Wayne State University

Nano Fabrication Core Facility (nFab)

Safety Manual

Nov 14, 2011

Director: Dr. David Coleman

Lab Managers: Dan Durisin
&
Bill Funk

Operational Hours: 8:00am-6:00pm, M-Fri

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nFab Emergency Contact Phone List

Public Safety 313-577-2222

Environmental Health and Safety 313-577-1200

EH&S STAFF	Office	Cell	Pager
Tom Perez	313-993-7679	313-610-6768	
Walter Pociask	313-993-7655	734-576-1421	
Scott Brown	313-993-7597	313-282-9520	
Richard Harrison	313-993-7678	313-510-5916	

nFab Staff	**Office**	**Home**	**Cell**
Dan Durisin	**577-9529**	**313-383-3078**	**313-614-9313**
Bill Funk	**577-9529**	**248-542-7995**	**586-216-9128**
Dr. David Coleman	**577-2586**		**313-673-6519**

To Reset Fire Alarm, Contact Facilities Planning and Management (FP&M) to page a building engineer at 577-4315

Air Gas Hazardous Material Response Team
Contact Russell Westmoreland (Field Safety Manager)
989-529-4080, 989-496-7506, After Hours: 1-866-734-3438

Remember, messages left on cell phones may not have good signal, and message may be garbled

Safety & Operations Manual Overview

The intent of this manual is to provide the nFab user with safety procedures, chemical, gas information and guidelines for handling emergency situations. There are many hazards in the lab that have the potential for harm. Please use all precautions when working in the lab. There are electrical, chemical and radiation hazards. The standards for working in the lab must be maintained and followed by all users at all times. Please do not attempt a procedure, if something is unclear or not understood. As a reminder, all users must be trained on equipment. This training is a requirement before approval is authorized. A copy of the tool request form can be found on page 12. If a user attempts to use a tool before he or she gets the training, the user will be questioned and evaluated by the lab staff. Always ask for assistance if something fails while performing a task. nFab users are restricted from attempting any repair or maintenance work. In the gowning room there is a computer that can be used for checking both the availability and scheduling of tools. Please refer to the web site listed below. Have a safe work experience.

Nano Fabrication Core Facility Web Site:

https://my.ilabsolutions.com/service_center/show_external/2964/nano-fabrication-core-facility

Laboratory Design and Overview

The nFab clean room design focuses on optimizing equipment location. Each tool is fitted into a specific process bay. The layout drawing on page 8 shows 6 bays: Gowning, Thin Film, Inspection, Wet Bench, Photolithography and MBE. The lab has roughly 4300 square feet. The actual clean area is around 2300 sq ft and the chase area is 2000 sq ft. The lab uses a roof top make up air unit that feeds air to the plenum and chase areas. The lab then draws this air through the fan filter units and returns it through the grill openings at the bottom of each wall section. This keeps the lab pressurized and prevents air from traveling in, when an entry or exit door is opened.

The particle count will vary from class 10 in photolithography bay to class 1000 in the gowning bay. Since this facility is a clean room, it is very important that everyone follow the protocols for gowning. If you are conducting process work in the nFab that does not involve the photolithography bay, then a tyvek lab coat, hairnet, mask and gloves are acceptable. Upon entry into the photolithography bay, one must be fully gowned using a tyvek clean room suit, mask and gloves. The tyvek clean room suit can be used for a period of 2 weeks. A new suit will be issued after this amount of usage. Safety goggles will be required at all times when working in the lab. While working with the wet benches, face shields and acid aprons are required. All eye and safety protection will be found in the gowning room. It's mandatory for any nFab person using chemicals to read the MSDS (Material Safety Data Sheet) on that chemical. An electronic file containing all the chemical MSDS can be found on the computer that is in the Gowning bay.

The lab uses the following house services for the operation of equipment: electricity, demonized water, chilled water, house vacuum, clean dry air, and both inert and toxic gases. The equipment uses these utilities from each of the service bays. Only nFab staff should enter these chase areas, unless it specifically mentions in the standard operating procedure (SOP's) for you to enter. In the event that there is an emergency, then exit through the double doors at the end of the main isle way. The exits for the lab are shown on the layout drawing in figure 1.

Upon entry into the lab you will notice three lights. The blue light will be lit on normal conditions. The yellow light stands for gas and the red light refers to fire. If either of these lights is lit, please exit the building. Also, if no lights are lit, this is an indication that the emergency panic button has been pressed. You should not enter the lab under this condition. This panic alarm condition is not tied to the building's alarm. If you are in the lab and find it necessary to press the panic button, you need to convey to lab staff what caused you to take that action. If you are unsure of the environment, it's always best to clear the lab. The lab also has fire alarm pull stations. These stations should only be pulled if fire or smoke is seen or a true life-threatening emergency has occurred. Please keep these locations in mind.

The gas and fire detection systems are fed into the control room. A drawing showing the location of the gas sampling points will be displayed in the hallway, near the control room-viewing window. Public safety is tied into our detection system and will respond if an emergency should occur. The lab's alarm systems for gas and fire are connected into the building's alarm system. The lab has three fire extinguishers. They are positioned in the gowning room, chase 3 and in the MBE bay. Also, there are emergency eye wash showers

located in the lab. Please beware of their locations when working in the wet bench bay. The procedures for addressing all emergencies will be shown in our safety manual. Please read over these procedures. You will be given a test to see how well you know these procedures. The University Emergency Contingency Plan is also part of our safety manual and should be read.

In the event of an actual emergency, the first responders to the lab will be the members of the Emergency Response Team (ERT). This team is made up of clean room staff, the department of EH&S and public safety. Public safety will serve as security to keep people from entering the building. Please see the manual, titled Emergency Response Plan for Handling Fire and Gas for more specific info on handling emergency procedures. The lab is managed by two staff engineers, Dan Durisin and Bill Funk.

nFab Indicator Lights are Located at the Third Floor entrance and exit to cleanroom. (Top of stairs, straight ahead.)

Indicator Light Logic

RED Indicates Fire in the Cleanroom or a Fire elsewhere in the Engineering Building

YELLOW *Indicates a Low Level Gas Leak inside the Cleanroom*

RED and YELLOW Indicates a High Level Gas Leak inside the Cleanroom

BLUE Indicates a Safe Condition inside the Cleanroom

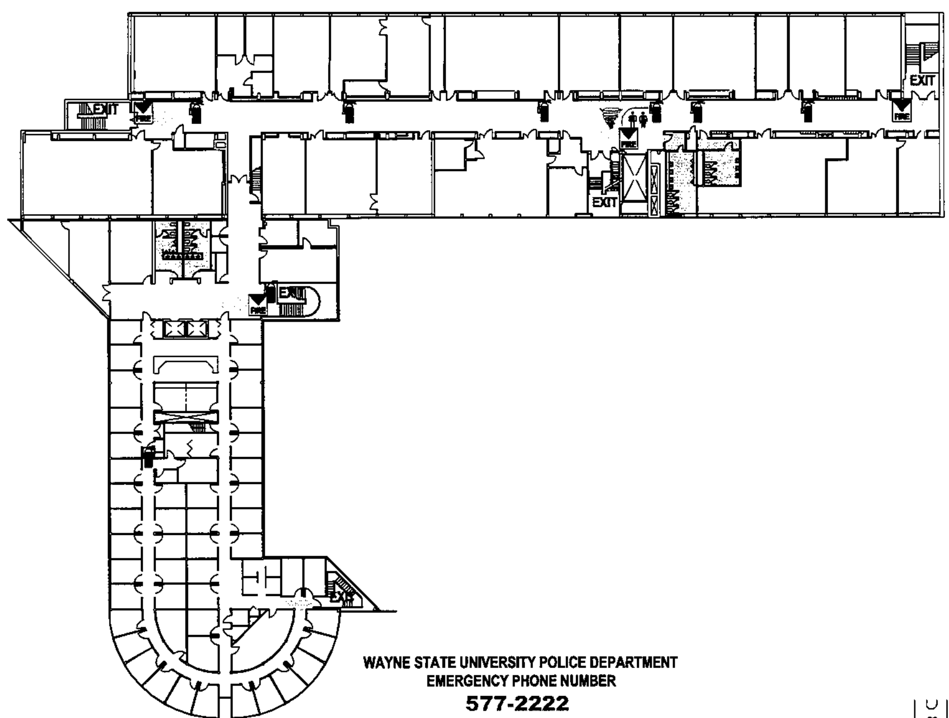
No Lights Indicates a Panic Button was activated.

Exact gas leak information can be ascertained from reading the gas monitoring LEDs in the nFab control room.

Nano Fabrication Care Facility

ENGINEERING BUILDING

THIRD FLOOR EVACUATION PLAN



WAYNE STATE UNIVERSITY POLICE DEPARTMENT
EMERGENCY PHONE NUMBER
577-2222

KEY

- TO STAIRWELL EXIT / EXIT AT FIRST FLOOR
- TORNADO SHELTER AREA
- STAIRWELL- AREA OF REFUGE
- OUTSIDE ASSEMBLY AREA
- REST ROOMS
- FIRE ALARM PULL BOX
- FIRE EXTINGUISHER
- CAMPUS PHONE

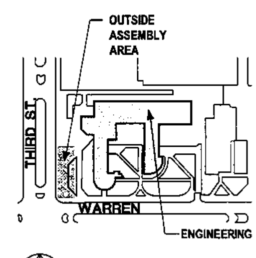
EMERGENCY GUIDELINES

A. FAMILIARIZE YOURSELF WITH ALL EXIT LOCATIONS.

B. EVACUATE THE BUILDING WHEN THE FIRE ALARM IS ACTIVATED AND PROCEED TO THE OUTSIDE ASSEMBLY AREA.

C. IN CASE OF FIRE, DO NOT USE THE ELEVATORS

D. IN THE EVENT OF SEVERE WEATHER WARNING, PROCEED TO A DESIGNATED TORNADO SHELTER AREA, OR RESTROOM AS NECESSARY OR INSTRUCTED TO DO SO BY MANAGEMENT.



LOCATION MAP

EVACUATIONS

Each WSU owned/leased facility must have an emergency evacuation plan/procedure(s) specific to that location. It is the responsibility of the highest-ranking individual user of each facility to develop and post such plan/procedure(s). The University Fire Safety Inspector can assist facilities/departments in the development and implementation of evacuation plans/procedure(s).

In the advance of an emergency, prepare an evacuation plan specific to your building and have it available at all times. The Office of Risk Management's Fire Safety Inspector can assist you in preparing one if your building currently does not have one. The Office of Risk Management can be reached at 577-3110.

In the event of a fire or other building emergency, the alarm system in your building may consist of strobe lights, audible horns, ringing bells, a slow whooping sound, emergency voice communication or any combination of these.

Highest-Ranking Individual User Responsibilities

- **Clearly identify the responsibilities of facility occupants to assist in evacuation procedures.**
- **Shut down any experiments, procedures, etc. that should not be left unattended. Extinguish any open flames and shut off flammable or noxious gas supply valves.**
- **When exiting the facility due to an emergency condition, proceed to a pre-determined location and begin verifying that everyone in facility has been accounted for.**

When a fire alarm is sounded at any WSU owned/leased facility, everyone should immediately leave the building in an orderly manner by means of the nearest exit. Under no circumstances are any personnel (excluding the Department of Public Safety, Environmental Health and Safety, Detroit Fire Department) to remain in the building.

- **Close the office, classroom, and lab door as you leave.**
- **Leave the building via the nearest available exit. Always know a secondary means of egress to use in the event your first choice is unattainable.**
- **Use the stairwells to evacuate (do not use elevators). Once in the stairwell, check to see that the door closed, proceed down to the level of exit discharge.**
- **If the facility is of a high rise occupancy (75' or 7 stories above grade) evacuation procedures are as follows: evacuate fire floor (s); two floors above; one floor below.**
- **Do not re-enter any facility until advised by the Department of Public Safety.**

Evacuation Procedures for Mobility Impaired/Disabled Persons

In the event of an emergency condition at a university facility, the following procedures with respect to mobility impaired/disabled persons should be followed:

Highest-Ranking Individual User Responsibilities

- **Clearly identify responsibilities of occupants to assist in evacuation procedures.**
- **Identify all mobility impaired/disabled persons within facility (faculty, staff, student assistants).**
- **A list of mobility impaired/disabled persons should be kept with each Building Coordinator. The list should be updated at least annually and contain the name, phone number, and floor/area assigned location of these persons.**
- **It is the responsibility of the Building Coordinator to provide the responding WSU Public Safety and Detroit Fire Department personnel with the list and location of mobility impaired/disabled persons.**

Building Occupant Responsibilities

- **During the evacuation of any WSU facility, all mobility impaired/disabled persons that are above the level of exit discharge, shall be placed in an "area of refuge" i.e., a fire rated construction room or enclosed emergency exit stairwell.**
- **Pre-determined facility occupants who are assigned responsibility for evacuation of a particular floor, shall assist mobility impaired/disabled persons into the area of refuge after all persons on that floor have evacuated.**
- **Unless department/facilities have special evacuation equipment i.e. emergency evacuation wheelchair, the responsibility for removal of mobility impaired/disabled persons rests with the WSU Department of Public Safety or the Detroit Fire Department.**

WAYNE STATE UNIVERSITY

Tool Sign-Off Form

Note: All nFab users are required to have prior training on a tool. They must demonstrate proficiency using the tool with the instructor present. This must be done before they will be given access rights on the tool. Depending on the complexity of the tool, the student might need to go through the instructional process a few times. Please e-mail the instructor; he will then schedule training session for the new tool user. This sheet will remain in your procession until all signatures have been issued. **(Print this form on clean room paper)**

Name of Applicant_____

E-mail Address_____

Phone Number_____

Advisor_____

Type of Class _____

Date of Initial Training _____

1**) Instructor Signature_____ (Must be signed after initial instruction)**

Desired tool for access rights: _____

Is this your first individual training class? _____

If not, how many other times have you been observed using the tool? _____

Instructor Approval Yes

2**) Instructor Signature**_____ Date _____

Reason for student not being approved_____

I will use the tool according to the standard operating procedure and will follow the safety protocols.

Student Signature_____

Operational & Safety Procedures

Gowning Procedure

1. Please come to the lab with clean face, hands and clothes.
2. No shorts are allowed. Your legs must be covered.
3. No sandals or open toed shoes.
4. No contact lenses are allowed in the lab.
5. All long hair should be tied back.
6. No perfume or cosmetics are allowed.
7. Put all brief cases and purses in your locker.
8. Cell phones can only be used in the gowning bay.
9. Do not allow contact between the outside surface of the clean room suit and your clothes.
10. Do not allow any part of the clean room suit to make contact with the floor.
11. Put your gloves on first. This keeps the surface of the suit clean.
12. Sit down on the gowning bench to slip on your suit. Then put on your shoe covers, facemask, hair net and hood. (the mirror on the wall will allow you to see if everything is tucked in properly)
13. All beards have to be covered.(No exposed facial hair). Beard covers are available.
14. Step over the bench. Put on your safety glasses.
15. The clean room suit can be used for 1 to 2 weeks.
16. If your gloves should rip or tear while you are in the nFab, walk to the gowning bay and put on a new pair of gloves.
17. Please check your gloves for stains. nFab staff do not want photo resist placed on door handles or other surfaces.

Acid Burn Procedure

1. If a worker has skin contact with an acid, the area should be flushed with water for 30 minutes. Lab staff or another worker must contact Public Safety at 313-**577-2222.**

2. Positioned throughout the lab are emergency showers. There are two in the main hallway and one located in the furnace chase next to the tube clean wet bench (Chase 3). Also, all wet benches have eye wash wands.

3. If a person does come in contact with hydrofluoric acid (HF), the area must be flushed with cold water for 1 minute. Place a glove on the hand that is used to apply the HF antidote gel (Calcium Gluconate Gel, located above the RCA wetbench). Calcium Gluoconate Gel is not for use in the eyes. Flush the eyes for at least 30 minutes with cold water. Keep the eyelids apart and away from the eyeballs. Massage the gel into the wound until the pain has stopped. You must receive medical attention after you have treated the area with the gel. Contact Public Safety at 313-577-7222 and they will take you to Detroit Receiving to be examined by a medical doctor. If the acid makes eye contact, have an eye specialist examine your eyes.

4. All acid burns will have to be reported to Public Safety and the lab manager. A medical doctor must examine all acid injuries.

5. The lab manager will contact the office of risk management to file a report.

Chemical Spill Procedure

1. If the spill is small and manageable, then the spill can be cleaned by members of the ERT team in house. If the spill is large, then all workers in the lab should be notified that the spill has taken place. If the chemical is of a type that is generating fumes, all personal should evacuate the lab. One member of the ERT team should use the microphone attached to the Gamewell fire detection system in the control room to make this announcement. The spill will then be reported to Environmental Health & Safety (7-1200) and inform them of the spill type and size.

2. Two members of the emergency response team should respond with respirators if the chemical is generating noxious fumes. The PH level of the chemical should be tested. The emergency spill cart should be rolled into action and containment absorbers be used to surround the spill.

3. The department of Environmental Health & Safety will conduct the final clean up.

4. In the event, that a person is injured, move the person to a safe area that has a fresh air supply. Remove all clothing that is contaminated. Contact 7-2222.

Wet Bench Safety Procedure

1. Wet bench operators will not be allowed to sit while working in this bay.
2. All wet bench users must wear acid resistant gloves, aprons and face shields. If your gloves come into contact with hazardous chemicals, rinse your gloves and dispose of them. Then replace them with brand new gloves.
3. There are many hazardous chemicals in this bay and caution should be exercised. Do not rush through any procedures.
4. All glass beaker solutions are to be placed in the wells of the wet bench. This will allow maximum exhaust of vapors. Beakers of any solution must not be placed on the top surface for processing.
5. Before activating a hot plate, the operator user must verify that the hot plate is not coming into contact with a flammable object, such as a clean room wipe. Please inspect the hot plate well thoroughly.
6. Do not leave any clean room wipes on the wet benches.
7. Users must dispose of all chemical waste products in the proper carboy or waste holding tanks. All chemical waste must be properly tagged in order for EH&S to dispose of it. Lab staff will fill out the tag. The complete chemical name and percentage of each chemical must be put on the tag. All chemical waste must be stored in secondary containment.
8. The carboy could be full, so please check with lab staff before dumping the solution into the carboys. The carboy containers are directly connected to the wet benches. No chemical waste is allowed to be dumped down the sink drain.
9. All users must make sure the hot plates and bath heaters are off before leaving the lab.
10. **Follow SOP's for any wafer process.**
11. Any broken wafers must be disposed of in the box housed in the photo bay. Broken wafers are not to be tossed into the regular trash.
12. No contact lenses are allowed in the clean room lab. By wearing these lenses you could potentially do harm to your eyes if an acid vapor was released.

Puddles and Water Leak Procedure

1. The puddle or spill should not be cleaned up unless the liquid is identified. The person encountering the spill must evaluate the potential danger to himself and others around him. Is the person properly trained to handle the clean up?

2. If the chemical is generating fumes, then all personnel must be notified and asked to leave the lab. One member of the ERT team will use the microphone in the control room to inform the lab of the emergency situation.

3. The location of the spill should be taped off to prevent anyone from entering the area. The chemical spill floor sign should be placed near the spill. The spill sign can be found in the gowning bay near the main isle way entry door.

4. One member of the emergency response team should be notified.

5. Appropriate personal protective equipment must be used when attempting to clean up the chemicals. Acid resistant gloves, acid apron and face shield must all be used.

6. If the liquid is not generating vapors, then the PH level can be measured.

7. Lab staff will place absorbent pads around and on the puddle. These pads can be found in our spill kit. The spill kit is located in chase 4.

8. The clean room manager will notify the department of Environmental Health & Safety. (7-1200)

Photolithography Bay Safety & House Keeping

The photolithography bay in the nFab is the main processing bay for patterning wafers. The photolithography process utilizes photo resist, developers, spin coaters, ovens and mask aligners. It's important that each user maintain excellent house keeping techniques while working in this lab. Please wipe up any photoresist that has spilled. All clean room wipes must be disposed of in the white waste container that's located near the viewing windows. Additionally, check your gloves to make sure that you do not have any photoresist on them. If you do have stained gloves, go to the gowning bay and carefully remove them and discard them in the normal trash. Please avoid making contact with any door surfaces while walking back to the gowning bay. Clean room wipes should also be used in the spin coat process. It's important to keep the bowl clean. The spin coat bowl must be lined with wipes. These wipes should be discarded in the white waste container, once the spin coat process is complete. Once you have completed your spin coat process please place a dummy wafer on the chuck. This will prevent any photoresist from dripping into the vacuum line. Wafers coated with photoresist should not be automatically transferred to the mask aligner. Please allow for some baking and cooling time. Clean room users do not want to discover photo resist on the stage or chuck surfaces for any microscopes, mask aligners and profilometers.

In the photolithography bay are a number of baking ovens and a two hot plates. Do not place clean room wipes or plastic parts in these ovens. Also, the ovens are not storage shelves. There are metal, glass and plastic wafer cassette holders. Only metal and glass cassette holders are to be placed in the ovens. The ovens are always on, but the hot plates must be shut off after use. Do not place any of the photoresist chemicals near any of these heat sources.

The photoresist chemicals are quite costly and have a set shelf life. Please dispense only the amount needed, so that waste is minimized. The photoresist can be applied by pouring it from a beaker, using a pipette or spin coating. When pipetting, do not pipette twice from the original bottle. The reason for this request is to avoid causing particles to be put into original mixture. Also, lab management has some concern with users transferring chemicals into other bottles and not using proper labeling techniques. If you have a need to store a chemical in a smaller bottle, then you must notify lab staff. The developers that are used in the photo bay should be treated as hazardous. If you are using the wet bench for dunk developing, then you must wear the proper personal protection equipment. This infers that acid resistant gloves, face shield and apron are required while dunk developing. Once you have finished, the wet bench should be left clean and dry with no beakers or bottles filled with solution. All glass ware should be rinsed thoroughly. All developers should be disposed of in the proper holding tank.

Toxic Gas Alarm Procedure

1. If the gas alarm should sound or if the yellow light should be on, then all lab personnel must immediately evacuate the lab until the ERT team can ascertain that it is safe to reenter the lab. Any gas leaks are life threatening and alarms need to be noticed and not ignored.

2. Please inform the clean room staff what state the equipment is on when the alarm sounded.

3. The lab manager or one member of the clean room staff will contact public Safety.

4. If additional information is required on handling gas emergencies, Air Gas Company has a 24 hr emergency response team. Please contact 1800- 230-4480. They will contact Kim Griffin who heads the team.

Fire Alarm Procedure

1. If the red indicator light is lit, do not enter the lab. Exit the building, and don't enter the building until you are told that conditions are safe.

2. If you are in the lab and smoke is present, exit the lab through the closest exit. Escape routes are shown in figure 1.

3. If you are in the lab and a fire does start, announce to everyone in the lab that there is a fire. The fire detection system will detect smoke and a female voice will announce over the speaker to evacuate the lab. The strobes and alarms will activate.

4. In the lab, located at various points are the fire alarm pull switches. These should be pulled in the event of a fire, small or large. Public Safety and the Fire Department will respond at that time.

5. If the fire is small and manageable, then locate one of the fire extinguishers located in chase 1 and 3. This should only be done by someone who has gone attended the fire extinguisher class which is offered by the Office of Risk Management .

Power Failure Procedure

1. In the event the there is a power failure, the back up generator will keep supplying power to the lights, exhaust and gas monitoring. The lights will turn back on within 15 seconds. All gas shut off valves will activate, safely shutting off all systems.

2. Outside users should not rush out of the lab, until they can properly store samples and chemicals. Beakers of acids should be transferred to sealed storage containers for later use. All outside personnel should exit the lab through the gowning room. They will need to check out through the lab manager before exiting the lab. WSU clean room staff will shut off all electrical disconnects and shut down all process gas and water lines.

3. nFab staff will then do a walk through of the penthouse scrubber area, hydrogen generator, DI water penthouse and HPM controllers located near the loading dock entrance. Each system has its own list of shut down procedures.

Utility Maintenance Procedure

1. All utility work personnel that require the entry of the nFab must first contact the nFab manager.

2. The utility worker will be escorted into the lab by the lab manager. Once inside, the gowning bay, the worker will be asked to wear a disposable Tyvek suit, mask, shoe covers and hair net.

3. The lab manager will explain the hazards that he or she may encounter while working in the lab.

4. All tools that are to be used by the worker must be wiped with alcohol.

5. If an alarm sounds in the lab, the worker will have to stop his work. He will have to evacuate the building until it's determined that its safe to return.

Pregnancy

In the event that a nFab user becomes pregnant, that person's access rights to the lab will not be removed. That person may want to consult the lab manager or the safety officer. There are chemicals in the lab that could be hazardous to an unborn fetus. Please consult the MSDS (Material Safety Data Sheet) for the risk of chemical exposure. Always try and minimize your exposure to chemicals while working in the lab.

EMERGENCY CONTINGENCY PLAN

Office of Environmental Health & Safety
5425 Woodward Avenue, Suite 300
Detroit Michigan 48202
(313) 577-1200 Phone
(313) 993-4079 Fax
www.oehs.wayne.edu **REVISED: February 29, 2012** 2

PURPOSE

The purpose of this plan is to minimize hazards to university students, staff, the public, and the environment, from fires, explosions or any unplanned sudden release of hazardous materials or hazardous waste to air, soil or water. The plan is to be consulted primarily by the Emergency Coordinators; however, all personnel involved in the management of hazardous materials and wastes at Wayne State University shall be familiar with the contents of this plan. In addition, the plan shall be circulated to appropriate emergency response units that might be involved with the emergencies described herein.

For the purpose of this plan, an emergency is defined as a fire, explosion, or release of hazardous material/waste which could threaten human health or the environment. The provisions of this plan must be carried out immediately whenever an emergency situation occurs. 3

DIALING INSTRUCTIONS FOR UNIVERSITY TELEPHONES

To call within the University, dial the last five digits of the telephone number desired. For example, dial 7-1234 for (57)7-1234 or dial 3-1234 for (99)3-1234.

To dial the University Medical Center from a 577–or-993 campus number, dial 132, then the 5-digit extension. If the extension is not known, dial (132)0. For example, if the number is 745-1234, dial (132)5-1234 from a campus phone.

To dial in the Detroit local calling area, dial 9, then the 7-digit telephone number.

To dial in area code 313, but beyond the local-calling area, dial 9, then 1, and the 7-digit telephone number.

When using a cellular phone to dial 911, your call will be routed to the Michigan State Police, then directed to the closest Police Department.

To call from an emergency blue light phone, dial the last five digits of the telephone number desired. For example, dial 7-1234 for (57)7-1234 or dial 3-1234 for (99)3-1234. 4

GENERAL OPERATING PROCEDURES IN THE EVENT OF AN EMERGENCY

A. Notify the **University Police Department (57)7-2222** that an emergency situation exists and give them all-important information and evacuate all personnel in the building, if necessary.

B. Contact the emergency coordinators to assess the situation. Consult the spill control and countermeasures plan (pages 12-13). **If radioactive materials may be involved, contact a representative of the Health Physics – Radiation Safety (57)7-1200.**

C. Depending on the severity of the emergency, assistance would be requested from the following parties in order of importance:

1. University Police Department (57)7-2222
2. Environmental Health and Safety (57)7-1200
3. Health Physics – Radiation Safety (57)7-1200
4. National Response Center 1-800-424-8802

D. After the emergency is over, restore facilities and safety equipment to pre-emergency status before resuming operations.

5

EMERGENCY PHONE NUMBERS

The following individuals are thoroughly familiar with this contingency plan and with the operations and activities of hazardous materials and waste storage areas to act as an emergency coordinator in the event of an emergency. (Listed in order of priority).

Primary Emergency Coordinators

Walter J. Pociask, Office of Environmental Health & Safety
Associate Director
21833 Knudsen Drive
Grosse Ile, MI 48138
Office Phone (313) 577-1200
Cellular Phone (734) 576-1421
Home Phone (734) 676-4808

Tom Perez, Office of Environmental Health and Safety
Director
11321 Leverne
Redford, MI 48239
Office Phone (313) 577-1200
Cellular Phone (313) 610-6768
Home Phone (313) 937-3157

Secondary Emergency Coordinators

Richard Harrison, Office of Environmental Health and Safety
Compliance Officer
5187 West Outer Drive
Detroit, MI 48235
Office Phone (313) 577-1200
Cellular Phone (313) 510-5916
Home (313) 864-2918

Nawana Lawson, Hazardous Materials Specialist
22043 Hallcroft Lane
Southfield, MI 48034
Office Phone (313) 577-1200
Cellular Phone (313)529-6265
Home Phone (248) 352-3590 6

Rob Moon, Office of Environmental Health and Safety
Associate Director
489 W. Sonoma Ave.
Hazel Park, MI 48030
Office Phone (313) 577-1200
Cellular Phone (313) 585-6508
Home Phone (313) 585-6508
Scott Browne, Office of Environmental Health and Safety
Environmental Health Specialist
2214 Anita
Grosse Pointe Woods, MI 48236
Office Phone (313) 577-1200
Cellular Phone (313) 282-9520
Pager (313) 325-3488

Health Physics – Radiation Control

Maha Srinivasan, Office of Environmental Health and Safety
Health Physicist
1398 Falcon Drive
Troy, MI 48098
Office Phone (313) 577-1200
Cellular Phone (313) 673-1896
Home Phone (248) 879-1123
Wendy Barrows, Office of Environmental Health and Safety
Health Physics Specialist
454 Beldale Drive
Troy, MI 48085
Office Phone (313) 577-1200
Cellular Phone (248) 930-8292
Home Phone (248) 740-4000 7

Other Emergency Numbers
University Police Department (Fire & Medical) (313) (57)7-2222
University Health Center (Medical) (313) 745-4522
Environmental Health and Safety (WSU) (313) (57)7-1200
Chemistry Dept. Representative (313) (57)7-2696
Health Physics – Radiation Control (313) (57)7-1200
Department of Environmental Quality (DEQ)
Warren Office (586) 753-3700
Lansing Office (517) 373-2730
Pollution Emergency Alerting System (PEAS) 1-800-292-4707 (Michigan Only)
National Response Center 1-800-424-8802
Marine Pollution Control (Spill Response) (313) 849-2333
Nuclear Regulatory Commission (NRC) 1- 800-522-3025 8

LOCATION AND DESCRIPTION OF EMERGENCY EQUIPMENT

Office of Environmental Health and Safety

5425 Woodward Avenue, Room 411
Detroit, MI 48202
(57)7-1200

This room is kept locked at all times, only authorized personnel can enter. There is generally someone in the office weekdays 8:30 am to 5:00 pm. An answering machine is on at all other times to record messages.

Personal Protection Equipment
3-Powered air purifying respirators with high efficiency particulate filters
1-Survivair SCBA with a 30 minute (rated) air supply
1-Survivair SCBA with a 60 minute (rated) air supply
1-North SCBA with a 60 minute (rated) air supply
4-Tyvek Paper Suits
4-Kappler CPF 3 Suits
2-Fully Encapsulated Suits (Level A)
1-Box Disposable Nitrile Gloves
4- Pairs Knit-Lined Nitrile Gloves
4-Pairs Leather Work Gloves
2-Face Shields
2-Chemical Aprons
3-Hardhats

Spill Response Equipment
2-Mercury Vacuums
2-Mercury Spill Kits
1-Wet/Dry Vacuum
1-Portable Ventilation Blower with 300’ of ducting
1-Box of Diking Material
8-50lb bags oil dry
4-Rolls Absorbent Padding
2-Boxes Chemical Spill Pillows
3-Gallons Clorox Bleach
3-Chemical Classifiers
2-Boxes pH paper
2-Rolls Peroxide Paper
8-Clor-N-Oil 50
4-Caustic Spill Kits
4-Acid Spill Kits 9

Emergency Response Equipment
1-Broom
1-Mop
2-Mop Heads
1-Non-Sparking Shovel
2-Floor Squeegees
2-Dust Pans
1-Roll CAUTION Tape
2-Flash Lights
2-50 Foot Extension Cords
2-Decon Buckets with Scrubbers
1-Gas Detection Kit
3-First Aid Kits
1-20 Foot Booster Cables

In addition, the Compliance Officer, the Environmental Health Manager, the Environmental Health Specialist, the Haz-Mat Manager, Haz-Mat Specialist, Haz-Mat Technician and Director have Survivair full face and half mask respirators with air purifying cartridges for non-IDLH conditions.

Other University Buildings

All other university buildings containing laboratories using hazardous chemicals have automatic sprinkler systems installed. They may be completely throughout buildings or in specific areas. A combination of Class A (water), ABC (dry chemical) and BC (carbon Dioxide) fire extinguishers are located in hallways outside the labs and any combination of Class ABC, BC and D fire extinguishers can be found inside the labs.

Fire alarm pull stations are located in conspicuous locations in the hallways on all floors. Fire alarm systems within university buildings are connected via a proprietary supervising station – fire alarms and fire troubles report to Wayne State University Police Department (57)7-2222

Some examples for the four classes of fires are:

Class A Fires – ordinary combustible materials (i.e., paper, wood, cloth)
Class B Fires – flammable liquids/chemicals/gases and oils
Class C Fires – energized electrical equipment
Class D Fires – combustible metals such as magnesium, sodium, and potassium

Description of Emergency Equipment

The Office of Environmental Health and Safety maintains emergency equipment for the purpose of responding to hazardous material incidents such as spills. The equipment is primarily stored at Wayne State University's Office of Environmental Health and Safety 10

at 5425 Woodward Avenue in Room 411. Brief descriptions of some of the emergency equipment are given to describe their capabilities and how they may be useful during chemical incidents.

1. **Personal Protective Equipment** consists of equipment such as chemical resistant coveralls and gloves, respirators, self-contained breathing apparatus and eye and face protection devices.

A. Tyvek coveralls provide a barrier to many dry particulates, including asbestos and other hazardous dusts. Tyvek resists abrasions, punctures and tears.
B. Kappler coveralls provide a barrier to many dry particulates as well as chemical liquids. Kappler forms a more effective barrier against a broader range of chemicals than Tyvek.
C. Chemical resistant gloves such as nitrile gloves offer protection against most common solvents, oils and acids.
D. Leather gloves provide protection against abrasions, punctures and cuts.
E. Rubber apron provides protection against various solvents, oils, greases and light acids.
F. Chemical resistant goggles and face shield provide eye and face protection whenever a splash hazard may be present. Goggles and face shield are resistant to mild acids, caustics, aromatics, hydrocarbons and methylene chloride.
G. Air purifying respirators will provide respiratory protection against acid gases, organic vapors and airborne particulates.
H. Self-contained breathing apparatus (SCBA) is the highest level of respiratory protection. If properly worn it will protect workers from atmospheres identified as Immediately Dangerous to Life or Health (IDLH).

2. **Miscellaneous Equipment**
A. pH paper (range 1-14) may be utilized to check whether a spilled liquid is acidic, neutral or basic.
B. Chlorox can be diluted 1:10 with water and used as a disinfectant in cleaning up bloodborne pathogen spills.
C. Emergency Cleanup System acid spill kit, sodium bicarbonate, spill pillows and spill absorbent pads can be utilized to clean up acid spills.
D. Emergency Cleanup System caustic spill kit, soda ash, spill pillows and spill absorbent pads can be utilized to clean up caustic spills.
E. Emergency Cleanup System solvent spill kit, spill pillows and spill absorbent pads can be utilized to clean up solvent spills.
F. Combustible gas meter (MSA) can be utilized to monitor for lower explosive atmospheric conditions. This condition may be present if a combustible or flammable material has been released.
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ARRANGEMENTS WITH LOCAL AUTHORITIES

The University Police Department, City of Detroit Fire Department, University Health Center personnel and Marine Pollution Control all have a role in the Wayne State Contingency Plan. Our arrangement with them includes but not limited to the following:

University Police Department - provide assistance in evacuation, crowd control, search and rescue, first aid, and other related police activities.

City of Detroit Fire Department - provide assistance in evacuation, search and rescue, first aid, fire response, hazardous waste emergencies and other related fire response activities.

University Health Center – provide medical evaluation and treatment.

Marine Pollution Control - provide assistance in spill response other related activities.

The University Police Department, City of Detroit Fire Marshal, University Health Center personnel and Office of Risk Management Fire Safety Inspector shall review this plan. The Office of Environment Health and Safety shall meet with appropriate representatives of these departments as needed to familiarize them with the layout of the large quantity generators, properties and associated hazards of the hazardous wastes; places where facility personnel would normally be working, types of hazardous materials located in building and access to all storage sites.

In the event that the above departments require additional assistance from other local and state emergency authorities, they will request such assistance as needed in consultation with the emergency coordinators. 12

SPILL PREVENTION, CONTROL AND COUNTERMEASURES PLAN

The following plan is a guideline for spill control, evacuation, notification of proper authorities and general emergency procedures in the event of a chemical incident at the large quantity generators site, chemical storage areas or laboratories maintained by Wayne State University. Because all emergency situations are different it is important to first protect human life and health.

Spill Control

1. **Non-ignitable, low toxicity liquids or solids and not generally dangerous gases** may be handled by first setting up restricted access to the spill area for small spills or evacuating the room/area in the case of large spills. The Office of Environmental Health and Safety should be called to initiate spill response/clean-up procedures. Chemical aprons, impermeable clothing, multiple cartridge respirators and/or self contained breathing apparatus should be worn consistent with the associated hazard. It is the emergency coordinator's responsibility to determine the level of safety equipment required. A minimum of two (2) trained clean-up personnel should always respond to any chemical spill. Further back-up personnel should then be called as required. Inert adsorbents or neutralizing materials may be used to prevent spreading of liquids. The absorbed liquids can then be carefully swept up and placed into plastic pails with covers.

2. **Ignitable liquids or solids, highly toxic materials, materials generating dangerous gases and/or reactive materials** may be handled by first evacuating the room/area in the case of any size spill and if there may be any potential hazard to other areas and people in the building, then the entire building or an extended area of evacuation should be initiated. Campus Safety should first be called, then the Office of Environmental Health and Safety. If the spill or hazard is sufficiently small, trained campus personnel can initiate the spill clean-up. This decision is to be made by the emergency coordinator. If the hazard is determined too great for university personnel to safely handle clean-up procedures, outside agencies/contractors should be called depending on the type of emergency. University spill response personnel are equipped to handle low risk chemical emergencies. Any level "A" protection clean-ups or level "B" protection clean-ups requiring extensive clean-up time (greater than 30 minutes) should be handled by properly equipped clean-up personnel. WSU does not have sufficient emergency equipment to safely respond to a clean-up in an immediately dangerous to life and health alarm. Small spills of these types of materials can be handled by at least two (2) university response personnel. Proper safety and clean-up equipment should be used as required by the type of hazard involved.

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Chemical Spill Countermeasures

A. Site personnel (responding to spills)

1. Attend to any persons injured or may have been exposed to any hazardous material, without placing yourself in danger.

2. Call University Police Department(57)7-2222 and notify persons in the immediate area of the hazard and evacuate the area if necessary.

3. Assess the situation (from a safe distance) as to:

a. type of spill

b. size of spill

c. type of hazard

radioactive

flammable

reactive

corrosive

toxic

4. Call the Office of Environmental Health and Safety (57)7-1200 for assistance. For radioactive spills call Health Physics (57)7-1200.

5. DO NOT attempt clean-up of any hazardous materials without first calling these emergency numbers. Assistance and/or spill response equipment will be provided by the Office of Environmental Health & Safety.

B. On-Scene Coordinator (responding to spill)

1. Assess the situation from a safe distance.

2. Attend to any injured persons.

3. Determine what chemicals are involved.

4. Determine the hazard of the chemicals.

5. Determine the extent of the hazard.

Notify the appropriate agencies.

6. Set-up restricted area and evacuate the area.

7. Stabilize the situation if possible.

Shut off gas, electric or chemical feed lines.

Remove hazardous materials from area, if it can be done safely.

8. Determine the level of protection required for personnel entering the restricted area.

9. Enter spill area, if appropriate, to further assess the situation and rescue victims using the proper level of personnel protection as required by the hazard.

10. Initiate and direct clean-up of the area.

11. If any residue needs to be processed or treated, do it away from the spill area.

12. Dispose of all contaminated materials.

13. Perform follow-up analysis of the area.

14. Restore area to its original condition.

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Evacuation Plan

A. Outline for Emergency Evacuation Procedures B. Emergency Building Evacuation Procedures C. Outline of Remaining in Building Procedures D. Evacuation Procedures for Disabled Persons E. Floor plans, showing evacuation routes

A. Outline for Emergency Evacuation Procedures

(Fire, Gas Leak, Hazardous Materials, Fire Alarm)

I. Evacuate building immediately

A. Identify problem

1. Notice hazardous condition

B. Ensure personal safety

1. Move away from hazardous area
2. Take valuables from the immediate work area only

C. Evacuation procedures

1. Alert other occupants

a. Fire alarm

b. Voice

2. Evacuate to outside of building

a. Keep clear of driveway

b. Keep clear of entrances

c. Do not use elevator

3. Contain Hazard

a. Close doors on the way out of the building

4. Headcount taken

a. Rosters of each department

b. Rosters of training sessions in the building

D. Notify University Police Department

1. Blue Light telephone
2. External or cellular telephone

E. Incident ends

1. University Police gives directions
2. Notify occupants when it is safe to return

B. Emergency Building Evacuation Procedures

(Fire, Gas Leak, Hazardous Materials, Fire Alarm)

Identify the problem by observing the hazardous condition. Instantly, take steps to ensure personal safety by moving away from the hazardous area. Take valuables from the immediate work areas only. Alert other occupants in the building by pulling the fire alarm and telling others of the situation. Evacuate to the outside of the building, keeping clear of driveways and entrances. **Do not use the elevator during an evacuation!** The last person to leave each area should close the doors on the way out to contain the hazard. 15

C. Outline for Remaining in Building Emergency Procedures
(Tornado or Earthquake)
I. Stay in Building
A. Identify problem
1. Monitor radio reports
2. Notify building occupants of potential hazard
3. Stay alert for visible warning
B. Ensure personal safety if event occurs
1. Stay away from doors and windows
2. Do not use elevator
3. Go to interior room, bathroom or closet
4. If there is no time:
a. Get under desk
b. Protect your head
C. Notify University Police Department
1. Use radio
2. Telephone or Blue Light telephone
D. Incident ends
1. University Police gives directions

II. Remaining in Building Procedures
(Tornado or Earthquake)
Identify the problem by observing visible warning signs and monitoring radio reports. Take steps to ensure personal safety. Once reports are received that imminent hazardous conditions exist, notify other building occupants.
Once notified, move to the lower areas of buildings, interior areas such as bathrooms or closets. **Do not use elevators and stay away from windows and doors**. If there is no time to move to interior areas, seek cover under desks; protect head.
D. Evacuation Procedures for Disabled Persons
I. Brief Summary of Policy
University Policy is that, upon request, faculty, staff, and students are encouraged to assist in the evacuation of any disabled person on campus in the event of an emergency, unless this action places the faculty/staff/student in personal danger. [Actions such as going back into a building once you have already exited, entering burning or smoky rooms, or passing through burning or smoky areas constitutes personal danger.] Once outside the building, faculty, staff, and students are further required to notify emergency personnel of any person known to be remaining in the building.
University Police Department can be reached by calling (57)7-2222 or by using an emergency bluelight telephone. 16

It is extremely important for all persons involved to remain calm during any emergency. University Police and Fire Department personnel will arrive within minutes to help complete the evacuation of the facility.

II. Evacuation Procedures

In the event of an emergency in any University facility that requires immediate evacuation, the evacuation of ALL occupants of that facility is of primary importance. In any emergency, life safety comes first. Often times in an emergency, evacuation may be difficult; to a disabled person, evacuation may be almost impossible without assistance. Therefore, Wayne State University has adopted the following evacuation procedures for the disabled on campus:

A. Evacuation With Assistance

Upon notification of any emergency that requires immediate evacuation, ALL occupants of the building must begin evacuating the facility. Any disabled person in that facility should make an immediate request for assistance from occupants of the building. This request may be made verbally or by any other method that the disabled person may need to use.

If the disabled person cannot locate any other occupant for assistance, then he/she will then follow the procedures outlined in Section B.

The person receiving the request should then offer assistance any follow the instructions of the disable person to the extent possible. In general, the following guidelines may be used:

1. BLIND, BUT MOBILE, PERSONS should first be moved out of the rush of traffic. Then, they should be assisted to the nearest exit.
2. DEAF, BUT MOBILE, PERSONS may be unaware of the need to evacuate. They should be calmly advised of the need to evacuate and then guided to the nearest exit.
3. TEMPORARILY IMMOBILIZED PERSONS (including those people wearing casts and/or using canes or crutches) should be given assistance as needed based on their ability to maneuver to an exit or to a Area of Refuge.
4. PERMANENTLY IMMOBILIZED PERSONS (those individuals who have either limited or no use of their legs and must rely on crutches, wheelchairs, or walkers for transport in buildings) should be assisted as follows:

a. As soon as an emergency is known, one person should remain with and assist the disabled individual.

b. The disabled individual should be quickly moved to an exit if one is located on that

floor of the building. If an exit to the outside is not located on that floor, then the disabled individual should be moved to an established Area of Refuge. Maps designating these established areas will be posted near each exit on every floor of the building. Generally, both individuals should remain inside the building until they have been given the okay to leave, or until emergency response personnel arrive and assist them in exiting the facility.

B. Evacuation Without Assistance

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Note: Disabled persons who may be occupying a facility during hours that are not considered to be normal working hours (generally, between 5:00 p.m. and 8:00 a.m. on Mondays through Fridays and at any time on weekends) are encouraged to call the University Police Department to let them know that they are in the building.
If the disabled person cannot locate any other occupant for assistance, then he/she will then follow the following procedures:
1. If the disabled person is in close proximity to an exit that opens immediately to the outside, then, at his/her discretion, that individual may attempt to exit on his/her own.
2. Otherwise, the disabled person should move to an Area of Refuge. Generally, the individual should remain inside the building until he/she has been given the okay to leave, or until emergency response personnel arrive and assist him/her in exiting the facility.
3. If the disabled person is not able to move to an Area of Refuge, the person should, if possible, open the bottom of an exterior window, or break a windowpane, and wait by the window for rescue. Any additional signaling from the window will further assist to notify emergency response personnel of the exact location of the disabled person. Generally, the individual should remain in this area until he/she has been given the okay to leave, or until emergency response personnel arrive and assist him/her in exiting the facility.

III. Rescue Priorities

As stated in Section II, the evacuation of ALL occupants of a facility is of primary importance in any emergency. Since life safety comes first, the rescue of disabled persons will be a top priority of the emergency response personnel.

IV. Implementation of Evaluation Procedures

These evacuation procedures have been established in order to provide the optimum level of safety for disabled persons in an emergency situation. Based on these procedures, the University Office of Risk Management Fire Safety Inspector, with the assistance of the Building Coordinators, will designate and establish Areas of Refuge in each facility. Facility Planning & Management will provide the maps and sinage for each building. Finally, the Building Coordinators and the Office of Risk Management Fire Safety Inspector will be responsible for reviewing the evacuation plans and then ensuring that each person in the facility is reasonably aware of the evacuation procedures and the obligation to assist those who may require help. Prior to the beginning of each semester, each department will review the name and location of each person employed by them who is disabled or who may require assistance. This information will be conveyed to the Building Coordinators.

V. Comments/Concerns

Wayne State University always welcomes any comments or concerns that may arise from any policies and procedures that have been put into effect. Any questions or comments concerning this particular policy should be referred to the Office of Risk Management Fire Safety Inspector at (57)7-3110. 18

E. Floor Plans

Evacuation Routes for Biological Sciences Building
5047 Gullen Mall
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor
5th Floor
6th Floor
7th Floor
8th Floor
9th Floor 19

Evacuation Routes for Chemistry Building
5101 Cass
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 20

Evacuation Routes for Engineering Building
5050 Anthony Wayne
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 21 22

Evacuation Routes for Science Hall
5045 Cass
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 23 24

Evacuation Routes for Gordon H. Scott Hall of Basic Medical Science
540 E. Canfield
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor
5th Floor
6th Floor
7th Floor
8th Floor
9th Floor 25

Evacuation Routes for Helen Vera Prentis Lande Building
550 E. Canfield
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 26 27

Evacuation Routes for Karmanos Cancer Institute
110 E. Warren
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 28 29

Evacuation Routes for C. S. Mott Center for Human Growth and Development
275 E. Hancock
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 30 31

Evacuation Routes for Bioengineering Building
818 W. Hancock
1st Floor
2nd Floor 32 33

Evacuation Routes for Louis M Elliman Clinical Research Building
421 E. Canfield
Basement
1st Floor
2nd Floor
3rd Floor
4th Floor 34 35

Evacuation Routes for Facilities Planning & Management
5454 Cass
1st Floor
2nd Floor
3rd Floor 36 37

Evacuation Routes for Eugene Applebaum College of Pharmacy and Health Sciences

259 Mack

Basement

1st Floor

2nd Floor

3rd Floor

4th Floor

5th Floor

6th Floor

7th Floor

8th Floor

9th Floor 38

Alarm Systems

Fire alarms in university buildings are received at University Police Department. If building occupants see/identify a fire in their presence, pull the nearest fire alarm pull station and call (57)7-2222. The chemical storage rooms (#0013.1 and #0013.2 Science Hall), Acid Room (#0015 Science Hall) and the Solvent Rebottling Room (#0025 Life Science Hall) have alarms direct to University Police Department.

Advisement

One emergency coordinator should always be present to advise assisting agencies/personnel of the character, amounts, source and extent of hazardous materials to local authorities and the National Response Center in the event of life threatening situations at any university facility. 39

Spill Response Personnel

University Police Department will notify members of the spill response team (see list) and any other appropriate agency.

Emergency Coordinator

In the event of an emergency, the emergency coordinator must immediately evacuate the hazardous area and notify appropriate local or state agencies for designated response assistance. Whenever there is a release, fire or explosion of hazardous waste/materials, the emergency coordinator must immediately identify the character, exact source, amount and extent of any released materials. This may be done by observation or review of facility records and, if necessary, by chemical analysis.

Concurrently, the emergency coordinator must assess possible hazards to human health or the environment that may result from a release, fire or explosion. This assessment must consider both direct and indirect effects of the release, fire or explosion (e.g. the effects of any toxic, irritant or asphyxiating gases that are generated or the effects of any hazardous surface water runoffs from water or chemical agents used to control fire and greatly induced explosions).

If the emergency coordinator determines that the release, fire or explosion could threaten human health or the environment outside of the facility, the findings must be reported as follows:

1. If the assessment indicates that evacuation of local areas may be advisable, immediately notify appropriate local authorities and help the appropriate officials decide the extent of the evacuation.
2. Immediately notify the National Response Center (1-800-424-8802) and report:

a. Name and telephone number of the reporter

b. Name and address of the facility

c. Time and type of incident (e.g., release, fire, etc.)

d. Name and quantity of material(s) involved, to the extent known

e. The extent of injuries, if any

f. The possible hazards to human health or the environment outside of the facility

During an emergency, the emergency coordinator must take all reasonable measures necessary to ensure that fires, explosions and releases do not occur, re-occur or spread to other hazardous materials/waste at the facility. These measures include, where applicable, stopping processes and operations, collecting and containing released materials/waste, and removing or isolating containers.

Immediately after an emergency, the emergency coordinator must provide treatment, storage, or disposal of recovered waste, contaminated soil or surface water or any other material that results from a release, fire or explosion at the facility.

The emergency coordinator must ensure that in the affected area(s) of a facility no waste materials which may be incompatible with the released material is treated, stored or disposed of

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until clean-up procedures are completed; and all emergency equipment listed in this plan is cleaned and fit for its intended use before operations are resumed.

Spill Kit Response Wagon Kit **Location : Chase 3**

Contents	Quantity	Size
Socks/Booms	10	3” x 4”
Pillows, One Liter	10	
Pads	50	18” x 18”
Disposal Bags	5	
SilverShield Gloves	2 pair	Large
Nitrile Gloves	2 pair	10
Goggles	2 pair	
Tyvek Coveralls	2	XL
Nonsparking Scoop		1-qt
Floor Stand Sign	1	
Spill-X-A Contents: 1. Sodium Carbonate 2. Petro AGS 3. Red Pigment 4. Attapulgite Clay (Magnesium Aluminum Silicate) 5. Magnesium Oxide		2.5 lbs
Spill- X-C Contents 1.Fumaric Acid 2. Attapulgite Clay (Magnesium Aluminum Silicate 3. Citric Acid 4. Petro AGS 5. Water Lock Polymer		2.0 lbs
Jumbo PH Paper		1
Repair Putty Stick	1	
Spill Response Guide	1	
Safety and Compliance Directory	1	

Approved Chemicals For Advanced
Clean Room

1) Acetone
2) Acetic Acid Glacial
3) Accuglass T-11(111,111TS,211,311) Spin-On Glass
4) Ammonium Hydroxide
5) Arch 8250-10 Deep UV Photoreist
6) Arch HMDS
7) Arttifical CSF Pefusion Fluid, NP59-7316
8) AZ®5214-E Photoreist
9) AZ EBR 70/30
10) AZ 400K Developer
11) AZ 351 Developer
12) Buffered Oxide Etch
13) Clariant AZ 351 Developer
14) Clariant AZ P4620 Photoresist
15) Cyantek Corporation UTE-1 Chromium Etchant
16) Cyantek Corporation CR-7S Chromium Etchant
17) Cyclotene 4026-46 Advanced Electronics Resin
18) Diffoil 20 Ultra
19) DOW Corning 200® Fluid, 100 CST
20) Dow Corning 200 ® Fluid, 10,000 CST
21) DOW: RINSE T1100
22) DOW: DEVELOPER DS3000
23) DOW :ADHESION PROMOTER AP3000
24) DOW CORNING SYLGARD® 184 Silicone Elastomer Kit
25) Enplate Stop-Off No.1
26) Ethyl Alcohol
27) Epoxy Technology EPO-TEK OG147-7
28) Epoxy Technology EPO-TEK OG146
29) Epoxy Technology EPO-TEK 301-2, Part A
30) Epoxy Technology EPO-TEK 301-2, Part B
31) Epoxy Technology Code #:310200
32) Epoxy Technology EPO-TEK H70S, Part A
33) Epoxy Technology EPO-TEK H70S, Part B
34) Epoxy Technology EPO-Tek H77S, Part A
35) Epoxy Technology EPO-Tek H77S, Part B
36) Epoxy Technology Code#:110309
37) Epoxy Technology EPO-Tek H31
38) FC-72 Fluorinert Brand Electronic Liquid
39) Fomblin® Y-Lvac 25/6
40) Futurrex IC1-200 Polysiloxane
41) General Electric Silicones, RTV 615 440-Kit, Silicone Potting Compound
42) Glycerol
43) HD Micro Systems P12611 Polyimide Coating

44) HD Micro Systems VM652
45) Halotron1 Pre-Sat Base
46) Hydrochloric Acid, 33-40%
47) Hydrofluoric Acid
48) Hydrogen Peroxide Solution
49) Iron (II) Chloride Tetrahydrate, 99+%
50) Isopropyl Alcohol (90-100%)
51) J T Baker 2-Propanol
52) Lanthanum Nitrate Hexahydrate
53) Lead Acetate
54) Loctite Product 3492 Epoxy
55) Loctite Product 3493 Epoxy
56) 2-Methoxyethanol
57) 3M FC-72 Fluorinert Brand Electronic Liquid
58) Methanol
59) Micro Chem LOR A Series Resist
60) Micro Chem LOR B Series Resist
61) Micro Chem NANO LOR B Series Resist
62) Micro Chem Nano A Thinner
63) Micro Chem LOR 7B Lift Off Resist
64) Micro Chem LOR 3A
65) Micro Chem LOR10A
65) Micro Chem LOR3B
66) Micro Chem MIBK/IPA
67) Micro Chem NANO 950 PMMA Resist
68) Micro Chem Nano LOR 1A
69) Micro Chem SU-8 Series Resists
70) Micro Chem SU-8 2000 Series Resist
71) Micro Chem SU-8 Developer
72) Micro Chem Remover PG GO50200
73) Micro Resist Technology, Developer for ORMOCERs ORMODEV, Product Code R41DEVX
74) Micro Resist Technology, Methacrylate Resin Ormocore (B59) (R 41B59D-GB-E.PDF)
75) Micro Resist Technology, Methacrylate Resin Ormocore (B66) (R 41B66D-GB)
76) Micro Resist Technology, Acrylat Resin, Ormocmp (US-S4), Product code: R41USS4-GB_E
77) Micro Resist Technology, Developer for Ormocerormodev, Product code, R41DEVX-GB_E
78) Micro Resist Technology, mr-1 7000 Series Imprint Polymer, Product Code: R340XXX-GB_E
79) Micro Resist Technology, mr-1 7000 Series Imprint Polymer, Product Code: R341XXX
80) Micro Resist Technology, mr-1 T85 Series, Product Code: R330XXX
81) Nickel Acetate Tetrahydrate
82) Nickel Sulfamate
83) Nitric Acid 50-70%
84) Nyogel OCK-433 Part A
85) Parylene Dimer DPX-C
86) Phosphoric Acid
87) Photomask Cleaner Solution

88) Polyethylene glycol 1000 MSDS
89) Potassium Hydroxide
90) Shin Etsu SEPR -1803-0.25
91) Shin Etsu SEPR-1801-0.3
92) Shipley Microposit MF CD-26M Developer
93) Shipley Microposit(TM) LDD(TM)-26W Developer
94) Shipley Microposit(TM) S1811(TM) Postive Photoresist
95) Shipley Microposit Developer CD-30
96) Shipley Microposit MF-319 Developer
97) Shipley Microposit Remover 1165
98) Shipley Microposit S1813 Photo Resist
99) Shipley Microposit S1818 Photo Resist
100) Shipley UV5 Positive Deep UV Photoresist
101) Shipley UV113 Positive DUV Photoresist
102) Shipley Microposit EC Solvent 11
103) Shipley Microposit EBR-10A
104) Shipley Megaposit SPR 505A PhotoResist
105) Silicon Resources, P-20 Thinner
106) Silcon Fluid 500 MSDS
107) Snoop
108) Spartan Chemical Company, Inc: Sheen 17
109) Sulfuric Acid, 52-100%
110) Titantanium Isopropoxide
111) TMAH: Tetramethylammonium Hydroxide, 25 % aqueous
112) Toluene
113) Transene Gold Etchant Type TFA
114) Transene, Aluminum Etchant Type A
115) Transene, Aluminum Etchant Type D
116) Transene Transetch N
117) Transene Tungsten Etch TFW
118) Transene Nickle Etchant TFB
119) USF C-211 Ion Exchange Resin
120) UTE-1 Chromium Etchant
121) UV(TM)5-0.6 Positive DUV Photoresist
122) Virginia Scale Remover
123) Zirconium n-propoxide 70% in propanol

Wayne State University
Office of Environmental Health and Safety
5425 Woodward, Suite 300
Detroit, Michigan 48226
(313) 577-1200, FAX: (313) 961-5603

Chemical Hygiene Plan

Reference Guide

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IN ACCORDANCE WITH 29 CFR 1910.1450 AND R325.70106

People Working Together To Provide Quality Service

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A. General Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations in the manual, Prudent Practices for Handling Hazardous Chemicals in Laboratories, general principles for safe laboratory work include the following:

1.Minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals. Skin contact with chemicals should be avoided as a cardinal rule.

2.Avoid underestimation of risk. Even for substances of no known significant hazard, exposure should be minimized. For work with substances which present special hazards, precautions should be taken. One should assume that any mixture can be more toxic than its most toxic component, and that all substances of unknown toxicity are toxic.

3.Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by the use of hoods and other ventilation devices.

4.Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed and should be a regular, continuing effort, not merely a standby or short-term activity. Its recommendations should be followed by all laboratory workers.

5.Observe the Permissible Exposure Limits (PELs) and the Threshold Limit Values (TLVs). PELs, set by OSHA, or TLVs, set by the American Conference of Governmental Industrial Hygienists (ACGIH) should not be exceeded.

6.Develop written standard operating procedures (SOPs). For work involving highly toxic chemicals, SOPs should be developed which include general safety procedures, housekeeping practices, personal protective equipment, waste disposal and emergency response procedures, etc.

B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rests at all of the following levels:

The Director of the Office of Environmental Health and Safety (OEH&S) has the ultimate responsibility for chemical hygiene within the University, and, along with the OEH&S staff and Principal Investigators, must provide continuing support for chemical hygiene.

The Chemical Hygiene Planning Committee is responsible for assuring that the Principal Investigators are meeting the requirements of the OSHA Laboratory Standard.

The Hazard Communication Program Coordinator is responsible for training laboratory employees in general lab safety andthe OSHA Laboratory Standard.

The Employee Health Service in the University Health Center serves as the primary contact for medical treatment and medical surveillance.

1.Office of Environmental Health & Safety (OEH&S) Staff Responsibilities

The OEH&S staff members are the Chemical Hygiene Officers. They will be responsible for the following:

a.Assisting each Principal Investigator in the development and implementation

of appropriate chemical hygiene policies and practices.

b.Monitoring procurement, use and disposal of chemicals used in the lab.

c.Ensuring that appropriate inspections are conducted and maintained.

d.Assisting Principal Investigators in the development of safety precautions in new and existing laboratory processes.

e.Determining if medical surveillance is necessary.

f.Closing labs that pose a serious threat to the health of the workers.

2.Principal Investigator Responsibilities

The Principal Investigator is expected to do the following:

a.Develop written standard operating procedures (SOPs) for employees to follow when working with highly hazardous chemicals.

b.Ensure that all laboratory employees and students receive training in the laboratory SOPs.

c.Ensure that all facilities and training are adequate for the use of all materials handled and ordered by the lab.

d.Determine and provide the appropriate personal protective equipment.

e.Provide regular, formal chemical hygiene and housekeeping inspections of emergency and personal protective equipment.

f.Ensure that all laboratory employees know and follow the chemical hygiene rules.

g.Ensure that appropriate personal protective equipment is:
available to all employees working in the lab
utilized by all employees when they are in the lab
in good condition

h.Provide appropriate training to employees on the proper selection, use and limitations of personal protective equipment.

Each laboratory researcher, technician and student assistant is responsible for planning and conducting each operation in accordance with the University's Chemical Hygiene Plan and the lab's standard operating procedures. Each individual is responsible for developing safe personal laboratory habits.

C. The Laboratory Facilities

1.Design

The laboratory facility should have:

a. An appropriate general ventilation system with air intakes and exhausts located so as to avoid intake of contaminated air;

b. Adequate, well-ventilated stockrooms/storerooms;

c.Laboratory hoods and sinks;

d.Other safety equipment, including eyewash fountains and drench showers, that meet the American National Standards Institute (ANSI) requirements.

2.Maintenance

Mechanical laboratory equipment (i.e. vacuum pumps, grinders etc.), should be inspected regularly and repaired or replaced as needed. Exposed belts or moving parts should be guarded.

3.Usage

The type of work conducted and the work load must be appropriate for the physical facilities available and the quality of ventilation in the lab.

4.Ventilation

a.General laboratory ventilation

The ventilation system should provide a source of air for breathing and for input to local ventilation devices. It should not be relied upon solely for protection from toxic substances released into the laboratory. Laboratory air should be continually replaced, preventing an increase of air concentrations of toxic substances during the working day. Air flow should be directed into the laboratory from non-lab areas and out to the exterior of the building.

b.Chemical Fume Hoods

A chemical fume hood should be provided for any employee who spends a significant amount of his/her time working with chemicals. A hood should be used when working with toxic materials and when transferring chemicals or mixing solutions into new containers. Each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use, and a 20 cm line drawn from the edge,

designating the safe work zone. If it is not possible to meet these recommendations, work with substances of unknown toxicity should be avoided, or other types of local ventilation devices should be utilized.

c.Biological Safety Cabinets

Biological safety cabinets shall be evaluated annually in accordance with the National Safety Foundation (NSF) Standard 49. If your biosafety cabinet hasn't been certified within the past year, contact OEH&S at
577-1200.

d.Other local ventilation devices

Ventilated storage cabinets, canopy hoods, etc. should be provided as needed and should have separate exhaust ducts. Flammable storage cabinets need not have separate exhaust ducts.

e.Special ventilation areas

Exhaust air from extremely toxic sources should pass through scrubbers or other treatments before release, it has been determined that public health is at risk.

f.Modifications

Any alteration in the ventilation system should be made only after testing indicates that worker protection from
airborne toxic substances will continue to be adequate.

g.Quality and performance

General airflow should not be turbulent and should be relatively uniform throughout the laboratory, with no highvelocity or static areas. Airflow into and within the hood should not be excessively turbulent (little eddy motions),and hood face velocity should measure between 60 and 100 lfm. A ventilation rate of 4-12 room air changes per
hour is normally adequate.

h.Evaluation

Ventilation systems should be evaluated upon installation, regularly monitored and reevaluated whenever change in local ventilation devices are made.

D. Components of the Chemical Hygiene Plan

1.Basic Rules and Procedures

a.Standard Operating Procedures (SOPs)

Develop written procedures relevant to safety and health considerations to be followed when laboratory work involves the use of highly hazardous chemicals such as carcinogens, teratogens or mutagens. SOPs and Material Safety Data Sheets (MSDSs) should be available to all laboratory workers for these substances. See theAppendices for a complete list of highly hazardous chemicals. The Principal Investigator shall review and update SOPs annually. Employees should read and sign SOPs when beginning work and whenever the SOPs areupdated or modified.

b.Exposures, injuries and illnesses

Report to the Employee Health Service, located on the fourth floor of the University Health Center (745-4774)for treatment of a non-emergency type injury/illness between the hours of 9:00 a.m. and 5:00 p.m., Monday through Friday. An appointment is not necessary.

If immediate treatment is necessary or the Employee Health Service is closed, report to Detroit Receiving or the nearest hospital emergency room.

If transportation is needed for an emergency situation, contact the Department of Public Safety (577-2222).

Eye contact: Promptly flush eyes with copious amounts of water for a prolonged period (at least 15 minutes) and seek medical attention.

Ingestion: Consult physician immediately and seek medical attention. See first aid section of chemical's Material Safety Data Sheet.

Skin contact: Promptly flush the affected area with water and remove any contaminated clothing. If symptoms persist after washing, or if damage to the skin has occurred, seek medical attention.

Inhalation: Get to a source of fresh air. Seek medical attention.

Complete a Report of Injury form for any injury/illness within 24 hours of the incident. Forms are available from Risk Management, 577-3110.

c.Avoidance of "routine" exposure

Develop and encourage safe habits. Avoid unnecessary exposure to chemicals by any route. Never smell or tastechemicals.

Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices. Do not release toxic substances into the laboratory. Inspect glove boxes before each use.

Inspect gloves, lab coat, eye protection and all personal protective equipment before each use.

d.Choice of chemicals

Use only those chemicals for which the quality of the available ventilation system is appropriate. Be familiar with the hazards and the precautions to take before beginning work with any chemicals.

e.Eating, drinking, smoking, etc.

Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present. Wash hands before leaving the lab and conducting these activities.

Never store food or beverages in refrigerators used for chemicals. Have an appropriately labeled refrigerator and storage area for food, away from chemicals.

f.Equipment and glassware

Handle and store laboratory glassware with care to avoid damage, and do not use damaged glassware. Use metalor cardboard containers for the disposal of glassware. Use equipment only for its designed purpose.

g.Exiting

Remove all protective equipment and clothing before leaving the lab. Wash hands and areas of exposed skin.

h.Horseplay

Avoid practical jokes or other behavior which might confuse, startle or distract another worker.

i.Mouth pipetting

Do not use mouth suction to pipet chemicals or to start a siphon. A pipette bulb or an aspirator should be used to provide vacuum.

j.Personal apparel

Confine long hair and loose clothing. Wear shoes at all times in the laboratory. Do not wear sandals, perforated shoes, sneakers, or shorts.

k.Housekeeping

Keep the work area clean, organized, and uncluttered. Clean up the work area on completion of an operation and at the end of the day.

l.Personal protective equipment

Assure that appropriate eye protection is worn by all persons, including visitors, where chemicals are stored ohandled. Do not wear contact lenses in the lab unless eye protection is being worn at all times.

Wear appropriate gloves when there is a potential for skin contact with chemicals. Inspect gloves before each use,and never wash or reuse disposable gloves. Wash rubber and utility gloves before removal, and replace them whenever there are cracks or tears in the material. See Appendix VIII for glove selection guidelines.

Use appropriate respiratory protection when air contaminant concentrations are not sufficiently restricted by engineering controls. Always inspect the respirator before using. In order to wear a respirator, you must receive a
physical examination and fit test through the University Health Center, and training through OEH&S. Contact
OEH&S at 577-1200 for assistance.

Use any other personal protective equipment appropriate for lab tasks.

Remove lab coat, gloves and other personal protective equipment whenever they become contaminated and before leaving the lab.

m.Planning

Seek information and advice about hazards, plan appropriate protection procedures, and plan positioning of equipment before beginning any new operation. Contact OEH&S for assistance in this area.

n.Unattended operations

If possible, please avoid procedures which cannot be attended at all times. If it is necessary to leave an operation unattended, leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water).

Never leave open flame burners, heating elements, etc. unattended.

o.Use of fume hood

Use the hood for operations which may result in the release of toxic chemical vapors, dusts, mists or aerosols.

Use the hood or other local ventilation devices when working with any appreciably volatile substance with a TLV
or PEL of less than 50 ppm.

Confirm adequate hood performance before use.Keep the sash closed except when work or adjustments are being done within the hood. Do not use the hood to store chemicals or other materials. Only perform work in the

hood when the sash is set at the proper level for the correct face velocity. Face velocity should measure between 60 - 100 fpm (linear feet per minute).

p.Vigilance

Be alert to unsafe conditions and see that they are reported to the appropriate department and corrected when detected.

q.Waste disposal

Chemical waste disposal is carried out by OEH&S. The plan for each laboratory operation should include planning and training on waste disposal procedures. See page 15 for more information on chemical waste disposal, or call OEH&S at 577-1200.

r.Working alone

Avoid working alone in a building, and never work alone in a laboratory if the procedures being conducted are hazardous.

2.Chemical Procurement, Distribution, and Storage

a.Procurement

When a substance is received, information on proper handling, storage, and disposal should be made known to those who will be working with the chemical. If chemicals are shipped with material safety data sheets (MSDSs),
they must be kept on file in the lab.

b.Distribution

When transporting chemicals, use a secondary container, such as, a cart with sides, a bucket, or a bottle carrier.Gas cylinders should be capped during transport and when not in use. Cylinders should always be transported individually using a secure gas cylinder dolly.

c.Laboratory storage

All laboratory chemicals should be stored in approved labeled storage cabinets/containers by compatibility and not alphabetically. Do not store any chemicals on the floor, in the aisles, or on top of cabinets. Do not store more chemicals in the lab than necessary. Store only those amounts that will be used in a reasonable amount of time.

Flammable liquids shall be stored in flammable cabinets or safety cans. Large volumes of solvents shall be stored in separate chemical storage areas outside of the laboratory. Chemicals requiring refrigeration must be stored in a
labeled explosion proof refrigerator.

Highly toxic materials shall be stored in a separate labeled area. For detailed information on proper chemical storage, contact OEH&S.

d.Gas cylinder storage

All gas cylinders must be secured to a rigid surface. Oxidizers must be stored at least 20 feet away from flammable gas cylinders, or separated by a barrier.

3.Environmental Monitoring

The Manager of Environmental Health and Safety is responsible for monitoring airborne concentrations of chemicals and
determining whether conditions are hazardous to the health of laboratory workers.

4.Housekeeping, Maintenance, and Inspections

a.Cleaning

Floors, bench tops andwork areas should be cleaned daily.

b.Inspections

Formal housekeeping and chemical hygiene inspections should be performed regularly by the Principal Investigator and the research staff.

c.Equipment maintenance

Flush eyewash fountains weekly. Safety showers should be tested every six months by FP&M. Inspect respirators and other personal protective equipment before and after each use. All emergency equipment, including eyewashes, safety showers and fire extinguishers must be visible, unobstructed and readily accessible.Before performing any maintenance work on electrical lab equipment, unplug the equipment and follow proper
lockout procedures. Call 577-1200 or 961-5605 for more information.

d.Passageways

Stairways and hallways should not be used for storage. Never block exits, emergency equipment, or utility controls. All aisles in the lab should be at least three feet wide.

5.Medical Program

a.Routine surveillance

Routine medical surveillance should be established if required by any regulations, (e.g. respiratory protection program, lead standard, or any other substance specific OSHA standard). The University Health Center (UHC)
and OEH&S will determine the need for and the frequency of medical surveillance for specifically regulated materials.

b.Bloodborne Pathogen Program

If laboratory work involves the use of human blood, body fluids or tissue, the Hepatitis B vaccination must be made available to all employees at risk of exposure at the beginning of their employment. Vaccinations must be paid for by the employer and are available through the Employee Health Service, 4K University Health Center.
For more information on the Bloodborne Pathogen Standard and the WSU Exposure Control Plan, contact OEH&S.

c.Injury reports

A Report of Injury form must be completed for any laboratory accident that results in an injury, illness and/or exposure.Report of Injury forms are available from the Office of Risk Management, 217 ASB II, 577-3110.

6.Records

a.Report of Injury forms should be prepared by the injured employee whenever possible, and signed by the employee's supervisor. The completed form should be forwarded to Risk Management within 24 hrs.

b.Chemical Hygiene Plan records should document that laboratory facilities and procedures are compatible with current knowledge and regulations.

c.Inventory and usage records for highly toxic substances should be kept by the lab manager.

d.Written SOPs should be read and signed by all lab personnel.

7.Signs and Labels

a.Emergency signs

Emergency notification stickers (available through OEH&S) should be placed on the lab door and should list the
following names and phone numbers:

principal investigator
laboratory supervisor
Department of Public Safety (577-2222)

b.Hazard signs

Post the type(s) of hazard(s) (biohazard, cancer hazard, radioactive hazard, UV radiation, etc.) on the laboratory door, in areas where work is performed using those chemicals (e.g. fume hood), and in storage areas.

c.Chemical labeling

All chemical and waste containers must be correctly labeled. Chemicals from a manufacturer must have the

following information included on the label:

name of chemical
signal word (Danger, Warning, Caution)
type of hazard (poison, irritant, inhalant, carcinogen, etc.)
precautions (i.e., avoid skin contact, use only in well ventilated area, etc.)
instructions in case of emergency.
storage requirements and expiration date if applicable.

d.Chemicals removed from the original container and poured into a secondary container, or solutions mixed in the lab, must be labeled with regard to the name of the chemical and the principle hazard, and expiration date if applicable (e.g. ether and other peroxidizable chemicals).

8.Spills and Accidents

a.In the event of a large spill, call the Office of Environmental Health & Safety at 577-1200 or the Department of Public Safety at 577-2222.

b.Prevent spills through proper storage of chemicals, use of standard operating procedures, monitoring and inspection of storage areas, and training of laboratory personnel. For minor spills, contain the spill with sand or absorbent materials. Wash area thoroughly after clean-up and notify OEH&S for further clean-up and to dispose of waste materials.

c.For skin or eye contact, flush area with water immediately. For spills on clothing, remove clothing immediately, including shoes, to prevent soak through, and flush affected area with water.

9.Information and Training Program

a.Aim

To assure that all individuals working in a laboratory setting are adequately informed about hazards associated with lab work, and the proper precautions to take to protect their safety and health in the lab.

b.Emergency and personal protective equipment training

Every laboratory worker should know the steps to take in the event of an accident, injury, exposure or spill. Laboratory workers should know the location and proper use of personal protective equipment, including lab coats, gloves and eye protection.

c.Laboratory safety and Chemical Hygiene Plan training

Chemical Hygiene Plan/laboratory safety training is required for all lab employees before beginning work in the lab. Contact OEH&S at 577-1200 or 961-1803 for training information. Training records must be kept in the lab.

d.Material Safety Data Sheets (MSDSs)/reference material

Literature/reference material concerning chemical hazards, including Material Safety Data Sheets (MSDSs), should be readily available to laboratory personnel in the SOPs. MSDSs for all hazardous chemicals are available through OEH&S by calling 577-1200. Copies of MSDSs for highly hazardous materials being used should be kept in the lab with the Chemical Hygiene Plan and the SOPs. Reference material is also available through OEH&S.

10.Waste Disposal Program

a.Aim

To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals.

b.Chemical waste disposal procedures

Do not discharge into the sewers concentrated acids or bases, highly toxic, malodorous, or lachrymatory substances, or any other substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage, or obstruct flow.

Collect all chemical waste in appropriately labeled receptacles. Chemical waste containers and waste tags are available from OEH&S. Contact OEH&S at 577-1200 or 961-1801 to have waste picked up from the lab.

c.Methods of disposal

OEH&S determines the proper disposal method for all hazardous wastes generated at the university. Chemicals should never be dumped down drains into the sewer system, or evaporated through the hood.

More information about chemical waste disposal

E. Computer-Aided Management of Emergency Operations (CAMEO)

1.Aim

To assure that firefighters, police officers, and emergency responders are adequately informed of risks at the site.
Information on laboratories is collected by OEH&S through a questionnaire given to each lab.

2.Information

a.Facility information should include the following:

Building location (room number)

Principal Investigator's name and home address
Emergency phone number
List of chemicals in reportable quantities
List of all gas cylinders

b.The facility plan should consist of the following:

Diagram of the chemical storage area
Indication of the location of gas cylinders

F. General Procedures (SOPs) for Working with Highly Hazardous Chemicals

1.Working with Allergens and Teratogens

a.Allergens: diazomethane, chromium, nickel, isocyanates, bichromates, formaldehyde, certain phenols, etc.

One should wear gloves to prevent hand contact with allergens or substances of unknown allergenic activity. Conduct aerosol producing procedures in a fume hood.

b.Teratogens and embryotoxins: organomercurials, lead compounds, formamide, etc. (for a complete list see
Appendix V)

Women of childbearing age should only handle these substances in a hood which has a confirmed satisfactory performance, using appropriate protective apparel (especially gloves) to prevent skin contact. Because the period of greatest susceptibility to embryotoxins is the first 8 - 12 weeks of pregnancy, which includes a period when a woman may not know she is pregnant, women of child-bearing potential should avoid skin contact with all chemicals.

If you are pregnant, or plan on becoming pregnant, contact OEH&S before beginning work with any of these materials.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify Principal Investigator and OEH&S of all incidents of exposure or spills. Consult the University Health
Center in the event of an exposure.

2.Working with Chemicals of Moderate Chronic or High Acute Toxicity

Examples include diisopropylfluorophosphate, hydrofluoric acid, and hydrogen cyanide.

a.Records

Maintain an inventory of names and amounts of these materials on hand, amounts used, material safety data sheets, and names of workers involved.

b.Personal protective equipment

Always avoid skin contact by wearing gloves and lab coats. Always wash hands and arms immediately after working with these materials.

c.Storage

Use and store these substances only in areas of restricted access with special hazard warning signs. Store breakable containers in chemically resistant trays.

d.Engineering controls

Always use a chemical fume hood (currently evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) or other containment devices for procedures which may result in the generation of aerosols or vapors containing the substance. Trap released vapors, or prevent them from being discharged with the hood exhaust.

e.Prevention of spills and accidents

Assure that at least two people are present at all times if a compound in use is highly toxic or of unknown toxicity.

If a major spill occurs outside of the hood, evacuate the area and contact OEH&S at 577-1200 or DPS at 577-2222.

f.Waste

Arrange waste disposal through the OEH&S Hazardous Materials Section at 961-1801 or 577-1200. Waste containers can be supplied by OEH&S.

3.Working with Chemicals of High Chronic Toxicity

Examples include Dimethylmercury, nickel carbonyl, benzo-a-pyrene, N-nitrosodiethylamine, other human carcinogens or substances with high carcinogenic potency in animals. (See the Appendices for a complete list.)

a.Access

Conduct all transfer and work with these substances in a "controlled area", such as a restricted access hood, glove box, or a specific area in the lab, designated for use of highly toxic substances. All people with access should be aware of the substances being used and the necessary precautions to take to prevent exposure.

b.Approvals

Prepare a standard operating procedure (SOP) for the use and disposal of these materials, and obtain the approval of the Principal Investigator and laboratory supervisor.

c.Decontamination

Decontaminate the controlled area before normal work is resumed.

d.Medical surveillance

If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 or more times per week), consult OEH&S and the University Health Center concerning medical surveillance.

e.Records

Keep accurate records of the amounts of these chemicals stored and used, MSDSs for each chemical, dates of use, and names of the users.

f.Signs and labels

Assure that the controlled area and storage areas are conspicuously marked with warnings and restricted access signs, and that all containers of these chemicals are clearly labeled as to their hazard.

g.Chemical spills

Assure that contingency plans (SOPs), equipment, and materials to minimize exposures of people and propert are available in the event of an accident.

h.Storage

These chemicals should be stored in well ventilated, labeled, limited access areas in appropriately labeled, unbreakable, secondary containers.

i.Gloves boxes

For a negative pressure glove box, ventilation rates must be at least 2 volume changes per hour and pressure at least 0.5 inches of water. For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap the exit gases or filter them through the approved mechanism.

APPENDICES

APPENDIX I

PART 1910--OCCUPATIONAL SAFETY AND HEALTH STANDARDS

SUBPART Z - TOXIC AND HAZARDOUS SUBSTANCES

Air contaminants
Asbestos, tremolite, anthophyllite, and actinolite
Coal tar pitch volatiles
4-Nitrobiphenyl
alpha-Naphthylamine
Methyl chloromethly ether
3,3'-Dichlorobenzidine (and its salts)
bis-Chloromethyl ether
beta-Naphthylamine
Benzidine
4-Aminobiphenyl
Ethyleneimine
beta-Propiolactone
2-Acetylaminofluorene
4-Dimethylaminoazobenzene
N-Nitrosodimethylamine
Vinyl chloride
Inorganic arsenic
Lead
Benzene
Coke oven emissions
Cotton dust
1,2-dibromo-3-chloropropane
Acrylonitrile
Ethylene oxide
Formaldehyde

If you are working with any of the above chemicals, please contact the Office of Environmental Health and Safety
at 577-1200.

APPENDIX II

PEROXIDIZABLES

The following materials may form explosive peroxides. Ensure that the label has an expiration date. Do not store peroxidizables
after they are expired. Please indicate if any of these are present in your lab:

SOLID

sodium amide

LIQUIDS

acetal
cyclohexene
decahydronaphthalene
dicyclopentadiene
diethyl ether
diethylene glycol
dimethyl ether (liquid or gas)
dioxane
divinyl acetylene
ethyl ether
ethylene glycol dimethyl ether (glyme)
tetrahydronaphthalene
isopropyl ether
tetrahydrofuran
vinyl ethers
vinylidene chloride

GASES

diacetylene
dimethyl ether (gas or liquid)
methyl acetylene

If you have any of the materials in Appendix II or IIII in defective containers, or if they have been stored past the
expiration date, please contact the Office of Environmental Health and Safety for disposal at 577-1200.

APPENDIX III

SHOCK SENSITIVE MATERIALS

The following are examples of materials which can be shock sensitive:
Please indicate if any of these are present in your lab.

SOLIDS

acetylides
aluminum ophorite explosive
amatol

ammonal
ammonium nitrate
ammonium perchlorate
ammonium picrate
ammonium salt lattice
butyl tetryl
calcium nitrate
copper acetylide
cyanuric triazide
cyclotrimethylenetrinitramine
dinitroethyleneurea
dinitrophenol
dinitrophenyl hydrazine
dinitrotoluene
dipicrylamine
dipicryl sulfone
erythritol tetranitrate
fulminate of mercury
fulminate of silver
fulminating gold
fulminating mercury
fulminating platinum
gelatinized nitrocellulose
guanyl nitrosamino guanyltetrazene
guanyl nitrosamino guanylidene
guanylidene
hydrazine
heavy metal azide
hexanite
hexanitrodiphenylamine
hexanitrostilbene
hexogen
lead azide
lead mannite
lead mononitroresorcinate
lead picrate
lead salts
lead styphnate
magnesium ophorite
mannitol hexanitrate
mercury oxalate
mercury tartrate
nitrated carbohydrate
nitrated glucoside
nitrogen tri-iodide
nitroguanidine
nitronium perchlorate
nitrourea
organic nitramines

picramic acid
picramide
picric acid
picryl chloride
picryl fluoride
organic amine nitrates
potassium nitroaminotetrazole
robenzoic acid
silver acetylide
silver azide
silver styphnate
silver tetazene
sodatol
sodium amatol
sodium nitrate-potassium explosive mixtures
sodium picramate
syphnic acid
tetranitrocarbazole
tetraze
tetrytol
trinitroanisole
trinitrobenzene
trinit
trimonite
trinitronaphthalene
trinitrophenetol
trinitrotoluene
urea nitrate

LIQUIDS

dinitroglycerine
hydrazoic acid
nitroglycerin
nitroglycide
nitroglycol
nitroparaffins
nitrotoluene
sodium dinitro-ortho-cresolate

SOLID OR LIQUID

dinitrophenolates
hydrazine mixtures
hyrazinium nitrate
nitrogen trichloride
organic peroxides (t-butyl peroxide)

APPENDIX IV

KNOWN CARCINOGENS - American Conference of Government Industrial Hygienists (ACGIH)

Please indicate if any of the following are present in your lab.

SOLIDS

4-aminobiphenyl
asbestos-amosite, chrysotile,crocidolite
arsenic and certain arsenic compounds
benzidine
chromite ore (processing as Cr)
chromium (VI) compounds (certain water insoluble)
coal tar pitch volatiles (as benzene solubles)
B-naphthylamine
nickel
4-nitrodiphenyl (solid or liquid)
particulate polycyclic aromatic-hydrocarbons (coal tar pitch)
vinyl chloride (solid or gas)

LIQUID

bis (chloromethyl) ether

GAS

vinyl chloride (gas or solid)

APPENDIX V

SUSPECTED CARCINOGENS (A2)

Please indicate if any of the following are present in your lab.

SOLIDS

acrylamide
antimony trioxide (production)
arsenic trioxide (production)
beryllium (& compounds)
cadmium (& compounds)
chrysene

3,3-dichlorobenzidine
4,4-methylene bis (2-chloroaniline)
4,4-methylene dianiline
N-phenyl-beta-naphthylamine
potassium bromate
o-tolidine
p-tolidine

LIQUIDS

acrylonitrile
benzene
carbon tetrachloride
chloroform
chloromethyl methyl ether
dimethyl carbamoyl chloride
1,1-dimethylhydrazine
dimethyl sulfate
ethylene dibromide
ethylene oxide (at 12 deg. C)
ethyl acrylate
formaldehyde
hexachlorobutadiene
hexamethyl phosphoramide
methylene chloride
methyl hydrazine
methyl iodide
N-nitropropane
N-nitrosodimethylamine
phenylhydrazine
B-propiolacetone
propylene imine
propylene oxide
vinyl cyclohexene dioxide
xylidine (mixed isomers)

GASES

1-3 butadiene
ethylene oxide

APPENDIX VI

TERATOGENS

The following are examples of materials that can cause genetic mutations or abnormalities in a developing fetus.
Please indicate if any of these are present in your lab.

SOLIDS

arsenic
barium
bismuth
cadmium
caffeine
cannabis
carmine (sod. & lith.)
cesium-137
cobalt
codiene
congo red
cycloheximide
dinitrophenol
dioxin
diphenylamine
ethionamide
evans blue
hexachlorophene
iodoacetate
lead
lithium carmine
lithium chloride
LSD
marijuana
methyl arsenate
methyl mercury
methylurea (di-, tri-, tetra-)
niagara blue
nitrite (sodium)
nitrosurea
phenylalanine
picric acid
rhodium chloride
selenium
semicarbazide HCL
strontium (SR-90)
sodium cyanide
sodium nitrite
tellurium
thallium
thiosemicarbazide
triethanomelamine
trypan blue

urethane

LIQUIDS

benzene
benzyl alcohol
carbamate pesticides
carbon tetrachloride
chlorodan
diethylnitrosamine
dimethylacetamide
formamide
halothane
hydrazine(s)
mercury
methyl hydrazine
monomethylformamide
nicotine
organophosphate pesticides
propylene glycol
toluene
xylene

GASES

carbon monoxide
hexafluoroacetone
methane
ozone
tritium (H-3)

SOLID OR LIQUID

alkylting agents
azide
boric acid
chlorocholine chloride
cortisone
janus green B
nitrosomethylaniline
tetrachloroacetone

LIQUID OR GAS

anesthetic agents
bromide
dimethyl sulfoxide
ethylene oxide

SOLID, LIQUID OR GAS

chromium compounds
cyanide (sodium)

OTHERS

metahexamide
methyl arsenate
sodium carmine
sulphonamides

APPENDIX VII

INCOMPATIBLE CHEMICALS

Certain hazardous chemicals cannot be safely mixed or stored with each other because a severe reaction can take place or a toxic product can result. Chemicals should be stored by the hazard class and not alphabetically. The label and the MSDS of a chemical will contain information on imcompatibilities. The following are examples of incompatible chemicals:

acetic acid: chromic acid, nitric acid, hydroxyl compounds, perchloric acid, peroxides, permanganates acetylene: chlorine, bromine, copper, fluorine, silver, mercury alkali metals: water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, the halogens, alcohols, aldehydes, ketones, acids
ammonia: anhydrous mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid
ammonium nitrate: acids, metal powders, flammable liquids, chlorates, nitrites, sulfur, finely divided organic or
combustible materials
aniline: nitric acid, hydrogen peroxide
bromine: same as chlorine
carbon, activated: calcium hypochlorite, all oxidizing agents
chlorates: ammonium salts, acids, metal powders, sulfur, finely divided organic or combustible materials
chromic acid: acetic acid, naphthalene, camphor, glycerin, turpentine, alcohol, flammable liquids in general
chlorine: ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, turpentine, benzene, finely divided metals
chlorine dioxide: ammonia, methane, phosphine, hydrogen sulfide
copper: acetylene, hydrogen peroxide cumene hydroperoxide: acids, organic or inorganic flammable liquids: ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
hydrocarbons: fluorine, chlorine, bromine, chromic acid, sodium peroxide
hydrocyanic acid: nitric acid, alkali

hydrofluoric acid: ammonia, aqueous or anhydrous hydrogen peroxide: copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, flammable liquids, oxidizing gases
hydrogen sulfide: fuming nitric acid, oxidizing gases
iodine: acetylene, ammonia (aqueous or anhydrous), hydrogen
mercury: acetylene, fulminic acid, ammonia
nitric acid: acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids, flammable gases
oxalic acid: silver, mercury
perchloric acid: acetic anhydride, bismuth and its alloys, alcohol, paper, wood
potassium: carbon tetrachloride, carbon dioxide, water (see alkali metals)
potassium chlorate: sulfuric and other acids
potassium permanganate: glycerin, ethylene glycol, benzaldehyde, sulfuric acid
silver: acetylene, oxalic acid, tartaric acid, ammonium compounds sodium: carbon tetrachloride, carbon dioxide, water
(see alkali metals)
sodium peroxide: ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin,
ethylene glycol, ethyl acetate, methyl acetate, furfural
sulfuric acid: potassium chlorate, potassium perchlorate, potassium permanganate (or compounds with similar light
metals, such as sodium, lithium, etc.)
tellurides: reducing agents

Guide for Safety in the Chemical Laboratory, 2nd ed., Manufacturing Chemists' Association, Van Nostrand Reinhold: New York, 1972,
pp.215-217.

APPENDIX VIII

DEFINITIONS

ACUTE HAZARDS -- manifested after a single brief exposure and do not show permanent effects. These include:

1.Irritant: A chemical which causes reversible inflammation at the site of contact.
2.Cutaneous Hazard: A chemical that will affect the dermal layer of the body; causing defatting of the skin, rashes, or skin irritations.
3.Toxic Agent: A substance defined by one or more of the following:
a.It has an LD50* for oral doses in rats between 50 milligrams per kilogram body weight (mg/kg) and 500 mg/kg.
b.It has an LD50* for skin in a 24-hour exposure in rabbits of between 200 mg/kg and 1000 mg/kg.
c.It has an LC50* for inhalation doses administered for a one-hour duration in rats between 200 parts per million(ppm) and 2000 ppm.

*The LD50 and LC50 refer to the lethal dose and lethal concentration, respectively, at which one half of the test animals died.

4.Highly Toxic Agents: A substance defined by one or more of the following:
a.It has an LD50 (oral, rat) of less that 50 mg/kg.
b.It has an LD50 (skin, rabbit)of less than 200 mg/kg.
c.It has an LC50 (inhalation, rat) of less than 200 ppm.

5.Corrosive materials: Chemical that cause visible destruction of, or irreversible alterations in, living tissue at the site of contact, by chemical action.

6.Eye Hazards: Materials that affect the eyes or visual capacity by causing conjunctivitis or corneal damage. Common types include organic solvents, acids, and alkalis.

7.Hematopoietic Agents: Chemicals that act on the blood or hematopoietic system. These substances decrease the hemoglobin function and deprive the body tissues of oxygen. Cyanosis and loss of consciousness are typical symptoms.
Examples of these materials include carbon monoxide and cyanides.

CHRONIC HAZARDS -- These are chemicals which cause long term health effects. The effects may be slow to develop,and often are the result of repeat or continuous exposure over a long period of time. These include:

1.Sensitizer: A chemical that causes a number of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure.

2.Carcinogen: These include chemicals which are listed as a carcinogen in one of the following sources: National Toxicology Program (NTP), Report on Carcinogens, or OSHA's 29 CFR 1910 Subpart Z.

3.Reproductive Toxin: A substance which can cause birth defects or sterility. Our knowledge about reproductive toxinsis more recent than that of many other health hazards and not as extensive. It is also more difficult to obtain reliable information about such effects in humans. As a result of the uncertainties, some authorities recommend that pregnant women avoid contact with any chemicals whatsoever. Examples of reproductive toxins include PCBs and vinyl chloride.

4.Hepatotoxin: A chemical that can cause liver damage such as enlargement or jaundice. Examples include carbon tetrachloride, vinyl chloride, chloroform, and ethyl alcohol.

5.Nephrotoxin: A chemical that can cause kidney damage such as edema or proteinuria. Some examples are halogenated hydrocarbons and vinyl chloride.

6.Neurotoxin: A chemical that causes primary toxic effects on the central nervous system, such as narcosis, behavioralchanges or decreased motor function. Common examples are mercury, ethyl alcohol, and tetraethyl lead.

7.Agents That Damage the Lungs: These agents irritate the pulmonary tissue, resulting in cough, tightness in the chest,and shortness of breath. Examples include silica, asbestos fibers, and toluene diisocyanate.

PHYSICAL HAZARDS OF CHEMICALS

1.Combustible Liquid: A liquid having a flash point between 100 and 200 degrees F. The flash point is the temperature above which a flame will propagate through the vapors from an ignition source to the nearby surface of the liquid. A combustible liquid presents a fire danger at slightly elevated temperatures, but not when it is at or below room temperature. Examples include No. 1 fuel oil, and mineral spirits.

2.Flammable Aerosols: An aerosol that yields either: (1) a flame projection of more than 18 inches at full valve opening,or (2) a flame extending back to the valve at any valve opening. All aerosols are mixtures. Whether a particular aerosol is flammable often depends on the particular propellant formation.

3.Flammable Gas: Defined in two different ways: (1) a gas with a lower flammability limit (LFL) less than 13% by volume in air; or (2) a gas with an upper flammability limit (UFL) more than 12% higher than its LFL, regardless of the value of the latter.

4.Flammable Liquid: A liquid with a flashpoint below 100 degrees F. This presents a real fire hazard if present in opencontainers near a source of ignition at or below normal room temperatures. Examples include acetone, turpentine, and gasoline.

5.Flammable Solid: A solid which ignites and burns with a self-sustained flame at a rate of at least 0.1 in./sec along itsmajor axis. This does not include blasting agents or explosives. Examples include magnesium metal and nitrocellulose film.

6.Oxidizer: A chemical, other than a blasting agent or an explosive, that initiates or promotes combustion in other materials, causing fire through the release of oxygen or other gases. Examples include oxygen, nitric acid, and hydrogen peroxide.

7.Pyrophoric Materials: Substances that will ignite spontaneously in air at temperatures below 130 degrees F. An example is white phosphorus.

8.Compressed Gases: Defined in three ways: (1) a confined gas or mixtures of gases having an absolute pressure of at least 40 psi at 70 degrees F, or (2) a confined gas or mixture of gases having an absolute pressure of at least 104 psi at 130 degrees F; or (3) a liquid having a vapor pressure of at least 40 psi at 100 degrees F. Examples include nitrogen, oxygen, argon, propane, and carbon dioxide.

9.Explosives: Chemicals that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to shock, pressure or high temperatures. Examples include nitroglycerine and gun powder.

10.Organic Peroxides: A derivative of hydrogen peroxide in which one or both hydrogen atoms have been replaced by an organic radical or radicals. This definition also covers the class of compounds known to chemists as organic hydroperoxides. Examples include methyl ethyl ketone peroxide and benzoyl peroxide.

11.Unstable Materials: A chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense or become self reactive under conditions of shock, pressure, or high temperature. Examples include benzoyl peroxide and butadiene.

12.Water-Reactive Materials: A chemical that reacts with water to produce a gas that is either flammable or presents a health hazard. Some examples include acetic sodium metal and calcium carbide.

APPENDIX IX
GLOVE SELECTION CHART

RESISTANCE OF MATERIALS

S = Superior, E = Excellent, G = Good, F = Fair, NR= Not Recommended

CHEMICAL	Neoprene	Vinyl Plastic	Rubber Latex	Nitrile	Synthetic Latex	Natural Latex

alcohols	E	E	G	E	E	G
caustics	E	E	E	E	E	E
chlorinated solvents	G	F	NR	E	G	NR
ketones	G	NR	G	G	G	G
petroleum solvents	E	G	F	S	E	F
organic acids	E	E	E	E	E	E
inorganic acids	E	E	E	E	E	E
non-chlorinated solvents	G	F	NR	G	G	NR
insecticides	E	E	F	S	E	F
inks	E	E	F	S	E	F
formaldehyde	E	E	E	S	S	E
acrylonitrile	E	G	E	S	E	E
hydraulic fluid	E	E	F	S	E	F
carbon disulfide	NR	F	G	F	NR	G
paint remover	F	F	NR	E	F	NR

S = Superior, E = Excellent, G = Good, F = Fair, NR= Not Recommended

GAS List

	Gas cylinder stock for the cleanroom			
	Type	Location	PSI	Size
1	5% Hydrogen Nitrogen	furnace chase	no tank	-
2	Nitrous Oxide	furnace chase	680	k size
3	Helium	furnace chase	2400	k size
4	Argon	furnace chase	1100	k size
5	Sulfur Hexaflouride	furnace chase	290	k size
6	Oxygen (right side)	furnace chase	2500	k size
7	Oxygen (left side)	furnace chase	500	k size
8	Halocarbon 116	furnace chase	420	k size
9	Halocarbon 14	furnace chase	1350	k size
10	Hydrogen chloride	furnace chase (blue cabinet)	new tank	short
11	Ammonia	furnace chase (blue cabinet)	20	
12	Nitrogen	furnace chase (blue cabinet)	2100	k size
13	Oxygen	behind e-beam bjd 1800		k size
14	Argon	behind e-beam bjd 1800		k size
15	Nitrogen	blue cabinet behind LAM		k size
16	Chlorine	blue cabinet behind LAM	new tank	
17	Argon	Deep Trench chase	1950	k size
18	Oxygen	Deep Trench chase	1400	k size
19	Helium	Deep Trench chase	2200	k size
20	10% Oxygen CF4	Deep Trench chase	new tank	
21	Halocarbon C318	Deep Trench chase	14	short
22	Sulfur Hexaflouride	Deep Trench chase	300	
23	Silane	Outside	new tank	k size
24	2% silane in nitrogen	Outside	no tank	k size
25	Halocarbon 14	Rear of PECVD	1325	short
26	Hydrogen	Hydrogen Generator	Produced on demand	(No storage)

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