SUBJECT: Physical Plant
Procedure: Hazardous Materials
Effective: Spring 2006 Revised: Reviewed:

Chemical Hygiene Plan
Great Falls College MSU

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I. INTRODUCTION

The purpose of a Chemical Hygiene Plan (CHP) is to provide guidance for a chemical safety program at Great Falls College MSU. This plan is written to serve as a reference and provide control methods to prevent unacceptable exposure of hazardous chemicals to students and staff in laboratory settings. The U.S. Occupational Safety and Health Administration (OSHA) Laboratory Standard (29 CFR 1910.1450) and the Montana Department of Labor and Industries require that such a plan be in place (Appendix A).

CHP's are required in laboratory environments where hazardous materials are used or stored. The Laboratory Standards apply when hazardous materials are used and **ALL** the following criteria are met:

1. Operations using chemicals are carried out on a smaller, laboratory scale, i.e. materials used in the procedure are small and safely manipulated by one person;
2. Numerous chemical procedures or chemicals are used;
3. The procedures are not part of a production process nor simulate a production process; and
4. "Protective laboratory equipment and practices" are available and commonly used to prevent employee and student exposure.

Hazardous substances are defined as materials that are flammable, corrosive, water or air explosive, sensitive, oxidizing, or toxic. At Great Falls College MSU, any classroom (including science labs, shops, or art studios) where hazardous chemicals are used is classified as a laboratory.

This plan applies to all students and employees (including clerical and maintenance staff) that spend any time in a laboratory environment as part of their work duties. The CHP should be reviewed and updated as needed by the Science Faculty and the Safety Committee.

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Chemical Hygiene Plan (CHP)

II. RESPONSIBLE PARTIES

The following persons all have a part in implementation of the CHP.

A. Great Falls College MSU Safety Committee

The Safety Committee consists of representatives from respective departments within the College. The Safety Committee should serve as contact person for hazardous material emergencies and act as liaison with regulatory agencies. The Safety Committee should implement, and maintain the CHP. This includes:

1. Coordinating safety training,
2. Allowing for safety inspections and correction of deficiencies
3. Provide records pertaining to safety inspections and training to Human Resources.
4. Update the CHP as needed
5. Meet regularly to review CHP compliance
6. Oversee the direction of the chemical hygiene program
7. Develop enforcement policies in concert with the dean's office

B. Dean

The Dean provides employees with the leadership to maintain a safe work environment and may assist with disciplinary actions related to employees violating safety rules.

C. Department Chairs

1. Provide the leadership and necessary resources for the maintenance of safe working conditions in the department (e.g. working with the safety committee to implement safety programs)
2. Motivate and assist employees with CHP compliance
3. Communicate to department employees that they are required by federal and state law to attend all applicable training sessions
4. Refer to the dean's office employees violating safety rules

D. Lab Instructors and Faculty

1. Arrange for appropriate repairs to maintain a safe environment
2. Develop written standard operating procedures (SOPs) for each laboratory
3. Enforce the requirements of the CHP
4. Ensure appropriate training is provided to all students and laboratory employees prior to assigning them work with chemicals

5. Provide appropriate personal protective equipment (PPE)
6. Maintain chemical inventories
7. Ensure environmental and medical monitoring are provided as needed
8. Conduct safety inspections
9. Correct safety deficiencies in a timely manner
10. Ensure Material Safety Data Sheets (MSDS) are available in the department for their particular chemical inventory

E. Employees

1. Follow the established CHP, SOPs, and safety rules
2. Use appropriate PPE
3. Report safety hazards to supervisor
4. Report signs and symptoms of possible exposures, known exposures, accidents, and near misses to supervisor
5. Attend all required safety training sessions
6. Annual Safety meeting of Science Faculty

III. ENFORCMENT OF THE CHP

If a supervisor or staff member shows disregard for the contents of this plan, the following steps will be taken to correct the situation:

1. The individual will be notified of the problem and given the opportunity to comply in a timely manner.
2. If there is still a problem following step 1, the Department Chair will be notified of the problem. The Department Chair will meet with the individual and reinforce the need to fix the problem. The individual will be given the opportunity to comply in a timely manner.
3. If there is still a problem following step 2, the Safety Committee will meet with both the individual and Department Chair to again reinforce the need to fix the problem. The individual will be given the opportunity to comply in a timely manner.
4. If there is still a problem following step 3, the Department Chair must take the problem to the Associate Dean to consider further action, then to the Dean.

IV. LABORATORY SAFETY RULES

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1. If possible, don't work alone. Work alone only if the chances of injury are minimal. An effort should be made to keep in contact with any employee that is working alone. Students should never work with chemicals in lab without direct faculty supervision. Working alone (weekends or late at night) in areas with hazardous materials should be avoided.

2. In areas where hazardous materials are used or stored, staff and students must wear the appropriate eye protection- chemical splash proof goggles with indirect venting. Safety glasses are not acceptable in laboratory environments. They do not adequately protect from chemical splashes.

3. Exercise extreme caution when working with flammable chemicals. Make certain no ignition sources in exist in room to minimize fire hazard due to vapor release or a liquid spill.

4. Any student or staff member working with chemicals, must be aware of:
   a. The hazards of the chemicals, as determined from the MSDS or the four digit hazard code label on each bottle. (See Appendix B, C, D, E)
   b. The location and operation of all emergency equipment (emergency showers, fire extinguishers, eyewash stations).
   c. Emergencies procedures, including waste disposal methods, evacuation routes, and methods of spill cleanup
   d. The personal protective equipment for handling chemicals.
   e. Safe methods of transporting chemicals within the building.
   f. The chemical storage plan (where and how to properly store chemical) at Great Falls College MSU and proper disposal procedures.

5. Promptly notify the science faculty and Safety Committee in the event of an injury or accident.

6. Promptly report any unsafe condition and immediately report or correct them.

7. Access to emergency equipment, (safety showers, eyewashes, fire extinguishers, or exits) must never be blocked… even temporarily.

8. Label all containers of chemicals with Chemical Name, Chemical Formula, Hazard Color Code, and the four digit hazard code (See Appendix D, E).

9. Keep work areas and hoods free of clutter.

10. Keep aisles, hallways, and stairways clear of obstructions.

11. Return chemicals to their assigned storage areas immediately after use. Return flammable materials to flammable storage cabinets.

12. Waste containers must be properly stored and labeled. Solvent containers must have a minimum of 2" of air space above the surface of the liquid to accommodate for thermal expansion.

13. Clean all floors and countertops regularly. Keep floors free of hazards.

14. Test fume hoods for proper function before working inside them.

15. Do not store chemicals on desktops or workbenches or the floor. Return any materials requiring long-term storage to the appropriate location.

16. Cap all chemical containers when not in use.

17. A chemical inventory shall be maintained for the Biology and Chemistry Labs that indicates the chemical name, formula, storage location, hazard codes, and any other pertinent information.

18. A Notebook of MSDS will be maintained and kept in the lab for ready access. The Cabinet location will be clearly marked- "Contains MSDS".

19. Place broken glass in a separate "puncture-proof" container. Label the container "glass" so any custodial staff cleaning the classroom may take appropriate precautions.

20. Sharps and blood contaminated items should be placed into a puncture proof "sharps" container for isolation and steam sterilization.

21. Visitors to the lab should be provided with appropriate personal safety equipment so they are not exposed to hazardous materials when they are in the lab.

22. Children should not be allowed in laboratories unless an employee accompanies them.

23. FOOD OR BEVERAGES ARE STRICTLY PROHIBITED IN A LABORATORY WHERE HAZARDOUS MATERIALS ARE PRESENT!!! Food and beverages are only allowed in areas outside the lab.

24. Wear proper clothing in the laboratory and stock rooms. Shorts, short skirts, halter tops, high heels, sandals, open-toed shoes, and shoes constructed of woven material are not allowed. Tie back long hair and restrict loose clothing. Remove dangling jewelry before working in the laboratory.

v. UNDERSTANDING AND RECOGNIZING CHEMICAL HAZARDS

This section addresses how to understand and recognize chemical hazards. Great Falls College MSU staff and students are responsible for being conscious of chemical hazards in laboratory and work settings.

A. Training

To ensure that employees and students understand and recognize chemical hazards each group must be properly trained either annually or every semester depending upon the situation. Great Falls College MSU will provide training to its employees (work study students, faculty, lab instructors, custodial/maintenance staff) and all science students who find themselves in areas where hazardous materials are used or stored and to its employees (office staff) who work in areas where hazardous materials are not used or stored yet have the potential for incidental exposure because they are located in the same building. New employees must receive training on the requirements of the CHP prior to working with chemicals in the laboratory. Refresher training will be provided when procedures are updated in the CHP. Employee training records will be on file with the Human Resources Director:

Training will include the following:

1. The content and requirements of the Laboratory Standard.
2. The location and content of the chemical hygiene plan.
3. The location and availability of MSDS and other reference materials including access to web-based MSDS information.
4. The chemical Hazard Code Labeling plan.
5. Chemical inventory and usage record keeping.
6. The hazards associated with the chemicals used in Great Falls College MSU laboratories.
7. Measures employees may use to protect themselves from chemical hazards, including specific procedures such as safe work practices, personal protective equipment, and emergency procedures.

For questions regarding CHP training (to whom it applies, training dates and times, etc.), contact the Safety Committee.

B. Identification of Hazardous Chemicals

Before starting any procedure that requires the use of a chemical, it is the responsibility of the employee and student to identify the hazards associated with the chemical. Reading and understanding the warning or hazard labels on the chemical containers and the Material Safety Data Sheet (MSDS) for each chemical used can help achieve this. Other references available through the Safety Coordinator (including Internet sites) are listed in Appendix G. See Appendix H for details on the different classifications of hazardous chemicals.

C. Signs

Signs will be posted in laboratories with the following:

1. Telephone numbers for Police and Fire Departments, Safety Committee Chair (771-4307), maintenance staff (788-1188) and Science Faculty.
2. Location of safety equipment (safety showers, eye wash stations, fire extinguishers, emergency cut-off switches, and first aid equipment).
3. Location of all MSDS information.
4. Locations where food and beverages are NOT permitted.
5. Where dangerous equipment is in use or where potentially dangerous operations take place.
6. Chemical storage locations (if not flammable or acids).

D. Chemical Labeling

(A description of this system may be found in Appendix D, E)

At a minimum, each chemical container must be labeled with the following:

1. Name of chemical.
2. Chemical Formula (if known).
3. A four digit hazard code warning. (health/flammability/reactivity/contact).
4. A hazard color code.
5. Solutions must also be labeled with concentration (if known).

Containers of non-hazardous materials must also be labeled. (Example: distilled water). Dispose of unlabeled containers as unknown hazardous waste.

E. Material Safety Data Sheet (MSDS)

Each laboratory shall maintain copies of Material Safety Data Sheets (MSDS) for each hazardous chemical used in their department. MSDS must be readily accessible 24 hours a day, seven days a week, for any employee working in a laboratory. MSDS must be maintained for thirty years because they serve as exposure records. When a new MSDS arrives, date it. When the chemical is no longer in use or an updated MSDS is on file, forward the old MSDS copy to the Safety Committee.

Directions on how to read an MSDS can be found in Appendix B.

F. Chemical Inventory

Each department will maintain a chemical inventory. The inventory will be updated annually and a copy forwarded to the Safety Committee. The following information will be included in the inventory:

<u>Departmental Information:</u>

1) Name of individual(s) compiling the inventory
2) Phone numbers of the Department Staff
3) Name of the department
3) Location where the chemicals are located
5) Date of the original inventory and the most recent revision to the inventory

<u>Chemical Information:</u>

1) Name of the chemical/product
2) Chemical Formula
3) Room number/name where the chemical is located
4) Location of the chemical within the room (Be specific . . . cabinet, shelf, etc.)
5) Color of the Storage Hazard Code
6) Specific four digit hazard code
7) RCRA U and/or P codes
8) Quantity of the chemical stored on-site
9) Whether a MSDS is readily available for the product/chemical (yes or no)
10) Manufacturer

11) Shelf Life (if known)
12 Disposal Procedures
13) Alternative Names
14) Special Precautions.

Store all chemicals safely and properly. Do not store chemicals alphabetically. Store them by chemical classification and hazard. Separate incompatible materials. (See Appendix H)

G. Inspections

The Safety Committee is responsible for conducting periodic inspections of labs/storage areas. Semester inspections are strongly recommended. Include personal protective equipment (PPE), safety equipment, electrical cords, laboratory equipment, and general laboratory conditions during the inspection. If any defective equipment is identified during the safety inspection, tag it and remove it from service, until repaired. If the equipment will not be repaired, it is recommended that the item be disposed of or moved to a storage location. Maintain a file of inspection checklists and logs.

Emergency eye wash stations and showers will be inspected monthly. The inspector shall sign and date when each inspection occurred and designate if the equipment was in need of repair/replacement. Any safety shower or eyewash not passing the inspection will be immediately tagged and taken out of service until it is repaired.

Facilities Management is responsible for inspecting the performance of chemical fume hoods biannually. If a hood does not pass inspection, it will be immediately tagged and taken out of service until repaired.

Facilities Management will be responsible for inspecting fire extinguishers annually.

H. Lab Repair Work Related to Hazards

Report any needed facility repairs promptly!

1. Call the maintenance staff about the item needing repair. Be sure to point out that this is a safety issue.
2. Inform the person that you will be e-mailing a request as well.
3. Notification of the completed repair needs to be sent to the requestor.

Please report any and all needed repairs (leaky pipes, etc). The long-term damage from neglecting repairs can be expensive to fix and may generate safety hazards.

VI. REDUCING EXPOSURE TO CHEMICALS

Chemical safety is achieved through continual awareness of chemical hazards and by minimizing chemical exposures through the use of engineering controls (i.e. ventilation), personal protective equipment, and good lab practices.

A. Ventilation

General room ventilation is not usually sufficient to prevent accumulation of chemical vapors; therefore, use a chemical fume hood when working with toxic chemicals. There are many different types and sizes of hoods. Become familiar with the ventilation units in your work area. Chemical Storage cabinets should have their own source of ventilation.

1. **Ventilation failure**
   Fume hoods and ventilation fans should provide sufficient ventilation to adequately remove the fume hazard from a work area. In the event of a ventilation system failure, promptly shut down all operations within that system. Close or seal open containers or equipment containing hazardous materials to prevent the release of vapors into the room. If the ventilation equipment is a hood, post a sign stating the hood is not functioning properly. Phone the maintenance staff (x4369) and the Safety Committee (x4307) to notify them of the problem. Do not use chemicals in the hood until further notice is given that the system has been repaired. If the ventilation shut down creates an emergency situation (i.e. uncontrolled hazardous chemical vapors), then evacuate students/staff from the area, dial 911, and give as much detail as possible to the Emergency Services Personnel.

2. **Ventilation testing**
   Chemical fume hoods will be tested biannually by Facilities Maintenance. If a hood is not working properly, it will be tagged “out of service” until the repairs are made. If out of service, hoods cannot be used for chemical applications.

3. **Use of a chemical fume hood**
   Chemical fume hoods are protective equipment and must be used correctly to offer protection from chemical exposure. The following is a list of procedures to follow to ensure that the proper ventilation occurs at all times.

1. Keep laboratory doors accessing the hallway closed. This will help keep the hallways at a positive pressure and the labs at a negative pressure so chemical odors cannot migrate out of the lab.
2. Keep hood sashes in a lowered position. A maximum opening of 18 inches is recommended except when actively positioning equipment. A primary reason for this is safety. The hoods are designed to eliminate chemical inhalation exposure. When the sashes are wide open, the hood does not trap as much of the chemical vapor. When the hood is not being used, close the sash completely.
3. Chemicals and equipment should not be "stored" in a hood. Only materials currently being used should be in the hood. A cluttered hood will have blocked airflow. A spacious work area inside the hood will allow a person to work safely and efficiently.

B. Personal Protective Equipment (PPE)

1. Responsible Parties

Instructors are responsible for the Personal Protective Equipment (PPE) program in their laboratories. This includes enforcement of the program and checking to assure that equipment is maintained. Appropriate disciplinary action must be taken for repeated violation of this program. The college must provide the necessary PPE for its employees. To assist with PPE determinations, a PPE guide to hazard sources can be found in Appendix I. **NOTE: If there are any questions on how to select PPE, contact the Safety Committee.**

2. Workplace Assessments

Perform a workplace assessment in science laboratories to determine if hazards requiring the use of PPE are present. If potential hazards are present in the laboratory, perform the following:

1) Identify each hazard and the source
2) Determine which body parts are affected
3) Select appropriate PPE against the hazard
4) Train each employee and students on the hazards present and when PPE should be worn
5) Train employees and students on the proper use, maintenance and limitations of each PPE device used
6) Maintain training records within the department
7) Complete and maintain a workplace assessment form for each task or process performed in the laboratory that requires PPE

Do not rely solely upon a PPE to completely protect against hazards. Use it in conjunction with effective engineering controls and workplace practices to minimize hazards in the workplace.

3. Eye Protection

All safety eyewear must meet the ANSI Z87.1 standard (see Appendix J) for minimum allowable eye protection. All eye protection supplied by Great Falls College MSU must meet this standard. Safety glasses offer inadequate splash protection. Only chemical slash proof goggles will be allowed in lab. When liquids are under extreme, high pressure, wear a face shield. Never wear a face shield without wearing goggles underneath.

Contact lenses do not provide eye protection and may increase the potential for damage to the eye in case of a chemical spill! Wearing contact lenses is discouraged when working with materials or procedures that give off fumes, smoke or dust. If you choose to wear contacts, be aware of the hazards of wearing contacts in a lab. All students with contact lenses must sign a waiver informing them of the risk related to wearing contact lenses in lab (See Appendix K).

Eye Protection is Required:

1) When working with or near solvents or corrosive chemicals, or with any chemical that could produce an eye injury
2) When working near equipment or apparatus under a high pressure or vacuum, or when around equipment that might produce projectiles
3) When in the vicinity of laboratory benches where chemical reactions are being run
4) When transporting flammable, corrosive or toxic chemicals
5) During maintenance activities involving chemicals, hand/power or machine tools, welding, cutting, grinding, or abrasive blasting
6) When working behind hood sashes or blast shields
7) When heating any glassware.

4. Gloves

Gloves provide protection against radiological, chemical, and biological agents. Care must be taken to select proper gloves for the task to maintaining protection against hazardous agents. A glove selection table can be found in Appendix L.

Note the Following for Safe Glove Usage:

When working with corrosive liquids, solvents, or other potentially hazardous materials, wear proper gloves. One type of glove will not protect against all chemicals; therefore proper glove selection is critical.

1) Remove gloves prior to opening doors, answering phones, using computers or any other situations that might spread hazardous materials.
2) Remove gloves before leaving the laboratory area.
3) Wash hands after removing gloves.
4) Do not to touch parts of your body or your apparel while wearing gloves (i.e. pushing up your glasses, etc.).
5) Dispose gloves as hazardous waste if they have been in contact with hazardous wastes.

5. Lab Coats

A lab coat helps prevent the spread of hazardous and infectious materials outside the lab. Protective clothing can also prevent damage to employees' personal clothing. Remove contaminated clothing before leaving the laboratory area.

6. Lab Attire

Wear appropriate clothing in the laboratory. Shorts, short skirts, halter tops, open-toed shoes, high heels, sandals, and shoes with uppers constructed of woven material are not permitted. Constrict long hair and loose clothing. Remove dangling jewelry before working in the lab.

7. Hearing Protection

If laboratory processes conduct a high noise output, contact the Safety Committee for a noise survey. The following items can be addressed from this survey:

1) Sources of noise output
2) Whether the acceptable levels are exceeded
3) What types of hearing protection is needed and when they should be worn
4) Who is affected by the noise levels

If you have to raise your voice to have a conversation with the person standing next to you, the noise may be at a level that requires assessment.

C. Laboratory Practices

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Proper laboratory practices can greatly reduce exposure to chemicals. Whenever possible, if a less hazardous chemical will accomplish the same result and can be substituted for a chemical that is highly hazardous, use the less hazardous chemical. Observe the following practices at all times:

1) Be familiar with the chemicals being used, their hazards, and the associated signs and symptoms of exposures. (Refer to an MSDS for this information)
2) No food or drink is allowed in a laboratory area.
3) Wash hands prior to leaving the laboratory.
4) Wash the lab counter tops prior to leaving the labs.

D. Environmental Monitoring

In laboratories, monitoring for airborne contaminants is usually not necessary or required. The Safety Committee will conduct monitoring for substances regulated by a standard that requires monitoring or if a substance is suspected to have exposure levels that exceed the action level or PEL/STEL.

1) Employees may request an evaluation of their exposure to a chemical by contacting the Safety Committee.
2) Employees must be notified within 15 days after receiving monitoring results. The Safety Committee will provide the affected department with a monitoring report. It is the affected department's responsibility to ensure the employees are provided with results of the report.
3) The Safety Committee will maintain records pertaining to work-related exposure to chemicals or harmful physical agents for a minimum of 30 years after an employee's termination of employment.

E. Medical Surveillance Criteria

All employees working with chemicals may receive medical consultation and examination under any of these conditions:

1. The employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
2. If exposure monitoring suggests that there could have been an exposure above the action level (or PEL if there is no action level) for a chemical for which a substance-specific / standard has been established.
3. An event occurs (spill, leak, explosion) resulting in a hazardous chemical exposure.

The examining physician will provide a written opinion for examinations or consultations performed. The opinion shall include:

1. Any recommendations for additional medical follow-up.

2. The results of the medical examination and associated tests.
3. Conclusions regarding other medical conditions noted that could put the employee at increased risk.
4. An informed consent statement that the employee has been informed of these previous items.

Note: These statements shall not reveal findings that do not relate to the particular chemical exposure. Written medical opinions shall remain confidential.

F. Medical Records

All employees have the right to examine and obtain copies of their medical and chemical exposure records. No one shall have access to this information, except the employee and their physician.

1. All memos, reports and notes, related to a complaint of possible or actual exposure must be maintained in the medical record.
2. The health care provider shall maintain all medical records for at least 30 years after termination of employment.
3. These records must include the results of biological monitoring and blood tests performed for work-related monitoring programs.

VII SPECIFIC CHEMICAL HAZARDS

The Laboratory Standard specifies that the Chemical Hygiene Plan will include provisions for employee protection for work with particularly hazardous substances. This section addresses specific considerations. Departments are responsible for developing Standard Operating Procedures (SOPs) appropriate for their chemical use. See Appendix G, M.

A. Minimizing Hazardous Materials

Every effort must be made to completely avoid the use of hazardous materials or keep them to a minimum. Suggestions for minimizing hazards include but are not limited to:

1) Performing the same procedure but with new or different materials to obtain the same results.
2) Performing a different procedure with less hazardous materials
3) Microscaling so the procedure will result in using or generating much less hazardous material.

B. Particularly Hazardous Substances

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1. **Definitions**: p**articularly hazardous substances- select carcinogens, reproductive toxins and chemicals with a high degree of acute/chronic toxicity**.

   Select carcinogens are chemicals defined as carcinogens, by the National Toxicology Program (NTP) as "known to be carcinogens" and by the International Agency for Research on Cancer (IARC) as Group 1 carcinogens. Also included are chemicals or processes listed in either Group 2A or 2B by IARC or under the category "reasonably anticipated to be carcinogens" by NTP and that cause statistically significant tumor incidence in experimental animals in accordance with any of these criteria:

   1. Inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m^3
   2. After repeated skin application of less than 300 mg/kg of body weight per week.
   3. After oral dosages of less than 50 mg/kg of body weight per day.

   Reproductive toxins are any chemical which affects the reproductive capabilities of males or females, including damage to chromosomes (mutagenesis) and fetuses (teratogenesis). Information on reproductive effects are listed on an MSDS.

   Chemicals with a high degree of acute and chronic toxicity are chemicals with a high degree of acute toxicity and have a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each. The LD_{50} is that dose at which a lethal response is observed in 50% of the test animals. A chemical hazard should also be listed on its container label. Additionally, if a chemical hazard is not evident on the label, the MSDS will list the specific hazards. Use the MSDS to address chronic toxicity.

2. **Designated areas**

Extreme caution should be used when working with these chemicals. Work should be conducted in a designated/restricted area. Designated areas may include a hood, glove box, portion of a laboratory, or entire laboratory room. Post signs to clearly mark/define the boundaries.

3. **Guidelines/procedures for employees working in designated areas**

   Employees and students shall:

   1. Be trained to work with these toxic chemicals.
   2. Use the smallest amount of chemical that is practical.
   3. Use high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect pumps and vacuum lines.
   4. Decontaminate the designated area when work is completed.

5. Prepare wastes in accordance with the Resource Conservation and Recovery Act (RCRA).
6. Store the chemicals in locked and enclosed spaces with a slight negative pressure compared to the room.
7. Not wear jewelry in designated areas.
8. Wear long-sleeved disposable clothing, eye protection, and gloves known to resist the chemicals being used.

C. Toxic Chemicals

The exposure limits or OSHA-mandated limits can be found in the MSDS for chemicals used in the laboratory. Limits are expressed in threshold limit values (TLV), permissible exposure limits (PEL), short term exposure limits (STEL), ceilings (C), and action levels. These limits serve as guidelines for determining appropriate safety precautions to take when handling specific chemicals.

Wear eye protection, long sleeves, and gloves appropriate for the chemicals being used when handling toxic chemicals. Chemicals must be used in an operating fume hood, glove box, or similar device which is equipped with appropriate traps and/or scrubbers under the following conditions (if this equipment is not available, then no work shall be performed using that chemical):

1. When TLV or PEL values are less than 50 ppm or 100 mg/m^3.
2. When the animal or human lethal concentration, LC_{50}, is less than 200 ppm or 2000 mg/m^3 when administered continuously for one hour or less (this condition is followed in the event that a TLV, PEL, or comparable value is not available for that chemical).
3. When handling a chemical with a moderate or greater vapor pressure will likely exceed air concentration limits.

D. Corrosive Chemicals and Contact-Hazard Chemicals

A chemical is defined as corrosive if it meets any of the following definitions:

1. The chemical OSHA definition of corrosive if a chemical causes visible destruction of, or irreversible alterations of, living tissue at the site of contact by chemical action.
2. If the chemical has a pH greater than 12 or less than 2.5.
3. Is known to be corrosive to living tissue.

Acids and alkalis are known to be corrosive to living tissue. A contact-hazard chemical is identified in an MSDS, or a medical or industrial hygiene literature, or is known to be an allergen or sensitizer.

Take precautions when working with contact-hazard chemicals or corrosive chemicals:

1. Always wear PPE, especially eye protection (this may include safety goggles and face shield, gloves, and laboratory coats).
2. Add acids and alkalis to water; never add water to acids or alkalis.
3. Add acid to water slowly, large amounts of heat are typically formed.
4. Provide secondary containment for liquid storage bottles.
5. Immediately treat accidents resulting from contact with the skin. Wash affected area with large amounts of cold water for a minimum of 15 minutes. Seek immediate medical attention for chemical burns resulting from concentrated solutions.
6. Always store and separate acids, alkalis and other corrosive materials below eye level in properly labeled storage cabinets.
7. Store acids away from cyanides.
8. Store acids and bases away from flammable liquids and solvents.
9. Inspect containers frequently for corrosion.

E. Reactive Chemicals

Chemicals or combinations of chemicals that react violently or explosively, releasing large amounts of energy are considered reactive. This type of chemical can also produce toxic or flammable vapors.

A chemical is classified as reactive if it:

1. Is described as such in the MSDS.
2. Is ranked by National Fire Protection Association (NFPA) as a 3 or 4 for reactivity.
3. Is identified by the DOT as an oxidizer, organic peroxide, or a class A, B, or C explosive.
4. Fits the EPA definition of a reactive solid in 40 CFR 261.23.
5. Fits the OSHA definition of unstable in 29 CFR 1910.1450.

A reactive chemical is characterized by any of the following:

1. Readily undergoes violent changes without detonating.
2. Reacts violently with water.

3. Generates toxic gases or vapors in large quantities that endanger human health or the environment when mixed with water.
4. It contains sulfide or cyanide and generates toxic gases or vapors when exposed to conditions between pH 2.0 and 12.5.
5. Is capable of detonation or explosive decomposition or reaction at standard temperature and pressure (STP).
6. Is a chemical in pure state that will vigorously polymerize, condense, decompose, or become self-reactive under varying conditions of shock, pressure, or temperature.

Water reactive substances react with water to evolve heat and explosive or flammable gases. Examples include:

1. lithium aluminum hydride
2. potassium metal
3. sodium metal
4. aluminum alkyls (polymerization catalysts)

Pyrophoric substances not only react rapidly with oxygen in high concentrations, but also with oxygen in air. Examples include:

1. white phosphorus
2. boron hydride gas
3. finely powdered iron disulfide

Handle all reactive chemicals with extreme caution. Store them away from incompatible chemicals. Wear proper PPE at all times when handling chemicals.

F. Explosives

Explosives can be defined as chemicals that can result in an explosion, or an extremely rapid and violent decomposition producing large volumes of gas. "High explosives" result in detonations that occur in millionths of a second. "Low explosives" result in deflagrations which are rapid burning. A few examples of explosive chemicals include the following:

1) ammonium nitrate
2) benzoyl peroxide (explosion-sensitive to shock, heat, and friction)
3) picric acid

4) sodium azide

Many chemicals form highly explosive compounds if mixed together. Others become highly explosive when allowed to decompose or if exposed to air.

Every effort should be made to keep the presence of explosive chemicals to a minimum. Handle these chemicals with extreme caution. Wear proper PPE. When working with these types of chemicals, make safe handling techniques the number one priority.

G. Organic Peroxides or Peroxide-Forming Chemicals

Peroxide formers and organic peroxides are very unstable explosives. They are extremely sensitive to shock, sparks, heat, or other forms of accidental explosive initiation. Substances can form peroxides upon standing or in contact with air. After peroxides form, they may dry in the threads of a container or become concentrated if the chemical is distilled. Peroxides formed in this manner are highly explosive. Examples include:

1. aldehydes
2. ethers and ethers derived from primary and secondary alcohols (cyclic ethers, isopropyl ether, ethyl ether)
3. most alkenes (cyclohexene, cyclooctene)
4. vinyl compounds (vinyl acetate, vinylidene chloride)

Label all peroxide-forming chemicals with the date the container was received and the date the container was first opened (even if the chemical contains inhibitors to retard peroxide formation). Use or dispose of peroxide-forming chemicals prior to expiration dates.

Peroxide-forming chemicals have limited shelf lives, regardless of the container being opened or not. Below are two categories for storing these chemicals. Storage past these time limits is discouraged, as highly explosive compounds could form. Storage limits start when the chemical is first received, whether or not it is opened. If in doubt of the stability of the chemical, do not move it until you have received directions from the Safety Officer. **Dried crystals or residue are indications of a highly explosive state!**

Group "A" Peroxidizable Compounds – 3 month storage limit

divinylacetylene	sodium amide
diisopropyl ether	vinylidene chloride

potassium metal	

Group "B" Peroxidizable Compounds – 1 year storage limit

acetal	ethylene glycol dimethyl ether
acrylic acid	ethyl vinyl ether
acrylonitrile	methyl acetylene
1,3-butadiene*	methyl cyclopentane
1,3-butadiyne	methyl isobutyl ketone
2-butanol	2-propanol
chloroprene*	styrene
chlorotrifluoroethylene	tetrafluoroethylene*
cumene	tetrahydrofuran
cyclohexene	tetrahydronaphthalene (tetralin)
decahydronaphthalene (decalin)	vinyl acetate
dicyclopentadiene	vinylacetylene
diethylene glycol	vinyl chloride
diethyl ether	methyl methacrylate
p-dioxane	vinylpyridine
divinyl ether	

*If stored as a liquid, peroxide-forming potential increases. Butadiene, chloroprene, and tetrafluoroethylene should be considered List "A" compounds if stored as liquids.

References:

University of Nevada at Reno; author, Richard Foreman;
http://unr.edu/homepage/rforeman/percom.html
National Safety Council Newsletter; author, John F. Belta, IUPUI
Bretherick's Handbook of Reactive Chemical Hazards, 5th edition

H. Flammable and Combustible Liquids

Liquids usually form vapors which are denser than air. They tend to settle into low lying areas. The tendency of a liquid to ignite is measured by a test in which the liquid is heated and periodically exposed to a flame until the mixture of vapor and air ignites at the liquid's surface. The temperature at which this ignition occurs is the "flash point". A flammable liquid has a flash point below 37.8^{O}C

(100^{O}F). Combustible liquids have flash points above 37.8^{O}C (100^{O}F). Consult the label or MSDS for flash point values. OSHA divides flammable liquids into classes IA, IB, and IC and combustible liquids into classes II, IIIA and IIIB. Note the following storage precautions when working with flammable and combustible liquids:

1. Store flammable and combustible liquids in appropriate containers. Keep the containers in flammable liquid storage cabinets or in vented floor level cabinets away from any heat source.
2. Keep solvents in safety cans. Drums and five-gallon containers are not allowed in laboratories unless stored in a flammable liquid cabinet and used with smaller safety cans for dispensing.
3. Store flammable solvents requiring refrigeration in explosion proof refrigerators/freezers.
4. Use safety cans if possible. Do not store more than 10 gallons total of flammable liquids per laboratory outside of storage cabinets, unless in safety cans.
6. Do not store a total of more than 25 gallons of flammable liquids in safety cans per laboratory outside of a storage cabinets

Flammable liquids are divided into the following three classes:

Class	Flash Point	Boiling Point	Examples
IA	<73^{O}F (22.8^{O}C)	<100^{O}F (37.8^{O}C)	Diethyl ether, Pentane
IB	<73^{O}F (22.8^{O}C)	>=100^{O}F (37.8^{O}C)	Acetone, Ethanol
IC	>=73^{O}F (22.8^{O}C) <100^{O}F (37.8^{O}C)		Styrene, Nonane, Xylenes

Combustible liquids are divided into the following three classes:

Class	Flash Point	Examples
II	>=100^{O}F (37.8^{O}C) <140^{O}F (60^{O}C)	N,N-dimethylformamide
IIIA	>=140^{O}F (60^{O}C) <200^{O}F (93.3^{O}C)	Dodecane, Aniline
IIIB	>200^{O}F (93.3^{O}C)	Ethylene glycol, Mineral Oil

Maximum allowable container capacity for flammable and combustible liquids:

Container	IA	IB	IC	II	III
Glass	1 pint	1 quart	1 gallon	1 gallon	5 gallons
Metal/Approved Plastic	1 gallon	5 gallons	5 gallons	5 gallons	5 gallons
Safety Can	2 gallons	5 gallons	5 gallons	5 gallons	5 gallons

Exception: Glass containers up to one gallon in size are permitted for storage of flammable liquids if the required purity would be adversely affected by storage in a metal or approved plastic container, or if the liquid would cause excessive corrosion or degradation of the metal or approved plastic container.

Using flammable or combustible liquids:

1. Avoid handling these liquids near open flames.
2. Handle only minimal quantities of these liquids at a time.
3. Handle only in well-ventilated areas.
4. Keep containers closed or covered if possible to avoid release of flammable vapors.
5. Never use open flames for heating flammable solvents.
6. Keep hot plates and water baths at a moderate heat settings.
7. Fill flasks no more than half-full and use boiling chips if heating.

Examples of flammable liquids:

- acetaldehyde
- acetic acid
- acetone
- acetonitrile
- acrylonitrile
- allyl alcohol
- n-amyl acetate
- sec-amyl acetate
- n-amyl alcohol
- tert-amyl alcohol
- benzene
- 1-butanol (n-butanol)
- tert-butyl alcohol
- carbon disulfide
- chlorobenzene
- cyclohexane
- cyclohexene
- 1,1- and 1,2-dichloroethane
- diethyl ether
- 1,1- and 1,2-dimethylhydrazine
- dioxane
- ethanol

- ethyl acrylate
- ethylenediamine
- ethyl formate
- gasoline
- n-heptane
- n-hexane
- hydrazine
- isoamyl alcohol
- isobutyl alcohol (isobutanol)
- isopropyl acetate
- isopropyl alcohol
- methanol
- isopropylamine
- methyl ethyl ketone
- morpholine
- nitromethane
- 2-nitropropane
- pentane
- propylene oxide
- pyridine
- toluene
- triethylamine
- vinyl acetate
- xylene

I. Oxidizers

Oxidizers are substances that stimulate combustion of organic matter. These chemicals spontaneously produce oxygen either at room temperature or with slight heating. They can react vigorously when stored near or in contact with organic compounds. Examples include:

- chlorate compounds (potassium chlorate)
- permanganate compounds (potassium permanganate)
- nitrate compounds (potassium nitrate, uranyl nitrate, zinc nitrate)
- acid dichromate
- chromic acid
- chromium trioxide

- hydrogen peroxide (>30%)
- nitric acid
- sodium peroxide
- sulfuric acid
- chlorine gas
- manganese dioxide
- perchloric acid (see section J)
- potassium nitrite

Store oxidizers away from flammable/combustible liquids or combustible materials. Store oxygen gas cylinders at least 20 feet from flammables or separate with a firewall.

J. Perchloric Acid

Perchloric acid is an extremely hazardous and powerful oxidizing agent. Contact with combustible materials (wood, paper, grease, oil and most organic compounds) can cause these materials to become extremely flammable, and they may spontaneously explode or with friction, percussion, or heating. Fumes from perchloric acid may form explosive metal perchlorates in fume hoods which may cause explosions. This chemical requires special precautions when handling.
Because of the nature of Perchloric Acid, the policy of Great Falls College MSU is to ban this material from the campus and therefore eliminate all threats from this material.

K. Picric Acid

Picric acid (trinitrophenol) is explosive when dry. Dry picric acid is more explosive than TNT. Picric acid in a solution of at least 10% water is considered flammable but not explosive. Picric acid in a solution less than 10% water is considered explosive and should not be handled. Dry picric acid can accumulate on the outer surface of the container or in cap threads. Dry picric acid in cap threads is not always visible and can present a significant friction-sensitive hazard. Extreme caution should be given to containers with metal caps containing any solution of picric acid. Shock-sensitive picrates are formed when picric acid vapors come in contact with metals such as copper, lead or zinc. Contact with concrete floors can also form sensitive calcium picrate salts.
Because of the nature of Picric Acid, the policy of Great Falls College MSU is to ban this material from the campus and therefore eliminate all threats from this material.

L. Formaldehyde

Formaldehyde is a colorless gas that has a bitter odor. Formalin is an aqueous solution containing 37-50 percent formaldehyde. Overexposure to formaldehyde can lead to serious health concerns.

Exposure to formaldehyde can occur through inhalation, skin contact, ingestion, or contact with body openings and mucous membranes. Follow these guidelines if working with formaldehyde:

1. Wear proper PPE as determined from the standard operating procedures developed for each procedure involving formaldehyde.
2. Minimize exposures through the use of engineering controls and workplace practices.
3. If required, participate in the medical surveillance program.

Contact the Safety Officer for monitoring exposure levels of any procedures where formaldehyde is used outside of a fume hood. If exposure monitoring has been conducted and levels are found to be above the PEL or STEL, the area must be posted with the following information:

DANGER
FORMALDEHYDE
IRRITANT AND POTENTIAL CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

Label receptacles containing formaldehyde as follows:

FORMALDEHYDE
POTENTIAL CANCER HAZARD

M. Benzene

Benzene is a colorless to light yellow liquid with an aromatic odor. It is flammable and is a known human carcinogen and a possible reproductive toxin. It may exist as a liquid or a vapor. Because of a high evaporation rate, benzene liquid can quickly vaporize, generating increased concern for respiratory and fire hazards.

1. Wear proper PPE for each procedure involving the use of benzene.
2. Minimize exposure through the use of engineering controls and workplace practices.
3. If required, participate in the medical surveillance program.

Contact the Safety Officer for monitoring exposure levels of procedures where benzene is used outside of a fume hood. In areas where exposure monitoring has been conducted and levels are found to be above the PEL or STEL, the area must be posted with the following information:

DANGER
BENZENE
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

Label receptacles containing benzene as follows:

DANGER
CONTAINS BENZENE
CANCER HAZARD

N. Carbon Tetrachloride

Carbon tetrachloride is commonly used as an organic solvent and is also a carcinogen.

1. Wear proper PPE for each procedure involving the use of carbon tetrachloride.
2. Minimize exposure through the use of engineering controls and workplace practices.
3. If required, participate in the medical surveillance program.

Contact the Safety Officer for monitoring exposure levels of procedures where benzene is used outside of a fume hood. In areas where exposure monitoring has been conducted and levels are found to be above the PEL or STEL, the area must be posted with the following information:

DANGER
Carbon Tetrachloride
CANCER HAZARD
AUTHORIZED PERSONNEL ONLY

Label receptacles containing benzene as follows:

DANGER
Carbon Tetrachloride
CANCER HAZARD

VIII CHEMICAL DISTRIBUTION/STORAGE/INVENTORY/DISPOSAL

SUBJECT: Physical Plant
Procedure: Hazardous Materials
Effective: Spring 2006 Revised: Reviewed:

A. Ordering Chemicals

Prior to ordering chemicals, do the following:

1. Check the chemical inventory to verify that the chemical is not already available.
2. Obtain information regarding handling, storage and disposal of the chemical.
3. Determine the minimum amount of chemical needed. Do not order extra amounts of chemicals that will not be used in the near future. Disposal costs can outweigh the small cost savings of ordering large quantities.

Chemicals must arrive with hazard communications labeling and MSDS. Immediately label all incoming materials according to the Great Falls College MSU hazard code labeling system and add the quantity to the inventory.

B. Chemical Stockrooms and Storerooms

Stockrooms are defined as areas where chemicals are mixed, repackaged and/or distributed for laboratory use. Storerooms are defined as areas where chemicals are stored with no manipulation of chemicals. Only qualified staff are allowed into storerooms and stockrooms.

1. Store hazardous materials, when not in use, in an environmentally controlled, supervised stockroom, storeroom, or storage cabinet.
2. Do not use storerooms as preparation areas.
3. Record the removal of any chemical for inventory purposes.
4. Do not transport chemicals from the stockroom unless they are in an appropriate container.
5. Clearly mark all materials brought to the stockroom for waste disposal with the chemical content, particular hazards, the date, the employee responsible for their disposition, and how the waste materials were accumulated.

C. Transporting Chemicals on Campus

1. Use secondary containers, such as a bucket, to hand carry hazardous chemicals, concentrated acids, flammable solvents, or corrosives.
2. Use carts for moving large quantities. Exercise extreme caution when moving though hallways.
3. Wear proper PPE when moving chemicals.
4. Avoid movement of chemicals through hallways during peak traffic times.

D. Chemical Storage

SUBJECT: Physical Plant
Procedure: Hazardous Materials
Effective: Spring 2006 Revised: Reviewed:

Follow these general procedures for storage of chemicals:

1. Conduct annual inspections to examine containers for deterioration and integrity.
2. Store the smallest amounts of chemicals as practical
3. Do not use fume hoods as chemicals storage areas.
4. Store chemicals in cabinets or on shelves. Do not store chemicals on the floor.
5. Store chemicals according to hazard class. Do not store chemicals alphabetically.
6. Do not store incompatible materials together. (See Compatibility Table Appendix XXX)
7. Secure bottle caps to prevent accidental spills and minimize odors.
8. Provide secondary containment spill trays when storing liquid chemicals.
9. Store large quantities of chemicals on lower shelves. Store only lightweight or small quantities above eye level.
10. Do not store corrosive materials above eye level.
11. Wear appropriate PPE, including eye protection, when handling chemicals stored above eye level.
12. Keep a ladder or step stool available for reaching overhead storage.
13. Store chemicals away from direct sunlight and heat sources.
14. Conduct periodic, scheduled inventories.
15. Dispose of chemicals not used by the facility.

1. Flammable liquid storage

1. Store flammable liquids, in flammable storage cabinets designed specifically for and labeled as "Flammable Liquids". Do not store other materials in the cabinet.
2. Store plastic squeeze bottles containing flammable materials (normally used for rinse purposes) in a flammable storage cabinets.
3. Follow the guidelines in section VII part H for allowable quantities and container sizes.

2. Corrosive liquid storage

1. Store mineral acids, (sulfuric and hydrochloric acids) in acid storage cabinets.
2. Store bases and solutions of bases separate from acids.
3. Store oxidizing acids, (nitric and perchloric acids) with oxidizing materials and away from organics.
4. Store organic acids, (acetic and formic acids) with flammable materials.

3. Oxidizer storage (see definition: section VII part I)

1. Store oxidizers, (i.e. hydrogen peroxide or chlorine bleach), away from all organic chemicals and reducing agents.

2. Do not store near any combustible materials.

4. Compressed gas storage

1. Chain or secure gas cylinders to a wall and store with the caps on when not in use.
2. Store oxygen cylinders away from fuels or combustible materials.
3. Mark empty cylinders as "Empty" and store away from other cylinders.

5. Toxic chemicals and high risk chemicals

1. Store in a vented cabinet.
2. Store highly acute toxins and high-risk chemicals with the parent container inside an unbreakable secondary container.
3. Post specific warning signs on the storage area.
4. Maintain use and disposal records.

6. Reactive chemicals (see definition in section VII part E)

1. Store reactive chemicals away from other chemicals.
2. Store water reactive chemicals in cabinets protected from fire sprinkler systems.
3. Store specified reactive materials under either inert atmosphere and/or refrigeration.
4. Inventory chemicals that may form organic peroxides and dispose of them at the time of expiration.
5. Store explosive materials as specified by the manufacturer. Only knowledgeable and trained individuals may handle these materials.

E. Chemical Inventory

Maintain an inventory of all chemicals for both the Biology and Chemistry Departments in a central department location. Update the inventory at least annually and forward a copy to the Safety Officer.

The inventory must contain the following departmental and chemical information:

<u>Departmental information</u>

1. Phone number of the departmental contact
2. Name of the department
3. Building where the chemicals are located
4. Date of the original inventory and the most recent revision to the inventory

<u>Chemical information</u>

1. Name of the chemical (include alternative names if possible)
2. Manufacturer of the chemical
3. Room number/name where the chemical is stored
4. Location of the chemical is stored within a room (be specific, cabinet, shelf, etc.)
5. The physical state of the chemical – solid, liquid, or gas
6. Quantity of the chemical stored on-site
7. Whether a MSDS is readily available for the product/chemical (yes or no)

F. Shipping Hazardous Chemicals

Do not ship hazardous chemicals with commercial vendors without prior approval from the Safety Officer. The State of Montana has very specific regulations governing shipping of hazardous materials. Failure to comply with State and Federal regulations could result in severe penalties. Consult the Safety Officer with any questions regarding shipping of hazardous materials.

G. Employee Transporting of Chemicals Off Campus

Do not transport chemical or hazardous materials outside of the Colelge without prior approval from the Safety Coordinator. The employee is responsible for ensuring that the State regulations on shipping chemicals are not violated by transporting chemicals in private cars or on commercial carriers. The Safety Coordinator will help with questions regarding these regulations.

H. Hazardous Waste Disposal

The goal of a waste disposal program is to minimize the potential harm to people and the environment resulting from improper disposal of a hazardous chemical. First consider minimizing the amount of waste generated. Use non-hazardous alternatives if possible. Reclaim or recycle materials when possible. Research potential disposal problems before ordering new materials. **Note: Keep a detailed inventory of the contents and quantities of waste placed into the waste containers! Organize wastes according to the type of waste.**

1. What is a hazardous waste?

Hazardous waste is defined in the Federal Resource Conservation and Recovery Act (RCRA). A list of RCRA wastes is included in Appendix N. According to RCRA, waste is considered toxic and/or hazardous if it will "cause or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible illness; or pose a substantial present or potential

hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed."

RCRA regulations (40 CFR 261 and 262) specify that a waste is hazardous if it is a listed waste or has the characteristics of a hazardous waste. A hazardous waste meets any of the following conditions: (see Appendix A for details).

1) Has been named a hazardous waste and listed as a waste in the regulations
2) Exhibits any characteristics of a hazardous waste (ignitable, corrosive, reactive, toxic) = characteristic hazardous waste
3) Is a mixture containing a listed hazardous waste and a nonhazardous waste.
4) Is a waste derived from treatment, storage, or disposal of listed hazardous wastes.

Mixture Rule

A hazardous waste plus a non-hazardous waste is always a hazardous waste.

2. Waste disposal

These procedures apply to hazardous waste containers in laboratories:

1. Label all hazardous waste containers- "Hazardous Waste" before any waste added. Include the words "hazardous waste" on the label along with a complete description of the waste.
2. Keep containers closed when not in use.
3. Use containers in good condition.
4. Containers should be under the generator's control.
5. Inspect containers on a regular basis for degradation.
6. Keep an inventory of the contents. Record the name and amount of each chemical added to the waste container and the date it was added.
7. If adding new waste to a container, determine if the new waste is compatible with the original contents.
8. When the container is full, complete a hazardous waste label with percentages of each chemical and date when the container became filled. The % column must equal 100%.
9. A container is full if the liquid level reaches close to, but to the top of the container. This reduces the build-up of excessive vapors and ensures room for expansion.
10. Notify the Safety Officer for waste pick-ups.

Disposal of experimental compounds

1. Dispose of experimental compounds of unknown toxicity as hazardous waste.
2. Label the container with your name, department, and known compounds.

3. Under no circumstances should you dispose of unknown compounds down the drain or in the laboratory trash bins.

Drain disposal of chemicals

1. Salts, sugars, and starches that do not contain any hazardous material may be put down the drain if they present no possibility of coagulation in the drain.
2. "Neutral" buffer solutions (pH between 6 and 8) may be put down the drain.
3. Drain disposal of all other chemicals is prohibited!

Disposal of broken glass

1. Place broken glass in containers labeled "broken glass".
2. Never place broken glass in the regular trash cans.
3. Once a broken glass receptacle is filled it contact the building custodian for disposal.

IX CHEMICAL EMERGENCY ACTION

One of the best ways to avoid emergencies is to plan ahead. Always be prepared! Know the evacuation routes from an area. Prior to working with chemicals in the laboratory, locate the following items:

1. Emergency shower
2. Eyewash
3. First aid kit
4. Fire extinguisher
5. Emergency shut-off valves
6. Spill-control kit
7. Telephone

Emergency phone numbers should be listed on the laboratory doors. It is recommended that phone numbers of contact personnel be posted near phones.
The Great Falls College MSU Emergency Procedures placard can be found in Appendix N.

A. Spill Procedures

The most common incident involving a hazardous material involves a liquid spill or the release of a gas or vapor. Fires and explosions could occur. Because of the small quantities used in most procedures on campus, spills will usually be limited. However, the vapor released from a small spill can be dangerous if inhaled or if it is flammable. If a hazardous materials is spilled outside of a chemical fume hood it should be considered dangerous, and immediate steps must be taken to remediate the situation.

SUBJECT: Physical Plant
Procedure: Hazardous Materials
Effective: Spring 2006 Revised: Reviewed:

Spills can be classified as either hazardous or incidental. Hazardous spills are an emergency of unknown nature. They may be immediately dangerous to life and health, threaten the surrounding area or facility, threaten personnel and/or the public, and/or involve a toxic gas leak, or a corrosive, toxic, or reactive hazardous material. Hazardous cleanup response teams will be necessary to clean up all hazardous spills.

An incidental spill creates no fire hazard and involves low to moderately toxic materials in small amounts which can be neutralized, absorbed, contained, or otherwise controlled by employees in the immediate area. The individual who was involved in a incidental spill may be clean the area if they are properly trained and use approved spill cleanup kits and PPE. If the individual is not properly trained in clean up procedures, another trained individual should perform the cleanup.

1. Hazardous spills

Perform the following in the event of a hazardous chemical spill:

1. Eliminate any and all sources of ignition and evacuate the immediate area.
2. Close all doors leading into the spill area.
3. If applicable, assist contaminated persons to a safety shower or eyewash station.
4. Notify the emergency responders (call 911).
5. Report the spill immediately to your supervisor and to the Safety Coordinator. Report whether the spill has entered the ground, air, sanitary sewer, storm sewers, or any surface water.
6. All toxic spills that have an LD_{50}<50 mg/kg are considered highly toxic and must be immediately reported to your supervisor and to the Safety Officer. These might include suspected carcinogens or reproductive toxins.
7. Contact the appropriate MT DEQ Hazardous Waste Regulatory Personnel (Appendix O).

2. Incidental spills

Only those who have been properly trained and have the appropriate spill cleanup kits and PPE should perform cleanup of incidental spills. Training will be provided by your department or by the Safety Officer. Perform the following in the event of an incidental spill:

1. Assess the hazard.
2. Wear appropriate PPE. As a minimum this requires gloves, lab coat, and safety goggles.
3. Isolate/barricade the affected area.
4. Notify coworkers that you are cleaning up a spill.
5. Neutralize strong acids and bases.
6. Contain and clean up the spill with approved cleanup kits (located either in the stockroom).

7. You may temporarily place contaminated cleanup materials with volatile solvents or chemicals in a fume hood or place them in buckets for disposal.
8. All chemical spill cleanup materials should be disposed of as hazardous waste.
9. Write a brief report describing how the spill occurred and the cleanup procedures used. Send a copy to your supervisor and to the Safety Officer.
10. If you are not trained to cleanup spills, call the Safety Officer and remain on the scene to serve as a resource.

3. Mercury spills

Mercury vapors are highly toxic. Because of its toxicity- it is strongly recommended that only non-mercury thermometers are used in labs at Great Falls College MSU. Any spills of mercury, no matter how small, are considered toxic and must be cleaned up immediately by a trained employee. Collected mercury must be disposed of as hazardous waste. In the event of a mercury spill, do the following:

1. Isolate/barricade the area.
2. Call the Safety Officer (771-4307)
3. Remain at the scene to serve as a resource.

B. Personal Chemical Exposure

Chemical exposure can cause irritation or burns of the skin, eyes, throat, and lungs. They may also cause dizziness, headaches, disorientation or unconsciousness, or damage to internal organs.

If your eyes are splashed with a chemical:

1. Immediately flush them in an eyewash fountain for 15 minutes.
2. Hold your eyes open and blink repeatedly while washing them.
3. Seek medical attention.

If your skin comes in contact with a chemical:

1. Flush the area with water for 15 minutes and remove contaminated clothes.
2. If large areas are exposed, go to the emergency shower and begin flushing with water at once while removing clothes in the shower. Continue flushing with water for 15 minutes. (Always keep the emergency shower clear of books, backpacks, chairs and anatomical models!)
3. Seek medical attention.

If you inhale a chemical, immediately move to fresh air. Seek medical attention.

If you ingest a chemical, inducement of vomiting depends on the chemical. Refer to the MSDS for recommended first aid. Never induce vomiting when corrosives are ingested. Seek medical attention.

C. Detection of Chemical Odors

The human nose cannot be relied on as an adequate warning device against chemical hazards. Some materials (i.e.- hydrogen sulfide), can cause olfactory fatigue and render the sense of smell useless as a warning device. Alternatively, some materials are very odorous and subsequently offer good warning properties. In either case, if a chemical release is suspected, promptly secure any operating equipment and leave the area. Call 911. Do not return to the area until given approval.

D. Fire

In the event of fire, do the following:

1. Activate the fire alarm.
2. Clear the area of all personnel. Instruct all personnel to evacuate the facility.
3. If it can be done safely, and if you are trained in the use of a fire extinguisher, attempt to extinguish the fire using a portable fire extinguisher.

   Remember the "PASS" system when using a fire extinguisher:

   P=Pull pull the fire extinguisher pin
   A=Aim aim the nozzle at the base of the fire
   S= Squeeze squeeze the handle
   S=Sweep sweep the base of the fire from side to side

   Note: If a fire spreads from its origin or is not extinguished within 30 seconds, immediately evacuate the area!
4. Confine the fire by closing doors as you leave the area.
5. Stay near the building to advise emergency personnel on the nature of the fire and to make sure everyone is accounted for.

E. Utility Failure

The interruption of utility services (either scheduled or from natural causes), is considered an emergency event.

1. If the ventilation system shuts down, cease and safely shut down any operations in areas requiring ventilation. Close and secure all chemical containers. A building evacuation may be necessary.
2. Loss of water may affect cooling systems. Shut down procedures using circulating cooling water.

3. Shut down ovens and kilns in the event of the loss of gas service. Notify facilities management before restarting equipment. Do not use ignition sources before pilot lights have been re-lit.

F. Reporting Injuries

In case of ANY medical emergency, phone 911 for assistance. Indicate the nature of the problem, your identification, and your location.

In addition to the above, immediately report the incident to the Safety Officer: Ed Binkley at 771-4307. Reports should be phoned in by the injured employee's supervisor or by the injured person themselves.

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Appendix A

GLOSSARY OF TERMS, ABBREVIATIONS, AND ACRONYMS

ACGIH: American Conference of Governmental Industrial Hygienists.

Acute Effect: A health effect that occurs soon after a brief exposure to the offending agent.

Carcinogen: A chemical that is capable of causing cancer. Under the HCS a carcinogen is any chemical that has been found to be a carcinogen or potential carcinogen by the International Agency for Research on Cancer, is listed as a carcinogen or potential carcinogen in the *Annual Report on Carcinogens* published by the National Toxicology Program, or is regulated by OSHA as a carcinogen.

Chemical and Biological Safety in Laboratories: The University's general chemical hygiene plan, as required by the OSHA Laboratory Standard.

Chronic Effect: A health effect that occurs over a long period of time as a result of continued or periodic exposure to the offending agent.

Combustible Liquid: Any liquid having a flash point at or above 100 degrees F (37.8 degrees C), but below 200 degrees F (93.3 degrees C).

Compressed Gas: *I.* a gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 degrees F (21 degrees C); or *II.* a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 degrees F (54.4 degrees C) regardless of the pressure at 70 degrees F; or *III.* a liquid having a vapor pressure exceeding 40 psi at 100 degrees F (37.8 degrees C) as determined by ASTM D-323-72.

Corrosive: A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact.

Employee: An individual receiving a paycheck from the University.

EPA: U.S. Environmental Protection Agency.

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

Flammable: A chemical that catches on fire easily and burns readily.

Hazardous Chemical: Defined by OSHA as any chemical that is a health hazard or a physical hazard.

Hazard Warning: Any words, pictures, symbols, or combination thereof appearing on a label that convey the hazards of the chemical(s) in the container.

Health Hazard: 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. Chemicals covered by this definition include carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, that which act on the hematopoietic system, and agents that damage the lungs, skin, eyes, or mucous membranes.

Hematopoietic System: The body's blood system, including the production and circulation of blood and the blood itself.

Hepatotoxins: Chemicals that cause liver damage.

HSC: Hazard Communication Standard (OSHA: Title 29 Code of Federal Regulations 1910.1200).

Importer: The first business with employees working with the Customs Territory of the United States that receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States.

Irritant: A chemical that is not corrosive but causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

Label: Any written, printed, or graphic material displayed on or affixed to containers of hazardous chemicals.

Material Safety Data Sheet (MSDS): Written or printed material concerning a hazardous chemical that includes information on the chemical's identity; physical and chemical characteristics; physical and health hazards; primary routes of entry; exposure limits; whether the chemical is a carcinogen; precautions for safe handling and use; control measures; emergency and first aid procedures; the date of preparation of the MSDS or the last change to it; and the name, address, and telephone number of the manufacturer, importer, or employer distributing the MSDS.

Mixture: A heterogeneous association of substances where the various individual substances retain their identities and can usually be separated by mechanical means. Includes solutions or compounds but does not include alloys or amalgams.

MSDS: Material Safety Data Sheet.

Nephrotoxins: Chemicals that cause kidney damage.

Neurotoxins: Chemicals that produce their primary toxic effects on the nervous system.

Organic peroxide: An organic compound that contains the bivalent -O-O-structure and 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.

OSHA: Occupational Safety and Health Administration.

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.

Permissible Exposure Limit (PEL): An exposure limit that is published and enforced by OSHA as a legal standard.

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 (reactive), or water-reactive.

Pyrophoric: A chemical that will ignite spontaneously in air at a temperature of 130 degrees F (54.4 degrees C) or below.

Readily Available: To be quickly and easily accessible at any time for information and emergency use.

Reproductive Toxins: Chemicals that affect the reproductive capabilities including chromosomal damage (mutations) or effects on fetuses (teratogenesis).

Responsible Party: Someone who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

Safety Desk Book: A central safety resource for the laboratory, shop, and department safety documents.

Safety Plan: A laboratory-specific chemical hygiene plan required by the OSHA Laboratory Standard for research labs, teaching labs, and common facilities (those shared by more than one researcher).

SARA Title III: Title III of the Superfund Amendments and Reauthorization Act, it is also known as the Emergency Planning and Community Right-To-Know Act (EPCRA).

Sensitizer: A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

Threshold Limit Value (TLV): A time-weighted average concentration under which most people can work consistently for eight hours a day, day after day, with no harmful effects. The values are published in a table annually by the American Conference of Governmental Industrial Hygienists.

Toxic: Causing acute or chronic injury to the human body or suspected of being able to cause disease or injury under some conditions. The HCS defines "toxic" and "highly toxic" specifically by the chemical's median lethal dose and median lethal concentration for laboratory animals.

Unstable (reactive): A chemical that in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.

Water-reactive: A chemical that reacts with water to release a gas that either is flammable or presents a health hazard.

Work area: A room or defined space in a workplace where hazardous chemicals are produced or used and where employees are present.

Workplace: An establishment, job site, or project at one geographical location containing one or more work areas.

Appendix B

How to Interpret MSDS Information Sheets

This document provides a little guidance on the interpretation of MSDS data sheets. These sheets may at first seem complicated and difficult to understand, but they are a reliable source of the data you need to handle chemicals safely.

We discuss here the different sections into which MSDS sheets are generally divided, using portions of a sheet provided by a commercial supplier.

1 Identification of substance:

Trade name: Benzene
Manufacturer/Supplier:
Alfa Aesar, A Johnson Matthey Company Johnson Matthey Catalog Company, Inc. 30 Bond Street Ward Hill, ...

.... and, often, emergency call-out information.

Emergency information: During normal hours the Health, Safety and Environmental Department. After normal hours call .....

2 Composition/Data on components: identifies the material, and gives the CAS and other registry numbers.

Benzene (CAS# 71-43-3); 100%
Identification number(s):
EINECS Number: 200-753-7
EU Number: 601-020-00-8

3 Hazards identification: summarizes the major hazards associated with use of the chemical. The R and S codes in this section are followed by explanatory text.

Hazard description:
T Toxic F Highly flammable

Information pertaining to particular dangers for man and environment
R 45 Can cause cancer - Group I (extremely hazardous)
R 11 Highly flammable.
R 48/23/24/25 Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.

4 First aid measures: outlines first aid measures.

After inhalation: Supply fresh air. If required, provide artificial respiration. Keep patient warm. Seek immediate medical advice. After skin contact .....

5 Fire fighting measures: covers fire fighting and protective equipment.

Suitable extinguishing agents Carbon dioxide, extinguishing powder or water spray. Fight larger fires .....

6 Accidental release measures: outlines the procedures to be followed in case of accidental release of the chemical, including methods to be used to clean up spills. Note that these measures are unlikely to be sufficiently detailed if the chemical is particularly hazardous, and local procedures should be drawn up to supplement what is given in the MSDS sheet.

Person-related safety precautions: Wear protective equipment.....
Measures for environmental protection..... Do not allow material to be released to the environment without proper governmental permits. Measures for cleaning/collecting: Absorb with liquid-binding material (sand, diatomite, acid binders, universal binders, sawdust). Dispose contaminated material as waste according to item 13 .....

7 Handling and storage: contains information about the possible formation of peroxides in storage, flammability, explosive risks, etc. Pay particular attention to the possible need for flammable storage cabinets, explosion-proof fridges, and also the need to avoid storage near incompatible chemicals. This is an important section, sometimes overlooked by those using chemicals in the laboratory.

Information for safe handling:
Keep container tightly sealed. Store in cool, dry place in tightly closed containers. Ensure good ventilation at the workplace. Information about protection against explosions and fires: Keep ignition sources away. Protect against electrostatic charges. Fumes can combine with air to form an explosive mixture.

Storage
Requirements to be met by storerooms and receptacles: Store in a cool location. Store away from oxidizing agents .....

8 Exposure controls and personal protection: provides information on regulatory standards for exposure, in other words, the maximum permitted concentration of the material in the environment to which you are allowed to be exposed. It also usually contains information on suitable types of PPE (personal protective equipment).

Additional information about design of technical systems: Properly operating chemical fume hood designed for hazardous chemicals and having an average face velocity of at least 100 feet per minute. Components with limit values that require monitoring at the workplace: Benzene mg/m3 ml/m3 ACGIH TLV short term 1.6 0.5 ACGIH TLV long term 8 2.5 B VME 1,6 0,5 .....

Personal protective equipment General protective and hygienic measures The usual precautionary measures for handling chemicals should be followed. Keep away from foodstuffs, beverages and feed. Remove all soiled and contaminated clothing immediately..... Wash hands before breaks and at the end of work. Breathing equipment:.....
Protection of hands: Impervious gloves
Eye protection: Safety glasses, Full face protection .....

9 Physical and chemical properties:

Form: Liquid
Color: Colorless
Odor: Aromatic
Change in condition
Melting point/Melting range: 5.51 ° C
Boiling point/Boiling range: 80.1 ° C
.....

10 Stability and reactivity

Thermal decomposition / conditions to be avoided: Decomposition will not occur if used and stored according to specifications.
Materials to be avoided: Oxidizing agents

Dangerous reactions No dangerous reactions known
Dangerous products of decomposition: Carbon monoxide and carbon dioxide

11 Toxicological information: outlines the risks to which you may be exposed when using the chemical. It is therefore a section of crucial importance!

Acute toxicity: (The acute toxicity gives an indication of the kind of quantities of the chemical which may cause immediate damage to health if swallowed, inhaled or absorbed through the skin.)

LD/Lc50 values that are relevant for classification: If you have never heard of LD50s, look in the glossary on this site.

Oral: LD50: 3306 mg/kg (rat)
Dermal: LD50: 48 mg/kg (mus)
Inhalative: LC50/7H: 10.000 ppm/7H (rat)

(There follows a section which gives, often in some detail, an indication of the health effects which may be attributable to this chemical. This section should be read particularly carefully, since the range of health effects may be broad, and may include carcinogenic or sensitizer effects.)

Primary irritant effect:
on the skin: Irritant to skin and mucous membranes.
on the eye: Irritating effect.
Sensitization: No sensitizing effects known. (Chemical sensitization, for example by platinum compounds, is a potentially debilitating problem. Pay particular attention to any information which may suggest that the chemical is a sensitizer.)

Subacute to chronic toxicity: (Here we find details of the possible long-term effects of exposure to the chemical.)

Benzene has a strong irritating effect, producing erythema and burning. Edema and blistering is possible in more severe cases. Absorption through the skin may cause the same symptoms as inhalation or ingestion. These include gastrointestinal irritation, low blood pressure, headache, blurred vision, nausea, vomiting, dizziness, loss of balance and coordination, confusion, unconsciousness, coma, respiratory failure and death. Blood, liver and kidney damage is possible. Benzene is a recognized leukemogen and an experimental mutagen and teratogen.

Additional toxicological information:
To the best of our knowledge the acute and chronic toxicity of this substance is not fully known. (For this chemical there now follow important comments regarding the carcinogenicity. The acronyms such as IARC refer to regulatory or health agencies.)

EPA-A: human carcinogen: sufficient evidence from epidemiologic studies to support a causal association between exposure and cancer.

IARC-2A: Probably carcinogenic to humans: limited human evidence; sufficient evidence in experimental animals

NTP-2: Reasonably anticipated to be a carcinogen: limited evidence from studies in humans or sufficient evidence from studies in experimental animals.

ACGIH A2: Suspected human carcinogen: Agent is carcinogenic in experimental animals at dose levels, by route(s) of administration, at site(s), of histologic type(s), or by mechanism(s) considered relevant to worker exposure. Available epidemiologic studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.

12 Ecological information:

General notes: Do not allow material to be released to the environment without proper governmental permits.

13 Disposal considerations: deals with disposal, is often not sufficiently detailed for you to be able to undertake disposal yourself. If you need to dispose of the chemical after use, ensure that you know how to do this safely.

Consult state, local or national regulations for proper disposal.

14 Transport information: transport information, generally as a list of codes indicating the dangers associated with the chemical (flammable, radioactive, very toxic, etc.) and the type of transport which may be used. There are usually UN hazard codes given in this section.

DOT regulations:
Hazard class: 3 Identification number: UN1114 Packing group: II .....

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15 Regulations: lists the hazard codes (see glossary if you are not familiar with these) which indicate the principle hazards associated with the chemical and the precautions which should be taken when working with it.

Hazard symbols:
T Toxic F Highly flammable

Risk phrases:
45 Can cause cancer - Group I (extremely hazardous)
11 Highly flammable.
48/23/24/25 Toxic: danger of serious damage to health by prolonged exposure through inhalation, in contact with skin and if swallowed.
A full list of these risk phrases is given here.

Safety phrases:
20 When using do not eat or drink.
28 After contact with skin, wash immediately with plenty of ... .
36/37/39 Wear suitable protective clothing, gloves and eye/face protection.
45 In case of accident or if you feel unwell, seek medical advice immediately.
A full list of safety phrases is available here.

National regulations (This may include a variety of country-specific detail) All components of this product are listed in the U.S. Environmental Protection Agency Toxic Substances Control Act Chemical Substance Inventory .....
This product contains a chemical known to the state of California to cause cancer or reproductive toxicity.
This product contains benzene and is subject to the reporting requirements of section 313 of the Emergency Planning and Community Right to Know Act of 1986 and 40CFR372.

16 Other information: a section of an additional information, such as the name of the person preparing the data sheet, a list of references from which data have been drawn, disclaimers, etc.

Employers should use this information only as a supplement to other information gathered by them, and should make independent judgment of suitability of this information to ensure proper use and protect the health and safety of employees ....
Contact:

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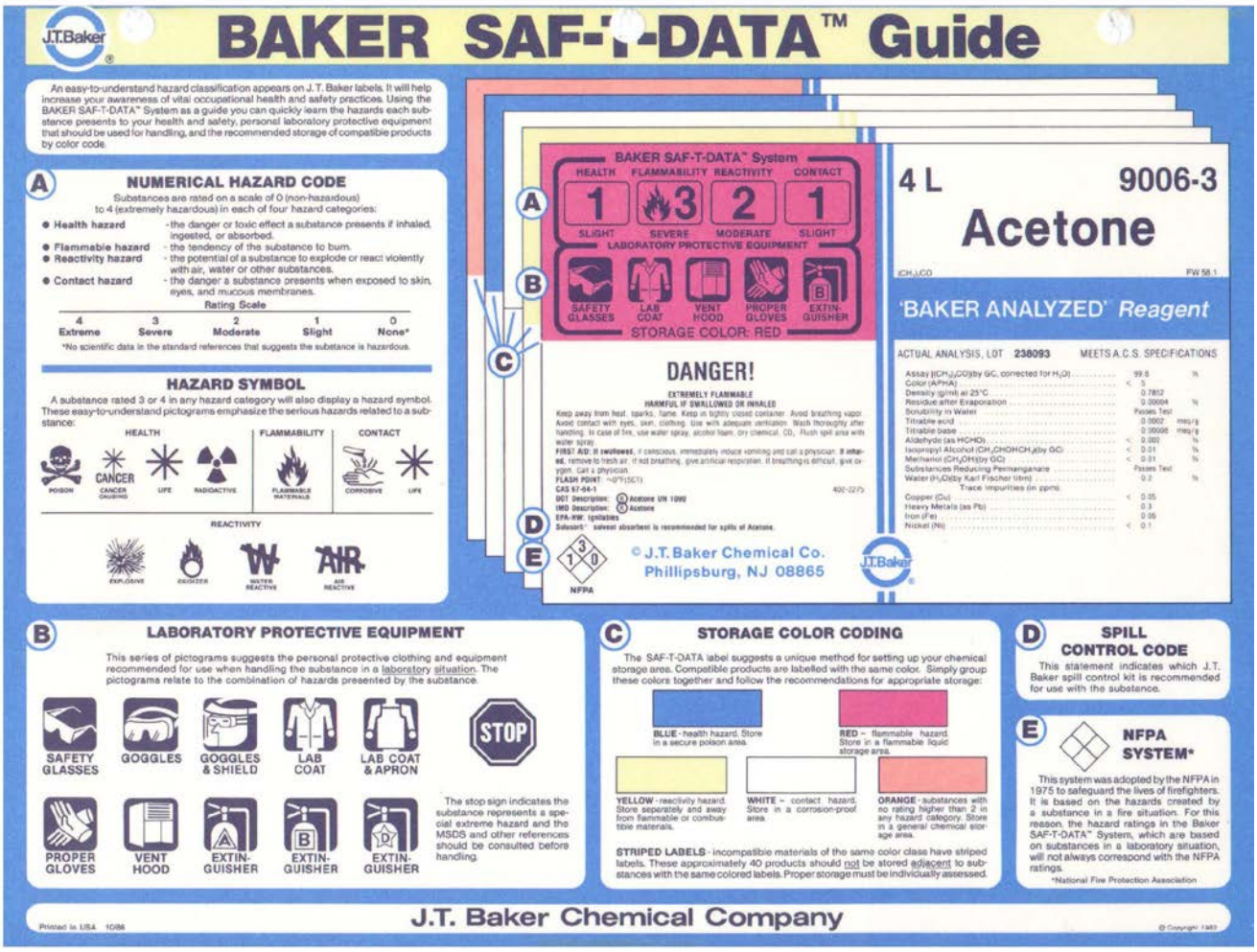
Appendix C



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Appendix D

LABORATORY CHEMICAL LABELING PLAN

As part of our Chemical Hygiene Plan for safe operation in our laboratories, students need to be aware of how to operate around chemical hazards in the laboratory. This document describes how some industrial and governmental standards are implemented in the Chemistry laboratories at Great Falls College MSU

These materials are to help students perform safely in the Chemistry laboratories and to learn methods of safe operation in any laboratory.

Wearing chemical safety goggles, close toed shoes, and long pants to cover your skin, not wearing loose clothing, and tying long hair back are precautions all people must observe while in the Chemistry laboratories. These items along with appropriate use of ventilation hoods provide the protective equipment standards for use of all chemicals in the Chemistry laboratory. In addition students may choose to provide and wear laboratory coats, and/or gloves when appropriate.

The following labeling information must be read to understand the terminology we will be using to communicate chemical hazards in chemistry laboratories.

TO DETERMINE IF A CHEMICAL IS HAZARDOUS AND TO HANDLE HARZARDS CORRECTLY

1) Words on the label, such as CAUTION, WARNING, OR DANGER indicate a chemical is hazardous
2) Follow all safety information and procedures in your laboratory directions.
3) Ask your instructor or the laboratory technician if you have concerns or questions about safe handling of chemicals in the laboratory.
4) Check the MSDS for hazard information and get help from your instructor or the laboratory technician in interpreting the MSDS information.

***"What is not a poison? All things are poison and nothing is without poison. It is the dose only that makes a thing not a poison"*- Paracelsus (15th Century)**

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KEY HAZARD RATING ORGANIZATIONS:

NIOSH – NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH

NFPA – NATIONAL FIRE PROTECTION ASSOCIATION

J.T. Baker CHEMICAL COMPANY (for college laboratories)

Their system of identification and labeling includes 4 hazard categories which are color coded and a rating scale from 4 to 0.

Hazard Code	Color	Rating Number and Key Words
Health – Defined as danger or toxic effect a substance presents if inhaled, ingested, or absorbed.	**Blue**	4 – Extremely Hazardous 3 – Highly Hazardous 2 – Moderately Hazardous 1 – Slightly Hazardous 0 – No Significant Hazard
Flammability – Defined as the susceptibility of a substance to burn.	**Red**	4 – Extremely Hazardous 3 – Highly Hazardous 2 – Moderately Hazardous 1 – Slightly Hazardous 0 – No Significant Hazard
Reactivity – Defined as the potential of a substance to explode or react violently with air, water, or other chemical substances.	**Yellow**	4 – Extremely Hazardous 3 – Highly Hazardous 2 – Moderately Hazardous 1 – Slightly Hazardous 0 – No Significant Hazard
Special – Defined as unusual reactivity, radioactivity, or other special characteristics.	**White**	Descriptive symbol (OXY) or 4 – Extremely Hazardous 3 – Highly Hazardous 2 – Moderately Hazardous 1 – Slightly Hazardous 0 – No Significant Hazard

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Baker SAF-T-DATA™ Labeling System

SAF-T-DATA™ is an easy-to-understand labeling system that provides vital safety information relevant to laboratory and production personnel.

Using the SAF-T-DATA™ labeling system as a guide, you can quickly learn three things:

- The hazards each substance presents to your health and safety.
- The proper protective equipment needed to handle the substance.
- The recommended storage area.

Hazard Information

Rating Scale				
4	3	2	1	0
Extreme	Severe	Moderate	Slight	No Known Hazard

Substances are rated on a scale of zero (no known hazard) to four (extremely hazardous) in each of four hazard categories:

1. *Health Hazard*
   Defined as the danger or toxic effect a substance presents if inhaled, ingested or absorbed. It is quantified using NIOSH guidelines for acute toxicity and various other sources for chronic health hazards including:

   - International Agency for Research on Cancer (IARC)
   - National Toxicology Program (NTP), Annual Report on Carcinogens
   - OSHA

2. *Flammability Hazard*
   Defined as the susceptibility of a substance to burn. It is quantified using National Fire Protection Association (NFPA) guidelines and is based on flash and boiling points.

3. *Reactivity Hazard*
   Defined as the potential of a substance to explode or react violently with air, water, or other chemical substances. The SAF-T-DATA™ reactivity ratings are based on data from a well known scientific references such as Bretherick, etc. and other expert sources.

4. *Contact Hazard*
   Defined as the danger a substance presents when exposed to skin, eyes, and mucous membranes. It is quantified from scientific data published by NIOSH and the Department of Transportation.

Hazard Symbols

When a hazard is severe (3 rating) or extreme (4 rating), symbols are used to emphasize and define the hazard. These symbols are easily recognized and most are used internationally.

The hazard symbols used in the SAF-T-DATA™ labeling system include:

Health Symbols:
Flammability:
Reactivity:
Contact:

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To use the label information better you need to understand how a hazardous chemical may enter the body.

The four main routes of entry are:

1] Absorption through the respiratory tract (lungs) through inhalation.
This is the most important route in terms of severity.

2] Absorption through the digestive tract.
This can occur through eating or smoking with contaminated hands or in contaminated work areas.

3] Absorption through the skin.
This is the most common cause of occupational disease (dermatitis).

4] Precutaneous injection through the skin.
This can occur through misuse of sharp materials, especially hypodermic needles. Toxic effects can be immediate or delayed; reversible or irreversible; local or systemic.

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MATERIAL SAFETY DATA SHEET ITEM LIST

Each item below must be provided on every MSDS

1] Product or chemical identity on the label

2] Name, address and phone number for hazard and emergency information

3] Date of MSDS preparation

4] Chemical and common names of hazardous ingredients

NOTE: This includes all hazardous ingredients which comprise 1 percent or greater of the composition, except for chemicals identified as carcinogens, which must be listed if the concentrations are 0.1% or greater.

5] Permissible exposure limit (PEL), Threshold limit value (TEL) and other applicable limits

6] Physical and chemical characteristics, such as vapor pressure and flash point

7] Physical hazards, including the potential for fire, explosion and reactivity

8] Primary routes of entry into the body, such as inhalation, ingestion, or skin absorption

9] Acute and chronic health hazards, including signs and symptoms of exposure and medical conditions aggravated by exposure

10] Carcinogenic hazard

NOTE: If a chemical is not carcinogenic or if there is no information about its carcinogenicity, then information about item 10 does not have to be listed unless a blank is provided on the form.

11] Emergency and first aid procedures

12] Precautions for safe handling and use including hygienic practices, repair and maintenance, protective measures, and spill/leak clean-up

13] Exposure control measures such as engineering controls, work practices, and personal protective equipment

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MUTAGEN: Chemical or physical agents that cause genetic alterations.

PRECAUTIONS: Handle with extreme care! Do not breathe vapors and avoid contact with skin, eyes, and clothing.

PEROXIDE FORMER: Substance which forms peroxides upon standing or when in contact with air.

PRECAUTIONS: Many peroxides are explosive! Do not open bottle if a residue is present on the outside of the cap or inside of the bottle.

POISON: Substances that have very serious and often irreversible effects on the body. Hazardous when breathed, swallowed, or in contact with the skin, and in sufficient quantity lead to death.

PRECAUTIONS: Avoid contact with the body. When handling, use suitable protective equipment.

TERATOGEN: Substances that cause the production of physical defects in developing fetus or embryo.

PRECAUTIONS: Handle with extreme care! Do not breathe vapors and avoid contact with skin, eyes, and clothing. Use suitable protective equipment when handling.

TOXIC: Substances which are hazardous to health when breathed, swallowed, or are in contact with the skin. There is danger of serious damage to health by short or prolonged exposure.

PRECAUTIONS: Avoid all the contact with the body. When handling use suitable protective equipment.

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In the Health Hazard Data Section of MSDS sheets and on chemical labels certain words or phrases are used. Generalized descriptions of many of these phrases and the precautions to be practiced follow:

AVOID CONTACT: General rule for all chemicals, even if they are considered non-hazardous.

PRECAUTIONS: Do not breathe vapors and avoid contact with skin, eyes, and clothing for all chemicals handled.

CARCINOGEN: Substances which are suspected or known to cause cancer. Some may have threshold limits of exposure.

PRECAUTIONS: Exercise extreme care when handling! Do not breathe vapors and avoid contact with skin, eyes, and protective equipment and suing appropriate confining apparatus.

CORROSIVE: Living tissue as well as equipment is destroyed on contact with these chemicals.

PRECAUTIONS: Do not breathe vapors and avoid contact with skin, eyes, and clothing. Use suitable protective equipment.

DANGER: Substances that have known harmful effects or which may have harmful effects, but have no available literature citing such effects.

PRECAUTIONS: Treat as if these are the most dangerous chemicals that exist. There may or may not be serious hazards associated with these chemicals.

EXPLOSIVE: Substances known to explode under some conditions.

PRECAUTIONS: Avoid shock (dropping), friction, sparks, and heat. Isolate from other chemicals which become hazardous when spilled.

FLAMMABLE: Substances which give off vapors that readily ignite under usual conditions.

PRECAUTIONS: Spontaneously flammable- Avoid contact with air/Flammable liquids, gases, vapors- Keep away from heat, sparks, or open flame- Sensitive to moisture- Keep dry.

IRRITANT: Substances that have an irritant effect on skin, eyes, respiratory tract, etc.

PRECAUTIONS: Do not breathe vapors and avoid contact with skin and eyes.

LACHRYMATOR: Substances that have an irritant or burning effect on skin, eye or respiratory tract. These are dangerous in very small quantities (opening the cap has an immediate effect on eyes.

PRECAUTIONS: Only open in the fume hood! Do not breathe vapors. Avoid contact with skin or eyes. Avoid heating.

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Appendix E

Chemical Hazard Code Labeling Procedures

Incoming Chemicals:

All incoming chemicals must be promptly labeled with hazard codes before being placed on storage shelves. Manufacturers/suppliers are required by law to provide an MSDS. Although some suppliers will send an MSDS separately, most will include them in the packing materials. Use the information on the MSDS to construct the hazard code label. If you cannot decipher the four digit code from the MSDS you can usually locate a different MSDS for the chemical from: http://www.JTBaker.com.

An internet search will yield numerous web-sites that provide access to MSDS information.

Label all bottles with hazard color codes and four digit hazard codes. Write the shelf number on the color code label. This assures that the chemical will be placed back on the shelf in the correct location after use.

Because some chemicals have limited shelf lives, it is important to keep track of when it was received and opened.

1) Write the month and year on the bottle when it was received. (e.g. recd 2/05)
2) When opening the bottle, write on the label the month and date opened. (e.g. opened 2/05)

The MSDS should then be hole-punched and placed into the designated MSDS notebook in the lab. There are dividers in the notebook to organize them alphabetically.

Take note of any special precautions related to the storage of the chemical. Some chemicals should only be stored in plastic bottles while others should only be stored in glass. Chemicals may also have sensitivities to temperature, light, etc.

Labeling Reagent/Solution Bottles:

Anytime a reagent/solution is mixed for a class the bottle must contain all the following information (if known):

Name of chemical
Concentration of solution

Chemical formula
Hazard color code with shelf storage location
Four digit hazard code (health/flammability/reactivity/contact)
When the solution was made (month/year)
Initials of the person that made the solution

Dispensing Chemicals to Students:

For dispensing solid compounds, small screw top jars have been purchased and are located in the storage room. Reagent bottle have also been purchased. If students are using reagents from bottles or solids from jars they should be labeled as mentioned above. Bags are not acceptable for reagent dispensing or for chemical storage.

In many cases, chemicals will be dispensed with dropper bottles. Numerous "screw top" dropper bottles have been purchased for this purpose. There is also a good supply of "stopper /dropper" type bottles available. Only containers that can be tightly closed or sealed will be used for dispensing reagents. All chemicals used in labs must have the following information on dropper bottles being used to dispense chemicals to students:

Name of chemical/chemical formula
Concentration of solution
Hazard color code
Four digit hazard code (health/flammability/reactivity/contact)

Environmental Samples:

Environmental water samples will be labeled with the following:

1) what the sample is
2) where the sample was obtained
3) date obtained
4) who obtained the sample

Any bottle or jar not labeled will be considered toxic and/or hazardous and treated as such.

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Appendix F

REFERENCES FOR CHEMICAL HAZARDS AND LABORATORY SAFETY

Reference Books

1. Bretherick's Handbook of Reactive Chemical Hazards
2. Rapid Guide to Chemical Incompatibilities
3. The Merck Index
4. CRC Handbook of Chemistry and Physics
5. Fire Protection Guide to Hazardous Materials
6. Chemical Protective Clothing, Volumes 1 and 2
7. Hawley's Condensed Chemical Dictionary
8. Safety in Academic Chemistry Laboratories
9. Safety in School Science Labs
10. Prudent Practices for Handling Hazardous Chemicals in Laboratories
11. Life Safety Code Handbook 2000
12. CRC Handbook of Laboratory Safety, 4th edition

Other Materials

1. National Fire Code
2. MIOSHA Regulations
3. OSHA Regulations

Internet Sites

MSDS and Chemical Information, Vermont SIRI
http://siri.uvm.edu/index.html

Governmental Agency Websites

NRC Nuclear Regulatory Commission
http://www.nrc.gov/

DOT Department of Transportation
http://www.dot.gov/

EPA Environmental Protection Agency
http://www.epa.gov/

SUBJECT: Physical Plant
Procedure: Hazardous Materials
Effective: Spring 2006 Revised: Reviewed:

OSHA Occupational Safety and Health Administration
http://www.osha.gov/

NIOSH National Institute of Occupational Safety and Health
http://www.cdc.gov/niosh/homepage.html

Montana Department of Environmental Quality
http://www.deq.state.mt.us/

Professional Environmental Health and Safety Organization Websites

AIHA American Industrial Hygiene Association
http://www.aiha.org/

ANSI American National Standards Institute
http://www.ansi.org/

APHA American Public Health Association
http://www.apha.org/

ASHRAE American Society of Heating, Refrigerating, and Air-Conditioning Engineers
http://www.ashrae.org/

CSHEMA Campus Safety, Health & Environmental Management Association
http://www.cshema.org/

NSC National Safety Council
http://www.nsc.org/

University of California at Davis
http://www-ehs.ucdavis.edu/

Appendix G

Risk Phrases

Chemical data sheets available in many countries now contain codes for certain "risk phrases", shown as R23, R45 etc. These risk phrase codes have the following meanings:

- R1 Explosive when dry.
- R2 Risk of explosion by shock, friction, fire or other source of ignition.
- R3 Extreme risk of explosion by shock, friction, fire or other sources of ignition.
- R4 Forms very sensitive explosive metallic compounds.
- R5 Heating may cause an explosion.
- R6 Explosive with or without contact with air.
- R7 May cause fire.
- R8 Contact with combustible material may cause fire.
- R9 Explosive when mixed with combustible material.
- R10 Flammable.
- R11 Highly flammable.
- R12 Extremely flammable.
- R13 Extremely flammable liquefied gas
- R14 Reacts violently with water.
- R15 Contact with water liberates extremely flammable gases.
- R16 Explosive when mixed with oxidizing substances.
- R17 Spontaneously flammable in air.
- R18 In use, may form inflammable/explosive vapor-air mixture.
- R19 May form explosive peroxides.
- R20 Harmful by inhalation.
- R21 Harmful in contact with skin.
- R22 Harmful if swallowed.
- R23 Toxic by inhalation.
- R24 Toxic in contact with skin.
- R25 Toxic if swallowed.

- R26 Very toxic by inhalation.
- R27 Very toxic in contact with skin.
- R28 Very toxic if swallowed.
- R29 Contact with water liberates toxic gas.
- R30 Can become highly flammable in use.
- R31 Contact with acids liberates toxic gas.
- R32 Contact with acid liberates very toxic gas.
- R33 Danger of cumulative effects.
- R34 Causes burns.
- R35 Causes severe burns.
- R36 Irritating to eyes.
- R37 Irritating to respiratory system.
- R38 Irritating to skin.
- R39 Danger of very serious irreversible effects.
- R40 Limited evidence of a carcinogenic effect.
- R41 Risk of serious damage to the eyes.
- R42 May cause sensitization by inhalation.
- R43 May cause sensitization by skin contact.
- R44 Risk of explosion if heated under confinement.
- R45 May cause cancer.
- R46 May cause heritable genetic damage.
- R47 May cause birth defects
- R48 Danger of serious damage to health by prolonged exposure.
- R49 May cause cancer by inhalation.
- R50 Very toxic to aquatic organisms.
- R51 Toxic to aquatic organisms.
- R52 Harmful to aquatic organisms.
- R53 May cause long-term adverse effects in the aquatic environment.
- R54 Toxic to flora.
- R55 Toxic to fauna.
- R56 Toxic to soil organisms.
- R57 Toxic to bees.
- R58 May cause long-term adverse effects in the environment.

- R59 Dangerous to the ozone layer.
- R60 May impair fertility.
- R61 May cause harm to the unborn child.
- R62 Risk of impaired fertility.
- R63 Possible risk of harm to the unborn child.
- R64 May cause harm to breastfed babies.
- R65 Harmful: may cause lung damage if swallowed.
- R66 Repeated exposure may cause skin dryness or cracking.
- R67 Vapors may cause drowsiness and dizziness.
- R68 Possible risk of irreversible effects.

Appendix H

Incompatible Chemicals

A wide variety of chemicals react dangerously when mixed with certain other materials. Some of the more widely-used incompatible chemicals are given below, but the absence of a chemical from this list should not be taken to indicate that it is safe to mix it with any other chemical!

- acetic acid:
  chromic acid, ethylene glycol, nitric acid, hydroxyl compounds, perchloric acid, peroxides, permanganates
- acetone:
  concentrated sulphuric and nitric acid mixtures
- acetylene:
  chlorine, bromine, copper, fluorine, silver, mercury
- alkali and alkaline earth metals:
  water, chlorinated hydrocarbons, carbon dioxide, halogens, alcohols, aldehydes, ketones, acids
- aluminium (powdered):
  chlorinated hydrocarbons, halogens, carbon dioxide, organic acids.
- anhydrous ammonia:
  mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
- ammonium nitrate:
  acids, metal powders, flammable liquids, chlorates, nitrites, sulphur, finely divided organic combustible materials

  aniline:
  nitric acid, hydrogen peroxide
- arsenic compounds:
  reducing agents
- azides:
  acids
- bromine:
  ammonia, acetylene, butadiene, hydrocarbons, hydrogen, sodium, finely-divided metals, turpentine, other hydrocarbons

- calcium carbide:
  water, alcohol
- calcium oxide:
  water
- carbon, activated:
  calcium hypochlorite, oxidizing agents
- chlorates:
  ammonium salts, acids, metal powders, sulphur, finely divided organic or combustible materials
- chromic acid:
  acetic acid, naphthalene, camphor, glycerin, turpentine, alcohols, flammable liquids in general
- chlorine:
  see bromine
- chlorine dioxide:
  ammonia, methane, phosphine, hydrogen sulfide
- copper:
  acetylene, hydrogen peroxide
- cumene hydroperoxide:
  acids, organic or inorganic
- cyanides:
  acids
- flammable liquids:
  ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
- hydrocarbons:
  fluorine, chlorine, bromine, chromic acid, sodium peroxide
- hydrocyanic acid:
  nitric acid, alkali
- hydrofluoric acid:
  aqueous or anhydrous ammonia

- hydrogen peroxide:
  copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing gases
- hydrogen sulphide:
  fuming nitric acid, oxidizing gases
- hypochlorites:
  acids, activated carbon
- iodine:
  acetylene, ammonia (aqueous or anhydrous), hydrogen
- mercury:
  acetylene, fulminic acid, ammonia
- mercuric oxide:
  sulphur
- nitrates:
  sulphuric acid
- nitric acid (conc.):
  acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gases
- oxalic acid:
  silver, mercury
- perchloric acid:
  acetic anhydride, bismuth and its alloys, ethanol, paper, wood
- peroxides (organic):
  acids, avoid friction or shock
- phosphorus (white):
  air, alkalies, reducing agents, oxygen
- potassium:
  carbon tetrachloride, carbon dioxide, water, alcohols, acids
- potassium chlorate:
  acids
- potassium perchlorate:
  acids

- potassium permanganate:
  glycerin, ethylene glycol, benzaldehyde, sulphuric acid
- selenides:
  reducing agents
- silver:
  acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
- sodium:
  carbon tetrachloride, carbon dioxide, water
- sodium nitrate:
  ammonium salts
- sodium nitrite:
  ammonium salts
- sodium peroxide:
  ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulphide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
- sulphides:
  acids
- sulphuric acid:
  potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light metals, such as sodium, lithium, etc.)
- tellurides:
  reducing agents
- zinc powder:
  sulphur

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Appendix I

CHEMICAL PROTECTIVE CLOTHING

Contents:

I. **INTRODUCTION**.

A. The purpose of chemical protective clothing and equipment is to shield or isolate individuals from the chemical, physical, and biological hazards that may be encountered during hazardous materials operations. During chemical operations, it is not always apparent when exposure occurs. Many chemicals pose invisible hazards and offer no warning properties.

B. These guidelines describe the various types of clothing that are appropriate for use in various chemical operations, and provides recommendations in their selection and use. The final paragraph discusses heat stress and other key physiological factors that must be considered in connection with protective clothing use.

C. It is important that protective clothing users realize that no single combination of protective equipment and clothing is capable of protecting you against all hazards. Thus protective clothing should be used in conjunction with other protective methods. For example, engineering or administrative controls to limit chemical contact with personnel should always be considered as an alternative measure for preventing chemical exposure. The use of protective clothing can itself create significant wearer hazards, such as heat stress, physical and psychological stress, in addition to impaired vision, mobility, and communication. In general, the greater the level of chemical protective clothing, the greater the associated risks. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. Overprotection as well as under-protection can be hazardous and should be avoided.

II. **DESCRIPTIONS**.

A. **PROTECTIVE CLOTHING APPLICATIONS**.

1. Protective clothing must be worn whenever the wearer faces potential hazards arising from chemical exposure. Some examples include:

- Emergency response;
- Chemical manufacturing and process industries;
- Hazardous waste site cleanup and disposal;
- Asbestos removal and other particulate operations; and
- Agricultural application of pesticides.

2. Within each application, there are several operations which require chemical protective clothing. For example, in emergency response, the following activities dictate chemical protective clothing use:

   - **Site Survey:** The initial investigation of a hazardous materials incident; these situations are usually characterized by a large degree of uncertainty and mandate the highest levels of protection.
   - **Rescue:** Entering a hazardous materials area for the purpose of removing an exposure victim; special considerations must be given to how the selected protective clothing may affect the ability of the wearer to carry out rescue and to the contamination of the victim.
   - **Spill Mitigation**: Entering a hazardous materials area to prevent a potential spill or to reduce the hazards from an existing spill (i.e., applying a chlorine kit on railroad tank car). Protective clothing must accommodate the required tasks without sacrificing adequate protection.
   - **Emergency Monitoring:** Outfitting personnel in protective clothing for the primary purpose of observing a hazardous materials incident without entry into the spill site. This may be applied to monitoring contract activity for spill cleanup.
   - **Decontamination:** Applying decontamination procedures to personnel or equipment leaving the site; in general a lower level of protective clothing is used by personnel involved in decontamination.

B. **THE CLOTHING ENSEMBLE**. The approach in selecting personal protective clothing must encompass an "ensemble" of clothing and equipment items which are easily integrated to provide both an appropriate level of protection and still allow one to carry out activities involving chemicals. In many cases, simple protective clothing by itself may be sufficient to prevent chemical exposure, such as wearing gloves in combination with a splash apron and faceshield (or safety goggles).

1. The following is a checklist of components that may form the chemical protective ensemble:

   - Protective clothing (suit, coveralls, hoods, gloves, boots);
   - Respiratory equipment (SCBA, combination SCBA/SAR, air purifying respirators);
   - Cooling system (ice vest, air circulation, water circulation);
   - Communications device;
   - Head protection;
   - Eye protection;
   - Ear protection;
   - Inner garment; and
   - Outer protection (overgloves, overboots, flashcover).

2. Factors that affect the selection of ensemble components include:

   - How each item accommodates the integration of other ensemble components. Some ensemble components may be incompatible due to how they are worn (e.g., some SCBA's

may not fit within a particular chemical protective suit or allow acceptable mobility when worn).
- The ease of interfacing ensemble components without sacrificing required performance (e.g. a poorly fitting overglove that greatly reduces wearer dexterity).
- Limiting the number of equipment items to reduce donning time and complexity (e.g. some communications devices are built into SCBA's which as a unit are NIOSH certified).

C. **LEVEL OF PROTECTION**.

1. Table VIII:1-1 lists ensemble components based on the widely used *EPA Levels of Protection: Levels A, B, C, and D.* These lists can be used as the starting point for ensemble creation; however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection. For example, if an emergency response activity involves a highly contaminated area or if the potential of contamination is high, it may be advisable to wear a disposable covering such as Tyvek coveralls or PVC splash suits, over the protective ensemble.

TABLE VIII:1-1. EPA LEVELS OF PROTECTION

LEVEL A:

Vapor protective suit (meets NFPA 1991)
Pressure-demand, full-face SCBA
Inner chemical-resistant gloves, chemical-resistant safety boots, two-way radio communication

OPTIONAL: Cooling system, outer gloves, hard hat

Protection Provided: Highest available level of respiratory, skin, and eye protection from solid, liquid and gaseous chemicals.

Used When: The chemical(s) have been identified and have high level of hazards to respiratory system, skin and eyes. Substances are present with known or suspected skin toxicity or carcinogenity. Operations must be conducted in confined or poorly ventilated areas.

Limitations: Protective clothing must resist permeation by the chemical or mixtures present. Ensemble items must allow integration without loss of performance.

LEVEL B:

Liquid splash-protective suit (meets NFPA 1992)
Pressure-demand, full-facepiece SCBA
Inner chemical-resistant gloves, chemical-resistant safety boots, two-way radio communications
Hard hat.

OPTIONAL: Cooling system, outer gloves

Protection Provided: Provides same level of respiratory protection as Level A, but less skin protection. Liquid splash protection, but no protection against chemical vapors or gases.

Used When: The chemical(s) have been identified but do not require a high level of skin protection. Initial site surveys are required until higher levels of hazards are identified. The primary hazards associated with site entry are from liquid and not vapor contact.

Limitations: Protective clothing items must resist penetration by the chemicals or mixtures present. Ensemble items must allow integration without loss of performance.

LEVEL C:

Support Function Protective Garment (meets NFPA 1993)
Full-facepiece, air-purifying, canister-equipped respirator
Chemical resistant gloves and safety boots
Two-way communications system, hard hat

OPTIONAL: Faceshield, escape SCBA

Protection Provided: The same level of skin protection as Level B, but a lower level of respiratory protection. Liquid splash protection but no protection to chemical vapors or gases.

Used When: Contact with site chemical(s) will not affect the skin. Air contaminants have been identified and concentrations measured. A canister is available which can remove the contaminant. The site and its hazards have been completely characterized.

Limitations: Protective clothing items must resist penetration by the chemical or mixtures present. Chemical airborne concentration must be less than IDLH levels. The atmosphere must contain at least 19.5% oxygen.

Not Acceptable for Chemical Emergency Response

LEVEL D:

Coveralls, safety boots/shoes, safety glasses or chemical splash goggles

OPTIONAL: Gloves, escape SCBA, face-shield

Protection Provided: No respiratory protection, minimal skin protection.

Used When: The atmosphere contains no known hazard. Work functions preclude splashes, immersion, potential for inhalation, or direct contact with hazard chemicals.

Limitations: This level should not be worn in the Hot Zone. The atmosphere must contain at least 19.5% oxygen.

Not Acceptable for Chemical Emergency Response

2. The type of equipment used and the overall level of protection should be reevaluated periodically as the amount of information about the chemical situation or process increases, and when workers are required to perform different tasks. Personnel should upgrade or downgrade their level of protection only with concurrence with the site supervisor, safety officer, or plant industrial hygienist.

3. The recommendations in Table VIII:1-1 serve only as guidelines. It is important for you to realize that selecting items by how they are designed or configured alone is not sufficient to ensure adequate protection. In other words, just having the right components to form an ensemble is not enough. The EPA levels of protection do not define what performance the selected clothing or equipment must offer. Many of these considerations are described in the "limiting criteria" column of Table VIII: 1-1. Additional factors relevant to the various clothing and equipment items are described in subsequent Paragraphs.

D. **ENSEMBLE SELECTION FACTORS**.

1. **Chemical Hazards**. Chemicals present a variety of hazards such as toxicity, corrosiveness, flammability, reactivity, and oxygen deficiency. Depending on the chemicals present, any combination of hazards may exist.

2. **Physical Environment**. Chemical exposure can happen anywhere: in industrial settings, on the highways, or in residential areas. It may occur either indoors or outdoors; the environment may be extremely hot, cold, or moderate; the exposure site may be relatively uncluttered or rugged, presenting a number of physical hazards; chemical handling activities may involve entering confined spaces, heavy lifting, climbing a ladder, or crawling on the ground. The choice of ensemble components must account for these conditions.

3. **Duration of Exposure**. The protective qualities of ensemble components may be limited to certain exposure levels (e.g. material chemical resistance, air supply). The decision for ensemble use time must be made assuming the worst case exposure so that safety margins can be applied to increase the protection available to the worker.

4. **Protective Clothing or Equipment Available**. Hopefully, an array of different clothing or equipment is available to workers to meet all intended applications. Reliance on one particular clothing or equipment item may severely limit a facility's ability to handle a broad range of chemical exposures. In its acquisition of equipment and clothing, the safety department or other responsible authority

should attempt to provide a high degree of flexibility while choosing protective clothing and equipment that is easily integrated and provides protection against each conceivable hazard.

E. **CLASSIFICATION OF PROTECTIVE CLOTHING**.

1. Personal protective clothing includes the following:

   - Fully encapsulating suits;
   - Nonencapsulating suits;
   - Gloves, boots, and hoods;
   - Firefighter's protective clothing;
   - Proximity, or approach clothing;
   - Blast or fragmentation suits; and
   - Radiation-protective suits.

2. *Firefighter turnout clothing, proximity gear, blast suits, and radiation suits by themselves are not acceptable for providing adequate protection from hazardous chemicals.*

3. Table VIII:1-2 describes various types of protection clothing available, details the type of protection they offer, and lists factors to consider in their selection and use.

TABLE VIII:1-2. TYPES OF PROTECTIVE CLOTHING FOR FULL BODY PROTECTION

Description	Type of Protection	Use Considerations
Fully encapsulating suit One-piece garment. Boots and gloves may be integral, attached and replaceable, or separate.	Protects against splashes, dust gases, and vapors.	Does not allow body heat to escape. May contribute to heat stress in wearer, particularly if worn in conjunction with a closed-circuit SCBA; a cooling garment may be needed. Impairs worker mobility, vision, and communication.
Nonencapsulating suit Jacket, hood, pants or bib overalls, and one-piece coveralls.	Protects against splashes, dust, and other materials but not against gases and vapors. Does not protect parts of head or neck.	Do not use where gas-tight or pervasive splashing protection is required. May contribute to heat stress in wearer. Tape-seal connections between pant cuffs and boots and between gloves and sleeves.

Aprons, leggings, and sleeve protectors **Fully sleeved and gloved apron. Separate coverings for arms and legs. Commonly worn over nonencapsulating suit.**	Provides additional splash protection of chest, forearms, and legs.	Whenever possible, should be used over a nonencapsulating suit to minimize potential heat stress. Useful for sampling, labeling, and analysis operations. Should be used only when there is a low probability of total body contact with contaminants.
Firefighters' protective clothing **Gloves, helmet, running or bunker coat, running or bunker pants (NFPA No. 1971, 1972, 1973, and boots (1974).**	Protects against heat, hot water, and some particles. Does not protect against gases and vapors, or chemical permeation or degradation. NFPA Standard No. 1971 specifies that a garment consists of an outer shell, an inner liner and a vapor barrier with a minimum water penetration of 25 lb/in^2 (1.8 kg/cm^2) to prevent passage of hot water.	Decontamination is difficult. Should not be worn in areas where protection against gases, vapors, chemical splashes or permeation is required.
Proximity garment (approach suit) **One- or two-piece overgarment with boot covers, gloves, and hood of aluminized nylon or cotton fabric. Normally worn over other protective clothing, firefighters' bunker gear, or flame-retardant coveralls.**	Protects against splashes, dust, gases, and vapors.	Does not allow body heat to escape. May contribute to heat stress in wearer, particularly if worn in conjunction with a closed-circuit SCBA; a cooling garment may be needed. Impairs worker mobility, vision, and communication.
Blast and fragmentation suit **Blast and fragmentation vests and clothing, bomb blankets, and bomb carriers.**	Provides some protection against very small detonations. Bomb blankets and baskets can help redirect a blast.	Does not provide for hearing protection.
Radiation-contamination protective suit Various types of protective clothing designed to prevent	Protects against alpha and beta particles. Does *not* protect against gamma radiation.	Designed to prevent skin contamination. If radiation is detected on site, consult an

contamination of the body by radioactive particles.		experienced radiation expert and evacuate personnel until the radiation hazard has been evaluated.
Flame/fire retardant coveralls Normally worn as an undergarment.	Provides protection from flash fires.	Adds bulk and may exacerbate heat stress problems and impair mobility

F. **CLASSIFICATION OF CHEMICAL PROTECTIVE CLOTHING**. Table VIII:1-3 provides a listing of clothing classifications. Clothing can be classified by design, performance, and service life.

TABLE VIII:1-3. CLASSIFICATION OF CHEMICAL PROTECTIVE CLOTHING

By Design	By Performance	By Service Life
gloves boots aprons, jackets, coveralls, full body suits	particulate protection liquid-splash protection vapor protection	single use limited use reusable

G.

1. **Design**. Categorizing clothing by design is mainly a means for describing what areas of the body the clothing item is intended to protect.

   In emergency response, hazardous waste site cleanup, and dangerous chemical operations, the only acceptable types of protective clothing include fully or totally encapsulating suits and nonencapsulating or "splash" suits plus accessory clothing items such as chemically resistant gloves or boots. These descriptions apply to how the clothing is designed and not to its performance.

2. **Performance**. The National Fire Protection Association (NFPA) has classified suits by their performance as:

   a. Vapor-protective suits (NFPA Standard 1991) provide "gas-tight" integrity and are intended for response situations where no chemical contact is permissible. This type of suit would be equivalent to the clothing required in EPA's Level A.

b. Liquid splash-protective suits (NFPA Standard 1992) offer protection against liquid chemicals in the form of splashes, but not against continuous liquid contact or chemical vapors or gases. Essentially, the type of clothing would meet the EPA Level B needs. It is important to note, however, that by wearing liquid splash-protective clothing, the wearer accepts exposure to chemical vapors or gases because this clothing does not offer gas-tight performance. The use of duct tape to seal clothing interfaces does not provide the type of wearer encapsulation necessary for protection against vapors or gases.

c. Support function protective garments (NFPA Standard 1993) must also provide liquid splash protection but offer limited physical protection. These garments may comprise several separate protective clothing components (i.e., coveralls, hoods, gloves, and boots). They are intended for use in nonemergency, nonflammable situations where the chemical hazards have been completely characterized. Examples of support functions include proximity to chemical processes, decontamination, hazardous waste clean-up, and training. Support function protective garments should not be used in chemical emergency response or in situations where chemical hazards remain uncharacterized.

d. These NFPA standards define minimum performance requirements for the manufacture of chemical protective suits. Each standard requires rigorous testing of the suit and the materials that comprise the suit in terms of overall protection, chemical resistance, and physical properties. Suits that are found compliant by an independent certification and testing organization may be labeled by the manufacturer as meeting the requirements of the respective NFPA standard. Manufacturers also have to supply documentation showing all test results and characteristics of their protective suits.

e. Protective clothing should completely cover both the wearer and his or her breathing apparatus. In general, respiratory protective equipment is not designed to resist chemical contamination. Level A protection (vapor-protective suits) require this configuration. Level B ensembles may be configured either with the SCBA on the outside or inside. However, it is strongly recommended that the wearer's respiratory equipment be worn inside the ensemble to prevent its failure and to reduce decontamination problems. Level C ensembles use cartridge or canister type respirators which are generally worn outside the clothing.

3. **Service Life**.

a. Clothing item service life is an end user decision depending on the costs and risks associated with clothing decontamination and reuse. For example, a Saranex/Tyvek garment may be designed to be a coverall (covering the wearer's torso, arms, and legs) intended for liquid splash protection, which is disposable after a single use.

b. Protective clothing may be labeled as:

- Reusable, for multiple wearings; or
- Disposable, for one-time use.

The distinctions between these types of clothing are both vague and complicated. Disposable clothing is generally lightweight and inexpensive. Reusable clothing is often more rugged and costly. Nevertheless, extensive contamination of any garment may render it disposable. The basis of this classification really depends on the costs involved in purchasing, maintaining, and reusing protective clothing versus the al ternative of disposal following exposure. If an end user can anticipate obtaining several uses out of a garment while still maintaining adequate protection from that garment at lower cost than its disposal, the suit becomes reusable. Yet, the key assumption in this determination is the viability of the garment following exposure. This issue is further discussed in the Paragraph on decontamination.

III. **PROTECTIVE CLOTHING SELECTION FACTORS**.

A. **CLOTHING DESIGN**. Manufacturers sell clothing in a variety of styles and configurations.

1. **Design Considerations**.

- Clothing configuration;
- Components and options;
- Sizes;
- Ease of donning and doffing;
- Clothing construction;
- Accommodation of other selected ensemble equipment;
- Comfort; and
- Restriction of mobility.

B. **MATERIAL CHEMICAL RESISTANCE**. Ideally, the chosen material(s) must resist permeation, degradation, and penetration by the respective chemicals.

1. **Permeation** is the process by which a chemical dissolves in or moves through a material on a molecular basis. In most cases, there will be no visible evidence of chemicals permeating a material.

Permeation breakthrough time is the most common result used to assess material chemical compatibility. The rate of permeation is a function of several factors such as chemical concentration, material thickness, humidity, temperature, and pressure. Most material testing is done with 100% chemical over an extended exposure period. The time it takes chemical to permeate through the material is the breakthrough time. An acceptable material is one where the breakthrough time exceeds the expected period of garment use. However, temperature and pressure effects may enhance permeation and reduce the magnitude of this safety factor. For example, small increases in ambient temperature can significantly reduce breakthrough time and the protective barrier properties of a protective clothing material.

2. **Degradation** involves physical changes in a material as the result of a chemical exposure, use, or ambient conditions (e.g. sunlight). The most common observations of material degradation are discoloration, swelling, loss of physical strength, or deterioration.

3. **Penetration** is the movement of chemicals through zippers, seams, or imperfections in a protective clothing material.

   It is important to note that no material protects against all chemicals and combinations of chemicals, and that no currently available material is an effective barrier to any prolonged chemical exposure.

4. Sources of information include:

   - *Guidelines for the Selection of Chemical Protective Clothing,* 3rd Edition. This reference provides a matrix of clothing material recommendations for approximately 500 chemicals based on an evaluation of chemical resistance test data, vendor literature, and raw material suppliers. The major limitation for these guidelines are their presentation of recommendations by generic material class. Numerous test results have shown that similar materials from different manufacturers may give widely different performance. That is to say manufacturer A's butyl rubber glove may protect against chemical X, but a butyl glove made by manufacturer B may not.

   - *Quick Selection Guide to Chemical Protective Clothing.* Pocket size guide that provides chemical resistance data and recommendations for 11 generic materials against over 400 chemicals. The guide is color-coded by material-chemical recommendation. As with the "Guidelines..." above, the major limitation of this reference is its dependence on generic data.

   - Vendor data or recommendations. The best source of current information on material compatibility should be available from the manufacturer of the selected clothing. Many vendors supply charts which show actual test data or their own recommendations for specific chemicals. However, *unless vendor data or the recommendations are well documented, end users must approach this information with caution.* Material recommendations must be based on data obtained from tests performed to standard ASTM methods. Simple ratings of "poor," "good," or "excellent" give no indication of how the material may perform against various chemicals.

5. Mixtures of chemicals can be significantly more aggressive towards protective clothing materials than any single chemical alone. One permeating chemical may pull another with it through the material. Very little data is available for chemical mixtures. Other situations may involve unidentified substances. In both the case of mixtures and unknowns, serious consideration must be given to deciding which protective clothing is selected. If clothing must be used without test data, garments with materials having the broadest chemical resistance should be worn, i.e. materials which demonstrate the best chemical resistance against the widest range of chemicals.

C. **PHYSICAL PROPERTIES**.

1. As with chemical resistance, manufacturer materials offer wide ranges of physical qualities in terms of strength, resistance to physical hazards, and operation in extreme environmental conditions. Comprehensive manufacturing standards such as the NFPA Standards set specific limits on these material properties, but only for limited applications, i.e. emergency response.

2. End users in other applications may assess material physical properties by posing the following questions:

   - Does the material have sufficient strength to withstand the physical strength of the tasks at hand?
   - Will the material resist tears, punctures, cuts, and abrasions?
   - Will the material withstand repeated use after contamination and decontamination?
   - Is the material flexible or pliable enough to allow end users to perform needed tasks?
   - Will the material maintain its protective integrity and flexibility under hot and cold extremes?
   - Is the material flame-resistant or self-extinguishing (if these hazards are present)?
   - Are garment seams in the clothing constructed so they provide the same physical integrity as the garment material?

D. **EASE OF DECONTAMINATION**. The degree of difficulty in decontaminating protective clothing may dictate whether disposable or reusable clothing is used, or a combination of both.

E. **COST**. Protective clothing end users must endeavor to obtain the broadest protective equipment they can buy with available resources to meet their specific application.

F. **CHEMICAL PROTECTIVE CLOTHING STANDARDS**. Protective clothing buyers may wish to specify clothing that meets specific standards, such as 1910.120 or the NFPA standards (see Paragraph on classification by performance). The NFPA Standards do not apply to all forms of protective clothing and applications.

IV. **GENERAL GUIDELINES**.

A. **DECIDE IF THE CLOTHING ITEM IS INTENDED TO PROVIDE VAPOR, LIQUID-SPLASH, OR PARTICULATE PROTECTION**.

1. Vapor protective suits also provide liquid splash and particulate protection. Liquid splash protective garments also provide particulate protection. Many garments may be labeled as totally encapsulating but do not provide gas-tight integrity due to inadequate seams or closures. Gas-tight

integrity can only be determined by performing a pressure or inflation test and a leak detection test of the respective protective suit. This test involves:

- Closing off suit exhalation valves;
- Inflating the suit to a prespecified pressure; and
- Observing whether the suit holds the above pressure for a designated period.

ASTM Standard Practice F1052 (1987 Edition) offers a procedure for conducting this test.

2. Splash suits must still cover the entire body when combined with the respirator, gloves, and boots. Applying duct tape to a splash suit does not make it protect against vapors. Particulate protective suits may not need to cover the entire body, depending on the hazards posed by the particulate. In general, gloves, boots and some form of face protection are required. Clothing items may only be needed to cover a limited area of the body such as gloves on hands. The nature of the hazards and the expected exposure will determine if clothing should provide partial or full body protection.

B. **DETERMINE IF THE CLOTHING ITEM PROVIDES FULL BODY PROTECTION**.

1. Vapor-protective or totally encapsulating suit will meet this requirement by passing gas-tight integrity tests.

2. Liquid splash-protective suits are generally sold incomplete (i.e. fewer gloves and boots).

3. Missing clothing items must be obtained separately and match or exceed the performance of the garment.

4. Buying a PVC glove for a PVC splash suit does not mean that you obtain the same level of protection. This determination must be made by comparing chemical resistance data.

C. **EVALUATE MANUFACTURER CHEMICAL RESISTANCE DATA PROVIDED WITH THE CLOTHING**.

1. Manufacturers of vapor-protective suits should provide permeation resistance data for their products, while liquid and particulate penetration resistance data should accompany liquid splash and particulate protective garments respectively. Ideally data should be provided for every primary material in the suit or clothing item. For suits, this includes the garment, visor, gloves, boots, and seams.
Closing off suit exhalation valves
2. Permeation data should include the following:

- Chemical name;
- Breakthrough time (shows how soon the chemical permeates);

- Permeation rate (shows the rate that the chemical comes through);
- System sensitivity (allows comparison of test results from different laboratories); and
- A citation that the data was obtained in accordance with ASTM Standard Test Method F739-85.

3. If no data are provided or if the data lack any one of the above items, the manufacturer should be asked to supply the missing data. Manufacturers that provide only numerical or qualitative ratings must support their recommendations with complete test data.

4. Liquid penetration data should include a pass or fail determination for each chemical listed, and a citation that testing was conducted in accordance with ASTM Standard Test Method F903-86. Protective suits which are certified to NFPA 1991 or NFPA 1992 will meet all of the above requirements.

5. Particulate penetration data should show some measure of material efficiency in preventing particulate penetration in terms of particulate type or size and percentage held out. Unfortunately, no standard tests are available in this area and end users may have little basis for company products.

6. Suit materials which show no breakthrough or no penetration to a large number of chemicals are likely to have a broad range of chemical resistance. (Breakthrough times greater than one hour are usually considered to be an indication of acceptable performance.) Manufacturers should provide data on the ASTM Standard Guide F1001-86 chemicals. These 15 liquid and 6 gaseous chemicals listed in Table VIII:1-4 below represent a cross-section of different chemical classes and challenges for protective clothing materials. Manufacturers should also provide test data on other chemicals as well. If there are specific chemicals within your operating area that have not been tested, ask the manufacturer for test data on these chemicals.

TABLE VIII:1-4. RECOMMENDED CHEMICALS TO EVALUATE THE PERFORMANCE OF PROTECTIVE CLOTHING MATERIALS

Chemical	Class
Acetone	Ketone
Acetonitrile	Nitrile
Ammonia	Strong base (gas)
1,3-Butadiene	Olefin (gas)
Carbpm Dosi;fode	Sulfur-containing organic
Chlorine	Inorganic gas
Dichloromethane	Chlorinated hydrocarbon
Diethylamine	Amine
Dimethyl formamide	Amide
Ethyl Acetate	Ester
Ethyl Oxide	Oxygen heterocyclic gas
Hexane	Aliphatic hydrocarbon
Hydrogen Chloride	Acid gas

Methanol	Alcohol
Methyl Chloride	Chlorinated hydrocarbon (gas)
Nitrobenzene	Nitrogen-containing organic
Sodium Hydroxide	Inorganic base
Sulfuric Acid	Inorganic acid
Tetrachloroethylene	Chlorinated hydrocarbon
Tetrahydrofuran	Oxygen heterocyclic
Toluene	Aromatic hydrocarbon

7.

D. **OBTAIN AND EXAMINE THE MANUFACTURER'S INSTRUCTION OR TECHNICAL MANUAL**.

1. This manual should document all the features of the clothing, particularly suits, and describe what material(s) are used in its construction. It should cite specific limitations for the clothing and what restrictions apply to its use. Procedures and recommendations should be supplied for at least the following:

   - Donning and doffing;
   - Inspection, maintenance, and storage;
   - Decontamination; and
   - Use.

   The manufacturer's instructions should be thorough enough to allow the end users to wear and use the clothing without a large number of questions.

E. **OBTAIN AND INSPECT SAMPLE CLOTHING ITEM GARMENTS**. Examine the quality of clothing construction and other features that will impact its wearing. The questions listed under "Protective Clothing Selection Factors, Clothing Design" should be considered. If possible, representative clothing items should be obtained in advance and inspected prior to purchase, and discussed with someone who has experience in their use. It is also helpful to try out representative garments prior to purchase by suiting personnel in the garment and having them run through exercises to simulate expected activities.

F. **FIELD SELECTION OF CHEMICAL PROTECTIVE CLOTHING**.

1. Even when end users have gone through a very careful selection process, a number of situations will arise when no information is available to judge whether their protective clothing will provide adequate protection. These situations include:

   - Chemicals that have not been tested with the garment materials;
   - Mixtures of two or more different chemicals;
   - Chemicals that cannot be readily identified;
   - Extreme environmental conditions (hot temperatures); and
   - Lack of data in all clothing components (e.g. seams, visors).

2. Testing material specimens using newly developed field test kits may offer one means for making an on-site clothing selection. A portable test kit has been developed by the EPA using a simple weight loss method that allows field qualification of protective clothing materials within one hour. Use of this kit may overcome the absence of data and provide additional criteria for clothing selection.

3. *Selection of chemical protective clothing is a complex task and should be performed by personnel with both extensive training and experience.*

   Under all conditions, clothing should be selected by evaluating its performance characteristics against the requirements and limitations imposed by the application.

V. **MANAGEMENT PROGRAM**.

A. **WRITTEN MANAGEMENT PROGRAM**.

1. A written Chemical Protective Clothing Management Program should be established by all end users who routinely select and use protective clothing. Reference should be made to 1910.120 for those covered.

   The written management program should include policy statements, procedures, and guidelines. Copies should be made available to all personnel who may use protective clothing in the course of their duties or job. Technical data on clothing, maintenance manuals, relevant regulations, and other essential information should also be made available.

2. The two basic objectives of any management program should be to protect the wearer from safety and health hazards, and to prevent injury to the wearer from incorrect use and/or malfunction of the chemical protective clothing. To accomplish these goals, a comprehensive management program should include: hazard identification; medical monitoring; environmental surveillance; selection, use, maintenance, and decontamination of chemical protective clothing; and training.

B. **PROGRAM REVIEW AND EVALUATION**. The management program should be reviewed at least annually. Elements which should be considered in the review include:

- The number of person-hours that personnel wear various forms of chemical protective clothing and other equipment;
- Accident and illness experience;
- Levels of exposure;
- Adequacy of equipment selection;
- Adequacy of the operational guidelines;
- Adequacy of decontamination, cleaning, inspection, maintenance, and storage programs;
- Adequacy and effectiveness of training and fitting programs;
- Coordination with overall safety and health program;
- The degree of fulfillment of program objectives;
- The adequacy of program records;
- Recommendations for program improvement and modification; and

- Program costs.

The results of the program evaluation should be made available to all end users and presented to top management so that program changes may be implemented.

C. **TYPES OF STANDARD OPERATING PROCEDURES**. Personal protective clothing and equipment can offer a high degree of protection only if it is used properly. Standard Operating Procedures (SOP's) should be established for all workers involved in handling hazardous chemicals. Areas that should be addressed include:
- Selection of protective ensemble components;
- Protective clothing and equipment donning, doffing, and use;
- Decontamination procedures;
- Inspection, storage, and maintenance of protective clothing/equipment; and
- Training.

D. **SELECTION OF PROTECTIVE CLOTHING COMPONENTS**.

0. Protective clothing and equipment SOP's must take into consideration the factors presented in the Clothing Ensemble and Protective Clothing Applications Paragraphs of this chapter. All clothing and equipment selections should provide a decision tree that relates chemical hazards and information to levels of protection and performance needed.

1. Responsibility in selecting appropriate protective clothing should be vested in a specific individual who is trained in both chemical hazards and protective clothing use such as a safety officer or industrial hygienist. Only chemical protective suits labeled as compliant with the appropriate performance requirements should be used. In cases where the chemical hazards are known in advance or encountered routinely, clothing selection should be predetermined. That is, specific clothing items should be identified in specific chemical operations without the opportunity for individual selection of other clothing items.

VI. **CLOTHING DONNING, DOFFING, AND USE**.

The procedures below are given for vapor protective or liquid-splash protective suit ensembles and should be included in the training program.

A. **DONNING THE ENSEMBLE**.

0. A routine should be established and practiced periodically for donning the various ensemble configurations that a facility or team may use. Assistance should be provided for donning and doffing since these operations are difficult to perform alone, and solo efforts may increase the possibility of ensemble damage.

1. Table VIII:1-5 below lists sample procedures for donning a totally encapsulating suit/SCBA ensemble. These procedures should be modified depending on the suit and accessory equipment

used. The procedures assume the wearer has previous training in respirator use and decontamination procedures.

2. Once the equipment has been donned, its fit should be evaluated. If the clothing is too small, it will restrict movement, increase the likelihood of tearing the suit material, and accelerate wearer fatigue. If the clothing is too large, the possibility of snagging the material is increased, and the dexterity and coordination of the wearer may be compromised. In either case, the wearer should be recalled and better-fitting clothing provided.

TABLE VIII:1-5. SAMPLE DONNING PROCEDURES

3. Inspect clothing and respiratory equipment before donning (see Paragraph on Inspection).
4. Adjust hard hat or headpiece if worn, to fit user's head.
5. Open back closure used to change air tank (if suit has one) before donning suit.
6. Standing or sitting, step into the legs of the suit; ensure proper placement of the feet within the suit; then gather the suit around the waist.
7. Put on chemical-resistant safety boots over the feet of the suit. Tape the leg cuff over the tops of the boots.
   If additional chemical-resistant safety boots are required, put these on now.
   Some one-piece suits have heavy-soled protective feet. With these suits, wear short, chemical resistant safety boots inside the suit.
8. Put on air tank and harness assembly of the SCBA. Don the facepiece and adjust it to be secure, but comfortable. Do not connect the breathing hose. Open valve on air tank.
9. Perform negative and positive respirator facepiece seal test procedures.
   To conduct a negative-pressure test, close the inlet part with the palm of the hand or squeeze the breathing tube so it does not pass air, and gently inhale for about 10 seconds. Any inward rushing of air indicates a poor fit. Note that a leaking facepiece may be drawn tightly to the face to form a good seal, giving a false indication of adequate fit.
   To conduct a positive-pressure test, gently exhale while covering the exhalation valve to ensure that a positive pressure can be built up. Failure to build a positive pressure indicates a poor fit.
10. Depending on type of suit:
    Put on long-sleeved inner gloves (similar to surgical gloves). Secure gloves to sleeves, for suits with detachable gloves (if not done prior to entering the suit).
    Additional overgloves, worn over attached suit gloves, may be donned later.
11. Put sleeves of suit over arms as assistant pulls suit up and over the SCBA. Have assistant adjust suit around SCBA and shoulders to ensure unrestricted motion.
12. Put on hard hat, if needed.
13. Raise hood over head carefully so as not to disrupt face seal of SCBA mask. Adjust hood to give satisfactory comfort.
14. Begin to secure the suit by closing all fasteners on opening until there is only adequate room to connect the breathing hose. Secure all belts and/or adjustable leg, head, and waistbands.
15. Connect the breathing hose while opening the main valve.

16. Have assistant first ensure that wearer is breathing properly and then make final closure of the suit.
17. Have assistant check all closures.
18. Have assistant observe the wearer for a periodof time to ensure that the wearer is comfortable, psychologically stable, and that the equipment is functioning properly.

B. **DOFFING AN ENSEMBLE**.

0. Exact procedures for removing a totally encapsulating suit/SCBA ensemble must be established and followed in order to prevent contaminant migration from the response scene and transfer of contaminants to the wearer's body, the doffing assistant, and others.

1. Sample doffing procedures are provided in Table VIII:1-6 below. These procedures should be performed only after decontamination of the suited end user. They require a suitably attired assistance. Throughout the procedures, both wearer and assistant should avoid any direct contact with the outside surface of the suit.

TABLE VIII:1-6. SAMPLE DOFFING PROCEDURES

If sufficient air supply is available to allow appropriate decontamination before removal:

3. Remove any extraneous or disposable clothing, boot covers, outer gloves, and tape.
4. Have assistant loosen and remove the wearer's safety shoes or boots.
5. Have assistant open the suit completely and lift the hood over the head of the wearer and rest it on top of the SCBA tank.
6. Remove arms, one at a time, from suit. Once arms are free, have assistant lift the suit up and away from the SCBA backpack--avoiding any contact between the outside surface of the suit and the wearer's body--and lay the suit out flat behind the wearer. Leave internal gloves on, if any.
7. Sitting, if possible, remove both legs from the suit.
8. Follow procedure for doffing SCBA.
9. After suit is removed, remove internal gloves by rolling them off the hand, inside out.
10. Remove internal clothing and thoroughly cleanse the body.

If the low-pressure warning alarm has sounded, signifying that approximately 5 minutes of air remain:

11. Remove disposable clothing.

12. Quickly scrub and hose off, especially around the entrance/exit zipper.
13. Open the zipper enough to allow access to the regulator and breathing hose.
14. Immediately attach an appropriate canister to the breathing hose (the type and fittings should be predetermined). Although this provides some protection against any contamination still present, it voids the certification of the unit.
15. Follow Steps 1 through 8 of the regular doffing procedure above. Take extra care to avoid contaminating the assistant and the wearer.

C. **USER MONITORING AND TRAINING**.

0. The wearer must understand all aspects of clothing/equipment operation and their limitations; this is especially important for fully encapsulating ensembles where misuse could potentially result in suffocation. During protective clothing use, end users should be encouraged to report any perceived problems or difficulties to their supervisor. These malfunctions include, but are not limited to:

    - Degradation of the protection ensemble;
    - Perception of odors;
    - Skin irritation;
    - Unusual residues on clothing material;
    - Discomfort;
    - Resistance to breathing;
    - Fatigue due to respirator use;
    - Interference with vision or communication;
    - Restriction of movement; and
    - Physiological responses such as rapid pulse, nausea, or chest pain.

1. Before end users undertake any activity in their chemical protective ensembles, the anticipated duration of use should be established. Several factors limit the length of a mission, including:

    - Air supply consumption as affected by wearer work rate, fitness, body size, and breathing patterns;
    - Suit ensemble permeation, degradation, and penetration by chemical contaminants, including expected leakage through suit or respirator exhaust valves (ensemble protection factor);
    - Ambient temperature as it influences material chemical resistance and flexibility, suit and respirator exhaust valve performance, and wearer heat stress; and
    - Coolant supply (if necessary).

II. **DECONTAMINATION PROCEDURES**.

C. **DEFINITION AND TYPES**.

0. Decontamination is the process of removing or neutralizing contaminants that have accumulated on personnel and equipment. This process is critical to health and safety at hazardous material response sites. Decontamination protects end users from hazardous substances that may contaminate and eventually permeate the protective clothing, respiratory equipment, tools, vehicles, and other equipment used in the vicinity of the chemical hazard; it protects all plant or site personnel by minimizing the transfer of harmful materials into clean areas; it helps prevent mixing of incompatible chemicals; and it protects the community by preventing uncontrolled transportation of contaminants from the site.

1. There are two types of decontamination:

- **Gross decontamination:** To allow end user to safely exit or doff the chemical protective clothing.
- **Decontamination** for reuse of chemical protective clothing.

D. **PREVENTION OF CONTAMINATION**. The first step in decontamination is to establish Standard Operating Procedures that minimize contact with chemicals and thus the potential for contamination. For example:

- Stress work practices that minimize contact with hazardous substances (e.g. do not walk through areas of obvious contamination, do not directly touch potentially hazardous substances).
- Use remote sampling, handling, and container-opening techniques (e.g. drum grapples, pneumatic impact wrenches).
- Protect monitoring and sampling instruments by bagging. Make openings in the bags for sample ports and sensors that must contact site materials.
- Wear disposable outer garments and use disposable equipment where appropriate.
- Cover equipment and tools with a strippable coating that can be removed during decontamination.
- Encase the source of contaminants, e.g. with plastic sheeting or overpacks.
- Ensure all closures and ensemble component interfaces are completely secured; and that no open pockets that could serve to collect contaminant are present.

E. **TYPES OF CONTAMINATION**.

0. **Surface Contaminants**. Surface contaminants may be easy to detect and remove.

1. **Permeated Contaminants**. Contaminants that have permeated a material are difficult or impossible to detect and remove. If contaminants that have permeated a material are not removed by decontamination, they may continue to permeate the material where they can cause an unexpected exposure.

Four major factors affect the extent of permeation:

- **Contact time.** The longer a contaminant is in contact with an object, the greater the probability and extent of permeation. For this reason, minimizing contact time is one of the most important objectives of a decontamination program.
- **Concentration.** Molecules flow from areas of high concentration to areas of low concentration. As concentrations of chemicals increase, the potential for permeation of personal protective clothing increases.
- **Temperature.** An increase in temperature generally increases the permeation rate of contaminants.
- **Physical state of chemicals.** As a rule, gases, vapors, and low-viscosity liquids tend to permeate more readily than high-viscosity liquids or solids.

F. **DECONTAMINATION METHODS**.

0. Decontamination methods either (1) physically remove contaminants; (2) inactivate contaminants by chemical detoxification or disinfection/sterilization; or (3) remove contaminants by a combination of both physical and chemical means.

1. In general, gross decontamination is accomplished using detergents (surfactants) in water combined with a physical scrubbing action. This process will remove most forms of surface contamination including dusts, many inorganic chemicals, and some organic chemicals. Soapy water scrubbing of protective suits may not be effective in removing oily or tacky organic substances (e.g. PCB's in transformer oil). Furthermore, this form of decontamination is unlikely to remove any contamination that has permeated or penetrated the suit materials. Using organic solvents such as petroleum distillates may allow easier removal of heavy organic contamination but may result in other problems, including:

    - Permeation into clothing components, pulling the contaminant with it;
    - Spreading localized contaminant into other areas of the clothing; and
    - Generating large volumes of contaminated solvents that require disposal.

2. One promising method for removing internal or matrix contamination is the forced circulation of heated air over clothing items for extended periods of time. This allows many organic chemicals to migrate out of the materials and evaporate into the heated air. The process does require, however, that the contaminating chemicals be volatile. Additionally, low level heat may accelerate the removal of plasticizer from garment materials and affect the adhesives involved in garment seams.

3. Unfortunately, both manufacturers and protective clothing authorities provide few specific recommendations for decontamination. There is no definitive list with specific methods recommended for specific chemicals and materials. Much depends on the individual chemical-material combination involved.

G. **TESTING THE EFFECTIVENESS OF DECONTAMINATION**.

0. Protective clothing or equipment reuse depends on demonstrating that adequate decontamination has taken place. Decontamination methods vary in their effectiveness and unfortunately there are no completely accurate methods for nondestructively evaluating clothing or equipment contamination levels.

1. Methods which may assist in a determination include:

- Visual examination of protective clothing for signs of discoloration, corrosive effects, or any degradation of external materials. However, many contaminants do not leave any visible evidence.
- Wipe sampling of external surfaces for subsequent analysis; this may or may not be effective for determining levels of surface contamination and depends heavily on the material-chemical combination. These methods will not detect permeated contamination.
- Evaluation of the cleaning solution. This method cannot quantify clean method effectiveness since the original contamination levels are unknown. The method can only show if chemical has been removed by the cleaning solution. If a number of garments have been contaminated, it may be advisable to sacrifice one garment for destructive testing by a qualified laboratory with analysis of contamination levels on and inside the garment.

H. **DECONTAMINATION PLAN**.

0. A decontamination plan should be developed and set up before any personnel or equipment are allowed to enter areas where the potential for exposure to hazardous substances exists. The decontamination plan should:

- Determine the number and layout of decontamination stations;
- Determine the decontamination equipment needed;
- Determine appropriate decontamination methods;
- Establish procedures to prevent contamination of clean areas;
- Establish methods and procedures to minimize wearer contact with contaminants during removal of personal protective clothing; and
- Establish methods for disposing of clothing and equipment that are not completely decontaminated.

1. The plan should be revised whenever the type of personal protective clothing or equipment changes, the use conditions change, or the chemical hazards are reassessed based on new information.

2. The decontamination process should consist of a series of procedures performed in a specific sequence. For chemical protective ensembles, outer, more heavily contaminated items (e.g. outer boots and gloves) should be decontaminated and removed first, followed by decontamination and removal of inner, less contaminated items (e.g. jackets and pants). Each procedure should be performed at a separate station in order to prevent cross contamination. The sequence of stations is called the decontamination line.

3. Stations should be separated physically to prevent cross contamination and should be arranged in order of decreasing contamination, preferably in a straight line. Separate flow patterns and stations should be provided to isolate workers from different contamination zones containing incompatible wastes. Entry and exit points to exposed areas should be conspicuously marked. Dressing stations for entry to the decontamination area should be separate from redressing areas for exit from the decontamination area. Personnel who wish to enter clean areas of the decontamination facility, such as locker rooms, should be completely decontaminated.

4. All equipment used for decontamination must be decontaminated and/or disposed of properly. Buckets, brushes, clothing, tools, and other contaminated equipment should be collected, placed in containers, and labeled. Also, all spent solutions and wash water should be collected and disposed of properly. Clothing that is not completely decontaminated should be placed in plastic bags, pending further decontamination and/or disposal.

5. Decontamination of workers who initially come in contact with personnel and equipment leaving exposure or contamination areas will require more protection from contaminants than decontamination workers who are assigned to the last station in the decontamination line. In some cases, decontamination personnel should wear the same levels of protective clothing as workers in the exposure or contaminated areas. In other cases, decontamination personnel may be sufficiently protected by wearing one level lower protection (e.g. wearing Level B protection while decontaminating workers who are wearing Level A).

I. **DECONTAMINATION FOR PROTECTIVE CLOTHING REUSE**. Due to the difficulty in assessing contamination levels in chemical protective clothing before and after exposure, the responsible supervisor or safety professional must determine if the respective clothing can be reused. This decision involves considerable risk in determining clothing to be contaminant-free. Reuse can be considered if, in the estimate of the supervisor:

- No "significant" exposures have occurred.
- Decontamination methods have been successful in reducing contamination levels to safe or acceptable concentrations.

Contamination by known or suspected carcinogens should warrant automatic disposal. Use of disposable suits is highly recommended when extensive contamination is expected.

J. **EMERGENCY DECONTAMINATION**.

0. In addition to routine decontamination procedures, emergency decontamination procedures must be established. In an emergency, the primary concern is to prevent the loss of life or severe injury to personnel. If immediate medical treatment is required to save a life, decontamination should be delayed until the victim is stabilized. If decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life, decontamination should be continued.

1. If an emergency due to a heat-related illness develops, protective clothing should be removed from the victim as soon as possible to reduce the heat stress. During an emergency, provisions must also be made for protecting medical personnel and disposing of contaminated clothing and equipment.

III. **INSPECTION, STORAGE, AND MAINTENANCE**.

The end user in donning protective clothing and equipment must take all necessary steps to ensure that the protective ensemble will perform as expected. During emergencies is not the right time to discover discrepancies in the protective clothing. Teach end user care for his clothing and other protective equipment in the same manner as parachutists care for parachutes. Following a standard program for inspection, proper storage, and maintenance along with realizing protective clothing/equipment limitations is the best way to avoid chemical exposure during emergency response.

. **INSPECTION**.

0. An effective chemical protective clothing inspection program should feature five different inspections:

   - Inspection and operational testing of equipment received as new from the factory or distributor.
   - Inspection of equipment as it is selected for a particular chemical operation.
   - Inspection of equipment after use or training and prior to maintenance.
   - Periodic inspection of stored equipment.
   - Periodic inspection when a question arises concerning the appropriateness of selected equipment, or when problems with similar equipment are discovered.

1. Each inspection will cover different areas with varying degrees of depth. Those personnel responsible for clothing inspection should follow manufacturer directions; many vendors provide

detailed inspection procedures. The generic inspection checklist provided in Table VIII:1-7 may serve as an initial guide for developing more extensive procedures.

2. Records must be kept of all inspection procedures. Individual identification numbers should be assigned to all reusable pieces of equipment (many clothing and equipment items may already have serial numbers), and records should be maintained by that number. At a minimum, each inspection should record:

   - Clothing/equipment item ID number;
   - Date of the inspection;
   - Person making the inspection;
   - Results of the inspection; and
   - Any unusual conditions noted.

Periodic review of these records can provide an indication of protective clothing which requires excessive maintenance and can also serve to identify clothing that is susceptible to failure.

A.

TABLE VIII:1-7. SAMPLE PPE INSPECTION CHECKLISTS

Clothing	
Before use:	Determine that the clothing material is correct for the specified task at hand.
Visually inspect for:	▪ Imperfect seams; ▪ Nonuniform coatings; ▪ Tears; and ▪ Malfunctioning closures.
Hold up to light and check for pinholes	
Flex product:	▪ Observe for cracks. ▪ Observe for other signs or shelf deterioration.

If the product has been used previously, inspect inside and out for signs of chemical attaack:	▪ Discoloration ▪ Swelling ▪ Stiffness
During the work task, periodically inspect for:	▪ Evidence of chemical attack such as discoloration, swelling, stiffening and softening. ▪ Keep in mind, however, that chemical permeation can occur without any visible effects. ▪ Closure failure ▪ Tears ▪ Punctures ▪ Seam discontinuities
Gloves	
Before use:	Pressurize glove to check for pinholes. Either blow into glove, then roll gauntlet towards fingers or inflate glove and hold under water. In either case, no air should escape.
Fully Encapsulating Suits	
Before use:	▪ Check the operation of pressure relief valves ▪ Inspect the fitting of wrists, ankles, and neck ▪ Check faceshield, if so equipped, for: - cracks - crazing - fogginess

B. **STORAGE**.

0. Clothing must be stored properly to prevent damage or malfunction from exposure to dust, moisture, sunlight, damaging chemicals, extreme temperatures and impact. Procedures are needed for both initial receipt of equipment and after use or exposure of that equipment. Many manufacturers specify recommended procedures for storing their products. These should be followed to avoid equipment failure resulting from improper storage.

1. Some guidelines for general storage of chemical protective clothing include:

    - Potentially contaminated clothing should be stored in an area separate from street clothing or unused protective clothing.
    - Potentially contaminated clothing should be stored in a well-ventilated area, with good air flow around each item, if possible.
    - Different types and materials of clothing and gloves should be stored separately to prevent issuing the wrong material by mistake (e.g. many glove materials are black and cannot be identified by appearance alone).
    - Protective clothing should be folded or hung in accordance with manufacturer instructions.

C. **MAINTENANCE**.

0. Manufacturers frequently restrict the sale of certain protective suit parts to individuals or groups who are specially trained, equipped, or authorized by the manufacturer to purchase them. Explicit procedures should be adopted to ensure that the appropriate level of maintenance is performed only by those individuals who have this specialized training and equipment. In no case should you attempt to repair equipment without checking with the person in your facility who is responsible for chemical protective clothing maintenance.

1. The following classification scheme is recommended to divide the types of permissible or nonpermissible repairs:

    - **Level 1:** User or wearer maintenance, requiring a few common tools or no tools at all.
    - **Level 2**: Maintenance that can be performed by the response team's maintenance shop, if adequately equipped and trained.
    - **Level 3** : Specialized maintenance that can be performed only by the factory or an authorized repair person.

2. Each facility should adopt the above scheme and list which repairs fall into each category for each type of protective clothing and equipment. Many manufacturers will also indicate which repairs, if performed in the field, void the warranty of their products. All repairs made must be recorded on the records for the specific clothing along with appropriate inspection results.

IV. **TRAINING**.

. **BENEFITS**. Training in the use of protective clothing:

- Allows the user to become familiar with the equipment in a nonhazardous, nonemergency condition.
- Instills confidence of the user in his/her equipment.
- Makes the user aware of the limitations and capabilities of the equipment.
- Increases worker efficiency in performing various tasks.
- Reduces the likelihood of accidents during chemical operations.

I. **CONTENT**. Training should be completed prior to actual clothing use in a non-hazardous environment and should be repeated at the frequency required by OSHA SARA III legislation. As a minimum the training should point out the user's responsibilities and explain the following, using both classroom and field training when necessary, as follows:

- The proper use and maintenance of selected protective clothing, including capabilities and limitations.
- The nature of the hazards and the consequences of not using the protective clothing.
- The human factors influencing protective clothing performance.
- Instructions in inspecting, donning, checking, fitting, and using protective clothing.
- Use of protective clothing in normal air for a long familiarity period.
- The user's responsibility (if any) for decontamination, cleaning, maintenance, and repair of protective clothing.
- Emergency procedures and self-rescue in the event of protective clothing/ equipment failure.
- The buddy system.

The discomfort and inconvenience of wearing chemical protective clothing and equipment can create a resistance to its conscientious use. One essential aspect of training is to make the user aware of the need for protective clothing and to instill motivation for the proper use and maintenance of that protective clothing.

II. **RISKS**.

. **HEAT STRESS**. Wearing full body chemical protective clothing puts the wearer at considerable risk of developing heat stress. This can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors, including:

- Environmental conditions;
- Type of protective ensemble worn;

- The work activity required; and
- The individual characteristics of the responder.

When selecting chemical protective clothing and equipment, each item's benefit should be carefully evaluated for its potential for increasing the risk of heat stress. For example, if a lighter, less insulating suit can be worn without a sacrifice in protection, then it should be. Because the incidence of heat stress depends on a variety of factors, all workers wearing full body chemical protective ensembles should be monitored.

Review Paragraph III: Chapter 4, Heat Stress, in the OSHA Technical Manual. The following physiological factors should be monitored.

A. **HEART RATE**. Count the radial pulse during a 30-second period as early as possible in any rest period. If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle should be shortened by one-third.

B. **ORAL TEMPERATURE**.

0. *Do not permit an end user to wear protective clothing and engage in work when his or her oral temperature exceeds 100.6°F (38.1°C).*

1. Use a clinical thermometer (three minutes under the tongue) or similar device to measure oral temperature at the end of the work period (before drinking), as follows:

- If the oral temperature exceeds 99.6°F (37.6°C), shorten the next work period by at least one-third.
- If the oral temperature exceeds 99.6°F (37.6°C) at the beginning of a response period, shorten the mission time by one-third.

C. **BODY WATER LOSS**. Measure the end user's weight on a scale accurate to plus or minus 0.25 pounds prior to any response activity. Compare this weight with his or her normal body weight to determine if enough fluids have been consumed to prevent dehydration. Weights should be taken while the end user wears similar clothing, or ideally, in the nude. The body water loss should not exceed 1.5% of the total body weight loss from a response.

III. **BIBLIOGRAPHY**.

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Appendix J

ANSI Z87.1-2003

ANSI Z87.1-2003
The new standard is a voluntary standard and there is no requirement that manufacturer or end user comply with it unless it is mandated by the United States Department of Labor – OSHA. However, in the past, most manufacturers have chosen to comply with revisions to the Z87.1 Standard.
Currently, OSHA requires (29 CFR 1910.133) that eye protectors comply with the 1989 version of the Z87.1 Standard, and eye protection devices now in use may continue to be used.

****All of the protective eyewear we sell already complies with the performance requirements of the new standard. The new marking requirements will be phased in over time by each manufacturer.****

1. Two Levels of Protection:
Basic and High
LENSES: The new standard designates that lenses will be divided into two protection levels, Basic Impact and High Impact as dictated by test criteria. Basic Impact lenses must pass the “drop ball” test, a 1" diameter steel ball is dropped on the lens from 50 inches. High Impact lenses must pass “high velocity” testing where 1/4" steel balls are “shot” at different velocities.

Spectacles: 150 ft./sec.
Goggles: 250 ft./sec.
Faceshields: 300 ft./sec.

FRAMES: Now, all eyewear/goggle frames, faceshields or crowns must comply with the High Impact requirement. (This revision helps eliminate the use of “test lenses”, and assures all protectors are tested as complete - lenses in frame - devices). After making an eye hazard assessment, employers (safety personnel) should decide on appropriate eyewear to be worn, although High Impact would always be recommended. All of our spectacles are High Impact protectors.

2. Now, Products Must Indicate
Impact Protection Level.
To identify a device’s level of impact protection, the following marking requirements apply to all new production spectacles, goggles and faceshields. Basic Impact spectacle lenses will have the manufacturer’s mark, i.e. an AOSafety product will have “AOS” and a Pyramex product will have a "P" etc. Goggles and faceshields will have AOS and Z87 (AOS Z87). High Impact spectacle lenses will also have a plus + sign, (AOS+) or "P+" etc. All goggle lenses and faceshield windows are to be marked with the manufacturer's mark, Z87, and a + sign (AOSZ87+).

Note: Lenses/windows **may have** additional markings. Shaded lens may have markings denoting a shade number such as 3.0, 5.0 etc. Special purpose lenses may be marked with “S”. A variable tint lens may have a “V” marking.

3. Sideshield Coverage Area Increased
Sideshield coverage, as part of the lens, part of the spectacle, or as an individual component, has been increased

rearward by 10-millimeters via a revised impact test procedure. While side protection in the form of wraparound lens, integral or attached component sideshield devices is not mandated in this standard, it is highly recommended. Further, OSHA does require lateral protection on eye protection devices wherever a flying particle hazard may exist, and flying particle hazards are virtually always present in any occupational environment. All of our non-prescription safety spectacles meet the requirements of OSHA and the new Z87.1 for side protection.

4. No Minimum Lens Thickness Requirement For High Impact Lenses.

The new standard does not have a "minimum lens thickness" requirement for High Impact spectacle lenses. The previous standard required a 2-millimeter "minimum". However, the protective advantages of wrap-around lenses and the many other advancements in eyewear design, have eliminated this need.

Note: Glass lenses still fall into the Basic Impact lens category. The "minimum lens thickness" of 3 millimeters remains in effect for this category.

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Appendix K

ATTENTION- Students Who Wear Contact Lenses:

Recently, concerns about wearing contact lenses in science labs have come to our attention. The following is an article from the Washington Science Teachers Journal.

(A) **All contact lenses**- It has been argued that contact lenses offer a great deal of protection from damage by particles and chemicals in science labs. According to the National Institute for Occupational Safety and Health, nothing could be further from the truth. An eye that has received a chemical splash should be irrigated with water until the material has been completely removed. The recommended time for this is fifteen minutes as a minimum. If a contact lens is present, the chemical may be drawn under the lens by capillary action where it is not reached by normal irrigation water. Therefore, the lens must be removed to permit effective washing. Under the traumatic conditions of pain and possible fear, it may prove next to impossible to remove a lens from a victim's eyes. Thus contact lenses should be **discouraged** or if possible, **prohibited** in science labs.

(B) **Soft Contact Lenses**- Students and teachers should pay heed to the restrictions suggested by the manufacturers of contact lenses. For example, a brochure issued by Bausch and Lomb, Inc. reads as follows; "Softlens Contact Lenses (polymacon) should be removed before sleeping or swimming and in the presence of noxious and irritating vapors."

Some chemical vapors can readily be absorbed by the Soflens Contact Lenses. Not only can there be irritation to the eye, but as some vapors are soluble in the plastic of the lens, there is a possibility that a lens might adhere to the cornea of the eye.

In light of this article, and for the maximum protection of your student, we recommend that:

(a) Glasses be worn instead of contact lenses for laboratory work.
OR
(b) If glasses are not worn, contact lenses should be removed before laboratory work is done, if visual acuity will so allow.

Please sign and return the lower portion of this form. Thank you.

CONTACT LENS FORM

I have read this form and understand the risks of wearing contact lenses in Biology/ Chemistry laboratories.

_____ _____

Date Name

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Appendix L

Chemical Resistant Gloves Guide

The following table gives recommended material for chemically-resistant gloves for work involving a variety of chemicals.

Chemical resistant gloves	
Material	Generally suitable for
Butyl rubber	Aldehydes Carboxylic acids Glycols and ethers Hydroxyl compounds and alcohols Peroxides
Latex	See note below
Natural rubber	Acetone Acohols Alkalies and Caustics Ammonium fluoride Dimethyl sulphoxide (DMSO) Phenol Plating solutions
Neoprene	Alcohols Alkalies and caustics Cellosolve Degreasing solvents Mineral acids Oils Plating solutions
Nitrile rubber	Alcohols Ammonium fluoride Freons Hexane Hydrofluoric and hydrochloric acid Perchloric acid Perchloroethylene Phosphoric acid Potassium and sodium hydroxide Water soluble materials, dilute acids and bases
Vinyl	General prevention of contamination Medical examination Nuisance materials

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Note:

All latex gloves present a risk of causing irritation, sensitization or allergic reaction in susceptible individuals, although this risk is reduced in gloves with lower levels of latex protein and process chemicals. Powdered latex gloves carry an additional risk to sensitized individuals, because the latex protein leaches into the powder and becomes airborne when gloves are removed, or may be carried around on the wearer's clothing.

This may affect others in the vicinity, not just the person wearing the gloves. Therefore powdered latex gloves must not be used. If latex gloves are chosen, then only good-quality, powder-free ones with low levels (< 100 micrograms per gram) of extractable or leachable latex protein should be used.

Note that a ban on powdered latex gloves is a Great Falls College MSU Safety Policy; such gloves are not to be used in the building.

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Appendix M

EPA Regulations for Hazardous Wastes

Please see documentation link:

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Appendix N

EMERGENCY PROCEDURE

1. Call 911 (Depending upon the emergency at your discretion)

2. Notify Crisis Team: Dial 9999 from any campus phone.

3. Evacuate building if necessary and move to UGF McLaughlin Center, our Emergency Evacuation Site.

4. Faculty/Supervisors must account for all staff and students they teach/supervise at that time.

5. All information should be reported to and announced by the Director of Communications and Marketing.

6. Wait for instructions from a member of the Crisis Team, for prolonged situations, check the Great Falls College web site and look for a text from GFC Alert.

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Appendix O

Montana State Department of Environmental Quality Contact List

http://svc.mt.gov/deq/staffdir.asp