DEPARTMENT OF CHEMISTRY SAFETY MANUAL

COLORADO STATE UNIVERSITY
CHEMISTRY BUILDING - DEPARTMENT NUMBER 1872

SAFETY OFFICE: *ADMINISTRATIVE OFFICE*
ROOM: *B101 CHEMISTRY*
PHONE: *(970) 491-6381*

EMERGENCY?

What is an emergency? An emergency is defined as a crime, fire, explosion or release of hazardous material that could threaten human health or the environment.

CALL CSU POLICE (911) AND GIVE THE OPERATOR THE FOLLOWING INFORMATION:

- Your name and phone number
- The location of the emergency (building and room number)
- A description of the incident

Stay on the line to answer the operator's questions or get assistance for what to do next.

NON-EMERGENCY SITUATIONS?

Urgent Facilities Problem? After-Hours Flood?

- **CALL FACILITIES AT (970) 491-0077**
- Only call Facilities for urgent/after-hour problems - routine facilities requests should be submitted to the Assistant Building Proctor, Diane Hellbusch in B101 or by phone at (970) 491-0502

Theft or Non-emergency Crime to Report?

- **CALL CSU POLICE AT (970) 491-6425**

Environment Health and Safety Issue?

- **CALL EHS AT (970) 491-6745**
- Describe the incident to the operator to get transferred to an appropriate individual.

WORKING EARLY/LATE?

CSU POLICE DEPARTMENT SPONSORS A FREE SAFE WALK PROGRAM. Campus Service Officers (CSOs) are available to walk with you any place on campus, the Veterinary Teaching Hospital, Foothills Campus, or within a three block radius of campus. **CSOs PROVIDE ESCORT SERVICE YEAR-ROUND, ANY TIME DAY OR NIGHT, 7 DAYS PER WEEK.** CSOs receive training in a variety of safety and security-related subjects and are in constant contact with the CSU PD's Dispatch Center via 2-way radio.

The number for the Safe Walk program is **(970) 491-1155**. Call them 10-15 minutes before you are ready to leave and a CSO will meet you outside of the building and escort you to your car. Learn more about Safe Walk and other CSUPD services at http://police.colostate.edu/.

COLORADO STATE UNIVERSITY OFFICE OF RISK MANAGEMENT

Notice to Employees

This notice must be posted in a visible place on your premises

Your Rights Under the Workers' Compensation Act:

Workers' Compensation insurance provides employees with appropriate medical care and a portion of lost wages following a compensable work-related injury, illness or disease. This insurance is provided by employers at no cost to employees.

If you are injured on the job or sustain a work-related illness or disease, compensation and medical benefits are paid as provided by the Workers' Compensation laws. CSU's Workers' Compensation Claims are handled by claims adjusters, outside of CSU. The adjuster(s) make the determination of whether or not you have sustained a compensatory injury or illness in accordance to the Work Compensation Rules. For more information https://www.colorado.gov/cdle/dwc

If Injured on the Job:

1. Notify your supervisor immediately. You must also complete a first report of injury via the internet:http://rmi.prep.colostate.edu/insurance/incident-reporting/, in writing and/or delivered to CSU's Workers Compensation Office located at General Services Building Rm 141- Mailing address: 1251 S. Mason Fort Collins, CO 80523 Attn: Kenda Weigang, WC Manager.
   a. If you fail to report your injury to your employer within four working days, your compensation benefits may be reduced.
   b. You may also file your own "Worker's Claim for Compensation" with the Division of Workers' Compensation, 633 17th St., Suite 400, Denver, CO 80202- 3660. You may call Customer Service at 303-318-8700, or visit our website at: www.coworkforce.com/dwc/.

2. You are entitled to reasonable and necessary medical, surgical and hospital treatment for your compensable injuries or occupational disease. CSU does have the right to designate a list of doctors / clinics you must seek treatment from for work- related injuries or diseases. Please contact the office of Workers' Compensation (970)491-6745 or refer to our website http://rmi.prep.colostate.edu/workers-compensation/authorized-treating-physicians/ for a list of physicians in your area.

3. Compensation payments made to you for lost wages resulting from a compensable injury or occupational disease begin after you have missed three scheduled work shifts.
   a. The treating doctor determines you need to be off work for any period of time.
   a. Your compensation rate while unable to work is 2/3 of your average weekly wage, not to exceed a maximum amount as set under the Workers' Compensation laws.
   b. Under the State of Colorado personnel rules, State Classified, Faculty or Administrative Professional employees may be entitled to injury leave, paid at your regular salary, provided that any compensation paid by CSU's Third Party Administrator or carrier during this time is to be reimbursed to the appointing authority.
   c. No compensation for medically authorized time off is payable for the first 3 days (cumulative) unless the period of disability and missed time exceeds two weeks or 80 hours for full time employees.

Authorized medical services are available at the CSU Health and Medical Center for work-related injuries. Employees may also seek treatment from any of the Authorized Treating Physicians listed on the RMI website at http://rmi.prep.colostate.edu/workers-compensation/.

CSU HEALTH & MEDICAL CENTER

151 WEST LAKE STREET ∞ SUITE 1500

Offering Services for Work-Related Injuries

SERVICES

- Walk in Urgent Care
- X-Ray
- Physical Therapy
- Occupational Health Services
- Pharmacy
- Lab Services
- Infusion
- Imaging and Radiology Service

UC HEALTH SERVICES

One of CSU's Authorized Treating Physicians (ATPs) for Workers' Compensation Care

Hours: M-F 8am-5pm

Phone: (970)495-8450

Associates in Family Medicine

Providing walk-in Urgent Care, First Aid treatment and initial visit services for Authorized Treating Physicians

Hours: M-F 8am to 8pm

Saturday and Sunday 9am-5pm.

Unless the initial visit is for First Aid only, employees will need to follow up with an Authorized Treating Physician.

UCHealth and Associates in Family Medicine share the same suite, making it convenient for CSU employees to get immediate care when they sustain a work-related injury. When seeking medical care, an injured employee will be scheduled with whichever provider with earliest availability.

To ensure appropriate care and billing for a work-related injury, employees must identify themselves as an employee of CSU who was injured while performing tasks for which they are paid through CSU.

IF YOU ARE INJURED ON THE JOB, WRITTEN NOTICE OF YOUR INJURY MUST BE GIVEN TO YOUR EMPLOYER WITHIN FOUR WORKING DAYS AFTER THE ACCIDENT, PURSUANT TO SECTION 8-43-102(1) AND (1.5), COLORADO REVISED STATUTES.

IF THE INJURY RESULTS FROM YOUR USE OF ALCOHOL OR CONTROLLED SUBSTANCES, YOUR WORKERS' COMPENSATION DISABILITY BENEFITS MAY BE REDUCED BY ONE-HALF IN ACCORDANCE WITH SECTION 8-42-112.5, COLORADO REVISED STATUTES.

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APPENDICES

SECTION I - CHEMISTRY BUILDING SAFETY PLAN
(EHS APPENDIX E-1)

EMERGENCY TELEPHONE NUMBERS

POLICE AND FIRE	**911 or (970) 491-6425**	
BUILDING PROCTOR	(970) 491-6475	Chris Rithner
ASSISTANT BUILDING PROCTOR	(970) 491-0502	Diane Hellbusch
DEPARTMENT CHAIR	(970) 491-7235	Matthew Shores
ASSISTANT TO THE CHAIR	(970) 491-5392	Kristin Berthold
DEPARTMENT OFFICE MANAGER	(970) 491-0502	Diane Hellbusch
ASSOCIATE DEPT CHAIR	(970) 491-6046	Alan Kennan
DEPARTMENT SAFETY COMMITTEE CHAIR	(970) 491- 2852	Chuck Henry
TEACHING LAB COORDINATORS	(970) 491-5581	Prep Room – General Chem Labs
	(970) 491-3763	Prep Room – Organic Chem Labs
	(970) 491-1322	Ben Reynolds – General Chem
	(970) 491-2875	Panduka Piyaratne –Organic Chem
	(970) 491-1761	Joseph DiVerdi – Upper Division
CHEMISTRY STOCKROOM	(970) 491-1169	
ENVIRONMENTAL HEALTH SERVICES	(970) 491-6745	
BIOSAFETY	(970) 491-6729	
FIRE SAFETY	(970) 491-4749	
HAZARDOUS CHEMICALS	(970) 491-4830	
RADIOACTIVE MATERIALS	(970) 491-3736	
FOOD SAFETY/WATER QUALITY/INDOOR AIR	(970) 491-6121	
FACILITIES MANAGEMENT	(970) 491-0077	
RISK MANAGEMENT	(970) 491-7726	
STUDENT HEALTH	(970) 491-7121	

POLICE RESPONSE

- Do not run from a police officer when contacted or instructed in any way. This could lead to injury to you or others, or enforcement action being initiated against you.
- When interacting with police, place hands forward and palms up like asking a question if the situation is at all confrontational – this allows them to see your hands and scan quickly for weapons (they don't know you're NOT the "bad guy" until they identify you).

- Even if you know the alarm to be false, you must STILL follow all instructions from responding police officers as well as any protocols that have been established for an alarming system within your building.

EVACUATION PLAN

- Faculty who are teaching classes at the time of an emergency are responsible for the orderly evacuation of the class and should be the last one out of the classroom to verify evacuation for responders.

- DO NOT take time to turn off computers, printers, or office lights. Close, but DO NOT lock, office door and windows.

- Gather your personal belongings **if it is safe to do so**. (Reminder: take prescription medications out with you if at all possible; it may be hours before you are allowed back in the building.)

- Exit the building through the closest exit. DO NOT use the elevator.

- All personnel should be familiar with exit paths for their areas. REFER TO YOUR FLOOR PLAN and be familiar with the shortest path possible and a secondary exit.

- Proceed in an orderly manner as quickly as possible to the nearest exit and then to the designated rally point.

- Be alert for individuals with disabilities or injuries who may need assistance. However, under no circumstances should an individual risk or jeopardize their personal safety in an attempt to rescue another person. Notify the building proctor or responding emergency personnel of any known individual that may be unable to independently exit the building.

- Stay at the designated rally point until you are instructed to leave. This way an accurate head count can be taken. Faculty and lab assistants are responsible for the students. Keep streets, fire lanes, hydrant areas and walkways clear for emergency vehicles and personnel.

- Upon arrival of University Police, the proctor will assist them in whatever manner they request or direct. Poudre Fire Authority staff or the University Police will clear the building, checking elevators, areas for the physically disabled and laboratory areas.

- Emergency alarms being turned off DOES NOT mean the building is clear and safe to re-enter. They are silenced so that emergency response personnel are able to communicate with each other. DO NOT RE-ENTER THE BUILDING for any reason until instructed to do so by fire department, EHS, or police officials.

CAMPUS EVACUATIONS

- Evacuate as instructed in emergency announcement.

- Leave by vehicle unless instructed otherwise.

- Do not return to campus until instructions are received saying it is safe.

- Move to designated campus rally points if unable to go home or if you are instructed to do so.

BUILDING EVACUATION PLANS

Map legend:

Red	●	= "You Are Here"
Blue	■	= Fire Alarm Pull Station
Green	▲	= Exterior Exit
Black	✖	= Fire Extinguisher
Yellow	✹	= Rally Point
Black	**AED**	= AED Cabinet
Black	**SS**	= Safety Shower
Black	**FB**	= Fire Blanket
Black	**SK**	= Spill Control Kit
Black	**EW**	= Eyewash
Black	**EGS**	= Emergency Gas Shutoff

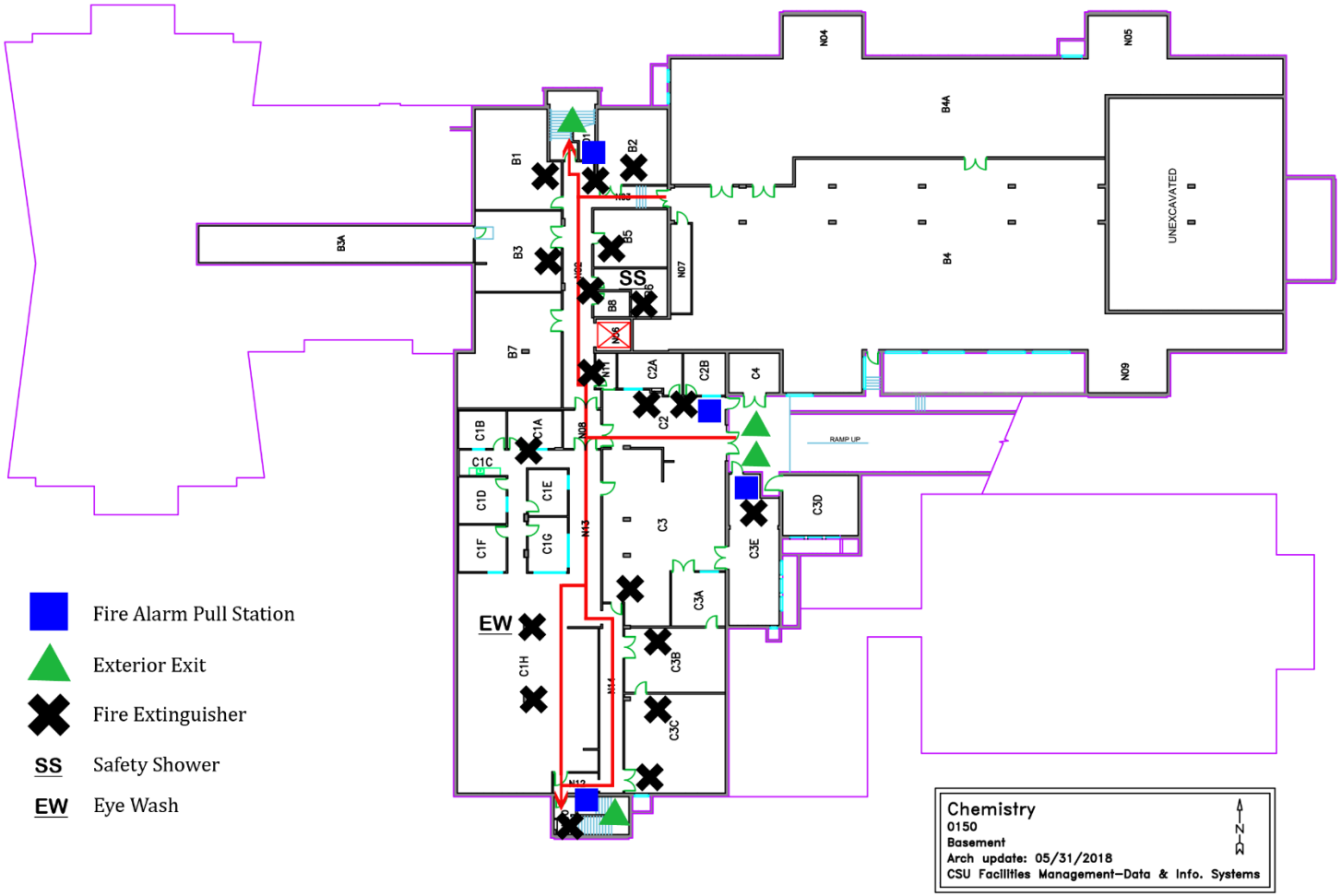
EMERGENCY EGRESS PLANS ARE CURRENT AS OF
JULY 24, 2018

BUILDING RALLY POINTS

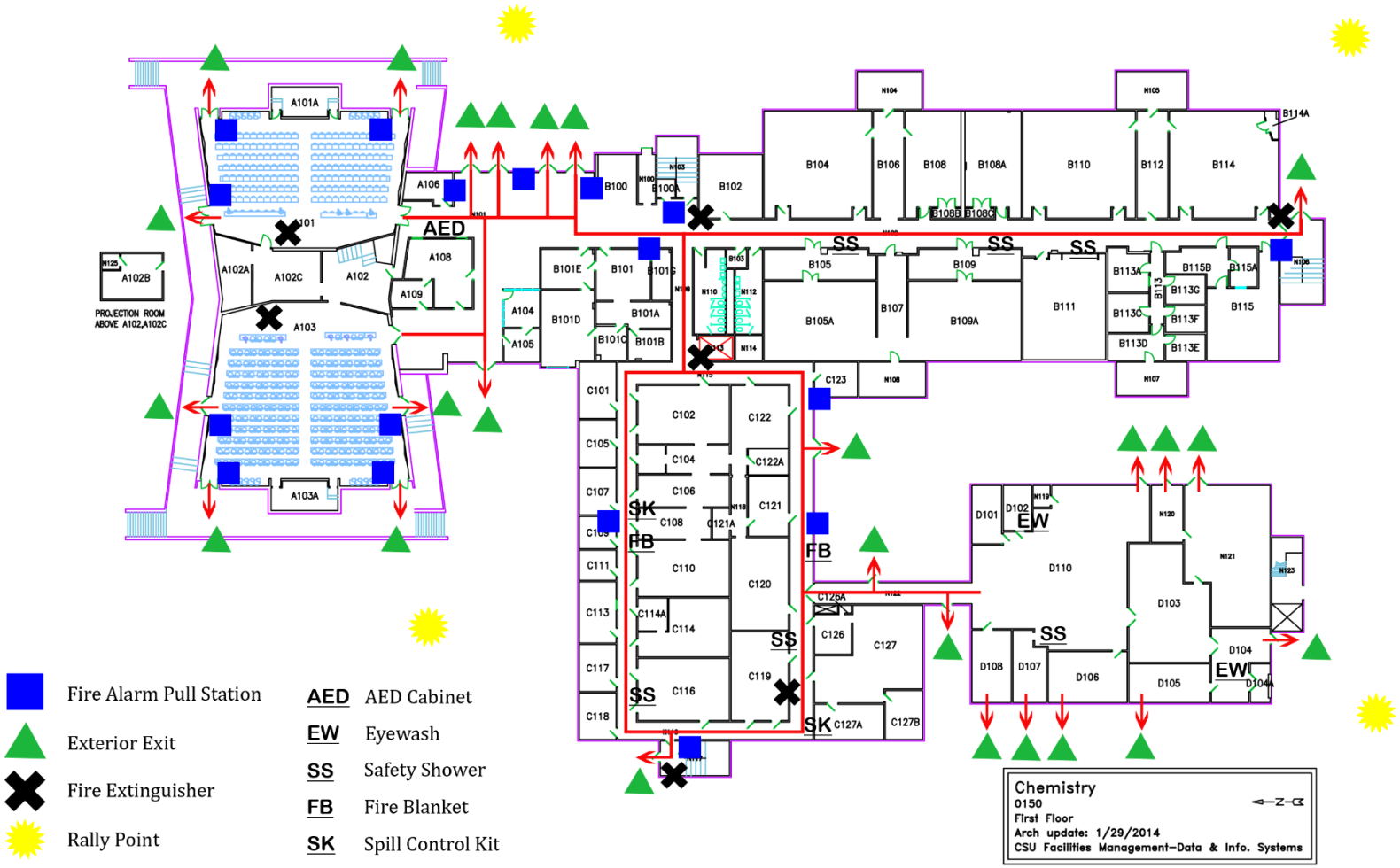
Rally points for each building are at the outdoor locations listed below.

- Chemistry Building
  - Main lobby/northeast exits (A-wing) – Front of building near Yates overpass
  - Southeast exit (B-wing) – Southeastern corner of building near bike racks
  - West exits (C-wing) – Northwestern corner of building in grass field
  - South/southwest exits (D-wing) – Grass field behind main stockroom
- Chemistry Research Building
  - Southeast exit – Picnic tables and 'molecules' at front of building
  - Southwest exit – Picnic tables and 'molecules' at front of building
  - Loading dock/west exit – Northeast corner of building along bike path
  - Northeast exit – Northeast corner of building along bike path
- Yates Building
  - East exit – East side of Yates in near bike racks (walkway toward CHEMR)
  - West exit – Front of building near Yates overpass

Emergency Evacuation Plan - Chemistry Basement



Emergency Evacuation Plan - Chemistry 1st Floor



Fire Alarm Pull Station

Exterior Exit

Fire Extinguisher

Rally Point

AED AED Cabinet

EW Eyewash

SS Safety Shower

FB Fire Blanket

SK Spill Control Kit

Emergency Evacuation Plan - Chemistry 2nd Floor

Fire Alarm Pull Station

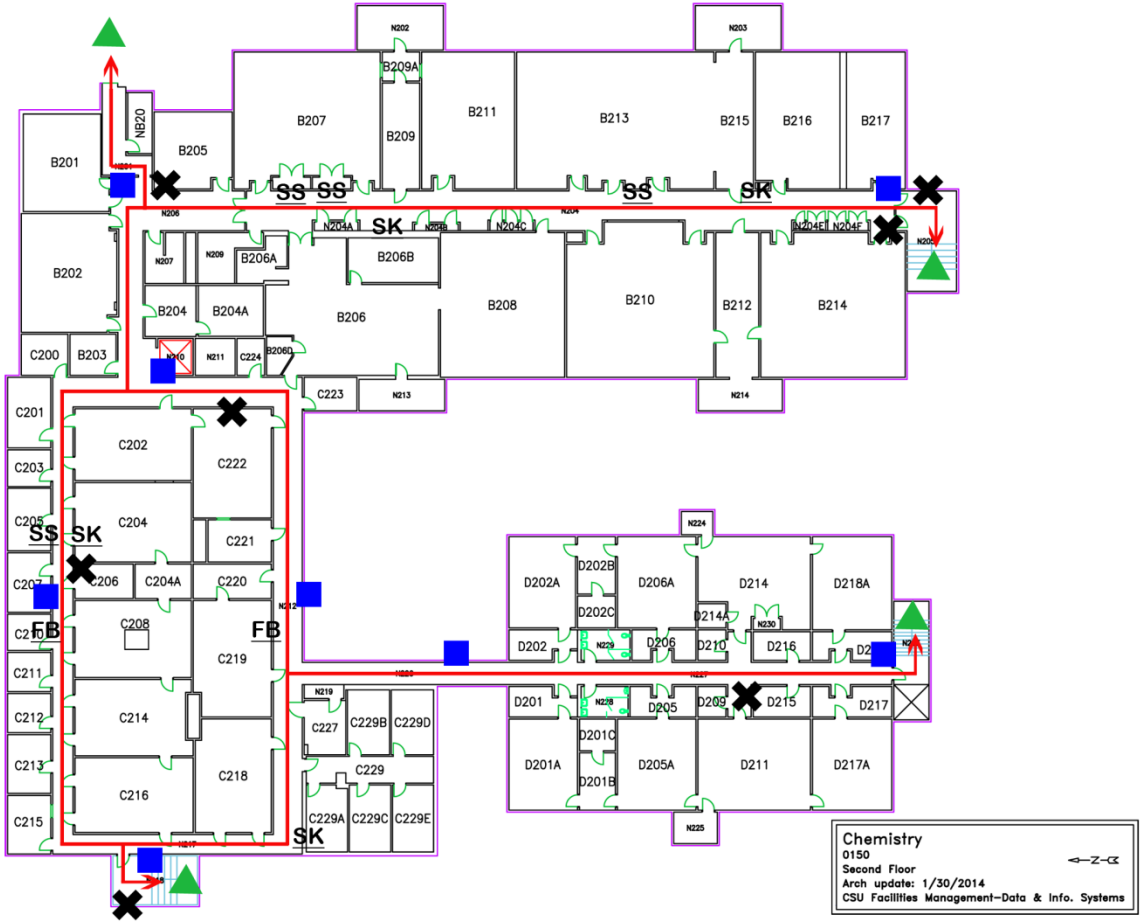
Exterior Exit

Fire Extinguisher

SS Safety Shower

FB Fire Blanket

SK Spill Control Kit



Emergency Evacuation Plan - Chemistry 3rd Floor

Fire Alarm Pull Station

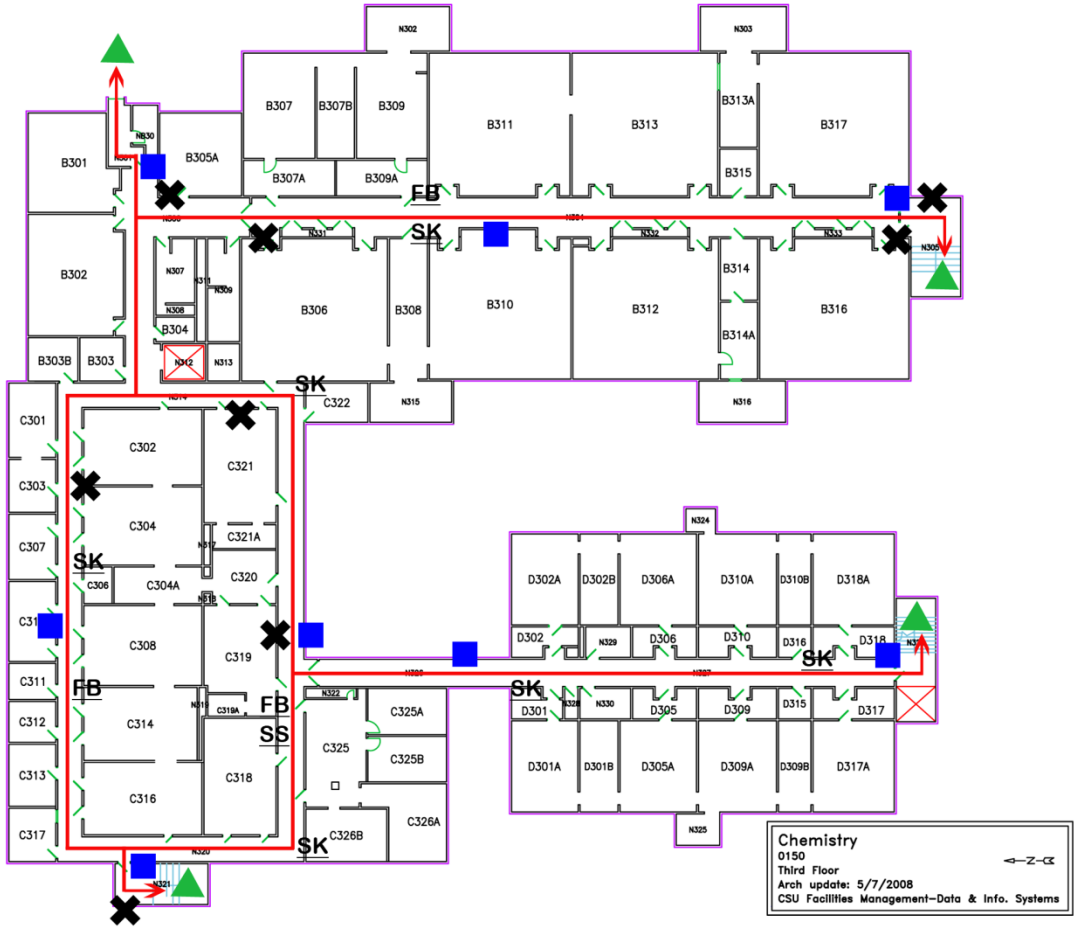
Exterior Exit

Fire Extinguisher

SS Safety Shower

FB Fire Blanket

SK Spill Control Kit



Emergency Evacuation Plan - Chemistry Research 1st Floor

Fire Alarm Pull Station

Exterior Exit

Fire Extinguisher

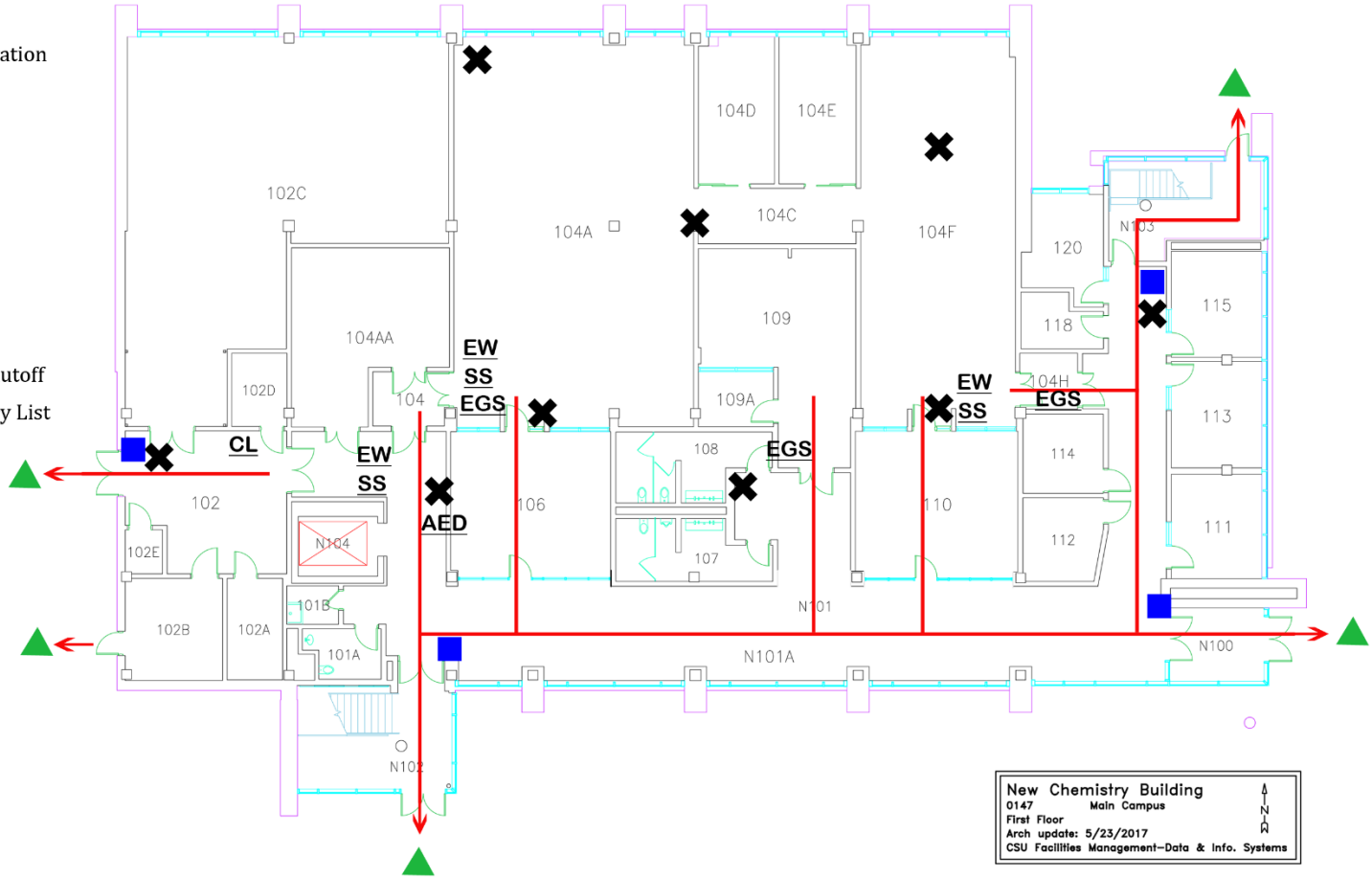
AED AED Cabinet

EW Eyewash

SS Safety Shower

EGS Emergency Gas Shutoff

CL Chemical Inventory List



Emergency Evacuation Plan - Chemistry Research 2nd Floor

Fire Alarm Pull Station

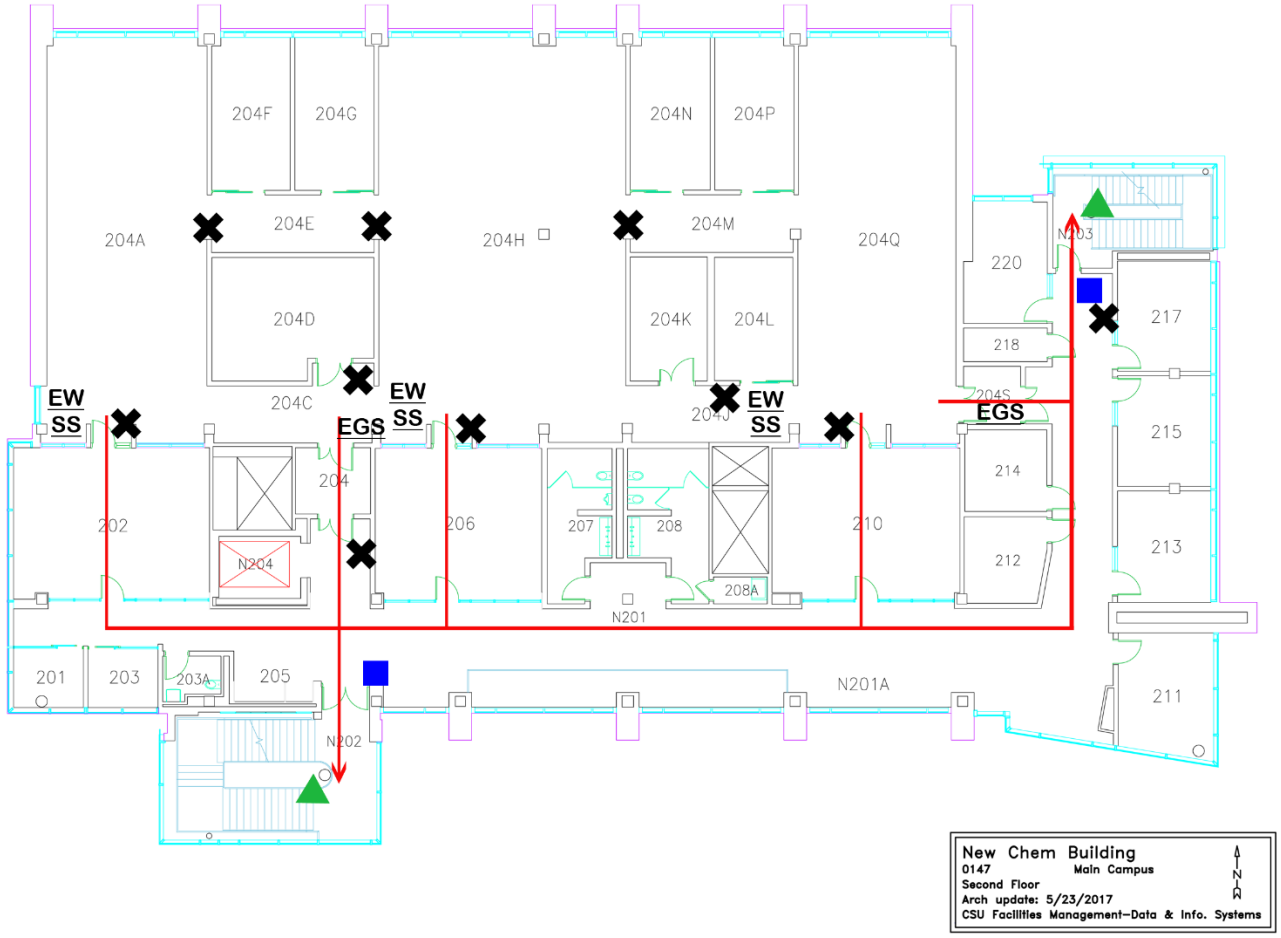
Exterior Exit

Fire Extinguisher

EW Eyewash

SS Safety Shower

EGS Emergency Gas Shutoff



Emergency Evacuation Plan - Chemistry Research 3rd Floor

Fire Alarm Pull Station

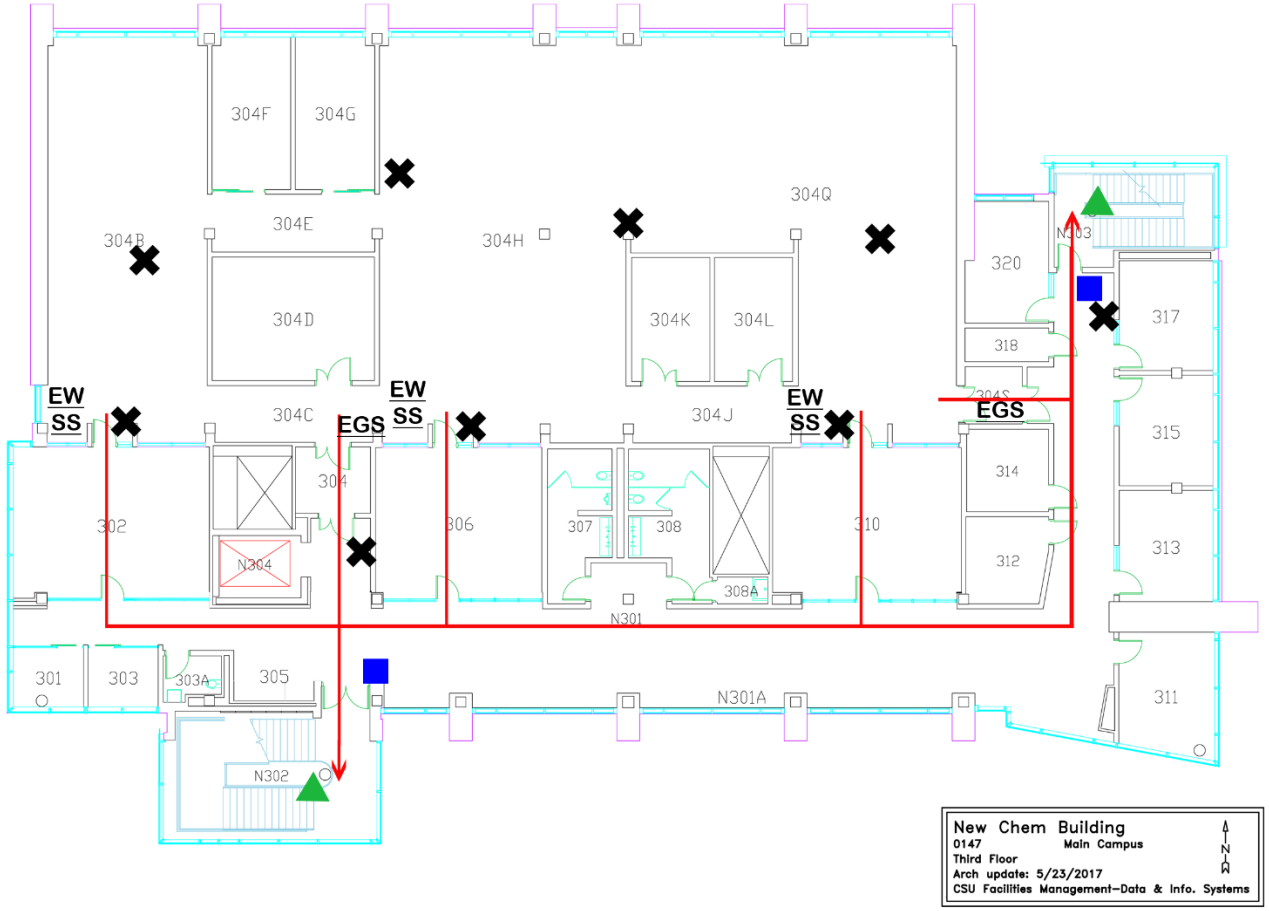
Exterior Exit

Fire Extinguisher

EW Eyewash

SS Safety Shower

EGS Emergency Gas Shutoff



Emergency Evacuation Plan - Chemistry Research 4th Floor

Fire Alarm Pull Station

Exterior Exit

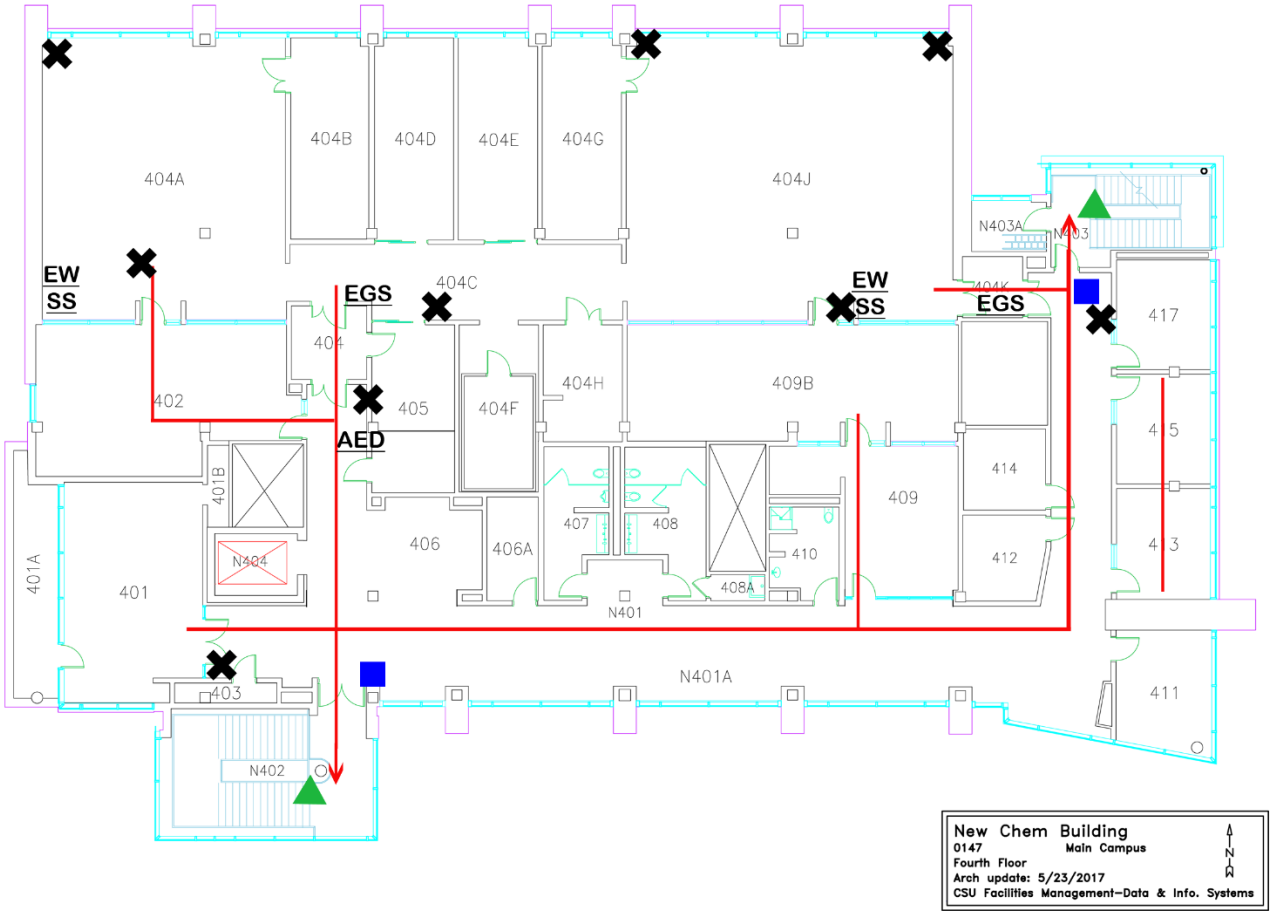
Fire Extinguisher

AED AED Cabinet

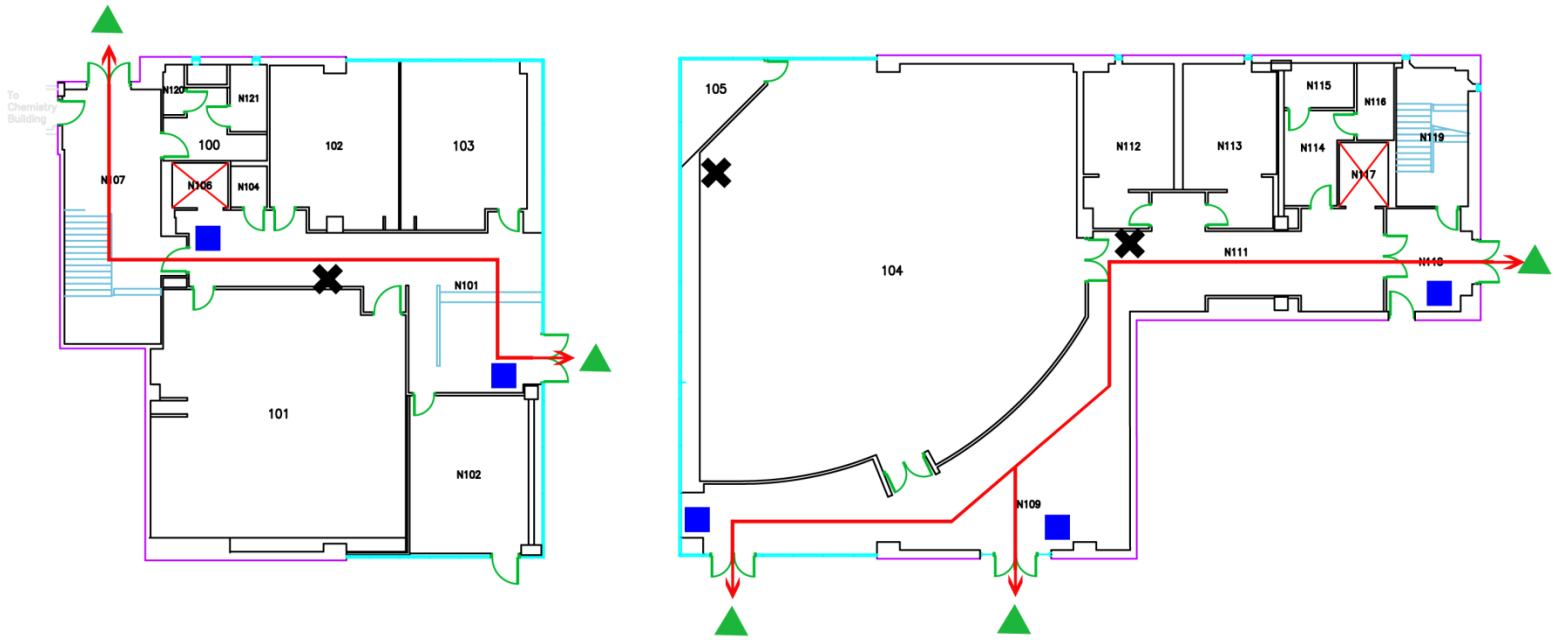
EW Eyewash

SS Safety Shower

EGS Emergency Gas Shutoff



Emergency Evacuation Plan - Yates 1st Floor



Fire Alarm Pull Station

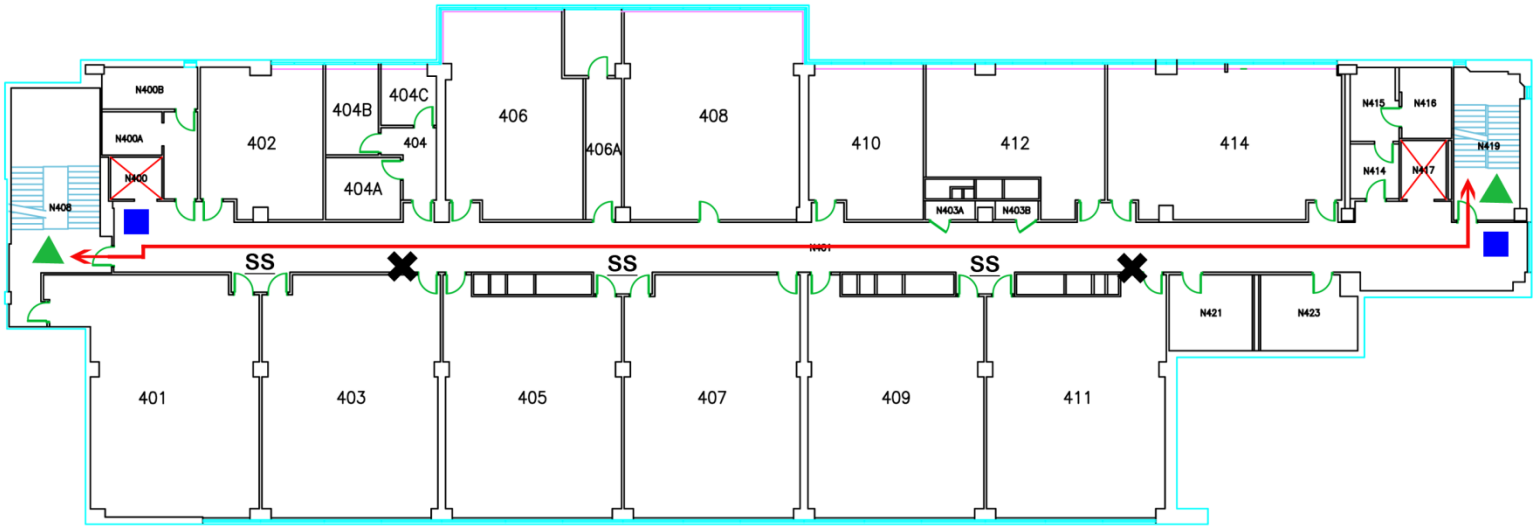
Exterior Exit

Fire Extinguisher

Albert C. Yates Hall
0145
First Floor
Arch update: 7/22/2002
CSU Facilities Management–Data & Info. Systems

N

Emergency Evacuation Plan - Yates 4th Floor



Fire Alarm Pull Station

Exterior Exit

Fire Extinguisher

SS Safety Shower

Albert C. Yates
0145
Fourth Floor
Arch update: 7/21/2014
CSU Facilities Management–Data & Info. Systems

N

Emergency Evacuation Plan - Yates 5th Floor

Fire Alarm Pull Station

Exterior Exit

Fire Extinguisher

SS Safety Shower

Albert C. Yates Hall
0145
Fifth Floor
Arch update: 7/21/2014
CSU Facilities Management–Data & Info. Systems

N

SHELTER IN PLACE

If you are told to shelter-in-place, follow these instructions.

- Immediately bring students and employees indoors. If you have evacuated because of a fire or other event, entering the building may put you at higher risk. You need to assess each situation and use your best judgment for each incident.
- Get your "Go Kit".
- Provide for the safety of visitors in your building and ask them to stay – not leave. Do not drive or walk outdoors.
- Have at least one telephone in each room. There should be a way to communicate among all rooms where people are sheltering-in-place.
- Select an interior room with the fewest windows or vents. Select several rooms if necessary. Classrooms may be used if there are no windows or the windows are sealed and cannot be opened. Large storage closets, utility rooms, meeting rooms, and even a gymnasium without exterior windows also may be appropriate.
- Close and lock all windows, exterior doors, and any other openings to the outside.
- Close window shades, blinds, or curtains.
- Call emergency contacts and have a phone available if you need to report a life-threatening condition.
- If directed to do so, use duct tape and plastic sheeting (heavier than food wrap) to seal all cracks around the door(s) and any vents into the room.
- Write down the names of everyone in the room, and report to your designated building proctor.
- Listen or watch for an official announcement from emergency personnel (via local radio, CSU email or text) and stay where you are until you are told all is safe or you are told to evacuate.
- University and local officials on the scene are the best sources of information for your particular situation. Follow their instructions during and after emergencies regarding sheltering, food, water, and clean-up.

FIRE

- Pull the red fire alarm. Refer to the floor plan and be familiar with the nearest alarm location. An alarm will ring at CSU police. CSUPD will call the fire department.
- If there is immediate danger, remain calm and follow evacuation procedures and then call CSUPD at 911 from a nearby building.
- If there IS NOT an immediate danger, call CSUPD at 911.
- If calling 911 from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location at CSU and you will be transferred to CSUPD dispatch.
- Follow evacuation plan. Listen for directions and congregate at the designated rally point. Faculty and lab assistants will account for students.
- Before opening any door, feel it with the back of your hand. **If it is hot, do not open it!** If it is not hot, open cautiously, bracing yourself against it to slam it shut if you feel a rush of heat.
- Call the building proctor. (See emergency telephone numbers).
- DO NOT RE-ENTER THE BUILDING.

IF YOU ARE TRAPPED IN THE BUILDING…

- If the door to the room you are in is hot to the touch or smoke is seeping in around it, **DO NOT OPEN IT.**
- Remain calm. Walls, ceilings, floors, and doors are designed to withstand fire for a period of time.
- Move as far away from the fire as you can, closing every door between you and the fire.
- Hang or wave an object from a window or outside the door to attract the attention of rescuers.
- Pack the crack under the door with clothing or other material to keep the smoke out.
- Let someone know you are trapped. Call **911** and stay on the line until the dispatcher tells you to hang up. If there is no phone available, yell and wave out the window to gain attention.
- If calling **911** from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location at CSU and you will be transferred to CSUPD dispatch.
- Stay low to the floor near the window as the smoke will fill higher areas first.
- FIRE EXTINGUISHERS ARE TO BE USED TO KNOCK DOWN A FIRE BETWEEN YOU AND YOUR EXIT. THE USE OF A FIRE EXTINGUISHER TO PUT OUT A FIRE IS NOT RECOMMENDED WITHOUT PROPER TRAINING.

HAZARDOUS MATERIALS SPILL

BENCH TOP SPILLS

A bench top spill is defined as a spill that will not contaminate the water supply, sewer, air handling system, or any other area, is small enough to be easily and safely handled by staff, and occurs where there are **NOT** any injuries to persons in the vicinity.

- Remain calm.
- Consult the Materials Safety Data Sheet (MSDS).
- Contain the spill with absorbent material.
- If you are familiar with handling the spilled reagent, obtain the proper spill kit and follow the MSDS directions to clean the spill.
- Notify the principal investigator for the laboratory.
- Dispose of all material according to the Colorado State University Hazardous Chemical Waste Systems Manual.

IF YOU ARE NOT FAMILIAR WITH THE SPILLED REAGENTS OR YOU DO NOT FEEL COMFORTABLE CLEANING UP THE SPILL, FOLLOW INSTRUCTIONS FOR LARGE SPILLS.

LARGE SPILLS

A large spill is defined as a spill that may contaminate the water supply, sewer, air handling system, or any other area, is too large to be easily handled by staff, and/or involves injuries.

- Remain calm.

- Evacuate and isolate the immediate area. Evacuating the entire building is not required if the spill and fumes or vapors can be contained within a single area inside the building.
- If there **is danger to all building occupants**, pull the fire alarm and follow the building evacuation procedures. Call 911 and have the information below available,
    - where the spill has occurred
    - what was spilled
    - how much was spilled
    - when the spill occurred
    - if there are any injuries

  Stay on the line until the dispatcher tells you to hang up.
- If calling **911** from a cell phone, immediately identify your location at CSU and follow the dispatcher's instructions.
- Call the principal investigator for the laboratory.

ALL LABORATORIES MUST BE EQUIPPED WITH SPILL KITS FOR THE APPROPRIATE MATERIALS BEING USED IN THE LABORATORY, FOR EXAMPLE, ACIDS, BASES, MERCURY, ETC.

SUSPICIOUS ODORS (INDOOR AIR QUALITY)

- Report to the building proctor for EHS to evaluate. THIS IS ESPECIALLY TRUE IN LABORATORY, CHEMICAL STORAGE OR HAZARDOUS MATERIALS AREAS AND BUILDINGS.
- Do NOT stay in the area.
- Identify people who may have been exposed to any dangerous fumes for medical follow-up.

When a complaint is received, please try to obtain the following basic information:

- When the odor or smell was first detected.
- Exact location of the odor or smell.
- What type of odor or smell is present (sewer gas, burning electrical, natural gas, etc.).
- Determine whether there is work being done in or around the area (inside or outside) where the complaint is located.

CALL 911 IF ANYONE IS HAVING MEDICAL OR PHYSICAL REACTIONS TO FUMES OR ODORS AND MOVE OUT OF THE AREA.

EARTHQUAKE

- Remain calm.
- Take cover under heavy furniture – a table, desk, or bench – or within a doorway.
- Keep away from glass.
- Wait for quake or tremor to subside and all falling objects to come to rest.
- For small quakes and tremors with **NO** apparent damage, return to normal activities, building proctors will survey entire building for possible damage such as leaking pipes, fallen books, etc. All proctors will meet in designated areas to report damages to CSUPD.
- If damage appears heavy, evacuate **ONLY** when notified by emergency personnel that it is safe to leave.
- Proceed immediately to the designated rally point.
- Stay away from electrical power sources, fallen lines, buildings, or other tall objects.
- Do **NOT** smoke. Gas lines may have ruptured.
- If building is damaged, secure the building against entry. Notify CSUPD of the damage and evacuation. Do not reenter damaged buildings.
- Be prepared for aftershocks. Aftershocks are usually smaller than the main quake but may be large enough to do additional damage to structures weakened during the main shock.

SUSPICIOUS MAIL

- Do not try to open the package. If there is spilled material, do not try to clean it up and do not smell, touch or taste the material.
- Do not shake or bump the package or letter.
- Isolate the package, placing it in a sealable plastic bag, if available.
- Calmly alert others in the immediate area and leave the area, closing the door behind you.
- Wash hands and exposed skin vigorously with soap and flowing water for at least 20 seconds. Antibacterial soaps that do not require water are not effective for removing anthrax or other threatening materials.
- Call CSUPD and give them your exact location, the location of the item and why it appears suspicious or concerning.
- Wait for CSUPD to respond. Do not leave the building unless instructed to do so by CSUPD personnel.

IDENTIFYING SUSPICIOUS PACKAGES AND ENVELOPES

- Inappropriate or unusual labeling
- Excessive postage
- Handwritten or poorly typed addresses
- Misspellings of common words
- Strange return address or no return address
- Incorrect titles or title without a name
- Not addressed to a specific person
- Marked with restrictions, such as: "Personal," "Confidential" or "Do not X-ray"
- Marked with threatening language
- Postmarked from a city or state that does not match the return address
- Powdery substance felt through or appearing on the package or envelope
- Oily stains, discolorations, or odor
- Lopsided or uneven envelope
- Excessive packaging material such as masking tape, string, etc.
- Excessive weight
- Ticking sound
- Protruding wires or aluminum foil

FLOODING

INTERIOR FLOODING

If you safely can do so,

- Secure vital equipment, records and hazardous materials (chemical, biological and radioactive) – and move items to a higher level.
- Shut off all electrical equipment. Secure all laboratory experiments.
- Evacuate the affected area.
- Report to designated rally point.

- Call Facilities for assistance in shutting off water, electrical and gas supplies.
- Call **911** and have the following information available:
  - where the flooding occurred
  - if there are any injuries

  Stay on the line until you are told to hang up.
- If calling **911** from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location as at CSU and you will be transferred to CSUPD dispatch.
- Stay away from all power (electrical) sources.
- Stay away from utility vaults.
- Do not return until you have been instructed to do so by someone from an emergency responder.
- Report any oil, chemical, biological, radioactive materials or food preparation areas suspected of mixing with the flood waters to EHS.
- Do not dump flood water down any drain (storm or sanitary) unless approved by EHS staff.
- After the main power is off, unplug electrical appliances and do not turn on any appliances which have become wet until they are checked for proper operation.

EXTERIOR FLOODING

- Remain calm.
- Call **911** and let them know:
  - what building you are in
  - how high the water is
  - how many people are with you
- If calling **911** from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location at CSU and you will be transferred to CSUPD dispatch.
- If there is water all around the building, proceed to the roof of the building or the highest point accessible.
- If there is water on only one side of the building, proceed in an orderly fashion out of the building exit that has **NO** water.
- Immediately go to the highest area possible.

FIRST AID / MEDICAL

- Remain calm.
- Call **911** and stay on the line until the dispatcher tells you to hang up.
- If calling **911** from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location at CSU and you will be transferred to CSUPD dispatch.
- Send an individual to meet the ambulance.
- Do **NOT** move the victim or give first aid unless you are trained and certified to do so.
- Remain with the victim and try to keep the victim warm and alert by talking with them until emergency response teams arrive.

TORNADOS AND WINDS

- Alert employees and students in your immediate area.
- Proceed to the nearest interior room, lower level hallway, basement or designated shelter, close the door and stay away from the windows (refer to floor plan). If at all possible have a phone, radio, flashlights and first aid kits available.
- Call **911.**
- If calling **911** from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location at CSU and you will be transferred to CSUPD dispatch.
- Monitor the storm by listening to the radio. **DO NOT LEAVE THE SAFE AREA UNTIL TOLD TO DO SO.** CSUPD and Poudre Fire Authority will be making rounds throughout campus determining damages and will contact you when it is safe to leave the building. This may take a while, so remain in the designated area until you are contacted to leave. There may be structure damage.

NOTE: TORNADOES HAVE BEEN KNOWN TO LEAVE THE GROUND AND COME BACK DOWN AGAIN IN A MATTER OF MINUTES OR EVEN AS LONG AS HALF AN HOUR. REMAIN IN THE DESIGNATED AREA UNTIL NOTIFIED BY CSUPD OR THE POUDRE FIRE AUTHORITY THAT IT IS SAFE TO LEAVE.

BOMB THREAT

- Locate the Bomb Threat Checklist and fill it out while talking to the caller. If checklist is not immediately available, record every word spoken by the caller and any background noises. Then immediately fill out the Bomb Threat Checklist.
- Alert a co-worker via note (if possible) while on the line with the bomb threat. Have co-worker call CSUPD at **911** and have the following information available:
  - where the bomb threat is
  - who is taking bomb threat call
  - an estimate of how many people are in the building
  - try to determine the exact location of the bomb(s) and when it is suggested to go off
  - have them stay on the line until the dispatcher tells them to hang up
- If calling **911** from a cell phone, the call will go to the Larimer County Dispatch Center. Immediately identify your location at CSU and you will be transferred to CSUPD dispatch.
- Immediately dial *57 or write number down incoming telephone number from phone display.
- Notify the department head.
- Notify the building proctor.
- Evacuate the building immediately if requested by CSUPD.

TRAIN DERAILMENT

If evacuation is the prescribed action, please consider the following:

1) If possible, evacuate in your own vehicle. This will provide you with needed transportation during the evacuation period.
2) When evacuating remember to evacuate upwind, uphill, upstream from the incident.
3) Remember that an evacuation may last for several hours or even days. Be sure to take essential items with you, medications, some clothing, health aids, telephone contact lists. **Do not allow this to delay your evacuation.**
4) Monitor updated information about the accident and evacuation.

If sheltering in place is recommended, you should do the following:

1) Turn off all air conditioners and fans. Facilities Management will turn off building HVAC units.
2) Close and seal all exterior windows and doors using materials in your go kit.
3) Monitor local radio or television for details and instructions.

WARNING AND NOTIFICATION

- Ensure that all telephone trees and email listings are up to date at least once per year.
- Practice once per semester doing a "call out" to ensure that staff know what to expect, how to use information, and that numbers are up to date (especially cell phones).
- Post telephone trees in appropriate locations for review.
- Telephone number for updated messages: **(970) 491-6381**

Information from the PSTEC can be obtained from the following sources:

1) Emergency text and e-mails;
2) CSU Public Safety and CSU homepage websites;
3) SOURCE.colostate.edu announcements;
4) Social media (Facebook, Twitter);
5) (970) 491-7669;
6) Local and regional television stations;
7) Local and regional radio stations.

OTHER EMERGENCIES

ASSAULT, HARASSMENT, DESTRUCTION OF PROPERTY, MUTILATION, VANDALISM, PROBLEM PATRONS, AND THEFT:

- Call CSUPD immediately at **911.**
- Notify the building proctor.
- Observe suspicious persons but *DO NOT TRY TO DETAIN THEM.*
- Ask the victim to remain until police arrive.
- Obtain names, addresses, and telephone numbers of witnesses.

LOSS OF BUILDING UTILITIES

- Contact Facilities Maintenance.
- Contact CSUPD after normal working hours and on the weekends.
- Laboratory personnel should secure all experiments, unplug electrical equipment (including computers) and shut off research gases. All chemicals should be stored in their original locations. Fully *CLOSE* fume hoods. If this is not possible or natural ventilation is inadequate, evacuate the laboratory until the power is restored.

IF PEOPLE ARE TRAPPED IN AN ELEVATOR

- Tell passengers to stay calm and that you are getting help.
- Call 911 and provide information.
- Stay near the passengers until police or other assistance arrives provided it is safe to do so.
- Do not try to pry open the elevator or extract people from a trapped elevator car.

SEVERE WEATHER

- The Public Safety Team Executive Committee will announce closures with actions to take.
- In a severe storm, Housing and Dining Services along with other university operations will coordinate food and shelter as necessary.

ACTIVE SHOOTER

If the shooter is outside your building:

- Turn off all the lights, close and lock all windows and doors. If you cannot lock the door, try to block the door with desks and chairs.
- If you can do so safely, get all occupants onto the floor and out of the line of fire.
- If you can do so safely, move to the core area of the building and remain there until the police tell you it is safe to leave. Do not respond to commands until you are certain they are issued by a police officer.

If the shooter is inside your building:

- If it is possible to escape the area safely and avoid danger, do so by the nearest exit or window. Do not take anything with you.
- As you exit the building, keep your hands above your head and listen for instructions that may be given by police officers. If an officer points a firearm at you, make no movement that may cause the officer to mistake your actions for a threat. Try to stay calm.
- If you get out of the building and do not see a police officer, attempt to call the police by dialing 911. Tell the dispatcher your name and location and follow their instructions.
- If you are unable to escape the building, move out of the hallway and into an office or classroom and try to lock the door. If the door will not lock, try barricading the door with desks and chairs. Lie on the floor or, if possible under a desk and remain silent. Wait for the police to come and find you.

If the shooter enters your office or classroom:

- There is no set procedure in this situation. If possible, call 911 and talk with a police dispatcher. If you cannot speak, leave the phone line open so the police can hear what is going on.
- Use common sense. If you are hiding and flight is impossible, playing dead may also be a consideration.
- Attempting to overcome the suspect with force is potentially very risky and should only be considered in the most extreme circumstances. **Only you can decide if this is something you should do.** If you opt for this action, your odds are best if you act as a group to confront the attacker, but remember there may be more than one shooter.
- If the shooter exits your area and you are able to escape, leave the area immediately. Do not touch anything in the area and remember to be alert for responding police officers who may mistake you as the shooter.
- While escaping, as soon as you see a police officer put your hands over your head and immediately comply with the officers' instructions.

Additional resources on active shooter situations are available online at http://police.colostate.edu/active-shooter-resources/

EMERGENCY PREPAREDNESS

SAFETY SECURITY INSPECTIONS / VIOLATION REPORTING

- At least once a week, check AEDs, Fire Extinguishers, Fire Department Water Connections, emergency exits and routes, and posted maps to ensure that all are functional and up to date.
- If you have a generator at your facility, see that Facilities tests it and advises you of results or repairs on a scheduled basis.
- Once each semester, review designated rally points to ensure that they still fit department needs. Also check secondary (weather contingency) locations and update agreements with other buildings or departments regarding these.

WORKPLACE VIOLENCE RECOGNITION / REPORTING / PREVENTION

- Ensure that staff are trained to recognize behavioral warning signs and implied or direct threats.
- Ensure that staff know expected reporting procedures, situation review processes, and documentation requirements and are comfortable with them.
- Practice a situation or scenario once per year to make sure the staff knows the expectations.
- Make "course corrections" as needed to improve process and prevent violent events.
- If you are directly threatened or in danger, do whatever is necessary to escape, hide, or defeat the threat and call 911 as soon as possible!
- Involve police, Human Resources, EAP, supervisors and others as needed during any event or suspected threat.

AFTER-ACTION REVIEWS (DEBRIEFING)

- After EVERY emergency or exercise, a review will be held with all staff involved directly or indirectly in the event as soon as practical in coordination with the Emergency Management Coordinator.
- The review will include factual events, emotional impacts and support, and an update of the department's plan for future emergencies.
- When needed, additional support from experts on campus or in the community (e.g. EAP, Counseling Center, mental health, etc.) will be contacted for assistance.
- An after-action report and updated building safety plan will be submitted to the director and the Emergency Management Coordinator within 30 days of the event.

EXERCISE POLICY AND SCHEDULE

Orientation exercises (described below) that will take place. One each semester.

1) Fall semester – Safety introduction and training of new departmental hires and graduate students.
2) Spring semester – Department safety review and updates to safety response plan.

Annual table top exercise or drill that will take place.

1) Chemistry department will work with EHS and Public Safety for annual table top exercise or drill.

SAFETY STAFF

Identification of Safety Staff:

1) Primary:
   - Department Chair – Matthew Shores, (970) 491-7235
   - Building Proctor – Chris Rithner, (970) 491-6475
2) Secondary:
   - Assistant to the Chair – Kristin Berthold, (970) 491-5392
   - Department Office Manager – Diane Hellbusch, (970) 491-0502
   - Department Associate Chair – Alan Kennan, (970) 491-6046
   - Department Safety Committee Chair – Chuck Henry, (970) 491-2852
3) Tertiary:
   - Principal Investigators (PIs)
   - Department Safety Committee Members
   - Lab Group/Unit Safety Representatives (research, teaching, CIF, support, and affiliated units)

ESSENTIAL/EMERGENCY POSITIONS

Below is a list of essential, emergency positions:

Name	Emergency Position
_____	_____
_____	_____

BUSINESS CONTINUITY

What are your department's business interdependencies? What do you need from other departments to perform critical functions? What departments depend on you to perform critical functions?

- *The department houses several multi-user facilities that act as an institutional resource to many other departments within the University as well as extramural organizations. These facilities include the Central Instrumentation Facility (CIF), Colorado Center for Drug Discovery (C2D2), and three professional shops (electronic, glassblowing, machine).*

Are there days of the week or month, or months of the year, when a major emergency would be even more disruptive than at other times?

- *Regular business days (Mon-Fri) during the regular 9-month academic calendar would be most disruptive to teaching and research activities.*

Is your essential data backed up regularly? Would the information be accessible if your building was closed, or if the University network was down?

- *Research data is backed up on a lab-by-lab and individual user basis. Some users backup data to external servers and cloud services, thus, some information is accessible if the University network was down.*

Does your College or division and its constituent departments have planning documents for continuing operations in the event of disaster?

- *The chemistry department does not currently have planning documents for continuing operations in the event of disaster.*

Is there a process for tracking the cost of business recovery (including funds spent on overtime, special materials and supplies, temporary personnel, etc.) and a mechanism for distinguishing emergency recovery costs from other business expenditures?

- *No, there are no plans currently in place for such cost tracking.*

Are special vendor or contractor arrangements necessary for your department(s) to insure continuity of services?

- *Yes, Airgas delivery of gas supplies (nitrogen, helium, etc) is essential to core teaching and learning instrumentation and experimentation.*

Does your College or Division have a method to make emergency purchases?

- *Yes, many faculty and staff possess Pcards capable of making emergency purchases.*

What human resources would you need to restore your most critical functions?

- *Most department staff and key faculty would be needed to help restore the most critical department functions.*

Do your employees have personal emergency preparedness plans for their households?

- *It is not known how many employees have personal emergency preparedness plans for their own households.*

If only 50% of your staff and faculty could return to work, could you open?

- *Yes, but at reduced levels.*

Can some employees telecommute during a disaster? What can you do now to plan for that?

- *Yes, many staff, faculty, and other researchers within the department could telecommute to continue some level of routine operations.*

If the University had volunteer workers available after a disaster, what skills would be needed in your department?

- *Depending on the disaster and level of impact to the physical infrastructure, workers with hazardous materials training would be essential to any cleanup or restoration efforts.*

What equipment is necessary for the department to perform its functions?

- *Fume hoods/HVAC systems and electricity must remain functional. Access to non-potable water is also essential in many lab processes.*

Have precautions been taken to secure essential equipment in the event of most likely emergencies?

- *Backup generators have been installed to provide short-term upkeep of essential equipment until personnel can properly discontinue use and shut-down as needed.*

How would you replace equipment within hours or days to be able to resume normal business?

- *Major disaster resulting in the destruction of scientific equipment would be a significant loss and would not be easily replaced in hours or days.*

If your department couldn't use its office space to operate, how much space would you need to relocate? What kinds of equipment are essential for performing your unit's critical functions?

- *The current space in the department is extensive (157,000 square feet) and includes both lab and office space. Any temporary relocation due to a building disaster would likely require a minimum of 30-50% of the current space to maintain a minimal level of activity.*

COMMUNICATION TREE

LAST UPDATE: AUGUST 2019

Department Chair
Matthew Shores
970-491-7235

Associate Chair
Alan Kennan
970-491-6046

EC-Organic	EC-Inorganic	EC-Analytical	EC-Physical	CIF Director/ Building Proctor
Rob Paton 491-7746	Amy Prieto 491-1592	Alan Van Orden 491-6286	Grzegorz Szamel 491-2795	Chris Rithner 491-6475
Jeff Bandar 491-7746	Chris Ackerson 491-0521	Travis Bailey 491-4648	Elliot Bernstein 491-6347	Ron Costello 491-2486
Eugene Chen 491-5609	Rick Finke 491-2541	George Barisas 491-6641	Jean Chung 491-6842	Karolien Denef 491-3832
Debbie Crans 491-7635	Jamie Neilson 491-2958	Thomas Borch 491-6235	Amber Krummel 491-3694	Tom Frederick 491-5545
Andy McNally 491-6782	Tony Rappe 491-6292	Delphine Farmer 491-0624	Nancy Levinger 491-1331	Roy Geiss 491-6103
Garret Miyake 495-4340	Chuck Henry 491-2852	Ellen Fisher 491-5250	Martin McCullagh 491-3572	Pat McCurdy 491-4282
Yian Shi 491-7424	Steve Strauss 491-5104	Melissa Reynolds 491-3775	Carmen Menoni 491-8659	Brian Newell 491-6209
Bob Williams 491-6747		A.R. Ravishankara 491-2876	Chris Snow 491-5276	Michael Olsen 491-5229
		Justin Sambur 491-3096		Claudia Boot 491-7049

NTTF	Department Office	Accounting	IT	Department Email List
Anna Allen 491-7938	Kristin Berthold 491-5392	Karen Kahler 491-6382	Ross Madden 491-5710	Staff
Joseph DiVerdi 491-1761	Lauren Albin 491-6060	Jane Burkman 491-0503	Aaron Vanasse 491-6284	Regular Faculty
Kassy Mies 491-0731	Kathy Lucas 491-7966	Connie Cooley 491-3812		Joint Faculty
Carlos Olivo 491-0722	Elizabeth McCoy 491-7602	Terri Frank 491-2071		Emeritus Faculty
Panduka Piyaratne 491-2875	Julie Mintle 491-5409	Dezi Todd 491-2678		Non-tenure Faculty
→ Heather Bodell 491-3763	Cindy Ungerman 491-1090			Adjunct Faculty
Ben Reynolds 491-1322	**Diane Hellbusch 491-0502**	**→ Stockroom**		Staff
→ Lonnie Thomas 491-5581		Steve Alles 491-1169		Postdocs
Patty Somers 491-2854				Graduate Students
Harmony Tucker 491-0731				

RALLY POINT CHECKLIST

Date: _____ Time: _____

☐ Immediately report to responders anyone who cannot be accounted for or may need assistance.

Individual	Location

☐ Report ANY suspicious people, vehicles, activities, or packages to police via 911 ***immediately.***

Suspicious Activity	Location

☐ Be on the lookout for additional threats until the emergency is over.

Additional Threats	Location

☐ Media and inquiries referred to Public Relations or their on-site representative.

☐ DO NOT release anyone to re-enter the building until advised that it is safe by emergency responders.

Emergency Responder Releasing Building _____ Time _____

☐ Staff briefed before re-entering the building about what has happened, what they need to do to ensure the safety of their work area and customers, and when and where a review and debriefing will be held.

Briefing Time _____ Location _____

☐ Update Building Safety Plan if required.

☐ Update Not Required

Update

_____

_____

_____

_____

_____

_____

_____

_____

TEMPLATE FOR POST EVENT DEBRIEFING/REVIEW

(Every emergency or drill/exercise should be followed by a debrief and review)

1. What was the event? Date, time and location?

2. Did the staff follow the department's building safety plan?

3. Was a debriefing held to make sure staff knew of events and needed actions and that the workplace was safe to return to work?

4. What did the staff learn from this event and how can the plan be improved for the next emergency or drill?

5. Who will follow up with emotional issues, questions, and plan changes and by what date?

BOMB THREAT

Colorado State University
Police Department

1. When is the bomb going to explode?
2. Where is the bomb right now?
3. What does the bomb look like?
4. What kind of bomb is it?
5. What will cause the bomb to explode?
6. Did you place the bomb?
7. Why?
8. What is the address?
9. What is your name?

EXACT WORDING OF BOMB THREAT:

_____

_____

_____

_____

Sex of caller: _____ Race: _____

Age: _____ Length of call: _____

Telephone number at which call is received:

_____

Time call received: _____

Date call received: _____

CALLER'S VOICE:

- ☐ Calm
- ☐ Soft
- ☐ Stutter
- ☐ Excited
- ☐ Laughter
- ☐ Rasp
- ☐ Rapid
- ☐ Normal
- ☐ Slurred
- ☐ Ragged
- ☐ Deep Breathing
- ☐ Disguised
- ☐ Nasal
- ☐ Angry
- ☐ Loud
- ☐ Lisp
- ☐ Slow
- ☐ Crying
- ☐ Deep
- ☐ Distinct
- ☐ Whispered
- ☐ Clearing Throat
- ☐ Cracking Voice
- ☐ Accent

CALLER'S VOICE

Familiar (if voice is familiar, who did it sound like)?

_____

_____

BACKGROUND SOUNDS:

- ☐ Street Noises
- ☐ Voices
- ☐ Animal noises
- ☐ PA System
- ☐ Music
- ☐ Long distance
- ☐ Motor
- ☐ Booth
- ☐ Factory machinery
- ☐ Crockery
- ☐ Clear
- ☐ Static
- ☐ House noises
- ☐ Local
- ☐ Office machinery
- ☐ Other (please specify):

BOMB THREAT LANGUAGE:

- ☐ Well spoken (education)
- ☐ Incoherent
- ☐ Foul
- ☐ Message read by threat maker
- ☐ Taped
- ☐ Irrational

REMARKS:

Your name: _____

Your position: _____

Your telephone number: _____

Date checklist completed: _____

Colorado State University
Police Department

Emergency: 911
Non-Emergency:970-491-6425
http://police.colostate.edu

57 Initiates "CALL TRACE"

SECTION II - LABORATORY SAFETY POLICIES AND PROCEDURES

Governmental and other regulatory agencies require that Colorado State University implement, maintain, and enforce policies and procedures to prevent occupational exposure to hazardous materials while on university property or in its buildings. The University buildings are owned and maintained by the citizens of Colorado and these citizens expect these premises to be respected and maintained similar to what is expected of occupants that rent space in private buildings. CSU expects personnel to maintain areas in a safe, clean manner. Building component changes to the space must be approved and overseen by Facilities Services to ensure all required codes are being addressed. Issues with pets, bikes, solicitors, maintenance, security, keys, smoking, building safety plans etc can be directed towards the building proctor.

Colorado State University is committed to providing a safe and healthy environment for its students, staff, faculty, and the general public.

To minimize the potential exposure to hazardous materials, Colorado State University requires its students, staff, and faculty to adhere to basic laboratory safety rules and guidelines with regards to the safe handling and use of chemicals, bio-hazardous materials, radioactive materials, and laboratory equipment.

The principal investigator or individual in charge of the laboratory is ultimately responsible for safety in their lab. This includes training and ultimate release of the laboratory. All laboratories must be released by the PI or individual in charge without the need of cleanup or disposal of hazardous materials by other entities.

The following are basic *general* laboratory safety rules to safeguard your health and the health of your co-workers/other students. These minimum requirements for laboratories are basic standards and shall be followed in conjunction with other safety issues addressed for individual laboratories.

Specific laboratory procedures and safety rules are outlined in laws and regulations that govern the research and usage of specific hazards such as extremely toxic chemicals, radioactive materials, or bio-hazardous materials. Please refer to your principal investigator, laboratory manager, building proctor or superiors for this vital safety information.

CSU Environmental Health Services conducts unannounced inspections to insure compliance with these and other issues. Violations may warrant a written warning requiring immediate compliance and/or closure of fume hoods, work areas or entire laboratories.

QUESTIONS OR CONCERNS ABOUT LAB HEALTH AND SAFETY?

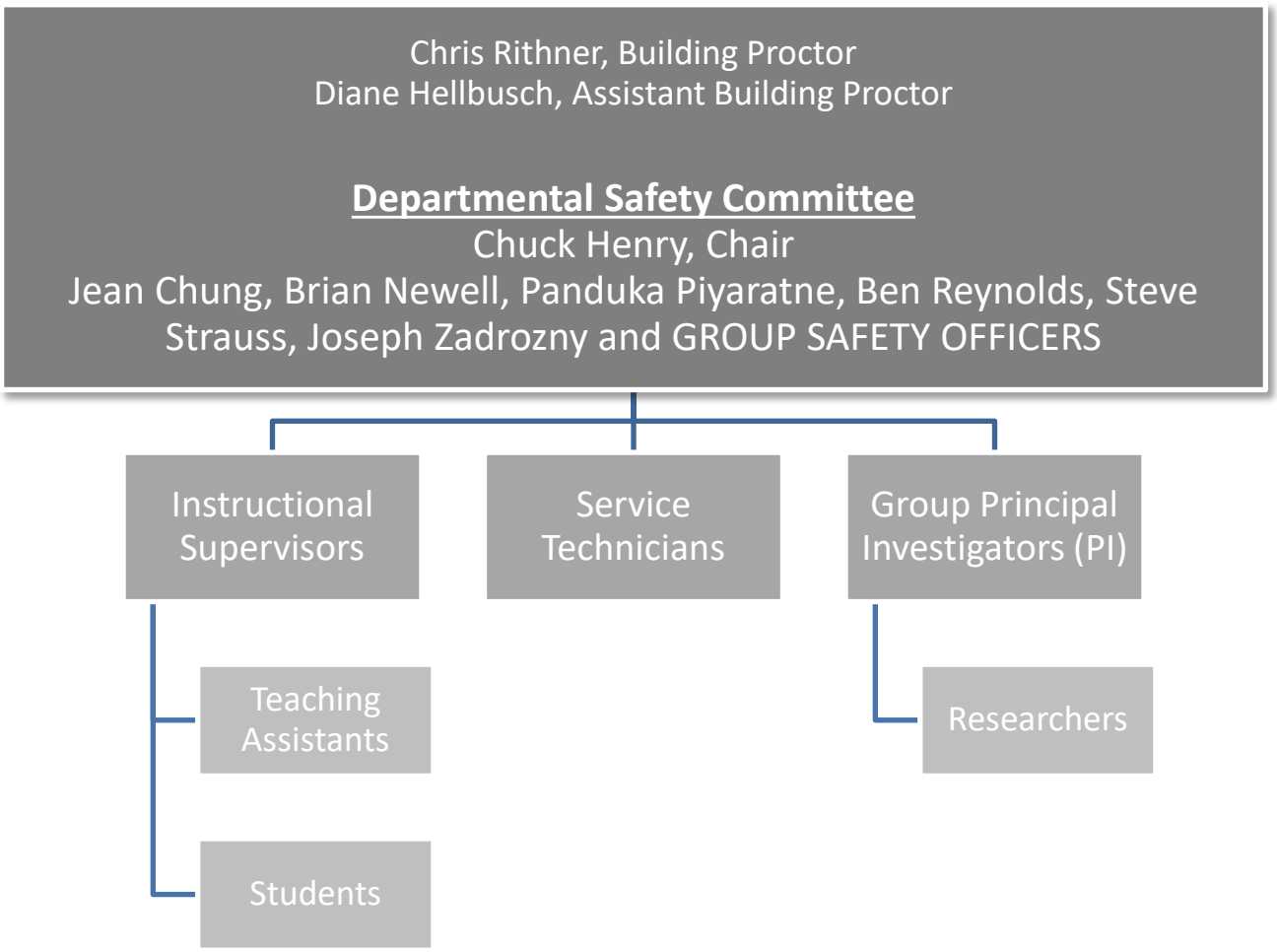
CONTACT A MEMBER OF THE DEPARTMENT SAFETY COMMITTEE OR ADMINISTRATION.

In addition, you may contact EHS directly:
CSU Environmental Health Services
141 General Services Building
(970) 491-6745

CHEMISTRY DEPARTMENT SAFETY ORGANIZATION

ORGANIZATIONAL CHART – SAFETY

LAST UPDATE: JULY 2019



RESPONSIBILITY FOR SAFETY

Each member of the chemistry department is a member of the safety team; this includes all employees as well as postdoctoral fellows, and graduate and undergraduate students associated with the department. Each is responsible to the department through the line organization. Primary responsibility is placed on the individual doing the work. For example, the student, the craftsman, or the researcher is responsible to their supervisor or principal investigator (PI) for doing their work safely. In turn the teaching assistant, the instructor, or the service supervisor is responsible to their supervisor who in turn is responsible to the Chair and to the Dean of the College.

DEPARTMENT SAFETY COMMITTEE

Members of the committee representing major work areas in the department are appointed by the department chair. The committee is responsible for:

1) Establishing department safety policy
2) Promoting uniform safety practices
3) Fostering good communication in safety
4) Reviewing the department's safety program
5) Reviewing the department's accident experience
6) Conducting departmental safety inspections at intervals
7) Assessing the department's safety protection equipment
8) Formulating the annual safety budget

DEPARTMENT CHEMICAL SAFETY/HYGIENE COORDINATOR

The chair of the Department Safety Committee serves as Chemical Safety/Hygiene Coordinator for the department. Their duties as safety coordinator include:

1) Developing a safety program for the department.
2) Assisting the safety representative of the various research groups to develop safety programs.
3) Receiving accident reports.
4) Seeing that safety matters common to the entire department are handled in a uniform manner.
5) Coordinating contacts with other departments.
6) Issuing department safety reports.
7) Maintaining a library of safety publications and safety data applicable to the department's activities.
8) Circulating safety information as required within the department.
9) Representing the department on accident investigations.
10) Performing such other duties as Chemical Safety & Hygiene Officer as specified in CSU's Biosafety Handbook, 29CFR (Code of Federal Regulations) (http://ecfr.gpoaccess.gov/) 1910.1450 (OSHA Laboratory Standard) and the Chemistry Department's Safety and Chemical Hygiene Plan.

PRINCIPAL INVESTIGATOR AND GROUP SAFETY REPRESENTATIVE

The PI and/or supervisor of each operational group in the department is responsible for the safety program within that group. To assist in discharging this responsibility, he or she should appoint a member of their group to serve as safety representative and an alternate. On the other hand, the supervisor or preceptor may elect to serve in this capacity himself or herself. The primary duties of the safety representative include:

1) Development of a safety program for their group.
2) Consultation on matters pertaining to safety.
3) Establishing procedures to handle emergencies.
4) Reviewing new or modified practices.
5) Reviewing design and construction of new and modified experimental units.
6) Periodically participating in division safety inspections.

TEACHING ASSISTANT DUTIES AND RESPONSIBILITIES FOR SAFETY

The strength of the department's safety program depends on the performance of its Teaching Assistants in the undergraduate instructional laboratories. By their actions and example the Teaching Assistant develops students with safe working habits. By doing so he or she strengthens their own safe working habits and acquires an alertness to the hazards of the chemistry laboratory. These habits carry over to their own graduate research work. A few guidelines regarding the Teaching Assistant's duties with respect to safety are:

1) Teach and enforce safety as an integral part of the course.
2) Make and see the students make a careful analysis for safety before starting an experiment. Such an assessment includes:
   a. Collecting pertinent information.
   b. Forecasting potential hazards.
   c. Selection of safe techniques.
   d. Use of protective equipment.
   e. Plan of action in case an unanticipated accident occurs.
3) See that safety rules are obeyed; set a good example yourself.
4) Remain in the laboratory at all times when students are present; have someone else in charge if you must leave.
5) Know the location and use of the protective equipment provided.
6) In case of accident or illness:
   a. Render prompt first aid.
   b. Have someone report to the course storeroom for help.
   c. If injury or illness appears serious, have someone call for an ambulance.
   d. Report all accidents that cause injury, no matter how minor, immediately to your supervisor and the Chair of the Department Safety Committee.
   e. Prepare a written report on all accidents that cause injury.
7) In case of a fire:
   a. If small and easily extinguished, select and use the laboratory extinguisher at once.
   b. If a fire cannot be snuffed out immediately, have someone sound the building fire alarm and call 911. Give name and room number. At the same time proceed with an orderly evacuation of the building.
   c. Tag all fire extinguishers that have been used as empty. Call the Asst. Building Proctor at (970) 491-0502 to report the extinguisher as one that must be replaced.
   d. Prepare a report on all fires that cause damage or injury. Inform supervisor and the Chair of the Department Safety Committee.

FOOD AND DRINK

- Food, drink and related utensils shall not be brought into, stored in, or consumed in a laboratory.

  - The separation of food and drink from locations containing hazardous materials and potentially contaminated items minimizes the risk of accidental ingestion. The risk of exposure is also reduced by not using laboratory equipment for preparing or storing foods. Food, drinks and other related utensils may also contaminate samples and be detrimental to the related research performed in the laboratory.

PERSONAL & HYGIENE ITEMS

- Avoid the insertion or removal of contact lenses and other manipulations that could transfer hazardous materials to your eyes or mouth. DO NOT apply cosmetics or lip balm in a laboratory environment.

- Smoking is strictly prohibited inside all university buildings / laboratories. The proximity to hazardous, toxic, radioactive, infectious, and flammable substances makes smoking in laboratories an extreme risk for ingestion and fire. It also violates local and university smoking policies.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Shoes shall be worn that provide full coverage of the feet. In BSL labs, follow the requirements for those areas.

- Clothes that leave skin exposed shall not be worn, for example shorts, mini-skirts, tank-tops, and half-shirts.

- Lab coats, smocks or scrubs must be worn at all times when using hazardous materials. These provide the initial barrier that helps to prevent contamination and injury.

- Appropriate gloves for the hazardous material being used must be worn during handling.

- Appropriate eye protection shall be worn when working with hazardous materials.

- LABORATORY COATS AND GLOVES SHALL BE REMOVED BEFORE LEAVING THE LABORATORY.*

    - It is possible that laboratory coats may be contaminated with radioactive material, bio-hazardous agents or chemicals. For this reason lab coats and gloves shall not be worn in areas such as coffee areas, cafeterias, snack shops, offices, general use corridors, and meeting rooms. Personal Protective Equipment does not belong in public areas even if presumed uncontaminated and should not be removed from the lab (taken home) unless it is for professional cleaning.

  *This requirement excludes movement and transport of materials between adjacent areas (laboratories, equipment areas, storage areas) as long as potentially contaminated PPE is removed and changed before leaving the laboratory (PPE must be changed if contaminated while working).

- Hands shall be washed before leaving laboratories.

    - Make sure to wash your hands before leaving the laboratory to minimize the risk of carrying radioactive, biological, or other hazards out of your work area into areas that should be clean and uncontaminated. The wearing of gloves is no guarantee that your hands are not contaminated. Make certain that soap and towels are provided in your work area.

- Occupants shall be familiar with the locations and operation of safety and emergency equipment such as fire extinguishers, first aid kits, spill kits, emergency eye wash stations, emergency

showers, fire alarm pull stations, emergency telephones, and emergency exits. Emergency contact numbers should be posted close to the telephone and on the outside of the laboratory.

- Learn and know what to do in an emergency and where the necessary items and phone numbers are located. Become familiar with the whole chain of events before it is necessary to respond to an emergency.

GENERAL HOUSEKEEPING

Good housekeeping is a necessary requirement for maintaining safety. Clean and tidy work sites hold fewer hazards for all employees. Accidents and injuries are avoided and productivity improved where good housekeeping is a daily occurrence. General housekeeping of the area will reduce the likelihood of accidents and reduce the possibility of personnel contamination.

- Provide sufficient safe clearances and access to any and all work stations and work areas, fire aisles, fire extinguishers, fire blankets, electrical disconnects, safety showers, other emergency aids, doors, and access to stairways.

- Keep aisles and walkways free of physical obstructions that would prevent access, including path-blocking objects, liquid or solid spills, and other obstructions.

- Keep aisles at least 3 feet wide where necessary for reasons of access to doors, windows, or standpipe connections.

- Keep floors clean; dry; slip-resistant; and free of waste and any other unnecessary material.

- Provide an adequate number of non-hazardous waste receptacles at accessible locations throughout all work areas.

- Chemical residue on surfaces is not allowed.

- Stock containers should be returned to the storage location after each use and not left on the bench top work area. Storage on benchtops prevents protection from ignition sources and are more easily knocked over. Only chemicals in use should be in the work area.

- All work surfaces should be disinfected before and after working with biological agents. Disinfectant (diluted to the correct concentration) should be available at the work area.

- Labeled biohazardous waste containers and sharps containers should be available for disposal of biohazardous materials and sharps such as needles and scalpel blades.

- All biohazardous materials should be autoclaved or decontaminated prior to disposal and autoclaves should be tested periodically to ensure that all infectious materials are sterilized prior to disposal.

- Correct sharps containers, including broken glass containers, need to be provided and accessible.

- Label all chemical waste as “Hazardous Waste.” Include start date, name of generator and contents.

- All chemicals must be appropriately labeled. If possible store chemicals in their original containers. If they are transferred to secondary containers, the secondary container must have a label that contains a minimum of full chemical name, concentration of each chemical, hazard (danger, warning, caution, water reactive, flammable, etc.) and date of transfer.

BIOLOGICAL SAFETY CABINETS (BSC)

- All persons using a BSC must be trained by a Biosafety Officer in the correct procedures for use and maintenance of the cabinet. Contact EHS for more information.

- A certified BSC is required when performing manipulations that could potentially result in aerosolization of infectious agents.

- DO NOT use a flame inside a BSC as this creates turbulence and inhibits correct function of the cabinet.

CHEMICAL FUME HOODS

Exhausted fume hoods should not be used for dual use (i.e. performing processes and storage). While the fume hood is used for processes, any items such as hazardous waste containers and other nonessential equipment or stock in the hood must be removed to prevent unsafe turbulence or the blocking of airflow in the hood exhaust components. Clutter in the hood disrupts the airflow, reducing its capture efficiency. If the fume hood will be used for storage of chemicals, the fume hood must be marked "CHEMICAL STORAGE ONLY" and no processes are allowed in the fume hood.

Other items for fume hood use are:

- Procedures involving the liberation of volatile or toxic or flammable materials shall be performed in a chemical fume hood. Do not expose yourself or your colleagues to hazardous materials - use the provided fume hoods to eliminate the risk at the source.

- Do not allow paper or other debris to enter the exhaust duct of the hood.

- Keep the sash closed when the exhausted fume hood is not in use. When using the exhausted fume hood, keep the sash as low as possible without interfering with the work process, but never exceed the maximum sash height as indicated by the arrows placed on the sides of sash closure. The only time the sash should be completely open is while setting up equipment.

- Keep head outside of exhausted fume hoods. Keep all work at least 10 cm away from the front edge of the hood to allow proper ventilation and reduce the chance of exposure to hazardous vapors.

- Utilize a simple air flow indicator by hanging a small (approximately 1" x 4') piece of Kimwipe, or similar lightweight material, from the bottom of the hood sash in the corner and away from ignition sources. The Kimwipe should be drawn in when the exhausted fume hood is operating normally, and will hang straight down when the hood is operating marginally, or not at all.

- Keep objects away from the air baffles.

- Any large object that must be in a hood (e.g. centrifuge, water bath) should be raised to allow air flow on all sides.

- Do not rely on the fume hood to protect you from splashes or projectiles – WEAR SAFETY GLASSES or a FACE SHIELD.

- Wear gloves appropriate for the chemicals being used.

- Electrical equipment is not allowed in the fume hood if the hood is used for chemical storage.

- DO NOT use the fume hood to handle infectious agents.

- DO NOT use porous materials inside the fume hood (wood, notepads, pencils etc.).

- If a fume hood stops working and fumes or vapors are released into the work area, immediately leave the area.

- Respirator protection should not be worn when working with fume hoods unless specifically approved by EHS. Respirators should only be used when all other controls fail to meet the safety requirements.

LABORATORY ACCESS

Unauthorized person(s) shall not be allowed in a laboratory.

- Authorized means having business in the laboratory with the permission of the principal researcher. It also means that such authorized persons must be provided the same kind of protection from hazards as persons working in the laboratory, and made aware of the hazards in the laboratory.

LABORATORY SECURITY

- Laboratory shall remain locked when unoccupied. This includes locking the room when you leave for the night and also when you enjoy a coffee break or take lunch.

- LABORATORY DOORS AND WINDOWS SHALL REMAIN CLOSED DURING NORMAL OPERATIONS. This is necessary to preserve proper air flow and air balance in the building.

CHEMICAL STORAGE

- All chemicals must be stored appropriately (see Appendix II - Hazardous Chemical Storage Precautions).

LABORATORY CHEMICAL TRANSPORTATION

PACKAGING

All chemicals must be in their original packaging or be packed to withstand routine transportation. This includes:

- Secondary containment for all chemicals (this requires closed topped secondary containers i.e. closed boxes for solids, closed secondary containers that will contain liquids and not react with the containers)
- Securing all containers to prevent movement during normal transportation.

PAPERWORK

A list of all the chemicals must accompany the driver and must be located beside the driver or in the driver's side door. The paperwork must contain:

- Chemical name (no diagrams)
- Quantity (measurement units included)
- Container description

VEHICLE

The vehicle must be a CSU state vehicle and be driven by a full time CSU employee who has had CSU Hazardous Waste Generator Training. No transportation can occur in personal vehicles. The vehicle has to have a spill kit, which includes appropriate PPE, for the chemicals being transported.

ROUTE

Transportation can only occur on streets owned by CSU. Transportation between the main campus and south campus can only occur if the vehicle crosses Prospect at the light on Center Avenue and turns off Center Avenue on the road south of the NRRC D building (see transportation map). Transportation between any other campuses is not permitted without specific EHS approval.

ERGONOMICS

PIPETTES

- Use pipettes with upgraded triggers to reduce required force.
- Use pipettes that are comfortable and fit in the hand.
- Although difficult to learn, switch the pipette to the non-dominant hand.
- Use automatic pipettes when feasible.
- Take rest breaks periodically throughout the day. Approximately 5 minute breaks every hour.
- Adjust the workstation appropriately so awkward postures are decreased. Raise or lower the workstation as needed. Avoid awkward arm postures (elevated arms, bent wrists, etc.).
- Use an appropriately designed ergonomic chair.
- Rotate jobs to avoid overexertion.

MICROSCOPES

- Don't use a microscope for more than 4 hours per day at the maximum.
- Sit upright when at the microscope.
- Pull the scope closer to the body when feasible to reduce any awkward shoulder postures and excessive reach.
- Elevate the scope if it is too low, lower if too high.
- Use an appropriately designed ergonomic chair.
- Take rest breaks periodically throughout the day: approximately 5 minute breaks every hour.
- When feasible, use a monitor to view specimens rather than binocular eyepieces and the scope itself.
- Rotate jobs to avoid overexertion.

CABINETS AND WORKBENCHES

- Use the correct ergonomically designed chair.
- If the work surface is too high, raise the chair and use a foot rest/foot support.
- Apply an approved padding on hard surface edges of the cabinet to reduce contact forces.
- Remove drawers and other obstructions from under the bench or work surface to allow for adequate leg room.
- Position frequently used materials as close to the body as possible to avoid reaching.
- Use anti-fatigue mats when employees must stand for extended durations.
- Take rest breaks periodically throughout the day: approximately 5 minute breaks every hour.

GLOVE BOXES

- Use the correct ergonomically designed chair.
- If the work surface is too high, raise the chair and use a foot rest/foot support.
- Use foot rests when the work surface is too high.
- Rotate jobs to avoid overexertion.
- Ensure the design of the glove box openings are at an appropriate height.

HEAVY LIFTING

- Use proper body mechanics when lifting heavy objects.
  - Use hand trucks, carts and other assist devices to help reduce lifting and carrying.
- Obtain help from co-workers when lifting, especially when objects are heavy.
- Avoid twisting and turning the back while lifting.
- Lift with the knees bent and back straight.

STORAGE

- Store heavy objects below shoulder height and above knee height.
  - Light weight items on the top shelves.
- Implement step stools and step ladders when dealing with high shelves.

GENERAL WASTE AND DISPOSAL HANDLING POLICIES

The Building Services Division comprises both Custodial Services and Integrated Solid Waste (ISW) operations. The division handles waste from the standpoint of individual generation to the approved waste or recycle containers. The only exception to that service is in handling waste streams that fall privy to regulations interpreted, defined, and enforced by the Environmental Health Services (EHS) Department. Many of those regulations are directed at hazardous waste generated by laboratory operations. Hazardous waste must be handled according to the policies and practices available from EHS, the policies for handling all other waste types are described below.

Every member of the department shares responsibility for following appropriate policies and practices regarding generating, handling and disposing of wastes, both hazardous and non-hazardous. Policies and procedures for handling hazardous chemical waste are discussed separately in this safety manual.

Laboratory personnel are responsible for ensuring that only non-hazardous waste is disposed in these bins and that waste is properly segregated into the appropriate containers. These are the waste streams typically generated:

- Hazardous waste
- Cardboard
- Mixed recycling
- Sharps/metal
- Glassware (broken or lab glass)
- Electronic waste (E-waste)
- Regular trash

Building Service's custodial personnel have placed dedicated and marked central collection bins both inside and outside the Chemistry building. These bins are dedicated to the disposal of regular trash, mixed-recycling (blue and green bins), and sharps/metal/broken glass waste (red bins).

Proper segregation and disposal of waste streams is important with regard to health and safety but it is also a legal issue. Colorado state laws and city of Fort Collins ordinances apply to the proper disposal of cardboard and electronic waste. **FINES CAN RESULT TO ORGANIZATIONS AND INDIVIDUALS FOUND TO BE IMPROPERLY DISPOSING OF CARDBOARD AND E-WASTE IN REGULAR TRASH (THESE PENALTIES APPLY ON-CAMPUS AND AT YOUR OWN RESIDENCE).**

MIXED RECYCLING

Recycling and waste minimization are key components to making Colorado State a more sustainable campus. Recycling efforts at CSU have garnered annual awards in the university recycling competition, RecycleMania (sponsored by The National Recycling Coalition and U.S. Environmental Protection Agency). In May 2008, the Colorado Association For Recycling, or CAFR, awarded CSU the Outstanding Government Recycling/Waste Diversion Program Award.

ACCEPTABLE RECYCLING ITEMS

Paper

- Junk mail (remove any non-paper items)
- Newspapers and newspaper inserts
- White paper
- Phone books
- Brown paper bags
- Pastel-colored paper
- Magazines, catalogs, books
- File folders, index cards, envelopes

Plastic (labels are okay)

- Clean #1 - #7 plastic bottles, tubs and containers
- Butter and yogurt tubs

Other recyclable items

- Cardboard
- Pizza boxes, corrugated boxes

Paperboard

- Cereal and pasta boxes
- Wax-lined cartons (milk, ice cream)
- Brown paper grocery bags

Glass & Aluminum (labels are okay)

- Glass bottles and jars of any color
- Aluminum cans (do not crush or flatten)
- Steel (tin) cans
- Metal jar lids and bottle caps
- Empty aerosol cans (no caps)
- Aluminum foil (flattened, clean foil only)

DO NOT RECYCLE

- Screw top caps
- Plastic bags
- Pesticide or motor oil containers
- To-go containers & Styrofoam
- Microwavable trays or food/party trays
- Broken glass
- Light bulbs
- Plate glass or cookware
- Neon or carbon paper
- Disposable utensils and plates
- Compostable cups and containers

SHARPS AND METAL WASTE

Any sharps made of metal (including, but not limited to: scalpel blades, razor blades and needles), and/or biohazard-contaminated glassware must be placed in a puncture-resistant container. When said container is full, it will be autoclaved (if necessary), sealed and placed in a cardboard box, which will in turn be sealed. The container and box will both be labeled with the laboratory PI's name, a contact phone number, the date, and the words, "Decontaminated Laboratory Sharps" written conspicuously on the top of the box.

To avoid needle stick injuries and possible exposure to hazardous agents, needles should not be recapped, bent, sheared or broken. Retractable or self re-sheathing needles should be used when appropriate. In rare instances a one-handed technique (eg., use a one-handed scoop technique, or hold the cap with a hemostat or forceps) may be used to recap needles, but this is discouraged. Used needles, as is the case with other sharps, must be appropriately disposed of in a sharps container.

LABORATORY PERSONNEL ARE RESPONSIBLE FOR SAFELY DEPOSITING SHARPS WASTE USING APPROVED CONTAINERS INTO THE CENTRAL COLLECTION BINS. If bins are full and they cannot immediately deposit the waste into the bin, they should return the waste to their lab temporarily and notify the Facilities Dispatch operator at (970) 491-0077 of the situation. Only two types of containers are approved by EHS for this waste. Labs must either use approved disposable (single use) sharps containers or a sturdy, double box (cardboard) system that is taped shut at the time of disposal and will fit into the designated bins provided in their buildings. Bin size is 23" by 19" (mouth) by 33" high. Five gallon buckets will not be acceptable to EHS and must be disposed of after placing sharps in one of the approved containers. Place sharps in one of the approved containers until they are full and then tape them shut securely before taking to the designated bin. Building Services will not handle containers left anywhere except inside the designated bins.

GLASSWARE (BROKEN AND LAB GLASS)

Lab glass should be boxed up for disposal. Most labs utilize broken glass collection boxes (these are available in the main stockroom D110). Regular cardboard boxes may be used, but they must be clearly marked "Broken Glass" and the box should fit within the red sharps collection bins. When a broken glass collection box is ready for disposal, tape the box securely shut. Lab personnel should then place full and securely taped glass boxes directly into the red sharps collection bins. **FACILITIES WILL NOT PICK UP AND DISPOSE OF ANY BOXES OF BROKEN GLASS THAT ARE NOT TAPED UP SECURELY AND PLACED WITHIN THE BINS.**

CARDBOARD

WITHIN THE CITY OF FORT COLLINS, A LOCAL ORDINANCE BANS CARDBOARD FROM TRASH BINS FOR ALL BUSINESSES, FAMILY RESIDENCES AND CONSTRUCTION SITES – AND IMPOSES A FINE IF CARDBOARD IS FOUND IN A TRASH CAN.

Colorado State University Facilities Management is asking all faculty, staff and students to comply with the ordinance by recycling cardboard on campus, helping the university avoid fines. Cardboard can be recycled on campus in blue recycling containers usually located at most desks, in 'single stream' collection receptacles, in designated large receptacles in buildings across campus and at most building dock areas.

CSU Facilities Management needs your help to keep cardboard out of the trash. Please use designated collection receptacles in your building or place cardboard in single-stream collections. Facilities Management will no longer be able to collect waste in receptacles that are not in compliance with the ordinance, with the exception of cardboard boxes containing sharps for disposal.

Within the building, cardboard which has been broken down and flattened will be picked up by Facilities. Place flattened boxes in the hallway outside room doors for pickup.

ELECTRONIC WASTE (E-WASTE)

IT IS A VIOLATION OF SOLID WASTE REGULATIONS FOR RESIDENTS OF COLORADO TO DISPOSE OF ELECTRONIC WASTE IN THEIR TRASH. While it has been for many years and continues to be violation of the hazardous waste regulations for industry, businesses, and government agencies to dispose of any electronic waste that exhibits one or more characteristics of hazardous waste in municipal solid waste landfills, Senate Bill 12-133 bans landfill disposal of certain electronic wastes from households. Under limited conditions, a Board of County Commissioners may vote to temporarily exempt its residents from the ban.

Some common electronics that are banned from disposal include:

- Computers
- Computer monitors
- Laptops, notebooks
- Ultrabooks, netbooks & tablets
- Peripherals such as keyboards, mice & speakers
- Printers
- Fax machines
- Televisions
- DVD & VCR players
- Video game consoles
- Radios & stereos

CSU's Surplus Property supports an e-cycling or electronic recycling program on campus. It accepts CSU property as well as personal electronics from faculty, staff and students.

If you have CSU owned E-waste, it must be disposed of through CSU Surplus Property. This includes computers, appliances, and any lab equipment (small or large). For more information please contact CSU Surplus Property at (970) 491-1918.

Surplus electronics, which includes appliances, computer systems/peripherals, and lab equipment, can be disposed by completing an Equipment Accountability Change Request (EACR). EACR's must be completed and submitted online at http://eacr.colostate.edu. An additional Refrigerator, Freezer, Labratory Equipment Declaration Form (RFLE DEC Form) is also required for any refrigerator, freezer, or laboratory equipment that has been in contact with chemical, biological, or radioactive material. These items must be cleaned and decontaminated prior to surplus removal. All items for surplus must be clearly labeled "Surplus" and made safely accessible to Surplus property workers (this is often done by short-term placement of surplus items in the hallway outside active lab areas).


Waste Stream
Hazardous Waste
Regular Trash
Mixed Recycling
Sharps/ Metal
Lab glass
Cardboard
E-waste
Dispose according to EHS policies (eRFD)
Dispose in standard trash receptacles
Dispose in marked single-stream blue recycling bins
Dispose in approved sharps container following appropriate protocol
Dispose in "Broken glass" box following appropriate protocol
Break down flat and place in hallway outside room doors for custodial pickup
Submit EACR request form to Building Proctor for proper disposal
EHS will pickup
Custodial will pickup within building
Lab personnel should place large quantities directly into large recycling bins
Lab personnel should place directly into large red bins
Lab personnel should place directly into dumpsters
Custodial will pickup within building
Surplus Property will pickup

CHEMICAL INVENTORIES

LABORATORY CHEMICAL STORAGE

Chemical inventories in research laboratories should be kept at the minimum level consistent with efficiency and safety. Unneeded chemicals should be placed in the department chemical morgue or turned over to the University's surplus program (administered by Environmental Health Services). Chemicals in the morgue or in the surplus program are available to all research groups and both should be checked for chemicals prior to ordering new reagents.

Flammable chemicals, those having flash points less than 38°C, should be stored in solvent cabinets. Chemicals should be stored according to functional group or reactive character and NOT alphabetically. Items stored in refrigerators should have secondary containment so as to protect the evaporator coils (aluminum) in the refrigerator. Oxidants should not be stored next to reducing agents and should have secondary containment.

Highly toxic chemicals and those known to be carcinogens should be stored in isolated and properly labeled storage cabinets. These chemicals should be labeled "CAUTION: HIGH CHRONIC TOXICITY OR CANCER SUSPECT AGENT." These chemicals should be used only in a designated area with appropriate warning signs (see Chemical Biohazards in the CSU Biosafety Handbook).

Hoods should not be used for general chemical or equipment storage.

Cylinders of compressed gases should be chained to the bench top or wall except when being transported. Cylinders not in use should have the top cap screwed on tight. Small cylinders not equipped with caps should be stored in such a way as to prevent them being accidentally dropped to the floor when not in use. All cylinders that are in the laboratory for more than twelve months should have regular (bimonthly) inspections to check for leaks and corrosion. Cylinders should be returned to the manufacturer at the first sign of corrosion. Leaking cylinders should be immediately moved to the hood and the contents released and neutralized or rendered non-hazardous by the appropriate technique. The empty cylinder should then be returned to the manufacturer.

INVENTORIES

An inventory of the chemicals stored in the laboratory should be taken annually and reported to the Department Safety Committee. This information is further communicated to Environmental Health Services and to the local fire departments. This is a requirement of the Emergency Planning and Community Right-to-Know Act as well as the CSU Building and Fire Code.

Each laboratory maintaining a stock of chemicals should have on hand, in a loose leaf or other readily available form, a Material Safety Data Sheet (MSDS/SDS) for every chemical in the laboratory. The annual inventory is a good time to compare the items on the inventory with the SDS available and request/acquire those SDS that are not on hand. A copy of each SDS should be kept in an easily accessible location.

- All fume hoods are inspected annually; preventive maintenance on fans, motors, belts is done on the first Monday morning of each month. During this time a hood may go down momentarily without notice while a belt is checked or replaced.

- Safety showers, face washes, eye washes and drench hose assemblies should be checked regularly by the Safety Committee. Repairs are made immediately to those found to be defective.

- Fire extinguishers are inspected during an annual Facilities Services inspection of the building. If you use a fire extinguisher, label the extinguisher as empty and call the main office at (970) 491-6381 to report the extinguisher as one that must be replaced.

- The building air is changed approximately six times every hour. **SHOULD THE BUILDING AIR SUPPLY AND HOODS GO OFF FOR AN EXTENDED PERIOD OF TIME, OVER TEN MINUTES, THE BUILDING SHOULD BE EVACUATED.**

- Problems with the building should be brought to the attention of the main office to be transmitted to the relevant personnel for attention.

SECTION III – SAFE PRACTICES

SP-1: GENERAL WORK PRACTICES

LABORATORY LAYOUT AND FACILITIES

It is important that graduate students, postdoctoral fellows, and faculty assigned to a given laboratory make a thorough safety assessment of the facility before starting work.

The scope of such a safety check of the laboratory layout should include:

1) Locating the exits from the laboratory and from the building. Are the aisles, stairwells, and corridors clear? Do not block exits.

2) Locating the fire doors. State codes require that fire doors be kept closed.

3) Locating the nearest telephone and fire alarm box for use in case of an emergency.

4) Locating and checking the condition type and accessibility of fire extinguishers.

5) Locating and checking the operability of the safety showers /emergency sprays.

6) Checking to make sure the exhaust hood system is operating properly and is appropriate for the work that is planned.

7) Locating and checking the operating condition of utility lines, such as hot and cold water, distilled water, steam, gas, nitrogen, oxygen, electrical power, and sewer drains. Location of the main cut-off switches to the laboratory should be known. All drains, valves, and fittings should be checked and requests submitted for repairs when necessary. University and State codes require that only authorized mechanics are to repair or modify power and utility lines.

8) Make an inventory of chemicals and apparatus. Arrange for discarding waste chemicals and obsolete apparatus (see SP-4 and SP-5).

9) Inspect and clean all lockers, cabinets, and benches.

10) Check to see that the proper trash, chemical, and solvent waste disposal containers are available and properly labeled (see SP-5).

11) Make sure gas cylinder supports (bases, chains or straps) are available and used. If needed, make a request to the Associate Chair.

12) Special chemicals or spill kits needed to deal with particular types of hazardous materials must be available in the labs in which the hazardous materials are being used.

Teaching Assistants assigned to an instructional laboratory for the first time are expected to make a like assessment of the instructional laboratory in order to be prepared to handle emergencies. The Teaching Assistant should know:

1) Location of emergency exits from the laboratory and building.
2) Location of the fire alarm.
3) Location, type and condition of the fire extinguishers.
4) Location and operability of safety showers.
5) Location of power line and utility line cutoffs.
6) Operating condition of exhaust hoods.

WORKING ALONE

Faculty, postdoctoral fellows, and graduate researchers may work alone in areas other than offices provided the following minimum safety criteria are met:

1) The researcher's presence is known to a second researcher located on the same floor within calling distance.

2) There is little potential for a serious injury producing accident which would render the researcher helpless to call for assistance by voice, telephone, etc.

3) The researcher shall stay in periodic contact with the second person on the floor.

When the experiment is such that there is any potential for a serious accident then a second researcher must be immediately available for assistance.

To perform experimental work in a laboratory, an undergraduate student must have authorization from their instructor. Under no circumstances is an undergraduate permitted to work alone without written permission of faculty advisor or department head.

WORKING AT NIGHT

Except for regularly scheduled courses, all students and postdoctoral fellows must obtain authorization from their faculty advisor for a permit to work in the building after 5:00 p.m. A signed Preliminary Key Request requesting building entry implies permission to work in the building after 5:00 p.m. Building keys will not be issued to undergraduates without an agreement to follow strict policies signed by both student and faculty. (See following example)

Undergraduate Chemistry Building Entrance Door Key Policy

After hours access for the Chemistry Building will only be issued to undergraduate students if they meet the following criteria:

(1) Undergraduate students have sufficient previous research experience to pose no danger to others in the lab.
(2) Undergraduate students NEVER work in the laboratory alone. Somebody else must always be present in the labs, within sight and hearing, should an accident occur.
(3) Should an undergraduate student gain entrance to the building after hours and find the laboratory he is working in unoccupied, the student will leave the building.

UTILITY OR POWER FAILURES

To perform laboratory work safely, it is essential that the worker include in their experimental design provision for a possible utility failure which could cause an accident situation or an unsafe condition to develop. For example, in distillation operations loss of cooling water flowing through the condenser would develop an unsafe condition and result in a possible fire unless provision is made to cut off the source of heat to the still pot. Loss of power to vacuum pumps can cause serious damage to vacuum systems and expensive instruments unless the equipment design and operating procedures are carefully planned to meet such an eventuality. A broken fan belt could shut down a hood.

In the event of loss of power or a critical utility, the worker should quickly terminate their experiment, close down the laboratory, and evacuate. He or she should then inform their supervisor and report the situation to the Department Office. At night or on weekends the CSU police department should be called at (970) 491-6425 or 911.

UNATTENDED OPERATIONS

Operations or experiments are not to be left unattended except for certain routine operations where automatic safeties have been installed to effect shutdown in the event of loss in power and other utilities. Such unattended operations must be approved by the research supervisor. On an operation where permission has been given for unattended operation at night, another researcher who will be present in the building must be informed of the operation with agreement to check it periodically. Always leave your telephone number where you may be reached in case of an emergency.

The department periodically experiences a financial loss when a cooling water hose breaks loose and floods the area. Hoses and clamps should be inspected daily. Hoses should not be 'wired' on to connectors; a proper clamp should be used. These clamps are available in the stockroom.

EATING

Preparation, storage, or consumption of food or drink in chemical laboratory work areas is forbidden and shall not be practiced due to the danger of contamination with toxic substances. Each laboratory has a designated safe eating area. Before handling food or drink or any other item, which may be placed in the mouth, researchers shall thoroughly wash their hands with soap and water to prevent ingestion of harmful materials. If the hazardous chemical is not readily soluble in soap and water, another effective safe solvent should be used, followed by washing with soap and water. Refrigerators used for chemicals should be labeled with a warning indicating such and are not to be used for food or drink.

The same rules and considerations for food handling also apply to the handling and application of cosmetics.

SMOKING, ALCOHOL AND DRUGS

An Executive Order was issued by the Governor of the state banning smoking and the sale of tobacco products in state-owned buildings effective January 1, 1991. There are no exceptions to this order in academic buildings including offices, rest rooms, hallways, etc. The use of alcoholic beverages and illegal drugs in a chemical laboratory is also forbidden.

REPORTING UNSAFE PRACTICES AND CONDITIONS

Unsafe practices and conditions cause virtually all accidents. Immediate correction of a potential accident cause is a basic accident-prevention technique. A person observing an unsafe act, practice, or situation should call it to the attention of the researcher involved or their supervisor.

REPORTING ACCIDENTS

All accidents resulting in an injury, property damage, fire or release of toxic chemicals into the environment must be reported promptly to the instructor in charge or to the appropriate supervisor AND to department administration. In the event of an accident, take the following steps:

During the incident:

- In case of injury, render prompt first aid doing only the minimum necessary to prevent more serious injury to the victim. Wash off chemicals with water (shower/spray). Cool burns with water. Control bleeding. Administer CPR if necessary.
- If injury appears serious, have someone call 911 identifying CSU campus, building, room number, and the scope of the accident/injury.
- If the incident occurs in an instructional lab, have someone summon help from the prep room.
- For minor injuries involving students, have someone accompany the injured individual to the CSU Health and Medical Center (corner of College & Prospect) for treatment.
- Any suspicious odors/smells (and any other situation that may annoy those in other locations) must be reported, even if they are not hazardous. If you create or detect such a smell, call the main chemistry office at (970) 491-6381. After-hours, contact CSUPD at the non-emergency phone number: (970) 491-6425.

After the incident:

1) Work-related injuries involving department faculty/staff/graduate students are handled as Workers' Compensation. Most on-site injuries to graduate students paid on either RA or TA will be handled as Workers' Compensation – so all procedures should be followed accordingly to ensure costs will be covered.

   ****For medical treatment of work-related injuries to be covered under Workers' Compensation, non-emergency medical care must be at an approved Authorized Treating Physician. The two most common approved treatment centers are:**

   CSU Health and Medical Center (1st floor suite 1500, 495-8450, identify work-related injury upon check-in)
   Emergency Department of Poudre Valley Hospital (1024 South Lemay Avenue, 495-8000)

   For other treatment facilities, please see the CSU Office of Risk Management Workers' Compensation website for the most up-to-date list:
   http://rmi.prep.colostate.edu/workers-compensation/authorized-treating-physicians/

2) Report the accident promptly to your supervisor, also to the Department administration. Various written reports must be completed depending on the nature of the accident:

   - ***Chemistry Department accident report***: A formal written report should be filed with the chemistry department whenever an accident results in injury, property damage, or fire.

Departmental accident report forms are done on paper and are available in the main office and within the appendix of the dept safety manual.

- ***Risk Management and Insurance incident report***: The CSU Risk Management office utilizes a separate online incident reporting tool: http://rmi.prep.colostate.edu/insurance/incident-reporting/

  For reporting incidents that would not involve workers' compensation (such as injury to a student in the teaching labs) – the Safety Concern/Near Miss report should be completed.

  For reporting incidents involving a work-related injury (even if medical treatment is not sought initially), the Workers' Compensation Incident report should be completed.

  ****Worker's Compensation rules require that initial notification must be made within 48 hours and that a written accident report be turned in to the department and through the Risk Management and Insurance office by the injured employee within four days.**

EMERGENCY EVACUATION PLAN

The following plan outlines the responsibilities of laboratory personnel, floor monitors, and the Safety Committee in the event an emergency evacuation should become necessary. Fire, explosion, toxic fumes filling the building, etc. may all make necessary such an evacuation. Of prime concern is the safety of all personnel and consideration for property damage should be secondary to assuring personal safety.

All Laboratory Personnel Procedure

When the alarm sounds, proceed as follows:

1) Turn off electrical equipment and flammable gas outlets and shut, but do not lock, doors to localize fire if you are not in immediate danger.
2) Vacate building by predetermined exit.
3) Proceed to a safe distance and do not reenter the building until directed by law enforcement or a member of the Safety Committee.
4) If emergency is in your area, retreat to a safe distance and then:
   a) Sound alarm by pulling down lever in fire alarm box.
   b) Immediately call 911 and give location and nature of emergency. Do not hang up immediately; pause to give the person you're talking with a chance to ask questions. Go and/or send another individual to the front door of the building to direct emergency personnel to the location of the emergency.
   c) Attempt to contain fire with hand extinguishers only if you are not in immediate danger. If necessary, use extinguisher to clear path to exit.

Building Proctor Procedure

When the alarm sounds, he/she will proceed as follows:

1) Immediately check to see that the elevator is unoccupied.
2) Locate specific area and determine nature of emergency.
3) Make certain emergency has been reported.
4) Meet and coordinate with emergency personnel until emergency has concluded.

Building	Room	Primary Exit	Secondary Exit
Chemistry	Basement	Exterior Load Ramp	Front Door
Chemistry	A101, A102, A103	Lecture Room Exit Doors	Front Door
Chemistry	Other A-Wing Rooms	Front Door	South End B-Wing
Chemistry	B101, B102, B104, B105, B106, B108, B109	Front Door	South End B-Wing
Chemistry	B110, B111, B114, B115	South End B-Wing	Front Door
Chemistry	B201, B202, B205, B206, B207, B208, B210, B211, B213, B214, B216	South End B-Wing	North End B-Wing (Front Door)
Chemistry	B301, B302, B305, B306, B307	North End B-Wing (Front Door)	South End B-Wing
Chemistry	B310, B311, B312, B313, B316, B317	South End B-Wing	West End C-Wing
Chemistry	B203, B204, B303, All C-Wing Rooms	West End C-Wing	North End B-Wing (Front Door)
Chemistry	All D-Wing Rooms	South End Stairwell	West End C-Wing
Yates	101, 102, 103	East End Exit Door (Underpass)	West End Stairwell
Yates	401, 402, 403, 404, 405, 406	West End Stairwell	East End Stairwell
Yates	407, 408, 409, 410, 411, 412, 414	East End Stairwell	West End Stairwell
Yates	501, 502, 503, 504, 505, 506	West End Stairwell	East End Stairwell
Yates	507, 508, 509, 510, 511, 512, 514, 516	East End Stairwell	West End Stairwell
Chemistry Research	102 A-E	Loading Ramp Exit Door	Southwest Entry Door
Chemistry Research	104AA, 104, 106	Southwest Entry Stairwell Exit Door	Southeast Entry Door
Chemistry Research	107, 108, 109, 110, 111, 112, 114	Southeast Entry Door	Northeast Entry Stairwell Exit Door
Chemistry Research	104C-H, 113, 115, 118, 120	Northeast Entry Stairwell Exit Door	Southeast Entry Door
Chemistry Research	201, 202, 203, 204, 204A-H, 206, 207, 208, 301, 302, 303, 304, 304A-H, 306, 307, 308, 401, 402, 404A-F, 405, 406, 406A, 407, 408	Southwest Entry Stairwell Exit Door	Northeast Entry Stairwell Exit Door
Chemistry Research	204J-S, 210, 211, 212, 213, 214, 215, 217, 218, 220, 304J-S, 310, 311, 312, 313, 314, 315, 317, 318, 320, 404G-K, 409, 409B, 410, 411, 412, 413, 414, 415, 417	Northeast Entry Stairwell Exit Door	Southwest Entry Stairwell Exit Door

VISITORS

Visitors shall comply with all safety regulations in force in each location visited. Appropriate eye protection shall be worn by visitors to any laboratory. In each laboratory it is the responsibility of the occupant assigned to work there to remind visitors of this regulation.

DRESS

Appropriate clothing is to be worn in the laboratories at all times. Clothing should not be loose (saris, dangling neckties, overlarge shirts/blouses, bare midriffs, etc.), skimpy (shorts and/or halter tops) nor torn but should provide adequate protection in case of spills. Long hair should be tied back. Shoes should cover the upper part of the foot and be made of a material that will shed or repel liquids. ***Lab coats must be worn at all times when using hazardous materials; flame-retardant lab coats should be worn at all times when using flammable and/or pyrophoric chemicals or materials.***

SAFETY GLASSES

All persons in a laboratory, whether conducting experiments or not and including visitors, are required to wear safety glasses, at a minimum, or other appropriate eye protection (goggles or face shield). In areas of the laboratory designated as office areas, which are often also designated food areas, safety glasses are not required, but their use is still suggested.

SP-2: HOUSEKEEPING

The continuous practice of good housekeeping is essential to the prevention of accidents, fires, and personal injuries. Students and researchers working in laboratories are expected to keep their benches neat and orderly. A cluttered laboratory is a dangerous place in which to work; by cleaning up after each step of an experiment, a general housecleaning is necessary only occasionally.

EACH LABORATORY WORKER IS RESPONSIBLE FOR:

- Keeping benches, tables, hoods, floors, aisles, and desks clear of all materials not being used.
- Keeping clear an adequate passageway to exits.
- Keeping clear space around safety showers, fire extinguishers, fire blankets, and electrical controls.
- Keeping floors free of spilled ice, dropped stirring rods, stoppers, pencils, and other tripping hazards.
- Cleaning up spills and disposing of broken glass.
- Using proper waste disposal receptacles for solvents, glass, rags, paper, etc.
- Keeping chemical containers clean and properly labeled.
- Retaining only the quantities of chemicals needed for current work.
- Disassembling and returning to storage surplus equipment.
- Hanging clothing in its proper place; do not drape over equipment and work benches.

SP-3: CHEMICAL HYGIENE

* Waiting for EHS to provide guidelines.

SP-4: HANDLING CHEMICALS

GENERAL

Chemicals can be hazardous unless properly handled. Serious skin and eye irritations and damage to clothing can result from needless spills and sprays. Toxic materials can cause severe illness, even death. All chemicals, especially new compounds for which the toxicity has not yet been determined, should be assumed to be highly toxic. Flammable gases, liquid, and solids can cause fires or develop into explosive mixtures.

Before working with any chemical, it is essential to know its properties. The properties of known reaction products, intermediates, or even possible reaction products should be ascertained before work begins. In exploratory research work only very small quantities of chemicals should be employed. Larger amounts may be used only after the initial work has been successfully completed and the reaction rates and the properties of the reaction products have been established. It is worthwhile in making predictions about reactions to calculate the free energy of reaction for the planned experiment.

Hazardous chemicals include, in addition to flammable materials, those substances which are pressurized, cryogenic, temperature sensitive, toxic, corrosive, and/or reactive. It must be recognized that a material, which by itself is comparatively harmless, can become very hazardous under conditions of use and under conditions to which it may be subjected accidentally--as in the event of fire.

TRAINING

The faculty member in charge of each laboratory group is responsible for initial and continuous training the members of their group. The department may provide an initial, partial safety training and orientation for incoming graduate students. However, department-level training is not a substitute for individual laboratory group safety training. All training is to be documented as to the type of training, who received it, and when the training was completed.

This training must include the following:

1) Safety and hazards associated with procedures and chemicals used by each group, including biohazards and their symptoms, proper use of personal protective equipment, safe methods for handling and storage of hazardous materials, specific hazards of chemicals to which the group/individual may be exposed. Individuals in each group are also to be trained in methods and observations that they can use to detect the presence of hazardous chemicals, e.g., smell, visual appearance or monitoring equipment that may be available.

2) Location and availability of reference materials (including MSDS/SDS) on chemicals used in the laboratory covering the following data:

Hazards	*Safe Storage*
Safe Handling Procedures	*Safe Disposal*

3) Location and proper use of fire and spill control equipment.
4) Provisions of the University-level Chemical Hygiene Plan and how it is to be implemented in the department.

5) Proper labeling as required by 29 CFR (Code of Federal Regulations) 1910.1200 (http://ecfr.gpoaccess.gov/). A copy of this document is kept at Environmental Health Services.
6) Procedures for waste reduction, detoxifying, hazard reduction and proper disposal for all waste generated in the laboratory.
7) Circumstances under which prior approval must be obtained before a procedure is started i.e.: use of controlled substances, use of radioisotopes, chemicals that are biohazards.
8) Permissible exposure limits for regulated substances and recommended exposure limits for other hazardous chemicals where no OSHA standard exits.

LABELING

A most important safety practice in the handling of chemicals is to keep reagent containers properly LABELED. Containers of all substances in your laboratory shall be labeled showing:

1) The chemical name and structure.
2) The date of purchase, preparation, or transfer to its present container.
3) The owner's name.
4) A brief notation of hazard if any, as for example, a word like one of the following: toxic, corrosive, flammable, explosive, poison.

Containers used to collect and temporarily store chemical waste should be clearly labeled 'HAZARDOUS WASTE' and in addition information as to:

1) Type of waste, i.e., halogenated solvents, acid waste, etc.
2) Date when waste collection in the container was initiated.
3) Owner's name and room.
4) A running record should be kept of the types of waste and quantities so as to be able to give percent composition (1%) of the contents of the filled container.

Labels are available to print online at: http://www.ehs.colostate.edu/WHazWaste/

HAZARDOUS VAPORS

Experiments involving toxic, flammable and/or corrosive vapors should be carried out in fume hoods. In general, when working with small quantities of such materials the hood exhaust volume is sufficient to prevent an atmospheric pollution problem above and outside the building. When large-scale operations are carried out in fume hoods which evolve large amounts of either flammable, corrosive, or toxic vapors, these vapors should be treated to destroy the harmful effects and thereby prevent atmospheric pollution outside the building. For example:

1) Condense flammable vapors and then dispose of the condensate.
2) Absorb halogens and like materials in an appropriate reducing agent and flush the resulting solution to the sewer (check pH). See Appendix II for a list of chemicals that may not be flushed to the sewer.
3) Absorb HCN in an alkaline oxidizing agent such as Clorox and flush the solution to the sewer.

EXPLOSIVE REACTANTS

Perchloric acid is especially dangerous because it explodes on contact with organic materials. Do not use perchloric acid on wooden benches or tables. Keep perchloric acid bottles on glass or ceramic trays having enough volume to hold all the acid in case the bottle breaks. Discolored acid (contaminated) should be disposed of immediately. Gently pour the discolored acid into a beaker or porcelain jar which contains at least twenty volumes of cold water for each volume of acid. Mix gently, neutralize to a pH range of 6-9 and pour the diluted and neutralized material down a drain with large amounts of cold water. A special hood is required if an operation is carried out in which the acid is heated to fuming. Such fuming operations are forbidden in ordinary hoods.

UNUSED CHEMICALS

Unused chemicals should not be allowed to accumulate in a laboratory. All reagents should be inspected periodically and those not needed should be removed. Dates on labels of materials that may form hazardous substances on prolonged storage should be checked periodically and those that are excessively old should be disposed of in a prudent manner. EHS maintains a chemical recycling program for chemicals that can be used in other lab groups.

The following items should not be stored beyond **three months** after opening (***common**):

Acetal
Decahydronaphthalene (Decalin)
Dicyclopentadiene
Diethylene glycol dimethyl ether (Diglyme)
Divinyl acetylene
Glycol monoethers (uninhibited)
Sodium amide
Potassium with Organic Material (e.g., oil)
Tetrahydronaphthalene (Tetralin)
Vinylidene chloride
Cyclohexene
Diacetylene
Diethyl ether*
Dioxane (uninhibited)
Glycol ether acetates (uninhibited)
Isopropyl ether
Methylacetylene
Tetrahydrofuran* (uninhibited)
Vinyl ethers

The following items should not be stored beyond **six months** after opening.

Acrylonitrile
Chlorotrifluoroethylene
Methyl methacrylate (uninhibited)
Tetrafluoroethylene
Vinyl chloride
Butadiene
Chloroprene
Styrene
Vinylacetylene
Vinylpyridine

Peroxidizable solvents should always be regarded as containing peroxides. Accordingly, the practice of routinely testing for peroxides prior to running a distillation should be adopted. A little practice with standard peroxide detection procedures should enable a chemist to make a round estimate of the quantity of peroxide found. A qualitative test for peroxides follows.

IODINE TEST METHOD based on the oxidation of iodide to iodine by the peroxide:

This procedure is satisfactory for all of the common solvents but does not indicate the presence of dialkyl peroxides or some dimericand trimeric ketone peroxides. Add 6 ml of the solvent to be tested to 3 ml of a 1% absolute ethanolic solution of sodium iodide (potassium iodide is insoluble) in a standard 6" test tube. Add one drop of 1% HCl solution, purge with N_2 and stopper. Mix and compare the color intensity developed after about three minutes with that of a standard prepared to represent 1:5000 parts of active oxygen (0.02%). If the test indicates this peroxide content or

greater, the solvent should be discarded or the peroxide removed. The standard is prepared by dissolving 1.7 g of $FeCl_3 \cdot 6H_2O$ in 100 ml of 5% HCl to reproduce the color obtained when 1.2 ml of $0.1NI_2$ solution is diluted to 15 ml. The standard solution is stable.

FLAMMABLE REAGENTS

The total amount of volatile, flammable solvents stored in a laboratory should not exceed 10 gallons (five gallons in teaching laboratories). Whenever corrosion or contamination is not a factor, store solvents in excess of one gallon quantities in metal containers and store low flash point liquid in standard safety cans. Limit quantities of solvents in glass bottles to the smallest practical size but not over one gallon; store glass bottles of solvents in closed metal cabinets. Because of the danger of fire, low flash point liquids and gases under pressure should not be stored close to sources of heat such as radiators, hot plates, ovens, etc. Also, keep cloth and paper towels away from heat sources. (Safety may be increased by storing glass bottles in topless metal cans.)

SPILLS

Non-hazardous materials may be cleaned up using normal procedures. The appropriate response for a hazardous spill depends on the location (lab, hallway, outside the building) and the chemical (solid, liquid, flammable, toxic). Absorbent pillows are available in every lab and should be in a location known to all lab personnel. The spill should be contained as quickly as possible using appropriate means to do so. Corrosive material should be neutralized with sodium carbonate or sodium bisulfate. Avoid breathing vapors and use a respirator if necessary. Material that is especially hazardous may necessitate evacuation of the area/building and require special cleanup apparel (bromine, hydrofluoric acid, etc.) DO NOT ENDANGER HEALTH OR LIVES by failing to evacuate promptly if such a hazard exits. After containing the spill consult a manual, MSDS/SDS or Environment Health Services for proper cleanup procedure.

ROUTINE PRECAUTIONS

Listed below are a few simple but important reminders of precautions that should be considered in the routine handling of reagents. It should be remembered that under the right set of conditions any chemical can be hazardous. In the last analysis you are in charge of your own safety, it is your responsibility to use good safety practices at all times.

- Keep reagent containers clean on the outside to protect your hands; use rubber or plastic gloves when appropriate.
- Be sure laboratory gloves are clean on the inside before using; cleanse or decontaminate gloves regularly.
- Avoid prolonged contact of chemicals with skin; wash hands and face frequently; be sure laboratory clothing is cleaned regularly.
- If water is not the appropriate washing agent or antidote, procure proper emergency supplies before starting work.
- Avoid inadvertent contamination by not returning unused portion of reagents to stock bottles. Stoppers should be held while pouring.
- Never taste a chemical.

- Smell cautiously--sniff (never inhale).

- Use a safety pipette filler (pipetting by mouth is prohibited).

- Cool sealed vials of chemicals below the boiling point of the substance contained therein before breaking seal. Cool gradually, first in ice water, then CO_2, etc. to avoid temperature shock to the glass vial and a possible explosion.

- Add concentrated chemicals to water (never vice versa).

- Keep flammable solvents such as benzene, ether, etc. away from hot plates and flames.

- Use bonding and grounding wires when transferring flammable solvents.

- Use adequate eye protection for the job you are doing. If you are working with liquids, use goggles that fit tight against the forehead and sides of the face. If you are working with solids where the danger is from propelled particles then regular safety glasses are probably sufficient. You must be the judge of the danger in what you are doing. Under no conditions should contact lenses be worn in the laboratory. If chemicals do get into the eyes they should be washed for at least 15 minutes with the spray and help should be summoned. In all cases involving the eyes a physician should be seen.

- Use caution in working with mercury to avoid vapor contamination of the laboratory air. The equilibrium concentration of Hg vapor over liquid mercury at room temperature is approximately 20 times the threshold toxic limit (TLV).

- Clean up spills of mercury and other chemicals promptly. Mercury spill kits are available in the main stockroom (D110). After the cleanup is complete have Environmental Health Services check the area.

- Know the locations of safety showers and eye washes, and know how to use them.

- Be sure that incompatible chemicals are stored in separate locations. See Appendix IV for a typical list of incompatible materials.

- Never eat, drink or apply cosmetics in an area where chemicals are used or stored.

- Always wash areas of exposed skin after handling chemicals and prior to leaving the laboratory area.

- Use appropriate protective equipment as the situation may warrant, i.e., lab coats, respiratory equipment, gloves, face shields, chemically resistant aprons. Bear in mind that plastic aprons can accumulate static electricity and should not be worn around flammable solvents. Lab coats should be removed immediately upon significant contamination.

- Do not use chemicals with which you have not had previous experience prior to receiving clearance from the PI. Discuss each experimental procedure with your laboratory PI from a safety standpoint prior to carrying it out for the first time. Where possible calculate a free energy for the reaction prior to actually trying the reaction.

- Read the MSDS/SDS for each new chemical prior to using it for the first time and follow the recommended safety procedures. Have available the spill response equipment needed to clean up in case of a spill.

- Be aware of the types of compounds that are susceptible to peroxide formation. Discard any that are suspicious. Active peroxide formers should be dated when first opened and then not kept for more than three months.

SECONDARY CONTAINMENT OF CAUSTIC/FLAMMABLE CHEMICALS

When transporting caustic or flammable chemicals from laboratory to laboratory or from the stockroom to the laboratory these chemicals should have secondary containment sufficiently large to hold the contents of the chemical container if it were to break. See Appendix A, Paragraph D. of CFR (Code of Federal Regulations) Part 1910.1450 (http://ecfr.gpoaccess.gov/). A copy of this document is kept at Environmental Health Services.

SP-5: CHEMICAL WASTE DISPOSAL

RESPONSIBILITY

In the instructional laboratories, the disposal of unused chemicals is incorporated as an integral part of the course and specific instructions are given on methods of handling and disposing of waste products. In the research laboratory, where many unusual and specific chemicals are used, the responsibility for disposal of unused reagents and waste reaction products is vested directly with the researcher and their project supervisor because, in most cases, it is only the researcher who knows how to handle the materials safely. In either case, waste chemicals should never be deposited in wastebaskets or other trash containers, but rather should be disposed of by one of the following general procedures. See Appendix II for further details. All researchers must take the University Hazardous Waste Training and have a yearly refresher course.

WATER SOLUBLE WASTES

In general, small quantities (100 ml or less) of water-soluble chemicals, which do not hydrolyze to form volatile, toxic, or odoriferous materials may be flushed down the drain. Larger quantities of waste acids, bases, and chemicals which hydrolyze to form corrosive and hazardous products should be treated to render them harmless before flushing to the sewer. In general, hazardous chemical wastes should be subjected to a process in the laboratory, which converts them into harmless products not requiring special handling. See Appendix II for the list of chemicals which may not be disposed of through the drain system.

FLAMMABLE LIQUID WASTE

Flammable liquids not miscible with water must not be poured into the sink or other sewer drains. Low flash point, flammable wastes and solvents should be placed in safety cans and turned over to Environmental Health Services for disposal. Waste solvents containing materials in solution apt to form toxic or corrosive substances of hydrolysis, oxidation, etc. should first be treated to render them harmless prior to disposal. When in doubt, contact Environmental Health Services (970) 491- 6745.

WATER INSOLUBLE SOLIDS AND NONFLAMMABLE LIQUIDS

Those hazardous materials which can be stored safely over a period of time without deterioration should be kept in their original containers and turned over to Environmental Health Services for disposal. Forms are available in the Main Office to initiate this procedure. Used column packing (Al_2O_3, SiO_2) should not be dumped loose into waste paper baskets. It should be packaged and then disposed of by placing it in the dumpster or, if contaminated by highly toxic compounds, disposed of by normal hazardous waste procedures.

EMPTIED CHEMICAL CONTAINERS

Before discarding, all empty chemical containers must be triple rinsed and dried. All organic reagent containers should be rinsed with acetone and then with water. This practice prevents subsequent injury to those handling the discarded containers. Discard with the lids removed. **ALL CHEMICAL LABELS MUST BE REMOVED OR COMPLETELY MARKED OUT BEFORE DISPOSAL.** Metal cans must be punctured or open at both ends.

SPECIAL ATTENTION

Mercaptans and organic sulfides have posed a number of problems for the chemistry department when improperly disposed. The proper disposal of these chemicals includes a pre-treatment, in the hood, with hypochlorite to oxidize the sulfur followed by acid/base neutralization (neutral to litmus), if necessary. This solution may then be washed to sewer with excess water.

SP-6: HANDLING COMPRESSED GAS CYLINDERS

Compressed gases impose potential hazards on the laboratory worker if not properly handled. Such gases can be used in the laboratory with safety if the following precautions are complied with completely during cylinder receiving operations, storage, transportation, usage, and empty cylinder disposal.

KNOW CYLINDER CONTENTS AND ITS PROPERTIES

The physical properties, flammability, corrosiveness, and physiological (e.g., toxicity, anesthetic, and irritating) properties of a cylinder gas should be known before it is used. If the contents of a cylinder cannot be determined completely from looking on the cylinder or an accompanying tag attached to the cylinder (not its cap), mark the cylinder "Unidentified" and return to the supplier. Do not rely on cylinder colors, which vary from company to company; some people are color blind. Never remove or deface a label.

HANDLING OF CYLINDERS

Cylinders are built as lightweight as possible consistent with safety and durability for use as shipping containers. They therefore should be transported carefully--large cylinders (over 24 inches high) should be transported only with a wheeled cart. Large cylinders should be fastened securely with a strap or chain before removing the cap. Abuse and hard knocks can seriously weaken a container, and a falling cylinder can break legs and crush feet. Finally, should the valve be broken, the cylinder becomes a powerful rocket. Keep these hazards in mind when working with gas cylinders.

HEATING OF CYLINDERS

Most cylinders are equipped with fusible metal safety plugs which release if it is heated above 70°C. Therefore, if it is necessary to warm a cylinder to facilitate discharge of the contents, immerse no more than the lower 20% in warm water; steam should never be used directly on a cylinder. The valve must be partly open whenever a cylinder is warmed.

USE OF VALVES AND REGULATORS

A cylinder is always used with a regulator selected specifically for the given gas. The threads of the regulator will match the threads of the cylinder outlets. If the connection must be forced, you have either the wrong regulator or the wrong gas. To remove gas through a regulator, first ensure that all valves are closed, then, in succession, and slowly open all valves (starting with the cylinder valve). Be sure that the final valve opening directs the flow of gas away from you, others and any ignition source if applicable. Always wear safety glasses or goggles. Close all valves in the same order as used in opening them. Since cylinder valves, particularly those used with corrosive gases, are designed so that the valve stem and packing are protected from contact with the gas when the valve is either completely open or closed, it should always be in either of these two positions. The cylinder valve should be closed when gas is not in use.

CONTROL OF GAS AND REACTION SYSTEM

To prevent contaminants from entering the system, always place a trap between the cylinder and the system. To prevent an explosion resulting from suck-back of contamination into the cylinder, never completely empty the cylinder. If pressure may build up in the system, equip the line with a pressure indicator and a safety vent.

HANDLING OF EMPTY CYLINDERS

The valve should be closed and the cap replaced on empty cylinders. They should be marked with "MT" and dated. Call Jane Burkman at (970) 491-0503 to arrange pick-up of the empty cylinder. Do not attempt to refill a cylinder.

REPAIR AND ADJUSTMENT OF EQUIPMENT

Do not attempt to repair a regulator yourself. Also, never attempt to tighten nuts or bolts on fittings of high-pressure equipment while it is in use. Release the pressure first, then make adjustments.

SP-7: HANDLING EQUIPMENT AND APPARATUS

Any material (be it a chemical, an apparatus, an item of furniture, a fixture...) can present a hazard, start a fire, or cause injury if not properly handled. You can remove or minimize the hazard with proper handling. Some of the precautions in handling common laboratory equipment are listed below.

EQUIPMENT LOCATION

Locate equipment set-ups as far back from the bench edge as possible, and be sure that the center of gravity of the apparatus is within the base area. Use ring stands properly.

HIGH-PRESSURE APPARATUS

Inspect all pressure equipment carefully before using and establish the limitations of the equipment with respect to temperature, pressure, and capacity. Be certain that the system is equipped with a safety relief valve and that it is operative. Introduce compressed gas from cylinders slowly and cautiously into the system, making certain that there is adequate shielding between you and the system including the pressure gauge. Remember to reduce the internal pressure to atmospheric pressure via the relief valve before you open the pressure vessel. High-pressure apparatus should be used in the bomb room on the roof. Never work alone in this room or at least have a contact check in on a regular basis.

REDUCED-PRESSURE SYSTEMS

Many of the precautions for use of high-pressure equipment apply equally here (e.g., limitations and inspection of equipment, provision for capillary relief valve, turning vacuum lines on (or off) slowly, examination of pressure gauges). In addition, round-bottom flasks should be used for low-pressure reactions, and vacuum pumps should be protected from corrosive gases (such as halogens, SO_2, HCl, etc.) by placing appropriate traps in the system. All glass vessels used in vacuum or pressure systems should be wrapped in tape to reduce the danger of flying glass in case of an implosion/explosion.

MECHANICAL SYSTEMS

Avoid personal injury by protecting or covering pump shafts, moving belts, etc. from towels or clothing, using explosion-proof motors on which liquid has been spilled, and use again only after they have thoroughly dried inside and out.

ELECTRICAL ASSEMBLIES

Avoid dangerous makeshift wiring assemblies by having permanent wiring (either conduit or BX cable) installed by an electrician. Replace immediately worn extension cords. Never handle any electrical connections with damp hands or when standing in or near water, and be wary of static accumulations, especially in high voltage situations. Never leave any conductor exposed if the electrical potential from it to ground exceeds 50 volts.

SP-8: HANDLING LABORATORY GLASSWARE

If not properly handled, glass apparatus can be a serious hazard to you. These hazards can be minimized by exercising certain precautions.

HANDLING GLASSWARE AND TUBING

Always carry glass tubing or rod in a vertical position. Protect your hands with a cloth towel or with gloves when cutting or breaking tubing, and fire polish immediately sharp edges of all glassware. Remember glass is still extremely hot even after it loses its glow. Never set a hot piece of glass on a cold surface. Test glassware for strains, and when necessary remove strains by annealing.

INSERTING AND REMOVING TUBING AND STOP-COCKS

Lubricate, using water or glycerine, the surface of glass tubing before inserting into rubber tubing or stoppers. When working such connections, protect your hands with gloves or a towel, and keep your hands close together. Use the same technique to remove glass tubing from rubber tubing or stoppers, and never use great force. If necessary, a lubricant can be worked between the rubber and the glass with the neck of a file. Frozen stoppers or stop-cocks should be removed with a stop-cock lifter.

USING VACUUM GLASSWARE

Protect yourself from flying glassware in the event of an explosion or implosion whenever glass apparatus under pressure or vacuum is used by employing a safety shield. Face shields should be required when using glass vacuum lines containing corrosive or toxic materials.

Additional protection can be gained by wrapping vacuum desiccators and Dewar flasks with electrical tape. Remove the cover of a desiccator with caution, after the pressure has been equalized, by sliding the cover to one side; do not lift. If the lubricant on the ground-glass surface has hardened, soften it by gentle warming with hot water. Vacuum lines containing hazardous materials must be located in fume hoods.

DISPOSING OF BROKEN GLASSWARE

Glassware should always be washed before it is stored or discarded. Remove broken glass fragments from desktops and floors with a brush, placing it in the proper disposal box (boxes are available in the main stockroom D110). Never store broken or fractured glass in the lab.

SP-9: FIRE PREVENTION

FIRE REQUIREMENTS

To start a fire three components must be present: a fuel, an oxidizing agent, and a source of heat for ignition. Many fires can be avoided by keeping fuel and oxidant away from the hot ignition sources. The major source of oxidant is, of course, air (oxygen); however, other oxidizing agents in labs can also supply the oxidant.

Common sources of heat in the lab are:

- Matches
- Bunsen burner
- Electric hot plates
- Electric sparks
- Steam baths

Common sources of fuel in the lab are:

- Wood
- Painted surfaces
- Towels, oily rags
- Paper and books
- Hair and clothing
- Gases (methane, hydrogen)
- Flammable solvents
- Many other chemicals or dusts thereof

PRECAUTIONS

The storage and handling of volatile flammable liquids requires that certain precautions be taken to minimize the fire hazard. The inherent fire and explosion hazard depends not only on the flash point of the fuel but also on its ignition temperature, explosive range, and vapor density.

- The flash point of a fuel is the lowest temperature at which it volatilizes fast enough to form an ignitable mixture with the air surrounding the flash apparatus.

- The ignition temperature of a material (whether solid, liquid, or gaseous) is the temperature required to cause sufficiently rapid oxidation to be self-sustained when the hot ignition source is removed.

- The explosive range of a fuel refers to the definite limitations of combustibility and rate of burning of the flammable vapor or dust mixture in air. The mixture is "too lean to burn" when the particles are so widely separated that those set afire by the hot ignition source will not set fire to others that are nearest. The mixture is "too rich to burn" when the particles are so close together that they exclude the oxygen necessary for combustion. The concentration between the "leanest" and the "richest" mixtures that will burn is called the "explosive range".

- A flash fire results from very rapid oxidation and occurs only when:

    - The fuel is mixed with sufficient oxygen for complete combustion. The particles of fuel vapor or dust are suspended in a diffused state in air, close enough to each other to propagate the flame through the vapor or dust and still sufficiently separated to make room for the required amount of oxygen for combustion.

- A source of heat equal to the ignition temperature is present.

    - To avoid a flash fire, keep the fuel at a temperature below its flash point and keep it away from hot surfaces that are above the ignition temperature. Remember the vapors having a density greater than air will flow downward to the hot plate whereas those less dense than air will flow upward.

FIRE EXTINGUISHING

A fire is extinguished by applying the same principles followed in trying to avoid it.

- Reduce the air supply by smothering--cover the vessel or apply CO_2.
- Shut off or reduce the fuel supply.
- Cool the fuel below its ignition temperature.
- Lower the concentration of the fuel by dilution with an inert material.

Types of fires:

- Class A: burning wood, paper, cloth, etc.; extinguished with water, foam, soda-acid, or CO_2.
- Class B: burning oils, greases, paints, etc.; extinguished with foam, CO_2, or dry chemical.
- Class C: live electrical equipment; extinguished with CO_2 or dry chemical.
- Class D: active metals such as sodium, potassium, aluminum, magnesium, lithium, also diborane, etc.; extinguished by smothering with dry soda ash, dry sodium chloride, sand (never use water, foam, CO_2, or CCl_4).

SAFE PRACTICES

The following safe practices must be known and observed to prevent or handle a fire:

1. See that corridors and stairwells are kept clear; avoid placing chemicals, equipment or furniture therein.

2. See that fire doors are kept closed at all times.

3. Know the location of fire blankets, safety showers, buckets, and fire extinguishers.

4. Know how to operate fire extinguishers and the type of fires for which they are to be used.

5. If a fire occurs, first get a fire extinguisher, and after assessing the situation and your personal safety, extinguish the fire, render assistance, or get additional help.

6. Never return an empty or partially used extinguisher to its rack. Tag it empty and call the Asst. Building Proctor to have it replaced at (970) 491-0502.

7. All fires for which an extinguisher is used or which causes damage or injury must be reported.

8. If your clothing should catch fire, try to stay calm, don't run, but quickly get under a shower and keep the water running. Or, wrap yourself in a fire blanket. Yell for help.

9. If a fire cannot be snuffed out immediately, have someone sound the building fire alarm and call 911. Give name and room number. Go to the front door of the building to direct firemen.

10. After hours call the emergency number (911). Give name, building, and room number.

APPENDICES

APPENDIX I: FLAMMABLE AND COMBUSTIBLE LIQUIDS

These guidelines provide requirements for all University faculty, staff, and students using, handling, or storing flammable and combustible liquids. These requirements are established to ensure faculty, staff and students know the physical characteristics of the material used and the protective measures necessary to prevent fire, explosion, or violent reaction.

DEFINITIONS

Flammable Liquid: A liquid having a flash point below 100°F (38°C) and a vapor pressure not exceeding 40 psi at 100°F (thus excluding liquefied petroleum gases, liquefied natural gases and liquefied hydrogen). Flammable liquids are subdivided as follows:

Class IA: Liquids with a flash point below 73°F (23°C) and a boiling point below 100°F.
Examples: acetaldehyde, butyne, chloropropylene, dimethyl sulfide, ethyl chloride, ethyl ether.

Class IB: Liquids with flash point below 73°F and a boiling point at or above 100°F.
Examples: acetone, benzene, carbon disulfide, ethyl alcohol, ethyl acetate, gasoline, hexane, isopropanol, methanol, toluene.

Class IC: Liquids with a flash point between 73°F and 100°F.
Examples: amyl alcohol, butyl alcohol, isobutyl alcohol, methyl isobutyl ketone, styrene, turpentine, xylene.

Combustible Liquid: A liquid having a flash point above 100°F. Combustible liquids are subdivided as follows:

Class II: Liquids with a flash point at or above 100°F and below 140°F (60°C).
Examples: No. 1, 2 and 3 fuel oils, kerosene, and hexyl alcohol.

Class IIIA: Liquids with a flash point at or above 140°F and below 200°F (93°C).
Examples: aniline, benzaldehyde, butyl cellosolve, nitrobenzene and pine oil.

Class IIIB: Liquids with a flash point at or above 200°F.
Examples: animal oils; ethylene glycol; glycerine; lubricating, quenching, and transformer oils; triethanolamine; benzyl alcohol; hydraulic fluids and vegetable oils.

Boiling Point: The temperature at which a liquid's vapor pressure is equal to the atmospheric pressure. Liquids with low boiling points are very volatile.

Flash Point: The minimum temperature of a liquid at which sufficient vapor is liberated to form a vapor-air mixture that will ignite and propagate a flame away from the ignition source (flash fire not continuous combustion).

Flammable (Explosive) Limits/Flammable (Explosive) Range: The terms flammable and explosive are used interchangeably since unconfined vapors mixed in air will burn while confined vapors will produce an explosion. The minimum vapor concentration in air that, when ignited, will propagate a flame is the lower flammable limit (LFL or LEL). The maximum vapor concentration in air that when ignited will propagate a flame is the upper flammable or explosive limit (UFL or UEL).

Vapor Pressure: A measure of the pressure created by a liquid's vapor at a specific temperature. Flammable or combustible liquids with a high vapor pressure at room temperature are more hazardous

than liquids with lower vapor pressures because they will produce more flammable vapor without heating.

Vapor Density: The weight of a volume of pure vapor or gas (with no air present) compared to the weight of an equal volume of dry air at the same temperature and pressure. A vapor density figure less than one indicates the vapor is lighter than air. A figure greater than one indicates the vapor is heavier than air.

Fire Area: An area of a building separated from the remainder of the building by construction having a fire resistance at least 1 hour (i.e. a single laboratory area).

Flammable Material Storage Cabinet: A storage cabinet constructed and arranged in accordance with NFPA and International Fire Code standards. **Note:** Cabinets that are typically located underneath bench tops and fume hoods are not considered approved cabinets unless they are provided with appropriate UL/FM labeling.

Flammable Liquid Storage Room: A room used for the storage of large quantities of flammable and combustible liquids which meets the construction, arrangement and protection requirements of Poudre Fire Authority (PFA), NFPA and International Building and Fire Code standards.

Safety Can: A metal container of not more than 5 gallon capacity which is UL/FM Approved and is provided with a flame arrestor, a spring-closing lid and spout cover designed to relieve internal pressure when subjected to fire exposure.

Approved Plastic Container: A plastic container meeting the requirements of and containing products authorized by the U. S. Department of Transportation (DOT) Hazardous Materials Regulations, 49 CFR or by Part 6 of the United Nations Recommendations on the Transport of Dangerous Goods (i.e. UN 1H1 – nonremovable head type plastic containers or as authorized by DOT exemption). The 5 gallon "red" container commonly used for ethanol is an example of a container meeting these guidelines.

HAZARDS DESCRIPTION

Flammable liquids are easily ignited and difficult to extinguish. Combustible liquids require heating for ignition and are easier to extinguish. Flammable and combustible liquids produce a high heat release rate once ignited (i.e., fires produce high temperatures in a short period of time), and associated fires spread rapidly.

Vapors from flammable and combustible liquids can be present at room temperature and can form explosive mixtures with air. Some liquids are unstable or very reactive (e.g., burn when exposed to air without an ignition source, susceptible to spontaneous heating, react violently with other materials including water). These characteristics combine to create a significant fire and/or explosion hazard.

Since the vapors generated from flammable liquids are most often heavier than air, they will seek the lowest available level in a building. This movement of vapors can produce potentially dangerous conditions far removed from the actual vapor source. Flammable vapor, if not removed by ventilation, can flow to an ignition source and flash back to the vapor source. The volatility of the liquid is increased when externally heated at or above its flash point. Overall, an increase in temperature will increase the hazard created by a flammable or combustible liquid by increasing its vapor's flammable range. Due to this, heated Class II and Class III liquids should be subject to all applicable requirements for Class I and Class II liquids respectively.

GENERAL GUIDELINES FOR FLAMMABLE AND COMBUSTIBLE LIQUIDS

- The volume of flammable and combustible liquids in a lab, room or location is restricted by University guidelines, and International Fire Codes. EHS should be contacted regarding any questions or for additional guidance.
- Below grade locations should not be used for Class I flammable liquids. If this is unavoidable, EHS must be contacted for review and guidance.
- Volumes of flammable and/or combustible liquids in laboratories should be kept to the minimum necessary for the work being done. The following guidelines provide the maximum allowable container size and type based on the flammable and/or combustible liquid classification.

Container Type	Liquid Classification and Maximum Container Size				
	IA	IB	IC	II	III
Glass	1 pt (0.5L)	1 qt (1L)	1.3 gal (5L)	1.3 gal (5L)	5 gal (20L)
Metal or Approved Plastic	1.3 gal (5L)	5 gal (20L)	5 gal (20L)	5 gal (20L)	5 gal (20L)
Safety Cans	2.6 gal (10L)	5 gal (20L)	5 gal (20L)	5 gal (20L)	5 gal (20L)

- The use of glass and plastic containers (with the exception of small squeeze bottles) for flammable and combustible liquids should be avoided where possible. If flammable liquids are handled in glass or plastic containers, carriers designed to protect the containers during transit should be used to prevent spillage.
    - Class IA and Class IB liquids can be stored in glass containers of not more than 1.3 gallon (5 L) capacity if the required purity (such as ACS analytical reagent grade or higher) would be affected by storage in a metal container or if the liquid can cause excessive corrosion of the metal container.
    - Many suppliers furnish glass containers with shatter-resistant coatings that offer significant protection from accidental breakage and are recommended for use when hazardous chemicals need to be kept in glass rather than plastic or metal containers.
- The combined volume of flammable and combustible liquid containers stored in a single fire area (laboratory) outside of a storage cabinet or flammable liquid storage room should be restricted as follows:
    - **Not in Safety Cans:** No more than 1 gallon of Class IA; 5 gallons of Class IB or Class IC; and no more than 10 gallons of Class I and Class II combined.
    - **In Safety Cans:** No more than 2.6 gallons of Class IA; 5 gallons of Class IB and Class IC; and no more than 25 gallons of Class I and Class II combined.
    - Class IIIA liquids should not exceed 60 gallons (230L).
    - Class IIIB liquids should not exceed four, 55 gallon drums. This applies only to mechanical areas containing hydraulic oils, lubricating oils, etc.
- Flammable aerosols and unstable liquids should be treated as Class IA liquids.
- Flammable and combustible liquids should be segregated and stored separately from incompatible materials such as acids, bases, corrosives and oxidizers.
- Empty and partially full containers should be handled and stored like full containers, that is, in an area suitable for flammable liquid storage (e.g., storage room, flammable liquid cabinet). Contact EHS for proper disposal methods for empty containers.

STORAGE OF FLAMMABLE AND COMBUSTIBLE LIQUIDS

Flammable Liquid Storage Cabinet

- An approved flammable liquids storage cabinet is required when:

    - The aggregate volume of Class I and Class II liquids in an individual fire area not in safety cans exceeds 10 gallons.
    - The aggregate volume of Class I and Class II liquids in an individual fire area in safety cans exceeds 25 gallons.
    - The aggregate volume of Class IIIA liquids exceeds 60 gallons.
    - The aggregate volume of Class IIIB liquids exceeds 220 gallons. This applies only to mechanical areas containing hydraulic oils, lubricating oils, etc.
- When a cabinet is provided, it shall be used for the storage of all flammable and combustible materials not in immediate use.

- Flammable Material Storage Cabinets must be:
    - UL/FM approved and marked in conspicuous lettering:
      "FLAMMABLE – KEEP FIRE AWAY"
    - Limited so that the maximum quantity of Class IA liquids is 30 gallons within the cabinet.
    - Must be connected to a dedicated exhaust (Lab or Hood) or not exhausted.
    - Equipped with self-closing and self-latching doors if purchased after 2005. If the cabinets were purchased prior to 2005 and came equipped with self-latching door mechanisms, it is recommended that this safety device be maintained as operational.
- A maximum of three (3) flammable material storage cabinets may be located within a single fire area (room).

<u>Flammable Storage Rooms</u>

- Approved Flammable Liquid Storage Rooms are constructed and utilized in compliance with the following guidelines:
    - Containers of Class I and Class II liquids with a capacity greater than 5 gallons.
    - The quantity of Class III liquids exceeds 330 gallons (the maximum capacity of 3 flammable liquids cabinets).
    - The floor must be liquid tight (including wall junctions) and pitched to a drain.
    - The drain (2 inch minimum) must go to outside containment or a grated covered containment basin of appropriate size in the facility to contain the flammable liquid and the sprinkler water.
    - Walls, floors and ceilings must be constructed of non-combustible materials and have a fire-resistive rating of not less than one hour. In many cases, a 2 hour rating may be necessary.
    - Doorways must be provided with non-combustible liquid-tight four inch raised sills or ramps to contain spilled material or a grate-covered trench across the door entrance.
    - Approved fire doors must be provided, and kept closed and latched at all times (or arranged to close automatically in case of fire).
    - The entrance to the room should be labeled in accordance with NFPA 704 – Identification of the Hazards of Materials for Emergency Response. Consult EHS.
    - Proper mechanical ventilation must be provided. Storage and other materials should not obstruct the exhaust ventilation. Ventilation must be a minimum of 8 inches in diameter with screened openings 6-12 inches above the floor. This includes the air inlet which should be located opposite the exhaust. Exhausts should be a minimum of 15 CFM or at least one air exchange every 5 minutes.
    - Heating is restricted to low pressure steam or hot water.
    - Explosion proof lighting and electrical service must be properly rated for the materials being stored and/or dispensed in the room. Electrical wiring and utilization equipment for Class I liquid storage shall be Class I, Division 2, and electrical wiring and utilization equipment in inside storage rooms used for the storage of Class II and Class III liquids shall be suitable for general purpose. Electrical switches and controlling equipment will be installed outside the room.

- No electrical or heating equipment is allowed below the four-foot level.
- The room should be kept free of compressed gases, and all combustible materials such as empty boxes, styrofoam shipping containers, plastic supplies and materials, and trash containers.
- As applicable, automatic detection and/or suppression systems are required in new or renovated rooms (one sprinkler head for every 80 square feet of floor space).
- A carbon dioxide (CO_2, 40BC) type fire extinguisher must be provided within 10 ft. of the door entrance external to a flammable liquids storage room.
- Containers of more than 30 gallons should not be stacked.

Refrigerated Storage of Flammable and Combustible Liquids

- Flammable and combustible materials that must be kept cold should be stored in refrigerators, freezers and coolers that are UL approved and rated for flammable material storage, and shall be stored in closed containers. Note that explosion-proof refrigerators are rarely necessary for University research applications. Consult with EHS for proper refrigeration unit selection.
- Modified or retrofitted refrigerators, freezers or coolers or standard domestic refrigerators must not be used.
- Fire protection depends on the class and quantity of liquids. The following table outlines this:

Fire Protection* Provided	Fire Resistance Required	Maximum Room Size (Sq. Ft.)	Allowable Loading (gals./sq. ft. of floor space)	Total Gallons Permitted
Yes	2-Hour	500	10	5,000
No	2-Hour	500	**4	2,000**
Yes	1-Hour	150	5	750
No	1-Hour	150	2	300

*Fire protection may be automatic sprinklers, water spray, dry chemical, carbon dioxide or other systems approved by PFA.
**Total Allowable Capacities are limited to:
Class IA – 660 Gallons
Class IB – 1,375 Gallons
Class IC – 2,750 Gallons
Class II – 4,125 Gallons
Class IIIA – 13,750 Gallons
Class IIIB – 13,750 Gallons

Dispensing and Control of Ignition

- Dispensing of Class I liquids to or from containers less than or equal to 5 gallons (20 L) in capacity shall be performed in one of the following locations:
  - In a chemical fume hood or,
  - In an area provided with ventilation adequate to prevent accumulations of flammable vapor/air mixtures from exceeding 25 percent of the lower flammable limit or,
  - Inside a flammable liquid storage room arranged for dispensing Class I flammable liquids.
- Dispensing of Class I liquids to or from containers greater than 5 gallons (20 L) shall be performed in one of the following locations:
  - In a separate area outside the building or,
  - Inside a flammable liquid storage room arranged for dispensing Class I flammable liquids.
- Class I liquids shall not be transferred between conductive containers of greater than 1.3 gallon (5 L) capacity unless the containers are electrically interconnected by direct bonding or by indirect bonding through a common grounding system.

    - The use of squeeze bottles is currently permitted, since their use greatly reduces spills and the small rate of intermittent discharge through a squeeze bottle's discharge tube has not proven to be a hazard.
- The following applies for the dispensing of flammable and combustible liquids from containers greater than 5 gallons (20 L):
    - For dispensing of Class I flammable liquids, drum pumps should be used. For dispensing of Class II and Class III liquids, self-closing faucets may be used. Use drip cans below faucets with on-side dispensing operations of Class II liquids in areas where the ambient temperature can approach 100°F (38°C). A shallow metal drip pan is acceptable for use with Class II (except as noted) and Class III combustible liquids. The drum pumps, self-closing faucets, and drip cans should be UL/FM Approved.
    - When dispensing by faucet, the spout or the flexible metal hose MUST be in contact with the containers by a bonding strap or grounding wire cable.
    - When dispensing by pump, the dispensing hose must be equipped with a ground wire, both to ground the supply and the receiving container.
    - When using metal drum racks, the drums, racks and containers being filled must be bonded and grounded.
    - Rotary pumps must be equipped with proper hoses and grounding straps to the receiving container.
    - Where possible, dispensing from larger to smaller containers should utilize approved safety cans.
    - Provide safety bungs on drums of Class I liquids arranged for upright dispensing with a drum pump that is not equipped with pressure and vacuum relief vents. If ambient temperatures can approach 100°F (38°C), safety bung use should include Class II liquids. Also provide safety bungs on drums of Class II and III liquids arranged for on-side dispensing.

<u>Heating Equipment for Flammable and Combustible Liquids</u>

- Heating equipment or heating baths with flammable liquids or combustible liquids heated to their flash points shall be placed in a chemical fume hood or shall be vented to a safe location to control vapors.
- All unattended electrical heating equipment shall be equipped with a manual reset over-temperature shutoff switch, in addition to normal temperature controls, if overheating could result in a fire or explosion.
- Heating equipment with circulation fans shall be equipped with an interlock arranged to disconnect current to the heating element if the fan fails.
- Electrically heated constant temperature baths shall be equipped with overtemperature shutoff switches in addition to normal temperature controls, if overheating could result in a fire or an explosion.
- Bath containers shall be of noncombustible materials.
- Burners, induction heaters, ovens, furnaces, and other heat-producing equipment shall be located a safe distance from areas where temperature-sensitive and flammable materials and compressed gases are handled.

<u>Safety Considerations</u>

- For all areas using flammable or combustible liquids, CO_2 fire extinguishers should be located within a 50 ft. travel distance.
- Eliminate or exclude all sources of ignition within use and storage areas for flammable and combustible liquids.

- Spark-proof tools should be used to eliminate friction sparks made by metal striking metal contact.
- Oil or solvent soaked wiping clothes, rags or waste must be stored in a UL/FM Approved metal container with a self closing lid. The containers should be marked, identifying the contents of the container (e.g. "Oil Soaked Rags")
- Users of flammable or combustible liquid should maintain absorbent material to control spills.

<u>Spills</u>

- Minor Spills of Flammable or Combustible Liquids
    - Extinguish ignition sources.
    - Contain spilled material.
    - Use absorbent material to clean spill.
    - Place clean up material in chemical waste stream following guidelines for safe handling of flammable and combustible liquid found in this document.
- Spills of flammable or combustible liquids that are beyond the clean-up capabilities of the persons using the materials shall be handled by the Department of Environmental Health Services. Such a spill constitutes emergency response and must be promptly reported to EHS or Colorado State University Police Department.

APPENDIX II: HAZARDOUS CHEMICAL STORAGE PRECAUTIONS

AMOUNTS IN STORAGE

Labs should limit the quantity of chemicals to be only what is necessary to complete the task requirements. Limits for the National Fire Protection Association must be met for all locations. Prudent practice is that the quantity of chemicals in a laboratory not exceed a total of 60 gallons or three month's supply (for all such chemicals combined).

STORAGE LOCATIONS

A designated storage location should be identified. Storage areas should be away from sun and heat. Storage under sinks is not allowed except for cleaning chemicals used in the laboratory. All storage locations for chemicals must be secured against theft. To prevent theft, workers should make sure doors are locked when unattended. Chemicals regulated by the Drug Enforcement Agency may require registration controlled storage. Storage above eye level should be avoided.

SHELVING

The best shelving is steel with acid-resistant paint; next best is wood with acid-resistant paint. Shelving should be labeled clearly to indicate what kinds of chemicals may be stored there. An easy way to do this is to color-code the edges of shelves with paint or tape to match the color-coding of labels; materials then can be returned to proper storage at a glance. Lips or restraining devices on shelves should be used. All shelving must be securely attached to the building or its components. Free standing shelving is not allowed. No chemicals can extend beyond the edge of the shelf.

LIQUID CHEMICALS

Liquid chemicals must be in some type of secondary container. Compatible liquids can be stored in the same secondary container. Secondary containers must have a capacity of 110% of the largest container or 10% of the aggregate volume of the containers, whichever is greater.

LECTURE BOTTLES

Lecture bottles must be placed in a rack designed for the purpose (resembling an oversize test-tube rack) or be firmly clamped to a ring stand with a heavy base, in an upright position. They may not be used or stored lying on their sides. These precautions are designed to avoid the cylinder cap being broken off through a fall or a sudden increase in pressure. In such events explosions may result, and the gas cylinder may become a dangerous projectile.

FUME HOODS

Exhausted fume hoods should not be used for dual use (i.e. process use and storage). If the fume hood is used for process use, any items, such as hazardous waste containers and other nonessential equipment placed in the hood will create some turbulence or block airflow in the exhausted fume hood. Keep only those items necessary for the experimental procedure in the hood enclosure. Clutter in the hood disrupts the airflow, reducing its capture efficiency and may provide fuel if there is a fire. If the fume hood will be used for storage of chemicals, the fume hood must be marked "CHEMICAL STORAGE ONLY" and no processes are allowed in the fume hood.

STORAGE ON THE FLOOR

Glass and liquid filled containers are not allowed to be stored directly on the floor. They must be in secondary containers in order to be stored on the floor.

COMPATIBILITY

Chemicals must be stored by compatibility. Chemicals can be stored alphabetically with other compatible chemicals. This is outlined and discussed below. Many chemicals pose hazards that correspond to more than one storage type. These chemicals should be stored in the lowest type number.

STORAGE CONTAINERS

Use

All chemicals should be maintained per manufacturer requirements. Stock containers should be returned to the storage location after each use and not left on the bench top work area. Storage on benchtops prevents protection from ignition sources and are more easily knocked over. Only chemicals in use should be in the work area. The law requires that damaged containers be disposed of immediately. "Damaged" includes: cracked or broken caps; chipped threads on bottle necks; and corrosion of metal containers, even if an interior glass container is intact. Do not stack containers in storage areas.

Closures

All containers must have tight closing lids and be secure and place when not in use.

LABELING

All chemicals must be appropriately labeled. If possible store chemicals in their original containers. If they are transferred to secondary containers, the secondary container must have a label that contains a minimum of full chemical name, concentration of each chemical, hazard (danger, warning, caution, water reactive, flammable, etc) and date of transfer.

TYPE 1

Explosive and highly unstable

- Special provisions for storage are required.
- Inventory and oversight are required by the University Licensed explosives permit holder. Contact EHS

Compatibility chart

TYPE 2	TYPE 3	TYPE 4	TYPE 5	TYPE 6	TYPE 7	TYPE 8	TYPE 9
NO	NO	NO	NO	NO	NO	NO	NO

Lead (II) Azide	Diazomethane	Silver (I) fulminate
Silver (I) Azide	Azobisisobutylnitrile	Lead acetylides
Sodium Azide	Lead (II) fulminate	Silver acetylides
Propyl nitrate	Pentaerylthritol tetranitrate (PETN)	Cyclonite (RDX)
Dinotrophenol	Dinitrotoluene	Dinotrophenylamine
Nitrocellulose	Trinitrophenol (Picric Acid)	Trinitrotoluene (TNT)
Perchlorate acid digests	Transition metal perchlorate salts	

TYPE 2

Volatile TOXIC COMPOUNDS

- Store volatile toxics (evaporation rate above 1.0 - ether = 1.0) in exhausted flammable cabinets.
- Storage of containers less than 1 liter for a total of 4 liters is allowed in refrigerators.
- Store according to hazardous nature of chemical, using appropriate security when necessary.
- The storage location should be labeled "TOXIC CHEMICALS".
- **WARNING**: These chemicals are dangerous to health and life when inhaled, swallowed, or absorbed by skin contact. Take proper precautionary measures to avoid exposure. Ensure that any appropriate antidotes are available.

Compatibility chart

TYPE 1	TYPE 3	TYPE 4	TYPE 5	TYPE 6	TYPE 7	TYPE 8	TYPE 9
NO	**NO**	**YES**	**NO**	**NO**	**NO**	**NO**	**NO**

Liquids

Carbon Disulfide	p-Dioxane	Hydrogen Peroxide >70%
Carbon Tetrachloride	Formic Acid	Phosphourous Trichloride
Chloroform	Hydrochloric Acid	Nickel Carbonyl

Gases

Carbon Monoxide	Formaldehyde	Nitrogen dioxide
Chlorine	Hydrogen Bromide	Ozone
Cyanogen	Hydrogen Chloride	Sulfur Dioxide
Diborane	Hydrogen Cyanide	Carbonyl Fluoride
Fluorine	Hydrogen Sulphide	Phosgene
Germane	Hydrogen Selenide	Nitric Oxide

TYPE 3

Pyrophoric and water reactive

PYROPHORIC SUBSTANCES (Substances liable to spontaneous combustion)

- Store in a cool, dry place.
- **WARNING:** Pyrophoric substances ignite spontaneously upon contact with air.
- Label, date, and inventory all highly reactive materials as soon as they are received.
- Make sure to label secondary containers with the name of the chemical, and the words **"DANGER! HIGHLY REACTIVE MATERIAL"**.
- Do not open a container of highly reactive material that is past its expiration date.
- Do not use metal spatulas to handle peroxides because contamination by metals can lead to explosive decomposition. Use ceramic, Teflon, or wooden spatulas.

Compatibility chart

TYPE 1	TYPE 2	TYPE 4	TYPE 5	TYPE 6	TYPE 7	TYPE 8	TYPE 9
NO	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Solids

Boron	Diborane	*Manganese
*Cadmium	Dichloroborane	*Nickel
*Calcium	*Zinc	+Phosphorous, Yellow
*Chromium	*Iron	*Titanium
*Cobalt	*Lead	2-Furaldehyde

*Finely divided metals form a pyrophoric hazard.
+Phosphorous, Yellow should be stored and cut under water.

WATER REACTIVE CHEMICALS

- Store in a cool, dry place.
- In case of fire, keep water away.
- **WARNING:** These chemicals react with water to yield flammable or toxic gases or other hazardous conditions.
- For secondary containers include the warning **"DO NOT USE WATER TO EXTINGUISH FIRE."**
- Do not open a container that is past its expiration date.

Solids

Aluminum Chloride, anhydrous	+Lithium	Phosphorous Pentasulfide
Calcium Carbide	Magnesium	+Potassium
Calcium Oxide	Maleic Anhydride	+Sodium
Ferrous Sulphide	Phosphorous Pentachloride	

+Lithium, Potassium, and Sodium should be stored under kerosene or mineral oil.

Liquids

Acetyl Chloride	Silicon/Tetrachloride	Sulfuryl Chloride
Chlorosulfonic Acid	Stannic Chloride	Thionyl Chloride
Phosphorous Trichloride	Sulfur Chloride	

TYPE 4

FLAMMABLES

- Flammable liquids (flashpoints <140F) should be returned to the flammable cabinet or explosion-proof storage area immediately after use.
- Do not store flammable liquids in cold rooms which are neither vented or explosion proof.
- Store in approved safety cans or cabinets (when greater than 10 gallons).
- Segregate from oxidizing acids and oxidizers.
- Keep away any source of ignition: flames, localized heat or sparks.
- Safety cans or drums containing flammable liquids should be grounded and bonded when these liquids are being transferred.
- Keep appropriate fire-fighting equipment readily available (e.g. metals fire extinguisher if metal fires a possibility.
- Have spill cleanup materials handy.
- Refrigerators used to store flammable liquids (containers < 1 liter and a maximum of 4 liters) are to be of the explosion proof type.

Compatibility chart

TYPE 1	TYPE 2	TYPE 3	TYPE 5	TYPE 6	TYPE 7	TYPE 8	TYPE 9
NO	**YES**	**NO**	**NO**	**YES**	**NO**	**YES**	**YES/NO**

Solids

Benzoyle Peroxide	Phosphorous, yellow
Calcium Carbide	Picric Acid (crystals)

Gases

Acetylene	Ethane	Hydrogen
Ammonia	Ethylene	Hydrogen Sulphide
Butane	Ethylene Oxide	Methane
Carbon monoxide	Formaldehyde	Propane propylene

Liquids

Acetaldehyde	Ethylamine	Methyl Ethyl Ketone
Acetone	Ethyl Benzene	Methyl Formate
Acetyl Chloride	Ethylene Dichloride	Methyl Isobutyl Ketone

Allyl Alcohol	Ethyl Ether	Methyl Methacrylate
Allyl Chloride	Formate	Methyl Propyl Ketone
N-Amyl Acetate	Furan	Morpholine
N-Amyl Alcohol	Gasoline	Naptha
Benzene	Heptane	*Nitromethane
N-Butyl Acetate	Hexane	Octane
N-butyl Alcohol	Hydrazine	Piperidine
N-Butylamine	Isobutyl Alcohol	Propanol
Carbon Disulfide	Isopropyl Acetate	Propyl Acetate
Chlorobenzene	Isopropyl Alcohol	Propylene Oxide
Cyclohexane	Isopropyl Ether	Pyridine Ethyl
Diethylamine	Mesityl Oxide	Styrene
Diethyl Carbonate	Methanol	Tetrahydrofuran
p-Dioxane	Methyl Acetate	Toluene
Ethanol	Methyl Acrylate	Turpentine
Ethyl Acetate	Methylal	Vinyl acetate
Ethyl Acrylate	Metyl Butyl Ketone	Xylene
Acetonitrile		

*Most nitrohydrocarbons are flammable

TYPE 5

ACIDS

- Always slowly add acid to water (A&W), never add water to acids.
- Store large bottles of acid on low shelf or in acid cabinets.
- Strong acids will likely corrode most metal cabinets. It is recommended that hydrochloric acid not be stored in any metal cabinet.
- Oxidizing acids (nitric, sulfuric, phosphoric, perchloric) should have secondary containment and, as a group, be stored separately from other acids (organic and mineral).
- Perchloric acid should not be stored in a wooden cabinet.
- Segregate acids from bases and active metals such as sodium, potassium, magnesium, etc.
- Segregate acids from chemicals that could generate toxic gases upon contact such as sodium cyanide, iron sulfide, etc.
- Use bottle carriers for transporting hazardous chemicals (e.g. acids, bases, and flammables) in glass bottles.
- Have spill control pillows or acid neutralizers available in case of acid spills.
- Store oxidizing acids below organic and mineral acids.

Compatibility chart

TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 6	TYPE 7	TYPE 8	TYPE 9
NO	**YES**	**NO**	**NO**	**NO**	**NO**	**YES**	**YES/NO**

+Acetic Acid	Hydrofluoric Acid	Phosphoric Acid
+Benzoic Acid	Hydroiodic Acid	Phosphorous Acid
+Chloracetic Acid	*Iodic Acid	+Propionic Acid
*Chromic Acid	Muriatic Acid	+Sulfamic Acid
*Hydrobromic Acid	*Nitric Acid	+Sulfanilic Acid
Hydrobromous Acid	Nitrous Acid	*Sulfuric Acid
Hydrochloric Acid	*Perchloric Acid	Sulfurous Acid
Hydrochlorous Acid	+Phenol	

+ Indicates organic acids
*Indicates strong oxidizing acids

TYPE 6

BASES

- Segregate bases from acids.
- Store solutions of inorganic hydroxides in polyethylene secondary containers.
- Have spill control pillows or caustic neutralizers available for caustic spills.
- Secondary containment for all bases.

Compatibility chart

TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5	TYPE 7	TYPE 8	TYPE 9
NO	**NO**	**NO**	**YES**	**NO**	**YES**	**NO**	**YES/NO**

Ammonium Hydroxide	[2] Carbonates, salts of	Potassium Hydroxide
[1] Bicarbonates, salts of	Calcium Hydroxide	Sodium Hydroxide

[1] Potassium bicarbonate, sodium bicarbonate, etc.
[2] Calcium carbonate, sodium carbonate, etc.

TYPE 7

Oxidizers and peroxide formers

OXIDIZERS – Strong supporters of combustion

- Store in a cool, dry place.
- Keep away from flammable and combustible materials (such as paper, wood, etc.)
- Keep away from reducing agents such as zinc, alkaline metals, and formic acid.
- Total quantities exceeding 3 liters should be kept in a cabinet housing no other chemicals.

- Smaller quantities must be double-contained if kept near other chemicals, e.g., in a refrigerator.
- Do not store on combustible shelving.

Compatibility chart

TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5	TYPE 6	TYPE 8	TYPE 9
NO	**NO**	**NO**	**NO**	**YES**	**YES**	**YES**	**YES/NO**

Solids

Ammonium Dichromate	Ferric Chloride	Potassium Ferricyanide
Ammonium Perchlorate	Iodates, Salts of [3]	Potassium Permanganate
Ammonium Persulfate	Iodine	Potassium Persulfate
Benzoyl Peroxide	Magnesium Perchlorate	Sodium Bismuthate
Bromates, Salts of [1]	Manganese Dioxide	Sodium Chlorite
Calcium Hypochlorite	Nitrates, Salts of [4]	Sodium Dichromate
Cerric Sulfate	Peroidic Acid	Sodium Nitrate
Chlorates, Salts of [2]	Permangic Acid	Sodium Perborate
Chromium Trioxide	Peroxide, Salts of [5]	Sulfates, Salts of [6]
Ferric Trioxide	Potassium Dichromate	

[1] Potassium bromate, sodium bromate, etc.
[2] Potassium chlorate, etc.
[3] Sodium iodate, etc.
[4] Ammonium nitrate, ferric nitrate, etc.
[5] Lithium peroxide, sodium peroxide, etc.
[6] Ferric sulfate, potassium sulfate, etc.

Liquids

Bromine	Hydrogen Peroxide	Perchloric Acid
Chromic Acid	Nitric Acid	Sulfuric Acid

Gases

Chlorine	Nitrogen Dioxide	Ozone
Chlorine Dioxide	Nitrogen Oxide	
Fluorine	Oxygen	

PEROXIDE FORMING CHEMICALS

- Store in airtight containers in a dark, cool dry place.
- Store containers in flammable cabinets.
- Label containers with receiving, opening, and disposal dates.
- Dispose of peroxide forming chemicals before six months (three for some).

- Test for the presence of peroxides periodically.
- Do not open if crystals or a precipitate are present.
- Avoid friction, grinding, and all forms of impact near peroxides, especially solid peroxides (ie benzoyl peroxide) and diazomethane solution (used in methylation of some pesticides). Glass containers that have screwcap lids or glass stoppers **should *not* be used**. Instead, use polyethylene bottles with screw-cap lids.
- Store liquid organic peroxides at the lowest possible temperature consistent with the solubility or freezing point. Liquid peroxides are particularly sensitive during phase changes.
- **WARNING:** Compounds that form peroxides can be extremely dangerous and may cause an explosion. Under proper conditions, these chemicals will form explosive peroxides, which can be detonated by shock, heat or friction.

Acetal	+p-Dioxane	*Potassium Metal
Acetaldehyde	9,10 Dihydroanthracene	[1]Potassium Cyclohexene
Acrylaldehyde	+Diacetylene	*Sodium Amide
Butadiene	Dibenzocyclopentadiene	Styrene
t-Butyl Alcohol	+Diethyl Ether	Tetrafluoroehtylene
Chlorobutadiene	Ethyl Ether	+Tetrahydrofuran
Chlorotrifluoroethylene	+Ethylene Glycol Dimethyl Ether	Tetrahydronapthalene
Crotonaldehyde	*Isopropyl Ether	+Tetralin
+Cumene	Indene	Vinyl Ethers
+Cyclohexene, Cyclopentene	+Methyl I-Butyl Ketone	*Vinylidene Chloride
*Divinyl Acetylene	Methylcyclopentane	Vinyl Pyridine
Dicyclopentadiene	+Methylacetylene	Vinyl Acetate
+Dioxane	+Methylcycloalkanes	Vinyl Acetylene

[1]Potassium peroxide often exists in the crust around a chunk of potassium. When cut with a knife the peroxide rapidly oxidizes the residual kerosene resulting in an explosion.
*Indicates that the chemical should not be stored more than three months.
+Indicates that the chemical should not be stored more than six months.

TYPE 8

TOXIC COMPOUNDS

- Amounts less than 1 liter may be stored in a cabinet above bench level if the cabinet has sliding doors (not swinging).
- Store according to hazardous nature of chemical, using appropriate security when necessary.
- **WARNING**: These chemicals are dangerous to health and life when inhaled, swallowed, or absorbed by skin contact. Take proper precautionary measures to avoid exposure. Ensure that any appropriate antidotes are available (e.g. calcium gluconate for HF).
- Do not store on open shelves in the lab or cold room.
- Liquid poisons in containers larger than 1 liter must be stored below bench level on shelves closest to the floor.

- The storage location should be labeled "TOXIC CHEMICALS".

Compatibility chart

TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5	TYPE 6	TYPE 7	TYPE 9
NO	**NO**	**NO**	**YES**	**YES**	**NO**	**YES**	**YES/NO**

Solids

Antimony Compounds	Fluorides, Salts of	Phosphorous Pentasulfide
Arsenic Compounds	Iodine	Picric Acid
Barium compounds	Lead Compounds	Potassium
Beryllium Compounds	Mercuric Compounds	Selenium compounds
Cadmium Compounds	Oxalic Acid	Silver Nitrate
Calcium Oxide	Phenol	Sodium Hydroxide
Chromates, salts of	Phosphorous, Yellow	Sodium Hypochlorite
Cyanides, Salts of	Phosphorous Pentachloride	

Liquids

Aniline	Hydrazine	Nitric Acid
Bromine	Hydrobromic Acid	Sulfuric Acid
Chromic Acid	Hydrofluoric Acid	Tetrachloroethane
Ethylene Glycol	Mercury	Tetrachloroethylene

TYPE 9

Other

LIGHT SENSITIVE CHEMICALS

- Avoid exposure to light.
- Store with other compatible type chemicals.
- Store in amber bottles in a cool, dry place.

TYPE 1	TYPE 2	TYPE 3	TYPE 4	TYPE 5	TYPE 6	TYPE 7	TYPE 8
NO	**NO**	**NO**	**YES/NO**	**YES/NO**	**YES/NO**	**YES/NO**	**YES/NO**

Bromine	Mercuric Salts [1]	Sodium Iodide
Ethyl Ether	Oleic Acid	Mercurous Nitrate
Ferric Ammonium citrate	Potassium Ferrocyanide	
Hydrobromic Acid	Silver Salts [2]	

[1] Mercuric chloride, mercuric iodide, etc.
[2] Silver Acetate, silver chloride, etc.

APPENDIX III: COMPRESSED GAS GENERAL SAFETY PRECAUTIONS

GENERAL INTRODUCTION

Compressed gas cylinders can be extremely hazardous when misused or abused. Compressed gas cylinders can present a variety of hazards due to their pressure and/or content.

Depending on the particular gas, there is a potential for simultaneous exposure to both mechanical and chemical hazards. Gases used maybe:

- Flammable (Type 4)
- Inert (Type 9)
- Combustible (Type 7)
- Acidic (Type 5)
- Corrosive (Type 6)
- Reactive (Type 3)
- Explosive (Type 1)
- Poisonous (Type 2)
- or a combination of hazards

Without proper use and care compressed gas cylinders can explode killing workers and destroying equipment. Cylinders can also become flying projectiles when cylinder valves are damaged or broken off. Regulators can become bullets that tear through workers if safety precautions are not taken.

Careful procedures are necessary for handling the various compressed gases, cylinders, regulators or valves used to control gas flow, and the piping used to confine gases during flow. This booklet can be used as a guideline for the safe use of compressed gas.

REGULATIONS APPLICABLE TO COMPRESSED GAS CONTAINERS

- **Compressed gases.** Compressed Gas Association Pamphlet P-1-1965, covers in-plant handling, storage, and use of all compressed gas cylinders, portable tanks, or motor vehicle cargo.

- **Inspection of compressed gas cylinders.** Each employer must determine that compressed gas cylinders under his/her control are in a safe working condition to the extent that can be determined by a visual inspection. Visual and other inspections must be conducted as prescribed in the *Hazardous Materials Regulations of the Department of Transportation (49 CFR parts 171-179 and 14 CFR part 103).*

Where those regulations are not applicable, visual and other inspections shall be conducted in accordance with *Compressed Gas Association Pamphlets C-6-1968 and C8-1962*.

- **Safety relief devices for compressed gas containers.** Compressed gas cylinders, portable tanks, and cargo tanks shall have pressure relief devices installed and maintained in accordance *with Compressed Gas Association Pamphlets (CGA) S-1.1-1963 and 1965 addenda and S-1.2-1963*

- **Welding and cutting.** The storage, handling, and use of compressed gas containers for welding and cutting shall comply with the *American National Standards Institute ANSI Z-49.1* and *29 CFR 1910.252*.

- **National Fire Prevention Association.** NFPA 55, Standard for the Storage, Use, and Handling of Compressed and Liquefied Gases in Portable Cylinders.

Checklist A is intended to assist you in identifying possible safety and health hazards concerning compressed gas cylinders for general use. Following each check is the reference number to the CGA Pamphlet P-1 1974 (see appendix A).
Checklist B is intended to assist you in identifying possible safety and health hazards concerning installation and operations of oxygen and fuel/gas systems for welding and cutting. Following each check is the reference number for *ANSI-49.1 1969* (see appendix B).

COMPRESSED GAS SAFETY GUIDELINES

Identification "ALWAYS READ THE LABEL"

- The contents of any compressed gas cylinder must be clearly identified. Gas identification should be stenciled or stamped on the cylinder or a label. Commercially available three-part tag systems may be used for identification and inventory.
- No compressed gas cylinder should be accepted for use that does not legibly identify its contents by name. If the labeling on a cylinder becomes unclear the cylinder should be marked "contents unknown" and returned to the supplier.
- Do not rely on the color of the cylinder for identification. Color-coding is not reliable because cylinder colors may vary with supplier. Also, never rely on labels on caps because they are interchangeable.
- All gas lines leading from a compressed gas supply should be clearly labeled to identify the gas and the area served. The labels should be coded to distinguish hazardous gases such as flammable, toxic, or corrosive substances. Signs should be posted in areas where flammable compressed gases are stored or used, identifying the substance and appropriate precautions.

Handling and Use

Before cylinders are first used the following precautions should be taken:

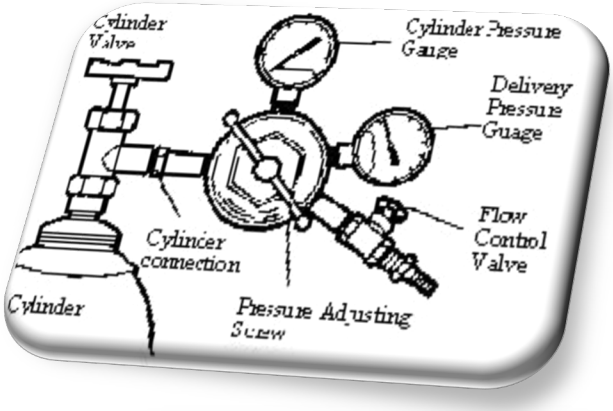
- Make sure the cylinder is equipped with the correct regulator.
- Inspect the regulator and cylinder valves for grease, oil, dirt, and solvent. Never use grease or oil to lubricate regulators or cylinder valves because they can cause an explosion.
- The cylinder should be placed so that the valve handle at the top is easily accessible.
- When using toxic or irritating gas, the valve should only be opened while the cylinder is in a working fume hood.
- Only use wrenches or tools that are provided by the cylinder supplier to open or close a valve. Pliers should never be used to open a cylinder valve. Some regulators require washers; this should be checked before the regulator is fitted.
- Refer to MSDS for the gas being used for information regarding use and toxicity.
- Fire extinguishing equipment should be readily available when combustible materials can be exposed to welding or cutting operations using compressed cylinder gases.

Cylinder Storage

- Gas cylinders must be secured at all times to prevent tipping.
- Use appropriate material, such as chain, plastic coated wire cable, commercial straps, etc., to secure cylinders.
- Gas cylinders cannot be stored in public hallways or other unprotected areas.
- Cylinders must be segregated in hazard classes while in storage. Oxidizers (oxygen) must be separated from flammable gases, and empty cylinders must be isolated from filled cylinders.
- The proper storage for oxygen cylinders requires that a minimum of 20 feet is maintained between flammable gas cylinders and oxygen cylinders or the storage area be separated, at a minimum, by a firewall five (5) feet high with a fire rating of 30 minutes.
- Store out of direct sunlight and away from sources of heat and ignition; temperatures must not exceed 125°F.
- Acetylene cylinders must never be stored on their sides.
- Always place valve protectors on gas cylinders when the cylinders are not connected for use.
- Cylinders must be protected from damage. Do not store cylinders near elevators or gangways, or in locations where heavy-moving objects may strike or fall on them.
- Cylinders must be stored where they are protected from the ground to prevent rusting.
- Cylinders should be protected against tampering by unauthorized individuals.
- Storage areas must be well-ventilated, cool, dry, and free from corrosive materials.

Moving Cylinders

- Never drag, slide or roll a cylinder; use a cylinder cart or basket.
- Always have the protective cap covering the valve when transporting the cylinder.
- Never transport the cylinder with the regulator in place.
- Make sure the cylinder is secured to the cart before moving it.
- Do not drop cylinders or strike them against each other or against other surfaces violently.
- Do not use the valve cover to lift cylinders; they could be damaged and become unattached. If the cylinder is dropped on a hard surface it can cause an explosion.



Use and Operation

- Only properly trained personal should handle compressed gas cylinders.
- Back off the pressure adjusting screw of the regulator to release spring force before opening the cylinder valve.
- Open the valve slowly and only with the proper regulator in place. Stand with the cylinder between yourself and the regulator (cylinder valve outlet facing away) when opening the cylinder valve.
- Acetylene or other flammable gas cylinder valves should not be opened more than ½ turns of the spindle, and preferably no more than ¾ of a turn. This reduces the risk of explosion and allows for the cylinder valve to be closed quickly to cut off the gas flow.
- Never heat a cylinder to raise the pressure of the gas (this can defeat the safety mechanisms built in by the supplier).
- Keep the cylinder clear of all electrical circuits, flame, and sparks.
- Never leave the valve open when equipment is not in use, even when empty; air and moisture may diffuse through an open valve, causing contamination and corrosion within the cylinder.
- Do not refill a cylinder. Mixing of residual gases in a confined area may cause a dangerous reaction.
- Never use copper fittings or tubing on acetylene tanks – an explosion may result.
- Never use compressed gas to dust off clothing, this could cause injury to the eyes or body and create a fire hazard. Clothing can become saturated and burst into flames if touched off by an ignition source such as a spark or cigarette.
- Never leave pressure in a regulator when it is not in use.
- Valve protection caps should remain in place until ready to withdraw gas, or connect to a manifold.
- Cylinder discharge lines should be equipped with approved check valves to prevent inadvertent contamination of cylinders connected to a closed system.
- Do not force connections that do not fit.
- Close the cylinder valve and release all pressure before removing the regulator from the cylinder.

- Do not smoke when oxygen or fuel gases are present. Smoking can cause a fire or explosion.
- Do not use acetylene at operating pressures above 15 psig.
- Purge fuel and oxygen hoses individually before lighting up a torch tip.
- Follow the equipment manufacturer's operating instructions at all times.
- If an outlet valve becomes clogged with ice, thaw it with warm water (if the gas is not water reactive), applied only to the valve.
- Use the cylinder valve for turning gas off, not the regulator.
- Workers should wear safety glasses and face shields when handling and using compressed gases, especially when connecting and disconnecting regulators and lines.

- OXYGEN IS NOT COMPRESSED AIR, IT IS OXYGEN
- Never use oxygen as a substitute as a "compressed air" to run pneumatic tools, in oil heating burners, to start internal combustion engines, to blow out pipelines, or to create pressure for ventilation.
- Oxygen cylinder valves should be opened all of the way during use.

Cylinder Leaks

- If the cylinder contains a **flammable, inert, or oxidizing gas**, remove it to an isolated area, away from possible ignition sources. Allow it to remain isolated until the gas has discharged, making certain that appropriate warnings have been posted.
- If the gas is a **corrosive**, remove cylinder to an isolated, well-ventilated area. The stream of leaking gas should be directed into an appropriate neutralizing material.
- For **toxic** material, the cylinder should be removed to an isolated, well-ventilated area, but only if this is possible while maintaining personal safety. It may be necessary to evacuate the facility.
- If the leak is at the junction of the cylinder valve and cylinder, do not try to repair it. Contact the supplier and ask for response instructions.
- Never use a flame to detect a gas leak. Use soapy water.

After the cylinder is no longer needed, the following steps should be taken:

- Do not completely empty the cylinder; always leave some residual pressure.
- If the cylinder is empty, replace the cap and remove it to the empty cylinder storage area.
- Label all empty cylinders with tags so that everyone will know their status. Empty cylinders can be marked with "MT and date" with chalk.
- Handle empty cylinders as carefully as full ones; residual pressure can be dangerous.
- Never refill a cylinder. This requires specialized equipment and techniques.
- Never mix gases in a cylinder. The next person who draws from it may unknowingly cause an explosion.

Piping for compressed air

- Polyvinyl chloride (PVC) plastic pipes cannot be used for transporting compressed gases aboveground unless they are completely enclosed in a conduit or casing of sufficient strength to provide protection from external damage and deterioration. The heat generated from compressed air can weaken the PVC pipe and create an explosion hazard. When PVC piping explodes, plastic shrapnel pieces can be thrown in all direction and injure workers or damage equipment.
- Copper piping shall not be used for acetylene.
- Do not use cast iron pipe for chlorine.
- Distribution lines and their outlets need to be clearly labeled.
- Inspect piping systems on a regular basis.
- Pay attention to fittings as well as possible cracks that may have developed.

Hoses and Connections

- Examine hoses regularly for leaks, set up an inspection schedule.
- Do not use unnecessarily long hoses.
- Keep hoses free from kinks and away from high traffic areas.
- Repair leaks promptly and properly.
- Store hoses in a cool place, and protect them from hot objects, and sparks.
- Do not use a single hose having more than one gas passage.

Engineering Controls

Listed below are some engineering controls that can be used in some cases to control the risk of compressed gas use.

A. **Emergency Shutoff Switch** – can be used at a remote location to cause pneumatic valves to shut, stopping gas flow. Switches should be non-electric so that arcs or sparks are not created around flammable gases.

B. **Gas Cabinets** – hazardous gas cylinders should be housed in a gas cylinder cabinet. These cabinets can be equipped with sprinkler protection and ventilation.

C. **Flow Restrictors** – can be used to limit hazardous gas flow to just over maximum flow needed, must be installed immediately downstream of each hazardous gas cylinder.

D. **Emergency Eyewash** – must be present in areas were corrosive materials or gas is used.

Resources

Listed below are a few resources that can be used to find safety and health information and standards.

National Institute for Occupational Safety and Health, (NIOSH)
Department of Health and Human Services,
200 Independence Ave. SW 317B,
Washington, DC 20201
Phone: 1-800-356-4674, 1-800-35-NIOSH
Web site: www.niosh.gov

U.S. Department of Labor, Occupational Safety & Health Administration, (OSHA)
Public Affairs Office -Room 3647,
200 Constitution Ave,
Ashington, D.C. 20210
Phone: (202) 693-1999
Web site: www.osha.gov

Compressed Gas Association (CGA)
1725 Jefferson Davis Highway Suite 1004
Arlington, VA 22202-4102
Phone: (703) 412-0900
Fax: (703) 412-0128
Web site: www.cganet.com

_____ Are containers/cylinders labeled properly?
_____ Pressure Relief Device present and free from damage?
_____ Container free of corrosion and other recognized damage?
_____ Valve protection caps in place and at least hand tight?
_____ Containers are not used as rollers, supports, or other unintended purposes?
_____ Are empty cylinders marked as such and valves closed?
_____ Cylinders are not placed where they may become part of an electrical circuit?
_____ Cylinders are not exposed to temperatures greater than 125ºF?
_____ Are cylinders Leaking?

- ____ Tighten valve
- ____ Close valve
- ____ Tag Unserviceable
- ____ Toxic? Provide proper respirator protection
- ____ Keep away from flames
- ____ Take outdoors or place in exhaust system
- ____ Place warning tag on cylinder
- ____ Notify supplier

_____ Valve caps are not used to lift cylinders
_____ Ropes, slings, or chains are not used to suspend cylinders without appropriate lifting attachments?
_____ Storage

- ____ Grouped by types and labeled with name of gas
- ____ Full and empty containers separate and stored upright
- ____ Storage rooms dry and well ventilated
- ____ Not stored near salts, corrosive chemicals or fumes, dampness
- ____ Protected from damage by other material
- ____ Stored away from walkways, gangplanks, aisles, doors, exits, etc.
- ____ Outside storage chemicals protected from bottom corrosion

_____ Employees trained on handling and use of cylinders?
_____ Containers are secured to prevent them from being knocked over?
_____ Compressed gasses are not used to dust off clothing?

_____ Mixtures of fuel and air or oxygen guarded against?
_____ Acetylene used <15 psi <30 psi absolute pressure?
_____ Only approved apparatus used?
_____ Employees trained on handling and use?
_____ Cylinders labeled properly?
_____ Storage
- _____ Kept away from heat and flame
- _____ Empty cylinders valves closed
- _____ Valve protection caps in place and hand tight
- _____ Greater than 20 feet from combustibles
- _____ Ventilation
- _____ Protected from damage

_____ Oxygen cylinders, valves, regulators, hose and apparatus free of oil and grease?
_____ Cylinder valves open and closed by hand?
_____ When parallel lengths of oxygen and acetylene hose are taped together, not more than 4 inches out of 12 inches shall be cover with tape
_____ Proper pressure reducing regulators used for gas and pressures for which they are intended?

Flammable Gases (Type 4)

_____ Adequate fire extinguishers near storage areas
_____ No Smoking signs posted near storage

Oxygen (Type 4)

_____ Containers, valves, regulators, hose, and other apparatus free from oil and grease
_____ Stored 20 feet from combustibles or separated by a wall at least 5 foot high and made of non-combustible material with at least a 30 minute fire rating
_____ Ambient air oxygen content not greater than 23 percent except hyperbaric chambers

Acid and Alkaline Gases (Type 5 and 6)

_____ Proper Personal Protective Equipment – Goggles, faceshields, gloves, aprons, long sleeve shirts, trousers. No open shoes or sneakers.
_____ Proper Respiratory protection available
_____ Eyewash stations and showers

Some Common Acid and Alkaline Gases

Ammonia	Boron	Hydrogen Chloride	Hydrogen Bromide
Fluorine	Sulfur Dioxide	Triflouride	Chlorine
Hydrogen Sulfide	Dimethyl amine	Ethyl amine	Methyl amine
Trimethyl amine	Nitrosyl Chloride		

Highly Toxic Gases (Type 2)

_____ Proper respiratory protection available
_____ Store outside or in separate, noncombustible building, without other occupancy
_____ Used in forced ventilation
_____ Employees trained on proper use and handling

Some Common Highly Toxic Gases

Carbonyl Fluoride	Germane	Nickel Carbonyl (liquid)	Chlorine
Phosgene	Hydrogen Cyanide	Nitrogen Dioxide	Nitric Oxide
Phosphine	Hydrogen Selenide	Ozone	Fluorine

APPENDIX IV: EXAMPLES OF INCOMPATIBLE CHEMICALS*

CHEMICAL	IS INCOMPATIBLE WITH
Acetic Acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali and Alkaline Earth metals	Water, carbon tetrachloride or chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine, Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Carbon tetrachloride	Alkali metals
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid & Chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	see bromine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumenehydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Everything
Hydrocarbons (such as butane, benzene)	Fluorine, Chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali

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

**** Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Research Council, pg. 73-74, 1981***

APPENDIX V: CITY OF FORT COLLINS WASTE DISPOSAL LIMITS

The City of Fort Collins has set certain limits on what may be discharged into the sanitary sewer system. And the city monitors this by taking samples at random times. The portions of the law that apply to the chemistry department are shown below.

112-75-A-3 Waters having a pH less than 6.0 or greater than 9.0 may not be discharged to the sewer.

112-75-A-6 Wastes containing concentrated dyes may not be discharged to the sewer system.

112-75-A-9 Any liquid or vapor having a temperature higher than 65.5° C at the point of entrance to the public sewer may not be discharged.

112-75-A-10 Waste containing free, floating or insoluble oil may not be discharged to the sewer system.

112-75-A-14 Chemicals which cause noxious or malodorous conditions which either singly or by interaction with other wastes are sufficient to be hazardous to personnel in the maintenance and repair of the sewer utility may not be discharged to the sewer. This would include sulfides, cyanides, sulfites, nitrites, etc.

112-75-A-17 Waters or wastes having the following substances with a concentration greater than that shown may not be discharged to the sewer system.

Phenolic compounds as phenol	5.0 mg/l
Hydrogen sulfide	5.0 mg/l
Ammonia nitrogen asurea	10.0 mg/l
Cyanides	1.0 mg/l
Sulfur dioxide	5.0 mg/l
Nitrous oxide	5.0 mg/l

112-75-A-18 Water or wastes having a twenty-four hour proportionate composite sample concentration in excess of the following:

Hexavalent Cr as Cr	0.25 mg/l
Copper as Cu	3.0 mg/l
Nickel as Ni	5.0 mg/l
Cadmium as Cd	0.05 mg/l
Zinc as Zn	2.0 mg/l
Iron as Fe	15.0 mg/l
Lead as Pb	0.25 mg/l
Arsenic as As	0.25 mg/l
Manganese as Mn	0.25 mg/l
Selenium as Se	0.05 mg/l
Silver as Ag	0.25 mg/l
Mercury as Hg	0.025 mg/l

112-75-B Any discharge to the sewer system in which the concentration of any prohibited substance exceeds five (5) times the twenty-four hour concentration is prohibited.

The City of Fort Collins does not specify what chemicals may be discharged to the system and in the absence of such information "Prudent Practices for Disposal of Chemicals from Laboratories" may be taken as a guide. The following information is taken from that source. Notes in parentheses are modifications for Fort Collins laws.

Organic compounds

Organic compounds that are discharged to the sewer system should be water soluble to at least 3%, present a low toxicity hazard and be readily biodegradable. The following may be used as a guide:

- Alcohols - Alcohols with less than 5 carbon atoms, alkanediols with less than 8 carbon atoms, glycerol, sugars and sugar alcohols, alkoxyalkanols with less than 7 carbon atoms.
- Aldehydes - Aliphatic aldehydes with less than 5 carbon atoms.
- Amides - Primary and Secondary aliphatic amides with less than 5 carbon atoms, tertiary aliphatic amides with less than 11 carbon atoms.
- Amines - (Amines should be neutralized to a legal pH) Aliphatic amines with less than 7 carbon atoms, aliphatic diamines with less than 7 carbon atoms, benzylamine and pyridine.
- Carboxylic acids - (Acids should be neutralized to a legal pH) Alkanoicacids with less than 6 carbon atoms, alkanedioic acids with less than 6 carbon atoms, hydroxyalkanoic acids with less than 6 carbon atoms, aminoalkanoic acids with less than 7 carbon atoms. Ammonium, sodium and potassium salts of the above acids classes with less than 21 carbon atoms. Chloroalkane-dioic acids with less than 4 carbon atoms.
- Esters - Esters with less than 5 carbon atoms, isopropyl acetate.
- Ethers - Tetrahydrofuran, dioxolane, dioxane.
- Ketones - ketones with less than 6 carbon atoms.
- Nitriles - Acetonitrile, propionitrile.
- Sulfonic Acids - Sodium or potassium salts of most are acceptable.

Inorganic Chemicals

This list is of the low-toxic-hazard ions. The ions in parentheses are those which Fort Collins has special controls on disposal concentrations. Again solutions should be neutralized to the legal pH range before discharging to the sewer.

Cations: Al^{3+}, Ca^{2+}, (Cu^{2+}), ($Fe^{2+,3+}$), K^{+}, Li^{+}, Mg^{2+}, Na^{+}, (NH_4^{+}), Sn^{2+}, Sr^{2+}, $Ti^{3+,4+}$, (Zn^{2+}), Zr^{2+}

Anions: BO_3^{3-}, $B_4O_7^{2-}$, Br^{-}, CO_3^{2-}, Cl^{-}, (HSO_3^{-}), OCN^{-}, I^{-}, NO_3^{-}, PO_4^{3-}, SO_4^{-}, SCN^{-}

Laboratory destruction of hazardous chemicals

Many chemicals in small quantities may be safely destroyed in the chemical laboratory. It is not possible here to give all the procedures, however, a good source is "Prudent Practices for Disposal of Chemicals from Laboratories", put out by the National Research Council.

APPENDIX VI: USE OF CHEMICAL BIOHAZARDS

Chemicals that pose a carcinogenic, teratogenic, neurotoxic, spontaneous abortion or sexual dysfunction risk are considered to be health hazards. Use of these chemicals may require special safeguards, training and/or permission.

Chemicals that are currently (1991) controlled as chemical health hazards are shown below along with the approval level.

Compound	Use Condition	Principal Investigator Approval Level	Laboratory or Branch Chief Approval Level	Institutional Biosafety Committee Approval Level
Benzene	Storage	≤10 L	>10 L	- - -
Carbon tetrachloride	Normal Operation[1]	≤1 L	> 1 L	- - -
Chloroform	Complex Operation[2]	< 0.1 L	0.1 to 1 L	> 1 L
1,2-Dibromo-3-chloropropane				
1,1-Dimethyl-ethylenimine				
p-Dioxane				
Ethylene Dibromide				
Proplyenimine				
Ethionine	Storage	≤1000 g	>1000 g	- - -
3'-Methyl-4-aminoazobenzene	Normal Operation	≤100 g	> 100 g	- - -
Urethane	Complex Operation	<10 g	10 to 100 g	< 100 g
Bromoethylmethansulfonate	Storage	<1 L	1 to 10 L	>10 L
Chloromethyl methyl ether	Normal Operation	< 0.l L	0.1 to 1 L	> 1 L
Diepoxybutane	Complex Operation	< 0.10 L	0.01 to 0.1 L	> 0.1 L
1,1-Dimethylhydrazine				
1,2-Dimethylhydrazine				
Ethylenimine				
Ethyl methanesulfonate				
Hydrazine				
Methylhydrazine				
Methyl methanesulfonate				
N-Nitro-sodiethylamine				
N-Nitro-sodimethylamine				
N-Nitrosodi-n-butylamine				
N-Nitrosodi-n-propylamine				
N-Nitroso-N-ethylurethane				
N-Nitroso-N-methylurethane				
N-Nitrosopiperdine				
Polychlorinated biphenyls				
β–Propiolactone				

Compound	Use Condition	Principal Investigator Approval Level	Laboratory or Branch Chief Approval Level	Institutional Biosafety Committee Approval Level
N-Acetoxy-2-acetylaminofluorene	Storage	<100 g	100 to 1000 g	>1000 g
2-Acetylaminofluorene	Normal Operation	<10 g	10 to 100 g	>100 g
Aflatoxins	Complex Operation	<1 g	1 to 10 g	>10 g
2-Aminofluorine				
Benzanthracene				
Benzopyrene				
Chlorambucil				
Cycasin				
Diazomethane				
Dibenzanthracene				
7,12-Dimethylbenzanthracene				
4-Dimethylaminazobenzene				
3,3'-Dimethylbenzidine				
1,4-Dinitrosopiperazine				
N-Hydroxy-2-acetylaminofluorene				
3-Methylcholanthrene				
4,4'-Methylene bis(2-chloraniline)				
1-Methyl-3-nitro-1-nitrosoquanidine				
1-Naphthylamine				
N-[4-(5-Nitro-2-furyl)-2-thiazoyl]formamide				
N-Nitroso-N-ethylurea				
N-Nitroso-N-methylurea				
4-Nitroquinoline-1-oxide				
Procarbazine				
1,3-Propane sulfone				
m-Toluenediamine				
Uracil mustard				
Vinyl chloride				
Bis(chloromethyl) ether	Storage	- - -	≤1 L	> 1 L
	Normal Operation	- - -	≤0.01 L	> 0.01 L
	Complex Operation	- - -	- - -	Any quantity
4-Aminobiphenyl	Storage	- - -	≤100 g	> 100 g
Benzidine	Normal Operation	- - -	≤1 g	> 1 g
3,3'-Dichlorobenzidine	Complex Operation	- - -	- - -	Any quantity
3,3'-Dimethoxybenzidine				
2-Naphthylamine				
4-Nitrobiphenyl				

Note: Approval levels apply to Principal Investigators who have successfully completed the NIH or CSU course in the recognition of chemical hazards in the laboratory.

[1]Normal Operation: Any operation involving simple manipulations or reactions, where the potential for release of the material is remote (e.g., dilutions, use of analytical standards, etc.).

[2]Complex Operation: Any operation involving the manipulation, handling or reaction of materials where the potential for release of the material is significant (e.g., rapid, exothermic reactions, etc.).

APPENDIX VII: ACCIDENT REPORT FORMS AND WORKERS COMP INFO

ACCIDENT REPORT FORMS ARE AVAILABLE IN THE CHEMISTRY MAIN OFFICE, B101.

ACCIDENT REPORT

1. List the name, address, and telephone number of the person(s) experiencing the accident:

_____

_____

_____

2. List the name, address, and telephone number of the person(s) injured:

_____

_____

_____

3. List the name, address, and telephone number of all witnesses, if any:

_____

_____

_____

4. List the building, room number and location in room where the accident occurred:

_____

_____

5. If accident occurred in an instructional course, list the course number and section:

_____

6. If accident occurred in a research group, list the name of the preceptor/principal investigator:

_____

7. Give the date and time of the accident: _____

8. Describe briefly, but sequentially, all the know facts concerning events leading up to and following the accident. These facts may be established with participants or witnesses. Avoid opinions and conclusions.

_____

_____

_____

9. If the accident resulted in injury, describe briefly the nature and extent of the injury, the type of first aid rendered and by whom, whether or not an ambulance was called and used, and the time involved. Also indicate the condition of the injured after treatment.

_____

_____

_____

10. If the accident resulted in a fire, how was the fire extinguished, was the fire alarm sounded, was the fire department called, how soon did the fire department arrive, and if hand fire extinguisher were used, were they submitted for refill?

_____

_____

_____

11. If the accident resulted in property damage, describe briefly the extent of damage.

_____

_____

_____

12. Give the name, address and telephone number of person preparing the report if someone other than listed under item 1 above.

_____

_____

13. Show a copy of this completed report your supervisor and complete Workers' Compensation form (if applicable).

WORKERS' COMPENSATION OF INJURY REPORT FORMS CAN ONLY BE COMPLETED ONLINE THROUGH THE RISK MANAGEMENT WEBSITE AT:
http://rmi.prep.colostate.edu/workers-compensation/file-an-incident/

Introduction:
The CSU Workers' Compensation management program is a division of Risk Management & Insurance at Colorado State University. Caring for an injured worker is important to us, and it is our intent to respond in a timely and responsive manner. Colorado State University and the Department of Risk Management serve as liaison and employee advocate. They work with injured employees and employing departments to ensure proper medical care and/or assistance is provided, so employees can return to work.

Authorized Treating Physicians:
Employees injured on the job must seek medical treatment through one of CSU's Authorized Treating Physicians. These providers are selected on their knowledge of occupational injuries, the workers compensation process and quality of care provided to our employees. If you initially seek care at the Emergency Room you will still need to follow up with one of our Authorized Treating Physicians.

Work Comp. Health Care Providers Contacts:
A full list of on-the-job injury health care providers is available online at:
http://rmi.prep.colostate.edu/workers-compensation/authorized-treating-physicians/

*******FOR EMERGENCIES GO IMMEDIATELY TO THE NEAREST EMERGENCY ROOM*******

APPENDIX VIII: HANDLING OF HALOGENATED SOLVENTS

Halogenated solvents (methylene chloride, chloroform, etc.) must **NEVER** come in contact with the wastewater leaving this building. To prevent this, the following procedures must be observed at all times.

1. All aqueous phases of extractions involving halogenated solvents are to be deposited in properly labeled waste cans, **NOT** down the sink. Methylene chloride is soluble to the extent of 2% in water, so 100 mL of wash water contains 2g of CH_2Cl_2.

2. Aspirators must **NEVER** be used to suction filter solutions in halogenated solvents since appreciable quantities get aspirated down the drain. Use a Büchi recirculating water pump or an alternate source of vacuum, but **NOT** an aspirator.

3. **ALL** halogenated solvents **MUST** be concentrated on rotary evaporators connected to diaphragm pumps, **NOT ASPIRATORS**. Methylene chloride cannot be efficiently trapped when aspirators are used.

4. All glassware used with halogenated solvents is to be rinsed with acetone (and these rinses placed in a halogenated waste container) **PRIOR** to washing the glassware in the sink.

I have read, I understand, and I will follow these procedures.

Printed Name _____

Signature _____ Date _____

RETURN THE COMPLETED FORM TO MAIN OFFICE, B101.