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CHEMICAL HYGIENE PLAN

INTRODUCTION

This Safety Manual is intended to be a reference document for laboratory workers and students at The George Washington University. The manual constitutes the University's "Chemical Hygiene Plan" required by the Occupational Safety and Health Administration's "Occupational Exposures to Hazardous Chemicals in Laboratories" CFR 1910.1450.

Each laboratory which uses hazardous materials is required to have a copy of this manual readily available to employees and students in the laboratory. It is important that each laboratory worker be familiar with the contents of this manual and procedures for obtaining additional safety information.

Suggestions and/or comments for improving this manual are welcome and encouraged. Comments can be sent to the Safety Office, Room 205 in Woodhull House or call (202) 994-6947.

The Chemical Hygiene Policy is hereby approved.

Louis H. Katz
Vice President and Treasurer

7/15/92
Date

John A. Schauss
Associate Vice President for Finance

7/15/92
Date

1.0 Purpose

This policy is to serve as a standard for all full and part-time George Washington University employees who handle, store, or use hazardous chemical/biological agents in the laboratory and to inform them of their responsibility, as well as the University's responsibility to comply with the OSHA 29 CFR 1910.1450 Laboratory Standard.

2.0 SCOPE

The scope of this policy pertains to all employees engaged in the laboratory use of hazardous chemicals (definitions are provided in Section 5.5).

This policy does not apply to:

2.1 George Washington University students. Laboratory safety training and information for students enrolled in the science curriculum will be administered by individual academic departments with the assistance of the Office of Risk Management.

2.2 Laboratory procedures using chemically impregnated test media such as Dip-and Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip.

2.3 Commercially prepared kits such as those used in performing pregnancy test in which all of the reagents needed to conduct the tests are contained in the kit.

3.0 OVERVIEW OF THE OSHA LABORATORY STANDARD

Approximately twenty-five million workers, about one in four of the nation's work force are exposed to one or more chemical hazards. There are an estimated 580,000 existing chemical products and hundreds introduced annually.

Because of the seriousness of the potential safety and health problems arising from chemical exposure and lack of information available to employees and employers, the Occupational Safety and Health Administration (OSHA) issued a standard in November of 1985 entitled **Hazard Communication**. The goal of the standard was to reduce the incidence of chemical source illnesses and injuries in the manufacturing industries.

OSHA has gone a step further to protect employees who work exclusively in laboratory with the indoctrination of the **Laboratory Standard**. The Laboratory Standard requires that all employers protect workers from intermittent exposure to a broad range of chemicals encountered by workers in laboratories. OSHA determined "that laboratories typically differ from industrial

operations in their use and handling of hazardous chemicals and that a different approach than that found in OSHA's substance specific health standards in warranted to protect (laboratory) worker's". The standard applies to all laboratories that use hazardous chemicals including those found within the University System.

4.0 GOALS/OBJECTIVES

The goals of this policy are listed below:

4.1 Ensure the safety and health of all employees engaging in the use of laboratory chemicals.

4.2 Assure compliance with the OSHA Laboratory Standard.

5.0 DEFINITIONS

5.1 Chemical Hygiene Officer

An employee who is designated by the employer, and who is qualified by training and experience, to provide technical guidance in the development and implementation of the provisions of the chemical hygiene plan.

5.2 Chemical Hygiene Plan

A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular work place and meets the requirements of paragraph (e) of the 1910.1450 Laboratory Standard.

5.3 Hazardous Chemical

A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principals that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, agents which act on the hematopoitic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

5.4 Permissible Exposure Limit

A legal standard issued by the Occupational Safety and Health Administration which is

based on an average exposure weighted for an 8-hour work day.

5.5 Action Level

A legal standard issued by the Occupational Safety and Health Administration which requires specific protective measures be taken when an air contaminant reaches an established level, usually 1/2 of the PEL.

6.0 IMPLEMENTATION

6.1 It is the intent of the George Washington University to comply with the OSHA Laboratory Standard by establishing this comprehensive written program which includes provisions for; permissible exposure limits, employee information and training, medical examinations, hazard identification, recordkeeping and a chemical hygiene plan.

6.2 Procedures and Responsibilities

(Responsibility for chemical hygiene rests at all levels including:)

6.2.1 Chief Executive Officer, Director of Risk Management, who has the ultimate responsibility for chemical hygiene within the institution and must, with other administrators provide continuing support for institutional and chemical hygiene.

6.2.2 Chemical Hygiene Officer, Safety Manager, Safety Specialists (Dept. of Risk Management) who will:

6.2.2.1 Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices.

6.2.2.2 Monitor use and disposal of chemicals used in research and teaching laboratories.

6.2.2.3 See that appropriate audits are conducted in the laboratories.

6.2.2.4 Know the current legal requirements concerning regulated substances.

6.2.3 Department Head, _____, who is responsible for chemical hygiene in the department.

6.2.4 Laboratory Supervisor, _____, (primary person named on a grant, in charge of a class or research project), who has the overall responsibility to:

6.2.4.1 Ensure that workers know and follow the chemical hygiene rules, that personal protective equipment is available and that appropriate training is provided.

6.2.4.2 Know that current legal requirements concerning OSHA regulated substances.

6.2.4.3 Determine the required levels of protective apparel and equipment.

6.2.4.4 Provide regular, formal chemical hygiene/safety inspections including routine inspections of emergency equipment.

6.2.4.5 Ensure that training for use of any material being ordered is adequate.

6.2.5 Laboratory Worker, who is responsible for:

6.2.5.1 Planning and conducting each operation in accordance with the laboratory's written chemical hygiene plan.

6.2.5.2 Practicing good personal and chemical hygiene habits.

6.3 Permissible Exposure Limits

OSHA has published a list of regulated substances and their permissible exposure limits in 29 Code of Federal Regulations part 1910 subpart 2. (This list is included in SECTION 6, of the chemical hygiene plan). For laboratory uses of OSHA regulated substances the Laboratory Supervisor (LS) with the assistance of the Chemical Hygiene Officer (CHO), will assure that the laboratory employees exposures do not exceed the permissible exposure limits specified by OSHA.

The greatest potential for exposure generally occurs during transfer operations involving concentrated chemicals. These operations should be conducted in a laboratory fume hood. As provided for in the Laboratory standard, and laboratory employee may request monitoring and be notified of the results, in writing, within 15 days of the receipt of the results.

To file a formal request for monitoring: Photocopy and complete the form in APPENDIX 2 and send to the University Safety Office.

6.3.1 Initial Monitoring

The CHO will measure employees exposure to any substance regulated by the Standard which requires monitoring if there is a reason to believe that exposure

levels for that substance routinely exceed the action level, (or in the absence of an action level the PEL).

6.3.2 Periodic Monitoring

If initial monitoring discloses employee exposures over the action level (or in the absence of an action level the PEL), the CHO will assure compliance with exposure monitoring provisions of the relevant standard.

6.3.3 Termination of Monitoring

Monitoring will be terminated in accordance with the relevant standard.

6.3.4 Employee Notification of Results

The CHO will within 15 working days after receipt of any monitoring results, notify the employee of these results in writing individually or by posting results in an appropriate location that is accessible to employees.

6.4 Employee Information

The CHO will provide employees with information and training to ensure that they are aware of the chemical hazards in their work area. Chemical hygiene training and information will be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training will be conducted annually or as the CHO sees fit.

(The CHO and LS will inform employees of:)

6.4.1 The contents of the Laboratory Standard.

6.4.2 The location and availability of the University's Chemical Hygiene Plan.

6.4.3 Permissible exposure limits for OSHA regulated substances, or recommended exposure limits for other hazardous chemical where there is no applicable OSHA standard.

6.4.4 Signs and symptoms associated with exposures to hazardous chemicals in the laboratory.

6.4.5 The location of reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including material safety data sheets.

6.5 Training

(Employees will be trained in the following:)

6.5.1 Methods that may be used to detect the presence or release of a hazardous chemical such as personal monitoring, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released.

6.5.2 Physical and health hazards of chemicals in the work area.

6.5.3 Measures an employee can take to protect themselves from these hazards including specific procedures outlined in the chemical hygiene plan. These procedures will include appropriate work practices, emergency procedures and protective equipment.

6.6 Medical Program

The George Washington University will provide all employees who work with hazardous chemicals an opportunity to receive a medical examination by a licensed physician at no cost to the employee when:

6.6.1 The employee exhibits signs or symptoms associated with exposure to a hazardous chemical in the laboratory.

6.6.2 A spill, leak, or explosion occurs resulting in the likelihood of a hazardous exposure, the affected employee will be given the opportunity for medical consultation.

6.6.3 Any employee who is routinely exposed above the action level, or in the absence of an action level, above the permissible exposure limit for which there are exposure monitoring or medical requirements.

To arrange for medical consultation or examination: Complete the "Request for Medical Examination" form in APPENDIX 1 and send to the University Safety Office.

6.6.4 Medically Relevant Information

The laboratory supervisor or his/her representative must provide the physician with the identity of the chemicals, description of exposure conditions and symptoms. The physician's opinion must be written and include any need for follow up, results, any increased risk and a statement that the employer has been notified of the previous items.

6.7 Hazard Identification

The chemical hygiene officer and the laboratory supervisor will ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

The University Safety Office maintains a master file of material safety data sheets (MSDS) for all chemicals used on campus. These MSDS's should be readily available in all areas that use or store hazardous chemicals. MSDS's can be found in yellow three ring binders labeled **"MATERIAL SAFETY DATA SHEETS"**. These yellow notebooks should be located in each laboratory and in any storeroom where chemicals are present.

6.8 Record Keeping

The Safety Office will establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation or examinations.

7.0 CHEMICAL HYGIENE PLAN

7.1 General Principals for Work With Laboratory Chemicals

7.1.1 Minimize all chemical exposures.

Precautions for handling all laboratory chemicals should be followed by workers. Exposure to chemicals can occur through inhalation, ingestion, skin absorption. Never smell or taste chemicals. Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices. Inspect all personal protective equipment prior to use.

7.1.2 Avoid Underestimation of Risk.

Even for substances with no know significant hazard, exposure should be minimized. One should assume that any mixture will be more toxic than its most toxic component and that all substances of unknown toxicity are hazardous.

7.1.3 Control Exposures.

Substitute less toxic materials whenever possible. Prevent substances from escaping into the working atmosphere by the use of hoods and other ventilation devices.

7.1.4 Observe PELs, TLVs.

The Permissible Exposure Limits of OSHA and Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded.

SECTION 2

LABORATORY SAFETY GUIDELINES

8.0 Fire Prevention

Know the location of all fire extinguishers and pull stations in the laboratory. All extinguishers must be fully charged and easily accessible. Exit doors must be unobstructed.

An extinguisher is labeled according to whether the fire on which it is to be used is wood or cloth, flammable liquids, electrical, metal sources. Using the wrong type of extinguisher on a fire can make the fire much worse.

The following list identifies the type of fire extinguishers and what kinds of materials they are designed to extinguish.

Type (A) - **ordinary combustibles, paper, cloth, wood and rubber.**

Type (B) - **flammable liquids, oils, gasoline, solvents and paints.**

Type (C) - **electrical equipment, wiring, fuse boxes, etc.**

Type (D) - **metals, combustible metals, magnesium, sodium.**

Fire extinguishers are designed to put out small fires, not large ones. Once you have the appropriate extinguisher to put out a small fire, use the **P.A.S.S.** technique.

(P) - **PULL the pin.**

(A) - **AIM the extinguishers nozzle at the base of the fire.**

(S) - **SQUEEZE or press the handle.**

(S) - **SWEEP from side to side at the base of the fire.**

IN THE EVENT OF A FIRE

1. Evacuate the area immediately.

2. Call the Fire Department **(911)** or University Police **(4-6111).**

3. Notify Fire Department of the chemicals involved (if known).

4. Only attempt to extinguish small fires.

5. Close door and windows to prevent the spread of fire.

9.0 Eye Washes and Safety Showers

Emergency eyewashes and safety showers are required by law whenever corrosive materials are used or stored in a laboratory. When the body or eyes have been exposed to chemicals, it is extremely important that immediate attention is given to the victim. These safety devices can be most effective it the following rules are adhered to.

1) Eyewash and safety showers must be easily accessible and clearly marked.

2) For chemical exposures of the eyes, flush eyes in a constant stream of water for approximately 15 minutes.

3) Check victims eyes for contact lenses and remove if possible. Do not stop flushing the eyes.

4) Forcibly hold eye open to wash thoroughly behind eyelids and have victim rotate eyes so that all surfaces are rinsed.

5) Continue flushing until medical team has arrived.

6) For chemical exposures of other body areas, get victim under the safety shower immediately.

7) Remove all contaminated clothing while victim is under shower.

8) Victim should remain under the shower until medical help arrives.

A copy of the **Medical Safety Data (MSDS)** should be made available to the medical team upon arrival. The MSDS can be a helpful guide for the treatment that will be administered.

The laboratory supervisor should be responsible for routine flushing of all eyewash stations in his area for at least 30 seconds, on a weekly basis to verify proper operation and to eliminate the potential for microbial contamination.

10.0 Compressed Gases

Cylinders of compressed gases should be handled as high energy sources and, therefore, should be considered a potential explosive. The following rules must be followed by all laboratory users.

1) All compressed gas cylinders must be restrained by straps, chains, or a suitable stand to prevent them from falling.

2) When moving or storing a cylinder, the protective cap must be in place in order to protect the valve stem.

3) Never lubricate, modify or tamper with a cylinder valve.

4) Incompatible gases, such as oxidizers and flammables (e.g., oxygen and propane) must never be stored together.

5) Never use a cylinder that cannot be identified positively.

6) When not in use, cylinder and bench valves should be closed tightly.

7) Do not expose cylinders to temperatures higher than 50 C. Some rupture devices on cylinders will release at about 65 C. Small cylinders such as lecture bottles, are not fitted with rupture devices and may explode if exposed to high temperatures.

8) Do not extinguish a flame involving a highly combustible gas until the source of gas has been shut off; otherwise, it can reignite, causing an explosion.

9) Cylinders of toxic, flammable, or reactive gases should be used in fume hoods only.

10) Under no condition should high-pressure gases be directed at a person.

11) Compressed gas or compressed air should not be used to blow away dust or dirt; the resultant flying particles are dangerous.

12) Cylinders must be labeled by contents and hazard.

11.0 Personal Protective Equipment

All rules for the use of personal protective equipment should be followed as required by the instructor, and will include the rules listed below. The lab instructor should be responsible for enforcing all rules.

Eye Protection

Upon implementation of the Chemical Hygiene Plan, the University policy on eye protection will require that eye protective devices be worn by students, faculty, staff and visitors in laboratories where chemicals are stored or handled. The type of safety device will depend on the nature of the hazard and the frequency with which it is encountered. There are three basic types of eye and face protection which meet the OSHA laboratory requirements. They are: safety glasses (with side shields), goggles and face shields. It will be the responsibility of the laboratory supervisor to determine the level of protection required and to enforce eye protection rules.

Ordinary prescription glasses do not provide adequate protection from injury to the eyes. The minimum acceptable eye protection requires the use of hardened glass or plastic safety spectacles. Safety spectacles are recommended for employees and students who require eye protection frequently and/or for long durations (more than two hours per day).

Goggles are usually not intended or general use. They are intended for wear when there is a danger of splashing chemicals or flying particles. Splash goggles that have splash proof sides are to be used when protection from harmful chemical splash is needed.

Goggles, offer little protection for the face and neck. Full-face shields that protect the face and neck should be worn when maximum protection from flying particles and corrosive liquids is needed.

Contact lenses should not be worn in the laboratory. They can trap vapors and liquids in your eyes.

The following guidelines on personal protective equipment are offered for your safety.

1) When working in the laboratory, a lab coat should be worn, and may in fact be required by your instructor.

2) Gloves should be worn if necessary to prevent absorption of chemicals into the skin. Be sure the gloves that you wear are protective against the chemical you are using. (For further information concerning proper glove selection see Appendix 10).

3) Shoes that cover the entire foot must be worn whenever in the laboratory. Sandles and open toed shoes are prohibited.

4) Loose fitting clothes, neckties, long unrestrained hair and necklaces are safety hazards and should not be worn in the laboratory.

5) Laboratory personnel are urged to dress with potential laboratory hazards in mind. Clothing should protect as much as of the body as possible.

12.0 Basic First-Aid in the Laboratory

The following is a list of basic first-aid procedures to be followed in the event of an accident or emergency in the laboratory. Immediate action is necessary to prevent more serious problems from occurring to the victim and assistance should be given to the medical team when they arrive.

FOR ALL EMERGENCIES CALL (911) OR EXT. 4-6111 (UNIVERSITY POLICE)

I. Chemical exposures

Inhalation: Remove victim from contaminated area.

Absorption: Remove contaminated clothing. Wash affected area with soap and water.

Ingestion: Check chemical label or Material Safety Data Sheet (MSDS) for specific instructions.

II. Burns

Get victim under safety shower or use fire blanket if clothing is on fire. Keep burn areas under shower. Clothing adhering to the flesh should not be removed.

III. Eye Injury

In cases where chemicals or dirt have entered the eyes, rinse eyes for 15 minutes at an eye wash station. Projectiles embedded in the eye should not be removed.

IV. Puncture Wounds

Never remove an object that is lodged into the body. Wash area with soap and water. Try to control bleeding.

V. Severe Bleeding

Cover wound with a clean cloth while applying direct pressure to the wound.

IV. Electrical Shock

Turn off power source if possible. Remove victim from current by using a non-conducting object. Perform artificial respiration if needed and if trained to do so.

13.0 Material Safety Data Sheets (MSDS)

Chemical manufactures and suppliers are required to supply one copy of a material safety data sheet the first time they supply a given chemical. The safety sheets follow a uniform format and contain data on the chemical. Material Safety Data Sheets contain the following detailed information about a chemical:

1) Chemical identity
2) Hazardous ingredients
3) Physical and chemical characteristics
4) Fire and explosion data
5) Reactivity
6) Health hazards
7) Spill and leak procedures
8) Personal protection
9) Control measures

On campus, MSDS's can be found in yellow 3-ring binders labeled "MATERIAL SAFETY DATA SHEETS". These yellow notebooks should be located in each laboratory and in any storeroom where chemicals are stored. In addition to labs and storage areas a master copy of all MSDS's is retained in the Safety Office in Woodhull House.

14.0 General Guidelines for handling chemicals

The following rules and guidelines have been established to ensure a safe working environment and to prevent accidental exposures to chemicals being used in the laboratory.

1) All chemical containers in the lab should be clearly labeled. The label should include the date the bottle was opened.

2) All chemicals brought into the department are to be entered on the annual inventory list.

3) All MSDS's are kept in each individual lab.

4) A lab may never contain more than 20 gallons of flammable material.

5) Smoking, drinking, and eating are prohibited in the laboratory due to danger of chemicals entering the mouth or lungs.

6) Treat all chemicals in the laboratory as toxic substances. Minimize your exposure to all chemicals.

7) Do not taste anything in the laboratory. This applies to food as well as to chemicals.

8) Do not place your mouth on any chemical equipment.

9) Avoid inhalation of vapors of any kind. Exhaust vapors through a hood. To test an odor, fill your lungs with air and cautiously sniff the vapors as you waft (fan) them from the source. Never inhale vapors directly from a chemical substances.

10) Always wash before eating, drinking, smoking, or apply makeup.

11) Wash thoroughly before leaving the lab.

15.0 Housekeeping in the Lab

Working Alone

Generally, it is prudent to avoid working in a laboratory building alone. Under normal working conditions, arrangements are to be made between individuals working in separate laboratories outside of working hours to cross check periodically. In addition, University Police may be requested to check on the laboratory worker. The laboratory supervisor has the responsibility for determining whether the work requires special safety precautions, such as having two persons in the same room during a particular operation.

Safety in the lab is ultimately your job. Follow all instructions and safety guidelines.

1) Horseplay is prohibited.

2) Benchtops should be kept clear of any devices or materials not directly involved in the experiment in progress. This minimizes the chances of an accident and diminishes the severity of any accident that might occur.

3) All work surfaces should be cleared and wiped down with a damp paper towel immediately following use. This includes benchtops, fume hood work surfaces, sink drainboards, sinks, balance pans and scales. Leave the area cleaner than you found it.

4) Glassware should be rinsed immediately following use to prevent others from coming in contact with residues left in or on the glassware. All lab users are responsible for prompt and proper cleaning, drying and storage of glassware.

5) All spills must be cleaned up immediately to prevent further exposure.

6) All chemical containers must be secured immediately after use to prevent evaporation or accidental spills.

16.0 Electrical Hazards

1) Laboratory supervisors should be familiar with the location of circuit breakers and how to disconnect the electrical service to the laboratory in case of a fire or accident.

2) Eliminate wiring that is frayed or worn or stretched across the floor where someone could trip over it. Eliminate using unlabeled panel boards, electrical outlets with open (or missing) cover plates, and avoid excessive use of extension cords.

3) All electrical outlets should carry a grounding connection requiring a three pronged plug. All electrical equipment except glass-cloth heaters should be wired with a grounding plug.

4) All electrical equipment should be inspected periodically for faulty wiring.

17.0 Chemical Storage

Storage of chemicals should be minimized. Chemicals should be ordered in quantities that are likely to be consumed within a year or less. Many chemicals have a short shelf life. Some-chemicals such as ethers and secondary alcohols oxidize to explosive peroxides in as short as three months after the container is first opened.

1) Fume hoods must not be used as permanent storage areas. Fume hoods must not be cluttered with chemicals so accidental spills do not occur.

2) Chemicals should be stored in reactivity groups so that two chemicals that might react explosively are not stored next to each other.

3) All chemicals in storage should be contained in tightly closed, sturdy, appropriate containers. The container must be clearly labeled with the name, grade and supplier of the chemical, and contain the date the material was first opened.

4) Large containers should be stored on low shelves, preferably in a tray large enough to contain the contents in the event of a spill or container rupture.

5) All flammable materials must be stored in approved flammable storage cabinets. There should never be more than 13 gallons of flammable material stored in any area that is not a designated flammable storage area.

6) All storage areas should be secure. They should not be locate in heavily traveled areas, and should be in separate areas other than laboratories whenever possible. They must be accessible only to those few individuals who have a need for the chemicals and who have had the proper training in the use of all of the materials in that storage area.

(For specific storage regulations consult the Code of Federal Regulations (CFR) 29 1910.107).

18.0 Fume Hoods

A key to safety handling of chemicals in the laboratory is a good, properly installed hood system. The National Academy of Sciences' Report "Prudent Practices for Handling Hazardous Chemicals in Laboratory" provides extensive information on laboratory ventilation and recommends that in a laboratory where workers spend most of their time working with chemicals, there should be a hood for each two workers, and each worker should have at least 2.5 linear feet of working space at the hood face.

Fume hoods serve to exhaust toxic, offensive, or flammable vapors from the laboratory and, with the hood sash closed, to provide a physical barrier between the worker and the chemical reaction. Apparatus used in hoods should be fitted with condensers, traps, or scrubbers to contain or collect waste solvents or toxic vapors. The hood should not be a means of disposing of chemicals.

Operations where flammable gas, toxic vapors, or noxious odors are given off should be performed under fume hoods. The exhaust rate is not reliable single measure of hood performance. Air supply to the room is also important, because drafts across the hood face decrease the hood's effectiveness. Periodic inspections should be made to determine whether hood is overcrowded and to check the air tightness of the ducts and exhaust system. Fans should be located on building roof so that all ductwork in the building is under negative pressure. There should be no circulation of exhaust air from fume hoods back into the laboratory.

Equipment should be placed as far back in the hood as possible and activities carried out at least 6 inches from the edge of the hood. Never put our head inside the hood while working with chemicals.

The Federal Environmental Protection Agency (EPA) has determined that fume hood face velocities should range from 80 fpm. in ideal laboratory situations to 100 fpm. in good laboratory situations. Rates in this zone will provide adequate protection to the fume hood user. The National Safety Council recommends that fume hood face velocities should average 100 fpm with no more than 15% variation in either direction. Fume hoods intended for highly toxic or radioactive materials require the higher flow rates. However, if the air flow is greater than 150 fpm., there is a real possibility that turbulence within the fume hood will cause vapors to be expelled through the face opening and back into the laboratory.

The fume hoods at The George Washington University are adjusted to draw between 100 - 120 fpm. at a sash height of 14". The hoods are tested annually and the results of the measured air flow are posted on each hood face.

If you encounter a fume hood not working properly, immediately contact the Safety Office at (994-6947), and do not attempt to use the hood.

19.0 Biological Laboratory Safety

Persons working with infectious agents or materials must be trained in the proper procedures required for safe handling of these materials. Departmental chairs should insure that appropriate training is provided for all laboratory personnel working with infectious agents. All safety procedures shall be used in conjunction with facility design, engineering features and safety equipment to ensure laboratory personnel safety.

Laboratory personnel must be informed of any special hazards and signs that are present in the work area.

The following standard safety practices should be followed by all laboratory personnel.

1) Access to the laboratory shall be restricted by the instructor when work with infectious agent is in progress.

2) Laboratory doors shall remain closed at all times when experiments are in progress.

3) Lab coats and gloves shall be worn by all workers to avoid skin contamination with infectious agents.

4) Eating, drinking, smoking, and application of cosmetics is strictly prohibited in the laboratory.

5) All infectious waste shall be decontaminated and disposed of properly.

6) All working surfaces shall be decontaminated at the end of each lab and immediately after any spill of viable material.

7) Laboratory personnel must wash thoroughly after handling infectious agents prior to leaving the laboratory.

SECTION 3

HAZARDOUS CHEMICAL WASTE DISPOSAL PROCEDURES

The Hazardous Chemical Waste Disposal Policy is hereby approved.

Louis H. Katz
Vice President and Treasurer

7/15/92
Date

John A. Schauss
Associate Vice President for Finance

7/15/92
Date

THE GEORGE WASHINGTON UNIVERSITY
HAZARDOUS CHEMICAL WASTE DISPOSAL POLICY

1.0 STATEMENT OF PURPOSE

1.1 This policy is to serve as a guide for laboratory researchers, professors, students, and other university personnel who generate hazardous waste and to inform them of their responsibilities in the disposal of hazardous waste. It also formalizes the existence of a university waste management program.

1.2 Employees must become familiar with the hazardous waste disposal program. Such familiarization will develop cooperation and assistance, which are essential in making the hazardous chemical waste disposal operation reliable and efficient.

2.0 SCOPE

The scope of this policy pertains to the disposal of hazardous chemical waste, as defined in Section 5.0. This policy does not include the disposal of radioactive waste nor the disposal of non-hazardous solid waste. Disposal of these materials is administered by the University Radiation Safety Office and the Physical Plant Department respectively.

3.0 OVERVIEW OF HAZARDOUS WASTE (BACKGROUND INFORMATION)

The George Washington University is an institution that provides teaching, research and service activities which may generate any or all of the hazardous waste listed in the Resource Conservation and Recovery Act (hereinafter referred to as "RCRA"). Through RCRA, congress in 1976 required the Environmental Protection Agency (hereinafter referred to as "EPA"), to organize a "cradle to grave" management system of hazardous waste.

In its first act of regulation in 1980, contained in Parts 260 through 271 Title 40 of the Code of Federal Regulations, the EPA began regulating only companies that generated large quantities (in excess of one thousand (1,000) kilograms (kg.)) of hazardous waste per month (hereinafter referred to as **Large Quantity Generators - "L.Q.G."**). In 1984, Congress amended the regulations to begin regulating generators of one hundred (100) to one thousand (1,000) kg of waste per month (hereinafter referred to as **Small Quantity Generators - "S.Q.G."**). Although less stringent than regulations for L.Q.G. regulations for S.Q.G. have certain legal requirements to comply with. The District of Columbia Government of Consumer and Regulatory Affairs adopted the federal EPA regulations in 1984 and finalized its adoption and rules governing hazardous waste in the District of Columbia in July of 1987.

These regulations now qualify any business within the District of Columbia that generates less

than fifty (50) kg of hazardous waste per month as a S.Q.G. Therefore, an establishment that generates any hazardous waste is now regulated. Currently, the George Washington University maintains a Small Quantity Generator Status.

4.0 GOALS

4.1 Protect the health and safety of employees and students.

4.2 Assure compliance with applicable regulations.

The hazardous waste policy at The George Washington University will comply with federal E.P.A., Department of Transportation and District of Columbia regulations.

4.3 Reduction of Hazardous Waste

Efforts will be made to reduce of the volume of waste that is generated and transported off-site.

5.0 DEFINITIONS

5.1 Department of Consumer and Regulatory Affairs

The District of Columbia government agency responsible for the administration and enforcement of the District's Hazardous Waste Regulations, 20 DCMR Chapter 40.

5.2 Department of Transportation (DOT)

The federal agency responsible for policy concerning the transportation of hazardous waste.

5.3 Environmental Protection Agency (EPA)

The federal agency responsible for regulations concerning the generation, handling, and disposal of hazardous (non-radioactive) chemical wastes.

5.4 Flash Point

The minimum temperature at which a liquid gives off vapors in sufficient concentration to form and ignitible mixture with air.

5.5 Generator

Any person or department within the University which produces hazardous waste.

5.6 Small Quantity Generator

Facility that, under the D.C. Hazardous Waste Regulations, generates less than fifty (50) kg of hazardous waste (or (1) kg of acute hazardous waste) in a single month.

5.7 Hazardous Waste

Any waste included in the "listed hazardous waste as specified in Part 261, 40 CFR of the EPA regulations or if it displays a hazardous characteristics of a corrosive, reactive, flammable or toxic.

5.8 Acute Hazardous Waste

Chemical that can cause serious harm from a single or short duration of exposure. (Example include: carbon disulfide, fluorine, mercury fulmate, and arsenic trioxide).

5.9 Manifest

A required form which is used for shipping hazardous waste. The manifest must have the name and address of the generator, the hazard class, and the types and quantities of hazardous waste to be shipped off-site.

6.0 PROCEDURES/RESPONSIBILITIES

6.1 Safety Office

The Safety Office provides the service of the waste evaluation, contractor procurement and in-house compliance of the removal or reduction of hazardous waste at The George Washington University. Waste that cannot be reduced in-house will be stored in appropriate storage areas. Waste will then be transferred to an outside qualified hazardous waste contractor. The Safety Office will at the appropriate time initiate waste disposal process by requesting waste inventories from the various departments and coordinate a waste pick-up.

6.2 Departmental Waste Generator Procedures

Any department who generates hazardous waste must follow the procedures outlined below:

6.2.1 Containers

6.2.1.1 If possible, the same container in which the original material arrived in the laboratory should be used for disposal.

6.2.1.2 All containers of liquids must have a screw cap or lid and must not leak when inverted. Corks, plastic sheeting, cotton plugs, etc., are not acceptable stoppers for containers of hazardous waste liquids.

6.2.1.3 The outside of containers must be clean and free of chemical contamination.

6.2.1.4 All glass containers should be securely packaged to prevent breakage during transport.

6.2.1.5 Loose solid materials should be placed in a sealed container, box or carton lined with two plastic bags.

6.2.2 Waste Segregation

6.2.2.1 Solvents

The most cost effective disposal for labpack solvents is to "bulk" them into 5 gallon steel cans (or the original cans they arrived in). This will eliminate large quantities of small containers. Compatible solvents include: alcohols, (methanol, ethanol, propanol, etc.) ethers, liquid ketones, water phenol, aniline, benzene, pyridine, toluenes, acetates, and halogenated solvents (i.e., methylene chloride, chloroform, and carbon tetrachloride). **Waste solvent containers must be labeled with all constituents and approximate percentages, +; - 10%.**

6.2.2.2 Heavy Metals

Heavy metals such as arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver are difficult to dispose of if in large concentrations in flammable solvents due to EPA's Land disposal restrictions (Land Bans). all hazardous waste disposal facilities must incinerate flammable solvents and are regulated on how much metal they can burn. Therefore, it is extremely important to keep the above listed heavy metals out of organic solvents otherwise, it may not be accepted for disposal. Substitutes for the solvents

could be acids of sulfuric, phosphoric, hydrochloric or water. If organic solvents must be used, the key is to keep the metal concentrations low.

6.2.3 Waste Container Labeling

6.2.3.1 All waste containers must be labeled with the following information:

A. Name of material.
B. Volume, weight or percentage of mixture.
C. The date accumulation began.
D. The words "Hazardous Waste"

6.2.4 Waste pick-ups by the Safety Office will be scheduled on a quarterly basis or as necessary. Advance notice will be given prior to scheduled pick-ups.

7.0 EMPLOYEE SAFETY AND HEALTH

7.1 Departments

Employee safety and health must be maintained at all times. When pouring waste into a container prior to pick-up, employees should perform this procedure inside an operating chemical fume hood. Employees should wear the proper personal protective equipment (safety goggles, face shields and rubber gloves).

7.2 Housekeeping Personnel

Housekeeping personnel are not authorized to handle hazardous waste. All non-hazardous waste must be clearly labeled as non-hazardous waste before it is put into the trash. Also, sharp items such as glass are to be placed into another container (such as a box) before putting it in the waste basket.

SECTION 4

HAZARDOUS WASTE CLASSIFICATION

WHAT IS A HAZARDOUS WASTE?

To properly understand "hazardous waste" in relation to identifing potential hazardous waste streams, "solid waste" must be defined. Solid waste is defined as any discarded material that is abandoned by being disposed of, burned or incinerated, recycled or considered "waste-like." A solid waste can physically be a solid, liquid, semi-solid, or container of gaseous material.

Hazardous waste is defined as a " solid waste", or combination of solid wastes, which because of its quantity, concentration, or physical, chemical,or infectious characteristics may:

A. pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed; or

B. cause, or contribute to an increase in mortality or an increase in serious irreversible or incapacitating reversible illness.

DETERMINE WHETHER YOUR WASTE IS HAZARDOUS

It is the responsibility of the person or business that generates a waste to determine if that waste is hazardous by using the criteria outlined in Chapter 41 of Title 20 DCMR. There are two ways a waste can be identified as hazardous: it may be defined by it's hazardous **CHARACTERISTIC**, which is defined in Title 20 DCMR, Section 4102, or it may be a **LISTED** waste as listed in Title 20 DCMR, Section 4103.

Hazardous Waste Mixtures: In general mixing a hazardous waste

with a nonhazardous waste will result in the entire volume being regulated as a hazardous waste. This includes mixing liquids with liquids and liquids with solids. For example, adding a teaspoon (more or less) of an acutely listed hazardous solvent to a 55 gallon drum of water could result in the entire drum of liquid being regulated as a hazardous waste. It is good management practice to keep hazardous and nonhazardous waste separated while in storage.

CHARACTERISTIC WASTE

If a waste posseses at least one of the four characteristics of ignitability, corrosivity, reactivity or EP toxicity, it is considered to be characteristic waste:

IGNITABILITY (D001)

A solid waste that exhibits any of the following properties is considered a hazardous waste due to its ignitability:

- a liquid waste which has a flash point of less than or equal to 140 degrees Fahrenheit (60 degrees C) as determined by the Pensky-Martens Closed Cup flash point test. Kerosene, petroleum naphtha and petroleum based lacquer thinner are examples of commonly used solvents which would be considered ignitable hazardous waste.

- a non-liquid which is capable of causing a fire through friction, absorption of water or spontaneous chemical change and wnen ignited burns so vigorously that it creates a hazard.

- an ignitable compressed gas as defined in 49 CFR 173, Department of Transportation Regulations.

CORROSIVITY (D002)

A solid waste that exhibits any of the following properties is considered a hazardous waste due to its corrosivity:

- An aqueous waste with a pH less than or equal to 2 or greater than or equal to 12.5 is considered to be a corrosive hazardous waste.

- A liquid waste that corrodes steel at a rate of .25 inch per calendar year at the standard set temperature of 55 degree C.

Examples of corrosives include battery acids, paint and varnish removers, and industrial degreasing solutions.

REACTIVITY (D003)

A waste is considered to be a reactive hazardous waste if it is

normally unstable, reacts violently with water, or generates toxic gases when exposed to water or other materials. Examples are cyanide, plating waste, waste bleaches and explosives.

TOXICITY (D000)

To determine the toxicity of hazardous waste a representative sample of the material must be subjected to the Extraction Procedure (EP) toxicity test. If the waste contains one of the contaminants listed below at or in excess of the concentration given then it is considered a toxic hazardous waste.

TOXICITY LIST

MAXIMUM CONCENTRATION OF CONTAMINANTS FOR CHARACTERISTIC OF EP TOXICITY

Hazardous Waste Code	Metal Contaminant	Maximum Concentrations in parts per million(ppm)
D004	Arsenic (As)	5.0
D005	Barium (Ba)	100.0
D006	Cadmium (Cd)	1.0
D007	Chromiuim (Cr VI+)	5.0
D008	Lead (Pb)	5.0
D009	Mercury (Hg)	0.2
D010	Selenium (Se)	1.0
D011	Silver (Ag)	5.0
D012	Endrin	0.02
D013	Lindane	0.4
D014	Methoxychlor	10.0
D015	Toxaphene	0.5
D016	2,4-D (2,4-Dichlorophenoxyacetic acid).	10.0
D017	2,4,5-TP Silvex (2,4,5-Trichlorophenoxypropionic acid).	1.0

LISTED WASTE

TABLE I **Hazardous Waste from Non-Specific Sources (F-Wastes)**
This table contains a list of wastes that are by-products of a process. These materials have been used and are being discarded at the end of some process. Many commonly used solvents are listed in this table.

TABLE II **Hazardous Waste from Specific Sources (K-Wastes)**
The wastes in this table are by-products of specific manufacturing processes. Waste from the production of many chemicals and pesticides are included here.

TABLE III **Acutely Hazardous Commerical Chemical Products and Manufacturing Chemical Intermediates (P-Wastes)**

This table lists unused chemicals that are considered acutely hazardous when discarded. A chemical waste from this list might be a commerically pure grade, an off specification grade, or residues from the clean up of a spill of that chemical. These are considered acutely hazardous because they can be extremely dangerous to human health in small quanities.

TABLE IV **Toxic Commerical Chemical Products and Manufacturing Intermediates (U-Wastes)**

The chemicals in this table are considered toxic, but not acutely hazardous. Similar to Table III, these chemicals would be considered hazardous if improperly disposed.

EXCLUSIONS

The following waste streams are not solid wastes and have been excluded from District of Columbia Hazardous Waste regulations:

A. Domestic sewage
B. Industrial wastewater discharges subject to the Clean Water Act
C. Nuclear sources covered by the Atomic Energy Act
D. Irrigation return flows
E. Waste samples for laboratory analysis
F. Extraction ores
G. Drilling fluids
H. Photographic waste, in which chromium is exclusively trivalent chromium.
I. Fly ash, bottom ash waste, slag waste, and flue gas emission control waste from the combustion of coal or other fossil fuels
J. Used oil that has not been mixed with hazardous waste
K. Spent lead batteries that will be recycled

HAZARDOUS WASTE LISTS

The hazardous waste lists reproduced here on pages 11 through 36 are from Section 4103 of the District of Columbia Hazardous Waste Management Regulations. In them you will find the correct EPA Hazardous Waste Numbers that are required on the "Notification of Hazardous Waste Activity" (Form 8700-12). If you have any questions, call the D.C. Hazardous Waste Branch at (202)783-3194 or the EPA Hazardous Waste Hotline, 382-3000 in the District or 1(800)424-9346.

TABLE I
HAZARDOUS WASTE FROM NON-SPECIFIC SOURCES

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Generic:		
F001	The following spent halogenated solvents used in degreasing: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of ten percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(T)
F002	The following spent halogenated solvents: tetrachloroethylene, methylene chloride, trichloroethylene, 1,1,1-trichloroethane, chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends, containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those listed in F001, F004, or F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(T)
F003	The following spent non-halogenated solvents: xylene, acetone, ethyl acetate,	(I)

	ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixture/blends containing, before use, one or more of the above non-halogenated solvents, and a total of ten percent or more (by volume) of one or more of those solvents listed in F001, F002, F004 and F005; and still bottom from the recovery of these spent solvents and spent solvent mixtures.	
F004	The following spent non-halogenated solvents; cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/ blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002 and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(T)
F005	The following spent non-halogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of ten percent or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002 or F004; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.	(I,T)
F006	Wastewater treatment sludges from electroplating operations except from the following processes: (1) Sulfuric acid anodizing of aluminum; (2) tin plating on carbon steel; (3) zinc plating (segregated basis) on carbon steel; (4) aluminum or zinc-aluminum plating on carbon steel; (5) cleaning/stripping associated with tin, zinc and aluminum plating on carbon steel; and (6) chemical etching and milling of aluminum	(T)
F019	Wastewater treatment sludges from the chemical conversion coating of aluminum	(T)
F007	Spent cyanide plating bath solutions from electroplating operations	(R, T)
F008	Plating bath residues from the bottom of plating baths from electroplating opera-	(R, T)

	tions where cyanides are used in the process	
F009	Spent stripping and cleaning bath solutions from electroplating operations where cyanides are used in the process	(R, T)
F010	Quenching bath residue from oil baths from metal heat treating operations where cyanides are used in the process	(R, T)
F011	Spent cyanide solutions from salt bath pot cleaning from metal heat treating operations	(R, T)
F012	Quenching wastewater treatment sludges from metal heat treating operations where cyanides are used in the process	(T)
F024	Wastes, including but not limited to, distillation residues, heavy ends, tars, and reactor clean-out wastes from the production of chlorinated aliphatic hydrocarbons, having carbon content from one to five, utilizing free radical catalyzed processes. [This listing does not include light ends, spent filters and filter aids, spent dessicants, wastewater, wastewater treatment sludges, spent catalysts, and wastes listed in §4103.6 of Title 20 DCMR.	(T)
F020	Wastes(except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- or tetrachlorophenol, or of intermediates used to produce their pesticide derivatives. (This listing does not include wastes from the production of Hexachlorophene from highly purified 2,4,5-trichlorophenol.).	(H)
F021	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of pentachlorophenol, or of intermediates used to produce its derivatives.	(H)
F022	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-) or hexachlorobenzenes under alkaline conditions.	

F023	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the production or manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tri- and tetrachlorophenols. (This listing does not include wastes from equipment used only for the production or use of Hexachlorophene from highly purified 2,4,5-trichlorophenol.).	(H)
F026	Wastes (except wastewater and spent carbon from hydrogen chloride purification) from the production of materials on equipment previously used for the manufacturing use (as a reactant, chemical intermediate, or component in a formulating process) of tetra-, penta-, or hexachlorobenzene under alkaline conditions.	(H)
F027	Discarded unused formulations containing tri-, tetra-, or pentachlorophenol or discarded unused formulations containing compounds derived from these chlorophenols. (This listing does not include formulations containing Hexachlorophene sythesized from prepurified 2,4,5-trichlorophenol as the sole component.).	(H)
F028	Residues resulting from the incineration or thermal treatment of soil contaminated with EPA Hazardous Waste Nos. F020, F021, F022, F023, F026, and F027.	(T)
	(I,T) should be used to specify mixtures containing ignitable and toxic constituents.	

TABLE II
HAZARDOUS WASTE FROM SPECIFIC SOURCES

Industry and EPA hazardous waste No.	Hazardous waste	Hazard code
Wood preservation:		
K001	Bottom sediment sludge from the treatment of wastewaters from wood preserving processes that use creosote and/or pentachlorophenol	(T)
Inorganic pigments:		
K002	Wastewater treatment sludge from the production of chrome yellow and orange pigments	(T)
K003	Wastewater treatment sludge from the production of molybdate orange pigments	(T)
K004	Wastewater treatment sludge from the production of zinc yellow pigments	(T)
K005	Wastewater treatment sludge from the production of chrome green pigments	(T)
K006	Wastewater treatment sludge from the production of chrome oxide green pigments (anhydrous and hydrated)	(T)
K007	Wastewater treatment sludge from the production of iron blue pigments	(T)
K008	Oven residue from the production of chrome oxide green pigments	(T)
Organic chemicals:		
K009	Distillation bottoms from the production of acetaldehyde from ethylene	(T)
K010	Distillation side cuts from the production of acetaldehyde from ethylene	(T)
K011	Bottom stream from the wastewater stripper in the production of acrylonitrile	(R, T)
K013	Bottom stream from the acetonitrile column in the production of acrylonitrile	(R, T)
K014	Bottoms from the acetonitrile purification column in the production of acrylonitrile	(T)

K015	Still bottoms from the distillation of benzyl chloride	(T)
K016	Heavy ends or distillation residues from the production of carbon tetrachloride	(T)
K017	Heavy ends (still bottoms) from the purification column in the production of epichlorohydrin	(T)
K018	Heavy ends from the fractionation column in ethyl chloride production	(T)
K019	Heavy ends from the distillation of ethylene dichloride in ethylene dichloride production	(T)
K020	Heavy ends from the distillation of vinyl chloride in vinyl chloride monomer production	(T)
K021	Aqueous spent antimony catalyst waste from fluoromethanes production	(T)
K022	Distillation bottom tars from the production of phenol/acetone from cumene	(T)
K023	Distillation light ends from the production of phthalic anhydride from naphthalene	(T)
K024	Distillation bottoms from the production of phthalic anhydride from naphthalene	(T)
K093	Distillation light ends from the production of phthalic anhydride from ortho-xylene	(T)
K094	Distillation bottoms from the production of phthalic anhydride from ortho-xylene	(T)
K025	Distillation bottoms from the production of nitrobenzene by the nitration of benzene	(T)
K026	Stripping still tails from the production of methy ethyl pyridines	(T)
K027	Centrifuge and distillation residues from toluene diisocyanate production	(R, T)
K028	Spent catalyst from the hydrochlorinator reactor in the production of 1,1,1-trichloroethane	(T)
K029	Waste from the product steam stripper in the production of 1,1,1-trichloroethane	(T)

K095	Distillation bottoms from the production of 1,1,1-trichloroethane	(T)
K096	Heavy ends from the heavy ends column from the production of 1,1,1-trichloroethane	(T)
K030	Column bottoms or heavy ends from the combined production of trichloroethylene and perchloroethylene	(T)
K083	Distillation bottoms from aniline production	(T)
K103	Process residues from aniline extraction from the production of aniline	(T)
K104	Combined wastewater streams generated from nitrobenzene/aniline production	(T)
K085	Distillation or fractionation column bottoms from the production of chlorobenzenes	(T)
K105	Separated aqueous stream from the reactor product washing step in the production of chlorobenzenes	(T)
K111	Product washwaters from production of dinitrotoluene via nitration of toluene	(C,T,)
K112	Reaction by-product water from the drying column in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K113	Condensed liquid light ends from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K114	Vicinals from the purification of toluenediamine in the production of toluenediamine via hydrogenation of dinitrotoluene	(T)
K115	Heavy ends from the purification of toluenediamine via hydrogenation of dinitrotoluene	(T)
K116	Organic condensate from the solvent recovery column in the production of toluene diisocyanate via phosgenation of toluenediamine	(T)
K117	Wastewater from the reactor vent gas scrubber in the production of ethylene dibromide via bromination of ethene	(T)

K118	Spent adsorbent solids from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene.	(T)
K136	Still bottoms from purification of ethylene dibromide in the production of ethylene dibromide via bromination of ethene	(T)
Inorganic chemicals:		
K071	Brine purification muds from the mercury cell process in chlorine production, where separately prepurified brine is not used	(T)
K073	Chlorinated hydrocarbon waste from the purification step of the diaphragm cell process using graphite anodes in chlorine production	(T)
K106	Wastewater treatment sludge from the mercury cell process in chlorine production	(T)
Pesticides:		
K031	By-product salts generated in the production of MSMA and cacodylic acid	(T)
K032	Wastewater treatment sludge from the production of chlordane	(T)
K033	Wastewater and scrub water from the chlorination of cyclopentadiene in the production of chlordane	(T)
K034	Filter solids from the filtration of hexachlorocyclopentadiene in the production of chlordane	(T)
K097	Vacuum stripper discharge from the chlordane chlorinator in the production of chlordane	(T)
K035	Wastewater treatment sludges generated in the production of creosote	(T)
K036	Still bottoms from toluene reclamation distillation in the production of disulfoton	(T)
K037	Wastewater treatment sludges from the production of disulfoton	(T)
K038	Wastewater from the washing and stripping of phorate production	(T)
K039	Filter cake from the filtration of diethylphosphorodithioic acid in the production of	(T)

	phorate	
K040	Wastewater treatment sludge from the production of phorate	(T)
K041	Wastewater treatment sludge from the production of toxaphene	(T)
K098	Untreated process wastewater from the production of toxaphene	(T)
K042	Heavy ends or distillation residues from the distillation of tetrachlorobenzene in the production of 2,4,5-T	(T)
K043	2,6-Dichlorophenol waste from the production of 2,4-D	(T)
K099	Untreated wastewater from the production of 2,4-D	(T)
K123	Process wastewater (including supernates, filtrates, and washwaters) from the production of ethylenebisdithiocarbamic acid and its salt.	(T)
Explosives:		
K044	Wastewater treatment sludges from the manufacturing and processing of explosives	(R)
K045	Spent carbon from the treatment of wastewater containing explosives	(R)
K046	Wastewater treatment sludges from the manufacturing, formulation and loading of lead-based initiating compounds	(T)
K047	Pink/red water from TNT operations	(R)
Petroleum refining:		
K048	Dissolved air flotation (DAF) float from the petroleum refining industry	(T)
K049	Slop oil emulsion solids from the petroleum refining industry	(T)
K050	Heat exchanger bundle cleaning sludge from the petroleum refining industry	(T)
K051	API separator sludge from the petroleum refining industry	(T)
K052	Tank bottoms (leaded) from the petroleum refining industry	(T)
Iron and steel:		

K061	Emission control dust/sludge from the primary production of steel in electric furnaces	(T)
K062	Spent pickle liquor generated by steel finishing operations of facilities within the iron and steel industry (SIC codes 331 and 332)	(C, T)
Secondary lead:		
K069	Emission control dust/sludge from secondary lead smelting	(T)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting	(T)
Veterinary pharmaceuticals:		
K084	Wastewater treatment sludges generated during the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K101	Distillation tar residues from the distillation of aniline-based compounds in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
K102	Residue from the use of activated carbon for decolorization in the production of veterinary pharmaceuticals from arsenic or organo-arsenic compounds	(T)
Ink formulation:		
K086	Solvent washes and sludges, caustic washes and sludges, or water washes and sludges from cleaning tubs and equipment used in the formulation of ink from pigments, driers, soaps, and stabilizers containing chromium and lead	(T)
Coking:		
K060	Ammonia still lime sludge from coking operations	(T)
K087	Decanter tank tar sludge from coking operations	(T)

4103.7 The following materials or items are hazardous wastes if and when they are discarded or intended to be discarded as described in §4100.4, when they are mixed with waste oil or used oil or other material and applied to the land for dust suppression or road treatment, when they are otherwise applied to the land in lieu of their original intended use or when they are contained in products that are applied to

the land in lieu of their original intened use, or when, in lieu of their original intended use, they are produced for use as (or as a component of) a fuel, distributed for use as a fuel, or burned as a fuel.

(a) Any commercial chemical product, or manufacturing chemical intermediate having the generic name listed in §4103.7(e) and (f).

(b) Any off-specification commercial chemical product or manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in §4103.7(e) or (f).

(c) Any residue remaining in a container or in an inner liner removed from a container that has held any commercial chemical product or manufacturing chemical intermediate having the generic name listed in §4103.7(e), unless the container is empty as defined in §4100.39.

(1) Unless the residue is being beneficially used or reused, or legitimately recycled or reclaimed; or being accumulated, stored, transported or treated prior to such use, re-use, recycling or reclamation, the Department considers the residue to be intended for discard, and thus, a hazardous waste. An example of a legitimate re-use of the residue would be where the residue remains in the container and the container is used to hold the same commerical chemical product or manufacturing chemical intermediate it previously held. An example of the discard of the residue would be where the drum is sent to a drum reconditioner who reconditions the drum but discards the residue.

(d) Any residue or contaminated soil, water or other debris resulting from the cleanup of a spill into or on any land or water of any commercial chemical product or manufacturing chemical intermediate having the generic name listed in §4103.7(e) or (f), or any residue or contaminated soil, water or other debris resulting from the cleanup of a spill, into or on any land or water, of any off-specification chemical product and manufacturing chemical intermediate which, if it met specifications, would have the generic name listed in §4103.7(e) or (f).

(1) The phrase "commercial chemical product or manufacturing chemical intermediate having the generic name listed in . . ." refers to a chemical substance which is manufactured or formulated for commercial or manufacturing use which consists of the commercially pure grade of the chemical, any

technical grades of the chemical that are produced or marketed, and all formulations in which the chemical is the sole active ingredient. It does not refer to a material, such as a manufacturing process waste, that contains any of the substances listed in §4103.7(e) or (f). Where a manufacturing process waste is deemed to be a hazardous waste because it contains a substance listed in §4103.7(e) or (f), such waste shall be listed in either §§4103.5 or 4103.6 or shall be identified as a hazardous waste by the characteristics set forth in §4102.

(e) The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in §4103.7(a) through (d) are identified as acute hazardous wastes (H) and are subject to be the small quantity exclusion defined in §4100.23.

(1) The primary hazardous properties of these materials have been indicated by the letters T (Toxicity), and R (Reactivity). Absence of a letter indicates that the compound only is listed for acute toxicity.

TABLE III - EPA "P-LISTED CHEMICALS" (Acutely toxic)

Generators cannot accumulate more than 1 quart in satellite accumulation area.

The commercial chemical products, manufacturing chemical intermediates or off-specification commercial chemical products or manufacturing chemical intermediates referred to in this list are identified as acute hazardous wastes (H) and are subject to the small quantity exclusion defined in §261.5(e).

[*Comment:* For the convenience of the regulated community the primary hazardous properties of these materials have been indicated by the letters T (Toxicity), and R (Reactivity). Absence of a letter indicates that the compound only is listed for acute toxicity.

These wastes and their corresponding EPA Hazardous Waste Numbers are:

Waste Code	CASRN	Substance
P023	107-20-0	Acetaldehyde, chloro-
P002	591-08-2	Acetamide, N-(aminothioxomethyl)-
P057	640-19-7	Acetamide, 2-fluoro-
P058	62-74-8	Acetic acid, fluoro-, sodium salt
P002	591-08-2	1-Acetyl-2-thiourea
P003	107-02-8	Acrolein
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
P099	506-61-6	Argentate(1-), bis(cyano-C)-, potassium
P010	7778-39-4	Arsenic acid H3 AsO4
P012	1327-53-3	Arsenic oxide As2 O3
P011	1303-28-2	Arsenic oxide As2 O5
P011	1303-28-2	Arsenic pentoxide
P012	1327-53-3	Arsenic trioxide
P038	692-42-2	Arsine, diethyl-
P036	696-28-6	Arsonous dichloride, phenyl-
P054	151-56-4	Aziridine
P067	75-55-8	Aziridine, 2-methyl-
P013	542-62-1	Barium cyanide
P024	106-47-8	Benzenamine, 4-chloro-
P077	100-01-6	Benzenamine, 4-nitro-
P028	100-44-7	Benzene, (chloromethyl)-
P042	51-43-4	1,2-Benzenediol, 4-[1-hydroxy-2 (methylamino) ethyl]-, (R)

Waste Code	CASRN	Substance
P046	122-09-8	Benzene ethanamine, alpha,alpha-dimethyl-
P014	108-98-5	Benzenethiol
P127	1563-66-2	7-Benzofuranol, 2,3-dihydro-2,2-dimethyl-, methylcarbamate.
P188	57-64-7	Benzoic acid, 2-hydroxy-, compd. With (3aS-cis)-1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethylpyrrolo[2,3-b]indol-5- yl methyl carbamate ester (1:1).
P001	\1\81-81-2	2 H-1-Benzopyran-2-one, 4-hydroxy-3-(3-oxo-1-phenylbutyl)-, & salts, when present at concentrations greater than 0.3%
P028	100-44-7	Benzyl chloride
P015	7440-41-7	Beryllium powder
P017	598-31-2	Bromoacetone
P018	357-57-3	Brucine (methylthio)-, O-[(methylamino) carbonyl] oxime
P021	592-01-8	Calcium cyanide
P021	592-01-8	Calcium cyanide Ca(CN)2
P189	55285-14-8	Carbamic acid, [(dibutylamino)-thio]methyl-, 2,3-dihydro-2,2-dimethyl- 7-benzofuranyl ester.
P191	644-64-4	Carbamic acid, dimethyl-, 1-[(dimethyl-amino) carbonyl]- 5-methyl-1H- pyrazol-3-yl ester.
P192	119-38-0	Carbamic acid, dimethyl-, 3-methyl-1-(1-methyl-ethyl)-1H- pyrazol-5-yl ester.
P190	1129-41-5	Carbamic acid, methyl-, 3-methylphenyl ester.
P127	1563-66-2	Carbofuran.
P022	75-15-0	Carbon disulfide
P095	75-44-5	Carbonic dichloride
P189	55285-14-8	Carbosulfan.
P023	107-20-0	Chloroacetaldehyde
P024	106-47-8	p-Chloroaniline
P026	5344-82-1	1-(o-Chlorophenyl)thiourea
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide
P029	544-92-3	Copper cyanide Cu(CN)
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
P033	506-77-4	Cyanogen chloride (CN)Cl
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

Waste Code	CASRN	Substance
P038	692-42-2	Diethylarsine
P041	311-45-5	Diethyl-p-nitrophenyl phosphate
P040	297-97-2	O,O-Diethyl O-pyrazinyl phosphorothioate
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P004	309-00-2	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa-chloro-1,4,4a,5,8,8a,-hexahydro-, (1alpha,4alpha, 4abeta,5alpha,8alpha,8 abeta)-
P060	465-73-6	1,4,5,8-Dimethanonaphthalene, 1,2,3,4,10,10-hexa- chloro-1,4,4a,5,8,8a-hexahydro-, (1alpha,4alpha,4abeta,5beta,8beta,8abeta)-
P037	60-57-1	2,7:3,6-Dimethanonaphth[2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2aalpha,3beta,6beta,6a alpha,7beta, 7aalpha)-
P051	\1\ 72-20-8	2,7:3,6-Dimethanonaphth [2,3-b]oxirene, 3,4,5,6,9,9-hexachloro-1a,2,2a,3,6,6a,7,7a-octahydro-, (1aalpha,2beta,2abeta,3alpha,6alpha,6 abeta,7beta, 7aalpha)-, & metabolites
P044	60-51-5	Dimethoate
P046	122-09-8	alpha,alpha-Dimethylphenethylamine
P191	644-64-4	Dimetilan.
P047	\1\ 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-
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P039	298-04-4	Disulfoton
P049	541-53-7	Dithiobiuret
P185	26419-73-8	1,3-Dithiolane-2-carboxaldehyde, 2,4-dimethyl-, O- [(methylamino)- carbonyl]oxime.
P050	115-29-7	Endosulfan
P088	145-73-3	Endothall
P051	72-20-8	Endrin
P051	72-20-8	Endrin, & metabolites
P042	51-43-4	Epinephrine
P031	460-19-5	Ethanedinitrile
P194	23135-22-0	Ethanimidothioic acid, 2- (dimethylamino)-N-[[(methylamino) carbonyl]oxy]-2-oxo-, methyl ester.
P066	16752-77-5	Ethanimidothioic acid, N-[(methylamino)carbonyl] oxy]-, methyl ester
P101	107-12-0	Ethyl cyanide
P054	151-56-4	Ethyleneimine
P097	52-85-7	Famphur
P056	7782-41-4	Fluorine
P057	640-19-7	Fluoroacetamide

Waste Code	CASRN	Substance
P058	62-74-8	Fluoroacetic acid, sodium salt
P198	23422-53-9	Formetanate hydrochloride.
P197	17702-57-7	Formparanate.
P065	628-86-4	Fulminic acid, mercury(2+) salt (R,T)
P059	76-44-8	Heptachlor
P062	757-58-4	Hexaethyl tetraphosphate
P116	79-19-6	Hydrazinecarbothioamide
P068	60-34-4	Hydrazine, methyl-
P063	74-90-8	Hydrocyanic acid
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.
P007	2763-96-4	3(2H)-Isoxazolone, 5-(aminomethyl)-
P196	15339-36-3	Manganese, bis(dimethylcarbamodithioato-S,S[prime])-,
P196	15339-36-3	Manganese dimethyldithiocarbamate.
P092	62-38-4	Mercury, (acetato-O)phenyl-
P065	628-86-4	Mercury fulminate (R,T)
P082	62-75-9	Methanamine, N-methyl-N-nitroso-
P064	624-83-9	Methane, isocyanato-
P016	542-88-1	Methane, oxybis[chloro-
P112	509-14-8	Methane, tetranitro- (R)
P118	75-70-7	Methanethiol, trichloro-
P198	23422-53-9	Methanimidamide, N,N-dimethyl-N[prime]-[3-[[(methylamino)- carbonyl]oxy]phenyl]-, monohydrochloride.
P197	17702-57-7	Methanimidamide, N,N-dimethyl-N[prime]-[2-methyl-4-[[(methylamino)carbonyl]oxy]phenyl]-
P050	115-29-7	6,9-Methano-2,4,3-benzodioxathiepin,6,7,8,9,10,10-hexachloro-1,5,5a,6,9,9a-hexahydro-, 3-oxide
P059	76-44-8	4,7-Methano-1H-indene, 1,4,5,6,7,8,8-heptachloro-3a,4,7,7a-tetrahydro-
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	315-8-4	Mexacarbate.
P072	86-88-4	alpha-Naphthylthiourea
P073	13463-39-3	Nickel carbonyl
P073	13463-39-3	Nickel carbonyl Ni(CO)4, (T-4)-

Waste Code	CASRN	Substance
P074	557-19-7	Nickel cyanide
P074	557-19-7	Nickel cyanide Ni(CN)2
P075	\1\ 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
P078	10102-44-0	Nitrogen oxide NO2
P081	55-63-0	Nitroglycerine (R)
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P085	152-16-9	Octamethylpyrophosphoramide
P087	20816-12-0	Osmium oxide OsO4, (T-4)-
P087	20816-12-0	Osmium tetroxide
P088	145-73-3	7-Oxabicyclo[2.2.1]heptane-2,3- dicarboxylic acid
P194	23135-22-0	Oxamyl.
P089	56-38-2	Parathion
P034	131-89-5	Phenol, 2-cyclohexyl-4,6-dinitro-
P048	51-28-5	Phenol, 2,4-dinitro-
P047	\1\ 534-52-1	Phenol, 2-methyl-4,6-dinitro-, & salts
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-dinitro-
P009	131-74-8	Phenol, 2,4,6-trinitro-, ammonium salt (R)
P128	315-18-4	Phenol, 4-(dimethylamino)-3,5-dimethyl-
P199	2032-65-7	Phenol,(3,5-dimethyl-4-(methylthio) methylcarbamate
P202	64-00-6	Phenol, 3-(1-methylethyl)-, methyl carbamate.
P201	2631-37-0	Phenol, 3-methyl-5-(1-methylethyl)-,methyl carbamate.
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
P039	298-04-4	Phosphorodithioic acid, O,O-diethyl S-[2-(ethylthio)ethyl] ester
P094	298-02-2	Phosphorodithioic acid, O,O-diethyl S-[(ethylthio)methyl] 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
P089	56-38-2	Phosphorothioic acid, O,O-diethyl O-(4-nitrophenyl) ester
P040	297-97-2	Phosphorothioic acid,O,O-diethylO-pyrazinyl ester

Waste Code	CASRN	Substance
P097	52-85-7	Phosphorothioic acid, O-[4-[(dimethylamino) sulfonyl]phenyl] O,O-dimethyl ester
P071	298-00-0	Phosphorothioic acid, O,O,-dimethyl O-(4-nitrophenyl) ester
P204	57-47-6	Physostigmine.
P188	57-64-7	Physostigmine salicylate.
P110	78-00-2	Plumbane, tetraethyl-
P098	151-50-8	Potassium cyanide
P098	151-50-8	Potassium cyanide K(CN)
P099	506-61-6	Potassium silver cyanide
P201	2631-37-0	Promecarb
P070	116-06-3	Propanal, 2-methyl-2-(methylthio)-, O-[(methylamino)carbonyl]oxime
P203	1646-88-4	Propanal, 2-methyl-2-(methyl-sulfonyl)-O-[(methylamino)carbonyl] oxime.
P101	107-12-0	Propanenitrile
P027	542-76-7	Propanenitrile, 3-chloro-
P069	75-86-5	Propanenitrile, 2-hydroxy-2-methyl-
P081	55-63-0	1,2,3-Propanetriol, trinitrate (R)
P017	598-31-2	2-Propanone, 1-bromo-
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
P075	\1\ 54-11-5	Pyridine, 3-(1-methyl-2-pyrrolidinyl)-(S)-, & salts
P204	57-47-6	Pyrrolo[2,3-b]indol-5-ol, 1,2,3,3a,8,8a-hexahydro-1,3a,8-trimethyl-methylcarbamate (ester),(3aS-cis)-
P114	12039-52-0	Selenious acid, dithallium(1+) salt
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P104	506-64-9	Silver cyanide Ag(CN)
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P106	143-33-9	Sodium cyanide Na(CN)
P108	\1\ 57-24-9	Strychnidin-10-one, & salts
P018	357-57-3	Strychnidin-10-one, 2,3-dimethoxy-
P108	\1\ 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)

Waste Code	CASRN	Substance
P062	757-58-4	Tetraphosphoric acid, hexaethyl ester
P113	1314-32-5	Thallic oxide
P113	1314-32-5	Thallium oxide Tl2 O3
P114	12039-52-0	Thallium(I) selenite
P115	7446-18-6	Thallium(I) sulfate
P109	3689-24-5	Thiodiphosphoric acid, tetraethyl ester
P045	39196-18-4	Thiofanox
P049	541-53-7	Thioimidodicarbonic diamide [(H2N)C(S)]2 NH
P014	108-98-5	Thiophenol
P116	79-19-6	Thiosemicarbazide
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
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Vanadic acid, ammonium salt
P120	1314-62-1	Vanadium oxide V2 O5
P120	1314-62-1	Vanadium pentoxide
P084	4549-40-0	Vinylamine, N-methyl-N-nitroso-concentrations greater than 0.3%
P205	137-30-4	Zinc, bis(dimethylcarbamodithioato-S,S[prime])-,
P121	557-21-1	Zinc cyanide
P121	557-21-1	Zinc cyanide Zn(CN)2
P122	1314-84-7	Zinc phosphide Zn3 P2, when present at concentrations greater than 10% (R,T)
P205	137-30-4	Ziram.

\1\ CAS Number given for parent compound only.

SECTION 5

CHEMICAL SPILL EMERGENCY PLAN

The Chemical Spill Emergency Policy is hereby approved.

Louis H. Katz
Vice President and Treasurer

7/15/92
Date

John A. Schauss
Associate Vice President for Finance

7/15/92
Date

THE GEORGE WASHINGTON UNIVERSITY
CHEMICAL SPILL EMERGENCY PLAN

1.0 PURPOSE

For the purpose of this plan, a chemical emergency shall be defined as any spill, explosion or release of a hazardous substance that may harm human life or the environment.

The purpose of this plan is to minimize hazards to George Washington University students, faculty, staff, the general public, and the environment from any unplanned sudden released of hazardous chemicals. The plan will be consulted primarily by the Emergency Coordinators; however, all George Washington University personnel involved in the transportation, handling, storage, disposal and the management of hazardous chemicals should be familiar with the contents of this plan. The plan will also be distributed to University faculty, staff members and local response authorities who may be involved in a chemical emergency.

The provisions of this plan should be carried out immediately whenever there is a fire, explosion, or release of hazardous waste which would threaten human life or the environment.

The Chemical Spill Emergency Plan will be reviewed annually by the Hazardous Materials Committee for the purpose of updating changes and to insure that the Emergency Telephone Contact List is accurate.

2.0 EMERGENCY PROCEDURES FOR UNIVERSITY PERSONNEL

2.1 Report any spill or leak of a hazardous substance immediately to the University Police dispatcher at the emergency number (994-6110).

2.2 When calling in a chemical emergency, the caller must provide the following information to the dispatcher:

- **2.2.1** Name and telephone number of the reporting person.
- **2.2.2** Name and address of accident location.
- **2.2.3** Time and type of incident (e.g., spill, fire, explosion).
- **2.2.4** Name and quantity of material(s) involved, if known.
- **2.2.5** Extent of injuries, if any.
- **2.2.6** Possible hazards to human health (e.g., toxic vapors)
- **2.2.7** Damage to property or environment.

2.3 Notify the department head or chairman of the area(s) that are affected by the chemical release. Evacuate all personnel from the immediate work and/or laboratory area. If the

chemical release has the potential to affect large areas in the building, the internal fire alarm should be sounded.

2.4 Persons involved with the spill should remain near the scene and direct people away from the spill until one of the Emergency Coordinators arrives to assess the situation.

2.5 Consult the Spill Prevention, and Control Plan (Section 4.0) for more detailed information about chemical emergencies.

3.0 PROCEDURES FOR "EMERGENCY COORDINATORS"

University Police officers routinely respond to all emergencies occurring on campus, therefore, they will be designated as **"Emergency Coordinators"** in the event of a chemical emergency. The shift sergeant will be responsible to make an assessment of the situation and notify the proper response personnel in the event the Safety Manager or Safety Specialist are not available to respond to the emergency. During the B shift working hours (7:00a.m. to 3:00p.m.), the University Safety Manager and the Safety Specialist will be the primary Emergency Coordinators. Anytime other than the B shift working hours the shift sergeant will be designated as the primary Emergency Coordinator. (The Safety Manager can always be reached by pager for information during an emergency. **(See Emergency Telephone list 7.0).**

3.1 Notification

The Emergency Coordinator shall contact the District of Columbia Fire Department Hazardous Materials Team in the event of any chemical spill, unless a properly trained and experienced person (e.g., laboratory professor, safety personnel) can safely handle the spill. The Emergency Coordinator has the final authority to call in the Hazardous Materials Team if it is deemed necessary. The Emergency Coordinator must remain at the spill site to advise assisting agencies on the character, amounts and source to extent known to local authorities.

3.2 Evacuation

The Emergency Coordinator shall insure that persons in the immediate vicinity of a chemical spill are evacuated from the immediate work area, and if there is a substantial hazardous chemical release into the air, consideration should be given to evacuating the entire building by activating the internal fire alarm. The Emergency Coordinator is also responsible for keeping persons away from the spill and not allowing students, faculty, or staff to return to a building until it is safe for re-entry.

3.3 Assessment

The Emergency Coordinator will to the best of his or her knowledge whenever possible identify the character, source, amount, and real extent of any released hazardous materials. This may

be done by observing a chemical label on a container or reviewing campus records. The (EC) shall to the best of knowledge, assess possible hazards to human health or the environment that may result from the release. During an emergency, the (EC) shall take all reasonable measures to ensure that further releases do not occur, recur or spread to other hazardous chemicals on campus. These measures may include, where applicable, stopping operations, or containing released chemical materials.

4.0 SPILL PREVENTION, AND CONTROL (SPC) PLAN

The following are guidelines for spill control and safety precautions in the event of a chemical incident in which there is potential for a significant release on campus.

4.1 Chemical Identification

Individuals directly involved with the spill or personnel responding to an emergency should attempt to the best of their ability, identify the chemical spilled without causing harm to themselves. It is very important to determine what chemical is involved in a spill because each chemical has its own physical hazards, health effects, levels of toxicity, incompatibilities and clean up procedures. The District of Columbia Fire Department's Hazardous Materials Team can handle the clean up of a spill more effectively, and in a timely manner when the identity of a chemical is known.

The most obvious means of identifying a spilled chemical is locating the container from which it came from and read the label. All containers should be labeled with the chemical's name, name and address of the manufacturer, physical and health hazards, and recommended personal protective equipment. Labels are a quick source of important information about a chemical. More detailed information about a chemical can be found on the Material Safety Data Sheet (MSDS). MSDS's can be found in yellow 3-ring binders labeled **"MATERIAL SAFETY DATA SHEETS."** These yellow notebooks should be located in each laboratory and in any stockroom where chemicals are stored. In addition to labs and storage areas, a master copy of all MSDS's is retained in the Safety Office located in Woodhull House.

Material Safety Data Sheets contain the following detailed information about a chemical:

- **4.1.1** Chemical identity
- **4.1.2** Hazardous ingredients
- **4.1.3** Physical and chemical characteristics
- **4.1.4** Fire and explosion data
- **4.1.5** Reactivity
- **4.1.6** Health hazards
- **4.1.7** Spill and leak procedures
- **4.1.8** Personal protection
- **4.1.9** Control measures

Follow all warnings and precautions listed on a MSDS in the event of a chemical spill or release.

4.2 Spill Control

If the identity of a chemical spilled is not known and if the toxic effects and health hazards related to the chemical are unknown; University personnel should not attempt to handle the spill. Spills of unknown materials should be left the District of Columbia Hazardous Materials Team which has been designated as the primary emergency authority **(telephone 911 or 745-2348)**. Spills should only be attempted to be contained/controlled by individuals who are experienced and properly trained in chemical handling (e.g., laboratory personnel, safety personnel).

Non-ignitable, low toxicity liquids or solids not generating dangerous gases can be handled by laboratory personnel and representatives of the Safety Office (based on their level of training and experience) if the volume is sufficiently small. Inert absorbent or neutralizing solids should be used to prevent the spread of liquids. Absorbent material should be spread around the periphery of the spill and the center of the spill. Persons should not attempt to handle spills unless they are properly trained and have the proper personal protective equipment such as, chemical resistant gloves, chemical aprons, impermeable suits, and multiple cartridge chemical respirators.

When spills occur in laboratories and interior building spaces, affected areas should be ventilated when possible. This can be done by opening windows and doors in the affected area.

4.3 Personal Contamination

In the case of any chemical exposure, prompt medical attention should be sought immediately by dialing the campus emergency number, ext. (4-611) or (911).

If a chemical is spilled on the body, all contaminated clothing should be removed and the affected areas should be flooded with cold water. Safety showers are located in chemical laboratories and should be utilized when a chemical is spilled on the body. If a chemical gets into the eyes, the eyes should be flushed with tepid water for at least 15 minutes. Emergency eyewash stations can also be found in chemical laboratories.

5.0 ARRANGEMENTS WITH LOCAL AUTHORITIES

The Safety Manager of the Office of Risk Management shall meet on a yearly basis with the representatives of the District of Columbia Fire Department's Hazardous Materials Team as needed to familiarize them with the following.

5.1 The layout of campus hazardous chemical usage and storage areas.

5.2 Lists of hazardous chemicals being used and stored by location.
5.3 Inspection of storage and usage sites.
5.4 Updated Emergency Coordinator contact lists.

In addition, the Safety Manager will coordinate the treating, storing and disposal of recovered waste resulting from a spill with either an EPA authorized contractor of the District of Columbia Hazardous Materials Team immediately following the emergency.

6.0 STORAGE, USAGE AND RECEIVING FACILITIES

The following areas listed below are identified as areas where potential chemical spills may occur.

1) **Corcoran Hall - 725 21st St.** (Chemistry; Physics) - Basement chemical storage rooms and laboratories throughout building.

2) **Bell Hall - 2029 G St.** (Geology) - Chemical storage rooms and laboratories.

3) **Lisner Hall - 2023 G St.** (Biology) - Chemical storage rooms and laboratories.

4) **Samson Hall - 2035 H St.** (Forensic Science) - Laboratories.

5) **Smith Hall - 801 22nd St.** (Art Building) - Chemical storage rooms and laboratories.

6) **Tompkins Hall - 725 23rd St.** (Engineering) - Chemical storage rooms and laboratories.

7) **Building EE - 2129 33rd St.** (Physical Plant) - Shop and chemical storage areas.

8) **Support Building - 2025 F St.** (Physical Plant) - Chemical Storage areas.

9) **Academic Center - 801 22nd St.** (Printing and Graphics) - Chemical storage areas printing operating areas.

7.0 EMERGENCY TELEPHONE NUMBERS

The following numbers should be used in the event of a chemical emergency. All calls should be directed to the University Police Emergency number. The University Police Dispatcher will notify the appropriate response personnel.

Emergency Response Personnel	Telephone Number
University Police	**Ext. 4-6111**
Safety Office	**Ext. 4-6947**

Safety Office (24 hour pager)	**(703) 912-1003**
D.C. Fire Department	**(9) 911**
D.C. Metropolitan Police Department	**(9) 911**

SECTION 6

OSHA PERMISSIBLE EXPOSURE LEVELS

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (f)	Transitional limits			Final rule limits**						
		PEL*		Skin designation	TWA		STEL (c)		Ceiling		Skin designation
		ppm (a)	mg/m³ (b)		ppm (a)	mg/m³ (b)	ppm (a)	mg/m³ (b)	ppm (a)	mg/m³ (b)	
Acetaldehyde	75-07-0	200	360		100	180	150	270			
Acetic acid	64-19-7	10	25		10	25					
Acetic anhydride	108-24-7	5	20						5	20	
Acetone	67-64-1	1000	2400		750	1800	1000	2400			
Acetone[a]	67-64-1	1000	2400		750	1800	1000 [b]	2400 [b]			
2-Acetylaminofluorine; see 1910.1014	53-96-3										
Acetylene dichloride; see 1,2-Dichloroethylene											
Acetylene tetrabromide	79-27-6	1	14		1	14					
Acetylsalicylic acid (Aspirin)	50-78-2					5					
Acrolein	107-02-8	0.1	0.25		0.1	0.25	0.3	0.8			
Acrylamide	79-06-1		0.3	X		0.03					X
Acrylic acid	79-10-7				10	30					X
Acrylonitrile; see 1910.1045	107-13-1										
Aldrin	309-00-2		0.25	X		0.25					X
Allyl alcohol	107-18-6	2	5	X	2	5	4	10			X
Allyl chloride	107-05-1	1	3		1	3	2	6			
Allyl glycidyl ether (AGE)	106-92-3	(C)10	(C)45		5	22	10	44			
Allyl propyl disulfide	2179-59-1	2	12		2	12	3	18			
alpha-Alumina	1344-28-1										
Total dust			15			10					
Respirable fraction			5			5					
Aluminum (as Al) Metal	7429-90-5										
Total dust			15			15					
Respirable fraction			5			5					
Pyro powders						5					
Welding fumes***						5					
Soluble salts						2					
Alkyls						2					
4-Aminodiphenyl; see 1910.1011	92-67-1										
2-Aminoethanol; see Ethanolamine											
2-Aminopyridine	504-29-0	0.5	2		0.5	2					
Amitrole	61-82-5					0.2					
Ammonia	7664-41-7	50	35				35	27			
Ammonium chloride fume	12125-02-9					10		20			
Ammonium sulfamate	7773-06-0										
Total dust			15			10					
Respirable fraction			5			5					
n-Amyl acetate	628-63-7	100	525		100	525					
sec-Amyl acetate	626-38-0	125	650		125	650					
Aniline and homologs	62-53-3	5	19	X	2	8					X
Anisidine (o-,p-isomers)	29191-52-4		0.5	X		0.5					X
Antimony and compounds (as Sb)	7440-36-0		0.5			0.5					
ANTU (alpha Naphthylthiourea)	86-88-4		0.3			0.3					
Arsenic, organic compounds (as As)	7440-38-2		0.5			0.5					
Arsenic, inorganic compounds (as As); see 1910.1018	7440-38-2										
Arsine	7784-42-1	0.05	0.2		0.05	0.2					
Asbestos; see 1910.1001 and 1910.1101	Varies										
Atrazine	1912-24-9					5					
Azinphos-methyl	86-50-0		0.2	X		0.2					X
Barium, soluble compounds (as Ba)	7440-39-3		0.5			0.5					
Barium sulfate	7727-43-7										
Total dust			15			10					
Respirable fraction			5			5					
Benomyl	17804-35-2										
Total dust			15			10					
Respirable fraction			5			5					
Benzene; see 1910.1028	71-43-2										
See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028.[g]											
Benzidine; see 1910.1010	92-87-5										
p-Benzoquinone; see Quinone											
Benzo(a)pyrene; see Coal tar pitch volatiles											
Benzoyl peroxide	94-36-0		5			5					
Benzyl chloride	100-44-7	1	5		1	5					
Beryllium and beryllium compounds (as Be)	7440-41-7		Tbl. Z-2			Tbl. Z-2		Tbl. Z-2		Tbl. Z-2	
Biphenyl; see Diphenyl											
Bismuth telluride, Undoped	1304-82-1										
Total dust			15			15					
Respirable fraction			5			5					
Bismuth telluride, Se-doped						5					
Borates, tetra, sodium salts											
Anhydrous	1330-43-4					10					
Decahydrate	1303-96-4					10					
Pentahydrate	12179-04-3					10					
Boron oxide	1303-86-2										
Total dust			15			10					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
Boron tribromide	10294-33-4								1	10	
Boron trifluoride	7637-07-2	(C)1	(C)3						1	3	
Bromacil	314-40-9				1	10					
Bromine	7726-95-6	0.1	0.7		0.1	0.7	0.3	2			
Bromine pentafluoride	7789-30-2				0.1	0.7					
Bromoform	75-25-2	0.5	5	X	0.5	5					X
Butadiene (1,3-Butadiene)	106-99-0	1000	2200		1000	2200					
Butane	106-97-8				800	1900					
Butanethiol; see Butyl mercaptan											
2-Butanone (Methyl ethyl ketone)	78-93-3	200	590		200	590	300	885			
2-Butoxyethanol	111-76-2	50	240	X	25	120					X
n-Butyl acetate	123-86-4	150	710		150	710	200	950			
sec-Butyl acetate	105-46-4	200	950		200	950					
tert-Butyl acetate	540-88-5	200	950		200	950					
Butyl acrylate	141-32-2				10	55					
n-Butyl alcohol	71-36-3	100	300						50	150	X
sec-Butyl alcohol	78-92-2	150	450		100	305					
tert-Butyl alcohol	75-65-0	100	300		100	300	150	450			
Butylamine	109-73-9	(C)5	(C)15	X					5	15	X
tert-Butyl chromate (as CrO_3)	1189-85-1		(C)0.1	X						0.1	X
n-Butyl glycidyl ether (BGE)	2426-08-6	50	270		25	135					
n-Butyl lactate	138-22-7				5	25					
Butyl mercaptan	109-79-5	10	35		0.5	1.5					
o-sec-Butylphenol	89-72-5				5	30					X
p-tert-Butyltoluene	98-51-1	10	60		10	60	20	120			
Cadmium fume (as Cd)	7440-43-9		Tbl. Z-2			0.1				0.3	
Cadmium dust (as Cd)	7440-43-9		Tbl. Z-2			0.2				0.6	
Calcium carbonate	1317-65-3										
Total dust			15			15					
Respirable fraction			5			5					
Calcium cyanamide	156-62-7					0.5					
Calcium hydroxide[i]	1305-62-0					5[i]					
Calcium oxide[i]	1305-78-8		5			5[i]					
Calcium silicate	1344-95-2										
Total dust			15			15					
Respirable fraction			5			5					
Calcium sulfate	7778-18-9										
Total dust			15			15					
Respirable fraction			5			5					
Camphor, synthetic	76-22-2		2			2					
Caprolactam	105-60-2										
Dust						1		3			
Vapor					5	20	10	40			
Captafol (Difolatan®)	2425-06-1					0.1					
Captan	133-06-2					5					
Carbaryl (Sevin®)	63-25-2		5			5					
Carbofuran (Furadan®)	1563-66-2					0.1					
Carbon black	1333-86-4		3.5			3.5					
Carbon dioxide	124-38-9	5000*	9000		10,000	18,000	30,000	54,000			
Carbon disulfide	75-15-0	Tbl. Z-2			4	12	12	36			X
Carbon monoxide	630-08-0	50	55		35	40			200	229	
Carbon tetrabromide	558-13-4				0.1	1.4	0.3	4			
Carbon tetrachloride	56-23-5	Tbl. Z-2			2	12.6					
Carbonyl fluoride	353-50-4				2	5	5	15			
Catechol (Pyrocatechol)	120-80-9				5	20					X
Cellulose	9004-34-6										
Total dust			15			15					
Respirable fraction			5			5					
Cesium hydroxide	21351-79-1					2					
Chlordane	57-74-9		0.5	X		0.5					X
Chlorinated camphene	8001-35-2		0.5	X		0.5		1			X
Chlorinated diphenyl oxide	55720-99-5		0.5			0.5					
Chlorine	7782-50-5	(C)1	(C)3		0.5	1.5	1	3			
Chlorine dioxide	10049-04-4	0.1	0.3		0.1	0.3	0.3	0.9			
Chlorine trifluoride	7790-91-2	(C)0.1	(C)0.4						0.1	0.4	
Chloroacetaldehyde	107-20-0	(C)1	(C)3						1	3	
α-Chloroacetophenone (Phenacyl chloride)	532-27-4	0.05	0.3		0.05	0.3					
Chloroacetyl chloride	79-04-9				0.05	0.2					
Chlorobenzene	108-90-7	75	350		75	350					
o-Chlorobenzylidene malononitrile	2698-41-1	0.05	0.4						0.05	0.4	X
Chlorobromomethane	74-97-5	200	1050		200	1050					
2-Chloro-1,3-butadiene; see b-Chloroprene											
Chlorodifluoromethane	75-45-6				1000	3500					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
Chlorodiphenyl (42% Chlorine) (PCB)	53469-21-9		1	X		1					X
Chlorodiphenyl (54% Chlorine) (PCB)	11097-69-1		0.5	X		0.5					X
1-Chloro,2,3-epoxypropane; see Epichlorohydrin											
2-Chloroethanol; see Ethylene chlorohydrin											
Chloroethylene; see Vinyl chloride											
Chloroform (Trichloromethane)	67-66-3	(C)50	(C)240		2	9.78					
bis(Chloromethyl) ether; see 1910.1008	542-88-1										
Chloromethyl methyl ether; see 1910.1006	107-30-2										
1-Chloro-1-nitropropane	600-25-9	20	100		2	10					
Chloropentafluoroethane	76-15-3				1000	6320					
Chloropicrin	76-06-2	0.1	0.7		0.1	0.7					
beta-Chloroprene	126-99-8	25	90	X	10	35					X
o-Chlorostyrene	2039-87-4				50	285	75	428			
o-Chlorotoluene	95-49-8				50	250					
2-Chloro-6-trichloro-methyl pyridine	1929-82-4										
Total dust			15			15					
Respirable fraction			5			5					
Chlorpyrifos	2921-88-2					0.2					X
Chromic acid and chromates (as CrO_3)	7440-47-3		Tbl. Z-2							0.1	
Chromium (II) compounds (as Cr)	7440-47-3		0.5			0.5					
Chromium (III) compounds (as Cr)	7440-47-3		0.5			0.5					
Chromium metal (as Cr)	7440-47-3		1			1					
Chrysene; see Coal tar pitch volatiles											
Clopidol	2971-90-6										
Total dust			15			15					
Respirable fraction			5			5					
Coal dust (less than 5% SiO_2), Respirable fraction			Tbl. Z-3			2					
Coal dust (greater than or equal to 5% SiO_2), Respirable quartz fraction.			Tbl. Z-3			0.1					
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene.	65966-93-2		0.2			0.2					
Cobalt metal, dust, and fume (as Co)	7440-48-4		0.1			0.05					
Cobalt carbonyl (as Co)	10210-68-1					0.1					
Cobalt hydrocarbonyl (as Co)	16842-03-8					0.1					
Coke oven emissions; see 1910.1029	-										
Copper	7440-50-8										
Fume (as Cu)			0.1			0.1					
Dusts and mists (as Cu)			1			1					
Cotton dust (raw)			1			1					
This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.											
Crag herbicide (Sesone)	136-78-7										
Total dust			15			10					
Respirable fraction			5			5					
Cresol, all isomers	1319-77-3	5	22	X	5	22					X
Crotonaldehyde	123-73-9; 4170-30-3	2	6		2	6					
Cruformate	299-86-5					5					
Cumene	98-82-8	50	245	X	50	245					X
Cyanamide	420-04-2					2					
Cyanides (as CN)	Varies with compound		5			5					
Cyanogen	460-19-5				10	20					
Cyanogen chloride	506-77-4								0.3	0.6	
Cyclohexane	110-82-7	300	1050		300	1050					
Cyclohexanol	108-93-0	50	200		50	200					X
Cyclohexanone	108-94-1	50	200		25	100					X
Cyclohexene	110-83-8	300	1015		300	1015					
Cyclohexylamine	108-91-8				10	40					
Cyclonite	121-82-4					1.5					X
Cyclopentadiene	542-92-7	75	200		75	200					
Cyclopentane	287-92-3				600	1720					
Cyhexatin	13121-70-5					5					
2,4-D (Dichlorylphenoxyacetic acid)	94-75-7		10			10					
Decaborane	17702-41-9	0.05	0.3	X	0.05	0.3	0.15	0.9			X
Demeton (Systox®)	8065-48-3		0.1	X		0.1					X
Dichlorodiphenyltrichloroethane (DDT)	50-29-3		1	X		1					X
Dichlorvos (DDVP)	62-73-7		1	X		1					X
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone)	123-42-2	50	240		50	240					
1,2-Diaminoethane; see Ethylenediamine											
Diazinon	333-41-5					0.1					X
Diazomethane	334-88-3	0.2	0.4		0.2	0.4					
Diborane	19287-45-7	0.1	0.1		0.1	0.1					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
1,2-Dibromo-3-chloropropane; see 1910.1044	96-12-8										
2-N-Dibutylaminoethanol	102-81-8				2	14					
Dibutyl phosphate	107-66-4	1	5		1	5	2	10			
Dibutyl phthalate	84-74-2		5			5					
Dichloroacetylene	7572-29-4								0.1	0.4	
o-Dichlorobenzene	95-50-1	(C)50	(C)300						50	300	
p-Dichlorobenzene	106-46-7	75	450		75	450	110	675			
3,3'-Dichlorobenzidine; see 1910.1007	91-94-1										
Dichlorodifluoromethane	75-71-8	1000	4950		1000	4950					
1,3-Dichloro-5,5-dimethyl hydantoin	118-52-5		0.2			0.2		0.4			
1,1-Dichloroethane	75-34-3	100	400		100	400					
1,2-Dichloroethylene	540-59-0	200	790		200	790					
Dichloroethyl ether	111-44-4	(C)15	(C)90	X	5	30	10	60			X
Dichloromethane; see Methylene chloride											
Dichloromonofluoromethane	75-43-4	1000	4200		10	40					
1,1-Dichloro-1-nitroethane	594-72-9	(C)10	(C)60		2	10					
1,2-Dichloropropane; see Propylenedichloride											
1,3-Dichloropropene	542-75-6				1	5					X
2,2-Dichloropropionic acid	75-99-0				1	6					
Dichlorotetrafluoroethane	76-14-2	1000	7000		1000	7000					
Dicrotophos	141-66-2					0.25					X
Dicyclopentadiene	77-73-6				5	30					
Dicyclopentadienyl iron	102-54-5										
Total dust			15			10					
Respirable fraction			5			5					
Dieldrin	60-57-1		0.25	X		.025					X
Diethanolamine	111-42-2				3	15					
Diethylamine	109-89-7	25	75		10	30	25	75			
2-Diethylaminoethanol	100-37-8	10	50	X	10	50					X
Diethylene triamine	111-40-0				1	4					
Diethyl ether; see Ethyl ether											
Diethyl ketone	96-22-0				200	705					
Diethyl phthalate	84-66-2					5					
Difluorodibromomethane	75-61-6	100	860		100	860					
Diglycidyl ether (DGE)	2238-07-5	(C)0.5	(C)2.8		0.1	0.5					
Dihydroxybenzene; see Hydroquinone											
Diisobutyl ketone	108-83-8	50	290		25	150					
Diisopropylamine	108-18-9	5	20	X	5	20					X
4-Dimethylaminoazobenzene; see 1910.1015	60-11-7										
Dimethoxymethane; see Methylal											
Dimethyl acetamide	127-19-5	10	35	X	10	35					X
Dimethylamine	124-40-3	10	18		10	18					
Dimethylaminobenzene; see Xylidine											
Dimethylaniline (N-Dimethyl-aniline)	121-69-7	5	25	X	5	25	10	50			X
Dimethylbenzene; see Xylene											
Dimethyl-1,2-dibromo-2,2-dichloroethyl phosphate	300-76-5		3			3					X
Dimethylformamide	68-12-2	10	30	X	10	30					X
2,6-Dimethyl-4-hepta-none; see Diisobutyl ketone											
1,1-Dimethylhydrazine	57-14-7	0.5	1	X	0.5	1					X
Dimethylphthalate	131-11-3		5			5					
Dimethyl sulfate	77-78-1	1	5	X	0.1	0.5					X
Dinitolmide (3,5-Dinitro-o-toluamide)	148-01-6					5					
Dinitrobenzene (all isomers)	(alpha-) 528-29-0 (meta-) 99-65-0 (para-) 100-25-4		1	X		1					X
Dinitro-o-cresol	534-52-1		0.2	X		0.2					X
Dinitrotoluene	25321-14-6		1.5	X		1.5					X
Dioxane (Diethylene dioxide)	123-91-1	100	360	X	25	90					X
Dioxathion (Delnav)	78-34-2					0.2					X
Diphenyl (Biphenyl)	92-52-4	0.2	1		0.2	1					
Diphenylamine	122-39-4					10					
Diphenylmethane diisocyanate; see Methylene bisphenyl isocyanate											
Dipropylene glycol methyl ether	34590-94-8	100	600	X	100	600	150	900			X
Dipropyl ketone	123-19-3				50	235					
Diquat	85-00-7					0.5					
Di-sec octyl phthalate (Di-2-ethylhexyl-phthalate)	117-81-7		5			5		10			
Disulfiram	97-77-8					2					
Disulfoton	298-04-4					0.1					X
2,6-Di-tert-butyl-p-cresol	128-37-0					10					
Diuron	330-54-1					10					
Divinyl benzene	1321-74-0				10	50					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
Emery	112-62-9										
Total dust			15			10					
Respirable fraction			5			5					
Endosulfan	115-29-7					0.1					X
Endrin	72-20-8		0.1	X		0.1					X
Epichlorohydrin	106-89-8	5	19	X	2	8					X
EPN	2104-64-5		0.5	X		0.5					X
1,2-Epoxypropane; see Propylene oxide											
2,3-Epoxy-1-propanol; see Glycidol											
Ethanethiol; see Ethyl mercaptan											
Ethanolamine	141-43-5	3	6		3	8	6	15			
Ethion	563-12-2					0.4					X
2-Ethoxyethanol	110-80-5	200	740	X	200	740					X
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	100	540	X	100	540					X
Ethyl acetate	141-78-6	400	1400		400	1400					
Ethyl acrylate	140-88-5	25	100	X	5	20	25	100			X
Ethyl alcohol (Ethanol)	64-17-5	1000	1900		1000	1900					
Ethylamine	75-04-7	10	18		10	18					
Ethyl amyl ketone (5-Methyl-3-heptanone)	541-85-5	25	130		25	130					
Ethyl benzene	100-41-4	100	435		100	435	125	545			
Ethyl bromide	74-96-4	200	890		200	890	250	1110			
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230		50	230					
Ethyl chloride	75-00-3	1000	2600		1000	2600					
Ethyl ether	60-29-7	400	1200		400	1200	500	1500			
Ethyl formate	109-94-4	100	300		100	300					
Ethyl mercaptan	75-08-1	(C)10	(C)25		0.5	1					
Ethyl silicate	78-10-4	100	850		10	85					
Ethylene chlorohydrin	107-07-3	5	16	X					1	3	X
Ethylenediamine	107-15-3	10	25		10	25					
Ethylene dibromide	106-93-4	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2
Ethylene dichloride	107-06-2	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	1	4	2	8			
Ethylene glycol	107-21-1								50	125	
Ethylene glycol dinitrate [k]	628-96-6	(C)0.2	(C)1	X				[k] 0.1			X
Ethylene glycol methyl acetate; see Methyl cellosolve acetate											
Ethylenemine; see 1910.1012	151-56-4										
Ethylene oxide; see 1910.1047	75-21-8										
Ethylidene chloride; see 1,1-Dichloroethane											
Ethylidene norbornene	16219-75-3								5	25	
N-Ethylmorpholine	100-74-3	20	94	X	5	23					X
Fenamiphos	22224-92-6					0.1					X
Fensulfothion (Dasanit)	115-90-2					0.1					
Fenthion	55-38-9					0.2					X
Ferbam	14484-64-1										
Total dust			15			10					
Ferrovanadium dust	12604-58-9		1			1		3			
Fluorides (as F)	Varies with compound		2.5			2.5					
Fluorine	7782-41-4	0.1	0.2		0.1	0.2					
Fluorotrichloromethane (Trichlorofluoromethane)	75-69-4	1000	5600						1000	5600	
Fonofos	944-22-9					0.1					X
Formaldehyde; see 1910.1048; See Table Z-2 for operations or sectors excluded from 1910.1048 or for which limit(s) is(are) stayed.	50-00-0										
Formamide	75-12-7				20	30	30	45			
Formic acid	64-18-6	5	9		5	9					
Furfural	98-01-1	5	20	X	2	8					X
Furfuryl alcohol	98-00-0	50	200		10	40	15	60			X
Gasoline	8006-61-9				300	900	500	1500			
Germanium tetrahydride	7782-65-2				0.2	0.6					
Glutaraldehyde	111-30-8								0.2	0.8	
Glycerin (mist)	56-81-5										
Total dust			15			10					
Respirable fraction			5			5					
Glycidol	556-52-5	50	150		25	75					
Glycol monoethyl ether; see 2-Ethoxyethanol											
Grain dust (oat, wheat, barley)						10					
Graphite, natural respirable dust	7782-42-5		Tbl. Z-3			2.5					
Graphite, synthetic											
Total dust			15			10					
Respirable fraction			5			5					
Guthion[h]; see Azinphos methyl											
Gypsum	13397-24-5										
Total dust			15			15					
Respirable fraction			5			5					
Hafnium	7440-58-6		0.5			0.5					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
Heptachlor	76-44-8		0.5	X		0.5					X
Heptane (n-Heptane)	142-82-5	500	2000		400	1600	500	2000			
Hexachlorobutadiene	87-68-3				0.02	0.24					
Hexachlorocyclo-pentadiene	77-47-4				0.01	0.1					
Hexachloroethane	67-72-1	1	10	X	1	10					X
Hexachloronaphthalene	1335-87-1		0.2	X		0.2					X
Hexafluoroacetone	684-16-2				0.1	0.7					X
n-Hexane	110-54-3	500	1800		50	180					
Hexane isomers	Varies with compound				500	1800	1000	3600			
2-Hexanone (Methyl n-butyl ketone)	591-78-6	100	410		5	20					
Hexone (Methyl isobutyl ketone)	108-10-1	100	410		50	205	75	300			
sec-Hexyl acetate	108-84-9	50	300		50	300					
Hexylene glycol	107-41-5								25	125	
Hydrazine	302-01-2	1	1.3	X	0.1	0.1					X
Hydrogenated terphenyls	61788-32-7				0.5	5					
Hydrogen bromide	10035-10-6	3	10						3	10	
Hydrogen chloride	7647-01-0	(C)5	(C)7						5	7	
Hydrogen cyanide	74-90-8	10	11	X			4.7	5			X
Hydrogen fluoride (as F)	7664-39-3	Tbl. Z-2			3		6				
Hydrogen peroxide	7722-84-1	1	1.4		1	1.4					
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2		0.05	0.2					
Hydrogen sulfide	7783-06-4	Tbl. Z-2	Tbl. Z-2		10	14	15	21			
Hydroquinone	123-31-9		2			2					
2-Hydroxypropyl acrylate	999-61-1				0.5	3					X
Indene	95-13-6				10	45					
Indium and compounds (as In)	7440-74-6					0.1					
Iodine	7553-56-2	(C)0.1	(C)1						0.1	1	
Iodoform	75-47-8				0.6	10					
Iron oxide fume	1309-37-1			10			10				
Iron pentacarbonyl (as Fe)	13463-40-6				0.1	0.8	0.2	1.6			
Iron salts (soluble) (as Fe)	Varies with compound					1					
Isoamyl acetate	123-92-2	100	525		100	525					
Isoamyl alcohol (primary and secondary)	123-51-3	100	360		100	360	125	450			
Isobutyl acetate	110-19-0	150	700		150	700					
Isobutyl alcohol	78-83-1	100	300		50	150					
Isooctyl alcohol	26952-21-6				50	270					X
Isophorone	78-59-1	25	140		4	23					
Isophorone diisocyanate	4098-71-9				0.005		0.02				X
2-Isopropoxyethanol	109-59-1				25	105					
Isopropyl acetate	108-21-4	250	950		250	950	310	1185			
Isopropyl alcohol	67-63-0	400	980		400	980	500	1225			
Isopropylamine	75-31-0	5	12		5	12	10	24			
N-Isopropylaniline	768-52-5				2	10					X
Isopropyl ether	108-20-3	500	2100		500	2100					
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240		50	240	75	360			
Kaolin											
Total dust			15			10					
Respirable fraction			5			5					
Ketene	463-51-4	0.5	0.9		0.5	0.9	1.5	3			
Lead inorganic (as Pb); see 1910.1025	7439-92-1										
Limestone	1317-65-3										
Total dust			15			15					
Respirable fraction			5			5					
Lindane	58-89-9		0.5	X		0.5					X
Lithium hydride	7580-67-8		0.025			0.025					
L.P.G. (liquefied petroleum gas)	68476-85-7	1000	1800		1000	1800					
Magnesite	546-93-0										
Total dust			15			15					
Respirable fraction			5			5					
Magnesium oxide fume	1309-48-4										
Total particulate			15			10					
Malathion	121-75-5										
Total dust			15	X		10					X
Maleic anhydride	108-31-6	0.25	1		0.25	1					
Manganese compounds (as Mn)	7439-96-5		(C)5							5	
Manganese fume (as Mn)	7439-96-5		(C)5			1		3			
Manganese cyclopenta-dienyl tricarbonyl (as Mn)	12079-65-1					0.1					X
Manganese tetroxide (as Mn)	1317-35-7					1					
Marble	1317-65-3										
Total dust			15			15					
Respirable fraction			5			5					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits			Final rule limits**						
		PEL*		Skin designation	TWA		STEL (c)		Ceiling		Skin designation
		ppm (a)	mg/m³ (b)		ppm (a)	mg/m³ (b)	ppm (a)	mg/m³ (b)	ppm (a)	mg/m³ (b)	
Mercury (aryl and inorganic) (as Hg)	7439-97-6		Tbl. Z-2							0.1	X
Mercury (organo) alkyl compounds (as Hg)	7439-97-6		Tbl. Z-2			0.01		0.03			X
Mercury (vapor) (as Hg)	7439-97-6		Tbl. Z-2			0.05					X
Mesityl oxide	141-79-7	25	100		15	60	25	100			
Methacrylic acid	79-41-4				20	70					X
Methanethiol; see Methyl mercaptan											
Methomyl (Lannate)	16752-77-5					2.5					
Methoxychlor	72-43-5										
Total dust			15			10					
2-Methoxyethanol; see Methyl cellosolve											
4-Methoxyphenol	150-76-5					5					
Methyl acetate	79-20-9	200	610		200	610	250	760			
Methyl acetylene (Propyne)	74-99-7	1000	1650		1000	1650					
Methyl acetylene-propadiene mixture (MAPP)		1000	1800		1000	1800	1250	2250			
Methyl acrylate	96-33-3	10	35	X	10	35					X
Methylacrylonitrile	126-98-7				1	3					X
Methylal (Dimethoxy-methane)	109-87-5	1000	3100		1000	3100					
Methyl alcohol	67-56-1	200	260		200	260	250	325			X
Methylamine	74-89-5	10	12		10	12					
Methyl amyl alcohol; see Methyl isobutyl carbinol											
Methyl n-amyl ketone	110-43-0	100	465		100	465					
Methyl bromide	74-83-9	(C)20	(C)80	X	5	20					X
Methyl butyl ketone; see 2-Hexanone											
Methyl cellosolve (2-Methoxyethanol)	109-86-4	25	80	X	25	80					X
Methyl cellosolve acetate (2-Methoxyethyl acetate)	110-49-6	25	120	X	25	120					X
Methyl chloride	74-87-3	Tbl. Z-2			50	105	100	210			
Methyl chloroform (1,1,1-Trichloroethane)	71-55-6	350	1900		350	1900	450	2450			
Methyl 2-cyanoacrylate	137-05-3				2	8	4	16			
Methyl cyclohexane	108-87-2	500	2000		400	1600					
Methylcyclohexanol	25639-42-3	100	470		50	235					
o-Methylcyclohexanone	583-60-8	100	460	X	50	230	75	345			X
Methylcyclopentadienyl manganese tricarbonyl (as Mn)	12108-13-3					0.2					X
Methyl demeton	8022-00-2					0.5					X
4,4'-Methylene bis (2-chloroaniline) (MBOCA)	101-14-4				0.02	0.22					X
Methylene bis(4-cyclohexylisocyanate)	5124-30-1								0.01	0.11	X
Methylene chloride	75-09-2	Tbl. Z-2			Tbl. Z-2		Tbl. Z-2		Tbl. Z-2		
Methyl ethyl ketone peroxide (MEKP)	1338-23-4								0.7	5	
Methyl formate	107-31-3	100	250		100	250	150	375			
Methyl hydrazine (Monomethyl hydrazine)	60-34-4	(C)0.2	(C)0.35	X					0.2	0.35	X
Methyl iodide	74-88-4	5	28	X	2	10					X
Methyl isoamyl ketone	110-12-3				50	240					
Methyl isobutyl carbinol	108-11-2	25	100	X	25	100	40	165			X
Methyl isobutyl ketone; see Hexone											
Methyl isocyanate	624-83-9	0.02	0.05	X	0.02	0.05					X
Methyl isopropyl ketone	563-80-4				200	705					
Methyl mercaptan	74-93-1	(C)10	(C)20		0.5	1					
Methyl methacrylate	80-62-6	100	410		100	410					
Methyl parathion	298-00-0					0.2					X
Methyl propyl ketone; see 2-Pentanone											
Methyl silicate	681-84-5				1	6					
alpha-Methyl styrene	98-83-9	(C)100	(C)480		50	240	100	485			
Methylene bisphenyl isocyanate (MDI)	101-68-8	(C)0.02	(C)0.2						0.02	0.2	
Metribuzin	21087-64-9					5					
Mica; see Silicates											
Molybdenum (as Mo)	7439-98-7										
Soluble compounds			5			5					
Insoluble compounds											
Total dust			15			10					
Monocrotophos (Azodrin®)	6923-22-4					0.25					
Monomethyl aniline	100-61-8	2	9	X	0.5	2					X
Morpholine	110-91-8	20	70	X	20	70	30	105			X
Naphtha (Coal tar)	8030-30-6	100	400		100	400					
Naphthalene	91-20-3	10	50		10	50	15	75			
alpha-Naphthylamine; see 1910.1004	134-32-7										
beta-Naphthylamine; see 1910.1009	91-59-8										
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007		0.001	0.007					
Nickel, metal and insoluble compounds (as Ni)	7440-02-0		1			1					
Nickel, soluble compounds (as Ni)	7440-02-0		1			0.1					
Nicotine	54-11-5		0.5	X		0.5					X
Nitric acid	7697-37-2	2	5		2	5	4	10			
Nitric oxide	10102-43-9	25	30		25	30					
p-Nitroaniline	100-01-6	1	6	X		3					X
Nitrobenzene	98-95-3	1	5	X	1	5					X

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
p-Nitrochlorobenzene	100-00-5		1	X		1					X
4-Nitrodiphenyl; see 1910.1003	92-93-3										
Nitroethane	79-24-3	100	310		100	310					
Nitrogen dioxide	10102-44-0	(C)5	(C)9				1	1.8			
Nitrogen trifluoride	7783-54-2	10	29		10	29					
Nitroglycerin[1]	55-63-0	(C)0.2	(C)2	X				[1]0.1			X
Nitromethane	75-52-5	100	250		100	250					
1-Nitropropane	108-03-2	25	90		25	90					
2-Nitropropane	79-46-9	25	90		10	35					
N-Nitrosodimethylamine; see 1910.1016	62-75-9										
Nitrotoluene		5	30	X	2	11					X
o-isomer	88-72-2										
m-isomer	99-08-1										
p-isomer	99-99-0										
Nitrotrichloromethane; see Chloropicrin											
Nonane	111-84-2				200	1050					
Octachloronaphthalene	2234-13-1		0.1	X		0.1		0.3			X
Octane	111-65-9	500	2350		300	1450	375	1800			
Oil mist, mineral	8012-95-1		5			5					
Osmium tetroxide (as Os)	20816-12-0		0.002		0.0002	0.002	0.0006	0.006			
Oxalic acid	144-62-7		1			1		2			
Oxygen difluoride	7783-41-7	0.05	0.1						0.05	0.1	
Ozone	10028-15-6	0.1	0.2		0.1	0.2	0.3	0.6			
Paraffin wax fume	8002-74-2					2					
Paraquat, respirable dust	1910-42-5		0.5	X		0.1					X
	4685-14-7										
	2074-50-2										
Parathion	56-38-2		0.1	X		0.1					X
Particulates not otherwise regulated											
Total dust			15			15					
Respirable fraction			5			5					
Pentaborane	19624-22-7	0.005	0.01		0.005	0.01	0.015	0.03			
Pentachloronaphthalene	1321-64-8		0.5	X		0.5					X
Pentachlorophenol	87-86-5		0.5	X		0.5					X
Pentaerythritol	115-77-5										
Total dust			15			10					
Respirable fraction			5			5					
Pentane	109-66-0	1000	2950		600	1800	750	2250			
2-Pentanone (Methyl propyl ketone)	107-87-9	200	700		200	700	250	875			
Perchloroethylene (Tetrachloroethylene)	127-18-4	Tbl. Z-2			25	170					
Perchloromethyl mercaptan	594-42-3	0.1	0.8		0.1	0.8					
Perchloryl fluoride	7616-94-6	3	13.5		3	14	6	28			
Perlite											
Total dust			15			15					
Respirable fraction			5			5					
Petroleum distillates (Naphtha)		500	2000		400	1600					
Phenol	108-95-2	5	19	X	5	19					X
Phenothiazine	92-84-2					5					X
p-Phenylene diamine	106-50-3		0.1	X		0.1					X
Phenyl ether, vapor	101-84-8	1	7		1	7					
Phenyl ether-biphenyl mixture, vapor		1	7		1	7					
Phenylethylene; see Styrene											
Phenyl glycidyl ether (PGE)	122-60-1	10	60		1	6					
Phenylhydrazine	100-63-0	5	22	X	5	20	10	45			X
Phenyl mercaptan	108-98-5				0.5	2					
Phenylphosphine	638-21-1								0.05	0.25	
Phorate	298-02-2					0.05		0.2			X
Phosdrin (Mevinphos®)	7786-34-7		0.1	X	0.01	0.1	0.03	0.3			X
Phosgene (Carbonyl chloride)	75-44-5	0.1	0.4		0.1	0.4					
Phosphine	7803-51-2	0.3	0.4		0.3	0.4	1	1			
Phosphoric acid	7664-38-2		1			1		3			
Phosphorus (yellow)	7723-14-0		0.1			0.1					
Phosphorus oxychloride	10025-87-3				0.1	0.6					
Phosphorus pentachloride	10026-13-8		1			1					
Phosphorus pentasulfide	1314-80-3		1			1		3			
Phosphorus trichloride	7719-12-2	0.5	3		0.2	1.5	0.5	3			
Phthalic anhydride	85-44-9	2	12			6					
Phthalodinitrile	626-17-5					5					
Picloram	1918-02-1										
Total dust			15			10					
Respirable fraction			5			5					
Picric acid	88-89-1		0.1	X		0.1					X
Piperazine dihydro-chloride	142-64-3					5					
Pindone (2-Pivalyl-1,3-indandione)	83-26-1		0.1			0.1					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
Plaster of Paris	26499-65-0										
Total dust			15			15					
Respirable fraction			5			5					
Platinum (as Pt)	7440-06-4										
Metal						1					
Soluble salts			0.002			0.002					
Portland cement	65997-15-1										
Total dust			Tbl. Z-3			10					
Respirable fraction			Tbl. Z-3			5					
Potassium hydroxide	1310-58-3									2	
Propane	74-98-6	1000	1800		1000	1800					
Propargyl alcohol	107-19-7				1	2					X
beta-Propriolactone; see 1910.1013	57-57-8										
Propionic acid	79-09-4				10	30					
Propoxur (Baygon)	114-26-1					0.5					
n-Propyl acetate	109-60-4	200	840		200	840	250	1050			
n-Propyl alcohol	71-23-8	200	500		200	500	250	625			
n-Propyl nitrate	627-13-4	25	110		25	105	40	170			
Propylene dichloride	78-87-5	75	350		75	350	110	510			
Propylene glycol dinitrate	6423-43-4				0.05	0.3					
Propylene glycol monomethyl ether	107-98-2				100	360	150	540			
Propylene imine	75-55-8	2	5	X	2	5					X
Propylene oxide	75-56-9	100	240		20	50					
Propyne; see Methyl acetylene											
Pyrethrum	8003-34-7		5			5					
Pyridine	110-86-1	5	15		5	15					
Quinone	106-51-4	0.1	0.4		0.1	0.4					
Resorcinol	108-46-3				10	45	20	90			
Rhodium (as Rh), metal fume and insoluble compounds	7440-16-6		0.1			0.1					
Rhodium (as Rh), soluble compounds	7440-16-6		0.001			0.001					
Ronnel	299-84-3		15			10					
Rosin core solder pyrolysis products, as formaldehyde						0.1					
Rotenone	83-79-4		5			5					

Rouge											
Total dust			15			10					
Respirable fraction			5			5					
Selenium compounds (as Se)	7782-49-2		0.2			0.2					
Selenium hexafluoride (as Se)	7783-79-1	0.05	0.4		0.05	0.4					
Silica, amorphous, precipitated and gel	112926-00-8		Tbl. Z-3			6					
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica.	61790-53-2		Tbl. Z-3			6					
Silica, crystalline cristobalite (as quartz), respirable dust	14464-46-1		Tbl. Z-3			0.05					
Silica, crystalline quartz (as quartz), respirable dust	14808-60-7		Tbl. Z-3			0.1					
Silica, crystalline tripoli (as quartz), respirable dust	1317-95-9		Tbl. Z-3			0.1					
Silica, crystalline tridymite (as quartz), respirable dust	15468-32-3		Tbl. Z-3			0.05					
Silica, fused, respirable dust	60676-86-0		Tbl. Z-3			0.1					
Silicates (less than 1% crystalline silica)											
Mica (respirable dust)	12001-26-2		Tbl. Z-3			3					
Soapstone, total dust			Tbl. Z-3			6					
Soapstone, respirable dust			Tbl. Z-3			3					
Talc (containing asbestos): use asbestos limit See 29 CFR 1910.1001			Tbl. Z-3								
Talc (containing no asbestos), respirable dust	14807-96-6		Tbl. Z-3			2					
Tremolite See 29 CFR 1910.1101			Tbl. Z-3								
Silicon	7440-21-3										
Total dust			15			10					
Respirable fraction			5			5					
Silicon carbide	409-21-2										
Total dust			15			10					
Respirable fraction			5			5					
Silicon tetrahydride	7803-62-5				5	7					
Silver, metal and Soluble compounds (as Ag)	7440-22-4		0.01			0.01					
Soapstone; see Silicates											
Sodium azide	26628-22-8										
(as HN_3)									0.1		X
(as NaN_3)										0.3	X
Sodium bisulfite	7631-90-5					5					
Sodium fluoroacetate	62-74-8		0.05	X		0.05		0.15			X
dium hydroxide	1310-73-2		2							2	
odium metabisulfite	7681-57-4					5					
Starch	9005-25-8										
Total dust			15			15					
Respirable fraction			5			5					
Stibine	7803-52-3	0.1	0.5		0.1	0.5					
Stoddard solvent	8052-41-3	500	2900		100	525					
Strychnine	57-24-9		0.15			0.15					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits PEL* ppm (a)	Transitional limits PEL* mg/m³ (b)	Transitional limits Skin designation	Final rule limits** TWA ppm (a)	TWA mg/m³ (b)	STEL (c) ppm (a)	STEL (c) mg/m³ (b)	Ceiling ppm (a)	Ceiling mg/m³ (b)	Skin designation
Styrene	100-42-5	Tbl. Z-2			50	215	100	425			
Subtilisins (Proteolytic enzymes)	9014-01-1							0.00060 (60 min.)[e]			
Sucrose	57-50-1										
Total dust			15			15					
Respirable fraction			5			5					
Sulfur dioxide	7446-09-5	5	13		2	5	5	10			
Sulfur hexafluoride	2551-62-4	1000	6000		1000	6000					
Sulfuric acid	7664-93-9		1			1					
Sulfur monochloride	10025-67-9	1	6						1	6	
Sulfur pentafluoride	5714-22-7	0.025	0.25						0.01	0.1	
Sulfur tetrafluoride	7783-60-0								0.1	0.4	
Sulfuryl fluoride	2699-79-8	5	20		5	20	10	40			
Sulprofos	35400-43-2					1					
Systox[g], see Demeton											
2,4,5-T	93-76-5		10			10					
Talc; see Silicates											
Tantalum, metal and oxide dust	7440-25-7		5			5					
TEDP (Sulfotep)	3689-24-5		0.2	X		0.2					X
Tellurium and compounds (as Te)	13494-80-9		0.1			0.1					
Tellurium hexafluoride (as Te)	7783-80-4	0.02	0.2		0.02	0.2					
Temephos	3383-96-8										
Total dust			15			10					
Respirable fraction			5			5					
TEPP	107-49-3		0.05	X		0.05					X
Terphenyls	26140-60-3	(C)1	(C)9						0.5	5	
1,1,1,2-Tetrachloro-2,2-difluoroethane	76-11-9	500	4170		500	4170					
1,1,2,2-Tetrachloro-1,2-difluoroethane	76-12-0	500	4170		500	4170					
1,1,2,2-Tetrachloroethane	79-34-5	5	35	X	1	7					X
Tetrachloroethylene; see Perchloroethylene											
Tetrachloromethane; see Carbon tetrachloride											
Tetrachloronaphthalene	1335-88-2		2	X		2					X
Tetraethyl lead (as Pb)	78-00-2		0.075	X		0.075					X
Tetrahydrofuran	109-99-9	200	590		200	590	250	735			
Tetramethyl lead, (as Pb)	75-74-1		0.075	X		0.075					X
Tetramethyl succinonitrile	3333-52-6	0.5	3	X	0.5	3					X
Tetranitromethane	509-14-8	1	8		1	8					
Tetrasodium pyrophosphate	7722-88-5					5					
Tetryl (2,4,6-Trinitrophenyl-methyl-nitramine)	479-45-8		1.5	X		1.5					X
Thallium, Soluble compounds (as Tl)	7440-28-0		0.1	X		0.1					X
4,4'-Thiobis(6-tert, Butyl-m-cresol)	96-69-5										
Total dust			15			10					
Respirable fraction			5			5					
Thioglycolic acid	68-11-1				1	4					X
Thionyl chloride	7719-09-7								1	5	
Thiram	137-26-8		5			5					
Tin, inorganic compounds (except oxides) (as Sn)	7440-31-5		2			2					
Tin, organic compounds (as Sn)	7440-31-5		0.1			0.1					X
Tin oxide (as Sn)	21651-19-4					2					
Titanium dioxide	13463-67-7										
Total dust			15			10					
Toluene	108-88-3	Tbl. Z-2			100	375	150	560			
Toluene-2,4-diisocyanate (TDI)	584-84-9	(C)0.02	(C)0.14		0.005	0.04	0.02	0.15			
m-Toluidine	108-44-1				2	9					X
o-Toluidine	95-53-4	5	22	X	5	22					X
p-Toluidine	106-49-0				2	9					X
Toxaphene; see Chlorinated camphene											
Tremolite; see Silicates											
Tributyl phosphate	126-73-8		5		0.2	2.5					
Trichloroacetic acid	76-03-9				1	7					
1,2,4-Trichlorobenzene	120-82-1								5	40	
1,1,1-Trichloroethane; see Methyl chloroform											
1,1,2-Trichloroethane	79-00-5	10	45	X	10	45					X
Trichloroethylene	79-01-6	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2	50	270	200	1080			
Trichloromethane; see Chloroform											
Trichloronaphthalene	1321-65-9		5	X		5					X
1,2,3-Trichloropropane	96-18-4	50	300		10	60					
1,1,2-Trichloro-1,2,2-trifluoroethane	76-13-1	1000	7600		1000	7600	1250	9500			
Triethylamine	121-44-8	25	100		10	40	15	60			
Trifluorobromomethane	75-63-8	1000	6100		1000	6100					
Trimellitic anhydride	552-30-7				0.005	0.04					
Trimethylamine	75-50-3				10	24	15	36			
Trimethyl benzene	25551-13-7				25	125					
Trimethyl phosphite	121-45-9				2	10					

TABLE Z-1-A.—LIMITS FOR AIR CONTAMINANTS—Continued

Substance	CAS No. (f)	Transitional limits			Final rule limits**						
		PEL*		Skin designation	TWA		STEL (c)		Ceiling		Skin designation
		ppm (a)	mg/m³ (b)		ppm (a)	mg/m³ (b)	ppm (a)	mg/m³ (b)	ppm (a)	mg/m³ (b)	
2,4,6-Trinitrophenyl; see Picric acid											
2,4,6-Trinitrophenylmethyl nitramine; see Tetryl											
2,4,6-Trinitrotoluene (TNT)	118-96-7		1.5	X		0.5					X
Triorthocresyl phosphate	78-30-8		0.1			0.1					X
Triphenyl amine	603-34-9					5					
Triphenyl phosphate	115-86-6		3			3					
Tungsten (as W)	7440-33-7										
Insoluble compounds						5		10			
Soluble compounds						1		3			
Turpentine	8006-64-2	100	560		100	560					
Uranium (as U)	7440-61-1										
Soluble compounds			0.05			0.05					
Insoluble compounds			0.25			0.2		0.6			
n-Valeraldehyde	110-62-3				50	175					
Vanadium	1314-62-1										
Respirable dust (as V_2O_5)			(C)0.5			0.05					
Fume (as V_2O_5)			(C)0.1			0.05					
Vegetable oil mist											
Total dust			15			15					
Respirable fraction			5			5					
Vinyl acetate	108-05-4				10	30	20	60			
Vinyl benzene; see Styrene											
Vinyl bromide	593-60-2				5	20					
Vinyl chloride; see 1910.1017	75-01-4										
Vinylcyanide; see Acrylonitrile											
Vinyl cyclohexene dioxide	106-87-6				10	60					X
Vinylidene chloride (1,1-Dichloroethylene)	75-35-4				1	4					
Vinyl toluene	25013-15-4	100	480		100	480					
VM & P Naphtha	8032-32-4				300	1350	400	1800			
Warfarin	81-81-2		0.1			0.1					
Welding fumes (total particulate)***						5					
Wood dust, all soft and hard woods, except Western red cedar						5		10			
Wood dust, Western red cedar						2.5					
Xylenes (o-, m-, p- isomers)	1330-20-7	100	435		100	435	150	655			
m-Xylene alpha, alpha'- diamine	1477-55-0									0.1	X
Xylidine	1300-73-8	5	25	X	2	10					X
Yttrium	7440-65-5		1			1					
Zinc chloride fume	7646-85-7		1			1		2			
Zinc chromate (as CrO_3)	Varies with compound	Tbl. Z-2	Tbl. Z-2	Tbl. Z-2						0.1	
Zinc oxide fume	1314-13-2		5			5		10			
Zinc oxide	1314-13-2										
Total dust			15			10					
Respirable fraction			5			5					
Zinc stearate	557-05-1										
Total dust			15			10					
Respirable fraction			5			5					
Zirconium compounds (as Zr)	7440-67-7		5			5		10			

*The transitional PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit.

**Unless otherwise noted, employers in General Industry (i.e., those covered by 29 *CFR* 1910) may use any combination of controls to achieve these limits until Dec. 31, 1992 as set forth in 29 CFR 1910.1000(f).

***As determined from breathing-zone air samples.

(a) Parts of vapor or gas per million parts of contaminated air by volume at 25°C and 760 torr.

(b) Approximate milligrams of substance per cubic meter of air.

(c) Duration is for 15 minutes, unless otherwise noted.

(d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply.

(e) Exposures under 10,000 ppm to be cited de minimus.

(f) The CAS number is for information only. Enforcement is based on the substance name. For an entry covering more than one metal compound measured as the metal, the CAS number for the metal is given—not the CAS numbers for the individual compounds.

(g) Compliance with the subtilisins PEL is assessed by sampling with a high volume sampler (600–800 liters per minute) for at least 60 minutes.

(h) The acetone STEL does not apply to the cellulose acetate fiber industry. It is in effect for all other sectors.

(i) The Final Rule Limit of 5 mg/m³ is not in effect as a result of reconsideration. Calcium hydroxide is covered by the exposure limits for particulates not otherwise regulated of 5 mg/m³ respirable dust and 15 mg/m³ total dust.

(j)The Final Rule Limit TWA of 5 mg/m³ is not in effect as a result of reconsideration. The calcium oxide Transitional Limit of 5 mg/m³ remains in effect and employee exposures shall be kept below that level pursuant to the methods of compliance specified in 29 CFR 1910.1000(e).

(k)The Final Rule Limit STEL of 0.1 mg/m³ is not in effect as a result of reconsideration for the industrial sector of civilian manufacture and distribution of explosives and propellants for civilian use. The Final rule limits skin designation and the Transitional limits ceiling limit of 1 mg/m³ remain in effect for this sector until completion of the reconsideration.

(l)The Final Rule Limit STEL of 0.1 mg/m³ is not in effect as a result of reconsideration for the industrial sector of civilian manufacture and distribution of explosives and propellants for civilian use. The Final rule limits skin designation and the Transitional limits ceiling limit of 2 mg/m³ remains in effect for this sector until completion of the reconsideration.

NOTE.—Pursuant to administrative stays effective September 1, 1989 and published in the FEDERAL REGISTER on September 5, 1989, and extended in part by notices published in the FEDERAL REGISTER on October 6, 1989, December 6, 1989, February 5, 1990, April 6, 1990 and on May 9, 1990 the September 1, 1989 start-up specified in 29 CFR 1910.1000(f)(2)(i) is stayed as follows:

Until November 1, 1990 for manufacture of nitroglycerin and nitroglycerin based explosives and propellants for military and space use; until October 1, 1989 for perchloroethylene in the drycleaning industry; until September 1, 1990 for the acetone TWA for certain "doffers" in the cellulose acetate fiber industry; and until the decision on the merits of the Eleventh Circuit Court of Appeals in the case of Courtaulds Fibers Inc. v. U.S. Department of Labor, No. 89-7073 and consolidated cases, for the Ceiling for carbon monoxide for blast furnace operations, vessel blowing at basic oxygen furnaces and sinter plants in the steel industry (SIC 33). OSHA will publish in the FEDERAL REGISTER notice of the termination of the carbon monoxide stay.

TABLE Z-2

Material	8-hour time-weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift	
			Concentration	Maximum duration
Benzene (Z37.40-1969) [1]	10 ppm	25 ppm	50 ppm	10 minutes.
Beryllium and Beryllium compounds (Z37.29-1970)	2 μg/m³	5 μg/m³	25 μg/m³	30 minutes.
Cadmium fume (Z37.5-1970)	0.1 mg/m³	0.3 mg/m³		
Cadmium dust (Z37.5-1970)	0.2 mg/m³	0.6 mg/m³		
Carbon disulfide (Z37.3-1968)	20 ppm	30 ppm	100 ppm	30 minutes.
Carbon Tetrachloride (Z37.17-1967)	10 ppm	25 ppm	200 ppm	5 minutes in any 4 hours.
Chromic acid and chromates (Z37.7-1971)		1 mg/10 m³		
Ethylene dibromide (Z37.31-1970	20 ppm	30 ppm	50 ppm	5 minutes.
Ethylene dichloride (Z37.21-1969)	50 ppm	100 ppm	200 ppm	5 minutes in any 3 hours.
Formaldehyde (Z37.16-1967) [2]	3 ppm	5 ppm	10 ppm	30 minutes.
Hydrogen fluoride (Z37.28-1969)	3 ppm			
Hydrogen sulfide (Z37.2-1966)		20 ppm	50 ppm	10 minutes once only if no other measurable exposure occurs.
Fluoride as dust (Z37.28-1969)	2.5 mg/m³			
Mercury (Z37.8-1971)		1 mg/10 m³		
Methyl chloride(Z37.18-1969	100 ppm	200 ppm	300 ppm	5 minutes in any 3 hours.
Methylene chloride (Z37.23-1969)	500 ppm	1,000 ppm	2,000 ppm	5 minutes in any 2 hours.
Organo (alkyl) mercury (Z37.30-1969)	0.01 mg/m³	0.04 mg/m³		
Styrene (Z37.15-1969)	100 ppm	200 ppm	600 ppm	5 minutes in any 3 hours.
Tetrachloroethylene (Z37.22-1967)	100 ppm	200 ppm	300 ppm	5 minutes in any 3 hours.
Toluene (Z37.12-1967)	200 ppm	300 ppm	500 ppm	10 minutes.
Trichloroethylene (Z37.19-1967)	100 ppm	200 ppm	300 ppm	5 minutes in any 2 hours.

[1] This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the benzene standard at 1910.1028. This standard also applies to any industry for which 1910.1028 is stayed or otherwise not in effect.

[2] This standard applies to any industry for which 1910.1048 is stayed or otherwise not in effect.

SECTION 7

APPENDIX

APPENDIX 1

REQUEST FOR MEDICAL CONSULTATION

Name of Employee:_____Soc. Sec.#:_____

Telephone #:_____ Title:_____Dept.:_____

Supervisor:_____Bldg./Rm.#:_____

Reason for request for medical consultation or examination:_____

_____

_____

Name of chemical to which employee was or may have been exposed:_____

_____

Describe the nature of the exposure and date of occurance.

_____

_____

Description of signs and symptoms experienced:_____

_____

_____

_____ _____

Employee Signature Date

Return to: Safety Office
205 Woodhull House

APPENDIX 2

REQUEST FOR MONITORING

Name of Employee:_____Soc. Sec.#:_____

Telephone #:_____ Title:_____Dept.:_____

Supervisor:_____Bldg./Rm.#:_____

Chemical for which monitoring is requested:_____

Describe operations for which monitoring is requested:_____

_____

Date and time of operations for which monitoring is requested:_____

_____

_____ _____

Employee Signature Date

Complete and return to the Safety Office, 205 Woodhull House. Results will be sent within 15 days after monitoring results have been received.

APPENDIX 3

GENERAL CLASSES OF INCOMPATIBLE CHEMICALS

Compounds listed under Section A should not be combined with those listed under Section B.

A	B
Acids	Bases, metals
Oxidizing agents	Reducing agents
Chlorates	Ammonia, anhydrous
Chromium trioxide	Carbon
Dichromates	Metals
Halogens	Metal hydrides
Halogenating agents	Nitrites
Hydrogen peroxide	Organic compounds
Nitric acid	Phosphorus
Nitrates	Silicon
Perchlorates	Sulfur
Organic acyl halides	Organic hydroxy and amino compounds
Organic anhydrides	Bases, hydroxy and amino compounds
Organic halogen	Group IA & IIA metals, aluminum
Organic nitro compounds	Strong bases
Oxalic acid	Mercury, silver & salts
Phosphorus	Oxidizing agents, strong bases
Phosphorus pentoxide	Alcohols, bases, water
Sulfides, inorganic	Acids
Sulfuric acid (conc.)	Bases, potassium permanganate, water

APPENDIX 4

WATER REACTIVE CHEMICALS

The following lists contains some common laboratory chemicals that react violently with water. In addition, these chemicals should only be stored and handled in such a way that they do not come in contact with liquid water or water vapor.

Alkali metals
Alkali metal hydrides
Alkali metal amides
Metal Alkyls, such as litium alkyls and aluminum alkyls
Grignard reagents
Halides of nonmetals such as BC13, BF3, PC13, PC15, SiC14 S2C12
Inorganic acid halides suchas POC13, SOC12, SO2C12
Anhydrous metal halides such as A1C13, TiC14, ZrC14, SnC14
Phosphorus pentoxide
Calcium carbide
Organic acid halides and anhydrides of low molecular weight

APPENDIX 5

PERIOXIDE-FORMING CHEMICALS

Peroxides are sensitive heat, friction, impact and light and are prone of explosion. The following organic structures are in approximate order of decreasing hazard.

Ethers and acetal with hydrogen atoms
Olefin with allyic hydrogen atoms
Chloroolefins and fluoroolefins
Vinyl halides, esters and dienes
Vinylacetylenes with hydrogen atoms
Alkylacetylenes with hydrogen atoms
Alkylarenes that contain tertiary hydrogen atoms
Alkanes and cycloakanes that contain tertiary hydrogen atoms
Acrylates and methacrylates

APPENDIX 6

PYROPHORIC CHEMICALS

Many members of the following readily oxidized classes of common laboratory chemicals ignite spontaneously in air. Pyrophoric chemicals should be stored in tightly closed containers under an inert atmosphere (or for some, an inert liquid, and all transfers and manipulations of them must be carried out under an inert atmosphere or liquid.

Grignard reagents, RMgX
Metal alkyls and aryls, such as RLi, RNA, R3A1, R2Zn
Metyl carbonyls such as Ni(CO)4, Fe(CO)5, Co2(CO)8
Alkali metals such as Na, K
Metal powers such as A1, Co, Fe, Mg, Mn, Pd, Pt, Ti, Sn, Zn, Zr
Nonmetal hydrides such as B2H6 and other boranes, Ph3, AsH3
Nonmetal alkyls such as R3B, R3P, R3As
Phosphorus (white)

APPENDIX 7

LABORATORY SAFETY CHECKLIST

(Inspections to be performed on a monthly basis)

Instructor _____ Building _____ Room _____

AREA OF INSPECTION _____ COMMENTS _____

Bench tops _____

Areas under sinks _____

Chemical labels _____

Fume hoods _____

Aisles _____

Fire extinguishers _____

Personel protective equipment _____

Compressed gas (chained) _____

Broken glass (proper disposal) _____

Tubing (condition, proper use) _____

Guards on equipment _____

Electrical wiring _____

Eyewash/Safety showers _____

Amount of chemicals in lab _____

Refrigerators _____

General housekeeping _____

Other (comments/recommendations) _____

Inspection made by _____ on _____
(Signature) Date

APPENDIX 8

HAZARDOUS MATERIALS CHARACTERISTICS

Biohazards: Infectious agent(s), or part thereof, presenting a real or potential risk to the well-being of man, other animals, or plants, directly through infection or indirectly through disruption of the environment.

Carcinogen: Substance that has been shown to cause cancer.

Combustible liquid: A liquid having a flashpoint at or above 100°F (37.8°C).

Corrosive: Chemicals which may cause burns on contact with skin and which have a ph value less than or equal to 2, or greater than or equal to 12.5.

Flammable: Chemicals characterized by a flashpoint below 100°F and a vapor pressure not exceeding 40psi at 100°F.

Mutagen: Substance that causes the development of mutations (step-wise changes in the structure or function of cells).

Oxidizer: Chemicals that readily yield oxygen to stimulate the combustion of organic matter. Examples are oxygen chlorates, permanganates, inorganic peroxides and nitrates.

Reactive: Chemicals which have the potential to be violently reactive including those which may be heat, shock, light or pressure sensitive, and all substances designated as explosives.

Teratogen: Substance capable of causing production of abnormal embryonic development.

Toxic Substances: A material is toxic if it has shown through experience or testing to pose a hazard to human health or the environment because of carcinogenicity, acute toxicity, chronic toxicity, bioaccumulative properties or persistance in the environment. This includes an acute LD50 (lethal dose to 50% of a test population).

Sensitizer: A substance that may cause no reaction in a person during initial exposures, but afterwards, further exposures will cause an allergic response to the substance.

APPENDIX 9

RESISTANCE TO CHEMICALS OF COMMON GLOVE MATERIALS
(E = Excellent, G = Good, F = Fair, P = Poor)

Chemical	Natural Rubber	Neoprene	Nitrile	Vinyl
Acetaldehyde	G	G	E	G
Acetic acid	E	E	E	E
Acetone	G	G	G	F
Acrylonitrile	P	G	-	F
Ammonium hydroxide (sat)	G	E	E	E
Aniline	F	G	E	G
Benzaldehyde	F	F	E	G
Benzenea	P	F	G	F
Benzyl chloride	F	P	G	P
Bromine	G	G	-	G
Butane	P	E	-	G
Butyraldehyde	P	G	-	G
Calcium hypochlorite	P	G	G	G
Carbon disulfide	P	P	G	F
Carbon tetrachloride	P	F	G	F
Chlorine	G	G	-	G
Chloroacetone	F	E	-	P
Chloroforma	P	F	G	P
Chromic acid	P	F	F	E
Cyclohexane	F	E	-	P
Dibenzyl ether	F	G	-	P
Dibutyl phthalate	F	G	-	P
Diethanolamine	F	E	-	E
Diethyl ether	F	G	E	P
Dimethyl sulfoxide (b)	-	-	-	-
Ethyl acetate	F	G	G	F
Ethylene dichloride	P	F	G	P
Ethylene glycol	G	G	E	E
Ethylene trichloride	P	P	-	P
Fluorine	G	G	-	G
Formaldehyde	G	E	E	E
Formic acid	G	E	E	E
Glycerol	G	G	E	E
Hexane	P	E	-	P
hydrobromic acid (40%)	G	E	-	E

APPENDIX 9 (CONT'D)

RESISTANCE TO CHEMICALS OF COMMON GLOVE MATERIALS
(E = Excellent, G = Good, F = Fair, P = Poor

Chemical	Natural Rubber	Neoprene	Nitrile	Vinyl
Hydrochloric acid (conc)	G	G	G	E
Hydrofluoric acid (30%)	G	G	G	E
Hydrogen peroxide	G	G	G	E
Iodine	G	G	-	G
Methylamine	G	G	E	E
Methyl cellosolve	F	E	-	P
Methyl chloride	P	E	-	P
Methyl ethyl ketone	F	G	G	P
Methylene chloride	F	F	G	F
Monoethanolamine	F	E	-	E
Morpholine	F	E	-	E
Naphthalene	G	G	E	G
Nitric acid (conc)	P	P	P	G
Perchloric acid	F	G	F	E
Phenol	G	E	-	E
Phosphoric acid	G	E	-	E
Potassium hydroxide (sat)	G	G	G	E
Propylene dichloride	P	F	-	P
Sodium hydroxide	G	G	G	E
Sodium hypochlorite	G	P	F	G
Sulfuric acid (conc)	G	G	F	G
Toluenea	P	F	G	F
Trichloroethylene	P	F	G	F
Tricresyl phosphate	P	F	-	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	-	P

Aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glove materials. Should swelling occur, the user should change to fresh gloves and allow the swollen gloves to dry and return to normal.

(b) No data on the resistance to dimethyl sulfoxide of natural rubber, neoprene, nitrile rubber, or vinyl materials are available; the manufacturer of the substance recommends the use of butyl rubber gloves.

APPENDIX 10

Select Carcinogen List

The OSHA Laboratory Standard 29 CFR 1910:1450 defines select carcinogen as those chemical which are:

- Regulated by OSHA as carcinogens;
- Listed by the National Toxicology Program (NTP) as "known to be carcinogens";
- Listed by the International Agency for Research on Cancer Monographs (IARC) in Group 1 (carcinogenic to humans); and,
- Listed by NTP as reasonably anticipated to be carcinogens or by IARC in Group 2A (probably carcinogenic to humans) or in Group 2B (possibly carcinogenic to humans) and causes statistically significant tumor incidence in experimental animals.

The following is a combined list of chemicals carcinogens from OSHA, NTP, and IARC.

Acetaldehyde
Acetamide
Acetylaminofluorence, 2-
Acrylamide
Acrylonitrile
Adriamycin
Aflatoxins
Alpha-Chlorinated toluenes
Aluminium production
Amino-2-methylanthraquinone, 1-
Amino-5-(5-nitro-2-furyl)-1,3,4,-thiadiazole, 2-
Amino-9H-pyride[2,3-beta]indole), A-alpha-C(2-
Aminoanthraquinone,2-
Aminoazobenzene, para-
Aminoazotoluene, ortho-
Aminobiphenyl, 4-
Amitrole
Analgesic mixtures containing phenacetin
Androgenic (anabolic) steroids
Anisidine, ortho-
Aramite
Arsenic and arsenic compounds
Asbestos
Auramine, technical-grade
Azaserine
Azathioprine

Azathioprine
Benz(a)anthracene
Benzene
Benzidine
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(j)fluoranthene
Benzo(k)fluoranthene
Benzothrichloride
Benzyl violet 4B
Beryllium and beryllium compounds
Bis (2-chloroethyl)-2naphthylamine(chlornaphazine), N,N- Bis(chloromethyl)ether
Bischloroethyl nitrosourea (BCNU)
Bitumens, extracts of steam-refined and air-refined
Bleomycins
Bracken fern
Butadiene, 1,3-
Butanediol dimethanesulphonate (Myleran), 1.4-
Butanediol Dimethylsulfonate (Myleran), 1,4-
Butylated hydroxyanisole (BHA)
Butyrolactone, beta-
C.I. Basic Red 9 Monohydrochloride
Cadnium and Cadnium Compounds
Carbon tetrachloride
Carrageenan, degraded
Chlorambucil
Chloramphenicol
Chlordecone (Kepone)
Chlorendic Acid
Chlorethy)-3-cyclohexyl-1-nitrosourea (CCU), 1-(2-
Chlorinated Paraffins (C12, 60% Chlorine)
Chloro-2-methylpropene, 3-
Chloro-o-phenylenediamine, 4-
Chloro-ortho-toluidine, para-
Chloroform
Chloromethyl ether
Chlorophenols
Chlorophenoxy herbicides
Chromium compounds hexavalent*
Chromium
Cisplatin
Citrus Red No. 2
Conjugated Estrogens
Cresosotes

Cresidine, para-
Cupferron
Cycasin
Cyclophosphamide
Dacarbazine
Daunomycin
DDT
Di(2-ethylhexyl)phthalate
Diacetylbenzidine, N,N'-
Diaminoanisole, 2,4-
Diaminoanisole, Sulfate, 2, 4-
Diaminodiphenyl ether, 4,4'
Diaminotoluene, 2,4-
Dibenz(a,h)acridine
Dibenz(a,h)anthracene
Dibenz(a,j)acridine
Dibenzo(a,e)pyrene
Dibenzo(a,h)pyrene
Dibenzo(a,i)pyrene
Dibenzo(a,l)pyrene
Dibenzo(c,g)carbazole, 7H-
Dibenzo[c,g]carbazole, 7H-
Dibromo-3-chloropropane, 1,2-
Dibromoethane (EDB), 1,2-
Dichloro-4,4'-diaminodiphenyl ether, 3,3'-
Dichlorobenzene, para-
Dichlorobenzidine, 3,3'-
Dichloroethane, 1,2-
Dichloromethane (Methylene Chloride)
Dichloropropene (Technical Grade), 1,3-
Diepoxybutane
Diethyl sulphate
Diethylhydrazine, 1,2-
Diethylstilbestrol
Diglycidyl resorcinol ether
Dihydrochloride
Dihydrosafrole
Dimethoxybenzidine, 3,3'-
Dimethoxybenzidine(ortho-Dianisidine), 3,3'
Dimethyl sulphate
dimethylaminoazobenzene, para
Dimethylbenzidine, 3,3'-
Dimethylbenzidine (ortho-Tolidine), 3,3'-
Dimethylcarbamoyl chloride

Dimethylhydrazine, 1,1-
Dimethylhydrazine, 1,2-
Dimethylvinyl Chloride
Dioxane, 1-4-
Direct Black 38
Direct Blue 6
Epichlorohydrine
Erionite
Estrogens (Not Conjugated): Estradiol-17
Estrogens (Not Conjugated): Estrone
Estrogens (Not Conjugated): Mestranol
Estrogens (Not Conjugated): Ethinylestradiol
Ethyl acrylate
Ethyl methanesulphonate
Ethyl-N-nitrosourea, N-
Ethylene oxide
Ethylene thiourea
Ethylene dibromide
Ethyleneimine
Formaldehyde
Formylhydrazino)-4-(5-nitro-2-furyl)thiazole, 2-(2-
Furyl)-3-(5-nitro-2-furyl)acrylamide],AF-2[2-
Glue-P-1 (2-Amino-6-methyldipyrido{1,2-a:3'2'-d]imidazole)
Glue-P-2(2-Aminodipyrido{1,2-a:3',2'-d]imidazole)
Glycidaldehyde
Griseofulvin
Hexachlorobenzene
Hexachlorocyclohexanes
Hexamethylphosphoramide
Hexamethylphosphoramide
Hydrazine
Hydrazine and Hydrazine Sulfate
Hydrazobenzene
Indeno(1,2,3-cd)pyrene
IQ(2-Amino-3-methylimidazo[4,5-f]quinoline)
Iron Dextran Complex
Kepone (Chlordecone)
Lasiocarpine
Lead Acetate and Lead Phosphate
Lead and lead compounds, inorganic
Lindane and Other Hexachlorocyclohexane Isomers
MeA-alpha-C(2-Amino-3-methyl-9H-pyrido[2,3-b]indole)
Medroxyprogesterone acetate
Melphalan

Methoxsalen with Ultra-violet A Therapy (PUVA)
Methoxpsoralen, 8- plus ultraviolet radiation
Methoxypsoraen, 5-
Methyl methanesulphonate
Methyl Chloromethyl Ether
Methyl-1-nitroanthraquinone (uncertain purity), 2-
Methyl-N'-nitro-N-nitrosoguanidine, N-(MNNG)
Methyl-N-nitrosourethane, N-
Methyl-N-nitrosourea, N-
Methylaziridine (Propyleneimine), 2-
Methylazoxymethanol and its acetate
Methylchrysene, 5-
Methylene bis(2-methylaniline), 4,4'- (MOCA)
Methylenebis (N,N-dimethyl)benzenamine, 4-4'-
Methylenebis(2-chloroaniline) (MBOCA), 4,4'-
Methylenedianiline, 4,4'-
Methylthiouracil
Methronidazole
Michler's Ketone
Mirex
Mitomycin C
Monocrotaline
Morpholinomethyl)-3-[5-nitrofurfurylidene)amio]-2- oxazolidinone, 5-(
Mustard Gas
Mustard Gas (Sulphur mustard)
Nafenopin
Naphthylamine, beta-
Nickel and nickel compounds
Niridazole
Nitrilotriacetic Acid
Nitro-2-furyl)-2-thiazolyl]acetamide, N-[4-(5-
Nitro-o-anisidine, 5,
Nitroacenaphthene, 5-
Nitrobiphenyl, 4-
Nitrododi-n-propylamine, N-
Nitrofen
Nitrofurfurylidene)amino]-2-imidazolidinone, 1-[(5-
Nitrogen mustard N-oxide
Nitrogen Mustard Hydrochloride
Nitrogen mustard
Nitropropane, 2-
Nitroso-N-ethylurea, N-
Nitroso-N-methylurea, N-
Nitrosodi-n-butylamine, N-

Nitrosodi-n-propylamine, N-
Nitrosodiethanolamine, N-
Nitrosodiethylamine, N-
Nitrosodimethylamine, N-
Nitrosodiphenylamine, p-
Nitrosomethylamino)propionitrile, 3-(N-
Nitrosomethylamino)-1-(3-pyridyl)-1-butanone (NNK), 4-(N-
Nitrosomethylethylamine, N-
Nitrosomethylvinylamine, N-
Nitrosomorpholine, N-
Nitrosonornicotine, N-
Nitrosopiperidine, N-
Nitrosopyrrolidine, N-
Nitrososarcosine, N-
Norethisterone
Oestrogens, nonsteroidal*
Oestrogens, steroidal*
Oil Orange SS
Oxadiazole, 1,3,4,-
Oxydianiline, 4,4'-
Oxymetholone
Panfuran S (containing dihydroxymethylfuratrizine)
Phenacetin
Phenazopyridine hydrochloride
Phenobarbital
Phenoxybenzamine hydrochloride
Phenytoin
Polybrominated biphenyls
Polychlorinated biphenyls
Ponceau MX
Ponceau 3R
Potassium bromate
Procarbazine hydrochloride
Progesterone
Progestins
Propane Sultone -Propiolactone, 1,3-
Propane sultone, 1,3-
Propiolactone, beta-
Propylene Oxide
Propylene oxide
Propylthiouracil
Reserpine
Saccharin
Safrole

Selenium Sulfide
Sodium ortho-phenylphenate
Sterigmatocystin
Streptozotocin
Streptoxotocin
Styrene
Styrene oxide
Sulfallate
Tetrachlorodibenzo-p-dioxin (TCDD), 2,3,7,8-
Tetrachloroethylene (Perchloroethylene)
Thioacetamide
Thiodianiline, 4,4'-
Thiourea
Thorium Dioxide
Toluene diisocyanates
Toluidine, ortho-
Toxaphene (polychlorinated camphenes)
trans-2[(Dimethylamino)methylimino]-5-[2-(5-nitro-2-furyl)vinyl]- Treosulphan
Trichlorophenol, 2,4,6-
Tris(1-aziridinyl)phosphine Sulfide
Tris(2,3-dibromopropyl)phosphate
Trp-P-1 (3-Amino-1,4-dimethyl-5H-pyrido[4,3-b]indole)
Trp-P-2(3-Amino-1-methyl-5H-pyrido[4,3-b]indole)
Trypan blue
Uracil mustard
Urethane
Vinyl Chloride
Vinyl bromide

REFERENCES

American Chemical Society, Committee on Chemical Safety, 1990. Safety in Academic Chemistry Laboratories, Washington, D.C.: American Chemical Society.

American Conference of Governmental Industrial Hygienists, 1987. Guidelines for the Selection of Chemical Protective Clothing, 3rd ed. Cincinnati, OH: ACGIH.

American Industrial Hygiene Association, 1989. Odor Thresholds for Chemical with established Occupational Health Standards, Akron, OH: AIHA.

Bretherick, L. (ed.), 1986. Hazards in the Chemical Laboratory, 4th ed. Port Washington, NY: Royal Soc. Chem.

Clayton, G.D., and F.E. Clayton (eds.), 1980, 81, 82. Patty's Industrial Hygiene and Toxicology, Toxicology, Vol. 2., 3rd ed. New York, NY: Wiley and Sons.

Compressed Gas Association, 1990. Handbook of Compressed Gases, 3rd ed. New York, NY: Van Nostrand Reinhold, ISBN 0-442-25419-9.

International Agency for Research on Cancer, 1979. Handling of Chemical Carcinogens in the Laboratory: Problems of Safety, IARC Scientific Publications No. 33. Geneva, Switzerland: WHO Publications Center.

International Agency for Research on Cancer, 1972. Monographs on the Evaluation of the Carcinogenic Risks of Chemicals to Humans: Geneva, Switzerland: WHO Publications Center.

McKinnon, G.P., 1981. Fire Protection Handbook. Quincy, MA: NFPA

Miller, B.M. (ed.), 1986. Laboratory Safety: Principles and Practices, Washington, D.C.: American Society for Microbiology.

National Institute of Occupational Safety and Health (NIOSH), 1985-86. Registry of Toxic Effects, 14th ed., Washington, D.C.: U.S. Gov't Printing Office.

National Research Council, 1981. Prudent Practices for Handling Hazardous Chemicals in Laboratories, Washington, D.C.: National Academy Press.

National Research Council, 1983. Prudent Practices for Disposal of Chemicals from Laboratories, Washington, D.C.: National Academy Press.

Pitt, M.J., and E. Pitt. 1985. Handbook of Laboratory Waste Disposal. New York, NY: Wiley-Halstead.

Sax, N.I., and R.J. Lewis, Sr., 1987. Hazardous Chemicals Desk Reference. New York, NY: Van Nostrand Reinhold.

San, N.I., and R.J. Lewis, Sr., 1987. Hawley's Condensed Chemical Dictionary, 11th ed. New York, NY: Van Nostrand Reinhold.

Searle, C.E., 1984. Chemical Carcinogens, 2nd ed., Washington, D.C.: American Chemical Society.

Steere, N.V., 1989. Handbook of Laboratory Safety, 3rd edition. West Palm Beach, FA: CRC Press.

Walters, D.B. (ed.), 1980. Safe Handling of Chemical Carcinogens, Mutagens, Teratogens and Highly Toxic Substances. Ann Arbor, MI: Ann Arbor Science.

Young, J.A., 1987. Improving Safety in the Chemical Laboratory: A Practical Guide. New York, NY: Wiley and Sons.