larger than 5 gallons may be left on the floor in front of the bench. Please do not block the door. Do not leave waste containers on the right hand bench.
5. Do not attempt to add waste to the bulk non-halogenated drum located in the hood. Proper procedures must be followed to add to bulk waste.
6. Do not leave any waste in the Waste Storage Room (MSL-G30B) unless you are specifically authorized to do so.
7. Empty waste bottles are available in a variety of sizes. Take what you need. Waste labels are located in the top drawer next to the sink. A roll of labels is quite expensive; please take only the labels that you will use a reasonable amount of time.
8. Additional materials are available for cleanup and waste collection. Contact the Chemical Hygiene Officer for specific requests.
12. The College's waste is picked up twice yearly (typically, March and October). All waste, including outdated chemicals, should be brought to MSL-G30A prior to pick up. The CHO will send an e-mail announcement to this effect.
13. 

Figure 1. Williams College hazardous waste label

Notes regarding our generator status

Williams College is classified as a Small Quantity Generator (SQG). Having SQG status is very important for the following reasons:

- Waste is allowed to be accumulated in SAA indefinitely rather than a 3 month limit
- Waste is picked up semi-annually instead of quarterly
- We are subject to a lower level of scrutiny by regulatory agencies
- We are not required to have detailed contingency plans
- Moving to Large Quantity Generator status (LQG) would require additional staffing needs and significant additional expense.

In order to maintain our SQG status, we must meet certain criteria:

- We may accumulate up to 1000Kg of waste per month with never more than 6000Kg of waste on site at one time
- We may accumulate up to 1Kg of acutely hazardous waste per month with never more than 2kg of acutely hazardous waste at one time (see Appendix C)
- Must have a person to respond to emergency situations (the Chemical Hygiene Officer)

Your help in minimizing waste production is appreciated.

APPENDIX B

HHS SELECT AGENTS AND TOXINS

The following is the Health and Human Services list of select agents. At the time of this CHP revision Williams College possesses none of these agents. If any of these agents are discovered notify the chemical hygiene officer immediately. In general, Williams College lacks the facilities to properly protect against exposure to these agents and their use in research is strongly discouraged. Use of any of these agents requires special permission by the Centers for Disease Control and Prevention.

Viruses

Crimean-Congo Haemorrhagic fever virus
Ebola viruses
Cercopithecine herpesvirus 1 (Herpes B virus)
Lassa fever virus
Lujo virus
Marburg virus
Monkeypox virus
South American Haemorrhagic fever viruses (Junin, Machupo, Sabia, Chapare, Guanarito)
Tick-borne encephalitis comples (flavi) viruses
Variola major virus (smallpox virus) and variola minor virus (Alastrim)
Eastern Equine Encephalitis virus
Nipah and Hendra Complex viruses
Rift Valley fever virus
Venezuelan Equine Encephalitis virus
Reconstructed 1918 Influenza virus
SARS-associated Conavirus (SARS-CoV)

Bacteria

Rickettsia prowazekii
Rickettsia rickettsii
Yersinia pestis
Bacillus anthracis
Brucella abortus
Brucella melitensis
Brucella suis
Burkholderia mallei (formerly *Pseudomonas mallei*)
Burkholderia Pseudomallei (formerly *Pseudomonas Pseudomallei*)
Botulinum neurotoxin producing species of *Clostridium*
Coxiella burnetii
Francisella tularensis

Fungi

Coccidioides posadasii
Coccidioides immitis

Toxins

Abrin
Conotoxins
Diacetoxyscirpenol
Ricin
Saxitoxin
Tetrodotoxin
Shigatoxin and Shiga-like ribosome inactivating proteins
Botulinum neurotoxins
Clostridium perfringens epsilon toxin
Staphyloccoccal enterotoxins A, B, C, D, E subtypes
T-2 toxin

Genetic Elements, Recombinant Nucleic Acids and Recombinant Organisms derived, naturally or synthetically, from select agents.

Additional USDA select agents and toxins can be found at *www.selectagents.gov*

Appendix C

US EPA List of Acutely Hazardous Substances (P-list)

Summary: The p-list (pesticide) and the u-list (unused) contain chemicals of particular concern to the US EPA due to their toxic nature and potential to cause environmental harm. Our status as a SQG entitles us to accumulate up to a total of 1Kg per month of chemicals from the p-list per month. Accumulating greater than these amounts threatens our small quantity generator status. In addition, the chemicals on these lists are particularly expensive to dispose of. Disposing of these chemicals is only a concern if they are unused. Chemicals used during lab procedures may be labeled as "spent" which allows it to be disposed of as normal hazardous waste.

It is highly recommended that users of these chemicals take steps to minimize use and disposal, and minimize ordering of new material unless it is determined that there is insufficient material available already on site.

Examine the p-list (arranged alphabetically) to determine if there are any chemicals that are used by your lab. The complete p- and u-lists can be found at http://www.epa.gov/osw/hazard/wastetypes/listed.htm.

Code	CAS #	Name
P057	640-19-7	Acetamide, 2-fluoro-
P002	591-08-2	1-Acetyl-2-thiourea
P070	116-06-3	Aldicarb
P203	1646-88-4	Aldicarb sulfone.
P004	309-00-2	Aldrin
P005	107-18-6	Allyl alcohol
P006	20859-73-8	Aluminum phosphide (R,T)
P007	2763-96-4	5-(Aminomethyl)-3-isoxazolol
P008	504-24-5	4-Aminopyridine
P009	131-74-8	Ammonium picrate (R)
P119	7803-55-6	Ammonium vanadate
P010	7778-39-4	Arsenic acid H3AsO4
P011	1303-28-2	Arsenic oxide As2O5
P012	1327-53-3	Arsenic trioxide
P013	542-62-1	Barium cyanide
P014	108-98-5	Benzenethiol
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine
P021	592-01-8	Calcium cyanide
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P029	544-92-3	Copper cyanide
P202	64-00-6	m-Cumenyl methylcarbamate.

P030		Cyanides (soluble cyanide salts), not otherwise specified
P031	460-19-5	Cyanogen
P033	506-77-4	Cyanogen chloride
P034	131-89-5	2-Cyclohexyl-4,6-dinitrophenol
P016	542-88-1	Dichloromethyl ether
P036	696-28-6	Dichlorophenylarsine
P037	60-57-1	Dieldrin
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan.
P047	534-52-1	4,6-Dinitro-o-cresol, & salts
P048	51-28-5	2,4-Dinitrophenol
P020	88-85-7	Dinoseb
P085	152-16-9	Diphosphoramide, octamethyl-
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethane dinitrile
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate.
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P063	74-90-8	Hydrogen cyanide
P096	7803-51-2	Hydrogen phosphide
P060	465-73-6	Isodrin
P192	119-38-0	Isolan.
P202	64-00-6	3-Isopropylphenyl N-methylcarbamate.
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P112	509-14-8	Methane, tetranitro- (R)

P118	75-70-7	Methanethiol, trichloro-
P199	2032-65-7	Methiocarb.
P066	16752-77-5	Methomyl
P068	60-34-4	Methyl hydrazine
P064	624-83-9	Methyl isocyanate
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P190	1129-41-5	Metolcarb.
P128	315-18-4	Mexacarbate.
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P074	557-19-7	Nickel cyanide
P075	54-11-5	Nicotine, & salts
P076	10102-43-9	Nitric oxide
P077	100-01-6	p-Nitroaniline
P078	10102-44-0	Nitrogen dioxide
P076	10102-43-9	Nitrogen oxide NO
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N- Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphor amide
P087	20816-12-0	Osmium tetroxide
P194	23135-22-0	Oxamyl.
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P047	534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P092	62-38-4	Phenylmercury acetate
P093	103-85-5	Phenylthiourea
P094	298-02-2	Phorate
P095	75-44-5	Phosgene
P096	7803-51-2	Phosphine
P041	311-45-5	Phosphoric acid, diethyl 4-nitrophenyl ester
P044	60-51-5	Phosphorodithioic acid, O,O-dimethyl S-[2-(methylamino)- 2-oxoethyl] ester
P043	55-91-4	Phosphorofluoridic acid, bis(1-methylethyl) ester
P040	297-97-2	Phosphorothioic acid, O,O-diethyl O-pyrazinyl ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P098	151-50-8	Potassium cyanide
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-

P102	107-19-7	Propargyl alcohol
P003	107-02-8	2-Propenal
P005	107-18-6	2-Propen-1-ol
P067	75-55-8	1,2-Propylenimine
P102	107-19-7	2-Propyn-1-ol
P008	504-24-5	4-Pyridinamine
P114	12039-52-0	Selenious acid, dithallium(1+) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P108	57-24-9	Strychnine, & salts
P115	7446-18-6	Sulfuric acid, dithallium(1+) salt
P109	3689-24-5	Tetraethyldithiopyrophosphate
P110	78-00-2	Tetraethyl lead
P111	107-49-3	Tetraethyl pyrophosphate
P112	509-14-8	Tetranitromethane (R)
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallium oxide Tl2O3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P045	39196-18-4	Thiofanox
P014	108-98-5	Thiophenol
P026	5344-82-1	Thiourea, (2-chlorophenyl)-
P072	86-88-4	Thiourea, 1-naphthalenyl-
P093	103-85-5	Thiourea, phenyl-
P185	26419-73-8	Tirpate.
P123	8001-35-2	Toxaphene
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-
P001	81-81-2	Warfarin, & salts, when present at concentrations greater than 0.3%
P121	557-21-1	Zinc cyanide
P122	1314-84-7	Zinc phosphide Z[3]P[2], when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram.

Appendix D

Permissible Exposure Limits for Common Solvents

These are the permissible exposure limits (PEL) and odor thresholds for common solvents found in the science center. Note that these two factors are largely unrelated to each other. Solvents with strong odor components are not necessarily toxic and toxic chemicals do not necessarily have a strong odor.

Chemicals with a PEL below 50 and/or with a very low odor threshold should be used in a fume hood.

Chemical Name	PEL (8-TWA)	Odor threshold (ppm)
acetone	250	13
acetonitrile	40	70
benzene	1	4.6
n-butyl alcohol	100	0.8
chloroform	50	3.3
dimethyl formamide	10	0.5
ethanol	1000	10
ethyl acetate	400	0.006 - 0.6
ethyl ether	400	1
hexane	500	65-250
isopropanol	400	90
methanol	200	2000
methylene chloride	25	205-307
pentane	1000	2.2
phenol	5	0.1
toluene	200	2
xylene	100	5e-5

Appendix E

Chemical Storage

Stanford University Compatible Storage Group Classification System
Should be used in conjunction with specific storage conditions taken from the manufacturer's label and MSDS.

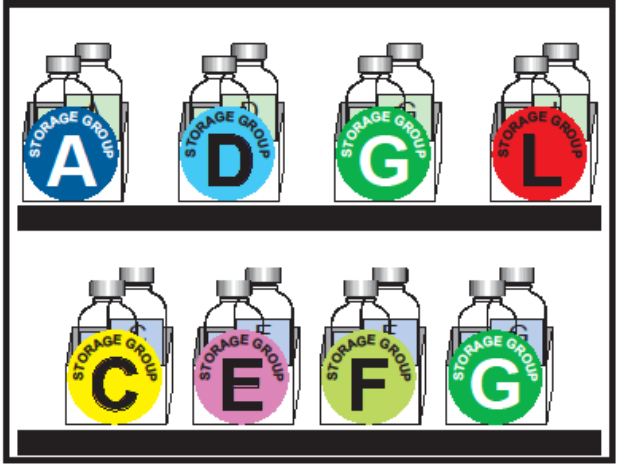
STORAGE GROUPS

Store chemicals in separate secondary containment and cabinets
Find Storage Group Information in Chemtracker:
https://chemtracker.stanford.edu/chemsafety

A	Compatible Organic Bases
B	Compatible Pyrophoric & Water Reactive Materials
C	Compatible Inorganic Bases
D	Compatible Organic Acids
E	Compatible Oxidizers including Peroxides
F	Compatible Inorganic Acids not including Oxidizers or Combustible
G	Not Intrinsically Reactive or Flammable or Combustible
J*	Poison Compressed Gases
K*	Compatible Explosive or other highly Unstable Material
L	Non-Reactive Flammable and Combustible, including solvents
X*	Incompatible with ALL other storage groups

***Storage Groups J, K and X: Contact EH&S @ 3-0448**
For specific storage - consult manufacturer's MSDS

If space does not allow Storage Groups to be kept in separate cabinets the following scheme can be used with extra care taken to provide stable, uncrowded, and carefully monitored conditions.



Storage Group X must be segregated from all other chemicals.

Storage Group B is not compatible with any other storage group.

Last updated 04/17/09

Appendix E:
EPA's Chemical Compatibility Chart

EPA-600/2-80-076 April 1980

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

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
1	acids mineral, non-oxidizing																																								
2	acids, mineral, oxidizing																																								
3	acids, organic		G,H																																					
4	alcohols and glycols	H	H,F	H,P																																				
5	aldehydes	H,P	H,F	H,P																																				
6	amides	H	H,GT																																					
7	amines, aliphatic and aromatic	H	H,GT	H		H																																		
8	azo compounds, diazo compounds, hydrazines	H,G	H,GT	H,G	H,G	H																																		
9	carbamates	H,G	H,GT						G,H																															
10	caustics	H	H	H		H				H,G																														
11	cyanides	GT,GF	GT,GF	GT,GF					G																															
12	dithiocarbamates	H,F,GF	H,F,GF	H,GT,GF		GF,GT		U	G,H																															
13	esters	H	H,F						G,H		H																													
14	ethers	H	H,F																																					
15	fluorides, inorganic	GT,GF	GT	GT,GF																																				
16	hydrocarbons, aromatic		H,F																																					
17	halogenated organics	H,GT	H,F,GT					H,GT	G,H		H,GF	H																													
18	isocyanates	H,G	H,F,GT	H,G	H,P			H,P	G,H		H,P,G	H,G	U																												
19	ketones	H	H,F						G,H		H	H																													
20	mercaptans, other organic sulfates	GT,GF	H,F,GT						G,H																															
21	metals, alkali and alkaline earth	H,F,GF	H,F,GF	H,F,GF	H,F,GF	H,F,GF	GF,H	GF,H	GF,H	G,F,H	H,GF	H,GF	H,GF,GT	H,GF							H	H	H	H,E	H,GF	H,GF	H,GF													
22	metals and alloys as powder, vapor or sponge	H,F,GF	H,F,GF	G,F					H,F,GT	U	H,GF												H,F,GF	H,E	H,GF															
23	metals and alloys as sheets, rods drops etc	H,F,GF	H,F,GF						H,F,G															H,F															
24	metals and metal compounds, toxic	S	S	S			S	S			S																													
25	nitrides	GF,HF	H,F,E	H,GF	H,E,GF	GF,H			U	H,G	U	H,GF	H,GF	H,GF						H,GF	U	H,GF	H,GF	E															
26	nitriles	H,GT,GF	H,F,GT	H							U													H,P			S	H,GF												
27	nitro compounds, organic		H,F,GT			H					H,E													H,E,GF				H,E,GF											
28	hydrocarbons, aliphatic, unsaturated	H	H,F			H																			H,E														
29	hydrocarbons, aliphatic, saturated		H,F																																				
30	peroxides and hydroperoxides organic	H,G	H,E		H,F	H,G		H,GT	H,F,E	H,F,GT		H,E,GT	H,F,GT							H,E	H	E	H,F,GT	H,E	H,G		H,G	H,E,GF	H,P,GT		H,P									
31	phenols and cresols	H	H,F						G,H												H,P			H,GF				H,GF											
32	organophosphates, phosphothioates, phosphodithioates	H,GT	H,GT						U		H,E													H															
33	sulfides, inorganic	GT,GF	H,F,GF	GT,GF		H			E												H																		
34	epoxides	H,P	H,P	H,P	H,P	U		H,P	H,P		H,P	H,P	U										H,P	H,P	H,P		H,P	H,P					H,P	H,P	U	H,P				
35	combustible and flammable material, misc.	H,G	H,F,GT																					H,F,G				H,F,GF					H,F,GT						
36	explosives	H,E	H,E	H,E					H,E		H,E			H,E										H,E	H,E	H,E	E	E					H,E	H,E		H,E	H,E	H,E		
37	polymerizable compounds	P,H	P,H	P,H					H,P		H,P	H,P	U											H,P	H,P	H,P	H,P	H,P					H,P	H,P		H,P			H,E	
38	oxidizing agents strong	H,GT		H,GT,GF	H,F	H,F	H,F,GT	H,F,GT	H,E	H,F,GT		H,E,GT	H,F,GT	H,F	H,F		H,F	H,GT	H,F,GT	H,F	H,F,GT	H,F,E	H,F,E	H,F		H,F,E	H,F,GT	H,E	H,F	H,F	H,G	H,F	H,F,GT	H,F,GT	H,F,G	H,F,G	H,E	H,F,GT	
39	reducing agents strong	H,GF	H,F,GT	H,GF	H,F,GF	H,F,GF	H,GF	H,G				H,GT	H,F				H,F,E	H,E	H,GF	H,GF	H,GF					H,GF	H,E			H,E	H,GF	H,GF,GT		H	H,GF	H,E	H,P,GF	H,F,E		
40	water and mixtures containing water	H	H						G			H,G							H,G				H,GF	H,GF		S	H,GF						GF,GT					GF,GT	
41	water reactive substances	EXTREMELY REACTIVE! DO NOT MIX WITH ANY CHEMICAL OR WASTE MATERIAL!																																					

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

Instructions: This chart is intended to provide general guidelines about the compatibility of chemicals in a WASTE STREAM. To read, identify the first chemical from the left hand column (ordered alphabetically), follow the row across to the right end (number) and then down to the row corresponding to the second chemical. The box contains a code corresponding to the potential consequence of mixing the two chemicals.

Example: to evaluate the compatibility of ketones and nitrides, find ketones on row 19, follow it to the end and down to nitrides on row 25 which indicates a possible risk of heat and flammable gas formation (H, GF).

Appendix F

Instructions for cleaning chemical spills:
PLEASE READ

1. **If there is an inhalation risk resulting from the spill leave the area and call for help.**
2. If you are unsure of how to safely and properly handle the cleanup, or if the spill is larger than 0.5 liter, seek assistance from the Chemical Safety Officer and/or your supervisor.
3. **ALWAYS** wear personal protective equipment when cleaning a spill (nitrile gloves and goggles at a minimum).
4. If there is a large amount of liquid, use the supplied socks as dams to prevent the spread of the spill.
5. The supplied absorbent pads will each hold approximately 2 liters of liquid. Use these to collect liquid spills.
6. Use your dustpan and brush to collect dry spills.
7. Contain all spilled chemicals in the supplied poly bags. For larger spills use the 2 gallon pail that holds your spill kit.
8. Label all collected material using the supplied hazardous waste labels.
9. Bring all collected material to the central accumulation area located in MSL G30A on the Morley Science loading dock. Do not store spills in your satellite accumulation area.
10. Contact the Chemical Safety Officer to replenish spill kit supplies and report the spill.
11. Use the back of these instructions to make notes on the spill. Include this with the material that you bring to the central accumulation area.

Contents of spill kit:

2 gallon pail with screw top lid
Nitrile gloves (one pair each: medium, large)
Goggles
Absorbent sock
Absorbent pads (3)
Poly bags (5)
Hazardous waste labels (2)
Instructions
Pencil

Details of Spill:

Person who initiated or found the spill_____

Person who cleaned the spill _____

Location of the spill (please be specific, i.e. back left corner of fume hood etc. draw a map in the notes section below if necessary)_____

_____

Date and time of the spill_____

Amount of material spilled_____

Identity of spilled chemical (if known)_____

Was the spill cleaned completely? Y N

Were there any injuries as a result of this incident? Y N

What was the nature of the injuries (if any)? _____

_____

_____

Notes:

Appendix G
GHS Information

Physical hazards pictograms

Explosive

Flammable

Oxidizing

Compressed Gas

Corrosive

Toxic

Irritant

Carcinogen

Environmentally Damaging

GHS Hazard Statements

Physical hazards

- H200: Unstable explosive
- H201: Explosive; mass explosion hazard
- H202: Explosive; severe projection hazard
- H203: Explosive; fire, blast or projection hazard
- H204: Fire or projection hazard
- H205: May mass explode in fire
- H220: Extremely flammable gas

- H221: Flammable gas
- H222: Extremely flammable aerosol
- H223: Flammable aerosol
- H224: Extremely flammable liquid and vapour
- H225: Highly flammable liquid and vapour
- H226: Flammable liquid and vapour
- H227: Combustible liquid
- H228: Flammable solid
- H229: Pressurized container: may burst if heated
- H230: May react explosively even in the absence of air
- H231: May react explosively even in the absence of air at elevated pressure and/or temperature
- H240: Heating may cause an explosion
- H241: Heating may cause a fire or explosion
- H242: Heating may cause a fire
- H250: Catches fire spontaneously if exposed to air
- H251: Self-heating; may catch fire
- H252: Self-heating in large quantities; may catch fire
- H260: In contact with water releases flammable gases which may ignite spontaneously
- H261: In contact with water releases flammable gas
- H270: May cause or intensify fire; oxidizer
- H271: May cause fire or explosion; strong oxidizer
- H272: May intensify fire; oxidizer
- H280: Contains gas under pressure; may explode if heated
- H281: Contains refrigerated gas; may cause cryogenic burns or injury
- H290: May be corrosive to metals

Health hazards

- H300: Fatal if swallowed
- H301: Toxic if swallowed
- H302: Harmful if swallowed
- H303: May be harmful if swallowed
- H304: May be fatal if swallowed and enters airways
- H305: May be harmful if swallowed and enters airways
- H310: Fatal in contact with skin
- H311: Toxic in contact with skin
- H312: Harmful in contact with skin
- H313: May be harmful in contact with skin
- H314: Causes severe skin burns and eye damage
- H315: Causes skin irritation
- H316: Causes mild skin irritation
- H317: May cause an allergic skin reaction
- H318: Causes serious eye damage
- H319: Causes serious eye irritation
- H320: Causes eye irritation
- H330: Fatal if inhaled
- H331: Toxic if inhaled

- H332: Harmful if inhaled
- H333: May be harmful if inhaled
- H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled
- H335: May cause respiratory irritation
- H336: May cause drowsiness or dizziness
- H340: May cause genetic defects
- H341: Suspected of causing genetic defects
- H350: May cause cancer
- H351: Suspected of causing cancer
- H360: May damage fertility or the unborn child
- H361: Suspected of damaging fertility or the unborn child
- H361d: Suspected of damaging the unborn child
- H362: May cause harm to breast-fed children
- H370: Causes damage to organs
- H371: May cause damage to organs
- H372: Causes damage to organs through prolonged or repeated exposure
- H373: May cause damage to organs through prolonged or repeated exposure

Environmental hazards

- H400: Very toxic to aquatic life
- H401: Toxic to aquatic life
- H402: Harmful to aquatic life
- H410: Very toxic to aquatic life with long lasting effects
- H411: Toxic to aquatic life with long lasting effects
- H412: Harmful to aquatic life with long lasting effects
- H413: May cause long lasting harmful effects to aquatic life
- H420: Harms public health and the environment by destroying ozone in the upper atmosphere