Chemical Hygiene Plan

Safety Procedure and Policy

Tour Lab
Rice University

Updated 5-31-03

MAJOR MEDICAL EMERGENCIES

- **If it is not practical to move the ill or injured individual**, call the Rice University Police and they will obtain an ambulance and escort it to the location of the emergency.
- **DO NOT PLACE A 911 CALL - THE RICE UNIVERSITY POLICE WILL DO THIS.**
- For job sustained injury/illness, all patients should be taken to **Hermann Hospital's Emergency Room, 6411 Fannin (704-4060) or their own hospital of choice**. Hospital personnel should be told it is an on-the-job injury for Rice University, if applicable. Proof of Rice employment, such as a campus ID card, will be required. A First Report of Injury Form must also be filed with the Risk Manager, VP for Investments/Treasurer.
- When the injury or illness involves a chemical, a Material Safety Data Sheet (MSDS) should accompany the victim to the hospital.
- *The procedure outlined above applies to all individuals receiving pay from Rice University who are injured or become ill while performing an activity that directly benefits Rice University. If transportation is unavailable within the injured's department, a request may be made to the Campus Police to provide such.*
- **Students** who are injured/become ill and who might require hospitalization should go to **Park Plaza Hospital's Emergency Room (527-5129).** Rice ID required.

MINOR MEDICAL EMERGENCIES

- On-the-job, minor medical injuries/illness (i.e., falls, cuts, sprains and strains) involving employees should be reported immediately to the injured's supervisor. The supervisor should fill out a First Report of Injury Form (available from Human Resources or the Environmental Health & Safety Department). If medical attention is required, the injured should be taken to **Hermann Hospital's Emergency Room, 6411 Fannin (704-4060)** or their **physician of choice.**
- Students who incur a minor injury during normal class/working hours should be referred to the **Student Health Services at Hanszen College, x4966 or x2326**.

REPORTING ACCIDENTS

To report an accident, "near miss" or hazardous situation on campus **not involving an injury**, contact the Environmental Health & Safety Department, x4444. Complete an Accident/Incident Report Form and submit it to your Department Head and the Environmental Health & Safety Department. Forms are available from EH&S.

Emergency procedures taken from www.rice.edu/ehs

1. Standard Operating Procedures

1.1 General Rules

1. Avoid working alone in a laboratory or chemical storage area. When you must, take extra precaution to ensure your safety.

2. Wear appropriate eye protection at all times; see section 1.3

3. When working with flammable chemicals, be certain that there are no sources of ignition near enough to cause a fire or explosion in the event of a vapor release or liquid spill.

4. Use a blast shield for protection whenever an explosion or implosion might occur.

For the chemicals they are working with, all employees and students should know and constantly be aware of:

1. The chemicals' hazards, as determined from the MSDS and other appropriate references. All MSDS information can be found online at www.jmtour.com.

2. Appropriate safeguards for using that chemical, including personal protective equipment.

3. The location and proper use of emergency equipment.

4. How and where to properly store the chemical when it is not in use.

5. Proper personal hygiene practices.

6. The proper methods of transporting chemicals within the facility. A carry jacket must be used when transporting chemicals out of the designated laboratory area.

7. Appropriate procedures for emergencies, including evacuation routes, spill cleanup procedures and proper waste disposal.

1.2 Personal Hygiene

1. Wash promptly whenever a chemical has contacted the skin.

2. Avoid inhalation of chemicals; do not "sniff" to test chemicals.

3. Do not use mouth suction to pipette anything; use suction bulbs.

4. Wash well with soap and water before leaving the laboratory; do not wash with solvents.

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

6. Do not bring food, beverage, tobacco, or cosmetic products into chemical storage areas or use areas.

1.3 Protective Clothing and Equipment

1. Eye protection worn when working with chemicals should meet the requirements of the American National Standards Institute (ANSI) Z87. Wear goggles such as type G, H, or I at all times. When working with more that 30 mL of a corrosive liquid, also wear a face shield, type N, large enough to protect the chin, neck, and ears, as well as the face.

2. When working with corrosive liquids, also wear gloves made of material known to be resistant to permeation by the corrosive chemical and tested by air inflation (do not inflate by mouth) for the absence of pin-hole leaks.

3. When working with chemicals, shorts and short-sleeve shirts will only be permitted with the use of either a high-necked, calf- or ankle-length, rubberized laboratory apron or a long-sleeve, calf- or ankle-length laboratory coat as indicated by Rice University's Environmental Health and Safety office.

4. When working with allergenic, sensitizing, or toxic compounds, wear gloves made of material known to be tested and found to be resistant to permeation by the chemical and tested for the absence of pin holes.

5. Always wear low-heeled shoes with fully covering "uppers"-, do not wear shoes with open toes, including sandals.

6. Whenever exposure by inhalation is likely to exceed the threshold limits described in the MSDS use a hood; if this is not possible a respirator must be worn. Consult with your supervisor before doing any such work.

7. Carefully inspect all protective equipment before using. Do not use defective protective equipment and report all defective equipment to the lab safety officer.

1.4 Housekeeping

1. Access to emergency equipment, showers, eyewashes, and exits should NEVER be blocked by anything, not even a temporarily parked chemical cart or clutter around the sink area.

2 To avoid a flood, dirty glassware should never be left in the bottom of the sink.

3. Liquids should never be stored above 5'6" or above any solid chemicals.

4. All chemical containers must be labeled in English with at least the identity of the contents and the hazards those contents present to the users.

5. Keep all work areas, especially laboratory benches, clear of clutter.

6. Keep all aisles, hallways, and stairs clear of all chemicals.

7. All chemicals should be placed in their assigned storage areas at the end of each workday.

8. At the end of each workday, the contents of all unmarked containers are to be considered wastes.

9. Wastes should be properly labeled and kept in their proper containers.

10. Promptly clean up all spills; properly dispose of the spilled chemical and cleanup materials. Contact the Environmental Safety Office at x4444 for assistance.

11. All working surfaces and floors should be cleaned regularly.

12. No chemicals are to stored in aisles or stairwells, on desks or laboratory benches, on floors or in hallways, or to be left overnight on the workbenches.

13. Horseplay and running in the laboratory are strictly forbidden.

1.5 Prior Approval

Laboratory employees and students must obtain prior approval to proceed with a laboratory task from the principle investigator whenever:

1. A new laboratory procedure is to be carried out.

2. It is likely that toxic limit concentrations could be exceeded or that other harm is likely.

3. There is a change in a procedure or test, even it is very similar to prior practices. "Change in a procedure or test" means:

    a. A 10% or greater increase or decrease in the amount of one or more chemicals used.

    b. A substitution or deletion of any of the chemicals in a procedure.

    c. Any change in other conditions under which the procedure is to be conducted.

4. There is a failure of any of the equipment used in the process, especially of safeguards such as fume hoods or clamed apparatus.

5. There are unexpected results.

6. Members of the laboratory staff become ill, suspect that they or others have been exposed, or otherwise suspect a failure of any safeguards.

1.6 Spills and Accidents

Spills of toxic substances or accidents involving any hazardous chemical should be resolved immediately according to the Rice University laboratory safety plan, which can be found at http://www.rice.edu/ehs.

2.0 Procedure-Specific Safety Procedures

All laboratory procedures must contain a written description of specific safety practices incorporating the applicable precautions described in this section. Employees should read and understand these practices before commencing a procedure.

2.1 Procedures for Toxic Chemicals

The MSDSs for many of the chemicals used in the laboratory will state recommended limits or OSHA-mandated limits, or both, as guidelines for exposure. Typical limits are threshold limit values (TLV),

permissible exposure limits (PEL), and action levels. When such limits are stated, they will be used to assist the chemical hygiene officer in determining the safety precautions, control measure, and safety apparel that apply when working with toxic chemicals.

1. When a TLV or PEL value is less that 60 or 100, the user of the chemical must use it in an operating fume hood, glove box, vacuum line, or similar device, which is equipped with appropriate traps and/or scrubbers. If none are available, no work should performed using that chemical.

2. If a TLV, PEL, or comparable value is not available foe that substance, the animal or human median inhalation lethal concentration information, LC50, will be assessed. If that value is less than 200 ppm or 2000mg/m^3 (when administered continuously for one hour or less) suggested, then the chemical must be used in a operating fume hood, glove box, vacuum line, or similar device, which is equipped with the appropriate traps and/or scrubbers. If none are available, no work should be performed using that chemical.

3. Whenever laboratory handling of toxic substances with moderate or greater vapor pressures will be likely to exceed air concentration limits, laboratory work with such liquids or solids will be conducted in an operating fume hood, glove box, vacuum line, or similar device, which is equipped with the appropriate traps and/or scrubbers. If none are available, no work should be performed using that chemical.

2.2 Procedures for Flammable Chemicals

In general, the flammability of a chemical is determined by its flash point, the lowest temperature at which an ignition source can cause the chemical to ignite momentarily under certain controlled conditions.

1. Chemicals with a flash point below 200°F (93.3°C) will be considered “fire-hazard chemicals”.

2. OSHA standards and the National Fire Protection Association (NFPA) guidelines on when a chemical is considered flammable apply to the use of flammable chemicals in the laboratory. In all work with fire-hazard chemicals, follow the requirements of 29 CFR, subparts H and L; NFPA Manual 30, “Flammable and Combustible Liquids Code”; and NFPA Manual 45, “Fire Protection for Laboratories Using Chemicals”.

3. Fire-hazard chemicals should be stored in a flammable-solvent storage area or in storage cabinets designed for flammable solvents.

4. Fire-hazard chemicals should be used only in vented hoods and away from sources of ignition.

2.3 Procedure for Reactive Chemicals

The most complete and reliable reference on chemical reactivity is found in the current edition of “Handbook of Reactive Chemical Hazards” by L. Bretherick, published by Butterworths. Reactivity information is sometimes given in the manufacturers MSDS and on labels. Guideline on which chemicals are reactive can be found in regulations promulgated by the Department of Transportation (DOT) in 49 CFR and by the Environmental Protection Agency (EPA) in 40 CFR. Also see NFPA Manual 325M, “Fire Hazard Properties of Flammable Liquids, Gases, Volatile Solids”; Manual 49, “Hazardous Chemical Data”; and Manual 491M, “Manual of Hazardous Chemical Reactions”.

1. A reactive chemical is one that:

    a. Is described as such in Bretherick or the MSDS,

b. Is ranked by the NFPA as 3 or 4 for reactivity,

c. Is identified by the DOT as:

i) An oxidizer

ii) An organic peroxide, or

iii) An explosive, Class A, B, or C,

d. Fits the EPA definition of reactive in 40 CFR 261.23

e. Fits the OSHA definition of unstable in 29 CFR 1910.1450, or

f. Is known or found to be reactive with other substances.

3. Handle reactive chemicals with all proper safety precautions, including segregation in storage and prohibition on mixing even small quantities with other chemicals without prior approval and appropriate personal protection and precautions.

2.4 Procedures for Corrosive Chemicals and Contact-Hazard Chemicals

Corrosivity, allergenic, and sensitizer information is sometimes given in manufacturers' MSDS and on labels. Also, guidelines on which chemicals are corrosive can be found in other OSHA standards and in regulations promulgated by DOT in 49 CFR and the EPA in 40 CFR.

1. A corrosive chemical is one that:

a. Fits the OSHA definition of corrosive in Appendix A of 29 CFR 1910.1200,

b. Fits the EPA definition of corrosive in 40 CFR 261.22 (has a pH greater that 12 or less that 2.5), or

c. Is known or found to be corrosive to living tissue.

2. A contact-hazard chemical is an allergen or sensitizer that:

a. Is so identified or described in the MSDS or on the label,

b. Is so identified or described in the medical or industrial hygiene literature, or

c. Is known or found to be an allergen or sensitizer.

3. Except as noted in 2.1.3(1), handle corrosive substances with all proper safety precautions, including wearing both safety goggles and face shield, gloves tested for absence or pin holes and known to be resistant to permeation, and a laboratory apron or coat.

3.0 Control Measures and Equipment

3.1 **Ventilation**

1. Laboratory ventilation should be not less that six air changes per hour (calculated). This flow is not necessarily sufficient to prevent accumulation of chemical vapors. Work with toxic chemicals that have low air concentration limits, or that have high vapor pressures, should always be done in a hood.

2. Fume hoods should provide 70 to 90 linear feet per minute of air flow.

3. Laboratory employees should understand and comply with:

    a. A fume hood is a safety backup for condensers, traps, or other devices that collect vapors and fumes. It is not used to "dispose" of chemicals by evaporation unless the vapors are trapped and recovered for proper waste disposal.

    b. The apparatus inside the hood should be placed on the floor of the hood at least six inches away from the front edge.

    c. Fume hood windows should be lowered (closed) at all times except when necessary to raise (open) them to adjust the apparatus inside the hood.

    d. The hood fan should be kept "on" whenever a chemical is inside the hood, whether or not any work is being done in the hood.

    e. Personnel should be aware of the steps to be taken in the event of power failure or other hood failure.

    f. Inspect hood vent ducts and fans at frequent intervals to be sure they are both clean and clear of obstructions.

    g. Hoods should never be used as storage areas for chemicals, apparatus, or other materials.

3.2 **Flammable-Liquid Storage**

1. Fire-hazard chemicals (see paragraph 2.2.2a) in quantities greater that 4 L should be kept in metal safety cans designed for such storage. The cans should be used only as recommended by the manufacturer, including the following safety procedures:

    a. Never disable the spring loaded closure.

    b. Always keep the flame-arrestor screen in place, replace if punctured or damaged.

2. Cabinets designed for the storage of flammable materials should be properly used and maintained. Read and follow the manufacturer's information and also follow these safety practices:

    a. Store only compatible materials inside a cabinet.

    b. Do not store paper or cardboard or other combustible packaging material in a flammable-liquid storage cabinet.

c. The manufacturer establishes quantity limits for various sizes of flammable-liquid storage cabinets, do not overload a cabinet.

3.3 Eyewash Fountains and Safety Showers

1. Equip all laboratories with eyewashes and safety showers. These must be located so they can reached from any point in the laboratory, as specified in ANSI Z358.1.

2. Check the functioning of eyewash fountains weekly and the functioning of safety showers annually. Promptly report any facility with low water flow requirements to the work control center at x2485.

3. Be sure that access to eyewash fountains and safety showers is not restricted or blocked by temporary storage of objects or in any other way.

3.4 Respirators

1. Employees should wear respirators whenever it is possible that engineering controls or work practices could become or are ineffective and that employees might be exposed to vapor or particulate concentrations greater than the PEL, action level, TLV, or similar limit, whichever is lowest.

2. The requirements of 29 CFR 1910.134 should be followed, including in particular:

    a. Written standard operating procedures governing the selection and use of respirators.

    b. All employees who are likely to need to use respirators must be trained in their proper use, inspection, and maintenance. (See "NIOSH Guide to Industrial Respiratory Protection", DHHS Publ. No. 87-0116, NIOSH, Cincinnati, 1987, for details.)

3.5 Vapor Detection

Do not use odor as a means of determining that inhalation exposure limits are or are not being exceeded. Whenever there is reason to suspect that a toxic chemical inhalation limit might be exceeded, whether or not a suspicious odor is noticed, notify the supervisor. Laboratory workers should wear a respirator suitable for protection against the suspect chemical until measurements of the concentration of the suspect vapor in the air show that the limit is not exceeded. Under this circumstance and if there is no reason to anticipate an increase in the concentration of the chemical, and if the supervisor approves, the respirator can be removed and the work may continue.

4.0 Procedures for Carcinogens, Reproductive Toxins, Substances That Have a High Degree of Acute Toxicity, and Chemicals of Unknown Toxicity

Follow the procedures described in this section when performing laboratory work with greater than 100 mg of any carcinogen, reproductive toxin, substance that has a high degree of acute toxicity, or a chemical whose toxic properties are unknown.

1. The following definitions will apply:

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

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

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

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

e. For the purposes of the CHP, chemicals in these four categories will be called "inimical".

f. Designated area: A hood, glove box, portion of a laboratory, or an entire laboratory room designated as the only area where work with quantities of inimical chemicals in excess of the specified limit shall be conducted.

2. Designated areas should be posted and their boundaries clearly marked. Only those persons trained to work with inimical chemicals will work with those chemicals in a designated area. All such persons will:

a. Use the smallest amount of chemical that is consistent with the requirements of the work to be done.

b. Use high-efficiency particulate air (HEPA) filters or high-efficiency scrubber systems to protect vacuum lines and pumps.

c. Store inimical chemicals or remove them from storage.

d. Decontaminate a designated area when work is completed

e. Prepare wastes from work with inimical chemicals for waste disposal in accordance with specific disposal procedures consistent with the Resource Conservation and Recovery Act (RCRA) and as designated by Rice University's hazardous waste officer.

3. Store all inimical chemicals in locked and enclosed spaces with a slight negative pressure compared to the rest of the building.

4. Because the decontamination of jewelry may be difficult or impossible, do not wear jewelry when working in designated areas.

4.1 **Using the Parr Hydrogenator**

Hydrogenation is a common synthetic tool and often requires the use of a Parr hydrogenator. The following procedures must be used when working with this apparatus to minimize injury to yourself or others due to a flash fire.

Always anticipate that a fire could occur. Typically, when a fire is contained within the bottle, a watch glass or beaker can be placed over the opening and the fire will extinguish. DO NOT PANIC!! BE READY FOR THE POSSIBILITY THAT A FIRE CAN OCCUR BEFORE BEGINNING.

1. Always wear goggles, gloves, and a lab coat when setting up any hydrogenation reaction. Always assume a flash fire is likely to occur.

2. Methanol should be avoided as the solvent when using a palladium catalyst since a fire is almost always likely. If you must use methanol, and water is not a problem, wet the catalyst before adding the methanol.

3. Clear the work area before beginning your work and remove flammable objects. Ensure the reaction flask is clamped down before adding any reagents.

4. In the hood, first add the catalyst to the bottle, then with a slow nitrogen purge add the solvent down the side of the bottle and cover the catalyst. **Never fill the bottle more than half full.** Next, add the compound you wish the hydrogenate and stopper the flask before removing it from the hood.

5. Do not pressurize the bottle to more than 40 psi, unless it is a new bottle. Even then, do not pressurize above 50 psi and never pressurize a 500 mL bottle or larger with more than 40 psi.

6. Always keep the high-pressure tank closed and do not leave the apparatus unattended until the possibility of pressure from a heated, or potentially exothermic reaction has stabilized.

7. Ensure a blast shield is securely in place in the event of a sudden explosion.

8. After hydrogenation is complete and the reaction has cooled to room temperature, add a blanket of nitrogen twice to the flask before the bottle is removed from the shaker.

9. Filter the reaction mixture through celite because it does not burn and wash with methylene chloride.

10. Dispose of the used catalyst and celite in the solid waste container in the lab.

4.2 Nitrations

1. When running or working up a nitration you must use a blast shield, safety glasses, face shield, rubber gloves, and rubber apron.

2. The first time a new compound is nitrated, do not exceed 1 g of starting material.

3. Run the nitration multiple times at 1 g before scaling up.

4. 10 g is the upper limit when running a nitration.

5. When drying a nitrated aromatic compound, ensure this happens in the hood behind a blast shield. It is common for explosions to occur upon drying, use them as “wet” compounds if at all possible.

4.3 Lab Sign Out Procedure

1. If you are the last person to leave the lab at night, ensure the following tasks are completed and sign and date the sign out sheet on the door.

    a. All nitrogen bubblers have a flow rate of less than 1 bubble per second or less.

b. All hood sashes in the lab are completely closed.

c. All water lines are secured with copper wire.

d. All faucets are tuned off (except those used for reactions in progress).

e. All variacs are on cork rings.

f. All stills are turned off and the THF still is on low.

g. All the lights are turned off, including the lights in the hoods.

h. All the lab doors are locked, including the doors to the instrument and computer rooms.

4.4 Disciplinary Procedure

1. Everyone in the lab must make a conscious effort to adhere to the safety guidelines established herein, otherwise the following disciplinary action will be brought against them.

2. Mistakes will be made and things will be forgotten, that is understandable. However, if it becomes apparent that a student consistently and willfully fails to follow the guidelines established in this document, as determined by the lab safety officer and/or the principle investigator, the following actions will be taken:

    a. A letter of reprimand will be filed with the principle investigator and Rice University's Environmental Health and Safety Office indicating refusal to follow lab safety protocol.

    b. The student(s) will be notified that such action has taken place in hopes to prevent a future violation.

    c. Two violations of this nature will result in termination from the group.

4.5 Disability Clause

In the event you are unable to conform to the safety guidelines established herein due to a medical or psychological reason, a physician's note on office letterhead must be filed with the lab safety officer before beginning work.

For further reference please see "The Tour Group Research Handbook" at www.jmtour.com as well as www.rice.edu/ehs.