

Drexel University

Chemistry Department

Chemical Hygiene Plan

**Compiled by the
Chemistry Department Safety Committee**

**Revised
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I. Introduction

Lab Safety Standard

On January 31, 1990, the Department of Labor published in the Federal Register an amendment to 29 CFR 1910, subpart Z, identified as Section 1910.1450. The title of this amendment is "*Occupational Exposure to Hazardous Chemicals in the Laboratory*", but is better known as the "*Laboratory Standard*". Compliance in carrying out provisions of the *Laboratory Standard* has been mandatory since January 31, 1991. This standard requires the formulation and implementation of a comprehensive Chemical Hygiene Plan (CHP) to ensure the use of safe work practices, procedures, and policies in order to avoid overexposures to hazardous chemicals and to ensure that workers are protected from potentially hazardous chemicals used in the laboratory workplace. The CHP is just one section of the Drexel University Hazardous Materials Program. Under this plan, each department is to develop its own individual CHP tailored to the unique requirements in that area. This document serves as the response of the Chemistry Department to that charge.

Note to the reader:

References to page numbers in the publication *Prudent Practices for Handling Hazardous Chemicals in Laboratories* are denoted by footnotes for a more detailed presentation. "Prudent Practices" was published in 1981 and revised in 1983 by the National Research Council (copies are available from the National Academy Press, 2101 Constitution Ave., NW, Washington DC 20418). A copy is also available on loan from the University Safety & Health Department.

Important Note: Changes made since the last revision of the departmental CHP are highlighted in blue in the on-line version of the document.

II. General Principles

The 73-page publication *Safety in Academic Chemistry Laboratories, 5th ed.*, published by the ACS Committee on Chemical Safety (available from the American Chemical Society, 1155 Sixteenth Street, NW, Washington, DC, 20036 or on loan from the Chemistry Department office) is an excellent reference for both laboratory safety and chemical hygiene. Each chemistry graduate student will be provided with a copy upon starting graduate studies at the University. Please note that the points discussed below are meant to reinforce rather than supersede any of the information given in that publication.

A. Employee Information and Training

Employee training shall include:

- Methods and observations that may be used to detect the presence or release of a hazardous chemical.
- The physical and health hazards of chemicals in the work area.
- Measures employees can use to protect themselves from these hazards, including specific procedures, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.
- Applicable details of the written departmental CHP.

B. Minimize all Chemical Exposures

Since few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals¹. Skin contact with chemicals should be avoided as a cardinal rule². Safety glasses are to be worn in the laboratory at all times. Special precautions regarding contact lenses need to be observed: in general, hard contact lenses should not be worn by anyone working in a laboratory where chemicals are used, handled or prepared.

C. Avoid Underestimation of Risk

One should assume that any mixture will be more toxic than its most toxic component³ and that all substances of unknown toxicity are toxic⁴. Even for substances of no known significant hazard, exposure should be minimized. For work with substances that present special hazards, special precautions should be taken⁵. Examples of such special handling precautions are listed below:

Special Handling Precautions:

- Hydrofluoric acid, unlike most other acids, may not cause a noticeable burning sensation when it first contacts skin. It can be a very serious hazard because it is rapidly absorbed through the skin and goes deep into body tissue, subsequently causing excruciating pain, burns and tissue destruction. Special precautions for the handling of hydrofluoric acid must be established by the laboratory supervisor. Inhalation of fumes released from hydrofluoric acid should also be avoided. [No concentrated hydrofluoric acid may be ordered until the laboratory workers discuss the particular hazards with the departmental chemical hygiene officer. No work with the material can be started until the chemical fume hood performance is checked and calcium gluconate first aid cream is on hand.](#)
- Perchloric acid is especially dangerous and may explode violently when heated in the presence of organic materials or some metals. Perchloric acid must not be used except when contained behind a safety shield in a specially designed perchloric acid hood; it should also not be used until after explicit instruction is given by the laboratory supervisor and then only under direct supervision.

D. Provide Adequate Ventilation

The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of appropriately chosen condensers or chemical traps. Work with particularly volatile or otherwise toxic compounds should only be performed in properly functioning chemical fume hoods⁶. The hood should be considered the last line of defense rather than the primary safety device. [Details about the operation, maintenance and routine testing of chemical fume hoods is found in the separate Drexel University Chemical Fume Hood Testing and Maintenance Program document.](#)

E. Institute a Chemical Hygiene Program

This document serves as the Chemistry Department's CHP, addressing those specific issues pertinent to this department. This written program has been submitted to the University Safety & Health Department for review and comment. Departmental employee adherence to the chemical hygiene program is mandatory, as it is designed to minimize exposure to hazardous chemicals and reduce health risks. Refinement of the CHP will be a regular, continuing effort ⁷.

F. Observe Permissible Exposure Limits (PELs) and Threshold Limit Values (TLVs)

The Permissible Exposure Limits set by OSHA and the Threshold Limit Values set by the American Conference of Governmental Industrial Hygienists for the concentration of chemical contaminants in air should not be exceeded⁸. The Permissible Exposure Limits for air contaminants (29 CFR 1910.100 subpart Z) is reproduced in Appendix 1 of Drexel University's Hazardous Materials Program.

III. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rests at all levels⁹ including:

A. Executive Director/Director of University Safety & Health

The Executive Director of the University Safety & Health Department has the ultimate responsibility for chemical hygiene within the University community and must, with other administrators (including the Director), provide continuing support for the institutional chemical hygiene program¹⁰.

B. University Chemical Hygiene Officer

The University Hazardous Materials Manager may also act as the University Chemical Hygiene Officer. The University Chemical Hygiene Officer has the responsibility to:

- Work with the Executive Director of the University Safety & Health Department, other administrators, and other employees to develop and implement appropriate chemical hygiene policies and practices¹⁰.
- Monitor procurement, use and disposal of chemicals used in the University¹¹.
- See that annual departmental chemical audits are maintained¹¹.
- When requested, assist Principal Investigators, Professors, Project Directors, and Laboratory Instructors to develop precautions and adequate facilities¹².
- Know the current legal requirements concerning regulated substances¹³.
- Seek ways to improve the university's chemical hygiene program¹⁰.

C. Departmental Chemical Hygiene Officer

The Departmental Chemical Hygiene Officer will be appointed by the Department Head; [this person also usually serves as the chairperson of the departmental safety committee](#). The Departmental Chemical Hygiene Officer has the responsibility to:

- Work with the University Chemical Hygiene Officer to further refine and implement appropriate chemical hygiene policies and practices in the department¹⁰.
- [See that annual departmental chemical inventories are conducted by the Laboratory Supervisors](#)¹¹.
- When requested, assist Principal Investigators, Project Directors, Laboratory Supervisors, Professors, and Laboratory Instructors to develop precautions and adequate facilities¹².
- Arrange for periodic laboratory inspections to be carried out by members of the department or departmental safety committee.
- Report regularly to the departmental safety committee on the matters of chemical hygiene training and compliance.

D. Laboratory Supervisor

Each laboratory assigned to the chemistry department will be labeled with a sign giving the name, office location, and phone number of the Laboratory Supervisor. For a research laboratory, the Laboratory Supervisor will be the tenured or tenure-track faculty member (or principal investigator) assigned to that laboratory; for a teaching laboratory, the Laboratory Supervisor will be a tenured or tenure-track faculty member whose teaching duties are in that area of chemistry. Another person may be duly appointed as the Laboratory Supervisor with the consent of the Department Head; their identity must be transmitted to both the Department Head and the departmental Chemical Hygiene Officer in writing. The Laboratory Supervisor has overall responsibility for chemical safety and hygiene in that laboratory¹⁴, including responsibility to:

- Ensure that all laboratory workers receive appropriate (at least annual) training on the chemical hygiene rules and procedures detailed in the departmental CHP.
- Ensure that all laboratory workers know and follow the chemical hygiene rules.
- Ensure that appropriate personal protective equipment is available and in working order, and that appropriate training in operation of that equipment has been provided¹⁴.
- Ensure that all laboratory workers receive appropriate training on the instrumentation present in that laboratory. Standard operating procedures (SOPs) and appropriate prior-approval processes should also be developed for using hazardous equipment (e.g. high voltage equipment, compressed gases, lasers, etc.).
- Provide regular, recorded chemical hygiene and housekeeping inspections, including routine inspections of emergency equipment¹⁴.
- Determine, in accordance with the University Safety & Health Department, the required levels of protective apparel and equipment required for that laboratory¹⁶.
- Supervise the waste collection and storage in the lab and ensure that the waste is checked into the Hazardous Materials Work Area both promptly and properly (See the Check In Procedure given below).
- Keep an up-to-date chemical inventory for that laboratory. The chemical inventory should be updated at least annually (by July 1st of each year), or whenever the quantity or identity of chemicals present changes dramatically (as might happen when new research projects commence). **All reagent chemicals (no matter what size) must be included on the laboratory inventory, which will be checked during each quarterly safety inspection. Synthesized chemical products or analytical samples of small size do not need to be individually inventoried; however, the containers do need to be completely labeled with contents, name of the investigator, and enough information to track back to a research notebook or sample list. The laboratory chemical inventory may be maintained on either a spreadsheet (MS Excel) or database (MS Access) program. Information that must be included is the chemical name, container size and quantity, separated by laboratory (if you maintain more than a single lab). You may provide further information such as where in the laboratory each container is stored, if desired. A copy of the inventory should be forwarded to both the University Safety & Health Department and the departmental CHO.**
- Ensure that Material Safety Data Sheets (MSDSs) are readily available. **Each laboratory (both teaching and research) is now required to have printed MSDS sheets for each of the reagent chemicals found within the laboratory. These must be filed in alphabetical order in a loose-leaf binder and be accessible 24-hours a day outside the front door of the laboratory. MSDS sheets are not required for appropriately inventoried synthesized chemical products or analytical samples of small size.**

E. Principal Investigator or Project Director

The Principal Investigator (PI) or Project Director (PD) has primary responsibility for chemical hygiene procedures for that operation¹⁰. This applies to work conducted in the laboratory assigned to that PI/PD (see above for the description of the responsibilities of the laboratory supervisor) as well as project related work conducted by their workers (post-doctoral associates, research assistants, graduate students, work-study students, or any others) in other locations within the university.

F. Laboratory Worker

Every person working in a laboratory has responsibility for:

- Planning and conducting each operation in accordance with Drexel University's chemical hygiene procedures¹⁷.
- Developing good personal chemical hygiene habits¹⁸.
- Remaining aware of the hazards of those materials and handling those chemicals in a safe manner.
- Knowing how to handle a hazardous chemical safely according to its types of hazards, and if unsure of the hazards or safety procedures required, to ask for assistance.

IV. The Laboratory Facility

A. Design

The laboratory facility should have:

- An appropriate general air ventilation system with air intakes and exhausts located as to avoid intake of contaminated air ¹⁹.
- Adequately sized, well-ventilated stockrooms/ storerooms²⁰.
- Laboratory fume hoods and sinks²¹.
- Other essential safety equipment including eyewash fountains, safety showers, fire blankets, and fire extinguishers²¹

B. Maintenance

Chemical hygiene related equipment (fume hoods, safety showers, etc.) are to undergo continuing appraisal and be repaired if malfunctioning or modified if inadequate. As these devices are part of the basic physical plant of the university, the University Facilities Management department is responsible for any costs associated with the repair and replacement of spent (e.g. fire extinguishers) or inoperable equipment, UNLESS the reason for repair can be demonstrated to be due to deliberate misuse or tampering.

C. Usage

The work conducted³ and its scale²³ must be appropriate to the physical facilities available and, especially, to the quality of ventilation²⁴.

D. Ventilation

The general laboratory ventilation system should:

- Provide a source of air for breathing and for input to local ventilation devices (e.g. fume hoods)²⁵. General building ventilation should not be relied on for protection from toxic substances that may be released into the laboratory air².
- Ensure that laboratory air is continually replaced, preventing an increase of air concentrations of toxic substances during the working day¹⁹.
- Direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building¹⁹.

1. *Quality:*

General airflow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas¹⁹. Airflow into and within the fume hood should not be excessively turbulent²⁶; hood exhaust volume should be adequate to confine toxic or volatile materials within the hood under normal operating conditions²⁶.

2. *Evaluation:*

The quality and quantity of ventilation is evaluated on installation, regularly monitored (at least every 3 months) and should be re-evaluated whenever a change in local ventilation devices is made. Routine quarterly evaluation will be conducted by an inspection team from the University Safety & Health Department; quarterly maintenance inspections will be conducted by trained personnel from the Facilities Management Department. Annual flow rate measurements will be conducted by trained personnel from the University Safety & Health Department. All hood evaluations will be made in accordance with Drexel University's formal Chemical Fume Hood Maintenance and Testing Program.

V. Components of Drexel's Chemical Hygiene Plan

A. Accident Reports

Accident reports should be filed **within 24 hours** of the incident with the Departmental Chemical Hygiene Officer; he/she will forward a copy to the University Safety & Health Department. [Incident report forms for incidents occurring in either a teaching or research laboratory are found on the chemistry department web site at www.chemistry.drexel.edu/safety/safety.htm.](http://www.chemistry.drexel.edu/safety/safety.htm)

All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit, including the University Insurance Manager, University Safety & Health Department, University Safety Committee, Departmental Chemical Hygiene Officer, etc.¹¹.

B. Building Evacuation and Emergency Reporting

Refer to the *Campus Emergency Procedures and Safety Guide* or the appendices of the *University Telephone Directory* for general procedures for evacuation, medical care, accident & fire reporting and drills. Note that an alarm from any building is routed to a central location, the dispatcher at this location notifies the appropriate emergency personnel.

C. Chemical Procurement and Distribution

Before a substance is received, information concerning the proper handling, storage, and disposal should be disclosed to those who will be involved²⁷. No container should be accepted

without an adequate identifying label²⁷. All substances should be received through Drexel's Central Receiving Department, 34th & Ludlow Streets., Philadelphia, PA 19104.

D. Chemical Storage

The key to safe storage of chemicals is a thorough knowledge of the physical and chemical properties of the chemicals involved.

- The bottle's label and chemical's MSDS should be carefully read before storing any chemical. The MSDS will provide any special storage information and incompatibilities.
- Toxic substances should be segregated in a well identified area with local exhaust ventilation²⁸. DO NOT STORE UNSEGREGATED CHEMICALS IN ALPHABETICAL ORDER. Once segregated into hazard classes (compatible groups), chemicals may be stored alphabetically. [The department has chosen to follow the chemical segregation recommendations outlined in the Flinn Scientific catalog \(and available on the web at <http://www.flinnsci.com/homepage/sindex.html>\)](http://www.flinnsci.com/homepage/sindex.html). Direct any detailed questions concerning hazard classification to the University Hazardous Materials Manager.
- Use UL approved storage containers (such as safety cans) for all flammable liquids.
- Avoid purchase and storage of excess quantities of materials.
- No chemicals should be stored above eye level.
- All containers should be properly labeled.
- Peroxides or peroxide forming chemicals should be dated the day they are opened as well as the date they are received. Refer to the Appendices of the University Chemical Hygiene Plan for identification of specific peroxide forming chemicals and their recommended storage time.
- Chemicals which are highly toxic²⁹ or reactive should be placed in unbreakable secondary containers²⁰.
- Stored chemicals should be examined periodically (every 6 months) for replacement, deterioration and container integrity²⁰.
- A chemical inventory should be kept accurate and up to date.
- Departmental stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours and access should be controlled by one person²⁰.

E. Laboratory Chemical Storage:

- Quantities of materials stored in labs should be as small as feasible; storage practices should be consistent with the flammability/reactivity classification of the chemical in question.
- Storage on bench tops and in fume hoods is inadvisable.
- Exposure to heat or direct sunlight should be avoided.
- Periodic reviews should be conducted, with unneeded items being discarded or returned to the storeroom/ stockroom³⁰.

F. Chemical Spills

[Any spill of less than 500g of solid or 500mL of liquid \(unless the material is acutely hazardous\) is the responsibility of the investigator. For a spill of greater than 500g of solid or 500mL of any liquid, or any amount of an acutely hazardous material, the University Safety & Health](#)

department must be contacted and they will make the determination of what procedures should be followed. This can range from requesting that the investigator involved clean-up the spill following their recommendations, to evacuating the immediate area (the research or teaching laboratory) and waiting for an outside Hazardous Response Team to arrive on-site. Regardless of size the Safety & Health Department should be notified of any chemical spill.

G. Environmental Monitoring Regular instrumental monitoring of airborne concentrations is not usually justified or practical, but may be appropriate when testing or redesigning hoods or other ventilation devices²¹. Monitoring is designed to comply with Permissible Exposure Limits which are listed in Appendix 1 of Drexel University's Hazardous Materials Program. Both area and personnel sampling will be performed by the University Safety & Health Department when deemed appropriate by the Director of the University Safety & Health Department. The samples will be sent out to independent laboratories for analysis; results will be shared with the departmental chemical hygiene officer, but will be kept on file by the University Safety & Health Department.

H. Housekeeping, Maintenance, and Inspections

- Floors and laboratory benchtops should be cleaned regularly.
- Formal housekeeping and chemical hygiene inspections should be held at least quarterly³¹; records of these inspections will be kept by the departmental Chemical Hygiene Officer and a copy forwarded to the University Chemical Hygiene Officer. Informal inspections should be continual¹⁴. All inspections will be conducted by teams appointed by and reporting to the Departmental Chemical Hygiene Officer.
- Eyewash fountains will be inspected at regular 3 month intervals⁹.
- Safety showers will be tested annually³². Other safety equipment should be inspected regularly (see the Drexel University Hazardous Material Program for more information concerning suggested maintenance and inspection intervals).
- Stairways and hallways should not be used as storage areas.
- Access to exits, emergency equipment and utility controls are never to be blocked.
- Workers in individual laboratories are responsible for the safety devices and cleanliness of their own areas. Inoperable or missing equipment should be reported to the department Operations Manager and Departmental Chemical Hygiene Officer immediately; emergencies concerning fume hood failure, etc. should be reported to the Departmental Chemical Hygiene Officer and directly to the Facilities Management Department at 895-2808. All reports of inoperable or missing safety equipment should be made in writing to the Departmental Chemical Hygiene Officer **within 24 hours** of their discovery.

I. Labeling of Chemical Containers All chemical containers must be labeled completely. Original manufacturers labels should not be obscured. Chemicals transferred to other containers or prepared solutions should be labeled clearly with the following information:

- Name of the chemical and concentration
- Name of the solvent (if not water)
- Date of preparation
- Course number
- Name (not initials) of the person preparing solution/sample

For chemicals prepared for use in a research lab a research notebook and page number should replace the Course Number line in the information above. Further, when a chemical container is emptied the original label should be either removed or defaced completely using indelible ink marker or paint.

This will minimize the possibility of accidentally using the wrong material due to a labeling confusion.

J. Medical Program

Personnel medical examination and surveillance is performed to the extent required by Federal and State regulations. Contact the Executive Director of the University Safety & Health Department for more information. Drexel provides medical examinations to employees who may have had an over-exposure to chemical substances. For example, medical surveillance programs are implemented when a project is established that may lead to exposure to hazardous materials.

K. Personal Protective Apparel and Equipment

These protective items should include (depending upon the needs of each laboratory):

- Protective apparel (such as goggles, safety glasses with side-shields, gloves, aprons) compatible with the required degree of protection for substances being handled in that laboratory¹⁶.
- An eyewash fountain and safety shower.
- A fire extinguisher of an appropriate type such as CO₂, Halon, or dry chemical²²
- Respiratory protection such as dust masks or a respirator.
- Fire detection devices
- A telephone for emergency use.

For more information concerning what protective apparel is required for a given laboratory, refer to the MSDS for the chemicals used in that laboratory or contact the University Chemical Hygiene Officer in the University Safety & Health Department.

L. Records

- Accident reports are retained in the departmental office.
- Chemical Hygiene Plan records will be kept in the department office and will document that the facilities and precautions are compatible with current knowledge and regulations¹⁰.
- Medical records are compiled and retained by the University Safety & Health Department in accordance with the requirements of state and federal regulations.

M. Signs and Labels

Prominent signs and labels of the following types should be posted in every lab:

- Emergency telephone numbers (such as security, 895-2222 and the University Hazardous Materials Manager) should preferably be kept near each telephone.
- Gummed emergency information labels (available from the University Safety & Health Department) are to be placed on each laboratory door. Home phone numbers must be provided for both the Laboratory Supervisor and knowledgeable alternate contact person in case of an after-hours emergency.
- Identity labels, showing contents of containers (including waste receptacles) and associated hazards³³ should be used. The label must have the chemical name and a listing of all component parts along with its hazard and appropriate protective equipment required. When material is placed in a new container, such as a spray bottle, it must be correctly labeled as to its contents. If a solution is made, all constituents and their concentrations must be indicated. It is the responsibility of the department to provide labels for this

purpose. Specific requirements will be reviewed at departmental training sessions. The label will minimally include the information described above in section IVD. Labels for hazardous waste are available through the University Safety & Health Department.

- Location signs for safety showers, eyewash stations, spill clean up materials and exits will be provided by the University Safety & Health Department.
- Signs should be displayed where food and beverage consumption and storage are not permitted³⁴. No smoking signs should be posted where appropriate.
- Warnings should be posted in areas or near equipment where special or unusual hazards exist³³.

N. Training Programs

The aim of informational and training programs is to assure that all individuals at risk are adequately informed about the work in the laboratory, its risks and what to do in the event that an accident occurs³⁶.

- Individualized training is to be given by each department. The University Safety & Health Department will assist and monitor that this training is performed by qualified individuals. Signed attendance sheets for these departmental training sessions should be forwarded to the University Safety & Health Department
- General programs will be given by the University Safety & Health Department
- Every laboratory worker should know the location and proper use of available protective apparel and equipment, such as goggles, gloves, respirator etc.³⁷.
- Emergency equipment and procedures and first aid instruction is available and encouraged for everyone who might need it.
- Receiving and stockroom/ storeroom personnel are to be given training about hazards, handling equipment, protective apparel, and relevant regulations³⁸.
- The training and educational programs are a regular, continuing activity. Training for faculty, post-doctoral associates, graduate and work-study students should be given at least annually, and should minimally include the following:
 1. description of the physical & health hazards of chemicals in work area
 2. methods & observations used to detect/monitor presence or release of hazardous chemicals
 3. measures employees can take to protect themselves from exposure
 4. training on the written Chemical Hygiene Plan
 5. chemical/hazardous waste disposal procedures
 6. chemical spill procedures
 7. question & answer session in reference to PELs, MSDSs, emergency procedures and equipment along with sources of more information
- Literature and consultation is available to laboratory personnel from the University Safety & Health Department

VI. Waste Management and Disposal Program

The goal of Drexel's Waste Management and Disposal program is to assure the safe and proper disposal of waste laboratory chemicals³⁹.

RCRA: The cradle-to-grave provisions of the Resource Conservation and Recovery Act of 1986 (RCRA) established a system for the handling of hazardous waste from generation through disposal. Under RCRA, the EPA separately regulates hazardous waste generators, hazardous waste transporters, and owners and operators of hazardous waste treatment, storage or disposal facilities. Drexel University is subject to RCRA small quantity generator rules, which are found in the Code of Federal Regulations, 40 CFR part 262.

A. Policy Statement

It is against Drexel University's policy to discharge to the sewer concentrated acids or bases; highly toxic, malodorous, or lachrymatory substances; or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow. All persons must follow said policy.

B. Training

- The Laboratory Supervisor will assure that the workers in each laboratory receive proper training for waste storage, disposal and documentation.
- The University Hazardous Materials Manager will provide both generalized and specific training upon request.

C. Responsibility

The handling and proper disposal of hazardous waste once it has been brought to the hazardous materials work area, Stratton Hall room 144, is the responsibility of the University Hazardous Materials Manager of the University Safety and Health Department

D. Waste Pre-Check In

- Each laboratory will deposit chemical waste in appropriate receptacles that are compatible and resistant to the specific waste.
- Complete the requested information on the Hazardous Materials label (orange label) provided by the University Safety & Health Department.
- Make sure that the phone number on the label is for someone familiar with the waste so that if any questions arise pertaining to constituents or concentrations that the person listed has the answer.
- Affix the label to the container. ***If the waste is in the original container, do not cover the original label with orange label. If in a small container, attach the label using a string around the neck of the container.***
- Material is to be stored in accordance to the Chemical Storage section of this plan. Each lab's waste should be checked in at least monthly with no more than one gallon stored in any lab.

E. Waste Check In

When a hazardous material is of no further use to your department, it is to be checked into the Hazardous Materials (HazMat) Work Area, room 144/145 Stratton Hall.

The laboratory worker should complete a Chemical Pick-Up Request/Chain of Custody form and fax it to the University Safety & Health Department at 215-762-7899. The University Hazardous Materials Manager will contact the laboratory worker for a personal pick-up of the chemical waste material. Waste should no longer be taken directly to either the HazMat Work Area or the chemical storeroom in Stratton Hall. Check-in is an integral part of the waste "cradle-to-grave" tracking

which is required by RCRA. ***The Hazardous Materials Manager will determine at the time of Waste Check In whether another department can use the material; therefore what is "waste" for one department is not necessarily "waste" for Drexel University.***

F. Unknowns

Unknown chemicals are very difficult and expensive to dispose of. Contact the Hazardous Materials Manager before checking in any unknowns.

G. After Waste Check In

The Hazardous Materials Manager has responsibility and authority over materials checked into the HazMat work area, Stratton Hall room 144/145 and 05A.

- Log in: All checked in materials are logged into an inventory/ tracking log book and database by the Hazardous Materials Manager or trained technician.
- Segregation and Evaluation: The material is then segregated and evaluated to determine its destination. Materials in good condition (i.e., unopened containers of chemicals or uncontaminated detergents) are returned to the Chemistry stockroom or Biology Department depending on the nature of the chemical. Non-Hazardous, Nonregulated material that is appropriate for dumpster disposal will be marked as such and placed in appropriate receptacles by the Hazardous Materials Manager. Material deemed as waste will be labeled "Waste" and segregated into Regulated and NonRegulated. Regulated Waste will be segregated into DOT Hazard Classes by the Hazardous Materials Manager. This expedites the process of commercial waste disposal and insures storage compatibility.
- Generator Classification: Drexel is classified as a Small Quantity Generator. The University generates between 100 and 1000 kg of waste per month with not more than 1 kg of acute waste per month.
- Frequency of Disposal: Wastes can be stored on the premises no more than 180 days. Commercial waste disposals are regularly scheduled every 6 months.
- Disposal Site: Waste is packaged and then shipped off-site to EPA-approved hazardous waste treatment facilities.
- Lab pack: Due to a large variety of small amounts of chemicals in Drexel's waste-stream, lab packing is utilized. A lab pack is a DOT officially recognized packaging unit that allows different materials from the same hazard class to be packaged together.

VII. Basic Rules and Procedures for Working with Chemicals

Drexel University's Chemical Hygiene Plan requires that laboratory workers know and follow its rules and procedures. Specific departmental rules and procedures are outlined in each department's chemical hygiene plan.

General Rules

All workers must follow the general university emergency procedures. The following rules are to be followed for essentially all laboratory work with chemicals:

Accidents and Spills

- Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention⁴⁰.

- Skin Contact: If practicable, refer to MSDS. If material is not water reactive, Promptly flush the affected area with water⁴⁰ and remove any contaminated clothing⁴¹. If symptoms persist after washing, seek medical attention³³.
- Clean-up: Promptly clean up spills, using appropriate protective apparel and equipment. Examples of spill clean up materials are vermiculite and speedi-dri. Properly dispose of all spill clean up materials³⁴. See pp.233-237 of *Prudent Practices* for specific clean-up recommendations.
- Reporting: All accidents and chemical spills must be reported in writing to the departmental chemical hygiene officer within 24 hours of occurrence.

Approved Personnel

No individuals not connected with Drexel University are allowed to work in any teaching or research laboratory under any conditions.

Avoidance of "Routine" Exposure

- Develop and encourage safe work habits⁴². Avoid unnecessary exposure to laboratory chemicals by any route⁴².
- Do not smell or taste chemicals⁶. Vent any apparatus which may discharge toxic laboratory chemicals (vacuum pumps, distillation columns, etc) into local exhaust devices²⁵.

Choice of chemicals

Before handling laboratory chemicals, read the MSDS and check to see if the ventilation is sufficient for using that chemical. Use only those chemicals for which the quality of the available ventilation system is appropriate.

Contact Lenses

Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken in case of an accident⁵⁴.

Eating, Smoking, etc.

- Drinking, smoking, chewing gum, or applying cosmetics in areas where laboratory chemicals are present⁴³ is forbidden; wash hands before conducting such activities.
- The storage, handling, or consumption of food or beverages in laboratory chemical storage areas is forbidden. Do not use refrigerators, glassware or utensils used for laboratory operations for handling or storing food or beverages⁴⁴.

Equipment and Glassware

- Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware⁴⁵. Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them with electrical tape to contain glass fragments should implosion occur⁴⁵.
- Use equipment only for its designed purpose⁴².

Exiting

Wash areas of exposed skin well before leaving the laboratory.

Horseplay

Avoid practical jokes or other behavior which might confuse, startle or distract another worker ⁴².

Lab Coats

Lab coats should be worn at all times when working with laboratory chemicals. Remove laboratory coats immediately upon significant contamination⁵⁵.

Pipetting

Do not use mouth suction for pipetting or starting a siphon⁴⁶.

Personal Apparel

Confine long hair and loose clothing⁴². Wear shoes at all times in the laboratory but do not wear sandals or perforated shoes⁴⁷. Short pants should not be worn unless protected with a full-length lab coat.

Personal Housekeeping

Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day⁴⁸.

Personal Protection

- Assure that appropriate eye protection⁴⁹ (i.e., goggles, safety glasses with side-shields) are worn by all persons, including visitors, where chemicals are stored or handled⁵⁰.
- Wear appropriate gloves when the potential for contact with toxic materials exists; inspect the gloves before each use, wash them before removal, and replace them periodically⁵¹. Refer to a table of resistance to chemicals of common glove materials for chemical compatibility.
- Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls⁵³, inspecting the respirator before use³². ***Do not use a respirator without first being fit-tested*** and medically cleared as well as completing the appropriate training given by the University Safety & Health Department (refer to information on the Respirator Program in the Drexel University Hazardous Materials Manual)

Planning

Seek information and advice about hazards¹⁰, plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation⁵⁰.

Transportation of Chemicals

All chemicals being transported through the hallway or in passenger elevators not in an approved safety can **must** be contained in an unbreakable secondary container ("rubber bucket"). All chemicals should be transported between floors using the elevators, not via the stairwell.

Unattended Operations

- Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as electric power or cooling water) to an unattended operation⁵⁶.
- Make sure that the label on door has appropriate information in reference to the operation left unattended. Minimal information *required* includes: the identity of the material in use/operation in progress; nature of the hazard involved; basic instructions for emergency shutdown; the name of the person to contact who knows the nature of the unattended operation or reaction, their campus office location and phone number, and a home phone number in case of an after hours emergency.

Use of a Chemical Fume Hood

- Use the hood for operations which might result in release of toxic chemical vapors or dust²⁵.
- As a rule of thumb, use a hood or other local ventilation device when working with any appreciable volatile substance with a TLV of less than 50 ppm²⁴.
- Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made; keep materials stored in hoods to a minimum and do not allow them to block vents or air flow²⁶
- Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off"²⁶.

Vigilance

Be alert to unsafe conditions and see that they are corrected when detected¹⁸.

Working Alone

Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous⁵⁷. First Aid usually can not be self administered. Inform a worker in a neighboring lab if you are working alone.

VIII. Working with Allergens and Embryotoxins

Allergens: Examples include; diazomethane, isocyanates, dichromates.

- Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity⁵⁸.

Embryotoxins: Examples include; organomercurials, lead compounds, formamide⁵⁹.

- Women who are pregnant or are of childbearing age should handle these substances only in a hood whose satisfactory performance has been confirmed; appropriate protective apparel should be employed (especially gloves) to prevent skin contact.
- Review each use of embryotoxins with the research supervisor and review continuing uses annually or whenever a procedural change is made.
- Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.
- Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

IX. Working with Chemicals of Moderate Chronic or High Acute Toxicity

Examples of such chemicals are: hydrofluoric acid, hydrogen cyanide.

- Aim: To minimize exposure to these toxic substances by any route using all reasonable precautions⁶¹. The MSDS's should be reviewed with the laboratory supervisor to ensure adequate protection.
- Applicability: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities⁶¹.

- Location: Use and store these substances only in areas of restricted access with special warning signs⁶².
- Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60-100 linear feet per minute)⁶² or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance⁶¹; trap released vapors to prevent their discharge with the hood exhaust⁶².

The following supplemental rules are to be followed in addition to general precautions⁶⁰.

Personal protection

Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate)⁶¹. Always wash hands and arms immediately after working with these materials⁶².

Records

Each department should maintain records of the amounts of these materials on hand, locations, and the names of the workers involved⁶².

Prevention of spills and accidents

Be prepared for accidents and spills by having emergency equipment and spill clean up material nearby⁶³. (Refer to Campus Emergency Procedures and Safety Guide)

- Ensure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity⁶¹.
- Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper⁶².
- If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment⁶³.

Waste

- Store contaminated waste in closed, suitable labeled, impervious containers.
- Refer to Waste Management and Disposal Program included in this plan.

X. Working With Chemicals of High Chronic Toxicity

Examples: dimethylmercury and nickel tetracarbonyl, benzo-a-pyrene, N-nitrosodiethylamine, other human carcinogens or substances with high carcinogenic potency in animals⁶⁴.

The following further supplemental rules are to be followed for work with substances of known high chronic toxicity, in quantities above a few milligrams to a few grams, depending on the substance⁶⁰.

Access

Conduct all transfers and work with these substances in a controlled area: a restricted access hood, glove box or portion of a lab, designated for use of highly toxic substances for which all people with access are aware of the substances being used and are aware of necessary precautions⁶⁴.

Approvals

Any person working with such substances should prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor and department chemical hygiene officer prior to use⁶⁴.

Exiting

On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck ⁶⁵.

Housekeeping

If the toxic substance was a dry powder, use a wet mop instead of dry sweeping the floor¹³. For example, in weighing process some particles will become airborne and settle to surfaces. Wipe bench top with damp cloth and damp mop the floor. These materials should only be weighed out in a well-functioning fume hood; any use of a sonicator involving this material should also be carried out in a hood.

Medical Surveillance

If using toxicologically significant quantities of such a substance on a regular basis (i.e. 3 times a week), you have the right to consult a qualified physician concerning desirability of regular medical surveillance¹³. Contact the University Safety & Health Department for more information.

Records

Each department should keep accurate records of the amounts of these substances stored³⁰ and used, the dates of use, and names of users⁶⁴. These records will be reviewed annually by University Safety & Health Department.

Signs and labels

Assure that the controlled area is conspicuously marked with warning and restricted access signs⁶⁵ and that all containers of these substances are appropriately labeled with identity and warning labels⁶⁴.

Spills

Each department should assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of an accident are available and known to personnel⁶⁶.

Storage

Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers⁶⁷.

Waste

- Store contaminated waste in closed, suitably labeled, impervious containers.
- Refer to Waste Management and Disposal Program included in this plan.

XI. Animal Work

See Animal Care Standard Operating Procedures. All research with animals must first be cleared by Drexel University's Animal Care Committee.

XII. Decontamination Areas

See Drexel's Animal Care Standard Operating Procedures and *Drexel's Asbestos Program*.

XIII. Document Revision History

original draft:	February 4, 1991
first revision:	February 5, 1993
second revision	March 4, 1994
third revision	April 4, 1995
fourth revision	October 15, 2001

XIV. Appendices**A. Footnotes**

The numbers given in the footnotes below refer to pages in Prudent Practices for Handling Hazardous Chemicals in Laboratories, (National Research Council, 1983):

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