# LABORATORY SAFETY MANUAL
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# INTRODUCTION

THE LABORATORY SAFETY STANDARDS MANUAL WAS DEVELOPED AS A READY SOURCE OF INFORMATION FOR YOUR USE WHILE WORKING WITH CHEMICAL SUBSTANCES AND EQUIPMENT AT GEORGIA GWINNETT COLLEGE. THE GOAL IS TO PROVIDE LABORATORY EMPLOYEES WITH CLEAR DESCRIPTIONS OF SPECIFIC WORK PRACTICES AND PROCEDURES TO REDUCE THE RISK OF PERSONAL INJURY AND PROPERTY LOSS. THE LABORATORY SAFETY STANDARDS MANUAL DETAILS THE STANDARD BY WHICH ALL LABORATORY OPERATIONS MUST BE CONDUCTED.

AT GEORGIA GWINNETT COLLEGE, WE ALL HAVE THE RESPONSIBILITY FOR OUR OWN SAFETY, AS WELL AS THE SAFETY OF THOSE WE IMPACT.

## A. RESPONSIBILITIES SUMMARY

At Georgia Gwinnett College (GGC), we are all responsible for our own safety as well as the safety of those we impact. That is why each of us is responsible for and evaluated on how well we know and follow safe work practices.

Safety is a part of every job, and the person most able to ensure the safety of your job is you. Your role is to know the safety and health hazards related to your job. Become skilled at probing for and recognizing unsafe conditions or unsafe actions, so they may be reported and corrected. An important part of your job is to work safely and avoid risk to others.

In order to meet the above responsibility, all laboratory employees must read and implement the safety procedures outlined in the Laboratory Safety Standards Manual. This manual was established as *the standard by which all laboratory operations are to be conducted.*

### 1.0 ENVIRONMENTAL HEALTH AND SAFETY (EH&S)

1.1 Work within the organization to develop, implement and update appropriate health and safety policies and procedures.

1.2 Monitor procurement, use and disposal of chemicals in the laboratory.

1.3 Conduct audits and maintain records to assure compliance with established standards, and all applicable regulations.

### 2.0 LABORATORY SAFETY OFFICER AND SUPERVISORS

2.1 Ensure that all faculty/staff know and follow the standards established by the Laboratory Safety Standards Manual.

2.2 Instruct faculty/staff on the availability of protective equipment.

2.3 Ensure that all faculty/staff receive appropriate training to safely do their jobs.

2.4 Conduct routine inspections of work areas to assure compliance with established standards.

2.5 Ensure that a Risk Analysis of new or unfamiliar chemistry, equipment or processes is done before beginning any experiment.

## A. RESPONSIBILITIES SUMMARY - continued

### 3.0 LABORATORY PERSONNEL

3.1 Plan and conduct each operation in accordance with the standards outlined in the Laboratory Safety Standards Manual.

3.2 Develop good personal chemical hygiene practices.

### 4.0 CHEMICAL HYGIENE OFFICER

4.1 To oversee the implementation of the Chemical Hygiene Plan.

4.2 To assist the laboratory with questions associated with the Chemical Hygiene Plan.

## B. CHEMICAL HYGIENE PLAN

### 1.0 LABORATORIES COVERED UNDER THIS CHEMICAL HYGIENE PLAN:

Laboratories are defined by the OSHA Standard (29 CFR 1910.1450) as facilities where relatively small quantities of hazardous chemicals are used on a non-production basis. Quality control labs normally do not fall under this standard because QC is considered to be a part of production. Laboratories under the OSHA definition include locations where chemical manipulations are carried out in containers designed to be easily and safely manipulated by one person, excluding preparation of commercial quantities, where multiple chemical procedures or chemicals are used, where procedures are not part of nor simulate a production process, and where laboratory procedures, practices, and equipment are available, effective, and in common use to minimize potential for employee exposure to hazardous chemicals.

### 2.0 CHEMICAL HYGIENE OFFICER

The Chemical Hygiene Officer is responsible for overseeing the implementation of the Chemical Hygiene Plan. The Chemical Hygiene Officer is Janet Whelan ext. 5032.

Although the Chemical Hygiene Officer has been given the responsibility for overseeing the implementation of this plan, it is the responsibility of each faculty/staff member, supervisor to insure that the procedures contained in this manual are followed. See Section A Employee Responsibilities.

This Chemical Hygiene Plan has been incorporated into GGC's already existing Laboratory Safety Standards Manual. This plan was developed and designed to be:

- Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory, and
- capable of keeping exposures below OSHA's PELs and other, more stringent exposure limits.

## B. CHEMICAL HYGIENE PLAN - continued

This plan includes:

- Safety and health standard operating procedures for laboratory work.
- Criteria GGC uses to determine and implement control measures to reduce employee exposure to hazardous chemicals.
- Hood function requirements and maintenance program.
- Provisions for training under the laboratory standard.
- Prior approval program for laboratory operation, procedure or activity.
- Provisions for medical consultation and medical examinations.
- Provisions for additional employee protection for work with hazardous substances.

## C. PRUDENT LAB PRACTICES

### 1.0 GENERAL PRINCIPLES

1.1 Plan your work to avoid working alone in the laboratory.

1.2 Know the safe ways to do your job.

1.3 Do not perform any job task until you have been appropriately instructed on the equipment or process by your supervisor or qualified individual.

1.4 Follow all established safety rules and regulations.

1.5 Report all unsafe conditions or practices to your supervisor.

1.6 NO PRACTICAL JOKES!

1.7 Know the location of and how to use emergency equipment in your area.

1.8 Be familiar with emergency procedures.

1.9 Know the types of protective equipment necessary for the job.

1.10 All mechanical equipment must have guards that prevent access to electrical connections or moving parts.

### 2.0 HOUSEKEEPING

2.1 Work areas should be kept clean and free from obstruction.

2.2 Cleanup should follow the completion of any operation or at the end of each day.

2.3 Spills should be cleaned up immediately and disposed of properly.

2.4 Aisles and hallways are not to be used as storage areas.

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

## 3.0 GLASSWARE

3.1 Adequate hand protection must be used when inserting glass tubing into stoppers or when placing rubber tubing on glass hose connections.

3.2 Only glassware designed for vacuum work should be used for that purpose.

3.3 Hand protection should be used when picking up broken glass.

3.4 When rinsing glassware that contained chemistry, discard the first rinse volume into the appropriate waste container. Subsequent water rinses can be discarded to the sink.

## D. EMERGENCY PROCEDURES

### 1.0 SUMMONING EMERGENCY ASSISTANCE

The following actions are to be used to activate emergency assistance:

| Emergency Type | Dial or Activate |
|---|---|
| **Chemical spill** | **#5034** |
| **First Aid** | **#5034** |
| **Serious medical injury** | **9-911** |
| **Fire** | **Fire alarm pull box/9-911** |

### 2.0 PERSONAL INJURY

2.1 If you are injured, obtain prompt medical assistance.

2.2 All accidents, injuries, illnesses, and near misses must be immediately reported to your supervisor.

2.3 An “Accident Investigation Report” must be completed within twenty four (24) hours.

2.4 In case of chemical contact:

2.4.1 Flush exposed area with water in the nearest eye wash or safety shower for a minimum of 15 minutes.

2.4.2 Remove contaminated clothing and continue washing.

2.4.3 Get help by dialing #5034 and notify your supervisor and Environmental Health and Safety Officer.

### 3.0 EVACUATION

3.1 Familiarize yourself with the evacuation routes and the location of the nearest exits.

3.2 When the building alarm sounds all employees must evacuate via the nearest designated emergency exit and proceed to the designated assembly areas.

3.3 Do not call the operator or security unless you have an emergency to report. These lines must be kept open for evacuation-related calls.

3.4 Follow directions given to you by your supervisor, manager or evacuation monitor.

## D. EMERGENCY PROCEDURES - continued

### 4.0 FIRE

4.1 If a fire occurs, pull the nearest building alarm. If you feel you can use a fire extinguisher safely, then follow the instructions below:
**NOTE: All fires do not use the same type of extinguisher media. Use the correct extinguisher for the specific fire.**

4.1.1 Remove the fire extinguisher from the wall

4.1.2 Approach the fire with your escape route behind you.
Pull the pin.
Aim at the base of fire.
Squeeze trigger.
Sweep from the front of the fire to the back.

4.2 If you don't know how to operate a fire extinguisher, do not attempt to fight the fire. Pull the alarm, close the door behind you and evacuate the area.

### 5.0 CHEMICAL SPILLS

5.1 It is important that all chemical spills be responded to in a safe and expeditious manner by trained personnel.

5.2 If a chemical is spilled in a quantity that can be safely cleaned up by the person causing the spill, then do so.

5.3 If the quantity exceeds one quart, call Janet Whelan at 5034. The recorded instructions ask for the following information.

5.3.1 Your NAME

5.3.2 Your EXACT LOCATION

5.3.3 The TYPE OF EMERGENCY

5.3.4 The TELEPHONE EXTENSION you are calling from.

5.4 Clean-up procedure

5.4.1 All non-essential personnel must leave the area and barriers should be placed to prevent other personnel from entering the area.

5.4.2 All spills must be evaluated and the appropriate personal protective equipment donned.

5.4 Clean-up procedure - continued

5.4.3 The spill must be diked, neutralized (if possible) and placed in a labeled container for disposal.

5.4.4 Contact the hazardous waste coordinator for disposal instructions.

5.4.5 An investigation report must be completed and forwarded to Environmental Health and Safety Officer.

## 6.0 EMERGENCY POWER SHUT DOWN

6.1 The power sources to the following equipment should be shut off:

Heaters
Agitation Equipment
Motors
Vacuum pumps
UV lamps
Air compressors
Any electrical equipment

6.2 Leave cooling water on, if possible.

6.3 Shut off all process water (Rinse tank, faucet, etc...)

6.4 Do not work with chemicals or equipment under emergency lighting.

## E. RISK ASSESSMENT - PROCESS OPERATIONS

### 1.0 GENERAL

1.1 Researchers are always responsible for understanding the hazards of the chemicals which they handle and the procedures which they perform.

1.2 Before any work begins, a risk assessment should be conducted. Work should proceed only if it can be done safely for the people and the environment.

1.3 Address out-of-hours operations in SOP's/JSA's, PHA's, etc., including issues such as working alone, emergency response, and utility failures.

1.4 In the absence of specific process risk assessment, as outlined in Section 2.0, the following process monitoring is necessary.

1.4.1 Active procedures **can not** be left unattended.

1.4.2 Active procedures include weighing, charging, heating, refluxing, filtration, vacuum operations, pressure operations, flowing water, open containers, etc.

1.5 If the potential consequences of a procedure could not be prevented even if it is supervised (attended), then the procedure must be evaluated using the risk assessment procedures described in section 2.0.

### 2.0 RISK ASSESSMENTS

2.1 The purpose of a risk assessment is:

to identify the hazards that exist
to identify the consequences and probabilities of adverse occurrences
to identify necessary control systems to eliminate unacceptable consequences.

2.2 The following three tiers of risk assessment will be used to evaluate laboratory operations:

Tier I - Preliminary Hazard Analysis (PHA) or Job Safety Analysis (JSA).
Tier II - Environmental Health and Safety (EH&S) Review.
Tier III - Hazard and Operability Study (HAZOP).

## E. RISK ASSESSMENT - PROCESS OPERATIONS – continued

2.3 Tier I Assessments - PHA and JSA

When: Before beginning any experiment involving unfamiliar chemistry or equipment, or a significant process change.
Who: Lab employee plus supervisor, or research team.
Procedure: JSA form (Appendix E1) or PHA checklist (Appendix E2)
Deliverable: A record of the process (completed checklist or form) that includes all recommendations and a determination whether a more exhaustive review is necessary.

2.4 Tier II Assessments - EH&S Review

When: For highly toxic materials, extreme operating conditions (e.g.: temperature and pressure) unusual equipment requirements, scale-ups to pilot plant or production.
Who: EH&S plus research team.
Procedure: EH&S Review Checklist
Deliverable: Written report that includes all EH&S concerns, a list of necessary actions, and identification of action item responsibilities.

2.5 Tier III Assessments - HAZOP

When: Whenever the potential consequences of a systems failure may be severe (e.g. fire, explosion, chemical release to the environment).
Who: EH&S plus a cross-functional team
Procedure:

1. The team defines process intentions.
2. Guide words are systematically applied to each intention to identify deviations.
3. The team identifies possible causes and consequences of the deviation.
4. Recommendations and comments are recorded for follow-up action.

Deliverable: HAZOP Worksheets with a summary of recommendations, action plans, and closure

**APPENDIX E1**

# JOB SAFETY ANALYSIS (JSA)

| **Job Description:** | | |
|---|---|---|
| **Prepared By:** | **Department:** | **Date:** |
| Sequence of Job Steps | Potential Incidents | Recommended Controls |
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**APPENDIX E2**

## PRELIMINARY HAZARD ANALYSIS
## for Laboratory Operations

Author: _____

Date: _____

Instrument or Procedure:_____
Lab location: _____

PHA Participants (other than author): _____

EH&S Review Recommended: Yes No

**MATERIAL:**

_____

_____

_____

_____

Are any new chemical substances (NCS) involved? Yes* No

***If the NCS is shipped outside the laboratory, an MSDS must be sent with it and the recipient notified in writing in advance that an NCS is being sent.***

A. List ALL chemicals to be used in the operation. (Attach a list if more than 6.)

| | |
|---|---|
| 1 | 4 |
| 2 | 5 |
| 3 | 6 |

B. Review the current MSDS sheets for each of the chemicals listed in A.

**PRELIMINARY HAZARD ANALYSIS**

C. List those materials (from above) which will require the use of special protection, handling, medical monitoring, storage, or disposal. Identify the HAZARD and the appropriate precaution to be taken.

| MATERIAL | HAZARD | PRECAUTIONS REQUIRED |
|---|---|---|
| | | |
| | | |
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| | | |

D. List the spill supplies needed at location of operation.

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E. Identify the waste stream(s) (if applicable).

| |
|---|
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| |

**II. PROTECTION:**

In addition to SAFETY GLASSES, list the minimum protective equipment for this operation:

| **Protection** | **Required (Yes/No)** | **Protection** | **Required (Yes/No)** |
|---|---|---|---|
| Splash Goggles | | Respirator | |
| Face Shield | | Safety Shoes | |
| Gloves | | Apron | |
| Ear Plugs | | Other (Specify) | |

Comments: _____

_____

**PRELIMINARY HAZARD ANALYSIS**
**for Laboratory Operations – Page Three**

## III. HAZARDS ASSOCIATED WITH LABORATORY OPERATION:

Carefully consider each question as it applies to your operation. Check (√) those that require clarification and include what safeguards are in place to address the perceived hazards.

### A. REACTIONS/PROCEDURES:

Is there a hazard due to any one of the following?

- ☐ Runaway chemical reaction or side reactions
- ☐ Loss of cooling
- ☐ Blocked vent lines
- ☐ Equipment/power failure
- ☐ Loss of temperature control
- ☐ Loss of pressure control
- ☐ Faulty pressure/temperature monitoring devices ☐ Inadequate ventilation
- ☐ Glassware/apparatus failure

### B. EQUIPMENT:

- ☐ Radiation
- ☐ Excessive noise
- ☐ Flammability hazard (ignition sources)
- ☐ Ventilation
- ☐ Instrument exhaust
- ☐ Shielding (moving parts, hot or cold surfaces, high or low pressure sources, sharp edges
- ☐ Wiring/grounding
- ☐ Compressed gasses/cryogenic liquids
- ☐ Vacuum
- ☐ Accidentally changing control settings
- ☐ Mislabeled feed/discharge lines
- ☐ Spill large quantities of chemicals
- ☐ Spills into sinks

**PRELIMINARY HAZARD ANALYSIS**

**for Laboratory Operations – Page Four**

**B. EQUIPMENT:**

- ☐ Pump control failure
- ☐ General power failure
- ☐ Service failure (house/water pressure/hoods/compressed gases/$N_2$)
- ☐ Instrument alarm failure
- ☐ Control system loss (computer failure)
- ☐ Potential hazards not yet mentioned
- ☐ Are there potential hazards associated (e.g., electrical shock)?
- ☐ Out of hours operation

**C. ARE OPERATING INSTRUCTIONS NEEDED?**
YES NO

**IV. OUT OF HOURS OPERATION:** Approved?
YES NO

**V. EQUIPMENT EMERGENCY SHUTDOWN PROCEDURE:**
Describe emergency shutdown for equipment. Post in lab at time of PHA.

| |
|---|
| |
| |

**VI. IMMEDIATE MODIFICATIONS TO BE DONE/GENERAL COMMENTS:**

| |
|---|
| |
| |

**F. EQUIPMENT**

## 1.0 LABORATORY METHODS FOR HEATING SOLUTIONS

### 1.1 SOLUTION HEATING: IMMERSION HEATERS

1.1.1 Immersion heaters *must be an integral part of a heater-controller system.*

1.1.2 For *in situ* heating, use Teflon™ coated immersion heaters only.

1.1.3 Controllers: Must be equipped with the following features:

Thermistor-controlled solution temperature
Single set-point latched system
P-III thermocouple heater control-separate wiring
Twist lock plug from heater to controller (no other type outlet permitted!)
Bipolar plug to 20 amp outlet (U. S.), or the equivalent outside the U. S.

1.1.4 Fusible link type Teflon heaters: May **not** be used in the laboratory.

1.1.5 Quartz heaters are ***prohibited***, unless specifically authorized by EH&S.

**SOLUTION HEATING BY OTHER METHODS**

***Open flames are prohibited except as required instrumentation.***

**HOT PLATES**

- Containers to be heated on hot plates should be no larger than the dimensions of the hot plate surface.
- Where circular bottomed beakers are placed on square or rectangular hot plate surfaces, the diameter of the beaker should be no greater that the smallest dimension of the rectangle.
- Large battery jars must not be heated on hot plates.

**F. EQUIPMENT**

**SOLUTION HEATING BY OTHER METHODS – cont.**

- Large battery jars must not be heated on hot plates.
- Appropriate quality glass should be used for hot plate heating.
- Keep in mind that Pyrex, or similar brands of glass, can break if it contains surface flaws or bubbles.
- Upon receipt, all new beakers should be inspected by the user for such flaws and imperfect glassware.
- Hot plates must be controlled by additional external mechanism(s).
- Flammable liquids should not be heated on hot plates.
- Do not use ceramic top hot plates if they are scratched because they can shatter upon heating.

## 2.0 ELECTRICAL EQUIPMENT: GENERAL STANDARDS

2.1 ELECTRICAL SPECIFICATIONS FOR EQUIPMENT

2.1.1 Save all catalogs and manuals. Copy and save all important specifications (voltage, current limits).

2.1.2 Motor-driven electrical equipment used where volatile materials may be present must be equipped with a nonsparking induction motor rather than a series-wound motor that uses carbon brushes.

2.1.3 Electric power receptacles for operations in hoods should be located outside the hood.

2.2 FRAYED CORDS: Repair immediately

2.2.1 Tag defective electrical items to prevent their use while waiting for repair.

## F. EQUIPMENT

## 2.0 ELECTRICAL EQUIPMENT: GENERAL STANDARDS – cont.

2.2.2 Remove the item to Maintenance to ensure timeliest return to service.

2.3 EXTENSION CORDS: Use only if necessary

2.3.1 When necessary, they must be supported and secured.

2.3.2 They must not lie on the floor or across aisles (lab or office).

2.4 Locate Variacs and other electrical items in a way which protects them from spills or leaks.

2.5 The choice of solution agitation equipment should take into account the flammability rating of the substances.

2.6 Since flammable solvents pose a static discharge hazard during pouring, minimize the container-to-container free fall distance when transferring.

2.7 Switch off all appliances before removing plugs from outlets in order to avoid voltage surges when plug is reinserted to the outlet.

2.8 All appliances must have grounded plugs.

2.9 **Remember** to **unplug** all electrical equipment at the end of each workday.

## 3.0 VACUUM PUMPS

3.1 Distillation or concentration operations using volatile materials should normally be performed using a water or steam aspirator instead of a mechanical vacuum pump.

3.2 Mechanical vacuum pumps should be used for the distillation of less-volatile materials, the removal of final traces of solvents, or other operations that require pressures lower than those obtained via aspiration.

## F. EQUIPMENT – cont.

## 3.0 VACUUM PUMPS - continued

3.2.1 Input lines from the system to the vacuum pump need to be fitted with a cold trap to collect volatile materials from the system and minimize the amount that enters the pump and pump oil.

3.2.2 Do not use liquid nitrogen or liquid air in cold traps. The use of these liquid materials increases the flammability hazard.

3.2.3 The output of each pump should be vented to an exhaust system.

## 4.0 DRYING OVENS

4.1 Volatile materials should not be dried in a conventional laboratory oven unless the oven has continuous ventilation of the atmosphere **inside** the oven.

4.2 "Explosion proof" drying ovens with rear blow-out panels should be used for volatile materials.

4.3 Bimetallic strip thermometers should be used for monitoring oven temperatures. Mercury thermometers should not be mounted through holes in the tops of ovens.

## 5.0 REFRIGERATORS

5.1 Laboratory refrigerators must never be used for the storage of food or beverages.

5.2 "Explosion-proof" refrigerators are to be used for storing flammable or combustible materials.

5.3 Uncapped containers should never be placed in a refrigerator.

## 6.0 STIRRING AND MIXING DEVICES

6.1 Only spark-free induction motors should be used to run stirring and mixing devices.

6.2 Stirring motors that will be left unattended should be fitted with a suitable fuse or thermal-protection device.

6.3 For stirring motors that will be left unattended, it is good practice to attach a stirring impeller to the shaft of the stirring motor by using lightweight rubber tubing. If the motion of the impeller becomes blocked, the rubber will twist until it breaks.

## G. COMPRESSED GASES, PRESSURE REACTIONS,

## AND VACUUM WORK

### 1.0 COMPRESSED GASES

1.1 Gas cylinders must be firmly secured at all times.

1.2 Only Compressed Gas Association (CGA) standard combinations of valves and fittings can be used in compressed gas installations.

1.3 Compressed gas cylinders must be placed so that the cylinder valve is accessible at all times.

1.4 When the cylinder is not in use, the main cylinder valve must be closed.

1.5 The main cylinder valve should be opened slowly and only to the extent necessary. It is never necessary to open the main cylinder valve all the way.

1.6 Empty cylinders must be clearly marked as "empty" and returned to a storage area.

1.7 Empty and full cylinders should not be stored in the same place.

### 2.0 PRESSURE VESSELS

2.1 Inspection and Testing

2.1.1 You must always know the allowable working pressure of a vessel. The allowable pressure should be stamped on the vessel or be attached via a name plate.

2.1.2 All pressure equipment must be tested or inspected periodically. Consult the equipment's instructions or manufacturer for the appropriate testing intervals.

2.2 Assembly and Operation

2.2.1 Piping must not be used to support the weight of the equipment.

## G. COMPRESSED GASES, PRESSURE REACTIONS,

## 2.0 PRESSURE VESSELS – cont.

2.2.2 All threaded connections must match correctly and not be forced.

2.2.3 Sharp tubing bends should be avoided.

2.2.4 **All pressure reactions must be shielded**.

2.2.5 Adequate space should be left in all vessels to accommodate the expansion of liquids.

2.2.6 Signs or placards should be placed in the area to inform others of the reaction in progress.

2.3 Pressure-Relief Devices

2.3.1 All pressure or vacuum systems and all vessels that will be subjected to pressure or vacuum must be protected by pressure relief devices. Rupture discs and spring-loaded valves are examples of pressure-relief devices.

2.3.2 The maximum operating pressure of the system must never exceed two-thirds of the rated working pressure of the vessel or system.

2.3.3 The maximum setting for the pressure-relief device must be less than the rated working pressure for the vessel or for the weakest member of the pressure system.

2.3.4 Shutoff valves must not be placed between the equipment and the pressure-relief device.

2.3.5 The discharge side of a pressure-relief device must be vented to a safe area (e.g.: a lab hood).

## G. COMPRESSED GASES, PRESSURE REACTIONS,

## 2.0 PRESSURE VESSELS – cont.

2.4 Glass or Plastic Equipment

2.4.2 Glass equipment should be provided with adequate shielding to protect from flying glass.

2.4.3 A liquid seal, Bunsen tube, or equivalent relief device is to be used for protecting glassware against excess pressure. Corks, rubber stoppers, and rubber or plastic tubing **must not** be used.

2.4.4 Plastic equipment for pressure or vacuum work must not be used unless it is rated for the pressure or vacuum work to be undertaken.

## 3.0 VACUUM WORK

3.1 Equipment and Glassware

3.1.1 All glassware should be inspected for cracks or flaws before each use.

3.1.2 Only glassware specifically designed for operations at reduced pressure (e.g., Pyrex) can be used.

3.1.3 Flasks and desiccators must be shielded by a friction tape or by an enclosure

3.2 Assembly and Operation

3.2.1 **All vacuum work must be shielded**.

3.2.2 All equipment should be set up to avoid equipment strain or stress.

3.2.3 Heavy apparatus should be supported from below as well as by the neck.

## G. COMPRESSED GASES, PRESSURE REACTIONS,

## 3.0 VACUUM WORK - continued

### 3.3 Cold Traps

3.3.1 Input lines from the system to a mechanical vacuum pump need to be fitted with a cold trap to collect volatile materials from the system and minimize the amount that enters the pump and pump oil.

3.3.2 Do not use liquid nitrogen or liquid air in cold traps. The use of these liquid materials increases the flammability hazard.

3.3.3 The output of each pump should be vented to an exhaust system.

3.3.4 Change the vacuum pump oil regularly.

3.3.5 After the operation is complete, the system must be vented and the trap must be cleaned. This venting and cleaning is important because volatile substances that have collected in the trap may vaporize when the coolant has evaporated and cause a pressure buildup that could blow the apparatus apart.

## H. CHEMICAL PROCUREMENT, LABELING AND STORAGE

### 1.0 Procurement of Chemicals

1.1 Prior to ordering, determine whether the chemical is in stock.

1.2 Space must be allocated for storage of the chemical before ordering.

1.3 Order only quantities that are necessary for the project. Remember: **"Less is better**".

1.4 Fill out a “Material Request Form” and give it to Lab Support.

1.5 Upon receipt of the chemistry, make sure the date received and the owner’s initials are on the label.

1.6 If unused chemistry is not needed in the laboratory, return it to Lab Support.

### 2.0 Chemical Labeling

2.1 Chemical containers must be labeled.

2.2 Portable chemical containers, intended only for the **immediate** use of the employee, do not require labels. Remember, immediate use means that it can not be left unattended

2.3 Labels on incoming containers of hazardous materials should not be removed or defaced. Other information placed on the container should not obscure or detract from existing labels.

2.4 Recommendations found on labels should be read and followed.

## H. CHEMICAL PROCUREMENT, LABELING AND STORAGE - continued

## 3.0 Chemical Storage

3.1 All chemicals must be stored according to chemical compatibility..

3.2 Chemicals should be stored in areas designed for chemical storage. Storage rooms, storage cabinets, storage shelves and refrigerators are examples of appropriate areas.

3.2.1 Flammable liquids should be stored in approved flammable liquid storage cabinets.

3.2.2 Corrosives should be stored in approved corrosive storage cabinets

3.3 Chemicals must not be stored in offices, desks or file cabinets.

3.4 Chemicals should not be stored on bench tops because they are unprotected from potential exposure to fire and they are more readily knocked over.

3.5 Chemicals should not be stored on the floor or in the aisles.

3.6 Nothing may be stored on top of cabinets, shelves or shelf racks in the laboratory.

3.7 Except for work in progress, chemicals and equipment should not be stored in lab hoods. Lab hoods are designed to provide protection when working with hazardous materials. Storing chemical and equipment in lab hoods can interfere with the air flow in the hood and compromise the protection afforded the hood operator.

# I. HAZARDOUS WASTE DISPOSAL

5.1 Each chemist is responsible for his/her own waste in terms of proper preparation for waste disposal. This is to include the use of proper containers and completing a waste identification tag in a neat and legible fashion with all the required information.

5.2 **The use of laboratory sinks for the disposal of chemicals is strictly prohibited!**

5.2.1 When rinsing glassware that contained chemistry, discard the first rinse volume into the appropriate waste container. Subsequent rinses can be discarded to the sink.

5.3 Separate waste containers are required to properly segregate waste for disposal. The following waste categories should be used.

1. NITRIC ACID
2. HYDROFLUORIC ACID
3. HEXAVALENT CHROME
4. CYANIDES
5. OXIDIZERS
6. REDUCING AGENTS
7. SULFIDES
8. PALLADIUM
9. HIGH PH ALKALINE SOLUTIONS
10. LOW PH ACIDIC SOLUTIONS
11. NON-CHLORINATED SOLVENTS
12. CHLORINATED SOLVENTS

5.4 Water/air reactive wastes are restricted by waste disposal companies and must be deactivated prior to disposal. This is particularly true of materials which ignite or release gases on contact with air or water.

5.5 Dispose of chemically contaminated paper and disposable clothing in approved solid waste containers.

5.6 Reassigned samples must be re-labeled with the new custodian's name.

5.7 Dispose of all broken glass in those containers marked "Glass only".

5.8 Broken mercury filled thermometers require the use of special mercury spill clean-up kits.

## J. PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

Personal protective clothing and equipment, in conjunction with emergency procedures, help to minimize injuries or damage. Every laboratory worker must be familiar with the location and proper use of the available protective clothing and safety equipment.

### 1.0 EYE AND FACE PROTECTION

1.1 Contact lenses may not be worn when working in a laboratory.

1.2 Safety glasses with side shields must be worn by **all** people (including visitors) entering into or working in a laboratory where chemicals are used or stored. Only glasses meeting the American National Standards Institute requirements or equivalent are acceptable.

1.3 Ordinary prescription glasses are not acceptable unless protective goggles are worn over them.

1.4 Goggles (or face shield) must be worn when splashing is a possibility.

1.5 Full-face shields must be used when working with glassware under reduced or elevated pressure, glassware used in high-temperature operations, or any time there is a possibility of implosions or explosions.

1.6 Specialized eye protection may be needed when working with lasers, ultraviolet light sources, or intense lights sources. Consult with EH&S when choosing specialized eye protection.

### 2.0 HAND AND ARM PROTECTION

2.1 Chemical resistant gloves must be worn when handling corrosive materials, toxic materials, or materials of unknown toxicity.

2.2 Gloves must be selected on the basis of the material being handled and the operation being conducted. One type of glove is not suitable for all chemicals.

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2.3 Before each use, gloves must be inspected for any defects.

2.4 Gloves must be discarded if any defects are found.

2.5 Gauntlet style (elbow length) gloves should be worn when the potential exists for chemical exposure to the forearm.

## J. PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT

### 2.0 HAND AND ARM PROTECTION - continued

2.6 Leather gloves or equivalent should be used for handling broken glassware or manipulating glass tubes.

2.7 Before removal, gloves should be washed appropriately. (NOTE: Some gloves are water permeable.)

2.8 Gloves must be removed before leaving the work area.

### 3.0 FOOT PROTECTION

3.1 Laboratory personnel are required to wear closed toe.

### 4.0 BODY PROTECTION

4.1 Laboratory coats must be worn when working in the laboratory.

4.2 Rubber aprons should be worn when handling corrosive liquids.

4.3 Coats and aprons must be removed when leaving the laboratory. Lab coats are prohibited from being worn in meeting rooms and cafeterias.

### 5.0 RESPIRATORY PROTECTION

5.1 Laboratories are designed so that respiratory protection is not usually needed because of the engineering controls in place (i.e. laboratory hoods).

5.2 When effective engineering controls are not possible, respiratory protection should be provided. Refer to the EH&S “Respiratory Protection Policy”.

### 6.0 SAFETY SHOWERS

6.1 Safety showers must be provided in all areas where chemicals are handled.

6.2 Safety showers must be located in areas that are accessible and unblocked by obstacles.

6.3 The shower should have a quick opening valve which requires manual closing.

6.4 Safety showers must be tested at least quarterly.

## J. PERSONAL PROTECTIVE CLOTHING AND EQUIPMENT - Continued

### 7.0 EYEWASH FOUNTAINS

7.1 Eyewash fountains must be provided in all laboratories where chemicals are handled.

7.2 Eyewash fountains must be capable of providing at least 15 minutes of water in a soft stream.

7.3 Fountains should be located close to the safety showers so that, if necessary, the eyes can be washed while the body is showered.

7.4 Eyewash fountains must be tested at least monthly.

## K. VENTILATION

### 1.0 Laboratory Hoods

1.1 All chemical operations that may generate air contaminants are to be conducted in a hood.

1.2 Conduct all work at least 6 inches back from the face of the hood. Hoods are to be kept clear and the sash at the proper working height.

1.3 Air flows will be routinely monitored by EH&S and the proper sash height noted.

1.4 Hoods used for flammable liquids must be made of flame-proof materials with electrical outlets on the outside of the hood.

1.5 Do not put your head in the hood when contaminants are being generated.

1.6 Do not use a hood for chemical or equipment storage. Store chemicals in an approved storage area.

1.7 Keep the hood sash closed as much as possible.

1.8 Keep the slots in the hood baffle free of obstruction by equipment or containers.

**2.0** Local exhaust is to be used when it is not possible to use a hood. Examples of equipment which need local exhaust include ovens, solvent cabinets, process equipment and instrumentation.

**3.0** Cold traps are to be used during distillations and vacuum drying in order to minimize the contact of fumes or vapors with the vacuum source and/or release to the atmosphere and to protect vacuum pumps.

**4.0** All new ventilation additions need to be approved by EH&S.

## L. ENVIRONMENTAL MONITORING

Environmental monitoring is not normally warranted or applicable in a laboratory setting. However, on occasion a situation will arise that requires environmental monitoring. In most cases, the monitoring is conducted to assess the effectiveness of the ventilation equipment.

### 1.0 General Exposure Reduction Principles

1.1 Even for small substances of no significant hazard, exposure should be minimized.

1.2 It should be assumed that any mixture will be at least as toxic as its most toxic component.

1.3 All containers of chemicals must be capped or sealed to avoid escape into the work atmosphere.

1.4 Permissible exposure limits (PEL) and Threshold Limit Values (TLV) should never be exceeded. All routine exposures above 50% of these limits will require engineering or administrative control measures.

1.5 Threshold limit values refer to airborne concentrations of substances and represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect.

### 2.0 Monitoring Requests

2.1 If you are concerned about any exposures in your workplace, contact EH&S.

2.2 A job review and workplace assessment will be conducted to determine if environmental monitoring is warranted.

2.3 If monitoring is conducted, you will be notified of the results obtained.

# M. TRAINING

## 1.0 New Employees

1.1 All new members (including temporaries) must receive a safety orientation from their supervisor using the New Employee Supervisors Safety Checklist. The form should be completed and sent to EH&S.

1.2 Prior to starting work in the laboratory all new employees must receive proper instruction in the operation of the equipment in the laboratory. This should include reading the equipment manual when appropriate.

1.3 All new employees must review the Laboratory Safety Standards Manual.

## 2.0 All Employees

2.1 All new processes or chemistries must be reviewed and authorized by your supervisor prior to commencement.

2.2 All employees must participate in required safety training programs that are conducted throughout the year.