GEORGIA INSTITUTE OF TECHNOLOGY

SCHOOL OF CHEMISTRY AND BIOCHEMISTRY

SAFETY MANUAL

SEPTEMBER 1996

FIRST AID RESPONSE AND TRANSPORTATION POLICY
PROCEDURE

IF A PERSON IS INJURED OR BECOMES SERIOUSLY ILL ON CAMPUS:

NOTIFY THE GEORGIA TECH POLICE DEPARTMENT (EXT. 4-2500)

THE NUMBER IS KNOWN TO MOST MEMBERS OF THE COMMUNITY OR IS ALREADY POSTED IN MOST AREAS.

THE CALLER (YOU) SHOULD BE ABLE TO PROVIDE THE DISPATCHER WITH SOME BASIC INFORMATION:

LOCATION, E.G. BOGGS, SECOND FLOOR, ROOM 2-47

NATURE OR KIND OF INJURY OR ILLNESS

IS VICTIM CONSCIOUS OR UNCONSCIOUS?

SHOULD AN AMBULANCE BE CALLED?

IF THE CALLER CAN PROVIDE THAT INFORMATION, THE DISPATCHER WILL SEND AN OFFICER TO THE SCENE AND CALL FOR AN AMBULANCE IMMEDIATELY IF ONE IS REQUESTED.

IF THE CALLER CANNOT PROVIDE THAT INFORMATION, THE DISPATCHER WILL SEND AN OFFICER WHO, UPON ARRIVAL, WILL MAKE AN ASSESSMENT OF THE SITUATION, PROVIDE FIRST AID TO THE VICTIM AND REQUEST AN AMBULANCE AT THE OFFICER'S DISCRETION.

IF THE PERSON CAN BE TRANSPORTED IN THE POLICE UNIT, THE OFFICER WILL PROVIDE THAT TRANSPORTATION.

INJURIES - EMERGENCY TREATMENT

There are two different procedures depending upon whether the injury is "work related" or not.

> Emergency treatment for work related injuries to faculty, staff, and students employed by the department should be obtained from the nearest hospital emergency room (normally not the campus infirmary).

Other students should obtain emergency treatment at the campus infirmary.

Financial coverage for work related injuries are handled through the state worker's compensation unit insurance and all follow-up care after the initial emergency treatment must be rendered by an institution from a list of approved providers. This list can be obtained from the Main Office or from the Chairman of the Safety Committee.

There are certain reports which should be filled out after any accident whether or not an injury has occurred. See page 13, "Procedure for Reporting Injuries, Accidents, Hazards, or Hazardous Practices," for details.

INTRODUCTION

The Safety Manual has been revised and updated with the objective of providing workers in the School of Chemistry with new information on laboratory safety procedures and procedures for handling hazardous chemicals. This manual does not cover all conceivable safety requirements which may be necessary when working with specific chemicals or carrying out specialized procedures. Each research worker is responsible for consulting other sources before undertaking any unusual operation which is likely to have safety hazards associated with it. One important source of information on chemical hazards are the material safety data sheets (MSDS) which are available on-line for a large number of compounds in the chemistry stockroom.

While the entire manual should be studied in detail, please pay special attention to the following parts: The General Safety Rules on Page 1 (you may wish to make a copy of these simple rules and post them in the Laboratories); The Housekeeping Rules on Page 2 (Violation of these and other rules will be noted when safety inspections are made); Procedures for Reporting Injuries, Accidents, Hazards, or Hazardous Practices on Page 12 (Please see to it that all necessary forms are filled out and turned in promptly); Building Evacuation in Case of Emergency on Page 15; First Aid on Page 17; and Reporting Accidents to Campus Police on Page 19 (Be completely familiar with the procedure for reporting an accident).

The Safety Committee would appreciate written or oral suggestions for corrections,additions, or deletions to this manual for incorporation into future printings.

Safety Committee
September 1996

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GENERAL SAFETY RULES

(In Case of emergency, call Ext. 4--2500)

1. Exhibit a professional attitude and apply common sense at all times.

2. In case of doubt about a procedure, or the operation of an instrument or a piece of apparatus, consult your course instructor, research director or someone who has knowledge about the equipment in question.

3. Know the location of emergency equipment, fire alarms (fires still should be reported by Calling Ext. 4-2500 even if the alarm has been pulled), fire extinguishers, eye-wash fountains, showers, etc., and familiarize yourself thoroughly with the operation of all these items. Also call 4-4002 to inform the Chemistry Main Office in the event of fire or injury. Know the building exits which are nearest to your work place and the classrooms in which you instruct.

4. Follow good housekeeping principles at all times.

5. There should be no smoking, eating, and/or applying of cosmetics in areas where chemicals are being used. If Research Supervisors allow these activities in research laboratories, specific areas should be set aside in which these activities are permitted but in which no chemicals are allowed.

6. Shoes which cover both top and bottom of the feet should always be worn in the Chemistry Building and Annex.

7. Safety glasses should always be worn in the laboratory. Other appropriate safety attire - goggles, face shields, lab coats, aprons, and gloves - should be worn when working with dangerous chemicals and equipment.

8. Never undertake unauthorized experiments unless you have been given permission to work independently by your Research Supervisor.

9. Before starting an experiment make sure you understand its operation in detail, are aware of possible danger points, and have formulated plans to handle emergencies that may conceivably arise.

10. Before activating an instrument or starting a machine, make certain you understand how it is to be operated and what precautions are necessary for its safe operation.

11. Use approved methods for transporting chemicals and equipment in the building and for disposing of waste chemicals and refuse. This includes safety carriers for bottles of concentrated acids and bases.

12. All laboratory workers should wash their hands thoroughly to remove any chemicals before leaving the laboratory for whatever purpose.

I. SAFETY RULES

A. Responsibility Defined

1. The overall responsibility for the enforcement of all safety regulations rests with the Director of the School of Chemistry and Biochemistry. The Director may appoint a Safety Committee (or specific individuals) to assist in the discharge of this responsibility.

2. The Research Directors have the primary responsibility of seeing to it that those individuals working under their direction follow the School of Chemistry and Biochemistry Safety Rules, and for establishing any additional safety rules which may be deemed necessary.

3. The Faculty member in charge of any teaching laboratory has the responsibility for the enforcement of safety rules in that laboratory and for setting hours other than regularly scheduled hours when the laboratory may be used.

4. Laboratory workers or other workers have the responsibility of performing their assigned duties safely.

5. The names and telephone numbers of all knowledgeable persons in a laboratory who can be contacted in case of emergency should be posted in the laboratory door's window.

B. Housekeeping

1. It is the basic responsibility of all workers to follow good housekeeping practices in their specific working area(s) and to take general responsibility for the room(s) in which this working area(s) is located.

2. The overall responsibility for the housekeeping in each laboratory rests with the person in charge. It is that person's job to see that all persons working in the laboratory area keep the working space in good order, and that unsafe conditions in the working space and utilities are reported and corrected.

It is the specific duty of the Research Director to see that excessive amounts of chemicals and equipment do not accumulate in the laboratory.

The Storekeeper is responsible for housekeeping in the stockroom and storage sheds.

3. Some general and specific housekeeping rules are:

a. Keep benches, dry boxes, and hoods neat and orderly. Hoods in which experiments are being performed should never be used for storage.

b. Use bench drawers for storing equipment.

c. Do not allow excess quantities of chemicals or equipment to accumulate in the laboratory. Monthly housecleaning should result in the disposal of unnecessary chemicals, particularly hazardous ones. See Section III-D for appropriate procedures for return or disposal of chemicals and equipment.

d. Keep apparatus, containers, furniture, etc., in their appropriate places so that aisles are not cluttered; especially make sure that the emergency exit to the chase is not blocked. No glass containers should ever be left on the floor.

e. All cylinders containing compressed gasses must be secured at all times and capped when not in use. Transport cylinders only in the appropriate manner. For handling cylinders see Section Ill-E.

f. Make sure that electrical wires and gas or water conducting lines are not placed on the floor (unless appropriately bridged) or hung so low as to endanger persons passing under them. Light fixtures are **NOT** to be employed as supports for wires and tubing!

g. Make sure that all motor belts (especially pumps) have guards.

h. Glass windows in laboratory doors should not be covered. Emergency notification cards taped to the inside of the windows are acceptable. A removable covering may be utilized when the laboratory is to be used as a reduced lighting environment. These covers should be promptly removed when experiments are completed.

C. Personal Protection

1. General Attire. Shoes which protect both the bottom and the top of the feet are to be worn at all times in the Chemistry Building and Annex. Do not wear loose clothing that may knock bottles off benches or get caught in apparatus or moving machinery parts. Restrain long hair. Students should avoid wearing skimpy clothing (e.g., shorts, halters, etc.) in the laboratory. Such clothing offers little or no protection to the skin from chemical splashes or spills.

2. Eye Protection. Eye protection (laboratory safety glasses as a minimum) must be worn when any experimental and mechanical work is being conducted or when one is in the proximity of such activity. (When desk work is being conducted exclusively, safety glasses are not required, but they should be kept on if one is going back and forth between experimental and desk work.) Certain operations require the use of additional eye protection. Special glasses, goggles, and face shields should be worn when operations are being conducted which offer unusual danger to the eyes. **CONTACT LENSES SHOULD NOT BE WORN IN CHEMICAL LABORATORIES.** (If anyone is required to wear contacts for corrective purposes, this matter should be discussed with the Laboratory Supervisor.) Prescription glasses can be worn in place of laboratory safety glasses only if they are constructed from tempered safety glass and are equipped with side shields. Safety goggles or face shields must be worn over normal or non-safety corrective glasses.

3. Skin Protection. Wear a lab coat with the sleeves rolled down and use an apron, especially when working with corrosive chemicals and when undertaking experiments where splattering is possible. Use a safety shield where appropriate.

   Protect your hands and arms by wearing gloves. These come fabricated from a variety of materials and the appropriate choice will depend on the chemicals against which protection is sought. Consult Section III-J for data on material selection.

4. Respiratory Protection. The basic and best protection is to make sure that the lab is well ventilated. Check ventilation periodically. Conduct all operations which generate hazardous and/or noxious fumes in a hood. Remember, however, that a hood can protect only if operated in the appropriate manner. Familiarize yourself thoroughly with the information on hoods in Section III-K.

   In exceptional cases, use of a respirator may be required. This should be discussed with the Research Supervisor.

5. Reproductive Hazards - Chemists who are planning to have families sould be aware of the potential hazards posed by exposure to mutagenic and teratogenic chemicals, radioactive materials, and ionizing radiation. The School of Chemistry and Biochemistry will be happy to co-operate with the physicians of those concerned to develop plans for minimizing these dangers.

D. Eating, Smoking, and Applying Cosmetics in Working Areas

1. Smoking is strictly prohibited throughout the Boggs building, except in private offices.

2. Eating and/or drinking in the laboratory is prohibited unless permission is obtained from the person having primary responsibility for the laboratory. If these activities are permitted in the laboratory, specific areas should be set aside for them and no chemicals should be allowed in those areas.

3. Storage of food or beverages is prohibited in the laboratories or in the laboratory refrigerators. Store food only in facilities approved for this purpose; do not use facilities designated for chemical storage. Microwaves and refrigerators designated for food should be clearly marked for non-chemical use.

4. Cosmetics should not be stored or applied in areas where chemicals are being used.

5. All laboratory workers should wash their hands thoroughly before eating, smoking, applying cosmetics, or leaving the laboratory for whatever purpose.

E. Working after Regular Hours

1. Under normal conditions, at least two persons are required on each floor if laboratory work is to be performed after the usual working hours. Arrangements shall be made between individuals for crosschecking periodically. It is permissible for a person to work alone only when doing desk work.

2. For unusual experimental conditions special rules may have to be formulated if work is to be done after the usual working hours. For example, two persons may be required in one room if an unusually hazardous operation such as the use of HCN is in progress. The person in charge of the laboratory has responsibility for determining whether or not the normal rules are adequate, and for specifying additional coverage if deemed necessary.

F. Specific Rules for Lab Operation

1. Keep exposure to all chemicals to a minimum. Form the habit of washing your hands and face frequently when handling chemicals. Always wash your hands before eating or smoking.

2. Never use mouth suction to fill pipets. Apply vacuum from an aspirator bulb or vacuum line.

3. Do not start a siphon by mouth.

4. Use care in handling all hot items. Protect your hands with protective gloves.

5. Avoid moving large glass vessels of any type when they are filled with liquids. If transportation is necessary, be sure that appropriate safety precautions are taken to prevent breakage and spillage and that clean-up equipment is ready in case of mishap.

6. Working with glassware, boring holes into stoppers and inserting glass tubes into them can present hazards. Consult Section I-M on how to conduct these operations safely.

7. Use boiling stones, sticks, or some other ebullator when performing distillation. However, do not add any of these to a liquid which is already hot.

8. When volatile solvents are shaken in separatory funnels, considerable pressure may develop. Release the pressure by frequent venting. This is accomplished by inverting the funnel and opening the stockcock briefly while making sure to point the funnel away from your face.

9. Be cautious when smelling compounds to examine them. Never hold the nose directly over the container. Rather waft a little bit of atmosphere from above the container towards the nose with your hand. Before smelling, inhale deeply so that air can be expelled immediately in case the fumes are irritating.

10. There is an upper limit to the size or weight of a load that can be safely lifted or transported by one person. Get assistance when your personal limit is approached. Remember, lift with your legs, not with your back.

11. When borrowing equipment, talk with the owner or person in charge of it. Get information as to the correct operation, any shortcomings or defects, and possible contaminations.

G. Operations Hazards

1. All new operations and equipment or significant changes in operations or equipment should be approved by the person in charge of the laboratory.

2. Hazardous operations must be appropriately labeled and guarded to prevent injury to others. Nearby workers should be warned before a hazardous operation is started and warning signs should be posted at all entrances. Examples of such operations include:

   a. Performing reactions or procedures that use highly reactive or toxic compounds in appreciable quantities (i.e. more than 0.1 mole). Examples would include:

      1. HCN (or cyanide derivatives), phosgene, carbon monoxide, or hydrogen fluoride.

      2. alkali metals or organometallic reagents: e.g. derivatives of Li, Na, K, Al, B, or Mg.

      3. volatile metal compounds (metal carbonyls, dimethylmercury, etc.)

      4. toxic heavy metal compounds (e.g. Hg, Os, Pb, Tl)

      5. catalytic hydrogenation or other procedures using hydrogen gas.

   b. Performing reactions or procedures that use 1.0 g or more of potentially explosive compounds. Examples would include:

      1. peroxides
      2. azides
      3. diazo compounds (e.g. diazomethane)
      4. ozonolysis to form ozonides and subsequent transformation of these ozonides.
      5. any reaction being performed under pressure (sealed tube, pressure bottle, autoclave).

c. Use of any other material suspected to be (1) toxic; (2) explosive; (3) mutagenic or teratogenic (4) highly inflammable. (The current edition of theMerck Index can serve as a brief, readily available guide to chemical hazards.) Refer to the books in the Safety Section of the Chemistry Reading Room for more detailed information. The book, `Prudent Practices for Handling Hazardous Chemicals in Laboratories,' is especially helpful since detailed handling procedures are provided.) Finally, material safety data sheets (MSDS) are available in the Chemistry Stockroom and should always be consulted for dangerous compounds.

d. Purification of anhydrous solvents in quantities of 500 mL or more. This is specially true for solvents refluxed over or distilled from a reactive metal hydride such as Lithium Aluminum Hydride.

e. Use of known, potent carcinogenic compounds in quantities of the order of 1.0 g or more. Some common examples include vinyl chloride, methyl chloromethyl ether (a common by-product in many chloromethylation procedures), N-nitrosodimethylamine, and ethylenimine.

f. Performing any reaction or procedure (e.g. large scale extraction) where the quantity of flammable organic solvent being used is 1000 mL or more.

g. Use of any apparatus involving a laser or other intense light source (e.g. UV lamps for preparative work) where eye protection would normally be advisable.

3. Unattended Operations. lt is essential that all unattended operations be designed to be "fail safe". Remember that every utility - cooling water, electricity, compressed air, natural gas, ventilation and tanked gas - is subject to failure without warning. Plan for such emergencies. Devices which will cut off heating equipment when the water pressure drops are available. Ensure that all water hoses are properly secured and in good operating condition.

4. Generalizations

a. When diluting acids, **ALWAYS** pour the acid into water, slowly and carefully, and not the reverse.

b. Never carry out a reaction in a closed system or heat an apparatus which is a closed system unless the system is designed to withstand the pressure which may develop. If it is undesirable that a reaction mixture be open to the atmosphere, consider the use of a mercury bubbler and nitrogen purge to ensure that a pressure build-up doesn't occur.

c. In case a new reaction is attempted, always try it first on a small scale. However, you should recognize that when a reaction is scaled up, certain safety problems may be amplified drastically; be prepared for such eventualities.

d. In case of doubt, always assume the worst will happen and carry out the reaction in the hood with sashes closed and an explosion shield in place. (The hood sashes are made of laminated safety glass, but they do not provide sufficient protection from powerful explosions.) Put yourself into a position where minimum exposure is guaranteed and inform other persons in the room about the situation. Never undertake such experiments when alone!

H. Machinery and Equipment Hazards

1. Be thoroughly familiar with machinery and equipment before attempting to operate it.

2. Equipment must not be operated until moving parts, such as shaft, couplings, gear trains, belt drives, etc., have been guarded.

3. Sometimes drill bits, saw teeth, grinding wheels, and shear points cannot be guarded. Be especially attentive while using machines having such hazards.

4. Gloves, ties, loose clothing, and long hair can be "caught" by rotating machine parts. Do not expose yourself to injury by ignoring such hazards. Restrain long hair and loose clothing.

I. Flame Hazards

1. Persons assigned to a laboratory may use an open flame in this laboratory, providing the following rules are scrupulously observed:

a. Use the open flame only when absolute necessary and only for the period of time it is actually needed.

b. Check with all other occupants of the room before using an open flame.

c. Prior to lighting the flame, remove all flammable liquids from the area where the flame is to be used. Check all containers of flammable liquids in the room to be sure that they are sealed.

d. See Section III F on the handling of flammable materials and Section III I on the handling of pyrophoric materials.

J. Vacuum Hazards

1. Any glass equipment operated under vacuum can collapse violently, causing a shower of flying glass. For this reason, appropriate shielding must be used during these operations. For suction filtrations, always use the thick-walled flat-bottom flasks specifically designed to withstand vacuum. Even these are dangerous if cracked or otherwise weakened. Ordinary Erlenmeyer flasks larger than the 50 ml size should never be subjected to vacuum. Always inspect the glassware for defects before using in a system that will be placed under vacuum.

2 Unless they are stored or equipped with metal mesh cages, protect vacuum desiccators or bottles by application or several strips of adhesive tape.

3. Dewar flasks must be shielded or wrapped with electrical or cloth tape.

4. Cold traps of adequate size and temperature to catch all condensable vapors should be inserted between the system and the vacuum pump. A pressure-measuring device should be installed before the cold trap. Check these cold traps frequently to guard against their becoming plugged by the material collected in them.

5. Consult "Organic Chemistry Laboratory Techniques", School of Chemistry and Biochemistry, Georgia Tech, Chapter XII, for more details on the use of vacuum equipment.

K. Electrical Hazards

1. General. While all research personnel, in varying degrees, may be familiar with utilities and services, electrical repairs should be made only by authorized personnel. Electrical service lines (110 or 220 volt) can be a source of serious injury. Under certain conditions, contact with only 25 volts can cause fatalities. If there are any questions concerning the safety aspects of electrical connections, the Electronics Shop personnel will provide expert advice.

2. Required in All Laboratories

   a. Proper grounding of all units is required.

   b. Do not use defective or damaged wires or equipment.

   c. Explosion-proof equipment must be used in those areas where the possibility of a flammable atmosphere exists.

d. Open Variacs, heat guns, and other non-explosion-proof electrical equipment should not be used around flammable materials. ALL VARIACS SHOULD BE MOUNTED OUTSIDE OF HOODS AND ON WALLS OR FRAMES ABOVE BENCH TOPS SO AS TO MINIMIZE THEIR EXPOSURE TO FLAMMABLE MATERIALS. See "Organic Chemistry Laboratory Techniques", Chapter I, for details concerning the proper operation of devices such as Variacs, heat guns, heating mantles, oil baths, etc., and for the possible dangers associated with their use.

e. Have connecting wires and cables arranged in appropriate positions. Do not place them on the floor (unless bridged) or so low over an aisle that normal traffic is impaired! All connections involving 110 V wiring should be mechanically secure; the use of alligator clips, etc., for making electrical connections is not permissible.

3. Precautions. Damp concrete provides a good electrical ground. Never stand on a wet floor when operating switches, Variacs, stirrers, etc. Rubber floor mats are recommended where such hazards exist.

4. Electrical Shock

a. Report all cases of electrical shock, however minor, to your Research Director. Until the defect which caused the shock is remedied, do not attempt to use the device again.

b. Familiarize yourself with the appropriate procedures for action in case of an electrical accident, and first aid measures for a shock victim. See Section II.

L. Radiation Hazards

In some investigations, intense light, laser beams and radioactivity are employed. These operations require thorough familiarization with the equipment, its use, and the necessary precautionary measures. Consult your Research Director for the procedures to be followed in these situations.

For persons not engaged in the work, the basic rule is to stay away from the areas marked as restricted and to obey signs on doors.

M. Hazards Associated with the Handling of Glassware and Related Equipment

A major portion of laboratory injuries result from wounds inflicted through improper usage of ordinary glassware. Certain basic steps may be followed to prevent these injuries. One of the most important steps is to always provide hand protection, either by use of properly padded gloves or by use of heavy cloth, whenever manipulating glass tubing.

1. Inserting Glass Tubing into Rubber Equipment

   a. Be sure that the ends of the tubing are fire polished.

   b. Never try to force glass tubing into an orifice that is too small.

   c. Lubricate the tubing before insertion. Glycerine is a handy lubricant, although water or stopcock grease may also be used.

2. Removing Rubber from Glassware Connections

   a. Do not use excessive force to disconnect glass joints, rods, or tubes.

   b. Wet the glass tubing with water, and also force some water between the glass and rubber surface. If lubrication does not loosen the connection, cut the rubber away.

3. Removing Frozen Stopcock Plugs and Stoppers

   a. Avoid the use of force.

   b. Gentle tapping of a frozen stopper with another glass stopper will often loosen the stopper.

   c. Immersion of frozen stoppers into warm water may also help free the stopper.

   d. Special assistance may be obtained from the glassblower.

4. Breaking Glass Tubing

   a. Always hold the tubing inside a cloth towel near the scratch and break away from yourself. It may be necessary to wet the scratch to obtain a clean break.

   b. Always fire polish the freshly broken ends.

5. Broken Glassware and Glass Waste

a. Intact standard taper joints from broken glassware should be washed and saved to be used in construction of new items in the Glass Shop. Broken glass should be placed it in special blue plastic containers labeled "Sharps Only". One of these containers is located in the north hallway on each floor of the Boggs Building and in the stockroom at Chem Annex. Broken glass should not be placed in the waste baskets with other trash as this presents a hazardous situation for custodians.

6. Cork and Stopper Borers

Cork and stopper borers are knives and can inflict severe wounds if not handled properly. Be sure that the blade is sharp, since undue pressure may be necessary if a dull blade is used. Lubricate the area to be bored with either household oil or glycerine. Leave the borer in good condition.

7. Consult "Organic Chemistry Laboratory Techniques", School of Chemistry and Biochemistry, Georgia Tech, Chapter XIX, for more details on the handling of glass.

N. Procedure for Reporting Injuries, Accidents, Hazards, or Hazardous Practices

1. A person receiving an injury (no matter how trivial it may seem) shall report this without delay to the Research Director, if possible, or see that he or she is advised. The person notified of the injury shall be responsible for seeing to it that written reports are filled out by the injured and shall set any accident preventative measures in motion at once.

2. The necessary written reports are as follows:

a. For any accident whether or not an injury occurs, the person involved in the accident must fill out a School Accident form (obtained from the Chairman of the Safety Committee or from the Main Office) and submit this report to the Research Director for additional comments. The completed report should be turned in to the Chairman of the Safety Committee. The reporting of accidents occurring in the undergraduate teaching laboratories will normally be the responsibility of the Teaching Assistant in charge of the laboratory.

b. For work-related injuries, there are two Worker's Compensation forms which must be filled out, one for the employee and one for the employer (Research Director). These forms are for the individual's protection, since insurance payments may not be issued if this form is not filed. They should be filled out the day of the accident unless this is prevented by the seriousness of the injury. In this case, the Research Director or Laboratory Supervisor fills out both reports. These forms may be obtained from the Chairman of the Safety Committee or from the Main Office.

In addition, any appropriate health insurance forms for any health plan that the individual is covered by should be filled out, especially for those people covered by the Board of Regents Health Plan. The Regents Health Plan forms can be obtained or from the Main Office.

The completed forms should be turned in to the Chairman of the Safety Committee.

3. Accidents (non-injury), hazards, and hazardous practices must also be promptly reported by the observers of them to the Research Director or Safety Committee. In the case of hazards or hazardous practices which involve the facilities or housekeeping of any particular laboratory, the person responsible for the area should be notified.

It may appear that some accidents, hazards, and hazardous practices are of such a trivial nature that no report seems necessary. The point to be remembered is: Will a report of the accident or hazard be of service in detecting and eliminating an unsafe condition?

4. In the case of serious accidents and accidents of obscure origin, none of the evidence should be disturbed until an investigation is made by the proper authorities. Naturally, all steps necessary for protection of personnel take precedence over preservation of evidence.

II. EMERGENCY PROCEDURES

A. Building Evacuation in Case of Emergency

I. It is imperative that the building be evacuated in an orderly manner and that security be maintained in case of an emergency. If the fire alarm is sounded, leave the building immediately via the nearest exit and move well away from the building exit so as not to interfere with fire fighting or rescue personnel. (If an experiment is in progress and time permits, take a few seconds to do what is necessary to shut it down or leave it in a safe operating mode. Obviously, you will have to exercise professional judgement in such situations.) If you are in the classroom (as an instructor or student), leave the building by the nearest exit. Instructors should be familiar with the exit routes for their classroom so that they can instruct their classes on the procedure for leaving the building in an orderly manner. The sketch of the Boggs building below shows the location of the various exits.

B. Fires in Laboratory Areas

1. Fire Prevention. It is imperative that all possible means of fire prevention be practiced continuously. Should a fire occur, it becomes essential that it is brought under control and extinguished as soon as possible. This is possible only if all persons understand clearly their responsibilities and know fully the proper steps for handling emergencies of this type.

2. Responsibilities

a. The Research Directors are responsible for:

(1) instruction and training for their research students, technicians, and assistants in fire prevention and in proper handling of fires in the laboratory;
(2) making periodic inspections of their research laboratories for potential fire hazards and for correction thereof and for making sure of the availability of fire fighting equipment.

b. The Teaching Staff is responsible for:

(1) instruction and training for all teaching and student assistants in the laboratories under their control;
(2) making periodic inspections of these laboratories for potential fire hazards and for making sure of the availability of fire fighting equipment.
(3) complete shut-down of all apparatus prior to evacuation for power outages.

c. The Research and Teaching Personnel are responsible for:

(1) fire prevention and elimination of fire hazards;
(2) recognizing the potential fire hazards of each laboratory operation;
(3) knowing the location of and proper manner of use of fire alarms and all fire fighting equipment;
(4) in the event of a fire, knowing whom to call for assistance.

3. Reporting Fires

a. If it is certain that you can control the fire yourself, proceed to do so immediately.

b. Should it be apparent that the fire is out of control or is likely to get out of control, the following is to be done:

(1) Sound the fire alarm so that the building can be evacuated.

(2) Call Campus Security (Ext. 4-2500) immediately and report the location of the fire and, if possible, the type of fire, e.g., chemical, electrical, etc. (The Campus Police will call the Fire Department to report the fire and will escort the fire trucks to the proper location.)

(3) Call the Main Office of the School of Chemistry and Biochemistry (Ext. 4-4002).

(4) Notify the research director or the faculty member responsible for the laboratory. Should this person not be available, notify the nearest faculty member.

4. Methods of Extinguishing Fires

a. Organic solvent fires - use dry powder or CO_2, extinguishers.

b. Electrical fires - use dry powder or CO_2, extinguishers. (Do not use water type).

c. Chemical fires - use dry powder A-, B-, C-type fire extinguishers for all chemical fires except active metals such as Na, K, Ca, etc., and their alkyls.

d. Active metal and metal alkyl fires - use Met-L-X fire extingtishers on Class D (metal) fires. The extinguishers should be available in all laboratories in which active metals, metal hydrides, and/or metal alkyls are used. Vermiculite, sand, graphite, and dry salts are also effective materials for smothering metal fires.

C. First Aid

I. General. First aid is emergency care of a person who is injured or ill so as to prevent death or further injury, to relieve pain, and to counteract shock until medical aid can be obtained. The objectives of first aid are:

a. to prevent further injury, e.g., removal of victim from fire or gas area or the use of safety shower or eye fountain;

b. to check conditions which may endanger life, e.g., stopping blood losses, restoring breathing, or preventing or moderating shock;

c. to protect injuries from complication, e.g., immobilizing fractures and dislocations or protecting burns or open wounds from dirt, etc.;

d. to reassure and to make the patient as comfortable as possible, e.g., shock can often be lessened or even prevented and patient's strength conserved by comforting the injured. In many cases a light cover, e.g., a blanket is helpful.

2. lnitiating First Aid

a. The responsibility for first aid rests initially with the first person(s) on the accident scene. One need not be highly trained to give first aid; by all means, remain calm.

b. Common sense should be the first aid guide for assisting after an injury. The first principle of first aid to an injured person concerns that person's life; the second principle concerns the injury.

c. The person giving first aid in case of serious injury should:

(1) follow the "First Aid Response and Transportation Policy Procedure" shown on page 2. A copy of this procedure is posted on the bulletin boards in the Boggs Chemistry Building.

(2) not move the injured person unless it is quite apparent that the person is in further danger by remaining at the present position. In such instances, move the person as little as possible and with utmost care and gentleness.

D. Spills

1. General. Chemical spills can present serious hazards and should be cleaned up immediately. If a spill should occur, the general procedure outlined below should be followed.

a. The person who caused the spill is responsible for the cleanup - unless that person has sustained an injury as a result of the spill.

b. Medical attention should be obtained for any person who is injured by the spill.

c. Notify all persons in the area about the spill, including the faculty research advisor.

d. Have all nonessential personnel leave the area of the spill.

e. Post warning signs or station someone to prevent the spill area from being entered.

f. If the spilled material is flammable, turn off all ignition and heat sources in the area.

g. Avoid breathing the vapors of spilled materials.

h. Leave on or establish exhaust ventilation.

i. If there is any uncertainty as to how the spill should be cleaned up, see your Research Director, or, if he is not available, a member of the Safety Committee, another faculty member, or the Environmental Safety Office (ext.4-4636).

j. Never turn a chemical spill over to an untrained person for cleanup. If assistance from the building janitors, maids, or other Physical Plant personnel is required, make certain that the work is carefully supervised.

k. Anticipate spills and have cleanup supplies - paper towels, sponges, brushes, mops, etc. - available.

l. During the cleanup, wear the appropriate gloves and other clothing as well as glasses or goggles to provide personal protection.

2. Handling of Spilled Chemicals. If it is feasible, corrosive or toxic substances should be deactivated before a cleanup is attempted. The general guidelines given in Section III D 2 and IV L should be followed for deactivating such materials.

For liquid spills adhere to the following general guidelines:

a. Confine the spill to as small an area as possible.

b. For inorganic acids or bases, use a neutralizing agent or an absorbent mixture, e.g., soda ash or diatomaceous earth. For small quantities of other materials, absorb the liquid with a nonreactive material, e.g., vermiculite, sand, or towels. Use care because the absorbent materials will give off vapors, or paper towels may be ignited as certain chemicals dry out in air. Commercial spill control agents and cleanup kits for various substances are available.

c. Very large liquid spills can be flushed down with large amounts of water if this will cause no damage.

d. Carefully remove any containers from the spill area and clean the outside of them completely.

e. If the spilled material is volatile, let it evaporate and be exhausted by mechanical ventilation.

f. Mop up the spill completely. Wring out the mop in a sink or a pail equipped with rollers.

g. Clean all items, e.g., mops, before returning then to storage or before using them for other purposes.

h. Dispose of residues resulting from the cleanup in an appropriate manner.

For solid spills follow the following rules:

a. Sweep non-toxic spilled solids into a dust pan and place them in an appropriate waste disposal container.

b. Toxic solids should be cleaned up with an efficient vacuum cleaner approved for the material involved.

c. Always clean equipment used in the cleanup carefully when the operation is finished.

III. HANDLING OF CHEMICALS (GENERAL)

A. General

You should recognize that almost all chemicals are potentially dangerous if improperly used and that strict safety precautions should always be adhered to when handling them. Before a chemical is ordered from an outside supplier or checked out of the stockroom, you should be certain about the following points: (1) The chemical is definitely needed for the work you are attempting to accomplish, (2) The possible hazards associated with storage and use of the chemical have been assessed (refer to MSDS Files) and the information and facilities for its proper handling are available, (3) The proper reagents and equipment for detoxifying and cleaning if it is accidently spilled are available, (4) The chemical can be disposed of safely without endangering the health of others. It is essential that professional chemists with prior knowledge of the chemical, recognize that they have the responsibility of disposing of it safely themselves or delegating the responsibility to those persons familiar with hazardous substances.

You should recognize that this Manual will not provide you with enough detailed information for handling all of the chemicals which you will encounter. However, it is hoped that the following general rules will be helpful and will serve as a stimulus for you to seek additional information. A bibliography of reference books on laboratory safety is found in Section V. These books may be found in the School of Chemistry Reading Room (Room 2-31).

B. Labeling for Identification

All containers of chemicals and other materials must be labelled properly so that a stranger will have sufficient information to handle the substances safely. When receiving new chemicals, make certain that the label is legible and has not been contaminated with chemicals which will cause it to fade or deteriorate. If the need arises, make a fresh label. When containers are being labelled for the first time, the label should contain at a minimum the following information: name of substance, date, unusual hazard information, and the name of the individual who prepared it if it is a special preparation. The stock of chemicals in the laboratory should be checked periodically to make certain the labels are in good condition. If a label is fading or becoming unglued so that it is likely to fall off, it should be replaced immediately. **NEVER** place a new label on top of an old one; always wash off the old label completely before applying a new one.

C. Storage and Transport of Chemicals

1. Storage. Chemicals may be stored in the laboratories in the area provided, but the number and quantity of chemicals on hand should be kept at a minimum, consistent with the efficiency of the operation. Storage of chemicals on bench tops or in hoods should be avoided. Storage trays or secondary containers should be used to minimize spreading of material in case of a break or leak.

Storage areas should be well-ventilated. One should exercise good safety practices when storing chemicals. Two chemicals that are likely to react with each other should not be stored in close proximity. This is especially true if the chemicals would react explosively, (e.g., certain organic solvents and strong oxidizing agents), or react to form a toxic product, (e.g., KCN and acid). Pyrophoric materials or materials which are highly reactive with water should never be stored near flammable liquids. See Section III I for further information on pyrophoric materials.

Especially volatile or thermally unstable chemicals may be stored in the refrigerator. All refrigerators which are used for chemical storage must be of the explosion proof type or must have had all devices that can cause a spark moved outside. All containers of volatile material must be tightly sealed before being placed in a refrigerator. When possible, store all liquids in the refrigerator in screw-cap bottles with Teflon liners in the caps. Food should **NEVER** be stored in a refrigerator which is being used for chemical storage presently or in the past.

Toxic chemicals, e.g., carcinogens, should be stored in secured, well-ventilated areas and only those persons who are authorized by Research Supervisors should have access to them. An inventory should be carefully maintained on these chemicals by the Research Supervisors. Refrigerators or other areas where toxic chemicals are being stored should be also labelled and the toxic material should be removed as soon as it is practical to do so.

The possession and storage of certain materials are regulated by state or federal agencies. All legal requirements concerning the ordering, handling, and storage of any such substances should be complied with. Chemicals should never be stored or handled near writing desks. Stored chemicals should be inspected regularly for leakage due to container corrosion, decomposition, and label deterioration. Radioactive chemicals must be handled, stored, and disposed of according to the procedures which are developed by the Georgia Tech Radiological Safety Office.

2. Transport. All chemicals should be transported with the utmost care. If more than one or two items are to be transported, appropriate laboratory carts and the freight elevator should be used. Know what to do in case of a spill before starting to transport any chemical. Do not transport unprotected glass bottles of chemicals in the halls, stairwells, or either elevator. Instead carry bottles in rubber or metal safety pails.

D. Disposal of Waste or Excess Chemicals

1. General. Information from the Environmental Safety Office concerning waste chemical disposal is dispensed frequently. Please keep abreast of this and all new procedures.

Ultimately the responsibility for disposal of waste substances rests with the workers who order and use them. Hazardous, toxic chemicals are best disposed of by professional chemists. Such substances should be converted into less hazardous ones in the laboratory prior to disposal. For example, strong carcinogens should be oxidized in solution before disposal and highly reactive substances, e.g., active metals, metal hydrides, etc., should be deactivated under controlled conditions. The reference book, "Prudent Practices for Disposal of Chemicals from Laboratories," provides much helpful information.

Toxic, malodorous, or lachrymal (tear producing) chemicals should never be disposed of by pouring them down the sink drain. The sink drains are interconnected; a substance which is poured in one drain may be detected as a vapor in another laboratory. However, this problem may be minimized if all drain traps, including floor traps, are kept filled with water.

2. General Suggestions for Waste Disposal. The following are general suggestions for disposal of non-hazardous water-soluble chemicals and other refuse:

a. Acids and alkali in small quantities and in low concentrations may be disposed of in laboratory sinks. Salt solutions and water-soluble organic compounds may be disposed of in the same manner.

All water-soluble materials disposed of in sinks should be washed down with large volumes of water to prevent clogging of the drains and corrosion of the pipes.

b. Chemicals which react violently with water should never be dumped into the sinks. First, neutralize these chemicals with the appropriate agents, then wash them down the sink with water if not prohibited due to other considerations.

c. Higher-boiling, water-insoluble organic materials (hexane, etc.) should not be poured into sinks. Notify the Environmental Safety Office at Ext. 4-4635 for pick-up.

d. Small quantities of relatively non-toxic, low-boiling, water-soluble organic materials may be allowed to evaporate in flame-free, well-ventilated hoods. Volatile materials should never be poured into the sink.

e. Information on the proper means of disposal of larger quantities of waste solvents should be obtained from the Environmental Safety Office (Ext. 4-4636).

f. Non-hazardous, water-insoluble solids may be placed in the trash cans in the laboratory after being packaged in plastic bags.

Make certain that all solids, (e.g., chromatographic materials), are free of moisture or organic solvents before placing them in the trash cans. If the solid is contaminated with a flammable liquid, a fire could easily result during the ensuing disposal of the refuse. The trash cans are used for disposal of paper and other flammable material. Therefore, never place any solid, e.g., an active hydrogenation catalyst, which has the potential for ignition in the trash cans. No substances may be placed in the trash cans in closed glass or metal containers. In fact, all glass bottles or other containers which are being thrown away should be washed thoroughly and disposed in "sharps" containers. Be considerate of those persons who handle disposal of trash. Broken glass with sharp edges, glass rods, tubing, and pipetts should also be placed in special trash containers that are marked "SHARPS."

3. Procedures for Adding or Removing Compounds Kept in the "Organic Stockroom" (Room B-73). Room B-73 in the School of Chemistry and Biochemistry, formerly known as the "Organic Stock Room", has been placed on a special key and this room and its contents are now a part of the Chemistry Departmental Storeroom. Any person wishing to withdraw a chemical from (or add a chemical to) the stock in this room can do so by filling out a standard form at the stockroom counter in Room B-36. There are special requirements (see the Procedures Manual for details) for any compound that you might wish to donate to this stock of chemicals.

*** CAUTION *** Since the chemicals in the "Organic Stockroom" have been obtained from a variety of sources, we cannot guarantee that the content and purity of material in any given bottle corresponds with the description on the label. Thus, both for reasons of safety and to avoid wasting time and other reagents, **ALWAYS VERIFY THE CONTENT** of any bottle of chemical obtained from this collection by measuring a mp value, spectra, or some other characteristic property.

4. Special Waste Problems. The Georgia Tech Environmental Safety Office can arrange for the disposal of hazardous chemicals if the need arises. The School of Chemistry Department Office or the Safety Committee will provide information about this service and the regulations which must be followed when it is used. Further information is available from Ext. 4-4635, the Environmental Safety Office.

E. Compressed Gas Cylinders

1. General. A Compressed gas is defined by the Interstate Commerce Commission as "any material or mixture having the container either at absolute pressure exceeding 40 pounds per square inch at 70°F, or an absolute pressure exceeding 104 psig at 130°F, or both; or any liquid flammable material having a Reid vapor pressure exceeding 40 psig absolute at 100°F."

2. General Rules

   a. Cylinders may not be filled except by or with the consent of the owner.

   b. Each cylinder must bear a proper caution label and carry a legible identification mark.

   c. When returning empty cylinders, valves should be closed and protective caps replaced.

   d. Never attempt to repair or alter a cylinder.

   e. Never repaint a commercial cylinder. To do so may destroy its identifying paint code.

3. Specific Rules

   a. Cylinders should be stored in a definite, assigned location.

   b. Cylinders that cannot be easily carried or controlled should be transported on a special cylinder cart.

   c. Cylinders should be transported with cap in place and should never be transported on the passenger elevator.

d. All cylinders must be tightly secured to a wall, bench, or heavy table with a chain or other approved retainer while they are in use and during storage.

e. Compressed gases should be handled only by experienced and properly instructed persons.

f. Always be sure that the proper regulator is used. Never force connections that do not fit readily.

g. Open cylinder valves slowly. Avoid the use of a wrench on valves equipped with handwheels.

h. Consult reference material for use of specific cylinders.

i. Keep the quantity of flammable gases in the laboratory at the minimum consistent with current requirements. Do not store unused cylinders in the laboratory.

j. Cylinders containing corrosive or toxic gases should be opened only in the hoods.

k. Avoid keeping gas cylinders in the laboratory for extended periods. Demurrage charges mount rapidly and soon become greater than the cost of the cylinder content.

F. Handling of Flammable Liquids

Most organic liquids are flammable in the sense that the vapors will burn or explode under the proper conditions. By definition in the National Fire Codes: A "flammable liquid" shall mean any liquid having a flash point below 140°F and having a vapor pressure not exceeding 40 lb./sq. in. absolute at 100°F. "Flash Point" shall mean the minimum temperature in degrees Fahrenheit at which a flammable liquid will give off flammable vapor as determined by a specific test procedure and apparatus.

Flammable liquids present serious fire and explosion hazards when stored or handled improperly. The following rules should be observed:

1. Large quantities of flammable liquids (drums, cans, and bottles) should be stored in the Solvents Storage Area (i.e. external building under control of departmental stockroom).

2. Outside storage cabinets for flammable solvents should be used whenever possible.

3. Non-glass containers (either plastic or metal) should be used whenever possible, but it should be recognized that some solvents will dissolve certain

plastics.