BUREAU OF FORENSIC SERVICES
4/1/2007 CHEMICAL HYGIENE PLAN
TABLE OF CONTENTS

ATTACHMENTS:

INTRODUCTION

The Chemical Hygiene Plan is a portion of the Bureau's Safety Program which has as its goals to:

- Promote and maintain the well-being of Bureau personnel by the prevention of occupational accidents, injuries and illnesses;
- Locate and eliminate hazards that endanger the health and safety of Bureau personnel;
- Reduce work interruptions and delays caused by accidents;
- Prevent destruction or damage to property and equipment resulting from accidents due to poor safety practices;
- Develop safety consciousness in Bureau personnel through their active participation in the Chemical Hygiene Plan;
- Maintain and evaluate the effectiveness of the Chemical Hygiene Plan through periodic inspections and review of practices and procedures.

A Safety Program's effectiveness is directly related to the dedication with which it is implemented by both management and employees. Every person is expected, as an individual, to comply in all respects with the goals and requirements in the Chemical Hygiene Plan to ensure safety for themselves and for their fellow workers.

The CHP is a generic document applying recognized safety principles across all BFS laboratories. For labs that are performing unique or exceptionally hazardous chemical operations, special procedures should be developed and attached to the CHP.

Any identification of omissions, errors or suggestions for improvement of the Chemical Hygiene Plan should be submitted to the Bureau Health and Safety Unit (HSU).

ROLES AND RESPONSIBILITIES

The following individuals and units are responsible for implementing the Bureau of Forensic Service's Chemical Hygiene Plan. Their duties and responsibilities are:

Bureau Chief

The Bureau Chief is responsible for the development of both policies and procedures for the Bureau of Forensic Services. The Bureau Chief is also responsible for ensuring that all employees of the Bureau adhere to all State and Federal Regulations outlined herein. Finally, the Bureau Chief is responsible for ensuring that employees have the necessary resources for meeting the goals of the Chemical Hygiene Plan.

Assistant Bureau Chief

The Assistant Bureau Chief is responsible for assisting the Bureau Chief in the development of both policies and procedures, by providing constant input concerning the needs of the Bureau's employees. The Assistant Bureau Chief is also responsible for ensuring that employees under his command comply with State and Federal Regulations outlined herein.

Manager/Supervisor

The manager/supervisor is responsible for ensuring that proper health and safety procedures are being followed by all staff. The manager/supervisor also has overall responsibility for chemical hygiene in the workplace. Additional responsibilities include:

- Appointing a Laboratory Safety Officer;
- Implementation of the Chemical Hygiene Plan;
- Ensuring that their employees know and follow the Chemical Hygiene Plan;
- Providing personal protective equipment that is in working order;
- Ensuring that no employee is assigned a task without appropriate safety training;
- Preventing exposure by controlling workplace hazards using a number of different methods including the following:

- Administrative Controls: limit exposure by adjustment of the work schedule;
- Engineering Controls: control by means of general or local exhaust ventilation or by isolation or enclosure of health hazard producing operations;
- Work Practices: limit exposure by using safe work practice procedures;
- Personal Protective Equipment: use of respiratory protection, safety glasses, laboratory coats, gloves and other types of personal protective equipment.

Laboratory Safety Officer

The Laboratory Safety Officer is responsible for performing the following tasks:

- Working with the laboratory manager/supervisor and other employees to implement an effective health and safety program;
- Determining ways to improve the Chemical Hygiene Plan;
- Ensures that monthly inspections are performed to verify that portable fire extinguishers are charged, and plumbed eyewash and shower equipment functions properly;
- Disseminate information and recommendations made available by HSU concerning occupational and environmental regulations that impact their laboratory facility.

Health and Safety Unit

The Health and Safety Unit provides technical consultation and training to all Bureau facilities concerning environmental and occupational health and safety. Included in these responsibilities are:

- Furnishing technical information to provide assistance in complying with the Chemical Hygiene Plan;
- Assist in evaluating new analytical protocols to be implemented in the Bureau laboratories for potential health and safety impact and providing recommendations to mitigate those impacts;

- Assisting Bureau managers/supervisors in developing appropriate health and safety programs and procedures;

- Providing assistance in facility surveys, industrial hygiene monitoring and environmental monitoring;

- Providing guidance to Bureau managers/supervisors in the collection and disposal of chemical and biological waste;

- Providing updated information on occupational and environmental regulatory requirements to Bureau managers/supervisors and Laboratory Safety Officers and making recommendations for compliance.

Health and Safety Technical Advisory Group

The "Health and Safety Technical Advisory Group" (HSTAG) was established by Bureau Order #99-01. HSTAG is chaired by a Senior Industrial Hygienist from HSU, is composed of the Laboratory Safety Officers, and meets at least annually. The purpose of meeting is to:

- Review regulatory changes concerning health and safety issues affecting the Bureau;

- Review accidents, injuries, significant near-misses and safety suggestions;

- Review the Bureau Safety Manual

- Receive current training on topics applicable to the Bureau's Health and Safety Program;

- Make recommendations concerning the Bureau's Health and Safety Program to the Bureau Chief. The recommendations are submitted in writing to the Bureau Chief by the Senior Industrial Hygienist.

Bureau Employees

Employees (including students and volunteers) working with or around chemical, biological and radiological materials are responsible for exercising caution and handling hazardous materials in safe manner. If employees are unsure of a hazard or safety procedures, they should ask their Laboratory Safety Officer or their manager/supervisor.

All Bureau employees have the following responsibilities:

- A person's own safety and that of his colleagues should be considered at all times;
- To become familiar with safety practices and potential hazards associated with equipment;
- To become familiar with Material Safety Data Sheets;
- To recognize that all chemicals should be considered hazardous and should be handled with care;
- To report any potentially hazardous situations to their Laboratory Safety Officer and manager/supervisor.

DESIGN & VENTILATION SYSTEMS

Electrical

Electrical hazards include electrical shock and shorts that could cause a fire or ignition of flammable vapors and gases. To prevent the presence of electrical hazards the following precautions should be taken:

- Ensure that all electrical equipment installed within any of the Bureau's facilities is UL approved;
- Employees should have access to electrical panels in the event of equipment malfunction, and that circuits contained within the electrical panels are appropriately labeled;
- In areas where explosive vapors may be present, all electrical equipment must meet NFPA requirements;
- Ensure that equipment is properly grounded or labeled as ungrounded.
- Use interlock devices and protective barriers to prevent contact with laser beams, any bare terminals or metal parts on electrical devices that cannot be grounded, such as those on electrophoresis equipment;
- Ensure that electrical cords and equipment are not exposed to chemicals or excessive temperatures;
- Cover all electrical cords to prevent a tripping hazard
- Replace any worn, frayed, abraded or corroded electrical cords;
- Do not attempt to repair any piece of electrical equipment unless you are qualified to do so.
- Turn power stats and centrifuges off by use of the "on-off" switch.

Lighting Levels

Reference: Section 3317, Title 8 of the California Code of Regulations

Adequately, well-balanced levels of illumination are essential in establishing safe working conditions. Working areas, stairways, aisles, passageways, workbenches and machines shall be

provided with either natural and/or artificial illumination, which is adequate to provide a safe place of employment. Ensure that:

- Sufficient emergency lighting is provided to allow safe exit during a power failure;
- A warning sign is posted, protective eyewear is provided and written procedures are available when using ultraviolet lights and lasers;
- Fluorescent and incandescent bulbs are protected by plastic shields unless such shielding would result in a hazard;
- Light levels are monitored, on an as-needed basis.

Biosafety Cabinets

Reference: National Sanitation foundation Standard #49 for Class II Biohazard Cabinetry, 2002

Biosafety cabinets were developed to protect workers when handling infectious agents. Biosafety Cabinets are used by the Bureau to prevent contamination of evidence in DNA procedures. Many cabinets exhaust into the room so NONE of these cabinets are designed for use with volatile chemicals.

BFS operates exclusively at Biosafety Level II, which does not require a biosafety cabinet. No pathogens are present. However, biosafety cabinets are used. Face velocity measurements will be recorded annually to determine proper operation. Full evaluation to determine NSF Std. 49-02 compliance as required by 8 CCR 5154.2 and complete integrity of the HEPA filter will not be performed as the cabinets are not used for the purpose of preventing harmful exposure to biological agents. Management may choose to do a full NSF Standard evaluation for other reasons. A sticker will be placed on each BFS biosafety cabinet to indicate that full NSF testing has not been done.

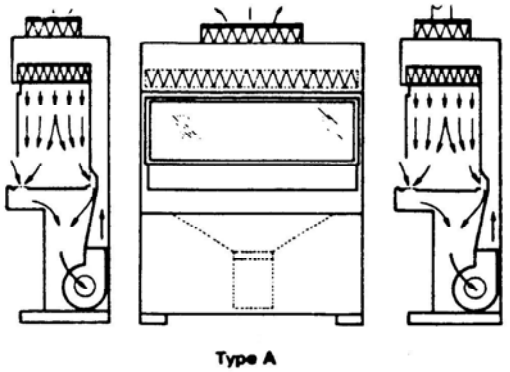
There are three classes of cabinets: I, II, and III.

- Class I cabinets are open-front with a negative face velocity of 75-100 fpm. The exhaust air is HEPA filtered. These do not meet the Bureau's needs and are not used for these purposes.
- Class II cabinets have three configurations: A, B1 and B2. A drawing of the A and B cabinets is shown on the next page. An older type, "A/B3" or "Convertible" is also in use in some Bureau labs.

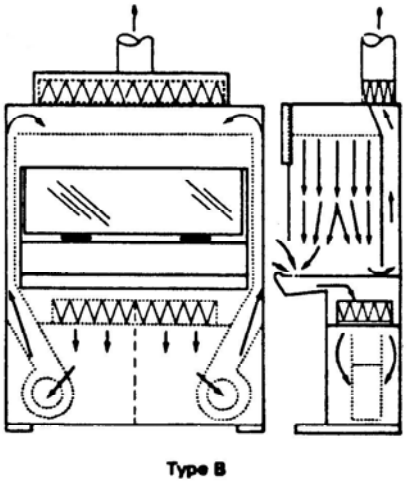
Type	A	B1	B2	B3
Inward Airflow fpm	75	100	100	100
Downflow air source	Partially HEPA filtered exhaust air	Recycled uncontaminated inflow air	Laboratory or outside air	HEPA filtered inflow and exhaust air
Contaminated Ducts	May be under positive pressure	Under negative pressure or surrounded by negative pressure ducts	Under negative pressure or surrounded by directly exhausted air	Under negative pressure or surrounded by negative pressure ducts

- Class III cabinets are totally enclosed and gas-tight. During operation, a negative pressure of at least 0.5 inches w.g. must be maintained. Both supply and exhaust are HEPA filtered. Exhaust air must be discharged to the outside environment through two sets of HEPA filters. Class III cabinets are not used by the Bureau.

Biohazard Hood Design Configurations



Type A



Type B

Laboratory Fume Hoods

Reference: 8 CCR 5143, 5154.1, 5191, 5209
Laboratory Ventilation Workbook, 2nd Ed., D. Jeff Burton, 1994

To prevent unnecessary exposure to hazardous materials, laboratory fume hoods have been installed at all facilities. Ensure that:

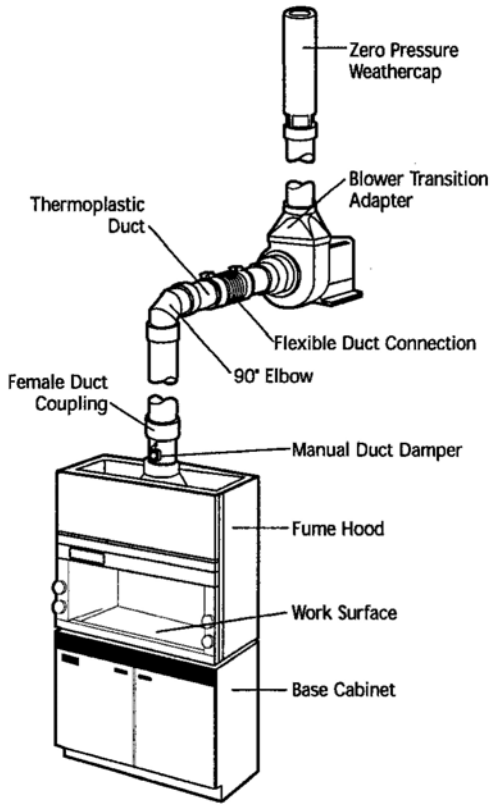


Figure 16. Typical components of a hood ventilation system

- Laboratory hoods are compatible with the materials used in them (i.e., perchloric acid);
- An average face velocity of at least 100 feet per minute (ŧfm) with a minimum of 70 ŧfm at any point is maintained for all hoods except those handling materials requiring special hood requirements (e.g. Cal/OSHA regulated carcinogens);
- Any hood failing to meet the above requirements is deficient in airflow and shall be posted with a placard which prohibits the use of hazardous substances within the hood;
- Caution should be used with ductless fume hoods: the filter may only accommodate dusts or have limited use with organic substances. Use of a ductless fume hood with organic substances is only allowed if the filter will capture the organic substance of concern, and the manufacturer can assist in developing a change-out schedule for the filter.
- When the required velocity can be obtained by partly closing the sash, the sash and/or jamb are marked to show the maximum opening to meet the 100 fpm hood face velocity requirement;
- Ventilation rates of hoods are measured at least annually. Visualization of hood capture (with smoke or dry ice vapor) will be performed annually. A sticker will be placed on the front of the ventilation hood indicating the date of test, average face velocity and name of tester. The test results will be recorded and the records are to be kept for 5 years;

- A quantitative (tape is not satisfactory) airflow indicator (magnehelic gauge or flow meter) is provided at each laboratory ventilation hood to continuously demonstrate that air is flowing into the exhaust system during operation;

- Personnel using a chemical ventilation hood should verify proper operation of the hood by looking at the quantitative airflow meter, hood sash marking and inspection sticker before use.
- Any chemicals stored in the hood are covered or capped. Hoods are not to be used for disposal of volatile chemicals.
- The hood remains "on" at all, times when open chemicals and/or evidence that may cause chemical exposure are inside the hood, regardless of whether any work is being done in the hood or if the hood provides ventilation to a separate flammable liquid cabinet.
- Hoods are kept clean and orderly; do not use the hood as a storage cabinet. Excessive equipment inside a hood disrupts the airflow and may not effectively remove contaminants.
- Equipment and materials used in the hood should be at least 6 inches back from the opening of the hood.

- Anytime personnel must work on the roof of the laboratory, use of chemicals in ventilation hoods will cease. Dept. of General Services and other personnel have the responsibility to notify BFS when personnel need to work on the roof.

The three main types of laboratory fume hoods are displayed on page 14. They are:

1. **Conventional hood.** This hood type draws air in at a constant rate. Therefore, when the sash is lowered, the airflow increases. Increased airflow above 150 fpm may cause turbulence and allow contaminants to be ejected from the hood. Conventional hoods may be used in conjunction with a variable air (VAV) system. The VAV

system reduces the fan speed or increases a damper in the exhaust when the sash is lowered so that the airflow is constant.

2. **Bypass hood.** The Bypass hood maintains a constant volume of air by allowing air in through the top when the sash is lowered.

3. **Auxiliary-air hood.** This hood has a makeup air system integrated so that untempered (not cooled or heated) air is used. The example shows it to be like a bypass hood. The energy savings comes from not using standard room air for most of the air supply.

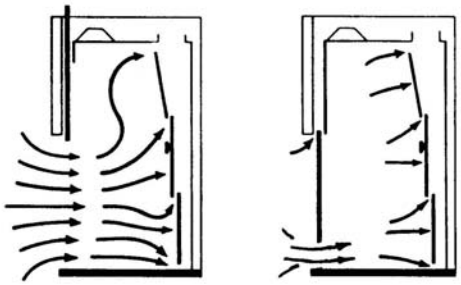
Additional laboratory hoods include:

4. **Ductless hoods.** Usually these portable or bench top devices are not physically ducted to the outside. They have a built-in motor, and rely on a filter to remove the contaminants. After filtration, the air is exhausted into the room where the hood is being used. Dust filtration involves a HEPA filter. Organic solvent filtration involves the use of an activated carbon filter. The organic solvent filters may require frequent replacement depending on use. In addition, certain organics (e.g. methanol) are not readily absorbed and will be exhausted into the room. These should also be tested to demonstrate that they operate at 100 fpm.

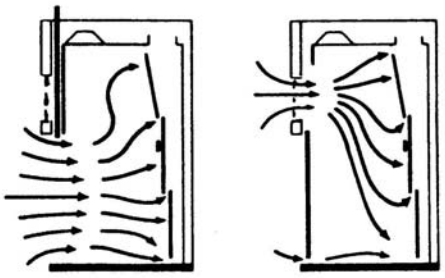
5. **Slot hoods.** These provide ventilation across the surface of a working area. These are used in latent prints and by criminalists performing drug testing. They are not laboratory fume hoods and do not meet those ventilation standards. The effectiveness of each slot system should provide an adequate airflow that will remove contaminants from the worker's breathing zone. Annual visual testing with smoke or dry ice will be performed to ensure adequate operation.

Laboratory Ventilation Hood Configurations

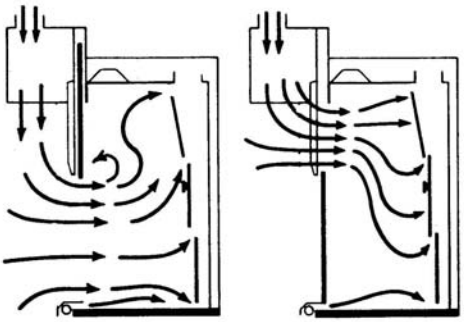
Conventional (or standard) hood



Bypass hood (also known as the constant volume hood)



Auxiliary-air hood



STORAGE PROCEDURES

Each facility has one or more storage rooms for chemicals, glassware, equipment and supplies. The Laboratory Safety Officer is also responsible for inspecting and making recommendations for the proper storage of chemicals and other laboratory supplies.

Storage Requirements:

- Storage areas shall be well lighted;
- Aisles kept free of debris and obstructions;
- Items shall not project beyond front shelf limits;
- Heavier items shall be stored on lower shelves, preferable no higher than an individual can reach without the use of a ladder or stool;
- Cabinets and shelves shall be mounted to the wall or floor.

General Guidelines for Chemical Storage

When storing chemicals:

- To prevent mixing of reactive chemicals and accidental breakage that may result in severe personal injury or property damage, chemicals should be properly labeled and stored.
- All chemicals are stored in containers based on their chemical properties;
- Incompatible chemicals are separated so that mixing cannot occur (the use of chemically resistant buckets, tubs or trays is acceptable if separate cabinets are not available);
- Chemicals that do not require a ventilated cabinet, should be stored inside a closable cabinet or on a shelf that has a lip to prevent containers from sliding off in the event of a fire, serious accident, or earthquake.
- An annual chemical survey is performed.
- Storage shall be limited within the laboratory to the smallest practical quantity needed for effective operations;

- Only the minimal amount of materials (chemicals) needed shall be ordered;
- Outdated chemicals, those kept beyond their shelf life, shall be disposed of properly;
- Any chemical container that has deteriorated, leaks, developed corroded caps or any other problem should be discarded;
- Chemical storage within a fume hood should not interfere with hood operation;
- Chemicals should not be stored above eye level unless stored in an enclosed cabinet;
- Material Safety Data Sheets shall be available for all hazardous materials handled or stored within each facility

Attachment #2 contains an incompatibility table.

Guidelines for Flammable Liquid Storage

Reference: NFPA 45- Fire Protection for Laboratories using chemicals
NFPA 30- Flammable and Combustible Liquids Code

Storage cabinets shall be used for the storage of flammable chemicals. These cabinets shall be made of 18 gauge steel, double-walled constructed, and have locking doors. Cabinet door openings shall be two inches above the base to prevent liquids from leaking out. The cabinet must be marked: "Flammable-Keep Fire Away."

Flammable liquid cabinets are not required to be vented; however, if vented, they must comply with local regulations. Venting is desirable for removing odors. Airflows ranging from 25 fpm for small cabinets to 50 fpm for large cabinets are adequate for removing odors. Higher rates may be needed if lab hoods are nearby and the room is under negative pressure. Venting should not be directly into a fume hood; at the exhaust is acceptable. A spark resistant fan and explosion proof motor is recommended.

The following general storage rules shall be followed:

- Store only compatible materials inside the cabinet (see Attachment #2);
- Do not store paper or cardboard inside storage cabinets with chemicals;
- Do not overload the cabinet (not to exceed 120 gallons total or 60 gallons of Class I and II liquids);
- No more than three storage cabinets are allowed in the same fire area unless stored 100 feet apart;
- Separate flammables from oxidizing agents and mineral acids (see Attachment #2);
- Routinely check container integrity and replace when necessary.

Since code requirements for special storage are often stated in terms of the fire hazard classification of a material, or in terms of a specific degree of hazard, it is necessary to describe the classifications and definitions in terms of flash point temperatures.

FIRE HAZARD CLASSIFICATION

Flammable liquids have flash points below 37.8°C (100°F) and vapor pressure not exceeding 40 psia at 37.8°C (100°F).

CLASSIFICATION	TERM	FLASH POINT TEMPERATURE
Class I	Flammable Liquid	Below 37.8°C (100°F)
Class IA	Flammable Liquid	Below 22.8°C (73°F) and a boiling point below 37.8°C (100°F)
Class IB	Flammable Liquid	Below 22.8°C (73°F) and a boiling at or above 37.8°C (100°F)
Class IC	Flammable Liquid	At or above 22.8 C (73°F) and below 37.8°C (100°F)

Combustible liquids have flash points at or above 37.8°C (100°F)

Class II	Combustible Liquid	Below 60°C (140°F) and at or above 37.8°C (100°F)
Class IIIA	Combustible Liquid	Below 93.4°C (200°F) and at or above 60°C (140°F)
Class IIIB	Combustible Liquid	At or above 93.4°C (200°F)

Refrigerated Flammable Liquid Storage

Different requirements exist when flammable solvents have to be refrigerated. Laboratory "Explosion Proof" and "Explosion Safe" designations are used. "Explosion Proof" refrigerators have equipment mounted inside the storage compartment, on the door or on the door frame, and are required for Class I, Division 1 locations (NFPA Std. 70, Article 501). "Explosion Safe" refrigerators have the electrical equipment mounted outside of the storage compartment and must meet Class I. Division requirements. Storage of flammable solvents in the Bureau's laboratories shall be in at least an "Explosion Safe" refrigerator.

Corrosive Materials

The following guidelines shall be used when storing both acids and bases:

- Store only compatible materials inside the cabinet;
- Do not store paper or cardboard inside storage cabinets with the chemicals;
- All corrosive chemicals should be kept in specifically designed cabinets or be placed in a chemical resistant container;
- Do not store corrosives in cabinets that contain gas lines;

- Separate acids and bases into different areas or cabinets;
- Acids must be separated from substances which react to evolve heat, hydrogen or other explosive gases;
- Store organic acids (formic and acetic) with organic liquids, or keep segregated from oxidizing acids (see below);
- Physically separate mineral acids from flammables and combustibles by use of a suitable secondary container;
- Containers shall be examined periodically for deterioration and container integrity. Replace those in which you suspect either of the above.
- Hydrofluoric acid has unique hazards beyond corrosivity. Contact a HSU Industrial Hygienist before purchase and handling of HF to receive special information on emergency procedures and neutralization.

Acids and bases are generally identified as to type by color-coding the cap of the bottle.

COLOR	**TYPE OF ACID OR BASE**
Yellow	Sulfuric acid
Red	Nitric acid
Blue	Hydrochloric acid
Orange	Perchloric acid
Brown	Acetic acid
Black	Phosphoric acid
Green	Ammonium hydroxide

Materials that react with acids include:

Lithium	Nitrides	Phosphides
Sodium	Sulfides	Cyanides
Potassium	Carbides	Conc. alkalis
Calcium	Borides	Arsenic metal
Rubidium	Silicides	Selenium metal
Common metals		

Oxidizing Agents

Due to the reactive nature of oxidizing agents, care must be exercised when handling these compounds. Examples are nitric acid, perchloric acid and concentrated sulfuric acid, chromate and dichromate, permanganate, chlorates, nitrates, hydrogen peroxide (>20%).

- Store oxidizing agents in separate storage areas;
- Only the minimal amount of strong oxidizing agents should be stored in the laboratory;
- Separate oxidizing agents from materials they may react with, such as acids, bases, organic solvents, metal powders and phosphorus;
- Routinely examine containers for deterioration and container integrity; replace suspect ones.
- If perchloric acid is used, prevent contact with any organic materials. Also, beware of other special handling and storage requirements. Contact HSU for information.

Reactive Materials

Reactive materials include substances that are air or water reactive, may become unstable and explode or may polymerize in an uncontrolled manner.

Air Reactive Materials:

1. White phosphorus is pyrophoric (spontaneously flammable in air) if allowed to dry out; store under water.

Water Reactive Materials:

1. Lithium, Potassium, and Sodium are reactive and spontaneously flammable if in contact with water; store under oil.
2. Thionyl chloride will fume sulfur dioxide and hydrogen chloride if in contact with water. Keep container tightly sealed.
3. Mossy Zinc will generate heat and produce hydrogen upon contact

with water; fire will result if combustible material is present. Keep fresh zinc in a tightly sealed container. Store waste zinc in a dedicated metal or glass container and allowed to dry in a hood.

Potentially Unstable Materials:

1. Diethyl Ether may form shock-sensitive peroxides if distilled or subjected to sunlight. Normal ether containers are either steel cans or brown bottles. Inhibitors are usually added. Use ethyl ether by date shown on the container. If longer storage is desired, the chemical must be checked for the presence of peroxides using peroxide test strips. No chemical will be kept that has more than 50 ppm of peroxides. Other chemicals that form peroxides include Tetrahydrofuran, Acetaldehyde, 2-butanol and Isopropyl Ether.
2. Formic acid has been known to degrade to H_20 and CO_2, creating pressure within the container and causing rupture. A 2.5 liter bottle will accumulate 7 bar of pressure over a year of storage at room temperature (Bretherick's Handbook of Reactive Substances, 6th Ed.). Formic acid containers should be checked for pressure buildup annually. To check, while wearing nitrile gloves, loosen the cap in a hood to release any pressure and re-seal.
3. Picric Acid will become shock-sensitive if allowed to dry. Always wipe off threads after removing picric acid from the container. Will form very sensitive explosive if in contact with metals; always use a plastic spatula and plastic caps. The container should be checked every 6 months for the presence of water. A safer alternative is to procure a commercial 1% picric acid solution.
4. Nitromethane may be shock-sensitive if bottle has severe impact. May form explosive salts when in contact with acids, bases and amines. Acts as an oxidizer for organic compounds.

Polymerizing Materials:

1. Methyl acrylate may spontaneously polymerize and over-pressurize the container if allowed to overheat. Store in an explosion-resistant refrigerator. Dispose of if manufacturer's storage time has been exceeded.

Compressed Gases

Compressed gases, because of their unique properties and hazards, must be handled and used with care. Properties of compressed gases that require consideration are their high pressure, rapid rate of diffusion, low flash points for flammable gases, lack of odor and color for most gases and their cooling effect upon rapid release. Diffusion of leaking gases may cause rapid contamination of the atmosphere, giving rise to toxic or anesthetic effects, asphyxiation or rapid formation of explosive concentrations of flammable gases.

The procedures for the safe handling of compressed gases are based on containment to prevent escape into the atmosphere.

Compressed gas cylinders shall be examined when received. If there is any indication of damage, leakage or improper identification, the cylinders should be removed to an isolated area and then returned to the supplier as soon as possible. Care must be exercised in the handling of all cylinders. Employees shall adhere to the following guidelines.

Guidelines for Storage and Handling Compressed Gas

- Avoid dropping or permitting cylinders to strike each other violently;
- Keep cylinders upright and secured in a position away from sources of heat and direct sunlight when in storage or in use;
- Separate empty and full cylinders unless tagged properly;
- Oxygen cylinders shall never be stored near highly combustible materials or near any other substances likely to cause or accelerate fire;
- Leave the valve protective cap in place on cylinders until they are secured in place and ready for use;
- Always close cylinder valves and cap before moving cylinders;
- Do not lift cylinders using the valve protection devices;
- Use a cylinder hand truck when moving cylinders and ensure that they are latched to the cradle on the truck in as nearly an upright position as possible;
- Do not drag, roll, or slide cylinders even for short distances;
- Use compressed gases only in well-ventilated areas;
- Do not use a compressed gas without a pressure regulator and ensure that the regulator is compatible with the gas;
- Check labels on the cylinder to be sure of the purpose for which the cylinder is to be used;

- Close cylinder valves when work is finished;
- Always close the cylinder valve and bleed the pressure in the regulator to atmospheric pressure when shutting down a system for an extended period of time;
- Never attempt to refill a cylinder by transfer of a gas from a full cylinder to an empty one;
- Close the valves; replace the protective caps and tags on empty cylinders before returning them to the supplier.

Compressed gases are routinely purchased by the Bureau are listed below:

AIR: nonhazardous, nontoxic, atmospheric air
HELIUM: colorless, odorless, tasteless gas; nontoxic, but can act as an asphyxiant
HYDROGEN: nontoxic, flammable; can act as an asphyxiant
NITROGEN: nontoxic, but can act as an asphyxiant
OXYGEN: highly reactive
PROPANE: toxic, flammable; can act as an asphyxiant

Cryogenic Liquids

Cryogenic liquids are materials with boiling points of less that -73°C (-100°F). Liquefied nitrogen is the chief cryogen used in BFS. Liquid nitrogen is used in the Scanning Electron Microscope, Nicolet FTIR Microscope, in the LINK XRF and the DNA Lab Bone Mill. The following hazards are present when using liquid nitrogen:

1. Freezing of human tissue. Liquid nitrogen has a boiling point of -195°C. Therefore any skin contact will result in severe frostbite with results similar to the thermal burn. Skin contact with a bare container of liquid nitrogen will cause the skin to adhere and cause tearing when removed. Therefore, use the following precautions:

- When handling containers to transfer liquid nitrogen, insulated gloves and a face shield must be used.

- Always use an insulated container when transferring liquid.
- When pouring liquid, do so slowly to minimize splashing and boiling.

2. Rapid expansion. One liter of liquid nitrogen at atmospheric pressure vaporizes to 24.6 ft^3 of nitrogen gas at 20°C. This may result in oxygen depletion in a small room if a significant volume is spilled or an un-insulated vessel is ruptured. It may also cause an explosion of a sealed container. Use the following precautions:
   - Leave the room if a significant spill occurs. Use an oxygen meter to determine if it is safe to re-enter (>19.5% oxygen).
   - If an intermediate storage vessel is to transfer liquid nitrogen from the primary storage container to the instrument storage reservoir, always use an unsealed, insulated container.

Dry Ice

Dry ice may be stored in bulk to serve as a refrigerant when shipping samples. Dry Ice sublimates to gaseous carbon dioxide at –109 ^{o}F. Any storage of dry ice will result in a buildup of carbon dioxide in the storage area. Small quantities should be stored and freezer doors should be opened for 5 minutes to allow ventilation before entering.

Dry ice is also a contact hazard. Human skin freezes at 10 ^{o}F. Therefore, thermal insulated gloves must be worn whenever handling dry ice.

If dry ice is used for shipping, personnel must be trained in Department of Transportation requirements regarding shipping papers and labeling.

CHEMICAL EXPOSURES

Chemicals can cause external or internal bodily injuries. External injuries may result from skin contact with caustic or corrosive substances such as acids, bases or strong salts. Internal injuries may come from toxic or corrosive substances absorbed by the skin, by ingestion or by inhalation. Hazardous chemicals may be in a liquid, solid or gaseous form.

Irritants

Generally, liquid irritants cause the greatest number of external injuries by their direct action on the skin. Irritants may react chemically with the skin, dissolve or "extract" essential components, or disturb the equilibrium in the skin cells. Caution should be exercised when handling these chemicals and adequate protective equipment must be utilized. If accidental exposure occurs, the affected area should be flushed with copious amounts of water.

Typical examples of liquid irritants are concentrated acids and bases, chlorinated hydrocarbons, and esters and ketones. Solid irritants may also cause damage by contact with the skin. Injury generally results from their solubility in the moisture of the skin. Contact can be insidious. By the time, pain is felt the injury can be more than superficial.

Gaseous irritants attack the respiratory tract. The damage may vary from local intense inflammation of the pharynx to lung damage with acute edema. The best protection against irritation from gaseous irritants is to work with them in a hood or in a well-ventilated area. If exposure is more than superficial and injury seems to have occurred, emergency treatment should be obtained from a medical facility.

Acids/Bases

Acids have been found to cause severe damage to both the internal and external tissues of the body. Bases have also been found to damage the tissues of the body due to the corrosive action of these chemical compounds.

Reproductive Effects

Chronic chemical exposure may prevent conception, cause spontaneous abortion, low birth weight, mental retardation and birth defects. At the Bureau, male reproductive organs could be affected by lead, carbon disulfide, perchloroethylene, ethylene dibromide, ionizing radiation and heat. Female reproductive organs and the fetus could be affected by organic solvents, carbon disulfide, lead, toluene, chloroform, ethanol, noise and ionizing radiation. Special care should be used when

handling these materials. Exposures to these chemicals should be kept **a**s **l**ow **a**s **r**easonable **a**chievable (ALARA).

However, test firing a weapon greater the .22 caliber may contribute to hearing loss in an unborn child. Therefore, a pregnant firearm examiner shall have another person perform the test firing for larger weapons.
DLE General Order #02-03, dated July 18, 2002 outlines procedures to be used if a pregnant employee wishes to be removed from the laboratory environment where chemicals that cause reproductive harm may be found.

Carcinogens

Carcinogens are agents, which misdirect cellular growth. Typical examples of carcinogens are benzene, carbon tetrachloride and chloroform. It is sometimes necessary to store and use known and suspected carcinogens in the laboratory. Carcinogens should be considered a severe biohazard and stored and handled as such.

Title 8 of the California Administrative Code, Section 5209 identifies a number of carcinogens that have been designated by Cal/OSHA as "Regulated Carcinogens". These chemicals have special handling requirements based on their toxicity. "Regulated Carcinogens" shall not be stored or used by employees of the Bureau.

2-Acetylaminofluorene
4-Aminodiphenyl
Benzidine (and its salts)
3,3'-Dichlorobenzidine (and its salts)
4-Dimethylaminoazobenzene
α-Naphthylamine
β-Naphthylamine
4-Nitrobiphenyl
N-Nitrosodimethylamine
β-Propiolactone
bis-Chloromethyl ether
Methyl chloromethyl ether
Ethyleneimine

Other chemicals have been identified as cancer causing and require special handling if action limits are exceeded. Handling of these chemicals will always require the use of ventilation and appropriate gloves to ensure that Bureau employees are not exposed above the action level, or absent an action

level, the PEL. These chemicals and actionlevels/PELs are:

Asbestos (0.1 fiber/cc)
Vinyl chloride (0.5 ppm)
1,2-dibromo-3-chloropropane (0.001 ppm)
Acrylonitrile (1 ppm)
Inorganic arsenic (5 $\mu g/m^3$)
4,4'-Methylenebis(Chloroaniline) (10$\mu g/m^3$)
Formaldehyde (0.75 ppm)
Benzene (0.5 ppm)
Ethylene dibromide (0.015 ppm)
Ethylene oxide (0.5ppm)
Methylene Chloride (25 ppm)

Other organizations have identified chemicals known to cause cancer or reasonably suspected of causing cancer. The National Toxicology Program (NTP), the International Agency for Research on Cancer (IARC) and the American Conference of Industrial Hygienists (ACGIH) have various rating systems for carcinogenic substances. They are as listed in Attachment #3

Regulated Areas

Lead and formaldehyde exposures have been evaluated for Bureau personnel. No regulated areas concerning these chemicals are required.

LABELS & SIGNS

Reference: 8 CCR 5194 (f)

All hazardous materials are to be stored in original containers that are properly labeled.
The manufacturer ensures that the original container is properly labeled. If a chemical is transferred from the original container, the new container must be labeled appropriately. Every effort should be made to minimize secondary containers.

A "label" means any written, printed, or graphic material, displayed on or affixed to a chemical container. Each container of hazardous chemicals must be labeled with at least the following information:

Required Label Information for original containers

- Identity of the chemical;
- Appropriate hazard warnings.
- Manufacturer's name and address

Required Label Information for secondary containers

- Common chemical name;
- Initials or name of the person who filled the container;
- Date materials were placed in the container; and
- Target organ information and symptoms of over-exposure must be provided on the label or may be posted in conspicuous place or included in procedures. Use of the NFPA label is optional.

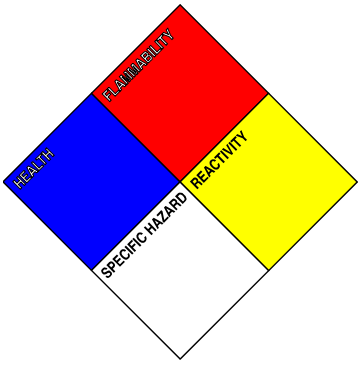
As an alternative, hazard warnings and target organ information may be placed in procedure manuals or posted in the laboratory area. Each BFS lab that performs controlled substances color tests must post the hazard communication poster. Contact HSU for further information.

Removing or defacing labels on incoming chemical containers is prohibited. Containers that have a damaged or missing label must be relabeled. Before handling any containers, read and follow the warnings.

*Do not use any chemical stored in an unlabelled container. Notify your manager/supervisor in the event that one is found***.**

Signs and/or placards may be posted within a work area to convey the hazard information in lieu of written labels if there are a number of stationary containers that have similar contents and hazards.

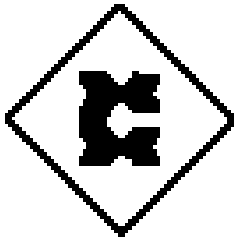
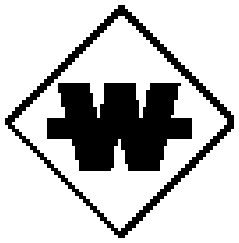
National Fire Protection Association



The National Fire Protection Association (NFPA) has developed a color-coded number system called NFPA 704. The system uses a color-coded diamond with four quadrants in which numbers are used in the upper three quadrants to signal the degree of health hazard (blue), flammability hazard (red), and reactivity hazard (yellow). The bottom quadrant is used to indicate special hazards. The NFPA system is good for alerting personnel of the degree of hazard of the chemical and helpful in drawing attention to storage needs and the necessary emergency equipment needed. This system does not indicate chronic health hazards.

Hazard Rating	Health Hazard (blue)	Flammability Hazard (red)	Stability Hazard (yellow)
4 Severe Hazard	Substance considered highly toxic under OSHA's Hazard Communication Standard. Under emergency conditions, these substances can be lethal.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is readily capable of detonation or explosive reaction at normal temperatures and pressures. This includes substances that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard
3 Serious Hazard	Substance considered highly toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause serious or permanent injury.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance that in itself is capable of detonation or explosive reaction, but require a strong initiating source or must be heated under confinement before initiation. Substance considered explosive under OSHA's Hazard Communication Standard.
2 Moderate Hazard	Substance considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause temporary incapacitation or residual injury.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Substance normally undergoes a violent chemical change at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard.
1 Slight Hazard	Substance not considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance can cause significant irritation.	Substance considered a flammable liquid under OSHA's Hazard Communication Standard.	Normally stable material but become unstable at elevated temperatures and pressures. Substance considered explosive under OSHA's Hazard Communication Standard
0 Minimal Hazard	Substance not considered toxic under OSHA's Hazard Communication Standard. Under emergency conditions, this substance would offer no hazard beyond that of ordinary combustible material..	Substance is not considered combustible or flammable under OSHA's Hazard Communication Standard. Substance that will not burn.	Normally stable material that does not react with water. Substance not considered explosive under OSHA's Hazard Communication Standard

Special Hazards

 Acid	 Alkali
 Biohazard	 Carcinogen
 Corrosive	 Use NO WATER
 Oxidizer	 Radiation Hazard

Hazardous Materials Information System or Guides

Additional symbols may be found on containers received from manufacturers. The National Paint and Coatings Association designed the Hazardous Materials Information System (HMIS) to be used as a warning label on chemical containers. A similar system was also produced by Lab Safety Supply and is called the Hazardous Materials Information Guides (HMIG). Both resemble the NFPA system; however, HMIS/HMIG use pictures to indicate what appropriate protective equipment should be used when handling the chemical.

The HMIS III has several new variations that were implemented in 2002.

1. Two boxes in the health category. The first box will have an asterisk (*) if the chemical is a chronic health hazard.
2. Instead of reactivity, HMIS III uses a “Physical Hazards” section. Physical hazards include: water reactives, organic peroxides, explosives, compressed gases, pyrophoric materials, oxidizers and unstable reactive materials.

HMIG System

HMIS/HMIG PPE Symbols:

Symbol	Personal Protective Equipment (PPE) Required
A	Safety Glasses 
B	Safety Glasses Gloves 
C	Safety Glasses Gloves Apron 
D	Face Shield Gloves Apron 
E	Safety Glasses Gloves Dust Respirator 
F	Safety Glasses Gloves Apron Dust Respirator 
G	Safety Glasses Gloves Vapor Respirator 
H	Splash Goggles Gloves Apron Vapor Respirator 
I	Safety Glasses Gloves Dust and Vapor Respirator 
J	Splash Goggles Gloves Apron Dust and Vapor Respirator 
K	Air Line Hood or Mask Gloves Full Suit Boots 
X	Ask supervisor or safety specialist for handling instructions.

LAB CHEMICAL LABEL INFORMATION AND HAZARD COMMUNICATION INFORMATION

CHEMICAL	HEALTH	FIRE	REACTIVITY	TARGET ORGAN	CARCINONGEN	SYMPTOMS
ACETALDEHYDE	3	4	2	eye, skin, resp., kidneys, CNS, repro		Eye, skin, upper resp. irrit., CNS
ACETIC ACID	2	2	0	eye, skin, resp.		eye, skin, upper resp. irritation
ACETONE	1	3	0	skin, CNS		headache, fatigue, skin & resp. irritation
ACRYLAMIDE	3	2	2	eye, skin, resp..	X	eye, skin irritation, numbness, ataxia
ALKALI METALS	3	3	2	eye, skin,		eye, skin
AMMONIA	3	1	0	eye, skin, resp.		eye, skin, resp. irritation
BENZENE	2	3	0	eye, skin, resp., CNS, blood	X	eye, skin irritation, dizziness, dermatitis
BENZIDINE	4	0	0	bladder, skin, kidney, liver	X	anemia, liver disorder
BORIC ACID	4	0	0	digestive, CNS		nausea, headache, dizziness
BROMINE	3	0	0	eye, respiratory, CNS,		dizziness, headache, cough
CARBON DISULFIDE	2	4	0	eye, kidney, CNS, CVS, repro		dizziness, headache, nervousness
CARBON TETRACHLORIDE	3	0	0	eye, lung, CNS, liver, kidney	X	eye, skin irritation, nausea, vomiting
CHLOROFORM	2	0	0	liver, kidney, heart	X	eye, skin irritation, dizziness
COOMASSIE BLUE				eye, skin		eye, skin irritation
CYANIDE SALTS	4	4	1	eye, skin, resp., CNS, CVS		eye, skin, upper resp. irritation, weakness
CYCLOHEXANE	1	3	0	eye, skin, resp., CNS,		eye, skin, upper resp. irritation
ETHYL ETHER	2	4	1	eye, skin, resp., CNS,		eye, skin, resp. irritation, dizziness
ETHIDIUM BROMIDE				eye, skin, resp		eye, skin, resp. irritation
ETHYL ACETATE	1	3	0	eye, skin, resp.		eye, skin, upper resp. irritation

CHEMICAL	HEALTH	FIRE	REACTIVITY	TARGET ORGAN	CARCINONGEN	SYMPTOMS
ETHYLENE GLYCOL	1	1	0	eye, skin, resp.		eye, skin, upper resp. irritation
FICINE				skin		eye, skin, mucous membranes
FORMALDEHYDE	3	2	0	eye, upper resp. (nasal cancer)	X	eye, skin, upper resp. irritation
HEXANE	1	3	0	eye, skin, resp., CNS,		eye, nose irritation, nausea
HYDROCHLORIC ACID	3	0	0	eye, skin, resp.		eye, skin, upper resp. irritation
HYDROGEN PEROXIDE	2	0	1	eye, skin, resp.		eye, upper resp. irritation
HYDROGEN SULFIDE	3	4	0	mucous membranes, CNS		mucous membranes, headache, nausea
IODINE	3	0	1	eye, skin, resp.		eye, skin, upper resp. irritation
ISOPROPANOL	1	3	0	eye, skin, resp.		eye, upper resp. irritation
L-AMINO ACID OXIDASE				CNS		anorexia, vomiting, anemia, CNS
LEAD	3	1	0	GI tract, CNS		weakness, lassitude, abdominal pain
LEUCOMALACHITE GREEN				eye, skin, resp.		eye, skin, upper resp. irritation
LUMINOL				eye, skin, resp.		eye, skin, upper resp. irritation
MERBROMIN	4	0	0	eye, skin, CNS		eye, skin irritant
METHYLENE CHLORIDE	2	1	0	eye, skin, CNS, CVS	X	eye, skin irritant
NINHYDRIN	1	1	0	eye, skin, resp.		eye, skin irritant, weakness, numbness
NITRIC ACID	3	0	0	eye, skin, resp., teeth		respiratory irritant
PARAFORMALDEHYDE	2	1	0	eye, skin,		eye, skin irritant
PETROLEUM ETHER	1	4	0	CNS		headache, nausea
PHENOL	3	2	0	eye, skin, resp., kidney		mucous membranes irritation, weakness
PICRIC ACID	3	4	4	eye, skin, kidney, liver, blood		eye, skin irritation, dermatitis

CHEMICAL	HEALTH	FIRE	REACTIVITY	TARGET ORGAN	CARCINONGEN	SYMPTOMS
POTASSIUM DICHROMATE	3	0	1	skin, resp.	X	skin, resp. irritation
POTASSIUM HYDROXIDE	3	0	1	eye, skin, resp.		eye, skin, resp. irritation
POTASSIUM PERMANGANATE	1	0	0	eye, skin, resp.		eye, skin, resp. irritation
PYRIDINE	2	3	0	eye, skin, CNS, liver		eye irritation, headache, dizziness, nausea
RHODAMIN 6G				eye, skin		eye, skin irritation
SODIUM HYDROXIDE	3	0	1	eye, skin, resp.		eye, skin irritation, skin burns
SULFURIC ACID	3	0	2	eye, skin, resp.	?	eye, skin, upper resp. irritation, pulmonary edema
3,3,5,5 TETRAMETHYLBENZIDINE	1	0	0	eye, skin, resp, mutagen		eye, skin, resp. irritation
TOLUENE	2	3	0	eye, skin, resp., CNS		eye, upper resp. irritation, weakness, dizziness
ZINC CHLORIDE	3	0	0	eye, skin, resp. (fume)		eye irritation

MATERIAL HANDLING & HYGIENE

The following procedures will reduce or eliminate exposure to chemicals and reduce accidents:

Material Handling

- Warn nearby colleagues when unusual hazards are present;
- Practice proper lifting technique;
- Hoods shall be used for all chemical spraying. Care should be taken not to contaminate other items in the hood;
- Procedures involving potentially hazardous materials shall be performed in fume hoods when appropriate;
- To prevent aerosol contamination, tubes should be covered when using ultrasonic and vortexing devices;
- Do not open the centrifuge cover until the rotating head is stopped;
- When diluting an acid, pour the acid slowly into water, never the reverse;
- Do not look down the opening of a test tube, flask or beaker, instead observe the contents through the sides of the container;
- Carefully monitor experiments involving flammable or combustible materials;
- When flammable or combustible materials must be heated, use a steam bath, non sparking electric mantle or hot plate;
- Never return unused chemicals to stock bottles;
- Do not use belt-driven equipment (e.g. vacuum pump) unless it has a suitable belt guard.
- If chemicals need to be transported off-site, all applicable DOT requirements (Materials of Trade) will be followed with respect to packaging, documentation and vehicular use. Chemical test or screening kits are exempt from these requirements. Contact a HSU Industrial Hygienist for DOT requirements.

Hygiene

- Eating, drinking, gum chewing, application of cosmetics and taking of medicine in the laboratory area is prohibited;
- Laboratory glassware is not to be used for the preparation or consumption of food or beverages. Items used for the preparation or consumption of food or beverages are not to be washed with the laboratory glassware;
- Food for personal use can be stored only in designated areas and never with chemicals or biological materials;
- Smoking is prohibited in all buildings;
- Wash hands with soap and water when leaving the work area;
- Wash promptly if skin contact is made with any chemical, regardless of corrosivity;
- Do not place objects which may become contaminated into the mouth;
- No mouth pipetting of any substance will be permitted.

CHEMICAL SPILLS

Spill Clean-up Plan

A Spill Clean-up plan must be developed as part of the Hazardous Materials Emergency Response Plan required by Chapter 6.95 of the Health and Safety Code. The Spill Plan must include:

- Emergency Coordinators and contact numbers;
- Notification systems for employees and governmental agencies
- Spill Response Team and Equipment
- Spill Response Procedures; and
- Spill Response Equipment Locations (all facilities will maintain spill cleanup supplies)

Containment and Cleanup Procedures

1. Small spill (1 gallon or less) that does not require respiratory protection

    a. Immediately alert personnel in the area and your supervisor
    b. Check the MSDS concerning relevant health hazards
    c. Use the personal protective equipment described in the MSDS, confine the spill appropriately.
    d. Remove the material through absorption, adsorption, sweeping or other appropriate method and dispose of in an appropriate container. Label as hazardous waste.

2. Small spill (1 gallon or less) that requires respiratory protection

    a. Immediately evacuate the area; turn on ventilation hoods and close doors to the room.
    b. Alert personnel in the area and your supervisor.
    c. Contact the Spill Response Team. If there is no spill response team, contact the local HAZMAT team for assistance.
    d. The Spill Response Team will don appropriate PPE and test the room air to determine whether entry is safe(<10% LEL). When within safety limits, the Team will continue with the spill cleanup.

3. Large spills (more than a gallon) or extremely hazardous substance release

    a. Immediately evacuate the area, and close all doors.

b. Notify supervisor and Emergency Co-coordinators.
c. Evacuate building if necessary.
d. Contact local HAZMAT team or the Bureau Hazardous Waste Contractor for assistance.

Mercury Spill Procedures

The following applies to breakage of a mercury thermometer:

Materials needed:

- Nitrile gloves
- Booties (if breakage is on a floor)
- Polyethylene bottle
- Glass or plastic Pasteur pipette and bulb (or combination)
- Stiff paper/light cardboard for scoop
- Flashlight
- Kaypak waste bag and marker

Procedure:

- Notify personnel in the immediate area that a mercury spill has occurred
- Use chalk or tape to mark off the spill boundary
- Pools and globules of mercury should be pushed together with stiff paper or light cardboard
- Collect the mercury with the pipette and bulb and empty into polyethylene bottle
- Broken glass and other contaminated materials will be placed into Kaypak waste bag
- After initial cleanup, with the room lights off, check the spill area with a flashlight near the surface of the spill area. A carpeted area should just be cut out and the contaminated section of carpet bagged for disposal.
- Cleanup articles such as booties and gloves should also be placed in the Kaypak disposal bag. The bag should be sealed and marked “Metal Mercury Hazardous Waste”.
- Wash hands, arms and face thoroughly after completing cleanup activities[1]

Any mercury spill large than a thermometer requires evacuation of the immediate area and contacting HSU for assistance.

Spill Response Team Requirements

[1] From http://www.ehs.iastate.edu/oh/hgspills.htm (Iowa State Dept. of Environmental Health and Safety

All personnel on the Spill Response Team must meet the following requirements:

1. Have attended either the 40 hour Clan Lab Safety Training course, or a 24 hour Hazardous Materials Technician course;
2. Have attended a refresher course within the past year;
3. Have a current medical approval for respirators;
4. Have a current respirator fit test; and
5. Be trained on use of the emergency spill cleanup equipment at their facility.

Decontamination Procedures

The decontamination process is a means of removing and/or neutralizing contaminants from employees and their equipment. These procedures protect the employees, the public and the environment by containing the contaminants.

Employee Decontamination Procedures

- Immediately place the individual under a shower and/or use an eye wash if appropriate;
- Remove all contaminated clothing to prevent additional injury;
- Flush contaminated areas with water for not less than 15 minutes;
- Notify the manager/supervisor whenever an employee has been contaminated.
- Contact the Occupational Health Physician and determine further course of action.

Equipment Decontamination Procedures

- Wash and rinse air purifying respirators and self-contained breathing apparatus;
- Wipe down air monitoring instrumentation;
- Take appropriate measures to dispose of decontamination solutions and absorbents.

GENERAL EMERGENCY PROCEDURES

All labs have developed an Emergency Action Plan, an evacuation, and a Fire Prevention Plan. The manager/supervisor of each facility shall ensure that these plans are implemented:

- An Emergency Action Plan which includes: emergency escape procedures and emergency escape route assignments; procedures to be followed by employees who remain to operate critical plant operations before they evacuate; procedures to account for all employees after emergency evacuation has been completed; rescue and medical duties for those employees who are to perform them; the preferred means of reporting fires and other emergencies; and names or regular job titles of persons or departments who can be contacted for further information or explanation of duties under the plan.

- An evacuation plan indicating the location of exits, electrical panels, emergency eyewashes and showers, fire alarms, fire extinguishers and fire hoses;

- A Fire Prevention Plan is developed pursuant to Section 3221, Title 8 of the California Code of Regulations (see Attachment C, pages 44-45);

- Annual training on the aforementioned plans will be provided to all employees.

In general, employees should:

- Not use the elevator during a fire; always use the stairs.
- Use the telephone in the elevator to call for help if the elevator malfunctions.
- Learn where the exits, fire alarms, first aid kits and emergency telephone numbers are located.
- Learn the location and proper use of safety equipment, such as emergency showers and eyewashes, fire extinguishers, and spill kits.

Additional emergency requirements associated with chemical spills and hazardous waste are located in the Spill Response section.

AIR MONITORING

Personal Air Monitoring

When exposures to airborne contaminants are found or expected to exceed allowable levels, steps shall be taken to monitor and control such harmful exposures. The Bureau of Forensic Services HSU shall monitor when new procedures are employed.

Whenever it is reasonable to suspect that an employee has been exposed to high concentrations of airborne contaminants, the manager/supervisor shall notify the Bureau Chief immediately by phone if possible, and follow up with an E-mail notification as soon as possible.

Personal air monitoring has been conducted for BFS exposures to lead and formaldehyde, which indicate that employees are not exposed above the action level for either chemical. These and other air monitoring results are kept by HSU. Employees who have had personal air monitoring will be advised of exposure levels measured by HSU.

Phosphine Air Monitoring

Due to the high hazard of exposure to phosphine gas which may be emitted from clandestine drug lab paraphernalia and associated chemicals, a phosphine monitor will be worn by lab personnel who are opening and handling evidence transportation buckets and kaypak bags containing such materials outside of a hood. Each lab that processes clandestine drug lab evidence has either ToxiRAE PGM-35 or Industrial Scientific T-82 meters.

The ToxiRAE PGM-35 and Industrial Scientific T-82 are passive air-monitoring devices, which should be worn in worker's breathing zone (clipped on the lab coat lapel). Either will measure phosphine concentrations as low as 0.1 ppm. The 8-hour exposure limit (PEL) is 0.3 ppm; the short-term (15-minute) exposure level is 1 ppm. The instrument will start an alarm at 0.3 ppm. Readings above 20 ppm are unreliable. The instrument should be calibrated monthly and checked before and after use with a known phosphine source (this could be expired calibration gas or emissions from a container of red phosphorus).

The instruments have cross sensitivities to hydrogen chloride, hydrogen sulfide, silane, diborane and germane. Either instrument should be calibrated monthly. The sensors will last approximately 1 year.

HOUSEKEEPING

There is a definite relationship between safety performance and orderliness in the laboratory. When housekeeping standards fall, safety performance inevitably deteriorates. The work area should be kept clean and chemicals and equipment should be properly labeled and stored.

- Work areas should be kept clean and free of unnecessary chemicals, equipment, and personal items;
- Work areas should be cleaned at the end of each work day;
- Wastes should be deposited in appropriate receptacles;
- Chemical spills should be cleaned up immediately;
- All laboratory floors should be wet mopped on a regular basis;
- All aisles, hallways, and stairs shall be kept clear;
- Keep routes to exits free of impediments or obstructions;
- A solution such as hypochlorite or Amphyl may be used for routine decontamination procedures;
- Office areas where evidence is received shall be kept clean and routinely disinfected.

INSPECTIONS

The proper function of safety equipment needs to be checked on a routine basis. Title 8 regulations require annual verification of fume hood performance. Monthly operation of the safety shower and eyewash is also required. To encompass all the inspections and function tests required by Title 8, the Bureau of Forensic Services has implemented a periodic inspection program.

The **"Laboratory Safety Inspection Report"** is designed for this purpose and is found in the "Safety Manual" folder on the Intranet Drive letter: m. This document should be retained for five years as proof of compliance.

MEDICAL CONSULTATIONS & EXAMINATIONS

All Laboratory Personnel

All Department of Justice employees who are engaged in the use of hazardous materials will have an opportunity to receive medical attention, including any follow-up examinations determined necessary by the examining physician under the following circumstances:

- If an employee develops exposure symptoms associated with hazardous materials;
- When air monitoring reveals an exposure level above the action level (or absent an action level, the exposure limit) for a Cal/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;
- When an event takes place in the work area such as a spill or leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure.

All medical examinations and consultations shall be performed by, or under the direct supervision of a Licensed Physician preferably Board Certified in Occupational Medicine. Examinations will be provided without cost to the employee, without loss of pay and at a reasonable time and place.

It is the responsibility of the employee's direct supervisor to ensure that the injured employee:

- Receives prompt medical attention;
- Is transported to a medical facility;
- That the exposure is documented.

The examining physician shall be provided the following information:

- Identity of the material;
- Conditions under which the exposure occurred;
- Description of the employee's symptoms;

- A copy of the Material Safety Data Sheet, if appropriate.

Medical and exposure records shall be retained for at least the duration of employment plus 30 years pursuant to Section 3204, Title 8 of the California Code of Regulations.

FIRST AID PROCEDURES

The laboratory manager/supervisor will encourage personnel to receive First Aid and CPR training upon initial assignment. Re-certification for First Aid is every three years; re-certification for CPR is annually. This portion of the safety section comments on a few of the common injuries that occur in laboratories and suggests simple emergency treatment. The American National Red Cross book, First Aid and Personal Safety, is an excellent source for a more comprehensive treatment of the subject.

Burns

Burns, for the most part, are preventable. Time spent in eliminating hazardous conditions is well worth the effort. Burns are grouped in order of their severity: (1) first degree burns show reddening of the skin, but no damage to the deeper layers; (2) second degree burns involve blistering of the skin; and (3) third degree burns involve severe damage to deep layered skin. The seriousness of a burn is determined not only by the degree but also by the extent of the burned area.

If the burn is relatively minor, the burned area should be immersed in cold water as soon as possible. Cold-water treatment should be continued until the pain is gone and does not return even after cold-water treatment is stopped. Prompt application of cold water tends to ease pain and reduce the severity of the burn. When the burn has dried, it should be bandaged with sterile gauze. If there is more than superficial blistering, the employee should be seen by a physician. In the meantime, the blisters should not be disturbed.

Burns are probably the most painful of all injuries. Pain is most severe at the time of the burn and shortly thereafter. Shock may occur if the burn is extensive.

Chemical Burns

Burns produced by chemicals should be flushed immediately with copious amounts of water. This procedure should be continued until all the chemical has been washed away and pain is reduced or eliminated. For additional first aid, procedures refer to the above section on burns.

Bleeding

To stop bleeding, apply steady pressure directly over the wound with a sterile pad or compress. If bleeding is more than superficial and a gauze pad is not immediately available, any clean cloth may be used. The pad should not be removed to see if the bleeding has stopped. If blood saturates the pad, apply more layers and maintain the pressure. If a limb is involved, raising the injured limb will

help reduce the flow of blood.

Poisoning By Inhalation

Remove the victim from exposure and get him to fresh air as quickly as possible by carrying or dragging.

Poisons For Which Vomiting Should Not Be Induced:

Do not induce vomiting if the person has swallowed anything listed below. Give milk or water (1-2 cups for ages 1 to 5, one quart if over 5 years of age):

Ammonia
Lye (Sodium Hydroxide)
Benzene
Naphtha (Petroleum Ether)
Bleach (Sodium Hypochlorite)
Paint Thinner
Carbolic Acid Disinfectant
Phenol
Detergents
Pine Oil
Dry Cleaning Fluids
Sodium Carbonate
Gasoline
Strong Acids
Kerosene
Strychnine
Lime (Calcium Oxide)

Poisons For Which Vomiting Should Be Induced:

Alcohols
Antifreeze (Ethylene Glycol)
Borax
Camphor
Formaldehyde
Insect Repellents

Fractures

Do not move the victim until trained help arrives with proper stabilizing equipment.

PROTECTIVE EQUIPMENT & APPAREL

General Policy

Use of personal protective equipment is required when performing certain procedures within the laboratory. Each Bureau of Forensic Service employee shall follow proper procedure and wear the required personal protection to ensure their safety and of those working around them. Basic policy for laboratory protective clothing is as follows:

- When hazardous substances are being handled in the laboratory and contact contamination may occur, lab coats and appropriate gloves will be worn in the laboratory area;
- Laboratory coats must be removed prior to leaving the laboratory areas in order to prevent the spread of contamination to common areas;
- No open-toed shoes, sandals or clogs are to be worn in the laboratory area;
- Avoid touching unprotected body areas with gloved or ungloved hands;
- Personal protective equipment such as safety glasses, face shields, gloves, lab coats, aprons, and respirators are to be used to prevent or reduce exposures when handling chemicals;
- Laboratory coats shall be laundered through the provided service or be disposable.

Protective Apparel

Eye Protection

- Eye protection (safety glasses with side shields) must be worn whenever there is danger of mechanical, injury to the eyes (such as grinding, test firing and the use of ESDA) or when generally handling chemicals.
- Eye protection (goggles or face shield) must be worn whenever there is the possibility of splash from chemicals that may physically damage your eye (corrosives such as>0.1 M HCl or NaOH; reactive materials such as lithium or potassium; cryogenic materials such as liquid nitrogen;

- Eye protection designed to filter out harmful frequencies of ultra-violet, infrared and laser radiation shall be worn when using sources that produce these types of radiation such as laser fluorescence in latent print work, use of UV to view DNA gels or in biosafety cabinets.

- Personnel may use prescription contacts in the laboratory area. If unusual eye irritation occurs while working with volatile chemicals in the lab, it is recommended that wearing of contacts be suspended.

Hand Protection

To prevent cuts or freezing, or to prevent toxic or irritating substances from coming into contact with the skin, adequate hand protection shall be used. Glove selection shall be made based on chemical compatibility. Due to the possibility of latex allergy development, the use of latex gloves should be limited to situations where it provides greater chemical protection and/or dexterity.

Personnel using phenol/chloroform/isoamyl alcohol mixtures for DNA extraction should use Microflex Neopro gloves (or equivalent) which are the only gloves that provide protection.

Body Protection

When there is a risk of injury because of the operation being performed, Bureau personnel shall wear appropriate body protection. The following items shall be available at each facility: laboratory coats and chemically resistant clothing.

Hearing Protection

Whenever noise levels are suspected to exceed 85 decibels, hearing protection shall be used. Hearing protection provided shall consist of earplugs or earmuffs. Test firing of weapons and operation of the DNA Bonemill will require this.

Thermal Protection

Whenever employees have to work inside of refrigerated spaces, adequate clothing and boots will be required to prevent hypothermia. Thermal gloves are required for handling cryogenic liquids or dry ice.

Respiratory Protection

See the Bureau Health and Safety Manual for the most recent version of the Respiratory Protection Program.

Safety Equipment:

Each facility is equipped with a number of safety-related items. These items are as follows:

Eye Washes & Safety Showers

Reference: 8CCR 5162
ANSI Std. Z358.1 – 2004

Whenever chemicals have the possibility of damaging the skin or eyes by corrosion or irritation, or are toxic by skin absorption, an emergency eyewash or shower must be available. If splashed with such material, the exposed area should be flushed for at least 15 minutes before transport to an emergency facility.

- Emergency eyewashes and showers shall be located so that an exposed employee can reach it in 10 seconds or less (if using strong acids or bases, the emergency shower should be immediately adjacent);
- The emergency shower location should be identified with a highly visible sign;
- If both an eyewash and shower are needed, they shall be located so that both can be used simultaneously by one person;
- The area immediately surrounding the eyewashes and showers shall be maintained free of items which obstruct their use;
- Plumbed eyewash and shower equipment shall be activated at least monthly to flush the line and to verify proper operation. A three-minute flush is recommended to eliminate bacterial build-up. Other units shall be maintained in accordance with manufacturer's instructions.

- Plumbed emergency shower/eyewashes have the following flow requirement:

  - 30 psi supply
  - drench hose: 3 gpm (not a substitute for an eyewash/shower)
  - eyewash: 0.4 gpm
  - eye/face unit: 3 gpm
  - shower: 20 gpm

- Portable eyewash units may be used in the laboratory or on vehicles responding to crime scenes or clandestine drug labs. Such units will be kept filled with potable water and the manufacturer's recommended preservative. The units will be tested monthly to ensure operation. The water supply will be changed according to the manufacturer's recommendations.

Portable Fire Extinguishers

The following describes the different types of fires, which may be encountered within the Bureau's facilities and extinguishing methods that should be used:

CLASS A Fires: Ordinary combustible materials such as wood, cloth, paper, rubber and plastics;

CLASS B Fires: Flammable and combustible materials, tars, greases, oils, oil based paints and lacquers that require a blanketing or smothering effect;

CLASS C Fires: Electrical equipment requires nonconductive extinguishing media;

CLASS D Fires: Combustible metals such as magnesium, titanium, sodium, lithium and potassium require specialized dry chemical extinguishers. These metals react violently with water.

Requirements for locating and placing fire extinguishers are:

- Portable extinguishers (CLASS A,B,C,) shall be maintained in a fully charged and operable condition, inspected monthly, annually maintained, and kept in their designated places at all times when they are not being used;

- Extinguishers shall be conspicuously located where they will be readily accessible and immediately available in case of a fire;
- They shall be located along normal paths of travel at a distance of no more than 50 feet apart;
- Class D fire extinguishers will not be provided to laboratories. If a class D fire initiates and cannot be controlled by normal physical limitations, evacuate the area and notify the fire department of the source of the fire.

Total Flooding Halon Extinguishing System

Halon 1301 is a halogenated hydrocarbon, bromotrifluoromethane, which is effective in extinguishing Class B and C fires. Extinguishment is accomplished by a chemical reaction. An obvious advantage is that Halon leaves no residue after application making this type of extinguishing system ideal for computer rooms and solvent storage areas. The main disadvantage is possible toxic effects when agent concentrations exceed 7% and from the products of decomposition. Therefore, great care must be exercised in using total flooding Halon extinguishing systems and personnel should be educated on what to expect.

Halon Extinguishing System Precautions:

- A sign should be posted stating that the area is equipped with a Halon extinguishing system;
- Outward swinging doors with panic hardware and with automatic closures;
- An alarm system should be installed to warn of impending discharge;
- All persons present should be informed of the requirement to leave when the alarm is sounded and the system is activated;
- No one should be permitted to enter the area without proper respiratory protection until the area has been adequately ventilated and cleared.

RECORDKEEPING

Medical & Exposure Records

Exposure Records

1. Air monitoring

All documentation of air monitoring results will be maintained by HSU. A copy of the report will be provided to each affected laboratory and should be maintained with the Safety Inspection Report.

2. Accidents involving injuries or exposures

For instances where only first aid is required or the employee will not miss any work, the Bureau uses the "Report of Minor Injury" form (JUS 1005, 8/94) to capture the information. This information should be kept with the Safety Inspection Reports and reviewed by the Supervisor and employees to learn from accidents and near-misses. A copy should also be forwarded to HSU.

For accidents that involve loss of work time or potential Workman's Compensation issues, the Department of Justice Administrative Bulletin # 98-10 describes the process and criteria.

Training Records

All training that is received by employees will be documented and retained by the manager/supervisor at the facility where the employee is assigned. These records shall be maintained for a period of five years past the last date of employment. The employees Automated Training Reporting System file should also be updated with this information.

Chemical Survey

Stored chemicals shall be surveyed annually in order to:

1. Determine the need for replacement, deterioration and container integrity. Special attention should be give to expiration dates on ethyl ether containers as ethyl ether may form shock-sensitive peroxides. In addition, picric acid must be kept in a wetted condition; if allowed to dry out, it will become shock-sensitive and explode.

2. Determine that Material Safety Data Sheets are available for the chemicals in the survey.

3. Each facility may be required to provide an inventory of hazardous chemicals to the local administering agency as required by Chapter 6.95 of the Health and Safety Code for the "Hazardous Materials Business Plan." The inventory should be kept with the Safety Inspection Report and other health and safety records and documents for the facility

Hazardous Waste Documents

Hazardous waste storage areas that are away from the regular work area (and not routinely observed) must be inspected weekly. See the form provided in Attachment #5

Hazardous waste manifests documenting not only the initial pickup, but also confirmation of the arrival of the waste at the designated hazardous waste site must be kept for 5 years at the Bureau facility that generates the waste.

EMPLOYEE INFORMATION & TRAINING PROGRAM

All Bureau of Forensic Service employees (including students and volunteers) who work in the laboratory shall receive training on chemical hazards in the laboratory. Information and training will apprise employees of hazards present in their work area. Training will be provided at the employee's initial assignment to a work area and prior to assignments involving new exposure situations. A written exam will be taken to evaluate competency; the passing score is 80%. Refresher information and training will be provided on an as-needed basis.

Specific requirements concerning training and testing are found in the Health and Safety Training Plan, section 7.

Chemical Hygiene Plan

Employees will be provided with the following information as part of their initial and ongoing training:

- The location, content and availability of the Chemical Hygiene Plan;
- The contents of occupational safety and health regulations, which apply to them;
- Exposure limits, regulatory and recommended, for substances they are working with;
- Symptoms associated with exposure to hazards;
- Methods to prevent exposure from hazards in their workplace;
- The location and availability of reference material including Material Safety Data Sheets.

It is the responsibility of the manager/supervisor to document and maintain records of the employee's participation in information and training programs.

Additional Training Requirements

- Employees who are part of the laboratory spill response team must meet the training

requirements necessary to respond to Clandestine Laboratories. This requires to have attended 40 hours of safety instruction relative to hazards at Clandestine Laboratories, 24 hours of on-the-job training and annual 8-hour refresher training (8 CCR 5192e).

- First Aid training is required every three years and CPR training is required annually for those who wish to be certified;

- The facility fire prevention plan may have a requirement for training in the use of fire extinguishers;

- Annual training is required for employees who handle hazardous waste. The training must review proper hazardous waste management procedures and cover your chemical spill plan. Competency will be determined by written or oral exam as well practical exercise.

- The Lab Safety Officer (LSO) will complete HS-102, Lab Safety Officer course offered by the California Criminalistics Institute within a year of appointment to the position. The LSO will also attend the annual Health and Safety Technical Advisory Group for continuing education.

MATERIAL SAFETY DATA SHEETS (MSDS)

Material Safety Data Sheets are a part of the Hazard Communication Program, which is fully described in the Bureau Safety Manual. MSDS are required by OSHA to be readily available to all employees. MSDS will be stored in the workroom where the chemicals used.

The Material Safety Data Sheet or MSDS is divided into a number of different sections. These will vary in number and content according to the manufacturer and date of publication. Material Safety Data Sheets are required to provide all of the following information:

- Name and address of the manufacturer;
- Emergency information and telephone numbers;
- Date the MSDS was prepared.

- Hazardous ingredients and identifying information;
- Chemical family and formula of the substance.

- Physical and chemical characteristics;
- Boiling point;
- Appearance and odor.

- Fire and explosion data;
- Flash point;
- Flammable explosive limits;
- Fire extinguishing media.

- Reactivity data;
- Incompatibility data;
- Hazards associated with the decomposition of the substance.

- Health hazard data concerning routes of entry;
- Signs and symptoms of exposure;
- Emergency and first aid procedures.

- Precautions for safe handling of the material;
- Steps to be taken in case of a spill or release.

LABORATORY WASTE DISPOSAL

Proper handling, storage and disposal of waste generated in each facility are necessary to assure that employees and the environment will not be harmed. All managers will ensure that laboratory waste is handled according to Bureau of Forensic Service policy and regulatory requirements.

Wastes generated by the Bureau are classified into one of the four categories below:

General Waste

General waste is solid waste such as paper, non-hazardous materials that can be disposed of through the facility's garbage system: Some special considerations regarding solid waste are:

- Dispose of damaged glassware immediately in designated glass containers to prevent injury.
- Any empty container of less than 5 gallons that formerly contained chemicals (except Hydrochloric Acid and Di-ethyl ether) may be disposed of as general waste as long as all pourable material has been drained off and the chemical label has been obliterated. It is recommended that large glass bottles be kept and re-used to collect chemical wastes.
- Polymerized acrylamide gels have been found to be non-hazardous through aquatic testing and review of toxicity data (Sax's Dangerous Properties of Industrial Materials, "Toxicity of polyacrylamide and acrylamide monomer" by DJ King, Rev Env Health, 1989, 8(1-4):3-16). As long as ethidium bromide is NOT used, polyacrylamide gels may be disposed of in the normal waste stream.

Universal Waste

Fluorescent lights, Cathode-ray tubes (CRT or computer monitors) and batteries of any type are classified as "universal wastes." These items may not be disposed of in the general waste stream because of hazardous contents. Fluorescent light tubes are managed by the Department of General Services at BFS facilities. CRTs must be taken to appropriate recycling centers. Batteries must be segregated (alkaline and lithium) and stored for disposal at battery recycling facilities or with hazardous waste.

PCB Wastes

Cargille Refractive Index Liquids (RILs) contained polychlorinated biphenyls (PCBs) until 1978. Any wastes generated by contact with RILs, such as wipes, cover slips and slides have to be treated as PCB wastes. All pre-1978 containers have been removed from BFS labs. For reference, a RIL with a four-sided label is suspect, and the manufacturer should be contacted with the lot number to determine if the RIL contains PCBs.

Chemical Hazardous Waste:

Materials that are defined by Title 22, California Code of Regulations or Section 260-263, Code of Federal Regulations as a hazardous waste. These materials include items such as organics, acids and bases that are used in the laboratory. Chemical hazardous waste must be disposed of through a hazardous waste hauler. Each laboratory shall have an EPA Identification Number and meet the requirements as stated in Section 25123.3(b) of the California Health and Safety Code.

Some basic procedures concerning chemical waste disposal include:

- Do not pour solvents down sinks or drains
- Solvents may not be disposed of by evaporation. Close the waste container after depositing waste solvents.
- GC-MS Vials containing solvents must be disposed of as hazardous waste. Vacuum pump oil shall be disposed of as hazardous waste since it may contain controlled substances;
- Wastes that are only acidic or basic (pH <2, >12.5), without containing other toxic materials may be neutralized and disposed of in the sewer.
- Empty chemical bottles may be disposed of as glass waste if they have been triple rinsed. Triple rinsing involves a primary rinse with acetone followed by two rinses with water. All rinse waste is considered hazardous waste.
- Divide waste into the following categories:

    1. Dichromate solutions regardless of valence: place in a sturdy glass or plastic container and label as “Dichromate Solution.” Hazards include toxicity, corrosivity.
    2. Liquid Chlorinated compounds including phenol/chloroform/isoamyl alcohol mixture

should be stored in either glass or HPDE container labeled: "Chlorinated Organics. " Hazards include toxicity, corrosivity, and flammability.

3. Spent solvents, non-chlorinated including organic acids: glass container labeled "Organics." Hazards include flammability, toxicity.
4. Mineral Acids pH 2 or less: glass container labeled: "Acids." Hazards are corrosivity.
5. Bases such as ammonium hydroxide or sodium hydroxide, with a pH of >12.5: glass container labeled: "Bases". Hazards are corrosivity.

Label the container "Hazardous Waste" and print the waste type, the accumulation start date and the address of the facility. Quantities of less than 55 gallons of each category can be stored up to three years;

- If full containers are removed from the hood and placed in a storeroom until disposal, weekly inspection must be made and recorded to determine that the containers are not leaking. Use the inspection form in Attachment #5 to document the weekly inspections.

- Three methods of disposal may be used.

    1. The Bureau maintains a contract with a hazardous waste disposal company. When time limits require it, or excessive volumes have accumulated, then the hazardous waste disposal company should be contacted to arrange removal. The LSO should coordinate the pickup with HSU. HSU will oversee the contractor during packaging and removal. Upon completion, the LSO will receive a copy of the waste manifest. After 30 days, a copy of the hazardous waste manifest should be received from the disposal site. All these records should be kept for five years.

    2. Some cities or counties provide a local business hazardous waste drop-off, which may be used for small volumes. Contact the local Environmental Health Department for details.

    3. Bench-top treatment by neutralizing waste acids and bases are allowed if the waste does not contain any other contaminants that would not be destroyed in the process. If neutralization is to be used, the volume may not exceed 5 gallons. The person performing the neutralization must know what the waste contents are and what process produced the waste. The person must have training in how to perform the treatment and what to do in an emergency. Documentation of the date, batch and volume treated, as well as the training of the individual involved must be kept for 3 years.

Hazardous Waste Reduction

- All facilities shall minimize the amount of waste produced and whenever possible waste will be recycled. It will be the responsibility of HSU to document the amount of hazardous waste on an annual basis.

Hazardous Waste Manifests

Hazardous waste manifests must only be signed by Bureau personnel who meet current Department of Transportation HazMat Employee training requirements and are familiar with waste descriptions, DOT identification numbers and Department of Toxic Substances Control manifest requirements.

After a pickup has occurred, a copy of the Hazardous waste manifest will be immediately sent to the Department of Toxic Substances Control, P.O. Box 400, Sacramento, CA 95812-0400.

Thirty days after the pickup, the signer must verify that the laboratory has received the final copy of the manifest indicating that the waste was received by the designated waste facility. If not, then the contractor should be immediately contacted to correct the discrepancy. The receiver of the final copy will send a copy to DTSC, PO Box 3000, Sacramento, CA 95812

SPECIFIC PROCEDURES & SUPERVISOR SIGN-OFF

Specific Procedures

8 CCR 5191 requires that specific procedures be developed when particularly hazardous substances are to be used in the laboratory, including but not limited to select carcinogens, reproductive hazards and substances with a high degree of toxicity.

Attachment #4 provides a form to be used in analyzing a procedure and determining the applicable hazards. A specific procedure must be developed identifying those hazards and how they will be dealt with. The procedure will be attached to this Chemical Hygiene Plan and employees trained appropriately.

Supervisor Sign-off

Procedures that require prior approval of a supervisor must also be described and attached to the Chemical Hygiene Plan.

GLOSSARY

Listed below are terms used in this program or in Material Safety Data Sheets (MSDS). Although we have not included every term found in these sources, the most frequently used ones are defined. If you do not understand a word or one of the definitions, contact your Laboratory Safety Officer.

ACGIH: American Conference of Governmental Industrial Hygienists, a professional organization, which recommends exposure limits for toxic substances.

ABSORPTION: The movement of a material through the skin.

ACID: A substance which dissolves in water and releases hydrogen ions (H+). Acids cause irritation, burns, or more serious damage to tissue depending on the strength of the acid, which is measured by pH (see pH).

ACTION LEVEL: A quantitative limit of a chemical, biological or radiological agent at which certain activities are performed to prevent or reduce exposure or contact.

ACUTE EFFECT: An adverse effect, usually the result of a short term and high-level exposure, with symptoms developing rapidly.

AIR PURIFYING RESPIRATOR: A device designed to protect the wearer from the inhalation of harmful atmospheres by removing the contaminants through a filtering media.

ALLERGIC REACTION: An abnormal physiological response to a chemical or physical stimulus by a sensitive person.

ANSI: American National Standards Institute, a private organization that recommends safe work practices and engineering designs.

ANESTHETIC EFFECT: The temporary loss of feeling induced by certain chemical agents which reduce the ability to feel pain or other sensations.

ANHYDROUS: Describes chemical compounds that do not contain water.

ANTIDOTE: An agent that neutralizes or counteracts the effects of a poison.

ASPHYXIANT: A vapor or gas, which can cause unconsciousness or death by suffocation. Asphyxiation is one of the principal potential hazards of working in confined spaces. See CHEMICAL ASPHYXIANT.

AUTOIGNITION TEMPERATURE: The approximate lowest temperature at which a flammable gas or vapor-air mixture will spontaneously ignite without spark or flame. Vapors and gases will spontaneously ignite at a lower temperature in oxygen than in air.

BOILING POINT: The temperature at which a liquid changes to a vapor state at a given pressure.

CARCINOGEN: A substance that induces cancer from either acute or chronic exposure.

CAUSTIC: A substance that strongly irritates, corrodes or destroys living tissue.

CHEMICAL ASPHYXIANT: A substance, which prevents the body from receiving or utilizing an adequate oxygen supply.

CHEMICAL HYGIENE PLAN: A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that are capable of protecting employees from hazardous chemicals used in that particular workplace.

CHRONIC EFFECT: An adverse effect, usually the result of a long term and low-level exposure, with symptoms developing slowly.

COMBUSTIBILITY: The capacity of a material to fuel a fire. The term is also used to classify certain liquids based on their flash points. A chemical property defined by having a flash point greater than 100^{o}F and below 200^{o}F.

CORROSIVE: The capacity of a material to cause immediate and extensive damage to human tissue at the site of contact.

DERMAL: Pertaining to the skin.

DERMATITIS: Inflammation, irritation or reddening of the skin.

EPA: Environmental Protection Agency is responsible for environmental protection.

EPA HAZARDOUS WASTE NUMBERS: Identification number, consisting of one letter and three numbers, assigned by EPA to each hazardous waste.

EPA ID NUMBERS: A 12-digit number assigned by EPA or the State to hazardous waste generators, transporters and facilities.

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

EXPLOSIVE LIMIT: The range of concentrations (% by volume in air) of a flammable gas or vapor that can result in an explosion. Usually given as Upper and Lower Explosive Limits.

EXPOSURE OR EXPOSED: Any situation arising from a work operation where an employee may ingest, inhale, absorb through the skin or eyes, or otherwise come into contact with a hazardous substance.

EYE PROTECTION: Recommended safety glasses, shields, goggles or other headgear to be utilized when handling materials.

GENERATOR: Any person, company or organization that produces hazardous waste which is subject to regulation.

HAZARD COMMUNICATION STANDARD: A right-to-know regulation that requires industrial users and processors of chemicals to warn their workers of hazards, conduct training in the safe use of the materials and to make available information on the chemicals contained in the Material Safety Data Sheets.

HAZARD EVALUATION: The impact or risk that hazards pose to employees, the public and the environment.

HAZARD WARNING: Any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which conveys the health hazards and physical hazards of the substance(s) in the container(s).

HAZARDOUS SUBSTANCE: A substance or combination of substances, which, because of its concentration, physical, chemical or infectious characteristics may cause injury or death.

INCOMPATIBLE: A term used to describe materials, which could cause dangerous reactions from direct contact with one another.

INGESTION: Taking a substance into the body by mouth.

INHALATION: Taking a substance into the body by breathing.

IRRITANT: A material which will cause an inflammatory response or reaction of the eyes, skin or

respiratory system following single or multiple exposures.

LOWER EXPLOSIVE LIMIT (LEL): Minimum amount of fuel in air creating an explosive atmosphere.

MILLIGRAMS PER CUBIC METER (mg/m^3): A mass to volume relationship describing the concentration of a contaminant in air.

MUTAGEN: A chemical capable of damaging chromosomes (i.e., altering the genetic code). Example: benzene.

NFPA: National Fire Protection Association. NFPA has developed a scale for rating the severity of fire, reactivity and health hazards of substances.

NIOSH: National Institute for Occupational Safety and Health, a federal agency, which conducts research on occupational safety and health, questions and recommends new standards to Federal OSHA. NIOSH, along with MSHA, tests and certifies respirators.

OSHA: Occupational Safety and Health Administration, which regulates workplace safety, and health.

OXIDIZER: A substance that readily acts as an oxygen donor to stimulate combustion of a chemical material. Example: chlorate, permanganate, inorganic peroxide or nitrate.

PARTS PER MILLION (PPM): A unit for measuring the concentration of a substance in a volume per volume or weight per volume ratio.

PERMISSIBLE EXPOSURE LIMIT (PEL): A term used to express the regulatory airborne concentration of a material to which nearly all persons can be exposed day after day without adverse effects.

pH: Indicates how acidic or alkaline a solution or chemical is using a logarithmic scale of 1 to 14.

PYROPHORIC: Any liquid or solid that will ignite in air below 130°F (54.4°C). [Hawley's Condensed Chemical Dictionary, 10th ed., 1977.

RADIOACTIVE: The property of an isotope or element which is characterized by giving off radiant energy in particles or rays by the disintegration of atomic nuclei.

REPRODUCTIVE TOXINS: Chemicals, which affect the reproductive function of the adult

including chromosomal damage and effects on fetuses. Examples: ethanol, lead, carbon disulfide.

SELF-CONTAINED BREATHING APPARATUS (SCBA): A respirator designed to protect the wearer from the inhalation of harmful atmospheres by providing a clean air source carried by the wearer.

SHORT-TERM EXPOSURE LIMIT (STEL): A term used by the American Conference of Governmental Industrial Hygienists (ACGIH) to indicate the maximum average concentration allowed for a continuous 15-minute exposure period.

TERATOGEN: A chemical capable of producing reproductive birth defects. Example: mercury compounds, N-methyl formamide.

TIME WEIGHTED AVERAGE (TWA): The average concentration of a chemical in air over the total exposure time (usually an 8-hour work day).

TOXICITY: The capacity of a material to produce adverse health effects resulting from overexposure to that material.

UPPER EXPLOSIVE LIMIT (UEL): Maximum amount of fuel (flammable gas or vapor) in air creating an explosive atmosphere.

WATER REACTIVE: May spontaneously ignite when mixed with water.

REFERENCES

Handbook of Chemical Health & Safety
Robert J. Alaimo, Editor
Oxford University Press
New York, New York 2001

Fundamentals of Industrial Hygiene, 4th Edition
Julian B. Olishifski
National Safety Council
Chicago, Ill 1996

Handbook of Laboratory Safety, 3rd Edition
A. Keith Furr
CRC Press Inc.
Boca Raton, FL 1989

Hawley's Condensed Chemical Dictionary
Richard J. Lewis
Van Nostrand Reinhold
New York, NY 1987

Laboratory Health and Safety Handbook
Scott Stricoff
John Wiley and Sons
New York, NY 1990

Modern Toxicology
Ernest Hodgson
Elservire
New York, NY 1987

Prudent Practices for Handling Hazardous Chemical in the Laboratories
National Research Council
National Academy Press
Washington D.C. 1995

The Foundations of Laboratory Safety
Stephen Rayburn
Springer-Verlag
New York, NY 1990

ATTACHMENT #1: SELECTED CHEMICAL REFERENCES

Acetone

Acetone is a volatile and highly flammable liquid. It must be kept away from sources of ignition. Prolonged or repeated topical use of acetone may cause irritation and dryness of the skin. Symptoms of inhalation may include headache, fatigue, excitement, bronchial irritation and in large amounts, narcosis. PEL = 750 ppm. Sweet odor.

Acetaldehyde

Animal and possible human carcinogen (ACGIH-3, IARC-2B, NTP-2). Poison by intratracheal and intravenous routes. A human systemic irritant by inhalation. An experimental teratogen. Other experimental reproductive effects. A skin and severe eye irritant. A narcotic. Human mutation data reported. Highly flammable liquid. Mixtures of 30–60% of the vapor in air ignite above 100º. It can react violently with acid anhydrides, alcohols, ketones, phenols, NH_3, HCN, H_2S, halogens, P, isocyanates, strong alkalies, and amines. May form unstable peroxides when exposed to air (by distillation or evaporation). When heated to decomposition it emits acrid smoke and fumes. Ceiling = 25 ppm.

Acrylamide

This substance is highly toxic and irritating. It can cause central nervous system paralysis. It can also be absorbed through unbroken skin. Animal studies indicate that acrylamide is a neurotoxin. Repeated skin contact, inhalation or swallowing may cause nervous system disorders. Reproductive effects have indicated decreased male fertility, increased spontaneous abortion and low birth weights in infants. When acrylamide is cross-linked, it becomes "polyacrylamide," and no longer is toxic. Acrylamide is a suspected human carcinogen (IARC –2A, NTP-2 and ACGIH-3) and should be handled with care. PEL =0.03 mg/m^3.

The following guidelines should be followed when using acrylamide:

- Always wear gloves and a mask when handling powdered acrylamide (Polyacrylamide is not toxic);
- If liquid acrylamide comes into direct contact with skin, wash with soap and rinse the exposed area thoroughly with water;
- Avoid any highly vigorous agitation, which may create an aerosol.

Alkali Metals

The most hazardous property of this class of chemicals is their violent reaction with water and the production of hydrogen. As a result of heat produced during the reaction, the hydrogen may react with oxygen in the air to cause a violent explosion. Elements in this group include sodium, potassium and lithium metals. Under certain conditions, these metals may ignite spontaneously upon exposure to air. For this reason, the metals should be stored in a petroleum-based liquid, which does not contain water.

Ammonia

Ammonia reacts with iodine to produce nitrogen trioxide, which is explosive. Mixtures of ammonia with organic halides react violently when heated under pressure. Ammonia should be stored away from halogens, silver and mercury.

Benzene

Benzene is a "Regulated Carcinogen" pursuant to Section 5218, Title 8 of the California Code of Regulations and shall not be stored or used by employees of the Bureau. Exposure to this compound may cause cancer. If an employee is required to handle benzene, a self-contained breathing apparatus (SCBA) shall be used. PEL = 1 ppm. Aromatic odor.

Benzidine

Benzidine is also a "Regulated Carcinogen" pursuant to Section 5209, Title 8 of the California Coed of Regulations and shall not be stored or used by employees of the Bureau. If an employee is required to handle benzidine, appropriate personal protective clothing shall be used; including a self-contained breathing apparatus (SCBA).

Boric Acid (Boracic Acid)

Boric acid is used in fireproofing fabric, cosmetics, printing and as an insecticide for cockroaches. It is incompatible with alkali carbonates and hydroxides. Ingestion or absorption may cause nausea, vomiting, diarrhea, central nervous system depression, abdominal cramps and lowered blood pressure, tachycardia, cyanosis and death (adult consumption of 5-20 grams). Chronic effects to boric acid may result in weight loss, kidney and liver damage and death.

Bromine

Bromine when inhaled will cause coughing, nosebleeds, dizziness and headaches followed by abdominal pain and skin rashes. Severe irritation of the respiratory tract also occurs when individuals are exposed to 40-60 ppm for short periods of time. PEL = 0.1ppm.

Carbon Disulfide

Carbon disulfide is a widely used solvent, which must be handled with care due to its flammability. It should be stored separately from aluminum, chlorine, azides, sulfuric acid, permanganates and other oxidizing agents. Carbon disulfide is also very toxic and can be absorbed into the body through the skin or by inhalation and ingestion. Symptoms of exposure include fatigue, visual disturbances, headaches, motor sensory disturbances, unconsciousness, respiratory failure and death. Carbon disulfide is also a developmental toxin, as well as a reproductive toxin for both men and women. PEL = 4ppm. Sweet, aromatic odor.

Carbon Tetrachloride

Carbon tetrachloride was commonly used as a dry cleaning solvent. However, due to the toxicity of this compound and its carcinogenic nature (Liver cancer: IARC-2B,NTP-2, and ACGIH-2), its use has considerably decreased. It is still used as a solvent in some laboratory procedures. Common routes of exposure to carbon tetrachloride include inhalation, ingestion and skin absorption. Acute symptoms include nausea, vomiting, diarrhea, headache, stupor and renal damage. Chronic symptoms include both liver and kidney damage. PEL = 2ppm. Ether-like odor.

Chloroform

Chloroform can produce dizziness, nausea and headaches. At high concentrations, it may produce disorientation, delirium and unconsciousness. Chronic exposures to chloroform may produce an enlarged or cancerous liver. Contact with the skin can result in drying and inflammation. Chloroform is considered a suspected human carcinogen (Liver, IARC-2B, NTP-2, ACGIH-3). PEL = 2ppm. Sweet odor.

Chromogen (3,3,5,5 Tetramethylbenzidine)

DNA staining dye. White to yellow powder. Can be absorbed through the skin. Can cause skin and eye irritation. Mouse Intraperitoneal LD50 = 135 mg/kg (moderately toxic). AVOID ingestion by good hygiene practice and use of gloves. Human mutagenic data reported for “high dose” exposures. No regulatory exposure level.

Coomassie Blue (Anazolene Sodium)

Coomassie blue will stain both skin and clothing. The LD50 in mice (intravenously) is 450 mg/kg.

Cyanides

These compounds are poisons, which prevent the absorption of oxygen by the body. Cyanides appear in the blood very rapidly after they are inhaled, swallowed or absorbed through the skin. Symptoms include salivation, headaches, and difficulty in breathing, unconsciousness and death. Cyanides must be kept away from acids. HCN Ceiling value = 4.7 ppm. Burnt almond odor.

Cyclohexanone

A ketone. Flammable liquid, suspected carcinogen (IARC 3). PEL = 25 ppm, IDLH = 700 ppm. Oral Rat LD50 = 1535 mg/kg (moderately toxic). Irritating to skin, eye and respiratory system. Has degenerative effects on liver and kidney.

Dichloromethane (Methylene Chloride)

Dichloromethane is commonly employed as a solvent for paints, aerosol propellants and degreasers. Dichloromethane is a suspected carcinogen (Lung and Liver, IARC-2B, NTP-2, ACGIH-3) and should be handled with care. Exposure to dichloromethane may occur via inhalation and ingestion. Symptoms of exposure include eye and respiratory irritation, nausea, vomiting, faintness, chills, unconsciousness and death.

Diethyl Ether

Also referred to as "ethyl ether." Diethyl ether is a very volatile, highly flammable liquid, which tends to form explosive peroxides when exposed to air, light and elevated temperatures. At concentrations as low as 1.85 percent by volume, diethyl ether forms explosive mixtures in the environment. It may also explode when brought into contact with anhydrous nitric acid. It is mildly irritating to the skin and mucous membranes. Inhalation of high concentrations of diethyl ether causes narcosis, unconsciousness and death. PEL = 400 ppm. Pungent, sweet odor.

Exposure of diethyl ether to air, sunlight and elevated temperatures for an extended period of time increases the formation of peroxides. Any ether solvents that display a precipitate or that seem more viscous than usual may contain peroxides. Peroxides are less volatile than ethers, however, they can explode spontaneously due to shock, sparks, heat, friction, impact, light and other forms of accidental ignition.

Ethidium Bromide

Ethidium bromide is irritating to the eyes, skin, mucous membranes and upper respiratory tract. It may be harmful by inhalation, ingestion or skin absorption. Long-term exposure may alter genetic material. LD50 = 110 mg/kg (subcutaneous, mouse)

Ethyl Acetate

Ethyl acetate is used in the manufacture of smokeless powders, pharmaceuticals and plastics. It should be stored away from sources of ignition due to its flammable and explosive properties. Exposure may occur via inhalation and ingestion. Symptoms include irritation to the skin, mucous membranes and eyes. PEL = 400 ppm. Fruity, ether-like odor.

Ethylene Glycol

Ethylene glycol is used in the manufacture of laminates, brake fluids, polyester fibers and films. It is also the primary ingredient in antifreeze and coolant. Ethylene glycol by itself is not toxic, however, its breakdown products are extremely toxic. Exposure may occur via inhalation and ingestion. Symptoms include nausea, coma, seizures, respiratory failure and death. PEL = 50 ppm. No odor.

Formaldehyde (solution)

Formaldehyde at room temperature is a gas. However, in forensic applications it is normally used in a 37% aqueous solution known as formalin. Routes of exposure include skin contact, inhalation and ingestion. Symptoms related to skin contact include dermatitis, conjunctivitis and damage to the cornea. Formaldehyde exposure through inhalation causes irritation to the respiratory tract and mucous membranes, headaches and palpitations. Ingestion of formaldehyde causes nausea, vomiting, diarrhea, dizziness, hematuria (red cells in the urine), convulsions and death due to respiratory failure. Formaldehyde has the potential to cause cancer in humans.

Glacial Acetic Acid

Glacial acetic acid is a flammable organic acid and should be separated from mineral acids such as hydrochloric acid and sulfuric acid. It is incompatible with carbonates, hydroxides and phosphates.

Exposures to glacial acetic acid via inhalation may result in burns of the skin and mucous membranes. Ingestion may cause severe corrosion of the mouth and GI tract, with vomiting, hematemesis (vomiting of blood), diarrhea, circulatory collapse, uremia and death. PEL = 10 ppm,

Ceiling = 40 ppm. Sour, vinegar odor.

Glutaraldehyde

Glutaraldehyde is used in 2% solutions to sterilize biological materials. PEL = 0.2 ppm (ceiling). Oral Rat LD50 = 250-2380 mg/kg (moderately toxic). Severe respiratory, skin and eye irritant; can cause allergic dermatitis and skin sensitization. Teratogenic effects.

Hexane

Hexane is a flammable solvent used in the manufacture of paints, plastics and petroleum products. Exposure to hexane may occur via inhalation and ingestion. Symptoms of exposure include respiratory irritation, edema and hemorrhage of the pulmonary membranes. PEL = 50 ppm. Sweet, pungent odor.

Hydrochloric Acid

Hydrochloric acid (HCl) is hydrogen chloride gas dissolved in water. Laboratory grade = 35-39%. Commercial concentrations known as "Muriatic Acid" are 20%. HCl is a mineral acid, which should not be stored with organic acids. Exposure to hydrochloric acid may cause severe burns to the skin, permanent eye damage and dermatitis. If inhaled, hydrochloric acid may cause coughing, choking and inflammation of the respiratory tract. Hydrochloric acid if ingested may cause irritation of the mucous membranes, nausea, vomiting, intense thirst, diarrhea and death. Ceiling = 5 ppm. Pungent and irritating odor.

Hydrogen Sulfide

Hydrogen sulfide is a flammable, poisonous gas, which is detectable in air at concentrations as low as 0.002 mg/L. The odor of hydrogen sulfide cannot be used as a warning sign since sensitivity to this odor disappears with continuous exposure to very low levels of the gas. Symptoms of hydrogen sulfide exposure include irritation of mucous membranes, headache, nausea, coma and death. PEL = 10 ppm. Ceiling =50 ppm. "Rotten egg" odor.

Hydrogen Peroxide

Concentrated hydrogen peroxide reacts violently when mixed with iron, copper, chromium or other metals. Household hydrogen peroxide is a 3% solution with few hazardous characteristics. Hydrogen peroxide in concentrations greater than three percent may cause severe burns to the skin. PEL = 1 ppm. Sharp, characteristic odor.

Iodine

Iodine is used in the manufacture of pharmaceuticals, soaps, food and dyes. It is incompatible with alkaloids, starch and ammonia. Exposure to iodine may occur via inhalation and ingestion. Symptoms include irritation of the eyes and mucous membranes, nausea, vomiting and diarrhea. PEL = 0.1 ppm. Sharp, characteristic odor

Isopropanol

Isopropanol is used in the manufacture of acetone, glycol, resins, lacquers and pharmaceuticals. It is incompatible with oxidizing agents and is very flammable. Exposure to isopropanol may occur via skin absorption, inhalation and ingestion. Symptoms of exposure include headaches, dizziness, mental depression, nausea, vomiting, and irritation of the skin. Excessive exposure in a confined space could cause coma and death. PEL = 400 ppm. Rubbing alcohol odor.

Lead

Exposure to lead may be toxic to your body when absorbed by either inhalation or ingestion. Occupational exposure limits have been set to prevent employee exposure above permissible or safe levels. The Cal/OSHA regulation covering exposure to LEAD is Section 5216, Title 8 of the California Code of Regulations. This standard sets a permissible exposure limit (PEL) of fifty micrograms (50 ug/m^3) of lead per cubic meter of air, over an 8-hour workday. This standard also establishes an action level where an employer must institute special handling procedures for their employees. This level has been set at 30 ug/m^3 of air.

Acute lead poisoning may cause anorexia, vomiting, convulsions and permanent brain damage. Chronic cases may show weight loss, weakness and anemia. Lead is a developmental toxin and a reproductive toxin for both men and women.

Leucomalachite Green

Leucomalachite Green can be harmful via ingestion, inhalation and skin absorption. May cause skin and eye irritation. White to tan colored powder. Incompatible with strong oxidizing agents. No regulatory exposure limits.

Luminol

Luminol can be harmful via ingestion, inhalation, or skin absorption. May cause skin and eye irritation. Luminol is also irritating to the upper respiratory tract and mucous membranes. Pale yellow to tan colored powder. Incompatible with strong oxidizing agents, strong acids, strong bases,

and strong reducing agents. No regulatory exposure limits.

Merbromin

Merbromin is a derivative of fluoroscein with bromine and hydroxymercury groups. It has been used historically as a topical antiseptic. Synonyms include mercurochrome, aseptichrome, flavurol and planochrome. The solution applied in fingerprint analysis is a mixture of merbromin, formic acid, ethanol and zinc that has been refluxed up to 8 hours. Intravenous mouse LD50 is 50 mg/kg, intraperitoneal mouse LD50 is 200 mg/kg. No oral LD50 is known to exist. It is labeled "highly toxic" in the United States. Merbromin has exhibited positive mutation effects in Saccharomyces cerevisiae. The only literature regarding human effects is allergic dermatitis and elevated blood mercury following ingestion.

The greatest concern from exposure to merbromin is ingestion. It is an aryl mercury compound. These compounds cause neurological effects such as tremor, weakness, upset stomach, edema and fatigue when exposed chronically. Acute exposure would result in eye, skin and respiratory irritation. (NOTE: Ingestion can occur from respiratory exposure when inhaled particles are removed from the lung in mucus and subsequently swallowed. Maximum allowable inhalation values (ceiling) are 0.1 mg/m^3).

Methanol

Methanol is used in the manufacture of solvents, fuels, resins, paints and dyes. Exposures to methanol may occur via skin absorption, inhalation and ingestion. Symptoms of exposure include dizziness, central nervous system depression, shortness of breath, visual disturbances, coma and eventual death. Methanol has a specific degenerating effect on the optic nerve, which may result in permanent damage and blindness, even if only a small quantity has been ingested.

Ninhydrin

Ninhydrin causes irritation if swallowed. Avoid contact with eyes, skin, and clothing. Respiratory irritant. White to pale yellow powder or crystals. Incompatible with strong bases, amines, and alkali metals. No regulatory exposure levels.

Nitric Acid

Nitric acid is widely used in the manufacture of fertilizers, explosives and nitro organic compounds. Nitric acid should also be stored away from organic acids due to the risk of fire. Exposure to nitric

acid occurs via inhalation and ingestion. Symptoms of inhalation exposures include coughing, chest pain, bronchitis and pulmonary edema. Ingestion exposures are characterized by yellow discoloration of the teeth and mouth, nausea, vomiting of blood, hematuria (blood in the urine) shock and death.

O-Tolidine

This substance is a probable carcinogen (bladder, IARC-2B, NTP-2, ACGIH-2). Absorption is possible through respiratory, ingestion and skin contact. Containers of o-tolidine should be kept closed and protected from light. PEL = 2 ppm. Aromatic, aniline odor.

Paraformaldehyde

Paraformaldehyde is a polymerized form of formaldehyde. It is used for disinfections, as a contraceptive, a fumigant and in manufacture of synthetic resins. Soluble in water with the release of formaldehyde. Combustible solid (flash point 158 degrees F). A severe skin and eye irritant. Moderately toxic by ingestion (Rat Oral LD =800 mg/kg).

Petroleum Ether

Petroleum ether (naphtha) is a petroleum distillate fraction used to manufacture paint, paint thinners and dye-cleaning solvents. It consists of pentane, hexane, and heptanes. It is flammable and should be kept away from sources of ignition. Exposure to petroleum ether may occur via skin absorption, inhalation and ingestion. Symptoms of exposure include headaches, drowsiness, vomiting, and diarrhea. Coma and death are possible in confined spaces. There is no PEL; however, the PEL for n-hexane is 50 ppm.

Phenol

One of many aromatic compounds in coal tar. White crystalline solid with a characteristic sharp medicinal sweet, tangy odor. Highly corrosive. Phenol is incompatible with strong oxidizing agents and halogens. Avoid dermal (skin) absorption, eye contact, ingestion, and inhalation. Phenol is rapidly absorbed through the skin and can cause death through respiratory collapse and kidney failure. Severe systemic toxicity if the skin is not promptly decontaminated after exposure. PEL = 5 ppm. Sweet, acrid odor.

Picric Acid

Picric acid is a class A explosive and should be kept in a cool environment remote from fires. It explodes when rapidly heated. It is shock sensitive when dry. Picric acid is also incompatible with

all oxidizing agents, metals and metallic salts. Ingestion of picric acid may cause nausea, vomiting, diarrhea, abdominal pain, yellow staining of the skin, itching, skin eruptions, stupor, convulsions and death. PEL = 0.1 mg/m.

Potassium Dichromate

Potassium dichromate is a bright, yellow-red crystal used for calibration in blood alcohol analysis. It is used in industry in wood preserving, chrome plating, photography. It is a strong oxidizer, and causes an explosive reaction with hydrazine. It reacts violently with sulfuric acid and acetone. It is toxic and corrosive by skin contact or ingestion. Exposure may result in skin ulceration and perforation of the nasal septum. Chromium (VI) compounds are human carcinogens (IARC-1, NTP-1, ACGIH-1), causing lung cancer to workers who inhale dust or mists containing Cr(VI). PEL = 0.05 mg/m^3.

Potassium Hydroxide

Potassium hydroxide is a very strong corrosive, which absorbs moisture from the air. Potassium hydroxide should be stored away from acids, chloroform, sodium oxide and water. Exposures of potassium hydroxide can occur via inhalation and ingestion. Symptoms of inhalation include irritation of the respiratory tract and inflammation of the lungs. Ingestion of potassium hydroxide results in nausea, vomiting, diarrhea, cardiovascular collapse, coma and death. Potassium hydroxide, due to its caustic nature can cause severe damage to the skin and eyes.

Potassium Permanganate

Potassium permanganate crystals are dark purple. It is an oxidizer, which will explode when mixed with sulfuric acid. It is also incompatible with carbon disulfide and benzene.

Pyridine

Pyridine is used in the synthesis of pharmaceuticals, rubber, dyes and fungicides. Pyridine vapors, when exposed to heat or flame, can present an extreme fire hazard. Exposure to pyridine may occur via inhalation and ingestion. Symptoms include headaches, dizziness, light-headedness, insomnia and liver and kidney damage.

Rhodamine 6G

Rhodamine 6G is a possible carcinogen. Harmful if ingested, inhaled, or absorbed through the skin. May cause skin and eye irritation. Brown crystalline powder. Incompatible with strong oxidizing agents. IARC-3. No regulatory exposure limits.

Sodium Hydroxide

Sodium hydroxide is a corrosive compound used in the manufacture of pharmaceuticals, dyes, soaps and plastics. Sodium hydroxide is a very strong corrosive, which absorbs moisture from the air. Sodium hydroxide should be stored away from acids, chloroform and water. Exposures of sodium hydroxide can occur via inhalation and ingestion. Symptoms of inhalation include irritation of the respiratory tract and inflammation of the lungs. Ingestion of sodium hydroxide results in nausea, vomiting, diarrhea, coma and death. Sodium hydroxide, due to its caustic nature can cause severe damage to the skin and eyes. PEL = 1 mg/m^3.

Sulfuric Acid

Sulfuric acid is a mineral acid and should be stored away from organic acids. Additionally, sulfuric acid is incompatible with metals, chlorates, perchlorates, permanganates, pyridine, carbon disulfide and nitric acid. Exposures to sulfuric acid result in severe damage to the skin, respiratory tract and may cause death.

3,3,5,5 Tetramethylbenzidine

See Chromogen.

Tetramethyl Ethylene Diamine

Flammable liquid, which is moderately toxic by ingestion. Skin and severe eye irritant. Rat Oral LD50 = 1580 mg/kg

Toluene

Toluene is used as the moving phase in Thin Layer Chromatography for marijuana and as a carrier solvent in GC/MS analysis. High exposures of toluene can result in CNS encephalopathy, headache, depression, lassitude, impaired coordination, transient memory loss, and impaired reaction time. Reproductive effects observed in glue-sniffers include fetal development defects. Aromatic odor. Colorless. Highly flammable. PEL =50 ppm, IDLH = 500ppm, IARC- 3, ACGIH-A4.

Zinc Dust (Mossy Zinc)

The dust can irritate eyes and skin; relatively non-toxic by ingestion. Zinc evolves hydrogen upon contact with acid, water or moisture in the air if the zinc particle is small enough; heat of

reaction may be adequate to self-ignite. Combustible solid

Zinc Chloride

Zinc chloride is used in the Latent Print Section in conjunction with the laser. Symptoms related to the exposure of zinc chloride include irritation of the skin and mucous membranes. PEL = 1 mg/m^3 as fume.

ATTACHMENT #2: CHEMICAL COMPATIBILITY CHART

Below is a chart adapted from the CRC Laboratory Handbook, which groups various chemicals in to 23 groups with examples and incompatible chemical groups. This chart is by no means complete but it will aid in making decisions about storage. For more complete information, please refer to the MSDS for the specific chemical.

Group	Name	Example	Incompatible Groups
Group 1	Inorganic Acids	Hydrochloric acid Hydroflouric acid Hydrogen chloride Hydrogen fluoride Nitric acid Sulfuric acid Phosphoric acid	2,3,4,5,6,7,8,10,13,,1,4,16,17,18,19,21,22,23
Group 2	Organic acids	Acetic acid Butyric acid Formic acid Propionic acid	1,3,4,7,14,16,17,18,1,9,22
Group 3	Caustics	Sodium hydroxide Ammonium hydroxide solution	1,2,6,7,8,13,14,15,16,17,18,20,23
Group 4	Amines and Alkanolamines	Aminoethylethanolamine Aniline Diethanolamine Diethylamine Dimethylamine Ethylenediamine 2-Methyl-5-ethylpyridine Monoethanolamine Pyridine Triethanolamine Triethylamine Triethylenetetramine	1,3,4,11,14,17
Group 5	Halogenated Compounds	Allyl chloride Carbon tetrachloride Chlorobenzene Chloroform Methylene choloride Monochlorodifluoro methane 1,2,4-Trichlorobenzene 1,1,1,-Trichlorobenzene	

		Trichloroethylene Trichlorofluoromethane	

Group	Name	Example	Incompatible Groups
Group 6	Alcohols Glycols Glycol Ether	1,4-Butanediol Butanol (iso, n, sec, tert) Diethylene glycol Ethyl alcohol Ethyl butanol Ethylene glycol Furfuryl alcohol Isoamyl alcohol Methyl alcohol Methylamyl alcohol Propylene glycol	1,7,14,16,20,23
Group 7	Aldehydes Acetaldehyde	Acrolein Butyraldehyde Crotonaldehyde Formaldehyde Furfural Paraformaldehyde Propionaldehyde	1,2,3,4,5,6,8,15,16,17,19 ,20,23
Group 8	Ketones	Acetone Acetophenone Diisobutyl ketone Methyl ethyl ketone	1,3,4,7,19,20
Group 9	Saturated Hydrocarbons	Butane Cyclohexane Ethane Heptane Paraffins Paraffin wax Pentane Petroleum ether	20
Group 10	Aromatic Hydrocarbons	Benzene Cumene Ethyl benzene Naphtha Naphthalene Toluene Xylene	1,20
Group 11	Olefins	Butylenes 1-Decene	1,5,20

		1-Dodecene Ethylene Turpentine	
Group 12	Petroleum Oils	Gasoline Mineral Oil	20
Group 13	Esters	Amyl acetate Butyl acetates Castor oil Dimethyl sulfate Ethyl acetate	1,3,4,19,20
Group	Name	Example	Incompatible Groups
Group 14	Monomers Polymerizable Esters	Acrylic acid Acrylonitrile Butadiene Acrylates	1,2,3,4,5,6,15,16,19,20,21,23
Group 15	Phenols	Carbolic acid Creosote Cresols phenol	3,4,7,14,16,19,20
Group 16	Alkylene Oxides	Ethylene oxide Propylene oxide	1,2,3,4,6,7,14,15,17,18,19,23
Group 17	Cyanohydrins	Acetone cyanohydrin Ethylene cyanohydrin	1,2,3,4,5,7,16,19,23
Group 18	Nitriles	Acetonitrile Adiponitrile	1,2,3,4,16,23
Group 19	Ammonia	Ammonium Hydroxide Ammonium Gas	1,2,7,8,13,1,415,16,17,20,23
Group 20	Halogens	Chlorine Fluorine	3,6,7,8,9,10,11,12,13,14,15,19,21,22
Group 21	Ethers	Diethyl Ether THF	1,14,20
Group 22	Phosphorus	Phosphorus, Elemental	1,2,3,20
Group 23	Acid Anhydrides	Acetic anhydride Propionic anhydride	1,3,4,6,7,14,16,17,18,19

ATTACHMENT #3 CARCINOGEN CLASSIFICATION SYSTEMS

IARC: International Agency for Research on Cancer, World Health Organization

Group 1- The agent (mixture, exposure circumstance) is carcinogenic to humans.

Group 2A- The agent (mixture, exposure circumstance) is probably carcinogenic to humans. There is "limited evidence" of carcinogenicity from studies in humans, and "sufficient evidence" of carcinogenicity in experimental animals.

Group 2B- The agent (mixture, exposure circumstance) is possibly carcinogenic to humans.

Group 3- The agent (mixture, exposure circumstance) is not classifiable as to its carcinogenicity to humans.

Group 4- The agent (mixture, exposure circumstance) is probably not carcinogenic to humans.

NTP: National Toxicology Program, US Department of Health and Human Services

Type 1- Substances or groups of substances, and medical treatments that are known to be carcinogenic. Known carcinogens are defined as those substances for which the evidence from human studies indicates that there is a causal relationship between exposure to the substance and human cancer.

Type 2- Substances or groups of substances, and medical treatments, which may reasonably be anticipated to be carcinogens.

1. There is limited evidence of carcinogenicity from studies in humans, which indicates that causal interpretation is credible, but that alternative explanations, such as chance, bias or confounding, could not adequately be excluded, or

2. There is sufficient evidence of carcinogenicity from studies in experimental animals which indicates that there is an increased incidence of malignant tumors: (a) in multiple species or strains, or (b) in multiple experiments (preferably with different routes of administration or using different dose levels), or (c) to an unusual degree with regard to incidence, site or type of tumor, or age at onset. Additional evidence may be provided by data concerning dose-response effects, as well as information on mutagenicity or chemical structure.

Type 3- Occupational exposures associate with a technological process that is known to be carcinogenic.

Type 4- Delisted substances; bases on absence from US distribution and production, or new evidence or re-evaluation of existing data.

OSHA: Occupational Safety and Health Administration, US Department of Labor

Emphasis is on chemicals with industrial significance

- R means regulated by Federal and California OSHA.
- C means regulated by California OSHA only.
- S means select carcinogen

OSHA "select carcinogens" are substances that meet one of the following:

- Regulated by Federal and California OSHA
- NTP Type 1.
- IARC Group 1.
- IARC Group 2 or NTP Type 2, and causes statistically significant tumor incidence in experimental animals according to the following criteria:

  1. After inhalation exposure of 6 to 7 hours per day, 5 days per week for a significant portion of a lifetime, to dosages of less than 10 mg/m3.
  2. After repeated skin application of less than 300 mg/kg of body weight per day.
  3. after oral dosages of less than 50 mg/kg of body weight per day.

ACGIH: American Conference of Governmental Industrial Hygienists

Type 1- *Confirmed Human Carcinogens.* The agent is carcinogenic to humans based on the

weight of evidence from epidemiological studies of, or convincing clinical evidence in, exposed humans.

Type 2- *Suspected Human Carcinogens.* The agent is carcinogenic in experimental animals at dose levels, by route(s) that are considered relevant to worker exposure. Available epidemiological studies are conflicting or insufficient to confirm an increased risk of cancer in exposed humans.

Type 3 –*Animal Carcinogen.* The agent is carcinogenic in experimental animals at a relatively high dose, by route(s) of administration, at site(s), of histological type(s), or by mechanism(s) that are not considered relevant to worker exposure. Available evidence suggests that the agent is not likely to cause cancer in humans except under uncommon or unlikely routes or levels of exposure.

Type 4- *Not Classifiable as Human Carcinogen.* There are inadequate data on which to classify the agent in terms of its carcinogenicity in humans and/or animals.

Type 5-*Not suspected as a Human Carcinogen.* The agent is not suspected to be a human carcinogen on the basis of properly conducted epidemiological studies in humans. These studies have sufficiently long follow-up, reliable exposure histories, sufficiently high dose, and adequate statistical power to conclude that exposure to the agent does not convey a significant risk of cancer to humans. Evidence suggesting a lack of carcinogenicity in experimental animals will be considered if it is supported by other relevant data.

ATTACHMENT #4
HAZARD ANALYSIS FORMS FOR SPECIAL PROCEDURES

JOB SAFETY ANALYSIS	JOB TITLE: Page __ of __ JSA No. ____		DATE:	New ___ Revised ___
Employer: Facility: Location:	Classification(s) Doing Job: Supervisor:	Required and/or Recommended Personal Protective Equipment:	Analysis by: Reviewed by: Approved by:	

SEQUENCE OF BASIC JOB STEPS	POTENTIAL HAZARDS	RECOMMENDED ACTION OR PROCEDURE

INSTRUCTIONS FOR COMPLETING JOB SAFETY ANALYSIS FORM

Source: Fundamentals of Industrial Hygiene, 3rd Edition, National Safety Council, 1988, page 599

SEQUENCE OF BASIC JOB STEPS

Break the job down into steps. Each of the steps of a job should accomplish some major task and then determine the next logical set of movements.

Be sure to list all the steps in a job. Some steps might not be done each time, however, that task is part of the job as a whole, and should be listed and analyzed.

POTENTIAL HAZARDS

Identify the hazards associated with each step. Examine each step to find and identify hazards, actions, conditions and possibilities that could lead to an accident.

It is not enough to look at the obvious hazards. It is also important to look at the entire environment and discover every conceivable hazard that might exist.

RECOMMENDED ACTION/PROCEDURE

Using the first two columns as a guide, decide what actions are necessary to eliminate or minimize the hazards that could lead to an accident, injury or occupational illness.

Among the actions that can be taken are:
1) engineering the hazard out;
2) providing personal protective equipment;
3) job instruction training;
4) good housekeeping;
5) good ergonomics.

List recommended safe operating procedures on the form and also list required or recommended PPE for each step of the job.

Be specific. Say exactly what needs to be done to correct the hazards. Avoid general statements like “be careful”.