CHEMICAL HYGIENE GUIDE

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Rutgers University Chemical Hygiene Guide

Introduction

Purpose

In February 1993, New Jersey's Public Employees OSHA adopted 29 CFR 1910.1450, Federal OSHA's "Occupational Exposure to Hazardous Chemicals in Laboratories Rule", (also known as the Laboratory Standard). The standard provides for the health and safety of employees in the laboratory by generally requiring the following:

* Development of a laboratory Chemical Hygiene Plan.

* Designation of a Chemical Hygiene Officer.

* Standard operating procedures to be followed when using hazardous chemicals.

* Establishment of "designated areas", as well as other protective measures, when working with select carcinogens, reproductive toxins, or particularly hazardous materials.

* Procedures for the "prior approval" of hazardous laboratory operations.

* Training of laboratory workers.

* Medical consultations and examinations for employees with hazardous chemical exposures.

* Identification of hazards.

* Recordkeeping for any measurements of employee exposure and medical consultations/examinations.

An overview of the Laboratory Standard, as well as a full copy of the regulation, is provided in Appendix 1.

The purpose of this Guide is to provide a model for the development and implementation of a Chemical Hygiene Plan (CHP) for each university laboratory, as required by the Laboratory Standard. While it is not mandatory that all University laboratories use this model plan, it is provided as a guide for compliance for those who do wish to use it. This document is "generic" and applies to many types of laboratories; however, it must be modified and amended for each specific laboratory. When properly developed and followed, this plan should serve as a comprehensive health and safety program for each laboratory. If this model plan is not used, it is the responsibility of the principal investigator to produce a Chemical Hygiene Plan that is thorough and complete, will demonstrate compliance with the Laboratory Standard and is fully consistent with the policies contained herein.

Scope/Applicability

At Rutgers University, the Laboratory Standard applies to all employees and students engaged in the "laboratory use" of hazardous chemicals. It applies to research and teaching laboratories that are carrying out small-scale operations (those which can be handled safely and easily by one person) using multiple chemicals and procedures, where the procedures are neither a part of, nor simulate, a production process.

Designation of Responsibility

The following designates responsibility for implementation of the Laboratory Standard at Rutgers University:

* **LABORATORY WORKER** - Follows safe work practices, attends required training and is familiar with the laboratory Chemical Hygiene Plan.
* **LABORATORY SUPERVISOR** - Assures that all employees/students in the lab follow safe work practices, provides necessary hands-on training, develops the laboratory Chemical Hygiene Plan, ensures the Chemical Hygiene Plan is available to all occupants of the lab, and provides "prior approval", when necessary.
* **CHEMICAL HYGIENE OFFICER** - Implements the laboratory Chemical Hygiene Plan, provides guidance on safe laboratory procedures, and assists in the annual review and update of the Chemical Hygiene Plan.
* **DEPARTMENT CHAIR** - Designates the Chemical Hygiene Officer (either one for the department, or individual Chemical Hygiene Officers for each lab), assures department compliance with the standard, appoints department Unit Safety Committee.
* **UNIVERSITY LABORATORY SAFETY AND DESIGN COMMITTEE** (Subcommittee to the University Health Safety Council) - Serves as the University Chemical Hygiene Committee, reviews annually the Chemical Hygiene Guide, reviews and approves University policy on laboratory safety.

CHEMICAL HYGIENE PLAN ELEMENTS

The Laboratory Standard requires that the CHP, when implemented, be capable of protecting employees from health hazards associated with chemicals in the laboratory and that it keep exposures below occupational exposure limits.[*] The laboratory Chemical Hygiene Plans must be made readily available to all laboratory employees, and must contain the following elements:

A. Standard operating procedures for laboratory safety and health.

B. Criteria that Rutgers University will use to determine and implement control measures to reduce employee exposures to hazardous chemicals.

C. Documentation of requirements that fume hoods and other protective equipment are functioning properly, and measures that will be taken to ensure their adequate performance.

D. Provisions for employee information and training, as detailed in the standard.

E. Documentation of circumstances under which certain laboratory operations will require prior approval.

F. Provisions for medical consultations and exams, as detailed in the standard.

G. Provisions for additional employee protection when working with "particularly hazardous substances", as defined in the standard.

[*] At Rutgers University, these occupational exposure limits include either Threshold Limit Values (TLVs), which are established by the American Conference of Governmental Industrial Hygienists (ACGIH) or Permissible Exposure Limits (PELs) promulgated by Federal OSHA, whichever is LOWER.

This Chemical Hygiene Plan encompasses the following area(s) (to be completed by Chemical Hygiene Officer):

Name of Department or Division: _____

Name(s) of Chemical Hygiene Officer(s): _____

_____

_____

List building/room(s) covered by the Plan: _____

_____

EMPLOYEE ACKNOWLEDGEMENT AND REVIEW OF CHEMICAL HYGIENE PLAN

Principal investigators[1] are responsible for communicating university, as well as their own safety requirements to individuals in their laboratory. REHS has prepared the following form to assist documenting this communication and hands-on training. Additional copies of this form (PDF) are available from the REHS website at http://rehs.rutgers.edu/pdf_files/CHG-Acknowledgement.pdf.

Specific safety requirements will vary based upon the individual and their assigned work activities in each laboratory. Principal investigators are expected to review relevant topics with individuals based upon their anticipated and assigned work activities. At a minimum, principal investigators need to review:

- The N.J. Hazard Communication Standard, including applicable provisions of the N.J. Worker Community Right-to-Know Act. For additional information and resources on these programs, go to http://rehs.rutgers.edu/lslab_hcs.htm and http://rehs.rutgers.edu/rehs_njrtk_all.html.
- The OSHA Occupational Exposure to Hazardous Chemicals in Laboratories (the Lab Standard) as it pertains to the standard (Appendix 1 of this Guide), the location of the Chemical Hygiene Plan, applicable exposure limits (Appendix 1 of this Guide), exposure symptoms, reference locations (MSDS'), exposure monitoring methods used, physical and chemical hazards, and protective measures. For additional information and resources on these programs, go to http://rehs.rutgers.edu/lslab_lsch.htm.

The following employees have reviewed and understood the Rutgers University Chemical Hygiene Guide, this Laboratory's Standard Operating Procedures (SOP's), as well as the Material Safety Data Sheets (MSDS's) for the chemicals they use:

Print Name	Sign Name	Date

[1] The principal investigator may designate the responsibility to a senior laboratory person who has: (i) responsibility for laboratory safety, (ii) the authority to enforce and implement safety procedures and policies in the laboratory, and (iii) process knowledge or familiarity with the lab activities or operations.

A. STANDARD OPERATING PROCEDURES

The following SOPs are generic, and apply to most laboratories where chemicals are used. They should be modified, as appropriate, for each specific laboratory. SOPs specific to procedures and operations in each laboratory must be developed and included in each laboratory's CHP.

1. Emergency Procedures

a. Priorities

An emergency is any event that requires an immediate stop in work and the following of a special procedure to protect life, health, and property.

The best time to know what to do in an emergency is before, not after, it happens. The best time to read this Guide, then, is at your leisure -- before the fire begins, and before the chemical is spilled. Though no single guide can possibly cover the range and combination of events that can constitute an emergency, it is hoped that careful reading of the following emergency procedures will help you begin the planning process that will best fit your situation. Your experimental protocols or written procedures must always include safety measures, and at times may need to include specific emergency procedures. In any case, all such emergency procedures will need to be practiced and reviewed periodically.

Most emergencies will be small, consisting of a single unexpected event. More serious emergencies involve a series of events, which stem from an initial incident, expanding in unfortunate sequence. Under any circumstances, decisions may have to be made quickly, often without adequate information, in a context that may have no precedent. Use the best and calmest judgment you have, and try to stay within the following general priorities:

1) **LEAVE** the area of danger. This is of paramount importance to enable rescuers to do what is necessary to sustain life. If the area includes other people's workspace, make sure they leave, too. If you can safely turn off equipment as you go, do so.

2) **CALL** the campus emergency number from the nearest safe area. Calling takes precedence over everything except evacuation in all emergencies. This also applies for seemingly minor emergencies; it is far better to make an occasional unnecessary call than to fail to call and needlessly endanger life or health.

   For ALL emergencies:

   New Brunswick 911 via the emergency call system or 932-7211 (24 hours)
   Newark (973) 353-5111
   Camden (856) 225-6111 or dial 8 from any campus phone

   For off-campus locations, please list emergency number here:

   _____

   Calmly state: your name; the location and nature of the emergency; whether an ambulance or fire fighting equipment is needed; any hazards that might threaten persons on the scene or responding; and a phone number and location at the scene where you can be reached.

After calling, stay off the phone. The only exception is in cases of poisoning, when you may need to call the NJ Poison Information and Education System: 1-800-222-1222.

3) PROTECT the life and health of anyone who may be injured. The First Aid advice given in this Guide is contingent on rescue equipment and qualified personnel being 2 or 3 minutes away. In a number of isolated experiment stations this is not so; suitable modifications to the emergency procedures should be made.

After calling, do what you can to continue to preserve life, but do no more than the necessary first aid procedures unless you are specifically trained to do so. Subsequent steps will depend on the nature of the emergency and your assessment of its severity. In each of the following situations, be sure you are in a safe place, summon help quickly, and try to protect the lives of those involved.

b. Injury

Ideally, only people with first aid training should render first aid (call 445-4902 for more information on first aid training). In an emergency, however, untrained help may be better than none. Stay calm, do only what you must before help arrives, and follow these priorities:

1) **REMOVE THE VICTIM FROM THE AREA OF DANGER** -- fire, spill, fumes, etc. If the victim is not conscious – DO NOT ENTER THE AREA - proceed immediately to step 2, "Call for help."

[NOTE: If the victim is in contact with electricity, he or she becomes "the area of danger". Avoid direct physical contact with the injured and the source of power; disconnect the power, or push/pull the victim away from the circuit with a non-conductive material (board, rope, etc.)].

2) **CALL FOR HELP** New Brunswick 911 via the emergency call system or 932-7211 (24 hours), Newark (973) 353-5111, Camden (856) 225-6111 or dial 8 from any campus phone. For off-campus locations, list emergency number here:

_____

Always initiate the process to get trained medical help before you take any other extensive action. For a serious injury (very heavy bleeding, chemical in eyes, etc.), you will often need to stabilize the situation briefly before calling. Common sense will dictate this potentially difficult decision, but in no case should calling be delayed except for the most immediate life-threatening situation.

If two people are available, one can go for help while the other begins first aid.

3) **REESTABLISH AIRWAY** for breathing, if breathing has stopped.

Check for an object blocking the airway; remove it if possible. Only if there is no blockage should artificial respiration be attempted; otherwise the victim could be injured further.

Lift the victim's neck and tilt head back to open airway. Pinch the victim's nostrils and cover the mouth with yours. Blow your breath into the victim's mouth until you see the chest rise. Remove your mouth and let the victim exhale while you breathe in.

Repeat 15 times per minute until the victim starts breathing or help arrives. DO NOT STOP, even if you think there is no hope.

4) **CONTROL BLEEDING** by applying direct pressure to the wound, using a clean cloth or your hand. If possible, elevate the injured area above the heart. Keep the victim warm and lying down. Never use a tourniquet except for amputated or crushed limbs.

5) **REESTABLISH CIRCULATION** through cardio-pulmonary resuscitation (CPR). Only those trained in this procedure should attempt it. Training is available through the Rutgers University Emergency Services; for information, go to http://rues.rutgers.edu/cpr.shtml.

6) Treat for **CHEMICAL CONTACT**.

If the chemical was ingested, call the campus emergency number and then the NJ Poison Information and Education System (1-800-222-1222). Follow their instructions. If for some reason you cannot reach professional advice, do not give the victim water, milk, or anything else unless so directed by a Material Safety Data Sheet (MSDS), Hazardous Substance Fact Sheet (HSFS), or other text. Do not induce vomiting if the victim complains of pain or a burning sensation in the mouth or throat, or if the ingested substance is known to be caustic, a cleaning fluid, or a petroleum product. Induce vomiting only if directed to do so by Poison Control. To induce vomiting, place the victim's head below the hips, mouth down or to the side, and place a finger at the back of the victim's throat.

If the chemical was inhaled **and the victim is conscious**, call the campus emergency number and then carry or drag the victim to fresh air. Do not let the victim walk unassisted or engage in any unnecessary activity that will increase the circulation of poison in the bloodstream. If you need to use artificial respiration, be careful you do not inhale the poison from the victim. **If the victim is not conscious, do not enter the area**; the victim may have been overcome by gases in the area, or by a lack of oxygen in the space. There have been many documented instances, some on University campuses, of would-be rescuers becoming additional victims.

If the chemical was splashed in the eye, immediately seek an eyewash, safety shower, or spigot. The eye must be washed for at least 30 minutes with the eyelids held apart to allow maximum exposure of the eyeball. While washing, check for contact lenses by looking into the eye, and by asking the victim. Ask the victim to remove them if possible. Otherwise, contacts may be removed under gentle water pressure. Do not attempt to remove contacts by hand or with any other object. Emergency personnel are trained to do this. Be careful not to rub the eyes.

If chemicals are on the skin, follow the recommendations under the First Aid section of the MSDS. If such information is not readily available, wash the affected area with continuous clean water for 30 minutes. Remove any clothing contaminated with chemicals; be careful that the rescuer does not become contaminated as well.

Be aware of the possibility of inadvertent injection or unnoticed introduction of chemicals into the body. Many solids, oily liquids, or water solutions can enter through cuts in the skin. In addition, the skin will absorb many oily liquids and oil soluble solids. Keep victim quiet and wait for medical assistance.

7) Treat for **SHOCK**.

Though in appearance less dramatic than the above injuries, shock can kill just as quickly. If a person goes into severe shock, treatment for shock takes priority over all first aid except for reestablishing airway, control of bleeding, and CPR.

Symptoms of shock include paleness, cold and clammy skin, weakness, nausea/vomiting, shallow breathing, rapid pulse, cold sweat, chills and shaking.

If possible, remove the cause of shock (e.g., control heavy bleeding). Keep victim warm and lying down. Elevate legs if no spinal or head injuries are suspected. Keep airway open and give non-alcoholic liquids if the victim can swallow and does not have a "belly wound."

c. Fires and Explosions

1) **LEAVE** the area of danger -- usually the building. When needed, use a fire extinguisher to clear a safe path, or "shoot your way out" as directed in the University Emergency Action Plan (refer to Appendix 2 of this guide).

2) **CALL** the campus emergency number. The emergency number should be called, or the building alarm sounded, for all unintentional fires, without exception.

3) Be sure that others in the area of the fire are notified as well, whether verbally or through the fire alarm. If you hear a fire alarm (a loud bell or horn), immediately leave the building, making sure that others do too.

4) On your way out, turn off equipment and move explosive materials away from possible heat, **ONLY IF THERE IS SAFE TIME TO DO SO**. Your leaving quickly is **THE HIGHEST PRIORITY**.

5) In determining the nearest safe place, be aware of the possible spread of toxic gases and fumes, including the likely direction of spread (for example, gases heavier than air will accumulate in low places). When the Fire Department arrives, tell them which chemicals are involved.

6) If a person's clothing is on fire, he or she must not be allowed to run, as this will fan the flames and cause a more serious burn. Douse with water or wrap in a fire blanket, coat, or whatever is available to extinguish the fire. Roll the person on the floor if necessary. After calling the emergency number, place clean, wet, ice-packed cloths on the burned areas, wrap the person warmly to avoid shock, and wait for assistance.

7) The primary purpose for fire extinguishers is to "shoot your way out" in order to reach safety; fire fighting is always better done by those with the equipment and training to do it. Know in advance which type of extinguisher is appropriate for which type of fire (consult the data on the extinguisher); be sure to use the appropriate extinguisher and direct discharge at the base of the flames. Training on the proper use of fire extinguishers is available through the Fire Safety

Section of Rutgers Emergency Services. Call (732) 932 – 4875 or go to http://rues.rutgers.edu/firetrain.shtml for more information.

8) Covering the vessel with an inverted beaker or watch glass can usually smother a fire contained in a small vessel. Do not use dry paper towels or cloths. Remove nearby flammable materials while the fire burns itself out.

d. Chemical Spills

Procedures for handling spills in laboratories are given in Appendix 2. If there has been any chemical contamination of personnel or clothing, follow Emergency Procedures for Chemical Contact (see section b.6, above).

e. Identifying Hazardous Substances in Emergencies

To help identify hazardous substances involved in an emergency, REHS has established a Caution Sign program that provides for door signs bearing the room supervisor's name and phone number and a listing of potential hazards in the room. Caution signs may be obtained at http://halflife.rutgers.edu/forms/cautionsign.php. A copy of the Caution Sign program is given in Appendix 3.

f. Reporting Accidents

In the event of a laboratory accident, the supervisor or instructor must log onto the Accident Reporting System and submit an accident report form. This form contains valuable information to help determine causes and prevent future accidents in the laboratory, and should be completed for all laboratory accidents, no matter how minor.

Instructions to access and submit and accident report form can be found at https://halflife.rutgers.edu/accident/index.php**,** in Appendix 4 of this guide, or in the University Emergency Action Plan found in Appendix 2 of this guide.

g. Power Failures

If your laboratory loses power during an emergency, suspend and secure experiments to prevent an emergency condition and disconnect equipment that could be damaged by a power surge when electricity is restored. Contact the Utilities Operations at (732) 445 – 4117, X 150 between 7:30 AM – 4:30 PM, or University Police on weekends, holidays, or after normal business hours at (732) 932 – 7211. Review the University Emergency Action Plan for guidance on how to respond to other utility outages.

2. General Laboratory Behavior

a. Safety Rules

1) Know the location of laboratory exits.

2) Know the location and use of the safety showers and eyewashes.

3) Know the location and use of fire extinguishers.

4) Know the location and use of spill kits, when available.

5) Know the location of the nearest phone, which can be used in an emergency.

6) Know the potential hazards of the materials, facilities, and equipment with which you will work. If you are uncertain ask your instructor, your supervisor, or REHS.

7) Use the proper safety equipment for your procedure. This could include a fume hood, glove box, biosafety cabinet, shield, or other equipment.

8) Do not wear contact lenses in laboratories where chemicals are used.

9) Wear eye protection in the laboratory. Splash goggles are required for wet chemical work or work with dusts and powders.

10) Wear other personal protective gear where laboratory or experimental conditions dictate. This includes laboratory aprons, lab coats, gloves, gauntlets, glass blowers' goggles, face shields, dust masks, respirators. Anyone requiring respiratory protection must participate in Rutgers Respiratory Protection program. Contact REHS at 445-2550 for more information, and other equipment.

11) Wear clothes that protect the body against chemical spills, dropped objects, and other accidental contact. Thus, bare midriffs, shorts, open shoes, sandals, and high heels are prohibited.

12) Confine long hair when in the laboratory. Remove or secure ties or other articles of clothing or jewelry that might become entangled in equipment.

13) Do not eat, drink, smoke or apply cosmetics in the laboratory. Do not store food or drink in the laboratory, or use laboratory equipment for eating or drinking.

14) **Do not pipette by mouth**. Use only mechanical pipette devices.

15) Wash hands frequently when handling chemicals and before leaving the laboratory. Beware of contamination of clothing or of doorknobs, frames, etc. Remove any protective gear before leaving the laboratory; this includes gloves and laboratory coats.

16) Follow written protocols or instructions. Perform only authorized experiments. (See Sec. E, "Laboratory Operations Which Require Prior Approval".)

17) Do not move or disturb equipment in use without consent of the user.

18) For reasons of safety and security, it is prudent to avoid working alone in the laboratory, particularly after hours. The laboratory supervisor is responsible for determining and implementing procedures to provide for emergency notification and periodic checks of an individual working "alone" in the laboratory. The extent of the procedures is dependent on the nature of the laboratory work and the degree of potential hazard.

19) Do not play in the laboratory.

20) Follow good housekeeping practices -- clean up as you go, and keep work areas, aisles and exits uncluttered.

21) Do not deface labels on chemical containers. Make sure all container labels correctly identify their contents.

22) Report all accidents and injuries immediately to your laboratory instructor, supervisor, or Chemical Hygiene Officer.

23) Report unsafe conditions to your instructor, supervisor, Chemical Hygiene Officer, or REHS.

b. Additional Rules for Students

1) Read and follow the Safety Rules listed previously.

2) Know who is in charge of your laboratory.

3) Perform only authorized experiments, and be sure you understand the procedures involved before you begin. If anything unexpected, dangerous, threatening, or unmanageable happens, immediately call your instructor.

4) Do not use unfamiliar equipment without instruction and permission.

5) Behave and dress appropriately for conscientious work in a potentially hazardous place. Never play in the laboratory.

6) Report all accidents and injuries, however small, to your instructor.

c. Additional Rules for Instructors and Supervisors

1) Take responsibility, in attitude and action, for the safety conditions of your laboratory.

2) Observe all rules and see that they are enforced.

3) Set an example by wearing protective equipment and by following proper laboratory procedures to promote safe work habits.

4) Carefully review all laboratory experiments for possible safety problems before the experiments are assigned to students.

5) Make both preventative and remedial safety measures part of your instruction. Be sure all students and laboratory workers are familiar with emergency procedures and equipment.

6) Be alert for unsafe conditions. Inspect often and intelligently; take effective corrective action promptly.

7) Assume responsibility for visitors and require that they follow the same rules as students and other laboratory workers.

8) Keep a current file of publications on laboratory safety. Encourage its use. See Section D on Employee Information and Training.

d. Rules for Custodial Workers

1) You may sweep, mop, wash the floors and remove normal trash from any laboratory, including a radiation laboratory.

2) Rooms, which have a Caution Sign and any of the nine different stickers on the door, may contain materials or equipment, which if used improperly, may cause harm.

3) Do not touch any material, container, or waste container with a biohazard symbol or radiation symbol on it.

4) You must not touch, disturb, move, or handle any containers of any chemicals or materials except those issued to you by your department. If you need chemicals or other laboratory materials moved in order to perform your duties, have the room supervisor arrange for this to be done, or contact your supervisor.

5) If the contents of any containers (other than those issued to you) are spilled, DO NOT TOUCH THEM OR ATTEMPT TO CLEAN THEM UP. Tell your supervisor, who will then contact emergency personnel.

6) Wear safety glasses if there are persons working in the laboratory.

7) Do not eat, drink, smoke, or apply cosmetics in a laboratory.

8) If you have any questions, contact the room supervisor first, your supervisor next, or finally, REHS.

e. Rules for Maintenance Workers

1) Before working in a laboratory, or on a chemical fume hood, inform the room supervisor what you will be doing, and when you will be working. The room supervisor's name should be posted on the main laboratory door.

2) The room supervisor is responsible for assuring that your work area within the room is free from physical, chemical, and/or biological hazards. Your work area may include hoods, sinks, cabinets and benches, bench tops, floors, and/or equipment. You may be required to repair, move, remove, replace, paint, etc. as part of your duties.

3) Do not handle or move chemicals in the laboratory. If you need chemicals moved in order to perform your duties, have the room supervisor arrange for this to be done.

4) Generally, you should not move or handle equipment in the laboratory. If your work requires you to move, remove, or replace a piece of equipment, have the room supervisor assure you that the equipment is free of any physical, chemical and/or biological hazards.

5) Do not eat, drink, smoke, or apply cosmetics in the laboratory.

6) In situations where the hazard cannot be totally removed, specific work procedures will be developed in conjunction with the room supervisor, and REHS. If there is a chance your work may bring you in contact with chemical hazards (e.g. working on laboratory sinks, working in areas where there is a chance of chemical contamination) or when working in rooms where chemical experiments are taking

place, have the room supervisor provide you with the necessary protective equipment, including gloves, goggles, etc.

7) When working on a fume hood, ask the room supervisor if the hood was used for perchloric acid or radioactive materials. Contact REHS before performing maintenance on any part of a perchloric acid or radioactive materials fume hood system (including: hood, base, duct, fan, stack, etc.). Lubricate perchloric acid hood fans with fluorocarbon grease only.

8) If you are working in a room labeled with a radiation symbol, refer to the handout "Maintenance Staff - Procedures For Dealing With Equipment In Laboratories Using Radioactive Materials".

9) If you have any questions, contact the room supervisor first, your supervisor next, or finally REHS.

Contact Lens Use in the Laboratory Environment

Historically, laboratory workers have been prohibited from wearing contact lenses. However, a recent NIOSH document (NIOSH Current Intelligence Bulleting #59) recommends that workers be permitted to wear contact lenses when handling hazardous chemicals provided the guidelines listed in this bulletin are followed, contact lenses are not banned by regulation, and contact lens use is not contraindicated by medical or industrial hygiene recommendations. The rationale for this recommendation is that wearing contact lenses provides workers with a greater choice of eye and face protection, as well as better visual acuity.

The standard operating procedures contained in this Chemical Hygiene Guide requires individuals to wear appropriate eye protection in all labs where chemicals, dusts, and powders are used. Typically, appropriate eye protection means splash goggles where liquids are prepared, manipulated, and transferred to other containers. However, laboratory and department Chemical Hygiene Plans may specify other eye protection as appropriate based upon a hazard assessment of their work activities.

Whenever possible, this Chemical Hygiene Guide recommends the continued use of prescription eyewear with chemical splash goggles while working in the laboratory. However, laboratory workers may wear contact lenses if the following conditions are met:

1. The principal investigator and/or Chemical Hygiene Officer must enforce the use of appropriate eye protection, regardless of contact lens use in the lab.
2. Regulations do not prohibit contact lenses for specific substances used in the lab. Principal investigators and laboratory workers must consult material safety data sheets (MSDS's), hazardous substance fact sheets (HSFS's), or REHS to confirm compliance with this requirement. As of June 2006, the Occupational Health and Safety Administration (OSHA) has issued substance specific recommendations against the use of contact lenses for the following 5 substances:
    - Acrylonitrile, 29 CFR 1910.1045
    - Ethylene Oxide, 29 CFR 1910.1047
    - Methylenedianaline, 29 CFR 1910.1050
    - 1,3 Butediene, 29 CFR 1910.1051
    - Methylene Chloride, 29 CFR 1910.1052
3. The principal investigator and/or Chemical Hygiene Officer does not prohibit the use of contact lenses in the Chemical Hygiene Plan.

REHS will initiate an assessment of the work activities, the visual acuity required to complete tasks, and the substances used by an individual in response to any of the following issues:

1. When the principal investigator, department chair, or chemical hygiene officer determines an individual may not wear contact lenses,
2. When an individual has a medical need to wear contact lenses based upon an optometrist or physician's opinion, or
3. When an employee reports eye irritation while wearing contact lenses in the laboratory environment.

3. Safety Systems

a. Personal Protective Equipment

1. Eye Protection

Splash Goggles

Eyes are particularly sensitive to any contact with chemicals; therefore, splash goggles must be worn at all times in laboratories where liquid chemicals, dusts, or powders are being used. Safety glasses do not offer sufficient protection from fumes or particles entering from the side.

Shields

Standing shields and face shields protect the face and neck. Shields of good rigidity and strength, which protect the face and neck, should be used for vacuum work, when working with low or high-pressure systems, or where mild explosions may be anticipated.

2. Respiratory Protection

Dust masks, cartridge respirators, self-contained breathing apparatus, or any other type of respiratory protection should not be necessary in a properly designed laboratory. If you believe you may nevertheless require such protection, contact REHS for information and recommendations.

3. Skin and Body Protection

Gloves

Gloves protect the hands against contact with chemicals and also against abrasion and extremes of heat and cold. Check gloves before use, for worn spots, cracks, and other signs of wear. When removing gloves, be careful to avoid touching the outside of the gloves with your bare hands; also avoid touching doorknobs, light switches, etc., with the gloves. Always remove gloves (and all other protective gear) before leaving the laboratory.

Different kinds of gloves offer different levels and types of protection. Gloves made of cotton or cotton with leather protect against abrasion, sharp objects, and glass; however, they offer virtually no wet chemical protection, and may actually absorb chemicals and keep them in contact with the skin. Surgical type

gloves made of rubber or synthetics offer some hand protection and also allow dexterity. For more substantial protection against some acids and most other corrosives, heavy rubber gloves are available with various lengths of forearm protection. Heavy rubber gloves do not effectively protect against a number of concentrated acids, organic solvents, or PCBs. These substances require gloves made of a synthetic material, for example neoprene nitrile rubber or Viton, depending on the chemical being used. Insulated gloves should be used when dealing with temperature extremes. Proper fit and comfort must also be considered when selecting gloves.

Aprons and Lab Coats

Aprons and lab coats protect the body as gloves do the hands. Heavy-duty rubber aprons should be used for protection against strong acids and bases. As discussed above, heavy rubber will not protect against all materials, in which case a synthetic material must be used. Vinyl aprons are recommended for general use; cloth lab coats are also useful, but mainly for protecting clothing.

As with gloves, lab coats and aprons should remain in the laboratory. Many of the substances, which are found in the laboratory, can be inadvertently taken home on lab coats and aprons.

Shoes

Sturdy closed shoes should be worn in the laboratory at all times to protect against spills and splashes, which reach the floor. Leather shoes offer better protection against corrosion than canvas shoes; open-toed shoes are prohibited in the laboratory.

4. Hearing Protection

Standards for hearing protection and acceptable noise levels have been established by PEOSHA regulations. If you feel that a noise hazard is present in your laboratory, contact REHS for evaluation and recommendations.

b. Fire Protection

Fire Extinguishers

Everyone working in a laboratory must know the location and correct use of fire extinguishers. Although extinguishers are capable of putting out small, contained fires, their primary purpose is to allow you to "shoot your way out" -- to establish and maintain a safe exit path as you leave.

It is important to use the right kind of extinguisher for the fire. The following letters identify the classes of fires extinguishers:

A – ordinary combustible solids including paper, wood, coal, rubber, and textiles.

B – flammable and combustible liquids, including gasoline, diesel fuel, alcohol, motor oil, grease, and flammable solvents.

C – electrical equipment.

D – combustible or reactive metals (such as sodium and potassium), metal hydrides, or organometallics (such as alkylaluminums).

Each fire extinguisher is clearly marked by the letter(s) of the class of fire that it can extinguish. Because using the wrong kind of extinguisher can be very dangerous, the time to read the extinguisher is before the fire, at your leisure.

Fire extinguishers are supplied and maintained by the Fire Safety Section of Rutgers Emergency Services. If you have any questions, call the Fire Safety Section non-emergency number (732-932-4875).

c. Laboratory Equipment

1) Fume Hoods

Fume hoods are a common means of control of exposure to toxic substances. The variety of hood used should depend on the materials involved; for example, hydrofluoric acid will etch glass, perchloric acid requires a stainless steel hood interior and duct, and wash-down system and radioisotopes may require stainless steel ducts. REHS can advise as to the variety of hood that will be appropriate, and will also perform periodic hood tests.

A chemical fume hood is designed to operate most effectively at an optimum air velocity, usually 80 - 100 linear feet per minute. While it is good practice to work with the sash as low as possible, this measurement is made with the sash fully open to ensure protection at any sash height. This air velocity will result in a laminar airflow pattern that will capture most fumes and vapors likely to be given off within the hood. Lower air velocities may be insufficient to capture and remove most fumes and vapors. Higher velocities can lead to a turbulent airflow that does not capture the fumes and vapors as well. Higher or lower air velocities may be acceptable in certain cases with REHS approval. REHS annually surveys all fume hoods within the University to determine if they are operating at acceptable levels. If your fume hood does not have an inspection sticker, or if you have a new hood, please contact REHS.

The following are guidelines for safe fume hood use, and are to be followed when using a fume hood. All laboratory supervisors should periodically review these procedures with all laboratory personnel.

a) Use the fume hood with the sash as low as possible, at or below the indicated operating height. The operating height should be clearly marked by arrows on either side of the sash track. These marks are placed on a hood when it is surveyed by REHS. If your fume hood does not have an operating height sticker on it, call REHS, as the hood probably has not been surveyed. If you need to move large pieces of equipment into or out of the hood, raise the sash for as long as is necessary, and lower it as soon as possible. Do not work on the hood with the hood sash fully open. The fume hood operates more effectively with the sash at the operating height. Additionally, this will allow the sash to serve as a physical barrier between your face and the contents of the fume hood.

b) Do not store chemical or equipment that are not currently being used, in the hood.

c) Raise large pieces of equipment up on blocks approximately 2", to allow air to pass under the equipment and allow more even airflow through the hood.

d) Do not place equipment or chemicals very close to the slot openings in the baffles at the rear of the hood, or very close to the front edge of the hood. Putting items in those spots will interfere with even airflow through the hood. Keep materials at least six inches back from the front edge.

e) Keep the sash glass clean, and never obstruct your view through it with paper, notices, decals, or other items.

f) Avoid sudden movement past the face of the hood when it is operating. Simply walking briskly past the hood can disrupt air currents, and pull vapors out of the hood.

g) Keep your head outside the fume hood. Do not walk into a "walk-in" hood when it is operating. "Walk-in" hoods are designed to hold large pieces of equipment and are not to be literally “walked-into".

h) **NEVER** use perchloric acid in a fume hood not specifically designed for this purpose. A properly designed perchloric acid hood has a stainless steel liner, with a stainless steel duct that runs vertically to the roof. It is designed with a water wash-down system to periodically remove dangerous perchloric acid residues. Using perchloric acid in a conventional fume hood can leave explosive residues on the hood, duct, or fan.

i) If your hood is equipped with a flow-indicating device, check to see that it is functioning properly before use. If your hood is not equipped with a flow-indicating device, you can periodically check it with a hand-held velocity meter or by hanging a small (approximately 1" x 4") piece of tissue, Kimwipe, or similar light- weight paper from the bottom of the hood sash. This should be drawn in when the hood is operating normally and will hang straight down, when the hood is operating marginally or not at all. If your fume hood is not operating properly, first check to see that it is on and that the rear slots are not blocked. If that is not the problem, then call your campus Facilities Operations Services or Physical Plant immediately to arrange to have it repaired.

Keep in mind that a chemical fume hood is an important piece of laboratory safety equipment. Using and maintaining a fume hood properly will help protect you and your fellow workers from potential chemical hazards in the laboratory. If you have questions about fume hood use, or need training on the proper use of a chemical fume hood, please contact REHS.

2) Glove Boxes

Where highly toxic substances must be contained, or reactive substances must be handled in an inert or dry atmosphere, it may be necessary to use a completely enclosed unit such as a glove box.

3) Eyewashes

An emergency eyewash unit should be located in every laboratory and should deliver a gentle flow of clean, aerated water. The eyewash must be kept free of obstructions.

When a chemical has splashed into the eye, irrigate the eye immediately. Flush the eye with a copious amount of water under gentle pressure. If the victim is wearing contact lenses, have him or her remove them at once if possible. Forcibly hold the eye open to wash thoroughly behind the eyelids. The victim must be given prompt medical attention regardless of the severity of the injury. Continue irrigating for 30 minutes before transport to a hospital or health center.

Eyewash units and safety showers are installed, maintained, and tested annually by Facilities Operations Services. REHS and the using department determine the need and location for new showers and eyewash stations. If there is a need in your department, contact REHS.

4) Safety Showers

Each laboratory should have a safety shower in an easily accessible location, often in a corridor. The shower area must be kept clear of obstructions.

In case of chemical contamination over a large part of the body, the contaminated clothes must be removed immediately and the person doused with water continuously for 30 minutes or until medical help arrives. A blanket can be used for warmth and modesty during dousing. Someone should be sent at the beginning of this procedure to summon medical attention.

5) Ground Fault Circuit Interrupters

A ground fault circuit interrupter is an electrical device that protects against leakage of electrical current to ground. If even a minor leakage is detected, the device opens the circuit, preventing possible electrocution. Ground fault circuit interrupters can be portable -- placed within the laboratory where needed -- or installed in the circuit box itself by Facilities Operations Services. These devices are required where damp or wet conditions are likely.

6) Spill Containment

Use absorbent paper on the bench top to contain small spills. Absorbent paper will also help reduce possible contamination of the laboratory furniture and apparatus. Procedures using larger amounts of liquid should be performed in or over spill trays. Spill kits of absorbent material should be available for containment and neutralizing of large spills. Be sure to use each kit only for the materials designated on the kit container. All spills requiring the use of a kit should be reported to the campus emergency number.

4. Preparing For Laboratory Work

Before beginning any laboratory work, a plan should be made describing goals; chemicals and equipment needed; and the sequence of steps to be followed, including safety measures.

a. Chemicals

Full descriptions of chemicals used in the laboratory can be found on Material Safety Data Sheets (MSDSs) or Hazardous Substance Fact Sheets (HSFSs), which contain information on physical characteristics, hazards, disposal, and routine and emergency precautions. There is a sheet for virtually every chemical marketed, available from chemical suppliers, University RTK Central Files (available in Libraries), REHS, and a number of computer based information systems. HSFSs are available from the NJ Department of Health for each of the substances regulated by the New Jersey Worker and Community Right-to-Know law. The Right-to-Know law requires, among other things, that persons who may be exposed to chemicals be trained in general and specific chemical hazards and chemical safety. MSDSs and HSFSs should be used as part of this training. An MSDS or HSFS should be acquired for every chemical used and should be kept on file for reference. The information on the MSDS or HSFS should be given to every laboratory worker who will be handling the chemical in question. Design your procedure to use the least hazardous chemicals and the minimum possible quantity of each chemical that will still allow meaningful results. Using smaller quantities of chemicals means that less can be spilled or volatilized, and that less must be treated and/or disposed as hazardous waste.

b. Equipment

Specific information must be obtained about any equipment to be used. Most equipment is sold with this information, ranging from one-page instruction sheets to complete books. This information must be read thoroughly and followed exactly for safest use of the equipment. When used equipment is sold or donated to the University, recipients must obtain operating instructions if at all possible.

c. Written Procedures

Developing a protocol is basic to the experimental process, and should result in a written set of procedures. Writing the procedures allows the researcher or instructor to go through the experiment in the planning stage, and identify areas where special precautions may be necessary. The written protocol will provide workers with step-by-step instructions, minimizing the chance of errors. A good written protocol will allow for modifications and will include safety precautions (e.g., "wear splash goggles," "pour acid into water," "perform this operation in fume hood"). Written procedures should also include MSDSs or HSFSs for all chemicals used in the experiment. In addition, a laboratory notebook should be kept during the procedure, documenting each action and its result. In the event of an accident, a set of written procedures and laboratory notebook may indicate what went wrong, and possibly why.

d. Setting Up

Just before beginning the work, review the written procedures, following the expected sequence of the experiment. Review the materials to be used as to their degree and nature of hazard, including flammability, volatility, reactivity, etc.

All equipment and supplies should be in place before actual work begins, including proper protective equipment (e.g., hoods, glove boxes, gloves, aprons, safety goggles,

shields, and lab coats). The work area should be uncluttered and orderly. Where areas of possible contamination and exposure might exist, take precautionary measures, such as lining the work surface with absorbent paper. Also, have on hand all the necessary equipment to deal with a spill or accident (more absorbent paper, spill-control kits, etc.)

5. General Laboratory Equipment Setup

a. Preparing the Work Space

Workspace should be uncluttered. Only necessary materials, equipment, protocols, instructions, notebook, and pen or pencil should be present. Books, unnecessary materials, and scraps of paper should be removed and stored properly. Keep measuring equipment, such as glass cylinders, where it will not be easily knocked over. Do not place equipment on the floor of a working area where it may trip others or be knocked over.

Use only equipment that is free of flaws (cracks, chips, inoperative switches, frayed cords, etc.). Ensure that all necessary guards are in place before using equipment. Examine glassware carefully. All defective glassware should be returned to the stockroom for replacement, or should be discarded safely. All defective electrical equipment must be repaired before use, or discarded.

Set up clean, dry apparatus, firmly clamped and well back from the edge of the laboratory bench. Keep burners and open flames a safe distance from solvents and reagent bottles. Allow enough space for the equipment used, and enough working space to avoid crowding other workers and disturbing their apparatus. Select vessels of the proper capacities for each experiment.

Place a tray or absorbent paper under the apparatus to confine spilled liquids.

All equipment must be properly supported to prevent unnecessary movement and to maintain proper alignment during the experiment. Apparatus attached to a ring stand should be positioned so that the system's center of gravity is over the base and not to one side. Securely attach clamps to stands. Set up the equipment with adequate space and configuration for removing burners or baths. Orient equipment so that stopcocks, hoses, and other attachments will not be loosened by gravity. Use a retainer ring or spring where necessary.

Use a fume hood if the experiment is expected to evolve noxious odors, or toxic or flammable gases, vapors, or fumes. Do not use perchloric acid, hydrofluoric acid, or radioisotopes in hoods that are not specifically approved for those materials.

Use a protective shield when conducting a reaction, which may result in a mild explosion or when using a vacuum system (which may implode). Use a face shield that is sufficiently large and strong to protect your face and neck, or use a standing shield. A standing shield is indicated if an explosion is likely. Standing shields must be adequately stabilized with weights or fasteners to prevent their being knocked over by an explosion, and should be secured near the top. Eye protection must be worn even when using the shields.

b. Glassware

Pyrex or borosilicate glassware is recommended for all laboratory glassware except for special experiments, which use ultraviolet or other light sources. The only soft glass provided in the laboratory should be reagent bottles, measuring equipment, stirring rods, and tubing. Any sizable nonspherical glass equipment to be evacuated, such as suction

flasks, should be specially designed with heavy walls. Dewar flasks and large vacuum vessels should be taped or otherwise screened or contained in a metal jacket to avoid flying glass from an implosion. Thermos bottles, with thin walls, are not adequate substitutes for Dewar flasks.

Large bottles and jars containing acids or corrosive chemicals should only be moved in suitable acid bottle carriers, such as those made of rubber.

Cuts from glass constitute the most common laboratory accident, and potentially one of the most dangerous, as the open cut provides a way for toxic chemicals to enter the bloodstream directly. Do not begin any operation of cutting, bending, or inserting glass into a stopper or hose without understanding the complete procedure and each separate step.

1) When cutting glass tubing, be sure to hold the tubing firmly, and to make a single steady stroke with a sharp file. When breaking the tubing at the cut, cover the tubing with cloth and hold it in both hands, well away from the body. Push out on the tubing but do not deliberately bend the glass with your hands. Wetting the nick will help open the fracture. Be sure that you are well away from others in the laboratory. Be especially careful in cutting a short piece from a long piece of tubing, since the long end may whip around and injure a nearby person.

2) When boring a stopper, be sure the borer is sharp and one size smaller than that which will just slip over the tube to be inserted. In the case of a rubber stopper, lubricate with water, or preferably glycerol or ethylene glycol. Holes should be bored by slicing through the stopper, twisting with moderate forward pressure, grasping the stopper only with the fingers and keeping the hand away from the back of the stopper. Place the stopper on a wooden board or block to avoid damaging the cutting edge of the borer. Keep the index finger of the drilling hand against the barrel of the borer and close to the stopper in order to stop the borer when it breaks through. Preferably drill only part way through, and then finish by drilling from the opposite side. Discard a stopper if a hole is irregular or does not fit the inserted tube snugly, if the stopper is cracked, or if it leaks.

3) Stoppers should fit so that 1/3 to 1/2 of the stopper is inserted into the joint. First soften corks by rolling and kneading. With hands close together to minimize being cut in case the vessel breaks, gently but firmly twist the stopper in place. Avoid exerting any pressure on inserted glass tubes. When available, ground glassware is preferable. Glass stoppers and joints should be clean, dry, and lightly lubricated. Stuck glass stoppers can be removed using commercially available bottle stopper remover. Students should ask instructors for assistance when glass connections, stoppers, or corks are stuck.

4) Fire polish all glass tubing and rods, including stirring rods. Unpolished glass has a razor-sharp edge which will not only lacerate the skin, but will cut into a stopper or rubber hose, making it difficult to insert the glass properly. After fire polishing or bending glass, allow ample time for it to cool; grasp it gingerly at first, in case it is still hot.

5) To remove a glass tube from a stopper, use a lubricated, dulled cork borer or the tang of a small file, inserted between tube and stopper. Lubricate as separation progresses. Sometimes it may be useful to roll the stopper with a block of wood under enough pressure to flex the rubber. If none of these procedures works, remove the tube by cutting the stopper with a single edged razor blade or an X-Acto® knife. If this is not feasible, discard the stopper and tube.

6) When inserting glass tubing or rods into rubber hoses, fire polish both ends of the glass to be inserted. Lubricate the glass with water, or preferably glycerol or ethylene glycol. Wrap a cloth around the glass and hold it close to the hose (not more than 5 cm). Protect the hand holding the hose with a cloth or glove. Insert the glass into the hose with a slight twisting motion, avoiding too much pressure and torque.

c. Electricity

Electricity becomes a hazard in the laboratory when the current passes through a person or through a flammable or explosive material. Care with electrical connections, particularly with grounding, and not using frayed electrical cords can reduce such dangers.

Equipment in the laboratory must have grounded (three-prong) plugs or be double insulated. Temporary wiring and the use of extension cords should be avoided. All wiring must meet the National Electric Code specifications. Where wet conditions are likely, ground fault circuit interrupters must be installed. All switches that are not directly and obviously attached to a piece of equipment should be labeled to show the equipment they control; in-line cord switches are discouraged.

If, when you touch a piece of electrical equipment, you feel a shock or "tingle," you should disconnect it and report it for repair immediately. Shorts in circuitry get worse, and delay greatly increases the hazard. If you suspect a piece of equipment to be electrically dangerous, have it checked by a qualified electrician. Never attempt to repair any electrical equipment with the current on. Equipment that is faulty or broken must be unplugged and moved or taped in such a way that it cannot be accidentally plugged in or turned on. The equipment should be clearly labeled as unsafe and not to be used while awaiting repair.

d. Vacuum Operations

Because of the pressures involved, equipment used in vacuum operations must be carefully inspected frequently and regularly.

Apparatus must be assembled so as to avoid strain, and heavy assemblies must be supported from below as well as by the flask neck. Vacuum apparatus should always be placed well back from the edge of the bench top or hood sill, where it will not be accidentally struck. Inspect frequently for signs of fatigue or wear.

1) Shielding

Either standing shields or face shields should be used in all vacuum operations, especially when the apparatus contains flasks of 1 liter or larger.

2) Vacuum Desiccators

Vacuum desiccators should be enclosed in a box or approved shielding device (such as "desigard") for protection in case of an implosion. When opening a desiccator that has been under vacuum, make sure that atmospheric pressure has been completely restored. A "frozen" vacuum desiccator lid can be loosened by a single-edge razor blade inserted as a wedge and then tapped with a wooden block to raise the lid.

3) Water Aspirators for Vacuum

Water aspirators for vacuum are used mainly for filtration purposes; use only equipment that has been approved for this purpose. Never apply a vacuum to a flat bottom flask unless the flask is a heavy walled filter flask designed for the purpose.

Place a trap and a check valve between the aspirator and the apparatus so that water cannot be sucked back into the system if the water pressure should fall unexpectedly while filtering. These recommendations also apply to rotary evaporation operations where water aspirators are being used for vacuum.

4) Vacuum Pumps

A cold trap should be placed between the apparatus and the pump so that volatiles from a distillation do not get into the pump oil or out into the atmosphere of the laboratory. Exhausts from pumps should be vented properly. All pumps must also have a belt guard to prevent hands or loose clothing from being pulled into the belt pulley.

e. Pressure Operations

As with vacuum operations, the equipment used in high pressure procedures must be regularly and frequently inspected for any signs of wear or fracture. Each pressure vessel should be clearly stamped or labeled with its basic allowable working pressure, the allowable temperature at this pressure, and the material of construction. Always use a pressure relief disk or other suitable device in pressure systems. The relieving pressure and setting data should be printed on a tag attached to installed pressure-relieving devices, and the setting mechanisms should be sealed.

Before any pressure equipment is altered, repaired, stored, or shipped, it should be carefully vented and cleaned. When assembling such apparatus, avoid strain and excessive force. Threads must match correctly. Never use oil or hydrocarbon-based lubricant on apparatus that will contain oxygen. Kel-F oils or greases (polychlorotrifluoroethylene oils or greases) are the proper lubricants for these systems. In assembling copper tubing, avoid sharp bends and allow flexibility.

Check for hardening and cracking in the copper; renew if necessary.

All reactions under pressure must be shielded, and prominent signs should be placed to warn others of high-pressure hazard.

f. Heating

1) Open Flame

Wherever possible, use heating mantles, heating tapes, or laboratory hot plates in place of gas (Bunsen) burners. When using a heating mantle, always operate below the maximum allowable voltage for that mantle. It is obvious that open flame must never be used where explosive or flammable chemicals are present, but the presence of such chemicals may be unsuspected or sudden. If a burner must be used, distribute its heat with flame retardant wire gauze, or by moving the burner about underneath the container being heated. Test tubes being heated in this way should be held with a test tube holder at about a 45-degree angle and

heated gently along the side, not at the bottom, to minimize superheating which may cause the contents to be ejected. Avoid pointing a test tube toward yourself or any nearby person.

2) Hot Oil Baths

Hot oil used for heating purposes is often overlooked as a hazard, yet it carries serious dangers: (1) spattering caused by water falling into hot oil, (2) smoking caused by decomposition of the oil or of organic materials in the oil, and (3) fire caused by overheated oil bursting into flame. Operating baths should not be left unattended unless a high temperature cut off is installed.

Precautions should be taken to contain any spills of hot oil caused by breakage or overturning of the baths. Fiberboard, cardboard, or other combustible components must not be used in heated apparatus.

In evaluating a hot oil bath setup, carefully consider the size and location of the bath, the operating temperature and temperature-control device, the type of oil used (silicone oil is suggested for most heating baths), the ventilation available, and the method of cooling the hot oil. A label on the bath should include the name of the oil and its safe working temperatures.

Silicone oil is a safe non-flammable fluid that can be used in heating baths to 250^{o}C (about 480^{o}F) without decomposition.

3) Temperature Control

The rates of all reactions increase as the temperature increases. Highly exothermic reactions may become dangerously violent unless provisions are made for cooling, for example, by bringing a cooling bath up around a flask. Virtually all reactions require some temperature control, and thus apparatus should be assembled in such a way that either heating or cooling can be quickly applied or withdrawn. A suitable thermometer should be used in a boiling liquid where a strong exothermic reaction is likely so that there will be warning and time to apply cooling.

Boiling stones or boiling sticks should be used in unstirred vessels of boiling liquid (other than test tubes) to prevent superheating and "bumping". Do not reuse boiling stones or sticks. Do not add them or any other solid material to a liquid, which is near its boiling point since this is likely to cause splattering or boil over.

g. Cooling

1) Flowing Water

When cooling with flowing water, beware of differences in water pressure when operations have to be left unattended for long periods, particularly overnight. In such situations, you may need to use an automatic water regulator installed in the line to keep the flow even, as well as a water flow monitor that will shut down all equipment if the flow is interrupted. Wire all rubber or plastic tubing to metal or glass connections to prevent the tubing from detaching, thus avoiding the risk of a flood.

2) Cooling Baths

When ice water is not cool enough as a bath, salt and ice may be used. For even lower temperatures, dry ice may be used with an organic liquid, such as acetone, ethanol, or ethylene glycol. Ethylene glycol, with a flash point of 111^{o}C (230^{o}F), is the best of the three listed above, considering flammability. When choosing a liquid for use with dry ice, you must consider the viscosity, flammability, volatility, solubility in water, and the possibility of toxic vapors.

Few, if any, liquids are free from all of these hazards. Your choice must also be made based on the temperature requirements of your procedure and the limitations of your equipment.

3) Cryogenics

Cryogenic equipment setups involve hazards due to extremely low temperatures, and also hazards associated with the high-pressure gases that are often part of such setups (see the following section on Compressed Gases). Be careful to control ignition sources and to monitor the formation of very high or very low concentrations of oxygen.

Safe management of the hazards associated with extremely low temperatures requires thorough understanding of the unique conditions created. For example, the extreme cold of liquid nitrogen can make metals and other materials brittle. Non-insulated equipment can condense oxygen from the air to yield dangerously high concentrations of liquid oxygen, which can explosively ignite many combustibles. On the other hand, liquid nitrogen, left open, reduces the oxygen content of air as the oxygen condenses and the nitrogen evaporates. A person working in an inadequately vented area could lose consciousness without warning, and will die without rescue. Good ventilation is essential in all cryogenic operations, along with an understanding of the low-temperature behavior of the substances involved.

Contact of liquefied gases with eyes or skin produces serious burns. Damaged tissue should be flooded with a gentle stream of water, not warmer than body temperature (using an eyewash, for example). The affected area should then be dried very gently (excluding eyes) and protected until medical assistance arrives. To avoid contact with liquefied gases, wear goggles, face shield, and insulated gloves that fit loosely enough to throw off in case of a spill. The body should be completely covered, with no skin exposed. Wear no jewelry, and avoid clothing with cuffs or pockets that could trap and hold a cryogenic liquid close to the skin.

Put objects into a cryogenic liquid slowly, and pour liquids into containers slowly in order to minimize the inevitable boiling and splashing.

For the same reason, dry ice should be added to liquid slowly and in small amounts, to avoid foaming and boil over. Handle dry ice with dry leather or insulated gloves, and never lower your head into a dry ice chest, as the oxygen content may be inadequate and suffocation can result.

Dewar flasks and cold traps should be taped to prevent flying glass in case of breakage. Avoid pouring cold liquid over the edge of a Dewar flask, as it may break and implode.

h. Compressed Gases

Gases are supplied in cylinders under great pressures, some as much as several thousand pounds per square inch. If the valve is broken off at the cylinder neck, the cylinder becomes a potentially deadly rocket, propelled with great momentum and high speed. Gas cylinders have been documented to cause extensive property damage, injury, and death. For this reason, all gas cylinders, full or empty, must always be strapped or chained to a sturdy support to prevent the cylinder from falling and breaking off the valve. All cylinders of compressed gas should be treated as high-energy sources and therefore regarded as potential explosives.

In addition, released gas can rapidly displace the breathing air in a room, causing suffocation. Many gases are toxic or corrosive and can cause injury if inhaled or contacted in even small amounts. Many gases are reactive with other materials or gases. Oxygen, in greater than normal concentrations, greatly increases the risk of fire and explosion.

Compressed gas cylinders have certain safety features, including special valves, fittings, and caps. For example, many gases have special valves that prevent the inadvertent mixing of incompatible gases. The best protection, though, lies in following the guidelines developed over years of experience with the hazards of compressed gas.

1) Use

Begin with thorough knowledge of the substances and equipment involved. Always know the identity of the gas in a cylinder; if for some reason a cylinder is unlabeled, return it to the vendor; do not guess. Know the properties and potential of the gas to be used, and the procedures for using it. Be careful not to exceed the design pressure of the apparatus. Always wear safety goggles when handling or using compressed gases.

Carefully inspect fittings, regulators, and apparatus for damage before using. Do not use damaged equipment. Use only regulators, gauges, and connections with matching threads and which are designed for use with the gas and cylinders involved. Never lubricate, modify, force, or tamper with a cylinder valve.

Only those tools approved by the cylinder vendor should be used on cylinder connections. Do not modify or alter cylinders or their attachments. Use cylinders and manifold systems only with their appropriate pressure regulators.

Use cylinders only in well-ventilated areas. Corrosive gases should be used only in locations with access to safety showers and eyewash stations. Corrosive, toxic, and flammable gases should be used only in fume hoods designed for use with the particular gas or group of gases. Use flammable gases only after proper bonding and grounding connections have been made.

Do not expose cylinders to temperatures higher than about 50^{o}C (122^{o}F). Some rupture devices on cylinders will release at about 65^{o}C (149^{o}F). Some small cylinders, including those not fitted with rupture devices, may explode if exposed to high temperatures.

Open cylinder valves slowly. Rapid release of a compressed gas will cause an unsecured gas line to whip dangerously and also may build up a static charge, which could ignite a combustible gas. Never direct high-pressure gases at a person, or use compressed gas or compressed air to blow away dust or dirt;

resultant flying particles can be dangerous. Close cylinder and bench valves when the cylinder is not in use; the pressure regulator is not sufficiently strong to assure safe closure.

Do not extinguish a flame involving a highly combustible gas until the source of the gas has been shut off. Otherwise, it can re-ignite, causing an explosion.

Always use a trap to prevent back siphonage of liquid chemicals, and a check valve to prevent back flow of gases into the cylinder. When gas is passed from a cylinder into a vessel containing a liquid, contamination of the cylinder gas with other chemicals is a real possibility. Such contamination makes the gas unsuitable for future use and may result in explosion with resultant injury, damage, or even death. Use of a safety trap to contain liquid and a check valve to prevent back flow of gas will eliminate this possibility. These are installed immediately after the pressure regulator, and before the vessel containing the liquid. The safety trap should have a volume of about one and one half times the total liquid volume in the system.

Never bleed a cylinder completely empty. Always leave a residual pressure (about 25 psig) to keep contaminants out.

Promptly remove the regulators from empty cylinders, being sure to bleed the gas from the regulator first. Replace the protective caps at once. Mark the cylinder "EMPTY" in removable printing. Never refill a cylinder.

2) Used Cylinders

Handle used cylinders as you would full cylinders. Keep them strapped or chained at all times. Store the used cylinders separately from full cylinders so there is no chance of confusing them. Mark all used cylinders "MT" or "EMPTY" in removable writing (such as chalk), or tear the attached tag to indicate empty.

3) Leaking Cylinders

Cylinders that are leaking or otherwise damaged are an immediate danger. If they can be transported safely, they should be taken to an open place separate from all other cylinders to await vendor pickup.

Be very careful, however, in moving any cylinder that is leaking. Avoid inhaling gases while carrying or loading such a cylinder, and try to avoid spreading gases in corridors and stairwells. In the case of toxic or flammable gases, call the emergency number for help.

New Brunswick 911 via the emergency call system or 932-7211 (24 hours)

Newark (973) 353-5111

Camden (856) 225-6111 or dial 8 from any campus phone

For off-campus locations, please list emergency number here:

_____

4) Transportation

Do not move a cylinder unless the cap is in place.

Generally, cylinders must be transported on a hand truck to which they can be strapped or chained. Cylinders may be rolled on edge only for very short distances. Use an elevator, if possible, to move cylinders to upper or lower floors. If stairs must be used, move cylinders on a hand truck, which is equipped for stairs.

When handling cylinders, always consider them to be full. Do not allow them to strike each other, or to be dropped, cut, scraped, or otherwise damaged.

5) Storage

Keep only those cylinders currently in use in the laboratory. All cylinders, in use or in storage, must be secured to a sturdy object, such as a wall, bench, or stand, using a strong strap or chain.

Store full and used (empty) cylinders only in isolated areas that are ventilated and protected from direct sunlight, rain, snow, damp ground, heat, fire, and electrical contact. Temperatures in storage should be maintained between -20^{o}F and 120^{o}F unless the manufacturer indicates otherwise. Storage can be indoors or outdoors under shelter. Never store or use cylinders in corridors, stairwells, or in high traffic areas.

Cylinders of the same gas should be stored together. Oxidizers should be separated from flammables and combustibles by 20 feet of space or by a one-hour rated firewall and five feet of space. In addition, store used (empty) and full cylinders separately and clearly indicate whether they are full or empty.

Keep caps on all cylinders except when connected for use, and keep cylinders upright, whether in use or storage. Consult the University Health/Safety Manual for additional information on storage of gas cylinders.

6. Handling Chemicals

Following are guidelines and principles for safety in the direct manipulation of chemicals -- holding, pouring, mixing, transporting, storing, and so on. The list of situations covered is far from exhaustive; emphasis is instead on the most common ways in which chemicals are handled in the laboratory. Safety precautions for use of laboratory equipment can be found in Safety Systems, Section 3, and General Laboratory Equipment Setup, Section 5.

a. Personal Contact

The primary safety goal in handling chemicals is to prevent the chemicals from entering your body. It cannot be said too often that protective gear must be worn at all times, and precautions for avoiding personal contact with the chemicals must always be in mind.

1) Avoid direct contact of any chemical to the hands, face, and clothing. Be aware of what you touch; be careful not to touch gloves to your face, for example. After any skin contact, and always before you leave the laboratory, wash face, hands, and arms. Leave all equipment in the laboratory.

2) Never taste chemicals or sniff from chemical containers.

3) Never eat, drink, smoke, or apply cosmetics in the laboratory.

4) Dispense and handle hazardous materials only in areas where there is adequate ventilation.

5) If you believe that significant ingestion, inhalation, injection, or skin contact has occurred, call the emergency number on your campus and follow the Emergency Procedures given earlier in this Guide.

b. Handling Containers

Clearly label all chemical containers. The Laboratory Standard requires that labels on incoming chemical containers not be removed or defaced. Do not use any substance from an unlabeled or improperly labeled container. Printed labels that have been partly obliterated or scratched over, or crudely labeled by hand, should be relabeled properly. Unlabeled chemical containers are a violation of the NJ Right-to- Know Act and should be disposed of promptly and properly.

Carefully read the label before removing a chemical from its container. Read it again as you promptly recap the container and return it to its proper place. Names of distinctly different substances are sometimes nearly alike; mistakes are easy to make and can be disastrous.

When picking up a bottle, first check the label for discoloration, and if it is clean, grasp it by the label. Spilled chemical will show up on the label better than on the glass; holding the container by the label will protect you from prior spills, and protect the label from present ones. After use, wipe the bottle clean.

If a stopper or lid is stuck, use extreme caution in opening the bottle. Friction caused by removing tops may cause explosions with some substances (such as hydroperoxides formed from ethers or picric acid contaminated with heavy metals).

Support beakers by holding them around the side with one hand. If the beaker is 500 ml or larger, support it from the bottom with the other hand; also, consider using a heavy-duty beaker slowly on the clean surface of the bench. If the beaker is hot, use beaker forceps or tongs, and place the beaker on a heat- resistant pad.

Grasp flasks by the center neck, never by a side arm. If the flask is round bottomed, it should rest on a proper sized cork ring when it is not clamped as part of a reaction or distillation assembly. Large flasks (greater than 1 liter) must be supported at the base during use.

Never look down the opening of a vessel, in case of unforeseen volatility or reaction.

c. Pouring

Do not pour toward yourself when adding liquids or powders. Stoppers too small to stand upside down on the bench should be held at the base and outward between two fingers of the pouring hand.

Use a funnel if the opening being poured into is small. If a solid material will not pour out, be careful when inserting anything into the bottle to assist removal. Students should seek advice from instructors before proceeding.

Always add a reagent slowly; do not "dump" it in. Observe what takes place when the first small amount is added and wait a few moments before adding more.

When combining solutions, always pour the more concentrated solution into the less concentrated solution or water. Stir to avoid violent reactions and splattering. The more concentrated solution is usually heavier and any heat evolved will be better distributed. This procedure is particularly applicable in preparing dilute acid solutions. Be sure to wear goggles and use the hood when diluting solutions.

Make sure the stopcock is closed and has been freshly lubricated before pouring a liquid into an addition or separatory funnel.

Use a stirring rod to direct the flow of the liquid being poured. Keep a beaker under the funnel in the event the stopcock opens unexpectedly.

Wear an apron and gloves, in addition to goggles, whenever pouring bromine, hydrofluoric acid, or other very corrosive chemicals, to avoid painful chemical burns.

d. Pipetting

NEVER pipette by mouth. Use an aspirator bulb, or another mechanical Pipetting device. Constantly watch the tip of the pipette and do not allow it to draw air.

e. Storage

Keep as few chemicals as possible on the bench top. All chemicals not immediately needed should be properly stored.

Do not store incompatible materials together or in close proximity. Use safety cans with flame arrestors for quantities of flammable solvent larger than 4 liters, and be sure to leave a space at the top of a closed container for expansion of liquid and vapors. If chemical purity requirements preclude metal containers, glass containers may be used. Containers no larger than one pint (500 ml) should be used to store NFPA Class IA liquids, including, but not limited to: acetaldehyde, diethyl ether, ethyl chloride, methyl formate, low boiling petroleum ether, pentane and propylene oxide.

Store large containers of reagents on low shelves, preferably in a tray adequate to contain spills or leaks.

Dispense corrosive liquids in small containers, no larger than 500 ml, preferably in chemically resistant coated containers. Never take more than is immediately needed.

1) Refrigerators

Ordinary household refrigerators constitute a hazard when used for storage of flammable or unstable chemicals. These units produce conditions that can lead to explosion. Domestic (household- type) refrigerators may not be used for flammable chemical storage unless suitably modified to eliminate all possible contact between vapors and electric spark or arcing.

Explosion proof refrigerators are preferred.

When searching for an item in a refrigerator used for chemical storage, be careful not to inhale vapors that may have built up in the cabinet.

All chemicals, including those stored in refrigerators, should be sealed and labeled with the name of the material, the date it was placed in storage, and the name of the person storing it there. Refrigerators should be cleaned on a regular schedule, and old chemicals should be properly discarded.

Food must NEVER be stored in any refrigerator used to store chemicals.

2) Storage of Flammable Chemicals

Keep flammables in use in the laboratory in safety cans specifically designed for that purpose at all times. In the event that such cans are not available, glass bottles may be used with the proper precaution. The containers used by the manufacturer must meet certain standards for shipping. These same containers are not always suitable for routine use. The shipping container must be sealable and of suitable shape and strength for transport. This transport is usually within another container - carton, crate, etc. Do not use screw caps to close bottles containing volatiles (such as diethyl ether, low-boiling petroleum ether, methylene chloride, and pentane) as pressure build up can cause failure in a bottle which is not new and which may have internal strains that come from normal use. In such situations, use corks or neoprene stoppers. Use a one-holed cork fitted with a drying tube if moisture must be excluded. To relieve pressure build up, use a cork fitted with a check valve. Keep all flammables away from direct sunlight and sources of heat.

Storage of Flammable Liquids

Flammable storage limits for laboratories are given in the following Table.

Maximum Allowable Storage of Flammables[1] in Laboratories[2]

	Total Quantity Outside Of Safety Cabinets/Safety Cans		Total Quantity Including Safety Cabinets/Safety Cans	
Class	Research Labs	Instructional or Teaching Labs	Research Labs	Instructional or Teaching Labs
I	20 gallons	5 gallons	40 gallons	10 gallons
I, II, III Total	40 gallons	10 gallons	80 gallons	20 gallons

NOTE: [1] Class I = Liquids with flash point <100^{o}F
Class II = Liquids with flash point >100^{o}F and <140^{o}F
Class IIIA = Liquids with flash point >140^{o}F and <200^{o}F
Class IIIB = Liquids with flash point >200^{o}F.

NOTE: [2] Based on labs >200 ft^2. For labs <200 ft^2, use half the quantities given above. Larger quantities may be allowed with REHS approval.

The maximum container size is given in the table below.

Maximum Allowable Container Capacity (NFPA) 45.7*

	Flammable Liquids			Combustible Liquids	
Container Type	**IA**	**IB**	**IC**	**II**	**IIIA**
Glass	1 pint	1 quart	1 gallon	1 gallon	5 gallon
Metal (other than DOT Drums) or approved plastic	1 gallon	5 gallons	5 gallons	5 gallons	5 gallons
Safety Cans	2 gallons	5 gallons	5 gallons	5 gallons	5 gallons
Metal Drums (DOT)	N/A	5 gallons	5 gallons	60 gallons	60 gallons

In instructional laboratory work areas, no container for Class I or II liquids shall exceed a capacity of 1 gallon, except that safety cans may be of 2 gallon capacity.

***** Exceptions:

- Glass containers as large as 1 gal. (3.785 L) may be used if needed and if the required purity would be adversely affected by storage in a metal or an approved plastic container, or if the liquid would cause excessive corrosion or degradation of a metal or approved plastic container.

- Drums of not more than 60 gallons (227 L) capacity are permitted in a separate area inside the building if the inside area meets the requirements of NFPA 30, Flammable and Combustible Liquids Code.

Storage Cabinets

Only (1) storage cabinet may be located in a laboratory. Cabinets shall be labeled in conspicuous lettering, "FLAMMABLE--KEEP FIRE AWAY".

Flammable storage cabinets are designed to protect the contents from external fires. For this reason, the door(s) must be kept closed except when removing or replacing the cabinet's contents. These cabinets do not necessarily protect people from solvent vapors during normal use of the cabinet. There are vent kits available for flammable storage cabinets, however these cabinets are fire tested with the vent holes closed. The NFPA Flammable & Combustible Liquids Code Handbook recommends against venting these cabinets as this practice may defeat the designed purpose. Where particularly noxious or toxic chemicals are being used, cabinets may be vented, with prior REHS approval.

The interior of the cabinet is capable of withstanding the effects of vapors from solvents, but not of other materials such as corrosives. As these materials are incompatible with most flammables, only flammable storage cabinets are designed with a lip to contain a two-inch depth of a spilled liquid.

3) Storage of Acids

Acid storage cabinets are designed to withstand corrosion, contain spills, keep like materials together, and protect the contents from physical damage. If ordinary cabinets used for acid storage show signs of deterioration, consider relocating the acids to a specially designed cabinet. As acids are incompatible with alkalis, flammables, and other classes of chemicals, only acids may be stored in these cabinets.

Dichromate cleaning solution is an unsuspected source of pressure build up explosions in the laboratory. Although storage of this common cleaning solution in the glass shipping container is a common laboratory practice, it has led to several serious incidents. Occasionally, the dichromate solution will contain sufficient amount of organic material from previous glass cleanings to evolve a large enough quantity of carbon dioxide to explosively rupture a screw topped glass bottle. To prevent a possible explosion, and subsequent potential injury, a stopper is recommended. See the recommendation given above for storage of flammables.

f. Chemical Inventories

The NJ Right-to-Know law requires that all laboratories that have not received research and development exemptions prepare, maintain, and update a list of all chemicals present in the laboratory. The list should include, for each container, the chemical name(s) of the contents, the CAS Number (Chemical Abstracts Service Number), the quantity and the container type. This list is also useful for acquiring the MSDSs and HSFSs needed and to carry out work both safely and in compliance with the PEOSHA standards. For example, identification of a substance as a Particularly Hazardous Substance and a carcinogen and taking the appropriate precaution in its use, would not be possible without compiling this list. For more information, see Section G, "Provisions for Employee Protection when working with Particularly Hazardous Substances."

In the case of shared spaces, information on chemicals present should be provided by a user to another user, upon request.

g. Transportation

Bottles of one gallon or more should be transported in bottle slings or bottle carriers that could completely contain the substance in the event of breakage. This is particularly important in transporting corrosive, toxic, or flammable liquids. If you need to move several such containers at once within a building, use bottle carriers and a properly designed cart. All containers should be tightly capped during transport.

Smaller bottles can be carried by their handles, or by grasping the label and placing the little finger under the base of the bottle.

Never try to balance a bottle by holding it solely from underneath. Approach all doors with caution.

If you do drop and break a container, you have the responsibility of calling the emergency number to report the spill and to request assistance in cleanup.

New Brunswick 911 via the emergency call system or 932-7211 (24 hours)
Newark (973) 353-5111
Camden (856) 225-6111 or dial 8 from any campus phone

For off-campus locations, please list emergency number here:

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7. Chemical Hazards

This section contains descriptions of the general categories of chemical hazard, and the principles of safety associated with each. This section purposefully does not contain advice for handling specific chemicals. Safe work in a chemical laboratory requires very detailed knowledge of the nature, potential, and compatibility's of each substance used; cursory or selective description in this Guide would be misleading and, as a result, unsafe. Anyone planning an experiment or procedure should acquire and review a Material Safety Data Sheet (MSDS) or Hazardous Substance Fact Sheet (HSFS) for each substance, and also for all likely products and byproducts. MSDSs and HSFSs for each chemical present in the laboratory must be available to every laboratory worker upon request within their work shift. They are available from REHS, Building 4054, Livingston Campus, upon request.

They are also available from the reference desks of the University libraries listed below:

LIBRARY OF SCIENCE AND MEDICINE, BUSCH
ALEXANDER LIBRARY, CAC
MABEL SMITH DOUGLASS LIBRARY, DOUGLASS
DANA LIBRARY, NEWARK
CAMDEN LIBRARY, CAMDEN

The following categories provide a structure for thinking about -- and planning protection against -- common chemical hazards.

In actual practice, such hazards do not group themselves in neat categories, but usually occur in combination and/or sequence.

The categories and concepts are provided as an aid to awareness, and as encouragement for consistent safe planning and practice.

a. Flammability

Flammability is one of the most common chemical hazards. The exact degree of hazard, however, depends on the specific substance and the conditions you expect to use it in. To handle a flammable substance safely, you must know its flammability characteristics: flash point, upper and lower limits of flammability, and ignition requirements. This information appears on each MSDS or HSFS.

1) Flash Point

For a liquid, the flash point is the lowest temperature at which the liquid gives off enough vapor to form an ignitable mixture with air and produce a flame when a source of ignition is present. Many common laboratory solvents and chemicals have flash points that are lower than room temperature.

2) Ignition Temperature

The ignition (or auto ignition) temperature of a substance -- solid, liquid, or gas -- is the minimum temperature required to initiate self- sustained combustion. Some ignition temperatures can be quite low (for example, carbon disulfide at $90^{o}C$ ($194^{o}F$).

3) Auto ignition

Auto ignition or spontaneous combustion occurs when a substance reaches its ignition temperature without the application of external heat. This characteristic is particularly important to keep in mind in the storage and disposal of chemicals.

4) Limits of Flammability

Each flammable gas and liquid (as a vapor) has a limited range of flammable concentration in mixtures with air. The lower flammable limit (or lower explosive limit) is the minimum concentration below which a flame is not propagated when an ignition source is present -- such a mixture would be too lean to burn. The upper flammable limit (or upper explosive limit) is the maximum concentration of vapor in air above, which a flame is not propagated -- such a mixture is too rich. The flammable range (or explosive range) lies in between the two limits.

Listed measurements of all these characteristics -- flash points, ignition temperatures, limits of flammability -- are derived through tests conducted under uniform and standard conditions that may be very different from actual practice. For example, concentrations of vapor in air in a laboratory are rarely uniform, and point concentrations can be quite high. It is good practice to set maximum allowable concentrations at 20 percent of the listed lower limit of flammability within closed systems. (It is important to note that, generally, this 20 percent limitation is still well above the maximum concentration considered to be safe for health considerations.)

5) Precautions with Flammable Liquids

Flammable liquids do not burn; their vapors do. For a fire to occur, there must be 1) a concentration of vapor between the lower and upper flammable limits, 2) an oxidizing atmosphere, usually air, and 3) a source of ignition. As it is unlikely that air can be excluded, and unrealistic (given the constant possibility of a spill) to assume that the vapor concentration can be controlled, the primary safety principle for dealing with flammable liquids is strict control of ignition sources.

Ignition sources include electrical equipment, open flames, static electricity, and, in some cases, hot surfaces. Others working in the laboratory should be informed of the presence of flammable substances so that ignition sources can be eliminated.

Obviously, it is very important to know which of those sources is capable of igniting a substance you are using.

Remember that most flammable vapors are heavier than air, and will spread out horizontally for considerable distances until an ignition source is contacted.

If possible, flammable liquids should be handled only in areas free of ignition sources. Heating should be limited to water and oil baths, heating mantles, and heating tapes.

Static-generated sparks can be sudden ignition sources. When transferring flammable liquids in metal equipment, take care that metal lines and vessels are bonded together and grounded to a common ground.

Ventilation is very important. A fume hood should be used when flammable liquids are allowed to stand in open containers or are handled in any way.

6) Precautions with Flammable Gases

Leaks of compressed or liquefied gases can quickly produce a flammable or explosive atmosphere in the laboratory. This is obviously true where the gases themselves are flammable and under high pressure, but may also be true in the use of non-pressurized liquefied gases. For example, even relatively safe liquefied gases such as liquid air or liquid nitrogen, if kept in open vessels for too long, will generate concentrations of liquid oxygen, which can contribute to an explosion. Proper care with compressed gas cylinders and cryogenic setups is essential (see General Laboratory Equipment Setup, Section 5).

b. Explosiveness

Ignition of flammable vapors or gases can occur with such speed that an explosion results. There are other substances that are explosive in themselves -- in response to heat, mechanical shock, or contact with a catalyst. With some substances, very tiny amounts of impurity are sufficient to begin a reaction that quickly becomes explosive.

1) Precautions

Acquire a Material Data Safety Sheet (MSDS) or Hazardous Substance Fact Sheet (HSFS) for each chemical you are using.

It is crucial that you know its potential including its compatibility with other substances.

Be alert to any unusual change in the appearance of a reaction mixture. Rapid unexpected temperature rise or fuming are signals for emergency measures such as removing the heat source, quickly applying a cooling bath, or leaving the room.

Explosive compounds should be protected from the conditions to which they are sensitive (mechanical shock, heat, light, etc.).

Check your MSDS/HSFS to see what those conditions are. Such substances should be brought to the laboratory only as required, and only in the smallest quantities absolutely necessary. Reactions involving or producing explosives should be designed on as small a scale as possible, and should be done behind a suitable barricade.

Special care should be taken that equipment is maintained (for example, that oil is routinely changed in vacuum pumps) and that heating methods used do not cause, or increase the potential for ignition.

Other laboratory workers must be notified when an explosive hazard is present, through direct announcement and conspicuous warning signs.

Highly exothermic or potentially explosive reactions must never be left unattended.

2) Personal Protection

In addition to protection otherwise required in the laboratory, wear face shields, and heavy gloves at all times when handling known explosive substances. Laboratory coats of a flame-resistant material or treatment may help reduce minor injuries from flying glass or flash. When serious explosive hazard is anticipated, shields and barricades will be necessary, along with devices for manipulating equipment at a safer distance long-handled tongs, stopcock turners, mechanical arms, etc.). Some experiments at Rutgers have required specially designed rooms be constructed for the safety of the researchers. Contact REHS if you plan to run an experiment with a significant explosion potential.

c. Toxicity

Toxicity is the potential of a substance to cause injury by direct chemical action with the body tissues. Whether the effect is acute or chronic, the only way to avoid such injury is to prevent or greatly minimize contact between toxic chemicals and body tissues.

1) Measurement

The dose, or amount of chemical, you are exposed to determines the body's response. In the workplace, there are certain guidelines or regulations that limit your exposure to hazardous substances. These guidelines, which are set by various regulatory or professional organizations, are referred to as "workplace exposure limits".

A workplace exposure limit is the airborne concentration of a material below which most persons can be exposed for long periods of time without adverse effect. These limits are based on an 8-hour time - weighted-average (TWA) over a working lifetime. Permissible Exposure Limits (PEL) are those set by PEOSHA. Workplace exposure limits may be expressed as Threshold Limit Values (TLV) or Workplace Environmental Exposure Limits (WEEL).

Time-Weighted Average (TWA) is the average concentration of a substance integrated over a period of time (e.g. a normal 8-hour workday).

A Short-Term Exposure Limit (STEL) is the maximum concentration limit for a continuous 15-minute exposure period, provided that the daily TWA is not exceeded. Because workplace exposure limits are generally expressed as average concentrations, excursions above these values are permitted. The exposure levels during such excursions must be below the STEL. However, there are certain levels, which must never be exceeded even instantaneously. These are known as the ceiling levels for a TLV, or TLV-C.

All these measurements, though often based on data from animal research, refer to the exposure and resistance of a healthy adult. These levels do not necessarily apply to pregnant women, their unborn fetuses, or adults who are ill or under special stress. In such situations the individual and his/her supervisor or instructor must carefully consider all pertinent information.

REHS can be consulted in such matters.

2) Acute Toxicity

Acute toxic effects are usually produced by a single large dose, generally well above the TLV, received in a short period of time. The effects are immediate, and may be partially or totally reversible. Acute toxic effects include:

Simple asphyxiation: the body does not receive enough oxygen (for example, when gaseous nitrogen has displaced the air in a room).

Chemical asphyxiation: the body is prevented from using oxygen (for example, when carbon monoxide instead of oxygen is absorbed in the blood).

Anesthetic: causes dizziness, drowsiness, headaches, and coma (for example, by the vapors of many organic solvents).

Neurotoxic: the brain's control of the nervous system is slowed down or changed (for example, by concentrations of lead and mercury).

Corrosive: body tissue is directly damaged by reaction with chemicals (for example, by strong acids or bases -- see separate subtopic below).

Allergic: repeated exposure to a chemical produces sensitizing, until there is an allergic reaction at the contact site (usually skin).

3) Chronic Toxicity

Chronic toxicity refers to adverse or injurious effects that can result from prolonged exposure to a substance, sometimes at dose levels just above the TLV. Damage may not appear for many years -- perhaps generations -- and is often irreversible. As a result, this class of hazard is both very difficult and very important to guard against. The body can filter and process levels of toxicity that might seem surprisingly high, but over extended periods of time, even with the dose very low, the filtering process may fail, and damage may occur.

Types of chronic toxic effects include:

Carcinogenicity: produces cancer (for example, asbestos and vinyl chloride are known to produce cancer in humans).

Mutagenicity: alters cell genes; subsequent generations show genetic damage.

Teratogenicity: harms developing fetus.

Reproductive toxicity: interferes with the reproductive system in men or women.

Specific organ toxicity: damages specific organs (for example, carbon tetrachloride can cause liver damage).

4) Precautions

The precautions to take against contact with toxic substances are repeated many times throughout this Guide. With chemicals of low acute toxicity, it may be tempting to be less rigorous; yet it is precisely those chemicals, which most require continual caution -- an unvarying habit of safety.

You must protect your body against all forms of chemical contact: absorption, inhalation, ingestion, and injection. Never eat, drink or smoke in the laboratory; wear the appropriate protective gear, and always remove it before you leave the laboratory.

Make sure you carefully wash your hands before leaving the laboratory. Remember that the chemicals you bring home on your clothes will have a more powerful effect on growing children and elderly people than on most adults.

In order to know what level of personal protection will be adequate, keep up to date on recent tests for substances you are using. MSDSs are updated regularly, and you should consult the most recent data each time you begin a new procedure. The best precaution is to treat all chemicals as toxic.

REHS staff conducts workplace assessments to identify and evaluate potential health and safety issues as part of its occupational health and safety program. Any student, faculty, or staff member who is pregnant, has a reproductive and developmental health concern, or works with known mutagenic, teratogenic, or carcinogenic agents may contact REHS at (732) 445-2550 to request an assessment. Participation is strictly voluntary, and is intended to provide the student, faculty, or staff member with information about potential reproductive health issues associated with their university environment, as well as recommended control measures, so they can make an informed decision about their continued work or learning activities with their personal obstetrician. A copy of the reproductive and developmental health policy statement, as well as the process and responsibilities, is contained in appendix 11 of this chemical hygiene guide.

d. Corrosives

Corrosiveness is a form of acute toxicity sufficiently common and hazardous to merit separate discussion. Corrosive chemicals include strong acids, strong bases, oxidizing agents, and dehydrating agents. When they come in contact with skin, eyes, or, through inhalation, the surface tissues of the respiratory tract, they react with the tissues they touch and cause local injury.

1) Liquid Corrosives

A liquid corrosive will act on the skin rapidly or slowly depending on concentration and length of contact. These chemicals react directly with the skin: dissolving or abstracting from it some essential components; denaturing the proteins of the skin; or disrupting the skin cells. Mineral acids, organic acids, and bases are among the typical liquid corrosives.

When handling liquid corrosives, contact with them must be scrupulously avoided. Wear goggles, rubber or suitable synthetic gloves, and a face shield. A rubber or synthetic apron and rubber boots may also be necessary. Since many liquid corrosives also release irritating vapors, procedures using these materials should be performed in a fume hood.

2) Solid Corrosives

Solid corrosives interact with the skin or other surfaces when dissolved by the moisture there. Damage then occurs both from the corrosive action and from the heat of solution. Because they are solid, these chemicals are relatively easy to remove; but because they may not react immediately and may not be painful at first (as with the caustic alkalis), they may cause much damage before being detected.

Solid corrosives are most commonly dangerous in a finely divided state. Dust control and good exhaust ventilation are essential, as well as goggles, gloves, and other protective clothing. In case of chemical contact, much care must be taken during the emergency shower irrigation to remove all particles of solid matter that might be lodged in the skin or clothes.

3) Gaseous Corrosives

Gaseous corrosives pose the most serious health hazard of all corrosives because of possible damage to the lungs, including spasm, edema, pneumonia, and even death. Different corrosive gases affect different parts of the lung (for example, ammonia affects the upper respiratory tract, while phosgene affects the lung, causing pulmonary edema), but all are to be avoided.

It is thus crucial that corrosive gases not be inhaled. Careful design and the use of fume hoods is essential. Skin and eyes must also be protected, as gases contact all exposed parts of the body.

e. Impurities and Combinations

MSDSs contain information on pure chemicals, known mixtures, and proprietary materials -- unfortunately there are no such sheets for other materials found in the laboratory, including solutions, mixtures of unknown or uncertain composition, and byproducts of reactions, all common in the laboratory. Impurities, synergistic effects, formation of unexpected products and byproducts, insufficiently clean equipment, and the combination of vapors from your experiment with that of your neighbor's can all produce sudden and unanticipated hazards.

There is no absolute protection against all contingencies, but it helps to wear protective gear, to clean equipment scrupulously, to be aware of experiments in progress in nearby areas, and to be completely familiar with emergency procedures.

8. Cleanup And Waste Disposal

a. Cleanup

Cleaning up should be a continual process, performed during as well as after an experimental procedure. Cleaning should include yourself and your clothing, laboratory surfaces, equipment, and containers. Wash hands frequently while working in the

laboratory; when you leave, remove protective gear and inspect clothing. Care with gear and clothing will prevent taking chemicals home with you; care with equipment and containers will help avoid future contamination and surprise mixtures. Such care requires planning as well as good housekeeping. Cleanup and disposal methods should be part of your written procedures.

When washing glassware, work with a few items at a time, and allow them to drain where they will not fall over. If anything falls, let it fall rather than risk severe cuts by grabbing it as it breaks. If glass has broken into a sink containing water, drain the water and then use gloves when picking out broken pieces.

Clean vessels or equipment with appropriate materials (water, soap, acid, etc.). Do not proceed unless you are sure which materials to use; check Material Data Safety Sheets (MSDSs), Hazardous Substance Fact Sheets (HSFSs), or other references for advice on proper cleaning materials to use with the specific substance to be cleaned up. Follow directions carefully. If you have any questions, call REHS.

b. Waste Disposal

Rutgers University has developed polices describing how to properly manage various waste streams generated in University laboratories. Periodically, new waste disposal policies are developed and existing programs are updated to reflect changes in regulatory or institutional requirements. For a description of the current waste disposal policies, go to http://rehs.rutgers.edu/lswaste.htm. A copy of these waste management polices are also included in this Chemical Hygiene Guide as appendices:

Appendix 5	Policy for the Disposal of Empty/Used Laboratory Containers and Glassware
Appendix 6	Hazardous Waste Disposal Policy and Procedures
Appendix 7	Policy for the Disposal Biological Waste
Appendix 9	Polychlorinated Biphenyls (PCB) Waste Management Plan
Appendix 10	Darkroom Waste Management Policy
Appendix 12	Electrophoresis Waste Disposal Guidance

B. CRITERIA TO DETERMINE AND IMPLEMENT CONTROL MEASURES

1. Determination

Whenever possible, MSDSs or HSFSs for chemicals used in the laboratory will be reviewed prior to the use of a chemical. These data, along with information on the conditions under which the chemical is to be used, will generally be used to determine the degree of protection required. In certain circumstances, REHS will conduct exposure monitoring to determine adequacy of controls and to determine if additional control measures are necessary. The following criteria will be used to determine and implement control measures:

a. **Occupational exposure limits** [usually an OSHA Action Level (AL) or Permissible Exposure Limit (PEL)), an ACGIH Threshold Limit Valve (TLV), or other equivalent standard -- Generally, substances with lower exposure limits require higher levels of protection.

b. **Vapor pressure** -- Generally, substances with higher vapor pressures require higher levels of protection.

c. **Exposure potential** -- This will be determined by reviewing experimental procedures. Exposure potential is generally increased with increased temperature or pressure, when working with open rather than closed systems, during transfer of materials, during the use of hazardous substances with live animals, etc. Exposure can occur via inhalation, skin contact (with liquid, solid or vapor) or through accidental ingestion. Generally, greater exposure potential requires higher levels of protection.

d. **Exposure monitoring results** -- REHS can use results of personal or area exposure monitoring to make judgments on appropriate control strategies.

2. Implementation

Once the required the degree of control is determined, control measures will be selected from one of the following categories:

a. Engineering Controls

Engineering controls reduce an exposure at its source. Engineering controls are the method of choice for reducing exposures and will be used whenever possible/practicable. Examples of some engineering controls include:

1) Substitution of hazardous materials or operations with those which are less hazardous

2) Use of Laboratory fume hoods

3) Use of glove boxes or other enclosures

4) Use of local exhaust ventilation (e.g. "elephant trunks", slotted exhaust hoods, and canopy hoods).

b. Administrative Controls

Administrative controls are work practices that are designed to control exposures. Administrative controls will be used in conjunction with engineering controls or when engineering controls are impractical or infeasible. Examples of administrative controls include:

1) Limiting time of exposure to maintain levels below acceptable exposure limits

2) Utilizing good housekeeping procedures to reduce exposures.

c. Personal Protective Equipment

Personal protective equipment does not reduce the source of exposure, but rather protects the individual. Personal protective equipment will be used in addition to engineering controls, while engineering controls are being installed or when engineering controls are impractical or infeasible. Some examples of personal protective equipment include:

1) Respirators -- This includes dust masks, as well as other types of respiratory protective equipment). Because all respirator users must participate in Rutgers respiratory protection program, you must call REHS if you think you have a need for respiratory protection.

2) Gloves, aprons, boots, and other skin protection.

3) Goggles, face shields.

C. DOCUMENTATION THAT FUME HOODS AND OTHER PROTECTIVE EQUIPMENT ARE FUNCTIONING PROPERLY

1. Fume Hoods

REHS performs annual face velocity surveys of all laboratory fume hoods to confirm they are functioning in accordance with University requirements. REHS will post a copy of the survey results on the fume hood and maintain a copy of the survey results on file. Any fume hoods found not to be operating in accordance with these requirements DUE TO THE USER'S ACTIONS (e.g. hood cluttered) will be referred to the user for correction. All other hood malfunctions will be reported to Campus Facilities Maintenance Services department for repair. Under certain circumstances, fume hoods will be placed out of order by REHS until such repairs can be made.

All fume hoods should be equipped with a flow-indicating device; if a fume hood is not equipped with a flow-indicating device, contact REHS to assess and arrange for installation of one.

All new and/or renovated fume hoods shall meet the "as manufactured" testing criteria established by the American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc. (ASHRAE) in ANSI/ASHRAE 110-1995, "Method of Testing Performance of Laboratory Fume Hoods". Upon installation, new and/or renovated fume hoods shall meet the appropriate "as installed" performance test guidelines as defined in the university design standards. REHS will request and maintain a copy of the "as installed" performance test results on file.

2. Safety Showers and Eyewashes

All safety shower and eyewash units will be inspected annually by campus Facilities Maintenance Services Departments. Safety shower and eyewash units found not to be operating in accordance with University requirements will be repaired immediately. If repairs cannot be made immediately, they will be placed out of order until such repairs are completed.

All inspected units will be tagged with the date of inspection and the initials of the person completing the inspection.

3. Biological Safety Cabinets

All biological safety cabinets at Rutgers University are certified upon installation, whenever relocated or repaired, and annually thereafter in accordance with the NSF International Standard 49 entitled, ""Class II Laminar Flow Biohazard Cabinetry" and the joint CDC/NIH Guidelines entitled "Biosafety in Microbiological and Biomedical Laboratories".

Rutgers University contracts with an approved outside vendor for the testing, repair, decontamination, and certification of biological safety cabinets and laminar flow clean air devices according to these guidelines. To certify new or relocated biological safety cabinets, laboratory users must contact REHS to identify the cabinet location and to schedule the certification test. Thereafter, the outside vendor performs annual certification of biological safety cabinets and laminar flow clean air devices on an established schedule.

The initial certification cost for new or relocated units is the responsibility of the principal investigator.

REHS pays for the cost for annual recertification of biological safety cabinets used for the manipulation of materials requiring biosafety level 2 containment or higher, as specified by the CDC/NIH Guidelines referenced above, the NIH "Guidelines for Research Involving rDNA Molecules," and/or the Rutgers Biosafety Subcommittee of the University Health and Safety Council.

The principal investigatory and/or department pays the annual recertification cost for all other biological safety cabinets and clean air devices.

D. EMPLOYEE INFORMATION AND TRAINING

The intent of the Information and Training Program is to inform workers of the physical agents and hazardous chemicals in their laboratory, the nature of the risks associated with handling these materials, and the proper disposal of wastes generated by research activities in the laboratory. Before working with any of these hazardous materials, lab workers will be informed of the conditions under which the materials may be harmful or may cause injury. They will be trained in the proper control methods (engineering, personal protective equipment, etc.) and appropriate procedures necessary to control occupational exposure to hazards in the laboratory. This training is designed to satisfy the requirements of the Public Employees OSHA Occupational Exposure to Hazardous Chemicals in the Laboratories Rule (the Laboratory Standard), the NJ Worker and Community Right-To-Know (NJ RTK) Act, and the Rutgers University Hazardous Waste Disposal Policy and Procedures.

Initial information and training will be provided to University laboratory employees in two separate training sessions. First, a general orientation session will be provided, scheduled, and documented by REHS. The session covers the topics outlined below, under "General Orientation (Classroom Training)". Second, a "hands-on" training session specific to the employee's work area must be scheduled by the employee's Department and given by their lab supervisor or Chemical Hygiene Officer. This session must cover the items listed below, under "Laboratory Training (Hands On/Specific to Work Area)". REHS will provide blank attendance forms to document this "hands-on" training session. However, a copy of the completed Department attendance form must be sent to REHS for compliance documentation.

University laboratory employees are also required to complete annual “refresher” training. This training reviews the key points of each program area, identifies program and policy changes implemented during the past calendar year, and discusses issues observed in the laboratories during annual audit activities. Refresher training is available to employees in either a “classroom” setting or “on-line” from the REHS web site. For “classroom” settings, REHS can modify the training program content to emphasize specific chemical and physical agents encountered in department laboratories. The “on-line” training program content covers all areas and enables employees to get additional information through links and photographs contained in the program. The annual “refresher” training program content is modified periodically to reflect program changes and emphasize different lab safety topics.

1. Initial Training

a. General Orientation (Classroom Training) - to be provided by REHS

1) **Regulatory Review** - the contents of the Laboratory Standard, the NJ RTK Act, and the EPA RCRA standard as applicable to the university policy will be reviewed, and a copy will be made available in the CHP.

2) **CHP** - The contents of the Chemical Hygiene Plan will be reviewed.

3) **Physical and Health Hazards** - the physical and health hazards of chemical exposure will be reviewed, including, but not limited to: biohazards, carcinogens, compressed gases, corrosives, cryogenic materials, embryotoxins, explosives, flammables, mutagens, oxidizers, poisons, radioactive materials, reactive materials, sensitizers, and teratogens.

4) **Methods of Determining Exposure** - the following methods of determining exposure will be reviewed:

   i. Exposure monitoring

   ii. Evaluation of work practices

   iii. Use of senses: sight with emphasis on sense of smell and focusing on the odor threshold of materials with poor warning properties.

5) **Permissible Exposure Limits (PELs)** - PELs and other occupational exposure limits will be reviewed. Also, a copy of OSHA Air Contaminants Standards, 29 CFR 1910.1000 is included in

the CHP in Appendix 8. If a material is considered hazardous but has no PEL, REHS will help establish controls for working with the material safely.

6) **Central Files** - Employees will be informed that the University maintains, for hazardous materials in the workplace, Material Safety Data Sheets (MSDSs) and Hazardous Substance Fact Sheets (HSFSs) in the Rutgers Environmental Health and Safety (REHS) Department and in all major campus libraries. Employees will be informed of the location and availability of these hazard information resources. Additional reference materials, available in individual departments, on the hazards, safe handling, and storage of hazardous materials will also be discussed.

7) **Chemical Exposure Prevention** - the following exposure prevention mechanisms will be reviewed:

   i. Engineering Controls:

      * Substitution - Substitute less hazardous materials for more hazardous material, whenever possible.

      * Isolation/Enclosure - Enclose the lab experiment or procedure; (e.g. utilize glovebox).

      * Ventilation - Remove airborne toxic materials from workers breathing zone through use of local exhaust ventilation (e.g. fume hoods).

   ii. Administrative Controls - minimize exposure through good housekeeping procedures, by minimizing exposure time, through good work practices.

   iii. Personal Protective Equipment - use of personal protective equipment will be discussed, including: eye and face protection, skin protection (e.g. gloves, aprons, lab coats), and respiratory protection.

8) **Hazardous Waste Management** – the following policies and methods used to manage hazardous waste generated at the university will be reviewed including, but not limited to: hazardous waste determination, drain disposal of chemicals, waste labeling and satellite accumulation areas, waste container management, waste compatibility, request for waste pick-ups, hazardous waste minimization techniques, empty/used laboratory containers and glassware, universal waste, and used oil disposal.

b. Laboratory Training ("Hands-On"/Specific to work area) to be provided by laboratory supervisor or principal investigator.

1) **CHP Availability** - The location and availability of the Chemical Hygiene Plan (CHP) for individual labs will be reviewed.

2) **SOPs** - Standard Operating Procedures developed for that specific lab will be reviewed.

3) **Emergency Procedures** - Emergency procedures and equipment for the lab (e.g. Location and use of eyewash, safety showers, fire extinguishers, exit routes, etc.) will be reviewed.

4) **Safety Equipment** - Safety equipment used in the lab (e.g. fume hoods, face shields, gloves, etc.) will be reviewed.

5) **Designated Areas** - Designated areas and any special procedures for handling extremely hazardous substances will be reviewed.

6) **Signs and Symptoms of Exposure** - Signs and symptoms associated with exposure to materials in the laboratory will be reviewed. In addition, the methods and observations that can be used to detect the presence or release of hazardous materials in the laboratory will again be covered in the hands-on training.

2. Annual Refresher Training – to be provided by REHS

a. Topics incorporated will cover all program areas listed above and may be modified to reflect potential hazards anticipated in specific departments or areas for "classroom" training.

b. "On-line" training requires lab workers to complete a short "test" to document completion of this program.

E. LABORATORY ACTIVITIES THAT REQUIRE PRIOR APPROVAL

The principal investigator is responsible for the safe conduct of laboratory work and for compliance with all applicable procedures, university policies, and regulatory requirements. The principal investigator or their designee[A] is expected to review, discuss, and approve routine activities through periodic meetings and other established practices for the laboratory workers they supervise.

However, the OSHA laboratory standard requires prior approval for certain research activities to protect laboratory workers from a significant risk of injury, illness, or exposure to hazardous substances. The risk is considered significant when there are large quantities of particularly hazardous substances involved or the experimental procedures exacerbate the potential for a hazardous condition. Obviously, these conditions must be applied on a case-by-case basis.

If the lab activities, operations, or circumstances meet any of the following criteria, then the Rutgers Chemical Hygiene Plan requires prior review and approval by the lab principal investigator (PI), the department chair, and REHS:

a. When the research activities pose extraordinary hazards (physical, chemical, or biological),
b. After an incident that results in chemical contact, physical injury (or could have been injured), property damage, or a large spill[B],
c. When laboratory workers become ill or suspect that they or others have been exposed as a result of an experimental procedure.

Principal investigators must ensure their research activities are safely supported with appropriate equipment, work procedures, as well as personal protective equipment before starting work, and may use the attached form as a guide when evaluating their laboratory activities. Principal investigators are encouraged to contact REHS for additional assistance or to answer any questions on appropriate control measures for the substances, physical hazards, or proposed work activities planned for their lab.

For prior approval after a laboratory incident or in response to an exposure above occupational limits, principal investigators must complete and submit the "Laboratory Activity Safety Review and Prior Approval" form to their department chair and REHS for review and approval. Hard copies of this form can be obtained from the Chemical Hygiene Guide, or the principal investigator may complete and submit the form on-line from the REHS web site. In some instances, such as when a proposed lab activity or incident response affects a significant population of laboratory workers, then REHS may distribute the completed form to the Laboratory Safety and Design Committee for comment and review. The review process used will ensure adequate hazard control measures are employed by the laboratory without causing unnecessary delay to the research activities in the lab.

Laboratory activities subject to safety oversight and approval by other university committees (Biological or Radiation) or by the Office of Research and Sponsored Programs (Animal Care) are considered to meet the prior approval requirements.

[A] The principal investigator may designate the responsibility for this review to a senior laboratory person. This person must have: (i) the responsibility for safety in the laboratory, (ii) the authority to enforce and implement safety procedures and policies in the laboratory, and (iii) process knowledge or familiarity with the lab activity or operation they are reviewing and approving.

[B] Any spill of an acutely hazardous chemical, regardless of size, must be considered a large spill.

LABORATORY ACTIVITY SAFETY REVIEW AND PRIOR APPROVAL FORM

Request Date: _____

Principal Investigator: _____ Department: _____

Building Name: _____ Room(s): _____

Lab Activity Name: _____

Activity Location(s) in Room: _____

Identify all individuals authorized/approved to perform this laboratory activity:

_____ _____

_____ _____

Reason for Safety Review and Prior Approval (Check appropriate item)

_____ Research activities pose extraordinary hazards (physical, chemical, or biological),

_____ Review initiated in response to an accident, incident, or large spill.

_____ Review required in response to a reported illness or exposure incident.

Section 1: General Information

Provide a brief description of the laboratory activity that requires prior approval. Activities can include, but are not limited to: a particular reaction, a laboratory system, use of a particular chemical, use or addition of new components to a new or old system, initiation of a new research project, or the addition of a new chemical to an old procedure. A copy of the written procedure submitted to satisfy existing institutional requirements (i.e., special review as specified on pages 2 or 3 of the ORSP endorsement form) may be attached to satisfy this requirement.

_____

_____

Section 2: Control Measures

A. Administrative Controls

1) Is a written standard operating procedure (SOP) for the lab activity available and maintained in the lab? __ Yes __ No

2) Has the PI reviewed this SOP with all individuals who will perform this activity? __ Yes __ No

3) Are copies of the MSDS' for the hazardous reagents available in the lab? (Copies may be printed or saved in electronic formats on *local* devices) __ Yes __ No

4) Have all individuals attended REHS Laboratory Safety Training? (This includes R-t-K, Hazard Communication, Chemical Hygiene, RCRA) __ Yes __ No

5) Have the designated area(s) for particularly hazardous substances use been identified and labeled in the lab? __ Yes __ No

B. Engineering Controls

1) Based upon the physical properties of the reagent(s) and the proposed handling methods, will this lab activity generate airborne dusts, mists, fumes, or vapors? __ Yes __ No
If yes, indicate the ventilation used to minimize and control exposure

___ Fume Hood ___ Gas Cabinet ___ Local Slot Exhaust

___ Other (Please specify)_____

2) Has the potential for emergency situations been addressed (e.g. runaway reaction, loss of containment, etc)? __ Yes __ No

3) Are compressed gas cylinder shut off valves or other critical process controls located where they can be readily reached and safely closed? __ Yes __ No

4) Indicate the control devices and equipment used to minimize and prevent exposures associated with this activity.

___ Glove box ___ Pressure Gages ___ Cylinder Valves

___ Gas Monitors ___ Auto Shut Off

___ Other (Specify) _____

5) Describe the performance measures used to ensure these control devices work properly.

_____

C. Personal Protective Equipment (PPE)

1) Identify the exposure routes associated with this lab activity.

___ Chemical Contact ___ Inhalation ___ Accidental Injection

2) Identify the PPE required to safely perform this lab activity (check all that apply)

___ Resistant Gloves (Immersion) ___ Splash Goggles ___ Face Shield

___ Disposable Gloves (Contact) ___ Safety Glasses ___ Lab Coat

___ Thermal Gloves (Heat & Cold) ___ Resistant Boots ___ Chemical Apron

___ Respirator* (this includes filtering face piece or "dust masks") ___ Other

Specify Other PPE: _____

* Respiratory protection selection and use must be assessed & approved by REHS *prior* to implementation

3) Is chemical contact intermittent (contact) or continuous (immersion)? _____

D. Waste Management

1) Does this lab activity have the potential to generate acutely hazardous waste? __ Yes __ No
(Click here to view the Acutely Hazardous Waste List)

2) Does the waste generated by this activity require any special handling? __ Yes __ No
(i.e., temperature or shock sensitive) If yes, please explain below:

_____

_____

3) Identify the primary waste types and quantities generated by this lab activity (i.e., 3 gallons flammable waste per week)

_____

_____

E. Emergency Response

1) Are there adequate spill clean up supplies available in the lab? __ Yes __ No

2) Are written emergency procedures written and available in the lab? __ Yes __ No

3) Are all lab personnel familiar with the emergency response procedures? (This includes spills and personal contamination incidents) __ Yes __ No

4) Are special decontamination procedures required for this material? (If yes, then indicate where these procedures are maintained in the lab.) __ Yes __ No

5) Are specific emergency shutdown instructions posted and visible? (*Post emergency shutdown procedures for all overnight and unattended operations. Ensure that there is a current Caution Sign posted on the laboratory door.)* __ Yes __ No

6) Are special instructions or precautions required for the lab activities? (i.e., calcium gluconate for hydrofluoric acid; water extinguishers prohibited in labs with reactive metals in use) __ Yes __ No

F. Additional Requirements (to be developed in consultation with REHS)

1) Based upon the lab activities, is exposure monitoring of lab personnel required? __ Yes __ No

2) Does this research collaborate with others outside the university and require shipping of biological or chemical samples? *(Contact REHS for assistance*) __ Yes __ No

3) Identify the chemical storage location, secondary containment, and security measures implemented to prevent unauthorized use or removal.

_____

4) Provide (estimate) the following information regarding chemical procurement and use for this activity.

Container Size Purchased: _____ Chemical Manufacturer: _____

Amount Used per Experiment: _____ Experiment Frequency: _____

Prior Approval Form Reviewed by:

_____ _____

Signature, Principal Investigator Signature, Department Chair

_____

Signature, REHS

F. MEDICAL CONSULTATIONS AND EXAMS

1. Medical Consultation

A laboratory worker will be offered a medical consultation or examination at no cost under the following circumstances:

a. If it is likely that the worker will be or has been exposed to a substance at a level in excess of either the OSHA recommended Action Levels, or in their absence, Permissible Exposure Limit (PEL) or the Threshold Limit Value (TLV) recommended by the ACGIH. REHS should be consulted for assistance in assessing the exposure or potential for exposure.

b. If a laboratory worker develops signs or symptoms associated with exposure to a chemical being used.

c. In the event of an exposure to chemicals through a spill, explosion, or other accident.

2. Procedure

a. All medical consultations are provided at no cost through the University Health Center located at each campus. The attending University physician will decide if the person needs to be referred to an area hospital or other such medical facility for further treatment. Off-campus facilities should contact the Occupational Health physician at Hurtado Health center for assistance in arranging for medical surveillance.

b. In case of exposure to a chemical spill, accident, explosion, etc., or onset of symptoms associated with a chemical being used, the supervisor of the laboratory shall refer the employee to the appropriate health center. If the center is closed or not easily accessible, he/she should be sent to the Emergency Room of the nearest hospital.

c. The supervisor shall collect as much information as possible about the person, chemical(s) involved, MSDSs and HSFSs, symptoms, exposure monitoring results, and other relevant data, and present this information to the physician, if needed.

d. The physician in charge will inform the employee about the medical examination results, related conditions, tests required, and any follow-up required.

e. REHS will be advised of the results of relevant tests conducted by the attending University physician.

3. Medical Records

a. The University physician shall keep written records of all such medical examinations. These records must be maintained for the length of employment plus thirty years.

b. Such records must contain, but are not limited to, physicians' opinions, recommendations, results of any tests performed and any follow-ups.

c. Upon written request, such records shall be made available for review by the employee or an authorized representative.

d. All such records shall be maintained and made available for review in accordance with the OSHA standard 29 CFR 1910.1020.

G. PROVISIONS FOR EMPLOYEE PROTECTION WHEN WORKING WITH PARTICULARLY HAZARDOUS SUBSTANCES (CARCINOGENS, REPRODUCTIVE TOXINS, SUBSTANCES THAT HAVE A HIGH DEGREE OF ACUTE TOXICITY, AND CHEMICALS OF UNKNOWN TOXICITY)

NOTE: The provisions described in this section of the Rutgers Chemical Hygiene Guide are intended to protect laboratory workers from either the acute and/or chronic toxicological properties associated with substances as defined in the Lab Standard at 1910.1450 (e)(3)(viii), while ensuring their continued safe use support the academic and research objectives contained in the university mission statement.

The actual control measures required for laboratory work with particularly hazardous substances depends upon the chemical(s), the quantity and concentration used per lab activity, its physical form, its hazardous properties, and the actual conditions of use. In many instances, established laboratory procedures (i.e., use of lab coats, safety glasses, appropriate chemical resistant gloves, properly operating fume hood, etc.) will be sufficient in controlling the hazard. In these cases, the principal investigator and laboratory worker must supplement the protocols with the following information:

a. Identify the designated area(s) in the lab for these research activities,

b. Restrict work activities to a properly operating fume hood, as appropriate,

c. Identify and make available appropriate personal protective equipment to protect against accidental skin contact, and

d. Describe how employees should respond to a small chemical spill or accident.

Principal investigators will establish and enforce procedures described in this section when performing laboratory work with any select carcinogen, reproductive toxin, substance that has a high degree of acute toxicity, or a chemical whose toxic properties are unknown. While the primary focus for this section of the Chemical Hygiene Guide is to address the acute and chronic toxicological properties associated with certain chemicals, all users must recognize that these chemicals may also possess other hazardous properties, such as flammability and reactivity. Laboratory workers need to consider and follow the requirements outlined in Section A, Standard Operating Procedures, to address these hazardous properties, as well as these requirements.

The following definitions apply:

a. Select carcinogen: Any substance defined as such in 29 CFR 1910.1450 and any other substance described as such in the applicable MSDS.

b. Reproductive toxin: Any substance described as such in the applicable MSDS.

c. Substances with a high degree of acute toxicity: Any substance for which the LD_{50} data described in the applicable MSDS cause the substance to be classified as a "highly toxic chemical" as defined by ANSI Z129.1.

d. Chemical whose toxic properties are unknown: A chemical for which there is no known statistically significant study conducted in accordance with established scientific principles that establish its toxicity.

e. For the purposes of this CHP, chemicals in the above four categories will be referred to as "particularly hazardous substances".

f. Designated area: A hood, glove box, portion of a laboratory, or an entire laboratory room designated as the only area where work with quantities of particularly hazardous substances shall be conducted.

REHS has identified 36 chemicals that meet the definitions of a select carcinogen, reproductive toxin, or substances with a high degree of acute toxicity to facilitate compliance with the Chemical Hygiene Plan requirements; these chemicals are listed in Table 1 at the end of this section. This list does not include all particularly hazardous substances; principal investigators and lab workers need to review the toxicological properties of the chemicals used to conduct their research work to determine if they meet the criteria defined in the section above, and implement appropriate work practices and control measures to ensure adequate worker protection.

Each laboratory that uses particularly hazardous substances is required to establish designated work areas, identify containment devices, properly dispose of wastes and contaminated materials, and develop and implement decontamination procedures for equipment and designated areas. The following summarizes these requirements and recommends methods to achieve compliance.

1. General Requirements

a. Designated Areas

Laboratory workers must request and receive permission from the principal investigator (faculty member) before working with particularly hazardous substances. In addition, each laboratory must delineate "designated areas" for research activities performed with particularly hazardous substances. The criteria used to identify the designated area will depend upon the chemical form (solid, liquid, gas), its physical properties, and the prevalence of use in the lab. Designated areas can include a specific piece of equipment (fume hood, spill tray, or balance), a work area within the lab, or the entire laboratory itself. All lab workers approved to use particularly hazardous substances must confine their work within these designated areas and decontaminate them when their work is completed. Since work areas and equipment are often shared among several users within a laboratory, it is prudent to confine and/or limit the designated areas established for research activities with particularly hazardous substances.

REHS will provide the following signs to delineate designated areas:

Caution
Designated Area
Substance Name: _____

b. **Containment Devices**
The actual control measures used to protect employees from exposure to particularly hazardous substances will vary based upon the chemical, its physical state (gas, liquid, powder, or solution), the amount used per specific research activity, and its condition of use. The following general control measures represent practical recommendations that apply to all laboratories using particularly hazardous substances. Substance specific control measures for particular operations shall incorporate and modify as appropriate these recommendations.

2. **Administrative Control Measures**
   a. Use the smallest amount and concentration of chemical that is necessary and consistent with the work activity to be performed.
   b. Ensure all particularly hazardous substance stock and process containers are properly labeled, stored in ventilated locations (as appropriate), and maintained within secondary containment. All stock and process containers shall be closed and/or covered, except during material transfers.
   c. Store and segregate all particularly hazardous substances stock containers by appropriate hazard class. These substances should be secured when not in use, and REHS recommends maintaining a log to record use and remaining quantities of chemical remaining.
   d. Establish, maintain, and enforce written standard operating procedures that identify the following:
      i. Material handling locations (i.e., designated areas)
      ii. Material storage locations
      iii. Segregation, collection, and disposal of waste generated by the lab processes according to current REHS requirements for satellite accumulation areas
      iv. Emergency response actions (spills and personal exposures) for the chemical used and work activity performed
      v. Personal protective equipment required for the work activity
   e. Enforce prohibitions on food consumption and cosmetic application in all labs containing designated areas.
   f. Do not wear jewelry when working in designated areas, and ensure good hygiene practices (washing hands) are followed after completing work activities, removing personal protective equipment, or when leaving the designated area.
   g. Immediately notify the principal investigator and/or lab supervisor of all spills, and seek medical evaluation for all incidents that result in personal exposure.
   h. Maintain supplies near the designated area in the lab to clean small spills of these substances.

3. Engineering Control Measures
   a. General Engineering Controls
      i. For research activities with powders, use wet cleaning methods or a HEPA equipped vacuum to clean up spills. As appropriate, conduct material transfer and weighing activities within enclosures to contain powder dispersal within the designated area.
      ii. Protect vacuum lines and other mechanical equipment to prevent contamination or dispersal of the particularly hazardous substance outside the regulated area.
      iii. Protect equipment and work areas from contamination by these substances, and decontaminate designated areas before returning them to “general use”. Use spill trays, absorbent paper, and other appropriate methods to contain spills and facilitate decontamination work in designated areas.

b. Fume Hoods
    i. Confine all laboratory research activities that may generate gases, vapors, mists, or fumes of a particularly hazardous substance within a laboratory fume hood or other appropriately ventilated area.
    ii. Fume hoods shall be equipped with a properly functioning flow-indicating device, and must be surveyed by REHS annually.
    iii. Maintain the fume hood free of clutter; and do not block the rear slot openings with equipment or materials. Items not currently in use shall not be stored in the fume hood, and large items required to support the research activities should be raised on blocks to allow air to flow under the equipment.

4. **Personal Protective Equipment (PPE)**

Although not a containment strategy, personal protective equipment supplements lab worker protection to prevent against personal exposure to particularly hazardous substances. Personal protective equipment must be worn when performing manipulations with particularly hazardous substances, when decontaminating designated areas after completion of research activities, or when cleaning up spills. The personal protective equipment selected must be appropriate to prevent or minimize lab worker exposure with the particularly hazardous substance used while not limiting or adversely affecting the work activities performed in the lab. The following are generic guidelines for the use of personal protective equipment; contact REHS to review the personal protective equipment selected for your work activities.

a. Prohibit lab workers from wearing of open toe shoes and sandals in laboratories that use particularly hazardous substances.
b. At a minimum, all lab workers must wear safety glasses when working in designated areas. Lab workers shall wear chemical splash goggles when handling liquids, as well as face shields when transferring large volumes (> 1 liter) of liquids from one container to another.
c. Laboratory coats must be available and worn in the laboratory, and removed before leaving the laboratory.
d. Wear chemical resistant gloves when performing research activities with particularly hazardous substances. Gloves selection shall be based upon the chemicals used, the anticipated chemical contact (intermittent splash or immersion) for the activity performed, and the nature of the task performed.
e. Lab workers shall not wear respirators in the lab when handling particularly hazardous substances unless their use has been properly evaluated by REHS. All employees wearing respirators must be medically cleared, fit-tested, trained, and included in the University Respiratory Protection Program.

5. Disposal of Wastes and Contaminated Materials

a. Waste Disposal

All waste solutions and contaminated materials containing particularly hazardous substances shall be disposed in accordance with the "Policy for the Disposal of Chemicals" contained in appendix 6 of this Chemical Hygiene Guide. Section II, Generator/Lab Personnel Responsibilities reviews in detail the requirements for managing waste in Satellite Accumulation Areas (SAA's).

b. Acutely Hazardous Waste Disposal

Of the 36 chemicals currently on the particularly hazardous substance list, the following 8 are listed as acutely hazardous wastes in 40 CFR 261.33(e):
Cyanide (soluble) salts Fluorine [7782-41-4]

Hydrogen Cyanide [74-90-8] Phosgene [75-44-5]
Phosphine [7803-51-2] Ethylenimine [151-56-4]
N-Nitrosodimethylamine [62-75-9]

Specific Organic Mercury Compounds:
Mercury Fulminate [628-86-4] (aceto-o)phenyl-mercury [62-38-4]

The maximum quantity of acutely hazardous waste that can be stored in each satellite accumulation area is 1 quart. Once this limit is reached, lab personnel must contact REHS immediately to enable us to remove the waste within 3 days. Lab personnel generating waste from the use of these chemicals must ensure these materials are properly managed and REHS is contacted when accumulation limits are reached.

c. **Contaminated Material Disposal**

Contaminated materials generated during research activities with particularly hazardous substances, such as used gloves, absorbent bench paper, and glassware, must also be collected and disposed in accordance with the "Policy for the Disposal of Chemicals". Contact REHS for assistance with the proper segregation and management of these wastes.

6. **Decontamination Procedures**

Lab workers must decontaminate designated areas in response to a spill or when the designated area (including equipment) is returned to general use. Lab workers performing these decontamination activities must wear appropriate personal protective equipment to avoid exposure through skin contact, inhalation, or injection, and must dispose of all wastes generated by this activity in accordance with section C above. The following outlines recommended guidelines for the decontamination of liquids and powders.

a. Liquids
   i. Select an appropriate solvent that will remove the liquid from the surfaces to be cleaned. Typically, a damp paper towel with a surfactant solution is adequate for this purpose.
   ii. Begin cleaning the designated area from the outer edges in toward the center. For equipment, begin cleaning the surfaces from the least contaminated area toward the higher contaminated area. Repeat cleaning in this manner for a total of three times.
   iii. Gloves selected for this purpose shall be resistant to both the particularly hazardous substance as well as the solvent used, provide protection from immersion to both chemicals, and resist tearing or damage from the cleaning activity.
   iv. Collect and manage the wastes generated by all decontamination work activities.

b. Powders
    i. Use wet cleaning methods or a HEPA equipped vacuum. Typically, a damp paper towel with a surfactant solution is adequate for this purpose.
    ii. Begin cleaning the designated area from the outer edges in toward the center. For equipment, begin cleaning the surfaces from the least contaminated area toward the higher contaminated area. Repeat cleaning in this manner for a total of three times.
    iii. Gloves selected for this purpose shall be resistant to both the particularly hazardous substance as well as the solvent used, provide protection from immersion to both chemicals, and resist tearing or damage from the cleaning activity.
    iv. Collect and manage the wastes generated by all decontamination work activities.

Table 1: Current Particularly Hazardous Substance List

Chemicals with Acute Toxicity*

Aniline [62-53-3]

Cyanide salts [592-01-8]

Dimethylmercury [593-74-8]

Hydrofluoric acid [7664-39-3]

Compressed Gases with Acute Toxicity

Arsine [7784-42-1]

Boron trifluoride [7637-07-2]

Bromine [7726-95-6]

Chlorine [7782-50-5]

Fluorine [7782-41-4]

Hydrogen bromide [10035-10-6]

Hydrogen chloride [7647-01-0]

Hydrogen cyanide [74-90-8]

Hydrogen fluoride [7664-39-3]

Methylamine [74-89-5]

Phosgene [75-44-5]

Phosphine [7803-51-2]

OSHA Carcinogens

4-Nitrodiphenyl [92-93-3]

alpha-Naphthylamine [134-32-7]

Chloromethyl methyl ether [107-30-2]

3,3'-Dichlorobenzidine [91-94-1]

Bis(chloromethyl)ether [542-88-1]

beta-Naphthylamine [91-59-8]

Benzidine [92-87-5]

4-Aminodiphenyl [92-67-1]

Ethylenimine [151-56-4]

beta-Propiolactone [57-57-8]

2-Acetylaminofluorene [53-96-3]

4-Dimethylamino-azobenezene [60-11-7]

N-Nitrosodimethylamine [62-75-9]

Benzene [71-43-2]

Formaldehyde [50-00-0]

Reproductive Toxins

Formamide [75-12-7]

Lead compounds

Organic mercury compounds

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* The ANSI Z129.1 classification as a "highly toxic chemical" includes chemicals in any of the following categories:

1) A chemical that has a median lethal dose (LD_{50}) of 50 milligrams or less per kilogram of body weight when administered orally into albino rats weighing between 200 and 300 grams each, or

2) A chemical that has a median lethal dose (LD_{50}) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less, if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each, or

3) A chemical that has a median lethal concentration (LC_{50}) in air of 200 parts per million by volume or less of a gas or vapor, or 2 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less, if death occurs within one hour) to albino rats weighing between 200 and 300 grams each, provided such concentrations and/or conditions are likely to be encountered in a reasonably foreseeable manner.

APPENDIX 1

OCCUPATIONAL EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES
29 CFR 1910.1450

Occupational Exposure to Hazardous Chemicals in Laboratories Rule

(Laboratory Standard)

Regulatory Overview

In February 1993, New Jersey's Public Employees OSHA adopted 29 CFR 1910.1450, Federal OSHA's "Occupational Exposure to Hazardous Chemicals in Laboratories Rule", (also known as the Laboratory Standard). An overview of the Laboratory Standard, as well as a full copy of the regulation is given in Appendix 1. The purpose of this Guide is to provide a model for the development and implementation of a Chemical Hygiene Plan (CHP) for each university laboratory, as required by the Laboratory Standard.

At Rutgers University, the Laboratory Standard applies to all employees and students engaged in the "laboratory use" of hazardous chemicals. It applies to research and teaching laboratories that are carrying out small-scale operations (those which can be handled safely and easily by one person) using multiple chemicals and procedures, where the procedures are neither a part of, nor simulate, a production process.

Generally, the Laboratory Standard requires:

1) EXPOSURE LIMITS: For OSHA - regulated substances, adherence to Action Levels, or, in their absence, Permissible Exposure Limits (PELs) for laboratory employees.

2) EXPOSURE DETERMINATION: Initial monitoring and, when necessary, periodic monitoring of employee exposures to OSHA - regulated substances when there is a reason to believe that an Action Level, or in its absence, a PEL, has been exceeded. Employees must be notified within 15 days of the results of the monitoring.

3) CHEMICAL HYGIENE PLAN: A Chemical Hygiene Plan must be developed. When implemented, the plan must be capable of protecting employees from health hazards associated with chemicals in the laboratory and must keep exposures below occupational exposure limits.

4) EMPLOYEE INFORMATION AND TRAINING: Employees must be provided with information and training regarding the requirements of the Laboratory Standard and the Chemical Hygiene Plan, and the hazards of chemicals present in the work area. This training must be provided when an employee is initially assigned to a laboratory area, or when new hazards are introduced.

5) MEDICAL CONSULTATIONS/EXAMINATION: Laboratory employees shall be provided with medical examinations under the following conditions:

   * When an employee develops signs or symptoms or exposure to a hazardous chemical in the laboratory.

   * When monitoring reveals exposure in excess of an Action Level or PEL.

   * When an event, such as a spill or explosion takes place, where there is a likelihood of exposure.

   These examinations shall be provided at no cost to the employee.

6) HAZARD DETERMINATION: Labels on incoming chemical containers must not be removed or defaced. Material Safety Data Sheets (MSDSs) that are received must be maintained and must be readily accessible to employees. For substances created in the laboratory, a hazard determination must be made.

7) RESPIRATORY PROTECTION: When respirators are required, they must be maintained and used in accordance with 29 CFR 1910.134.

8) RECORDKEEPING: Results of exposure monitoring as well as medical consultations and exams must be kept in accordance with 29 CFR 1910.1020.

APPENDIX 2

UNIVERSITY EMERGENCY ACTION PLAN

(PROCEDURES FOR RESPONDING TO VARIOUS EMERGENCY CONDITIONS)

TABLE OF CONTENTS

Rutgers University

EMERGENCY ACTION PLAN

During an emergency, proper action saves lives. For your safety, please familiarize yourself with these basic steps which pertain to students, faculty and staff on all University campuses.

University buildings are equipped with fire extinguishers in accordance with the requirements of the construction and/or fire safety codes. Students, Faculty and Staff are not expected to utilize these devices nor are they trained in their use due to the danger of their personal safety, which would result from attempting to extinguish a fire. Many buildings are protected by automatic sprinkler systems and others are provided with fire standpipe systems. All major buildings are equipped with automatic fire detection and alarm systems, which are constantly monitored by a campus's respective Rutgers University Police Department (RUPD) Communications Center. Special hazards, such as chemical storage, high voltage electrical, cooking, spray painting and computer installations are protected by fixed suppression systems in addition to the aforementioned types of built-in protection. There are no fire hoses for building occupant use located in any University building; only fire hose connections for fire department use exist.

If you discover a fire or smell smoke, sound the building fire alarm and begin to evacuate the building. Know the locations of the fire alarm stations and how they operate. Immediately activate the fire alarm station if the alarm is not already sounding. Do not attempt to fight a fire due to the hazards associated with the products of combustion and the threat of a spreading fire. Contact the RUPD's Communications Center using the preferred or alternate numbers to report the emergency.

RUPD Emergency Communications Center			
Campus	**Preferred Number (Campus Phone)**	**Alternate Number (Outside Line)**	**Emergency Number (Outside Line)**
New Brunswick/Piscataway	Obtain an Outside line then dial 9-1-1	732-932-7111	9-1-1
Newark	Dial 80 or 5111	973-353-5111	9-1-1
Camden	Dial 8 or 6111	856-225-6111	9-1-1
Farms, Research Stations, & other University Facilities	Obtain an Outside line then dial 9-1-1	9-1-1	9-1-1

1. Upon hearing a building fire alarm signal, which is a bell, horn, or voice message immediately begin evacuation. Close the doors behind you. Use the nearest safe exit, but DO NOT use elevators. **Full evacuation of the Building is required upon an activation of the fire alarm system.** Once you have evacuated the building, re-entry is permitted only after approval from the appropriate emergency responder. (Emergency Services, RUPD, municipal Fire Department or other mutual aid responder).
2. In most emergency situations, you will be required to immediately evacuate the building. In circumstances where immediate evacuation may not be warranted, such as an active shooter, shelter in place, bomb threat etc; you will be notified of what actions are necessary through established communication mechanisms. This may be via uniformed responders on the scene, 911 dispatcher, your supervisor, telephone, webpage, emergency text notification system, radio, television, or public address announcement (see attached guideline for general provisions).
3. Leave the building and assemble in an area established by the specific evacuation plan for your building (if required), your supervisor, or 100 feet from the main entrance of the building where you will not hinder the approaching firefighters and apparatus. Upon arrival at the assembly point, a survey of staff members/students/visitors present shall be conducted to determine if anyone failed to evacuate the building. If anyone is discovered to be missing, immediately report that information to the Emergency Responders. (Police, Fire or Emergency Services)

4. If caught in smoke or heat, stay low where the air is better and attempt to reach a safe exit or area of refuge.
5. Know the location of all exits from your building. All required exits in University facilities are properly marked with illuminated EXIT signs and directional arrows, where applicable.
6. If unable to leave your room or office due to heat or heavy smoke in the hallway, or due to physical disability, call RUPD and give your exact location so the firefighters can be directed to you. If you require special assistance during an evacuation due to a physical disability, the University "Emergency Evacuation of Physically Handicapped Individuals" plan can be obtained at: http://rues.rutgers.edu/emergencyevachandicapped.shtml.
7. Always use the preferred or alternate emergency access numbers to reach RUPD in an emergency. You could also activate the 9-1-1 telephone system. To utilize 9-1-1 from a university centrex telephone system, first obtain an outside line as you normally would to dial an outside telephone number, and then dial 9-1-1. The alternate RUPD emergency numbers; New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111
8. During an emergency event, the Department of Emergency Services, RUPD and municipal emergency forces, as necessary, will be responsible for rescue and emergency medical aid.

If you have any questions regarding this emergency action plan, please contact the following:

Campus	Department	Title	Phone Number
All	Rutgers University Emergency Services	Chief	732-932-4800
All	Rutgers Environmental Health and Safety	Director	732-445-2550
All	Rutgers Office of Emergency Management	Director	732-932-4880
New Brunswick	Rutgers University Police Department	Chief	732-932-8407
Newark	Rutgers University Police Department	Chief	973-353-5581
Camden	Rutgers University Police Department	Chief	856-225-6009

Additional safety and health information can be obtained from the following university web sites:

Campus	Department	Website
All	Rutgers University Emergency Services	rues.rutgers.edu
All	Rutgers Environmental Health and Safety	rehs.rutgers.edu
All	Rutgers Office of Emergency Management	emergency.rutgers.edu
New Brunswick	Rutgers University Police Department	publicsafety.rutgers.edu/rupd
Newark	Rutgers University Police Department	nwkpolice.rutgers.edu/
Camden	Rutgers University Police Department	rupd.camden.rutgers.edu/

REPORTING AN EMERGENCY

Immediately report emergency situations occurring in or near your facility (such as fire, explosion, storm damage, hazardous material spills, chemical odors, flooding, accidents, injuries, criminal or suspicious activities, etc.) to your campus's RUPD Communications Center or by using a campus emergency telephone.

RUPD Emergency Communications Center			
Campus	**Preferred Number (Campus Phone)**	**Alternate Number (Outside Line)**	**Emergency Number (Outside Line)**
New Brunswick/Piscataway	Obtain an Outside line then dial 9-1-1	732-932-7111	9-1-1
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Camden	Dial 8 or 6111	856-225-6111	9-1-1
Farms, Research Stations, & other University Facilities	Obtain an Outside line then dial 9-1-1	9-1-1	9-1-1

When reporting an incident include as much of the following information as possible:

- Location of emergency
- Nature of the emergency
- Status of the emergency condition (i.e., in progress or completed)
- Any immediate threat(s) to life
- Need for medical or other assistance
- Description, location or direction of travel of suspect(s), description of motor vehicle(s) involved, presence of weapons
- Any danger to emergency responders
- Other information that would aid the emergency response

Stay on the telephone until released by the dispatcher. If you are in a position of safety, you may be asked to maintain observation and report developments until the arrival of emergency response personnel. You may be given emergency instructions by the dispatcher.

SHELTERING IN PLACE

An emergency situation such as a hazardous materials release, major storm, terrorism incident, etc. may require that university personnel take shelter in their facility:

- Identify safe areas within the facility (preferably interior, windowless rooms) in which to take shelter
- DO NOT use basement areas during a hazardous materials release incident
- Close exterior windows and turn off heating, ventilation, and air conditioning (HVAC) systems in the event of hazardous materials incidents requiring sheltering in place
- Establish a "duty desk" for the facility to monitor communications, handle requests from building occupants, coordinate the distribution and use of resources, etc.
- Departments that wish to stock emergency equipment and supplies for use in emergency sheltering situations in their facilities should consider the items listed below. In planning for such a situation remember that very few emergencies requiring sheltering would last more than 24 hours.
    - Bottled water, one gallon per person per day (replace every 6 months)
    - Flashlights with extra batteries
    - AM/FM radio with extra batteries
    - First aid kit
    - Personal hygiene items
    - Disinfectant and household chlorine bleach
    - Non-perishable food in cans or sealed metal or plastic containers (replace every 6 months) and utensils/paper plates, etc.
    - Plastic buckets with tight lids (for use as emergency toilet)

IDENTIFYING AND HANDLING SUSPICIOUS MAIL

If you are suspicious of a mailing and unable to verify the contents with the addressee or sender:

- Do not open
- Treat it as suspect
- Isolate it
- Call the RUPD

Mail that may have a light coating of a powdery substance:

- Wash you hands with soap and water
- Notify RUPD and your immediate supervisor
- Ensure that all persons who have touched the letter/package wash their hands with soap and water
- List the names and contact information for all persons who have touched the letter/package

Other suspicious mail may have the following characteristics:

- Type of mail – Foreign, Priority, Special Delivery
- Restrictive Endorsements – Confidential, Personal, To Be Opened By Addressee Only
- Visual Distractions - Fragile, Rush, Handle with Care
- Postmark city different from return address
- Fictitious, unfamiliar or no return address
- Excessive postage (usually postage stamps)
- Address to title only (Vice President)
- Wrong title with name
- Poorly typed or handwritten address
- Misspelled words
- Rigid or bulky
- Protruding wires, screws or other metal parts
- Strange odor
- Oily stains or discoloration on wrapping
- Lopsided package or uneven envelope
- Excessive Binding Material – masking, electric or strapping tape, string or twine

BOMB THREAT

- Keep the caller on the line as long you can and attempt to obtain as much information as possible.
- Ask for the message to be repeated to confirm it. Write down all information received.
- If possible, record the message.
- Ask for the location of the bomb and the time of possible detonation.
- Pay particular attention to background noises, which may give a clue as to the location of the caller.
- Listen closely to the voice (male or female), voice quality (calm or excited), accents, and speech impediments.
- Report the threat immediately to RUPD.
- Wait for instructions from emergency responders (e.g., Public Safety, Dispatcher, Local Police, Bomb Squad, etc.).
- Do not activate the fire alarm.
- Do not touch or handle the suspicious package, if found.
- Avoid the use of cellular phones or two-way radios near package

UTILTY OUTAGES

In many instances, utility outages will be for a short duration of time. Emergency lighting and alarm systems will operate for a period of time to safely light your way out of a building.
Status of utility interruptions can be found at:

New Brunswick	http://www.fms.rutgers.edu/interruption/inter.asp
	http://campusstatus.rutgers.edu/
Newark	http://www.newark.rutgers.edu/campusstatus/
Camden	http://www.camden.rutgers.edu/

In the event of a longer outage, additional information will be provided using established communication mechanisms, as the circumstances dictate. The following information may be used during a utility outage:

Power Outage

- Disconnect all equipment that could be damaged by a power surge when electricity is restored.
- Turn off lights, appliances, window air conditioners, and other energy users to reduce power requirements for restoration.
- Notify your supervisor and call Facilities Maintenance.
- Do not light candles or use other types of flames for lighting.

Water Failure

- Notify your supervisor and call Facilities Maintenance.
- Discontinue any work with hazardous materials in areas where the emergency shower and/or eyewash stations are disabled due to water failure.
- Turn off all water cooled operations.

Gas Leak

- Evacuate the area immediately.
- Contact RUPD
- DO NOT turn electrical devices on or off; and DO NOT plug or unplug any device, as this may create a spark.
- Notify your supervisor and call Facilities Maintenance.

Sewage/Drainage Failure

- Notify your supervisor and call Facilities Maintenance on your campus.
- If backup is large, evacuate the area.

ACTIVE SHOOTER INCIDENT

The following guidelines are intended to reduce your personal risk in the unlikely event that an Active Shooter Incident should occur on campus.

If you are outside a building when an event occurs:

- Take immediate cover, preferably inside a building, circumstances permitting

If you are in a building when an event occurs:

- If possible without compromising your safety, leave building and call RUPD or 9-1-1.
- If the location of an Active Shooter does not permit you to leave, secure immediate area:
  - Lock and barricade doors
  - Do not stand by doors or windows
  - Turn off lights
  - Close blinds
  - Block windows
  - Turn off radios and computer monitors
  - Keep yourself out of sight and take adequate cover/protection (i.e. concrete walls, filing cabinets). Cover may protect you from bullets
  - Silence cell phones

Un-securing an area:

- Consider risks before un-securing rooms
- Remember, the shooter will not stop until they are engaged by an outside force
- Attempts to rescue people should only be attempted if it can be accomplished without further endangering the persons inside a secured area.
- Consider the safety of masses vs. the safety of a few
- If doubt exists for the safety of the individuals inside the room, the area should remain secured
- Know all alternate exits in your building

Contacting Authorities:

- Call 9-1-1
- Program the alternate RUPD numbers into your cell phone
  - New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111
- Even if phone lines are overwhelmed and your call does not go through, continue to call by dialing 9-1-1 or by using the recall function on your phone.

What to Report:

- Your specific location – building name and office/room number
- Number of people at your specific location
- Injuries, number injured, types of injuries
- Assailant(s) location, number of suspects,
- race/gender, clothing description, physical features,
- Type of weapons (long gun or handgun), backpack, shooters identity if known, separate explosions from gunfire, etc

INTRUDER/SUSPICIOUS PERSON

If an armed or threatening intruder comes on to your facility it is very important that faculty, staff and or students **report it immediately and take protective actions**. Rutgers University maintains an open campus in the middle of a residential and city setting, creating unique challenges when dealing with this type of situation.

Rutgers University recommends the following procedures.

If you see an armed intruder and you are in an office or classroom:

- Remain in the classroom or office and immediately lock all doors, if possible.
- Call RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111) or 9-1-1.
- Try and remain calm so you can give an accurate description of the person or person(s). Note type of dress, height, weight, sex, and any other characteristics/physical items that are particular to the individual(s). Report the type of weapon (if known) and direction of travel or building entered.
- Lock the windows and close blinds or curtains.
- Turn off lights and all audio equipment.
- Stay out of the open areas and be as quiet as possible.
- Try to remain as calm as possible.
- Keep classroom or office secure until police or Safety & Security arrive and give directions.

If you are caught in an open or exposed area and you cannot get into a classroom or office you must decide upon a course of action:

Hiding -Look for a safe and secure hiding area. Once in place try and remain calm. Stay hidden until you can make contact with emergency personnel.

Running -If you think you can safely make it out of the area, then do so. If you decide to run, stay low and do not run in a straight line. Attempt to keep objects (trees, vehicles, trash cans, etc.) between you and the hostile person. When away from immediate area of danger, summon help and warn others.

Playing Dead -If the intruder is causing death or physical injury to others and you are un-able to run or hide you may choose to assume a prone position and lay as still as possible.

Fighting -Your last option if you are caught in the open and are in close proximity of the intruder is to fight back. This is dangerous, but depending on your situation this could be your last option.

If you are caught by the intruder and are not going to fight back, obey all commands and avoid eye contact.

Once emergency personnel have arrived and taken over the situation, obey all commands. Once the threat is over, render first aid to injured near you and summon emergency aid responders.

PSYCHOLOGICAL CRISIS/SUICIDE THREAT

If someone around you is experiencing a PSYCHOLOGICAL CRISIS or is THREATENING SUICIDE:

- A psychological crisis exists when someone is threatening harm to themselves or others, or is out of touch with reality. The crisis may be manifested as paranoia, hallucinations, delusions, uncontrollable behavior, and/or complete withdrawal.
- If you come into contact with someone experiencing a psychological crisis that appears to be potentially dangerous (individual is unduly aggressive, hostile, has a weapon, or otherwise unmanageable) do NOT attempt to handle the situation alone—contacting your campus's RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111) or dialing 9-1-1.

On the New Brunswick Campuses RUEMS has partnered with Residence Life, Student Health Services and University of Medicine and Dentistry Behavioral Health, to provide Emergency Behavioral and Emotional Heath Services to the Rutgers Community. The EMS supervisors will perform a screening with the assistance of the UMDNJ facility on the Busch Campus

If a student is contemplating suicide:

- Remain calm and encourage others do the same.
- Try to provide a safe, quiet, secure place for the individual.
- Maintain a straightforward, supportive attitude.
- Remind them they are not alone.
- Do not moralize or minimize concerns.
- If the threat is immediate or imminent, call RUPD or 9-1-1.

If the person needs counseling assistance:

- New Brunswick Campuses call (732) 932-7884 or visit http://www.rci.rutgers.edu/~rccc/
- Newark Campus call (973) 353-5805 or visit http://psyacs.newark.rutgers.edu/
- Camden Campus call 856-225-6005 or visit http://healthservices.camden.rutgers.edu/psychservices/psychinfo-services.html
- Faculty and Staff call 732-932-3020, ext. 4010 or visit http://uhr.rutgers.edu/fas/EmployeeCounseling.htm

Other Centers providing the Rutgers' community after hour services:

New Brunswick Campuses, UMDNJ Behavior Health can be called direct at 732-235- 5700.

Newark campus UMDNJ Psychiatric Emergency Room can be contacted at (973)972-6134.

MEDICAL EMERGENCIES

Do not move a seriously injured person unless they are in a life threatening situation.

Request an Ambulance

In the event of a serious injury or illness, immediately call RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111) or dialing 9-1-1.

Give as much information as possible regarding:
- Nature of the illness or injury
- Victim's location
- Is victim conscious, breathing, bleeding?
- Victim's injuries
- If chemicals or radioactive materials were involved, provide as much detail as possible.

Send someone to the building entrance to meet the ambulance.

The university maintains automated external defibrillator (AED) at Athletic and Recreation Facilities on all campuses. University first responder vehicles (RUPD and RUES) are also equipped with automated external defibrillator.

Only trained personnel should provide first aid or CPR. If first aid or CPR training is desired, contact Rutgers University Emergency Services at 732-932-4800

Minor Injuries or illnesses

For employee with injuries and illness contact:
New Brunswick Campuses
Occupational Health - 732-932-8254 or visit http://occhealth.rutgers.edu/index.html

Newark Campus
Health Services - 973-353-5231 or visit http://health.newark.rutgers.edu/

Camden Campus
Health Services - 732-225-6005 or visit http://healthservices.camden.rutgers.edu/

For students with injuries and illness contact:
New Brunswick Campuses
Health Services - 732-932-7402 or visit http://health.rutgers.edu/

Newark Campus
Health Services - 973-353-5231 or visit http://health.newark.rutgers.edu/

Camden Campus
Health Services - 732-225-6005 or visit http://healthservices.camden.rutgers.edu/

ON THE JOB INJURY/ILLNESS

Reporting

Employees, who are injured or become ill on the job due to work related activities, must immediately notify their supervisor of their injury or illness. The supervisor must then complete the first page of the Employer's First Report of Accidental Injury [Secure Online Form requires NETID] by the end of the employees' work shift. The remaining pages of the form must be completed within five (5) working days of the date of the accident.

For assistance in investigating or reporting an accident, please contact REHS at 732-445-2550.
Online Form - https://halflife.rutgers.edu/accident/

Treatment

If treatment is required, employees on the New Brunswick Campuses must visit Occupational Health Department at the Hurtado Health Center and their supervisor must be notified. Employees on Camden or Newark campuses must go to their respective Student Health Center. If closed, the employee must go to the nearest hospital emergency room and contact their university health center the next day for further treatment. If an employee decides to seek treatment on their own and bypasses the health center, they are responsible for paying their medical bills.

Absence from Work

Full Time Full Benefits employees kept out of work by an Authorized University Physician (AUP) for a work related illness or injury are entitled to I-time for up to 13 weeks per accident, pending approval by Risk Management. Employees out for more then 13 weeks can receive full salary by using their sick or vacation time. If they do not elect to use their sick or vacation time they then will be paid the statutorily required Temporary Total Disability (TTD) Salary Continuation Benefit by the Rutgers Workers Compensation Administrator based on the State Average Weekly Wage. If the AUP returns the employee back to work on Alternate Duty and the department can accommodate the employee with the restrictions, the employee must return to work or the days missed will be charged to his/her vacation time only. If the employee has no vacation time available, the employee will be put on a leave of absence without pay.

Injury to Students or Public

If an injury occurs to students or members of the general public and is witnessed by an employee, then the employee must complete the Injury Report Form for Students or Public and forward it to Risk Management.

Injury Report Form for Students or Public:
http://riskmanagement.rutgers.edu/PDFForms/Inj_Stu_Pub.pdf

CRIMINAL/CIVIL DISTURBANCE/HOSTAGE

If you witness or experience VIOLENT or CRIMINAL BEHAVIOR:

- If you are a victim or a witness to any on-campus offense or observe a criminal act or suspicious person on campus, report it to your campus's RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111) or 9-1-1.
- Note details and supply the dispatcher with any helpful information.
- Everyone can help make the campus a safe place by promptly reporting suspicious or criminal activity.

If a CIVIL DISTURBANCE or RIOT is in progress:

- Keep a safe distance from any crowd activities that appear unsafe.
- Secure your area—lock doors, windows.
- Avoid confrontation with crowd participants.
- If police are not already present, report it to RUPD or call 911 and report details of the event.

If you are involved in a HOSTAGE SITUATION:

- Remain calm and be patient. Time is on your side. Avoid drastic action.
- The initial 45 minutes are the most dangerous. Follow instructions, be alert and stay alive. The captor is emotionally unbalanced. Don't make mistakes that could hazard your well-being.
- Don't speak unless spoken to and only when necessary. Don't talk down to the captor, who may be in agitated state. Avoid appearing hostile. Maintain eye contact with the captor at all times if possible, but do not stare. Treat the captor like royalty.
- Try to rest. Avoid speculating. Comply with instructions the best you can. Avoid arguments. Expect the unexpected.
- Displaying a certain amount of fear can possibly work to your advantage. Be observant. When you are released, or when you escape, the personal safety of others may depend on what you remember about the situation.
- Be prepared to answer the police on the phone. Be patient, wait. Attempt to establish rapport with the captor.
- If medications, first aid or restroom privileges are needed by anyone, tell the captor.

WORKPLACE VIOLENCE

Rutgers University prohibits workplace violence. Specifically, the University will respond promptly to violence, threats of violence, harassment, intimidation, or disruptive behavior of a threatening nature towards people or property. Individuals who violate this policy may be removed from Rutgers property and are subject to disciplinary and/or personnel action up to, and including, termination and/or criminal prosecution.

Workplace violence is defined as any actual or threatening behavior of a violent nature, as understood by a reasonable person, exhibited by faculty, staff, student employees, or others.

Examples of workplace violence include, but are not limited to:

- Intentional physical contact for the purpose of causing harm (such as slapping, punching, striking, shoving, or otherwise physically attacking a person).
- Menacing or threatening behavior (such as throwing objects, waving fists, damaging property, stalking, or otherwise acting in an aggressive manner; or, using oral or written statements specifically intended to frighten, coerce, or cause distress) where such behavior would be interpreted by a reasonable person as being evidence of intent to cause physical harm to individuals or property.
- Possessing any firearm, imitation firearm, or any components which can readily be assembled into a firearm or other weapon, as defined by the Laws of New Jersey, without specific written authorization from the Division of Public Safety, irrespective of whether the individual possesses a valid permit to carry the firearm or a valid firearms purchaser identification card.

Reporting Workplace Violence:

- General Reporting Responsibilities: Any member of the University community who has been subject to workplace violence or who has witnessed workplace violence should promptly notify the appropriate university official. Additionally, employees are encouraged to report behavior that they reasonably believe poses a potential for workplace violence as defined above. It is imperative that all University employees take this responsibility seriously.
- Reporting Imminent or Actual Violence: Any person experiencing or witnessing imminent or actual violence involving weapons or potential injuries should call RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111) or 9-1-1
- Reporting Acts of Violence Not Involving Weapons or Injuries to Persons: Any person who is the subject of, or witness to, a suspected violation of this policy should report the incident to his or her supervisor or, in lieu thereof, to the appropriate Designated University Representative listed below:
    - Camden: Associate Chancellor for Administration and Finance
    - Newark: Associate Chancellor
    - New Brunswick: Office of Labor Relations
- Law Enforcement Agencies: All individuals who believe a crime has been committed against them have the right, and are encouraged, to report the incident to the appropriate law enforcement agency.
- False Reports: Employees who intentionally file false reports pertaining to workplace violence will be subject to disciplinary action up to, and including, termination.

SEVERE THUNDERSTORMS AND LIGHTNING

If you are caught outdoors in a severe thunderstorm or when lightning threatens:

1. Immediately seek shelter in a substantial building.
   - DO NOT seek shelter under trees during thunderstorms.
   - DO NOT seek shelter in unprotected open structures such as picnic pavilions, rain shelters or bus stops.
   - If a substantial building is not available, a metal-topped vehicle with the windows up is your next best choice.
2. Avoid contact with metal fences, metal bleachers, or metallic structures.
3. Avoid using the telephone or any electrical appliances. Use phones ONLY in an emergency.
4. Do not take a bath or shower during a thunderstorm.
5. Wait 30 minutes or more after hearing the last thunder before leaving the safe location

If Caught Outdoors and No Shelter Is Nearby:

- Find a low spot away from trees, fences, and poles that is not subject to flooding.
- If you feel your skin tingle or your hair stand on end, squat low to the ground on the balls of your feet. Place your hands over your ears and your head between your knees. Make yourself the smallest target possible and minimize your contact with the ground. DO NOT lie down. If you are swimming, get out of the water immediately.

REMEMBER: If you can hear thunder, you are close enough to be struck by lightning.

Once you have taken shelter indoors, you should monitor a weather radio, commercial radio/television station, internet or other weather service provider. Even when a specific storm cell has passed beyond the area, conditions may still be right for high winds, lightning, and other hazardous weather conditions. In an emergency call RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111) or dial 9-1-1.

Rutgers University utilizes Lighting Detection Systems to detect and announce the proximity of lighting. The Lighting Detection Systems covers the large recreation and athletic fields, stadium and the golf course on the Busch and Livingston Campuses. The system will activate an audible horn alarm to announce the proximity of lighting. All activities on the fields are suspended and everyone must locate appropriate cover until the storm has passed.

FIRE EXTINGUISHER USE GUIDELINES

Employees are not expected to fight fires. In the event of a fire, you should alert others and immediately evacuate the building.

University buildings are equipped with fire extinguishers in accordance with the requirements of the construction and/or fire safety codes. Students, Faculty and Staff are not expected to utilize these devices to fight fires due to the danger of their personal safety, which would result from attempting to extinguish a fire, the hazards associated with the products of combustion and the threat of a spreading fire.

A fire extinguisher may be utilized to clear a safe path to an exit or "shoot your way out" of a building if you are trapped. Before using a fire extinguisher, you should know how to properly select and operate one. It is important to use the right kind (Class) of extinguisher for the fire. The following letters identify the classes of fire extinguishers:

Class A	For ordinary combustible solids including paper, wood, coal, rubber, and textiles such as wastebaskets, small pieces of furniture, etc. A pressurized water fire extinguisher.
Class B	For flammable and combustible liquids, including gasoline, diesel fuel, alcohol, motor oil, grease, and flammable solvents. Typically, a dry chemical fire extinguisher and can be used on all three Classes if it is rated as an ABC fire extinguisher.
Class C	Electrical equipment. A carbon dioxide fire extinguisher.

If you find yourself trapped and required to "shoot your way out" or to clear a safe path to an exit, the following are guidelines on how to use the extinguisher:

P.A.S.S - Use of a Fire Extinguisher

PULL	Holding extinguisher upright, twist the pin to break the plastic safety seal. Pull the pin completely out.
AIM	Aim low. Point the extinguisher nozzle (or its horn or hose) at the base of the fire not the flames. This is important – in order to put out the fire, you must extinguish the fuel.
SQUEEZE	Squeeze the handle. This releases the extinguishing agent.
SWEEP	Using a sweeping motion, move the fire extinguisher back and forth until the fire is completely out. Watch the fire area. Back away if fire breaks out again repeat the process.

If possible, do not attempt to extinguish any fire without calling for help and pulling the fire alarm.

- Operate the extinguisher from a safe distance, several feet away, and then move towards the fire once it starts to diminish.
- Be sure to read the instructions on your fire extinguisher - different fire extinguishers recommend operating them from different distances.
- Remember: Aim at the base of the fire, not at the flames!
- Don’t turn your back on it! Back away from the fire, watching it to make sure that it does not reignite.

CHEMICAL SPILLS

First, you must decide on whether to evacuate the immediate area of the spill. Anytime you are unsure about handling the spill yourself, be safe and evacuate the area.

Evacuation

- If the spill is contained within an operating fume hood, evacuation is not necessary.
- If the spill is outside of an operating fume hood but within your lab, evacuation is usually not necessary since the laboratories are generally under negative pressure with respect to surrounding areas.
- If the spill is outside a laboratory, if you spill a Particularly Hazardous Substance, or you have reason to believe that a spill in the laboratory may escape into the surrounding areas, please do not hesitate to pull a fire alarm if you feel the need for building-wide evacuation.

Personal Contamination

- If a spilled material has contacted any part of your body, start first aid measures immediately. Shout for help and move directly to the nearest eyewash or safety shower. Disrobe promptly if clothing is involved.
- If eyes or skin are involved Flush with and emergency eyewash or/and safety shower for a minimum of 30 minutes. Other persons should assist (you will need help with eye flushing) and should contact RUPD as soon as possible to obtain medical assistance

Spill Cleanup

If you have the appropriate laboratory training, you can clean up a chemical spill yourself. Make a determination on whether a cleanup can be handled or if assistance is required. Generally, the spill can/should be cleaned up by laboratory personnel if the material is of low hazard (low corrosivity and toxicity) and are a gallon or less. REVIEW THE APPROPRIATE MATERIAL SAFETY DATA SHEETS and use the following guidelines.

If you require any more information, contact REHS at (732) 445 - 2550

Small Spill	**Large Spill**
ASSESS spill size, chemical type and available cleanup equipment.	**ATTEND** to injured persons, seek appropriate medical attention.
EVACUATE the immediate area.	**EVACUATE** area/building.
WARN other personnel.	**EXTINGUISH** ignition and heat sources.
WEAR appropriate PPE.	**PREVENT** spill from spreading.
CLEAN UP spill using appropriate spill kit if trained to do so.	**CONTACT REHS** for assistance. After hours call RUPD.
CONTAIN spilled material in a sturdy plastic bag or sealed drum. Apply a hazardous waste label and contact REHS for disposal.	**FILE** a formal incident report.

RADIOLOGICAL SPILL

When an incident occurs, the worker must first make a judgment as to whether the incident is a minor or major incident. The chart below will help you to make the determination as to a minor or major incident. When in doubt, call REHS.

Notifications
The proper response to an emergency depends upon a thorough understanding of the magnitude of risks, priorities for action and the application of common sense. When calling REHS or the police to report a spill, the following information should be provided:

- Location of incident
- Authoree
- Name and telephone number of person reporting
- Persons contaminated or exposed, estimate of amount on skin
- Radionuclide involved
- Amount of radioactivity
- Volume of released material
- What steps have been taken so far?

In the event of a spill or emergency during normal business hours (Mon - Fri 8 am to 4:30 pm), REHS should be contacted at 732-445-2550. After business hours, call RUPD (New Brunswick 732-932-7111, Newark 973-353-5111, Camden 856-225-6111):

Emergency Procedures for Radiation Incidents

Minor Incident:	**Laboratory Guidelines**
• < 100 uCi of Radioactive Material (RAM) • No personal contamination • Localized contamination • No spread of RAM outside licensed areas • Proper tools and knowledge available for clean up	• Stop source of the spill • Warn other personnel • Survey and mark the affected areas • Minimize exposures • Notify Authoree or designee • Begin cleanup • If area cannot be cleaned, notify REHS at (732) 445-2550 • Document incident in laboratory survey book
Major Incident: (Any of the following conditions)	**Laboratory Guidelines:**
• > 100 uCi of Radioactive Material (RAM) • Skin and/or clothing contamination is involved (any quantity) • Airborne RAM is thought to be present • Large areas are contaminated • Contamination has spread outside licensed areas • Personnel injury or fire • * Anytime you are unsure of what to do, or how to do it	• Treat life threatening injuries first • Evacuate and lock (or post) laboratory if airborne or fire hazard exists • Perform first aid, if applicable • Remove contaminated clothing • Measure and record amount of contamination on skin with applicable meter and wash area gently with warm water and soap • Warn other personnel • Notify REHS at (732) 445-2550 and Authoree • If after hours, call RUPD • Try to prevent the spread of contamination, if possible • Await the arrival of REHS

EMERGENCY COMMUNICATION & CONTACT INFORMATION

The university's emergency notification system utilizes many different and overlapping mechanisms to provide time-critical information to the Rutgers community, as no single mechanism is sufficient to provide blanket notification. Methods include email, website announcements, TV, radio, and text messaging to cell phones, as well as low-tech mass communications such as electronic signs, bullhorns, and police car speaker systems.

As with all emergency planning, our notification systems are regularly tested and upgraded. The key goal is to notify as many subscribers as possible in as short a time as possible. To update your personal emergency notification information, go to https://personalinfo.rutgers.edu.

During an emergency, campus status pages will feature important information and updates about the campus status (e.g., class cancellations, office closings, etc.) for Rutgers and campus specific announcements are made, campus status information will also be available through:

Campus	By Phone	Website	TV
New Brunswick	732-445-INFO(4636)	http://campusstatus.rutgers.edu/ http://ruinfo.rutgers.edu/	RU-TV 3
Newark	973-353-1766	http://www.newark.rutgers.edu/campusstatus/	
Camden	856-225-1766	http://www.camden.rutgers.edu/resources/campus-closing-information	

Or via these local media outlets (class cancellations only):

Radio Stations			Television:
WCBS	880AM	- New York City	News 12 NJ Channel 12, Cablevision systems
WINS	1010AM	- New York City	WCBS - Channel 2
WCTC	1450AM	- New Brunswick	WNBC - Channel 4
WRSU	88.7 FM	- New Brunswick	
WRNJ	1510AM	- Hackettstown	
WKXW	101.5FM	– Trenton	
WKYW	1060AM	- Philadelphia	

Please refrain from calling the Rutgers Police regarding possible weather related delays, cancellations, or closures. During inclement weather conditions, it is vitally important that they be able to receive emergency calls. Also, please refrain from calling the radio and television stations. They will not give out information over the telephone anyway, and a large volume of calls can tie up their phone lines at critical times too.

Emergency Public Safety Numbers

For any Emergency Dial
9-1-1
or Obtain an Outside line then dial
9-1-1

-Alternate Public Safety Numbers-

New Brunswick Campuses
(732) 932 -7111
or 2-7111 from any Campus Phone

Newark Campus
(973) 353-5111
or 5111 from any Campus Phone

Camden Campus
(856) 225-6111
or 6111 from any Campus Phone

Farms, Research Stations or Off-Campus
9-1-1
or Obtain an Outside line then dial **9-1-1**

RUTGERS
Administration and Public Safety (For more emergency information please visit **emergency.rutgers.edu**)

Program the Alternate Public Safety Numbers into Your Cellular Phone

IMPORTANT UNIVERSITY TELEPHONE NUMBERS				
	New Brunswick Piscataway	**Newark**	**Camden**	**Farms, Research Stations, & other University Facilities**
Preferred Number (Campus Phone)	**Obtain an Outside line then dial 9-1-1**	**Dial 80 or 5111**	**Dial 8 or 6111**	**Obtain an Outside line then dial 9-1-1**
Alternate Number (Outside Line)	**732-932-7111**	**973-353-5111**	**856-225-6111**	**9-1-1**
Emergency Number (Outside Line)	**9-1-1**	**9-1-1**	**9-1-1**	**9-1-1**
Rutgers University Police Department	732-932-8407	973-353-5581	856-225-6009	732-932-8407
Rutgers University Emergency Services	732-932-4800	732-932-4800	732-932-4800	732-932-4800
Rutgers Environmental Health and Safety	732-445-2550	973-353-5131	856-225- 6327	732-445-2550
Rutgers Office of Emergency Management	732-932-4880	732-932-4880	732-932-4880	732-932-4880
Student Health Services	732-932-7402	973-353-5231	732-225-6005	732-932-7402
Occupational Health	732-932-8254	973-353-5231	732-225-6005	732-932-8254
Risk Management	732-932-7300	732-932-7300	732-932-7300	732-932-7300
Facilities, Maintenance	732-445-1234	973-353-5441	856-225-6000	732-445-1234
Parking and Transportation	732-932-7744	973-353-1839	856-225-6137	732-932-7744
Counseling Centers	732-932-7884	973-353-5805	856-225-6005	732-932-7884

APPENDIX 3

CAUTION SIGN PROGRAM

APPENDIX 3

CAUTION SIGN PROGRAM

PROGRAM OVERVIEW

This program is designed to partially satisfy the New Jersey Worker and Community Right-to-Know law, and to identify persons responsible for rooms and laboratories for routine and emergency purposes.

ROOM SUPERVISOR'S GUIDE

The potential hazards that may be present in the room, as well as the persons responsible for the room, will be posted on the caution sign on the hall entrance door(s) to the rooms.

1. Contact Information

   For Entry or Advice – The individual who should be contacted first for routine questions regarding the substances used and work activities conducted in the room. This may be the room supervisor, principal investigator, or other individual with knowledge of the space that can answer questions.

   In Emergency – The individual who should be contacted first in case of an emergency. This may be the same individual listed above.

   For each contact person, indicate the contact's name, their location [i.e., the campus address that includes the building name and room number], their campus phone number [the campus exchange and four digit extension], and their home telephone number [including the area code].

2. Caution Sign Hazard Stickers

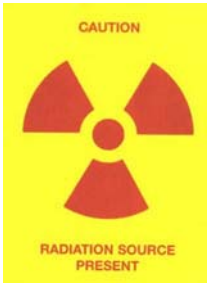
   The stickers posted on the caution sign are intended to provide a quick summary of the potential hazardous materials used within the room. These stickers posted on the caution signs must adequately reflect the hazardous materials present in the room, and should be updated as necessary to reflect changes in work activities and hazardous. REHS provides the following stickers to categorize the potential hazards present in the room.

NEW JERSEY REGULATED HAZARDOUS SUBSTANCE – Room contains one or more of the Right-to-Know listed materials in any quantity. Copies of the New Jersey Regulated Hazardous Substances list are available from REHS.

POTENTIAL CANCER HAZARD – Room may contain one or more of the Regulated or Select Carcinogens in any quantity. Select Carcinogens are listed in section G of the chemical hygiene guide, and regulated carcinogens are listed in the most recent copy of the Health and Human Services Report on carcinogens.

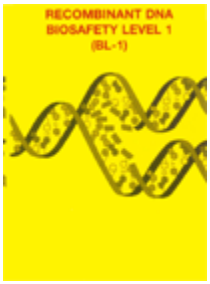
CHEMICAL STORAGE AREA – The room is used as a primary chemical storage area for a group, department, service operation unit, department, or division.

RADIOACTIVE MATERIAL – This room is designated for unsealed radioisotope use. The room may contain one or more radioisotopes used for research or other similar purposes.



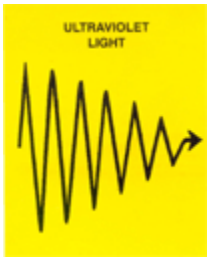
RADIATION SOURCE – This room is designated for use with sealed radioactive sources and generally licensed materials.

X-RAY GENERATING MACHINE – Room may contain an operative X-Ray generating machine or source.



RECOMBINANT DNA – Room contains recombinant DNA or other transgenic materials regulated at Biosafety Level 1 (BL – 1).

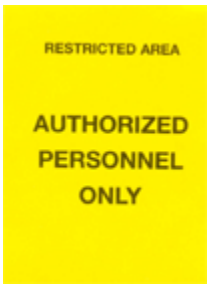
BIOHAZARD – Room may contain pathogenic organisms or recombinant DNA regulated at Biosafety Level 2 (BL – 2) or higher.



ULTRAVIOLET LIGHT – Room may contain an operative UV source other than ordinary room lighting, or equipment that produces UV radiation during operation.

LASER LIGHT (VISIBLE BEAM) – Room contains an operative laser with a visible beam. Hazard class 3b and 4 open beam laser systems capable of causing injury to the eye or skin will be audited by REHS and receive a supplemental warning sign on the room door.

LASER LIGHT (INVISIBLE BEAM) – Room may contain an operative laser with an invisible beam. Hazard class 3b and 4 open beam laser systems capable of causing injury to the eye or skin will be audited by REHS and receive a supplemental warning sign on the room door.



AUTHORIZED PERSONNEL ONLY – Room access is restricted to authorized personnel only.

INACTIVE LAB – REHS staff post this label on the caution sign when the laboratory discontinues research activities with unsealed radioactive materials and these materials are removed from the lab. REHS conducts a visual assessment and contamination survey of the lab, pending a change in room use or its renovation or demolition.

WATER REACTIVE – REHS staff post this label on the caution sign when the laboratory uses alkali metals [Group 1 of the periodic table]. These metals (lithium, sodium, potassium, rubidium, cesium, francium) react vigorously and/or violently with water

3. Special Procedures or Precautions

REHS will provide blank stickers that can be used to include other pertinent information useful to room visitors, maintenance staff, emergency personnel, or others. Examples of special procedures and precautions that could be indicated on the blank stickers include:

Alarmed Door
Bulk Storage Facility
Darkroom
Do Not Enter When Light Is On
Enter Only with Permission Of: [Room supervisor name]
Light Sensitive Experiments In Progress

CAUTION SIGN REQUESTS

A blank caution sign request form must be obtained and submitted from our website at http://halflife.rutgers.edu/forms/cautionsign.php. Complete this form for each room where hazardous agents are used only if there is no caution sign posted on the door, if the existing sign on the door is damaged or defaced, or if the existing sign needs to be updated to reflect changes in hazards or room responsibility/assignment.

APPENDIX 4

ACCIDENT REPORTING SYSTEM

ACCIDENT REPORTING SYSTEM

On July 1st, 2006, the University phased out the paper version of the Accident Report Form found in previous editions of the Chemical Hygiene Guide and replaced it with an Internet based application.

The new Accident Reporting System is similar to the paper version. The system has enhanced features to enable department heads or administrators to view the status of all current accidents reported by their department. Each department must designate an account administrator to establish who will be given rights to create accident reports for their respective departments. Access to the database requires an account from REHS or from the assigned Administrator for your department as well as a valid NetID. Instructions pertinent to use of this application are provided upon login.

Accident investigations are an integral part of the University's health and safety program. All accidents and "near miss" accidents must be investigated. Employees are required to report all accidents or "near miss" accidents to their supervisor immediately.

Supervisors are responsible for investigating all accidents, determining root causes, implementing corrective measures and performing follow up inspections to ensure that corrective measures were adequate.

To report, edit, or track accidents, log into https://halflife.rutgers.edu/accident/index.php.

For additional information and guidance regarding on the job injury and/or illness to employees, students, or the general public, review the University Emergency Action Plan contained within Appendix 2 of this Chemical Hygiene Guide or call REHS at (732) 445 – 2550 for assistance.

APPENDIX 5

POLICY FOR DISPOSAL OF EMPTY / USED LABORATORY CONTAINERS & GLASSWARE

RUTGERS UNIVERSITY POLICY FOR DISPOSAL OF EMPTY / USED LABORATORY CONTAINERS & GLASSWARE

Section I - General Information

A. Purpose

The purpose of this policy is to ensure used containers and discarded laboratory glassware are properly and safely managed to prevent injury and environmental contamination from improper disposal.

- This policy applies to all containers and laboratory glassware, intact as well as broken, including chemically contaminated containers and glassware.

- This policy does not cover radioisotope-contaminated containers/glassware, Regulated Medical Waste (RMW) contaminated containers/glassware, and raw material drums. These are to be managed in accordance with the Radioactive Waste Policy, RMW Disposal Policy, etc.

- This policy does not include glass, aluminum, or plastic food and beverage containers; the majority of this material is recycled.

B. Definitions/General Information

Acute Hazardous Waste, or "P" listed waste, are chemicals that the EPA deemed acutely toxic to human health and the environment. They are listed in 40 CFR 261.33(e), and on the REHS website. Acutely hazardous waste may be a commercial chemical product, off-spec commercial product, the spill residues, or the substance is the sole active ingredient of a formulation of any chemical bearing the generic name on this list.

Used Containers – Any empty containers that previously contained a chemical or petroleum product. Containers include plastic and glass bottles, metal and plastic pails, plastic bags, and bladders. These containers are considered contaminated until they are purposely decontaminated in accordance with this policy.

Empty containers must be discarded or can only be used to collect hazardous waste (see the Hazardous Waste Disposal Policy / Procedure in the Chemical Hygiene Guide), and under no circumstances be given to students, staff or the community for any other use.

Section II – Generator / Laboratory Personnel Responsibilities

Generator / Lab personnel Responsibilities

- Remove/empty all materials from the container by using the methods commonly employed to empty the container (pumping, pouring, etc.). Containers that are not empty of all contents will not be removed from the area.

- Empty containers, that contained aqueous based liquids or solid materials (i.e. acids or bases), are to be rinsed out. If the container previously held a hazardous chemical, the rinsate must be collected as hazardous waste. If the container previously held a material listed in the University Drain Disposal Procedure, of the Hazardous Waste Disposal Policy / Procedure, the rinsate can be drain disposed.

- Empty containers, that contained volatile liquids (i.e. solvents), are to be placed into an operating empty fume hood overnight (without the cap) to allow the vapors to disperse. ***Note: It is improper to dispose of volatile liquids by evaporating.***

- Empty containers that contained an acutely hazardous waste ("P" waste – see definition) should be disposed of as a hazardous waste in their entirety (container, cap and residuals) in accordance with the Hazardous Waste Disposal Policy / Procedure. These containers are not to be decontaminated or discarded by laboratory personnel.

- When containers are contaminated with residues that would be classified as a hazardous waste and the residues cannot be removed, the entire container with residues must be disposed of as a hazardous waste. See the Hazardous Waste Disposal Policy / Procedure**.**

- Empty compressed gas cylinders should be returned to the vendor. If the vendor will not accept the cylinder, it must be disposed of through REHS. See the Hazardous Waste Disposal Policy / Procedure.

- Deface labels by placing an "X" across the label or by removing it.

- Secure lids on all containers before placing them into the appropriate disposal receptacle.

- Place all glass, intact as well as broken, into a specially marked rigid container designed for this purpose (refer to "Specifications" section, below). The container must be lined with a leak-resistant liner (e.g. a polyethylene or polypropylene bag). Plastic and metal containers can be discarded directly into the general trash.

- If the container contains broken glass, clearly mark it as "BROKEN GLASS" to describe its contents.

- Always discard glass, plastic, and metal containers originating in the laboratory according to the above procedure and not into a recycling container.

- Make special arrangements for bulky or heavy boxes with Custodial Services by calling the Facilities Maintenance Service Desk on your campus.

Custodial Services Responsibilities / Container Removal

- Decontaminated and empty discarded glass, when packed in its special container, may be disposed of with the regular trash by Custodial Services.

- Custodial Services will not collect containers that are not properly emptied or decontaminated. The containers will be left in the location until properly emptied or decontaminated.

- If the container is too heavy or bulky that special handling is required, Custodial Services personnel should contact their supervisor for proper handling requirements.

Specifications -- Glass disposal containers

1. Table Model 8" x 8" x 10", with cover. Fisher Catalogue No. 12-009-7B

2. Floor Model 12" x 12" x 27", with cover. Fisher Catalogue No. 12-009-7A

These items are available for purchase through Fisher Scientific.

APPENDIX 6

HAZARDOUS WASTE DISPOSAL POLICY AND PROCEDURES

Table of Contents

POLICY FOR THE DISPOSAL OF CHEMICALS

Section I - General Information

A. Purpose

The purpose of the following policy and procedures is to ensure that all hazardous waste is properly and safely managed, from its generation through handling, storage, and preparation for transportation. This policy covers the responsibilities of both the individuals generating the waste (i.e. laboratory personnel) and the Environmental Services Group (i.e. Rutgers Environmental Health & Safety). The management of hazardous waste shall be conducted in accordance with all applicable local, state, and federal laws and regulations.

Rutgers Environmental Health and Safety (REHS) routinely coordinates the collection of all unwanted chemicals. You are encouraged to recycle chemicals that are not expired and that are usable within your department. REHS will also collect and offer chemicals for recycling. A chemical inventory is available on the REHS website.

The following procedures must be followed for the disposal of all unwanted chemicals. These Procedures apply to chemicals that REHS does not authorize for disposal in the regular trash. For information regarding Chemicals allowed for drain disposal, please refer to the Waste Treatment & Drain Disposal section of this policy. The Waste Treatment & Drain Disposal section of the policy contains a list of chemicals that can be disposed of via the sanitary sewer system.

This Hazardous Waste Policy, does not apply to radioactive waste, Regulated Medical Waste (RMW), and mixed wastes (i.e. hazardous waste & radioactive waste or hazardous waste & RMW), each of which is covered by a separate policy.

B. Definitions

General Definitions & Acronyms

Bulking – the consolidation of compatible wastes into a single container for storage/shipment.

Lab Pack – the consolidation of containers of small quantities of waste (i.e. out dated chemicals in their original containers) into a single container for storage/shipment.

EPA – Environmental Protection Agency

ESB – Environmental Services Building

ESG - Environmental Services Group

"P" Listed Waste - Specific chemicals that the EPA deemed Acutely Hazardous wastes when discarded and listed as hazardous wastes from commercial chemical product, intermediates, and residues. These substances have a "P" number and are subject to more rigorous management requirements. The empty containers for "P" waste are to be managed as hazardous waste.

RCRA – Resource Conservation and Recovery Act

REHS – Rutgers Environmental Health & Safety (Department)

SAA - Satellite Accumulation Area – This is a location within a laboratory or room where hazardous waste is stored. The regulations specify for this area to be located "at or near any point of generation" and to be "under the control of the operator" generating the waste.

Definition of Hazardous Waste

Hazardous waste is a waste that is dangerous or capable of having a harmful effect on human health or the environment. A discarded material will be deemed a hazardous waste if it exhibits any of the four hazardous waste characteristics identified below, or if it is contained on one of the four separate types of "listed waste", identified below.

Characteristic Hazardous Waste (All D-Codes):

- Ignitability: liquids with a flash point of 140˚F or below, oxidizers, or spontaneously combustible materials (D-Codes)
- Corrosivity: pH ≤ 2 or ≥ 12.5, (D-Codes)
- Reactivity: materials that readily explode or undergo violent reactions (D-Codes)
- Toxicity: wastes likely to leach dangerous concentrations of toxic chemicals into ground water (D-Codes)

Listed Hazardous Waste (F, K, P & U-Codes):

- Listed Hazardous Wastes from Nonspecific Sources (F-Codes)
- Listed Hazardous Wastes from Specific Sources (K-Codes)
- Listed "Acutely Hazardous" Waste, from discarded commercial chemical products (P-Codes)
- Listed "Toxic" Waste from discarded commercial chemical products (U-Codes)

Hazardous waste will generally include: all organic solvent waste and solid residues containing those solvents; most waste acids, alkalis, and other corrosive materials; some materials containing heavy metals, explosives, highly reactive materials; and many discarded process chemicals or laboratory reagents. All aerosol cans, which are full or partially full, will be disposed of as hazardous waste. Product wastes containing greater than 10% alcohol will be regarded as ignitable material and disposed of as hazardous waste. More information on the identification and listing of hazardous waste can be found in the Code of Federal Regulations, Title 40, Part 261, and is available on the United States Government Printing Office website: http://www.access.gpo.gov/nara/cfr/index.html.

Section II – Generator / Laboratory Personnel Responsibilities

A. Waste Generation & SAA Management

Waste Generation:

- Waste chemicals must be collected in individual, leak proof, sealed containers. The chemicals must be compatible with container material (*e.g.* acids must not be placed in a metal container). Glass containers may be safely used for virtually anything except hydrofluoric acid, acid fluoride salts, and very strong alkalis.

- Waste chemicals must not be placed in an unwashed container, which contains any incompatible residual material, from previous chemical storage.

- Select the smallest container available that will properly hold the material, with sufficient headspace above the surface of the liquid to allow room for expansion. Five-gallon carboys, pails, and fifty-five-gallon drums are available from REHS as needed. Do not use your own drums or pails without prior approval from REHS, as they may not meet US Department of Transportation requirements.

- Any containers holding a hazardous chemical or waste shall be kept securely closed, so there is no leak of hazardous waste or escape of vapors during storage, except when it is necessary to add or remove chemicals or waste. Ensure that lids, bungs, or rims are tightly in place.

- Broken or intact hypodermic needles or syringes that are contaminated by chemicals **must not** be disposed with medical waste. This includes needles that have been used in chemical laboratories **only** for chemical procedures such as the removal of a solution from a vial through a septum or adding liquid to a gas chromatograph. Collect these (chemically contaminated syringes and sharps) in a separate sharps container that is appropriately labeled with the Rutgers University black and white hazardous waste label. Please place the rutgers hazardous waste label (or place an X) over the biohazard symbol on the sharps container.

- See Section IV for Waste Treatment, Drain Disposal and Waste Minimization information.

Container Labeling

- All containers must be clearly identified and labeled with the proper chemical name(s) of the substance(s) at the start of collection. Trade names, acronyms, abbreviations, codes, or formulas **are not acceptable.**

- All chemical waste which cannot be recycled, because it is either spent, past the manufactures expiration date, or has been mixed or contaminated with another substance must be labeled with a Rutgers University black and white **Hazardous Waste Label**. This label must be affixed to the container prior to adding any waste material into the container. It is also acceptable to write the words "Hazardous Waste" on the original manufacturer's label. Note the later is only acceptable if the chemical is in its original container. Hazardous waste labels may be obtained by calling REHS. **Waste Labeling (or writing the words "Hazardous Waste" on the manufacturers label) must not be completed on bottles containing unopened / unexpired pure chemicals, as these materials may be recycled (by redistribution). Please place these chemical containers in the SAA and identify them on your Request for Hazardous Waste Disposal Form as "chemicals for reuse".**

- The concentration of each chemical or mixture component must be identified on the label. The units of concentration must be on the label together with their numerical values. When the solute is either a liquid or gas, the concentrations must be stated as, **percent by weight** or **percent by volume** or **molar concentration**. For containers being filled with multiple concentrations of a variety of compatible materials, the chemical concentrations can be added to the label when the container is full.

- The hazardous waste label must be completely filled out with all the laboratory contact information.

Unidentified Waste:

State and federal transportation regulations for waste haulers prevent REHS from collecting substances that are unidentified (unknown). The responsibility for establishing the identity of an unknown substance rests with department wishing to dispose of it. Upon request, REHS will furnish the names of state-certified analytical laboratories.

Satellite Accumulation Areas:

- Hazardous waste must be stored in the laboratory Satellite Accumulation Area (SAA), at or near the point of generation and under the control of the operator generating the waste. Typically there is an SAA in each laboratory. REHS will assist with the determination of appropriate locations for satellite accumulation areas.

- Chemical wastes must be segregated by general waste type (*e.g.* flammables, poisons, acids, and alkalis) and arranged so that incompatible substances will not mix. Incompatibles are those pairs

of substances that, when mixed, either react violently or emit flammable or poisonous gases or vapors. Below are a few general principles that must be followed for safe hazardous waste storage and chemical storage:

1. Store acids and bases separately.
2. Keep acids apart from cyanides or sulfides
3. Acids should never be put into steel containers.
4. Water-reactive, strong acids such as organic acid halides, organic acid anhydrides, inorganic acid anhydrides, and strong acidic salts must be kept apart from both alkalis and water.
5. Oxidizing agents must be kept apart from reducing agents and organic compounds.
6. Water-reactive agents must be stored apart from water, aqueous solutions, and acids.
7. Air-reactive materials must be packed in containers that are sealed off from the atmosphere.
8. Explosive and shock-sensitive materials present risks that require special handling. Consult with REHS before handling or preparing for disposal.

- Hazardous waste must be stored in secondary containment. Incompatible materials must not be stored in the same secondary containment bin.

- Containers must be arranged so that identification is readily visible.

- State and federal regulations allow up to fifty-five gallons of hazardous waste, or one quart of acutely hazardous waste in a Satellite Accumulation Area (SAA). Once accumulation limits are met, container labels must be dated with the start date excess accumulation begins. When the limit is reached, excess waste must be removed from the SAA within three days.

- Do not allow spill residues to accumulate in the bottom of the SAA bins.

Acutely Hazardous Waste Information (P-Listed Waste):

Acutely hazardous wastes are listed in 40CFR261.33(e), (also see appendix 1 of this Policy). They may be a commercial chemical product, off-specification commercial product, spill residues of an acutely hazardous material, or a substance is the sole active ingredient of a formulation (*e.g.* pesticides). The list of acutely hazardous waste is available on the REHS website.

Daily Laboratory Inspections:

- Waste containers must be inspected daily for signs of leakage, corrosion or any other forms of deterioration.
- Check to ensure that all containers are capped and properly labeled. These inspections need only be visual and do not have to be documented.
- Any containers found to be leaking or deteriorating must have their contents transferred into a new container.
- Any spillage that occurs when adding waste to the container must be cleaned up immediately.

B. Request for Waste Removal

Request for Waste Pick-up / Removal

Hazardous waste collection is performed by REHS on a routine basis and can be requested by faxing a hardcopy request or by an electronic submission through the REHS web site (see below for details). With either method, the requestor must include the following information:

- Requester: The name of the person submitting the form. This person should have knowledge of the waste in the event that REHS personnel have questions.

- Telephone #: A contact number for the requester or someone else with knowledge of the waste.

- Substance Location: Include the building name and room number. In addition, if the SAA is not readily apparent, the location of the waste container should also be noted in the event that REHS performs the waste pick-up when no lab personnel are present.

- Chemical Name: Use full chemical names. Do not use formulas or abbreviations. Include all the constituents of each waste container.

- Quantity: Include the number of containers of waste and their volumes.

Example:

Water 50%, Acetonitrile 30%, Methanol 20%	2 X 5 gallon cans
Water 50%, Acetonitrile 30%, Methanol 20%	4 X 1 gallon bottles
Acetone 100%	3 X 1 liter bottles
Hydrochloric Acid 90%, Mercuric Chloride 5% Lead Citrate 5%	1 X 100 ml

- If REHS supplies you with 5-gallon waste cans or pails, be sure to note how many replacement containers are needed. Note any additional information about the waste that you feel may be pertinent.

- In the event that waste containers to be collected are intermingled with containers that you want to keep, it is helpful if you mark which containers that are being offered for disposal.

- Remember that REHS cannot accept unknown materials. All waste containers must be labeled and their contents identified.

- All waste containers must have a tightly fitting cap that will not leak during transport. Be sure that you have the correct cap for your bottle. The bottles of the various chemical manufacturers all have differently threaded caps that are not interchangeable with one another, (i.e. Fisher bottle caps do not fit Aldrich bottles and vice versa). Improperly capped waste bottles **will leak** and will not be picked up by REHS..

- **Request for Hazardous Waste Disposal can be sent by one of these two methods**
  (Blank forms can be obtained from REHS or copied from Appendix 2 of this Policy)

- Via Fax to: **732-445-3109**

- Via Email on Web Page at: http://halflife.rutgers.edu/forms/hazwaste.php
  Complete the necessary information
  Click on "**Submit**" at the bottom of the form
  Or
  http://rehs.rutgers.edu/
  Go to Quick Links Column (Right Side of REHS Home Page)
  Click on "**Hazardous Waste**"
  Complete the necessary information
  Click on "**Submit**" at the bottom of the form

- For the New Brunswick/Piscataway campuses, the pick-up will occur within 5 to 10 working days after the request form is submitted. REHS schedules routine hazardous waste pick-ups on the Newark and

Camden campuses every 30 to 60 days. Manage your waste accordingly. Do not wait to submit a request form until your waste containers are completely full.

Section III – REHS Environmental Services Responsibilities

A. Waste Handling & Storage Prior to Shipment

Waste Handling

- When hazardous waste is picked up by REHS each container will be checked to ensure it is properly labeled and sealed.
- During each laboratory pick-up, an inspection of hazardous waste management will be performed. A copy will be left in the lab or with the lab contact, which outlines the necessary corrective actions.
- All waste containers are either shipped from the location for disposal or brought back to the Environmental Storage Building (ESB) on Busch Campus.
- Hazardous waste, which is brought to the ESB, is logged in the computerized Operating Record.
- The flammable solvents are consolidated (i.e. bulked) into 55-gallon drums. These drums are stored in the Flammable Storage Room of the ESB.
- The other "lab pack" waste is segregated by waste type and stored in the Cell Storage Section of the ESB.
- The "lab pack" items are segregated according to their classification until a sufficient amount is available for packing. Prior to shipping, compatible "lab pack" items are packed into a drum or other container and prepared for shipment.

B. Waste Shipment

- The REHS Environmental Services Group (ESG) will make all arrangements for proper off-site disposal hazardous waste.
- All drums require the proper hazardous waste (RCRA) and DOT labeling.
- The waste vendor or REHS completes the Hazardous Waste Manifest Form and packing slips.
- A **Hazardous Waste Manifest Form** is utilized for each shipment and the returned copies (from the Disposal / Transfer Site) are retained in the ESG files located at REHS.

C. Waste Inspections

Weekly Storage Location Inspections

- The ESB / Reactives shed is inspected on a weekly basis
- The Cook/Douglas 90 day Storage Shed is inspected on a weekly basis
- The Camden 90 Day Storage area is inspected on a weekly basis

- The Newark 90 Day Storage area is inspected on a weekly basis

- The Manager of Environmental Operations is responsible for scheduling an alternate inspector in the event that the primary inspector is unable to conduct the weekly inspection (i.e. sickness, vacation). If the supervisor is unable to locate an alternate inspector, the Supervisor will perform the inspection.

- Records of these inspections will be maintained at each location and annually placed in the ESG files at REHS.

Section IV – Miscellaneous Information
Treatment/Drain Disposal & Waste Minimization

A. Waste Treatment & Drain Disposal
(pH Neutralization of acids and alkalis only)

General Information

Research and instruction in laboratories continually produces small amounts of aqueous wastes. In such cases, laboratory workers must decide whether to pour particular solutions down the drain or keep them for pick-up by REHS personnel. This guide will help them make such decisions.

Typically, unwanted chemicals are collected by REHS for disposal. This is done in accordance with Section A. "Policy for the Disposal of Chemicals." Certain materials are suitable for drain disposal. These should be carefully considered to ensure they do not cause damage to the plumbing system or cause other problems such as odors in a building. The materials, which are suitable for drain disposal, are listed in the tables that follow. Other materials are prohibited from drain disposal without prior approval from REHS. If you have questions about the suitability of other materials for drain disposal, or about the proper disposal of any laboratory material, please contact REHS at (732) 445-2550.

Drain disposal of dilute acids and alkalis

Acids and alkalis, which have been rendered neutral by the experimental process may be discarded by drain disposal. Neutralization should be done in small quantities (i.e. no larger than 1 liter). This should be done as part of the experiment generating the waste. It is inappropriate to collect a quantity of waste, from multiple experiments, and conduct batch neutralization process.

Proper care must be taken to adjust solutions to a pH of between 6 and 9. Generally, 1N hydrochloric acid can be used to neutralize alkaline materials and 1N sodium hydroxide can be used to neutralize acid materials. When creating these 1N solutions, remember to SLOWLY add the acid to the water or the alkali to the water, not vice versa. Drain disposal is properly done in the following manner:

a. Protective gear (gloves, laboratory apron, and safety goggles) must be worn.

b. Before pouring the solution, turn on the tap to get a good flow of water to wash it down. Make sure that the sink and drain lines are washed free of any substances that will generate noxious gases when mixed with the solutions. These substances include cyanides, sulfides, bisulfides, sulfites, bisulfites, nitrates, and nitrites.

c. Pour the solution down the drain slowly, making sure that before, during and after pouring, the tap is turned on to provide a strong flow of water that aids in washing it down the drain.

Table 1: DRAIN-DISPOSABLE SUBSTANCES

SOLUTIONS ADJUSTED TO A pH OF 6 to 9		**POLYHYDROX-ALCOHOLS**
Hydrobromic acid	sodium hydroxide	1,2-propylene glycol
Hydrochloric acid	potassium hydroxide	glycerol (glycerine)
Hydriodic acid	ammonium hydroxide	mannitol
Nitric acid	potassium carbonate (potash)	sorbitol
Phosphoric acid	sodium carbonate (soda ash)	
Phosphorous acid	sodium pyrophosphate	
Sulfuric acid	trisodium phosphate	
Acetic acid		
Formic acid		

ALL VITAMINS	**ALL NATURALLY-OCCURRING AMINO ACIDS**	**ALL SUGARS**
l-ascorbic acid (vitamin c)	alanine	arabinose
Choline	cysteine	fructose
Inositol	glycine	galactose
Nicotinic acid (niacin)	histidine	glucose
Pantothenic acid	leucine	lactose
Pyridoxine (vitamin b6)	lysine	maltose
Riboflavin (vitamin b2)	serine	sucrose
Thiamine (vitamin b1)	tryptophan	
	tyrosine	

CHEMICALS* COMMONLY USED ON THE FARM AND IN THE HOUSEHOLD **(No pesticides of any kind)**		
Acetylsalicylic acid (aspirin)	casein	sodium bicarbonate
Alum (sodium aluminum sulfate)	citric acid (sour salt)	sodium bisulfate
Ammonium alum (ammonium aluminum sulfate)	corn syrup	sodium bitartrate
Borax (sodium tetra-Borate decahydrate)	dextrin	sodium carboxy-methylcellulose
Boric acid	gelatin	sodium chloride
Calcium chloride	magnesium sulfate (epsom salt)	sodium citrate
Calcium phosphate, monobasic	potassium aluminum sulfate(potassium alum)	sodium dihydrogen phosphate
Calcium superphosphate	potassium bitartrate (cream of tartar)	sodium hypochlorite
Calcium triple superphosphate		sodium mono- hydrogen phosphate
		sodium nitrate
		sodium potassium tartrate (rochelle salt)
		sodium silicate
		sodium sulfate(glauber's salt)
		urea

* For any chemical containing sodium, the corresponding potassium or ammonium (salt) compound may be substituted.

B. Waste Minimization

Chemical Reuse

Unused and unopened chemicals being disposed of as waste due to a change in research or discontinuation of a specific research protocol will be redistributed to other laboratories that can utilize the chemical. Sharing unused chemicals will reduce the amount of chemical waste generated. Specific applicable chemicals (typically stable compounds with a long shelf life) will be picked up by REHS and segregated in the ESB. These chemicals are cataloged on a list that is available on our web page at http://rehs.rutgers.edu/pdf_files/chemicalsreuse_lab.pdf . Please contact the REHS Environmental services group at (732) 445-2550, for delivery of a chemical for reuse from this list. The Environmental Services Group will deliver the chemical/s to your laboratory. Chemicals being redistributed will be tracked on a spreadsheet by REHS.

Microscaling

Microscale chemistry is a pollution prevention method that decreases the amount of chemical waste generated during laboratory experiments. This concept was first introduced by chemistry professors at Bowdoin College in Brunswick, Maine. Standard chemistry procedures are re-written for individual experiments and specialized microscale equipment is utilized to perform the work. In some cases, the amount of a particular chemical needed for an experiment has been decreased by as much as 99 percent. Microscaling has the following benefits:

- Reduce chemical waste produced at the source.
- Improve laboratory safety by decreasing potential exposure to chemicals and reducing fire and explosion hazards.
- Improve air quality due to greatly reduced volumes of solvents and other volatile substances used.
- Reduce laboratory costs for chemical purchase and disposal.
- Reduce the time required to perform experiments due to shorter chemical reaction times.
- Decrease the amount of storage space necessary for chemicals.
- Encourage students to think about waste minimization.
- Decrease disposal costs for the university
- Increase environmental awareness for the university

Inventory Control

Each laboratory is encouraged to maintain an appropriate inventory of chemicals in their laboratory as a method to reduce unnecessary purchase and disposal. The following methods can reduce the amount of chemicals in a laboratory and minimize waste generated from expired or unwanted excess chemicals:

- Check your laboratory inventory and the REHS chemical redistribution list before ordering.
- Purchase smaller containers of chemicals or fewer containers of chemicals.
- Avoid purchasing larger quantities of chemicals to save on raw material costs. (Chemical disposal costs are often much higher than the initial purchase cost.)
- Do not accept “free” samples from chemical manufacturers, unless you are certain that you will be using the materials. (Again, chemical disposal costs are often much higher than the initial purchase cost.)
- Rotate stock of chemicals in the laboratory to ensure the older chemicals are used before the newer chemicals.

Substitution of Less Hazardous Chemicals

In some instances, chemicals that are more environmentally friendly may be substituted for traditionally used chemicals.

Examples:

Propylene Glycol	instead of	Ethylene Glycol
Ethyl Alcohol	instead of	Methyl Alcohol
Alcohol Thermometers	instead of	Mercury Thermometers
Alconox, Pierce RBS35 and Nochromix	instead of	chromic acid cleaning solutions
Detergent and hot water	instead of	Organic solvent cleaning solutions

This Hazardous waste policy is designed to provide guidance for everyone at Rutgers University regarding the proper disposal of hazardous waste. If anyone has additional questions regarding hazardous waste disposal they are encouraged to contact the Environmental Services Group in REHS at (732) 445-2550.

Policy Updated – 10/13/09

APPENDIX 7

POLICY FOR THE DISPOSAL OF BIOLOGICAL WASTE

Policy for the Disposal of Biological Waste

1. Biological Waste

Laboratories that are engaged in research regulated at Biosafety Level 1 or Biosafety level 2 must abide by the following policy.

a. Biosafety Level 1 Laboratories

All solid waste items which are potentially contaminated with microorganisms, tissue culture, cell culture, recombinant DNA, genetically engineered organisms, or genetically engineered plants regulated by the CDC/NIH, USDA/APHIS, or ATCC at Biosafety Level 1 (BL-1) must be autoclaved prior to disposal in the building trash dumpster. Such items should be placed into a clear autoclave bag. **Rutgers University prohibits the use of red autoclave bags or bags with the biohazard symbol for the disposal of BL-1 waste.**

Autoclave Procedures

1) The clear autoclave bag should be filled to two-thirds of its capacity.

2) After the bag is 2/3 full, it should be loosely taped closed and labeled with the investigator's name.

3) Autoclave tape should be affixed to the exterior of the bag to ensure the waste has received proper autoclave time, temperature, and pressure.

4) REHS periodically challenges autoclaves throughout the university to ensure that biological waste is being appropriately disinfected. Please contact REHS at 732/445-2550 to arrange for an autoclave challenge.

5) Please see the Rutgers University Biological Safety Guide for additional information on autoclaving.

All liquid waste items must be autoclaved or chemically disinfected (with 10% bleach solution or other appropriate disinfectant) prior to drain disposal of the liquid.

All laboratories working with recombinant DNA, genetically engineered organisms, or genetically engineered plants must submit a "Registration Document for Recombinant DNA Experiments" for approval by the Rutgers University Biological Safety Committee. This form is available on the REHS website at http://rehs.rutgers.edu/lsbio_forms.htm.

b. Biosafety Level 2 Laboratories

All solid waste items which are potentially contaminated with microorganisms, tissue culture, cell culture, recombinant DNA, genetically engineered organisms or genetically engineered plants which are regulated by the CDC/NIH, USDA/APHIS, or ATCC at Biosafety Level 2 (BL-2) must be autoclaved and placed into the Regulated Medical Waste stream as Overclassified Medical Waste as outlined below. The following autoclave procedures should be followed when processing biological waste generated in BL-2 laboratories.

Note: The color of the autoclave bags used to package BL-2 laboratory waste is unimportant since the waste is packed in the Regulated Medical Waste (RMW) boxes for ultimate disposal after processing. However, REHS *strongly* prefers the use of clear bags to avoid accidental injury.

Autoclave Procedures

1) The autoclave bag should be filled to two-thirds of its capacity.

2) After the bag is 2/3 full, it should be loosely taped closed and labeled with the investigator's name.

3) Autoclave tape should be affixed to the exterior of the bag to ensure the waste has received proper autoclave time, temperature, and pressure.

4) REHS periodically challenges autoclaves throughout the university to ensure that biological waste is being appropriately disinfected. Please contact REHS at 732/445-2550 to arrange for an autoclave challenge.

5) Please see the Rutgers University Biological Safety Guide for additional information on autoclaving.

All liquid waste items must be autoclaved or chemically disinfected (with 10% bleach solution or other appropriate disinfectant) prior to drain disposal of the liquid.

All laboratories working with recombinant DNA, genetically engineered organisms, or genetically engineered plants must submit a "Registration Document for Recombinant DNA Experiments" for approval by the Rutgers University Biological Safety Committee. All laboratories working with tissue culture, cell culture, pathogenic microorganisms, human blood, or human tissue that is regulated at BL-2 must submit a "Registration Document for Biohazards" for approval by the Rutgers University Biological Safety Committee. These forms are available on the REHS website at http://rehs.rutgers.edu or by calling 732/445-2550.

2. Regulated Medical Waste

The following instructions apply to generators of Regulated Medial Waste (RMW). At Rutgers University, RMW generators may be engaged in health care delivery, athletics or biomedical research. Rutgers laboratories that work with human blood must complete a Registration Document for Biohazards. This form is available from REHS and must be submitted for review and approval by the University Biological Safety Committee. In addition, Rutgers University employees who are reasonably anticipated to come into contact with human blood or blood products must adhere to the Rutgers University Bloodborne Pathogen program. Please contact REHS at 732/445-2550 for information on the Bloodborne Pathogen program.

All generators of RMW must attend an initial RMW Orientation session provided by REHS. If you plan to generate RMW please contact REHS at 732/445-2550 to arrange for an orientation session. The initial orientation session is provided as needed to individuals, groups, or laboratories.

The following procedures for the proper processing, transportation, and ultimate disposal of RMW are taken from the Comprehensive Regulated Medical Waste Management Act (N.J.S.A. 13:1E-48) and the NJDEP Solid and Hazardous Waste Rules subchapter 3A: Regulated Medical Wastes (N.J.A.C. 7:26-3A).

a. Definition of RMW: The Regulated Medical Wastes subchapter 3A (N.J.A.C. 7:26-3A.6) defines RMW as solid waste that meets both the process definition and the classification definitions listed below.

1. *Process Definition:* RMW is any solid waste generated from one of the following processes: the diagnosis, treatment or immunization of humans or animals; research pertaining to the diagnosis, treatment or immunization of humans or animals; or the production or testing of biologicals.

2. *Classification Definition:* To be considered as RMW, items that are included in the above process definition must also belong to one of the following classes of regulated medical waste.

Table 1: Classes of Regulated Medical Waste

Class	Waste Type	Examples
Class 1	Cultures and Stocks	Cultures and stocks of infectious agents and associated biologicals: cultures from medical or pathological labs; cultures and stocks of infectious agents from research labs; wastes from the production of biologicals; discarded live and attenuated vaccines; culture dishes and devices used to transfer, mix, or inoculate cultures
Class 2	Pathological Wastes	Human pathological wastes including tissues, organs, and other body parts and fluids that are removed during surgery or autopsy or other medical procedures; specimens of body fluids and their containers
Class 3	Human Blood & Blood Products	Liquid waste human blood; items saturated, dripping or caked with human blood (including serum, plasma and other blood components) which were used or intended for use in either patient care, testing and laboratory analysis, or the development of pharmaceuticals. Intravenous bags, soft plastic pipettes and plastic blood vials are also included in this category.
Class 4	Sharps	Sharps that were used in animal or human patient care or treatment in medical research or industrial laboratories. Includes hypodermic needles, all syringes to which a needle can be attached (with or without the needle), Pasteur pipettes, scalpel blades, blood vials, carpules, needles with attached tubing, and broken or unbroken glassware (slides and coverslips) that were in contact with infectious agents.
Class 5	Animal Waste	Contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research, production of biologicals, or testing of pharmaceuticals.
Class 6	Isolation Waste	Biological waste and discarded materials contaminated with blood, excretions, exudates, or secretions from humans or animals that are isolated to protect others from certain highly communicable diseases.
Class 7	Unused Sharps	Unused, discarded sharps that were intended to be used. Includes hypodermic needles, suture needles, syringes and scalpel blades.

b. Overclassified RMW: Overclassified RMW is material that does not meet the strict definition of RMW listed in part A, above. Overclassified RMW materials resemble RMW but are generated from activities that do not meet both the "process" definition and the "classification" definition of RMW. Examples of these materials include blood products generated in teaching laboratories (while research laboratories are covered in the process definition, teaching laboratories are not) or culture dishes generated in basic research laboratories (because these materials are not being used in research pertaining directly to the diagnosis, treatment or immunization of humans or animals). To avoid confusion and to prevent problems stemming from misconceptions about RMW, such materials should be collected for disposal as overclassified RMW. Overclassified RMW must be packaged and labeled in the same manner as RMW and is collected by the RMW vendor.

There are also many activities that *do* meet the process definition but generate waste that does not belong in any of the seven specific classes. An example of this material would be gloves worn during blood drawing procedures in health centers (because gloves,

unless they are either saturated with blood or contaminated with an infectious disease agent are not included as one of the seven classes of RMW). This waste should be packaged and labeled as overclassified RMW.

c. Segregation of RMW: As RMW is generated it must be segregated into the following three categories: sharps (both class 4 and class 7), fluids (greater than 20cc), and other RMW. Collect each type of RMW in separate inner containers that will ultimately be placed into the outer cardboard container (i.e. needles, glass cover slips, scalpel blades and syringes must be collected in a sharps container; culture transfer devices, blood soaked items, and other paper or cloth related items must be collected in autoclave bags or red RMW liner bags.) Do not chop, bend, break or otherwise destroy hypodermic needles or syringes before discarding them into the sharps container.

d. Treatment of RMW: Generally, it is not necessary to treat RMW or overclassified RMW before placing it in the outer cardboard container for ultimate disposal. However, Rutgers University policy requires that laboratories working with human pathogens regulated by the CDC or NIH at Biosafety Level 2 or higher must autoclave or chemically disinfect their waste prior to placing the waste into RMW boxes for collection by the RMW vendor. Once autoclaved, this waste material is considered overclassified RMW.

e. Storage of RMW: Outer containers must be stored in a secure area protected for the elements, vandalism, insects and rodents. Unauthorized personnel must be denied access to this designated storage area. REHS recommends that RMW boxes not be stored in common areas, e.g. autoclave rooms. If RMW is to be stored in a common area, the location must be secured, e.g. locked, and the door appropriately labeled. When storing containers, be sure that their labels face outward so that they can be easily seen. Containers must also be sealed securely to prevent spillage or the leaking of vapors. Liquids (e.g. blood) must be put into containers that are packaged with a sufficient amount of surrounding absorbent material to prevent leakage. Volumes of liquid may not exceed 20cc per individual container.

f. Limitations on Storage of RMW: NJDEP Solid and Hazardous Waste Rules subchapter 3A: Regulated Medical Wastes (N.J.A.C. 7:26-3A) allows RMW to be stored on site for up to one year. In order to comply with this subchapter, RMW generators must dispose of RMW containers on a yearly basis, even if RMW containers are not full. REHS recommends frequent disposal of RMW boxes.

g. Packaging, Labeling and Marking Requirements

Packaging: The generator must package all RMW before the RMW vendor can remove it. The RMW vendor will not package your waste. All needles, syringes, scalpels and any sharp objects must be packaged in the appropriate puncture-resistant sharps container. Unbroken as well as broken glass must be packaged to prevent puncture of the outer RMW container. All other items may be packaged in autoclave bags or other appropriate inner containers. These items must then be packaged in an appropriate medical waste box before removal. Boxes used for the first shipment of RMW can be obtained by contacting REHS at 732/445-2550. Replacement boxes for use with future disposal of RMW will be available from the waste vendor upon arrival for subsequent pickups. Only the outer containers supplied by REHS or the vendor may be used to package RMW.

Labeling and Marking: Generators shall mark each package of RMW according to the following labeling and marking requirements before it can be transported off-site by the RMW vendor. The outermost surface of each cardboard box prepared for shipment shall be labeled with a special water resistant identification label called “Medical Waste Outer

Container Label." The Medical Waste Outer Container Label is available from REHS and provides the following information: campus, building and room where waste was generated. If these labels are unavailable, the required information may be written directly on the outside of the box. Only indelible or waterproof ink or marker fluid may be used to complete this label.

In addition to the requirements above, the generator must label inner containers including sharps containers and fluid containers. Each inner container shall be labeled only with a special water resistant identification label called "Medical Waste Inner Container Label." The Medical Waste Inner Container Label is available from REHS and provides the following information: campus, building, room, phone number and contact person name for the location where the waste was generated. If these labels are unavailable, the required information may be written directly on the inner container. Only indelible or waterproof ink or marker fluid may be used to fill out this label.

Note that all containers, both inner and outer, must be marked with the required information. Labels may be obtained by contacting REHS at 732/445-2550.

h. Tracking Form for RMW: The NJ Medical Waste Tracking Form (Appendix 7-A) is used to ensure proper transportation of RMW to an appropriate disposal site. Rutgers University has arranged with the RMW vendor to supply the four-copy RMW Tracking Form. The RMW vendor will fill out the tracking form. The generator must check Items 1 through 14 on the tracking form for purposes of verifying the accuracy of the information listed. After a thorough review of items 1 through 14, the generator must then sign Item 15 of the tracking form. After the RMW transporter has also signed in Item 16, Copy 4 (goldenrod sheet) of the tracking form will be given to the generator.

After the RMW is received by the disposal facility, a disposal facility representative will sign in Item 22. Copy 1 (white sheet) will be mailed back to the generator. Both Copies 1 and 4 of the tracking form must be kept by the generator at the generation site for at least three years from the date the waste was accepted by the RMW transporter. The destination facility must send Copy 1 to the generator within 15 days of receipt of the tracking form from the RMW hauler.

i. RMW Inspection: Periodically, the New Jersey Department of Health and Senior Services inspects RMW compliance at Rutgers University facilities. The inspector may visit health centers, laboratories, or athletic training areas. It is important to have both the white and goldenrod copies of the tracking forms readily available, as the inspector will likely review your waste tracking procedures. Container labeling is also an area that may be reviewed by an inspector, so it is good practice to be sure both inner and outer container labels are affixed to RMW containers.

j. Scheduling a RMW Pickup: Call REHS at 732/445-2550 to schedule a pickup of RMW. The RMW vendor is on site (Busch/Livingston and Cook/Douglass) on alternate Thursdays. Depending on the date of your request, you should allow up to 16 days for the RMW transporter to remove the waste. It is important that all requirements be completed prior to a pickup (e.g. labeling of the inner and outer container and sealing the box). Also, it is important that a representative of the RMW generator be on site to facilitate the RMW pickup. The RMW vendor will not pick up the waste without a representative of the RMW generator being present to sign the RMW tracking form.

k. Supplies Available from REHS: REHS will provide the following items upon request. (REHS does not provide sharps containers, autoclave bags, packing tape to Rutgers University laboratories. It is the responsibility of individual laboratories to provide sharps containers, autoclave bags, and packing tape.) Please call 732/445-2550 to request any necessary supplies.

RMW outer container box

RMW outer container box liner (red bag)

5-gallon open head bucket

Inner container label

Outer container label

l. Definitions

"Biologicals" means preparations made from living organisms and their products; includes vaccines and cultures intended to be used for diagnosing, immunizing, or treating humans or animals or in research pertaining thereto.

"Blood Products" means any product derived from human blood, including blood plasma, platelets, red or white blood corpuscles; and other derived licensed products including interferon, etc.

"Generator" means any person, by site, whose act or process produces regulated medical waste as defined in N.J.A.C. 7:26-3A.6, or whose act first causes a regulated medical waste to become subject to regulation.

"Infectious agent" means any organism (such as a virus or bacteria) that is capable of being communicated by invasion and multiplication in body tissues and capable of causing disease or adverse health impacts in humans.

"Inner container" means any container (sharps container, autoclave bag, 5-gallon bucket) that would collect RMW and would ultimately be placed into a properly lined outer container. This container must be labeled with the "inner container label."

"Inner container label" means the label available from REHS which states the campus, building, room, phone number and contact person name for the location where the RMW was generated.

"Laboratory" means any research, analytical, or clinical facility that performs health care related analysis or service. This includes medical, pathological, pharmaceutical, research, commercial and industrial laboratories.

"Medical waste" means any solid waste that is generated in the diagnosis, treatment, or immunization of human beings or animals; in research pertaining thereto; in the testing of biologicals; or in home self-care.

"Outer container" means the cardboard box that is supplied by the RMW vendor or REHS to collect inner containers of RMW. This outer container must be lined with a red RMW bag prior to placing any inner containers into the box. This box also must be labeled with the "outer container label."

"Outer container label" means the label available from REHS which states the campus, building and room where RMW was generated.

"Transporter" means a person engaged in the off-site transportation of regulated medical waste by air, rail, highway, or water.

Appendix 7 – A

Regulated Medical Waste Tracking Form

STATE OF NEW JERSEY
Department of Environmental Protection, Division of Solid and Hazardous Waste
P O Box 414, Trenton, N.J. 08625-0414

Please print or type. In case of an emergency discharge, immediately call the Department of Environmental Protection at (609) 292-7172 (24 hours a day)

TRACKING FORM • REGULATED MEDICAL WASTE (RMW)

GENERATOR

1. Generator's Name and Mailing Address

2. Tracking Form Number: B 1091411

3. Telephone Number ( )

4. State Permit or ID No.

5. Transporter's Name and Mailing Address

6. Telephone Number ( )

7. State Transporter Permit or ID No.

8. Destination Facility Name and Address

9. Telephone Number ( )

10. State Permit or ID No.

11. New Jersey Waste Description	12. Total No. Cont.	13. Total Weight
a. Regulated Medical Waste, 6.2, UN 3291, PG II (NJ Untreated)		
b. Regulated Medical Waste, 6.2, UN 3291, PG II (NJ Treated)		

14. Additional Information

a. Overclassified Material

b. Central Collection Point, Transfer Station Activity and Other Information

GENERATOR

15. Generator's Certification per 49 CFR 172.204(a)

I hereby declare on behalf of the generator that the contents of this consignment are fully and accurately described herein and are classified, packaged, marked, and labeled, and are in all respects in proper condition for transport, in accordance with all applicable state and federal laws and regulations, and that I am authorized to make such declaration.

PRINTED / TYPED NAME SIGNATURE DATE

TRANSPORTER

16. Transporter 1 (Certification of Receipt of RMW as described in Items 11, 12, & 13)

PRINTED / TYPED NAME SIGNATURE DATE

17. Transporter 2 or Intermediate Handler (Name and Address)

18 Telephone Number ( )

17a. Point of Transfer Address (If different from 17)

19. State Transporter Permit or ID No.

20. Transporter 2 or Intermediate Handler (Certification of Receipt of RMW as described in Items 11, 12, & 13)

PRINTED / TYPED NAME SIGNATURE DATE

21. New Tracking Form Number (for consolidated or remanifested RMW)

DESTINATION

22. Destination Facility (Certification of Receipt of RMW as described in Items 11, 12, & 13)

☐ Received in accordance with items 11, 12, & 13

PRINTED / TYPED NAME SIGNATURE DATE

(If other than destination facility, indicate address, phone, and Permit or ID No. in box 14)

23. Discrepancy Box (any discrepancies should be noted by Item number and initials)

Emergency Telephone Numbers (24 hours a day):		
Emergency Response	National Response Center, US Department of Transportation	1-800-424-8802
Emergency Discharge	NJ Department of Environmental Protection	1 609 292-7172
Infectious Substance Spills	Centers for Disease Control	1 400 232 0124

COPY 1 - GENERATOR COPY (WHITE): Mailed By Destination Facility To Generator

(Instructions Overleaf)

APPENDIX 7 – B

Biological Waste Management Table

Biological Waste Management

WASTE TYPE	BIOHAZARDOUS WASTE	REGULATED MEDICAL WASTE (RMW)	OVERCLASSIFIED MEDICAL WASTE	NONCONTAMINATED LABWARE	BIOLOGICALLY CONTAMINATED SHARPS	NONCONTAMINATED OR UNUSED SHARPS
EXAMPLES	Cultures and stocks of pathogenic microorganisms, e.g., those organisms regulated at BL-2 or higher. Solid waste (e.g., culture flasks, petri dishes, pipettes, pipette tips, gloves) potentially contaminated with pathogenic microorganisms.	The NJ RMW statute considers the following items to be RMW: cultures and stocks of infectious agents and associated biologicals; human pathological waste; human blood and blood products; needles, syringes, and sharps; contaminated animal waste including carcasses; hospital isolation waste; and unused sharps.	Overclassified RMW is generated from activities that do not meet the legal definition of RMW. Examples include blood products generated in teaching labs (research labs are covered but teaching labs are not) or culture dishes generated in basic research labs (materials not used in research into the diagnosis, treatment or immunization of humans or animals).	Labware that has been used to manipulate sterile media, buffers, water, and other innocuous materials may be considered noncontaminated labware. This material may not be placed directly into the regular trash due to perceived hazards associated with waste material of laboratory origin.	Sharps that were used in animal or human patient care, treatment, or biomedical research including hypodermic needles, all syringes with or without the attached needle, pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, used microscope slides and cover slips.	Hypodermic needles, suture needles, syringes, and scalpel blades.
PROCESSING INSTRUCTIONS	Autoclave or chemically disinfect prior to placing material in labeled regulated medical waste box, lined with red bag, for collection by vendor. Once autoclaved, this waste material is considered overclassified RMW.	Place material directly into labeled RMW box, lined with red bag, for collection by vendor.	Place material directly into labeled RMW box, lined with red bag, for collection by vendor.	Place material directly into black plastic bag. Label bag "noncontaminated labware" prior to placement in dumpster.	Place sharps directly into leak-proof puncture resistant commercially available sharps container. Never uncap, recap, bend, break, or shear attached needle from a syringe.	Place sharps directly into leak-proof puncture resistant commercially available sharps container. Never uncap, recap, bend, break, or shear attached needle from a syringe.
AUTOCLAVING REQUIRED	Yes	No	No	No	No	No
CONTAINER	Collect waste material in lidded container lined with autoclave bag. Exterior of container to be labeled with biohazard symbol. Transport autoclave bags, sealed with autoclave tape, to autoclave room in a covered leak-proof container. Once autoclaved (or chemically disinfected) processed material is placed in RMW boxes for collection by vendor.	Place material directly into labeled RMW box, lined with red bag, for collection by vendor. Smaller containers placed within the RMW box (e.g., sharps containers) must be labeled with inner RMW label.	Place material directly into labeled RMW box, lined with red bag, for collection by vendor. Handle overclassified RMW in the same manner as RMW.	Place material directly into black plastic bag. Label bag "noncontaminated labware" prior to placement in dumpster. When full seal bag and transport to dumpster or make arrangements with building services to transport to dumpster.	When full seal sharps container, label with inner RMW label, and place in labeled RMW box, lined with red bag for collection by vendor.	When full seal sharps container, label with inner RMW label, and place in labeled RMW box, lined with red bag for collection by vendor.
DISPOSITION	Transported by vendor to approved RMW incinerator for off-site incineration. Generator to retain RMW Tracking Forms.	Transported by vendor to approved RMW incinerator for off-site incineration. Generator to retain RMW Tracking Forms.	Transported by vendor to approved RMW incinerator for off-site incineration. Generator to retain RMW Tracking Forms.	Placed into dumpster by laboratory personnel or building services. Collected by solid waste carting vendor and transported to landfill.	Transported by vendor to approved RMW incinerator for off-site incineration. Generator to retain RMW Tracking Forms.	Transported by vendor to approved RMW incinerator for off-site incineration. Generator to retain RMW Tracking Forms.

APPENDIX 8

OSHA AIR CONTAMINANTS STANDARDS (PELS) 29 CFR 1910.1000

OSHA AIR CONTAMINANTS STANDARDS (PELS) 29 CFR 1910.1000

OSHA has adopted substance-specific standards for the following materials:

Substance	**Action Level***	**8-hour TWA PEL****	**Excursion Limit#**
Acrylonitrile	1 ppm	2 ppm	10 ppm @ 15 min.
Asbestos	-	0.1 fibers/cc	1 fiber/cc @ 30 min.
Benzene	0.5 ppm	1 ppm	5 ppm <15 min.
1,3 Butadiene	0.5 ppm	1 ppm	5 ppm @ 15 min.
Cadmium	2.5 ug/m^3	5 ug/m^3	
Chromium (VI)	2.5 ug/m^3	5 ug/m^3	
Coke oven emissions		150 ug/m^3	
Cotton dust (lint-free respirable cotton) from:			
- Yarn manufacturing and cotton-washing operations	100 ug/m^3	200 ug/m^3	
- Textile-mill waste, house operations, or `lower-grade washed cotton' in yarn manufacturing	250 ug/m^3	500 ug/m^3	
- Slashing and weaving	375 ug/m^3	750 ug/m^3	
1,2-dibromo-3-chloropropane		1 ppb	
Ethylene oxide	0.5 ppm	1 ppm	5 ppm @ 15 min.
Formaldehyde	0.5 ppm	0.75 ppm	2 ppm < 15 min.
Inorganic arsenic	5 ug/m^3	10 ug/m^3	
Lead	30 ug/m^3	50 ug/m^3	
Methylene Chloride	12.5 ppm	25 ppm	125 ppm @ 15 min.
Methylenedianiline	5 ppb	10 ppb	100 ppb @ 15 min.
Vinyl chloride	0.5 ppm	1 ppm	5 ppm <15 min.

Footnotes:

* Action Level 8-hour Time Weighted Average (TWA) air concentration of a substance at which certain substance- specific OSHA requirements go into effect (e.g. medical monitoring, exposure monitoring, training, etc.)

** 8-HOUR TWA PEL Permissible Exposure Level: 8-hour Time Weighted Average (TWA) air concentration to which worker may not be exposed without personal protective equipment.

\# Excursion limit: Maximum air concentration to which worker may be exposed (for the specified time interval) without exceeding the 8-hour TWA PEL.

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** Z
- **Subpart Title:** Toxic and Hazardous Substances
- **Standard Number:** 1910.1000
- **Title:** Air contaminants.

An employee's exposure to any substance listed in Tables Z-1, Z-2, or Z-3 of this section shall be limited in accordance with the requirements of the following paragraphs of this section.

1910.1000(a)

"Table Z-1."

1910.1000(a)(1)

"Substances with limits preceded by "C" - Ceiling Values." An employee's exposure to any substance in Table Z-1, the exposure limit of which is preceded by a "C", shall at no time exceed the exposure limit given for that substance. If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure which shall not be exceeded at any time during the working day.

1910.1000(a)(2)

"Other substances" - "8-hour Time Weighted Averages." An employee's exposure to any substance in Table Z-1, the exposure limit of which is not preceded by a "C", shall not exceed the 8-hour Time Weighted Average given for that substance any 8-hour work shift of a 40-hour work week.

1910.1000(b)

"Table Z-2." An employee's exposure to any substance listed in Table Z-2 shall not exceed the exposure limits specified as follows:

1910.1000(b)(1)

"8-hour time weighted averages." An employee's exposure to any substance listed in Table Z-2, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in Table Z-2.

..1910.1000(b)(2)
1910.1000(b)(2)

"Acceptable ceiling concentrations." An employee's exposure to a substance listed in Table Z-2 shall not exceed at any time during an 8-hour shift the acceptable ceiling concentration limit given for the substance in the table, except for a time period, and up to a concentration not exceeding the maximum duration and concentration allowed in the column under "acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift".

1910.1000(b)(3)

"Example." During an 8-hour work shift, an employee may be exposed to a concentration of Substance A (with a 10 ppm TWA, 25 ppm ceiling and 50 ppm peak) above 25 ppm (but never above 50 ppm) only for a maximum period of 10 minutes. Such exposure must be compensated by exposures to concentrations less than 10 ppm so that the cumulative exposure for the entire 8-hour work shift does not exceed a weighted average of 10 ppm.

1910.1000(c)

"Table Z-3." An employee's exposure to any substance listed in Table Z-3, in any 8-hour work shift of a 40-hour work week, shall not exceed the 8-hour time weighted average limit given for that substance in the table.

1910.1000(d)

"Computation formulae." The computation formula which shall apply to employee exposure to more than one substance for which 8-hour time weighted averages are listed in subpart Z of 29 CFR Part 1910 in order to determine whether an employee is exposed over the regulatory limit is as follows:

1910.1000(d)(1)
1910.1000(d)(1)(i)

The cumulative exposure for an 8-hour work shift shall be computed as follows:

(E = C(a)T(a) + C(b)T(b) + . . . C(n)T(n)) divided by 8

Where:

E is the equivalent exposure for the working shift.

C is the concentration during any period of time T where the concentration remains constant.

T is the duration in hours of the exposure at the concentration C.

The value of E shall not exceed the 8-hour time weighted average specified in Subpart Z or 29 CFR Part 1910 for the substance involved.

..1910.1000(d)(1)(ii)
1910.1000(d)(1)(ii)

To illustrate the formula prescribed in paragraph (d)(1)(i) of this section, assume that Substance A has an 8-hour time weighted average limit of 100 ppm noted in Table Z-1. Assume that an employee is subject to the following exposure:

Two hours exposure at 150 ppm
Two hours exposure at 75 ppm
Four hours exposure at 50 ppm

Substituting this information in the formula, we have

(2 X 150 + 2 X 75 + 4 X 50) divided by 8 = 81.25 ppm

Since 81.25 ppm is less than 100 ppm, the 8-hour time weighted

average limit, the exposure is acceptable.

1910.1000(d)(2)
1910.1000(d)(2)(i)

in case of a mixture of air contaminants an employer shall compute the equivalent exposure as follows:

E(m) = (C(1) divided by L(1) + C(2) divided by L(2)) + . . .
(C(n) divided by L(n))

Where:

E(m) is the equivalent exposure for the mixture.

C is the concentration of a particular contaminant.

L is the exposure limit for that substance specified in Subpart Z of 29 CFR Part 1910.

The value of E(m) shall not exceed unity (1).

1910.1000(d)(2)(ii)

To illustrate the formula prescribed in paragraph (d)(2)(i) of this section, consider the following exposures:

Substance	Actual Concentration 8 Hour Exposure (ppm)	TWA PEL (ppm)
B	500	1000
C	45	200
D	40	200

Substituting in the formula, we have:
E(m) = 500 divided by 1,000 + 45 divided by 200 + 40 divided by 200
E(m) = 0.500 + 0.225 + 0.200
E(m) = 0.925

Since E(m) is less than unity (1), the exposure combination is within acceptable limits.

1910.1000(e)

To achieve compliance with paragraphs (a) through (d) of this section, administrative or engineering controls must first be determined and implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or any other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and/or technical measures used for this purpose must be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with 1910.134.

1910.1000(f)

Effective dates. The exposure limits specified have been in effect with the method of compliance specified in paragraph (e) of this section since May 29, 1971.

- **Part Number:** 1910
- **Part Title:** Occupational Safety and Health Standards
- **Subpart:** Z
- **Subpart Title:** Toxic and Hazardous Substances
- **Standard Number:** 1910.1000 TABLE Z-1
- **Title:** TABLE Z-1 Limits for Air Contaminants.

TABLE Z-1 LIMITS FOR AIR CONTAMINANTS

NOTE: Because of the length of the table, explanatory Footnotes applicable to all substances are given below as well as at the end of the table. Footnotes specific only to a limited number of substances are also shown within the table.

Footnote (1) The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing-zone air samples.

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

Footnote (b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

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

Footnote (d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Table Z-2 apply. See 1910.1028 for specific circumstances.

Footnote (e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.

Footnote (f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z-3.

Footnote (2) See Table Z-2.

Footnote (3) See Table Z-3

Footnote (4) Varies with compound.

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Acetaldehyde.....	75-07-0	200	360	
Acetic acid.....	64-19-7	10	25	
Acetic anhydride.....	108-24-7	5	20	
Acetone.....	67-64-1	1000	2400	
Acetonitrile.....	75-05-8	40	70	
2-Acetylaminofluorene; see 1910.1014.....	53-96-3			
Acetylene dichloride; see 1,2-Dichloroethylene.				
Acetylene tetrabromide.	79-27-6	1	14	
Acrolein.....	107-02-8	0.1	0.25	
Acrylamide.....	79-06-1	.....	0.3	X
Acrylonitrile; see 1910.1045.....	107-13-1			
Aldrin.....	309-00-2	.....	0.25	X
Allyl alcohol.....	107-18-6	2	5	X
Allyl chloride.....	107-05-1	1	3	
Allyl glycidyl ether... (AGE).....	106-92-3	(C)10	(C)45	
Allyl propyl disulfide.	2179-59-1	2	12	
alpha-Alumina.....	1344-28-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Aluminum Metal (as Al).	7429-90-5			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
4-Aminodiphenyl; see 1910.1011.....	92-67-1			
2-Aminoethanol; see Ethanolamine.....				
2-Aminopyridine.....	504-29-0	0.5	2	
Ammonia.....	7664-41-7	50	35	
Ammonium sulfamate.....	7773-06-0			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
n-Amyl acetate.....	628-63-7	100	525	
sec-Amyl acetate.....	626-38-0	125	650	
Aniline and homologs...	62-53-3	5	19	X
Anisidine (o-,p-isomers).....	29191-52-4	.....	0.5	X
Antimony and compounds (as Sb).....	7440-36-0	.....	0.5	
ANTU (alpha Naphthylthiourea)....	86-88-4	.....	0.3	
Arsenic, inorganic compounds (as As); see 1910.1018.....	7440-38-2			

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Arsenic, organic compounds (as As)	7440-38-2	.....	0.5	
Arsine	7784-42-1	0.05	0.2	
Asbestos; see 1910.1001	(4)			
Azinphos-methyl	86-50-0	.....	0.2	X
Barium, soluble compounds (as Ba)	7440-39-3	.....	0.5	
Barium sulfate	7727-43-7			
Total dust		.....	15	
Respirable fraction		.....	5	
Benomyl	17804-35-2			
Total dust		.....	15	
Respirable fraction		.....	5	
Benzene; See 1910.1028. See Table Z-2 for the limits applicable in the operations or sectors excluded in 1910.1028(d)	71-43-2			
Benzidine; See 1910.1010	92-87-5			
p-Benzoquinone; see Quinone.				
Benzo(a)pyrene; see Coal tar pitch volatiles				
Benzoyl peroxide	94-36-0	.....	5	
Benzyl chloride	100-44-7	1	5	
Beryllium and beryllium compounds (as Be)	7440-41-7		(2)	
Biphenyl; see Diphenyl.				
Bismuth telluride, Undoped	1304-82-1			
Total dust		.....	15	
Respirable fraction		.....	5	
Boron oxide	1303-86-2			
Total dust		.....	15	
Boron trifluoride	7637-07-2	(C)1	(C)3	
Bromine	7726-95-6	0.1	0.7	
Bromoform	75-25-2	0.5	5	X
Butadiene (1,3-Butadiene); See 29 CFR 1910.1051; 29 CFR 1910.19(1)	106-99-0	1 ppm/5 ppm STEL		
Butanethiol; see Butyl mercaptan.				
2-Butanone (Methyl ethyl ketone)	78-93-3	200	590	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
2-Butoxyethanol.....	111-76-2	50	240	X
n-Butyl-acetate.....	123-86-4	150	710	
sec-Butyl acetate.....	105-46-4	200	950	
tert-Butyl-acetate.....	540-88-5	200	950	
n-Butyl alcohol.....	71-36-3	100	300	
sec-Butyl alcohol.....	78-92-2	150	450	
tert-Butyl alcohol.....	75-65-0	100	300	
Butylamine.....	109-73-9	(C)5	(C)15	X
tert-Butyl chromate (as CrO(3)).....	1189-85-1	.....	(C)0.1	X
n-Butyl glycidyl ether (BGE).....	2426-08-6	50	270	
Butyl mercaptan.....	109-79-5	10	35	
p-tert-Butyltoluene....	98-51-1	10	60	
Cadmium (as Cd); see 1910.1027.....	7440-43-9			
Calcium Carbonate.....	1317-65-3			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Calcium hydroxide.....	1305-62-0			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Calcium oxide.....	1305-78-8	.....	5	
Calcium silicate.....	1344-95-2			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Calcium sulfate.....	7778-18-9			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Camphor, synthetic.....	76-22-2	.....	2	
Carbaryl (Sevin).....	63-25-2	.....	5	
Carbon black.....	1333-86-4	.....	3.5	
Carbon dioxide.....	124-38-9	5000	9000	
Carbon disulfide.....	75-15-0		(2)	
Carbon monoxide.....	630-08-0	50	55	
Carbon tetrachloride...	56-23-5		(2)	
Cellulose.....	9004-34-6			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Chlordane.....	57-74-9	.....	0.5	X
Chlorinated camphene...	8001-35-2	.....	0.5	X
Chlorinated diphenyl oxide.....	55720-99-5	.....	0.5	
Chlorine.....	7782-50-5	(C)1	(C)3	
Chlorine dioxide.....	10049-04-4	0.1	0.3	
Chlorine trifluoride...	7790-91-2	(C)0.1	(C)0.4	
Chloroacetaldehyde.....	107-20-0	(C)1	(C)3	
a-Chloroacetophenone (Phenacyl chloride)..	532-27-4	0.05	0.3	
Chlorobenzene.....	108-90-7	75	350	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
o-Chlorobenzylidene malononitrile.....	2698-41-1	0.05	0.4	
Chlorobromomethane.....	74-97-5	200	1050	
2-Chloro-1,3-butadiene; See beta-Chloroprene.				
Chlorodiphenyl (42% Chlorine)(PCB)..	53469-21-9	.....	1	X
Chlorodiphenyl (54% Chlorine)(PCB)..	11097-69-1	.....	0.5	X
1-Chloro-2, 3-epoxypropane; See Epichlorohydrin.				
2-Chloroethanol; See Ethylene chlorohydrin				
Chloroethylene; See Vinyl chloride.				
Chloroform (Trichloromethane)...	67-66-3	(C)50	(C)240	
bis(Chloromethyl) ether; see 1910.1008.	542-88-1			
Chloromethyl methyl ether; see 1910.1006.	107-30-2			
1-Chloro-1-nitropropane	600-25-9	20	100	
Chloropicrin.....	76-06-2	0.1	0.7	
beta-Chloroprene.....	126-99-8	25	90	X
2-Chloro-6 (trichloromethyl) pyridine.....	1929-82-4			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Chromic acid and chromates (as CrO(3))	(4)		(2)	
Chromium (II) compounds (as Cr).....	7440-47-3	.....	0.5	
Chromium (III) compounds (as Cr)....	7440-47-3	.....	0.5	
Chromium metal and insol. salts (as Cr).	7440-47-3	.....	1	
Chrysene; see Coal tar pitch volatiles.....				
Clopidol.....	2971-90-6			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Coal dust (less than 5% SiO(2)), respirable fraction..			(3)	
Coal dust (greater than or equal to 5% SiO(2)), respirable fraction.....			(3)	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Coal tar pitch volatiles (benzene soluble fraction), anthracene, BaP, phenanthrene, acridine, chrysene, pyrene	65966-93-2	.....	0.2	
Cobalt metal, dust, and fume (as Co)	7440-48-4	.....	0.1	
Coke oven emissions; see 1910.1029				
Copper	7440-50-8			
Fume (as Cu)		.....	0.1	
Dusts and mists (as Cu)		.....	1	
Cotton dust (e), see 1910.1043		.....	1	
Crag herbicide (Sesone)	136-78-7			
Total dust		.....	15	
Respirable fraction		.....	5	
Cresol, all isomers	1319-77-3	5	22	X
Crotonaldehyde	123-73-9 4170-30-3	2	6	
Cumene	98-82-8	50	245	X
Cyanides (as CN)	(4)	.....	5	X
Cyclohexane	110-82-7	300	1050	
Cyclohexanol	108-93-0	50	200	
Cyclohexanone	108-94-1	50	200	
Cyclohexene	110-83-8	300	1015	
Cyclopentadiene	542-92-7	75	200	
2,4-D (Dichlorophen-oxyacetic acid)	94-75-7	.....	10	
Decaborane	17702-41-9	0.05	0.3	X
Demeton (Systox)	8065-48-3	.....	0.1	X
Diacetone alcohol (4-Hydroxy-4-methyl-2-pentanone)	123-42-2	50	240	
1,2-Diaminoethane; see Ethylenediamine				
Diazomethane	334-88-3	0.2	0.4	
Diborane	19287-45-7	0.1	0.1	
1,2-Dibromo-3-chloropropane (DBCP); see 1910.1044	96-12-8			
1,2-Dibromoethane; see Ethylene dibromide				
Dibutyl phosphate	107-66-4	1	5	
Dibutyl phthalate	84-74-2	.....	5	
o-Dichlorobenzene	95-50-1	(C)50	(C)300	
p-Dichlorobenzene	106-46-7	75	450	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
3,3'-Dichlorobenzidine; see 1910.1007.....	91-94-1			
Dichlorodifluoromethane	75-71-8	1000	4950	
1,3-Dichloro-5, 5-dimethyl hydantoin.	118-52-5	.....	0.2	
Dichlorodiphenyltri- chloroethane (DDT)...	50-29-3	.....	1	X
1,1-Dichloroethane.....	75-34-3	100	400	
1,2-Dichloroethane; see Ethylene dichloride..				
1,2-Dichloroethylene...	540-59-0	200	790	
Dichloroethyl ether....	111-44-4	(C)15	(C)90	X
Dichloromethane; see Methylene chloride...				
Dichloromonofluoro- methane.....	75-43-4	1000	4200	
1,1-Dichloro-1- nitroethane.....	594-72-9	(C)10	(C)60	
1,2-Dichloropropane; see Propylene dichloride.				
Dichlorotetrafluoro- ethane.....	76-14-2	1000	7000	
Dichlorvos (DDVP).....	62-73-7	.....	1	X
Dicyclopentadienyl iron	102-54-5			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Dieldrin.....	60-57-1	.....	0.25	X
Diethylamine.....	109-89-7	25	75	
2-Diethylaminoethanol..	100-37-8	10	50	X
Diethyl ether; see Ethyl ether.....				
Difluorodibromomethane.	75-61-6	100	860	
Diglycidyl ether (DGE).	2238-07-5	(C)0.5	(C)2.8	
Dihydroxybenzene; see Hydroquinone.....				
Diisobutyl ketone.....	108-83-8	50	290	
Diisopropylamine.....	108-18-9	5	20	X
4-Dimethylaminoazo- benzene; see 1910.1015.....	60-11-7			
Dimethoxymethane; see Methylal.....				
Dimethyl acetamide.....	127-19-5	10	35	X
Dimethylamine.....	124-40-3	10	18	
Dimethylaminobenzene; see Xylidine.....				
Dimethylaniline (N,N-Dimethylaniline)	121-69-7	5	25	X
Dimethylbenzene; see Xylene.....				

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Dimethyl-1,2-dibromo-2, 2-dichloroethyl phosphate	300-76-5	.....	3	
Dimethylformamide	68-12-2	10	30	X
2,6-Dimethyl-4-heptanone; see Diisobutyl ketone				
1,1-Dimethylhydrazine	57-14-7	0.5	1	X
Dimethylphthalate	131-11-3	.....	5	
Dimethyl sulfate	77-78-1	1	5	X
Dinitrobenzene				
(all isomers)			1	X
(ortho)	528-29-0			
(meta)	99-65-0			
(para)	100-25-4			
Dinitro-o-cresol	534-52-1	.....	0.2	X
Dinitrotoluene	25321-14-6	.....	1.5	X
Dioxane (Diethylene dioxide)	123-91-1	100	360	X
Diphenyl (Biphenyl)	92-52-4	0.2	1	
Diphenylmethane diisocyanate; see Methylene bisphenyl isocyanate				
Dipropylene glycol methyl ether	34590-94-8	100	600	X
Di-sec octyl phthalate (Di-(2-ethylhexyl) phthalate)	117-81-7	.....	5	
Emery	12415-34-8			
Total dust		.....	15	
Respirable fraction		.....	5	
Endrin	72-20-8	.....	0.1	X
Epichlorohydrin	106-89-8	5	19	X
EPN	2104-64-5	.....	0.5	X
1,2-Epoxypropane; see Propylene oxide				
2,3-Epoxy-1-propanol; see Glycidol				
Ethanethiol; see Ethyl mercaptan				
Ethanolamine	141-43-5	3	6	
2-Ethoxyethanol (Cellosolve)	110-80-5	200	740	X
2-Ethoxyethyl acetate (Cellosolve acetate)	111-15-9	100	540	X
Ethyl acetate	141-78-6	400	1400	
Ethyl acrylate	140-88-5	25	100	X
Ethyl alcohol (Ethanol)	64-17-5	1000	1900	
Ethylamine	75-04-7	10	18	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Ethyl amyl ketone (5-Methyl-3-heptanone)	541-85-5	25	130	
Ethyl benzene	100-41-4	100	435	
Ethyl bromide	74-96-4	200	890	
Ethyl butyl ketone (3-Heptanone)	106-35-4	50	230	
Ethyl chloride	75-00-3	1000	2600	
Ethyl ether	60-29-7	400	1200	
Ethyl formate	109-94-4	100	300	
Ethyl mercaptan	75-08-1	(C)10	(C)25	
Ethyl silicate	78-10-4	100	850	
Ethylene chlorohydrin	107-07-3	5	16	X
Ethylenediamine	107-15-3	10	25	
Ethylene dibromide	106-93-4		(2)	
Ethylene dichloride (1,2-Dichloroethane)	107-06-2		(2)	
Ethylene glycol dinitrate	628-96-6	(C)0.2	(C)1	X
Ethylene glycol methyl acetate; see Methyl cellosolve acetate				
Ethyleneimine; see 1910.1012	151-56-4			
Ethylene oxide; see 1910.1047	75-21-8			
Ethylidene chloride; see 1,1-Dichlorethane				
N-Ethylmorpholine	100-74-3	20	94	X
Ferbam	14484-64-1			
Total dust		.....	15	
Ferrovanadium dust	12604-58-9	.....	1	
Fluorides (as F)	(4)	.....	2.5	
Fluorine	7782-41-4	0.1	0.2	
Fluorotrichloromethane (Trichloro-fluoromethane)	75-69-4	1000	5600	
Formaldehyde; see 1910.1048	50-00-0			
Formic acid	64-18-6	5	9	
Furfural	98-01-1	5	20	X
Furfuryl alcohol	98-00-0	50	200	
Grain dust (oat, wheat barley)	.....	.....	10	
Glycerin (mist)	56-81-5			
Total dust		.....	15	
Respirable fraction		.....	5	
Glycidol	556-52-5	50	150	
Glycol monoethyl ether; see 2-Ethoxyethanol				

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Graphite, natural respirable dust	7782-42-5		(3)	
Graphite, synthetic				
Total dust		.....	15	
Respirable Fraction		.....	5	
Guthion; see Azinphos methyl				
Gypsum	13397-24-5			
Total dust		.....	15	
Respirable fraction		.....	5	
Hafnium	7440-58-6	.....	0.5	
Heptachlor	76-44-8	.....	0.5	X
Heptane (n-Heptane)	142-82-5	500	2000	
Hexachloroethane	67-72-1	1	10	X
Hexachloronaphthalene	1335-87-1	.....	0.2	X
n-Hexane	110-54-3	500	1800	
2-Hexanone (Methyl n-butyl ketone)	591-78-6	100	410	
Hexone (Methyl isobutyl ketone)	108-10-1	100	410	
sec-Hexyl acetate	108-84-9	50	300	
Hydrazine	302-01-2	1	1.3	X
Hydrogen bromide	10035-10-6	3	10	
Hydrogen chloride	7647-01-0	(C)5	(C)7	
Hydrogen cyanide	74-90-8	10	11	X
Hydrogen fluoride (as F)	7664-39-3		(2)	
Hydrogen peroxide	7722-84-1	1	1.4	
Hydrogen selenide (as Se)	7783-07-5	0.05	0.2	
Hydrogen sulfide	7783-06-4		(2)	
Hydroquinone	123-31-9	.....	2	
Iodine	7553-56-2	(C)0.1	(C)1	
Iron oxide fume	1309-37-1	.....	10	
Isomyl acetate	123-92-2	100	525	
Isomyl alcohol (primary and secondary)	123-51-3	100	360	
Isobutyl acetate	110-19-0	150	700	
Isobutyl alcohol	78-83-1	100	300	
Isophorone	78-59-1	25	140	
Isopropyl acetate	108-21-4	250	950	
Isopropyl alcohol	67-63-0	400	980	
Isopropylamine	75-31-0	5	12	
Isopropyl ether	108-20-3	500	2100	
Isopropyl glycidyl ether (IGE)	4016-14-2	50	240	
Kaolin	1332-58-7			
Total dust		.....	15	
Respirable fraction		.....	5	
Ketene	463-51-4	0.5	0.9	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Lead inorganic (as Pb); see 1910.1025	7439-92-1			
Limestone	1317-65-3			
Total dust		.....	15	
Respirable fraction		.....	5	
Lindane	58-89-9	.....	0.5	X
Lithium hydride	7580-67-8	.....	0.025	
L.P.G. (Liquified petroleum gas)	68476-85-7	1000	1800	
Magnesite	546-93-0			
Total dust		.....	15	
Respirable fraction		.....	5	
Magnesium oxide fume	1309-48-4			
Total Particulate		.....	15	
Malathion	121-75-5			
Total dust		.....	15	X
Maleic anhydride	108-31-6	0.25	1	
Manganese compounds (as Mn)	7439-96-5	.....	(C)5	
Manganese fume (as Mn)	7439-96-5	.....	(C)5	
Marble	1317-65-3			
Total dust		.....	15	
Respirable fraction		.....	5	
Mercury (aryl and inorganic)(as Hg)	7439-97-6		(2)	
Mercury (organo) alkyl compounds (as Hg)	7439-97-6		(2)	
Mercury (vapor) (as Hg)	7439-97-6		(2)	
Mesityl oxide	141-79-7	25	100	
Methanethiol; see Methyl mercaptan				
Methoxychlor	72-43-5			
Total dust		.....	15	
2-Methoxyethanol; (Methyl cellosolve)	109-86-4	25	80	X
2-Methoxyethyl acetate (Methyl cellosolve acetate)	110-49-6	25	120	X
Methyl acetate	79-20-9	200	610	
Methyl acetylene (Propyne)	74-99-7	1000	1650	
Methyl acetylene propadiene mixture (MAPP)		1000	1800	
Methyl acrylate	96-33-3	10	35	X
Methylal (Dimethoxy-methane)	109-87-5	1000	3100	
Methyl alcohol	67-56-1	200	260	
Methylamine	74-89-5	10	12	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Methyl amyl alcohol; see Methyl Isobutyl carbinol.....				
Methyl n-amyl ketone...	110-43-0	100	465	
Methyl bromide.....	74-83-9	(C)20	(C)80	X
Methyl butyl ketone; see 2-Hexanone.....				
Methyl cellosolve; see 2-Methoxyethanol.				
Methyl cellosolve acetate; see 2-Methoxyethyl acetate.....				
Methyl chloride.....	74-87-3		(2)	
Methyl chloroform (1,1,1-Trichloro-ethane).....	71-55-6	350	1900	
Methylcyclohexane.....	108-87-2	500	2000	
Methylcyclohexanol.....	25639-42-3	100	470	
o-Methylcyclohexanone..	583-60-8	100	460	X
Methylene chloride.....	75-09-2		(2)	
Methyl ethyl ketone (MEK); see 2-Butanone				
Methyl formate.....	107-31-3	100	250	
Methyl hydrazine (Monomethyl hydrazine).....	60-34-4	(C)0.2	(C)0.35	X
Methyl iodide.....	74-88-4	5	28	X
Methyl isoamyl ketone..	110-12-3	100	475	
Methyl isobutyl carbinol.....	108-11-2	25	100	X
Methyl isobutyl ketone; see Hexone.....				
Methyl isocyanate.....	624-83-9	0.02	0.05	X
Methyl mercaptan.....	74-93-1	(C)10	(C)20	
Methyl methacrylate....	80-62-6	100	410	
Methyl propyl ketone; see 2-Pentanone.....				
alpha-Methyl styrene...	98-83-9	(C)100	(C)480	
Methylene bisphenyl isocyanate (MDI).....	101-68-8	(C)0.02	(C)0.2	
Mica; see Silicates....				
Molybdenum (as Mo).....	7439-98-7			
Soluble compounds....		.....	5	
Insoluble Compounds Total dust.....		.....	15	
Monomethyl aniline.....	100-61-8	2	9	X
Monomethyl hydrazine; see Methyl hydrazine.				
Morpholine.....	110-91-8	20	70	X
Naphtha (Coal tar).....	8030-30-6	100	400	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Naphthalene.....	91-20-3	10	50	
alpha-Naphthylamine; see 1910.1004.....	134-32-7			
beta-Naphthylamine; see 1910.1009.....	91-59-8			
Nickel carbonyl (as Ni)	13463-39-3	0.001	0.007	
Nickel, metal and insoluble compounds (as Ni).....	7440-02-0	.....	1	
Nickel, soluble compounds (as Ni)....	7440-02-0	.....	1	
Nicotine.....	54-11-5	.....	0.5	X
Nitric acid.....	7697-37-2	2	5	
Nitric oxide.....	10102-43-9	25	30	
p-Nitroaniline.....	100-01-6	1	6	X
Nitrobenzene.....	98-95-3	1	5	X
p-Nitrochlorobenzene...	100-00-5	.....	1	X
4-Nitrodiphenyl; see 1910.1003.....	92-93-3			
Nitroethane.....	79-24-3	100	310	
Nitrogen dioxide.....	10102-44-0	(C)5	(C)9	
Nitrogen trifluoride...	7783-54-2	10	29	
Nitroglycerin.....	55-63-0	(C)0.2	(C)2	X
Nitromethane.....	75-52-5	100	250	
1-Nitropropane.....	108-03-2	25	90	
2-Nitropropane.....	79-46-9	25	90	
N-Nitrosodimethylamine; see 1910.1016				
Nitrotoluene (all isomers).....		5	30	X
o-isomer.....	88-72-2			
m-isomer.....	99-08-1			
p-isomer.....	99-99-0			
Nitrotrichloromethane; see Chloropicrin.....				
Octachloronaphthalene..	2234-13-1	.....	0.1	X
Octane.....	111-65-9	500	2350	
Oil mist, mineral.....	8012-95-1	.....	5	
Osmium tetroxide (as Os).....	20816-12-0	.....	0.002	
Oxalic acid.....	144-62-7	.....	1	
Oxygen difluoride.....	7783-41-7	0.05	0.1	
Ozone.....	10028-15-6	0.1	0.2	
Paraquat, respirable dust.....	4685-14-7	.....	0.5	X
	1910-42-5			
	2074-50-2			
Parathion.....	56-38-2	.....	0.1	X

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Particulates not otherwise regulated (PNOR)(f).....				
Total dust.....		.....	15	
Respirable fraction..		.....	5	
PCB; see Chlorodiphenyl (42% and 54% chlorine).....				
Pentaborane.....	19624-22-7	0.005	0.01	
Pentachloronaphthalene.	1321-64-8	.....	0.5	X
Pentachlorophenol.....	87-86-5	.....	0.5	X
Pentaerythritol.....	115-77-5			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Pentane.....	109-66-0	1000	2950	
2-Pentanone (Methyl propyl ketone).....	107-87-9	200	700	
Perchloroethylene (Tetrachloroethylene)	127-18-4		(2)	
Perchloromethyl mercaptan.....	594-42-3	0.1	0.8	
Perchloryl fluoride....	7616-94-6	3	13.5	
Petroleum distillates (Naphtha)(Rubber Solvent).....		500	2000	
Phenol.....	108-95-2	5	19	X
p-Phenylene diamine....	106-50-3	.....	0.1	X
Phenyl ether, vapor....	101-84-8	1	7	
Phenyl ether-biphenyl mixture, vapor.....		1	7	
Phenylethylene; see Styrene.....				
Phenyl glycidyl ether (PGE).....	122-60-1	10	60	
Phenylhydrazine.....	100-63-0	5	22	X
Phosdrin (Mevinphos)...	7786-34-7	.....	0.1	X
Phosgene (Carbonyl chloride).....	75-44-5	0.1	0.4	
Phosphine.....	7803-51-2	0.3	0.4	
Phosphoric acid.....	7664-38-2	.....	1	
Phosphorus (yellow)....	7723-14-0	.....	0.1	
Phosphorus pentachloride.....	10026-13-8	.....	1	
Phosphorus pentasulfide	1314-80-3	.....	1	
Phosphorus trichloride.	7719-12-2	0.5	3	
Phthalic anhydride.....	85-44-9	2	12	
Picloram.....	1918-02-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Picric acid.....	88-89-1	.....	0.1	X

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Pindone (2-Pivalyl-1, 3-indandione).....	83-26-1	.....	0.1	
Plaster of paris.....	26499-65-0			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Platinum (as Pt).....	7440-06-4			
Metal.....		.....	.....	
Soluble Salts.....		.....	0.002	
Portland cement.....	65997-15-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Propane.....	74-98-6	1000	1800	
beta-Propriolactone; see 1910.1013.....	57-57-8			
n-Propyl acetate.....	109-60-4	200	840	
n-Propyl alcohol.....	71-23-8	200	500	
n-Propyl nitrate.....	627-13-4	25	110	
Propylene dichloride...	78-87-5	75	350	
Propylene imine.....	75-55-8	2	5	X
Propylene oxide.....	75-56-9	100	240	
Propyne; see Methyl acetylene.....				
Pyrethrum.....	8003-34-7	.....	5	
Pyridine.....	110-86-1	5	15	
Quinone.....	106-51-4	0.1	0.4	
RDX: see Cyclonite.....				
Rhodium (as Rh), metal fume and insoluble compounds.....	7440-16-6	.....	0.1	
Rhodium (as Rh), soluble compounds....	7440-16-6	.....	0.001	
Ronnel.....	299-84-3	.....	15	
Rotenone.....	83-79-4	.....	5	
Rouge.....				
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Selenium compounds (as Se).....	7782-49-2	.....	0.2	
Selenium hexafluoride (as Se).....	7783-79-1	0.05	0.4	
Silica, amorphous, precipitated and gel.	112926-00-8		(3)	
Silica, amorphous, diatomaceous earth, containing less than 1% crystalline silica	61790-53-2		(3)	
Silica, crystalline cristobalite, respirable dust.....	14464-46-1		(3)	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Silica, crystalline quartz, respirable dust	14808-60-7		(3)	
Silica, crystalline tripoli (as quartz), respirable dust	1317-95-9		(3)	
Silica, crystalline tridymite, respirable dust	15468-32-3		(3)	
Silica, fused, respirable dust	60676-86-0		(3)	
Silicates (less than 1% crystalline silica) Mica (respirable dust)	12001-26-2		(3)	
Soapstone, total dust	.....		(3)	
Soapstone, respirable dust	.....		(3)	
Talc (containing asbestos): use asbestos limit: see 29 CFR 1910.1001			(3)	
Talc (containing no asbestos), respirable dust	14807-96-6		(3)	
Tremolite, asbestiform; see 1910.1001				
Silicon	7440-21-3			
Total dust		.....	15	
Respirable fraction		.....	5	
Silicon carbide	409-21-2			
Total dust		.....	15	
Respirable fraction		.....	5	
Silver, metal and soluble compounds (as Ag)	7440-22-4	.....	0.01	
Soapstone; see Silicates				
Sodium fluoroacetate	62-74-8	.....	0.05	X
Sodium hydroxide	1310-73-2	.....	2	
Starch	9005-25-8			
Total dust		.....	15	
Respirable fraction		.....	5	
Stibine	7803-52-3	0.1	0.5	
Stoddard solvent	8052-41-3	500	2900	
Strychnine	57-24-9	.....	0.15	
Styrene	100-42-5		(2)	
Sucrose	57-50-1			
Total dust		.....	15	
Respirable fraction		.....	5	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Sulfur dioxide.....	7446-09-5	5	13	
Sulfur hexafluoride....	2551-62-4	1000	6000	
Sulfuric acid.....	7664-93-9	.....	1	
Sulfur monochloride....	10025-67-9	1	6	
Sulfur pentafluoride...	5714-22-7	0.025	0.25	
Sulfuryl fluoride.....	2699-79-8	5	20	
Systox; see Demeton...				
2,4,5-T (2,4,5-tri- chlorophenoxyacetic acid).....	93-76-5	.....	10	
Talc; see Silicates...				
Tantalum, metal and oxide dust.....	7440-25-7	.....	5	
TEDP (Sulfotep).....	3689-24-5	.....	0.2	X
Tellurium and compounds (as Te)....	13494-80-9	.....	0.1	
Tellurium hexafluoride (as Te).....	7783-80-4	0.02	0.2	
Temephos.....	3383-96-8			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
TEPP (Tetraethyl pyrophosphaate).....	107-49-3	.....	0.05	X
Terphenylis.....	26140-60-3	(C)1	(C)9	
1,1,1,2-Tetrachloro-2, 2-difluoroethane.....	76-11-9	500	4170	
1,1,2,2-Tetrachloro-1, 2-difluoroethane.....	76-12-0	500	4170	
1,1,2,2-Tetrachloro- ethane.....	79-34-5	5	35	X
Tetrachoroethylene; see Perchloroethylene				
Tetrachloromethane; see Carbon tetrachloride.				
Tetrachloronaphthalene.	1335-88-2	.....	2	X
Tetraethyl lead (as Pb)	78-00-2	.....	0.075	X
Tetrahydrofuran.....	109-99-9	200	590	
Tetramethyl lead, (as Pb).....	75-74-1	.....	0.075	X
Tetramethyl succinonitrile.....	3333-52-6	0.5	3	X
Tetranitromethane.....	509-14-8	1	8	
Tetryl (2,4,6-Trinitro- phenylmethyl- nitramine).....	479-45-8	.....	1.5	X
Thallium, soluble compounds (as Tl)....	7440-28-0	.....	0.1	X
4,4'-Thiobis(6-tert, Butyl-m-cresol).....	96-69-5			
Total dust.....		.....	15	
Respirable fraction..		.....	5	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Thiram	137-26-8	.....	5	
Tin, inorganic compounds (except oxides) (as Sn)	7440-31-5	.....	2	
Tin, organic compounds (as Sn)	7440-31-5	.....	0.1	
Titanium dioxide	13463-67-7			
Total dust		.....	15	
Toluene	108-88-3		(2)	
Toluene-2, 4-diisocyanate (TDI)	584-84-9	(C)0.02	(C)0.14	
o-Toluidine	95-53-4	5	22	X
Toxaphene; see Chlorinated camphene				
Tremolite; see Silicates				
Tributyl phosphate	126-73-8	.....	5	
1,1,1-Trichloroethane; see Methyl chloroform				
1,1,2-Trichloroethane	79-00-5	10	45	X
Trichloroethylene	79-01-6		(2)	
Trichloromethane; see Chloroform				
Trichloronaphthalene	1321-65-9	.....	5	X
1,2,3-Trichloropropane	96-18-4	50	300	
1,1,2-Trichloro-1,2, 2-trifluoroethane	76-13-1	1000	7600	
Triethylamine	121-44-8	25	100	
Trifluorobromomethane	75-63-8	1000	6100	
2,4,6-Trinitrophenol; see Picric acid				
2,4,6-Trinitrophenyl-methyl nitramine; see Tetryl				
2,4,6-Trinitrotoluene (TNT)	118-96-7	.....	1.5	X
Triorthocresyl phosphate	78-30-8	.....	0.1	
Triphenyl phosphate	115-86-6	.....	3	
Turpentine	8006-64-2	100	560	
Uranium (as U)	7440-61-1			
Soluble compounds		.....	0.05	
Insoluble compounds		.....	0.25	
Vanadium	1314-62-1			
Respirable dust (as V(2)O(5))		.....	(C)0.5	
Fume (as V(2)O(5))		.....	(C)0.1	
Vegetable oil mist				
Total dust		.....	15	
Respirable fraction		.....	5	

TABLE Z-1. - LIMITS FOR AIR CONTAMINANTS

Substance	CAS No. (c)	ppm (a)(1)	mg/m(3) (b)(1)	Skin designation
Vinyl benzene; see Styrene.....				
Vinyl chloride; see 1910.1017.....	75-01-4			
Vinyl cyanide; see Acrylonitrile				
Vinyl toluene.....	25013-15-4	100	480	
Warfarin.....	81-81-2	.....	0.1	
Xylenes (o-, m-, p-isomers)..	1330-20-7	100	435	
Xylidine.....	1300-73-8	5	25	X
Yttrium.....	7440-65-5	.....	1	
Zinc chloride fume.....	7646-85-7	.....	1	
Zinc oxide fume.....	1314-13-2	.....	5	
Zinc oxide.....	1314-13-2			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Zinc stearate.....	557-05-1			
Total dust.....		.....	15	
Respirable fraction..		.....	5	
Zirconium compounds (as Zr).....	7440-67-7	.....	5	

Footnote (1) The PELs are 8-hour TWAs unless otherwise noted; a (C) designation denotes a ceiling limit. They are to be determined from breathing-zone air samples.

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

Footnote (b) Milligrams of substance per cubic meter of air. When entry is in this column only, the value is exact; when listed with a ppm entry, it is approximate.

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

Footnote (d) The final benzene standard in 1910.1028 applies to all occupational exposures to benzene except in some circumstances the distribution and sale of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures; for the excepted subsegments, the benzene limits in Table Z-2 apply. See 1910.1028 for specific circumstances.

Footnote (e) This 8-hour TWA applies to respirable dust as measured by a vertical elutriator cotton dust sampler or equivalent instrument. The time-weighted average applies to the cotton waste processing operations of waste recycling (sorting, blending, cleaning and willowing) and garnetting. See also 1910.1043 for cotton dust limits applicable to other sectors.

Footnote (f) All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the Particulates Not Otherwise Regulated (PNOR) limit which is the same as the inert or nuisance dust limit of Table Z-3.

Footnote (2) See Table Z-2.

Footnote (3) See Table Z-3

Footnote (4) Varies with compound.

[54 FR 36767, Sept. 5, 1989; 54 FR 41244, Oct. 6, 1989; 55 FR 3724, Feb. 5, 1990; 55 FR 12819, Apr 6, 1990; 55 FR 19259, May 9, 1990; 55 FR 46950, Nov. 8, 1990; 57 FR 29204, July 1, 1992; 57 FR 42388, Sept. 14, 1992; 58 FR 35340, June 30, 1993; 61 FR 56746, Nov. 4, 1996; 62 FR 42018, August 4, 1997]

TABLE Z-2 - 1910.1000 TABLE Z-2

TABLE Z-2

Substance	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	
			Concentration	Maximum duration
Benzene(a) (Z37.40-1969)	10 ppm	25 ppm	50 ppm	10 minutes.
Beryllium and beryllium compounds (Z37.29-1970)	2 ug/m(3)	5 ug/m(3)	25 ug/m(3)	30 minutes.
Cadmium fume(b) (Z37.5-1970)	0.1 mg/m(3)	0.3 mg/m(3)	.....	
Cadmium dust(b) (Z37.5-1970)	0.2 mg/m(3)	0.6 mg/m(3)		
Carbon disulfide (Z37.3-1968)	20 ppm	30 ppm	100 ppm	30 minutes.
Carbon tetrachloride (Z37.17-1967)	10 ppm	25 ppm	200 ppm	5 min. in any 4 hrs.
Chromic acid and chromates (Z37-7-1971)	.....	1 mg/10 m(3)		
Ethylene dibromide (Z37.31-1970)	20 ppm	30 ppm	50 ppm	5 minutes.
Ethylene dichloride (Z37.21-1969)	50 ppm	100 ppm	200 ppm	5 min. in any 3 hrs.

TABLE Z-2

Substance	8-hour time weighted average	Acceptable ceiling concentration	Acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift	
			Concentration	Maximum duration
Fluoride as dust (Z37.28-1969)	2.5 mg/m(3)	.....	.....	
Formaldehyde: see 1910.1048	.....	.....	.....	
Hydrogen fluoride (Z37.28-1969)	3 ppm	.....	.....	
Hydrogen sulfide (Z37.2-1966)	.....	20 ppm	50 ppm	10 mins. once only if no other meas. exp. occurs.
Mercury (Z37.8-1971)	.....	1 mg/10m(3)	.....	
Methylene chloride (Z37.18-1969)	.....	.....	.....	
Methylene Chloride: see 1910.1052				
Organo (alkyl) mercury (Z37.30-1969)	0.01mg/m(3)	0.04 mg/m(3)	.....	
Styrene (Z37.15-1969)	100 ppm	200 ppm	600 ppm	5 mins. in any 3 hrs.
Tetrachloroethylene (Z37.22-1967)	100 ppm	200 ppm	300 ppm	5 mins. in any 3 hrs.
Toluene (Z37.12-1967)	200 ppm	300 ppm	500 ppm	10 minutes
Trichloroethylene (Z37.19-1967)	100 ppm	200 ppm	300 ppm	5 mins. in any 2 hrs.

Footnote(a) This standard applies to the industry segments exempt from the 1 ppm 8-hour TWA and 5 ppm STEL of the benzene standard at 1910.1028.

Footnote(b) This standard applies to any operations or sectors for which the Cadmium standard, 1910.1027, is stayed or otherwise not in effect.

[62 FR 42018, August 4, 1997]

TABLE Z-3 Mineral Dusts - 1910.1000 TABLE Z-3

TABLE Z–3 MINERAL DUSTS

Substance	mppcf [a]	mg/m³
Silica:		
Crystalline		
Quartz (Respirable)	250 [b] / %SiO_2+5	10 mg/m³ [c] / % SiO_2 + 2
Quartz (Total Dust)		30 mg/m³ / % SiO_2 + 2
Cristobalite: Use ½ the value calculated from the count or mass formulae for quartz		
Tridymite: Use ½ the value calculated from the formulae for quartz		
Amorphous, including natural diatomaceous earth	20	80 mg/m³ / %SiO_2
Silicates (less than 1% crystalline silica):		
Mica	20	
Soapstone	20	
Talc (not containing asbestos)	20 [c]	
Talc (containing asbestos) Use asbestos limit.		
Tremolite, asbestiform (see 29 CFR 1910.1001).		
Portland cement	50	
Graphite (Natural)	15	
Coal Dust:		
Respirable fraction less than 5% SiO_2		2.4 mg/m³ [e]
Respirable fraction greater than 5% SiO_2		10 mg/m³ [e] / %SiO_2+2
Inert or Nuisance Dust: [d]		
Respirable fraction	15	5 mg/m³
Total dust	50	15 mg/m³

Note—Conversion factors - mppcf X 35.3 = million particles per cubic meter = particles per c.c.

[a] Millions of particles per cubic foot of air, based on impinger samples counted by light-field techniques.

[b] The percentage of crystalline silica in the formula is the amount determined from airborne samples, except in those instances in which other methods have been shown to be applicable.

[c] Containing less than 1% quartz; if 1% quartz or more, use quartz limit.

[d] All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by this limit, which is the same as the Particulates Not Otherwise Regulated (PNOR) limit in Table Z–1.

[e] Both concentration and percent quartz for the application of this limit are to be determined from the fraction passing a size-selector with the following characteristics:

Aerodynamic diameter (unit density sphere)	Percent passing selector
2	90
2.5	75
3.5	50
5.0	25
10	0

The measurements under this note refer to the use of an AEC (now NRC) instrument. The respirable fraction of coal dust is determined with an MRE; the figure corresponding to that of 2.4 mg/m³ in the table for coal dust is 4.5 mg/m³.

[54 FR 2920, Jan. 19. 1989, 54 FR 28059, July 5, 1989, as amended at 54 FR 36767, Sept. 5, 1989; 54 FR 47513, Nov. 15, 1989; 54 FR 50372, Dec. 6, 1989; 55 FR 19259, May 9, 1990; 55 FR 46950, Nov. 8, 1990; 57 FR 29205, July 1, 1992; 58 FR 35340, June 30, 1993; 58 FR 40191, July 27, 1993; 62 FR 1493, Jan. 10, 1997; 62 FR 42018, August 4, 1997]

APPENDIX 9

POLYCHLORINATED BIPHENYLS (PCB) WASTE MANAGEMENT PLAN

POLYCHLORINATED BIPHENYLS (PCB) WASTE MANAGEMENT PLAN

Section I. Program Overview and General Information

A. Purpose/Background

The use, storage, and disposal of PCB's are regulated by the Environmental Protection Agency (EPA) under the Toxic Control Substance Act (TSCA) and 40 CFR, Part 761.

Polychlorinated Biphenyls were widely used as a fire retardant and insulator in the manufacture of transformers and capacitors. This was due to their ability to withstand exceptionally high temperatures. Because of their classification as a human carcinogen, the EPA banned their use in 1979. The exception would be their regulated use in R&D research. Transformers and capacitors, which were manufactured prior to 1979 found at Rutgers University, contain oil, which may contain certain levels (ppm) of PCB's. Therefore, all oil -filled equipment must be disposed of through REHS. Because of their highly regulated use and disposal, all oils from transformers /power supplies need to be sampled by REHS prior to disposal of the oil and the carcass. Oil filled transformers and capacitors can be found as separate units or in laboratory equipment at the university such as

- X-ray Generating Devices
- Medical X-ray Units

In addition, contaminated oil with PCB's may be found in:

- Old high voltage power supplies (transformers)
- Vacuum pumps.

PCB's can also be found in fluorescent light ballasts. These are managed and sent off site for recycling through the Facilities/Maintenance departments with universal waste at each of the campus locations.

B. Definitions

CFR - Code of Federal Regulations

PCB- Polychlorinated Biphenyls

TSCA -Toxic Substance Control Act

Non-PCB Transformer - any transformer that contains oil/dielectric fluid less than 50 ppm PCB

PCB Contaminated Electrical Equipment - any electrical equipment, including but not limited to, transformers that contains PCB's at concentrations greater than or equal to 50 ppm and < 500 ppm in the contaminating fluid (oil).

PCB Transformer- any transformer that contains greater than or equal to 500 ppm PCB.

Capacitor - a device for accumulating and holding a charge of electricity and consisting of conducting surfaces separated by a dielectric (oil).

PPM - Parts per Million (mg/l)

C. Generator/User Responsibilities

It is the responsibility of the generator or user of oil filled equipment to contact REHS @ 732-445-2550 prior to disposal of the equipment. Types of common equipment that could contain oil can be referenced in Section A. An REHS representative will then evaluate the equipment and make a determination if any

sampling prior to disposal is necessary. (Details on these requirements can be founds in the Facilities/Maintenance PCB Management Procedure section of this document)

D. Laboratory Researcher Responsibilities

The researcher is responsible for notifying REHS prior to the use of PCB's in their lab. (Details on these requirements can be founds in the Laboratory PCB Management Procedure section of this document)

E. REHS Responsibilities

REHS has the responsibility to determine if sampling of equipment is necessary prior to disposal. If so, REHS will provide the sampling and submittal of the sample to a certified lab for analysis. Once the sample results are received, REHS will setup the proper disposal of the equipment. In addition, REHS is responsible for maintaining all appropriate documentation. This includes manifests, certificates of disposal, PCB annual document logs, transformer inventory, and all sample analysis results. REHS is responsible to conduct periodic assessments of PCB practices at the University. This includes yearly inspections of laboratories that use PCBs.

SECTION II. Procedure for Sampling of Oil filled Electrical Equipment for PCB's

A. Supplies Needed

- Plastic pipettes
- Safety Glasses
- Tyvek
- Plastic ziplock bags
- 40 ml vial
- Nitrile gloves
- Oil pads
- Tools (screwdriver/adjustable wrenches/channel locks); varies job to job

Before sampling any piece of equipment, make sure that the equipment, which you are sampling, is electrically disconnected. **NEVER SAMPLE EQUIPMENT THAT IS LIVE!!!**

B. Sample Collection

1. Before sample is taken, you need to document the type/ location of equipment along with its corresponding manufacturer and serial number. In cases when no serial number is present, sampler should create one and mark it on the unit. Currently, all this info is documented on an index card, which contains the following information:

- Location of equipment
- Manufacturer and serial number
- Date sampled
- Time
- Sample taken by
- Type of analysis (PCB)
- Results (analysis results)
- Disposal Site Info

This information is maintained in an index card file located at REHS.

2. Most oil filled equipment has either a drain plug on the bottom of the unit or a plug on the top of the unit where you can access the oil from and collect your sample. Note- the use of tools will be necessary to access the oil.

3. Nitrile gloves should be worn while taking the representative sample of the oil. Double gloves are recommended. Most samples will be grab samples from a specific unit. In addition, make sure gloves are changed out between different samples. This eliminates the chance of cross-contamination.

4. Samples are taken by using a plastic pipette to extract the oil from the unit and place it in the 40 ml vial.

5. Once the sample is taken, clean up any excess oil with a piece of oil absorbent pad. Gloves, used pipette, and oil absorbent pad(s) should be placed in a ziplock bag. The bag should be marked as to the sample number it is from to allow for proper disposal once the sample results are indicated from the lab.

4. The 40 ml vial should be marked with the identical information that is on the index card. Use a label to place onto the vial.

5. To submit the sample(s) to the lab, you must complete a Chain of Custody which accompanies the sample(s) to the lab.

6. Once the Chain of Custody is complete, you can call the lab to schedule a pickup.

7. When you receive the sample results back, proper disposal can be arranged with the contractor. (see the section of this procedure on disposal)

SECTION III. Storage and Inspection

A. Storage

The storage of Polychlorinated Biphenyls are regulated under 40 CFR 761.65. requirements for storage of PCB's greater than 50 ppm are as follows:

- All PCB wastes, which are greater than 50 ppm are stored prior to disposal at the Environmental Services Building in cell #7 in secondary containment bins/spill pallets**. Note- this only refers to laboratory and 55-gallon drum waste (used oil drums).** Storage requirements for large PCB equipment (transformers) will be discussed later in Section V.

- Storage limitations are as follows- Any PCB waste (>50ppm) in storage must be identified by a unique number and an Out of Service Date. The Out of Service date refers to the date at which it was determined to dispose of the waste**. It must be clearly written on the item**. All PCB waste must be disposed of (ultimate disposal) within 1-year from the Out of Service date. The 1-year timeframe consists of a maximum storage of 9 months at the ESB and allows 3 months for the disposal (destruction) after the PCB waste is shipped. If this cannot be achieved, a letter must be sent to the EPA Regional Administrator stating the reasons that the 1 year disposal timeframe could not be achieved.

B. Inspections

Inspections for all PCB items in storage at the ESB are required to be completed at least once every thirty days according to the regulations (40 CFR 761.65(c)(5). These inspections are currently incorporated into our TSDF (ESB) weekly inspections, which are more frequent than the federal requirement.

SECTION IV. DISPOSAL AND DOCUMENTATION

A. Manifest Requirements

Disposal of all PCB waste(s) requires the use of a uniform manifest. Key requirements for manifests are:

- All weights of PCB wastes listed on the manifest must be in kilograms (kg).
- Out of Service Dates must be listed on the manifest. In the case of a PCB labpack, the PCB item with the oldest Out of Service Date in the labpack should be listed. In addition, you can list the individual Out of Service Dates on the packing lists.
- Copy 3 and 8 should be kept in the manifest binders. In addition, copies are kept in a binder along with the PCB files. All manifests are to be kept on file indefinitely.

B. Certificates of Disposal

Other important documentation is the Certificate of Disposal (COD), which certifies that the particular PCB waste was ultimately disposed of in accordance with the federal regulations. Key components of a COD are:

- The identity of the disposal facility by name, address, and EPA identification number.
- The identity of the PCB waste including reference to the manifest number for the shipment.
- A statement which certifies the fact that disposal of the identified PCB waste has occurred including the date of disposal and identification of the disposal process used.

In addition, the generator should receive a COD within 30 days of when the material was ultimately disposed of. All COD's are to be kept on file indefinitely.

C. PCB Concentrations and Disposal Methods

The table below lists the most common types of PCB waste found and their respective disposal categories.

Type of PCB Waste	Disposal Vendor	Disposal Method	TSCA Classification
Oil (1-49ppm) <50	University Contract Vendor (RCRA Facility)	Fuel Blending	Non-PCB (Used Oil)
Oil (50ppm-500pm	University Contract Vendor (TSCA facility)	Incineration	PCB contaminated
Oil (>500ppm)	University Contract Vendor (TSCA facility)	Incineration	PCB
Transformer with Oil < 50ppm	Specialized Reclamation Facility	Recycle Oil/Scrap Metal Carcass	Non-PCB
Transformer with Oil (50ppm-500ppm)	University Contract Vendor (TSCA facility)	Incinerate Oil/ Flush Carcass and Scrap	PCB contaminated
Transformer with Oil >500ppm	University Contract Vendor (TSCA facility)	Incinerate Oil/ Flush Carcass and Scrap	PCB

SECTION V. FACILITIES' PCB MANAGEMENT PROCEDURES

A. Background

The Utilities Department at Rutgers is responsible for all electrical distribution at the University. Periodically transformers/switches are removed from service throughout the university due to electrical failure and/or equipment upgrades. Once they are taken out of service, the oil in the unit needs to be sampled for PCBs to allow for the proper disposal of the oil and the carcass. REHS provides this service. The oil will be drained into 55-gallon drums and the Utilites department will be left with the transformer carcass. The carcasses are then disposed of by the Utilities department by sending them to G&S Technologies in Kearny, New Jersey.

Throughout the late 1980's, the Utilities department completed an extensive retrofitting of all the transformers at Rutgers University. This process was accomplished by draining each unit which had contained PCB's of 50 ppm or more until the levels in the transformer oil become low enough to reclassify the transformer as NON-PCB (<50 ppm). Each drain is called a cycle. Depending on the levels initially in the transformer, it could have taken up to 3 & 4 cycles to get the PCB levels down below 50 ppm. It is important to remember that over time, levels of PCB's could elevate back to above 50 ppm, which would reclassify the oil and the carcass as PCB and regulate it under TSCA. This phenomenon is called leach-back. The PCB's tend to cling to the side of the units and then leach back into the oil over time. That is why it is so important to sample all transformer oils prior to disposal.

In addition, the Facilities' department manages the collection and disposal of PCB ballasts. PCB ballasts are collected and stored in 55-gallon drums at specific locations throughout the university. They are classified as universal waste and are sent out to an off-site recycler. **For more information on PCB ballasts you should refer to the Facilities/Maintenance Waste Management Procedures.**

B. Storage

Transformers and switches that are taken out of service by Utilities should be stored temporary in secondary containment until the unit(s) are disposed of. The regulations also specify that they should be covered or stored under a roof to prevent rainwater from contacting any PCB's. This is especially important if the PCB levels found in the oil are 50 ppm or more. The date that the unit was taken out of service should be clearly marked on the unit(s)/drums of oil as well and documented if the levels of the PCB's in the oil are found to be 50 ppm or more.

C. Disposal

Contact REHS for disposal at (732) 445-2550. REHS will sample the oil in the drums/unit to determine its waste classification. Once the sample results are known, REHS will set up the proper disposal of the oil/unit.

The following disposal requirements apply:

- All TSCA regulated oils and transformer/switch carcasses are disposed of through REHS.
- All used oil drums from transformers/switches are picked up and managed by REHS.
- Transformer/Switch carcasses which are not TSCA regulated (< 50 ppm) are disposed of through the Utilities department

SECTION VI. LABORATORY PCB MANAGEMENT PROCEDURE

A. Prior Notification

Any laboratory researcher that plans to use any amounts of PCB's in their lab must contact REHS at 732-445-2550 prior to their use. An REHS representative will then set up an appointment to discuss the precautions and safeguards with the lab PI. (Note: laboratories utilizing PCB standards in the ppb range are not required to comply with this procedure.)

B. Provide Protocols

Each lab that uses PCB's must submit a summary of their research with PCB's to REHS. The summary must include an inventory of the specific PCB items stored in the lab as well as the levels of the PCB's, which are stored in the lab.

C. Laboratory Storage Requirements

Laboratory must meet the following storage requirements:

- All PCB items in the lab are to be stored in secondary containment. This includes PCB items stored in refrigerators.
- If PCB items in storage contain PCB levels of 50 ppm or greater, the storage container/area must be marked with the PCB label. These are available from REHS.
- If any PCB items used in the lab contain PCB levels of 50 ppm or greater, the door(s) to the lab must be marked (posted) with the PCB label. These are available from REHS.

D. Disposal/Request Waste Pickup

All requests for PCB laboratory waste can be completed by using the Hazardous Waste Disposal form which can be accessed from the following link on the REHS web page http://halflife.rutgers.edu/forms/hazwaste.php or by faxing the form to REHS at 732-445-3109.

Policy Updated – 10/13/09

APPENDIX 10

DARKROOM WASTE MANAGEMENT POLICY

Darkroom Waste Management Policy

The photographic developing process involves many types of chemicals. Many of the common processes used generate hazardous waste. For example spent fixer often contains silver, which is regulated under the Resource Conservation and Recovery Act (RCRA). Unused chemicals such as stop bath are acidic, and are also regulated under RCRA. The following policy outlines procedures for managing dark room waste to ensure compliance with federal, state, and local environmental regulations.

1. Unused Photographic Chemicals

a. All unused photo chemicals should be disposed of through REHS. Please review the Waste Management section of this policy and the Hazardous Waste Disposal Policy and Procedure in your chemical hygiene guide or on the REHS website http://rehs.rutgers.edu for more information on managing your chemical waste.

b. If a chemical is still in good condition, and may be used in another department REHS will add it to the chemicals for reuse inventory.

2. Used/Spent Photographic Solutions

a. Spent Developer: Many developers contain hydroquinone and sodium sulfite. These may be drain disposed; however, all photographic waste generated at University locations with a septic system, such as research stations and farms, must be collected in containers and disposed of through REHS.

b. Spent Fixer: Most spent fixing solutions contain silver. If you do not use a silver recovery system, or have a septic system, the spent solution is regulated and must be managed as hazardous waste. If you have a septic system, you must collect the spent fixer, regardless if you use silver recovery equipment or do not use silver recovery equipment. This waste material must be collected in containers and disposed of through REHS.

Please see Silver Recovery Section of this policy.

c. Intensifiers, reducers, and toners: These may contain a variety of toxic compounds such as mercuric iodide, potassium cyanide, cyanide salts, carbon tetrachloride, or heavy metals such as selenium, gold, or lead. These items must be collected in containers and disposed of through REHS.

d. Other Spent Solutions: Most other solutions may be drained disposed; however, the pH must be between 5 and 9 and they must not be regulated. **Please contact REHS for approval before drain disposing chemicals.**

Table 1: Waste Management Options

WASTE TYPE	Darkroom On Public Sewer	Darkroom On Septic
Unused Photographic chemicals	Dispose of through REHS	Dispose of through REHS
Spent Developer	If non-hazardous drain dispose (contact REHS for classification)	Dispose of through REHS
Spent Fixer <u>with out</u> Silver recovery System	Dispose of through REHS	Dispose of through REHS
Spent Fixer <u>with</u> Silver Recovery System	Drain dispose. Ensure system is properly maintained and working	Dispose of through REHS

3. Waste Minimization

a. Purchase nontoxic, non-hazardous alternative photographic chemicals.

b. In order to minimize waste, please reuse or recycle materials whenever possible.

c. Consider employing a silver recovery system.

d. Donate unused and/or unwanted chemicals to the REHS chemicals for reuse inventory.

4. Silver Recovery

a. Silver recovery equipment must be maintained in a frequency, which ensures the proper capture of silver.

b. Documentation of maintenance must be kept on file for three (3) years to confirm the equipment is functioning properly. These records should be kept by personnel responsible for the darkroom equipment or purchase orders such as the P.I., department chair, or department administration. They must also be made available to regulatory agencies and/or REHS upon request during an inspection

c. The vendor responsible for servicing the equipment must use the "Silver Recovery Maintenance Log" in Attachment A.

d. The silver recovered from the unit must be transported by the vendor on a Bill of Lading or other Shipping Paper, and not a Hazardous Waste Manifest. Shipping papers must be kept for three years, and be made available to regulatory agencies and/or REHS upon request during an inspection.

5. Waste Management

a. Waste chemicals must be collected in individual, leak proof, sealed containers. The chemicals must be compatible with container material (*e.g.* acids must not be placed in a metal container). Glass containers may be safely used for virtually anything except hydrofluoric acid, acid fluoride salts, and very strong alkalis.

b. Waste chemicals must not be placed in an unwashed container, which contains any incompatible residual material, from previous chemical storage.

c. Select the smallest container available that will properly hold the material, allowing sufficient headspace above the surface of the liquid to allow room for expansion. This is economical and efficient. Five-gallon carboys, pails, and fifty-five-gallon drums are available from REHS as required. Do not use your own drums or pails without prior approval from REHS; they may not meet US Department of Transportation requirements.

d. Any containers holding a hazardous chemical or waste shall be kept securely closed, so there is no escape of hazardous waste or its vapors during storage, except when it is necessary to add or remove chemicals or waste. Ensure that lids, bungs, or rims are tightly in place.

e. See Section IV of the Hazardous Waste Disposal Policy and Procedure for additional Waste Treatment, Drain Disposal and Waste Minimization information.

6. Waste Container Labeling

a. All containers must be clearly identified and labeled with the chemical name(s) of the substance(s) at the immediate time when the collection starts. Trade names, acronyms, abbreviations, codes, or formulas **are not acceptable.**

b. All hazardous waste, which cannot be recycled because it is either spent, past the manufactures expiration date, or has been mixed or contaminated with another substance **must be labeled with** a Rutgers University black and white HAZARDOUS WASTE

LABEL. This label must be affixed to the container before any waste material is placed into the container. It is also acceptable to write the words "HAZARDOUS WASTE" on the original manufacturer's label. Note the later is only acceptable if the chemical is in its original container. Hazardous waste labels may be obtained by calling REHS. **Waste Labeling (or writing the words "Hazardous Waste" on the manufacturers label) must not be completed on bottles containing pure chemicals, as these materials may be recycled by redistribution.**

c. The concentration of each chemical or mixture component must be identified on the label. The units of concentration must be on the label together with their numerical values. When the solute is either a liquid or gas, the concentrations **may not** be expressed in percentages, but must be stated as either a **weight percent** or a **volume percent.** For containers being filled with varying concentrations of a variety of compatible materials, the chemical concentrations can be added to the label when the container is full.

d. The hazardous waste label must have all of the darkroom contact information completed.

Please note: Non-RCRA regulated waste that is being collected because drain disposal is not permitted or prior to drain disposal does not need a Hazardous Waste Label. Collection containers should be marked with the contents and concentrations (e.g. Spent Developer, 100%).

7. Unidentified Waste:

State and federal transportation regulations for waste haulers prevent REHS from collecting substances that are unidentified (unknown). The responsibility for establishing the identity of an unknown substance rests with the department wishing to dispose of it. Upon request, REHS will furnish the names of state-certified analytical laboratories.

8. Satellite Accumulation Areas:

a. Hazardous waste must be stored in the darkroom Satellite Accumulation Area (SAA), at or near the point of generation and under the control of the operator generating the waste. Typically there is an SAA in each darkroom. REHS will assist with the determination of appropriate locations for satellite accumulation areas.

b. Chemical wastes must be segregated by general waste type (*e.g.* flammables, poisons, acids, and alkalis) and arranged so that incompatible substances cannot mix. Incompatibles are those pairs of substances that, when mixed, either react violently or evolve flammable or poisonous gases or vapors. Below are a few general principles that must be followed for safe hazardous waste storage and chemical storage:

1. Keep acids and bases apart.
2. Keep acids apart from cyanides or sulfides
3. Acids should never be put into steel containers.
4. Water-reactive, strong acids such as organic acid halides, organic acid anhydrides, inorganic acid anhydrides, and strong acidic salts must be kept apart from both alkalis and water.
5. Oxidizing agents must be kept apart from reducing agents and organic compounds.
6. Water-reactive agents must be stored apart from water, aqueous solutions, and acids.
7. Air-reactive materials must be packed in containers that are sealed off from the atmosphere.
8. Explosive and shock-sensitive materials present special risks that require special handling. Consult with REHS before handling or preparing for disposal.

c. Hazardous waste must be stored in secondary containment. Incompatible materials must not be stored in the same secondary containment bin.

d. Containers must be arranged so that identification is readily visible.

e. State and federal regulations allow up to fifty-five gallons of hazardous waste, or one quart of acutely hazardous waste (for more information on acutely hazardous waste see section II of the Hazardous Waste Disposal Policy and Procedure) in a Satellite Accumulation Area (SAA). Once accumulation limits are met containers must be dated with the start date excess accumulation begins. At the time when the limit is reached, excess waste must be removed from the SAA within three days.

Attachment A

Silver Recovery Maintenance Log

Silver Recovery Maintenance Log

Note: This log must be kept on file for three years from the last date of service listed.

Date/Time of Service	Name of Service Company	Name of Service Technician	Type of Service Performed	Quantity of silver bearing material removed for reclaimation	Signature of Service Technician

APPENDIX 11

REPRODUCTIVE AND DEVELOPMENTAL HEALTH POLICY

Reproductive and Developmental Health Policy Statement

Rutgers University is committed to providing a safe work environment for students, faculty, and staff, and acts to minimize and control exposure to chemical, physical, biological, or radiological agents below regulatory and professionally recognized occupational health values.

Exposures during routine teaching or work activities, when performed according to manufacturer instructions and/or established work practices, should be minimal and below recognized occupational exposure limits.

However, there is often insufficient scientific information to determine safe exposure levels for a developing fetus, and there is uncertainty extrapolating the effects observed in animal studies to humans. Despite these limitations, information does exist for some chemical, physical, biological, or radiological agents that could produce adverse reproductive health outcomes.

Any Rutgers University student, faculty, or staff member who is pregnant, or has a reproductive and developmental health concern, or works with known mutagenic, teratogenic, or carcinogenic agents may contact REHS at (732) 445-2550 to request an assessment as described in this policy. Participation is voluntary and intended to provide the student, faculty, or staff member with information about potential reproductive health issues associated with their university environment as well as recommended control measures so they can make an informed decision about their continued work or learning activities with their personal obstetrician.

Objectives

The objectives of this Reproductive and Developmental Health (RDH) policy are to:

- Identify potential reproductive and developmental health issues through workplace and teaching lab assessments.
- Provide hazard and risk communication to students, faculty, and staff regarding chemical, biological, or radiological agents they use and physical activities they perform that may affect reproductive and developmental health.
- Recommend control measures to eliminate or minimize the potential exposure to reproductive and developmental health agents.
- Maximize student, faculty, or staff privacy while communicating recommended control measures to individuals and administrative units responsible for implementing elements of this policy.
- Identify the process used to assess reproductive and developmental health concerns as well as the responsibilities of each participant in this policy.

Process

Under this policy, any student, faculty, or staff member may use the following process to identify and assess potential reproductive and developmental health issues.

1. A student, faculty, or staff member contacts REHS to request and schedule a workplace or teaching lab assessment.
2. If desired, a student may call the Student Health Services, and faculty or staff may contact the Occupational Health Department to use as a resource to facilitate REHS review and transfer of information to their personal obstetrician/gynecologist.
3. REHS will conduct the assessment and provide a written report with recommendations to the student, faculty, or staff member.
4. REHS may share this information with other individuals, such as supervisors or University Physicians, to address concerns and implement recommendations contained within the assessment. If the student, faculty, or staff member requests privacy, REHS will maintain confidentiality with respect to the pregnancy or reproductive and developmental health concern to the extent permitted by applicable law.
5. After completing the assessment, REHS will offer to schedule a follow-up meeting with the student, faculty, or staff member to discuss their assessment, its recommendations, and potential health risks.

6. Students, faculty, or staff members are advised to contact REHS, Health Services, or Occupational Health if they have additional concerns or questions regarding their assessment.

Responsibilities

An effective Reproductive and Developmental Health policy identifies the individuals and units that participate in the assessment, evaluation, and communication processes and highlights their respective responsibilities. Although the decision to request an assessment and participate in this policy is strictly voluntary, if an individual chooses to request an assessment, then the following individuals and administrative units share responsibility for the participation in and implementation of this reproductive and developmental health policy.

1. Students, Faculty, and Staff
    a. Observe all safety requirements for the work activity you are performing. This includes, but is not limited to:
        - Attend required safety training [Right-to-Know, Chemical Hygiene, etc] for the work activities you perform.
        - Review and know the hazards associated with the substances and equipment you use to conduct your work activities, as well as others in your work area(s).
        - Perform your work according to manufacturer instructions, material safety data sheets (MSDS), training, and the Chemical Hygiene Plan [for lab work or instruction].
        - Immediately report all spills, concerns, or exposures to the instructor and/or faculty member (students), your supervisor, and REHS.
    b. Contact REHS promptly to request a workplace assessment to evaluate physical activities and potential chemical, biological, or radiological agents in your work area if you are pregnant, planning a pregnancy, breastfeeding, or if you have other reproductive and developmental health concerns.
    c. As soon as possible, share the results of your REHS assessment with:
        - Your personal obstetrician/gynecologist physician,
        - Your pediatrician - especially if you are breastfeeding.
    d. Students, faculty, and staff are advised to attend a follow-up meeting with REHS to discuss your assessment and its recommendations. If desired, a Rutgers University Health Services or the Occupational Health Department Physician is available to participate in the meeting to facilitate transfer of information to their personal obstetrician/gynecologist.
2. Teaching Assistants and Instructors
    a. Ensure students understand and follow the established practices and procedures [i.e., the laboratory Chemical Hygiene Plan] for the laboratory activity they are performing.
    b. Implement the REHS recommendations contained in the assessment report. If these recommendations cannot be implemented, notify REHS immediately.
    c. Report all spills and incidents to REHS immediately.
    d. If a student reports a pregnancy and/or has reproductive and developmental health concern, then inform them of this policy and refer the student to REHS.
3. Principal Investigators and Supervisors
    a. Ensure employees know and follow the manufacturer instructions, material safety data sheets (MSDS), training, and the Chemical Hygiene Plan [for lab work or instruction] required for their work activities.
    b. Ensure employees attend the required safety training for their work activities.
    c. Provide time during normal work hours for employees to receive consultations with the Occupational Health Department and/or REHS staff.
    d. Implement the REHS recommendations contained in the assessment report. If these recommendations cannot be implemented, notify REHS immediately.
    e. If an employee reports a pregnancy and/or has reproductive and developmental health concern, then inform them of this policy and refer the employee to REHS.
    f. Report all spills and incidents to REHS immediately.

4. REHS
   a. Upon request by a student, faculty, or staff member, conduct an assessment to identify potential chemical, physical, biological, or radiological hazards that may affect their reproductive and developmental health.
   b. Report the assessment results and exposure control recommendations to the student, faculty, or staff member, and offer follow-up as necessary and/or requested.
   c. Communicate the potential risks associated with the chemical, physical, biological, or radiological hazards identified in the assessment.
   d. Include the Reproductive and Developmental Health policy in new employee orientation and annual safety training programs, as appropriate.
   e. Advise the student, faculty, and staff member to share all information provided with their obstetrician/gynecologist and with their pediatrician - particularly if they are breastfeeding.
   f. Advise the student, faculty, or staff member to inform their professor, principal investigator, or supervisor as soon as possible of their pregnancy to implement REHS recommendations from the workplace assessment. However, upon request, REHS will not disclose a pregnancy or reproductive and developmental health concern.

5. Rutgers University Health Services
   a. Refer reproductive and developmental health inquiries and requests related to the university environment (i.e., lab work, campus housing) but not lifestyles to REHS for assessment.
   b. Upon request, facilitate REHS review of assessment results and information transfer to their personal obstetrician/gynecologist.

6. Occupational Health Department
   a. Refer reproductive and developmental health inquiries and requests to REHS for workplace assessments.
   b. Upon request, facilitate REHS review of assessment results and information transfer to their personal obstetrician/gynecologist.
   c. As necessary, provide appropriate medical surveillance to student employee, faculty, or staff members.

7. Reproductive Health Team
   a. In some instances, Rutgers may consult a Reproductive Team to address complex issues, which may include internal and/or external resources.

Written: 12/7/04

Approved: 1/19/05

APPENDIX 12

ELECTROPHORESIS WASTE DISPOSAL GUIDANCE

(For stock solutions, gels, non-sharp waste, and buffer solutions containing fluorescent dyes of Ethidium Bromide, Propidium Iodide, Acridine Orange, and SYBR Green)

ELECTROPHORESIS WASTE DISPOSAL GUIDANCE

(For stock solutions, gels, non-sharp waste, and buffer solutions containing fluorescent dyes of Ethidium Bromide, Propidium Iodide, Acridine Orange, and SYBR Green)

This guidance has been developed to ensure proper disposal of ethidium bromide and other common fluorescent dyes (Gels and Solutions), which are commonly used in electrophoresis for the identification of DNA. Ethidium bromide is the most commonly used dye for this type of DNA work and the most toxic. Other common fluorescent dyes used in electrophoresis are; propidium iodide, acridine orange, SYBR Green, etc. When these materials become waste, they are managed by the same guidelines as ethidium bromide wastes.
Note: Electrophoresis wastes containing acrylamide or polyacrylamide must be managed as hazardous waste, as per the Laboratory Hazardous Waste Disposal Policy and Procedures.

The following three types of wastes are commonly generated from electrophoresis methods at the university: (which contain ethidium bromide and/or other common fluorescent dyes i.e. propidium iodide, acridine orange, SYBR green, etc.)

- Stock Solutions
- Gels and Contaminated Non-Sharp Debris, (i.e. gloves, tips, paper towels, etc.)
- Buffer Solutions (including filtration of these Solutions)

Stock Solutions (>10ug/ml concentration)

1. **Collect** all electrophoresis stock solutions in an appropriately sized container, (REHS can provide 5-gallon carboy waste containers). The container cap should be closed securely when the container is not in use.
2. **Label** all electrophoresis stock solutions with an Electrophoresis Waste Label, which is available from REHS. Indicate on the label that it is a liquid waste, and check off the appropriate constituent box on the label.
3. **Dispose** of all electrophoresis stock solutions through REHS by utilizing the online request form for hazardous waste disposal at http://rehs.rutgers.edu. (If you are using the 5-gallon carboy provided by REHS, we will provide a replacement at the time of the waste pickup.)

Stock Solutions (<10ug/ml concentration)

1. Electrophoresis stock solutions containing <10 ug/ml can be drained disposed. **Note: This does not allow for the drain disposal of solutions at any locations that utilize a septic system such as research farms or marine research stations. All used electrophoresis stock solutions generated at these locations must be collected and disposed of by REHS.**

Electrophoresis Gels and Contaminated Non-Sharp Debris, (i.e. gloves, tips, paper towels, etc. – at any concentration)

1. **Collect** electrophoresis gels and contaminated non-sharp debris in 5-gallon screw-top pails with a clear plastic liner, which are provided by REHS. The container lid should be closed securely when the container is not in use.
2. **Label** electrophoresis gels and contaminated non-sharp debris with an Electrophoresis Waste Label, which is available from REHS. Indicate on the label that it is a solid waste, and check off the appropriate constituent box on the label.
3. **Dispose** of all electrophoresis gels and contaminated non-sharp debris through REHS by utilizing the online request form for hazardous waste disposal at http://rehs.rutgers.edu. An empty

replacement 5-gallon screw-top pail as well as a clear plastic liner will be provided by REHS at the time of the pickup.

Electrophoresis Buffer Solutions and Filtration

Buffer Solutions (>10 ug/ml concentration)

- Buffer solutions containing >10 ug/ml must be collected for disposal through REHS (follow the directions above for disposal of stock solutions), **or**

- Buffer solutions containing >10 ug/ml can be filtered through a filtration system and the effluent can be drain disposed (see details below). If a spent buffer contains any constituents, other than the organic fluorescence dyes, which are not acceptable for drain disposal, then do not treat the waste. Manage the used buffer solution as a hazardous waste in accordance with the University's Chemical Waste Disposal Procedures. **Note: This does not allow for the drain disposal of filtered solutions at any locations that utilize a septic system such as research farms or marine research stations. All used buffer solutions from electrophoresis generated at these locations must be collected and disposed of by REHS.**

Buffer Solutions (<10 ug/ml concentration)

- Buffer solutions containing <10 ug/ml can be drain disposed. **Note: This does not allow for the drain disposal of solutions at any locations that utilize a septic system such as research farms or marine research stations. All used buffer solutions from electrophoresis generated at these locations must be collected and disposed of by REHS.**

Filtration of Buffer Solutions

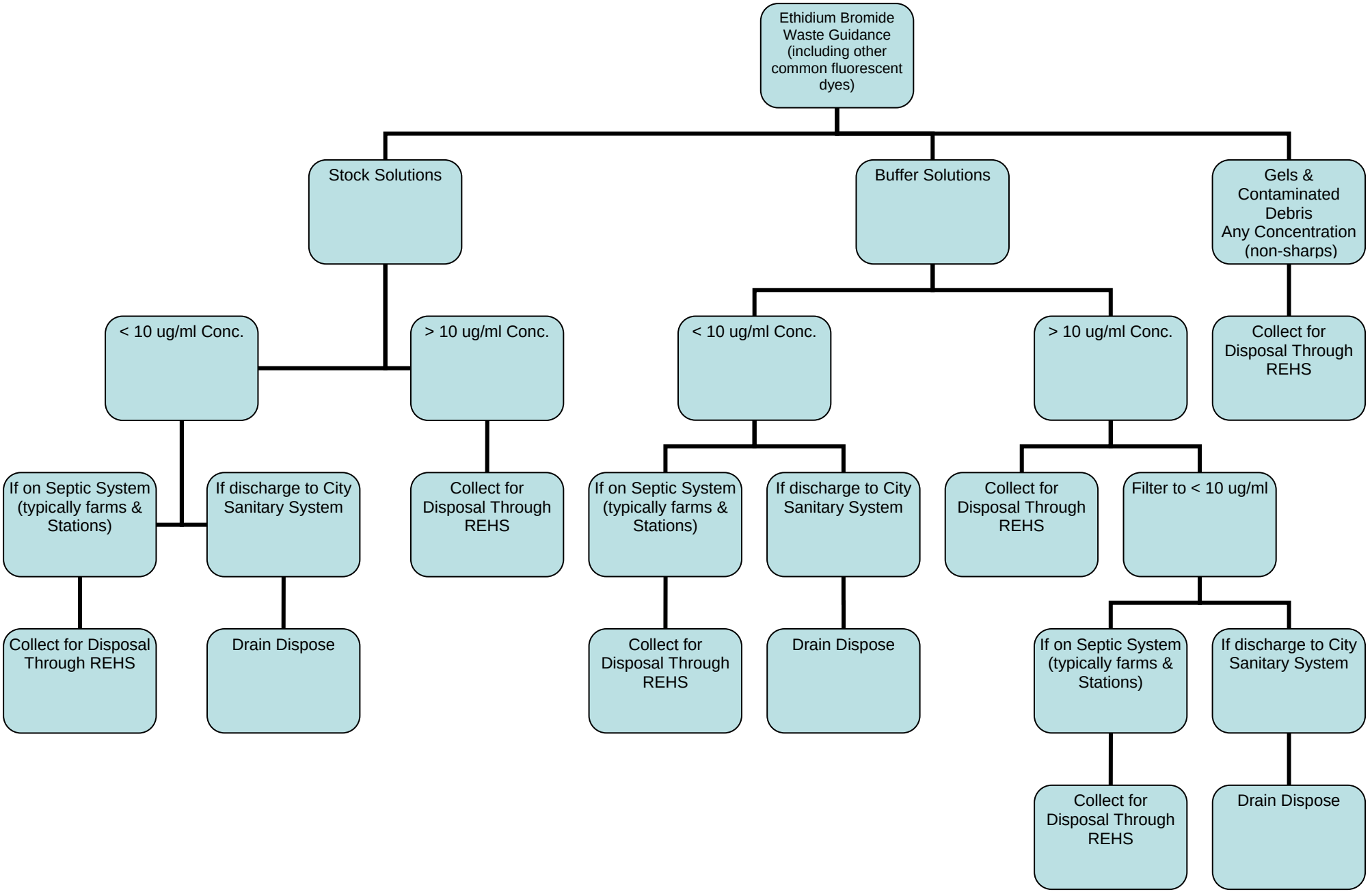
1. **Filter:** If the buffer solution contains only constituents which are acceptable for drain disposal, (other than the organic fluorescence dyes), then filter the solution through a bed or column of activated charcoal or ion exchange resin. Follow the manufacturer's directions for the filter's proper use and ensure the filter is replenished as necessary to ensure effectiveness. The following filter kits are examples of products available:

Company Name	Product Name	Product Code	Phone #	Website
Amresco, Inc.	Destaining Bags	E732	800-829-2805	www.amresco-inc.com
BD Biosciences-Clontech	BondEX Detoxicification Cartridges	K3080-1	877-232-8995	www.clontech.com
Qbiogene	Green Bag Diposal Kit	2350-200	800-854-0530	http://www.qbiogene.com/
VWR International	Extractor Waste Reduction System	28165-500	800-932-5000	http://www.vwrsp.com

2. **Flush:** Discharge the filtered solution to a sink drain with copious amounts of water.

3. **Dispose:** Dispose of the used filter cartridges / resins in the electrophoresis gel 5-gallon screw-top pails.

For additional information or guidance please contact REHS at (732) 445-2550.


Ethidium Bromide Waste Guidance (including other common fluorescent dyes)
Stock Solutions
Buffer Solutions
Gels & Contaminated Debris Any Concentration (non-sharps)
< 10 ug/ml Conc.
> 10 ug/ml Conc.
< 10 ug/ml Conc.
> 10 ug/ml Conc.
Collect for Disposal Through REHS
If on Septic System (typically farms & Stations)
If discharge to City Sanitary System
Collect for Disposal Through REHS
If on Septic System (typically farms & Stations)
If discharge to City Sanitary System
Collect for Disposal Through REHS
Filter to < 10 ug/ml
Collect for Disposal Through REHS
Drain Dispose
Collect for Disposal Through REHS
Drain Dispose
If on Septic System (typically farms & Stations)
If discharge to City Sanitary System
Collect for Disposal Through REHS
Drain Dispose

APPENDIX 13

MINORS AND VOLUNTEERS IN LABORATORIES

Policy for Minors and Volunteers in Laboratories

Overview

Over the past several years, the university has initiated a number of scholarly programs that invite high school students to work in laboratories to stimulate their interest in science. However, there currently is no University Policy to address minors and volunteers that work in laboratories, the application and approval process, the work activity review, as well as the information collected from these individuals, which vary by department and principal investigator. The objective of this policy is to provide uniform guidance to support the university's commitment to scholarly programs in research laboratories while also protecting the participants and the principal investigators that sponsor these programs.

Definitions

Minor – any individual under 18 years of age. This applies whether or not the individuals are paid for their work.

Volunteer – any individual that does not receive payment for work activities performed in a laboratory.

Process

Under this policy, faculty and their designated staff members shall follow this process for minors and volunteers that work in their labs.

1. The principal investigator must notify the department chair of the program utilizing minors or volunteers that will be working in their lab.
2. Prospective minors and volunteers must complete an application that provides appropriate individual information (address, phone, etc), emergency contact information, as well as any medical concerns.
3. All applicants must complete the Risk Management waiver forms and provide proof of medical coverage.
4. Departments must ensure compliance with applicable labor laws for all minors.
5. The minor or volunteer must attend training appropriate for the work activities they perform or that may be performed by others in their assigned laboratory.
6. Personal protective equipment shall be provided by the department and worn by the minor or volunteer as directed by the laboratory principal investigator and requirements specified in the chemical hygiene plan for the work activities performed by that individual.
7. Minors shall not be permitted to work unsupervised in the lab.
8. Minors shall be prohibited from the following work activities:
    a. Handle or manipulate organisms at Biological Safety Level 2 or higher
    b. Operate or work in laboratories with hazard class 3b or 4 open beam lasers
    c. Handle or manipulate Select Agents
    d. Handle or manipulate radioactive materials or ionizing radiation sources
    e. Handle or manipulate Particularly Hazardous Substance (PHS) without prior approval from the department chair and REHS.
    f. Perform research activities with laboratory animals

Responsibilities

An effective policy identifies the individuals and units that participate in the process and highlights their respective responsibilities. The following individuals and administrative units share responsibility for the participation in and implementation of this policy for minors and volunteers that work in laboratories.

1. Minors and Volunteers

   Observe all safety requirements for the work activity you are performing. This includes, but is not limited to:

   - Attending required safety training [Right-to-Know, Chemical Hygiene, etc] for the work activities you perform, as well as others in your work area(s).
   - Review and know the hazards associated with the substances and equipment you use to conduct your work activities, as well as others in your work area(s).
   - Perform your work according to manufacturer instructions, material safety data sheets (MSDS), training, and the Chemical Hygiene Plan.
   - Wear personal protective equipment as provided by the department.
   - Immediately report all spills, concerns, or exposures to your supervisor, the principal investigator, and REHS.

2. Principal Investigators and Supervisors

   - Ensure employees know and follow the manufacturer instructions, material safety data sheets (MSDS), training, and the Chemical Hygiene Plan requirements for their work activities.
   - Ensure employees attend the required safety training and wear appropriate personal protective equipment for their work activities.

3. REHS

   - Provide training appropriate for the work activities performed in the lab.
   - Upon request, assess the control measures and personal protective equipment used for the work activities performed

Written: August 13, 2009

Revised:

APPENDIX 14

POLICY FOR THE USE OF MICROWAVE OVENS IN LABORATORIES

SAFE USE AND SELECTION OF MICROWAVE OVENS IN LABORATORIES

The following information is for laboratories that use microwave ovens. These requirements must be followed to comply with applicable New Jersey Uniform Fire Code (NJUFC) and Public Employees' Occupational Safety and Health (PEOSH) regulations and to ensure the safe usage of the equipment.

- All microwave ovens must be approved for laboratory use and for the material placed in the microwave.
- Approval can be obtained by the manufactuer of the microwave oven or by REHS after a hazard assessment has been conducted.
- Microwave ovens specifically designed as "Laboratory Grade" or manufactured for laboratory research activities to control or minimize potential hazards are considered to be approved laboratory equipment and will not require additional hazard assessments as long as they are utilized according to the manufacturers' recommendations and established standard operating procedures.
- Under NO CIRCUMSTANCES are residential, household type microwave ovens permitted to be used in laboratories.
- Users of such equipment must be thoroughly familiar of operation procedures, safety devices and protocols before beginning experiments, especially when there is a possibility of fire (flammable solvents), over-pressurization, arcing or when hazardous vapors are produced.

PRE-APPROVED LABORATORY PROCEDURES

REHS conducted hazard assessments for the following materials commonly used in laboratory microwave ovens. These materials are permitted to be used as long as they are used in a microwave oven listed for commercial use and are in accordance with written experimental procedures (quantity, heat setting, time, etc.)

Material	Process
Agar	Melting/Heating
Agarose	Melting/Heating
Buffer Solution	Heating
Water	Melting/Heating
Slide	Drying
Sample preparation (nontoxic)	Drying
Staining (nontoxic)	Heating/Drying

1) **SPECIALIZED MICROWAVE USAGE – AGAR/AGAROSE -** The use of a microwave to melt agar/agarose can be particularly dangerous. The following precautions must be followed when performing this task to minimize the risk:

   a) Set the power level to the lowest level and heat for the minimum amount of time required to melt the agar/agarose. This should be pre-determined for the volumes normally used in the lab and displayed in a prominent position next to the microwave.
   b) Large amounts (e.g. 250 ml) of solidified agar should not be warmed in a microwave oven unless the agar is first chopped up with a sterile spatula or other suitable instrument. Failure to chop up the agar may result in an explosive vaporization.
   c) The lid on the bottles must be completely removed before heating. Use loose fitting sterile foam plugs or loose 'Kimwipe' plugs, rather than just relying on a loosely placed cap.
   d) Ensure adequate amount of headspace is available in the container above the substance being heated. Do not overfill containers (no more than two thirds full).
   e) Thermal gloves and a face shield must be worn when removing a bottle from the microwave or wait until the agar is sufficiently cooled before removing and handling (as a guide wait a minimum of five minutes).
   f) Care should be taken when placing the bottle on the bench so as not to cause unnecessary disturbance of the agar, which may cause the agar to boil over.

ADDITIONAL HAZARD ASSESSMENTS

The use of microwave heating as a reaction accelerator or with hazardous (flammable, corrosive, toxic, etc.) materials must be treated with extreme caution. While techniques exist, they usually involve the use of dedicated laboratory-grade specialized microwave oven rather than just commercially listed unit.

Prior to the use of a microwave oven for these procedures or for any other procedure not pre-approved as identified above, the researcher(s) must request a hazard assessment be performed by REHS.

HAZARD AWARENESS AND CONTROL MEASURES

- The uses of microwave ovens for heating, melting or drying in laboratories create various hazards, including: Significant and rapid temperature/pressure rise
- Ignition of flammable vapors
- Exposure to microwave radiation from a faulty or modified unit
- Electric shock from ungrounded, improperly wired or faulty units
- Ignition of materials being heated
- Integrity of containers holding materials
- Pressure build-up in sealed containers
- Sudden boiling of liquid in an open container following removal from an oven
- Contamination of food products with chemical residues

To assist the research community, REHS assessed the utilization of typical microwave oven processes to establish procedures for the safe operation of commercially listed microwaves at university laboratories consistent with the microwave's intended use.

The use of flammable materials, corrosive materials, hazardous substances, and radioactive materials is STRICTLY PROHIBTED.

The following hazard control measures must be implemented:

- Ensure that the oven cavity is adequately ventilated. The unit should be located on a clear open bench and not in a location where the vents could be obstructed by books or equipment.
- Conduct regular inspections to ensure that the sealing surfaces are clean and do not show any sign of damage. The presence of arcing or burn marks may be indicative of microwave leakage.
- Ensure that microwave ovens are electrically grounded and connected using a properly rated three-pin cord and plug directly into an outlet without overloading the circuit. The use of an extension cord or outlet strip are prohibited.
- Report defects in equipment or difficulties in operation with a microwave oven promptly to the laboratory manager or supervisor.
- Where possible, use microwave grade plastic vessels with a pressure relief valve. Where glass vessels are used check these for cracks and flaws before using in the microwave.
- Use appropriate protective equipment when removing heated liquids from the oven.
- DO NOT perform the following:
    - Defeat the interlock switch that prevents a microwave oven from operating with the door open.
    - Place any wires, cables, tubing, etc. between the door and the seal.
    - Modify in any way the mechanical or electrical systems of a microwave oven.
    - Perform unauthorized repairs on a microwave oven. When a unit is suspected to be faulty it should be disconnected from the power supply, removed from service and labeled with an appropriate tag while awaiting repair, surplus or disposal.
    - Use a microwave oven in a laboratory for food preparation.
    - Heat closed or sealed containers in a microwave oven. Even a loosened cap or lid poses a significant risk.
    - Use bottles with a restricted neck opening [e.g. medical flat bottles]
    - Place metal objects of any kind in a microwave oven. This includes aluminum foil and plastic coated magnetic stirrer bars.
    - Overheat liquids. It is possible to raise water to a temperature greater than the normal boiling point; when this occurs, any disturbance to the liquid can trigger violent boiling that could result in severe burns.
    - Use chemicals that can potentially produce harmful byproducts or odors.