UPMC
Presbyterian/Shadyside

CHEMICAL HYGIENE PLAN

UPMC Presbyterian/Shadyside
Environmental Health & Safety Office
200 Lothrop Street
Pittsburgh, PA 15213
(412) 647-6409

Date of Review: February 2009

PUH ADMINISTRATION-AP

CHP # 1

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SECTION I. INTRODUCTION

This Chemical Hygiene Plan applies to staff in any University of Pittsburgh Medical Center – Presbyterian/Shadyside Hospital (UPMC) department which meets the following Occupational Safety and Health Administration (OSHA) definitions of laboratory or laboratory use of hazardous chemicals. This Chemical Hygiene Plan is a part of the UPMC Laboratory Safety Program. Each hospital department that has a laboratory must appoint a departmental Chemical Hygiene Officer. It is the responsibility of the departmental CHO to implement the laboratory safety program within their department.

The UPMC Presbyterian/Shadyside laboratory safety program is overseen by the UPMC Environmental Health & Safety (EH&S) Office. The UPMC Presbyterian/Shadyside Chemical Hygiene Officer is David Toma, Safety Director, UPMC Presbyterian/Shadyside.

A. Definitions

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

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which the following conditions are met:

- Chemical manipulations are carried out on a small, or, "laboratory scale";
- Multiple procedures are performed in which hazardous chemicals are used;
- The procedures involved are not part of a production process, nor in any way simulate a production process; and
- Standard operating procedures (SOP's) are in use and protective equipment/clothing is available to minimize the potential for employee chemical exposure.

"Hazardous Chemicals" the OSHA definition for a "hazardous chemical" is a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur to exposed employees.

The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins,

nephrotoxins, neurotoxins, agents which act on the hematopoetic systems, and agents which damage the lungs, skin, eyes or mucous membranes.

The **"UPMC Definition"** for hazardous chemicals is defined as a chemical, which is a health hazard as described above or physical hazard. The term physical hazard includes chemicals, which have been identified as combustible liquids, compressed gases, explosives, flammables, organic peroxides, oxidizers, pyrophorics, unstable (reactives) and water reactive compounds.

B. Department Telephone Listings

DEPARTMENT	TELEPHONE NUMBER
Environmental Health and Safety Office (Oakland)	(412) 647-6409
24-hour long-range pager (after-hours)	(412) 392-7491
Environmental Health and Safety (Shadyside)	(412) 623-2407
Safety & Security Office (Western Psychiatric)	(412) 246-5075
Housekeeping / Engineering & Maintenance	
In Oakland and Shadyside Hospitals	(412) 647-3370
Engineering & Maintenance Command Center	(412) 647-3331
UPMC Employee Health	(412) 647-3695
Pittsburgh Poison Center	(412) 681-6669
Security	
• BST	(412) 648-2555
• MUH	(412) 648-2555
• PUH/Scaife	(412) 647-3191
• WPIC	(412) 246-9742
• Shadyside	(412) 623-2990
• Hillman Cancer Center	(412) 623-2990

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SECTION II. THE LABORATORY FACILITY

A. Requirements

The following lists the requirements for the laboratory facility as is appropriate.

- The physical facilities and, especially, the quality of ventilation, must be appropriate to the work being conducted and its scale.
- An appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air.
- Adequate, well-ventilated stockrooms/storerooms, where feasible.
- Laboratory chemical fume hoods and sinks.
- Other safety equipment including readily accessible eyewash fountains and drench showers that meet American National Standards Institute (ANSI) Standards.
- Chemical-hygiene-related equipment (i.e., chemical fume hoods) undergo continuing appraisal and are modified if inadequate.
- Arrangements for waste disposal.

B. Laboratory Ventilation

General Laboratory Ventilation

This general ventilation system provides a source of air for breathing and for input to local ventilation devices.

The general ventilation should remove air at a room air exchange rate of 6 to 12 room air changes per hour. This rate is normally adequate if local exhaust ventilation systems such as chemical fume hoods are used as the primary method of control.

This general ventilation provides minimal protection against exposure to toxic gases, vapors, aerosols and dusts. Work involving contaminants should be carried out in a chemical fume hood.

It is the responsibility of the Department Head/Principal Investigator to contact

UPMC Engineering & Maintenance or UPMC Environmental Health & Safety when laboratory ventilation concerns arise.

2. Chemical Fume Hoods

- Chemical fume hoods are used primarily to protect staff members from exposure to toxic, flammable or offensive chemical contaminants.

- Chemical fume hoods can also be used to create a physical barrier between a laboratory staff member and a chemical reaction.

- A closed sash on the chemical fume hood can provide protection against unexpected splashes, sprays, fires and minor explosions.

- The following are procedures to follow when chemical fume hoods are being operated:

- Chemical fume hoods **are not** to be used to dispose of chemicals. Chemical fume hoods are backup safety devices that will contain vapors, mists, and dusts if equipment should fail.

- Chemical fume hoods should be evaluated annually to ensure they are maintaining an adequate face velocity within the 80 to 120 linear feet per minute (lfpm) range. UPMC Environmental Health & Safety provides the annual evaluation of chemical fume hoods.

  Face Velocity: The rate at which air is drawn into the chemical fume hood from the laboratory area immediately surrounding it.

- Chemical fume hoods should be kept closed when not in use.

- Chemical fume hood performance depends on many different factors including airflow patterns and the location of equipment within the chemical fume hood. By moving vapor-producing portions of experiments away from the front of the chemical fume hood, vapor concentrations may be reduced at the face by nearly 90%.

- Storage of chemicals in chemical fume hoods is prohibited.

- Solid objects and materials (i.e., paper towels) should not be used near the chemical fume hood. Should these materials enter the exhaust system, they may lodge in ducts or fans and damage the system.

- Substances should be poured or otherwise handled at least six inches inside the chemical fume hood. This will significantly reduce exposure when following this technique.

- Never place your head inside a chemical fume hood while hazardous gases or vapors are being released.

3. Other Local Exhaust Ventilation

Other local exhaust ventilation such as snorkels, down-draft tables and ventilated enclosures must be maintained in good working order. Filters, if preset, shall be replaced on a periodic basis based on manufacturer's instructions. For inspection and evaluation of these devices, Environmental Health & Safety may be contacted.

C. Biological Safety Features

1. Biological Safety Cabinets

Biological Safety Cabinets (BSC's) are typically used as a clean area for handling and preparation of biological cultures, pharmaceuticals or work where airborne contamination by dust or microbes is contra-indicated.

Biological safety cabinets shall be used:

When there is a potential for exposure to infectious aerosols (airborne pathogens). The class/design of the cabinet shall meet the recommendations for the type of work being performed as prescribed in the Biosafety in Microbiological and Biomedical Laboratories (BMBL) – 4th Edition, published by the Center for Disease Control (*http://www.cdc.gov*). For clarification on what class and type of BSC is required for specific work practices, contact UPMC Environmental Health & Safety (412) 647-6409.

For pharmaceutical preparation. Biosafety cabinets used in the preparation of drugs that are potential chemical exposure hazards shall meet the design specifications for Class 2 – Type B2 as defined in the Biosafety in Microbiological and Biomedical Laboratories (BMBL) – 4th Edition, published by the Center for Disease Control (*http://www.cdc.gov*).

Biological Safety Cabinets require a certification to ensure their internal filters are working correctly. This certification should be performed upon installation then annually thereafter and in the even the BSC is moved or relocated. Once a BSC has been use with a potential pathogen, it must be disinfected prior to maintenance, relocation or disposal. Disinfection typically involves fumigation with a disinfecting gas or vapor. Certification and disinfection will be performed by an authorized, contracted service.

D. Laboratory Hygiene

Routine Cleaning

Areas where laboratory work is performed shall be kept clean and sanitary. Cleaning will be conducted on a regularly scheduled basis.

Eyewash and handwashing stations must be accessible, sanitary and in good working condition.

All equipment and work surfaces that have contact with chemical contaminants, blood or other potentially infectious substances should be properly decontaminated via an approved, written decontamination method. Cleaning of work surfaces should be performed at the completion of a procedure, after each shift, and immediately in the event of an accidental spill.

Any receptacle intended for reuse that has been contaminated with chemicals, blood or other potentially infectious material shall be inspected regularly and decontaminated via an approved, written decontamination method.

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SECTION III. CHEMICAL PROCUREMENT, DISTRIBUTION AND STORAGE

A. Procurement

1. Ordering Chemicals

Chemicals should be ordered in the smallest feasible package. Small containers have the following advantages:

- Disposal costs per package are less with smaller units.
- Packages are emptied faster; less chance for decomposition of reactive compounds when small containers are used.
- Risk of accident and exposure to the hazardous material is reduced when handling smaller container.
- Increases available storage space.
- Large containers often dictate a need for other equipment, i.e., smaller transfer containers, funnels, pumps and labels. Added labor to subdivide the larger quantities as well as additional personal protective equipment (PPE) also may be needed.

2. Receiving Chemicals

The UPMC Purchasing Department attempts to verify that all hazardous chemicals delivered to UPMC are properly labeled and that manufacturer's labels on incoming containers are not removed or defaced. Staff members should not accept containers if they are unlabeled, are leaking and/or have been damaged.

3. Material Safety Data Sheets (MSDS)

MSDS received with incoming shipments are to be forwarded to the department ordering the hazardous substance by the UPMC Purchasing Department and to the Environmental Health and Safety (EH&S) Office, which keeps master files of MSDS. To obtain an MSDS, staff may contact the EH&S Office or, if they have internet access, they may print them directly off the internet by utilizing links available on the EH&S website at: http://presbyterian.infonet.upmc.com/ehs.

4. Laboratory Produced Chemicals for Inside Laboratory Use

Any chemical substance produced in the laboratory for exclusive use in the laboratory should be evaluated to determine if it is hazardous. If this determination cannot be made, or if the chemical is determined to be a hazardous chemical, then all requirements of OSHA's Hazard Communication Standard found in 29 Code of Federal Regulations (CFR) 1910.1200 including labeling and MSDS preparation must be met.

5. Laboratory Produced Chemicals for Outside Laboratory Use

If the chemical substance is to be used outside of the producing laboratory, all requirements of OSHA's Hazard Communication Standard found in 29 CFR 1910.1200 including labeling and MSDS preparation must be met. Additional information may be found in the UPMC Written Hazard Communication Program. The EH&S Office should be contacted for further information.

B. Distribution

When chemicals are hand carried, they should be placed in secondary containment adequate to protect against breakage and spillage. Examples would be a safety bottle carrier or bucket.

When transporting chemicals, freight elevators should be used where available.

C. Storage

1. Storerooms

Stored chemicals should be examined periodically, but no less than annually, for expiration, deterioration and container integrity.

Storerooms should not be used as preparation or repackaging areas.

2. Hallways and Stairwells

Storage of hazardous chemicals or biohazardous materials is not permitted in hallways, stairwells or pathways that may be used to exit the building in the event of an emergency. Examples of some items that are not permitted are compressed gas cylinders, flammable liquids, infectious substances, radioactive materials and/or corrosive materials. For more information, refer to Appendices.

Laboratory procedures involving the use of hazardous materials are to be performed only inside the laboratory.

3. Laboratories

- Amounts of chemicals permitted should be as small as practical.
- Storage of chemicals on bench tops is undesirable.
- Storage in chemical fume hoods is prohibited because of interference with airflow.
- Exposure to heat or direct sunlight should be avoided. Incompatible chemicals **must not** be stored together. See Appendix A-L, Safe Storage of Hazardous Chemicals for additional information.
- Periodic inventories should be conducted to find unneeded and outdated chemicals to be discarded. Chemicals not having expirations dates should be labeled to expire within 5 years of receipt. A written chemical inventory should be kept in the MSDS binder and updated as appropriate, but annually at a minimum.
- Food and beverages are to be stored in refrigerators designated for food and beverage storage. These refrigerators must be labeled as "Food and Beverages Only". All hazardous substances are prohibited from being placed in food and beverage designated refrigerators.
- Chemicals in the laboratory are to be inventoried annually at a minimum. The inventory should alphabetically list all the hazardous chemicals by their proper name and the approximate quantity kept in storage. The inventory may be kept at the beginning of the laboratory's Material Safety Data Sheet (MSDS) Binder for use as a table of contents.
- Containers of flammable chemicals are not to be stored in chemical fume hoods. They should be stored in a flammable storage cabinet, flammable storage room or approved flammable storage refrigerator.
- Do not store waste solvents or other chemicals in the chemical fume hood for the purpose of venting fugitive vapors. This constitutes improper disposal of hazardous waste. Until they are properly disposed, containers of chemical wastes may be segregated according to their hazardous chemical and physical properties and stored with new chemicals. [Example: Waste acetone may be stored in the laboratory's flammable storage cabinet.]

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SECTION IV. EMPLOYEE EXPOSURE EVALUATION AND MONITORING

A. Exposures

The UPMC Presbyterian and Shadyside Emergency Departments have the facilities for decontamination of patients contaminated with hazardous and biohazardous materials. Staff members should report to the Emergency Department when:

- There is an accident where the staff member becomes grossly contaminated with a hazardous material.
- The type or amount of exposure is immediately threatening to the staff member's life or health.

Any feeling of ill health that a staff member feels is related to laboratory exposure to chemicals or biological agents should immediately be reported to their supervisor.

If the type or amount of exposure constitutes a medical emergency, staff should report as soon as possible to the UPMC Emergency Department. As soon as possible, the staff member's supervisor should fill out an incident report form and forward it to Employee Health or gather and phone in the necessary information to the Incident Report Phoneline at 1-(800) 633-1197. The staff member must contact Employee Health for a post-treatment medical evaluation and to schedule any necessary follow-up treatment. In Oakland, Employee Health is located on the fifth floor of the Medical Arts Building. At Shadyside Hospital, Employee Health is located in the Aiken Medical Building, Suite 209.

For exposures that do not require emergency medical treatment, the affected staff member's supervisor should complete an employee incident report form and forward it to Employee Health or gather and phone in the necessary information to the Incident Report Phoneline at 1-(800) 633-1197. The staff member should contact Employee Health for evaluation.

B. Incident Investigation

The EH&S Office will promptly investigate any incident where there is a possibility that staff members have been overexposed to a hazardous substance.

C. Overexposure Events/Conditions

The following events or conditions may indicate that an overexposure to hazardous chemicals has occurred:

- A rapid release of a hazardous chemical in an uncontrolled manner such as a leak or spill.
- Direct exposure to the hazardous chemical such as skin or eye contact.
- Feelings of ill health while working with hazardous chemicals (i.e. headaches, rash, nausea, irritation or redness of eyes, irritation of nose and throat). These symptoms may disappear or be relieved when the staff member is removed from the laboratory setting but soon reappear when the staff member returns to work with the hazardous chemical.
- Two or more staff members working in the same laboratory setting experience similar feelings of ill health.

D. Exposure Measurements

Based on the information provided by the staff member, the EH&S Office will determine the need for measuring exposure and the type of monitoring which will be used to determine the exposure level.

Should the exposure level for the hazardous chemical exceed the PEL or Action Level for the hazardous chemical, corrective actions will be taken to reduce staff member exposure to the hazardous chemical.

Periodic monitoring will be conducted in accordance with any relevant OSHA Standard requirements or at the discretion of the EH&S Office until employee exposures are reduced to satisfactory levels and are in compliance with the appropriate standard.

Monitoring may be terminated in compliance with relevant standard requirements.

Staff members shall be notified of the monitoring results in writing within 15 working days of receipt of the results by the EH&S Office.

All staff member complaints will be documented by the EH&S Office. If hazardous chemical monitoring is not deemed necessary after initial inquiries are made, the reason for this decision will also be documented.

All documentation of staff member complaints and exposure monitoring results will be maintained in the EH&S Office.

E. Permissible Exposure Limits (PEL) and Action Levels

- PEL's are established for approximately 700 chemicals. These PEL's represent concentrations to which most individuals may be exposed for 8 hours per day, 5 days per week without suffering any adverse effects from the exposure.

- These limits are specified by OSHA in 29 CFR 1910.1000, Subpart Z (found in Appendix G) and are available to all employees. For information on PEL's contact the EH&S Office at (412) 647-6409. UPMC makes every effort to assure that staff member's exposures to hazardous chemicals do not exceed these limits.

- Action Levels are concentrations designated for certain hazardous chemicals. When these levels are reached, additional monitoring and medical surveillance requirements must be met. For example, formaldehyde and benzene are two hazardous chemicals, which have an action level of 0.5 parts per million (ppm) calculated as an 8-hour time weighted average concentration.

F. Exposure Controls

Engineering controls such as chemical fume hoods are to be used as the primary means for protecting staff members from overexposure to hazardous chemicals.

When respiratory protection is required to maintain exposure levels below the PEL, the Department Head/Principal Investigator will provide respiratory protection equipment. The Department Head/Principal Investigator will consult the EH&S Office in the selection of the appropriate respirator. UPMC staff that wear respirators must be participants in the UPMC Presbyterian/Shadyside - Respiratory Protection Program. University of Pittsburgh staff that wear respirators will have to comply with the provisions of the University of Pittsburgh respiratory protection program.

G. Exposure to Noise and Hearing Protection

Chronic or temporary exposure to loud noises are capable of causing temporary or irreversible damage to the ear and can cause hearing loss. If you suspect that the amount of noise in your area is above a safe level, contact the UPMC Environmental Health & Safety Office, (412) 647-6409, to evaluate noise levels.

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SECTION V. HOUSEKEEPING, MAINTENANCE, AND INSPECTIONS

A. Housekeeping

UPMC Presbyterian Shadyside Environmental Services (Housekeeping) is responsible for routine trash removal and cleaning of the floors.

Laboratory staff are responsible for the daily cleaning of work tables, benches and equipment as well as small spills of blood, chemical agents or biological agents.

Stairwells and hallways are considered egress pathways and shall not be used as storage areas.

Access to exits, emergency equipment and utility controls should never be blocked.

B. Maintenance

1. Emergency Equipment and Engineering Controls

Emergency equipment and engineering controls must be maintained in good working order and accessible at all times. This equipment includes chemical fume hoods, eye wash stations, safety showers, fire extinguishers, and chemical spill kits.

2. Equipment Missing/Out of Service

The Department Head / Principal Investigator is responsible for informing UPMC Presbyterian Shadyside Engineering and Maintenance or the EH&S Office when equipment is found to be missing or in need of service.

3. Chemical Fume Hoods

To ensure the airflow across their face is adequate to provide protection from chemical vapors and fumes, on an annual basis chemical fume hoods should be assessed. This is performed by either the Environmental Health and Safety (EH&S) Office, UPMC Presbyterian Shadyside Engineering and Maintenance, or an outside vendor. It is the responsibility of the Department Head / Principle Investigator to schedule this annual assessment.

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To ensure the airflow across their face is adequate to provide protection from chemical vapors and fumes, on an annual basis chemical fume hoods should be assessed. This is performed by either the Environmental Health and Safety (EH&S) Office, UPMC Presbyterian Shadyside Engineering and Maintenance, or an outside vendor. It is the responsibility of the Department Head / Principle Investigator to schedule this annual assessment.

Following the assessment, a label will be placed on the fume hood indicating the height of the hood sash and the airflow in linear feet per minute (lfpm) at the time of assessment. If your hood has not been assessed, contact the UPMC Environmental Health & Safety Office at (412) 647-6409.

4. Biological Safety Cabinets

Biological safety cabinets (BSC's) in appearance are much like chemical fume hoods but function in a completely different way. They use a filter to maintain a biologically clean environment inside and outside the enclosure. These filters must be inspected for efficiency and integrity on an annual basis. They must also be inspected upon installation and when the cabinet is relocated. This service is provided by an outside vendor (Filtech). Certified BSC's are identified by a label that has been signed and dated by the vendor.

5. Safety Showers

UPMC Engineering and Maintenance will test safety showers minimally on an annual basis and when prompted by a request from the laboratory department. Engineering and Maintenance will maintain a record of the results of this testing.

6. Eyewash Stations

Staff involved in laboratory processes where the possibility of accidental eye contact exists must have access to an emergency eyewash station. Where emergency eyewash stations are provided in the laboratory, the Department Head / Principal Investigator is responsible for their weekly inspection and maintenance.

As weekly maintenance, fixed eyewash stations should be activated for five minutes. This will minimize the possibility of bacterial growth within the system. A log sheet documenting this activity should be maintained within the laboratory and should be available for review at all times. See Appendix A-II for a copy of an Eyewash Inspection Log Sheet.

7. Emergency Equipment

Fire extinguishers, fire blankets and spill kits will be checked periodically. In Oakland, this is performed by the EH&S Office and Engineering and Maintenance. In Shadyside, Shadyside Security performs this function.

C. Inspections

Laboratory inspections shall be conducted annually by either the departmental CHO or the University of Pittsburgh EH&S Office. It is recommended that informal inspections be performed on a regular basis. A copy of the UPMC Laboratory Staff Inspection Checklist may be found in Appendix B.

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SECTION VI. MEDICAL PROGRAM

A. Medical Consultation and Medical Examination

1. Reporting

The UPMC Hospital Emergency Departments have the facilities for decontamination of patients contaminated with hazardous materials. Staff members should report to the Hospital's Emergency Department when:

- There is an accident where the staff member becomes grossly contaminated with a hazardous chemical.
- The type or amount of chemical exposure is immediately threatening to the staff member's life or health.

Any feeling of ill health that a staff member believes to be related to chemical exposure in the laboratory should immediately be reported to their supervisor.

If the amount of exposure constitutes a medical emergency, staff should report as soon as possible to either the UPMC Shadyside or the UPMC Presbyterian Emergency Department. As soon as possible, the staff member's supervisor should file an incident report by calling the Claims Management - Incident Report Phone line at 1-(800) 633-1197. The staff member shall contact Employee Health for a post-treatment medical evaluation and to schedule any necessary follow-up treatment. In Oakland, Employee Health is located on the fifth floor of the Medical Arts Building. At Shadyside Hospital, Employee Health is located in the Aiken Medical Building, Suite 209.

For exposures that do not require immediate medical treatment, the staff member's supervisor should file an incident report by calling the Claims Management - Incident Report Phone line at 1-(800) 633-1197. The staff member should contact Employee Health for evaluation. In Oakland, Employee Health is located on the fifth floor of the Medical Arts Building. At the Shadyside campus, Employee Health is located in the Aiken Medical Building, Suite 209.

2. Incident Reports

The Department Head/Principal Investigator should be notified immediately of

each accident/incident. Incident reports should be completed as soon as possible following any accidents/incidents, which occur within the laboratory.

For incidents involving UPMC staff - File an **Employee Incident Report** by calling UPMC Work Partners Claim Management Services at 1 (800) 633-1197.

For incidents involving University of Pittsburgh Employees - File an **Employee Incident Report** by utilizing the links found on the University of Pittsburgh – Environmental Health & Safety website (**www.ehs.pitt.edu**) or by calling the University of Pittsburgh – Workers Compensation Office at or (412) 624-1198.

3. Medical Attention and Follow-up Care

OSHA requires that all employees who work with hazardous substances be provided an opportunity to receive medical attention and any follow-up care in three specific instances:

- Whenever a staff member develops signs or symptoms associated with exposure to a hazardous biological or chemical agent with which they work.

- When exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements. Medical surveillance will follow the requirements of the substance specific standard.

- In the event of an accident/incident such as a spill, leak, explosion or other occurrence, which may result in an exposure to a hazardous biological or chemical agent.

B. Information Provided to the Physician

As much information as possible concerning the staff member's exposure to a hazardous biological or chemical agent should be provided by the Department Head/Principal Investigator to Employee Health or to the Emergency Department Attending Physician. This information should include:

- The identity of hazardous substance(s) to which the staff member may have been exposed and a copy of the associated MSDS(s).

- A description of the conditions under which the exposure occurred (quantitative data should be provided, if available).

- The signs and symptoms experienced by the staff member.

Employee Health - Oakland	–	(412) 647-3695
Employee Health - Shadyside	–	(412) 623-1920
UPMC Emergency Department (Oakland)	–	(412) 647-3333
UPMC Emergency Department (Shadyside)	–	(412) 623-2063

C. Physician's Written Opinion

Upon completion of the medical consultation/medical examination, the physician will provide a written opinion to the UPMC Employee Health. This opinion should include:

- Recommendations for further medical follow-up, if necessary.

- Results of medical examinations and associated tests.

- Any medical condition revealed during the examination, which may place the staff member at increased risk as a result of exposure to hazardous chemical(s), found in the workplace.

- A statement that the staff member has been informed of the results of the consultation or medical examination and any medical condition which may require further examination or treatment.

NOTE: THE WRITTEN OPINION WILL NOT REVEAL ANY SPECIFIC FINDINGS OR DIAGNOSES CLEARLY UNRELATED TO THE OCCUPATIONAL EXPOSURE.

D. Access to Exposure and Medical Records

Staff members are reminded of UPMC's policy regarding their access to exposure and medical records. Medical records or exposure monitoring records related to a staff member must be made available to that staff member or designated representative. These records include any personal medical records maintained by UPMC Employee Health, environmental monitoring records maintained in the EH&S Office and monitoring records related to radiation safety maintained in the Radiation Safety Office.

Any staff member or designated representative may access relevant records by contacting the:

Employee Health - Oakland	-	(412) 647-3695
Employee Health - Shadyside	-	(412) 623-1920
Manager, EH&S	-	(412) 647-6409
Radiation Safety Office	-	(412) 624-2728

A copy of OSHA Standard 29 CFR 1910.20 - *Access to Employee Exposure and Medical Records*, may be obtained from the EH&S Office.

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SECTION VII PERSONAL PROTECTIVE EQUIPMENT AND APPAREL

A. Personal Protective Equipment (PPE)

A variety of specialized clothing and equipment is available for use in the laboratory. Proper use of such equipment will minimize or eliminate exposure to hazards associated with many laboratory operations. It is the responsibility of the Department Head/Principal Investigator to make PPE available, and train staff members on the usage and maintenance of this equipment. It is the responsibility of each staff member to comply with the requirements for using and maintaining PPE. Managers/Supervisors should enforce established PPE guidelines in the laboratory.

The MSDS and the chemical container label will provide information on the PPE required for handling a particular chemical. The PPE listed on the MSDS shall be used unless engineering controls are in place or there is information that documents the absence of need, (i.e., air sampling data to show a respirator is not needed). When PPE is selected and used, several precautions must be followed to ensure the fullest protection available.

B. Selection Precautions

Equipment should be selected according to the greatest degree of hazard expected to be encountered.

The limitations of the equipment must be understood. For example, street glasses must not be used in lieu of splash-proof goggles when handling corrosives.

The equipment must fit properly.

The equipment must be properly maintained.

Laboratory workers must be trained to use PPE correctly. They must know when equipment is necessary and recognize when service, cleaning and replacement is needed.

Specific PPE should be indicated in the laboratory's Standard Operating Procedure (SOP).

Latex examination gloves provide excellent protection against blood and body fluids but may not provide adequate protection against many chemicals.

C. Protective Apparel

Appropriate protective apparel must be worn for laboratory work. Such apparel can include coats, aprons, jump suits, special types of boots, shoe covers, goggles, gauntlets and etc. Laboratory apparel should resist physical hazards and permit easy execution of manual tasks while being worn. It should also satisfy other performance requirements such as strength, chemical and thermal resistance, flexibility and ease of cleaning.

Personal clothing and apparel worn in laboratories should be of a style and fabric that is appropriate for the work that is being performed. Appropriate clothing serves as an initial barrier against chemical mists, minor chemical splashes and splatters and will not adversely react with chemicals. A laboratory coat or similar garment that fully covers arms and upper torso shall be worn while working in laboratories. Long pants shall be worn when performing work with chemicals considered hazardous by skin contact. Shoes should also be of a style and fabric that will provide an initial barrier to a minor chemical splash. Sandals and open-toed shoes are not permitted for laboratory work.

PPE must remain in the laboratory area. It is not permissible to wear PPE outside the laboratory area.

D. Eye and Face Protection

1. Requirements

Eye and face protection shall be required where there is a reasonable probability that injury could be prevented by such protection. Eye and face protection should meet guidelines specified in ANSI, Standard Z87.1, "Practice for Occupational and Educational Eye and Face Protection".

2. General Eyewear Requirements

Safety glasses with side protection are required where there is a potential of being struck by projectile objects.

Safety goggles are required in chemical handling operations where protection is needed against fine dust, chemical fumes, mists and sprays.

Face shields are required where face protection is needed against agents in amounts that may cause a splash and where there is a potential of being struck by projectile objects. Do not use face shields as a substitute for eye protection. **Where both face and eye protection are needed, both types of protective equipment are required.**

Eye, and/or skin and face protection are required where radiant energy sources may create the potential for injury.

3. Comparison Chart

A comparison chart rating various eye protection devices is shown on Table 1.

TABLE 1
Comparison Chart - Eye Protection Devices

Type	Front Splash Protection	Side Splash Protection	Front Flying Object Impact Protection	Side Impact Protection	Neck, Face Protection	Comfort to Wearer	Cost
Goggles	Excellent	Excellent	Excellent	Excellent	Poor	Fair	Moderate to inexpensive
Glasses (no shields)	Good	Poor	Good	Poor	Poor	Good to very good	Moderate
Glasses (shields)	Good	Good	Excellent	Fair	Poor	Fair	Moderate
Face shield (various sizes)	Excellent	Good to excellent	Excellent (if adequate thickness)	Good to excellent	Depends on type and length	Good	Moderate (depending on type)

Face Shields often worn in clinical laboratories provide an initial barrier between the face and eyes and splashes of liquid substances. For this reason they are often directed for work where there is a potential for splashes of blood and body fluids. However, these disposable face shields do not provide adequate flying front object impact resistance and would not be sufficient for fast flying solid objects, as required by ANSI Standard Z87.1.

E. Hand Protection

Appropriate glove protection will significantly reduce hand exposure to hazardous biological agents and chemicals. However, the right glove material must be used to protect against specific chemicals. A table of glove material resistance is shown below. Most laboratory supply catalogs have similar tables.

TABLE 2

RESISTANCE OF COMMON GLOVE MATERIALS TO CHEMICALS (E=Excellent, G=Good, F=Fair, P=Poor)

Chemical	Natural Rubber[c]	Neoprene	Nitrile	Vinyl
Acetaldehyde	G	G	E	G
Acetic acid	E	E	E	E
Acetone	G	G	G	F
Acrylonitrile	P	G	-	F
Ammonium hydroxide (sat)	G	E	E	E
Aniline	F	G	E	G
Benzaldehyde	F	F	E	G
Benzene[a]	P	F	G	F
Benzyl chloride[a]	F	P	G	P
Bromine	G	G	-	G
Butane	P	E	-	P
Butyraldehyde	P	G	-	G
Calcium hypochlorite	P	G	G	G
Carbon disulfide	P	P	G	F
Carbon tetrachloride[a]	P	F	G	F
Chlorine	G	G	-	G
Chloroacetone	F	E	-	P
Chloroform[a]	P	F	G	P
Chromic acid	P	F	F	E
Cyclohexane	F	E	-	P
Dibenzyl ether	F	G	-	P
Dibutyl phthalate	F	G	-	P
Diethanolamine	F	E	-	E
Diethyl ether	F	G	E	P
Dimethyl sulfoxide[b]	-	-	-	-
Ethyl acetate	F	G	G	F
Ethylene dichloride[a]	P	F	G	P
Ethylene glycol	G	G	E	E
Ethylene trichloride[a]	P	P	-	P
Fluorine	G	G	-	G
Formaldehyde	F	E	E	E
Formic acid	G	E	E	E
Glutaraldehyde	F	E	E	G
Glycerol	G	G	E	E

TABLE 2

RESISTANCE OF COMMON GLOVE MATERIALS TO CHEMICALS (E=Excellent, G=Good, F=Fair, P=Poor)

Chemical	Natural Rubber[c]	Neoprene	Nitrile	Vinyl
Hexane	P	E	-	P
Hydrobromic acid (40%)	G	E	-	E
Hydrochloric acid (conc)	G	G	G	E
Hydrofluoric acid (30%)	G	G	G	E
Hydrogen peroxide	G	G	G	E
Iodine	G	G	-	G
Methylamine	G	G	E	E
Methyl cellosolve	F	E	-	P
Methyl chloride[a]	P	E	-	P
Methyl ethyl ketone	F	G	G	P
Methylene chloride[a]	F	F	G	F
Monoethanolamine	F	E	-	E
Morpholine	F	E	-	E
Naphthalene[a]	G	G	E	G
Nitric acid (conc)	P	P	P	G
Perchloric acid	F	G	F	E
Phenol	G	E	-	E
Phosphoric acid	G	E	-	E
Potassium hydroxide (sat)	G	G	G	E
Propylene dichloride[a]	P	F	-	P
Sodium hydroxide	G	G	G	E
Sodium hypochlorite	G	P	F	G
Sulfuric acid (conc)	G	G	F	G
Toluene[a]	P	F	G	F
Trichloroethylene[a]	P	F	G	F
Tricresyl phosphate	P	F	-	F
Triethanolamine	F	E	E	E
Trinitrotoluene	P	E	-	P

[a] Aromatic and halogenated hydrocarbons will attack all types of natural and synthetic glove materials. Should swelling occur, the user should change to fresh gloves and allow the swollen gloves to dry and return to normal.

[b] No data on the resistance to dimethyl sulfoxide of natural rubber, neoprene, nitrile rubber, or vinyl materials are available; the manufacturer of the substance recommends the use of butyl rubber gloves.

[c] Natural Rubber is also known as latex. People may become sensitized to latex or natural rubber. Latex sensitivity does not always manifest itself until after years of use. Symptoms of latex sensitivity may be mistaken for symptoms of chemical exposure.

[1] Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Research Council, 1981, p. 159.

F. Inhalation Protection

When a chemical is used in a way that may present an inhalation hazard, measures must be taken to control exposure. In a laboratory this is done primarily by using a chemical fume hood. When procedures cannot be performed in a chemical fume hood or when ventilation is not adequate to provide protection against inhalation hazards, respiratory protection equipment may be necessary.

Because regulations for respirator usage are extensive and OSHA requires engineering controls as the primary means of worker protection, the wearing of respirators should be the last option chosen for controlling an inhalation problem. When respiratory protection is required, the EH&S Office should be contacted. UPMC staff that wear respirators must comply with the provisions of the UPMC Respiratory Protection Program and University of Pittsburgh Staff must comply with the provisions of the University of Pittsburgh Respiratory Protection Program.

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SECTION VIII. SIGNS AND LABELS

A. Labels On Laboratory Containers

1. Laboratory Containers

OSHA requires manufacturers of hazardous substances, both biological and chemical, to label, tag, or mark their containers with specific information including the following:

- Proper name(s) of the hazardous contents
- Any applicable hazard warning(s)
- Name and address of the manufacturer/importer

UPMC relies on the information found on manufacturer's labels and staff should refrain from removing or defacing these labels. If a container is delivered without a label, staff may refuse delivery. If able to do so, staff may copy a label from another container with the same contents and affix it to the unlabeled container. At a minimum, the container may be labeled as if it is a secondary container (see below).

2. Secondary Containers

Secondary containers into which hazardous materials are transferred from the original containers shall be constructed of a compatible material and shall be labeled with at least the following:

- Proper name(s) of the chemical contents (as identified by the original container label)
- Any applicable hazard warning(s)

NOTE: All laboratory containers must be labeled with at least the proper name of the contents, even bottles of water and detergents must be labeled as such.

3. Immediate-Use Containers

Secondary containers, which are intended only for immediate use and remain in the immediate control of the laboratory worker are not required to have warning labels. These containers must be emptied by the end of the staff member's shift and before the staff member leaves the work area.

B. Unlabeling Containers

Prior to disposing of an empty laboratory container in a regular waste container, the

hazard warning labels must be removed or defaced in such a manner as to make evident that the container is empty and no longer poses a hazard. This may be done by writing the word "empty" directly on the container label and crossing out, removing or covering the hazard warning label. Containers potentially contaminated with pathogenic material must be thoroughly disinfected and the label removed/covered prior to disposal in a regular waste can.

For disposal purposes, a laboratory container is considered empty when it's contents will no longer come out and any residual content does not pose a hazard to waste handlers, to the waste stream, in transportation, or to the environment.

C. Prominent Signs

1. Safety Equipment Signage

Location signs are needed in areas where ***safety showers***, ***eyewash stations***, ***fire extinguishers***, ***first aid kits*** other safety and equipment exists. Signs are also needed in areas where food and beverage consumption and storage are permitted.

2. Hazard Warnings

Warning signs are needed for areas where special or unusual hazards exist. Some general recommendations for areas that require warning signs are:

- An area where **blood, body fluids or other potentially infectious materials are being handled or stored** must have a biohazard warning in a conspicuous location at all entrances to the area.

- An area where work is being performed involving the use of radioactive materials or **where radioactive materials are being handled or stored** must have a radiation hazard warning in a conspicuous location at all entrances to the area.

- An area **where work is being performed involving the use of lasers or other high-energy wave producing equipment** must have a warning sign conspicuously located at all entrances to that area. Labels must be white lettered on a green background.

- Areas **where purified compressed or liquid oxygen gas is stored or used** require an "OXYGEN" label at the entrance(s).

- An area **where there is high-voltage electrical equipment or where there is a potential for electrical shock** must have a hazard warning sign conspicuously located at all entrances to that area.

- Areas **where there are over 10 gallons of flammable material being stored** must have a hazard warning sign conspicuously located at all entrances to that area.

- Areas **where there is explosive material being stored** must have a hazard warning sign conspicuously located at all entrances to that area.

- All laboratories must have the appropriate Laboratory Hazard Identification DOT Hazard placard posted on all laboratory doors. Contact EH&S at (412)647-6409 for information on placards.

This list of examples is not all-inclusive but is used to suggest areas where warning signs and labels may be needed. For more detailed information on the requirements for hazard warnings, signs and labels, contact the UPMCP Environmental Health and Safety Office at (412) 647-6409.

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SECTION IX. EMERGENCIES, SPILLS AND ACCIDENTS **PAGE**

SECTION IX. EMERGENCIES, SPILLS AND ACCIDENTS

A. Chemical Spills - Definition

A **chemical spill** may be defined as an undesired release of a hazardous chemical, resulting in increased hazard or potential hazard to people, property or the environment.

1. Minor Spills

A **minor spill** does not spread rapidly, does not endanger people or property except by direct contact, and does not endanger the environment outside of the building. A minor spill can be neutralized, absorbed or otherwise managed by the user(s) of the chemical.

Minor chemical spills are those that involve no more than about a liter or kilogram of material. Lab personnel shall use the following procedures in dealing with such spills:

- Attend to any persons who may have been contaminated;
- Notify persons in the immediate area about the spill;
- Evacuate all nonessential personnel from the spill area;
- If the spilled material is flammable, turn off ignition/heat sources;
- Avoid breathing the vapors of the spilled material;
- In the event of a spill, utilize the UPMC Laboratory Spill Response Procedure found in Appendix C. This procedure should be copied and posted within the laboratory.

2. Major Spills

Spills involving substantially larger quantities of chemicals than discussed above are considered major spills and to be handled by specially trained personnel. **If a major spill occurs outside of a chemical fume hood and involves highly toxic and/or carcinogenic chemicals evacuate the laboratory immediately.**

B. Chemical Spills - General Directions

Laboratory Spill Response Procedure for emergency response can be found in Appendix C.

The following is a list of general directions to be used during a chemical spill.

- **DO NOT ATTEMPT TO MANAGE A CHEMICAL SPILL UNLESS YOU ARE TRAINED TO DO SO.**
- Contact the EH&S Office (412-647-6409) for technical assistance.
- Protect yourself with adequate personal protective equipment.
- Contain a liquid spill by diking it with absorbent or neutralizer.
- Use the plastic sheet to cover the spill reducing evaporation.
- Remove any broken glass using tongs.
- Dispose of contaminated broken glass in a puncture-resistant box that has been double-lined with plastic bags. This box must be labeled on the outside with a completed hazardous waste label and the words "Broken Glass".
- Prior to disposal, thoroughly mix the spilled chemical with an appropriate adsorbent or neutralizer until it has completely reacted or been adsorbed.
- Package waste according to UPMC hazardous waste disposal guidelines.
- Non-liquid materials without sharps may be doubled-bagged and boxed.

C. Chemical Fires

A fire contained in a small vessel can usually be suffocated by covering the vessel. Do not pick up the vessel. Do not use dry towels or cloth. Remove nearby flammable materials.

In the event of a larger fire, respond by immediately instituting the R.A.C.E. principle, as outlined in the UPMC Condition F Manual.

D. Fire

In the event of a fire emergency, that building's specific fire and emergency response procedures should be followed. All staff members should be familiar with these procedures. The locations of the nearest exit, manual pull station, fire extinguisher and fire blanket (if provided) should also be familiar to all laboratory staff members. If you find a fire, the following steps; outlined below in The R.A.C.E. Principle, should be taken:

THE R.A.C.E. PRINCIPLE

- **R** - **Rescue** anyone in immediate danger.
- **A** - **Alarm.** Activate the nearest fire alarm, then Dial the emergency phone number for your facility and report details.

– Biomedical Science Tower	-	(412) 647-3131
– Central Laboratory Services Inc.	-	(412) 692-5151
– Montefiore University Hospital	-	(412) 647-3131
– Presbyterian University Hospital	-	(412) 647-3131
– Shadyside Hospital	-	(412) 623-3131
– Hillman Cancer Center	-	(412) 623-3131
– Scaife Hall / School of Medicine	-	(412) 647-3131
– Western Psychiatric Institute & Clinic	-	(412) 246-6911
– Off-Site Facilities	-	911 or 9-911

- **C** - **Contain** fire by closing doors and windows.
- **E** - **Extinguish** the fire if it is safe to do so.

P.A.S.S. - This acronym describes the procedure for using a fire extinguisher.

- **P** - **Pull** the pin.
- **A** - **Aim** at the base of the fire.
- **S** - **Squeeze** the extinguisher handle.
- **S** - **Sweep** the hose from side to side.

E. Runaway Chemical Reactions

Runaway chemical reactions can result in a rapid, potentially violent rise in the

temperature of a liquid being heated. Proceed as follows:

Immediately remove heat, stop addition of reagents

Alert all persons nearby and quickly leave the area.
Contact the Environmental Health & Safety Office (412) 647-6409.

F. Explosions

In the case of an explosion (or similar sudden release of toxic or flammable gas/vapor), proceed as follows:

- Immediately turn off burners and other heating devices, stop any reactions in progress.
- Assist in evacuating any victims and vacate the area.
- Notify the Environmental, Health & Safety Office (412) 647-6409.

G. Chemical Fume Hoods

In the event of a chemical fume hood ventilation failure, immediately shut down and cover chemical operations, close hood sash and report the failure to the buildings Engineering and Maintenance Department. Do not use the chemical fume hood until adequate ventilation has been restored. Once the chemical fume has been repaired or properly adjusted, notify UPMC Environmental Health & Safety (412-647-6409) so that the fume hood may be certified for use.

H. Mercury Spills

Oakland Campus - Mercury spills are handled by the Engineering and Maintenance Department (412) 647-3370. Depending on the extent of the spill, the spill cleanup shall be performed using either special absorbent sponges, a special mercury vacuum hand pump or a specially designed and filtered mercury vacuum cleaner.

Shadyside Campus - Mercury spills are handled by the UPMC Shadyside Security Department (412) 623-2990. Until a spill responder arrives, the immediately surrounding area or room where the spill occurred should be secured to prevent the spread of mercury contamination.

I. Compressed Gas Leaks

Leaking compressed gas should be shut off immediately; the proper order is main tank valve, high-pressure regulator and then needle valve. Do not force valves. Contact the cylinder manufacturer for assistance.

J. Spill Supplies

The laboratory's appointed Chemical Hygiene Officer is responsible for assuring spill kits are provided for the chemicals existing in the lab. The UPMC Environmental Health & Safety Office (412) 647-6409 may be contacted for assistance. Spill supplies should be stored in a designated area and used only in the event of a spill emergency. Spill clean up materials and equipment should be sufficient to clean up any minor chemical spill occurring in the lab and might include:

- Neutralizing agents for acids, caustics, and solvent spills.
- Absorbent (Vermiculite) spill pillows
- Plastic Sheet (approx. 8 ft. x 8 ft. of 3 to 4 mil polyethylene)
- Goggles (2 pair)
- Chemical Resistant Gloves (3 pair)
- Disposable Coveralls or Aprons (2 pair)
- Shoe Covers (2 pair)
- Paper Towels
- Sponges (2)
- Dust Pan
- Whisk Broom
- Plastic Bags and Closures

Supplies to neutralize materials used in the laboratory, such as sodium bicarbonate for acids, sodium bisulfate or citric acid for bases, may be added to the spill equipment based on chemicals used in the laboratory.

EH&S may be contacted for more information regarding spill kits.

K. First-Aid/Medical Emergencies

1. Medical Emergencies

Medical emergencies can vary in severity from minor burns, cuts and scrapes to serious disabilities. The appropriate building medical emergency number should be used for assistance with medical emergencies.

2. Information to Provide in Emergencies

As much information as possible should be provided to responding emergency

personnel. If chemical contamination has caused the injury, the names of the chemicals involved, as well as copies of the MSDS, should be sent with the injured staff member.

3. Pittsburgh Poison Center - (412) 681-6669

If the medical emergency is a result of the ingestion of chemicals, the Pittsburgh Poison Center should also be contacted, (412) 681-6669, to determine necessary actions.

4. Chemical Contact (Skin) Emergency Procedure

If the medical emergency is the result of a chemical spill over an area of the body, contaminated clothing should be removed while using the safety shower. The affected body area should be flooded with cold water for at least 15 minutes. Neutralizing chemicals **should not** be used.

5. Chemical Contact With Eyes

Chemical contact with the eyes may cause serious consequences for the injured staff member. Eyes should be flushed for 15 minutes at an approved eyewash station.

6. Eyewash Stations

Eyewash stations are required where there are chemical processes that pose an eye hazard. An approved eyewash station has two spouts, single button activation and is capable of hands free operation. To ensure their proper function and to minimize bacterial growth, eyewash stations receive a weekly maintenance/inspection. (Refer to Appendix A-II **Eyewash Station Weekly Inspection Log**.) Portable eyewash bottles may be used to provide a temporary flush until an approved eyewash station can be reached. Portable eyewash bottles **do not** meet OSHA eyewash requirements for an eyewash station and cannot be installed in lieu of an approved eyewash station.

7. Incident Reporting

For incidents involving UPMC staff - File an **Employee Incident Report** by calling UPMC Work Partners Claim Management Services at 1-(800) 633-1197.

For incidents involving University of Pittsburgh Employees - File an **Employee Incident Report** by utilizing the links found on the University of Pittsburgh – Environmental Health & Safety website (**www.ehs.pitt.edu**) or by calling the University of Pittsburgh – Workers Compensation Office at (412) 624-1198.

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SECTION X. TRAINING AND INFORMATION

A. Department / Facility Training

The laboratory's Department Head is responsible for ensuring that all laboratory staff members are informed of the hazards of chemicals used in the laboratory. The Department Head is responsible for ensuring that this training is provided at the time of the staff member's initial appointment to the laboratory, prior to the start of new procedures involving different hazardous chemicals and as needed to ensure the continued safety of laboratory staff members. For information on training programs currently offered, please contact EH&S at (412) 647-6409.

B. General Laboratory Safety Training

Is provided by the UPMC EH&S Office. Information to be included:

- Methods and observations used to detect the presence or release of a hazardous chemical.
- A general discussion of physical and health hazards associated with laboratory usage of hazardous chemicals.
- Signs and symptoms associated with laboratory exposures to hazardous chemicals.
- Measures that staff members can take to protect themselves from hazardous chemical exposures including the use of engineering controls, (i.e. chemical fume hoods, shielding, etc.) PPE, appropriate work practices and emergency procedures.
- A discussion of the contents of this standard and its appendices along with applicable details of the Chemical Hygiene Plan.
- A review of the SOP common to all laboratories.
- Proper disposal of laboratory waste and waste minimization.
- A discussion of PEL's, action levels and how exposure levels are determined.
- An explanation of the Chemical Hygiene Plan.
- Additional health and safety related information relating to laboratory practices will be discussed.

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SECTION XI. WASTE DISPOSAL PROCEDURES

A. UPMC Policy

For information regarding waste disposal, refer to the UPMC Waste Management Plan for your facility. If there are questions regarding hazardous waste disposal, contact UPMC Environmental Health & Safety (EH&S) at (412) 647-6409.

B. Hazardous Waste Disposal

1. Unlabeled Containers

Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened.

2. Completion of Employment

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible for should be discarded or returned to storage.

3. Frequency of Disposal

The EH&S Office determines the frequency of disposal of waste chemicals. Contact EH&S (412) 647-6409 for pickup schedules, packaging requirements, labeling requirements, and documentation.

4. Indiscriminate Disposal

Indiscriminate disposal of waste chemicals by pouring them down the drain or disposing of them in mixed refuse for landfill burial is prohibited.

5. Chemical Fume Hoods

Chemical fume hoods shall not be used as a means of disposal for volatile chemicals. Open bottles of chemical waste or waste containers with funnels placed in the mouth of the bottle are prohibited. Containers should be kept sealed except when adding waste to the container.

6. Expired Chemicals

Expired chemicals must be disposed of promptly. Contact the EH&S Office for information on waste drop-off schedules and locations.

C. Infectious and Chemotherapeutic Waste Disposal

1. Infectious Waste

Infectious waste materials must be segregated by laboratory staff at the point of generation. Waste should be placed in biohazard boxes line with red bags. Staff should avoid placing large volumes of liquid waste in the red bags. When possible, liquid wastes should be discarded directly through the sanitary sewer system, or solidified and disposed of in the red bag. If a culture of stock is known to be infectious, it should be disinfected by bleach or other effective disinfection method prior to disposal via the sanitary sewer.

2. Chemotherapeutic Waste

Chemotherapeutic waste generated as a result of research must be segregated at the point of generation and placed into yellow and white disposal containers labeled with the word "Chemotherapeutic Waste". Liquid chemotherapy waste should be placed into a leak proof container with a tight fitting lid. Green Z universal absorbent or other absorbent suitable for used with chemotherapy agents should be added to the container to absorb the liquid and render if safer for transport. Containers of waste, which have had the absorbent added to, should then be placed in the yellow and white containers. Drain disposal of spent chemotherapeutic agents is never permitted.

3. Pathological Waste

Pathological waste included animal carcasses; gross sections of human or animal tissue, etc. should be segregated from other infectious of red-bagged waste. Tissue samples preserved in formalin solutions or other preservatives should be removed from the specimen containers. The containers of preservative should be disposed of via the hazardous waste stream. Tissues should be placed into biohazard boxes lined with red bags. The biohazard box should be sealed and the section on the outside of the box marked "Pathological Waste" should be check to indicated that the box containers pathological waste for incineration.

D. Laboratory Equipment Disposal

Laboratory equipment slated for disposal should be thoroughly decontaminated and cleaned out by laboratory staff. Biohazard labels should be completely removed. Radiation Safety should be contacted to remove any radioactive labels. Maintenance and Engineering should be contacted to remove the refrigerant from refrigerators and other equipment. Finally, EH&S should be contacted to certify the equipment safe for disposal.

APPENDIX A

STANDARD OPERATING PROCEDURES

STANDARD OPERATING PROCEDURES

INTRODUCTION

The following Standard Operating Procedures (SOP) are intended to serve as general guidance. It is not realistic to expect that these procedures will cover every hazardous condition found in the laboratory. Each laboratory should have their own specific set of SOP. These should be kept on file in the laboratory where they can be easily accessed by personnel. Specific hazardous conditions not addressed in these pages should be thoroughly discussed among laboratory staff members responsible for completing the procedure in question. Specific questions concerning hazardous procedures should be directed to the UPMC Environmental Health & Safety Office (EH&S) at (412) 647-6409.

LABORATORY PRACTICES

A. General Work Practices

Staff members should be familiar with the location and proper use of emergency equipment such as fire extinguishers, safety showers and eyewash stations. Staff members should also be familiar with emergency procedures related to first aid, fire/evacuation and chemical spills.

Staff members should be aware of any PPE needed to complete a specific operation and use this equipment as required by the procedure and as required by the MSDS. PPE is not permitted outside the laboratory area.

Potentially hazardous conditions and actions should be reported to the Department Head/Principal Investigator as soon as possible.

Where hazardous chemicals are present, there is no eating, drinking, smoking or application of cosmetics permitted.

Practical jokes and horseplay will not be tolerated at any time.

Equipment should be used only for its intended purpose.

Confine long hair when working in the laboratory.

Use an aspirator or pipette bulb to start a siphon or pipette chemicals. **DO NOT** use mouth suction to pipette chemicals.

Wash hands and any other portion of the skin exposed to hazardous chemicals prior to leaving the laboratory. **DO NOT** use solvents to wash skin surfaces.

All equipment and glassware must be handled and stored with care to avoid being damaged. Extra care must be taken with Dewar flasks and other glassware that is used under vacuum. This apparatus must be wrapped or shielded to contain hazardous chemical substances and glass fragments in case of implosion.

Lights must be left on and an appropriate sign should be placed on the laboratory door when operations are unattended. The sign should contain the telephone number of the people to contact in case of an emergency.

In the event of a power failure, re-entry to the laboratory must be restricted until the Department Head/Principal Investigator or designee makes a determination that any potential hazardous substances are contained.

Facility vacuum lines may not be used to provide direct vacuum for solvents, flammable liquids or acids. The facility vacuum lines are never to be used as a vacuum cleaner to siphon up liquids or solids.

B. Use of Chemicals - General

Laboratory personnel should work in uncluttered workspaces and clean up after each procedure. This includes, without limitation, properly disposing of waste and returning all equipment and apparatus to their proper place.

Prior to use of any chemicals in the laboratory, all employees should read and understand the MSDS for that chemical.

Laboratory personnel must never deliberately smell or taste any chemicals.

Apparatus, which may discharge toxic chemicals, must be vented into local exhaust or trapped.

The release of toxic substances must not occur in "cold rooms" or constant temperature rooms because of the nature of the re-circulating systems.

Any exposed skin surface should be washed thoroughly with soap and water whenever it comes in contact with a chemical. Solvents should never be used to clean skin surfaces. Face, hands and other exposed skin should always be washed before leaving the laboratory.

All containers holding chemicals should be clearly labeled. Containers should not be reused for another substance until the label has been removed and the container has been thoroughly cleaned.

Experiments should be designed to use the smallest amounts of chemicals.

Reagents should always be added slowly. Concentrated solutions should be buffered where feasible.

Never look down the opening of a vessel.

Assembled equipment shall be firmly clamped and set up away from the edge of the laboratory bench.

Equipment shall be free of flaws and defects. Equipment, which is not working properly, should be taken out of service. A label clearly indicating the problem should be affixed to the equipment that is "out of service".

Chemical waste must be disposed in properly labeled containers. Chemical waste should not be allowed to evaporate in the chemical fume hood. Contact EH&S for disposal procedures.

Staff members shall use only chemicals for which the quality of the available ventilation system is appropriate.

C. Unattended Operations

Laboratory procedures that must run on a continuous basis overnight should be planned well in advance to avoid or minimize potential hazardous conditions and clearly labeled as "experiment in progress".

Contingency plans should be designed into the procedure to compensate for the possible loss of utilities such as water or electricity. Arrangements should be made to inspect the operation periodically. Laboratory lights should always be left on. Emergency instructions, appropriate hazard warnings, an emergency contact person, and emergency telephone numbers should be posted at the entrance to the laboratory.

D. Working Alone

When working alone on off-hours or on weekends, staff members should notify the security guards attending the building entrances. The security guards will check on staff members periodically.

Staff members who are conducting projects, which involve hazardous chemical substances, should not be working alone.

E. Leaving the Laboratory

When leaving the laboratory at the end of the workday, the following should be done:

- Turn off all utilities not in use such as water, gas, or electricity;
- Close chemical fume hood sashes to lowest possible level;
- Turn off lights, unless unattended operations are in progress; and
- Lock doors (if appropriate).

F. Children In Laboratories

Children under 18 years of age are generally not permitted in UPMC laboratories except as a participant in a formally sponsored tour or educational program or as a guest of a staff member who is responsible for their supervision. Further, as a general policy, children of staff are not authorized to be in laboratories for childcare even if fully supervised.

During tours and educational programs, the Department Head, Principal Investigator and Laboratory Manager are responsible for ensuring the child's safety in the lab. Use of hazardous chemicals or dangerous procedures is discouraged during these programs. Children under 18 years of age that are working in UPMC laboratories should present a release agreement signed by their parent or guardian attesting to their understanding of the potential hazards of the work to be performed.

EQUIPMENT

A. Electrical Hazards

All 110-volt outlet receptacles in laboratories should be designed to accept a three-prong plug and provide a ground connection.

Electric equipment used in chemical fume hoods should be powered from outside the chemical fume hood. This will reduce the possibility of creating an electric spark inside the hood when equipment is plugged in. Remote locations of receptacles also permit the staff members to disconnect equipment from outside the chemical fume hood in the event of an emergency. Note: Electrical cords should not be permitted to dangle outside the chemical fume hood.

Electrical cords should be secured and out of the way. Equipment should not be used if electrical cords are frayed and/or damaged. Extension cords are prohibited.

If flammable vapors are present, motor driven electrical equipment should use an intrinsically safe motor to prevent explosion. This applies to motors used in vacuum pumps, mechanical shakers, stirring motors, magnetic stirrers and rotary evaporators.

Electrical equipment should be located in areas of the laboratory away from chemicals and water to avoid accidental spills on the equipment.

Should a spill occur involving electrical equipment, the equipment should be unplugged, tagged and removed from service. Before using again, the equipment should be inspected by Clinical Engineering.

When flammable solvents are handled, static electricity and sparks can present a dangerous exposure to staff members. To reduce this exposure, containers and equipment should be properly grounded and bonded.

B. Vacuum Pumps

Mechanical vacuum pumps should not be used when operations involve volatile substances. Mechanical vacuum pumps may be used to distill less-volatile substances, to remove final solvent traces and other operations.

The input line to the vacuum pump should be provided with a cold trap to collect volatile substances that may be present, and prevent contamination of vacuum pump oil. Liquid nitrogen and liquid air should not be used in these traps as an explosion hazard may be created.

The outlet of the vacuum pump should be vented to the laboratory's exhaust system to prevent the introduction of flammable, toxic or corrosive vapors into the laboratory atmosphere.

Vacuum systems should not be used to suction chemical residues. Vacuum systems are not to be used as Local Exhaust Ventilation.

If vacuum pump oil becomes contaminated with flammable, toxic or corrosive materials, it should be changed and disposed of properly before the apparatus is used again.

Used vacuum pump oil must be disposed of as hazardous waste.

C. Drying Ovens

Drying ovens are typically used to remove moisture or other solvents from chemical samples. Drying ovens are not typically vented; thus water or solvent vapors are released to the laboratory atmosphere when the oven door is opened. They are to be used for intended purposes **ONLY**.

Drying ovens should not be used to dry chemical samples with volatile or reactive properties as explosive mixtures may form within the oven.

Drying ovens should have heating elements and temperature controls separated from interior atmospheres. Thus, most household ovens are not suitable for use as drying ovens.

Drying ovens should not be placed under automatic sprinkler heads.

D. Refrigerators

Laboratory refrigerators are not to be used for the storage of food or beverage items intended for human consumption under any circumstances. Laboratory Refrigerators should be labeled: NO FOOD OR DRINK.

Refrigerators are not vented, thus, high concentration of toxic substances may collect in the unit. All items placed in the unit must be tightly sealed. **Aluminum foil, corks and glass stoppers do not provide a satisfactory seal and should not be used.**

FLAMMABLE SOLVENTS AND OTHER MATERIALS MUST NOT BE STORED IN ORDINARY REFRIGERATORS. If flammable solvents must be refrigerated, a UL labeled explosion-proof or fireproof, vapor tight unit shall be used.

Refrigerators should be labeled with appropriate hazard warnings that may be associated with the contents of the refrigerator.

Refrigerators or freezers that are equipped with an alarm system should be clearly labeled with the name of the owner of the unit and an emergency telephone number where the owner or responsible party may be reached. Critical temperature limits should be posted.

E. Heating Devices

Heating devices include hot plates, heating blocks, and thermal cyclers, heating mantles and tapes, oil baths, air baths, hot tub furnaces and hot-air guns. These devices are to be used for their intended purposes **ONLY**.

The heating element in these devices should be completely enclosed and intrinsically safe to minimize staff member exposure to electrical shock hazards.

If heating devices will be operated for long periods of time or overnight when the laboratory is unattended, the device should be equipped with a temperature limiting switch. This switch should be set to shut down the device if the preset temperature limit is exceeded.

Heating devices should not be placed below automatic sprinkler heads.

F. Eyewash Stations

To ensure their proper function and to minimize bacterial growth, eyewash stations receive a weekly maintenance/inspection. Laboratory staff is to perform the inspection. The inspection is simple and should confirm the following:

1. The covering caps are in place to prevent foreign objects from entering the eyewash nozzles.
2. The eyewash station is free from damage and does not have any cracks or signs of leakage and is free from rust.
3. Activate the eyewash station. Upon activation the covering caps should dislodge by themselves.
4. Both streams of water should rise to approximately the same height and should rise to a height adequate to rinse the eyes without obstruction by the faucet.
5. Allow the water to run for fifteen minutes. This is to ensure the water lines are well flushed.

6. Restore the eyewash station to it's ready condition then sign and date the Eyewash Station – Weekly Inspection Log.

Please call UPMC Engineering and Maintenance if the eyewash station fails any portion of the test.

* For convenience, an ***Eyewash Station – Weekly Inspection Log*** is provided on the following page.

Eyewash Station Weekly Inspection Log

The weekly inspection is simple and should consist of the following:

1. **The covering caps are in place to prevent foreign materials from entering the eyewash nozzels.**
2. **The eyewash station is free from damage and deterioration. It does not have any cracks or signs of leakage and is free of rust.**
3. **Activate the eyewash station. Upon activation the covering caps should dislodge by themselves.**
4. **Both streams of water should have approximately the same amount of water flow and should rise to a height adequate to rinse the eyes without obstruction from the faucet.**
5. **Let the water run for fifteen minutes. This will ensure the water lines are well flushed.**
6. **Restore the eyewash station to its ready condition.**

NOTE: Please call Engineering and Maintenance if the eyewash station fails this test.

Initials	*Date*

Initials	*Date*

GLASSWARE

A. Handling Precautions

Damaged glassware should be promptly disposed. Broken glassware should be placed in a box that has been double lined with garbage bags. The outside of the box shall be labeled with the words, "Broken Glass."

Broken glassware that has been contaminated with infectious agents, human tissue, blood or other body fluids should be sterilized prior to disposal. If sterilization is not feasible then disposal shall be in accordance with infectious waste and/or regulated medical waste guidelines.

Appropriate hand protection should be used whenever glass tubing is to be inserted in rubber tubing or corks.

Glass blowing operations should only be attempted by properly trained staff members in areas suited for these operations.

Extreme caution should be used when handling vacuum jacketed glass apparatus to prevent implosions.

Gloves should be worn when picking up broken glass. If available, use a dustpan and broom.

COLD TRAPS AND CRYOGENIC HAZARDS

A. Safe Practices

Cryogenic fluids shall be stored in a restricted access location.

Handle cryogenic materials only in well-ventilated areas to prevent excessive concentration of gas, and possible suffocation.

Do not perform prolonged activities in unventilated or poorly ventilated rooms or areas where large quantities of dry ice or other cryogenic solids or liquids are stored. Most cold storage rooms have poor ventilation. **Dry ice storage in poorly ventilated areas such as cold storage rooms may lead to an elevated interior atmospheric concentration of carbon dioxide gas.** Prior to entry, the doors should be opened and sufficient time allowed for the room to ventilate.

Cryogenic materials present special hazards because of their extremely low temperatures. Severe burns may result if these materials come in contact with the skin.

All staff members using cryogenic materials should be properly trained on the safe use, handling, and storage of these materials.

PPE should always be worn to provide protection against cryogenic material splashes.

Use only equipment and material designed for the ultra-low temperatures associated with cryogenic materials. Ordinary plastics and metals can become dangerously brittle.

Store cryogenic fluids only in Dewar flasks (double-walled evacuated containers made of either metal or glass).

Minimize moisture contact with cryogenic containers. Even a small amount of moisture freezing across the opening of a Dewar flask or its relief valve may cause a pressure buildup and possible explosion.

Wrap glass Dewar flasks with cloth tape to prevent flying glass if it shatters.

Caution must be used when lowering material into Dewar flasks to prevent the material from freezing tight in the neck of the flask.

Never handle Dewar flasks by the neck, which is the main support for the inner liner of the container. Always use handles provided on the container.

Use carts or dollies to transport large cryogenic containers.

PROCEDURES FOR HANDLING TOXIC CHEMICALS

All chemicals may be considered toxic to some degree and not all of the toxic properties are known about all chemicals. Because of this, it is prudent to routinely minimize exposure to all of the laboratory chemicals with which we work. To minimize exposure to toxic chemicals the route(s) of exposure must be determined (i.e., inhalation, ingestion, injection, skin contact). The following procedures should be followed when working with toxic chemicals.

A. Handling Procedures

Know the hazards of the chemicals with which you work. Before beginning work with a new chemical, review the MSDS and/or other safety information to determine it's toxic properties and any suggested handling or storage precautions.

Chemicals which are considered to be toxic by inhalation (those with a PEL below 50 ppm and/or those that may cause toxic effects if the vapor is inhaled at the atmospheric concentration that is likely to be produced) should be used only in a chemical fume hood, or approved Local Exhaust Ventilation system. If this equipment is not available but is necessary to prevent exposure above the permissible exposure limit, then the toxic chemical should not be used.

When transporting toxic chemicals outside the laboratory, utilize absorbent packaging and double containment as necessary to prevent exposure in the event of a spill or leak.

Proper gloves and protective gear must be used. Non-disposable protective gear should be washed after use. Disposable items must be discarded in marked containers inside the control area.

Be prepared for hazardous material emergencies and know what action(s) to take.

Wash hands and arms immediately after working with toxic materials.

Never eat, drink, smoke, apply cosmetics or store food in areas where toxic substances are being used. Never smell or taste a hazardous chemical.

PROCEDURES FOR HANDLING CORROSIVE CHEMICALS

Corrosive chemicals can be in solid, liquid or gaseous form and act on body tissues by direct contact, inhalation or ingestion. Corrosives can be categorized as strong acids, strong bases, dehydrating agents, oxidizing agents and water-reactives. Corrosive liquids are responsible for most corrosive-based injuries. Corrosive gases are the most serious because they can be readily absorbed into the body by dissolution with skin moisture and by inhalation. The following procedures should be followed when handling and storing corrosive chemicals.

A. Handling and Storage Procedures

Eye protection and rubber gloves should always be worn when handling corrosive materials. A faceshield, rubber apron, and rubber boots also may be appropriate depending upon work performed (check MSDS for PPE requirements).

An eyewash and safety shower must be readily accessible to areas where corrosives are used and stored. In the event of skin or eye contact with corrosives, immediately flush the area of contact with cool water for 15 minutes. Remove all affected clothing. Get medical help immediately.

Always add acid to water. Dehydrating agents such as sulfuric acid, sodium hydroxide, phosphorus pentoxide and calcium oxide should be slowly added to water to avoid violent reaction and splattering.

Strong oxidizing agents such as chromic and perchloric acids should be stored and used in glass or other inert containers (preferably unbreakable); corks and rubber stoppers should not be used.

Rubber safety bottle carriers or non-breakable bottles (PVC-coated) should be used as secondary containment for the transport of strong acids and bases from one location to another.

Containers and equipment used for storage should be corrosion resistant.

Acids, bases, flammables and oxidizers should be segregated and stored separately.

PROCEDURES FOR HANDLING CARCINOGENS, REPRODUCTIVE TOXINS, CHEMICALS WHICH ARE ACUTELY TOXIC AND CHEMICALS OF UNKNOWN TOXICITY

A list of National Toxicology Program (NTP), International Agency for Research on Cancer (IARC) and Occupational Health and Safety Administration (OSHA) carcinogens is found in Appendix I Carcinogens, as regulated by the OSHA Laboratory Safety Standard, include the chemicals listed by NTP and IARC. A list of reproductive toxins may be found in Appendix H.

A. Additional Procedures

The following additional procedures should be followed when working with carcinogens, reproductive toxins, acutely toxic chemicals and chemicals of unknown toxicity in quantities exceeding 10 milligrams.

Designate an area such as a chemical fume hood, portion of a laboratory, or an entire laboratory as the only area where these chemicals will be used. Provide appropriate hazard warning signs and/or clearly mark the boundaries of the designated area.

Only those persons trained to work with these substances should do so within the designated area and with prior approval of the Department Head/Principal Investigator.

Store these substances in locked areas and use only the smallest possible amounts.

Decontaminate designated area when work is complete.

PPE as recommended on the MSDS must be worn when handling these substances.

Chemical wastes must be disposed of in accordance with procedures detailed in the Waste Management Plan.

COMPRESSED GASES

A. The OSHA Definition of Compressed Gas

A gas or mixture of gases in a container having an absolute pressure exceeding 40 pounds per square inch (psi) at 70^0F; or

A gas or mixture of gases in a container having an absolute pressure exceeding 104 psi at 130^0F regardless of the pressure at 70^0F; or

A liquid having a vapor pressure exceeding 40 psi at 100^0F.

One hazard of compressed gas cylinders is the potential release of the gas into the work environment. Various substances, when released, create fire/ explosion, asphyxiation and toxic hazards.

When the gas is compressed, large amounts of potential energy are generated which turns the cylinder into a potential rocket.

B. General Principles for Compressed Gas Cylinders

Cylinders must be upright and secured at all times.

Valve caps should be left in place until pressure regulators are attached.

Containers must be marked clearly with the name of the contents.

Hand trucks or dollies must be used when moving cylinders. The safety chain must be in place. Do not roll or drag cylinders.

Do not use oil, grease, or lubricants on valves, regulators or fittings.

Do not attempt to repair damaged cylinders or to force frozen cylinder valves. Always call the cylinder manufacturer for maintenance of the cylinders.

Open valves slowly, standing away from the opening.

Treat all empty cylinders as you would full ones.

C. Cylinders Containing Flammable Gases

No more than two cylinders should be connected together in a manifold; however, several instruments or outlets are permitted for a single cylinder.

No more than one cylinder of highly flammable gas shall be in one room without specific review by the EH&S Office.

Do not store standby cylinders (full or empty) in the laboratory.

Cylinder size is generally limited to 250 cubic feet, (H cylinder) depending on the gas.

Shut off the valves on all flammable gas cylinders when the laboratory is unattended, and at night.

Flammable gases should be stored away from other gases, particularly oxidizers such as oxygen.

D. Pressure Regulators and Needle Valves

Valves and surfaces must be clean and tightly fitted. Do not lubricate.

Tighten regulators and valves firmly with the proper size wrench; do not use pliers. Do not force tight fits.

Open valve slowly. Do not stand directly in front of gauges (the gauge face may blow out). Do not force valves that "stick".

Check for leaks at connections. If you suspect a leak, look for it using a soap solution (look for bubbles). Leaks are usually due to damaged faces at connections or improper fit.

Leave valve handles attached to the cylinders.

Know how to use the regulators properly. Set the maximum rate of flow or pressure with the regulator adjustment; use the needle valve for fine-tuning.

Shut off the cylinders when not in use. Proper order is: main tank valve, high-pressure regulator and needle valve.

E. Empty Cylinders

After turning off the cylinder valve, remove the regulator using the proper wrench and replace the cylinder safety cap.

Return empty cylinders promptly. An empty cylinder is a safety hazard, and needs to be secured to prevent falling.

Avoid the use of disposable cylinders.

FLAMMABLE CHEMICALS AND COMBUSTIBLE LIQUIDS

A. Flammable Chemicals

Hazardous chemicals, which are flammable, may be aerosol, gas, liquids and solids. OSHA defines these flammable chemicals as follows:

Aerosol, flammable means an aerosol that when tested yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

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

Liquid, flammable means any liquid having a flashpoint below 100^0F (37.8^0C), except any mixture having components with flashpoints of 100^0F (37.8^0C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

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

The National Fire Protection Association (NFPA) classifies flammable liquids as Class I liquids and further subdivides this classification as follows:

Class IA - Flashpoint below 73^0F (22.8^0C) and boiling point below 100^0F (37.8^0C)

Class IB - Flashpoint below 73^0F (22.8^0C) and boiling point at or above 100^0F (37.8^0C)

Class IC - Flashpoint above 73^0F (22.8^0C) and below 100^0F (37.8^0C)

Many solvents used in the laboratory are flammable. Table A-1 list examples of flammable and combustible materials, which may be found in the laboratory.

B. Combustible Liquids

The OSHA definition of combustible liquid is "... any liquid having a flashpoint at or above 100^0F (37.8^0C), but below 200^0F (93.3^0C), or higher..."

The National Fire Protection Association (NFPA) further classifies combustible liquids as follows:

Class II - Flashpoint at or above 100^0F (37.8^0C) and below 140^0F (60^0C).

Class IIIA - Flashpoint at or above 140^0F (60^0C) and below 200^0F (93.3^0C).

Class IIIB - Flashpoints above 200^0F (93.3^0C)

The NFPA defines flashpoint as "the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid..."

Combustible liquids can contribute fuel to a fire. Combustible liquids should not be used or stored near open flames. The amount of combustible liquids stored in the laboratory should be minimized to reduce the laboratory's exposure to fire. Storage guidelines for flammable and combustible liquids follow the definitions of flammable materials. The maximum allowable container size for the storage of combustible liquids is one gallon.

TABLE A-1

COMBUSTIBLE AND FLAMMABLE LIQUIDS IDENTIFIED

FLAMMABILITY CLASS	IA	IB	IC	II	IIIA	IIIB
LIMITS	f.p. < 73°F b.p. < 100°F	f.p. < 73°F b.p. ≥ 100°F	f.p.73°F - 100°F	f.p. 100°F - 140°F	f.p. 140°F - 200°F	f.p. 200°F - Above
NFPA RATING	4	3	3	2	2	1
EXAMPLES	Acetaldehyde V M & P Naphtha Collodion Cyclohexene Dimethyl Sulfide Ethyl Ether Ethyl Mercaptan Ethylamine Ethylene Oxide Furan Isopentane Isopropyl Chloride Isopropyl Ether Methyl Formate Pentane Propylene Oxide Triethyl Borate Vinyl Bromide Vinyl Ethyl Ether 1,3-Pentadiene	Acetone Acetonitrile Acetyl Chloride Acrolein, Inhibited Allyl Alcohol Benzene Butyl Methyl Ether Carbon Disulfide Crotonaldehyde Cycloheptane Cyclohexane Ethyl Alcohol Heptane Hexanes Isopropyl Alcohol Methyl Alcohol Nickel Carbonyl Octane Permount Solution Wright's Stain Solution	Acetylacetone Allyltrichlorosilane Benzedrine Butyronitrile Chlorobenzene Cumene Cyclohexylamine Cyclopentanone Diethyldichloro-silane Ethylene Glycol Diethyl Ether Ethylenediamine Piperidine Terpinolene Trimethyl Phosphite Turpentine Vinyl Crotonate Xylene	Acetic Acid, Glacial Acetic Anhydride Acrylic Acid Anisole Bromobenzene Camphor Oil Cyclohexanone Ethyl Butanol Formic Acid Kerosene Isoamyl Alcohol Isobutyric Acid Methyl Parathion, 80% Pine Oil Propylene Glycol Monomethyl Ether Stoddard Solvent Trimethyl Benzene 2-Ethoxyethanol	Acetophenone Aniline Benzaldehyde Butyric Acid Cresol Crotonic Acid Cyclohexanol Dimethyl Sulfate Dimethyl Sulfoxide Dodecane Ethanolamine Ethyl Benzoate Ethylene Chlorohydrin Furfuryl Alcohol Phenethylamine Phenylhydrazine Proprionic Anhydride Pyruvic Acid Formaldehyde Solution, 37%	Benzyl Alcohol Caproic Acid Castor Oil Cetyl Bromide Chloropicrin Coconut Oil Dibutyl Phosphate Dinitrotoluene Ethylene Carbonate Ethylene Glycol Formamide Glycerin Hexadecane Lauryl Alcohol Light Mineral Oil Mustard Gas Nicotine Tannic Acid Triethanolamine Triton (R) X-100

f.p. = Flashpoint
b.p. = Boiling Point

Storage containers for flammable and combustible liquids must not exceed the quantities shown in the table below which is reprinted from NFPA 45. Exception to this table: Under no circumstances are container sizes to exceed 5 gallons in laboratory units.

TABLE A-2

MAXIMUM ALLOWABLE CONTAINER SIZE FOR USE IN LABORATORIES USING CHEMICALS

Container Type	Flammable Liquids[2]			Combustible Liquids[2]	
	1A	1B	1C	II	IIIA
Glass	1 pt[3]	1 qt[3]	1 gal	1 gal	5 gal
Metal (other than DOT drums) or Approved Plastic	1 gal	5 gal[1]	5 gal[4]	5 gal[4]	5 gal
Safety Cans	2 gal	5 gal[4]	5 gal[4]	5 gal[4]	5 gal
Metal Drums (DOT)	N/A[5]	5 gal[4]	5 gal[4]	60 gal[4]	60 gal

[1]This table is taken from NFPA 30, *Flammable and Combustible Liquids Code,* except for allowable quantities of Flammable Liquids in metal DOT drums.

[2]See Appendix B1 for definitions of the various classes of flammable and combustible liquids.

[3]Exception: Glass containers may be sized to 1 gal.

[4]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.

[5]N/A = Not Allowed.

For SI Units: 1 gal = 3.785 liters; 1 qt = 0.95 liter; 1 pt = .48 liters

C. Safe Handling and use of Flammable Chemicals

Flammable chemicals shall be used in areas free of ignition sources such as open flames, hot surfaces, cutting or welding sparks, operating electrical equipment and static electricity.

Minimize the amount of flammable chemicals stored in the laboratory unit. Less than 10 gallons of flammable chemicals may be stored on shelves, 10 to 25 gallons must be stored in flammable cabinets. If a lab needs to store more than 25 gallons of flammable liquids, then it must be in an approved flammable liquid storage room or with approval of the UPMC EH&S Office (412) 647-6409.

Spring-loaded closures on safety cans should not be disabled. Flame-arrestor screens must not be removed and must be replaced prior to the next use of the safety can if punctured or damaged.

Refrigerators and freezers must be certified by Underwriters Laboratories (UL) as "explosion-proof," or approved by UL for flammable storage. The refrigerators and freezers must be labeled with flammable hazard warnings.

Bonding and grounding protection must be provided whenever bulk flammable chemicals are transferred from metal containers or equipment.

Flammable chemicals should be used only in well-ventilated areas. When feasible, flammable chemicals should be used or handled in chemical fume hoods.

SAFE STORAGE OF HAZARDOUS CHEMICALS

A. Precautions

Proper storage of chemicals is not only a difficult and time-consuming task, but also one of importance. The large number of substances used in laboratories coupled with a myriad of chemicals with diverse individual physical properties complicates the safe storage process. The information below is intended to provide guidance and suggestions for proper storage, but is not intended to be all inclusive. Carefully read the MSDS and container label for more specific instructions for storage of individual chemicals.

Check to see that all containers are in good condition and properly labeled.

Store chemicals according to chemical compatibility and hazard identification (i.e., acids, bases, flammables, oxidizers and poisons).

Chemicals must be stored in cabinets or on shelves with anti-roll edges.

Provide shelving that can be cleaned and will not soak up spilled chemicals.

Do not store chemicals above eye level.

Do not store chemicals on top of shelving units.

Store poisons in a dedicated labeled cabinet

Store away from lighting fixtures or electrical sources.

B. Incompatible Chemicals

The table on the following pages gives some examples of incompatible chemical storage arrangements.

TABLE A-4[1]

EXAMPLES OF INCOMPATIBLE CHEMICALS

Chemical	Is Incompatible With
Acetic Acid, Glycol	Chromic acid, nitric acid, hydroxyl compounds, ethylene perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali & alkaline earth metals (such as powdered aluminum, magnesium, calcium, lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium Nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See Chlorine
Calcium Oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon Tetrachloride	Sodium
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic Acid & Chromium Trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene Hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, halogens
Fluorine	Everything
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic Acid	Nitric acid, alkali
Hydrofluoric Acid (anhydrous)	Ammonia (aqueous or anhydrous)

Table A-4[1]
(Continued)

Chemical	Is Incompatible With
Hydrogen Peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen Sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulfuric acid
Nitric Acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Acids
Oxalic Acid	Silver, mercury
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, gases
Perchloric Acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium Chlorate	Sulfuric and other acids
Potassium Perchlorate	(see Sulfuric and other acids also chlorates)
Potassium Permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartartic acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium Nitrite	Ammonium nitrate and other ammonium salts
Sodium Peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric Acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents

[1]Safety in Academic Chemistry Laboratories, American Chemical Society, 1985, p. 59.

OPERATIONS REQUIRING PRIOR APPROVAL

A. Specific Chemical Use

The facility/department Chemical Hygiene Officer can contact the UPMC Environmental Health and Safety Office for information on the following:

- Chemicals listed by NTP and IARC as carcinogens (Appendix I), reproductive toxins (Appendix H), or identified with special hazards to persons or the environment.

- Introducing a situation where the potential exists for release of a hazardous chemical or physical hazard to the laboratory or external environment.

- Installing or storing of any compressed flammable gases or any compressed toxic gases, or, installing or storing compressed oxygen or other oxidizing gases in quantities exceeding 300 cubic feet (11E cylinders or 1 H cylinder).

- Any process or procedure involving the use of extremely toxic or explosive substances such as cyanides, picric acid and trinitrotoluene (TNT).

ORGANIC PEROXIDES AND PEROXIDE FORMING CHEMICALS

Organic peroxides are hazardous chemicals, which have a bivalent -0-0- molecular structure. These compounds are unstable and are sensitive to heat, friction, impact, oxidizing and reducing agents. Organic peroxides are highly flammable.

Peroxide-forming chemicals react with oxygen to form peroxides. These chemicals can be divided into three hazard categories:

A. Hazard Categories

Compounds forming peroxides that can spontaneously decompose during storage. Maximum storage time = 3 months.

Examples: divinyl acetylene, isopropyl ether, potassium metal, sodium amide, vinylidene chloride.

Compounds forming peroxides that require the addition of a certain amount of energy (distillation, shock) to explosively decompose. Maximum storage time = 12 months.

Examples: acetyl, cyclohexene, diacetylene, dicyclopentadiene, diethyl ether, dioxane, 1,2-dimethoxyethane, methyl acetylene, methylcyclopentane, methyl isobutylketone, tetrahydrofuran, vinyl ethers, tetrahydronaphthalene.

Compounds that have the potential to form peroxide polymers, a highly dangerous form of peroxide which precipitate from solution easily and are extremely heat and shock-sensitive. Maximum storage time = 12 months.

Examples: acrylic acid, acrylonitrile, butadiene, chloroprene, chlorotrifluoroethylene, methyl methacrylate, styrene, tetrafluoroethylene, vinyl acetate, vinyl chloride, vinyl pyridine. Storage times begin once the chemical's container has been opened.

B. Handling Procedures for Peroxide Forming Chemicals

Date all peroxide forming chemical upon receipt and opening. Efforts should be made to purchase and use small quantities of these chemicals for laboratory use.

Do not open any container, which has obvious crystal formation around lid. If a container with crystal formations are found, contact Environmental Health and Safety immediately at (412) 647-6409.

Handling procedures for flammable chemicals shall also be followed.

REACTIVE CHEMICALS

This category includes explosives, oxidizers, reducers, water sensitive, acid sensitive, air sensitive and unstable chemicals. These substances are capable of producing toxic gases, explosive mixtures, being explosive, reacting with water violently and they may contain cyanide or sulfide. Reactive chemicals exhibit moderate to extremely rapid reaction rates and include materials capable of rapid release of energy by themselves (self-reaction, or polymerization), and/or rates of reaction that may be increased by heat, pressure or by contact with incompatible substances.

Reactivity of individual chemicals in specific chemical classes (e.g., alkali metals) varies considerably. This rate of activity may also vary as a result of aging or contamination.

REACTIVE MATERIALS SHOULD ONLY BE HANDLED BY KNOWLEDGEABLE AND TRAINED PERSONNEL. WHEN QUESTIONS ARISE, REFER TO THE MSDS OR CONTACT THE UPMC EH&S OFFICE AT (412) 647-6409.

A. Hazardous Properties

Pyrophoric - spontaneous ignition in contact with air

Polymerizable - Spontaneous polymerization in contact with air.

Oxidizer - violent reaction in contact with organic materials or strong reducing agents.

B. Special Handling Instructions

Pyrophoric - prevent contact with air or water; use and store in inert environments.

Polymerizable - keep cool and avoid contact with water.

Oxidizer - use minimum amounts for procedure; do not keep excessive amounts of material in the vicinity of process; store properly, away from organic materials, flammable materials and reducers.

Protect containers from physical damage, heat and incompatible chemicals.

ULTRAVIOLET LIGHT (UV)

A. UV Hazards

Ultra-violet light (UV) is defined as electromagnetic radiation in the spectral region between 180 and 400 nanometers (nm). Immediate or prolonged exposure to UV light can result in painful eye injury, skin burn, premature skin aging, or skin cancer. Individuals who work with or in areas where UV sources are used are at risk for UV exposure if the appropriate shielding and protective equipment is not used

The permissible exposure limit for UV light is somewhat complicated to determine. The limit is based on the wavelengths of the specific region of the UV spectrum to which the individual is exposed, the duration of the exposure, and the intensity of the light. As a benchmark, the threshold at which eye injury is experienced is 10 milliJoules/cm2. This level represents varying amounts of exposure time for many of the UV sources used.

B. Scope and Application

UV sources can be used or generated at a variety of locations. The areas or sources for which there is a potential for exposure to UV light include, but are not limited to:

- welding operations
- biological laboratories where gels are viewed
- areas in which germicidal UV lights are used, including biological safety cabinets
- science laboratories where Mineralights are used to cause fluorescence
- mercury vapor lamps with broken or missing envelopes

For some of the sources described, the user many not be fully protected from UV light exposure by any inherent shielding around the source or the user may not be aware of the hazards of UV light. The purpose of the UV Light Safety Program is to ensure that the safeguards necessary to limit exposure have been implemented

C. Program Description

Monitoring

Most UV light sources have the potential of causing photokeratitis (eye injury) with only short exposure periods and should, therefore, be used in a manner, which limits exposure time. Sources may also be surveyed at the discretion of EHS.

Many overexposures to UV light have occurred when the exposed individual was not aware of the hazards of the UV source. To prevent eye and skin injuries, sources of UV light must be conspicuously labeled with a warning attached to the housing of the source. The warning sign should state:

WARNING
DO NOT EXPOSE EYES AND SKIN TO ULTRA-VIOLET LIGHT
RAYS MAY BE HARMFUL TO UNPROTECTED EYES AND SKIN
or
WARNING
THIS DEVICE PRODUCES POTENTIALLY HARMFUL UV LIGHT
PROTECT EYES AND SKIN FROM EXPOSURE TO UV LIGHT

Warning signs are available from commercial suppliers or may be available from the manufacturer of the ultraviolet light product.

UV Light Protection

The key to effectively reducing UV exposure is to properly shield the source and to require that users wear the appropriate personal protection. Personal protection that is appropriate includes long sleeves, UV protective goggles and face shields.

First Aid

The symptoms of UV overexposure to the skin are well known and characteristically called sunburn. However, the symptoms of overexposure to the eyes are not widely known. They are:

- a burning and painful sensation in the eye
- a sensitivity to light
- the sensation of a foreign object in the eye, sometimes described as sand in the eye
- tearing

These symptoms usually develop several hours after the overexposure occurred. If an eye or skin injury is suspected, the individual should be examined by a physician. During work hours, staff may go to Employee Health. After hours, staff should go to the Emergency Room.

Training

Individuals who use UV sources need training that is commensurate with the associated hazards. Training is provided by the Lab CHO and includes:

- effects of UV light
- units of measuring UV light
- recommended UV exposure limits
- types of protective equipment and shielding
- handling medical emergencies

It is the responsibility of the supervisor to assure that individuals using UV light sources attend training and to keep records of attendance.

APPENDIX B
UPMC LABORATORY STAFF INSPECTION CHECKLIST

Date ____/____/____

Location:_____

Dept:_____Lab Supervisor:_____

		YES	NO
A.	**Fire/Electrical**		
1.	Is a copy of the Fire Safety Plan available	_____	_____
2.	Electrical cords are in good condition	_____	_____
3.	Extinguishers are inspected and accessible	_____	_____
4.	Exits/aisles/stairwells are clear	_____	_____
5.	Lab equipment has been inspected annually	_____	_____
B.	**Chemical Use**		
6.	Is a copy of the Chemical Hygiene Plan available	_____	_____
7.	Perchloric acid in proper hood	_____	_____
8.	Volatile operations in hood	_____	_____
9.	Hazards posted (radiation, biohazard, etc.)	_____	_____
10.	Proper waste disposal	_____	_____
11.	Is there an up to date chemical inventory available	_____	_____
12.	MSDS's are current and available	_____	_____
C.	**Chemical Storage**		
13.	Incompatibles are separate	_____	_____
14.	Flammables in approved cabinet	_____	_____
15.	Secondary containers labeled	_____	_____
16.	Compressed gas cylinders secured	_____	_____
17.	Floor storage avoided	_____	_____
D.	**Emergency**		
18.	Eye wash/shower present, working & inspected	_____	_____
19.	Spill kit available and well stocked	_____	_____
20.	Emergency phone list posted	_____	_____
21.	Evacuation routes posted	_____	_____
E.	**Safety and Hygiene**		
22.	Respirators authorized by EH&S	_____	_____
23.	Protective clothing/equipment available	_____	_____
24.	Work area clean/tidy	_____	_____
25.	No food/drink in lab	_____	_____
26.	Hoods functioning/inspected annually	_____	_____
27.	Other: _____	_____	_____

F. Comments on Deficiencies:

APPENDIX C
Laboratory Chemical Spill Response Procedure

IN THE EVENT OF A CHEMICAL SPILL, USE THE FOLLOWING PROCEDURE:

1. Stop the source of the spill as soon as possible if it is safe to do so. Once stopped, position the container to prevent further contamination, etc. Staff members that have become contaminated should utilize emergency equipment (i.e. drench showers, eyewash station, drench hoses).
2. EVACUATE all persons in the affected area. Isolate the area by using physical barriers and post "Do Not Enter" signs.
3. Notify the immediate supervisor and, if additional information or direction is needed, contact the UPMC EH&S Office at **(412) 647-6409.**
4. If possible, increase the exhaust ventilation in area. Call the telephone numbers listed below for your building.

BST, MUH, PUH, Scaife	**(412) 647-3331**
WPIC	**(412) 246-5350**
CLSI	**(412) 185-5151**
Hillman	**(412) 623-2534**

5. Call Security for notification and, if necessary, control of the area.

BST	**(412) 648-2555**	**CLSI**	**(412) 185-5151**
MUH	**(412) 648-2555**	**PUH**	**(412) 647-3191**
Scaife Hall	**(412) 647-3191**	**WPIC**	**(412) 246-6911**
SHY	**(412) 623-2990**	**Hillman**	**(412) 623-2990**

6. Put on PPE as specified on the MSDS. At the minimum, gloves and splash-proof goggles must be worn. An apron and shoe covers are optional dependant on the location, quantity and the hazards associated with the spilled chemical.

7. Use spill pillows, pads and appropriate absorbent to absorb the spill and decrease any vapors. Apply appropriate neutralizer to the affected area (Be sure to read instructions on the spill kit).

8. Place any contaminated material into a plastic bag, preferably a **yellow** hazardous material bag (found in spill kits). **DO NOT use the red biohazard bags.** Label the bag with a "Hazardous Waste" label and contact the EH&S Office at (412) 647-6409 for disposal.

9. Do not allow personnel to reenter the area until clean up actions have been completed. UPMC Engineering and Maintenance may be contacted to finalize cleanup efforts (e.g. remove neutralizer residue).

10. Complete an Incident Report and forward to your immediate supervisor.

*** ***IF THE SPILL IS LARGE AND POSES A THREAT TO PERSONNEL, THE ENVIRONMENT OR PROPERTY, EVACUATE ALL STAFF MEMBERS FROM THE AFFECTED AREA AND NOTIFY EH&S - (412) 647-6409.***

APPENDIX D
Emergency Telephone Numbers

DEPARTMENT		PHONE NUMBER
UPMC Environmental Health & Safety Oakland Office Number	—	**(412) 647-6409**
UPMC Environmental Health & Safety 24 hour long-range pager	—	**(412) 392-7491**
UPMC Environmental Health & Safety Shadyside Office Number	—	**(412) 623-2407**
WPIC Safety & Security Office	—	**(412) 586-9742**
UPMC Work Partners	—	**(412) 647-3695**
Radiation Safety Office	—	**(412) 624-2728**
University of Pittsburgh EH&S	—	**(412) 624-9505**
Security		
• Biomedical Science Tower	—	**(412) 648-2555**
• Central Laboratory Services Inc.	—	**(412) 185-5151**
• Eye & Ear Institute	—	**(412) 648-2555**
• Hillman Cancer Center	—	**(412) 623-2990**
• Montefiore University Hospital	—	**(412) 648-2555**
• Presbyterian University Hospital	—	**(412) 648-3191**
• Scaife Hall	—	**(412) 647-3191**
• Shadyside Hospital	—	**(412) 623-2990**
• Western Psychiatric Institute & Clinic	—	**(412) 246-6911**
Medical Emergencies		
• Biomedical Science Tower	—	**9-1-1 Then (412)648-2555**
• Central Laboratory Services Inc.	—	**(412) 647-3131**
• Eye & Ear Institute	—	**(412) 647-3131**
• Hillman Cancer Center	—	**9-1-1**
• Montefiore University Hospital	—	**(412) 647-3131**
• Presbyterian University Hospital	—	**(412) 647-3131**

APPENDIX D
Emergency Telephone Numbers

• Scaife Hall	—	**9-1-1**
• Shadyside Hospital	—	**(412) 623-3131**
• Western Psychiatric Institute & Clinic	—	**(412) 246-5555**
Engineering and Maintenance (Oakland)	—	**(412) 647-3370**
Engineering and Maintenance (Shadyside)	—	**(412) 623-2534**
Engineering and Maintenance (WPIC)	—	**(412) 246-5350**
Pittsburgh Poison Center	—	**(412) 681-6669**

APPENDIX E
Exposure Limits For Chemicals Commonly Used at UPMC*

Acetic Acid - Clear liquid. Moderate fire risk, pure acetic acid is toxic by ingestion. **PEL - 10 ppm.**

Acetonitrile - Colorless, limpid liquid. Flammable, fire risk. Toxic action by skin absorption and inhalation. **PEL - 40 ppm, STEL 60 ppm.**

Acrylamide - Colorless crystals. Toxic by skin absorption. **PEL - 0.03 mg/m3, suspect carcinogen.**

Barium Hydroxide (All compounds of Barium) - Silver white metal. Flammable at room temp, store under inert gas. **PEL - 0.5 mg/m3.**

Benzene - Highly toxic. Dangerous fire risk. **PEL - 1 ppm, STEL - 5 ppm.**

Butyl Alcohol - Colorless liquid. Toxic on prolonged exposure. Flammable. **TLV - Ceiling of 50 ppm.**

Cadmium - Flammable in powder form. Toxic by inhalation of dust or fume.
PEL - 0.05 mg/m3. A carcinogen.

Chloroform - Colorless liquid, sweet taste. Toxic by inhalation, anesthetic, may be fatal. **PEL - 2 ppm.**

Chromic Acid - Dark purplish-red crystals. Powerful oxidizing agent, may explode on contact with reducing agents. May ignite on contact with organic materials. A poison. **TLV - 0.05 mg/m3, STEL - 0.1 mg/m3. A human carcinogen.**

Enflurane (Ethrane) - Clear liquid. Volatile with anesthetic properties, but non-flammable. **PEL - 1 ppm.**

Ethyl Acetate - Colorless, fragrant liquid. Toxic by inhalation and skin absorption. Very flammable. **PEL - 400 ppm.**

Ethyl Ether - Colorless, mobile liquid. Central nervous system depressant by inhalation and skin absorption. Severe fire and explosion hazard. **PEL - 400 ppm, STEL - 500 ppm.**

Formaldehyde - Moderate fire risk. Toxic by inhalation, strong irritant, a carcinogen. Avoid breathing vapor and avoid skin contact. **PEL - 0.75 ppm.**

Formic Acid - Colorless liquid. Corrosive to skin and tissue. **PEL - 5 ppm.**

Exposure Limits For Chemicals Commonly Used at UPMC*

Glutaraldehyde - Irritant. **REL - 0.2 ppm. TLV-.05 ppm.**

Glycerol – TLV - 10 mg/m3.

Hematoxylin - Yellow crystals. May be carcinogenic.

Hexane - Colorless liquid. Flammable, dangerous fire risk. **PEL - 50 ppm.**

Hydrazine - Colorless fuming liquid. Severe explosion hazard when exposed to heat or by reaction with oxidizers. Toxic by ingestion, or inhalation. **PEL - 0.1 ppm. Suspect human carcinogen.**

Isoamyl Alcohol - Moderate fire risk. Vapor is toxic and irritant. **PEL - 100 ppm, STEL - 125 ppm.**

Lead - Toxic by ingestion and inhalation of dust and fume. A cumulative poison. **TLV - 0.15 mg/m3.**

Mercuric Chloride - White crystals or powder. Toxic by ingestion, inhalation and skin absorption. **TLV - 0.05 mg/m3.**

Mercury - Mercury, metallic: Highly toxic by skin absorption and inhalation of fume or vapor, absorbed by respiratory and intestinal tract. **PEL - 0.1 mg/m3, STEL - 0.03 mg/m3.**

Methyl Alcohol (Methanol) - Colorless liquid. Flammable. Toxic by ingestion. **PEL - 200 ppm, STEL - 250 ppm.**

Methylene Chloride (Dichloromethane) - Colorless, volatile liquid. Toxic, a narcotic. **TLV - 50 ppm.**

Perchloric Acid - Strong oxidizing agent, will ignite vigorously in contact with organic materials, or detonate by shock or heat. Toxic by ingestion and inhalation, strong irritant.

Phenol - White crystals, absorbs water from air and liquefies. Toxic by ingestion, inhalation and skin absorption. **PEL - 5 ppm.**

Phosphoric Acid - Toxic by ingestion and inhalation, irritant to skin and eyes. **PEL - 1 mg/m3, STEL - 3 mg/m3.**

Picric Acid - Yellow crystals. Severe explosion risk when shocked or heated. Toxic by skin absorption. **PEL- 0.1 mg/m3.**

Exposure Limits For Chemicals Commonly Used at UPMC*

Potassium Hydroxide - Toxic by ingestion and inhalation, strong caustic, handle with gloves or tongs, corrosive to tissue. **STEL- 2 mg/m3.**

Propyl Alcohol (Propanol)- Colorless liquid. Dangerous fire risk. Toxic by skin absorption. **PEL- 200 ppm, STEL- 250 ppm.**

Silver Nitrate - Colorless crystals becoming gray when exposed to light. Strong irritant to skin and tissue. **TLV- 0.01 mg/m3.**

Sodium Azide - Colorless crystals. Highly toxic. **STEL- 0.1 ppm.**

Sodium Hydroxide - Corrosive to tissue in presence of moisture. **STEL- 2 mg/m3.**

Sulfuric Acid - Strongly corrosive. Strong irritant to tissue. Keep away from water. **PEL- 1 mg/m3.**

Toluene - Colorless liquid. Flammable. **PEL- 100 ppm, STEL- 150 ppm.**

Uric Acid - Evolves highly toxic hydrogen cyanide when heated which is flammable and has a **TLV- 10 ppm.**

Xylene - Clear liquid, moderate fire risk. Toxic by ingestion and inhalation. **PEL - 100 ppm, STEL- 150 ppm.**

* **NOTE: This is not an all-inclusive list of hazardous chemicals at the UPMC. Please refer to Appendix G for a complete list of OSHA's PEL's. If there are any further questions regarding toxicity or exposure to hazardous chemicals, please contact the UPMC Environmental Health & Safety Office at (412) 647-6409.**

OSHA STANDARD - 29 CFR 1910.1450
"OCCUPATIONAL EXPOSURE TO HAZARDOUS CHEMICALS IN LABORATORIES"

(a)

Scope and application.

(a)(1)

This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(a)(2)

Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

(a)(2)(i)

For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2)(iii) of this section apply.

(a)(2)(ii)

Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(a)(2)(iii)

Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements paragraphs (d) and (g)(1)(ii) of this section shall apply.

(a)(3)

This section shall not apply to:

(a)(3)(i)

Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart 2, even if such use occurs in a laboratory.

(a)(3)(ii)

Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(a)(3)(ii)(A)

Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

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(a)(3)(ii)(B)

Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

(b)

Definitions -

"Action level" means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Carcinogen" (see "select carcinogen").

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

"Chemical Hygiene Plan" means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

"Combustible liquid" means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 C) as determined by ASTM D-323-72.

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

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

"Employee" means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

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

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flashpoint by Pensky-Martens Closed Tester, Z11.7 - 1979 (ASTM D 93-79)) - for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

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

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Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

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

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

"Laboratory-type hood" means a device located in a laboratory, enclosure on five sides with a movable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

"Laboratory use of hazardous chemicals" means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

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

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

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

"Physical hazard" means a chemical for which there is scientifically valid evidence tat it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer pyrophoric, unstable (reactive) or water-reactive.

"Protective laboratory practices and equipment" means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

29 CFR 1910.1450 - OSHA's Laboratory Safety Standard Cont...

"Reproductive toxins" means chemicals which affect the reproductive chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis).

"Select carcinogen" means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP)(latest edition); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for research on Cancer Monographs (IARC)(latest editions); or

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3);

(B) After repeated skin application of less than 300 (mg/kg of body weight) per week; or

(C) After oral dosages of less than 50 mg/kg of body weight per day.

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

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

(c)

Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

(d)

Employee exposure determination -

(d)(1)

Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(d)(2)

Periodic monitoring. If the initial monitoring prescribed by paragraph (d)(1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(d)(3)

Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

(d)(4)

Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e)

Chemical hygiene plan - General. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan).

(e)(1)

Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

(e)(1)(i)

Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

(e)(1)(ii)

Capable of keeping exposures below the limits specified in paragraph (c) of this section.

(e)(2)

The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

(e)(3)

The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection;

(e)(3)(i)

Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(e)(3)(ii)

Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

(e)(3)(iii)

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A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(e)(3)(iv)

Provisions for employee information and training as prescribed in paragraph (f) of this section;

(e)(3)(v)

The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

(e)(3)(vi)

Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

(e)(3)(vii)

Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer, and, if appropriate, establishment of a Chemical Hygiene Committee; and

(e)(3)(viii)

Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(e)(3)(viii)(A)

Establishment of a designated area;

(e)(3)(viii)(B)

Use of containment devices such as fume hoods or glove boxes;

(e)(3)(viii)(C)

Procedures for safe removal of contaminated waste; and

(e)(3)(viii)(D)

Decontamination procedures.

(e)(4)

The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

(f)

Employee information and training.

(f)(1)

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The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(f)(2)

Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

(f)(3)

Information. Employees shall be informed of:

(f)(3)(i)

The contents of this standard and its appendices which shall be made available to employees;

(f)(3)(ii)

the location and availability of the employer's Chemical Hygiene Plan;

(f)(3)(iii)

The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(f)(3)(iv)

Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(f)(3)(v)

The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier.

(f)(4)

Training.

(f)(4)(i)

Employee training shall include:

(f)(4)(i)(A)

Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(f)(4)(i)(B)

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The physical and health hazards of chemicals in the work area; and

(f)(4)(i)(C)

The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

(f)(4)(ii)

The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g)

Medical consultation and medical examinations.

(g)(1)

The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(g)(1)(i)

Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(g)(1)(ii)

Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(g)(1)(iii)

Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(g)(2)

All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(g)(3)

Information provided to the physician. The employer shall provide the following information to the physician:

(g)(3)(i)

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The identity of the hazardous chemical(s) to which the employee may have been exposed;

(g)(3)(ii)

A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(g)(3)(iii)

A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(g)(4)

Physician's written opinion.

(g)(4)(i)

For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(g)(4)(i)(A)

Any recommendation for further medical follow-up;

(g)(4)(i)(B)

The results of the medical examination and any associated tests;

(g)(4)(i)(C)

Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace; and

(g)(4)(i)(D)

A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(g)(4)(ii)

The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h)

Hazard identification.

(h)(1)

With respect to labels and material safety data sheets:

(h)(1)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(h)(1)(ii)

Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(h)(2)

The following provisions shall apply to chemical substances developed in the laboratory:

(h)(2)(i)

If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

(h)(2)(ii)

If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(h)(2)(iii)

If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of material safety data sheets and labeling.

(i)

Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

(j)

Recordkeeping.

(j)(1)

The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

(j)(2)

The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

(k)

Dates -

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(k)(1)

Effective date. This section shall become effective May 1, 1990.

(k)(2)

Start-up dates.

(k)(2)(i)

Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

(k)(2)(ii)

Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(l)

Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

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29 CFR 1910.1000 SUBPART Z
TOXIC AND HAZARDOUS SUBSTANCES

TABLE Z-1 Limits for Air Contaminants

NOTE: Because of the length of this 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 Number	PEL (ppm)	PEL (mg/m3)	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				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
(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			
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.	71-43-2			
See Table Z-2 for				
the limits				
applicable in the				
operations or				
sectors excluded				
in 1910.1028(d)				
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			

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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;	106-99-0	1 ppm/5		
29 CFR 1910.19(1)....		ppm STEL		
Butanethiol;				
see Butyl mercaptan.				
2-Butanone				
(Methyl ethyl ketone)	78-93-3	200	590	
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			

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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)				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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.....				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	2	6	
	4170-30-3			
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	
3,3'-Dichlorobenzidine;				
see 1910.1007.....	91-94-1			
Dichlorodifluoromethane	75-71-8	1000	4950	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
Dimethylaminobenzene;				
see Xylidine.....				
Dimethylaniline				
(N,N-Dimethylaniline)	121-69-7	5	25	X
Dimethylbenzene;				
see Xylene.....				
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				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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..				
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
Methyl amyl alcohol;				
see Methyl Isobutyl				
carbinol.....				
Methyl n-amyl ketone...	110-43-0	100	465	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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
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;				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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...				

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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			

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
Total dust.....		.....	15	
Respirable fraction..		.....	5	
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	

Substance	CAS Number	PEL (ppm)	PEL (mg/m3)	Skin Designation
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	
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.

TABLE Z-2 Toxic and Hazardous Substances

Substance	*8-Hour Time Weighted Average*	*Acceptable Ceiling Concentration*	*Acceptable Maximum Peak Above the Ceiling Concentration for an 8-Hour 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.
Fluoride as dust (Z37.28-1969).....	2.5 mg/m(3)	.....	.....	
Formaldehyde: see 1910.1048..... (Z37.28-1969).....	3 ppm.....	.....	.....	
Hydrogen sulfide (Z37.2-1966).....	.....	20 ppm.....	50 ppm...	10 minutes only once if no other measured exposure occurs.
Mercury (Z37.8-1971).....	.....	1 mg/10m(3)	.....	
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.

TABLE Z-3: Mineral Dusts

Substance	mppcf[2]	mg/m^3
Silica:		
Crystalline		
Quartz (respirable)	250[b]	10 mg/m^3 [e]
Quartz (Total Dust)	%SiO_2+5	% SiO_2+2 30 mg/m^3
Cristobalite: Use ½ the value calculated from the count or mass formula for quartz. Tridymite: Use ½ the value calculated from the count or mass formula for quartz.		% SiO_2+2
Amorphous, including natural diatomaceous earth	20	80 mg/m^3 [c] % SiO_2
Silicates (less then 1% crystalline silicates):		
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/m^3 [a]
Respirable fraction greater than 5% SiO_2		10 mg/m^3 [a] % SiO_2+2
Inert or Nuisance Dust [d]		
Respirable fraction	15	5 mg/m^3
Total Dust	50	15 mg/m^3

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.

APPENDIX H
Reproductive Toxins

REPRODUCTIVE TOXINS

Reference: "Catalog of Teratogenic Agents", T.H. Shepard, 6th ed., Johns Hopkins Press, 1989

Drugs and Environmental Chemicals

aminopterin
androgenic hormones
busulfan
chlorobiphenyls
coumarin anticoagulants
cyclophosphamide
diethylstilbestrol
diphenylhydantoin
etretinate
lithium
methylaminopterin
virus
mercury, organic
methimazole and scalp defects
penicillamine
13-cis-retinoic acid
tetracyclines
thalidomide
trimethadione
valproic acid

Radiation

ionizing radiation

Infections

cytomegalovirus
herpes virus hominis
parvovirus B-19
rubella virus
syphilis
toxoplasmosis
venezuelan equine encephalitis

Reference: "Liste Des Produits Purs Tertogenes, Mutagenes, Cancerogenes", Service du Repertoire Toxicologique, Commission De la Sante, et de la Securite du Travil, Desjardins Montreal (Quebec) H5B 1c2, Gouvernement du Quebec, October, 1989

List of Proven Teratogens and Mutagens

calcium arsenate
benzene
dimethylmercury
5-fluorouracil
methotrexate
methylmercury
dinitrogen pentoxide

APPENDIX I
List of Known or Suspected Carcinogens

The following list is a compilation of information from substance registries for known and suspected carcinogens from the National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC) and the Occupational Health and Safety Administration OSHA. This list conveys a weight of evidence approach and does not incorporate level of risk. A risk assessment should include considerations such as exposure, dose and biochemical relevance. These agencies are recognized as authoritative sources of information on the carcinogenicity of chemicals. The International Agency for Research on Cancer (IARC) has evaluated the majority of these chemicals and placed them in one of the following classifications:

Group 1	-	The agent is carcinogenic to humans.
Group 2A	-	The agent is probably carcinogenic to humans.
Group 2B	-	The agent is possibly carcinogenic to humans.
Group 3	-	The agent is not classifiable as to its carcinogenicity to humans.
Group 4	-	The agent is probably not carcinogenic to humans.

Following is an IARC chart listing materials found to be Group 1, Group 2A or Group 2B and an NTP Chart listing the materials that are known carcinogens or are reasonably suspected of being carcinogens.

IARC Listing

IARC Group 1 Substances

1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU; Semustine)	Chemical
1,4-Butanediol dimethanesulfonate (Busulphan; Myleran)	Chemical
2,3,7,8-Tetrachlorodibenzo-para-dioxin	Chemical
2-Naphthylamine	Chemical
4-Aminobiphenyl	Chemical
8-Methoxypsoralen (Methoxsalen) plus ultraviolet A radiation	Chemical
Aflatoxins (naturally occurring mixtures of)	Chemical
Alcoholic beverages	Mixture
Aluminum production	Exposure Circumstance
Analgesic mixtures containing phenacetin	Mixture
Areca nut	Mixture
Arsenic and arsenic compounds	Chemical
Arsenic in drinking water	Exposure Circumstance
Asbestos	Chemical
Auramine, manufacture of	Exposure Circumstance

List of Known or Suspected Carcinogens

IARC Group 1 Substances

Azathioprine	Chemical
Benzene	Chemical
Benzidine	Chemical
Beryllium and beryllium compounds	Chemical
Betel quid with tobacco	Mixture
Betel quid without tobacco	Mixture
Bis(chloromethyl)ether and chloromethyl methyl ether (technical-grade)	Chemical
Boot and shoe manufacture and repair	Exposure Circumstance
Cadmium and cadmium compounds	Chemical
Chlorambucil	Chemical
Chromium [VI] compounds	Chemical
Coal gasification	Exposure Circumstance
Coal-tar pitches	Mixture
Coal-tars	Mixture
Coke production	Exposure Circumstance
Cyclophosphamide	Chemical
Cyclosporin (ciclosporin)	Chemical
Diethylstilbestrol (DES)	Chemical
Epstein-Barr virus	Chemical
Erionite	Chemical
Estrogen therapy, postmenopausal	Chemical
Estrogens, nonsteroidal	Chemical
Estrogens, steroidal	Chemical
Ethylene oxide	Chemical
Etoposide in combination with cisplatin and bleomycin	Chemical
Formaldehyde	Chemical
Furniture and cabinet making	Exposure Circumstance
Gallium arsenide	Chemical
Gamma radiation	Chemical
Helicobacter pylori (infection with)	Chemical
Hematite mining (underground) with exposure to radon	Exposure Circumstance
Hepatitis B virus (chronic infection with)	Chemical
Hepatitis C virus (chronic infection with)	Chemical
Herbal remedies containing plant species of the genus Aristolochia	Chemical
Human immunodeficiency virus type 1 (infection with)	Chemical
Human papillomavirus type 16	Chemical
Human papillomavirus type 18	Chemical
Human T-cell lymphotropic virus type I	Chemical
Involuntary smoking	Exposure Circumstance
Iron and steel founding	Exposure Circumstance
Isopropanol manufacture (strong-acid process)	Exposure Circumstance
Magenta, manufacture of	Exposure Circumstance

List of Known or Suspected Carcinogens

IARC Group 1 Substances

Melphalan	Chemical
Mineral oils, untreated and mildly treated	Mixture
MOPP and other combined chemotherapy including alkylating agents	Chemical
Mustard gas (Sulfur mustard)	Chemical
N,N-Bis(2-chloroethyl)-2-naphthylamine (Chlornaphazine)	Chemical
Neutrons	Chemical
Nickel compounds	Chemical
Opisthorchis viverrini (infection with)	Chemical
Oral contraceptives, combined	Chemical
Oral contraceptives, sequential	Chemical
Painter (occupational exposure as a)	Exposure Circumstance
Phosphorus-32, as phosphate	Chemical
Plutonium-239 and its decay products (may contain plutonium-240 and other isotopes), as aerosols	Chemical
Radioiodines, short-lived isotopes, including iodine-131, from atomic reactor accidents and nuclear weapons detonation (exposure during childhood)	Chemical
Radionuclides, alpha-particle-emitting, internally deposited	Chemical
Radionuclides, beta-particle-emitting, internally deposited	Chemical
Radium-224 and its decay products	Chemical
Radium-226 and its decay products	Chemical
Radium-228 and its decay products	Chemical
Radon-222 and its decay products	Chemical
Rubber industry	Exposure Circumstance
Salted fish (Chinese-style)	Mixture
Schistosoma haematobium (infection with)	Chemical
Shale-oils	Mixture
Silica, crystalline (inhaled in the form of quartz or cristobalite from occupational sources)	Chemical
Solar radiation	Chemical
Soots	Mixture
Strong inorganic acid mists containing sulfuric acid (occupational exposure to)	Exposure Circumstance
Talc containing asbestiform fibers	Chemical
Tamoxifen	Chemical
Thiotepa	Chemical
Thorium-232 and its decay products, administered intravenously as a colloidal dispersion of thorium-232 dioxide	Chemical
Tobacco products, smokeless	Mixture
Tobacco smoking	Exposure Circumstance
Treosulfan	Chemical
Vinyl chloride	Chemical
Wood dust	Mixture
X- and Gamma radiation	Chemical

List of Known or Suspected Carcinogens

IARC Listing

IARC Group 2A Substances

1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea (CCNU)	Chemical
1,2,3-Trichloropropane	Chemical
1,2-Dimethylhydrazine	Chemical
1,3-Butadiene	Chemical
4,4´-Methylene bis(2-chloroaniline) (MOCA)	Chemical
4-Chloro-ortho-toluidine	Chemical
5-Methoxypsoralen	Chemical
a-Chlorinated toluenes (benzal chloride, benzotrichloride, benzyl chloride) and benzoyl chloride (combined exposures)	Chemical
Acrylamide	Chemical
Adriamycin	Chemical
Androgenic (anabolic) steroids	Chemical
Aristolochic acids (naturally occurring mixtures of)	Chemical
Art glass, glass containers and pressed ware (manufacture of)	Exposure Circumstance
Azacitidine	Chemical
Benz[a]anthracene	Chemical
Benzidine-based dyes	Chemical
Benzo[a]pyrene	Chemical
Bischloroethyl nitrosourea (BCNU)	Chemical
Captafol	Chemical
Chloramphenicol	Chemical
Chlorozotocin	Chemical
Cisplatin	Chemical
Clonorchis sinensis (infection with)	Chemical
Cobalt metal with tungsten carbide	Exposure Circumstance
Creosotes (from coal-tars)	Mixture
Dibenz[a,h]anthracene	Chemical
Diesel engine exhaust	Mixture
Diethyl sulfate	Chemical
Dimethyl sulfate	Chemical
Dimethylcarbamoyl chloride	Chemical
Epichlorohydrin	Chemical
Ethylene dibromide	Chemical
Etoposide	Chemical
Glycidol	Chemical
Hairdresser or barber (occupational exposure as a)	Exposure Circumstance
Hot materials	Mixture
Human papillomavirus type 31	Chemical
Human papillomavirus type 33	Chemical
Indium phosphide	Chemical
IQ (2-Amino-3-methylimidazo[4,5-f]quinoline)	Chemical

List of Known or Suspected Carcinogens

IARC Group 2A Substances

Kaposi's sarcoma herpesvirus/human herpesvirus 8 (KSHV/HHV-8)	Chemical
Lead compounds, inorganic	Chemical
Methyl methanesulfonate	Chemical
N-Ethyl-N-nitrosourea	Chemical
Nitrogen mustard	Chemical
N-Methyl-N´-nitro-N-nitrosoguanidine (MNNG)	Chemical
N-Methyl-N-nitrosourea	Chemical
N-Nitrosodiethylamine	Chemical
N-Nitrosodimethylamine	Chemical
Non-arsenical insecticides (occupational exposures in spraying and application of)	Mixture
ortho-Toluidine	Chemical
Petroleum refining (occupational exposures in)	Exposure Circumstance
Phenacetin	Chemical
Polychlorinated biphenyls	Mixture
Procarbazine hydrochloride	Chemical
Styrene-7,8-oxide	Chemical
Sunlamps and sunbeds (use of)	Exposure Circumstance
Teniposide	Chemical
Tetrachloroethylene	Chemical
Trichloroethylene	Chemical
Tris(2,3-dibromopropyl) phosphate	Chemical
Ultraviolet radiation A	Chemical
Ultraviolet radiation B	Chemical
Ultraviolet radiation C	Chemical
Vinyl bromide	Chemical
Vinyl fluoride	Chemical

NTP Listing

NTP – Substances Classified as Known Carcinogens

1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (MeCCNU)	Erionite
1,3-Butadiene	Estrogens, Steroidal
1,4-Butanediol Dimethylsulfonate (busulfan, Myleran ®)	Ethylene Oxide
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD); "Dioxin"	Hepatitis B Virus
2-Naphthylamine	Hepatitis C Virus
4-Aminobiphenyl	Human Papilloma Viruses: Some Genital-Mucosal Types
Aflatoxins	Melphalan
Alcoholic Beverage Consumption	Methoxsalen with Ultraviolet A Therapy (PUVA)

List of Known or Suspected Carcinogens

NTP – Substances Classified as Known Carcinogens

Analgesic Mixtures Containing Phenacetin	Mineral Oils (Untreated and Mildly Treated)
Arsenic Compounds, Inorganic	Mustard Gas
Asbestos	Neutrons
Azathioprine	Nickel Compounds
Benzene	Radon
Benzidine	Silica, Crystalline (Respirable Size)
Beryllium and Beryllium Compounds	Smokeless Tobacco
bis(Chloromethyl) Ether and Technical-Grade Chloromethyl Methyl Ether	Solar Radiation
Cadmium and Cadmium Compounds	Soots
Chlorambucil	Strong Inorganic Acid Mists Containing Sulfuric Acid
Chromium Hexavalent Compounds	Sunlamps or Sunbeds, Exposure to
Coal Tar Pitches	Tamoxifen
Coal Tars	Thiotepa
Coke Oven Emissions	Thorium Dioxide
Cyclophosphamide	Tobacco Smoking
Cyclosporin A (Ciclosporin)	Ultraviolet Radiation, Broad Spectrum UV Radiation
Diethylstilbestrol (DES)	Vinyl Chloride
Dyes Metabolized to Benzidine	Wood Dust
Environmental Tobacco Smoke	X-Radiation and Gamma Radiation

NTP Listing

NTP – Substances Reasonably Anticipated To Be Carcinogens

1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea	Dimethylvinyl Chloride
1,1-Dimethylhydrazine	Disperse Blue 1
1,2,3-Trichloropropane	Dyes Metabolized to 3,3'-Dimethoxybenzidine
1,2-Dibromo-3-chloropropane	Dyes Metabolized to 3,3'-Dimethylbenzidine
1,2-Dibromoethane (Ethylene Dibromide)	Epichlorohydrin
1,2-Dichloroethane (Ethylene Dichloride)	Ethyl Methanesulfonate
1,3-Dichloropropene (Technical Grade)	Ethylene Thiourea
1,3-Propane Sultone	Formaldehyde (Gas)
1,4-Dichlorobenzene	Furan
1,4-Dioxane	Glasswool (Respirable Size)
1,6-Dinitropyrene	Glycidol
1,8-Dinitropyrene	Hexachlorobenzene
1-Amino-2,4-dibromoanthraquinone	Hexachlorocyclohexane Isomoers

List of Known or Suspected Carcinogens

NTP – Substances Reasonably Anticipated To Be Carcinogens

1-Amino-2-methylanthraquinone	Hexachloroethane
1-Nitropyrene	Hexamethylphosphoramide
2,2-bis-(Bromoethyl)-1,3-propanediol (Technical Grade)	Hydrazine and Hydrazine Sulfate
2,3-Dibromo-1-propanol	Hydrazobenzene
2,4,6-Trichlorophenol	Indeno[1,2,3-cd]pyrene
2,4-Diaminoanisole Sulfate	Iron Dextran Complex
2,4-Diaminotoluene	Isoprene
2-Acetylaminofluorene	Kepone® (Chlordecone)
2-Amino-1-methyl-6-phenylimidazo[4,5-b]pyridine (PhIP)	Lead and Lead Compounds
2-Amino-3,4-dimethylimidazo[4,5-f]quinoline (MeIQ)	Lindane and Other Hexachlorocyclohexane Isomers
2-Amino-3,8-dimethylimidazo[4,5-f]quinoxaline (MeIQx)	Methyl Methanesulfonate
2-Amino-3-methylimidazo[4,5-f]quinoline (IQ)	Methyleugenol
2-Aminoanthraquinone	Metronidazole
2-Methylaziridine (Propylenimine)	Michler's Ketone [4,4'-(Dimethylamino)benzophenone]
2-Nitropropane	Mirex
3,3'-Dichlorobenzidine and 3,3'-Dichlorobenzidine Dihydrochloride	Naphthalene
3,3'-Dimethoxybenzidine	Nickel (Metallic)
3,3'-Dimethylbenzidine	Nitrilotriacetic Acid
3-Chloro-2-methylpropene	Nitrobenzene
4-(N-Nitrosomethylamino)-1-(3-pyridyl)-1-butanone	Nitrofen (2,4-Dichlorophenyl-p-nitrophenyl ether)
4,4'-Methylenebis(2-chloroaniline)	Nitrogen Mustard Hydrochloride
4,4'-Methylenedianiline and 4,4'-Methylenedianiline Dihydrochloride	N-Methyl-N'-nitro-N-nitrosoguanidine
4,4'-Oxydianiline	N-Nitrosodiethanolamine
4,4'-Thiodianaline	N-Nitrosodiethylamine
4-4'-Methylenebis(N,N-dimethyl)benzenamine	N-Nitrosodimethylamine
4-Chloro-o-phenylenediamine	N-Nitrosodi-n-butylamine
4-Dimethylaminoazobenzene	N-Nitrosodi-n-propylamine
4-Nitropyrene	N-Nitrosomethylvinylamine
4-Vinyl-1-cyclohexene Diepoxide	N-Nitrosomorpholine
5-Methylchrysene	N-Nitroso-N-ethylurea
6-Nitrochrysene	N-Nitroso-N-methylurea
7H-Dibenzo[c,g]carbazole	N-Nitrosonornicotine
Acetaldehyde	N-Nitrosopiperidine
Acrylamide	N-Nitrosopyrrolidine
Acrylonitrile	N-Nitrososarcosine
Adriamycin® (Doxorubicin Hydrochloride)	Norethisterone
Amitrole	Ntromethane
Azacitidine (5-Azacytidine®, 5-AzaC)	o-Aminoazotoluene
Benz[a]anthracene	o-Anisidine Hydrochloride
Benzo[a]pyrene	Ochratoxin A
Benzo[b]fluoranthene	o-Nitroanisole
Benzo[j]fluoranthene	o-Toluidine and o-Toluidine Hydrochloride

List of Known or Suspected Carcinogens

NTP – Substances Reasonably Anticipated To Be Carcinogens

Benzo[k]fluoranthene	Oxymetholone
Benzotrichloride	p-Chloro-o-toluidine and p-Chloro-o-toluidine Hydrochloride
beta-Propiolactone	p-Cresidine
bis(Chloroethyl) nitrosourea	Phenacetin
Bromodichloromethane	Phenazopyridine Hydrochloride
Butylated Hydroxyanisole (BHA)	Phenolphthalein
C.I. Basic Red 9 Monohydrochloride	Phenoxybenzamine Hydrochloride
Carbon Tetrachloride	Phenytoin
Ceramic Fibers (Respirable Size)	Polybrominated Biphenyls (PBBs)
Chloramphenicol	Polychlorinated Biphenyls (PCBs)
Chlorendic Acid	Polycyclic Aromatic Hydrocarbons (PAHs)
Chlorinated Paraffins (C12, 60% Chlorine)	Procarbazine Hydrochloride
Chloroform	Progesterone
Chloroprene	Propylene Oxide
Chlorozotocin	Propylthiouracil
Cisplatin	Reserpine
Cobalt Sulfate	Safrole
Cupferron	Selenium Sulfide
Dacarbazine	Streptozotocin
Danthron (1,8-Dihydroxyanthraquinone)	Styrene-7,8-oxide
di(2-Ethylhexyl) Phthalate	Sulfallate
Diazoaminobenzene	Tetrachloroethylene (Perchloroethylene)
Dibenz[a,h]acridine	Tetrafluoroethylene
Dibenz[a,h]anthracene	Tetranitromethane
Dibenz[a,j]acridine	Thioacetamide
Dibenzo[a,e]pyrene	Thiourea
Dibenzo[a,h]pyrene	Toluene Diisocyanate
Dibenzo[a,i]pyrene	Toxaphene
Dibenzo[a,l]pyrene	Trichloroethylene
Dichlorodiphenyltrichloroethane (DDT)	tris(2,3-Dibromopropyl) Phosphate
Dichloromethane (Methylene Chloride)	Ultraviolet A Radiation
Diepoxybutane	Ultraviolet B Radiation
Diesel Exhaust Particulates	Ultraviolet C Radiation
Diethyl Sulfate	Urethane
Diglycidyl Resorcinol Ether	Vinyl Bromide
Dimethyl Sulfate	Vinyl Fluoride
Dimethylcarbamoyl Chloride	

List of Known or Suspected Carcinogens

References:

International Agency for Research on Cancer, Monograph Volumes 1-88, 1972-2004.

US Department of Health and Human Services, *National Toxicology Program*, Eleventh Annual Report on Carcinogens, 2005.

Occupational Safety and Health Administration, Code of Federal Regulations, 29 CFR 1910. 1000 - 29 CFR 1910.1052

APPENDIX J
Biological Exposure Procedure

In the event of an exposure to a biological or other potentially infectious substance from a spill, splash, puncture (e.g. needlestick) or other means, the following procedure should be followed:

1. Remove any contaminated clothing and wash affected area.

    * For an accidental puncture such as a needle stick, express a few drops of blood to reduce contamination.

2. Thoroughly wash the affected area with soap and water. If available, use an anti-microbial agent (e.g. anti-microbial soap, Cidostat).

3. Inform the immediate supervisor.

4. Report immediately to Work Partners on the fifth floor of the Medical Arts Building. If Work Partners is closed, report to the UPMC Emergency Department in the PUH lobby.

5. An Employee Incident Report should be filed by calling UPMC Work Partners Claim Management Services at 1 (800) 633-1197.

In the event that staff member clothing has been contaminated, a set of scrubs can be acquired by the following means:

Montefiore, Presbyterian, Central Labs - Call the Linen Room at 647-7369.
If the linen room is closed, call PUH Escort at 647-3636.

APPENDIX K
Specimen Collection

A. **Patient Contact**

1. Clothes must be clean, hands must be washed and new gloves must be worn prior to all patient contact.

2. The dress code should be adhered to so that jewelry, clothes or hair do not touch the patient.

3. All equipment used for specimen collection should be clean (or sterile when applicable).

4. Any item that becomes contaminated with blood or other potentially infectious materials should be discarded, if disposable. Non-disposable items must be disinfected prior to re-use.

B. **Venipuncture**

1. Only sterile disposable needles may be used.

2. Needles are to remain capped until just prior to use.

3. **Needles are never to be re-used.**

4. **Needles are to be discarded immediately** after specimen collection in an appropriate sharps container that is provided in all patient rooms and units and beside all phlebotomy chairs.

5. **Needles should not be recapped unless absolutely necessary**. The only acceptable method is the one handed scoop method, which should be used only after proper training. Secure cap at bottom next to barrel, not from the top. There have been incidences of needles puncturing the cap.

6. **Needles, clean or used, should never be left in any patient room** unless in a sharps container.

C. **Collection of non-blood sample in outpatient lab areas**

1. All specimen collection containers must be leak-proof.

2. Inspect container for any sign of damage to before use.

3. All specimen containers are to be properly and clearly labeled on the side of container instead of on the lid before collection. Proper identification of the patient must be done prior to specimen collection.

4. Patients must be given complete instructions for collection, including instructions to close or cap container, and the appropriate area to deposit sample when collected.

5. After collection by the patient, the staff member must inspect the specimen to ensure integrity. Check to ensure that:

   a. Seal is complete.
   b. Proper collection of specimen type must match requisition or computer label.
   c. The specimen is not leaking or shows any sign of contamination on the outside of the container. If contamination exists, transfer the specimen to another container when possible.

6. Only specimens in sealed plastic bags may be transported.

D. **Surgical specimen collection for pick-up**

1. Any employee entering the Operating Room to obtain a surgical specimen must be dressed appropriately. Proceed to the OR desk and ask staff for instructions.

2. Any specimen found to be leaking or improperly bagged is not to be picked up until the condition is improved. Surgical specimens may not be transferred into other containers. Specimens or requisitions with visible contamination are unacceptable and will not be transported until the container is cleaned or a new requisition is sent.

3. Surgical specimens submitted to the laboratory must conform to UPMC Policy 3514, Guidelines for Handling Sharps, (see the UPMC Policy and Procedure Manual or Appendix 6 of this manual). All specimens received

in the laboratory that do not conform to these guidelines must be rejected and disposed of according to the same guideline.

SHIPPING SPECIMENS FOR DIAGNOSTIC PURPOSES BY MAIL

A. General

All specimens sent to any outside facility must be packaged appropriately for the safety of all those who are involved with specimen handling. This is to ensure the safe transport of all body fluids and tissue that is shipped for the purpose of diagnosis. Several express mail services, such as the United Parcel Service and Federal Express Corporation, have established that specimens sent via their organizations must be packaged according to the following directions. If these guidelines are followed, the chance for accidental exposure is minimal.

1. Place specimen in a watertight primary receptacle. The specimens should be free of contaminants in a sealed, leakproof plastic container. The container should be properly labeled with the patient's name, medical record or social security number and specimen type.

2. Place the primary receptacle in a watertight secondary package such as a shipping can, sealed styrofoam container or sealed plastic bag.

3. Adequate packing materials are to be used to cushion specimen when placed in outside container. Place an absorbent material (paper towels, cotton balls, superabsorbent packet or cellulose wadding) between the primary receptacle and the secondary packaging. If multiple primary receptacles are placed into secondary packaging, they must be wrapped individually to prevent contact between them. The absorbent material must be adequate to absorb the entire contents of all primary receptacles. Ensuring that sufficient absorbent material is used is the responsibility of the shipper.

4. Place all receptacles in sturdy outside packaging constructed of corrugated fiberboard, metal, rigid plastic or wood. Plastic bags and paper envelopes are **UNACCEPTABLE** outer packaging. A label clearly identifying the destination must be placed on the outer container. This should also have the return address and identify the individual sending the package.

5. A requisition or letter of explanation must accompany the specimen and should be placed inside the shipping carton.

6. Affix a biohazard label on the outer container.

B. **Frozen Specimens**

1. If possible, the specimen should be frozen when packaged.

2. Dry ice should be used in an adequate volume (10:1 ratio) to keep the specimen frozen.

   Caution: Dry ice will cause burns to the skin. Always use gloves with proper insulation and never touch dry ice with bare hands.

3. The shipping container should be large enough to allow for the size of the container carrying the specimen, plus expansion. Provide small vent holes in the outer shipping box for the release of $C0_2$ gas that is a by-product of the dry ice as it evaporates.

   Caution: The outer shipping box should not be air tight when sealed.

4. Label the carton "freeze upon arrival."

5. Fill out the courier forms completely. The information should include the name of the person sending the specimen, its destination and the name of a contact person.

6. Affix a biohazard label to the package and indicate the package weight and that the specimen is being shipped in dry ice.

SPECIMEN TRANSPORT

Specimens must always be transported in a manner that ensures the safety of staff, patients, and visitors. Care must also be taken to ensure that the integrity of each specimen has not been compromised.

A. **Specimen**

1. All specimens to be transported should be tightly capped in leak proof containers.

2. Specimens are to be sealed in plastic bags and carried in an appropriately labeled biohazard transport bag. Biohazard labels must be affixed on the outside of the plastic bags that contain the specimens if leaving the facility.

3. Glass containers or tubes must be transported in support racks or in sturdy specimen baskets.

4. Specimens are to be transported in syringes only if protection has been provided against accidental ejection of specimen and the needle has been removed and replaced with a tightly fitting cap. While removal of the needle is preferred in all cases, an exception to this policy exists for microbiology specimens where concerns for extremely small sample size (rarely), sterility and anaerobiosis must be satisfied. Specimens received for culture in syringes that have the needle attached and covered with a durable sheath are acceptable and should be transported to the Microbiology Laboratory in that condition. Refer to the Microbiology Procedure Manual for more detailed directions on how to process these specimens in the laboratory.

5. Specimens transported in any type of fixative must have appropriate chemical labeling (per MSDS sheets) affixed to the container.

B. **Personnel**

1. All transport personnel must wear latex exam gloves to pick up all human or animal specimens.

2. Gloves must be discarded after each use. **GLOVES MUST NOT BE WORN ON EITHER HAND WHILE WALKING THROUGH ANY AREA IN THE FACILITY UNLESS PHYSICALLY HANDLING SPECIMENS.** This will minimize transfer of organisms to doors or elevators.

3. **Never carry specimens (regardless of the manner packed) into any eating area, gift shop, store or restaurant.**

4. Never carry specimens through a patient or visitor area unnecessarily.

C. **Pneumatic Tube System**

The Pneumatic tube system has been established for rapid transportation of patient specimens throughout the medical center. Please refer to Appendix 5 of this manual for complete instructions on the proper use of the pneumatic tube system.

APPENDIX L
Preparations for Leaving the Laboratory

GUIDELINES FOR LEAVING A LABORATORY

INTRODUCTION

Moving from one office to another can be complicated, throw in hazardous materials, hazardous waste and regulation from three or four federal agencies and then you begin to see how complicated moving a laboratory can be. This document focuses on hazardous materials, hazardous waste, UPMC policies and the regulations associated with hazardous materials in transportation. It will help you to decide how to handle the disposal and movement of hazardous chemicals and biohazardous materials.

I BIOLOGICAL MATERIAL

A. Biological Waste / Red Bag Waste

1. ***All biohazardous material, including sharps, must be removed*** from the lab prior to leaving the laboratory.

2. ***All laboratory areas and equipment*** that have the potential to be contaminated by a biohazardous material ***shall be disinfected*** prior to finally leaving the laboratory. Examples:

    - Refrigerators / Freezers
    - Laboratory Chemical Fume Hoods
    - Biological Safety Cabinets
    - Laboratory Countertops
    - Storage Cabinets

3. All ***glass containers*** of known infectious material ***shall be disinfected prior to disposal*** or placed in a specially labeled contaminated glass box. A contaminated glass box may be made by double-lining a standard biohazard waste box with two "red" biohazard waste bags then labeling it on two opposing sides with the word, "GLASS."

4. Liquid blood and blood products may be disposed of down laboratory sink drains.

B. Movement of Biohazardous Materials and Equipment

1. Equipment shall normally be disinfected prior to removal from the laboratory. Equipment potentially contaminated with a biosafety level 2 or greater material may not be moved from one building to another without approval from the UPMC

Preparations for Leaving the Laboratory

Environmental Health & Safety (E,H&S) Office (647-6409). The E,H&S Office will label equipment as approved for transportation.

2. Biosafety level 1 materials may be transported from one building to another as long as they are packaged in accordance with federal, state and local regulations for transportation. [Generally, this means that the material must be packaged so that it is double contained. If it is a liquid, sufficient absorbent must be placed in the outer container to absorb the entire contents in the event of an inner container rupture. The outside container must be clearly labeled with a biohazard label and a description of the potentially biohazardous contents. (Example: Human Liver Cells). If there are questions on packaging requirements, contact the E,H&S Office at 647-6409].

3. Materials classified as biosafety level 2 or greater shall not be transported from building to building without approval by the UPMC Environmental Health & Safety Office. (In order to comply with various safety regulations such as labeling and engineering controls, University of Pittsburgh managed laboratories must be assessed and approved for use of biosafety level 2 and greater materials. For more information, contact the University of Pittsburgh Environmental, Health and Safety Office at 624-9505.)

4. Animals – May only be taken to laboratories that are approved for animal use by the Institutional Animal Care and Use Committee (IACUC). Use of animals in new laboratories constitutes a *Minor Modification to a Previously Approved Protocol* and requires a cursory review by the IACUC.

II. CHEMICAL MATERIAL

All chemicals and chemical containers (even those that are empty) shall be properly disposed of prior to leaving the lab. No chemicals, ***including those used for cleaning***, shall be left in the laboratory unless specifically requested by the incoming investigator. If an incoming investigator wishes to retain a chemical, that chemical container shall be labeled with the name of that incoming principle investigator / person assuming ownership.

Prior to leaving the laboratory, staff should segregate the chemicals into those they wish to take with them and those they wish to dispose. Once the decision has been made to dispose of a chemical, it is classified as a chemical waste.

The chemicals that they wish to take with them should be further segregated according to their hazardous properties and a determination made as to whether they may be personally transported or whether the services of a registered hazardous materials transporter are required.

Preparations for Leaving the Laboratory

A. Hazardous Chemical Waste

For laboratories located in UPMC managed facilities, the UPMC Environmental Health and Safety Office (EH&S) receives chemical hazardous waste according to a published schedule. At designated times, a representative from the EH&S Office will be stationed at a predetermined location to receive chemical waste. Please think ahead when planning for disposal since your day of departure may not coincide with the scheduled hazardous waste drop-off. Timely removal of waste chemicals minimizes laboratory hazards, mitigates storage problems and is in compliance with Pennsylvania hazardous waste regulations. If necessary, special waste drop-offs may be scheduled by contacting EH&S.

A copy of the waste disposal schedule, waste inventory forms and hazardous waste labels may be obtained at ***http://presbyterian.infonet.upmc.com/ehs*** - the UPMC EH&S website, or, by requesting a copies from EH&S. The waste disposal schedule provides information on the dates of waste pickups for your building. A completed waste inventory form must accompany deliveries of chemical hazardous waste. Copy the inventory form as needed. If you have questions or comments, please contact our office at (412) 647-6409 or, visit the UPMC EH&S website.

B. Compressed Gas Cylinders

Arrange to have compressed gases removed from the laboratory by the gas supplier prior to leaving the laboratory. If the lab is moving to another building on the campus, arrange to have new cylinders delivered to that location.

C. Non-Regulated Chemical Waste

1. Solid Chemicals

Many solid chemicals such as sodium chloride, glucose, amino acids, and silica are not classified as hazardous waste. Attached is a list of chemicals that when disposed of, are classified as non-hazardous waste. These chemicals may be disposed of in the regular waste cans. However, there are a few steps that need to be taken when disposing of them. Write the words "Non-Hazardous" clearly on each container label. Plastic containers, prior to being placed in the general waste, should be placed in an outer container or box. This is to avoid the appearance of disposing of hazardous chemicals in the general waste stream. For glass containers of non-hazardous dry chemical, empty the contents directly into the waste can and dispose of the container in a broken glass box.

2. Liquid Chemicals

Many liquid chemicals such as potassium iodine and sodium salicylate solutions, when disposed of, are classified as non-hazardous. Attached is a list of chemicals that are classified as non-hazardous chemical wastes. These materials may be disposed of down

the laboratory sink drains or absorbed with an absorbent and disposed of in the general waste cans. Liquid waste should not be placed in dry waste cans.

D. Transportation of Chemicals

The United States Department of Transportation (DOT) governs the transportation of hazardous materials over the road (49 Code Federal Regulations Part 172). Whenever a hazardous chemical is transported over the road, even if it is just to cross a street, the transporter is bound by the laws and requirements set forth by the DOT. According to the DOT, some materials are considered hazardous in transportation while others are not. Some are considered hazardous in transportation only if more than a certain amount is being transported while certain classifications of chemicals are considered hazardous no matter how much is being transported.

Because of the regulatory complexity and legal liability involved, the UPMC EH&S Office recommends not personally transporting any chemical that the DOT has classified as being hazardous in transportation. Information on whether a substance has been classified as hazardous by the DOT may be ascertained by reviewing the MSDS for that substance. Also, the Code of Federal Regulations, the DOT publishes a table [the Hazardous Materials Table (49CFR172.101)] of substances that are consider hazardous in transportation. (*Due to length, the table is not appended but may be viewed at* ***http://www.access.gpo.gov/nara/cfr/index.html*** *by searching for, "49CFR172.101".*) In addition to the substances specifically listed in this table, the DOT describes the criteria used to determine whether a substance not found in the table would be classified as hazardous in transportation. Below are general guidelines to follow for determining what is hazardous in transportation.

E. Guidelines for Determining Whether a Chemical Is A Transportation Hazard

	GUIDELINES FOR DETERMINING WHETHER A CHEMICAL IS A TRANSPORTATION HAZARD	
A.	Any substance listed in the DOT's Hazardous Material Table (49CFR172.101)	
B.	Any substance classified as hazardous as determined by the following criteria	
	Hazard Class	***Hazard Class Determination Criteria***
	1. Explosives	Any substance, article or device capable of causing a detonation.

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	GUIDELINES FOR DETERMINING WHETHER A CHEMICAL IS A TRANSPORTATION HAZARD	
	2. Compressed Gases	1. Flammable Gases 2. Non-Flammable, Non-Poisonous Gases 3. Poisonous Gases All compressed gases are considered hazardous in transportation because: ▪ Most rapid gas leaks, even if the gas is not toxic, may asphyxiate. ▪ A damaged cylinder may become a projectile.
	3. Flammable Liquids	Liquid materials with a flash point below 141° Fahrenheit. (A mixture containing a flammable liquid is not necessarily considered flammable unless the mixture's flash point is below 141° Fahrenheit. An example would be: a 15% ethanol in water solution is no longer classified as a flammable liquid.)
	4. Flammable Solids	1. Wetted explosives that, when dry, ignite or become explosive (picric acid). 2. Powdered metals that may self ignite and burn rapidly in the presence of oxygen (powdered magnesium). 3. Self-reactive chemical compounds that undergo strongly exothermal decomposition even without oxygen. 4. Pyrophoric materials - solid, wetted materials that may self-react in the presence of oxygen/air (phosphorous). 5. Dangerous when wet materials - Solid, dry materials that when wetted, react to ignite, explode or give off toxic gas (sodium). 6. Solid materials with a heat of decomposition below 300° Fahrenheit that are capable of self-reacting to ignite or give of toxic gas.

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	GUIDELINES FOR DETERMINING WHETHER A CHEMICAL IS A TRANSPORTATION HAZARD	
	5. Oxidizing Agents & Organic Peroxides	***Oxidizers*** – Are substances that readily lend oxygen to a chemical reaction and therefore cause or enhance combustion. ***Organic Peroxides*** – Are any organic compound containing oxygen in the O-O bivalent structure. They are both an oxidizer and a fuel source in one molecule and therefore may require special storage considerations. * Never store or transport oxidizers or organic peroxides with flammable or explosive materials.
	6. Poisonous	All chemicals are toxic. It just depends upon the amount of exposure to the chemical. The determination as to whether it may be transported depends upon a substance's degree of toxicity, it's route of exposure, and the quantity being transported. ▪ Any substance that would cause sickness or death, if it was leaked in an accident and incidentally absorbed through the skin. ▪ Any volatile substance or substance capable of becoming airborne, that would cause sickness or death if, in an accident, it leaked and was inhaled. ▪ Any substance that, if, leaked in an accident, would be toxic to people or the environment in very small quantities.
	7. Radioactive	Radioactive substances are highly regulated and considered the most hazardous of materials in transportation. If desiring to transport a radioactive material, contact the University of Pittsburgh Radiation Safety Office at (412) 624-2728.
	8. Corrosive	1. Materials capable of quickly and severely corroding skin and/or flesh (strong acids and/or strong bases). 2. Materials capable of quickly and severely corroding aluminum or steel (strong acids and/or strong bases).

Preparations for Leaving the Laboratory

The shipper of a hazardous material may be held legally responsible for all damages and/or injuries caused by that hazardous material in a transportation incident. Those staff wishing to transport hazardous chemicals should acquire the services of a licensed hazardous materials transporter. Upon request the UPMC EH&S Office (647-6409) will recommend a hazardous materials transporter.

III. LABORATORY EQUIPMENT

All permanent laboratory equipment and furnishings shall be properly cleaned and disinfected prior to leaving the lab. Examples:

- Chemical Fume Hoods,
- Laboratory Bench Tops,
- Laboratory Refrigerators/Freezers,
- Centrifuges,
- Biological Safety Cabinets

Laboratory equipment that will be transported should, whenever possible, be emptied of any hazardous chemical and if appropriate, disinfected or sterilized. The drained chemical should then be properly disposed. If it is not feasible to empty or drain the equipment, then the equipment should be packaged such that if there is a spill, the spill will be absorbed and contained within the packaging. Equipment containing a hazardous chemical falls under the same DOT regulation as the chemical contained therein.

Preparations for Leaving the Laboratory

NON-HAZARDOUS WASTES

Acetyl	Boron carbide	Epsom salts
Acetylsalicylic acid	Calcium acetate	Ethylenediaminetetra-
Actin	Calcium borate	Ferric chloride
Adenosine acetic acid	Calcium carbonate	Ferric sulfate
Agar	Calcium chloride	Ferritin phthalate
Agarose	Calcium citrate	Ferrous ammonium sulfate
Alanine	Calcium fluoride	Fluorescein
Albumen	Calcium gluconate	Fructose
Alconox	Calcium glycerophosphate	Fullers earth
Alginic acid	Calcium lactate	Galactose
Aluminum hydroxide	Calcium pantothenate	Gelatin
Aluminum oxides	Calcium phosphate	Globulin
Aluminum silicate	Calcium sulfate	Gluconic acid
Aluminum sodium sulfate	Carbon black	Glucosamine
Aluminum sulfate	Carborundum	Glutamic acid
Amber	Carbowax	Glutamine
Amberlite	Carnotine	Glutaric acid
Amino acids	Carotene	Glycerophosphate
Aminoacetic acid	Casein	Glycylglycine
Ammonium bicarbonate	Celite	Guaiac
Ammonium carbonate	Cellulose	Guanine
Ammonium chloride	Cellulose acetate	Guanosine
Ammonium citrate	Cellulose phosphate	Gum arabic
Ammonium lactate	Cerium oxide	Gypsum
Ammonium phosphate	Charcoal	Hemaglobin
Ammonium stearate	Chlorophyll	Heparin
Ammonium sulfate	Cholesterol	Hippuric acid
Ammonium valerate	Choline	Histamine phosphate
Amylopectin	Choline chloride	Histidine
Arabinoise	Chromatographic	Hydroxyproline
Arginine	Citric acid	Inositol
Ascorbic acid	Corn oil	Insulin
Asparagine	Corticotropin	Inulin
Aspartic acid	Creatinine	Iron oxide
Beef extract	Cysteine	Isoleucine
Bees wax	Cytosine	Kaolin
Bentonite	Deoxyribonuclease	Keratin
Benzoic acid	Dextran	Lactic acid
Bitumen	Dextrose	Lactose
Blood agar	Diathymosulfone	Lanolin
Boric acid	Drierite	Lecithin
Borneol	EDTA	Leucine

Lithium carbonate	Potassium carbonate	Sodium trimetaphosphate

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Lithium chloride	Potassium chloride	Sodium tungstate
Lithium sulfate	Potassium citrate	Sorbitol
Littmus	Potassium hydrogen	Sorbose
Magnesium borate	Potassium iodine	Starch
Magnesium carbonate	Potassium lactate	Steapsin
Magnesium citrate	Potassium phosphate	Stearic acid
Magnesium lactate	Potassium pyrophosphate	Strontium carbonate
Magnesium phosphate	Potassium sodium tartrate	Succinic acid
Magnesium sulfate	Potassium sulfate	Sucrose
Malt extract	Potassium sulfite	Sugars
Maltose	Pumice	Sulfur
Manganese acetate	Riboflavin	Talcum powder
Manganese chloride	Riboflavin-5-phosphate	Tartaric acid
Manganese sulfate	Ribonucleic acid	Thiamine hydrochloride
Mannitol	Salicylic acid	Tin oxide
Methionine	Saponin	Titanium dioxide
Methyl cellulose	Sephadex	Tocopherol
Methyl histidine	Serine	Tricalcium phosphate
Methyl lactate	Silica gel	Trisodium phosphate
Molecular sieves	Silicon carbide	Triton X
NADP	Silicon dioxide	Trypsin
Naphthoflavone	Sodium acetate	Trypticase absorbent
Niacinamide	Sodium ammonium	Tryptone
Nicotinamide	Sodium benzoate	Tryptophan
Nicotinic acid	Sodium bicarbonate	Tyrosine
Oleic acid	Sodium bisulfate	Urea
Pancreatin	Sodium bisulfite	Uricase
Papain	Sodium borate	Uridine
Paraffin	Sodium bromide	Valine
Pepsin	Sodium carbonate	Vanillic acid
Peptone	Sodium chloride	Vanillin
Petrolatum	Sodium citrate	Xanthine
Petroleum jelly	Sodium dodecyl sulfate	Yeast extract
Phenylalanine	Sodium fluoride	Zinc oxide
Phosphotungstic acid	Sodium formate	Zinc phosphate
Phosphyltidyl choline	Sodium iodine	
Phthalic acid	Sodium lactate	
Potassium acetate	Sodium phosphate	
Potassium acid phosphate	Sodium salicylate	
Potassium bicarbonate	Sodium silicate	
Potassium bisulfate	Sodium succinate	
Potassium bitartrate	Sodium sulfate	
Potassium borate	Sodium sulfite	
Potassium bromide	Sodium thiosulfate	

APPENDIX M
Glossary

A

ACGIH - ACGIH stands for American Conference of Governmental Industrial Hygienists. The ACGIH is an association of occupational health professional employed by the government and educational institutions. The Threshold Limit Value (TLV) Committee and Ventilation Committee of the ACGIH publish guidelines, which are used worldwide.

Active Ingredient - An active ingredient is the part of a product which actually does what the product is designed to do. It is not necessarily the largest part of the product. For example, an insecticidal spray may contain less than 1% pyrethrin, the ingredient that actively kills insects. The remaining ingredients are often called inert ingredients.

Acute - Acute means sudden or brief. Acute can be used to describe either an exposure or a health effect. An acute exposure is a short-term exposure. Short-term means lasting for minutes, hours or days. An acute health effect is an effect that develops either immediately or a short time after an exposure. (Also see Chronic).

Aerosol - An aerosol is a collection of very small particle suspended in air. The particles can be liquid (mist) or solid (dust or fume). The term aerosol is also commonly used for a pressurized container (aerosol spray) which is designed to release a fine spray of material such as paint. Inhalation of aerosol is a common route of exposure to many chemicals. As well, aerosols may be fire hazards.

Auto-Ignition Temperature - The auto-ignition temperature is the lowest temperature at which materials begin to burn in air in the absence of a spark or flame. Many chemicals will decompose (break down) when heated. The auto-ignition temperature is the temperature at which the chemicals formed by decomposition begin to burn. Auto-ignition temperatures for a specific material can vary by one-hundred degrees Celsius or more depending on the test method used. Therefore values listed on the MSDS may be rough estimates. To avoid the risk of fire or explosion, materials must be stored and handled at temperatures well below the auto-ignition temperature.

B

Biological Hazard,
Biohazard Materials - Under the Occupational Safety and Health Administration, a biohazard means those infective agents presenting a risk of death, injury or illness to employees. For example, a person exposed to a blood sample from someone with Hepatitis B may contract the disease.

Boiling Point - The boiling point is the temperature at which the material changes from a liquid

Glossary

to a gas. Below the boiling point, the liquid can evaporate to form a vapor. As the material approaches the boiling point, the change from liquid to vapor is rapid and vapor concentration in the air can be extremely high. Airborne gases and vapors may pose fire, explosion and health hazards. Sometimes, the boiling point is given as a range of temperatures. This is because different ingredients in a mixture can boil at different temperatures. If the material decomposes (breaks down) without boiling, the temperature at which it decomposes may be given with the abbreviation, "dec."

C

Carcinogen,
Carcinogenic,
Carcinogenicity - A carcinogen is a substance which can cause cancer. Carcinogenic means able to cause cancer. Carcinogenicity is the ability of a substance to cause cancer. Chemicals may be considered carcinogenic if recognized by the International Agency for Research on Cancer (IARC), by the US National Toxicology Program (NTP) or OSHA. The lists of carcinogens prepared by these organizations include known human carcinogens and some materials, which cause cancer in animal experiments. Certain chemicals may be listed as suspect or possible carcinogens if the evidence is limited or so variable that a definite conclusion cannot be made.

CAS Registry Number - The CAS Registry Number is a number assigned to a material by the Chemical Abstract Service (CAS) to provide a single unique identifier. A unique identifier is necessary because the material can have many different names. For example, the name given to a specific chemical may vary from one language or country to another. The CAS Registry Number has no significance in terms of the chemical nature or hazards of the material. The CAS Registry Number can be used to locate additional information on the material, for example, when searching in books or chemical data bases.

Ceiling (C) - See Exposure Limits for a general explanation.

Chemical Name - The chemical name is a proper scientific name for the principal or active ingredient of the product. For example, the chemical name for the herbicide 2,4-D is 2,4-dichlorophenoxyacetic acid. The chemical name can be used to obtain additional information.

Chronic - Chronic means long-term or prolonged. It can describe either an exposure or a health effect. A chronic exposure is a long-term exposure. Long-term means lasting for months or years. A chronic health effect is an effect that appears months or years after an exposure.

Coefficient of Oil/Water Distribution - The coefficient of oil/water distribution, also called the partition coefficient, abbreviated as P, is the ratio of the solubility of a chemical in an oil to its solubility in water. The P value is typically represented as a logarithm of P (log P). It indicates how easily the chemical can be absorbed or stored in the body. The P value is also used to help determine the effects of the chemical on the environment.

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Combustible - Combustible means able to burn. Broadly speaking, a material is combustible if it can catch fire and burn. (See Combustible Liquid). The term's combustible and flammable both describe the ability of material to burn. Commonly, combustible materials are less easily ignited than flammable materials.

Combustible Liquid - Under 29 CFR 1910.106(a)(18), a combustible liquid has a flash point at or above 37.8°C. This flash point is well above normal room temperature. Combustible liquids are, therefore, less of a fire hazard than flammable liquids. If there is a possibility that a combustible liquid will be heated to a temperature near its flash point, appropriate precautions must be taken to prevent a fire.

Compressed Gas - Under 29 CFR 1910.1200(c), a compressed gas is a gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F (21.1°C); a gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130°F (54.4°C) regardless of the pressure at 70°F; or, a liquid having a vapor pressure exceeding 40 psi at 100°F (37.8°C) as determined by ASTM D-323-72. Regardless of whether a compressed gas is packaged in an aerosol can, a pressurized cylinder or a refrigerated container, it must be stored and handled very carefully. Puncturing or damaging the container or allowing the container to become hot may result in an explosion.

Corrosive Material - A corrosive material can attack (corrode) metals or human tissue such as the skin or eyes. Corrosive material can cause metal containers or structures to become weak and eventually to leak or collapse. Corrosive materials can burn or destroy human tissues on contact and can cause effects such as permanent scarring or blindness.

D

Density - The density of a material is its mass for a given volume. Density is usually given in units of grams per milliliter (g/ml) or grams per cubic centimeters (g/cc). Density is closely related to specific gravity (relative density). The volume of a material in a container can be calculated from its density and mass.

E

Embryo,
Embryotoxic,
Embryotoxicity - An embryo is an organism in its early stages of development prior to birth. In humans, the embryo is the developing child from conception to the end of the second month of pregnancy. (See also Fetus). Embryotoxic means harmful to the embryo. Embryotoxicity is the ability of a substance to cause harm to the embryo. (See also Fetotoxicity and Reproductive Effects).

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Evaporation Rate - The evaporation rate is a measure of how quickly the material becomes a vapor at normal room temperature. Usually, the evaporation rate is given in caparison to certain chemicals, such as butyl acetate, which evaporates fairly quickly. For example, the rate might be given as 0.5 grams of material evaporates during the same time that 1 gram of butyl acetate evaporates. Often, the evaporation rate is given only as greater or less than 1, which means the material evaporates faster or slower than the comparison chemical. In general, a hazardous material with a higher evaporation rate presents a greater hazard than a similar compound with a lower evaporation rate.

Explosive Limits
* **LEL, LFL** - The Lower Explosive Limit (LEL), or lower flammable limit (LFL), is the lowest concentration of gas or vapor which will burn or explode if ignited.
* **UEL, UFL** - The Upper Explosive Limit (UEL), or the upper flammable limit (UFL), is the highest concentration of gas or vapor which will burn or explode if ignited.

From the LEL to the UEL, the mixture is explosive. Below the LEL, the mixture is too lean to burn. Above the UEL, the mixture is too rich to burn. However, concentrations above the UEL are still very dangerous because, if the concentration is lowered (for example, by introducing fresh air), it will enter the explosive range. In reality, explosive limits for a material vary since they depend on many factors such as air temperature. Therefore the values given on an MSDS are approximate.

Not Flammable:	**Flammable**	Not Flammable:
Too Lean to Burn	**Can Burn Explosively**	Too Rich to Burn
0% ←----------→**LEL**	←----------→	**UEL**←----------→ **100%**

Percent volume of vapor or gas in air

The explosive limits are usually given as the percent by volume of the material in the air. One percent by volume is 10,000 ppm. For example, gasoline has a LEL of 1.4% and a UEL of 7.6%. This means that gasoline vapors at concentrations of 1.4% to 7.6% (14,000 to 76000 ppm) are flammable or explosive.

Exposure Limits - An exposure limit is the concentration of a chemical in the workplace to which most people can be exposed without experiencing harmful effects. Exposure limits should not be taken as sharp dividing lines between safe and unsafe exposures. It is possible for a chemical to cause health effects, in some people, at concentrations lower than the exposure limits. Exposure limits have different names and different meaning depending on who developed them and whether or not they are legal limits.

Glossary

Threshold Limit Values (TLV's) *are exposure guidelines developed by the American Conference of Governmental Industrial Hygienists (ACGIH).*

Permissible Exposure Limits (PEL's) *are exposure limits defined by OSHA. Sometimes, a manufacturer will recommend an exposure limit for a material. Exposure limits have not been set for many chemicals, for many different reasons. For example, there may not be enough information available to set an exposure limit. Therefore, the absence of an exposure limit does not necessarily mean the material is not harmful.*

There are three types of exposure limits in common use:

TWA *- Time-Weighted Average exposure limit is the average concentration of a chemical in air for a normal 8-hour workday and 40-hour workweek to which nearly all workers may be exposed day after day without harmful effects. Time-weighted average means that the average concentration has been calculated using the duration of exposure to different concentrations of the chemical during a specific time period. In this way, higher and lower exposures are averaged over the day or week.*

STEL *- Short-Term Exposure Limit is the average concentration to which workers can be exposed to for a short period (usually 15 minutes) without experiencing irritation, long-term or irreversible tissue damage or reduced alertness. The number of times the concentration reaches the STEL and the amount of time between these occurrences can also be restricted.*

Ceiling (C) *- Ceiling (C) exposure limit is the concentration which should not be exceeded at any time.*

Skin *- "SKIN" notation (SKIN) means that contact with the skin, eyes and moist tissues (for example, the mouth) can contribute to the overall exposure. The purpose of this notation is to suggest that measures be used to prevent absorption occurs through the skin, then the airborne exposure limits are not relevant.*

F

Fetotoxic,
Fetotoxicity,
Fetus - Fetotoxic means the substance is harmful to the fetus. Fetotoxicity describes the ability of a substance to harm the fetus. (See also Embryotoxicity, Teratogenicity, and Reproductive Effects). A fetus is an organism in the later stages of development prior to birth. In human, it is the unborn child from the end of the second month of pregnancy to birth.

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Flammable,
Flammability - Flammable means able to ignite and burn readily. Flammability is the ability of a material to ignite and burn readily. (See Combustible, Flammable Aerosol, Flammable Gas, Flammable Liquid, Flammable Solid, and Reactive Flammable Material). Local, state and national fire codes also classify and regulate the use of flammable materials in the workplace.

Flammable Aerosol - Flammable Aerosol means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flash back at any degree of valve opening (29 CFR 1910.1200(c)). A flammable aerosol is hazardous because it may form a torch (explosive ignition of the spray) or because a fire fuelled by the flammable aerosol may flash back.

Flammable Gas - A flammable gas is a gas, which can ignite readily and burn rapidly or explosively. Under 29 CFR 1910.1200(c), it is a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or, a gas that at ambient temperature and pressure forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit. Flammable gases can be extremely hazardous in the workplace; for example:
* If the gas accumulates so that its lower explosive limit (LEL) is reached and if there is a source of ignition, an explosion will occur.
* If there is inadequate ventilation, flammable gases can travel considerable distances to a source of ignition and flash back to the source of the gas.

Flammable Limits - See Explosive Limits.

Flammable Liquids - A flammable liquid gives off a vapor, which can be easily ignited at normal working temperatures. Under the 29 CFR 1910.106(a)(19), a flammable liquid is a liquid with a flash point (using a closed cup test) below 37.8°C (100F). Flammable liquids can be extremely hazardous in the workplace; for example:
* If there is inadequate ventilation, flammable gases can travel considerable distances to a source of ignition and flash back to the flammable liquid.
* It may be difficult to extinguish a burning flammable liquid with water because water may not be able to cool the liquid below its flash point.

Flammable Solid - A flammable solid is a solid material that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing or which can ignite readily and when ignited burns vigorously and persistently as to create a serious hazard (29 CFR 1910.1200(c)). Flammable solids in the form of dust or powder may be particularly hazardous because they may explode if ignited.

Flash Back - Flash back occurs when a trail of flammable gas, vapor or aerosol is ignited by a distant spark, flame or other source of ignition. The flame then travels back along the trail of gas, vapor or aerosol to its source. A serious fire or explosion could result.

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Flash Point - The Flash Point is the lowest temperature at which a liquid or a solid gives off enough vapor to form flammable air-vapor mixture near its surface. The lower the flash point, the greater the fire hazard. The flash point is an approximate value and should not be taken as a sharp dividing line between safe and hazardous conditions. The flash point is determined by a variety of test methods, which give different results. Two of these methods are abbreviated as OC (open cup) and CC (closed cup).

Freezing Point - The temperature at which a material freezes. (See also Melting Point).

Fumes - Impervious Fumes are very small, airborne, solid particles formed by the cooling of a hot vapor. For example, a hot zinc vapor may form when zinc-coated steel is welded. The vapor then condenses to form fine zinc fumes as soon as it contacts the cool surrounding air. Fumes are smaller than dusts and are more easily breathed into the lungs.

H

Hazard,
Hazardous - Hazard is the potential for harmful effects. Hazardous means potentially harmful. The hazards of a material are evaluated by examining the properties of the material, toxicity, flammability and chemical reactivity, as well as how the material is used. How a material is used can vary greatly from workplace to workplace and, therefore, so can the hazard.

Hazardous Combustion Products - Hazard Combustion Products are chemicals, which may form products when a material burns. These chemicals may be toxic, flammable or have other hazards. The chemicals released and their amounts vary depending upon conditions such as the temperature and the amount of air (or more specifically, oxygen) available. The combustion chemicals may be quite different from those formed by heating the same material during processing (thermal decomposition products). It is important to know which chemicals are formed during combustion in order to plan the response to a fire involving the material.

Hazardous Decomposition Products - Hazardous Decomposition Products are formed when a material decomposes (breaks down) because it is unstable or reacts with common materials such as water or oxygen (in air). This information should be considered when planning storage and handling procedures.

I

IARC - IARC stands for International Agency for Research on Cancer. IARC evaluates information on carcinogenicity of chemicals, groups of chemicals and chemicals associated with certain industrial processes. IARC has published lists of chemicals which are generally recognized as human carcinogens, probable human carcinogens or carcinogens in animal tests.

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IDLH - IDLH stands for Immediately Dangerous to Life or Health. For the purpose of respirator selection, NIOSH defines the IDLH concentration as the maximum concentration, which would not cause any escape-impairing symptoms or irreversible health effects to a person, exposed for thirty minutes, if the respirator failed.

Impervious - Impervious is a term used to describe protective gloves and other protective clothing. If a material is impervious to a chemical, then that chemical cannot readily penetrate through the material or damage the material. Different materials are impervious (resistant) to different chemicals. No single material is impervious to all chemicals. If an MSDS recommends wearing impervious gloves, you need to know the type of material from which the gloves should be made. For example, neoprene gloves are impervious to butyl alcohol but not the ethyl alcohol.

Incompatible Materials - Incompatible materials can react with the product or with components of the product and may:
* destroy the structure or function of a product;
* cause a fire, explosion or violent reaction; or,
* cause the release of hazardous chemicals.

Inert Ingredient - An inert ingredient is anything other than the active ingredient of a product. It may be a solvent, colorant, filter or dispersing agent. In some cases, inert ingredients may be hazardous.

Ingestion - Ingestion means taking a material into the body by mouth (swallowing).

Inhalation - Inhalation means taking a material into the body by breathing it in.

Irritancy,
Irritation - Irritancy is the ability of a material to irritate the skin, eyes, nose, throat, or any other part of the body that it contacts. Signs and symptoms of irritation include tearing in the eyes and reddening, swelling, itching and pain or the affected part of the body. Irritancy is often described as mild, moderate or severe, depending on the degree of irritation caused by a specific amount of the material. Irritancy may also be described by a number on a scale of 0 to 4, where 0 indicated no irritation and 4 means severe irritation. Irritancy is usually determined in animal experiments. The Controlled Products Regulations, describe technical criteria for identifying materials which are skin or eye irritants.

L

LC50 - LC stands for lethal concentration. LC50 is the concentration of material in the air which causes the death of 50% (one half) of a group of test animals. The material is inhaled over a set period of time, usually 1 to 4 hours. The LC50 helps determine the short-term poisoning potential of a material. (See also LD50). The MSDS must indicate the species of animal tested

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and the route by which the hazardous substance was administered. Note: if the LC50 is known for a mixture, this should be listed for the mixture and not the separate ingredients.

LD50 - LD stands for lethal dose. LD50 is the amount of a material, given all at once, which causes death of 50% (one half) of a group of test animals. The LD50 can be determined by any route of entry, but dermal (applied to skin) and oral (given by mouth) are the most common. The LD50 is one measure of the short-term poisoning potential of a material. (See also LC50). The MSDS must indicate the species of animal tested and the route by which the hazardous substance was administered. Note: if the LD50 is known for a mixture, this should be listed for the mixture and not the separate ingredients.

Lower Explosion(ive) Limit (LEL) - See Explosive Limits.

Lower Flammable Limit (LFL) - See Explosive Limits.

M

Melting Point - The melting point is the temperature at which a solid material becomes a liquid. The freezing point is the temperature at which a liquid material becomes a solid. Usually one value or the other is given on an MSDS. It is important to know the melting or freezing point for storage or handling purposes. For example, a melted or frozen material may burst a container. As well, a change of physical state could alter the hazards of the material.

mg/m3 - The abbreviation mg/m3 stands for milligrams (mg) of material per cubic meter (m3) of air. It is a unit of metric measurement for concentration (mass/volume). The concentration of any airborne chemical can be measured in mg/m3, whether it is a solid, liquid, gas or vapor.

Mist - A mist is a collection of liquid droplets suspended in air. A mist can be formed when spraying or splashing a liquid. It can also be formed when a vapor condenses into liquid droplets in the air. (See also Aerosol).

Mutagen,
Mutagenic,
Mutagenicity - A mutagen is a substance which can cause changes in the DNA of cells (mutations). Mutagenic means able to cause mutations. Mutagenicity is the ability of a substance to cause mutations. A number of mutagenicity tests are used to screen chemicals for possible carcinogenicity or reproductive effects. This is because there is some evidence that mutations can increase the Risk of cancer and reproductive problems such as infertility or birth defects. However, mutagenicity test results are not very reliable predictors of these effects. One reason for this is that the human body can repair mutations while most mutagenicity tests cannot. Mutagenicity is indicated on MSDS's because it is an early indicator of potential hazard, and often there is very little evidence available on possible carcinogenic or reproductive effects. The

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Controlled Products Regulations describe technical criteria for identifying materials, which are mutagenic.

N

NA Number - See UN Number.

NIOSH - NIOSH stands for National Institute for Occupational Safety and Health. NIOSH is a branch of the Department of Health and Human Services which undertakes research and develops occupational health and safety standards.

NTP - NTP stands for National Toxicology Program. This program is part of the Department of Health and Human Services. The NTP has a large program for testing the potential carcinogenicity of chemicals. It also does many other types of studies on short-term and long-term health effects.

Nuisance Dust,
Nuisance Particulate - Nuisance particle is a term used by the ACGIH to describe airborne materials (solids and liquids) which have little harmful effects on the lungs and do not produce significant disease or harmful effects when exposures are kept under reasonable control. Nuisance particulate may also be called nuisance dusts. High levels of nuisance particulate may reduce visibility and can get into the eyes, ears and nose.

O

Odor Threshold - The Odor Threshold is the lowest concentration, in ppm, of a chemical in the air that is detectable by smell. The odor threshold should only be regarded as an estimate. This is because odor thresholds are commonly determined under controlled laboratory conditions using people trained in odor recognition. As well, in the workplace, the ability to detect the odor of a chemical varies from person to person and depends on conditions such as the presence of other odorous materials. Odors cannot be used as a warning of unsafe conditions since workers may become used to the smell (adaptation), or the chemical may numb the sense of smell, a process called olfactory fatigue. However, if the odor threshold for a chemical is well below its exposure limit, odor can be used to warn of a problem with your respirator.

OECD - OECD stands for Organization for Economic Cooperation and Development. The OECD is an international agency, which supports programs designed to facilitate trade and development. The OECD has published Guidelines for Testing Chemicals. These guidelines contain recommended procedures for testing chemicals for toxic and environmental effects and for determining physical and chemical properties.

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OEL - OEL stands for Occupational Exposure Limit. (See Exposure Limit for a general explanation).

OSHA - OSHA stands for Occupational Safety and Health Administration. It is the branch of the US government, which sets and enforces occupational health and safety regulations. For example, OSHA sets the legal exposure limits in the United States, which are called Permissible Exposure Limits (PEL's). OSHA also specifies what information must be given on labels and Material Safety Data Sheets (MSDS) for materials in the US that have been classified are hazardous using their criteria.

Oxidizing Agent,
Oxidizing Material - An oxidizing agent or material gives up oxygen easily or can readily oxidize other materials. Examples of oxidizing agents are chlorine and peroxide compounds. These chemicals will support a fire and are highly reactive.

P

Partition Coefficient - See Coefficient of Oil/Water Distribution.

PEL - PEL stands for Permissible Exposure Limit. PEL's are legal limits in the United States set by the Occupational Safety and Health Administration (OSHA). (See Exposure Limits for a general explanation).

Personal Protective Equipment (PPE) - Personal Protective Equipment (PPE) is clothing or devices worn to help isolate a person from direct exposure to a hazardous material or situation. On a MSDS, personal protective equipment, which protects from chemical exposure is listed. This can include protective clothing, respiratory protection and eye protection. The use of protective equipment is the least preferred method of protection from hazardous exposures. It can be unreliable and, it if fails, the person can be left completely unprotected. This is why engineering controls are preferred. Sometimes, personal protective equipment may be needed along with engineering controls. For example, a ventilation system (an engineering control) reduces the inhalation hazard of a chemical, while gloves and labcoat (personal protective equipment) reduce skin contact. In addition, personal protective equipment can be an important means of protection when engineering controls are not practical; for example, during an emergency or other temporary conditions such as maintenance operations.

pH - The pH is a measure of the acidity or basicity (alkalinity) of a material when dissolved in water. It is expressed on a scale from 0 to 14. Roughly, pH can be divided into the following ranges:
pH 0 - 2 Strongly acidic
pH 3 - 5 Weakly acidic
pH 6 - 8 Neutral

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pH 9 - 11 Weakly basic
pH 12 - 14 Strongly basic

ppm - The abbreviation stands for parts per million. It is a common unit of concentration of gases or vapor in air. For example, 1 ppm of a gas means that 1 unit of gas is present for every 1 million units of air.

R

Reactive Material - A reactive material that can react vigorously:
• with water to produce a very toxic gas;
• on its own by polymerization or decomposition; or
• under conditions of shock, or an increase in pressure or temperature.
A dangerously reactive material may cause a fire, explosion or other hazardous condition. It is very important to know which conditions (such as shock, heating or contact with water) may set off a dangerous reaction so that appropriate preventative measures can be taken.

Relative Density - See Specific Gravity.

Reproductive Effects,
Reproductive Toxicity - Reproductive effects are problems in the reproductive process which may be caused by a substance. Possible reproductive effects include reduced fertility in the male or female, menstrual changes, miscarriage, embryotoxicity, fetotoxicity, teratogenicity or harmful effects to the nursing infant from chemicals in breast milk. Most chemicals can cause reproductive effects if there is an extremely high exposure. In these cases, the exposed person would experience other noticeable signs and symptoms caused by the exposure. These signs and symptoms act as a warning of toxicity. Chemicals, which cause reproductive effects in the absence of other significant harmful effects, are regarded as true reproductive hazards. Very few workplace chemicals are known to be true reproductive hazards. The Controlled Products Regulations describe technical criteria for identifying materials, which have reproductive toxicity. These criteria refer to adverse effects on fertility.

S

Sensitization - Sensitization is the development, over time, of an allergic reaction to a chemical. The chemical may cause a mild response on the first few exposures but, as the allergy develops, the response becomes worse with subsequent exposures. Eventually, even short exposures to low concentration can cause very severe reaction. There are two different types of occupational sensitization: skin and respiratory. Typical symptoms of skin sensitivity are swelling, redness, itching, pain and blistering. Sensitization of the respiratory system may result in symptoms

similar to a severe asthma attack. These symptoms include wheezing, difficulty in breathing, chest tightness, coughing and shortness of breath.

"Skin" Notation - See Exposure Limits for a general explanation.

Specific Gravity - Specific Gravity is the ratio of the density of a material to the density of water. The density of water is about 1 gram per cubic centimeter (g/cc). Materials which are lighter than water (specific gravity less than 1.0) will float. Most materials have specific gravities exceeding 1.0, which means they are heavier than water and will sink. Knowing the specific gravity is important for planning spill clean-up and fire fighting procedures. For example, a light flammable liquid such as gasoline may spread and if ignited burn on top of a water surface.

Stability - Stability is the ability of a material to remain unchanged in the presence of heat, moisture or air. An unstable material may decompose, polymerize, burn or explode under normal environmental conditions. Any indication that the material is unstable gives warning that special handling and storage precautions may be necessary.

STEL - STEL stands for Short-Term Exposure Limit. (See Exposure Limits for a general explanation).

Synergism,
Synergistic - As used on MSDS, synergism means that exposure to more than one chemical can result in health effects greater than when expected when the effects of exposure to each chemical are added together. Very simply, it is like saying 1 + 1 = 3. When chemicals are synergistic, the potential hazards of the chemicals should be reevaluated, taking their synergistic properties into consideration.

Synonyms - Synonyms are other names for the same chemical. For example, methanol and methyl hydrate are synonyms for methyl alcohol. Synonyms may help in locating additional information on a chemical.

T

Teratogen,
Teratogenic,
Teratogenicity - A teratogen is a substance which can cause birth defects. Teratogenic means able to cause birth defects. Teratogenicity is the ability of a chemical to cause birth defects. Teratogenicity results from a harmful effect to the embryo or fetus. (See also Reproductive Effects).

Thermal Decomposition Products - Thermal Decomposition Products are chemicals, which may be formed when the material is heated but does not burn. These chemicals may be toxic, flammable or have other hazards. The chemicals released and their amounts vary depending

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upon conditions such as temperature. The thermal decomposition products may be quite different from the chemicals formed by burning the same material (hazardous combustion products). It is important to know which chemicals are formed by thermal decomposition because this information is used to plan ventilation requirements for processes where a material may be heated.

TLV - TLV stands for Threshold Limit Value. It is the occupational exposure limit established by the American Conference of Governmental Industrial Hygienist (ACGIH). TLV is a registered trademark of ACGIH. (See Exposure Limits for a general explanation).

Toxic,
Toxicity - Toxic mean able to cause harmful health effects. Toxicity is the ability of a substance to cause harmful health effects. Description of toxicity (e.g., low, moderate, severe, etc.) depend on the amount needed to cause an effect or the severity of the effect.

Trade Name - A trade name is the name under which a product is commercially known. Some materials are sold under common names, such as Stoddard solvent or degreaser, or internationally recognized trade name, like Varsol. Trade names are sometimes identified by symbols such as 'TM' or an 'R' with a circle around it.

TWA - TWA stands for Timed-Weighted Average. (See Exposure Limits for a general explanation).

U

UN Number - UN Number stands for United Nations number. The UN number is a four-digit number assigned to potentially hazardous material (such as gasoline, UN 1203) or class of material (such as corrosive liquids, UN 1760). These numbers are used by fire fighters and other emergency response personnel for identification of material during transportation emergencies. UN numbers are internationally recognized. NA (North America) numbers are used only for shipments with Canada and the United States. UN, NA and PIN numbers have the same use.

Upper Explosion(ive) Limit (UEL) - See Explosion Limits.

Upper Flammable Limit (UFL) - See Explosion Limits

V

Vapor - A Vapor is the gaseous form of a material, which is normally solid or liquid at room temperature and pressure. Evaporation is the process by which a liquid is changed into a vapor. Sublimation is the process by which a solid is changed directly into the vapor state.

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Vapor Density - Vapor Density is the mass per unit volume of a pure gas or vapor. On an MSDS, the vapor density is commonly given as a ration of the density of the gas or vapor to the density of air. The density of air is given a value of 1.

Vapor Pressure - Vapor Pressure is the pressure of a vapor when in equilibrium with its liquid or solid form. It is a measure of the tendency of a material to form a vapor. The higher the vapor pressure, the higher the potential vapor concentration. In general, a material with a high vapor pressure is more likely to be an inhalation or fire hazard than a similar material with a lower vapor pressure.

APPENDIX N
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