



Boston College
**Environmental
Health and
Safety**

Chemical Hygiene Plan

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BOSTON COLLEGE CHEMICAL HYGIENE PLAN

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Preface

On January 31, 1990, the Occupational Safety and Health Administration (OSHA) published the final rule for "Occupational Exposures to Hazardous Chemicals in Laboratories." The new standard, which applies to all laboratories meeting OSHA's definition of laboratory use of hazardous chemicals, became effective on May 1, 1990. Each laboratory employer is required to appoint a Chemical Hygiene Officer to develop a written Chemical Hygiene Plan (CHP) and implement the provisions of the CHP.

The standard operating procedures (laboratory practices and engineering controls) recommended in this Chemical Hygiene Plan identify the safeguards that should be taken when working with hazardous chemicals. While these safeguards should protect laboratory workers from unsafe conditions in most situations, there is no substitute for personal knowledge and vigilance when working with hazardous chemicals. There are instances when the proposed use of a particular chemical will be such that either additional, or fewer, controls might be appropriate to protect the laboratory worker. Professional judgment is essential in the interpretation of these standard operating procedures, and individual laboratories may modify these procedures to meet their specific uses and operational needs.

OSHA requires that employers comply with the standard in seven areas:

- Occupational exposure monitoring
- Preparation of a Chemical Hygiene Plan
- Employee information and training
- Medical surveillance
- Labeling and hazard identification
- Use of personal protective equipment
- Record keeping

The CHP is available to all laboratory students and researchers at Boston College. Requests for copies and questions regarding the plan should be addressed to the Safety Officer in your Department or to:

The Office of Environmental Health and Safety
St. Clement's Hall
Boston College
552-0307

The CHP is also accessible to BC personnel via the appleshare computer system by clicking on the Apple Icon, selecting Choser Appleshare, Choosing St. Clements as the location, name: MSDS in capital letters, password: MSDS in caps, check off Public Folder. Chose selected file from menu list. The Chemical Hygiene Plan is also available on the web at the Office of Environmental Health and Safety website at <http://www.bc.edu/ehs> under Programs and Manuals.

1.0 Introduction

This manual, entitled the *Boston College Chemical Hygiene Plan*, is written in accordance with the requirements of OSHA's laboratory standard, 29 CFR 1910.1450, "Occupational Exposures to Hazardous Chemicals in Laboratories." Boston College is firmly committed to ensuring that the procedures, safety and containment equipment, personal protective equipment, and work practices outlined herein are capable of protecting employees from the health hazards presented by hazardous chemicals.

1.1 Policy

Boston College, through the Office of Environmental Health and Safety, has established a comprehensive pro-active safety program. Boston College is committed to providing an environment which reduces recognized health hazards on campus for the safety of students, visitors, and employees. Consequently, Boston College's commitment is demonstrated by the development, implementation, and monitoring of programs designed to reduce these recognized hazards.

The responsibility for an effective occupational health, safety, and accident prevention program is a management responsibility. This responsibility will follow the regular lines of authority from the management to the individual. It is management's responsibility to provide a safe place to work, to develop health and safety rules and guidelines, and to enforce these rules and guidelines. However, the faculty of Boston College as Principal Investigators have the responsibility for implementing the provisions of the chemical hygiene program. It is the employees' responsibility to follow these rules and guidelines, and to report unsafe conditions to their immediate supervisor for corrective action.

Through the combined effort of management, the faculty, and support workers, the occupational health and safety program will work.

Chemical Hygiene Officer Signature

Date

1.2 Coverage

The policies set forth in this Chemical Hygiene Plan (CHP) are applicable to all laboratory employees. Laboratory employees include faculty, staff, teaching assistants, and laboratory technicians who are paid by Boston College. Laboratory health and safety policies, however, cover only duties and tasks performed by laboratory employees while physically situated in laboratory facilities.

The departments covered under this Plan include Chemistry, Physics, Biology, Psychology, and Geology and Geophysics. The CHP does not specifically cover students enrolled at Boston College, but it is strongly suggested that the Professors in each department discuss the elements of the CHP with each student working in a laboratory.

1.3 Organization, Roles and Responsibilities

The authority and responsibility for implementation of chemical hygiene policies at the operating level are delegated by the Office of Environmental Health and Safety to the science departments. To fully implement chemical hygiene policies, the assistance and cooperation of all laboratory staff is necessary. The following descriptions outline key roles and responsibilities of all Boston College employees involved in implementation of this plan.

1.3.1 Chemical Hygiene Committee

Boston College has two levels of Chemical Hygiene Committee (CHC). The University CHC(UCHC) is comprised of the University Chemical Hygiene Officer and the five Departmental Chemical Hygiene Officers in Chemistry, Biology, Geology & Geophysics, Physics and Psychology. The chair of the UCHC will be selected from the membership of the UCHC (excluding the UCHO) by all members of the UCHC. This campus-wide committee will meet once a semester and is charged with the responsibilities to:

- establish a laboratory hygiene monitoring and evaluation program as necessary.
- select and set guidelines for use of engineering controls, protective equipment, and special hygiene practices and make provisions for additional employee protection for work with particularly hazardous substances.
- review, evaluate and update the effectiveness of the CHP at least annually.
- establish, develop, and review laboratory health and safety training programs.
- review all incidents where the UCHO has had occasion to cause laboratory procedures to cease.
- review incident reports submitted by the UCHO, make recommendations concerning safety incidents and ensure that corrective action is taken, including, if necessary, cessation of some or all procedures in a laboratory. In cases where a persistent pattern of violations exists, the UCHC may submit a report to the appropriate Dean.

Each department has the responsibility of forming its own CHC from its own faculty and staff. The CHCs appoint a designated departmental Chemical Hygiene Officer (CHO), who works directly with the University Chemical Hygiene Officer. The chair of the CHC will be selected from the membership of the CHC by the members of the CHC. The departmental committees are charged with the responsibilities to:

- set criteria for evaluating potential exposures, including a description of circumstances requiring prior approval for use of hazardous chemicals/operations.
- overseeing the procurement, use, and disposal of chemicals as necessary.
- meet regularly and communicate safety and health policies and activities to laboratory staff and to other campus personnel affected by such policies.
- review the regular inspection reports submitted by the CHO surveying the safety of individual laboratories and forward documentation of the department chair and to the UCHO as an incident report.

- review incident reports and, together with the CHO, make recommendations concerning safety incidents and ensure that corrective action is taken.

1.3.2 University Chemical Hygiene Officer (UCHO)

The University CHO (UCHO) will be designated from the Office of Environmental Health and Safety. The UCHO is responsible for providing technical guidance in the development of the provisions of the CHP. In this capacity, the UCHO works with the Departmental Chemical Hygiene Officers and laboratory managers and staff to develop and implement appropriate chemical hygiene policies and practices and to continually seek to improve the chemical hygiene program. In emergency situations or cases where there is a clear and present danger existing in a laboratory, the UCHO has the authority to cause a particular laboratory procedure or all laboratory operations to cease.

The UCHO is also required to:

- periodically inspect laboratory facilities to ensure compliance with the provisions of the Chemical Hygiene Plan.
- monitor health and safety conditions at laboratory facilities and investigate accidents/exposures.
- arrange for industrial hygiene monitoring as appropriate and inform employees of results.
- consult with the UCHC, CHC's and laboratory management on matters pertaining to information and training; coordinate maintenance of training records.
- update the Chemical Hygiene Plan as necessary.
- ensure that safety devices (i.e. safety showers, eye washes, fire extinguishers and fume hood) are working properly.
- remain abreast of regulatory and legal requirements associated with use of hazardous chemicals.
- review incident reports submitted by departmental CHO's and determine those which should be brought to the attention of the UCHC.

1.3.3 Departmental Chemical Hygiene Officer

Each department which is involved in the laboratory use of hazardous chemicals is responsible for the adaptation and implementation of the Chemical Hygiene Plan within the laboratories under its administrative control. The Departmental CHO will assist laboratory supervisors in adapting the CHP to the needs of individual laboratories.

The Departmental CHO, along with each faculty member, are required to:

- ensure that workers know and follow chemical hygiene policies and practices, that workers have been properly trained, and that training activities have been properly documented.
- ensure that approved control measures are selected for use of any material in the laboratory and are employed.
- ensure that appropriate approved personal protective equipment is utilized.
- follow recommendations of the UCHO and correct any unsafe laboratory conditions.
- periodically inspect laboratory facilities to ensure compliance with the provisions of the Chemical Hygiene Plan.
- inform the UCHO of *any* accidents involving: exposure to hazardous chemicals, fire, significant property damage, calling an external agency (police, fire, OSHA) personal injury or significant potential for personal injury. Together with the CHC, the CHO will make recommendations concerning these incidents, ensure that corrective action is taken.
- maintain department's MSDS database or notebooks.
- supervise and review the annual hazardous materials inventory.

1.3.4 Laboratory Supervisors/Faculty

The immediate supervisor of laboratory employees is responsible for coordinating with the Departmental CHO to adapt and implement the policies and procedures of the CHP. This includes developing written standard operating procedures for chemical use, enforcing safety practices, providing or scheduling employee training, reporting hazardous conditions to the Departmental or UCHO, and maintaining adequate records to demonstrate compliance with all aspects of the Lab Safety Standard.

It is the responsibility of each laboratory supervisor to: 1) ensure that workers know and follow chemical hygiene policies and practices, that workers have been properly trained, and that training activities have been properly documented, 2) ensure that control measures selected for the use of any material in their laboratory are adequate and that protective equipment is available, 3) follow recommendations of the University and departmental CHOs and CHCs to correct any unsafe laboratory conditions.

1.3.5 Laboratory Employees

Laboratory employees are expected to learn, understand, and observe all chemical hygiene policies and practices listed herein. Laboratory employees are also required to:

- plan and conduct each laboratory operation in accordance with Boston College's chemical hygiene procedures. Employees should also become familiar with good standard practices with procedures and chemicals they are involved with by reviewing current literature, available Material Safety Data Sheets and applicable Boston College policies.
- wear the personal protective equipment required for each task to which they are assigned.
- use engineering controls and safety equipment properly and according to the requirements outlined in this Chemical Hygiene Plan.
- develop good personal chemical hygiene habits.
- participate in all required training programs, including chemical hygiene training.
- report to the responsible faculty, who will in turn report to the departmental CHC all facts pertaining to accidents resulting in exposure to hazardous chemicals, and any action or condition that may cause an accident and/or exposure to hazardous chemicals.
- assist with the medical consultation/examination after accidental exposure by the employee to hazardous chemicals by providing required information to the examining physician.

1.4 Revisions

Proposed revisions of the CHP can be submitted to the departmental CHC or the UCHO. The departmental CHC and UCHO will bring proposed revisions to the University Chemical Hygiene Committee for review and approval. Changes to the CHO can be made as necessary by the University Hygiene Officer but will be approved annually by the UCHO. The CHP will be reviewed and updated annually by the CHO to ensure policies and procedures comply with applicable regulations and program revisions.

2.0 Standard Operating Procedures

2.1 General Lab Procedures

2.1.1 Clothing

- Lab coats should be worn when performing work in the laboratory.
- Sandals and open-toed shoes are prohibited.
- Long hair should be secured back and off the shoulders, as appropriate.
- Ties, scarves, and other loose clothing should be secured.

2.1.2 Preventing Chemical Ingestion

- Do not smell or taste chemicals.
- Do not eat, drink, smoke, chew gum, or apply cosmetics in laboratories where chemicals are present.
- Avoid any hand to mouth or hand to face contact while working with chemicals.
- Eating, drinking, smoking, etc. is allowed in designated areas only. Designated areas will be assigned by each department.
- Handling, consumption, and/or storage of food or beverages in storage areas or refrigerators that are also used for laboratory operations are prohibited.
- Use mechanical pipetting devices; do not use mouth suction for pipetting or starting a siphon.
- Wash hands frequently and after conducting any chemical procedures.
- Eating and drinking will be allowed in designated areas only. Designated eating and drinking areas are limited to offices, lounges, lecture halls, locker rooms and foyer areas. Each department will be responsible for enforcing this policy along with inspections conducted by the Chemical Hygiene Officer.

If a department wishes to post designated eating areas, contact Planning and Construction for signage. Any questions, comments or issues regarding the policy may be directed to the Office of Environmental Health and Safety.

2.1.3 Cleanliness and Decontamination

- Keep work areas clean and uncluttered.
- Keep access to emergency equipment and exits open.
- Keep all aisles, walkways, hallways, and exits free of chemical containers, obstructions, and tripping hazards.
- Wash areas of exposed skin well before leaving the laboratory.
- Clean up spills and dispose of materials as necessary.
- Wash work surfaces well before leaving the laboratory.
- Clean up the work area on completion of an operation or at the end of each day.
- Do not leave contaminated or dirty glassware or tools in the work area.
- Dispose of broken glassware in "GLASS ONLY" containers.
- Dispose of sharp (e.g., scalpels, needles) in approved sharps containers.
- Give unwanted surplus chemicals should be given to colleagues who can use them, return them to designated storage areas, or properly disposed of.
- Do not use lab hoods for chemical storage except as required and or noted by departmental CHO's.

2.2 Procedures for Ordering Chemicals:

- Estimate the amount of each chemical required by carefully pre-planning the experimental procedure.
- Select only those chemicals for which the quality of available ventilation is adequate.
- Obtain approval from the lab supervisors prior to ordering
- Contact the manufacturer before ordering new or unusual chemicals for which adequate hazard information is unavailable.

- Request MSDSs from vendors when chemicals are ordered and forward copies to EH&S when MSDSs are received.
- Transmit proper handling information to all those who will be involved with the chemical (in most instances can be found on the MSDS)
- Prepare the laboratory for the arrival of the substance (i.e.. establish storage location, post appropriate signs, obtain and check personal protective equipment).

2.3 Procedures for Receipt and Distribution

- Do not accept any chemical whose container is not properly labeled.
- Review and observe information on the safe handling and storage of the chemical
- Place all chemical containers which are to be delivered by hand within shock-resistant carrying containers or buckets.
- When transporting gas cylinders, use an appropriate hand truck, never drag or roll cylinder, leave valve cover cap on until cylinder is in place, and handle only one cylinder at a time.

2.4 Chemical Storage

The proper storage of chemicals is complicated by the diverse individual physical properties of the numerous chemicals that may be present in the laboratory. Some general procedures for chemical storage are listed below. However, these procedures are not intended to be all-inclusive but rather to serve to supplement more specific procedures adopted for particular laboratory situations. Specific instructions on chemical storage may be obtained from the MSDS, container label, and by contacting the EH&S Office.

- Ensure that all containers are in good condition and properly labeled.
- Stored chemicals should be examined periodically (at least annually) for replacement, inactive status, deterioration, and container integrity.
- Unneeded items shall be properly discarded in accordance with existing local, state, and federal regulations.
- Storage on bench tops, hoods, and sinks should be avoided.
- Ensure that all storage locations are dry and adequately ventilated.
- Use spill trays, spill and shatter-proof containers, secondary containers, and proper receptacles as needed.
- Bottles of chemicals > 500 mL (especially corrosives and solvents) should not be stored on shelves higher than 6 feet.
- Flammables should be stored in approved safety cabinets.
- Use only explosion-proof refrigerators and freezers for storage of flammable liquids.
- The following limits for flammables in a laboratory are not to be exceeded.

<u>TOTAL*</u>	<u>Class 1</u>	<u>All Classes</u>
On Benches	10 gal	20 gal
In Lab	60 gal	120 gal

*These limits are based upon a 1,500 square foot laboratory. Limits may be lower for smaller laboratory spaces.

- Store caustic or corrosive materials near the floor to minimize danger of bottles falling from the shelf.
- Organic acids should be stored separately from strong oxidizing agents to prevent interaction of vapors and corrosion of storage cabinets.
- Store highly reactive or corrosive liquids in spill trays.
- Gas cylinders must be fully secured at all times and away from heat sources.
Refer to Section 2.5.3 "Safe Handling of Compressed Gases" for additional information.

- Store peroxides at the lowest possible temperature consistent with solubility or freezing point. (Liquid or solutions of peroxides should not be stored at or lower than the temperature at which the peroxide freezes or precipitates because peroxides in these forms are extremely sensitive to shock and heat.)
- Indicate the date of receipt and the date of opening on each container of peroxide forming chemicals.
- Dispose of peroxide forming chemicals within one year of purchase or six months after opening.
- Separate hazardous chemicals in storage as follows:

Solids

- oxidizers
- flammable solids (red phosphorus, magnesium, lithium)
- water reactives

Liquids

- acids
- oxidizers
- flammable/combustible
- caustics
- perchloric acid

Gases

- toxic
- oxidizers and inert
- flammable

Some examples of commonly encountered incompatible chemicals are provided in Figure 1.

2.5 Handling and Transport of Hazardous Chemicals

Among the many tasks and operations performed daily by laboratory employees, those involving direct handling and/or transport of hazardous chemicals pose the greatest potential for exposure. For this reason, specialized handling precautions and good laboratory practices have been developed for specific classes of chemical and physical hazards. Before working with Hazardous Chemicals a procedure should be written to ensure laboratory safety in the format provided in Appendix A "Required Elements for Safety Related Procedures."

Hazard classes can include the following:

- Combustible liquid
- Compressed gas
- Explosive
- Aerosol, flammable
- Gas, flammable
- Liquid, flammable
- Solid, flammable
- Oxidizer
- Peroxide
- Reactive
- Carcinogen
- Toxin
- Highly toxic agent
- Reproductive toxin
- Irritant
- Corrosive
- Sensitizer
- Chemicals with target organ effects.

Refer to the definitions contained in 29 CFR 1910.1450 and 1910.1200 for hazard classes. (See also Appendix B, Glossary).

2.5.1 Handling Hazardous Chemicals

- Use only chemicals for which the quality of the available ventilation system is appropriate, as indicated on the applicable MSDS.
- Protective equipment shall be worn during all operations that require chemical handling, per Section 3.0.
- The UCHC shall institute additional control measures and specific precautions for chemical handling, as appropriate.
- Decontaminate the laboratory area when work is completed.
- Reactions involving pressure build-up are prohibited in lab hoods without the appropriate relief equipment and shielding.

Corrosives

- The following controls and handling techniques shall be employed when handling corrosives:
 - As applicable, wear appropriate personal protective clothing, an acid-resistant apron, chemical-resistant gloves, and splash goggles/face shield.
 - Conduct the procedure in a fume hood.
 - Use proper pouring techniques when pouring acids into water. Use great care and add reagents slowly. Always add the acid to water; never water to acid. While adding, mix slowly by
 - Use bottle carriers for transport of containers of corrosives greater than one liter.
- Perchloric acid, a strong oxidizer and corrosive that can also be explosive under certain conditions, shall not be used without prior approval by the UCHO.

Peroxides

- The following controls and handling techniques shall be employed when handling peroxides:
 - Limit quantities.
 - Do not return unused peroxides to storage container.
 - Volatile solvents (such as ethyl ether) that may contain peroxides should not be evaporated to dryness unless precautions are taken to ensure the solvent is peroxide-free.
 - Use ceramic or wooden spatulas; do not transfer peroxides with metal spatulas because metal contamination can lead to explosive decomposition.
 - Keep peroxides and all oxidizers segregated from organics/solvents.
- Avoid all heat sources, friction sources, and all forms of impact.
- Test reagents for peroxide content as necessary.

Mercury

- The following controls and handling techniques should be employed when handling elemental mercury:
 - Containers of mercury should be kept closed and stored in a well-ventilated area.
 - Every effort should be made to prevent exposure to or spills of mercury.
 - Metallic mercury should be handled only over impervious surfaces to prevent contamination.
 - As applicable, wear appropriate personal protective equipment.
 - Transfer of mercury from one container to another should take place inside a hood, over a tray or pan to confine any spills.

—Wash hands thoroughly with soap and water after handling operations and cleaning spills.

Carcinogens, reproductive toxins, chemicals with a high degree of acute toxicity, and chemicals of unknown toxicity

• The following controls and handling techniques shall be employed when handling carcinogens, reproductive toxins, chemicals with a high degree of acute toxicity, and chemicals of unknown toxicity in greater than negligible quantities:

- Conduct procedure in a designated area (e.g., fume hood).
- Wear appropriate personal protection equipment including gloves, eye protection, and a lab coat.
- Care should be taken when weighing salts to avoid creation of a powder aerosol of the salt.
- Use the smallest amount of chemical that is consistent with the requirements of the work to be done.
- Decontaminate the area when work is completed.

2.5.2 Handling of Formaldehyde

- Confirm that a hazard warning label (see below) is affixed to all mixtures or solutions of formaldehyde composed of greater than 0.1 percent formaldehyde.
- Avoid contact of skin and eyes from liquids containing 1 percent or more formaldehyde. Always wear eye protection, lab coat or impervious apron, and gloves when working with formaldehyde.
- Place heavily contaminated articles of clothing (e.g., lab coats, scrubs) in closed containers labeled as containing a formaldehyde hazard. Contaminated personal protective equipment (PPE) (e.g., goggles, face shields) should be cleaned by flushing with water before re-use.
- Carry out operations with formalin in open vessels in an effectively functioning chemical fume hood.
- If skin becomes splashed with solutions containing 1 percent or greater formaldehyde, drench affected area immediately with water for at least 15 minutes.
- If eyes are splashed with solutions of formaldehyde containing 1 percent or greater formaldehyde, immediately use an eyewash to drench eyes with water for at least 15 minutes.
- Notify the lab supervisor immediately if exposure occurs. The lab supervisor shall arrange for medical follow-up with Health Services as necessary.
- Place formaldehyde contaminated waste in a sealed container labeled as containing a formaldehyde hazard.
- Labels should read as follows:

Formaldehyde Hazard Warning Label*

*Labels affixed to all containers of formaldehyde/formalin should also contain the name and address of the responsible party.

<p>DANGER FORMALDEHYDE IRRITANT AND POTENTIAL CANCER HAZARD</p>
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- Dispose of waste appropriately. Solutions containing greater than 1 mg/L formaldehyde must be disposed as hazardous waste and not allowed to enter the sewer system.

2.5.3 Safe Handling of Compressed Gases

- Compressed gas cylinders are safe to use when handled by personnel who are properly trained and aware of the potential hazards inherent with each type of gas. To insure the safe use of compressed gas cylinders, regulations have been established in 29 CFR 1910.101 that refer to guidelines (Pamphlet P-1-1965) published by the Compressed Gas Association. They set forth the minimum safety rules and precautions to be followed when handling compressed gas cylinders. The following SOP outlines safe handling practices for compressed gases.
- Compressed gas cylinders should only be used in well-ventilated areas.
- Compressed gas cylinders should not be used as rollers, supports, or for purposes other than containing the gas as labeled.
- The contents of compressed gas cylinders should be clearly identified with the proper DOT label or alternative marking required for the compressed gas contained. Cylinders, at a minimum, should carry a label or marking identifying the contents by chemical name or commercially accepted name.
- Lines, piping, and compressed gas cylinders should be labeled with the identity of the gas contained there in and/or color-coded as appropriate.
- All cylinders should have a three-part tag attached to the body of the cylinder indicating whether the cylinder is "Full," "In Service," or "Empty."
- Compressed gas cylinders must not contain gases capable of chemically combining with each other or with the container material.
- Never mix gases in a cylinder. Explosion, contamination, corrosion, and other hazards can result.
- Compressed gases should not be transferred from one cylinder to another except by the supplier or manufacturer.
- Tampering with pressure relief devices is prohibited and cylinder valves should not be altered or repaired except by the supplier or qualified instrumentation engineers. Compressed gas cylinder valves that become stuck must never be forced open or closed by hammering the valve handle. Report such cases to the laboratory supervisor who will take the appropriate action.
- Clothing should not be dusted off with compressed gas.
- Insure that all flammable compressed gas cylinders, lines, and equipment are grounded.
- Use cylinders only in an upright position.
- See Section 6.2 for labeling chemical storage areas containing compressed gases.

Maintenance of cylinders

- At no time should compressed gas cylinders be painted by personnel (only by the supplier).

- Cylinders and fittings should be inspected periodically for leaks. The lab supervisor should keep a record of all such inspections.
- The supplier of the compressed gas should be notified under any of the following conditions:
 - A harmful foreign substance enters.
 - The container leaks or becomes defective.
 - The container is exposed to fire.
 - Containers or valves become severely corroded.
 - Damage occurs that may impair the safety of the container

Leaking cylinder

- Should a compressed gas cylinder show major signs of leakage, the following steps should be taken:
 - Notify the Environmental Health and Safety Office and Campus Police immediately. As this is a chemical release, only trained personnel may respond.
 - For toxic gases, evacuate the area immediately.
 - For flammable gases, turn off ignition source (red electrical button in front of lab by door) and evacuate immediately.
 - Place an appropriate sign at the entrance of the laboratory or storage area warning others of the hazard present.
 - Afterwards, notify the gas supplier, and follow instructions as to the return or disposition of the cylinder.

Handling of cylinders

- The movement of both full and empty cylinders should be conducted using designated carts equipped with retaining straps and chains with the main valve closed and the protective cap secured over the valve assembly. Do not drag, roll, or slide cylinders.
- Never drop cylinders, or permit them to strike each other or other surfaces.

Use of cylinders

- Compressed gas cylinder valves must be operated with the appropriate valve handle and the main valve closed during non-use periods, such as at night or over the weekend.
- Compressed gas cylinders must never be completely emptied of gas to prevent contamination from material being sucked into the cylinder. Let a slight positive pressure remain in the cylinder and use a trap between the cylinder and the equipment to prevent liquid from being sucked into the cylinder.
- Do not attempt to refill a compressed gas cylinder.
- Compressed gas cylinders should be tagged with the date of receipt and should not be allowed to remain in a laboratory for more than one year without approval of the departmental CHC. Toxic and corrosive gases should not remain in a laboratory for more than six months or the vendor's recommendation, whichever is shorter, without approval of the departmental CHC. When the time period has elapsed and the cylinder is still partially filled, it should be removed from service, properly sealed and tagged to indicate that compressed gas is still present, and returned to the vendor. The laboratory supervisor will be responsible or appoint a responsible individual to ensure adequate record keeping is done.

- Use the proper regulator for the particular gas. Make certain that the threads on the regulator are proper for the cylinder. Never force connections which do not fit. Use no more torque than needed to ensure a gas tight seal.
- Compressed gas cylinders must be used with piping and equipment which has been designed and built with materials of construction which are suitable for the gas.
- Oil or grease should never be used to lubricate oxygen fittings or valves, since these lubricants may ignite spontaneously in the presence of oxygen, even at low oxygen concentrations. Use only special lubricants specified for oxygen service.
- A suitable pressure-relief device should be used to protect a system utilizing a compressed gas where the system has a pressure rating less than the compressed gas supply source and where, due to the gas capacity of the supply source, the system *pressure* rating may be exceeded in case of a regulator failure.
- Before a regulator is removed from a cylinder, the cylinder valve shall be closed and the regulator drained of gas pressure.
- Acetylene under pressure can decompose with explosive force. It can explode with extreme violence if ignited. Copper or brass (with more than 65% copper) can form explosive compounds in contact with acetylene. Ensure that tubing, manifolds etc. are made from materials that are chemically compatible (e.g., stainless steel) with acetylene.
- The laboratory supervisor will be responsible or will appoint a responsible individual to ensure adequate record keeping.

Storage of cylinders

- Cylinders should *not* be placed in any area where:
 - They may become part of an electrical circuit.
 - They are subject to temperatures above 125° F (51.7° C) or are in contact with a flame.
 - They are subject to low temperatures extremes (unless approved by the supplier).
- Removable caps and plugs should be kept on compressed gas cylinders at all times except when connected to dispensing equipment.
- Compressed gas cylinders should be grouped by type of gas and groups arranged to take into account the gases contained.
- Gas cylinders should be stored in well ventilated, dry areas. While in use or storage, all cylinders should be secured in place using chains, straps, or other devices, to prevent falling.
- Close valves and replace the cap on empty cylinders, mark them "EMPTY," and return to storage.
- Compressed gas cylinders should not be stored near readily ignitable substances or near combustibles in bulk.
- Cylinders, when stored inside, shall not be located in front of exits, stairways or in areas normally used or intended for the safe exit of people.
- Separate flammable gas cylinders from non-flammable gases.

- See Table 1 for maximum quantity and size limitations for compressed or liquefied gas cylinders in laboratory work areas.
- If possible, segregate empty cylinders from full cylinders.

2.5.4 Safe Handling of Flammable Chemicals and Solvents

General

- A flammable solvent is an organic liquid whose vapor can form an ignitable mixture with air. The solvent vapor is the fuel. The oxidizer is the surrounding atmosphere. For the mixture to burn, an ignition source must be present.
- Flammable solvents are the most common source of fires in industry.

Flammables

- Flammable liquids (flashpoint less than 100 F) in quantities greater than four liters should be stored in metal safety cans. The cans should be used only as recommended by the manufacturer, including the following safety practices:
 - Never disable the spring-loaded closure.
 - Always keep the flame arrestor screen in place; replace if punctured or damaged. (The flame arrestor screen is located at the opening of the safety can; it prevents flashback of flammable vapors into the can.)
 - If a reagent must be stored in glass for purity, the glass container may be placed in a bottle carrier to lessen the danger of breakage.
 - Flammable chemicals should be stored in flammable liquid storage cabinets that have been approved by Factory Mutual and/or listed by Underwriter's Laboratory and designed in accordance with Code No. 30 of the National Fire Protection Association (NFPA). The following safety practices shall be adhered to:
 - Store only compatible materials inside a cabinet.
 - Do not store paper, cardboard, or other combustible packaging material in or on top of a flammable liquid storage cabinet.
 - Do not overload cabinets; follow manufacturers' established quantity limits.
 - Follow NFPA and local fire department guidelines for maximum allowable volumes.
 - Do not store flammables in areas exposed to direct sunlight for prolonged periods.
 - The quantities of flammable chemicals stored in the laboratories shall be kept to a minimum.
- ##### ***Precautions***
- The following controls and handling techniques shall be employed when handling flammables:
 - Keep flammable compound away from ignition source such as an open flame.
 - Do not heat flammables over an open flame or glowing heating element.
 - When flammable liquids (greater than 5 gallons) are transferred in metal equipment, minimize generation of static sparks by using bonding and ground straps as appropriate.

- Only reasonable, working quantities (less than 1 liter) of organic solvents may be stored on open shelves in the laboratory. Other quantities should be stored in well marked containers in a safety cabinet as per OSHA regulations.
- Volatile liquids should be kept away from heat sources, sunlight, and electrical switches.
- Cool volatile liquids before opening.
- Practically all solvents dissolve fat and oil from the skin, and as a result, the skin becomes dry, cracks, and is easily infected. The skin should always be protected from contact with solvents.
- Do not store flammable solvents with oxidizers, e.g., perchlorate, nitrates, peroxide. Do not store reactives or corrosives with organics and toxicants.
- Transfer solvents under a fume hood.
- Work with organics should take place under a hood since organic vapors are usually heavier than air and will find ignition sources along the floor, down stairs, etc. Remember it is the vapor that burns, not the liquid.
- Perform operations with solvents having flash points below room temperature in a hood free of ignition sources.
- Never heat flammable liquids with an open flame, hot plate, or non-insulated resistance heater.
- The lids of safety cans must never be propped open.
- All containers containing flammable and combustible liquids are to be clearly labeled.
- For Class I flammable liquids, electrical driven stirrers are not to be used.

Safety cans

See Table 2 for proper size and types of safety containers to be used for the various classes of flammable and combustible liquids.

Flammable storage cabinets

Flammable solvents should be stored in flammable storage cabinets.

NFPA recommends that flammable storage cabinets be operated without forced venting in order to retain flammable vapors inside the cabinet. In this case, both vents must be kept sealed with the plugs provided with the cabinet. Should venting for noxious vapors be desired, however, the cabinet should be vented externally according to the manufacturer's instructions.

Flammable storage cabinet doors should be spring loaded to provide automatic closure.

Drum quantities of flammable liquids

- For Class I flammable liquids, electrical equipment shall be explosion proof (conforming to the requirements of the National Electrical Code No. 70 for Class I hazardous locations).

- Drums of flammable and combustible liquids must be connected to an electrical ground when they are used for dispensing or receiving vessels. Size No. 10 wire is the minimum size which shall be used for grounding. Clamps must penetrate dirt, corrosion, rust or any other coating.
- Metal containers or vessels must be electrically bonded to the drum when liquid is being dispensed from the drum.
- All drums should be properly labeled with name, date, chemical name, and the appropriate hazard identification (i.e., flammable, combustible, extremely flammable, etc.).

Refrigeration

- Flammable liquids requiring refrigeration should be stored in laboratory-safe or explosion-proof refrigerators.

2.5.5 Safe Handling of Pyrophoric Materials

A pyrophoric material is a substance that ignites spontaneously in air. Some substances would not normally be considered pyrophoric; however, under special conditions such as slightly elevated temperatures, the presence of moisture, or in a finely divided state, the material may be capable of self-ignition. In order to avoid contact with air, many of the compounds are packaged and stored under water or a hydrocarbon. In addition, many of these compounds are also highly reactive with water.

Precautions

- In all cases, protect containers of pyrophoric materials from physical damage.
- All locations where pyrophorics are used and/or stored should have a hazard warning affixed to them.
- If a material must be stored under water or kerosene, maintain appropriate liquid levels.
- Water reactive materials must not be stored unprotected in areas where sprinklers are provided as fire protection, or with aqueous containers, or under sinks.
- Store pyrophoric chemicals separately from other materials, if needed. This should be determined by reading the label, safety literature, or material safety data sheets.
- Limit shelf life and follow special fire protection requirements if needed.

2.5.6 Transport of Hazardous Chemicals

Containers

- Whenever chemicals are transported outside the laboratory, the primary container should be placed in a secondary, non-breakable carrier.
- Carts should be used when possible.
- Before moving containers, check and tighten caps, taps, or other enclosures.

Information

- Personnel at the destination area shall be informed of the transport.

2.6 Emergency/Contingency Planning

Laboratory employees shall be trained and prepared to respond to several types of emergencies commonly encountered in the laboratory environment. These emergencies may include:

- Spills of hazardous chemicals.
- Accidents and injuries, especially those which may result in exposure to hazardous chemicals.
- Fires.
- Electric shock.

Responses to these emergencies may include:

- Evacuation
- Spill clean-up
- First aid
- Fire-fighting (incipient only)

The following sections describe prudent emergency response practices, and outline Boston College policy on emergency response issues.

2.6.1 Spill Response

General

- In the event of a large spill (e.g., more than one gallon of a moderately hazardous substance), the BC Police Department should first be notified.
- The BC Police Department will then take the appropriate action, by calling for assistance and contacting the EHS officer.
- Whenever personnel from outside the immediate release area of a chemical spill are summoned to assist (e.g., the Boston or Newton fire department), the response is considered an emergency.
- If an emergency occurs, affected employees shall evacuate the workplace and shall **not** be permitted to assist in handling the emergency.
- The primary consideration during any hazardous spill response is to avoid employee exposure and to prevent ignition of flammable material. Secondary considerations include preventing material from going down a drain or sewer, minimizing property damage, and reducing downtime.
- Each laboratory worker must be familiar with these procedures and trained in their implementation.
- Appropriate personal protective equipment and other safety equipment should be available and all lab personnel should be familiar with its location and intended use.

Initial procedures for large spill response

A. Avoid personal exposure to the substance.

- Do not walk into or touch any spilled material.
- Avoid breathing any gases, vapors, fumes, or smoke.
- If the substance is unknown, leave the area and obtain help.
- Do not assume that a hazardous material is harmless just because you cannot smell it.

B. Isolate the hazard area and deny entry.

- Without entering the immediate hazard area, move and keep people away from the spill.
- If the material is a gas or volatile liquid, evacuate the surrounding areas.
- In the surrounding area, post warning signs.

—Only qualified personnel with the proper protective equipment and clothing will be allowed in the spill area.

C. Obtain help.

----Call BC Police at x2-4444

—Contact area supervision.

—Immediately report all spills to the laboratory management who will in turn coordinate any additional notification requirements.

—Contact medical support immediately in the event of any actual or suspected injury or exposure to the hazardous material and inform medical responders of the material involved.

D. If possible, identify the material as soon as possible without risking personal exposure.

—If the material cannot be identified as hazardous or non-hazardous, it must be treated as hazardous.

—Check the MSDS for hazard data as well as special protection information and handling precautions.

—Contact outside expertise (e.g., CHEMTREC, manufacturer) for identification if necessary.

E. Do not attempt clean-up until further direction is given from qualified personnel.

F. Spills to Sanitary Sewer:

The Massachusetts Water Resource Authority requires immediate reporting by telephone upon the occurrence of an accidental discharge of substances prohibited by Boston College's permit, regulations, or any slug load or spills that may reasonably be expected to enter the sanitary sewer.

Normal Business Hours: 617-242-6000 ext. 4900

After Hours: 617-539-4191

Notification shall include:

- Location of discharge
- Date and time
- Type of waste including concentration and volume
- Corrective actions taken

Within 15 calendar days of the date of occurrence, a written statement must be submitted describing cause of discharge, corrective measure taken to avoid future occurrences, and the information above.

This is described fully in pages 12 and 13 Part A of the Boston College's MWRA permit.

Spills involving contamination of personnel

If any harmful chemical comes into contact with your skin:

- Refer to the applicable MSDS
- Wash thoroughly, using the eyewash and/or shower as necessary.
- Discard any protective clothing that has been contaminated.
- Call for help as soon as possible. Inform a co-worker and have him/her notify supervisory personnel.

2.6.2 Spill Clean-up

Procedures for spill cleanup (incidental spills only)

In the event of an incidental spill, the following procedures should be followed to clean up the spill. These procedures are for incidental spills only; large spills should be responded to and cleaned up by

professionals. Chemical spill kits are located in each laboratory which contain the materials listed in Figure 2: “Chemical Spill Kit Checklist”.

- All spills constitute hazards and must be cleaned up immediately regardless of whether or not the substance is regarded as harmless or hazardous.
- Responses to incidental releases of hazardous substances where the substances can be quickly absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel, are **not** considered emergency responses. If the spill is more than 1 gallon of a moderately hazardous material, do not attempt cleanup.

The clean-up procedure for a spill will depend on the location and nature of the spill; different chemicals will require different response tactics rising from the nature of the hazard. For example, procedures for cleaning up a solid differ from those of a liquid spill. Also, the type and amount of equipment required will depend on the chemical spilled. A corrosive liquid acid will be treated differently than clean-up of a spill of flammable liquid. Such considerations should be part of a well thought-out plan prepared in advance.

- The laboratory management is ultimately responsible for ensuring that the cleanup is performed in a safe and environmentally sound manner.
- If evacuation of the area is necessary, evacuate the area before calling the emergency telephone number.
- For all spills, wear appropriate protective clothing for protection during cleanup procedures.
- If possible, have a co-worker dressed in appropriate Personnel Protective Equipment help with the cleanup.

Use of Spill Control Pillows

- Chemical spill control pillows contain a highly absorptive inert material in a porous bag that allows the flow of fluids into the absorbent. The fluids will be retained by the absorbent, making it possible to contain the majority of the spill within the bag for easy disposal.
- Use pillow on only one spill. Do not attempt to reuse pillows or dry out the pillow after use. Residues may remain that could react with other chemicals.
- **WARNING** — spill control pillows do not contain any chemical designed to make liquids less toxic or less flammable. Exercise extreme care when handling, storing, or disposing of spill control pillows containing absorbed material. *Do not use chemical spill pillows on hydrofluoric acid spills.*

Procedures for the Use of Spill Kits:

Identify the type of spilled chemical and select the appropriate material from the spill kit provided.

Solvent Spills

- Use a solvent spill kit. Apply sufficient absorbent (e.g., solusorb from JT Baker) from the spill kit on to the spill to absorb all of the solvent.
- Thoroughly mix the absorbent and solvent with the scoops provided until the absorbent regains its appearance as a dry, free-running, non-adhering granular material. *Note: If the proper quantity of absorbent is used, the solvent odor in the mixture will be very slight. If a strong odor persists, add additional absorbent.*

- Pick up the saturated absorbent with the scoops provided and transfer it to the plastic disposal bag provided. Place the used scoops and gloves in the disposal bag and twist seal with the bag tie provided.
- Fill out the disposal label, peel off the backing, and affix the label to the bag.

Acid Spills

- Use Hazorb from the spill kits provided. Hazorb is an absorbent and will not neutralize the spill, so take the necessary precautions.
- For severe acid spills, the neutralizer TEAM has been provided to each department. Make sure you know its location within your building.
- Pick up the saturated absorbent with the scoops provided and transfer it to the plastic disposal bag provided. Place the used scoops and gloves in the disposal bag and twist seal with the bag tie provided.
- Fill out the disposal label, peel off the backing, and affix the label to the bag.

— OR —

- Use an acid spill kit. Apply the acid neutralizer (e.g., Neutrasorb acid neutralizer from JT Baker) to the spill from the perimeter inward, applying sufficient neutralizer to obtain a uniform color change throughout.
- Note the color of the slurry.

<u>Color Code:</u>	•Red/Pink	— (Highly Acidic) HAZARDOUS
	• Yellow-Buff	— (Slightly Acidic) HAZARDOUS
	• Blue/Green	— (Safe)

If the slurry color indicates an acidic condition (may be encountered in spills of concentrated acids), carefully add water and additional Neutrasorb. Mix thoroughly with the plastic scoops provided until a persistent blue/green color appears. Do not proceed until foaming has ceased.

- Pick up the neutralized spill material with the scoops and transfer to the plastic disposal bag provided. Wipe up any residual neutralized spill material with the sponge (moistened) provided.
- Place used sponge, scoops, and gloves in the disposal bag and twist seal with the bag tie provided.
- Fill out the disposal label, peel off backing and affix to the bag.

Caustic Spills (sodium hydroxide, ammonia)

- Use Soluzorb from the spill kits provided. Soluzorb is an absorbent and will not neutralize the spill, so take the necessary precautions.
- Pick up the saturated absorbent with the scoops provided and transfer it to the plastic disposal bag provided. Place the used scoops and gloves in the disposal bag and twist seal with the bag tie provided.
- Fill out the disposal label, peel off the backing, and affix the label to the bag.

— OR —

- Use a caustic spill kit. Apply the caustic neutralizer (e.g., Neutracid-2 from JT Baker) to the caustic spill from its perimeter inward and completely absorb the spill. A color change from yellow to blue signifies caustic material (HAZARDOUS).

—Note: If absorption is slow or spill material is concentrated (40% or greater) add additional cool tap water to aid absorption and color reaction.

- Thoroughly mix the slurry with the scoops provided until it changes to a yellow/yellow-green color (neutralized). Add additional Neutracid-2 and/or water if necessary to obtain the above color reaction and desired slurry consistency.

— Note: This step will be accompanied by slurry boiling if concentrated caustic solutions are treated. Observe appropriate precautions when handling hot materials.

- Pick up the neutralized material with the scoops provided and transfer it to the plastic disposal bag provided. Please the used scoops and gloves in the disposal bag and twist seal with the bag tie provided.
- Fill out the disposal label, peel off the backing, and affix the label to the bag.

Mercury Spills:

- Avoid or minimize spills of elemental mercury. Use coated or non mercury thermometers whenever possible.

- Use the mercury spill kit provided to each department to clean up spills.
- Wear plastic shoe covers if mercury has been spilled on floor.
- Thoroughly wash hands, arms, and face after clean-up is complete.
- Dispose of the waste in accordance with applicable regulations. Use plastic waste containers when possible.
- Do not place elemental mercury waste in drains.

Finely Divided Solids Spills (Dusts, Fibers, Powders, Etc.)

- Extremely toxic dusts should be collected by using HEPA filter vacuum cleaners. Examples: elemental beryllium, cadmium, arsenic and their compounds, and barium, thallium and mercury compounds. (Boston College does **not** own a HEPA vacuum, therefore an outside contractor will be called in to perform this type of service.)

- Oxidizing solids such as nitrates, permangantes, perchlorates, etc., should NOT be dumped with combustible materials such as paper.

- Decontaminate the contaminated area with an appropriate cleaning agent.

Formaldehyde

The following procedures should be followed in the event of a formaldehyde spill:

If a small volume spill (less than 1 gallon 37% formaldehyde; less than 10 gallons 10% formaldehyde) occurs:

- Use formaldehyde spill clean-up kit to neutralize formaldehyde prior to cleanup.
- Put waste in a properly labeled, closed container for disposal.

If an excessive spill (greater than or equal to 1 gallon 37% formaldehyde; greater or equal to 10 gallons 10% formaldehyde) occurs:

- Evacuate the area.
- Close off all doors in the room.
- Notify the campus police.

Others

- Incidental Liquid Spills (1 liter or less of non-highly toxic chemicals):
 - Use Hazorb to absorb the spill.
 - Consult the MSDS for the chemical for specific cleanup and disposal techniques.
 - If the spilled material is hazardous, dispose of absorbed material as hazardous waste.
 - Clean the affected area with soap and water.
- Incidental Solid Spills
 - Do not dry sweep.
 - Cover the solid material with wet paper towels (using water or appropriate, compatible solvent, scoops, and gloves). Avoid spreading the compound as much as possible.
 - Carefully pick up the material.
 - Consult the MSDS for the chemical for more specific cleanup and disposal techniques.
 - If the spilled material is hazardous, dispose of absorbed material as hazardous waste.
 - Clean the affected area with soap and water.

2.6.3 Accidents and Injuries

Response

- All accidents and injuries shall be reported to the laboratory supervisor. If the laboratory supervisor is unavailable, notify the department head directly. Be sure to report exposures to any hazardous chemicals as well as obvious injuries.
- All accidents and injuries should also be reported to the BC Police Department and the Environmental Health and Safety Office.
- This permits early follow-up and subsequent medical care, and initiates the necessary investigation procedures.

Treatment

- It shall be the duty of each employee to see that he or she receives proper first aid treatment for all minor injuries at once.
- The supervisor shall make immediate arrangements for the employee to receive emergency treatment if the injury is of a serious nature.

Reporting

The following incidents shall be reported:

- Every condition with actual or potential injury or illness.
- Accidents resulting in damage to instruments, property, or the building
- Situations or conditions which have the potential for injury, hazard to health, or damage to the property
- Fires.
- Spills of more than one gallon or toxic or carcinogenic materials.

- Reports shall be initiated by Department CHO's or administrators and forwarded to the Chemical Hygiene Officer in the Environmental Health and Safety Office within 48 hours of the accident or event. Upon receipt of an incident notification the EH&S staff member will complete applicable sections of the BC EH&S "Incident Complaint Form," Figure 3.

- OSHA requires that the following be recorded:

- All occupational illness
- Fatalities
- Injuries resulting in one or more lost workdays
- Restriction of work or motion
- Injuries resulting in loss of consciousness
- Injuries resulting in transfer to another job
- Medical treatment other than first aid.

- OSHA 200 log records are maintained by Benefits.

- No deficient accident report will be accepted by management. The report will be returned to the originator whenever:

- The report does not provide an accurate account of what happened.
- Basic causes are not identified; only symptoms are cited.
- Remedial action plan is incomplete.

Investigation procedures

- Accident investigation of minor accidents is key to accident prevention.

- An incomplete investigation is a waste of time and may allow the real cause to go unnoticed, allowing a recurrence of the same incident, with worse ramifications.

- When conducting an investigation, follow these guidelines:

- Be objective.
- Define faulty situations, not individuals.
- Be thorough and dig until you find the real cause.
- Once the deficiencies have been examined and analyzed and their potential assessed, the supervisor must select the alternatives which control the causal factors.

- The Environmental Health and Safety Office and Risk Management should review accident report forms and allocate the resources necessary for corrective measures as needed and can distribute the "lesson learned" throughout the organization.

- The following incidents shall be reported directly to OSHA within 48 hours:

- Fatalities
- Hospitalization of three or more employees.

- It is the responsibility of the department head to insure that required accident report forms are completed, and proper authorities are notified.

Emergency numbers

- Call the BC Police Department at 552-4444 or 2-4444 if on campus, (available 24 hours) and provide the nature of emergency and exact location.

2.6.4 Emergency Medical Response

Definition

- A medical emergency is a medical condition which requires immediate professional medical attention.
- This includes any incident which results in loss of consciousness, especially that which results from exposure to toxic material.
- Such situations are best handled in a hospital emergency room.
- In the event that medical treatment is required, the injured person shall contact campus police who will arrange for treatment at a nearby hospital.

Procedures

- When a medical emergency occurs, the employee involved, or the person discovering the situation, should immediately:
 1. Call for help to bring others in the immediate area to assistance.
 2. Call the BC Police Department:
 - Give the exact location of the emergency, the nature of the emergency, and the name and condition of the employee(s) involved.
 - Do not hang up before the BC Police Department does. This ensures that the police have whatever information is needed to effectively respond.
 0. Stay with the victim and administer first aid or other support, as required. If an exposure to toxic materials has taken place, obtain information about the health and safety procedures specific for that chemical. This information can be obtained from the departments MSDS notebook or the department's Deputy Chemical Hygiene Officer.
 1. Give pertinent information to the ambulance personnel. If the victim was exposed to hazardous materials, give the emergency personnel as much information as possible about the toxicity and nature of the material to which the person has been exposed.
 2. Notify the Environmental Health and Safety Office and as soon as possible.
 3. The employee reporting the emergency must provide all necessary information about the incident within 24 hours so that appropriate accident reports can be completed.

First aid

The following sections provide detailed guidelines for proper selection and use of PPE.

- For serious personal injury, first aid should be administered (in this order, if more than one response is needed):
 1. Stop bleeding
 2. Administer artificial respiration
 3. provide CPR as appropriate by trained personnel
 4. Prevent shock.
- If a stretcher is needed to move a victim, a fire blanket may be used.

- Minor first aid cases (minor cuts, bruises, burns, etc.) will be handled internally by the Department of Health Services.
- For those suffering from over inhalation of gases, vapors or dust, bring the victim to fresh air and check the MSDS for next steps. Serious cases should be sent to the hospital.
- For skin and eye overexposure to corrosive chemicals or irritants, the first few seconds after contact are critical and immediate flushing of the eye may prevent permanent damage. Wash eyes, skin continuously with large amounts of water for 15 minutes. Remove contaminated clothing. Send serious cases to the hospital.
- Victims of electric shock should receive CPR from trained personnel.

2.6.5 Fires/Explosions/Evacuations

Response

If you discover a fire or witness an explosion:

— Turn on the alarm. Manual alarm stations are located throughout the building at each exit doorway, or dial the BC Police Department.

— Contact the Boston College Police Department and give the exact location of the fire or explosion and your name. Do not hang up until all relevant information has been provided.

----If appropriate, shut off power to the area.

— Evaluate the type of material burning:

- Solid *combustion*: Handle small objects with fire-resistant gloves, and extinguish with water or carbon dioxide.

- Flammable *liquids*: Carbon dioxide is effective only for small fires. Do not use water, as it enhances the spread of fire. If flammable liquids have spilled, but have not ignited, use a spill pillow to prevent spread and reduce the fire hazard.

- Electrical: Do not use water unless the circuit has been shut down. If power is off, water can be used. Shut down the circuit whenever possible. Carbon dioxide is generally the most suitable extinguishant as it is often not known whether a circuit has been shut down.

— If possible, put out the fire with a portable extinguisher or other appropriate means. Maintain a free route of exit at all times and try to have another person back you up with a second extinguisher.

— If you cannot extinguish the fire, leave the building but remain available to transmit information to the local fire department.

Fire extinguishers

- Each lab employee must assure that a functional A:B:C fire extinguisher is accessible in his/her work area at all times. If this is not the case, the supervisor must be notified immediately. Whenever a fire extinguisher is used, it must be exchanged through the Work Order Center for a fully charged, sealed extinguisher. A:B:C extinguishers are effective on virtually every type of fire including paper, wood, solvent, oil, electrical, organic, etc.

General evacuation

- Become familiar with the locations of the two closest exits in case of an evacuation.
- For a quick and orderly evacuation of a building, all personnel must familiarize themselves with the exits and the alternate exits in the area of their work station/office, etc.
- When the fire alarm signal sounds, proceed immediately to the nearest exit in an orderly fashion.

- Do not stop or return to laboratories, desks, washrooms, etc. to pick up personal items. When the alarm sounds, leave the building.
- If possible, shut down laboratory or any other equipment that is left running which would cause additional problems. Also close office doors and windows if time permits.
- Do not use an elevator.
- Do not enter a building until the "all clear" has been given by designated campus staff or the fire department.
- All department heads are to account for the people in their respective departments to ensure that everyone has left the building.

3.0 Control Measures

3.1 Hazard Identification, Characterization, and Control

Control measures to reduce employee exposure to hazardous chemicals can be determined and implemented by applying criteria necessary to identify and characterize the nature of chemical hazards in the laboratory workplace. At Boston College, hazard identification shall be performed at all levels through methods and observations used to detect the presence or release of hazardous chemicals, and by observance of safety vigilance. In addition, Boston College laboratories shall keep up-to-date chemical inventories and collections of Material Safety Data Sheets (MSDSs) for purposes of hazard identification and communication .

The goal of both the University and departmental CHC's efforts in hazard identification, characterization, and control is to ensure that laboratory employees' exposures to OSHA regulated substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

3.2 Review of Chemicals

Each principal investigator shall review the chemicals to be purchased in their respective laboratories. Approval is needed if the chemical is a known or probable human carcinogens, acutely toxic substance, or presents a pronounced physical hazard, such as explosives and/or the chemical is not included in current inventories.

The notice of intent form is designed to help set guidelines for the selection of controls (engineering controls, personal protective equipment, special hygiene practices, *etc.*) based on the level of physical and chemical hazard risk. Following purchase approval, and as needed, the departmental Chemical Hygiene Committee can assist in selecting appropriate control measures.

Whenever tasks involve work with particularly hazardous substances, including select carcinogens, reproductive toxins and/or substances with high acute toxicity, specific consideration shall be given to the following provisions for additional employee protection.

- specification of designated area(s)
- use of containment equipment such as fume hoods
- procedures for safe removal of contaminated waste
- decontamination procedures.

Selection of suitable control options for additional employee protection shall be based on the professional and technical judgment and discretion of the departmental Chemical Hygiene Committees in consultation with the Environmental Health and Safety Office, whose decisions shall become chemical hygiene policy.

3.3 Working alone

Working alone in a laboratory room should be avoided. However, if employees conduct hazardous work while alone, they should make arrangements with the BC Police Department and/or other individuals to provide periodic checks.

When working alone under unusual or hazardous conditions, special rules may be necessary. The lab supervisor must determine when special rules apply.

Researchers should not work alone without the PI being aware of the type of work being done, when, and with what frequency. Researchers should not use untested procedures or work with hazardous chemicals when working alone. Working alone should only take place with the approval of the PI.

3.4 Inspections

In order to ensure that the laboratory's chemical and overall safety is being maintained periodic inspections will be performed by the departmental CHC and by the UCHO. These will consist of formal reviews of chemical and general safety practices, housekeeping, and maintenance checks of safety related equipment.

All laboratory employees shall routinely inspect their laboratory to insure compliance with the Chemical Hygiene Plan.

If through departmental inspections, the same violation is noted more than three times in a particular laboratory, the UCHO must be notified in writing by either the Departmental CHO or CHC.

Documentation of inspections must be maintained by each laboratory or department or the EH&S Office as applicable.

In addition, the UCHO will conduct inspections as follows:

- At least once a year, all laboratories will be inspected by the CHO or designee. If a particular concern is addressed in a laboratory, then the laboratory will be re-inspected on a more frequent basis. If an issue is identified after the first inspection, the principal investigator will be notified. If the same concern is noted after the second inspection, the departmental CHC and the department head will be notified. If, after three inspections of a laboratory, the same problem persists, a report will be issued and sent to the Dean of Arts and Sciences and/or the Academic Vice President for further action.
- Inspections shall cover at least the items listed in the "Chemical Hygiene Inspection Checklist" (see Figure 4).
- Inspections may be unannounced; however, the CHO will attempt to include faculty members during inspections of their work areas.

3.5 Monitoring Chemical Fume Hoods and Vented Enclosures

3.5.1 Daily Visual Inspection

Before beginning any operations in a hood, a visual inspection must be performed by the person using the equipment, as described below.

If it appears that the hood is not functioning properly, seek immediate repair, immediately notify the laboratory supervisor and the Department Administrator.. The Department Administrator will contact Buildings and Grounds to ensure the hood is repaired by HVAC.

No work involving hazardous materials is to be conducted in a faulty hood or vented enclosure until the problem has been corrected.

Procedure for Conducting Daily Visual Inspection:

1. Inspect exhaust slots at the rear of the hoods. Slots must be clear and in the proper position.
2. For hoods with adjustable sashes, make sure that the sash is at the proper height. This is marked on the front of the hood beside the sash.

3. If a problem is noted, hold a piece of tissue paper or other thin paper at or near the face of the hood. Be careful not to let the paper be pulled into the exhaust inlet. The paper should be drawn inward toward the rear of the hood. There should be no obstructions to air flow.
4. If the hood is equipped with a pressure gauge, check the gauge to ensure that pressures are within acceptable ranges as marked on the gauge.
5. Do not tamper with alarms and monitors. If an alarm sounds or an alarm indicator is lit, notify the lab supervisor who will contact the HVAC department.

3.5.2 Annual inspection

- Face velocity measurements shall be performed at least once each year for all hoods in which hazardous substances are used.
- The monitoring shall include a verification of the rate and direction of air flow, as determined by measurement of the face velocity and smoke tube tests.
- Results of the annual inspections shall be submitted to the campus-wide CHC. The form that is to be used to record the results of the inspection is contained in Figure 5.
- Smoke tube tests shall be used to evaluate direction of air flow and to determine if there are any irregular or turbulent airflow patterns.

Procedure for Conducting Smoke Tests of Chemical Fume Hoods and Vented Enclosures:

1. Adjust the sash to the proper position, if appropriate. Smoke released several inches in front of the hood or vented enclosures should move directly to the exhaust slot.
2. Release smoke from the tube at or above the interior working space to locate any dead or turbulent areas.
3. Record the results as satisfactory or unsatisfactory.

Recommended Procedures for Measurement of Face Velocity for Chemical Fume Hoods and Vented Enclosures:

1. Adjust sash height to marked operating level. Turn off auxiliary air.
2. If the hood is connected to other hoods, measure the face velocity under the conditions of "maximum" use.
3. Using an appropriate, calibrated instrument (such as a velometer), measure the air flow at several sites. Record results for each determination.
4. Calculate the average velocity for the hood.

Face velocities for chemical fume hoods should average approximately 100 feet per minute (fpm) at the operating sash site. No individual point should be outside the minimum (80 fpm) and the maximum (120 fpm) unless it is demonstrated by smoke tube testing that flows above 120 fpm provide adequate capture and no significant turbulence.

3.5.3 Safe practices for chemical fume hoods

- Use a hood or other local ventilation device when working with any appreciable volatile substance with a threshold limit value (TLV) of less than 50 parts per million (ppm).
- Always use the hood for operations which might result in release of toxic chemicals, vapors, or dust.
- Place equipment well inside hood, approximately 9-12 inches.
- If heat sources (burners) are used in the hood, open exhaust slots at top of hood and increase total velocity.
- Keep materials stored in hoods to a minimum and do not allow them to block vents or air flow. Do not allow the hood to become a storage bin.
- Leave the hood "on" when it is not in active use if toxic substances are stored inside, or if it is uncertain whether adequate general lab ventilation will be maintained when hood is "off."
- Hoods should not be used to evaporate hazardous liquids or gases as a means of waste disposal.

3.6 Inspection and Maintenance of Safety Equipment

Schedule

- Eyewash stations shall be inspected annually, and the results recorded on the standard form for eyewash stations (see Figure 6).
- Safety showers shall be tested annually, and the results recorded on the standard form for safety showers (see Figure 7).
- Other safety equipment (list) shall be inspected regularly, at intervals of approximately 6 to 12 months.

Personal Protective Equipment

Personal Protective Equipment (PPE) is a critical control measure to help prevent employee exposures. At Boston College laboratories, the following PPE shall be used by all laboratory employees as applicable:

- Eye protection
- Proper gloves when skin contact with chemicals is likely
- Laboratory coats are recommended.

All non-laboratory personnel shall wear eye protection at all times while visiting or working in laboratories.

Individual departments are responsible for purchasing, from their own budgets the appropriate personal protective equipment for the employees in their departments or protection specific to each procedure.

- These requirements shall reflect the level of hazard present.
- Compliance to these requirements shall be monitored by the campus-wide CHC and laboratory management.

3.7 Eye Protection

Applicability

- Persons (including visitors) who do not normally work in eye protection areas, but who may be exposed to hazardous chemicals in these areas are required to wear eye protection.
- Eye protection is required while performing or watching work where there is any reasonable probability of exposure of the eyes (e.g., when mixing chemicals on a bench top).

Selection

- Specific requirements for the use of eye protection equipment shall be established by the campus-wide CHC. These requirements shall address impact, splash and vapor protection specific to each procedure.
- These requirements shall reflect the level of hazard present.
- Compliance to these requirements shall be monitored by the campus-wide CHC and laboratory management.

Types of eye protection equipment

Impact Protection

—Safety glasses and impact resistant face shields should be available for use in Boston College laboratories.

Splash Protection

- In areas where the likelihood of splashes may be high, specific protection shall be worn.
- Goggles, face shields and plastic splash guards for prescription glasses are available.
- Barrier shields may be used if appropriate.
- Face shields shall be worn when large quantities (greater than one gallon) of a corrosive chemical (e.g., acid and alkaline) are handled in open containers. Face shields shall also be worn whenever more complete protection of the face and neck is needed.

Vapors

- Gas-tight goggles shall be worn where hazardous chemical vapors are not otherwise controlled.

Contact Lenses

- It is suggested that contact lenses not be worn, even if used in combination with safety glasses.

3.8 Respiratory Protection***Provision***

- Boston College shall provide proper respiratory protection equipment and training to employees at no cost in accordance with 29 CFR 1910.134, "Respiratory Protection," where the use of respirators is necessary to maintain exposure below permissible exposure limits.

Applicability

- Respirators shall not be used without the approval of the CHO.
- Dust filter face masks with more than one strap are considered a form of respirator and should not be used without the approval of EH&S.
- Single strap dust filter masks are not an effective means of respiratory protection and should not be used.

3.9 Glove Selection and Use***Applicability***

All laboratory employees shall wear protective gloves under the following conditions:

- whenever potential for contact with corrosive or toxic materials and/or materials of toxicity exists.
- whenever protection is needed against accidental exposure to chemicals.
- whenever it is necessary to handle rough or sharp-edged objects, or very hot or very cold materials.

Selection

- Proper glove selection and use is dependent on the chemical resistance/permeability of the glove material to the chemical, as described below.
- Laboratory management shall ensure that gloves are selected and used according to these guidelines.

Chemical resistance

- Chemical resistance is influenced by the following factors:
 - Material type
 - Manufacturer
 - Thickness
 - Temperature
 - Chemical composition and concentration.
- The performance of barrier materials against various chemicals should be evaluated on a substance-by-substance basis.
- The glove should be able to withstand penetration, degradation, and permeation from the hazard.
- More permeation data are becoming available from both manufacturers and testing laboratories.
- Consult a permeation chart and/or a physical properties chart to determine the most appropriate glove material.

Figure 8. provides general information on the resistance to common laboratory chemicals of common glove materials.

Inspection

- Before each use, gloves shall be inspected for discoloration, punctures, and tears.
- Defective gloves shall not be used.

Replacement

- Gloves shall be replaced periodically, depending on frequency of use and permeability to substance(s) handled.
- Contaminated gloves shall be decontaminated or disposed of, as appropriate.
- Doffing should be done in a manner that restricts the transfer of chemical from the work area, and prevents contact between personnel and the outside of the contaminated glove.

3.10 Special Personal Protective Equipment (PPE)

Applicability

- Whenever particular laboratory environments and/or tasks require the use of “special” personal protective equipment as deemed necessary by laboratory management or the CHO, a selection shall be made and communicated to laboratory workers.

Selection

Selection of special PPE shall be based on:

- Knowledge of the hazards present and protection required (e.g., flame resistance, splash protection)
- Functional compatibility among pieces in an multi-component ensemble (.e.g., respirators and eye protection)
- Limitations of the PPE selected (e.g., permeation characteristics, breakthrough time, breathability, ease of movement)
- Cost and reuse factors
- Fit.

Types

Special PPE may include:

- Bonnet —Shoe covers.

- Hood —Boots
- Sleeves —Coveralls
- Coat —Bib-overalls
- Jacket —Apron
- Pants —Full-body encapsulating suit

These items may be constructed of the following materials:

- Disposable:
 - Tyvek®
 - Kleenguard®.
- Nondisposable:
 - neoprene
 - natural rubber
 - butyl rubber
 - Gore-tex®
 - cotton.

See information on chemical permeability for further information.

Inspection

- Before each use, special PPE should be inspected by the user for discoloration, punctures, tears, imperfect seams, malfunctioning closures, etc.
- Special PPE shall be inspected periodically during use.

Replacement

- Any item that has been physically damaged or chemically degraded should be doffed and replaced as soon as safely possible.
 - Doffing should be done in a manner that restricts the transfer of chemical from the work area, and prevents contact between personnel and the outside of the contaminated garment.
- Reusable PPE shall be decontaminated and cleaned as necessary.

4.0 Information and Training

4.1 Employee Information & Training

In accordance with the requirements specified in 29 CFR 1910.1450, Boston College shall provide laboratory employees with the information and training needed to ensure that they are apprised of the hazards of chemicals present in their work areas. The goal of the Boston College information and training program is to assure that all individuals at risk are adequately informed about the work in laboratory facilities, its risks, and appropriate response in case of emergency. The UCHO working in conjunction with the Departmental CHO shall ensure that records are maintained and accurate.

Training topics will include:

- contents of 29 CFR 1910.1450 and its appendices.
- locations and availability of the Boston College Chemical Hygiene Plan.
- permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals used in the laboratory where there is no applicable OSHA standard.
- signs and symptoms associated with exposures to hazardous chemicals used in the laboratory, as found in the applicable MSDS or other reference material.
- location and availability of reference material, such as MSDSs, pertaining to hazards, safe handling, storage and disposal of hazardous chemicals used in the laboratory.

- 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.
- the measures employees can take to protect themselves from chemical-associated hazards.

4.2 Record keeping

Boston College shall establish and maintain accurate and complete records concerning medical surveillance, chemical exposures, hood and vented enclosure monitoring, chemical inventory, and training.

4.2.1 Medical surveillance

- For each employee, Boston College's Health Services and Benefits departments shall establish and maintain an accurate record of any medical consultation and examinations including tests or written opinions required by the OSHA Laboratory Standard.
- These records should be kept, transferred, and made available for at least the duration of employment plus thirty years, with the exception of the following types of records (in accordance with 29 CFR 1910.20, "Access to Employee Exposure and Medical Records"):
 - Health insurance claims records maintained separately from the employer's medical program and its record;
 - First aid records (not including medical histories) of one-time treatment and subsequent observation of minor scratches, cuts, burns splinters, and the like which do not involve medical treatment, loss of consciousness restriction of work or motion, or transfer to another job, if made on-site by a non-physician and if maintained separately from the employer's medical program and its records;
 - The medical records of employees who have worked for less than one year for the employer; these records shall be provided to the employee upon the termination of employment.

4.2.2 Exposure records

- For each employee, Boston College shall establish and maintain an accurate record of any measurements taken to monitor employee exposures, maintained by the Health Services and Benefits departments.
- These records should be kept, transferred, and made available in accordance with 29 CFR 1910.20, “Access to Employee Exposure and Medical Records,” each employee exposure record shall be preserved and maintained for at least thirty years, except that:
 - Background data to environmental monitoring or measuring (laboratory reports and worksheets) need only be retained for one year as long as the sampling results, the collection methodology, a description of the analytical and mathematical methods used, and a summary of other background data relevant to interpretation of the results obtained, are retained for at least thirty years;
 - Material safety data sheets and records concerning the identity of the substance or agent (of chemicals not currently in use) need not be retained for any specified period as long as some record of the identity of the substance or agent, where it was used, and when it was used is retained for at least thirty years;
 - Biological monitoring results designated as exposure records by specific occupational safety and health standards shall be preserved and maintained as required by the specific standard.

4.2.3 Hood and vented enclosure monitoring records

- Boston College shall establish and maintain an accurate record of all results of chemical fume hood and vented enclosure inspections (see Figure 5). Records will be maintained by the EHS office.

4.2.4 Chemical inventory

- Each department shall maintain a record of all chemicals stored and used in the work area, which will be updated annually.

4.2.5 Training

- Boston College's Environmental Health and Safety Office shall establish and maintain an accurate record of all chemical hygiene training classes, including all information listed in Figure 9 (Attendance Training Record).

5.0 Exposure Assessment

5.1 Employee Exposure Determination

The University Chemical Hygiene Committee may use industrial hygiene monitoring techniques to determine exposures and necessary control measures. Should any Chemical Hygiene Committee receive reliable information that constitutes a “reason to believe” (29 CFR 1910.1450 (d)(1)) that exposure to any substance regulated by a standard which requires monitoring routinely exceeds the action level (or in the absence of an action level, the Permissible Exposure Limit (PEL), Boston College shall measure the employee(s)’ exposure. The University Chemical Hygiene Committee shall determine, on a case-by-case basis, the level of evidence needed to constitute a “reason to believe” that exposures routinely exceed permissible levels.

If initial monitoring discloses that employee exposure is over the action level (or in the absence of an action level, the PEL), Boston College shall immediately comply with the exposure monitoring provisions of the relevant standard, and may terminate monitoring in accordance with the relevant standard.

Within 15 working days after the receipt of any monitoring results, Boston College shall notify the employee(s) of these results in writing either individually or by posting results in an appropriate location accessible to employees. For each employee, Boston College shall establish and maintain an accurate record of any measurements taken to monitor employee exposures. These records shall be kept, transferred, and made available in accordance with 29 CFR 1910.20, “Access to Employee Exposure and Medical Records.”

5.2 Medical Consultation and Medical Examinations

All laboratory employees working with hazardous chemicals shall have access to medical attention, through BC Health Services, including follow-up examinations deemed necessary by the examining physician. All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician *without cost to the employee or loss of pay*. Medical examinations and consultations should be performed within 24 hours after exposure. Medical examinations shall be provided to Boston College’s employees under the following circumstances:

- whenever an employee develops specific signs or symptoms associated with possible exposure to a hazardous chemical handled in the laboratory.
- where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements; other medical surveillance requirements of relevant standards shall also be observed.
- following a medical consultation during which the physician determines the need for a medical examination, in response to an event such as a spill, leak, explosion or other occurrence causing likely exposure.

Under these circumstances, employees shall first report to the lab supervisor, who will then arrange medical follow-up with Health Services. Health Services will co-ordinate corrective actions with the Environmental Health and Safety Office.

For all medical consultations and examinations, the following information should be provided to the examining physician:

- the identity of the hazardous chemical(s) to which the employee may have been exposed.
- a description of the conditions under which the exposure occurred including quantitative exposure data, if available.
- a description of the signs and symptoms of exposure the employee experiences, if any.

For all medical consultations and examinations performed in accordance with the OSHA laboratory standard, the examining physician shall provide a written opinion to Health Services at Boston College that includes the following:

- recommendation for further follow-up.
- results of the medical examination and any associated tests.
- any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the laboratory workplace.
- a statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

The physician's written opinion shall not reveal specific findings or diagnoses unrelated to occupational exposure.

For each employee, Boston College shall establish and maintain an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by the OSHA laboratory standard. These records shall be kept, transferred and made available in accordance with 29 CFR 1910.20, "Access to Employee Exposure and Medical Records." Medical Records will be kept on file at Health Services.

6.0 Labeling and Material Safety Data Sheets

In accordance with requirements of 29 CFR 1910.1450(h), Boston College laboratory employees shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced. In addition, each department shall maintain any material safety data sheets (MSDSs) that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees. An MSDS is a detailed informational document prepared by the manufacturer or importer of a hazardous chemical which describes the physical and chemical properties of the product. Information included in a Material Safety Data Sheet aids in the selection of safe products, helps employers and employees understand the potential health and physical hazards of a chemical, and describes how to respond effectively to exposure situations. The following procedures provide instruction on maintaining MSDSs and proper procedures for posting signs and labels.

New Compounds

Some laboratories may synthesize or develop new chemical substances on occasion. If the composition of the substance is known and will be used exclusively in the laboratory, the laboratory worker must label the substance and determine, to the best of his/her abilities, the hazardous properties (e.g., corrosive, flammable, reactive, toxic, *etc.*) of the substance. This can often be done by comparing the structure of the new substance with the structure of similar materials with known hazardous properties. If the chemical produced is of unknown composition, it must be assumed to be hazardous, and appropriate precautions taken.

If a chemical substance is produced for another user outside this facility, the laboratory producing the substance is required to provide as much information as possible regarding the identity and known hazardous properties of the substance to the receiver of the material.

6.1 Material Safety Data Sheets

- MSDSs shall be maintained on file in the Office of Environmental Health and Safety, and each academic department.
- Every department is responsible for generating an annual list of hazardous chemicals handled by the department, with approximate quantities.
- Satellite files of most commonly used and hazardous materials should be maintained for ready access in close proximity to laboratories.

6.2 Signs and Labels

6.2.1 Signs

Signs bearing the following information shall be posted in the areas indicated:

- Emergency telephone numbers placed in accessible areas for emergency personnel/facilities, supervisors, and lab workers.
- Location signs for safety equipment, such as showers, eyewash stations, spill kits, and exits.
- Warnings in areas or on equipment where special or unusual hazards exist.
- Personal protective equipment requirements in designated areas.
- Rooms in the Chemistry Building are labeled with NFPA 704 placards, listing the flammability, reactivity, and health hazards of the most hazardous chemicals in each room in the event of a fire.

6.2.2 General Labeling Guidelines

- All chemicals must be adequately labeled upon arrival in the lab.
- Chemicals transferred from stock bottles to other (secondary) containers must be labeled with the identity of the chemical immediately. Hazard notices such as “toxic” or “flammable” must be included on the label where appropriate. Labeling of secondary containers must be consistent with that of primary containers.
- Everyone who receives a hazardous chemical in the work area must assure that the chemical has a label which fully identifies the chemical contents and the potential hazards associated with the handling of the chemical. If an adequate label does not exist, then such a label must be affixed by the individual receiving the hazardous chemical into the work area.
- Do not label the caps of containers.
- Materials subject to Nuclear Regulatory Commission (NRC) regulations must be labeled accordingly.

6.2.3 Special Signs and Labels

The following warnings should be placed in work areas where the hazard indicated is present:

- Acid/caustic
- Corrosive material
- Formaldehyde (29 CFR 1910.1048)
- Flammable (29 CFR 1910.106)
- Combustible (29 CFR 1910.106)
- Hydrogen (29 CFR 1910.103)
- Oxygen (29 CFR 1910.104)
- Propane (29 CFR 1910.110)
- Carcinogen (NIH Guidelines for the Laboratory Use of Chemical Carcinogens)
- Chemical Storage Area.

Refer to the regulations and standards given above for more details.

Specific requirements for OSHA chemicals listed in sections 29 CFR s1910.1003-1101 are forward to each department by the EH&S Office. These specific requirements are for the following chemicals: 4-Nitrobiphenyl; Alpha-Naphthyl-Amine; 3,3'-Dichlorobenzidine; Methyl-Chloromethyl Ether; Bis-Chloromethyl Ether; Beta-Naphthylamine; Benzidine; 4-Aminodiphenyl; Ethylemeimine; Beta-Propiolactone; 2-Acetylamino-Fluorene; 2-Dimethylaminoazo-benzene; N-Nitrosodimethyl-amine; Vinyl Chloride; Inorganic Arsenic; Lead; Benzene; 1,2 Dibromo-3-Chloropropane; Acrylonitrile; Ethylene Oxide.

7.0 Waste Management

The aim of the waste disposal program is to assure that minimal harm to people, other organisms, and the environment results from the disposal of waste laboratory chemicals. Laboratory wastes shall be handled, stored, transported, and disposed of in accordance with applicable local, state, and federal regulations, including those of the Department of Transportation (DOT), the Environmental Protection Agency (EPA) and the Department of Environmental Protection (DEP).

7.1 Standard Operating Procedure for the Disposal of Hazardous Waste

A hazardous waste service company is used to collect and segregate hazardous waste on campus bimonthly. No Boston College employee should take hazardous waste down to the storage areas, unless authorized by EH&S.

- Hazardous chemical waste shall be separated, to the extent practicable, according to the chemical classes and potential hazard.
- Sink disposal of all chemicals is prohibited in all buildings except in Merkert and Devlin. Sink disposal in designated laboratory sinks in Merkert and Devlin is confined to uncontaminated dilute acids and bases. Dilution for disposal purposes only is forbidden.
- One area in each laboratory should be marked and designated as a satellite accumulation area. If stored on the floor, containers should be placed on pallets or another type of containment system to prevent leaking, spilling and staining of the floor.
- The hazardous waste satellite area must be inspected weekly and documented on the Hazardous Waste Area Inspection Form (Figure 10).
- Choose appropriate containers for storage. Make sure all containers are impervious and labeled. Flammable wastes can be stored in only one gallon containers except for 2.5 gallons stored in fireproof-rated cans.
- All containers must be completely and properly labeled. Use BC's yellow chemical waste labels available at your department office or the EH&S Office.
- If you are using funnels to pour waste into containers, insert the funnel only when pouring. Funnels can be stored in a small plastic beaker. Waste containers must be kept closed at all times except when pouring waste.
- Once waste is ready to be picked up, the Hazardous Waste Inventory Form (Figure 11.) must be filled out. All completed forms should be dropped off at your department office by noon on Friday.
- Every other week, waste will be picked up from the accumulation areas in the laboratories and taken to its designated storage location by the service company.
- Call the EH&S Office for the procedure on disposal of unknown chemicals.
- If your department has a large amount of waste due to a lab clean-out, contact the EH&S Office for disposal procedures. DO NOT include waste clean outs in the regular pick-ups.
- Non-chemical wastes (e.g., broken glass, paper, etc.) should be placed in designated containers only after ensuring that such wastes are free of residues of hazardous chemicals
- The satellite accumulation area must be secured and under the responsibility of the staff person responsible for the waste. Once hazardous waste is stored in the area complete the Hazardous Waste Inventory Form (Figure 11) and post at the area.
- Only one container at a time may be used to collect one waste stream (one type of waste). The container will have a maximum capacity of 55 gallons.

Boston College is considered a small quantity generator of waste. There are specific regulations that must be followed to maintain this status. One item on every manifest states:

If I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available...

Please ensure that waste minimization, while still practicing correct disposal procedures, is put forth to the best of your effort.

7.2 Disposal of Gas Cylinders

1. Most five foot tanks are rented from WESCO. When empty, these gas tanks are exchanged for new ones by WESCO. The laboratory contacts WESCO for this exchange. No action is required by EH&S on this procedure.
2. Small lecture size gas cylinders once empty should be returned to the manufacturer. The manufacturer's labels should be kept intact. Contact with the manufacturer on the return should be completed by the department and or laboratory. Once information is received on (1) a return address, (2) a reference number, (3) associated costs and (4) packaging requirements, contact EH&S. BC's hazardous waste contractor, will then pick up the cylinder along with the required information.
3. Old cylinders with unknown contents should be reported to EH&S. Attempt to gain information by speaking to other laboratory personnel on it's contents prior to contact.
4. Releases of hazardous material from gas cylinders in a fume hood is strictly prohibited. Disposal of all hazardous material must be done in accordance with regulatory guidelines.

7.3 Sharps Disposal

The following is the procedure for storing and disposing of sharps in the laboratory

1. Obtain a sharps container (available from the department office).
2. Place the entire syringe or other sharp object to be disposed of in the container.
3. When the container is full, fully seal the container and make sure the waste label is completed.
4. Each department will be provided with a large cardboard box to store all of the department's sharps.
5. Place sealed container in designated location set by each department:
 - Higgins Rm# 334
 - Merkert Rm# 016
0. When boxes are full, contact EH&S for pick-up.
1. Please designate a separate sharps container for radioactive materials.

Tables

Table 1 Maximum Quantity and Size Limitations for Compressed or Liquefied Gas Cylinders in Laboratory Work Areas¹
Flammable Gases and/or Oxygen

Liquefied

Flammable Gases

	Sprinklered Space	Nonsprinklered Space	Sprinklered Space	Nonsprinklered Space	Gases with Health Hazard Rating of 3 or 4*
Max. No. of Cylinders per 500 sq ft or less	6	3	3	2	3
Max. Cylinder Size (in.)	10 x 50	10 x 50	9 x 30	9 x 30	4 x 15
Approx. Water Volume (ft ³)	2.0	2.0	0.6	0.6	0.1

¹ In instructional laboratory work areas, the total number of cylinders shall be reduced to three maximum size cylinders or ten 2-in. x 13-in. cylinders (or equivalent volume). In all other cases twenty-five 2-in. x 13-in. cylinders (or equivalent volume) shall be permitted. For SI Units: 1.0 in. = .25 mm; 500 sq ft = 46 m²; 1.0 cu ft = 28.3 L

* Examples include: hydrogen sulfide, phosphine

Source: *National Fire Protection Association Standard 45*

Table 2.

Proper size and types of safety containers to be used for various classes of flammable and combustible liquids.

	Flammable Liquids			Combustible Liquids	
	<u>Class I-C</u>	<u>Class II</u>	<u>Class III</u>	<u>Class I-A</u>	<u>Class I-B</u>
Flash Point (°C)	<23° 60°	<23°		23°	38°
Boiling Point (°C)	<38°	38°		38°	<60°
<u>Container Type</u>					
Glass or approved plastic 1 gal	1 pt	1 qt		1 gal	1 gal
Approved high-density polyethylene or metal 1 gal (DOT spec.)	1 gal	1 gal		1 gal	1 gal
Safety cans 5 gal. 1 gallon ~ 4 liters	2 gal	5 gal		5 gal	5 gal.

Source: *National Fire Protection Association (NFPA)*

Figure 1

Incompatible Chemicals

Some examples of commonly encountered incompatible chemicals are given below. An asterisk indicates chemicals that are sometimes placed erroneously in the same class.

<u>Chemical</u>	<u>Incompatible with</u>
Acetaldehyde	*Acetic Anhydride, *Ethanol, *Acetone, *Acetic Acid, Sulfuric Acid
Acetic Acid	*Acetaldehyde, Peroxides, *Chromic Acid, *Nitric Acid, *Perchloric Acid, Glycols
Acetone	Nitric/Sulfuric Acids Mixed, Hydrogen Peroxide
Acetonitrile	Nitric Acid, Perchloric Acid
Aniline	Nitric Acid, Chromic Acid, Peroxides
Bromines	Acetone, Acrylonitrile, Ethyl Ether, Hydrogen, Rubber
Carbon Tetrachloride	Diborane, Fluorine
Carbon Monoxide	*Oxygen, *Fluorine
Chlorine	*Ammonia, *Acetylene, *Propane, *Hydrogen, Benzene
Dimethyl Sulfoxide Chloride,	Perchloric Acid, *Acetyl Chloride, Benzenesulfonyl *Acetic Anhydride
Flammable Liquids Chlorine	Chromic Acid, Peroxide, Nitric Acid, Bromine, Fluorine,
Perchloric Acid	Acetic Anhydride, Ethanol, *Sulfuric Acid, Paper
Sodium Acid	All Acids
Sulfuric Acid Salts	Any Perchlorate, Permanganate, Cyanide, or Chlorate

Source: *Prudent Practices for Handling Hazardous Chemicals in Laboratories*

Figure 2.
BOSTON COLLEGE
CHEMICAL SPILL KIT CHECKLIST

DATE OF INSPECTION: _____ INSPECTOR: _____
 BUILDING: _____ ROOM: _____
 DEPARTMENT: _____ CONTACT: _____

The chemical spill kit was found to be deficient of the below listed items at the time of the inspection.

ITEM	INITIAL INSPECTION	REINSPECTION
2 Prs. Neoprene Gloves		
2 Prs. Goggles		
1 Scoop		
2 Haz Mat Disposal Bags		
2 Vapor Barrier Blankets		
1 Container Hazorb		
2 Hi-Density Liners		
1 Btl. Soulsorb		
1 Metal Pail w/ cover		
1 Set of Instuctions/CHP		
2 Yellow Waste Labels		

Replacement items are available through the Environmental Health and Safety. These items will be delivered to you shortly. It is the responsibility of Laboratory Management to ensure that these kits remain stocked and to arrange for prompt replacement as items are depleted or discarded.

Please call 552-0307 for assistance.

**Figure 4.
Chemical Hygiene Inspection Checklist**

Date of Inspection: _____ Conducted by: _____

Location (room number & building): _____

Principal Investigator/Supervisor: _____

Phone Number: _____

		<u>yes</u>	<u>no</u>	<u>comments</u>
1.0	General Work Practices			
1.1	Eating, drinking, smoking, etc. prohibited. Hallway outside the lab is free of evidence of eating and drinking.			
1.2	Mouth pipetting prohibited			
1.3	Food, drink not stored in lab, refrigerators, freezers, etc.			
1.4	Hands washed when work completed			
1.5	Radioactive, carcinogenic, biohazard, volatile or other particularly hazardous substances handled in laboratory hoods			
1.6	Open flames, sparks kept away from flammables			
1.7	Contact phone nos. for lab supervisor and safety officer current			
1.8	No open toe shoes or shorts worn.			
2.0	Housekeeping	<u>yes</u>	<u>no</u>	<u>comments</u>
2.1	General appearance of lab is neat and orderly packing cartons, unnecessary catalogs & paper bench tops areas under sink window ledges walls, floors			
2.2	Aisles and exits free from obstruction			
2.3	Work surfaces protected from obstruction			
2.4	Spills Absent			
2.5	Electrical cords and wires in good condition			
2.6	Tools and equipment in good repair			

2.7	Defective glassware absent			
2.8	Combustible materials not stored near flammables			
3.0	Hazard Communication	<u>yes</u>	<u>no</u>	<u>comments</u>
3.1	Primary and secondary chemical containers labeled with			
3.2	Signs on storage areas (e.g., refrigerators) and lab rooms			
3.3	Satellite MSDS collection complete and available			
3.4	The front door to all labs should have signs indicating the type of laser hazards present in the lab. Write down all information NFPA Diamond: Radiation: Laser: Special Hazards: Contact Person/Number: Other: Flammable: Corrosive: Biohazard Magnetic Field: Other:			
4.0	Personal Protective Equipment	<u>yes</u>	<u>no</u>	<u>comments</u>
4.1	Eye protection available and used			
4.2	Lab coats available, used appropriately			
4.3	Gloves available, used, and matched to hazards			
4.4	Respirators absent (unless by permission of the EH&S Office)			
4.5	Are lab workers wearing appropriate laboratory attire, (i.e. no			
5.0	Chemical Storage	<u>yes</u>	<u>no</u>	<u>comments</u>
5.1	Incompatible chemicals segregated (i.e. oxidants separated			
5.2	Permissible quantities of flammables stored on open shelves, in glass or plastic containers			
5.3	Hazardous chemicals not stored above 6' on open shelves			
5.4	Bulk quantities of flammable liquids stored in approved safety cans, cabinets			
5.5	Safety carriers available for bottles			
5.6	Expired or out-of-use chemicals absent			
5.7	Excessive quantities of chemicals not stored on benches			

5.8	Lab limits for flammables not exceeded (Limit = _____)			
6.0	Compressed Gas Cylinders and Vacuum Pumps	<u>yes</u>	<u>no</u>	<u>comments</u>
6.1	Chained, secured			
6.2	Inspected for condition, pressure retention			
6.3	Gas lines, piping, manifolds, etc. labeled with identity of contents. Gas ports labeled.			
6.4	Protective caps in place except when cylinders are in use			
6.5	Vacuum pumps appropriately ventilated. Rotovaporators wrapped in electrical tape when possible.			
6.6	Vacuum pumps enclosed with fan belt guard			
6.7	Flammable gas lines equipped with flashback arrestors			
7.0	Waste Disposal	<u>yes</u>	<u>no</u>	<u>comments</u>
7.1	Hazardous wastes not disposed in general sewer system			
7.2	Hazardous wastes not accumulated for longer than necessary			
7.3	Containers (glass or plastic. metal tends to erode) available for hazardous wastes. Are they of good integrity (i.e.			
7.4	Containers of hazardous waste labeled properly (corrosive, toxic, reactive, flammable) and dated			
7.5	Wastes segregated, Is there spill containment?			
7.6	Satellite accumulation areas posted and orderly?			
7.7	Broken glassware in designated containers			
7.8	Discarded sharps in designated containers			
8.0	Laboratory Hoods and Ventilation	<u>yes</u>	<u>no</u>	<u>comments</u>
8.1	Hoods in sound working condition			
8.2	Hoods marked with operating heights, average face velocity. Date of last check: _____			
8.3	Gauges, monitors and alarms operating properly			

8.4	Hoods not cluttered with chemicals, equipment			
8.5	General ventilation adequate			
9.0	Safety Equipment	<u>yes</u>	<u>no</u>	<u>comments</u>
9.1	Spill containment clean-up materials available? Are kits stocked with required supplies (refer to spill kit checklist)			
9.2	Eye wash/safety showers in sound working condition, not •Refer to Emergency Eyewash Inspection Report and attach to this report •Refer to Emergency Shower Inspection Report and attach to this report (Do not check without plumbing)			
9.3	Fire extinguishers: type and appropriate location, not obstructed, good working order. Date of last inspection: _____ All laboratories have at least one extinguisher. Locate all extinguishers in the lab, answer the following, then date and initial the back of the tag. Number of extinguishers in lab: Most recent inspection: All extinguishers labeled? All extinguishers have tags? Are any tags broken? Are all pins in place? All residue removed from nozzles? Are the extinguishers mounted on the wall?			
9.4	First aid kit available as appropriate. Are kits fully stocked with required supplies?			
9.5	Fire blanket available as appropriate			
9.6	Locations marked for all above items			
10.0	Sinks All sinks in the laboratory should be checked. This includes	<u>yes</u>	<u>no</u>	<u>comments</u>
10.1	Are the sinks free of chemical bottles?			
10.2	Are the sinks free of debris?			

Figure 5.

VAV FUME HOOD INSPECTION

Building: _____ Room: _____ Inspection Date: _____
Department: _____ State/Endowed _____ Last Inspection: _____
Contact person: _____ Phone: _____
Hood ID: _____ Fan #: _____ Location.: _____
MFG: _____ Sash type: vertical _____ horizontal _____ other _____
Usage of hood: chemical _____ radioisotope _____ perchloric acid _____ other: _____

**FUME HOOD FACE VELOCITY MEASUREMENT
(FPM)**

Sash height: _____ (FULL OPEN) Sash height 4"(.34) _____

AVERAGE VELOCITY: _____ (fpm) AVERAGE VELOCITY: _____ (fpm)

_____ SASH HEIGHT X _____ SASH WIDTH = SQUARE FEET

_____ (SQ' FT.) X _____ (FPM) = _____ CFM

FUME HOOD RATING
Satisfactory/Unsatisfactory

GENERAL INFORMATION

VENTILATED STORAGE CABINET - YES / NO SURFACE LOADING FACTOR _____ %

LINER MATERIAL: TRANSIT STAINLESS STEEL FIBERGLASS PLASTIC OTHER: _____

TYPE OF LAB ROOM: RESEARCH LAB TEACHING LAB WASH/PREP ROOM OTHER: _____

ANEMOSTAT CONTROL: YES / NO OTHER TYPE OF CONTROL _____

ANEMOSTAT CONDITION AT START: FAIL NORMAL HI LO VELOCITY SETTING: _____ F.P.M.

ACTUAL READING AT START: _____ F.P.M. READING AT 4" SASH HT. (AFTER 1') F.P.M.: _____

ANEMOSTAT READING AFTER ONE MINUTE WITH SASH FULL OPEN: _____ F.P.M.

COMMENTS: _____

IS THIS A RETEST OF A PREVIOUSLY FAILED HOOD? - YES ___ NO ___ INSPECTOR: _____

Figure 6.

BOSTON COLLEGE
EMERGENCY EYEWASH INSPECTION REPORT

Inspector : _____ Date of Inspection: _____

Building : _____ Room Number : _____

Department : _____ Contact : _____

Equipment Type: _____

Water Flow :
(Minimum 3.0 gpm for eye/face
wash combination, 0.4 gpm for eyewash only) _____

Water Condition :
(Color, Rust, etc.) _____

ANSI Z358.1 - 1990 VOLUNTARY SPECIFICATIONS

Valve stays open until intentionally closed? _____

Highly Visible Signage ? _____

No sharp projections in operation area of unit? _____

Nozzles protected from airborne contaminants by
covers which automatically displace when activated? _____

Nozzles 33" to 45" from floor? _____

Nozzles 6" from wall or nearest obstruction? _____

Maximum Distance from Hazard
(Closer to severe hazards) _____

Figure 7.

**BOSTON COLLEGE
EMERGENCY SHOWER INSPECTION REPORT**

Inspector: _____ Date of Inspection : _____

Building : _____ Room Number : _____

Department : _____ Contact : _____

Equipment Type _____

Water Flow :
(Minimum 30 gallons per minute) _____

Water Condition :
(Color, Rust, etc.) _____

ANZI Z358.1 - 1990 VOLUNTARY SPECIFICATIONS

Valve stays open until intentionally closed ? _____

Shower Head Height :
(Minimum 82" , Maximum 96" from floor) _____

Highly Visible Signage ? _____

Control Handle Height :
(Maximum 69" from floor) _____

Unobstructed Location ?
(32" circle held at 60" high) _____

Maximum Distance from Hazards 100' :
(Closer to severe hazards) _____

Figure 8.

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
Benzene ^a	P	F	G	F
Benzyl chloride ^a	F	P	G	P
Bromine	G	G	—	G
Butane	P	E	—	P
Butyraldehyde	P	G	—	G
Calcium hypochlorite	P	G	G	G
Carbon disulfide	P	P	P	F
Carbon tetrachloride ^a	P	F	G	F
Chlorine	G	G	—	G
Chloroacetone	F	E	—	P
Chloroform ^a	P	F	G	P
Chromic acid	P	F	F	E
Cyclohexane	F	E	—	P
Dibenzyl ether	F	G	—	P
Dibutyl pthalate	F	G	—	P
Diethanolamine	F	E	—	E
Diethyl ether	F	G	E	P
Dimethyl sulfoxide ^b	—	—	—	—
Ethyl acetate	F	G	G	F
Ethylene dichloride ^a	P	F	G	P
Ethylene glycol	G	G	E	E
Ethylene trichloride ^a	P	P	—	P
Flourine	G	G	—	G
Formaldehyde	G	E	E	E
Formic acid	G	E	E	E
Glycerol	G	G	E	E
Hexane	P	E	—	P
Hydrbromic acid	G	E	—	E

Figure 8. (continued)

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 ^a	P	E	—	P
Methyl ethyl ketone	F	G	G	P
Methylene chloride ^a	F	F	G	F
Monoethanolamine	F	E	—	E
Morpholine	F	E	—	E
Napthalene ^a	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 ^a	P	F	—	P
Sodium hydroxide	G	G	G	E
Sodium hypochlorite	G	P	F	G
Sulfuric acid (conc)	G	G	F	G
Toluene ^a	P	F	G	F
Trichloroethylene ^a	P	F	G	F
Tricresyl phosphate	P	F	—	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	—	P

Source: *Prudent Practices for Handling Hazardous Chemicals in Laboratories*

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

H = Health Hazard

4 = Deadly

3 = Extreme Danger

2 = Hazardous

1 = Slightly Hazardous

0 = Normal Material

F = Fire Hazard (Flash Points) R = Reactivity

4 = Below 73° F

3 = Below 100° F

2 = Below 200° F

1 = Above 200° F

0 = Will not burn

4 = May Detonate

3 = Shock and Heat May Detonate

2 = Violent Chemical Change

1 = Unstable if Heated

0 = Stable

Appendix A

Required Elements for Safety Related Procedures

Author: T.P. Fuller
Version: 1.0
Date: 10/22/96
System: Laboratory Facilities

I. Introduction

Safe operation of experiments in laboratories will require that operations have written procedures available to those who will perform the work. These procedures shall be approved by individuals designated through the Office of Environmental Health and Safety. The approved procedures will be distributed and used by those individuals performing the associated work. This document is designed to provide guidelines for formulating and writing these written procedures in a concise, uniform and effective manner.

II. Required Elements

A. Heading

The heading should include the title, version number, release date, author and other persons involved, who is authorized to perform the procedure, and the processes or systems involved including specific laboratory work spaces.

B. Introduction

The introduction should describe the purpose of the procedure and is designed to address and state why the procedure is necessary. The introduction should briefly summarize the procedure.

C. Scope

The scope should detail what items and activities are covered by the procedure. The scope should also clearly indicate when the procedure is to be followed and provide specific examples of where the procedure applies.

D. Safety Consequences of Procedure Failure

This section describes the consequences to safety resulting from failure to implement this procedure.

E. Definitions

Individual terms used in the procedure which may not be of common usage to those reviewing or using the procedure. Also, those terms which may be construed differently depending on the connotation in which it is used and could therefore cause confusion to the reader.

F. Responsibilities

This section shall identify the responsible personnel and detail their responsibilities in the affected areas.

G. Required Equipment

Wherever possible the specific equipment or laboratory instrumentation, including fume hoods to be used, shall be deigned in advance f the activity to be available during the procedure review process.

H. Procedure

This section should detail the steps which must be followed in the procedure. It should

cover the following areas:

1. Inspection of equipment of work areas.
2. Step by step detail of required elements of the work activity.
3. Engineering controls to be implemented.
4. Equipment required to perform the procedure.
5. Assumptions and prerequisites.
6. Justification for all requirements.
7. Posting requirements.
8. Medical surveillance when appropriate.
9. Maintenance

I. Training

This section should outline how workers are to be trained in this procedure.

J. Summary Checklist

The procedure should include a one or two page summary of procedure steps to be used as a checklist in performing the procedure to ensure all required elements of the procedure, particularly those associated with safety, have been completed.

K. Cross References

This section describes other items or areas affected by this procedure.

L. Distribution

Provide a list of persons to whom this procedure pertains and who should be on distribution for the procedure and all future revisions. Either job titles or individual names should be used for the distribution list.

M. References

The procedure should include a list of associated state, Federal, and local government regulations, supporting literature, or other reference material as appropriate.

N. Appendices and Supporting Documents

When appropriate, supporting documents, such as laser classification tables or lists of restricted materials should be included as appendices.

Appendix B

Glossary

Action level

A level of contaminant concentration that is below the permissible exposure limit (PEL), but above the level at which OSHA requires additional sampling or other action, such as medical surveillance. Usually, action levels are one-half the PEL for a given substance.

Acute effect

An adverse effect on a human or animal body, characterized by severe symptoms that develop rapidly.

Acute toxicity

The adverse effect resulting from a single dose or exposure to a substance.

Asphyxiant

A chemical that either displaces oxygen in the air, or prevents bodily absorption of oxygen, to cause suffocation.

Boiling point

The temperature at which a liquid changes to a vapor state at a given pressure. Flammable materials with low boiling points generally present special fire hazards.

Breakthrough time

The time elapsed between initial contact of a chemical with the outside surface of a protective clothing material and the time at which the chemical can be detected at the inside surface of the material.

“C” or ceiling

The maximum allowable human exposure limit for an airborne substance; not to be exceeded even momentarily (see also TLV).

Carcinogen

A substance or agent capable of causing or producing cancer in mammals. A carcinogen is defined as any substance which meets one of the following criteria:

- Regulated by OSHA as a carcinogen
- Listed as a carcinogen or potential carcinogen in the *NTP Annual Report on Carcinogens*
- Evaluated by IARC and found to be a carcinogen or potential carcinogen.

C.A.S.

Chemical Abstracts Service; A Columbus, Ohio organization that indexes information published in *Chemical Abstracts* by the American Chemical Society and provides index guides by which information about particular substances may be located in the *Abstracts* when needed. “C.A.S. numbers” identify specific chemicals.

cc

Cubic centimeter; a volume measurement in the metric system, equal in capacity to one milliliter (ml). One quart is about 946 cubic centimeters.

CFR

Code of Federal Regulations; a compilation of all current regulations and standards published by the Office of the Federal Register.

CGI

Combustible gas indicator.

Chemical family

A group of single elements or compounds with a common general name. Example: acetone, methyl ethyl ketone, and methyl isobutyl ketone are of the "ketone" family.

Chemical Hygiene Officer

An employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organization structure.

CHEMTREC

Chemical Transportation Emergency Center; a national center established by the Chemical Manufacturers Association (CMA) in Washington, D.C. in 1970, to relay pertinent emergency information concerning specific chemicals on request.

CHEMTREC has a 24-hour toll free telephone number (800-424-9300), intended primarily for use by those who respond to chemical transportation emergencies.

Chronic effect

An adverse effect on a human or animal body, with symptoms which develop slowly over a relatively prolonged period of time.

Chronic toxicity

Adverse effects resulting from repeated doses of or exposures to a substance over a relatively prolonged period of time.

CIH

Certified Industrial Hygienist.

CMA

Chemical Manufacturers Association.

Combustible Liquids

Any liquid having a flashpoint at or above 100°F (37.8°C), but below 200°F (93.3°C), except any mixture having components with flashpoints of 200°F (93.3°C), or higher, the total volume of which make up 99% or more of the total volume of the mixture. Combustible liquids do not ignite as easily as flammable liquids, but can be ignited under certain circumstances, and must be handled with caution.

Compressed gas

- A gas, or mixture of gases, having, in a container, an absolute pressure that exceeds 40 psi at 70 °F (21.1°C),
- A gas , or a mixture of gases, having, in a container, an absolute pressure that exceeds 104 psi at 130°F (54.4°C), regardless of the pressure at 70°F (21.1°C), or
- A liquid having a vapor pressure that exceeds 40 psi at 100°F (37.8°C)

Concentration

The relative amount of a substance when combined or mixed with other substances.

Corrosive

A liquid or solid that causes visible destruction or irreversible alterations in human skin tissue at the site of

contact or, in the case of liquid from its package, a liquid that has a severe corrosion rate on steel.

CPC or chemical protective clothing

An item of clothing used to isolate parts of the body from direct contact with a potentially hazardous chemical.

Cutaneous toxicity

See "Dermal Toxicity."

Decomposition

Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into parts or elements of simpler compounds.

Degradation

The physical breakdown of a protective material due to exposure to a chemical.

Dermal

Used or applied to the skin.

Dermal Toxicity

Adverse effects resulting from skin exposure to a substance.

Designated area

An area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree or acute toxicity. A designated area may be the entire laboratory, an area of a laboratory, or a device such as a laboratory hood.

DOL

U.S. Department of Labor; includes the Occupational Safety and Health Administration. (OSHA).

Emergency

Any occurrence, such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

EPA

U.S. Environmental Protection Agency; federal agency with environmental protection regulatory and enforcement authority. Administers the Clean Air Act, Clean Water Act, FFRA, RCRA, TSCA, other Federal environmental laws.

Evaporation rate

The rate at which a particular material will vaporize (evaporate) when compared to the rate of vaporization of a known material. The evaporation rate can be useful in evaluating the health and fire hazards of a material. The known material is usually normal butyl acetate, with a vaporization rate designated as 1.0. Vaporization rates of other solvents or materials are then classified as "fast evaporating" (greater than 3.0), "medium evaporating" (0.8-3.0), or "slow evaporating" (less than 0.8).

Explosive

Used to describe a chemical that causes a sudden, almost instantaneous release of pressure, gas and heat, when subjected to sudden shock, pressure, or high temperature.

Flammable aerosol

An aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full-valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening.

Flammable gas

- A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less; or
- A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

Flammable liquid

Any liquid having a flashpoint below 100°F (37.8°C), except any mixture having components with flashpoints of 100°F (37.8°C) or higher, the total of which makes up 99% or more of the total volume of the mixture.

Flammable solid

A solid, other than a blasting agent or explosive, that is liable to cause fire through friction, absorption of moisture, spontaneous chemical changes, or retained heat from manufacturing or processing, or that can be ignited readily and, when ignited, burns so vigorously and persistently as to create a serious hazard.

Flash point

The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid. There are several flash point test methods, and flash points may vary for the same material depending on the method used, so the test method is indicated when the flash point is given.

Fume

Airborne particulate formed by the vaporization of solid materials; usually refers to metals. Fume particles are usually less than one micron in diameter.

Gas

A state of matter in which the material has a very low density and viscosity, diffuses easily into other gases, and is readily distributed throughout any container. Examples of atmospheric gases include oxygen, nitrogen and carbon dioxide.

General exhaust

A system for exhausting air containing contaminants from a general work area.

Generic material

Made from one type of polymer or polymer combination. Examples are neoprene, nitrile, and polyvinyl alcohol. When products are manufactured from the polymer, additions of other materials are included for various reasons during the manufacturing process.

Hazardous chemical

A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

Health hazard

Includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

IARC

International Agency for Research on Cancer.

Incompatible

Used to describe materials that could cause dangerous reactions from direct contact with one another.

Ingestion

The taking in of a substance through the mouth.

Inhalation

The breathing in of a substance in the form of a gas, vapor, fume, mist, or dust.

Inhibitor

A chemical that is added to another substance to prevent an unwanted chemical change from occurring, e.g. polymerization.

Irritant

A substance, which is not a corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the sight of contact.

Lower Explosive/Flammable Limit (LEL/LFL)

The lowest concentration of a vapor or gas which will explode, ignite, or burn in the presence of an ignition source. Mixtures below this limit are too lean to burn. LELs are expressed in percent vapor or gas in air by volume; one percent equals 10,000 ppm.

Melting point

The temperature at which a solid substance changes to a liquid state. For mixtures, the melting range may be given.

Mists

Aerosolized liquid droplets generated wither by condensation of gases to liquids, or by fine dispersion of a liquid through splashing or atomizing.

Mutagen

Any substance that can cause a change (mutation) in the genetic material of a living cell. All carcinogens are mutagens.

NFPA

National Fire Protection Association; an international voluntary membership organization to promote/improve fire protection and prevention and establish safeguards against loss of life and property by fire. Best known for publishing the *National Fire Codes*, 16 volumes of codes, standards, recommended practices, and manuals developed (and periodically updated) by NFPA technical committees. Among these is *NFPA 704M*, the code for showing hazards of materials using the familiar diamond-shaped label or placard with appropriate numbers or symbols.

NIOSH

National Institute for Occupational Safety and Health of the Public Health Service, U.S. Department of Health and Human Services (DHHS); federal agency that tests and certifies respiratory protective devices, recommends occupational exposure limits for various substances, and assists OSHA and MSHA in occupational safety and health investigations and research.

NTP

National Toxicology Program.

Oral

Used in or taken into the body through the mouth or intragastrically.

Oral toxicity

Adverse effects resulting from taking a substance into the body via the mouth.

Organic peroxide

An organic oxidizer that can be shock and heat sensitive, flammable, and potentially explosive. An organic compound that contains the bivalent **-O-O-** structure, and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical group.

OSHA

Occupational Safety and Health Administration of the U.S. Department of Labor; federal agency with safety and health regulatory and enforcement authorities for most U.S. industry and business. Also see "MSHA."

Oxidation

A reaction in which a substance combines with oxygen provided by an oxidizer or an oxidizing agent.

Oxidizer

A chemical other than a blasting agent or explosive, that initiates or promotes combustion in other materials thereby causing fire either of itself or through the release of oxygen or other gases.

Particularly hazardous substances

These include "select carcinogens," reproductive toxins, and substances that have a high degree of acute toxicity.

Penetration

The transport of a chemical through design imperfections such as seams or zippers.

Percent volatile

The percentage of a liquid or solid (by volume) that will evaporate at an ambient temperature of 70°F. (Unless some other temperature is stated).

Permeation

Sorption of chemical into a protective clothing material; diffusion of the chemical through the material; desorption of the chemical from the clothing material.

Permeation rate

The amount of chemical that permeates through a protective material per unit area, per unit time; often given in micrograms per square centimeter per minute ($\mu\text{g}/\text{cm}^2/\text{min.}$).

Permissible Exposure Limits (PELs)

Limits developed by OSHA to indicate the maximum airborne concentration of a contaminant to which an employee may be exposed over the duration specified by the type of PEL assigned to that contaminant.

Persistent chemicals

Substances which resist biodegradation and/or chemical oxidation when released into the environment and tends to accumulate on land, in air, in water, or in organic matter.

Physical hazard

A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable, or water-reactive.

Polymerization

A chemical reaction in which one or more small molecules combine to form larger molecules. A hazardous polymerization is such a reaction which takes place at a rate which releases large amounts of energy. If hazardous polymerization can occur with a given material, the MSDS usually will list conditions that could start the reaction.

Pyrophoric

A chemical that ignites spontaneously in air at a temperature of 130°F (54.4°C) or below.

RCRA

Resource Conservation and Recovery Act; federal environmental legislation, administered by EPA, aimed at controlling the generation, treating, storage, transportation, and disposal of hazardous wastes.

Reaction

A chemical transformation or change; the interaction of two or more substances to form new substances.

Reactive

See "Unstable."

Reducing agent

In a reduction reaction (which always occurs simultaneously with an oxidation reaction), the reducing agent is the chemical or substance which combines with oxygen, or loses electrons to the reaction.

Reproductive toxins

Chemicals which affect the reproductive capabilities including chromosomal damage (mutagens) and effects on fetuses (teratogens).

Sensitizer

A substance that on first exposure causes little or no reaction in humans or test animals, but that on repeated exposure may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form of sensitization in the industrial setting, although respiratory sensitization to a few chemicals is also known to occur.

"Skin"

A notation, sometimes used with PEL or TLV exposure data; indicates that the stated substance may be absorbed by the skin, mucous membranes, and eyes, either airborne or by direct contact, and that this additional exposure must be considered part of the total exposure to avoid exceeding the PEL or TLV for that substance.

Solubility in water

A term expressing the percentage of a material (by weight) that will dissolve in water at ambient temperature.

Species

A biological type; on MSDSs, "species" refers to the test animals (usually rats, mice, or rabbits) used to obtain the toxicity test data reported.

Specific gravity

The weight of a material compared to the weight of an equivalent volume of water; an expression of the density (or heaviness) of the material.

Stability

An expression of the ability of a material to remain unchanged. For MSDS purposes, a material is stable if it remains in the same form under expected and reasonable conditions of storage and use. Conditions which may cause instability (dangerous change) are stated.

Steady state permeation

The constant rate of permeation that occurs after the breakthrough when all forces affecting permeation have reached equilibrium.

Teratogen

A substance or agent to which exposure of a pregnant female can result in malformations in the fetus.

Threshold Limit Value - Time Weighted Average (TLV - TWA)

The time-weighted average airborne concentration of a contaminant to which nearly all workers may be exposed, for normal 8-hour workday and a 40-hour workweek without adverse effect. Defined by the American Conference of Governmental Industrial Hygienists (ACGIH).

Threshold Limit Value - Short Term Exposure Limit (TLV - STEL)

The airborne concentration to which workers can be exposed for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue or materially reduce work efficiency (provided the daily TLV-TWA is not exceeded). A 15-minute TWA exposure should not occur more than four times per day, or occur more than once during a 60 minute period; defined by ACGIH.

Threshold Limit Value - Ceiling (TLV - C)

The airborne concentration that should not be exceeded during any part of the working exposure; may exceed the TLV - TWA as long as equivalent exposures are compensated by excursions below the TLV - TWA.

Toxicity

The sum of adverse effects resulting from exposure to a material.

TSCA

Toxic Substances Control Act; federal environmental legislation, administered by EPA, for regulating the manufacture, handling, and use of materials classified as "toxic substances." Part of RCRA.

Unstable

Describes a chemical that, in the pure state, or as produced or transported, vigorously polymerizes, decomposes, condenses, or becomes self-reactive under conditions of shock, pressure or temperature.

Upper Explosive/Flammable Limit (UEL/UFL)

The highest concentration of a vapor or gas which will explode, ignite, or burn in the presence of an ignition source. Mixtures above this limit are too rich to burn. UELs are expressed in percent vapor or gas in air by volume; one percent equals 10,000 ppm.

Vapor

The gaseous form of materials that are normally liquids or solids at room temperature and pressure, e.g. steam.

Vapor density

The weight of a vapor or gas compared to the weight of an equal volume of air; an expression of the density of the vapor or gas. Materials lighter than air have vapor densities less than 1.0. Materials heavier than air have vapor densities greater than 1.0.

All vapors and gases will mix with air, but the lighter materials tend to rise and dissipate (unless confined). Heavier vapors and gases are likely to concentrate in low places.

Vapor pressure

The pressure exerted by a saturated vapor above its own liquid in a closed container.

Ventilation

See "General exhaust."

Water reactive

A chemical that reacts with water to release a gas that is either flammable or presents a health hazard. Usually flammable solids will react in varying degrees with water or humid air.

Appendix C

Recommendations for Glassware Handling

Use the correct glass for the job.

<i>Type</i>	<i>Percent Silica</i>	<i>Normal Temp. Limit</i>	<i>Max. Temp.</i>
EXAX	72%	Do Not Heat	Do Not Heat
Pyrex and Kimax	80%	230 °C	300 °C
Vycor	96%	800 °C	1000 °C
Quartz	99%	1000 °C	1200 °C

- Handle and store glassware with care to avoid damage and injury. Inspect glass before use.
- Dispose of chipped, cracked, or badly etched glass in glassware only disposal boxes.
- Use a lubricant or mechanical aid when pushing glass through rubber stoppers or tubing.
- When stressing glass, always wear puncture-resistant gloves.
- Use support rings whenever possible. Glass under compression is stronger than glass under tension due to suspension.
- Use tongs or heat-resistant gloves when handling heated glassware.
- Do not subject a flask to sudden changes in temperature.

Appendix D

Fire Classification and Fire Extinguishers

Fire extinguishers are the first line of defense against hostile fires. Virtually all fires are small at first and easily extinguished if the proper type and amount of extinguishing agent is promptly applied. Portable fire extinguishers are designed for this purpose, but the following conditions are necessary for their successful use;

1. The extinguisher must be properly located and in good working order.
2. The extinguisher must be the proper type for the fire which occurs.
3. The fire must be discovered while still small enough for the extinguisher to be effective.
4. The fire must be discovered by someone ready, willing, and able to use the extinguisher.

Most important, the Fire Alarm should be activated and the Fire Department notified before trying to extinguish a fire with a portable fire extinguisher.

Because the effectiveness of various extinguishing agents are not uniform on different fires, fires are assigned the following classifications;

- * **Class A:** Fires in ordinary combustibles materials such as wood, cloth, paper, rubber, and many plastics. These materials require the heat absorbing (cooling) effect of water; the coating effects of certain dry chemicals which retard combustion; interruption of the combustion chain reaction.
- * **Class B:** Fires in flammable or combustible liquids, flammable gasses, greases, and similar materials. These materials require excluding air (oxygen); inhibiting the release of flammable vapors; or interrupting the combustion chain reaction.
- * **Class C:** Fires involving energized electrical equipment. Operator safety requires the use of electrically non conductive extinguishing agents. When you can be certain the equipment has been de energized extinguishers for class A or B fires may be used.
- * **Class D:** Fires in combustible metals (magnesium, titanium, zirconium, sodium, potassium, etc.). These metals require a heat absorbing extinguishing medium that does not react with the burning metals.

Some extinguishers will put out only one class of fire, some are suitable for two or three, but none is suitable for all four classes. Extinguishers on campus are labeled so users may quickly identify the class of for which they may be used. The following symbols or picture symbols are currently in use:

DIAGRAMS:

Rating numerals are also used on the labels of class A and B extinguishers. The rating numeral gives the relative extinguishing effectiveness of the extinguisher. For example, an extinguisher rated 4-A; 20-B:C: 1) It should extinguish approximately twice as Class A fire as a 2-A rated extinguisher. 2) It should extinguish approximately twenty times as much Class B fire as a 1-B rated extinguisher. Class C and D extinguishers have no numerical ratings.

Extinguishing Agents

1. **Water:** Water is an effective agent for Class A fires. Water reduces the heat of a fire (cooling effect) eliminating the evolution of flammable vapors, thus extinguishing the fire. Two and one half gallon, pressurized water extinguishers are located in corridors and common areas of most Academic, Administrative, and Residential Buildings on campus.
2. **Carbon Dioxide:** Carbon Dioxide is a compressed gas agent and is effective on Class B and C fires. Carbon Dioxide displaces oxygen in the atmosphere surrounding the fire. Its principal advantage is that it does not leave a residue and is an important consideration where delicate electronic equipment may be present. Carbon Dioxide extinguishers are located in laboratories containing delicate electronic equipment, in elevator machine rooms, and electric rooms about campus.
3. **Halon:** Halon 1211 (bromochlorodifluoromethane) is effective on Class B and C fires, and can also be effective on Class A fires. Like Carbon Dioxide it is a clean agent and leaves no residue, is virtually non-corrosive and non abrasive, and is at least twice as effective on Class B fires as Carbon Dioxide. Halon extinguishers are located only in the O'Neill computer facility and in the Conte Forum control room. The chief disadvantage of Halon 1211 is its relative toxicity; inhalation of 4 to 5 % for 1 minute is the maximum that can be safely inhaled.
4. **Dry Chemical:** There are two basic kinds of dry chemical agents. Ordinary dry chemical is effective on Class B and C fires and multipurpose dry chemical is effective on Class A, B, and C fires. Dry chemical agents interfere with the combustion chain reaction process at the surface quickly extinguish flames. Multipurpose dry chemical extinguishers are effective on Class A, B, and C, fires and are located in laboratories, mechanical rooms, and corridors and common areas of some academic and administrative buildings on campus. Regular dry chemical (sodium or potassium bicarbonate) are effective on cooking grease fires and will only be located in kitchens equipped with fryolators.
5. **Dry Powder:** Dry powder should not be confused with dry chemical. Dry powder is used to extinguish fires in combustible metals. These agents are usually graphite based, do not react with, and smother burning metals. Pails of this type agent are located in chemistry storerooms for use when combustible metals are being used.

Using Fire Extinguishers

All fire extinguishers located on the Boston College Campus have been selected to be effective for the Class and type of fire that would be expected to occur in that area. However, before attempting to use a fire extinguisher always check the label to be absolutely certain that the extinguisher is appropriate for the type of fire encountered. Never attempt to use an extinguisher if you do not feel comfortable doing so. Always make certain the Fire Alarm is activated before attempting to extinguish a fire. Do not let the fire get between you and the nearest exit; always keep the exit at you back when using a fire extinguisher. To operate a portable fire extinguisher properly remember the code word "PASS" .

P: Pull pin.

All fire extinguishers are equipped with a safety pin and seal. This pin and seal are intended to prevent accidental discharge of the extinguisher and to indicate that it has not been tampered with. Simply twist to break seal and remove the pin.

A: Aim.

Aim the extinguishers discharge nozzle at the base of the fire. Approach the fire cautiously and from upwind if possible. Extinguishers will not be effective if you are too far away from the fire. The effective range of most extinguishers is between 5 and 12 feet. Pressurized water units have a range of 30 to 40 feet.

S: Squeeze the Handle.

This will cause the agent to be expelled. The discharge time for most extinguishers is between 8 to 25 seconds. Pressurized water type units have a discharge time of approximately 1 minute.

S: Sweep from side to side.

Sweep the discharge nozzle from side to side starting at the base of the fire working upward as the flames are extinguished continue. Continue to operate the extinguisher until all flames are extinguished. On Class A deep seated fires the material should be separated or uncovered and agent applied to insure extinguishment. Class B flammable liquid fire can frequently re-ignite, stay alert and apply more agent if available.

After use, extinguishers should be placed on the floor near their original mounting position. Once used all extinguishers need to be serviced and recharged. Notify the Fire Safety Office at extension 2-0361 of all discharged fire extinguishers so they may be recharged promptly and returned to service.

All extinguishers should be serviced annually to insure they are operational. They should be inspected monthly to insure the pressure gauge reads in the proper range (green); that the pin and seal are in place and the unit has not been tampered with; and that the extinguisher has a tag indicating the annual service date and monthly inspections.

The Office of Environmental Health and Safety schedules Fire Extinguisher Training sessions quarterly. These sessions are open to all Boston College faculty and staff. Additional training sessions for specific groups can be scheduled by contacting the Fire Safety Office at X 2-0361

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