PHYSICS/CHEMISTRY BUILDING SAFETY PLAN

AND

CHEMICAL HYGIENE PLAN

James Madison University
Department of Chemistry and Biochemistry
Department of Physics and Astronomy
Physics/Chemistry Building
Harrisonburg, VA 22807
10/07/2020

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PURPOSE AND SCOPE

This Chemical Hygiene Plan (CHP) complies with OSHA regulations 29 CFR 1950.1450. This plan applies to laboratories where chemicals are used within the Physics/Chemistry building of James Madison University. A list of terms and definitions is included in Appendix A. Procedures regarding radiation safety, mechanical safety, electrical safety, laser safety, and fire safety and evacuation are included in the Physics/Chemistry building safety plan.

RESPONSIBILITIES AND CONTACTS

This CHP is administered by the Chemistry and Biochemistry Department, the Chemical Hygiene Officer, and the Physics/Chemistry Safety Committee.

Dr. Linette Watkins	Dr. William C Hughes "Chris"
Professor and Department Head	Professor and Department Head
Chemistry and Biochemistry	Physics and Astronomy
MSC 4501	MSC 4502
Harrisonburg, VA 22807	Harrisonburg, VA 22807
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Chemical Hygiene Officer (CHO)

The Chemical Hygiene Officer reports to the Chemistry Department Head and is responsible for the day to day activities described in this plan. The current Chemical Hygiene Officer is Dr. Catherine Adkins (adkinsqf@jmu.edu, 540-568-1655).

Laser Safety Officer (LSO)

The Laser Safety Officer is responsible for administering the Laser Safety Training and the Laser Safety Quiz as described in Appendix G. The current Laser Safety Officer is Dr. Sasha Kokhan (kokhan@jmu.edu, 540-568-1656).

Physics/Chemistry Safety Committee

The Physics/Chemistry Safety Committee is appointed by the Chemistry Department Head, in consultation with the Physics Department Head, and meets regularly to set policy regarding issues of chemical safety, laboratory safety, and shop safety within the Physics/Chemistry Building. The members of the 2017-2018 Physics/Chemistry Safety Committee are: Dr. Linette Watkins, Dr. Chris Hughe, Dr. Catherine Adkins, Dr. Scott Lewis, Mr. Brian Kane, and Mr. Jacob Brown.

PRUDENT LABORATORY PRACTICES AND STANDARD OPERATING PROCEDURES

General Laboratory Guidelines

- All laboratory work must be performed to provide minimal chemical exposure.
- Use only chemicals for which the laboratory in which you are working is adequately equipped to handle, i.e. adequate hood ventilation system.
- Never directly heat flammable chemicals with an open flame or hot plate. Instead, use a heating mantle, steam, or hot water bath.
- Never store flammables near an ignition source.
- All flammable solvents should be used in a chemical fume hood or well-ventilated area.
- When transferring flammables from one container to another, ground both containers if the potential for sparking exists.
- All flammable liquids should be stored in appropriately designed safety cabinets or safety cans.
- Avoid distracting or startling other laboratory workers. Never run or engage in horseplay in the laboratory.
- Laboratory workers are not allowed to work in the lab alone without the explicit permission of their supervisors. Arrangements should be between the supervisor and students to ensure the safety of the students in the lab during times without direct supervision. Other faculty or students should be aware of the arrival and departure of the student in the laboratory.
- Always be alert to conditions that are unsafe in the laboratory. Correct such conditions immediately, if possible, or report them to the lab supervisor.
- Familiarize yourself with the locations and content of MSDSs as well as other safety resources, and use them.

Personal Hygiene, Housekeeping, and Personal Protective Equipment (PPE)

- Do not eat, drink, smoke, chew gum, or apply cosmetics in the laboratory.
- Never put your nose directly over an open chemical container.
- Avoid skin contact with chemicals. Immediately flush any exposed area with water.
- Do not pipette by mouth.
- Never store food or drinks in laboratory refrigerators.
- Confine long hair and avoid loose clothing in the laboratory.
- Always wear closed shoes in the laboratory. Shoes with open toes or heels are not permitted. Sneakers with porous uppers are not recommended.
- ANSI-approved safety glasses, goggles, or other approved eyewear are to be worn at all times in the laboratory.
  Lab coat or apron are strongly recommended when working in laboratories.
- Always wear gloves that are appropriate for the chemical and task. Wash reusable gloves before removing them. Gloves are not to be worn out of the laboratory.
- Maintain a clean and clutter-free work area; clean up each day prior to leaving the laboratory.
- All chemicals (including synthesized chemicals and chemicals that have been transferred from their original container) must be properly labeled with the following information: chemical name and concentration; responsible party's name, and the date.
- Place all chemical waste into an appropriate container and attach a completed waste disposal label (Appendix B). All waste should be taken to the CHO for disposal (or CHO should be notified). Additional waste labels may be obtained from the CHO.
- Promptly clean up all spills; properly dispose of the spilled chemical and clean-up materials.
- Report all accidents or injuries to the research advisor or laboratory instructor, and the CHO.

Emergency Procedures

Accidents:

- Eye Contact: Promptly flush eyes with large amounts of water for 15 minutes and seek medical attention. Know the location of the nearest eye wash at all times.
- Skin Contact: Promptly remove any contaminated clothing and flush affected area with water for 15 minutes. For major incidences of skin contact, utilize the nearest safety shower. Seek medical attention as needed.
- Ingestion: Do not allow the victim to eat or drink anything. Do not induce vomiting. Seek medical attention promptly.

Accidents occurring in teaching and research laboratories of the Physics and Chemistry Building must be reported to the research advisor or laboratory instructor and the CHO. A laboratory incident report must be filled out and a copy maintained by the CHO in the Departmental safety records (Appendix C).

Spills:

- Promptly clean up all chemical spills while wearing proper PPE and properly dispose of clean-up materials.
  (Consult Hazards in the Chemical Laboratory or Prudent Practices in the Laboratory: Handling and Disposal of Chemicals for more specific clean-up procedures in advance of using a chemical).
- For large chemical spills (especially those of highly toxic material or volatile compounds), immediately evacuate the area and call campus police at 86911.

Fires:

- Small fires may be extinguished with a fire extinguisher, but only if the individual has been properly trained, has a clear means of egress, and feels comfortable doing so. Otherwise, manually pull the fire alarm and evacuate the area. Exit the building and call campus police (86911).
- If your clothing catches on fire, move away from the ignition source, roll yourself on floor and extinguish the flame with a safety shower.

Evacuation:

- When the building fire alarm sounds, turn off all sources of heat, electricity, and gas, and stabilize any reaction in process. Evacuate the building immediately. Please consult the Physics/Chemistry Building Fire Safety and Emergency Evacuation Plan for additional information regarding evacuation procedures,

Control Measures and Equipment

Chemical experiments should be conducted in chemical fume hoods. This is especially important for reactions employing volatile, flammable, or halogenated solvents and any aqueous solution containing toxic substances. The fume hood sash can be in the raised position to set up the experiment, but should be lowered to operating position once the experiment has started, and only be raised to check on reaction progress. You should always wear protective eyewear and gloves when working in a fume hood. Chemical storage in the fume hood should be kept to a minimum. Canopy hoods and/or snorkels are recommended for instruments that generate vapors or fumes in their operation. Exhaust hood performance specifications and testing schedule are given in Appendix D.

Departmental Safety Inspections

The Chemical Hygiene Officer conducts periodic safety inspections of all laboratories in the Physics/Chemistry Building to ensure that the CHP is being followed and advises the Chemistry and Physics Department Heads of any potential problems that should be corrected. The JMU Office of Risk Management conducts quarterly inspections of all laboratories and shops in the Physics/Chemistry building.

Chemical Procurement, Receipt, Transport, Storage, and Disposal

Procurement and Receipt: All chemicals used in the Physics/Chemistry Building will be ordered by the CHO or other specified individuals in the departments. Upon arrival in room 1362, the container will be visually inspected for damage or leakage. The container will then be dated, barcoded, and entered into the Vertere chemical inventory system. The individual requesting the chemical will be notified that it has arrived from the vendor and is available for pickup. Chemicals purchased by members of the Department of Physics and Astronomy are to be delivered to PCB room 1362 (chemical storeroom receiving) where they will be entered into the chemical inventory system and the purchaser will be notified that it has arrived and is available for pickup.

Transport: Laboratory carts should be used to transport chemicals between rooms when moving more than a kilogram of material and secondary containers should be used when transporting strong mineral acids, bases, and solvents. The elevator is to be used when transporting chemicals between floors. Stairs are not allowed to transport chemicals between floors

Storage: All chemicals should be stored according to their hazards and associated storage requirements. A walk-in cold storage room is located in Room 1224. Ultra-cold freezers and refrigerators are located throughout the Department in various research laboratories and prep rooms. Chemicals should be stored based on compatibility. Acids, bases, and organics must be segregated from one another. The quantities of chemicals stored in laboratories should be kept to a minimum. Bench top and hood storage of chemicals should be avoided. Take care to ensure that chemicals are not exposed to direct heat or sunlight.

Disposal: As a general rule, never purchase larger quantities of a chemical than you plan to use within a six-month period. Do not stockpile chemicals, and dispose of chemicals for which you have no planned use. Ethers, and substances that form explosive peroxides when open to the air, should be disposed of one year after receipt or prior to their stamped expiry if they have been compromised.

Chemical waste generated within the Physics/Chemistry building is collected and stored in the hazardous waste accumulation area in room 0332. The chemical waste is then removed from campus by a commercial waste broker. Chemical waste should be moved to room 0332 as soon as the waste container is full or the experiment is complete.

Consumed or disposed chemicals will be removed from inventory by attaching the barcode label onto the designated sheet found in each lab area. In addition to attaching the physical label to the sheet the barcode number will be written in the space provided along with the date of disposal. Once per week the barcodes on the designated sheets will be scanned and processed by the inventory manager to be removed from the inventory system.

Solid waste should be stored in glass containers that can be sealed with caps or lids. Aqueous solutions should be stored in glass or polyethylene containers. There should be separate containers for acidic and basic solutions, and for aqueous solutions of metals and organic substances. Prior to being moved to the collection area, a waste label (see Appendix B) must be completed and attached to the container. The label must include the following information: full name or student's full name, faculty name, detailed container contents (do not use chemical formulas or abbreviations). The CHO and/or designee will inspect the container and add a label designating the container as "Hazardous Waste". This label will also include the date and a container # (see Appendix B). The CHO and/or designee will maintain an inventory list of all hazardous waste and will place the properly labeled waste containers on the properly designated shelf in the hazardous waste accumulation area of room 0332. The hazardous waste accumulation area will be inspected weekly by the CHO and/or designee and all records of inspections will remain with the CHO.

Organic solvent waste should be stored in glass containers. Halogenated and non-halogenated liquid waste will be collected in UN/NA steel drums. The drums will be labeled as such and stored in a ventilated flammable storage cabinet in the chemical storage room (room 0332). Drums will be properly grounded within the cabinet. Faculty and staff only will be allowed to transfer waste into the bulk collection drums. Properly trained students may assist in the transfer of waste only in the presence of a faculty or staff member. A logbook will be present in the storage cabinet for the drum. At the time of a waste addition, the following information will be recorded: description/composition of waste, date, and the name of the person conducting the transfer.

<u>Donated Chemical Policy</u>

Donated chemicals to the Departments of Chemistry or Physics at James Madison University are prohibited. It is also prohibited to donate excess chemicals from James Madison University to outside entities such as local public/private schools.

<u>Donated Chemical</u>

A donated chemical shall be defined as a chemical from an outside source not paid for from departmental funds or a JMU administered grant that has no immediate or intended use on the JMU campus. It is not the intent of this policy to interfere with research activities. Either samples collected from outside the University or sent to a PI from another academic institution/government agency/business for research purposes shall not be considered a donated chemical.

<u>Removing Chemicals from Campus</u>

Faculty members of the Department of Chemistry and Biochemistry who engage with the public and our community often take chemicals off campus. As long as the chemicals are not being taken off campus for personal gain or nefarious activities, this practice shall not be hindered except by consultation with the AUH. Examples of appropriate off campus use of chemicals include (but are not limited to) educational demonstration shows at other institutions or public venues. In addition, chemicals used off campus for training exercises with local, state or federal agencies will be considered engaging with the community. It is the expectation of the AUH that all chemicals used off campus will be returned to the JMU Chemistry Department and or disposed of properly by the faculty member supervising the event.

<u>Hazard Identification</u>

Each lab space or suite of lab spaces will have signage at the entrance(s) indicating hazards and contact information. PI's and lab safety personnel will update signage as needed and will review the information for accuracy annually

The Safety Data Sheets (SDS) can be accessed at https://jmu.kha.com/.

SDS Mobile App by KHA can be downloaded to mobile devices from the App Store or Google Play.

Username: jmusds2019

Password: jmusds2019

Once logged in, click on settings, select James Madison University and save.

Chemical Specific Safety Procedures

Hydrofluoric Acid: Hydrofluoric acid is used in 0.5L quantities to clean surfaces prior to many experiments in the materials science program. The guidelines for using hydrofluoric acid are given in Appendix E.

All Organo-Lithium compounds such as tert-Butyl lithium, are extremely air and moisture sensitive reagents and are utilized in the Chemistry Department on an infrequent basis. The guidelines for using Organo-Lithium compounds are given in Appendix F

EMPLOYEE INFORMATION

General Information

James Madison University Department of Chemistry provides safety training for all Departmental employees to ensure safe handling of, and minimum exposure to, hazardous chemicals. The training methods employed by faculty and staff of the Chemistry Department include, but are not limited to course instruction (Chem 325: Chemical Hazards and Laboratory Safety), commercially produced films and literature, online training modules, and appropriate safety books. Additional aspects of Chemical Safety Training are detailed in Appendix H.

Training Requirements

All employees who use chemicals as part of their assigned duties in the Chemistry and Biochemistry Department and the Physics and Astronomy Department are expected to complete an annual chemical safety refresher, which will be available through the chemistry department website. Chemistry Department student employees receive safety training from the Chemical Hygiene Office. Student researchers will receive safety training from their respective faculty advisor. Information and training will be provided at the time of an employee's assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. All student assistants who are employed for more than one academic year will be required to participate in refresher training annually.

Exposure Limits/Exposure Assessment

This chemical hygiene plan has been prepared to ensure that the exposure to hazardous chemicals in the workplace is minimal and does not exceed permissible exposure limits (PELs), specified in 29 CFR part 1910, Z tables (Appendix I). All employees have the right to medical consultations and/or examinations if there is reasonable suspicion that an over exposure occurred. All exposures potentially exceeding the PEL should be reported to CHO..

Exposure Assessment

The purpose of the exposure assessment is to determine the facts surrounding a potential over exposure, including the names of the employees and hazardous chemicals involved.

An exposure assessment includes: (1) Interview of the complainant and victim (if not the same person), (2) determining whether the victim's symptoms match those described in the SDS, and (3) evaluation of current control measures and safety procedures.

The employee will be notified of the results of any monitoring within 15 days. All records of exposure monitoring results will be retained by the employer and will be accessible to the employee. Following an exposure assessment, if no further action is deemed necessary by both the CHO and the complainant, the reason for this decision will be included in the documentation.

Medical Consultations/Examinations

Laboratory employees and students who work with hazardous chemicals will be given an opportunity to receive medical attention, including any follow-up examinations that examining physician determines to be necessary, based upon the following:

- Whenever an employee or student develops signs or symptoms associated with a hazardous chemical to which he/she may have been exposed in the laboratory, or
- Whenever an event takes place in the work area such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure.

Terminating Employment with the University

When a faculty member terminates employment with the university they have a responsibility to ensure that all chemical hazards have been eliminated from their laboratory.

REFERENCES

The resources listed below contain in-depth information concerning laboratory safety and chemical hygiene practices. These resources were used in the development of and are meant to supplement the CHP. All of the resources contained on this list may be viewed by contacting the CHO or are available in the JMU library.

Alaimo, Robert J., ed. *Handbook of Chemical Health and Safety*. New York: Oxford University Press, 2001.

American Chemical Society. *Less is Better: Laboratory Chemical Management for Waste Reduction*. Washington, D.C.: ACS, 1996.

American Chemical Society. *Safety in Academic Chemistry Laboratories: Accident Prevention For College and University Students*. 7 Ed. Vol 1. Washington, D.C.: ACS, 2003.

American Chemical Society. *Safety in Academic Chemistry Laboratories: Accident Prevention For Faculty and Administrators*. 7 Ed. Vol 2. Washington, D.C.: ACS, 2003

American Chemical Society. Task Force on Lab Waste Management. *Laboratory Waste Management, A Guidebook*. Washington, D.C.: ACS, 1994.

Furr, A. Keith. *CRC Handbook of Laboratory Safety*. 5 Ed. New York: CRC Press, 2000.

Gorman, Christine E., ed. *Working Safely with Chemicals in the Laboratory*. Genium Publishing Corporation, 1993.

Kingsley, Warren. *Living with the Laboratory Standard: A Guide for Chemical Hygiene Officers*. Washington, D.C.: ACS, 1998.

Laboratory Exhaust hood Safety. Dir. Wynn O. Jones. 1992.

Lefèvre, Marc J. *First Aid Manual for Chemical Accident*. Stroudsburg: Dowden, Hutchinson, and Ross, Inc., 1980.

Lunn, George and Eric B. Sansone. *Destruction of Hazardous Chemicals in the Laboratory*. Wiley, 2012.

National Research Council. *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*. Washington, D.C.: National Academy Press, 2011.
National Research Council, *Promoting a Culture of Safety in Academic Chemical Research*, Washington D. C., 2014

U.S. Department of Labor. *Respiratory Protection*. OSHA, 2002.

Young, Jay A., et.al. *Developing a Chemical Hygiene Plan*. Washington, D.C.: ACS, 1990.

Young, Jay A. *Improving Safety in the Chemical Laboratory: A Practical Guide*. New York: Oxford University Press, 1991.

APPENDIX A

DEFINITIONS

Chemical Hygiene Officer- an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

Chemical Hygiene Plan- a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace.

Contact Hazard - (Allergens and Sensitizers)- A contact hazard chemical is an allergen or sensitizer that is so identified or described in the MSDS or on the label, is so identified or described in medical or industrial hygiene literature, or is known or found to be an allergen or sensitizer.

Corrosive- A corrosive chemical is one that fits the OSHA definition of corrosive in Appendix A of 29 CFR 1910.1200, fits the EPA definition of corrosive in 40 CFR 261.22 (meaning the chemical has a pH greater than 12 or less than 2.5), or is known or found to be corrosive to living tissue.

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

Emergency- an occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace and/or personal injury or illness.

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- any liquid having a flashpoint below 100 °F (37.8 °C). Aerosols and certain solids can also be classified as flammable.

Flashpoint- the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite.

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

Laboratory- a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory Scale- work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

Laboratory Chemical Exhaust hood- a device located in a laboratory, enclosed on five sides with a moveable sash or fixed partial enclosure on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure with out insertion of any portion of the employee's body other than hands and arms.

Medical Consultation- a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examination or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

Organic Peroxides- an organic compound that contains the bivalent –O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic substituent.

Oxidizer- a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either or itself or through the release of oxygen or other gases.

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.

Reactives- A reactive chemical is one that is described as such in the applicable MSDS or in the "Handbook of Reactive Chemical Hazards, is ranked by NFPA as 3 or 4, is identified by DOT as an oxidizer, organic peroxide, or class A, B, or C explosive, fits the EPA definition of reactive in 40 CFR 261.23, fits the OSHA definition of unstable in 29 CFR 1910.1450, or is known or found out to be reactive with other substances.

Reproductive Toxins- chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects of fetuses (teratogenesis).

Select Carcinogen- any substance which meets one of the following criteria:

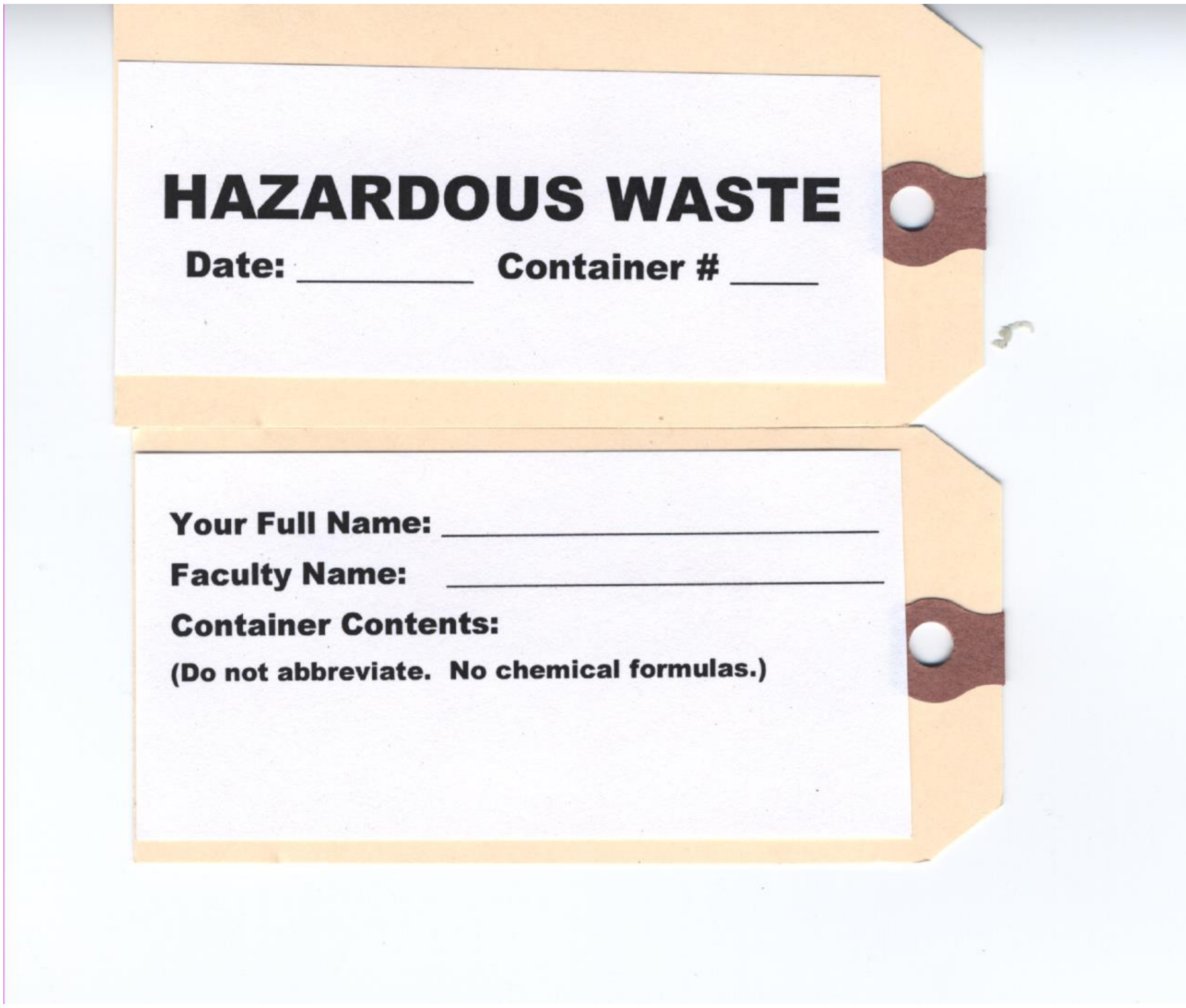
(a) is regulated by OSHA as a carcinogen; or
(b) it listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or
(c) is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
(d) it listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with established criteria.

Unstable "reactive"- a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.

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

APPENDIX B

Hazardous Waste Labels



APPENDIX C
LABORATORY INCIDENT REPORT FORM
James Madison University
Laboratory Incident Report

Date: _______ Time: _______ Location: ____________________

Date of report: ____________________

Incident Type – injury, fire, near miss, etc. ____________________

Name of person involved - print: ______________ Sign: ______________
Address room, apartment : ____________________
building, street ____________________
Telephone: ______________ Cell: ______________ E-mail: ______________

Name of person reporting - print: ______________ Sign: ______________
Telephone: ______________ Cell: ______________ E-mail: ______________

Name of witnesses - print: ______________ Sign: ______________
Telephone: ______________ Cell: ______________ E-mail: ______________

Name of witnesses - print: ______________ Sign: ______________
Telephone: Cell: ______________ E-mail: ______________

Incident

Description of Incident: ____________________

Corrective Actions Taken: ____________________

Additional Corrective Actions Planned: ____________________

Department Head signature:

Forward copies to: office of Risk Management

131 West Grace Street, MSC 6703, Harrisonburg, Virginia, 22807
(540) 568-7812, FAX: (540) 568-2878, Mooremg@jmu.edu, http://www.jmu.edu/riskmtmt/

APPENDIX D

Maintenance of Safety Equipment

FUME HOOD SPECIFICATIONS

- Hoods should be used when there is open handling of hazardous chemicals.
- Hoods will provide 2.5 linear feet of space per person for every two workers working in the hood.
- Hoods will provide a standard face velocity of 80-120 fpm.
- Storage of chemicals and equipment will be kept to a minimum in the laboratory hoods.
- Hoods will not be used to evaporate solvents (except for small quantities of volatile compounds).
- All Departmental laboratory fume hoods will be maintained in good working order at all times. The performance levels of all hoods will be monitored annually by the Chemical Hygiene Officer.

SAFETY SHOWER/EYEWASH STATIONS AND DRENCH HOSES

- We will follow ANZI Z358.1-2009 for any safety issues not specifically covered in this CHP.
- Safety showers/eyewash stations and drench hoses are inspected on a monthly basis by the CHO, or designee.
- The safety shower/eyewash stations and drench hoses must be clear and unobstructed. An area of 30" wide by 48" deep must be free of obstructions around the safety shower/eyewash stations.
- The safety shower is actuated to verify that there is sufficient flow. The eyewashes are inspected for tepid water temperatures and symmetry of flow.
- If all criteria is met, the laminated tag is initialed and dated by the CHO, or designee.

FIRE EXTINGUISHERS

All fire extinguishers in the Physics/Chemistry building are inspected on a monthly basis by JMU's Facilities Management staff.

VOLUNTARY USE OF DISPOSABLE DUST MASKS

Respirators are an effective method of protection against designated hazards when properly selected and worn. Respirator use is encouraged, even when exposures are below the exposure limit, to provide an additional level of comfort and protection for workers. However, if a respirator is used improperly or not kept clean, the respirator itself can become a hazard to the worker. Sometimes, workers may wear respirators to avoid exposures to hazards, even if the amount of hazardous substance does not exceed the limits set by OSHA standards. If your employer provides respirators for your voluntary use, or if you provide your own respirator, you need to take certain precautions to be sure that the respirator itself does not present a hazard. Pollen masks and dust masks are considered "respirators" by OSHA.

You should do the following if you use disposable pollen or dust masks (respirators):

- Read and heed all instructions provided by the manufacturer on use, maintenance, cleaning and care, and warnings regarding the respirators limitations.

- Choose respirators certified for use to protect against the contaminant of concern. NIOSH, the National Institute for Occupational Safety and Health of the U.S. Department of Health and Human Services, certifies respirators. A label or statement of certification should appear on the respirator or respirator packaging. It will tell you what the respirator is designed for and how much it will protect you.

- Do not wear your respirator into atmospheres containing contaminants for which your respirator is not designed to protect against. For example, a respirator designed to filter dust particles will not protect you against gases, vapors, or very small solid particles of fumes or smoke.

- Keep track of your respirator so that you do not mistakenly use someone else's respirator.

[29 CFR, Sec. 1910.134 Appendix D]

APPENDIX E

GUIDELINES FOR USING HYDROFLUORIC ACID

Introduction: Hydrofluoric acid (HF) has a number of chemical, physical and toxicological properties, which make handling this material especially hazardous. Although chemists consider hydrofluoric acid (HF) to be a "weak" acid, its potential to produce serious health effects greatly exceeds that of "strong" acids commonly used in the laboratory. HF shares the corrosive properties common among mineral acids but is unique in its ability to cause deep tissue damage and hypocalcemia. Anhydrous HF is a clear, colorless, fuming, corrosive liquid. HF is also available in the gaseous state. All forms including the solution or the vapor can cause severe burns to tissue which are extremely painful and very slow to heal.

Chemical Properties: Hydrofluoric acid solutions are clear and colorless with a density similar to that of water. The most widely known property of HF is its ability to dissolve glass. It will also attack glazes, enamels, pottery, concrete, rubber, leather, many metals (especially cast iron) and organic compounds. Upon reaction with metals, explosive hydrogen gas may be formed. Use and store HF in polyethylene, polypropylene, Teflon, wax, lead or platinum containers.

Toxicological Properties: The unique toxicological properties of HF are due to the action of the fluoride ion. Fluoride ion causes soft tissue necrosis (similar to alkali damage) and bone damage by binding calcium. Fluoride ions are both acutely and chronically toxic. Acute effects of HF exposure include extreme respiratory irritation, immediate and severe eye damage and pulmonary edema. Skin contact with HF is probably the most common route of exposure for laboratory personnel (often under fingernails); however HF can cause damage through eye contact, inhalation, or ingestion. Exposures to concentrated (>50%) HF solutions will cause immediate, severe, penetrating burns. Exposure to less concentrated solutions may have equally serious effects, but the appearance of symptoms can be delayed for up to 8 hours for concentrations of 20-50% and up to 24 hours for concentrations less than 20% HF. Concentrated HF burns can be fatal even if only 2 % (~ an 8-inch square) of the body is exposed. Working with anhydrous HF is extremely dangerous from the mist produced, which presents a severe inhalation hazard. If you are exposed to hydrofluoric acid seek medical attention immediately, even if you do not feel pain.

Protective Equipment: Always wear gloves, a lab coat, and chemical safety goggles when working with any HF solution. Additionally, a face shield and rubber apron should be worn when handling solutions greater than 2% (1 molar), or if high splash potential exists. Not all gloves provide adequate protection against HF; high quality gloves made from butyl or neoprene rubber are recommended. Two pairs of gloves are recommended when working with concentrations exceeding 20% or when heavy exposure to gloves is expected.

The purpose for personal protective equipment (PPE) is to shield the individual in the event of a release of vapor, a spill or other incident. PPE is not a substitute for safe work practices. Although accidents involving HF may not be totally eliminated, pre-planning will minimize the effects of such incidents. All laboratories that store or use HF should develop standard operating procedures that outline how to safely use HF, as well as how to respond to personnel contamination and HF spills.

HF Exposures: Although HF exposures can result in injury, quick response will minimize the damage. All exposures should be treated immediately even though burns may not be felt for hours.

HF first aid and spill response kits must be located in every lab in which HF is used.

Skin Contact – Immediately wash all affected areas with water. Be sure to remove any clothing or jewelry that could trap HF (remove goggles last). Flush skin for fifteen minutes or until medical attention is available. Flushing can be reduced to five minutes if calcium gluconate gel (2.5%) is immediately available. Apply calcium gluconate gel to the affected area (use rubber gloves) every fifteen minutes and massage continuously.

Eye Contact – Immediately flush eyes for at least fifteen minutes with water while holding eyelids open. Get medical attention. Flushing can be limited to five minutes if medical personnel are immediately available to administer sterile calcium gluconate (1%) solution (via continuous drip into eyes).

Inhalation – Move to fresh air as soon as possible. Get medical attention. Medical personnel can administer pure oxygen and calcium gluconate (via nebulizer) to patient. Laboratory personnel should only attempt to clean up small HF spills that do not involve personnel contamination and that are contained and under control.

Affected personnel must receive medical attention for all eye and inhalation exposures, and all but the most minor skin burns. Maintain a copy of these procedures and MSDS to take to the emergency room or doctor's office.

Using Hydrofluoric Acid Safely: You should never use Hydrofluoric Acid when working alone or after hours.

All lab personnel, not just those who will be using Hydrofluoric Acid, should be informed of the dangers of this chemical and the emergency procedures necessary in case of an accident. A sign should be posted to alert people that work with Hydrofluoric Acid is in progress.

All persons who will be using Hydrofluoric Acid must be made aware of its properties and trained in proper procedures for use and disposal.

Laboratories which keep or use Hydrofluoric Acid gas or concentrated solutions (>1% Hydrofluoric Acid) must have an operational safety shower and eyewash in their laboratory. Before beginning any procedure involving Hydrofluoric Acid, make sure the access to the emergency shower and eyewash is unobstructed.

A small supply of calcium carbonate or calcium hydroxide for spills should also be kept near the hood where the work will be conducted. If a small quantity (100 ml or less) of dilute Hydrofluoric Acid solution is spilled, use a commercial Hydrofluoric Acid spill kit located in
2224. If a larger amount is spilled, or the acid is concentrated, contain the spill as best you can, evacuate the area, and call 86911. Avoid exposure to the vapors.

Hydrofluoric acid should only be dispensed by individuals trained in the hazards and techniques associated with the chemical. If a student uses HF, ensure that a knowledgeable faculty member has reviewed the MSDS with them, instructed them on proper technique, and had them read and sign this appendix verifying the communication, and provided a photocopy to the CHO.

Name (printed): ____
Signature: ____
Date: _________________

APPENDIX F

GUIDELINES FOR USING ORGANO- LITHIUM

Organo-Lithium compounds such as Tert-Butyl lithium (t-BuLi) are an extremely air and moisture sensitive organometallic reagents. It must only be handled in a chemical fume hood.

Organo-Lithium should only be dispensed by individuals trained in the hazards and techniques associated with the task. If a student dispenses Organo-Lithium, ensure that a knowledgeable faculty member has reviewed the SDS with them, instructed them on proper technique, and had them read and sign this appendix verifying the communication.

Before dispensing Organo-Lithium, ensure that unnecessary clutter has been removed from the fume hood, the pathway to the nearest safety shower and eyewash are clear, and that a fire extinguisher is available.

Organo-Lithium must never be dispensed, used, or quenched by anyone alone.

If Organo-Lithium is to be removed from a septa-sealed bottle (like an Aldrich *Sure-Seal* bottle), verify the integrity of the syringe and needle and that they are completely dry and that an inert gas such as nitrogen or argon is available to spoil the vacuum created in the bottle by the syringing process.

If any Organo-Lithium is spilled in the hood, immediately close the sash. If a bottle of Organo-Lithium is dropped or spilled outside of the hood, do not try to clean it up yourself. Evacuate the area, and report the incident by calling 86911.

Organo-Lithium Training Sheet

The following sign-in sheet must be used to document safety training for organo-lithium reagents. At a minimum the training must include the specific names of the reagents trained on, chemical and physical hazards, proper handling and dispensing techniques, required PPE, potential emergencies and how to respond appropriately. A separate sheet detailing the specifics of training as well as the current Safety Data Sheet(s) communicated during the training must be attached.

Instructor Name (printed)	Instructor Signature/Date
Trainee Name (printed)	Trainee Signature/Date

APPENDIX G

LASER SAFETY

LASER HAZARD CLASSES

1. Virtually all of the U.S. domestic as well as all international standards divide lasers into four major hazard categories called the laser hazard classifications. The classes are based upon a scheme of graded risk. They are based upon the ability of a beam to cause biological damage to the eye or skin. In the FLPPS, the classes are established relative to the Accessible Emission Limits (AEL) provided in tables in the standard. In the ANSI Z 136.1 standard, the AEL is defined as the product of the Maximum Permissible Exposure (MPE) level and the area of the limiting aperture. For visible and near infrared lasers, the limiting aperture is based upon the "worst-case" pupil opening and is a 7 mm circular opening.

2. Lasers and laser systems are assigned one of four broad Classes (I to IV) depending on the potential for causing biological damage. The biological basis of the hazard classes are summarized in Table G-

   1. **Class I**: cannot emit laser radiation at known hazard levels (typically continuous wave: cw 0.4 µW at visible wavelengths). Users of Class I laser products are generally exempt from radiation hazard controls during operation and maintenance (but not necessarily during service).

      Since lasers are not classified on beam access during service, most Class I industrial lasers will consist of a higher class (high power) laser enclosed in a properly interlocked and labeled protective enclosure. In some cases, the enclosure may be a room (walk-in protective housing) which requires a means to prevent operation when operators are inside the room.

   2. **Class I.A.**: a special designation that is based upon a 1000-second exposure and applies only to lasers that are "not intended for viewing" such as a supermarket laser scanner. The upper power limit of Class I.A. is 4.0 mW. The emission from a Class I.A. laser is defined such that the emission does not exceed the Class I limit for an emission duration of 1000 seconds.

   3. **Class II**: low-power visible lasers that emit above Class I levels but at a radiant power not above 1 mW. The concept is that the human aversion reaction to bright light will protect a person. Only limited controls are specified.

   4. **Class IIIA**: intermediate power lasers (cw: 1-5 mW). Only hazardous for intrabeam viewing. Some limited controls are usually recommended.

      NOTE: There are different logotype labeling requirements for Class IIIA lasers with a beam irradiance that does not exceed 2.5 mW/cm^2 (Caution logotype) and those where the beam irradiance does exceed 2.5 mW/cm^2 (Danger logotype).

   5. **Class IIIB**: moderate power lasers (cw: 5-500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit, whichever is lower). In general Class IIIB lasers will not be a fire hazard, nor are they generally capable of producing a hazardous diffuse reflection. Specific controls are recommended.

   6. **Class IV**: High power lasers (cw: 500 mW, pulsed: 10 J/cm^2 or the diffuse reflection limit) are hazardous to view under any condition (directly or diffusely scattered) and are a potential fire hazard and a skin hazard. Significant controls are required of Class IV laser facilities.

HOW TO DETERMINE THE CLASS OF LASERS DURING INSPECTION.

1. The classification of a laser or laser product is, in some instances, a rather detailed process. It can involve determination of the AEL, measurement of the laser emission, measurement/determination of the emission pulse characteristics (if applicable), evaluation of various performance requirements (protective housing, interlocks, etc.) as specified by the FLPPS and/or ANSI standards.
2. It should be stressed that classification is a required specification provided by the laser manufacturer and the label that specifies the class is found in only one location on the laser product. The class of the laser will be specified only on the lower left-hand corner (position three) of the warning logotype label.
3. The logotype is the rectangular label that has the laser "sunburst" symbol and the warning statement of CAUTION (Class II and some Class IIIA) or DANGER (some Class IIIA, all Class IIIB and Class IV). This label will also have the type of laser designated (HeNe, Argon, CO_2, etc.) and the power or energy output specified (1 mW CW/MAX, 100 mJ pulsed, etc.).
4. Class I lasers have no required labeling indicating the Class I status. Although the FLPPS requires no classification labeling of Class I lasers it does require detailed compliance with numerous other performance requirements (i.e., protective housing, identification and compliance labeling, interlocking, etc.)

TABLE G-1. LASER CLASSIFICATIONS—SUMMARY OF HAZARDS

	Applies to --- wavelength ranges ---				------------ Hazards ------------		
Class	**UV**	**VIS**	**NIR**	**IR**	**Direct ocular**	**Diffuse ocular**	**Fire**
I	X	X	X	X	No	No	No
IA	--	X*	--	--	Only after 1000 sec	No	No
II	--	X	--	--	Only after 0.25 sec	No	No
IIIA	X	X**	X	X	Yes	No	No
IIIB	X	X	X	X	Yes	Only when laser output is near Class IIIB limit of 0.5 Watt	No
IV	X	X	X	X	Yes	Yes	Yes

Key:
X = Indicates class applies in wavelength range.
* = Class **IA** applicable to lasers "not intended for viewing" ONLY.
** = CDRH Standard assigns Class **IIIA** to visible wavelengths ONLY. ANSI Z 136.1 assigns Class IIIA to all wavelength ranges.

Physics-Chemistry Building Laser Safety Policy

All individuals working with Class IIIB, Class IV lasers, or another potential laser hazard identified by a project leader, are required to complete Laser Safety Training and pass the Laser Safety Quiz with a grade of 60% or higher. The PCB Laser Safety Officer is Dr. Sasha Kokhan who conducts the Laser

Safety Training and administers the Laser Safety Quiz. Laser Safety Quiz results are retained in Dr. Kokhan's office for 3 years after completion of Laser Safety Training.
Lasers are powerful tools in modern scientific research but they also are potential laboratory hazards. It is important to be aware of the classes of lasers, associated risks, mitigation strategies, and biological impact of possible injuries. The JMU Department of Chemistry and Biochemistry has substantial holdings of laser equipment. The laser safety policy for working with this equipment relies on three main points:

- *Communication*
- *Control of Experiments*
- *Common Sense*

Before a student can become an authorized user on a laser system they must see the Laser Safety Representative and listen to a 20-minute presentation on lasers and optical radiation hazards in the laboratory. This presentation will *communicate* several topics to a potential authorized user: (1) the types and classification of lasers at JMU, (2) how these laser types can cause personal injury, (3) use of personal protective equipment for laser applications. Afterwards, a potential authorized user must score 100% on a laser safety quiz given by the Laser Safety Representative.
Second, project leaders must take steps to ensure that all laser hazards are appropriately contained within a *Laser Control Area* (LCA). A LCA is a barrier between the hazard and the user and can take many forms. Examples include a window-less room with a closed door, a physical barrier, a laser curtain, or even an optical fiber. If an authorized user is inside a LCA (or if a LCA has not yet been established) then they must wear laser safety goggles at all times. If an authorized user is outside of a LCA then they must follow specific safety instructions from their project leader.
Finally, laser safety education within the JMU Department of Chemistry and Biochemistry relies on educating users on how to utilize a *common sense* approach to laser safety. After a student has passed the laser safety quiz they will spend approximately 20 minutes in the laboratory with the Laser Safety Representative. During this time, long-established common sense tips for safely using lasers in the laboratory will be discussed. Examples include (1) not wearing rings and (2) never crossing your line of sight through a plane containing a laser beam (anywhere in the lab).
The combination of communication, control of experiments, and common sense is important for all members of our department to follow and will minimize the risk of injury from optical radiation hazards at JMU.

APPENDIX H

ASPECTS OF CHEMICAL SAFETY TRAINING

Employee training shall include:

- Familiarization with the contents of the OSHA Laboratory Standard (29 CFR 1910-1450).
- Location, availability, and content of the CHP and the Physics/Chemistry Building Fire Safety and Emergency Evacuation Plan building.
- Signs and symptoms associated with exposures to hazardous chemicals.
- Location and availability of known reference materials on the hazards, safe handling, storage, and disposal of hazardous chemicals. Reference materials may include, but are not limited to, material safety data sheets received from chemical suppliers.
- Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as employee exposure monitoring, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.)
- Physical and health hazards of chemicals in their work area.
- Measures employees can take to protect themselves from such hazards, including specific procedures that have been implemented to protect laboratory employees from exposure to hazardous chemicals. These include utilizing engineering controls such as chemical exhaust hoods, appropriate work practices, and personal protective equipment to be used.
- Standard operating procedures specific to individual labs.

APPENDIX I

Links to **29 CFR 1910.1000 Z Tables**

Table Z-1: Limits for Air Contaminants
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9992

Table Z-2
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9993

Table Z-3: Mineral Dusts
http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=9994