LAMAR UNIVERSITY

SAFETY MANUAL

Office of EHS/Risk Management

Updated and Review 2017

LAMAR UNIVERSITY

SAFETY MANUAL

Lamar University is committed to providing its employees, students, and visitors a safe and healthful campus environment in which to work, study, and enjoy. Safety is the responsibility of every campus citizen and can be better achieved through proper engineering, education, training, protective equipment, and enforcement of safety rules. Each student and employee is responsible for understanding and practicing the appropriate safety procedures for his or her own protection and to protect others.

All Deans, Directors, Department heads, Chairpersons, and supervisors must take an active role in the University's safety program by initiating preventative measures to control hazards associated with activities under their direction. This safety manual has been developed by the Environmental Health, Safety & Risk Management office to assist you in this endeavor.

SECTION 1

GENERAL SAFETY

Section 1 of the safety manual provides guidelines and requirements for general safety. The following topics are covered.

1. Accident Reporting
2. Americans with Disabilities Act
3. Asbestos
4. Dress Code
5. Graphics Arts Media
6. Occupational Noise Program
7. Heat Stress
8. Housekeeping
9. Indoor Air Quality
10. Lead Paint
11. Lifting
12. Polychlorinated Biphenyls (PCBs)
13. Preventing Slips & Falls
14. Tobacco Use
15. Visitor Safety

Accident Reporting

An accident is an unplanned occurrence that may result in damage to people, property, equipment, or the environment. When accidents are reported promptly, injured employees, students, and visitors receive timely (preferably by the end of your shift) medical care and unsafe conditions receive prompt corrective action. The Environmental Health, Safety & Risk Management office (EHSRM) investigates accidents to identify accident trends, determine the effectiveness of current safety programs, and prevent future accidents.

IMPORTANT!
Report all accidents to your supervisor, EHSRM, or the LUPD, if it is a student or visitor, as appropriate. If an injury or exposure occurs on-the-job, the injured employee's supervisor must complete the Supervisor's Report of Injury, Injury or Illness, available on the Human Resource Webpage, as soon as possible.

EXAMPLE: - HAZARDS
Report hazards such as missing manhole covers or chemical spills, to Facilities.
Report accidents such as vehicle collisions to the LUPD.
Report unsafe conditions or potentially hazardous situations to Facilities Operations or the EHSRM as quickly as possible. The Office will then contact other departments and outside agencies as appropriate.

Americans with Disabilities Act

Lamar University complies with the requirements and guidelines of the Americans with Disabilities Act (ADA). This means that new facilities and renovations to existing facilities are designed to provide accessibility for persons with a disability.

Parking spaces for the disabled and wheelchair ramps must remain accessible at all times. Do not block these areas or tamper with other accessibility equipment. In addition, do not remove Braille tabs on elevator buttons or other signs.

Report accessibility violations such as blocked wheelchair ramps and blocked handicapped parking to LUPD...

Contact the Office of Disability Services (ODS) for more information on accommodating individuals with a disability or making your workplace more accessible.

Asbestos

Asbestos is a mineral fiber that causes cancer and various respiratory illnesses. Older buildings constructed prior to 1980 may contain asbestos. Asbestos is commonly found in older appliances, insulation, shingles, siding, putties, and caulking. Generally, it is not a problem unless the material that contains it crumbles or flakes.

The Texas Asbestos Health Protection Rules do not require building owners to conduct inspections and identify all asbestos locations. Inspections are required, however, prior to renovation or dismantling activities.

NOTE: Call Facilities Planning, Design and Construction before performing work on campus that will disturb building fixtures, walls, or ceiling (e.g., installing computer cables in the ceiling). Facilities will help ensure that the work does not affect asbestos containing materials.

WARNING! Do not handle asbestos or suspected asbestos or try to remove it yourself.

Graphics Arts Media

The art supplies and chemicals associated with graphic media are often extremely hazardous. Depending on the type of art supplies used, artists can develop the same types of occupational diseases as industrial workers. Studies show that people who work with hazardous graphic media chemicals can develop dermatitis, lead poisoning, silicosis, liver and kidney damage, nerve damage, reproductive problems, carbon monoxide poisoning, cancer, and other ailments. The risk of chemical hazards is directly linked to the following factors:

- Duration and frequency of exposure
- Chemical toxicity
- Chemical amount

Workers are exposed to graphic media hazards through skin contact, inhalation, and ingestion. Follow these safety guidelines for working with graphic media materials prior to use of a hazardous material:

- Be fully knowledgeable of the material – training under the Hazard Communication Act is mandatory.
- Wear protective clothing and follow MSDS, as appropriate.
- Use nontoxic or less toxic solvents and chemicals when possible.
- Eliminate toxic metals such as lead and cadmium. Instead, use cadmium-free silver solders and lead-free paint,
- Glazes and enamels.
- Use water-based instead of solvent-based materials.
- Use liquid materials to replace powders.
- Use wet techniques (such as wet sanding) instead of dry techniques.
- Apply coatings by brushing or dipping instead of spraying.
- Eliminate cancer-causing chemicals.

Solvents

Solvents are used to dissolve oils, resins, varnishes, and inks. They are also used to remove paint and lacquer. Due to their common usage, solvents are one of the most underrated media hazards. Most organic solvents are poisonous if swallowed or inhaled in sufficient quantities. They also cause dermatitis and narcosis.

Use the least toxic solvent possible. Denatured or isopropyl alcohol, acetone, and odorless mineral spirits are less toxic than solvents such as chloroform or ethylene.

Aerosol Sprays

Aerosol sprays, such as fixatives, paint sprays, and adhesive sprays, are extremely dangerous if someone inhales the fine mists produced by these products. Air brushes and spray guns are

equally hazardous. Use aerosol sprays in a well-ventilated area and wear a dust/vapor mask to protect you from the hazardous vapors.

Acids and Alkalis

The acids and alkalis used in ceramics, photo chemicals, paint removers, and similar materials can be very caustic to the skin, eyes, respiratory system, and gastrointestinal system. Likewise the acids and alkalis used to etch metals and glass can be very dangerous. Strong acids, such as hydrochloric, sulfuric, and perchloric acid, require special handling as outlined in the MSDS. Alkalis, such as caustic potash, caustic soda, quicklime, and unslaked lime, also require special treatment. Remember to add acid to water, not water to acid, when mixing chemicals.

Paints and Pigments

Many paints and color pigments contain hazardous chemical compounds. Lead paint, for example, is extremely dangerous, and should never be used in its powder form. Other paint components, such as chromate, cadmium, and cobalt pigments, are equally hazardous. Do not inhale powdered paint or spray paint vapors or accidentally ingest pigment by placing the brush tip in your mouth. In addition, do not eat, drink, or smoke while painting. Any of these activities could result in chronic poisoning.

The table below outlines common paint pigments and their hazardous chemical component:

Hazardous Chemicals

Hazardous Chemicals	Pigment (Paint Name)
Arsenic	Arsenic, Emerald Green, Cobalt Violet
Antimony	True Naples Yellow
Cadmium	All Cadmium Pigments
Chromium	Zink Yellow, Strontium Yellow, Chrome Yellow
Cobalt	Cobalt Violet, Cobalt Green, Cobalt Yellow, Cerulean Blue
Lead	Falk White, Lead White, Creminitz White, Mixed White
Manganese	Manganese Blue, Manganese Violet, Burnt Umber, Raw Umber, Mars Brown
Mercury	Vermilion, Cadmium Vermilion Red

Photography

Many of the chemicals used for photographic processing can cause severe skin and lung problems. The greatest hazards associated with photography include the preparation and use of concentrated chemical solutions. Never touch chemical powders or solutions with unprotected hands. In addition, take care not to stir up and inhale chemical dusts.

WARNING! Good ventilation is essential when working with photographic chemicals.

The following are common photographic agents and their hazards:

Developer	May cause skin irritation and allergic reactions
Stop-bath	May cause burns and throat irritation
Fixer	Highly irritating to lungs

Intensifier	Very corrosive and may cause lung cancer
Reducer	Contact with heat, concentrated acids, or ultraviolet radiation produces poisonous gas.
Toners	Highly Toxic
Hardeners and Stabilizers	Often contain formaldehyde which is poisonous, a skin irritant, and a known carcinogen (cancer causing).

Contain formaldehyde which is poisonous, a skin irritant, and a known carcinogen.

Plastics, Acrylics, Epoxy Resins

Plastic hazards result from making plastic and working with finished plastic. The greatest hazards associated with making plastic come from the monomers, solvents, fillers, catalysts, and hardeners that are commonly toxic. The hazards involved with finished plastics result mainly from the methods used to work the plastic. For example, overheating or burning plastic produces toxic gases. Polishing, sanding, and sawing plastic produces harmful dusts.

Certain types of plastics, such as acrylics and epoxy resins are also hazardous. The components in acrylic, for example, include irritants, explosives, and flammables. The main hazard associated with acrylic compounds, however, is inhalation. Always maintain good ventilation when working with acrylic.

The epoxy resins used in laminating, casting, glues, and lacquer coatings, are also skin irritants, sensitizers, and suspected cancer-causing agents. Avoid skin contact and inhalation when working with epoxy resins.

Pottery and Ceramics

Pottery clay contains silicates that can be hazardous if inhaled. Many low-fire clays and slip-casting clays also contain talc, which may be contaminated with asbestos. Long-term inhalation of asbestos can cause cancer and respiratory diseases. When mixing clay dust or breaking up dry grog, use exhaust ventilation and/or wear a toxic dust respirator. Work with wet clay when possible.

Pottery glazes also contain free silica, including flint, feldspar, and talc. Wear a toxic dust respirator when mixing or spraying glazes.

Toxic fumes and gases are often produced during the firing process. Ensure that all kilns are ventilated. In addition, use infrared goggles or a shield to look in the kiln peep hole. Proper eye protection will help prevent cataracts.

Wood Working

The hazards associated with woodworking include sawdust inhalation, exposure to toxic solvents and adhesives, and excessive noise from woodworking tools. Long-term inhalation of sawdust can cause chronic respiratory diseases. Depending on the type of wood, short-term sawdust inhalation may also produce allergic reactions. Toxic preservatives, such as arsenic compounds and creosote, may cause cancer and reproductive problems. Epoxy resins and solvent-based adhesives, also pose potential hazards. Use dust collectors around woodworking machines, ensure proper ventilation, and wear personal protective equipment, as appropriate.

Heat Stress

People may suffer from heat stress during hot, humid conditions. Because the climate at Texas State University is conducive to heat stress, people must take preventive measures to reduce their risk. To prevent heat stress, employees should limit strenuous physical activity during the hottest portion of the day, wear a brimmed hat when in the sun, take frequent breaks, and drink plenty of fluids.

Heat stress occurs in two forms: heat exhaustion, heat stroke, heat cramps, dehydration, and heat rash. The two most serious are discussed below:

Heat Exhaustion

Heat exhaustion is usually caused by strenuous physical activity, and hot humid conditions. Because heat exhaustion is the body's response to insufficient water and salt, it should be treated as quickly as possible.

Signs and symptoms of heat exhaustion include the following:

1. Exhaustion and restlessness
2. Headache
3. Dizziness
4. Nausea
5. Cold, clammy, moist skin
6. Pale face
7. Cramps in abdomen and lower limbs
8. Fast, shallow breathing
9. Rapid, weak pulse
10. Falling body temperature
11. Fainting

Take the following steps to administer first aid for heat exhaustion:

1. Have the victim lie down in a cool or shaded place.
2. If the victim is conscious, have him/her slowly sip cool water.
3. If the victim is unconscious or is conscious but does not improve, seek medical aid as soon as possible.
4. If the victim is sweating profusely, have him or her sip cool water that contains one teaspoon of table salt per pint of water.

Heat Stroke

Heat stroke is usually caused by exposure to extreme heat and humidity and/or a feverish illness. Heat stroke occurs when the body can no longer control its temperature by sweating. Heat stroke is extremely dangerous and may be fatal if not treated immediately.

The signs and symptoms of heat stroke include the following:

- Hot, and dry skin
- Headache
- Dizziness
- High temperature

- Strong pulse
- Noisy breathing
- Unconsciousness

Immediately take the following steps to administer first aid for heat stroke:

1. If possible, move the victim to a cool place.
2. Seek medical attention as soon as possible.
3. Remove the victim's clothing.
4. If the victim is conscious, place him in a half-sitting position and support the head and shoulders.
5. If the victim is unconscious, place him on the side with the head facing sideways.
6. Fan the victim and sponge the body with cool water.

Prevention

Drink plenty of fluids. Don't rely on your thirst; drink 5-7 ounces every 20 minutes.

Acclimatization: adjust to the heat

- The body takes 3-5 days to get used to the heat
- Be careful if returning from vacation or absence

Choose proper clothing

- Choose light colors and lightest weight possible
- Select proper personal protective equipment
- Take heat into account when scheduling tasks
- Implement work/rest cycles
- Conduct heaviest tasks early morning or dusk
- Eat properly
- Sleep and rest

Housekeeping

Good housekeeping skills are essential for personal safety. Lamar University employees are responsible for reducing potential hazards and keeping their work areas safe and clutter-free. Good housekeeping guidelines include keeping aisles and stairways free from clutter, cleaning spills, minimizing combustibles in workplace and storage areas, and keeping all exits free from obstructions.

Maintain clear and unobstructed access to emergency equipment, such as fire extinguishers, pull stations, eye wash units, showers, etc.

Lifting

All employees must use proper lifting techniques to avoid injury when lifting heavy objects. In general, employees should seek assistance when lifting objects that weigh 50 pounds or more. Use your good judgment to determine if you need assistance, a dolly, or other tool to safely lift an object.

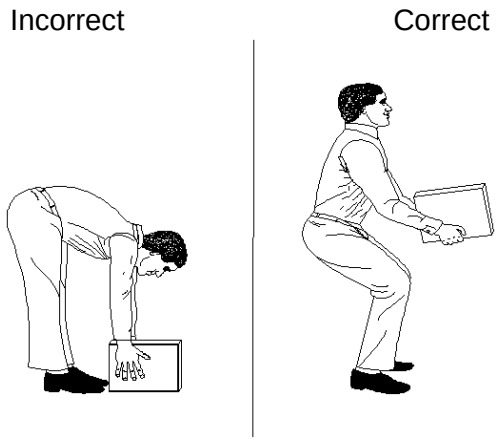
The back supports the weight of the entire upper body. When you lift objects or move heavy loads, your back has to support even more weight. If you exceed your body's natural limits, your back cannot support both your body and the extra load. The excess, unsupported pressure is transferred to the lower back, where injury is imminent. By using the muscles in your arms and legs and exercising proper lifting techniques, you can move loads safely and protect your back from possible injury.

Follow these guidelines to help avoid back injuries:

1. Avoid moving objects manually. Plan jobs and arrange work areas so that heavy items may be moved mechanically.
2. Keep in good physical condition. If you are not used to lifting and vigorous exercise, do not attempt difficult lifting tasks.
3. Think before you act. Use proper lifting techniques and lifting aides such as back support belts, dollies, etc. Seek assistance if you need it.

When lifting heavy objects, follow these steps and refer to the following illustration:

1. Test the object's weight before handling it. If it seems too heavy or bulky, get assistance.
2. Face the object, place one foot behind the object and one foot along its side.
3. Squat down, bending your knees. Keep your back arched.
4. Get a firm, balanced grip on the object. Use the palms of your hands, and use gloves if necessary.
5. Keep the object as close to your body as possible. (Pull the load in close before lifting.)
6. Lift by straightening your legs and slightly unbending your back.
7. If the object is too heavy or bulky, get help.
8. Do not twist the back or bend sideways.
9. Do not perform awkward lifts.
10. Do not lift objects at arm's length.
11. When moving objects, proceed with caution through doors and around corners.
12. Lower the object in the same proper, manner as lifting.



Preventing Slips & Falls

It is easy to prevent falling accidents. Employees should always follow good housekeeping practices and pay attention to their environment to avoid slips and falls.

In addition, employees should follow these guidelines:

1. Turn on office lights. Ensure that passageways are adequately lighted.
2. Avoid horseplay.
3. Avoid unnecessary haste. Do not run in work areas.
4. Use ladders or step-stools to reach high places.
5. Never climb onto a chair, drawer, or shelves.
6. Never stand on the top step of a ladder.
7. Keep hallways and stairwells neat and free of obstacles.
8. Remove items that may pose a potential slipping hazard.
9. Clean up spills as soon as they occur.
10. Never obstruct your view when walking.
11. Do not wear clothing that is too long or shoes that have slippery heels or soles.
12. Hold the handrail when using stairs.
13. Be careful when walking on wet surfaces or when entering a building while wearing wet shoes.
14. Report uneven surfaces, such as loose or missing floor tiles, to Facilities for repair.
15. Arrange office furnishings in a manner that provides unobstructed areas for movement.
16. Keep stairs, steps, flooring, and carpeting well maintained.
17. Ensure that glass doors have some type of marking to keep people from walking through them.
18. Clearly mark any difference in floor level that could cause an accident.
19. Secure throw rugs and mats to prevent slipping hazards.
20. Do not place wastebaskets or other objects in walkways.

Visitor Safety

Employees must take special care to ensure visitor safety. This is particularly important when bringing visitors to potentially hazardous areas such as construction sites or laboratories.

If a visitor is injured, after attending to the injury, be sure to report the occurrence to:

- University Police

End of Section

SECTION 2
OFFICE SAFETY

1. General Office Safety
2. Good Housekeeping Practices
3. Hazardous Objects & Materials
4. Preventing Cuts & Punctures
5. Preventing Machine Accidents
6. Preventing Slips & Falls
7. Preventing Stress
8. Equipment Safety
9. Work Station Arrangement

General Office Safety

A large percentage of workplace accidents and injuries occur in office buildings. Like the shop or laboratory, the office requires a few preventive measures to ensure a safe and healthful environment. Common causes of office accidents include the following:

- Slipping, tripping, and falling hazards
- Burning, cutting, and pinching hazards
- Improper lifting and handling techniques
- Unobservant and inattentive employees
- Improper office layout and arrangement
- Dangerous electrical wiring
- Exposure to toxic substances
- Horseplay

The following sections address several office safety practices. Other preventive measures not mentioned here might be necessary also.

REMEMBER:

The office building is not a sterile working environment; common workplace hazards can be extra dangerous when you ignore them. Refer to other chapters in this manual, such as Electrical Safety, General Safety, Fire/Life Safety, and others for more information on workplace safety. Always use common sense when safety is a concern.

Good Housekeeping Practices

Many office accidents are caused by poor housekeeping practices. By keeping the office floor both neat and clean, you can eliminate most slipping, tripping, and falling hazards. Other good housekeeping practices include the following:

Ensure that office lighting is adequate and available. Replace burned out light bulbs, and have additional lighting installed, as necessary.

Ensure that electrical cords and phone cords do not cross walkways or otherwise pose a tripping hazard. If you cannot move a cord, have a new outlet installed or secure the cord to the floor with cord covering strips.

Do not tape cords down or run them underneath carpet.

Report or repair tripping hazards such as defective tiles, boards, or carpet immediately.

Clean spills and pick up fallen debris immediately. Even a loose pencil or paper clip could cause a serious falling injury.

Keep office equipment, facilities, and machines in good condition.

Store items in an approved storage space. Take care to not stack boxes too high or too tight. Ensure that boxes are clearly labeled with their contents.

Hazardous Objects & Materials

Hazardous objects such as knives and firearms are not permitted in the workplace. In addition, hazardous chemicals and materials should not be stored in the general office. Hazardous materials include, but are not limited to the following:

- Carcinogens
- Combustibles
- Flammables
- Gas cylinders
- Irritants
- Oxidizers
- Reactives

Preventing Cuts & Punctures

Cuts and punctures happen when people use everyday office supplies without exercising care. Follow these guidelines to help reduce the chance for cuts and punctures:

1. When sealing envelopes, use a liquid dispenser, not your tongue.
2. Be careful when using kitchen knives, scissors, staplers, letter openers, and box openers. Any of these items could cause a painful injury.
3. Avoid picking up broken glass with your bare hands. Wear gloves and use a broom and a dustpan.
4. Place used blades or broken glass in a rigid container, such as a box before disposing in a wastebasket.

Preventing Machine Accidents

Only use machines that you know how to operate. Never attempt to operate an unfamiliar machine without reading the machine instructions or receiving directions from a qualified employee. In addition, follow these guidelines to ensure machine safety:

- Secure machines that tend to move during operation.
- Do not place machines near the edge of a table or desk.
- Ensure that machines with moving parts are guarded to prevent accidents. Do not remove these guards.
- Unplug defective machines and have them repaired immediately.
- Do not use any machine that smokes, sparks, shocks, or appears defective in any way.
- Close hand-operated paper cutters after each use and activate the guard.
- Take care when working with copy machines. If you have to open the machine for maintenance, repair, or troubleshooting, remember that some parts may be hot. Always follow the manufacturer's instructions for troubleshooting.
- Unplug paper shredders before conducting maintenance, repair, or troubleshooting.

Some items can be very dangerous when worn around machinery with moving parts. Avoid wearing the following items around machines within unguarded moving parts:

- Loose belts
- Jewelry

- Long, loose hair
- Long, loose sleeves or pants
- Scarves
- Ties

Preventing Slips & Falls

As outlined in the General Safety chapter of this manual, the easiest way to avoid slips and falls is to pay attention to your surroundings and to avoid running or rushing. To ensure safety for others in the office, however, follow these guidelines:

- Arrange office furnishings in a manner that provides unobstructed areas for movement.
- Keep stairs, steps, flooring, and carpeting well maintained.
- Ensure that glass doors have some type of marking to keep people from walking through them.
- Clearly mark any difference in floor level that could cause an accident.
- Secure throw rugs and mats to prevent slipping hazards.
- Do not place wastebaskets or other objects in walkways.

Preventing Stress

To reduce stress and prevent fatigue, it is important to take mini-breaks (not many breaks) throughout the day. If possible, change tasks at least once every two hours. Stretch your arms, neck, and legs often if you do the same type of work for long periods of time. Rest your eyes often by closing them or looking at something other than the work at hand. For a quick pick-me-up, breathe deeply several times by inhaling through your nose and exhaling through your mouth. In addition, always try to eat your lunch somewhere other than your desk.

Other examples of stress-relieving exercises that can be done at your desk include the following:

Head and Neck Stretch:

- Slowly turn your head to the left, and hold it for three seconds.
- Slowly turn your head to the right, and hold it for three seconds.
- Drop your chin gently towards your chest, and then tilt it back as far as you can.
- Repeat these steps five to ten times.

Shoulder Roll:

- Roll your shoulders forward and then backward using a circular motion.
- Upper Back Stretch: Grasp one arm below the elbow and pull gently towards the other shoulder.
- Hold this position for five seconds and then repeat with the other arm.

Wrist Wave:

- With your arms extended in front of you, raise and lower your hands several times.
- Finger Stretch:
- Make fists with your hands and hold tight for one second, then spread your fingers wide for five seconds.

Equipment Safety

As mentioned earlier, common office machines, such as the following, require special safety consideration: copiers, microwaves, adding machines, typewriters, and computers. Be sure you know how to operate these machines before using them, and never use one of these machines if you think it is defective.

Other office equipment that requires safety consideration includes furniture such as file cabinets and shelves, desks, and chairs.

File Cabinets and Shelves

Because file cabinets and shelves tend to support heavy loads, treat them with special care.

Follow these safety guidelines for file cabinets:

1. Secure file cabinets that are not weighted at the bottom. Either bolt them to the floor or to the wall.
2. Ensure that file cabinet drawers cannot easily be pulled clear of the cabinet.
3. Do not block ventilation grates with file cabinets.
4. Open only one drawer at a time to keep the cabinet from toppling.
5. Close drawers when they are not in use.
6. Do not place heavy objects on top of cabinets. Be aware that anything on top of a cabinet may fall off if a drawer is opened suddenly.
7. Close drawers slowly using the handle to avoid pinched fingers.
8. Keep the bottom drawer full. This will help stabilize the entire cabinet.

In addition, follow these safety guidelines for office shelves:

- Secure shelves by bolting them to the floor or wall.
- Place heavy objects on the bottom shelves. This will keep the entire structure more stable.
- Ensure that there is at least 18 inches between the top shelf items and the ceiling. This space will allow ceiling sprinklers (if present) to function properly if a fire occurs.
- Do not block ventilation grates with shelves.
- **Never** climb on shelves (even lower shelves). Use an approved ladder.

Desks

Follow these safety guidelines for office desks:

1. Keep desks in good condition (i.e., free from sharp edges, nails, etc.).
2. Ensure that desks do not block exits or passageways.
3. Ensure that glass-top desks do not have sharp edges.
4. Ensure that desks with spring-loaded tables function properly. The table should not spring forth with enough force to cause an injury.
5. Do not climb on desks. Use an approved ladder.
6. Keep desk drawers closed when not in use.
7. Repair or report any desk damage that could be hazardous.

Chairs

Safety guidelines for office chairs include the following:

1. Do not lean back in office chairs, particularly swivel chairs with rollers.
2. Do not climb on any office chair. Use an approved ladder.
3. Office desk chairs should have adjustable back supports and seat height. Make sure that your chair's back support position and seat height are comfortable.
4. Take care when sitting in a chair with rollers. Make sure it does not roll out from under you when you sit down.
5. Repair or report any chair damage that could be hazardous.
6. Do not roll chairs over electrical cords.

Ladders

Always use an approved ladder or stool to reach any item above your extended arm height. Never use a makeshift device, such as a desktop, file cabinet, bookshelf, or box, as a substitute for a ladder.

Follow these guidelines when using ladders:

1. Do not load a ladder above its intended weight capacity.
2. Place ladders on slip-free surfaces even if they have slip-resistant feet. Secure the ladder if a slip-free surface is not available.
3. Avoid placing ladders in walkways. Secure a ladder if its location could cause an accident.
4. Keep areas around ladders clean and free of debris.
5. Do not use a ladder in front of a door unless the door is locked and barricaded.
6. Refer to the Shop Safety chapter in this manual for more information on ladder safety.

Work Station Arrangement

With the extensive use of computers and other automated desk devices in the workplace, employees must take special care to ensure proper workstation arrangement. For the purpose of this manual, a workstation consists of the equipment and furniture associated with a typical desk job (i.e., desk, chair, and computer components).

In recent years, computer screens or Video Display Terminals (VDT's) have received much attention concerning non-ionizing radiation levels. Tests prove, however, that VDT's do not emit harmful levels of radiation. Improper workstation arrangement combined with repetitive motion, however, may contribute to visual and musculoskeletal fatigue.

Cumulative trauma disorders, such as carpal tunnel syndrome may result from the stress of repetitive motion. Therefore, it is very important to arrange your workstation properly and to take breaks frequently.

Your seating position at work is important to your comfort and safety. To reduce the painful effects of repetitive motion, follow these guidelines when working with computers or typewriters:

1. Always sit up straight. Make sure your chair is adjusted to provide adequate support to your back.

2. Place your feet flat on the floor or on a footrest. Lower legs should be approximately vertical, and thighs should be approximately horizontal. The majority of your weight should be on the buttocks.
3. Ensure that there is at least 1 inch of clearance between the top of your thighs and the bottom of the desk or table.
4. Keep your wrists in a natural position. They should not rest on the edge of the desk.
5. Keep the front edge of your chair approximately 4 inches behind your knees.

Equipment Arrangement

By properly arranging your equipment, you can also help reduce the harmful effects of repetitive motion. Follow these guidelines for arranging office equipment:

Lighting:

Lighting around computer workstations should illuminate the work area without obscuring the VDT or causing glare. Position computer screens, draperies, blinds, and pictures to reduce glare during work hours (e.g., place the VDT screen at a right angle to the window).

VDT Screen:

- VDT images should be clear and well defined.
- Adjust the screen's brightness, contrast and display size to meet your needs.
- If a screen flickers or jumps, have it repaired or replaced.
- Place the VDT 20-28 inches away from your face.
- The center of the VDT should be approximately 15 to 25 degrees below your line of vision.

Keyboards:

- Position computer keyboards so that the angle between the forearm and upper arm is between 80 and 120 degrees.
- Place the keyboard in an area that is accessible and comfortable.

Wrist Support:

- Use wrist supports made of a padded material.
- The support should allow you to type without bending your wrists.

Document Holders:

Keep documents at approximately the same height and distance from your face as the VDT screen.

Telephones:

- Neck tension is a common problem caused by holding the telephone between the head and neck.
- Use a headset or speakerphone if you use the telephone for extended periods of time.

End of Section

SECTION 3
SHOP SAFETY

The hazards associated with shop work require special safety considerations. Whether you work in a metal shop, wood shop, plumbing shop, or electrical shop, the potential hazards for personal injury are numerous. This section highlights essential safety information for working in a Lamar University shop. Refer to other sections in this manual, including General Safety, Electrical Safety, and Fire/Life Safety, for more information on handling many shop situations.

1. Common Shop Hazards
2. Personal Protection
3. Job Safety
4. General Shop Safety Guidelines
5. Hand Tools
6. Insulation
7. Ladders
8. Power Tools
9. Machine Guards
10. Power Tool Safety Guidelines
11. Spray Paint Booths
12. Hot Work Permits
13. Welding and Cutting Prerequisites
14. Welding Guidelines
15. Cutting Guidelines

Common Shop Hazards

The following table highlights common shop hazards:

Potential	Hazard Sources
Physical: – Compressed air/gases – Flying Debris – Noise – Pinching, cutting, amputation – Slipping, tripping	Oxygen, acetylene, air Grinders, saws, welders Any power tool Vises, power tools, hand tools Wood/metal chips, electrical cords, oil, etc. Welding
Electrical: – Overload – Fire – Shock – Too many cords per outlet – Frayed, damaged cords – - Ungrounded tools, equipment	Too many cords per outlet Frayed, damaged cords Ungrounded tools, equipment
Fire: – Flammable chemicals – Sparks – Chemical: – Toxic liquids – - Toxic fumes, gases, dusts	Gasoline, degreasers, paint thinners, etc. Welders, grinders Ungrounded tools or solvent containers Cleaning solvents, degreasers, etc. Welding, motor exhaust, etc.

It is not possible to detail all the risks involved with shop work. However, it is possible to foresee many hazards by carefully planning each job. To prevent accidents, utilize your knowledge, training, and common sense. Evaluate potential sources of injury, and attempt to eliminate any hazards.

Personal Protection

There are several measures you must take to protect yourself from shop hazards. For example, do not wear the following when working around machinery:

- Loose fitting clothing
- Neckties
- Jewelry
- Long sleeved shirt

If you must wear a long sleeved shirt, be sure the sleeves are rolled down and buttoned. Snug fitting clothes and safety shoes are essential safety equipment in the shop.

Always wear safety glasses with side shields when working with shop equipment. Additional protection using goggles or face shields may be necessary for the following types of work:

Grinding, Chipping, Sandblasting

- Welding
- Glass working

Wear ANSI approved hard hats whenever there is a chance of objects falling from above. In addition, wear suitable gloves, preferably leather, when working with the following:

- Scrap metal or wood
- Sharp-edged stock
- Unfinished lumber

Refer to the Personal Protective Equipment chapter in this manual for more information.

Job Safety

Before beginning work in a shop, be sure you are authorized to perform the work to be done and inspect your tools and equipment. If a procedure is potentially hazardous to others in the area, warn fellow workers accordingly. Use warning signs or barriers, as necessary.

Notify your supervisor if you notice any unsafe conditions such as the following:

- Defective tools or equipment
- Improperly guarded machines
- Oil, gas, or other leaks

Inform other employees if you see an unsafe work practice; however, be careful not to distract a person who is working with power tools.

General Shop Safety Guidelines

Follow these guidelines for general shop safety:

- Know the hazards associated with your work. Be sure you are fully educated on the proper use and operation of any tool before beginning a job.
- Always wear appropriate safety gear and protective clothing.
- Wear nitrile gloves when cleaning with degreasers or ferric chloride.
- Ensure that there is adequate ventilation to prevent exposure from vapors of glues, lacquers, paints and from dust and fumes.

Maintain good housekeeping standards.

- Keep the work area free from slipping/tripping hazards (oil, cords, debris, etc.).
- Clean all spills immediately.
- Remove sawdust, wood chips, and metal chips regularly.
- It is recommended that electrical cords pull down from an overhead pulley rather than lying on the floor.
- Leave tool and equipment guards in place.
- Know where fire extinguishers are located and how to use them.
- Make sure all tools and equipment are properly grounded and that cords are in good condition.
- Double-insulated tools or those with three-wire cords are essential for safety.
- Use extension cords that are large enough for the load and distance.
- Secure all compressed gas cylinders. Never use compressed gas to clean clothing or skin.
- Always use flashback arrestors on cutting/welding torches.
- Take precautions against heat stroke and heat exhaustion.

- Wear infrared safety goggles when appropriate.

Hand Tools

Hand tools are non-powered tools. They include axes, wrenches, hammers, chisels, screw drivers, and other hand-operated mechanisms. Even though hand tool injuries tend to be less severe than power tool injuries, hand tool injuries are more common. Because people take everyday hand tools for granted, they forget to follow simple precautions for safety.

The most common hand tool accidents are caused by the following:

- Failure to use the right tool
- Failure to use a tool correctly
- Failure to keep edged tools sharp
- Failure to replace or repair a defective tool
- Failure to store tools safely

IMPORTANT: Use the right tool to complete a job safely, quickly, and efficiently.

Follow these guidelines for general hand tool safety:

- Wear safety glasses whenever you hammer or cut, especially when working with surfaces that chip or splinter.
- Do not use a screwdriver as a chisel. The tool can slip and cause a deep puncture wound.
- Do not use a chisel as a screwdriver. The tip of the chisel may break and cause an injury.
- Do not use a knife as a screwdriver. The blade can snap and injure an eye.
- Never carry a screwdriver or chisel in your pocket. If you fall, the tool could cause a serious injury. Instead, use a tool belt holder.
- Replace loose, splintered, or cracked handles. Loose hammer, axe, or maul heads can fly off defective handles.
- Use the proper wrench to tighten or loosen nuts. Pliers can chew the corners off a nut.
- When using a chisel, always chip or cut away from you. Use a soft-headed hammer or mallet to strike a wooden chisel handle. A metal hammer or mallet may cause the handle to split.
- Do not use a wrench if the jaws are sprung.
- Do not use impact tools, such as chisels, wedges, or drift pins, if their heads are mushroom shaped. The heads may shatter upon impact.
- Direct saw blades, knives, and other tools away from aisle areas and other employees.
- Keep knives and scissors sharp. Dull tools are more dangerous than sharp tools.
- Iron or steel hand tools may cause sparks and be hazardous around flammable substances. Use spark-resistant tools made from brass, plastic, aluminum, or wood when working around flammable hazards.
- Improper tool storage is responsible for many shop accidents. Follow these guidelines to ensure proper tool storage:

Have a specific place for each tool.

- Do not place unguarded cutting tools in a drawer. Many hand injuries are caused by rummaging through drawers that contain a jumbled assortment of sharp-edged tools.
- Store knives or chisels in their scabbards.

- Hang saws with the blades away from someone's reach.
- Provide sturdy hooks to hang most tools on.
- Rack heavy tools, such as axes and sledges, with the heavy end down.

Insulation

Asbestos, man-made mineral fibers, PVC, and urethane foam can be extreme respiratory hazards. To protect yourself from these and other respiratory hazards, minimize your exposure to particulate matter from insulation, fumes, dusts, and aerosols. Refer to the General Safety chapter for more information on asbestos and respiratory hazards.

Ladders

Ladders can make many tasks easier, but they are also a continual safety hazard. Even the best ladder is not safe unless you are trained and proficient in using ladders. Each year, many people suffer serious injuries from accidents involving ladders. Before you use a ladder, take a moment to think about doing it safely.

A secure, well-made ladder is necessary for safe ladder use. Ladders come in different styles, including step, straight, and extension. They also vary in construction and may consist of wood, aluminum, or fiberglass. Choose the correct type and size ladder for the job. All ladders sold within the U.S. are rated as follows:

- Type I: Heavy-duty industrial ladder rated to hold up to 250 pounds.
- Type IA: Extra-heavy-duty industrial ladder rated to hold up to 300 pounds.
- Type II: Medium-duty commercial ladder rated to hold up to 225 pounds.
- Type IIA: Special-duty ladder rated to hold up to 375 pounds.
- Type III: Light-duty household ladder rated to hold up to 200 pounds.

Follow these guidelines for safe ladder usage:

1. Always inspect a ladder before you climb it. Make sure the steps are sturdy and the locking mechanisms are in good working order.
2. Carry ladders horizontally with the front end slightly higher than the back end.
3. To open a stepladder, make sure the spreader is locked and the pail shelf is in position. To open an extension ladder, brace the bottom end and push the rungs or rails out.
4. Place ladders on a solid, level surface to ensure safety:
5. Watch for overhead obstructions and powerlines.
6. To prevent ladders from sinking into soft ground, use a large board under the feet of the ladder.
7. Position a straight or extension ladder so that the base of the ladder is one foot away from the vertical support for every four feet of working ladder height (e.g., if you are working with eight feet of ladder, place the base of the ladder two feet from the wall).
8. Do not place the top of a ladder against a window or an uneven surface.
9. When possible, tie the top of a straight or extension ladder to supports. Stake and tie the feet of the ladder.

    - An extension ladder used for access to a roof must extend at least 3 feet beyond the support point.
    - Use a wooden or plastic ladder if you must work near electrical sources.

- Do not place a ladder in front of a door unless you lock and barricade the door and post a warning sign on the opposite side of the door.
- Use common sense when climbing or working on ladders:
- Wear shoes with slip-resistant soles and make sure they are dry before climbing.
- Never allow more than one person on a ladder.
- To climb or descend a ladder, face the ladder and firmly grip the rails, not the rungs, with both hands.
- Keep your body between the rails at all times. Do not shift your weight to one side.
- Have someone steady the ladder if it cannot be secured otherwise.
- Do not stand on the top four rungs of an extension ladder or the top two rungs of a step ladder.
- When working on a ladder, keep two feet and one hand on the ladder at all times.
- Do not stand on the bucket shelf of a ladder.
- When working on a ladder, carry small tools on a tool belt. Use a rope to raise and lower heavy tools.
- Never leave a raised or open ladder unattended.
- Store ladders away from heat and moisture. Destroy damaged or unsafe ladders.

Power Tools

Power tools can be extremely dangerous if they are used improperly. Each year, thousands of people are injured or killed by power tool accidents. Common accidents associated with power tools include abrasions, cuts, lacerations, amputations, burns, electrocution, and broken bones. These accidents are often caused by the following:

- Touching the cutting, drilling, or grinding components
- Getting caught in moving parts
- Suffering electrical shock due to improper grounding, equipment defects, or operator misuse
- Being struck by particles that normally eject during operation
- Touching hot tools or work pieces
- Falling in the work area
- Being struck by falling tools
- When working around power tools, you must wear personal protective equipment and avoid wearing loose clothing or jewelry that could catch in moving machinery.

In additional to general shop guidelines, follow these guidelines for working with power tools:

1. Use the correct tool for the job. Do not use a tool or attachment for something it was not designed to do.
2. Select the correct bit, blade, cutter, or grinder wheel for the material at hand. This precaution will reduce the chance for an accident and improve the quality of your work.
3. Keep all guards in place. Cover exposed belts, pulleys, gears, and shafts that could cause injury.
4. Always operate tools at the correct speed for the job at hand. Working too slowly can cause an accident just as easily as working too fast.
5. Watch your work when operating power tools. Stop working if something distracts you.
6. Do not rely on strength to perform an operation. The correct tool, blade, and method should not require excessive strength.
7. If undue force is necessary, you may be using the wrong tool or have a dull blade.

8. Before clearing jams or blockages on power tools, disconnect from power source. Do not use your hand to clear jams or blockages, use an appropriate tool.
9. Never reach over equipment while it is running.
10. Never disable or tamper with safety releases or other automatic switches.
11. When the chance for operator injury is great, use a push stick to move material through a machine.
12. Disconnect power tools before performing maintenance or changing components.
13. Keep a firm grip on portable power tools. These tools tend to keep a firm grip on portable power tools. These tools tend to "get away"
14. Remove chuck keys or adjusting tools prior to operation.
15. Keep bystanders away from moving machinery.
16. Do not operate power tools when you are sick, fatigued, or taking strong medication.
17. When possible, secure work pieces with a clamp or vise to free the hands and minimize the chance of injury. Use a jig for pieces that are unstable or do not lie flat.

Machine Guards

Moving machine parts must be safeguarded to protect operators from serious injury. Belts, gears, shafts, pulleys, fly wheels, chains, and other moving parts must be guarded if there is a chance they could contact an employee.

As mentioned before, the hazards associated with moving machinery can be deadly. Hazardous areas that must be guarded include the following:

- Point of operation.
- The area where the machine either cuts, bends, molds, or forms, the material.
- Pinch/nip point:
- Area where moving machine parts can trap, pinch, or crush body parts (e.g., roller feeds, intermeshing gears, metal shears, etc.).
- Sharp edges
- Stored potential energy

There are three types of barrier guards that protect people from moving machinery. They consist of the following:

- Fixed guards a fixed guard is a permanent machine part that completely encases potential hazards. Fixed guards provide maximum operator protection.

- Interlocked guards Interlock guards are connected to a machine's power source. If the guard is opened or removed, the machine automatically disengages. Interlocking guards are often preferable because they provide adequate protection to the operator, but they also allow easy machine maintenance. This is ideal for problems such as jams.

- Adjustable guards Self-adjusting guards change their position to allow materials to pass through the moving components of a power tool. These guards accommodate various types of materials, but they provide less protection to the operator.

NOTE:
Hand-held power tools typically have less guarding in place than stationary power tools. Use extreme caution when working with hand-held power tools and always wear a face shield.

POWER TOOLS SAFETY GUIDELINES

- Drill Press Safety
- Grinder Safety
- Joiner & Shaper Safety
- Lathe Safety
- Nail/Air Gun Safety
- Planer Safety
- Forging Machine Safety
- Sander Safety
- Saw Safety

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- Being struck by particles that normally eject during operation
- Touching hot tools or work pieces
- Falling in the work area
- Being struck by falling tools
- When working around power tools, you must wear personal protective equipment and avoid wearing loose clothing or jewelry that could catch in moving machinery.

In additional to general shop guidelines, follow these guidelines for working with power tools:

- Use the correct tool for the job. Do not use a tool or attachment for something it was not designed to do.
- Select the correct bit, blade, cutter, or grinder wheel for the material at hand. This precaution will reduce the chance for an accident and improve the quality of your work.
- Keep all guards in place. Cover exposed belts, pulleys, gears, and shafts that could cause injury.
- Always operate tools at the correct speed for the job at hand. Working too slowly can cause an accident just as easily as working too fast.
- Watch your work when operating power tools. Stop working if something distracts you.
- Do not rely on strength to perform an operation. The correct tool, blade, and method should not require excessive strength.
- If undue force is necessary, you may be using the wrong tool or have a dull blade.

- Before clearing jams or blockages on power tools, disconnect from power source. Do not use your hand to clear jams or blockages, use an appropriate tool.
- Never reach over equipment while it is running.
- Never disable or tamper with safety releases or other automatic switches.
- When the chance for operator injury is great, use a push stick to move material through a machine.
- Disconnect power tools before performing maintenance or changing components.
- Keep a firm grip on portable power tools. These tools tend to keep a firm grip on portable power tools. These tools tend to "get away"
- Remove chuck keys or adjusting tools prior to operation.
- Keep bystanders away from moving machinery.
- Do not operate power tools when you are sick, fatigued, or taking strong medication.
- When possible, secure work pieces with a clamp or vise to free the hands and minimize the chance of injury. Use a jig for pieces that are unstable or do not lie flat.

Drill Press Safety

Follow these safety guidelines when using drill presses:

1. Securely fasten work materials to prevent spinning. Never use your hands to secure work materials.
2. Use a center punch to score the material before drilling.
3. Run the drill at the correct speed. Forcing or feeding too fast can break drill bits.
4. Never attempt to loosen the chuck unless the power is off.
5. Lower the spindle before removing a chuck.
6. Never use a regular auger bit in a drill press.
7. Frequently back the drill out of deep cuts to clean and cool the bit.

Grinder Safety

Follow these safety guidelines when working with grinders:

1. Ensure that no combustible or flammable materials are nearby that could be ignited by sparks from the grinder wheel.
2. Ensure that a guard covers at least 270 degrees of the grinding wheel on bench-mounted machines.
3. Place the grinder tool rest 1/8 inch from the wheel and slightly above the center line. Adjust the upper tongue guard to ¼ inch from the wheel.
4. Allow the grinder to reach full speed before stepping into the grinding position. Faulty wheels usually break at the start of an operation.
5. Unless otherwise designed, grind on the face of the wheel.
6. Use vise-grip pliers or clamp to hold small pieces.
7. Slowly move work pieces across the face of wheel in a uniform manner. This will keep the wheel sound.
8. Do not grind non-ferrous materials.
9. Periodically check grinder wheels for soundness. Suspend the wheel on a string and tap it. If the wheel rings, it is probably sound.
10. Replace wheels that are badly worn or cracked.
11. Never use a wheel that has been dropped or received a heavy blow, even if there is no apparent damage.

12. Before using a new wheel, let it run a few seconds at full speed to make sure it is balanced.

Joiner & Shaper Safety

Follow these safety guidelines when using jointers and shapers:

- Ensure that jointers are equipped with cylindrical cutting heads.
- Use a push stick, as necessary.
- Do not use single cutter knives in shaper heads.
- Ensure that knives are balanced and correctly mounted.
- Adjust cut depth before turning the machine on.
- Do not use the jointer for strips that are less than 1 inch wide and less than 12 inches long.

Lathe Safety

Follow these safety guidelines when working with wood lathes:

- Examine wood for knots and other defects before placing it in the lathe.
- Ensure that glued materials are set and dried before placing them in the lathe.
- Before turning the lathe on, slowly turn rough materials a few times to ensure they will clear the tool rest.
- Keep hands off the chuck rim when the lathe is moving.
- Hold all wood cutting tools firmly with two hands.
- Start all jobs at the lowest speed. Ensure that materials are in a cylindrical form before advancing to higher speeds. Never turn large diameter materials at a high speed.
- Firmly screw faceplate work to the faceplate. Take care to avoid cutting too deep and hitting the screws.
- Do not cut too deep or scrape too long.
- Remove the Remove the "T"

Follow these safety guidelines when working with metal lathes:

- Make sure that all gear and belt guards are in place.
- Never leave a chuck wrench in a chuck.
- Keep your hands off chuck rims when a lathe is in operation.
- Do not attempt to screw the chuck onto the lathe spindle with the power on, as it may get cross-threaded and cause injury. Stop the machine, place a board under the chuck, and then screw on by hand.
- Steady rests should be properly adjusted to conform to the material being worked on.
- When filing work in a lathe, always face the head stock and chuck.
- See that tail stock, tool holder, and work are properly clamped before turning on power.
- Never attempt to adjust a tool while the lathe is running.
- Never apply a wrench to revolving work or parts.
- Always use a brush to remove chips; never your hands.
- When possible, use pipe sleeves to cover work protruding from the end of the lathe.
- Before removing your work from the lathe, remove the tool bit.

Nail/Air Gun Safety (Pneumatic Fastening Tools)

Nail guns and air guns are powered by compressed air. The main danger associated with pneumatic fastening tools is injury from one of the tool's attachments or fasteners.

Follow these safety guidelines for working with pneumatic tools:

- Ensure that pneumatic tools which shoot nails, rivets, or staples are equipped with a device that keeps fasteners from ejecting unless the muzzle is pressed against a firm surface.
- Never point a tool at items you do not want to fasten.
- Keep your finger off the trigger until you are ready to begin work. Most pneumatic tools have a hair-trigger that requires little pressure to activate the gun.
- Treat air hoses with the same care as an electrical cord.
- Do not drive fasteners into hard, brittle surfaces or areas where the fastener may pass through the material and protrude on the other side.

Planer Safety

Follow these safety guidelines for working with planers:

- Examine wood for knots and other defects before placing it in the planer.
- Do not plane against the grain of the wood.
- Let go of the materials as the feeder rolls catch. Do not follow the work with your hands.
- Do not run boards that are more than 2 inches shorter that the distance between the in feed and out feed rolls and less than 3/8 inch thick.
- Use a push stick if a board stops with its end on the in feed table.
- If a board sticks under the cutter head, turn off the machine to keep from burning the cutter knives.

Forging Machine Safety

Once punchers, shears, and benders are activated, it is impossible to stop them until the end of a cycle. Use extreme care when working with these tools.

Inspection and maintenance:

- All forge shop equipment must be maintained in a condition which will insure continued safe operation.
- Hammers and presses:
- All hammers must be positioned or installed in such a manner that they remain on or are anchored to foundations sufficient to support them according to applicable engineering standards.

Hammers:

Die keys and shims must be made from a grade of material that will not unduly crack or splinter.

Presses:

All manually operated valves and switches must be clearly identified and readily accessible.

Power-driven hammers:

Every steam or air hammer must have a safety cylinder head to act as a cushion if the rod should break or pull out of the ram.

Gravity Hammers:

Air-lift hammers must have a safety cylinder head.

Forging and trimming presses:

When dies are being changed or maintenance is being performed on the press, insure the following:

- The power to the pressure is locked out
- The flywheel is at rest.
- The ram is blocked with a material of the appropriate strength.

Up setters:

All upsetters must be installed so that they remain on their supporting foundations.

Sander Safety

Follow these safety guidelines for working with circular and belt sanders:

- Ensure that sanding belts are not too tight or too loose. Never operate a sanding disk if the paper is too loose.
- Use the correct grade of abrasive material.
- Ensure that the distance between a circular sander and the edge of the table is not greater than ¼ inch.
- Do not push materials against sanders with excessive force.
- Sand only on the down stroke side of a disk sander.
- Do not hold small pieces by hand. Use a jig for pieces that are difficult to hold securely.

Saw Safety

There are numerous types of power saws, such as band saws, circular saws, radial arm saws, saber saws, and table saws. Regardless of the type of saw you use, never reach over the saw line to position or guide materials.

Follow these safety guidelines for working with band saws:

- Set the blade evenly with the proper amount of tension.
- Keep your hands on either side of the cut line. Never reach across the cut line for any reason.
- Do not stand to the right of the band saw.
- Be sure the radius of your cutting area is not too small for the saw blade.
- If you hear a rhythmic click, check the saw blade for cracks.

Follow these safety guidelines for working with circular saws:

- Do not raise the saw any higher than absolutely necessary.
- Fasten a clearance block to the fence when cutting off short pieces.
- Never attempt to clear away scraps with your fingers.
- Do not cut thin tubular materials with a circular saw.
- Ensure that the fence is not in the cut line of the saw.

Take care when working with warped or twisted lumber.

Follow these guidelines when working with a radial arm saw:

- Push the saw blade against the stop before turning on the power.
- Never place one piece of wood on top of another when using this saw. The top piece may kick over.
- This saw pulls itself into wooden materials. It may be necessary to hold the saw back to prevent it from choking.
- Never leave the saw hanging over the end of the arm.

Follow these guidelines when working with table saws:

- Circular table saws must have a hood over the portion of the saw above the table. The hood must automatically adjust to the thickness of, and remain in contact with, the material being cut.
- Circular table saws must have a spreader aligned with the blade. The spreader must be spaced no more than Circular table saws must have a spreader aligned with the blade. The spreader must be spaced no more than ½
- Circular table saws used for ripping must have non-kickback fingers or dogs.
- Feed rolls and blades of self-feed circular saws must be protected by a hood or guard to prevent the operator's hand from coming in contact with the in-running rolls.

Machine Guards

Moving machine parts must be safeguarded to protect operators from serious injury. Belts, gears, shafts, pulleys, fly wheels, chains, and other moving parts must be guarded if there is a chance they could contact an employee.

As mentioned before, the hazards associated with moving machinery can be deadly. Hazardous areas that must be guarded include the following:

- Point of operation.
- The area where the machine either cuts, bends, molds, or forms, the material.
- Pinch/nip point:
- Area where moving machine parts can trap, pinch, or crush body parts (e.g., roller feeds, intermeshing gears, metal shears, etc.).
- Sharp edges
- Stored potential energy

There are three types of barrier guards that protect people from moving machinery. They consist of the following:

Fixed guards

A fixed guard is a permanent machine part that completely encases potential hazards. Fixed guards provide maximum operator protection.

Interlocked guards

Interlock guards are connected to a machine's power source. If the guard is opened or removed, the machine automatically disengages. Interlocking guards are often preferable because they provide adequate protection to the operator, but they also allow easy machine maintenance. This is ideal for problems such as jams.

Adjustable guards

Self-adjusting guards change their position to allow materials to pass through the moving components of a power tool. These guards accommodate various types of materials, but they provide less protection to the operator.

IMPORTANT:

- Guards must be in place. If a guard is removed to perform maintenance or repairs, follow lockout/tag out procedures.
- Replace the guard after repairs are completed. Do not disable or move machine guards for any reason. If you notice that a guard is missing or damaged, contact your supervisor and have the guard replaced or repaired before beginning work.

NOTE:
Hand-held power tools typically have less guarding in place than stationary power tools. Use extreme caution when working with hand-held power tools and always wear a face shield.

Hot Work Permits

Welding and cutting are two forms of hot work that require special safety considerations. Unless they are done in a designated shop area, welding and cutting are strictly prohibited without proper authorization. Contact EHSRM to obtain a Hot Work Permit.

Welding and Cutting Prerequisites

Before conducting welding or cutting operations, inspect your equipment for the following:

- Welding leads must be completely insulated and in good condition.
- Cutting torches and hoses must be leak-free and equipped with proper fittings, gauges, regulators, and flashback devices.
- Oxygen and acetylene tanks must be secured in a safe place.

In addition, follow these guidelines for most welding and cutting procedures:

- Conduct welding and cutting operations in a designated area free from flammable materials. When welding or cutting is necessary in an undesignated or hazardous area, have someone nearby act as a fire attendant.
- Periodically check welding and cutting areas for combustible atmospheres.

- Take care to prevent sparks from starting a fire.
- Remove unused gas cylinders from the welding and cutting area.
- Keep hoses out of doorways and away from other people. A flattened hose can cause a flashback.
- Mark hot metal with a sign or other warning when welding or cutting operations are complete.

The following table provides an overview of welding and cutting hazards:

POTENTIAL HAZARD	HAZARD SOURCE
Hazardous Atmosphere	Confined Space Inadequate ventilation Electrode (manganese, chromium, etc.) Base metal coating
Sparks, Fire, Explosion	Flammable materials Containers that have held combustibles
UV Radiation Burns	Gas arc Reflective enclosures Inadequate visor lens Welding curtain not in use
Confined Space	Atmosphere not monitored No safety attendant present
Gas Cylinders	Touching cylinder with electrode Storing cylinders on their side Unsecured cylinders

Cutting Guidelines

Gas welding and cutting tools are often powered by oxygen or acetylene gas cylinders. These tanks require special safety precautions to prevent explosions and serious injuries. Follow the safety guidelines below, and refer to the Laboratory Safety chapter in this manual for more information on gas cylinder safety:

- Ensure that acetylene/oxygen systems are equipped with flame or flashback arrestors.
- Store acetylene bottles upright and secured. Oxygen cylinders must be shored 20 feet from flammable gases or separated by a fire foot wall.
- Keep cylinder fittings and hoses free from oil and grease.
- Repair or replace defective hoses by splicing. Do not use tape.
- Do not tamper or attempt to repair cylinders, valves, or regulators.
- Do not interchange regulators or pressure gauges with other gas cylinders.
- Carefully purge hoses and torches before connecting a cylinder.
- Set acetylene pressure at or below 15 psig. Always use the minimum acceptable flow rate.
- Never use a match to light a torch. Use an approved lighter.

END OF SECTION

SECTION 4

ELECTICAL SAFETY

The danger of injury through electrical shock is possible whenever electrical power is present. When a person's body completes a circuit and thus connects a power source with the ground, an electrical burn or injury is imminent. Most fatal injuries result from high-voltage exposure; however, people can sustain severe injuries from low voltage power if it has a high current flow.

Electrical safety is important in every work environment. The following sections cover circuit breaker loads, electrical grounding, electrical safety guidelines, and electrical emergency response.

1. Definitions
2. Circuit Breaker Loads
3. Electrical Grounding
4. Electrical Panels
5. Electrical Safety Guidelines
6. Electrical Emergency Response
7. Lockout / Tag out Procedures
8. High Voltage Procedures
9. Minimum Clear Working Space
10. Proper Electrical Repair Procedures

Definitions

The following definitions help clarify general electrical safety:

1. **Amps:** The standard unit for measuring electrical current.
2. **Authorized Employee:** A person who locks out or tags out equipment for service or maintenance. Authorized employees have been formally trained in proper lockout/tag out procedures.
3. **Breaker Box:** An insulated box on which interconnected circuits are mounted.
4. **Circuit Breaker:** A device designed to open and close a circuit by non-automatic means and to open the circuit automatically on a predetermined overcurrent without damage to itself when properly applied within its rating.
5. **Current Flow:** The rate of flow of an electrical charge, generally expressed in amps.
6. **Electrical Load:** The amount of power delivered by a generator or carried by a circuit. A device to which the power is delivered.
7. **Electrical Panel:** An insulated panel on which electrical wires are mounted.
8. **Energy-Isolating Device:** a mechanical device that prevents the transmission or release of energy. Examples include the following:

    - Manually operated circuit breakers
    - Disconnect switches
    - Line or block valves
    - Pushbuttons, selector switches, and other control circuit devices do not isolate energy.
    - Energy-isolating devices should be lockable by means of a hasp or other type of attachment. It should not be necessary to dismantle or reassemble a device to lock it.

9. **Ground-Fault Circuit Interrupter (GFCI):** A GFCI detects grounding problems and shuts electricity off to prevent a possible accident.
10. **Hazardous Energy Sources:** This term applies to stored or residual energy such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.
11. **High Voltage:** The term high voltage applies to electrical equipment that operates at more than 600 Volts (for terminal to terminal operation) or more than 300 Volts (for terminal to ground operation). Low voltage, high current AC or DC power supplies are also considered to be high voltage.
12. **Lockout:** The placement of a lock on an energy-isolating device. This act prevents workers from energizing and operating a piece of equipment until the lock is removed.
13. **Tag out:** The placement of a tag on an energy-isolating device. A tag out device is a prominent warning device of a lockout.
14. **Voltage:** Electromotive force expressed in volts.
15. **Watt:** A unit of electrical power, equal to the power developed in a circuit by a current of amp flowing through a potential difference of one volt.

Circuit Breaker Loads

Most office and laboratory locations have 20 amp circuit breakers that serve two or more outlets. These breakers can handle most office equipment; however, the widespread use of personal computers and associated hardware can create an electrical overload. To determine your current electrical load, follow these steps:

1. Check office/laboratory equipment for a manufacturer's rating label that indicates total watts or amps. Take special care to check appliances that use electricity to generate heat.
2. Convert the watts rating to amps: Amps = Watts / 120 Volts
3. Total the amps for each circuit.
4. If the total equals more than 15 amps per 20-amp circuit, you may be overloading the circuit. Move enough equipment to a different circuit to reduce the circuit load; otherwise, have the Facilities Department inspect the circuit wiring.

Electrical Grounding

Proper electrical grounding can help prevent electrical injury. Most electrical equipment is grounded with either a three-prong plug or a two-prong plug and insulation. Because a grounding system may be defective without your knowledge, use a Ground Fault Circuit Interrupter (GFCI) to ensure electrical safety. GFCI's are required in moist or potentially damp environments.

Electrical Panels

Electrical panels or breaker boxes require special safety considerations, including the following:

- Know where your panel box is located.
- Do not tape circuit switches to keep a breaker from tripping.
- Ensure that breaker circuits are accurately labeled within panel boxes.
- Ensure that panel box doors are securely attached.
- Do not block panel boxes. There should be at least 36 inches of clear space in front of a panel box.

Report tripped breakers and refer any electrical questions to the Facilities Department.

Electrical Safety Guidelines

Follow these guidelines for general electrical safety:

- Be familiar with the electrical hazards associated with your workplace.
- Unplug electrical equipment before repairing or servicing it.
- If a prong breaks off inside an outlet, do not attempt to remove it yourself. Call the Facilities Department for assistance.
- Ensure that outlets are firmly mounted. Report loose outlets to the Facilities Department.
- Report all electrical problems, including tripped breakers, broken switches, and flickering lights, to the Facilities Department.
- All appliances used in Lamar University buildings must be UL (Underwriter's Laboratory) or FM (Factory Mutual) labeled.
- Do not use an appliance that sparks, smokes, or becomes excessively hot, unless the appliance is specifically designed to exhibit these characteristics.
- Portable electrical heaters must be placed to avoid causing a trip hazard and must be kept away from combustible material. Never leave a heater unattended. Unplug the heater at the end of the day or when not in use.
- Keep electrical equipment away from water, unless the appliance is specifically designed for use around water, such as a wet-dry shop vacuum.
- Use Ground Fault Interrupter Circuits (GFCI) whenever possible.

- Be aware of overhead power lines when working with tall equipment (e.g., grain augers, cranes, sailboats, etc.).
- Follow University Energy Lockout/Tag out Procedures as appropriate.

Follow these guidelines for electrical plug and cord safety:

- Do not remove the prongs of an electrical plug. If plug prongs are missing, loose, or bent, replace the entire plug.
- Do not use an adapter or extension cord to defeat a standard grounding device. (e.g., only place three-prong plugs in three-prong outlets; do not alter them to fit in a two-prong outlet.)
- Use extension cords only when necessary and only on a temporary basis. Do not use extension cords in place of permanent wiring. Request new outlets if your work requires equipment in an area without an outlet.
- Use extension cords that are the correct size or rating for the equipment in use. The diameter of the extension cord should be the same or greater than the cord of the equipment in use.
- Do not run electrical cords above ceiling tiles or through walls.
- Keep electrical cords away from areas where they may be pinched and areas where they may pose a tripping or fire hazard (e.g., doorways, walkways, under carpet, etc.)
- Avoid plugging more than one appliance in each outlet. If multiple appliances are necessary, use an approved power strip with surge protector and circuit breaker. Do not overload the circuit breaker.
- Discard damaged cords, cords that become hot, or cords with exposed wiring.
- Never unplug an appliance by pulling on the cord; pull on the plug.

Electrical Emergency Response

The following instructions provide guidelines for handling three types of electrical emergencies.

Electric Shock

When someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, do not touch the person and immediately turn off the electrical power source. If you cannot disconnect the power source, try to separate the victim from the power source with a nonconductive object, such as a wood-handled broom. Have someone call for emergency medical assistance immediately. Administer first aid, as appropriate.

IMPORTANT

Do not touch a victim that is still in contact with a power source; you could electrocute yourself.

Electrical Fire

If an electrical fire occurs, try to disconnect the electrical power source, if possible. If the fire is small, you are not in immediate danger, and you have been trained in fighting fires, use any type of fire extinguisher except water to extinguish the fire.

IMPORTANT: Do not use water on an electrical fire.

Power Lines

Stay away from live power lines and downed power lines. Be particularly careful if a live power line is touching a body of water. The water could conduct electricity. If a power line falls on your car while you are inside, remain in the vehicle until help arrives.

Lockout / Tag-out Procedures

Lockout/tag out procedures are used to isolate hazardous energy sources from electrical, hydraulic, or pneumatic machinery. Furthermore, when service or maintenance work is required, lockout and tag out devices help ensure personal safety from possible energy releases. All employees whose work involves hazardous energy sources must be trained in lockout/tag out procedures.

Before performing service or maintenance work on machines, turn them off and disconnect them from their energy sources. To further ensure employee safety, use lockout and tag out energy isolating devices.

The following sections provide information on lockout/tag out procedures. In addition to the procedures in this manual, Texas State University maintains a University Lockout/Tag out Procedures for the control of hazardous energy. A copy of this document is available from the Facilities Department and shall be referenced when preparing to work with high energy devices.

Applying Lockout/Tag-out Devices

Only authorized employees may apply lockout/tag out devices. The following steps provide a brief outline of approved application procedures:

- Notify employees that the equipment requires service or maintenance and is scheduled for shutdown and lockout/tag out.
- Use established procedures to identify the type, magnitude, and hazards of the equipment's energy source. Make sure you know the proper methods for controlling the energy source.
- If the equipment is currently operating, shut it down using normal shutdown procedures.
- Isolate the equipment from its energy source by activating the energy-isolating device(s). Either lockout or tag out the energy-isolating device(s).
- Dissipate or restrain stored and residual energy using methods such as grounding, repositioning, blocking, bleeding, etc. (Capacitors, springs, hydraulic systems, and air/gas/water pressure system may contain stored or residual energy.)
- Ensure that all employees are removed from the equipment. Then, test the equipment for successful isolation by attempting to operate it.

IMPORTANT: After verifying isolation, return the controls to neutral or off.

Removing Lockout/Tag-out Devices

When service and maintenance are complete, authorized employees may remove lockout/tag out devices and return equipment to normal operations. The following steps provide a brief outline of approved removal procedures:

- Inspect the work area and remove any nonessential items. Make sure the isolation equipment is intact and in good working condition.
- Ensure that all employees are safely removed from the equipment.
- Verify that the equipment controls are in neutral or off.
- Remove the lockout/tag-out devices and re-energize the equipment.

NOTE: The removal of some forms of blocking may require the equipment to be re-energized before safe removal.

- Notify employees that the equipment is ready for operation. See Lock-out Tag-out policy

High Voltage Procedures

In addition to the guidelines associated with general electrical safety and lockout/tag out procedures, there are more stringent safety requirements for high voltage procedures.

The following list provides high-voltage safety tips. For more information, please refer to OSHA Title 29 Section 1910.269 of the Code of Federal Regulations or NFPA 70 (National Electric Code).

- Ensure that only authorized employees work around high voltage equipment.
- Label entrances with a High Voltage Sign.
- Ensure that terminal voltage ratings can withstand surges caused by electrical faults or switching transients.
- Be careful around output circuits even when the input power is off. Parallel power sources and energy storage devices can still be dangerous.
- Be careful when working with power supplies that serve more than one area.
- Before working in a high voltage area, inspect the power supply and check all protective devices.
- Do not work alone near high voltage.
- Label equipment to identify power sources. Label input power sources to identify connected power supply loads.
- Attach emergency shutdown instructions and phone numbers to equipment that is remotely controlled or unattended while energized.

Before entering a power supply or associated equipment enclosure to work on hazardous energy sources, complete the following:

- De-energize the equipment.
- Open and lockout the main input power circuit breaker.
- Check for auxiliary power circuits that could still be energized.
- Inspect automatic shorting devices for proper operation.
- Short the power supply with grounding hooks.

Minimum Clear Working Space

The following table from the National Electric Code provides minimum depth of clear working space in front of electrical equipment:

Nominal Voltage to Ground	Conditions		
	i	ii	iii
	(ft)	(ft)	(ft)
601- 2,500	3	4	5
2,501- 9,000	4	5	6
9,001- 25,000	5	6	9
25,001-75kV	6	8	10
Above 75kV	8	10	12

- Where conditions (i), (ii), and (iii) are as follows:
- (i) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating materials. Insulated wire or insulated bus bars operating at not over 300 volts shall not be considered live parts.
- (ii) Exposed live parts on one side and grounded parts on the other side. Concrete, brick, or tile walls will be considered as grounded surfaces.
- (iii) Exposed live parts on both sides of the workspace [not guarded as provided in condition (i)] with the operator between.

Proper Electrical Repair Procedures

It will be mentioned that no electrical device should be opened, repaired, upgraded or changed with the power circuit energized to that device if possible.

There are times when an electrical device will be worked on for some reason while the device circuit is energized. All safety precautions and equipment will be utilized to safe guard the employee from coming in contact with a live electrical circuit.

If an electrical device is requested by work order for repair, these procedures should always be followed no matter the situation:

1. The electrical device circuit should be tested to see if the device is energized before any attempt of repair. There are many UL listed devices that can be used for this testing procedure.
2. If the device circuit is energized, then the power sources should be located by subpanel and breaker location or by using a tracer device to locate the circuit breaker and then the breaker for that circuit should be switched off and locked out and tagged out (LO/TO) .
3. If the electrical circuit cannot be located and the device must be repaired with the electrical circuit energized (HOT), then this procedure will be followed to insure that the HOT circuit will not come in contact with the device or the person doing the repairs.
4. The HOT circuit will be identified and will be isolated from the device frame by removing the HOT circuit from the device junction block, wire nut connection or internal connection.

5. The HOT circuit will have a wire nut or some type of insulated termination installed and tested before any attempt to repair the device. If the wire nut is larger than the wire itself than the employee will either fold the wire to increase the size of the wire so that the wire nut will attach to the HOT circuit or the employee will wrap the HOT circuit with UL listed

electrical rubber and vinyl tape to prevent the HOT circuit from coming in contact with the frame or the employee.

6. If the device is to be repaired with a HOT circuit in the device than there will be no less than two employees assigned to the repairs in the case that there will be a safety person on site if an electrocution were to occur.
7. Once the device is repaired than the HOT circuit can be reattached to the device to energize the device.

End of Section

SECTION 5

PROJECT MANAGEMENT AND DESIGN

CONSTRUCTION SAFETY

Construction work can be particularly hazardous. Personal Protective Equipment, Fire/Life Safety, Electrical Safety, and other precautions are essential for safe construction work. Refer to other chapters in this manual for more information. Follow these guidelines when visiting or working at construction sites: Do not walk, stand, or work under suspended loads. If you raise a load, be sure to crib, block, or otherwise secure the load as soon as possible. Avoid placing unusual strain on equipment or materials. Be prepared for unexpected hazards. BE ALERT!

1. Barriers & Guards
2. Heavy Equipment Hoists
3. Scaffolding

1. Barriers & Guards

University employees and all contractors must use barriers and guards as necessary to protect employees, students and visitors from physical hazards. If you suspect a hazard is not sufficiently protected, notify the attending workers, the Facilities Department or the Environmental Health, Safety & Risk Management Office immediately.

NOTE:
Barriers, guards, and warning signs are required to ensure safety against existing hazards.

Types of Barriers and Guards

Standard types of barriers and guards include the following:

- Guardrails and handholds
- Saw horses
- Tape
- Toe boards
- Cones
- Other physical barriers and solid separators (dust barriers, hazard barriers, temporary walkways, etc.)

NOTE:
Signs that state DANGER, WARNING, or CAUTION are also important when barriers or guards are necessary. Remember to make signs legible, visible, and brief.

Areas that Need Barriers or Guards

Any area that poses a physical threat to workers and/or pedestrians requires barriers or guards. Areas that typically require permanent or temporary protection include the following:

- Stairways
- Hatches
- Chutes
- Open Manholes
- Elevated platforms
- Areas with moving machinery
- Excavation sites
- Construction sites
- Temporary wall or floor openings

Using Barriers and Guards

The following list provides guidelines for using barriers and guards:

- When necessary, reroute pedestrian and vehicular traffic to completely avoid a construction site.
- Guard any permanent ground opening into which a person could fall with a guardrail, load-bearing cover, or other physical barrier.

- Ensure that temporary floor openings, such as pits and open manholes, are guarded by secure, removable guardrails. If guardrails are not available, have someone guard the opening.
- Ensure that all stairways, ladder ways, hatchways, or chute floor openings have handrails or hinged covers.
- Ensure that enclosed stairways with four or more steps have at least one railing, and that open stairways with four or more steps have two railings.
- Ensure that all platforms and walkways that are elevated or located next to moving machinery are equipped with handrails, guardrails, or toe boards.
- Barricade any wall openings through which a person or tools could fall. Use gates, doors, guardrails, or other physical barriers to block the opening.
- Mark and guard any excavation that is deeper than 12 inches.
- Mark and/or guard potholes and sidewalk damage as appropriate.
- Protect smoke detectors with some type of cover when construction work, such as dust or fume producing activities, may affect smoke detectors. Remove protectors immediately at the end of the activity or at the end of the each day.

2. Heavy Equipment

When using heavy equipment, there are five basic guidelines that employees must always follow to ensure safety:

1. Know how to properly operate the equipment you are using.
2. Do not use heavy machinery when you are drowsy, intoxicated, or taking prescription medication that may affect your performance.
3. Use only equipment that is appropriate for the work to be done.
4. Inspect your equipment to ensure that it is in good working condition before beginning a job. In addition, ensure that regular inspections and maintenance are conducted as appropriate.
5. Do not stress or overload your equipment.

Accidents do not just happen, they are caused. Therefore, employees should also follow these guidelines:

- Ensure the following before leaving equipment unattended:
    - All buckets, blades, etc. are on the ground.
    - Transmission is in neutral.
    - Engine is off.
    - Equipment is secure against movement.
- Never get on or off moving equipment.
- Do not attempt to lubricate or adjust a running engine.
- Turn the engine off before refueling.
- Keep all shields and safety guards in place.
- Avoid underground utilities and overhead power lines.

The following sections provide basic guidelines for working with forklifts, front-end loaders, and backhoes. Refer to the product documentation that accompanied your equipment for more information and specific instructions.

Forklifts

Only authorized employees may operate forklifts. The following list provides general safety guidelines:

- Do not allow riders.
- Do not raise people on a forklift.
- Do not speed.
- Drive up and back down ramps.
- Do not walk, stand, or work under the elevated portion of a forklift (even if it is not loaded).
- Ensure that the forklift has an overhead barrier to protect the operator from falling objects.

In addition, follow these guidelines for safe forklift operation:

- Always work within the capacity limits of your forklift. Consult with the manufacturer before modifying the operation or capacity limits of a forklift.
- Do not operate a forklift in areas with hazardous concentrations of acetylene, butadiene, hydrogen, ethylene, or diethyl ether, or other explosive environment.
- Never lift a load while moving. Wait until you are completely stopped before raising the mast.
- Be sure the top load sits squarely on the stack. An uneven load could topple.
- Travel with loads slightly tilted back to provide stability.
- Travel with loads at the proper height. A stable clearance height is usually 4 to 6 inches at the tips and 2 inches at the heels of fork blades.
- Lift stacked loads in the same manner as loads on the floor.
- When preparing to leave the forklift unattended, lower the mast, neutralize the controls, shut the power off, and set the brakes. The forklift is when preparing to leave the forklift unattended, lower the mast, neutralize the controls, shut the power off, and set the brakes. The forklift is "unattended"
- When ascending or descending a grade in excess of 10 percent, drive the forklift with the load upgrade.
- If you cannot see over a load, drive in reverse. Do not try to look around a load and drive forward.

Back Hoes

Only authorized employees may operate backhoes and front-end loaders. The following list offers general safety guidelines for both types of machinery:

- Always operate at a safe speed.
- Travel with the bucket low to the ground.
- Always lower the bucket before servicing the equipment or leaving the loader unattended.
- Use a rigid-type coupler when towing loads.
- Always check with the utility company before digging.
- Be extremely careful when operating near banks and slopes.
- When cutting a bank, be careful not to cause a cave-in. Do not drive on an overhang.

Hoists

Only authorized employees may use hoists to move heavy objects and equipment. When using hoists, remember to follow the five safety guidelines for working with heavy equipment. (Refer to the section on heavy equipment for more information.) In addition, follow the guidelines in the following sections.

Hoisting Guidelines

The following are general guidelines for working with hoists:

- Never walk, stand, or work beneath a hoist.
- Isolate hoisting area with barriers, guards, and signs, as appropriate.
- Never exceed the capacity limits of your hoist.
- Wear gloves and other personal protective equipment, as appropriate, when working with hoists and cables.
- Ensure that hoists are inspected regularly.
- Always hold tension on the cable when reeling it in or out.
- When the work is complete, always rig the hoist down and secure it.
- When the load block or hook is at floor level or its lowest point of travel, ensure that at least two turns of rope remain on the drum.
- Be prepared to stop operations immediately if signaled by the safety watch or another person.

Picking Up Loads with Hoists

Ensure that the hoist is directly above a load before picking it up. This keeps the hoist from becoming stressed. Picking up loads at odd angles may result in injury to people or damage to the hoist.

Do not pick up loads by running the cable through, over, or around obstructions. These obstructions can foul the cable or catch on the load and cause an accident.

Avoid Electrical Hazards with Hoists

Do not hoist loads when any portion of the hoisting equipment or suspended load can come within 6 feet of high-voltage electrical lines or equipment.

If you need to hoist near high-voltage electrical lines or equipment, obtain clearance from your supervisor first.

Inspecting Hoists

Hoists should be inspected daily. If there is any question about the working condition of a hoist, do not use it.

Hoist inspectors should note the following:

- The hooks on all blocks, including snatch blocks, must have properly working safety latches.
- All hooks on hoisting equipment should be free of cracks and damage.
- The maximum load capacity for the hoist must be noted on the equipment.
- Cables and wiring should be intact and free of damage.

3. Scaffolding

When employees must conduct construction work above the ground and away from solid platforms, scaffolds may be appropriate. The following list provides guidelines for using small scaffolds. Larger scaffolds must be designed and erected in accordance with applicable standards.

NOTE: Scaffolds and their components should be capable of supporting at least four times their maximum load.

- Ensure that scaffold anchors are sound, rigid, and capable of supporting the maximum intended load without shifting.
- For freestanding, mobile scaffolds, the height should not exceed four times the minimum base dimension. If workers are riding the scaffolding, however, the base dimension should be at least one half the height.
- Do not use unstable objects such as barrels, boxes, bricks, or blocks to support scaffolds or planks.
- Keep floors free of debris where mobile scaffolds are used.
- Lock scaffolds with wheels into position.
- Install guardrails, mid-rails, or toe boards on the open sides and ends of platforms that are more than 4 feet above the ground or floor level. Use lifelines for scaffolds that are more than 10 feet off the ground.
- Either overlap multiple planking and platforms by 12 inches or secure them to ensure stability.

NOTE: Planks must extend over end supports between 6 and 18 inches.

- Secure scaffolds to permanent structures with anchor bolts or other means.
- Do not load scaffolds in excess of their maximum load limits.
- Repair damaged scaffolds immediately.
- Do not work on scaffolds in high winds or during storms.
- Remove ice or snow from scaffolds and apply sand to the wood before conducting work in winter weather.
- Do not allow tools, equipment, or other debris to accumulate on scaffolds.
- Dismantle and remove scaffolds when they are no longer needed.
- Do not use temporary scaffolding as a permanent installation

End of Section

SECTION 6

CONFINED SPACE ENTRY

This of the safety manual provides guidelines and procedures for confined space entry. The following topics are covered.

1. Types of Confined Spaces
2. Confined Space Definitions
3. Employee Responsibilities
4. Confined Space Safety Procedures
5. Trenching & Shoring

1. Types of Confined Spaces:

IMPORTANT

All confined space entries shall be prepared and performed in accordance with the FSS PPS 04.05.01 Confined Space Entry.

A confined space is any enclosed area with the following characteristics:

- Limited means of entry or exit
- Structure that is not designed for extended human occupation
- Atmosphere that is actually or potentially hazardous
- Potential for other hazards

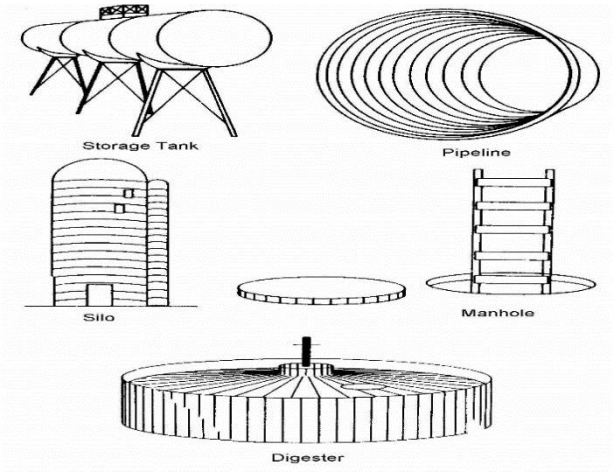
Because confined spaces offer limited means of entry or exit and may contain hazards, employees must comply with OSHA 29 CFR 1910.146 and the Texas State University Confined Space Entry Program when working in these areas. The Confined Space Entry Program is available from the Facilities Department.

Most confined spaces are actually or potentially hazardous. These confined spaces require work permits because they have one or more of the following:

- Hazardous atmosphere or the potential to contain hazardous atmosphere
- Materials that could engulf workers
- Internal structure or contents that could trap or asphyxiate employees
- Other recognizable hazards

Examples of confined spaces include the following:

- Manholes
- Crawl spaces
- Tunnels
- Tanks
- Trenches



2. Confined Space Definitions:

- **Authorized Attendant**: Properly trained worker who is positioned outside a confined space. This person monitors the entrants within a confined space and the external surroundings.
- **Authorized Entrants**: Properly trained workers with the authorization to enter confined spaces.
- **Confined Space**: Any enclosed space with limited means of entry or egress, which is not designed for continuous occupation.
- **Entry**: Physical act of entering a confined space. An entry occurs when a worker's face breaks the plane of the confined space opening.
- **Hazardous Atmosphere**: Atmosphere that is oxygen enriched, oxygen deficient, combustible, toxic, or otherwise immediately dangerous to life or health.
- **Hot work**: Operations that could provide a source of ignition, such as riveting, welding, cutting, burning, or heating.
- **Permit-Required Confined Space**: Confined space that contains actually or potentially hazardous atmospheres, or the potential for engulfment by particulate matter or liquid.
- **Person Authorizing Entry**: Worker who is properly trained in administrative, technical, and managerial aspects of confined space entry. This person authorizes entry and has the authority to terminate entry when conditions become unfavorable.

3. Employee Responsibilities

All employees and contractors must follow the guidelines in the Texas State University Confined Space Entry Program and other required programs to ensure safe entry into confined spaces.

In addition, Departments and Supervisors are responsible for the following:

- Selecting a person to authorize entry
- Authorizing entrants and attendants, as appropriate
- Providing atmospheric monitoring equipment, personal protective equipment, and other necessary equipment
- Training the people who authorize entry and the people who enter and attend confined spaces

The Facilities Department is responsible for the following:

- Assisting with identifying confined spaces, as necessary
- Assisting with training employees, as appropriate
- Monitoring program compliance

4. Confined Space Safety Procedures

The following sections cover proper procedures and guidelines for safely working within confined spaces.

- Inspecting the Space & Completing the Checklist
- Confined Space Entry Permit
- Obtaining Entry Permission

- Preparing the Entry Team
- Monitoring the Atmosphere
- Confined Space Ventilation
- Preparing Site for Entry
- Safeguarding Confined Space Operations
- Confined Space Emergency Procedures

NOTE:
Electrical manholes and other confined spaces with high voltage electrical hazards are covered by 29 CFR 1910.269. Please refer to the code for more information.

Inspecting the Space & Completing the Checklist

Before entering a confined space, evaluate the area and complete a Confined Space Checklist Form and Entry Document .A sample form addressing OSHA requirements is included after this section.

To complete the form, determine the following information:

- Identity and location of the confined space
- Purpose for entering the area
- Known and potential hazards
- Required isolation methods (e.g., lockout/tag out)
- Environmental conditions of the confined space
- Atmospheric readings to verify that acceptable environmental conditions are met and maintained
- Rescue services, procedures, and equipment that may be necessary in case of an emergency
- Communication procedures to be used
- Personal protective equipment to be used
- Any additional information relating to the specific circumstances of the confined space
- Names of the following: Person authorizing entry
    - Supervisor
    - Authorized entrants
    - Authorized attendants

IMPORTANT:
If you intend to perform ho-work within the confined space, you must note this on the form.

CONFINED SPACE ENTRY PERMIT

Obtaining Entry Permission

- Employees must notify the person who authorizes entry before working in confined spaces.
- The person who authorizes entry refers to any records on file and identifies the actual or potential hazards of the area in question. If no file exists for the specific space, a new one is developed.
- The person who authorizes entry then reviews and approves the entry form as appropriate. A copy of the form is filed for future reference.

Preparing the Entry Team

Before entering a confined space, all employees involved with the entry must attend a preparation meeting. The agenda for this meeting includes the following:

- Discussion of actual and potential hazards
- Review of emergency procedures including rescue and evacuation
- Completion of the entry form by all team members to acknowledge their understanding of the hazards involved with the confined space
- Issuance of personal protective equipment
- Discussion of site location and other essential information

Monitoring the Atmosphere

Due to poor ventilation and physical structure, the atmosphere in confined spaces may be actually or potentially hazardous. Atmospheric hazards include the following:

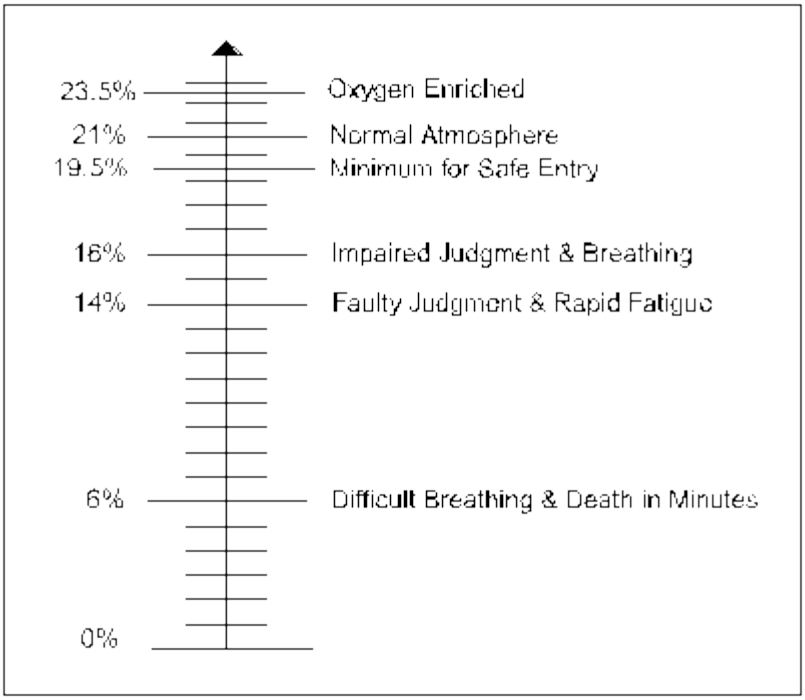
- Oxygen deficient or oxygen enriched atmospheres
- Combustible atmospheres
- Toxic atmospheres
- Any other atmosphere that is immediately dangerous to life or health

Employees trained in atmospheric monitoring will test several points in a confined space for the following:

- Oxygen content
- Combustible atmosphere
- Potential toxic contaminants

Oxygen Monitoring

Oxygen enriched atmospheres are more than 23.5% oxygen; oxygen deficient atmospheres are less than 19.5% oxygen. Certain chemical or biological reactions may reduce oxygen over time, but employee operations such as cutting or welding may reduce oxygen content very quickly. Oxygen levels must be tested regularly whenever hot work is performed within a confined space. The following graph outlines human reaction to various oxygen levels.



Human Reaction to Oxygen Concentrations

Combustible Atmospheres

Combustible atmospheres have enough oxygen and flammable vapor, gas, or dust to ignite and support a fire or explosion if exposed to flames, sparks, or heat. Oxygen-enriched atmospheres and hazardous atmospheres in excess of their lower flammable limits are extremely combustible and dangerous. The following graphic illustrates the relationship between oxygen, heat, and fuel.

Oxygen, Heat, Fuel Relationship

Toxic Atmospheres

Toxic atmospheres can cause injury, illness, or death. Safety concerns include inhalation and skin exposure. If the identity of the toxic atmosphere is known, check all appropriate Safety Data Sheets (SDSs) for threshold limit values and recommended personal protective equipment. If the identity of the toxic atmosphere is not known, use maximum PPE.

Confined Space Ventilation

Ventilation controls the atmospheric hazards of a confined space by replacing unsafe air with clean, breathable air. There are several methods for ventilating a confined space. The method and equipment used depend on the following factors:

- Size of the confined space
- Atmosphere
- Source of the makeup air

For most confined spaces, fans or other air-moving equipment can provide adequate ventilation. Two common types of mechanical ventilation include local exhaust ventilation and general ventilation.

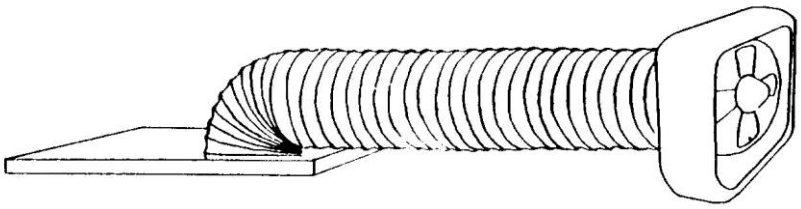
Local exhaust ventilation captures contaminants at their point of origin and removes them. This type of ventilation method is ideal for flammable and toxic materials produced at a single point (e.g., hot-work and work involving cleaning solvents). When using this type of ventilation system, keep the exhaust intake close to your work. Do not use this type of ventilation system for contaminants that are widely dispersed or for confined spaces that make ventilation difficult. Instead, use general ventilation.

General ventilation flushes the atmosphere by supplying and exhausting large volumes of air. Because this system does not reduce the amount of contaminants released, it is not recommended for highly toxic atmospheres. General ventilation is ideal for providing oxygen and controlling low concentrations of materials that are not highly toxic. When using this type of ventilation system during hot-work, monitor the atmosphere continuously and wear a SCBA, as necessary.

IMPORTANT: Ventilation alone cannot reduce some atmospheric hazards to safe levels. Use atmospheric testing to confirm whether the ventilation system has been successful.

Follow these guidelines for ventilating confined spaces:

- Begin ventilation in time to assure that the space is safe before entry.
- Test the atmosphere before entry to confirm that the ventilation system is working properly and that the space is safe.
- Continue ventilation as long as the space is occupied, or at least until the oxygen levels and hazardous concentrations are within safe limits.
- If work inside the space can make the air unsafe (e.g., hot work, painting, using solvents, sandblasting, etc.) continue ventilating.



Typical Exhaust Duct

Preparing Site for Entry

Employees must complete the following steps to prepare confined spaces for entry:

- Isolate the confined space entry site from the surrounding area using guards and barriers (including signs, rope, or tape).
- Drain, clean, ventilate, and/or purge the confined space, as necessary, to prevent flammable, toxic, and corrosive hazards.
- Isolate all electrical, mechanical, and pneumatic energy sources as outlined in the Lockout/Tag out section of this manual.
- Ensure that all workers are wearing appropriate personal protective equipment, and that all persons wearing respirators have been properly trained in their usage.
- Provide continuous ventilation, as necessary.
- Ensure that non-sparking tools and explosion proof equipment are used when working in a potentially combustible atmosphere.
- Position gas cylinders for cutting or burning outside the confined space.
- Ensure that a standby SCBA is available.
- Obtain personal protective equipment, including lifelines, winches, and harnesses, as required. Ensure that the equipment has been inspected as scheduled.
- Take precautions to ensure against engulfment hazards, such as water, dirt, grain, etc.

Safeguarding Confined Space Operations

Life support safety is critical during confined space operations. The following items are requirements for safeguarding confined spaces:

- Employees must wear appropriate personal protective equipment at all times.
- Employees must use harnesses, lifelines, and/or winches, as appropriate.

The Authorized Safety Attendant is specifically responsible for the following:

- Keeping a log of all authorized entrants working within the confined space
- Maintaining constant verbal contact with the authorized entrants within a confined space
- Taking necessary precautions and measures to prevent unauthorized persons from entering a confined space
- Initiating evacuation procedures whenever conditions within or outside the confined space pose a new hazard

All employees must evacuate a confined space when one or more of the following conditions occur:

- Authorized Safety Attendant orders evacuation
- Automatic atmospheric alarm sounds
- Authorized entrants believe they are in danger

Confined Space Emergency Procedures

If a worker is unable to evacuate the confined space during an emergency, the Authorized Safety Attendant will contact rescue personnel by radio or other means.

The Authorized Safety Attendant and other workers outside the confined space should attempt to hoist the worker out of the confined space using a lifeline.

IMPORTANT: Under no circumstances should unauthorized employees enter a confined space during an emergency.

NOTE: Electrical manholes and other confined spaces with high voltage electrical hazards are covered by
29 CFR 1910.269. Please refer to the code for more information.

See Confined Space Procedures Policy

End of Section

SECTION 7

FIRE/LIFE SAFETY

Fire/life safety involves numerous safety issues including fire prevention, fire suppression, and emergency evacuation/response. Fire/life safety is everyone's responsibility.

IMPORTANT! *Learn how to prevent fires and respond to fires - what you learn will be invaluable.*

Lamar University is committed to providing a safe environment for building occupants and emergency response personnel. Lamar University uses nationally accepted codes as guidelines for inspections, testing, and procedures.

Fire Effects

Most fires produce an immense amount of smoke that is highly toxic. In fact, smoke is responsible for more fire fatalities than flames. A Smoky fire can have the following effect on humans:

- Within 30 seconds- Disorientation
- Within 2 minutes -Unconsciousness
- Within 3 minutes -Death

Timing is critical during a fire. To ensure your safety, you must know how to prevent and respond to any fire emergency.

Fire Prevention

The greatest protection against property loss and injuries from fire is prevention. Follow these guidelines to promote fire/life safety:

- Minimize combustible storage.
- Store waste materials in suitable containers.
- Use flammable materials in well-ventilated areas. Use and store flammables away from ignition sources, such as cigarettes.
- Keep equipment in good working order. Have electrical wiring and appliances inspected regularly.
- Ensure that heating units are properly safeguarded.
- Do not hunt for gas leaks using an open flame. Use approved gas indicators.
- Report and repair all gas leaks immediately.
- Conduct hot work in well-ventilated areas.
- Test enclosed or confined spaces for flammable atmospheres.
- Use open flames carefully. Do not use open flames where flammable atmospheres may be present.

For more information on fire/life safety, refer to other chapters in this manual, including Emergency Preparedness, Electrical Safety, Laboratory Safety, Chemical Safety, Confined Space, etc.

Fire Response

If you see a fire or smoke, or if you smell smoke, complete the following steps:

1. Pull the fire pull station to begin evacuating the building.

    - If you are not in immediate danger, call 911 to report the fire. Provide the operator with the following information:

        - Building or area name
        - Approximate location of the fire
        - Size and type of fire
        - Your name

3. If you are formally trained in firefighting techniques and are not in immediate danger, you may attempt to fight the fire. Do not place yourself or others in unnecessary danger.
4. Exit the building by following posted evacuation routes. Do not use elevators during an emergency.

During actual emergencies, building occupants must receive permission from the LUPD, the Fire Department, or EHSRM before re-entering the building.

NOTE: Evacuation plans and fire drills are essential for building occupants to respond correctly to a fire alarm. Refer to the Emergency Preparedness chapter for more information.

IMPORTANT: *If you suspect arson, no matter how small the incident, contact the LUPD or EHSRM. Do not alter the fire scene in any way, unless you are trying to extinguish a live fire. The UPD and Fire Department work together to investigate possible arson.*

Combustible Storage

By storing excess combustible materials improperly, employees not only increase the potential for having a fire, they increase the potential severity of a fire. To reduce the hazards associated with combustible storage, follow these guidelines:

- Eliminate excess combustible materials such as paper and cardboard.
- Do not store combustible materials in hallways, stairwells, or mechanical rooms.
- When stacking materials, leave at least 18 inches between the top of the stack and the ceiling.

Portable LPG

The Texas Railroad Commission regulates the sale and use of Liquefied Petroleum Gas (LPG), including butane and propane. These regulations govern several types of LPG-powered equipment including the following:

- Forklifts
- Floor buffers
- Cooking and heating equipment
- Laboratory equipment

Exhaust fumes may contain carbon monoxide which can present a health hazard. Exhaust can also create smoke which may activate a smoke detector. Take special precautions to ensure adequate ventilation when using these machines indoors.

Because LPG is extremely flammable, it is a potential fire hazard. Do not store LPG near heat, flame, or other ignition sources. In addition, do not leave portable LPG containers larger than 16 oz. in a building overnight. Instead, place portable LPG containers and LPG equipment outside in a storage area that is at least 25 feet away from other buildings, combustible materials, roadways, railroads, pipelines, utility lines, and the property line. This storage area should prevent unauthorized entry and have a portable fire extinguisher within 25 feet.

Emergency Access & Egress

Emergency access and egress are critical during an emergency situation such as a fire. During a fire, timing and quick response are essential to save lives and property. Effective emergency access ensures that fire trucks can reach a building in time to extinguish the fire. Unobstructed emergency egress ensures that building occupants can exit a building to safety.

These definitions help clarify the concept of emergency access and egress:

Emergency Access

Emergency Egress

Pertinent facilities and equipment remain available and unobstructed at all times to ensure effective fire detection, evacuation, suppression, and response.

A continuous and unobstructed way to travel from any point in a public building to a public way. A means of egress may include horizontal and vertical travel routes, including intervening rooms, doors, hallways, corridors, passageways, balconies, ramps, stairs, enclosures, lobbies, courts, and yards.

IMPORTANT: *Each location within a building must have a clear means of egress to the outside. The following sections offer safety guidelines and procedures for maintaining emergency access and egress.*

Corridors, Stairways, and Exits

! IMPORTANT!

There must be at least 44 inches clear width of unobstructed, clutter-free space in all corridors, stairways, and exits.

Follow these guidelines to promote safe evacuation in corridors, stairways, and exits:

- Keep all means of egress clean, clutter-free, and unobstructed.
- Do not place hazardous materials or equipment in areas that are used for evacuation.
- Do not use corridors or stairways for storage or office/laboratory operations. Corridors may not be used as an extension of the office or laboratory

Fire Lanes

A fire lane is an area designated for emergency personnel only. It allows them to gain access to building and/or fire protection systems. Although most fire lanes on campus are clearly marked,

not all fire lanes are easy to distinguish. Texas State University - San Marcos has a program in place to clearly mark all fire lanes. An exit corridor and/or stairway is a pedestrian pathway that allows direct access to the outside of a building and/or allows access to a building entrance and subsequent pathways to the outside of a building (i.e., an exit corridor is the quickest, easiest, and most direct pathway for leaving a building.) Because exit corridors or passageways are the primary means of egress during an emergency, employees must follow the safety guidelines outlined in this section.

IMPORTANT!: *Do not park in fire lanes or within 15 feet of fire hydrants and other fire equipment.*

Fire Doors

A fire door serves as a barrier to limit the spread of fire and restrict the movement of smoke. Unless they are held open by the automatic systems, fire doors should remain closed at all times. Do not tamper with fire doors or block them with equipment, potted plants, furniture, etc.

Fire doors are normally located in stairwells, corridors, and other areas required by Fire Code. The door, door frame, locking mechanism, and closure are rated between 20 minutes and three hours. A fire door rating indicates how long the door assembly can withstand heat and a water hose stream.

Always keep fire doors closed. If it is necessary to keep a fire door open, have a special closure installed. This closure will connect the fire door to the building's fire alarm system, and will automatically close the door if the alarm system activates.

IMPORTANT: *Know which doors are fire doors and keep them closed to protect building occupants and exit paths from fire and smoke. Never block a fire door with a non-approved closure device such as a door stop, block of wood, or potted plant. For fire doors with approved closure devices, make sure that nothing around the door can impede the closure.*

Never alter a fire door or assembly in any way. Simple alterations such as changing a lock or installing a window can lessen the fire rating of the door.

Doors to offices, laboratories, and classrooms help act as smoke barriers regardless of their fire rating. Keep these doors closed whenever possible.

REMEMBER: A closed door is the best way to protect your path to safety from the spread of smoke and fire.

Fire Detection & Notification

Lamar University uses several types of fire detection and notification systems including heat detectors, smoke detectors, pull stations, and horns and lights. The following sections discuss these components.

Heat and Smoke Detectors

There are two types of fire detection devices used on the Lamar University campus: heat detectors and smoke detectors. Please note the location of the detectors in your area and prevent damage and accidental activation.

Heat Detectors

Heat detectors respond to the convected energy in hot smoke and fire gases (i.e., heat). Heat detectors are normally located in laboratories, mechanical rooms, storage areas, and areas that could produce high levels of dust, steam, or other airborne particles.

Smoke Detectors

Smoke detectors respond to the solid and liquid aerosols produced by a fire (i.e., smoke). Since smoke detectors cannot distinguish between smoke particles and other particles such as steam, building occupants must be aware of detector locations and be considerate when working around them. Smoke detectors are normally found in exit corridors, office areas, assembly areas, and residence halls.

An ionization smoke detector, the most common, contains a small amount of radioactive material. Contact EHSRM for disposal.

If your work produces steam, dust, or an environment that could damage or activate a detector, contact Facilities - Tech. Services to review the installation and/or allow temporary disarming.

Alarm Systems

Pull Stations

Fire alarm manual pull stations are installed to manually activate a building's alarms in addition to the automatic fire sensing devices. When pulled manually, a pull station activates the fire alarm system and notifies University personnel that an emergency exists. Pull stations are located near exit stairways and/or building exits.

If you smell smoke or if you see smoke or a fire, complete these steps:

- Pull a manual pull station to evacuate the area.
- If you are not in immediate danger, call 911.
- If you are trained in firefighting and it is reasonably safe to do so, attempt to extinguish the fire.

Horns and Strobes

Emergency horns/bells and lights are located throughout University buildings with fire alarm systems. They are typically found near emergency pull stations. Do not block emergency horns or lights. Report damaged or defective horns and lights to the Facilities.

Fire Suppression

Lamar University uses various types of fire suppression equipment including portable fire extinguishers, sprinklers, clean systems, carbon dioxide systems, and fire hose/standpipe systems. The following sections discuss each type of fire suppression equipment.

Fire Extinguishers

Fires are classified according to three basic categories. Each type of fire requires special treatment to control and extinguish it. Therefore, all fire extinguishers are clearly marked to indicate the fire classes for which they are designed.

Fires are classified as indicated below.

Fires involving ordinary combustibles such as wood, textiles, paper, rubber, cloth, and the trash. The extinguishing agent for a Class A fire must be cool. Water and multi-purpose dry chemical fire extinguishers are ideal for use on these types of fires.

Open Burning

Lamar University must comply with TNRCC, Beaumont Fire Department regulations for open burning. Follow these steps before burning anything outside:

- Only natural ground cover may be burned. It is not acceptable to store items for burning at a later date. Open burning must only be used as a way to remove brush and other acceptable items if no alternate removal can be used.
- Smoke and flying debris may not cross or contact public thoroughfares.
- Responsible persons must be present during the entire burn, be equipped with adequate firefighting agents, and be able to quickly communicate with emergency response personnel.

Please contact EHSRM for additional information on open burning and alternative methods of disposal and for obtaining permits.

Holiday Decorations

Holiday decorations are often fire hazards. Follow these guidelines to improve fire safety during the holidays:

- Do not use live Christmas trees in University buildings unless they are treated with fire retardants. Use an artificial tree that is fire resistant.
- Do not place holiday decorations where they may block emergency egress (e.g., stairways, corridors, near doors, etc.)
- Only use decorations that are flame retardant.
- Practice good housekeeping by minimizing paper and other combustible decorations.
- Avoid using extension cords.
- Use FM or UL labeled electrical decorations.
- Do not light candles or use other decorations with open flames.
- Turn off lights when the room is unoccupied.

Open Flame

Open flames are not permitted on campus without prior permission from the EHSRM. Departments planning an activity involving open flames, e.g. candles, special effects, must coordinate the event with the EHS/RM.

End of Section

SECTION 8

EMERGENCY PREPAREDNESS

Section 8 of the safety manual provides safety guidelines and procedures for emergency preparedness. The following topics are covered.

Elements of Emergency Preparedness

An emergency consists of any situation that poses immediate and extreme danger to people, property, or process. Because most emergencies are sudden, severe, and unexpected, it is extremely important to be prepared for a possible emergency. Proper preparation helps ensure safety and survival. A written emergency response or action plan is the best preparation tool for handling emergencies.

To ensure effectiveness, review and update emergency response plans regularly. Make sure that each response plan includes the following information:

- Procedure for sounding alarms
- Emergency escape procedures and escape route assignments
- Emergency procedures for employees with special needs
- Rescue and medical assistance requirements
- Names of persons or departments to contact for more information on handling emergencies
- Method for reporting emergencies
- Provision for training emergency procedures

Handling Emergencies

Regardless of the type of emergency in progress, you may call 911 and/or sound the fire alarm immediately. Remain calm, notify others, and respond to the emergency as appropriate. Do not attempt to handle any emergency situation in which you do not have training (e.g., firefighting, first aid, spill response, etc.).

IMPORTANT: Call 911 and/or pull the fire alarm whenever a situation poses immediate danger to people, property, or process.

When you call to report an emergency, provide the operator with the following information:

- Building or area name
- Location
- Brief description of the emergency
- Your name
- A return contact phone number

The following sections offer specific safety guidelines and procedures for handling different types of emergencies.

Bomb Threats

Bomb threats and other threats of violence are serious emergencies that required prompt attention. Although bomb threats are rare, they are most likely to occur during final exams. The following sections offer guidance for handling bomb threats.

How to Handle a Threatening Phone Call

If you receive a bomb threat over the phone, remain calm and act courteous. If feasible, notify another person to listen on another extension. Take notes on the caller's threat, tone, voice characteristics, and background noise. If the caller seems talkative, ask questions such as the following:

- When will the bomb go off?
- How much time remains?
- Where is the bomb located?
- What kind of bomb is it?
- How do you know about this bomb?
- What is your name?
- Do you know there are people in the building who could be hurt or killed?

IMPORTANT-If you receive a threatening phone call, remain calm and take notes. Try to find out as much as possible about the caller and threat.

The following Bomb Threat Information form is an example of sounds to note while the caller is on the phone.

LUPD Response to Bomb Threats

1. The LUPD regards all bomb threats as serious. After learning of a bomb threat, the UPD notifies the appropriate building official and asks him or her to notify key building personnel. Together, the building personnel and the LUPD search the building, including trash cans and restrooms, for anything “suspicious” or “out of the ordinary.” After interviewing the person who received the bomb threat, the UPD determines if the threat appears to be a hoax or an actual emergency.
2. The LUPD has the authority to evacuate a building if circumstances warrant this precaution. The building official may evacuate the building at his/her discretion based on the nature of the threat.
3. Building evacuations may be conducted by sounding the fire alarm. If a fire alarm is used in response to a bomb threat, the LUPD will advise the Fire Department.

Handling Suspicious-Looking Items

If you locate a suspicious-looking item, do not handle the item. Clear the area of personnel and notify the LUPD immediately. If necessary, the LUPD will call Beaumont Fire Department for Demolition Squad for assistance.

Bomb Threat Observations

For most bomb threats, the caller announces that a bomb is set to go off at a certain time and then hangs up. Because routine bomb threat evacuations may spawn numerous hoax calls, consider the following:

- Most intended explosions have no warning. Usually, after the bomb is detonated, a party claims credit and then explains why the bomb was set.

- In cases where an actual device is located, the caller usually provides specific information for finding the device before the detonation time.
- With few exceptions, bomb threats on campus are hoaxes designed to avoid or postpone an unpleasant task (e.g., exam).

University policy is to use restraint from evacuating buildings based on the following:

- A bomb that is set to detonate at a certain time is either a timed explosive device or a site-activated device. Both devices require considerable expertise to develop. Furthermore, a site activated device, such as a radio-controlled mechanism, must be activated in close proximity of the bomb.
- Unless a bomb contains a large amount of volatile explosive (e.g., C-4 plastic), damage will be limited to the immediate area of the detonation.

Emergency Power

Some buildings on campus provide automatic emergency power during electrical outages. The emergency power only supports essential life safety equipment such as elevators, corridor lighting, fire alarms, and exit lighting. Some new buildings have red emergency power outlets for essential equipment and machinery. Contact the Facilities Department to determine if other emergency outlets are available in your work area.

There are three types of emergency power sources:

- Portable generators
- Building generators
- Battery power packs

Contact the Facilities Department for more information on emergency power.

Evacuation Plans

Developing a Plan

Each department is responsible for developing a comprehensive plan for evacuations and fire drills. Consider the following when developing the plan:

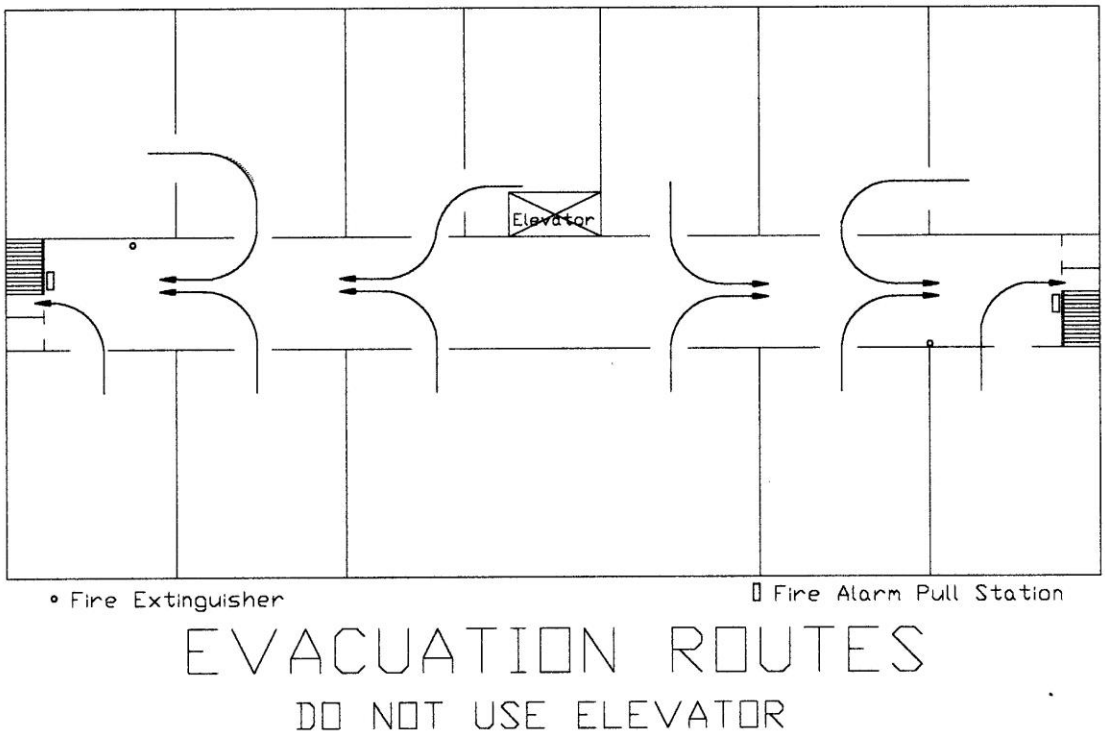
- Contact EHS/Risk Management for assistance in developing an evacuation plan for your building.
- Building evacuation routes or maps should provide accurate layout of the building and multiple exit routes from any location.
- These plans must be posted in prominently traveled areas (e.g., hallways, stairwells, dorm rooms, etc.). Unusual building layouts require more evacuation maps to be posted.
- Building floor plans used for evacuation plans are prepared by Facilities Operations.
- Special attention must be given to evacuation procedures for persons with disabilities. Even if no known building occupants have special needs, the evacuation plan must contain these provisions to ensure the safety of visitors or others with special needs.

- A preplanned meeting place for evacuated occupants should be at least 200 feet from the building and clear of fire hydrants and access roads.

Certain people on each floor should be responsible for the following:

1. Ensuring that persons on the floor are aware of an emergency and the need to evacuate
2. Ensuring that building evacuation routes are clearly posted in prominently traveled areas
3. Ensuring that new employees are familiar with evacuation and fire drill procedures

A written plan for emergencies and fire drills is essential for each major University building. Evacuation exercises are particularly important for student-residence facilities, high-rise buildings, patient treatment facilities, and daycare centers. Studies show that when occupants discuss, plan, implement, and practice evacuation plans, they are better able to protect themselves and others. The figure below shows a typical evacuation plan posted in University buildings.



Conducting Fire Exit Drills and Evacuations

To ensure that building occupants are prepared for an emergency evacuation, fire drills must be conducted periodically. A safe and orderly evacuation is more important than a quick evacuation.

Fire exit drills are only conducted by or under the direction of the Fire Safety Specialist for the Environmental Health, Safety & Risk Management office. When you schedule a drill, notify EHS/Risk Management, Facilities, and LUPD & Beaumont Fire Department

Before conducting a practice fire drill, the Fire Safety Specialist or his/her representatives will do the following:

- Notify UPD dispatch operator so they do not contact the local fire department.
- Department Heads are required to participate or observe the conduct of the drill.

Practice fire exit drills should proceed as follows:

- Fire drills should involve all occupants. Everyone should leave the building when the fire alarm sounds. A person may be exempt from a fire drill if it will cause un-do hardship (e.g., interrupt an experiment); however, exemptions are strongly discouraged.
- Occupants should close (not lock) doors as they leave the work area. Items that require security may be placed in a locking file cabinet or desk drawer on the way out.
- Department administrators should check all rooms and close doors on their way out.
- All building occupants should gather in the preplanned meeting place.
- Department administrators should take a “head count” to determine if all occupants have left the building.
- Upon completion of the drill, the Fire Safety Specialist completes a Fire Drill Checklist and forwards it to the affected department heads.

Emergency Medical Treatment

First Aid

First aid training is necessary to prevent and treat sudden illness or accidental injury. The primary objective of first aid is to save lives. This objective is achieved with the following:

- Preventing heavy blood loss
- Maintaining breathing
- Preventing further injury
- Preventing shock
- Getting the victim to a physician or Emergency Medical Service (EMS)

People who provide first aid must remember the following:

- Avoid panic.
- Inspire confidence.
- Do only what is necessary until professional help is obtained.

Student Health Center

The Student Health center is available to the staff and faculty for treatment of common (minor) injuries occurring in the course and scope of performing your duties. If medical treatment is necessary, contact your supervisor or Workmen's Comp Specialist to determine which local physician is authorized to handle work related injuries.

Call 911 from any telephone to obtain the EMS Service.

Initial First Aid

If you are the first one on the scene of a medical emergency, your first priority is to remain calm. Your action will vary depending upon the nature of the situation, but the following four rules apply to any medical emergency:

Assess the Situation:

1. Can you safely approach the victim? If not, what can you do to help without threatening your own safety?
2. Determine what is wrong with the victim.

Set Priorities:

- Is the victim conscious?
- How serious is the emergency?
- Can someone else call EMS, if necessary? If no one else is available, decide if it is more important to administer first aid immediately or to call EMS and leave the victim unattended.

NOTE: Never leave a victim in a life-threatening situation without first trying to help.

Snake Bites

Most snakebites are not fatal. If a snake bite occurs, follow these steps:

1. Have the victim move as little as possible.
2. Apply a constricting bandage (not a tourniquet) between the wound and the heart.
3. If possible, call EMS .In rural locations, transport the victim to the nearest hospital immediately. If necessary and possible, carry the victim to transportation. Do not let the victim walk.
4. If you cannot obtain medical attention:

    - Do not make any incisions or suck out the poison.
    - Do not cool the bitten area.
    - Every fifteen minutes, loosen the constricting bandage for a few seconds and then reapply it.

Spill Response

1. Shops, labs, and areas with hazardous chemicals should have spill clean-up supplies on hand. Call 8311 (LUPD) to report potential hazards from oil spills, fuel spills, chemical spills and other spills. LUPD will contact the Environmental Health, Safety & Risk Management Office and the Beaumont Fire Department. The Fire Department has an Emergency Response Team that is equipped and trained to handle spills.
2. See the Chemical Safety section for more information on chemical spill response procedures. See the Biological Safety section for more information pertaining to spills of biological materials. For spills of hazardous waste refer to procedures in the RCRA Contingency Plan and Emergency Response Procedures.

Spill Prevention Control & Countermeasure

The purpose of this Spill Prevention Control and Countermeasure (SPCC) is to describe measures implemented by Lamar University to prevent oil discharges from occurring.

- TxStateContingencyPlan10_2012 : Texas State Contingency Plan http://www.blr.com/Environmental/Emergency-Planning-Response/Contingency-Plan-in-Texas
- This plan describes the actions that University personnel will take in response to fires, explosions, or any planned or unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to air, soil, or surface water at the Container Accumulation Area (CAA).

Weather Emergencies

Weather emergency concerns for Central Texas primarily include high winds, heavy rains, lightning, flash flooding, and tornadoes. Because the city of San Marcos does not have an early warning system for weather emergencies, a weather emergency radio or Time Warner cable can be used to monitor changing weather conditions and act accordingly. The following sections provide general guidelines for handling various weather emergencies.

Heavy Rain/High Winds/Flash Flooding

Heavy rain and high winds provide dangerous driving conditions. Because flooding is a common problem in Central Texas, motorists should be aware of local weather conditions and avoid roads that tend to flood in heavy rains.

IMPORTANT: Do not drive in flooded areas or attempt to cross moving water in an automobile. Moving water can easily capsize a car or truck and drown the victim. Avoid creeks, low water crossings, rivers, ditches, and flooded roads during heavy rains. Keep children from playing in these areas during inclement weather.

High winds can topple trees, outdoor equipment, and electrical lines. Avoid downed power lines and notify the utility company of power outages. If an electrical line falls across your car, do not move the car or try to get out. Stay where you are until help arrives.

Lightning

Lightning is nature's worst destroyer. A typical lightning bolt contains several hundred million volts at 30,000 or more amperes.

- Lightning need not strike a person directly to be dangerous.
- Lightning can crash down from virtually clear sky.
- Stay away from open doors or windows during an electrical storm.
- Avoid using the telephone or television set and keep clear of all metal objects such as pipes and electrical appliances during a storm.
- Do not go outside.

If you find yourself caught in a storm away from a protected building:

- Avoid tree lines.

- Stay away from unprotected storm shelters.
- Stay away from flag poles, towers, and metal fences.
- Do not wade, swim, or go boating in a thunderstorm.
- A closed automobile provides a protective metal shell.
- If caught in the open, stay low.

Tornado

Tornadoes produce violent winds that can damage homes, vehicles, people, and wildlife. The primary dangers associated with tornadoes are high winds and flying debris. Severe thunderstorms and hail commonly precede a tornado. A dark funnel cloud or roaring noise (like a train) is evidence of an actual tornado.

A tornado watch is issued when weather conditions are ideal for a tornado to form. A tornado warning is issued when a tornado is actually identified in the immediate vicinity.

If a tornado warning is issued, seek shelter immediately. Stay away from windows, doors, and outside walls.

- Do not drive to shelter, unless you are already in a vehicle when the warning is issued. Drive to the nearest building or seek shelter in a ditch or ravine.
- Never try to outrun a tornado in your vehicle.
- If you are in a school, hospital, factory, shopping mall, or other public area, go to the designated shelter area. Interior halls on the lowest floors are usually best.
- If you are at a home or in a building, go to an interior room on the lowest level (e.g., bathroom, closet, hall, etc.). Get under a piece of sturdy furniture if possible.

Winter Weather

Even though extreme winter weather is uncommon in this area, people must still take special precautions to ensure safety. Wear appropriate clothing for local weather conditions and keep your vehicle in good working order. If the roads become slick with ice, use extreme caution or avoid driving.

- Slippery streets increase stopping distances. Drive slowly in winter weather.
- Choose shoes that provide the best footing for the weather.
- Clear walkways and steps of snow and ice.
- Use handrails where available.
- Clean snow and ice from all vehicle windows.

Hurricane

Because Lamar University – Beaumont, Texas is so close to inland, the main threat from a hurricane is heavy rains. Due to its location Southeast Texas is a common hurricane refuge for people from Beaumont, Lumberton, Groves, Port Neches, Nederland, Orange and other surrounding areas. (Refer to the Hurricane Manual) on the EHS/Risk Management web site.

End of Section

SECTION 9

PERSONAL PROTECTIVE EQUIPMENT

Personal Protective Equipment (PPE) includes all clothing and work accessories designed to protect employees from workplace hazards. Protective equipment should not replace engineering, administrative, or procedural controls for safety - it should be used in conjunction with these controls. Employees must wear protective equipment as required and when instructed by a supervisor.

IMPORTANT: Always remove protective clothing before leaving the work area. Do not wear PPE in public elevators, classrooms, restrooms, break rooms, etc.

The following sections provide general guidelines and requirements for using personal protective equipment.

1. Arm & Hand Protection
2. Body Protection
3. Ear & Hearing Protection
4. Eye & Face Protection
5. Eyewash Stations
6. Foot Protection
7. Head Protection
8. Respiratory Protection Program
9. Emergency Showers

Arm & Hand Protection

Arms and hands are vulnerable to cuts, burns, bruises, electrical shock, chemical spills, and amputation. The following forms of hand protection are available for employees:

- Disposable exam gloves
- Rubber gloves
- Nitrile gloves
- Neoprene gloves
- Leather gloves
- Non-asbestos heat-resistant gloves
- Metal-mesh gloves for meat cutters
- Cotton gloves

Always wear the appropriate hand and arm protection. Double your hand protection by wearing multiple gloves when necessary (e.g., two pairs of disposable gloves for work involving biological hazards). For arm protection, wear a long-sleeved shirt, a laboratory coat, chemical-resistant sleeves, or gauntlet-length gloves.

Follow these guidelines to ensure arm and hand safety:

- Inspect and test new gloves for defects.
- Always wash your hands before and after using gloves. Wash chemical-protective gloves with soap and water before removing them.
- Do not wear gloves near moving machinery; the gloves may become caught.
- Do not wear gloves with metal parts near electrical equipment.

IMPORTANT: Gloves are easily contaminated. Avoid touching surfaces such as telephones, door knobs, etc. when wearing gloves.

Body Protection

Hazards that threaten the torso tend to threaten the entire body. A variety of protective clothing, including:

- laboratory coats,
- long pants,
- rubber aprons,
- coveralls, and
- Disposable body suits are available for specific work conditions.
    - Rubber, neoprene, and plastic clothing protect employees from most acids and chemical splashes.
    - Laboratory coats, coveralls, and disposable body suits protect employees and everyday clothing from contamination.
    - Welding aprons provide protection from sparks.
    - Launder reusable protective clothing separate from other clothing.

Ear & Hearing Protection

If you work in a high noise area, wear hearing protection. Most hearing protection devices have an assigned rating that indicates the amount of protection provided. Depending on your level of exposure, you may choose from the following devices:

- Disposable earplugs
- Reusable earplugs
- Headband plugs
- Sealed earmuffs

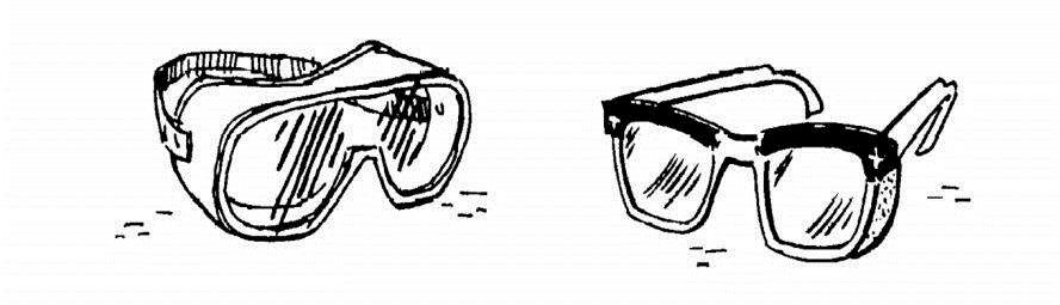
Earplugs may be better in hot, humid, or confined work areas. They may also be better for employees who wear other PPE, such as safety glasses or hats. Earmuffs, on the other hand, may be better for employees who move in and out of noisy areas, because the muffs are easier to remove. Before resorting to hearing protection, attempt to control noise levels through engineering or operational changes.

To avoid contamination, follow these guidelines when using earplugs:

- Wash your hands before inserting earplugs.
- Replace disposable earplugs after each use.
- Clean reusable earplugs after each use.

Eye & Face Protection

Employees must wear protection if hazards exist that could cause eye or face injury. Eye and face protection should be used in conjunction with equipment guards, engineering controls, and safe practices.



Eye Protection Examples

NOTE: Safety glasses are required in laboratories.

Always wear adequate eye and face protection when performing tasks such as grinding, buffing, welding, chipping, cutting, or pouring chemicals. Safety glasses with side shields provide protection against impact and splashes, but safety goggles provide protection against impact, splashes, and hazardous atmospheres.

IMPORTANT: Do not wear contact lenses in the laboratory or other areas where hazardous atmospheres may be present. Contact lenses do not provide eye protection and may reduce the effectiveness of an emergency eyewash.

- If you wear prescription glasses, wear goggles or other safety protection over the glasses.
- Safety glasses with side shields provide primary protection to eyes and are four times as resistant as prescription glasses to impact injuries.
- Goggles protect against impacts, sparks, chemical splashes, dust, and irritating mist. Wear full goggles, not just safety glasses, when working with chemicals.
- Eyecup welding goggles with filter lenses give protection from glare and sparks.
- A welding helmet protects from flash burn due to welding, soldering, or brazing, but does not provide primary eye protection; safety glasses or goggles should be worn with the helmet.
- A face shield is designed to protect the face from some splashes or projectiles, but does not eliminate exposure to vapors. A face shield should be worn with goggles or safety glasses.
- Sunglasses are useful to prevent eyestrain from glare and to minimize ultraviolet light exposure.

Eyewash Stations

Eye wash stations provide emergency eye treatment for people exposed to hazardous materials. There are three common types of eye wash stations:

- <u>Eye Wash Bowls:</u>
  These stations are ANSI approved and are usually attached to emergency showers. They provide a continuous water flow and are recommended for laboratories and other locations with hazardous materials.

- <u>Faucet Mount:</u>
  Faucet mount eyewash features twin spray heads with flow control and pop-off dust caps. Easily activated by an actuator pin on adapter. Faucet functions normally when pin is in closed position. Meets ANSI Z358.1-2004 standards.

- <u>Drench Hoses at Sinks:</u>
  These stations provide a continuous water flow, but they are easily contaminated with sediment, and they do not allow the free use of both hands; the use of both hands may be necessary. Drench hoses are not ANSI approved, and they are not preferred for laboratory usage. If you have a drench hose in your work area, flush the hose regularly to remove any sediment.

- <u>Plastic Eye Wash Bottles:</u>
  These stations do not provide a continuous water flow, and they do not allow free use of both hands. They are not approved in laboratories or other hazardous areas. Plastic eye wash bottles are ideal, however, for portable eye wash needs and short-term operations

where continuous flowing water is not immediately available. If you have a plastic eye wash bottle in your work area, make sure it is filled with sterile water or changed weekly.

IMPORTANT: If the eyes are exposed to hazardous materials or irritating elements, immediately flush the eyes with water for at least 15 minutes. Contact a physician, if necessary by dialing 911.

Foot Protection

To protect feet and legs from falling objects, moving machinery, sharp objects, hot materials, chemicals, or slippery surfaces, employees should wear closed-toed shoes, boots, foot guards, leggings, or safety shoes as appropriate. Safety shoes are designed to protect people from the most common causes of foot injuries - impact, compression, and puncture. Special foot protection is also available for protection against static electricity, sparks, live electricity, corrosive materials, and slipping.

NOTE: Foot protection is particularly important in laboratory, agricultural, and construction work.

IMPORTANT:
Do not wear sandals or open-toed shoes in laboratories, shops, or other potentially hazardous areas.

Head Protection

Accidents that cause head injuries are difficult to anticipate or control. If hazards exist that could cause head injury, employees should try to eliminate the hazards, but they should also wear head protection.

Safety hats protect the head from impact, penetration, and electrical shock. Head protection is necessary if you work where there is a risk of injury from moving, falling, or flying objects or if you work near high-voltage equipment.

Hard hats should be water resistant, flame resistant, and adjustable. Wear one of the following hard hats as appropriate for your work situation or one that is has all class ratings:

- Class A - General service, limited voltage protection
- Class B - Utility service, high-voltage protection
- Class C - Special service, no voltage protection

The class designation is found stamped within the inside of the hard hats.

Follow these guidelines for head safety:

- Check the shell and suspension of your head ware for damage before each use.
- Look for cracks, dents, gouges, chalky appearance, and torn or broken suspension threads. Discard damaged hats or replace broken parts with replacements from the original manufacturer.
- Discard any hat that has been struck or dropped from a great height, even if there is no apparent damage.

- Do not wear a hard hat backwards, unless this is necessary to accommodate other protective equipment (e.g., welders face shield).
- Do not paint the plastic shell of a hard hat or alter it in any way.

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- Do not paint the plastic shell of a hard hat or alter it in any way.
- Respiratory Protection Program

Lamar University uses engineering, administrative, and procedural controls to protect people from dangerous atmospheres, including harmful mists, smoke, vapors, and oxygen-deficient atmospheres. When these controls cannot provide adequate protection against harmful atmospheres, respiratory protection is necessary.

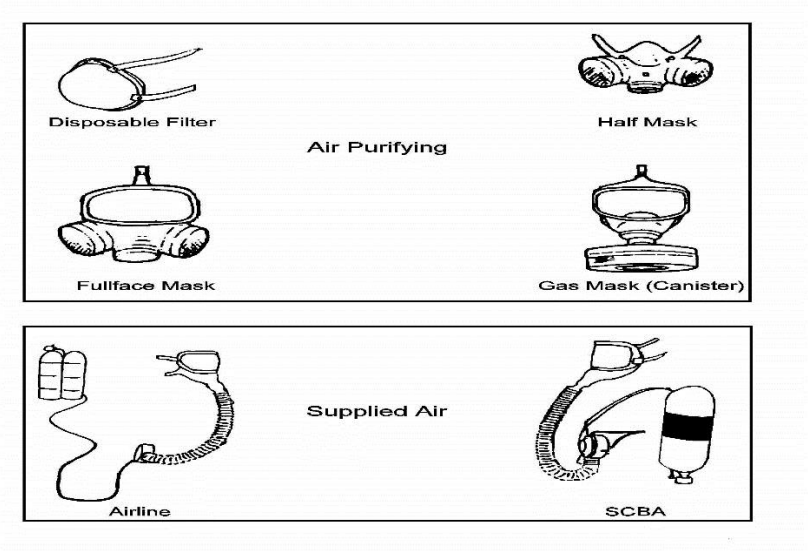
RESPIRATOR(S)

All employees who utilize respirators have to be trained and fit tested.

Usage Requirement

People who use respiratory protection must be physically capable of using and wearing the equipment. In most some cases, a physician must determine if an employee is healthy enough to use a respirator. In addition, all people required to wear respirators must be formally trained and instructed in proper equipment usage. This training should include instruction on common respiratory hazards and symptoms of exposure.

Types of Respirators



It is important to use only a particularly selected the right respirator for a specific job. There are many types of respirators and each type protects against different hazards at different levels. Respirators are classified according to these factors:

- Air source: supplied air or ambient air
- Pressure: positive or negative
- Mask configuration

The following lists information on various respirators:

- **Supply Air Respirators**:
  - Self-Contained Breathing Apparatus (SCBA's) use supplied air from a cylinder carried by the user.
  - Airline respirators require a compressor or cylinder(s) and an airline hose to the user.
  - Supply air respirators are necessary in oxygen deficient atmospheres.
  - When using a supply air respirator, have a back-up person with a SCBA standing nearby.

- **Air-Purifying Respirators**:
  - Air purifying respirators use ambient air and cannot be used in oxygen deficient atmospheres, immediately dangerous to life or health (IDLH) atmospheres, or areas where the identity or concentration of an airborne contaminant is unknown.
  - Ambient air is purified by a chemical cartridge, canister, or particulate filter.
  - Users must select the proper cartridge/canister/filter.
  - Cartridges and canisters must be replaced if the user notices an odor, taste, or throat irritation. Wet, damaged, and grossly contaminated cartridges/canisters must also be replaced.
  - Powered air- purifying respirators use filtered ambient air in a positive-pressure continuous flow mode.
  - Disposable or single-use respirators are made of cloth or paper and are primarily used for nuisance dusts or odors.
  - All filters (HEPA, dust pads, and disposable respirators) must be replaced if any of the following conditions occur: Breathing becomes difficult.
  - Filter or dust respirator becomes damaged, visibly dirty, wet, or contaminated on the inside.
  - Mask Types:
    - Full face mask covers the face from the hairline to below the chin. This type of mask provides eye protection.
    - Half-face mask covers the face from above the nose to below the chin.

The following table highlights various respirators and their ability to protect against different hazards:

RESPIRATOR TYPE	PROTECTION	NO PROTECTION
Filter Respirator (HEPA cartridge	Dust Fumes Smoke Mist Microorganisms Asbestos	Chemical vapors or gases Oxygen deficiency
Chemical Cartridge/Canister Respirators	Certain gases and vapors up to a particular concentration	Oxygen deficiency Particulate matter
Air Supply Respirator	Depending on type: – Particulates – Chemical vapors and gases – Oxygen deficiency	

Lamar University uses engineering, administrative, and procedural controls to protect people from dangerous Lamar University, including harmful mists, smoke, vapors, and oxygen-deficient atmospheres. When these controls cannot provide adequate protection against harmful atmospheres, respiratory protection is necessary.

The Facilities Department can provide training and fit testing for personnel who need respiratory protection. A copy of the Respiratory Protection Program is available on the EHS/Risk Management web site. .

Usage Requirements

People who use respiratory protection must be physically capable of using and wearing the equipment. In most some cases, a physician must determine if an employee is healthy enough to use a respirator. In addition, all people required to wear respirators must be formally trained and instructed in proper equipment usage. This training should include instruction on common respiratory hazards and symptoms of exposure.

Note: Only use respirators that are approved by NIOSH/MSHA or the Department of Interior-Bureau of Mines.

Selecting a Respirator

When selecting a respirator, consider the following factors are considered:

- Type of hazards
- Identity and concentration of the contaminant
- Time constraints
- Activity of the person wearing the respirator
- Degree of protection provided by each type of respirator

Follow these guidelines for selecting the correct respirator:

- Use a HEPA filtered respirator:
    - If the contaminant is a biological hazard or toxic contaminant in particulate form
- Use a supply air respirator:
    - If the identity and/or concentration of the contaminant is not known
    - If an oxygen deficient atmosphere is known or suspected
    - If an IDLH condition exists
- Use a SCBA instead of an airline respirator. If an airline respirator could be damaged by work or conditions within the area

IMPORTANT: Respirators are available in different types and sizes. Ensure you have selected the correct type and size of respirator for which you have been fit tested. Never replace with a different size or type of respirator.

Using Respirators Safely

Follow these guidelines to ensure safe respirator usage:

- Make sure you have the correct respirator for the job.
- Inspect respirators before each use.
- Shave facial hair and put in dentures (if applicable) to ensure a good seal with the facemask.
- If you are working in a dangerous area, have another person present.
- Remember that contaminants can harm the body as well as the respiratory tract; wear protective clothing as appropriate.
- Return to fresh air and remove the respirator in the following conditions: You feel nauseous, dizzy, or ill.
- You have difficulty breathing.

- The canister, cartridge, or filter needs to be replaced.
- Properly clean and store all reusable respirators.

In addition to the guidelines above, follow these instructions for respirator usage:

- Do not use a respirator unless you have been formally trained and have fit tested the respirator you plan on using?
- Do not mistakenly use a particulate or HEPA filtered respirator for protection against gases or vapors.
- Never remove a respirator in a contaminated atmosphere.
- Do not talk unnecessarily or chew gum while wearing a respirator.
- Do not wear contact lenses while wearing a respirator.
- Do not allow your hair or eyeglass frames to interfere with the face mask seal.

Emergency Showers

- Emergency safety showers provide emergency treatment for people exposed to harmful materials. If a person is contaminated with harmful chemicals, the emergency shower provides an instant deluge to protect the person from further exposure. Texas State University uses ANSI standards for shower locations, travel distance, testing, and function.
- Emergency showers must be located to ensure accessibility within 10 seconds.
- Travel distance between a shower and potential hazards may not exceed 100 feet.

IMPORTANT: Emergency showers are for emergencies only.

If a chemical spill occurs involving personal exposure, pull the cord and remove affected clothing immediately. Stay in the shower for at least 15 minutes. All laboratory personnel should keep a change of loose fitting clothing in the laboratory where they work, in the general vicinity of the emergency shower, should their lab coat and clothing become contaminated and must be removed.

End of Section

SECTION 10

LABORATORY SAFETY

Because laboratories involve numerous chemicals, procedures, and operations, they require extensive safety precautions. Laboratory safety involves chemical safety, fire safety, electrical safety, and other safety issues. Follow the guidelines in this section for general laboratory safety, but refer to other sections in this manual for specific information.

Common Laboratory Hazards

Because laboratories involve numerous chemicals, procedures, and operations, they require extensive safety precautions. Laboratory safety involves chemical safety, fire safety, electrical safety, and other safety issues. Follow the guidelines in this chapter for general laboratory safety, but refer to other chapters in this manual for specific information.

Examples of common hazards include the following:

- Chemical hazards: Toxins, corrosives, flammables, and reactives
- Biological hazards: Microbes, animals, plants, and genetically modified agents
- Radiation hazards: Ionizing and nonionizing radiation
- Physical hazards: Heating devices, noise, projectiles, fire, cold, etc.
- Electrical hazards: Fire and shock
- Mechanical hazards: Moving machinery
- Airborne hazardous materials: Vapors, dust, etc.
- Ergonomic factors: Standing, repetitive motion

Controlling Laboratory Hazards

Administrative and engineering controls can help minimize laboratory risks. However, safety conscious workers using good laboratory practices are the most important component of laboratory safety. The following factors are important for safe laboratory operations:

Adequate facilities:

- Proper ventilation
- Nonslip surfaces
- Hand washing facilities

Available and appropriate safety equipment:

- Personal protective equipment

Laboratory equipment

- Safety devices on laboratory equipment, machines, devices, and instruments

Appropriate emergency equipment:

- Fire extinguishers
- Emergency showers
- Eye wash stations

Appropriate procedures:

- Good housekeeping
- Personal hygiene (e.g., washing hands)

Knowledgeable workers:

- Experienced
- Trained

All laboratory rooms should be labeled with emergency contact information. If an incident occurs during off-hours, respondents need to know the names and telephone numbers of the people responsible for laboratory operations. Keep this information current and accurate. Emergency contact labels are available from EHSRM.

Properly trained and experienced workers have the greatest ability to control laboratory risks. By using good laboratory practices, workers can minimize hazards, exposure, contamination, and workplace accidents.

Safe Laboratory Practices

To ensure laboratory safety, follow safe laboratory practices, including the following:

- Know about the chemicals and hazards associated with your laboratory.
- Know what to do in different emergency situations.
- Know how to read and interpret MSDS's.
- Wear personal protective equipment, as appropriate.
- Follow safe practices for working with chemicals.
- Ice from a laboratory ice machine should not be used for human consumption.
- Ovens and refrigerators in the laboratory are exclusively for laboratory operations.
- No food for consumption is allowed in laboratories.
- Do not wear contact lenses around chemicals, fumes, dust particles, or other hazardous materials.
- Protect unattended operations from utility failures and other potential problems that could lead to overheating or other hazardous events.
- Avoid working alone in a laboratory.
- Avoid producing aerosols.
- Use extreme care when working with needles, blades, and glass.
- Do not eat, drink, or use tobacco products in the laboratory.
- Do not mouth pipet.
- Clean contaminated equipment and spills immediately. Avoid contaminating equipment with mercury.
- Clean mercury spills immediately. (Chronic exposure to mercury can result from a few drops left uncleaned.)
- Do not allow children in the laboratory. (It is a violation of state law for a child to be unattended in a place that presents a risk of harm.)
- Keep laboratory doors closed.
- Decontaminate all affected equipment.
- Avoid using dry ice in enclosed areas. (Dry ice can produce elevated carbon dioxide levels.)
- Dry ice mixed with isopropanol or ethanol may cause frostbite.
- Hallways, corridors, and exit ways must be kept clear. Do not locate (even temporarily) laboratory equipment or supplies in these areas.

IMPORTANT: Never underestimate the hazards associated with a laboratory. If you are unsure about what you are doing, get assistance. Do not use unfamiliar chemicals, equipment, or procedures alone.

Aerosol Production

The term "aerosol" refers to the physical state of liquid or solid particles suspended in air. Aerosols containing infectious agents and hazardous materials can pose a serious risk because:

- Small aerosol particles can readily penetrate and remain deep in the respiratory tract, if inhaled.
- Aerosols may remain suspended in the air for long periods of time.
- Aerosol particles can easily contaminate equipment, ventilation systems, and human skin.

The following equipment may produce aerosols:

- Centrifuge
- Blender
- Shaker
- Magnetic stirrer
- Sonicator
- Pipet
- Vortex mixer
- Syringe and needle
- Vacuum-sealed ampoule
- Grinder, mortar, and pestle
- Test tubes and culture tubes
- Heated inoculating loop
- Reparatory funnel

Follow these guidelines to eliminate or reduce the hazards associated with aerosols:

- Conduct procedures that may produce aerosols in a biological safety cabinet or a chemical fume hood.
- Keep tubes stoppered when vortexing or centrifuging.
- Allow aerosols to settle for one to five minutes before opening a centrifuge, blender, or tube.
- Place a cloth soaked with disinfectant over the work surface to kill any biohazardous agents.
- Slowly reconstitute or dilute the contents of an ampoule.
- When combining liquids, discharge the secondary material down the side of the container or as close to the surface of the primary liquid as possible.
- Avoid splattering by allowing inoculating loops or needles to cool before touching biological specimens.
- Use a mechanical pipetting device.

Centrifuges

Centrifuging presents the possibility of two serious hazards: mechanical failure and aerosols. The most common hazard associated with centrifuging is a broken tube. To ensure safety when operating a centrifuge, take precautions to ensure the following:

- Verify proper loading (accurate balancing)
- Safe operating speeds (do not exceed manufacturer recommendations)
- Safe stopping
- Complete removal of materials
- Proper cleanup
- Wear safety goggles/eyeglasses always

Follow these guidelines when working with a centrifuge:

- When loading the rotor, examine the tubes for signs of stress, and discard any tubes that are damaged.
- Inspect the inside of each tube cavity or bucket. Remove any glass or other debris from the rubber cushion.
- Ensure that the centrifuge has adequate shielding to guard against accidental flyaways.
- Use a centrifuge only if it has a disconnect switch that deactivates the rotor when the lid is open.
- Do not overfill a centrifuge tube to the point where the rim, cap, or cotton plug becomes wet.
- Always keep the lid closed during operation and shut down. Do not open the lid until the rotor is completely stopped.
- Do not brake the head rotation by hand.
- Do not use aluminum foil to cap a centrifuge tube. Foil may rupture or detach.
- When balancing the rotors, consider the tubes, buckets, adapters, inserts, and any added solution.
- Stop the rotor and discontinue operation if you notice anything abnormal such as a noise or vibration.
- Rotor heads, buckets, adapters, tubes, and plastic inserts must match.

Low-speed and small portable centrifuges that do not have aerosol-tight chambers may allow aerosols to escape. Use a safety bucket to prevent aerosols from escaping.

High-speed centrifuges pose additional hazards due to the higher stress and force applied to their rotors and tubes. In addition to the safety guidelines outlined above, follow these guidelines for high-speed centrifuges:

- Filter the air exhausted from the vacuum lines.
- Keep a record of rotor usage, in order to avoid the hazard of metal fatigue.
- Frequently inspect, clean, and dry rotors to prevent corrosion or other damage.
- Follow the manufacturers operating instructions exactly.

Compressed Gases

Compressed gases in the laboratory present chemical and physical hazards. If compressed gases are accidentally released, they may cause the following:

- Depleted oxygen atmosphere
- Fire
- Adverse health effects

Cylinders that are knocked over or dropped can be very dangerous and can cause serious injuries. If a valve is knocked off a compressed gas cylinder, the cylinder can become a lethal projectile. Because disposal of compressed gas cylinders is difficult and expensive, be sure to arrange a return agreement with suppliers prior to purchase.

IMPORTANT: Cylinders can travel through walls much like a torpedo travels through water. They can cause structural damage, severe injury, and death.

Follow these guidelines to ensure safe storage of gas cylinders:

- Secure all cylinders in racks, holders, or clamping devices. Fasten cylinders individually (not ganged) in a well-ventilated area.
- Do not rely on color to identify container contents. Check the label.
- Close valves, and release pressure on the regulators when cylinders are not in use.
- Minimize the number of hazardous gas cylinders in a laboratory.

Do not exceed the following:

- Three 10" x 50" flammable gas and/or oxygen cylinders, and
- Two 9" x 30" liquefied flammable gas cylinders, and
- 4" x 15" cylinders of severely toxic gases (e.g., arsine, chlorine, diborane, fluorine, hydrogen cyanide, methyl bromide, nitric oxide, phosgene).
- Keep heat, sparks, flames, and electrical circuits away from gas cylinders.
- Store cylinders of flammable and oxidizing agents at least 20 feet apart, or separate these items with a fire wall.
- Do not store gas cylinders in hallways or public areas.

When working with compressed gas cylinders, remember the following:

- Never move a gas cylinder unless the cylinder cap is in place and the cylinder is chained or otherwise secured to a cart.
- Do not move a cylinder by rolling it on its base.
- Only use regulators approved for the type of gas in the cylinder.
- Do not use adapters to interchange regulators.
- When opening a cylinder valve, follow these guidelines:
  - Direct the cylinder opening away from people.
  - Open the valve slowly.
- If a cylinder leaks, carefully move the cylinder to an open space outdoors. Have the supplier pick up the cylinder.
- Do not use oil or other lubricant on valves and fittings.
- Do not use oxygen as a substitute for compressed air.
- Do not lift cylinders by the cap.
- Do not tamper with the safety devices on a cylinder. Have the manufacturer or supplier handle cylinder repairs.
- Do not change a cylinder's label or color. Do not refill cylinders yourself.
- Do not heat cylinders to raise internal pressure.

- Do not use compressed gas to clean your skin or clothing.
- Do not completely empty cylinders. Maintain at least 30 psi.
- Do not use copper (>65% copper) connectors or tubing with acetylene. Acetylene can form explosive compounds with silver, copper, and mercury.
- Always wear impact resistant glasses or goggles when working with compressed gases.

Cryogenic Liquids

Cryogenic fluids, such as liquid air, liquid nitrogen, or liquid oxygen, are used to obtain extremely cold temperatures. Most cryogenic liquids are odorless, colorless, and tasteless when vaporized. When cryogenic liquids are exposed to the atmosphere, however, they create a highly visible and dense fog. All cryogens other than oxygen can displace breathable air and can cause asphyxiation. Cryogens can also cause frostbite on exposed skin and eye tissue.

Cryogens pose numerous hazards. For example, cryogenic vapors from liquid oxygen or liquid hydrogen may cause a fire or explosion if ignited. Materials that are normally noncombustible (e.g., carbon steel) may ignite if coated with an oxygen-rich condensate. Liquefied inert gases, such as liquid nitrogen or liquid helium, are capable of condensing atmospheric oxygen and causing oxygen entrapment or enrichment in unsuspected areas. Extremely cold metal surfaces are also capable of entrapping atmospheric oxygen. Additional hazards associated with cryogenic liquids include the following:

Cyrogenic Hazard Source	Hazard
Hydrogen, methane, and acetylene	Flammable gases
Oxygen	Increases the flammability of combustibles.
Liquefied inert gases	Possible oxygen entrapment
Extremely cold surfaces	Oxygen atmosphere may condense

Because the low temperatures of cryogenic liquids may affect material properties, take care to select equipment materials accordingly.

Follow these guidelines when working with cryogenic liquids:

- Before working with cryogenic liquids, acquire a thorough knowledge of cryogenic procedures,
- Equipment operation, safety devices, material properties, and protective equipment usage.
- Keep equipment and systems extremely clean.
- Avoid skin and eye contact with cryogenic liquids. Do not inhale cryogenic vapors.
- Pre-cool receiving vessels to avoid thermal shock and splashing.
- Use tongs to place and remove items in cryogenic liquid.
- When discharging cryogenic liquids, purge the line slowly. Only use transfer lines specifically designed for cryogenic liquids.
- Rubber and plastic may become very brittle in extreme cold. Handle these items carefully when removing them from cryogenic liquid.
- Store cryogenic liquids in double-walled, insulated containers (e.g., Dewar flasks).
- To protect yourself from broken glass if the container breaks or implodes, tape the exposed glass on
- cryogenic containers.

- Do not store cylinders of cryogenic liquids in hallways or other public areas.

IMPORTANT: Be aware of the tremendous expansion and threat of asphyxiation when a cryogenic liquid vaporizes at room temperature.

Electrophoresis

Electrophoresis equipment may be a major source of electrical hazard in the laboratory. The presence of high voltage and conductive fluid in this apparatus presents a potentially lethal combination.

Many people are unaware of the hazards associated with this apparatus; even a standard electrophoresis operating at 100 volts can deliver a lethal shock at 25 milliamps. In addition, even a slight leak in the device tank can result in a serious shock.

Protect yourself from the hazards of electrophoresis and electrical shock by taking these precautions:

- Inspect equipment before use:
    - Inspect power cords for frayed, cracked of dried out cords.
    - Discard and replace all cords that do not pass the inspection.
    - Inspect gaskets on vertical electrophoresis chambers to ensure they are not leaking.
    - Inspect the electrophoresis chamber for buffer leaks, caused by crazing or cracks in the plastic.
    - Inspect the safety guards to ensure proper function, including no load sensors, open load sensors, and ground leakage detectors on the power supply and safety interlocks cover.
    - Use physical barriers to prevent inadvertent contact with the apparatus
    - Use electrical interlocks.
    - Frequently check the physical integrity of the electrophoresis equipment.
    - Use warning signs to alert others of the potential electrical hazard.
    - Use only insulated lead connectors.
    - Turn the power off before connecting the electrical leads.
    - Connect one lead at a time using one hand only.
    - Ensure that your hands are dry when connecting the leads.
    - Keep the apparatus away from water and water sources.
    - Turn the power off before opening the lid or reaching into the chamber.
    - Do not disable safety devices.
    - Follow the equipment operating instructions.

Glassware

Accidents involving glassware are the leading cause of laboratory injuries. To reduce the chance of cuts or punctures, use common sense when working with glassware. In addition, follow special safety precautions for tasks that involve unusual risks.

Follow these practices for using laboratory glassware safely:

- Prevent damage to glassware during handling and storage.
- Inspect glassware before and after each use. Discard or repair any cracked, broken, or damaged glassware.
- Thoroughly clean and decontaminate glassware after each use.
- When inserting glass tubing into rubber stoppers, corks, or tubing, follow these guidelines:
  - Use adequate hand protection.
  - Lubricate the tubing.
  - Hold hands close together to minimize movement if the glass breaks.
- When possible, substitute plastic or metal connectors for glass connectors.
- Large glass containers are highly susceptible to thermal shock. Heat and cool large glass containers slowly.
- Use Pyrex or heat-treated glass for heating operations.
- Leave at least 10 percent air space in containers with positive closures.
- Never use laboratory glassware to serve food or drinks.
- Use thick-walled glassware for vacuum operation.
- Use round-bottomed glassware for vacuum operations. Flat-bottomed glassware is not as strong as round-bottomed glassware.

NOTE:
Do not use chromic acid to clean glassware. Use a standard laboratory detergent. Chromic acid is extremely corrosive and expensive to dispose of. Chromic acid must not be disposed in the sanitary sewer system.

Follow these safety guidelines for handling glassware:

- When handling cool flasks, grasp the neck with one hand and support the bottom with the other hand.
- Lift cool beakers by grasping the sides just below the rim. For large beakers, use two hands: one on the side and one supporting the bottom.
- Never carry bottles by their necks.
- Use a cart to transport large bottles of dense liquid.

Follow these guidelines for handling and disposing of broken glass:

- Do not pick up broken glass with bare or unprotected hands. Use a brush and dustpan to clean up broken glass. Remove broken glass in sinks by using tongs for large pieces and cotton held by tongs for small pieces and slivers.
- Glass contaminated with biological, chemical, or radioactive materials must be decontaminated before disposal or be disposed of as hazardous waste.
- Dispose of broken glass in designated cardboard boxes marked "Broken Glass."
- Contact your department lab services technician or EHSRM for additional boxes and thick gauge bags.
- When boxes are about 3/4 full, close the bag and tape the box closed. The box can then be safely disposed of in the dumpster. Each lab is responsible for disposal.

Heating Systems

Devices that supply heat for reactions or separations include the following:

- Open flame burners
- Hot plates
- Heating mantles
- Oil and air baths
- Hot air guns
- Ovens
- Furnaces
- Ashing systems

Some laboratory heating procedures involve an open flame. Common hazards associated with laboratory heating devices include electrical hazards, fire hazards, and hot surfaces.

Follow these guidelines when using heating devices:

- Before using any electrical heating device, follow these guidelines:
  - Ensure that heating units have an automatic shutoff to protect against overheating.
  - Ensure that heating devices and all connecting components are in good working condition.
- Heated chemicals can cause more damage and more quickly than would the same chemicals at a lower temperature.
- Heating baths should be equipped with timers to ensure that they turn on and off at appropriate times.
- Use a chemical fume hood when heating flammable or combustible solvents. Arrange the equipment so that escaping vapors do not contact heated or sparking surfaces.
- Use non-asbestos thermal-heat resistant gloves to handle heated materials and equipment.
- Perchloric acid digestions must be conducted in a perchloric fume hood.
- Minimize the use of open flames.

RULE OF THUMB:

Reaction rates double for each 10° C increase in temperature.

IMPORTANT: Never leave an open flame unattended.

Pressurized Systems

Do not conduct a reaction in, or apply heat to, a closed system apparatus unless the equipment is designed and tested to withstand pressure.

Pressurized systems should have an appropriate relief valve.

Pressurized systems must be fully shielded and should not be conducted in an occupied space until safe operation has been assured. Until safe operation is assured, remote operation is mandatory.

Safety points to remember:

- Minimize risk and exposure.
- Identify and assess all hazards and consequences.
- Use remote manipulations whenever possible.
- Minimize pressure, volume, and temperature.
- Design conservatively.
- Use material with a predictably safe failure mode.
- Ensure that the components of the pressurized system will maintain structural integrity at the maximum allowable working pressure. Avoid material that may become brittle.
- Operate within the original design parameters.
- Provide backup protection (e.g., pressure relief valves, fail-safe devices).
- Use quality hardware.
- Use protective shield or enclosures.
- Use tie-downs to secure tubing and other equipment.
- Do not leave a pressurized system unattended.

IMPORTANT: Normally pressurized systems should not include glass components unless they are specially designed and intended for that purpose.

Refrigerators & Freezers

Using a household refrigerator to store laboratory chemicals is extremely hazardous for several reasons. Many flammable solvents are still volatile at refrigerator temperatures. Refrigerator temperatures are typically higher than the flashpoint of most flammable liquids. In addition, the storage compartment of a household refrigerator contains numerous ignition sources including thermostats, light switches, and heater strips. Furthermore, the compressor and electrical circuits, located at the bottom of the unit where chemical vapors are likely to accumulate, are not sealed.

Laboratory-safe and explosion-proof refrigerators typically provide adequate protection for chemical storage in the laboratory. Laboratory-safe refrigerators, for example, are specifically designed for use with flammables since the sparking components are located on the exterior of the refrigerator. Explosion-proof refrigerators are required in areas that may contain high levels of flammable vapors (e.g., chemical storage rooms with large quantities of flammables).

Follow these rules for using refrigerators in the laboratory:

- Never store flammable chemicals in a household refrigerator.
- Do not store food or drink in a laboratory refrigerator/freezer.
- Ensure that all refrigerators are clearly labeled to indicate suitable usage.
- Laboratory-safe and explosion-proof refrigerators should be identified by a manufacturer label.
- Refrigerators used to hold food should be labeled "For Food Only" and should not be in the laboratory.
- Old refrigerators will be picked up by Materials Management.

Vacuum Systems

Vacuum systems pose severe implosion hazards. Follow these guidelines and requirements to ensure system safety:

- Ensure that pumps have belt guards in place during operation.
- Ensure that service cords and switches are free from defects.
- Always use a trap on vacuum lines to prevent liquids from being drawn into the pump, house vacuum line, or water drain.
- Replace and properly dispose of vacuum pump oil that is contaminated with condensate. Used pump oil must be disposed as hazardous waste.
- Place a pan under pumps to catch oil drips.
- Do not operate pumps near containers of flammable chemicals.
- Do not place pumps in an enclosed, unventilated cabinet.

IMPORTANT: All vacuum equipment is subject to possible implosion. Conduct all vacuum operations behind a table shield or in a fume hood.

¡CAUTION!
Do not underestimate the pressure differential across the walls of glassware that can be created by a water aspirator.

The glassware used with vacuum operations must meet the following requirements:

- Only heavy-walled round-bottomed glassware should be used for vacuum operations. The only exception to this rule is glassware specifically designed for vacuum operations, such as an Erlenmeyer filtration flask.
- Wrap exposed glass with tape to prevent flying glass if an implosion occurs.
- Carefully inspect vacuum glassware before and after each use. Discard any glass that is chipped, scratched, broken, or otherwise stressed.

Glass desiccators often have a slight vacuum due to contents cooling. When using desiccators, follow these guidelines:

- When possible, use molded plastic desiccators with high tensile strength.
- For glass desiccators, use a perforated metal desiccator guard.

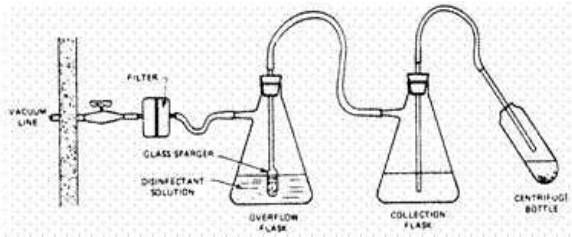
Cold Trap

A cold trap is a condensing device to prevent moisture contamination in a vacuum line. Guidelines for using a cold trap include:

- Locate the cold trap between the system and vacuum pump.
- Ensure that the cold trap is of sufficient size and cold enough to condense vapors present in the system.
- Check frequently for blockages in the cold trap.
- Use isopropanol/dry ice or ethanol/dry ice instead of acetone/dry ice to create a cold trap. Isopropanol and ethanol are cheaper, less toxic, and less prone to foam.
- Do not use dry ice or liquefied gas refrigerant bath as a closed system. These can create uncontrolled and dangerously high pressures.

Disinfectant Trap

A disinfectant trap should be used in-line when a vacuum is used with hazardous biological materials. The diagram below illustrates a suitable disinfectant trap assembly.



Disinfectant Trap System

Laboratory Safety Inspection Procedure and Checklist

Purpose: To anticipate, recognize, evaluate and control potentially hazardous conditions in the university's teaching and research laboratories.

Code Compliance:

- 29 Code of Federal Regulations 1910.1200 - Hazard Communication Standard
- 29 Code of Federal Regulations 1910.1450 - Standard for Laboratories Using Chemicals
- NFPA 45 - Standard on Fire Protection for Laboratories Using Chemicals
- NFPA 101 – Life Safety Code
- ANSI Z358.1 – Standard for Emergency Eyewash and Shower Equipment
- UPPS 04.05.15, 05.02f – Texas State University Hazard Communication Policy
- UPPS 04.05.15, 05.02c - Texas State University Safety Manual Section 10, Laboratory Safety section 10.1 D

Chemical Safety Inspection Report: The primary tool for accomplishing the stated purpose is the Laboratory Inspection Checklist, which will be completed by the Office of Environmental Health, Safety and Risk Management (EHS&RM), safety specialist(s) under the direction of the Director and Assistant Director of EHS&RM. This evaluation record contains 34 individual check points, and can be revised as needed or regulatory requirements dictate. The checklist is used to record data gathered during the inspection process or for data entry into the EHS&RM's electronic database, which is used to store the data, generate laboratory inspection reports, as well as any other statistical analysis reports.

Lab Inspection Frequency

1. All labs, current and future, known to be in existence by EHS&RM will be subject to a lab safety inspection at least once a year.
2. Frequency of inspections for each lab will be based on the presence or absence of high hazard chemicals. High hazard chemicals are defined as those that are found on EHS&RM's "Make No Entry" chemical spill response list. Presence or absence of high hazard chemicals will be determined by a review of each lab's most recent chemical inventory on file at EHS&RM office.
3. Labs will be inspected either:

- Quarterly
- Labs that possess high hazard chemicals will be inspected every three months.
- Semi-annual
- Labs that do not possess high hazard chemicals will be inspected every six months. Annual
- Labs that have been recognized as a “Rising Star Lab” for two consecutive inspections will be eligible to be inspected once a year.

4. A change in lab inspection frequency may occur due to:
   - Review of most recent chemical inventory.
   - Discovery of new chemicals during an inspection.
   - Being recognized as a “Rising Star Lab”.

5. For new labs the frequency of inspections will be determined through the “Lab Check- In” procedure conducted by EHS&RM staff.

6. **Lab Inspection Notification**
   1. Each lab Principle Investigator (PI) will be notified by e-mail one week before the month that inspections are to take place.
   2. E-mail message will include the following information:

      - An invitation to set an appointment for the PI or lab representative to attend the inspection.
      - Information detailing what the inspector will be looking for.
      - Information as to how safety issues are reported to the PI and how, if needed, enforcement action will take place.

   3. If PI does not reply to notification within 2 working days, inspection will take place at a time chosen by the inspector.
   4. If no response to notification is received. It is acknowledged that the PI understands that an inspector will be in the lab conducting the inspection at a time of the inspector’s convenience.

Lab Inspection Checklist

See appendix A. at end of document.

1. Notification of inspection results with infractions will be sent to the PI via e-mail within 5 business days from the date of inspection, this time frame may vary as needed.
2. If a lab has an infraction the e-mail sent to the PI will have an attached inspection report detailing the circumstances of the infraction and the action (as well as time frame) that needs to be taken to correct the issue.
3. In an effort to ensure that a PI has received the e-mail with the report, the delivery receipt and read receipt options of e-mail program (Microsoft Outlook) will be utilized

Correction of Lab Safety Issues

1. A lab that has an infraction will have 5 working days after receiving the inspection report to correct the infraction. If it is deemed to require more than five business days, progress must be shown towards correcting the issue or an action plan to resolve the issue must be submitted to EHS&RM.

2. If at any point the lab needs assistance with resolving an issue EHS&RM will provide assistance and any needed supplies as can be provided.

Enforcement Action of Uncorrected Safety Issues

If a lab has not corrected an issue or shown progress toward correction after 5 business days (from original notification) as noted by a re-inspection, the PI and the chairman of the department will be notified, **this time frame may vary. ****

If a lab has not corrected an issue or shown progress toward correction after 10 business days (from original notification) the director of EHS&RM will be notified for approval to forward the infraction report to the Dean.

If a lab has not corrected an issue or shown progress toward correction at 15 business days (from original notification) and approval was received by the director of EHS&RM, the Dean will be notified. The PI and the chairman of the department will also be notified.
If a lab has not corrected an issue or shown progress toward correction after 20 business days (from original notification) "The Indifference Clause" may be enacted by the director of EHS&RM.
** Depending on hazard risk, it is at the inspector's discretion to move an infraction forward in the enforcement process.

"The Indifference Clause"

With uncorrected issues EHS&RM reserves the right to isolate the hazards in the lab that have not been addressed after they have been reported to the PI., department chair, Dean, etc.… These isolation measures must stay in place until such time as the safety deficiency has been corrected or a written remediation plan that is acceptable to the Director of EHS&RM and has been put into action.

If it is absolutely necessary for the lab to continue to operate in the presence of the identified hazard(s) then written authorization signed by the Dean or his/her designee must be displayed in the lab and a copy provided to EHS&RM. The authorization must identify the hazards so that personnel entering the lab will be aware of the unsafe conditions.

Immediately Dangerous to Life & Health

1. If the inspector deems a safety issue a risk of immediate danger to life, health or facilities (i.e. chemical containers in distress, unsecured gas cylinders, etc.), the inspector, if conducting inspection, will attempt to contact the PI or associates to safely resolve the issue.
2. If the PI/associate cannot be found or issue requires specialized assistance, the inspector will contact as well as Director of EHS&RM and work to secure the area until assistance arrives.

Disputed Lab Safety Issues

If a PI disputes a safety issue and the dispute cannot be resolved though discussion with the inspector and/or the Director of EHS&RM along with chair of the department, the matter will be forwarded to the appropriate Texas State University safety committee for resolution.

“Rising Star” Lab Recognition Program

1) “Rising Star Labs”, are labs that show a high level of management in not only chemical safety, but other aspects of safety (hazardous waste management, office safety, electrical safety, etc.).
2) To be recognized as a “Rising Star” laboratory a lab must:

- Pass lab safety inspection (semi-annual or quarterly) with no safety issues being reported.
- Be free of any other safety issues that are not covered by the inspection checklist (i.e. accumulation of boxes, broken/unused equipment, etc…).
- The lab inspector has the option to get the opinion of other EHS&RM staff as to whether a lab qualifies as a “Rising Star” lab.

3) Labs that are rated as “Rising Star” labs may be recognized/rewarded by:

- Having lab inspections occur only once a year.
- A marker/poster to be placed outside the main entrance of the lab.
- A certificate of acknowledgement from office of EHS&RM for each member of the lab involved with the managing that area
- Other means that may become available to EHS&RM (i.e. EHS&RM newsletter, university/department web page, etc.).

Definitions

Principle Investigator (PI): is the primary contact in charge of a laboratory/work area. PI is an individual considered to be a faculty member/professor.

Lab Manager/Lab Coordinator: is the primary contact in charge of a laboratory/work area(s). Lab Manager/Lab Coordinator may or may not be a faulty member/professor.

Appendix A: Laboratory Inspection Checklist

The checklist is based on observations made by the specialist during the day of the inspection and should not be relied upon as an exhaustive record of all possible risks or hazards that may exist or potential improvements that can be made. Any unsafe condition noted in a laboratory environment can and will be reported.

1. Unlocked Lab (Item of Concern): Lock laboratory doors when no one is present to secure hazardous materials and equipment.
2. Permanent Use of Extension Cords: Extension cords are for temporary use only (no more than 8 hours per day). Replace with fuse-protected power strip or permanent wiring. To have permanent wiring installed, submit request through Work Orders.
3. Extension cords/power strips connected in series: Extension cords and power strips should be plugged directly into wall receptacle, not “daisy-chained” or connected in a series.

4. Blocked sprinkler head: Remove all items stored within the 18” plane below the level of the sprinkler heads, throughout the room.
5. Missing/damaged ceiling tiles: Submit request for a Work Order through AiM system to replace missing/damaged ceiling tiles.
6. Food/drink in lab (Deficiency): Food and beverages may not be consumed, stored, or prepared in lab areas. Post a 'NO FOOD and DRINKS ALLOWED' sign on the door to the lab or inside the lab.
7. Food/drink in lab refrigerator/freezer: Food/beverages and chemicals may not be stored in the same refrigerator or freezer. Rather, store food and drink in an area outside of the lab.
8. 8. Sharps are being disposed in sharps box.
9. 9. Lab countertops are free of clutter i.e. chemicals, unused equipment, boxes, trash, etc
10. Improperly secured gas cylinder: Properly secure compressed gas cylinder(s) with a device designed for such use. Ropes and bungee cords are not permitted for securing cylinders.
11. Gas cylinder missing safety cap: Apply safety cap to cylinders when not in use.
12. Vacuum pump missing guard: Replace the belt and pulley guard that is missing from the vacuum pump.
13. Clutter in fume hood: Fume hood should be clear of any clutter, including loose paper (paper towels, Kim wipes, notebook paper). Remove chemicals stored in fume hood and return them to chemical storage cabinets
14. Fume hood sash left up: Pull fume hood sash down completely when the hood is unattended. Pull down to lowest working level when working in the hood.
15. Blocked emergency shower and or eyewash: Remove obstruction(s) blocking emergency shower to ensure clear access to this safety equipment.
16. There are no liquids being stored above eye level. Ok if approved step stool is present.
17. Chemicals on floor: Do not store chemicals directly on the floor. Rather, store them in approved cabinets or in secondary containers large enough to hold the entire contents of the bottle in case of a spill.
18. Excessive flammables outside of flammable cabinet: Store flammable chemicals in excess of 10 gallons in a flammable storage cabinet.
19. Flammables in household-style refrigerator/freezer: Flammable chemicals needing refrigeration must be kept in a Lab-safe refrigerator/freezer (that is, safe for flammable storage).
20. Flammable chemicals may not be kept in a household style or commercial refrigerator/freezer or in a walk-in cooler.
21. Old non-time sensitive chemicals: Noted non-time sensitive chemicals older than 6 years in the lab. Periodically review chemical inventory. Dispose of old chemicals that are no longer used
22. Peroxide forming chemicals out of date: Explosive peroxide forming chemicals and oxidants such as ethyl ether, tetrahydrofuran (THF), perchloric acid, cyclohexene, butadiene, isopropyl ether and dioxanes must be used within 1 year of purchase or 6 months after opening and must be disposed of before the expiration date. Tag these chemicals for disposal immediately if past these time constraints.
23. Peroxide forming chemicals have date received and date opened written on label.
24. Damaged chemical container: Repackage or dispose of chemicals in deteriorated containers.

25. Unsegregated chemicals: Segregate chemicals by hazard class (flammable, corrosive, oxidizer, reactive, toxic). Recommend using Globally Harmonized System pictographs on chemical containers to quickly identify the hazard class.
26. Broken glass box is not overfilled.
27. Labels on primary containers in good condition.
28. Secondary containers are properly labeled
29. Emergency contact sign is posted
    "Right to Know" sign is posted
30. MSDS / SDS are present or sign stating where they may be found is posted
    General housekeeping, lab is free of clutter i.e. old equipment, empty boxes, etc…
    Chemical Hygiene Plan and or Lab Safety Plan present.
    Training records present (Hazard Communication, Hazardous Waste, etc.…)

End of Section

SECTION 11

BIOLOGICAL SAFETY

Biological safety guidelines and procedures. The following topics are covered.

Biosafety Principle

The primary principle of biological safety (i.e., biosafety) is containment. The term containment refers to a series of safe methods for managing infectious agents in the laboratory. The purpose of containment is to reduce or eliminate human and environmental exposure to potentially harmful agents.

Primary and Secondary Containment

There are two levels of biological containment — primary and secondary. Primary containment protects people and the immediate laboratory environment from exposure to infectious agents. Good microbial techniques and safety equipment provide sufficient primary containment. Examples of primary barriers include safety equipment such as biological safety cabinets, enclosed containers, and safety centrifuge cups. Occasionally, when it is impractical to work in biological safety cabinets, personal protective equipment, such as lab coats and gloves may act as the primary barrier between personnel and infectious materials.

Secondary containment protects the environment external to the laboratory from exposure to infectious materials. Good facility design and operational practices provide secondary containment. Examples of secondary barriers include work areas that are separate from public areas, decontamination facilities, and hand washing facilities, special ventilation systems, and airlocks.

Elements of Containment

Ultimately, the three key elements of biological containment are laboratory practices, safety equipment, and facility design. To ensure minimal exposure, employees must assess the hazards associated with their work and determine how to apply the biosafety principle appropriately.

IMPORTANT: Employees working with infectious agents or potentially infectious materials must be aware of the hazards associated with their work. These workers must be trained and proficient in biosafety procedures and techniques.

General Biosafety Guidelines

Biohazardous materials require special safety precautions and procedures. Follow these guidelines when working with infectious agents:

Personal Hygiene Guidelines

- Wash your hands thoroughly, as indicated below:
    - After working with any biohazard
    - After removing gloves, laboratory coat, and other contaminated protective clothing
    - Before eating, drinking, smoking, or applying cosmetics
    - Before leaving the laboratory area
- Do not touch your face when handling biological material.
- Never eat, drink, smoke, or apply cosmetics in the work area.

Clothing Guidelines

- Always wear a wrap-around gown or scrub suit, gloves, and a surgical mask when working with infectious agents or infected animals.
- Wear gloves over gown cuffs.
- Never wear contact lenses around infectious agents.
- Do not wear potentially contaminated clothing outside the laboratory area.
- To remove contaminated clothing, follow these steps:
- Remove booties from the back.
- Remove head covering from the peak.
- Untie gown while wearing gloves.
- Remove gloves by peeling them from the inside out.
- Remove the gown by slipping your finger under the sleeve cuff of the gown.

Handling Procedures

- Use mechanical pipetting devices.
- Minimize aerosol production.
- Add disinfectant to water baths for infectious substances.
- Use trunnion cups with screw caps for centrifuging procedures. Inspect the tubes before use.
- Use secondary leak-proof containers when transporting samples, cultures, inoculated petri dishes, and other containers of biohazardous materials.

Syringes

Avoid using syringes and needles whenever possible. If a syringe is necessary, minimize your chances of exposure by following these guidelines:

- Use a needle-locking or disposable needle unit.
- Take care not to stick yourself with a used needle.
- Place used syringes into a pan of disinfectant without removing the needles.
- Do not place used syringes in pans containing pipets or other glassware that require sorting.
- Do not recap used needles.
- Dispose of needles in an approved sharps container.

Work Area

- Keep laboratory doors shut when experiments are in progress.
- Limit access to laboratory areas when experiments involve biohazardous agents.
- Ensure that warning signs are posted on laboratory doors. These signs should include the universal biohazard symbol and the approved biosafety level for the laboratory.
- Ensure that vacuum lines have a suitable filter trap.
- Decontaminate work surfaces daily and after each spill.
- Decontaminate all potentially contaminated equipment.
- Transport contaminated materials in leak-proof containers.
- Keep miscellaneous material (i.e., books, journals, etc.) away from contaminated areas.
- Completely decontaminate equipment before having maintenance or repair work done.

Universal Precautions

Clinical and diagnostic laboratories often handle specimens without full knowledge of the material's diagnosis; these specimens may contain infectious agents. To minimize exposure, observe universal precautions when handling any biological specimen. Consider all specimens to be infectious and treat these materials as potentially hazardous.

CDC & NIH Biosafety Levels

The Centers for Disease Control (CDC) and the National Institutes of Health (NIH) have established four biosafety levels consisting of recommended laboratory practices, safety equipment, and facilities for various types of infectious agents. Each biosafety level accounts for the following:

- Operations to be performed
- Known and suspected routes of transmission
- Laboratory function

The following sections discuss the Biosafety Levels:

Biosafety Level 1

Biosafety Level 1 precautions are appropriate for facilities that work with defined and characterized strains of viable organisms that do not cause disease in healthy adult humans (e.g., Bacillus subtilis and Naegleria gruberi). Level 1 precautions rely on standard microbial practices without special primary or secondary barriers. Biosafety Level 1 criteria are suitable for undergraduate and secondary education laboratories.

Biosafety Level 2

Biosafety Level 2 precautions are appropriate for facilities that work with a broad range of indigenous moderate-risk agents known to cause human disease (e.g., Hepatitis B virus, salmonellae, and Toxoplasma spp.). Level 2 precautions are necessary when working with human blood, body fluids, or tissues where the presence of an infectious agent is unknown. The primary hazards associated with level 2 agents are injection and ingestion. Most Texas State University research laboratories should comply with Biosafety Level 2 criteria.

Biosafety Level 3

Biosafety Level 3 precautions apply to facilities that work with indigenous or exotic agents with the potential for aerosol transmission and lethal infection (e.g., Mycobacterium tuberculosis). The primary hazards associated with level 3 agents are autoinoculation, ingestion, and inhalation. Level 3 precautions emphasize primary and secondary barriers. For primary protection, all laboratory manipulations should be performed in biological safety cabinet or other enclosed equipment. Secondary protection should include controlled access to the laboratory and a specialized ventilation system.

Biosafety Level 4

Biosafety Level 4 precautions are essential for facilities that work with dangerous and exotic agents with a high risk of causing life-threatening disease, the possibility of aerosol transmission, and no known vaccine or therapy (e.g., Marburg or Congo-Crimean viruses). Level 4 agents require complete isolation. Class III biological safety cabinets or full-body air-supplied positive-pressure safety suits are necessary when working with level 4 agents. In addition, isolated facilities, specialized ventilation, and waste management systems are required. There are no Biosafety Level 4 facilities at Texas State University.

Animal Biosafety

Four biosafety levels are also described for infectious disease work with laboratory animals. Animal Biosafety Levels 1, 2, 3, and 4 designate safety practices, equipment, and facilities.

Refer to the Laboratory Safety chapter for more information regarding the use of hazardous materials with laboratory research animals.

Disinfection & Sterilization

ALCOHOLS	Ethyl or isopropyl alcohol at 70-80% concentration is a good general purpose disinfectant; not effective against bacterial spores.
PHENOLS	Effective against vegetative bacteria, fungi, and viruses containing lipids; unpleasant odor.
FORMALDEHYDE	Concentration of 5-8% formalin is a good disinfectant against vegetative bacteria, spores, and viruses; known carcinogen; irritating odor.
QUATERNARY AMMONIUM COMPOUNDS	Cationic detergents are strongly surface active; extremely effective against lipoviruses; ineffective against bacterial spores; may be neutralized by anionic detergents (i.e., soaps).
CHLORINE	Low concentrations (50-500 ppm) are active against vegetative bacteria and most viruses; higher concentrations (2,500 ppm) are required for bacterial spores; corrosive to metal surfaces; must be prepared fresh; laundry bleach (5.25% chlorine) may be diluted and used as a disinfectant.
IODINE	Recommended for general use; effective against vegetative bacteria and viruses; less effective against bacterial spores; Wescodyne diluted 1 to 10 is a popular disinfectant for washing hands.

Biological safety depends on proper cleanup and removal of potentially harmful agents. Disinfection and sterilization are two ways to help ensure biological safety in the laboratory.

- Disinfection: Reduction of the number of pathogenic organisms by the direct application of physical or chemical agents.
- Sterilization: Total destruction of all living organisms.

The following sections discuss guidelines and procedures for biological disinfection and sterilization:

General Guidelines

Choosing the best method for disinfection and sterilization is very important. The proper method depends on the following:

- Target organisms to be removed
- Characteristics of the area to be cleaned

Once you have chosen the proper method for disinfection or sterilization, follow these guidelines to ensure laboratory safety:

- Frequently disinfect all floors, cabinet tops, and equipment where biohazardous materials are used.
- Use auto-clavable or disposable materials whenever possible. Keep reusable and disposable items separate.
- Minimize the amount of materials and equipment present when working with infectious agents.
- Sterilize or properly store all biohazardous materials at the end of each day.
- Remember that some materials may interfere with chemical disinfectants — use higher concentrations or longer contact time.
- Use indicators with autoclave loads to ensure sterilization.
- Clearly mark all containers for biological materials (e.g., BIOHAZARDOUS - TO BE AUTO-CLAVED.).

Types of Disinfectant

Use the following table to aid in the selection of disinfectants:

NOTE: See the Radiation Safety chapter for information pertaining to the use of ultraviolet lights as a method of disinfection.

Sterilization Methods

There are three common methods for sterilizing laboratory materials: wet heat, dry heat, and ethylene oxide gas.

Wet Heat

When used properly, the damp steam heat from an autoclave effectively sterilizes biohazardous waste. Sterilization occurs when contaminated materials reach 15 psi pressure at 250°F or 121°C for at least 30 minutes.

IMPORTANT: For the autoclave process to be effective, sufficient temperature, time, and direct steam contact are essential.

Every State Lamar University Department that auto-claves for sterilization and standard operating procedures should include requirements for verifying sterilization.

Potential problems with wet heat sterilization and autoclaves include the following:

- Heavy or dense loads require higher temperature for sterilization.
- Poor heat conductors (e.g., plastic) take longer to sterilize.
- Containers may prevent steam from reaching the materials to be sterilized.
- Incomplete air removal from the chamber can prevent contact between the steam and the load.
- Deep trays can interfere with air removal.
- Tightly stacked loads can impede steam circulation and air removal.
- Double-bagging will impede steam penetration.
- Carcasses do not allow steam penetration.
- Some bags and containers rated as auto-clavable have thermal stability but they do not allow steam penetration.

To ensure that all materials are sterile, always test autoclave loads. Remember, however, that some sterilization indicators are incomplete. Autoclave tape, for example, verifies sufficient external temperature exposure, but it does not indicate internal equipment temperature, exposure time, or steam penetration. Thermocouples or other instrumentation can also indicate temperature, but they do not verify sterility. A biological indicator is the most effective monitor to ensure sterility. Commercially available strips or vials of Bacillus species endospores, for example, are suitable biological indicators.

Dry Heat

Dry heat is less effective than wet heat for sterilizing biohazardous materials. Dry heat requires more time (two to four hours) and a higher temperature (320–338°F or 160–170°C) to achieve sterilization. A Bacillus species biological indicator can verify dry heat sterilization.

Ethylene Oxide Gas

Ethylene oxide gas is lethal to all microorganisms. Because it is also a known carcinogen and potentially explosive (freon and carbon dioxide mixtures are stable), minimize your exposure and use extreme care when working with this gas. Ethylene oxide sterilizers and aerators must be properly vented. Ethylene oxide gas is most effective with heat-resistant organisms and heat sensitive equipment. The effectiveness of ethylene oxide gas may be affected by the following:

Temperature:

The antimicrobial activity of ethylene oxide increases with increased temperature.

- Normal sterilization temperature is 120–140°F or 49–60°C.
- Ethylene Oxide Concentration: Sterilization time decreases with increased gas concentration. Normal concentration is 500-1000 mg/L.
- Humidity: Relative humidity of 30-60% is necessary.
- Exposure Time: Follow the manufacturer's recommendations.

Biological Safety Cabinets

A biological safety cabinet is a primary barrier against biohazardous or infectious agents. Although biological safety cabinets surround the immediate workspace involving an agent, they do not provide complete containment (i.e., aerosols can escape). Therefore, careful work practices are essential when working with agents that require a biological safety cabinet.

NOTE: A biological safety cabinet is often referred to by other names such as: bio hood, tissue culture hood, or biological fume hood.

All biological safety cabinets contain at least one High Efficiency Particulate Air (HEPA) filter. These cabinets operate with a laminar air flow (i.e., the air flows with uniform velocity, in one direction, along parallel flow lines).

Biological safety cabinets must be inspected and certified:

- When newly installed
- After filter or motor replacement
- After being moved
- Annually

Types of Cabinets

CLASS I	Only exhaust air is filtered. The user and environment are protected but the experiment is not. Operator's hands and arms may be exposed to hazardous materials inside the cabinet. This cabinet may be used with low to moderate-risk biological agents.
CLASS II	Vertical laminar air flow with filtered supply and exhaust air. The user, product, and environment are protected.
Type A	Recirculates 70% of the air inside the cabinet. Do not use with flammable, radioactive, carcinogenic, or high-risk biological agents.
Type B1	Recirculates 30% of the air inside the cabinet and exhausts the rest to the outside. May be used with low to moderate-risk agents and small amounts of chemical carcinogens or volatiles.
Type B2	Offers total exhaust with no recirculation.
Type B3	Same as Class II Type A, but vented to the outside of the building.
Class III or Glove box	Gas-tight and maintained under negative air pressure. Used to work with highly infectious, carcinogenic, or hazardous materials. All operations are conducted through rubber gloves attached to entry portals.

Using Biological Safety Cabinets

Follow these guidelines for using biological safety cabinets properly:

Preparation

- Leave safety cabinets on at all times. Otherwise, turn the blower on and purge the air for at least five minutes before beginning work.
- Never turn off the blower of a biological safety cabinet that is vented to the outside.

- Turn off the UV light if it is on. Never work in a unit with the UV light illuminated. (UV light will damage your eyes.)
- Do not depend on the UV germicidal lamp to provide a sterile work surface; wipe down the surface with a disinfectant (70% alcohol is usually suitable).

NOTE: For more information on ultraviolet lights, refer to the Radiation Safety Safety Manual.

- Place everything needed for your procedure inside the cabinet prior to beginning work. Arrange the equipment in logical order.
- Provide a container for wastes inside the cabinet. (Remember, nothing should pass through the air barrier until the entire procedure is complete.)
- Never place any items on the air-intake grilles.
- Place a disinfectant-soaked towel on the work surface to contain any splatters or spills that occur.
- Keep the laboratory door shut and post signs stating "CABINET IN USE" on all the doors. Restrict activities that will disturb the cabinet's airflow, such as entry, egress, and walking traffic.

Cabinet Use

- Conduct work at least four inches from the glass view panel. The middle third area is ideal.
- Limit arm movement and avoid motions that could disturb airflow.
- If a burner is necessary, use the Touch-O-Matic type with a pilot light. Since flames cause air turbulence, place burners to the rear of the workspace.
- Never use flammable solvents in a biological safety cabinet unless it is a total-exhaust cabinet (e.g., Class II B2).

Experiment Completion

- Enclose or decontaminate all equipment that has been in direct contact with the infectious agent.
- Cover all waste containers.
- To purge airborne contaminants from the work area, allow the cabinet to operate for five minutes with no activity inside the cabinet.
- Remove all equipment from the cabinet.
- Decontaminate interior work surfaces.

IMPORTANT: Biological safety cabinets are not a substitute for good laboratory practices. Because aerosols can escape, take precautions to minimize aerosol production and to protect you from contamination

Clean Benches

A clean bench has horizontal laminar air flow. The HEPA-filtered air flows across the work surface towards the operator, providing protection for the product, but no protection for the user. Because clean benches offer no protection, use a clean bench only to prepare sterile media. Do not use clean benches when working with pathogenic organisms, biological materials, chemicals, or radioactive materials.

Importing & Shipping Biological Materials

The Public Health Service provides Foreign Quarantine regulations for importing etiologic agents and human disease vectors. Other regulations for packaging, labeling, and shipping, are administered jointly by the Public Health Service and the Department of Transportation. The U.S. Department of Agriculture regulates the importation and shipment of animal pathogens. It prohibits the importation, possession, and use of certain animal disease agents that pose a serious threat to domestic livestock and poultry.

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Biological Spill Response

The exact procedure for responding to a biological spill depends on the material, amount, and location of the spill.

In general, follow these steps immediately after a biological spill occurs:

- Warn others.
- Leave the room; close the door.
- Remove contaminated garments.
- Wash your hands.
- Notify your supervisor.

Follow these steps to clean up a biological spill:

- Wait for any aerosols to settle.
- Put on protective clothing, as appropriate.
- Apply disinfectant to the contaminated area.
- Cover the area with paper towels to absorb the disinfectant.
- Wipe up the towels and mop the floor.
- Autoclave all contaminated wastes.

NOTE: Spill cleanup must be appropriate for the hazards involved. Call EHSRM for assistance if the spilled material is radioactive.

If a spill occurs inside a biological safety cabinet, follow these steps:

- Decontaminate materials while the cabinet is operating to prevent contaminants from escaping.
- Spray or wipe all affected equipment with an appropriate disinfectant. (Wear gloves while doing this.)

- If the spill is large, flood the work surface with disinfectant and allow it to stand for 10 to 15 minutes before removing it.

Biological Waste Disposal

The Texas Department of State Health Services (DSHS) and the Texas Commission on Environmental Quality (TCEQ) regulate the disposal of biohazardous waste. Waste that contains infectious materials and waste that may be harmful to humans, animals, plants, or the environment is considered biohazardous. Examples of biohazardous waste include the following:

- Waste from infectious animals
- Bulk human blood or blood products
- Microbiological waste (including pathogen-contaminated disposable culture dishes, and disposable devices used to transfer, inoculate, and mix pathogenic cultures)
- Pathological waste
- Sharps
- Hazardous rDNA and genetic manipulation products

Texas State University's Waste Disposal Program (available from EHSRM) stipulates that biohazardous waste meets strict safety requirements for the following:

- Segregation
- Treatment
- Labels
- Packaging
- Transportation
- Documentation

Biohazardous waste mixed with hazardous chemical or radioactive waste must be treated to eliminate the biohazard prior to disposal. After treatment, manage the hazardous waste through EHSRM.

IMPORTANT: Disinfect all infectious material prior to disposal.

The following sections offer general safety guidelines and procedures for disposing of biological waste.

Segregation

- Segregation is necessary when working with hazardous biological agents.
- Any waste that could cause a laceration or puncture must be disposed of as "Sharps." Sharps must be segregated from other waste.
- Do not mix waste that requires incineration with glass or plastics.
- Do not mix biological waste with chemical waste or other laboratory trash.
- Segregate hazardous biological waste from nonhazardous biological waste.

Handling and Transport

Follow these guidelines for handling and transporting biohazardous waste:

- Properly trained personnel (not the custodial staff) are responsible for transporting treated biological waste to the dumpster or incinerator. Only properly trained technical personnel may handle untreated biohazardous waste.
- Contain and label all treated waste before transporting it to the incinerator or dumpster.
- Avoid transporting untreated biohazardous materials and foul or visually offensive materials through non laboratory areas.
- Do not use trash/laundry chutes, compactors, or grinders to transfer or process untreated biohazardous waste.

Labeling Biohazardous Waste

Follow these guidelines for labeling biohazardous waste:

- Clearly label each container of untreated biohazardous waste and mark it with the Biohazard Symbol.
- Label containers intended for landfill disposal to indicate the method of treatment. Cover the Biohazard Symbol with this label.
- Label autoclave bags with special tape that produces the word "AUTOCLAVED" upon adequate thermal treatment. Apply this tape across the Biohazard Symbol before autoclaving the bag.
- Label all containers for sharps as "ENCAPSULATED SHARPS."
- It is recommended to label nonhazardous biological waste as "NONHAZARDOUS BIOLOGICAL WASTE."

Disposal Methods

Different materials require different disposal methods to ensure safety. Follow these guidelines for physically disposing of biological waste.

- Animal Carcasses and Body Parts: Incinerate the materials or send them to a commercial rendering plant for disposal. Solid
- Animal Waste: All animal waste and bedding that is infectious or harmful to human, animals, or the environment should be treated by incineration, thermal disinfection, or chemical disinfection.
- Liquid Waste: Liquid waste, including bulk blood and blood products, cultures and stocks of etiological agents and viruses, cell culture material, and rDNA products should be disinfected by thermal or chemical treatment and then discharged into the sanitary sewer system.
- Metal Sharps: All materials that could cause cuts or punctures must be contained, encapsulated, and disposed of in a manner that does not endanger other workers. Needles, blades, etc. are considered biohazardous even if they are sterile, capped, and in the original container.
- Pasteur Pipets and Broken Glassware: Place in a rigid, puncture resistant container. Disinfect by thermal or chemical treatment, if contaminated. Label the container as "Broken Glass" and place it in a dumpster.

NOTE: If broken glass is commingled with metal sharps, encapsulation is required for disposal.

- Plastic Waste: Contaminated materials must be thermally or chemically treated and placed in a properly labeled, leak-proof container for disposition in the dumpster. Materials that are not contaminated may be placed directly in the dumpster.
- Microbiological Waste: Solids must be thermally or chemically treated and placed in a properly labeled, leak-proof container for disposition in the dumpster. Liquids must be thermally or chemically treated and then discharged into the sanitary sewer system.
- Human Pathological Waste: Human cadavers and recognizable body parts must be cremated or buried. Other pathological waste from humans and primates must be incinerated.
- Genetic Material: Materials containing rDNA or genetically altered organisms must be disposed of in accordance with NIH Guidelines and the Texas State University Waste Disposal Program.

Nonhazardous Biological Waste

Most biological waste that is not infectious or otherwise hazardous to humans, animals, plants, or the environment may be discarded as regular waste or sewage. The only exceptions are animal carcasses and body parts. These wastes must be incinerated or sent to a commercial rendering plant for treatment. In addition, there are no record-keeping requirements for nonhazardous biological waste.

Follow these guidelines for nonhazardous biological waste:

- It is recommended to autoclave or disinfect all microbial products, even if they are not biohazardous.
- Avoid disposing of waste in a manner that could cause visual or odorous problems.
- Do not label nonhazardous biological waste as hazardous (e.g., do not use the Biohazard Symbol, red bags, etc.). Instead, it is recommended to label the container as "NONHAZARDOUS BIOLOGICAL WASTE."
- Use nonhazardous animal bedding and manure for compost or fertilizer when possible.

Recordkeeping Requirements

Some department that generates biohazardous waste must comply with the record keeping requirements of the Lamar University Waste Disposal Program and State regulations. Written records must contain the following information:

- Date of treatment
- Amount of waste treated
- Method/conditions of treatment
- Name (printed) and initials of person performing the treatment

If a department generates more than 50 pounds per calendar month of biohazardous waste, the records must also include a written procedure for the operation and testing of any equipment used and a written procedure for the preparation of any chemicals used in treatment. The records must also include either the results of a biological indicator or a continuous readout (e.g., strip chart) to demonstrate proper parameters for effective treatment.

Blood-borne Pathogens

Blood-borne pathogens are biological agents that cause human disease. Examples of blood borne diseases include the following:

- Hepatitis
- Syphilis
- Malaria
- Human Immunodeficiency Virus (HIV)

Two significant and deadly blood-borne diseases are hepatitis B virus (HBV) and HIV. These pathogens may be present in the following:

- Human blood
- Body fluids, such as saliva, semen, vaginal secretions, phlegm, and other body fluids visibly contaminated with blood
- Unfixed human tissues or organs other than intact skin
- HIV or HBV cultures
- Blood, organs, or other tissues from experimental animals infected with HIV or HBV.

Blood-borne pathogens may enter the body and infect you through a variety of means, including the following:

- Accidental injury with a sharp object contaminated with infectious material.
- Open cuts, nicks, and skin abrasions that come into contact with infectious materials. Other potential sites of transmission include acne sores and the mucous membranes of the mouth, nose, or eyes.
- Unprotected sexual activity with someone who is infected with the disease.
- Indirect transmission, such as touching a contaminated object and then transferring the pathogen to the mouth, eyes, nose, or open skin.

If you suspect you have been exposed to a blood-borne pathogen, report the incident to your supervisor immediately.

End of Section

SECTION 12

CHEMICAL SAFETY

Section 12 of the safety manual provides chemical safety guidelines and procedures. The following topics are covered.

General Safety Guidelines

Always follow these guidelines when working with chemicals:

- Assume that any unfamiliar chemical is hazardous.
- Know all the hazards of the chemicals with which you work. For example, perchloric acid is a corrosive, an oxidizer, and a reactive. Benzene is an irritant that is also flammable, toxic, and carcinogenic.
- Consider any mixture to be at least as hazardous as its most hazardous component.
- Never use any substance that is not properly labeled.
- Follow all chemical safety instructions precisely.
- Minimize your exposure to any chemical, regardless of its hazard rating.
- Use personal protective equipment, as appropriate.
- Use common sense at all times.

The five prudent practices of chemical safety sum up these safety guidelines:

- Treat all chemicals as if they were hazardous.
- Minimize your exposure to any chemical.
- Avoid repeated exposure to any chemical.
- Never underestimate the potential hazard of any chemical or combination of chemicals.
- Assume that a mixture or reaction product is more hazardous than any component or reactant.

Safety Data Sheets

Before using any chemical, read the container label and the appropriate Material Safety Data Sheets (MSDS). Container labels and MSDSs are good sources of information for chemical safety. They provide the following information:

- Hazardous ingredients
- Exposure limits
- Physical and chemical characteristics, including the following:
    - Boiling point
    - Vapor pressure
- Physical hazards, including the following: Flammability
- Explosiveness
- Reactivity
- Health hazards, including chemicals that are:
    - Toxic
    - Carcinogens
    - Irritants
- First-aid procedures
- Proper leak, spill, and disposal techniques
- Proper storage and handling procedures
- Other special provisions

Safe Handling Guidelines

Employees should treat all chemicals and equipment with caution and respect. When working with chemicals, remember to do the following:

- Remove and use only the amount of chemicals needed for the immediate job at hand.
- Properly seal, label, and store chemicals in appropriate containers. Keep the containers clearly marked and in a well-ventilated area.
- Check stored chemicals for deterioration and broken containers.
- Learn how to dispose of chemicals safely and legally. Follow Texas State University waste disposal requirements.
- Clean up spills and leaks immediately.
- Know what to do in an emergency.

Likewise, when working with chemicals, remember the following:

- Do not store chemicals near heat or sunlight or near substances that might initiate a dangerous reaction.
- Do not transport unprotected chemicals between the work area and other areas. Use a tray, rack, cart or rubber carrier. Always use a secondary container when transporting hazardous or highly odorous chemicals on an elevator.
- Do not pour hazardous chemicals down the sink.
- Do not put fellow workers or yourself in danger.

Hygiene and Chemical Safety

Good personal hygiene will help minimize exposure to hazardous chemicals. When working with chemicals, follow these guidelines:

- Wash hands frequently and before leaving the laboratory. Also, wash hands before eating, drinking, smoking, or applying makeup.
- Remove contaminated clothing immediately. Do not use the clothing again until it has been properly decontaminated.
- Follow any special precautions for the chemicals in use.

In addition, follow these special precautions:

- Do not eat, drink, smoke, or apply makeup around chemicals.
- Do not wear contact lenses near chemicals, especially corrosives or volatile solvents.
- Do not keep food or food containers anywhere near chemicals.
- Do not use laboratory equipment to serve or store food or drinks.
- Do not sniff or taste chemicals.

Globally Harmonized System (GHS) (Reference Hazard Communication Program)

Lamar University has a written program (Lamar University Hazard Communication Program) that complies with OSHA standards and the Texas Hazard Communication Act for hazardous chemicals. This program is available from the Environmental Health, Safety & Risk Management Office. It requires the following:

- Employee training (including recognition of signs of exposure)
- Labeling procedures
- MSDSs for chemicals at each workplace
- Instructions on how to read and interpret MSDSs
- Chemical inventory reporting procedures
- Record keeping requirements
- Emergency response procedures

Refer to the Texas State University Hazard Communication Program, and other sections in this manual for detailed information on these topics.

An integral part of hazard communication is hazard identification. Everyone who works with hazardous chemicals should know how to read and interpret hazard information. Signs, like the NFPA diamond in the illustration below, alert employees to the known hazards in a particular location.

OSHA has updated the requirements for labeling of hazardous chemicals to align with the Globally Harmonized System (GHS). As of June 1, 2015 all labels will be required to have the six elements seen in the example below.

Figure 1 - Globally Harmonized System (GHS) Hazard Communication System

1. **Product Identifier** – Should match the product identifier on the Safety Data Sheet
2. **Signal Word** – Either use “danger” (severe) or “Warning” (less severe).
3. **Hazard Statements**
4. **Precautionary Statements**
5. **Supplier Identification**
6. **Pictograms**

See Figure 2 below for the required standard pictograms that are to be used on the label for a hazardous chemical labelled IAW the Globally Harmonized System.

Figure 2 - Hazard Communication Standard Pictograms

Corrosives

A corrosive chemical destroys or damages living tissue by direct contact. Some acids, bases, dehydrating agents, oxidizing agents, and organics are corrosives.

Examples of Corrosives

Examples of acidic corrosives include the following:

- Hydrochloric acid
- Sulfuric acid
- Perchloric acid
- hydrofluoric acid (also health hazard due to fluoride ion)

Examples of alkaline corrosives include the following:

- Sodium hydroxide (lye)
- Potassium hydroxide

Examples of corrosive dehydrating agents include the following:

- Phosphorous pentoxide
- Calcium oxide

Examples of corrosive oxidizing agents include the following:

- Halogen gases
- Perchloric acid

Examples of organic corrosives include the following:

- Phenol
- Acetic acid

NOTE: Concentrated acids can cause painful burns that are often superficial. Inorganic hydroxides, however, can cause serious damage to skin tissues because a protective protein layer does not form. Even a dilute solution such as sodium or potassium hydroxide can saponify fat and attack skin. At first, skin contact with phenol may not be painful, but the exposed area may turn white due to the severe burn. Systemic poisoning may also result from dermal exposure.

Safe Handling Guidelines for Corrosives

To ensure safe handling of corrosives, the following special handling procedures should be used:

- Always store corrosives properly. Refer to the MSDSs and the Chemical Storage section of this manual for more information.
- Always wear gloves and face and eye protection when working with corrosives. Wear other personal protective equipment, as appropriate.
- To dilute acids, add the acid to the water, not the water to the acid.
- Corrosives, especially inorganic bases (e.g., sodium hydroxide), may be very slippery; handle these chemicals with care and clean any spills, leaks, or dribbles immediately.
- Use a chemical fume hood when handling fuming acids or volatile irritants (e.g., ammonium hydroxide).
- A continuous flow eye wash station should be in every work area where corrosives are present. An emergency shower should also be within 100 feet of the areas.

Corrosive Example: Perchloric Acid

Perchloric acid is a corrosive oxidizer that can be dangerously reactive. At elevated temperatures, it is a strong oxidizing agent and a strong dehydrating reagent. Perchloric acid reacts violently with organic materials. When combined with combustible material, heated perchloric acid may cause a fire or explosion. Cold perchloric acid at less than 70% concentration is not a very strong oxidizer, but its oxidizing strength increases significantly at concentrations higher than 70%. Anhydrous perchloric acid (>85%) is very unstable and can decompose spontaneously and violently. If possible, purchase 60% perchloric acid instead of a more concentrated grade. Always wear gloves and goggles while using perchloric acid. Be thoroughly familiar with the special hazards associated with perchloric acid before using it. Heated digestions with perchloric acid require a special fume hood with a wash-down system. The vapors can form crystals on the hood interior that are explosive.

Corrosive Example: Hydrofluoric Acid

HF is one of the most dangerous common reagents that we use in a laboratory environment. Exposures of only 2% of the body to concentrated HF can lead to death, and it is also lethal at a concentration of 50 ppm in air. Fluoride ions bind rapidly to electrolytic ions in your tissues, such as Ca^{+2}, causing severe electrolyte imbalance. Death can occur in as little as 30 minutes. Death is usually from massive organ failure (heart failure, etc.). If you do not die quickly you will develop severe burns and excruciating pain. The idea that HF primarily affects your bones is a common misunderstanding, bone problems only develop if you survive.

Protective Measures

There are several ways to help prevent hydrofluoric acid accidents from occurring in the first place. Never use hydrofluoric acid when working solo or after hours. HF may be used when working alone during regular working hours provided knowledgeable personnel have been alerted and at least one is in the general vicinity.

- All personnel, not just those who will be using hydrofluoric acid, should be informed of the dangers of this chemical and the emergency procedures necessary in case of an accident.
- All persons who will be using HF must be made aware of its properties and trained in proper procedures for use and disposal.
- Companies/Laboratories which keep or use HF gas or concentrated solutions (>1% hydrofluoric acid) should have these emergency procedures on hand as well as an MSDS.
- Undergraduate students should never be given the task of mixing HF solutions. Only experienced persons familiar with its properties should handle the concentrated acid.
- A small supply of calcium carbonate or calcium hydroxide should be kept near where the work will be conducted. If a small quantity (100 ml or less) of dilute HF solution is spilled, clean it up by using powdered calcium carbonate or calcium hydroxide. A commercial hydrofluoric acid spill kit can also be used.
- If a large amount is spilled, or the HF is concentrated, contain the spill as best as can, evacuate the area, and call 911. Avoid exposure to the vapors.
- Dispose of unwanted hydrofluoric acid by contacting RMSO.
- When working with hydrofluoric acid or concentrated HF solutions (> 1%):
    - Wear goggles and a face shield. Wear a long-sleeved, buttoned lab coat, pants or long skirt, and closed-toe shoes. Wear Neoprene or Nitrile (22mil) gloves or other hydrofluoric acid resistant gloves (HF burns around the fingernails are extremely painful, difficult to treat, and may require surgical removal of the nail). A chemical resistant apron is also recommended.
    - Make sure to have a tube of HF "antidote" Calcium gluconate gel on hand in case HF comes into contact with the user’s skin.
    - Calcium gluconate gel has a shelf life stamped on the tube. Replace prior to expiration.
    - Wash skin with soap and water then dry and immediately apply the calcium gluconate gel. Repeat application every 5-10 minutes for several rounds.
    - Any person exposed to HF must seek immediate medical assistance.

Flammables

A flammable chemical is any solid, liquid, vapor, or gas that ignites easily and burns rapidly in air. Consult the appropriate MSDSs before beginning work with flammables.

Flashpoint, Boiling Point, Ignition Temperature, and Class

Flammable chemicals are classified according to flashpoint, boiling point, and ignition temperature. Flashpoint (FP) is the lowest temperature at which a flammable liquid gives off sufficient vapor to ignite. Boiling point (BP) is the temperature at which the vapor pressure of a liquid is equal to the atmospheric pressure under which the liquid vaporizes. Flammable liquids with low BPs generally present special fire hazards. The FPs and BPs of certain chemicals are closely linked to their ignition temperature — the lowest temperature at which a chemical will ignite and burn independently of its heat source.

Conditions for a Fire

Improper use of flammable liquids can cause a fire. The following conditions must exist for a fire to occur:

- Flammable material must be present in sufficient concentration to support a fire (i.e., fuel).
- Oxygen or another oxidizer must be present.
- An ignition source must be present (i.e., heat, spark, etc.).

When working with flammables, always take care to minimize vapors which act as fuel.

Safe Handling Guidelines for Flammables

Follow these guidelines when working with flammable chemicals:

- Handle flammable chemicals in areas free from ignition sources.
- Never heat flammable chemicals with an open flame. Use a water bath, oil bath, heating mantle, hot air bath, etc.
- Use ground straps when transferring flammable chemicals between metal containers to avoid generating static sparks.
- Use a fume hood when there is a possibility of dangerous vapors. (Ventilation will help reduce dangerous vapor concentrations.)
- Restrict the amount of stored flammables, and minimize the amount of flammables present in a work area.
- Remove from storage only the amount of chemical needed for a particular experiment or task.

The following table illustrates flammable class characteristics: (OSHA Std 29 CFR1910.106 and NFPA 30)

CLASS	FLASHPOINT (F)	BOILDING POINT (F)	EXAMPLES
1A	<73	<100	Ethyl ether “Flammable Aerosols”
AB	<73	>100	Acetone, Gasoline, Toluene
1C	<73	<100	Butyl alcohol, Methyl isobutyl keytone, Turpentine
2	100 – 140	--	Cyclohexane, Kerosene, Mineral Spirits
3A	140 – 199	--	Butyl cellosolve
3B	>200	--	Cellosolve Ethylene glycol Hexylene glycol

The following table provides examples of common flammables and their flashpoint and class.

CHEMICAL	FLASHPOINT (F)	CLASS
Acetone	0	1B
Benzene	12	1B
Butyl Acetate	>72	1C
Carbon Disulfide	-22	1B
Cyclohexane	-4	1B
Diethylene Glycol	225	3B
Diethyl Ether	-49	1A
Ethanol	55	1B
Heptane	25	1B
Isopropyl Alcohol	53	1B
Methanol	52	1B
Pentane	<-40	1A
Toulene	40	1B

Solvents

Organic solvents are often the most hazardous chemicals in the work place. Solvents such as ether, alcohols, and toluene, for example, are highly volatile or flammable. Chlorinated solvents such as chloroform are nonflammable, but when exposed to heat or flame, may produce carbon monoxide, chlorine, phosgene, or other highly toxic gases.

Always use volatile and flammable solvents in an area with good ventilation or in a fume hood. Never use ether or other highly flammable solvents in a room with open flames or other ignition sources present.

Solvent Exposure Hazards

Health hazards associated with solvents include exposure by the following routes:

- Inhalation of a solvent may cause bronchial irritation, dizziness, central nervous system depression, nausea, headache, coma, or death. Prolonged exposure to excessive concentrations of solvent vapors may cause liver or kidney damage. The consumption of alcoholic beverages can enhance these effects.
- Skin contact with solvents may lead to defatting, drying, and skin irritation.
- Ingestion of a solvent may cause severe toxicological effects. Seek medical attention immediately.

The odor threshold for the following chemicals exceeds acceptable exposure limits. Therefore, if you can smell it, you may be overexposed — increase ventilation immediately.

- Chloroform
- Benzene
- Carbon tetrachloride
- Methylene chloride

NOTE: Do not depend on your sense of smell alone to know when hazardous vapors are present. The odor of some chemicals is so strong that they can be detected at levels far below hazardous concentrations (e.g., xylene).

In addition, some solvents (e.g., benzene) are known or suspected carcinogens.

Reducing Solvent Exposure

To decrease the effects of solvent exposure, substitute hazardous solvents with less toxic or hazardous solvents whenever possible. For example, use hexane instead of diethyl ether, benzene or a chlorinated solvent.

NOTE: The best all-around solvent is water; use it whenever possible.

The following table outlines possible solvent substitute

Instead of Using	Substitute
Benzene	Cyclohexane/Toluene/Xylene
Halogenated Solvents	Non Halogenated Solvents
Aromatic hydrocarbon	Aliphatic hydrocarbon
Diethyl ether	Hexane Petroleum ether

Solvent Example: DMSO

Dimethyl sulfoxide is unique because it is a good solvent with many water-soluble as well as lipid-soluble solutes. Due to these properties, dimethyl sulfoxide is rapidly absorbed and distributed throughout the body. It can also facilitate absorption of other chemicals such as grease, oils, cosmetics, and other chemicals that may contact the skin. For these reasons wear protective clothing (gloves, lab coat, closed toed shoes) when working with this solvent.

Toxic Chemicals

The toxicity of a chemical refers to its ability to damage an organ system (kidneys, liver), disrupt a biochemical process (e.g., the blood-forming process) or disturb an enzyme system at some site remote from the site of contact. Toxicity is a property of each chemical that is determined by molecular structure. Any substance can be harmful to living things. But, just as there are degrees of being harmful, there are also degrees of being safe. The biological effects (beneficial, indifferent or toxic) of all chemicals are dependent on a number of factors.

For every chemical, there are conditions in which it can cause harm and, conversely, for every chemical, there are conditions in which it does not. A complex relationship exists between a biologically active chemical and the effect it produces that involves consideration of dose (the amount of a substance to which one is exposed), time (how often, and for how long during a specific time, the exposure occurs), the route of exposure (inhalation, ingestion, absorption through skin or eyes), and many other factors such as gender, reproductive status, age, general health and nutrition, lifestyle factors, previous sensitization, genetic disposition, and exposure to other chemicals.

The most important factor is the dose-time relationship. The dose-time relationship forms the basis for distinguishing between two types of toxicity: acute toxicity and chronic toxicity. The acute toxicity of a chemical refers to its ability to inflict systemic damage as a result (in most cases) of a one-time exposure to relative large amounts of the chemical. In most cases, the exposure is sudden and results in an emergency situation.

Chronic toxicity refers to a chemical's ability to inflict systemic damage as a result of repeated exposures, over a prolonged time period, to relatively low levels of the chemical. Some chemicals are extremely toxic and are known primarily as acute toxins (hydrogen cyanide); some are known primarily as chronic toxins (lead). Other chemicals, such as some of the chlorinated solvents, can cause either acute or chronic effects.

The toxic effects of chemicals can range from mild and reversible (e.g. a headache from a single episode of inhaling the vapors of petroleum naphtha that disappears when the victim gets fresh air) to serious and irreversible (liver or kidney damage from excessive exposures to chlorinated solvents). The toxic effects from chemical exposure depend on the severity of the exposures. Greater exposure and repeated exposure generally lead to more severe effects.

Exposure to toxic chemicals can occur by:

- Inhalation
- Dermal absorption
- Ingestion
- Injection

NOTE:
Inhalation and dermal absorption are the most common methods of chemical exposure in the workplace.

The following sections provide examples and safe handling guidelines for the following types of toxic chemicals:

- Toxicants
- Carcinogens
- Reproductive Toxins
- Sensitizers
- Irritants

IMPORTANT: Minimize your exposure to any toxic chemical.

Acute Toxins

Acute toxins can cause severe injury or death as a result of short-term, high-level exposure. Examples of acute toxins include the following:

- Hydrogen cyanide
- Hydrogen sulfide
- Nitrogen dioxide
- Ricin

- Organophosphate pesticides
- Arsenic

Do not work alone when handling acute toxins. Use a fume hood to ensure proper ventilation.

Chronic Toxins

Chronic toxins cause severe injury after repeated exposure. Examples of chronic toxins include the following:

- Mercury
- Lead
- Formaldehyde

Carcinogens

Carcinogens are materials that can cause cancer in humans or animals. Several agencies including OSHA, NIOSH, and IARC are responsible for identifying carcinogens. There are very few chemicals known to cause cancer in humans, but there are many suspected carcinogens and many substances with properties similar to known carcinogens. Examples of known carcinogens include the following:

- Asbestos
- Benzene
- Tobacco smoke
- Chromium, hexavalent
- Aflatoxins

Zero exposure should be the goal when working with known or suspected carcinogens. Workers who are routinely exposed to carcinogens should undergo periodic medical examinations.

Reproductive Toxins

Reproductive toxins are chemicals that can produce adverse effects in parents and developing embryos. Chemicals including heavy metals, some aromatic solvents (benzene, toluene, xylenes, etc.), and some therapeutic drugs are capable of causing these effects. In addition, the adverse reproductive potential of ionizing radiation and certain lifestyle factors, including excessive alcohol consumption, cigarette smoking, and the use of illicit drugs, are recognized.

While some factors are known to affect human reproduction, knowledge in this field (especially related to the male) is not as broadly developed as other areas of toxicology. In addition, the developing embryo is most vulnerable during the time before the mother knows she is pregnant. Therefore, it is prudent for all persons with reproductive potential to minimize chemical exposure.

Reproductive Toxins	
Acrylontrile	Carbon disulfide
Benzene	Chloroform
Benzo(a)pyrene	Sodium azide
Cadmium nitrate	Warafin

Sensitizers

Sensitizers may cause little or no reaction upon first exposure. Repeated exposures may result in severe allergic reactions. Examples of sensitizers include the following:

- Isocyanates
- Nickel salts
- Beryllium compounds
- Formaldehyde
- Diazomethane

Irritants

Irritants cause reversible inflammation or irritation to the eyes, respiratory tract, skin, and mucous membranes. Irritants cause inflammation through long-term exposure or high concentration exposure. For the purpose of this section, irritants do not include corrosives. Examples of irritants include the following:

- Ammonia
- Formaldehyde
- Halogens
- Sulfur dioxide
- Poison ivy
- Phosgene

Reactive & Explosives

Reactive chemicals are sensitive to either friction or shock or they react in the presence of air, water, light, or heat. Explosive chemicals decompose or burn very rapidly when subjected to shock or ignition. Reactive and explosive chemicals produce large amounts of heat and gas; they are extremely dangerous. Examples of reactive compounds include the following:

REACTIVE CLASSIFICATION	CHEMICAL EXAMPLES
Acetylenic compounds	Acetylene, Copper(II)acetylide
Azides	Benzenesulfonyl azide, Lead (II) azide
Azo compounds	Azomethane, Diazomethane
Chloro/perchloro compounds	Lead perchlorate, Potassium chlorite, Silver chlorate
Fulminate	Copper (II) fulminate, Silver fulminate
Nitro compounds	Nitromethane, Trinitrotoluene
Nitrogen-containing compounds	Silver amide, Silver nitride
Organic peroxide formers	Diethyl ether, Isopropyl ether
Picrates	Picric acid (dry), Lead picrate
Peroxides	Diacetyl peroxide Zinc peroxide
Strained ring compounds	Benzvalene, Prismane
Polymerizable compounds	Butadiene, Vinyl chloride

Cleaning Agents

Many of the chemicals contained in cleaning agents are corrosive. Follow these guidelines when working with any cleaning agent:

- Always read and understand the label instructions or the MSDS before using any cleaning agent.
- Mix solutions to the recommended strength.
- When diluting acid with water, always add the acid to the water, not the water to the acid. (Concentrated acids may splatter when mixed improperly.)
- Wear appropriate eye protection and gloves for the job (e.g., neoprene, nitrile, or rubber).
- Do not leave aerosol cans in direct sunlight or areas where the temperature may exceed 120° F. Heated aerosol cans may explode.

The following table outlines common cleaning agents, their hazards, and safety precautions:

CLEANING AGENT	POSSIBLE HAZARDS	SAFETY MEASURES
Ammonia	– Can cause severe eye and lung irritation. – If mixed with bleach, can form poisonous chlorine gas.	– Use in Well Ventilated Area – Do Not Mix with bleach – **Wear Eye Protection**
Bleach	– Can produce poisonous gas if mixed with other cleaners	– Never mix with toilet cleaners or ammonia. – **Wear gloves and eye protection**
Toilet/Drain Cleaners & Lye	– Can cause serious burns	– **Wear gloves and avoid skin contact.** – Never mix with bleach – Protect eyes from possible splashes. – **Wear chemical goggles**
Cleaning Fluids/Degreasers	– May cause skin and eye irritations. – May contain solvents that can cause headaches, painful cough, dizziness, and liver or kidney damage.	– Avoid direct contact – Only use in well ventilated areas. – Follow label directions carefully. – **Wear gloves and eye protection**
Aerosol Sprays	– Can irritate nasal passages if inhaled. – Can cause eye irritation	– Follow label directions carefully. – Use in well ventilated area. – **Wear eye protection**
Floor Waxes & Furniture Polish	– Can irritate skin and nasal passages	– Use in well ventilated area – Avoid skin contact – **Wear gloves**

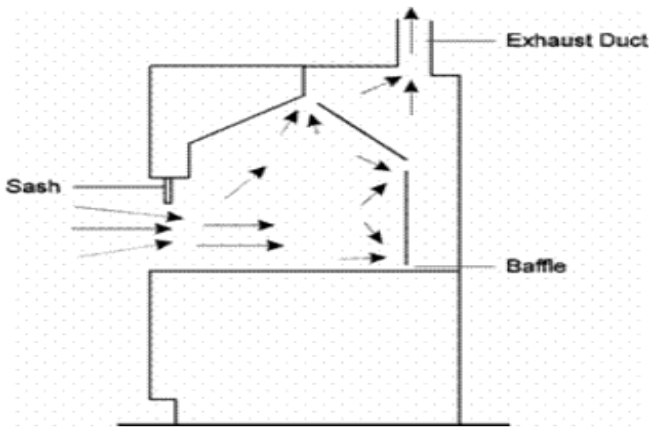
Fume Hoods

Fume hoods provide primary confinement in a chemical laboratory. They exhaust toxic, flammable, noxious, or hazardous fumes and vapors by capturing, diluting, and removing these materials. Fume hoods also provide physical protection against fire, spills, and explosion. Fume hoods provide the best protection when the fume hood sash is in the closed position. All chemical fume hoods must be ducted to the outside of the building.

Types of Chemical Fume Hoods

There are three basic types of general purpose fume hoods:

(1) standard,
(2) bypass, and
(3) auxiliary air.



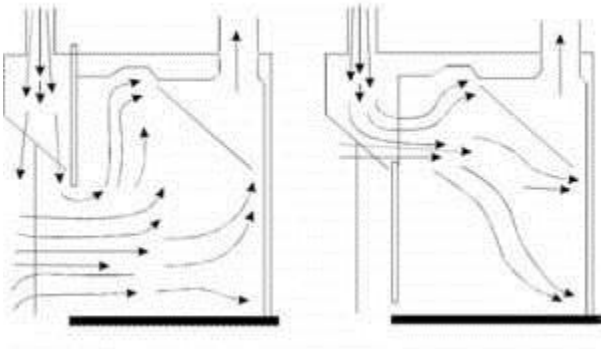
STANDARD FUME HOODS

The face velocity of a standard fume hood is inversely related to the open face area, allowing a constant volume of air to be exhausted. If the sash is lowered, the inflow air velocity increases.

IMPORTANT: Face velocity that is too high may disturb sensitive apparatus, extinguish Bunsen burners, or create excessive turbulence.

BYPASS FUME HOODS

Bypass fume hoods are also called "balanced air" or "constant volume" fume hoods. As the sash is lowered, bypass fume hoods allow constant exhaust volumes that help keep the room ventilation system balanced. Constant exhaust volumes also eliminate the problem of high face velocity as the sash is lowered.

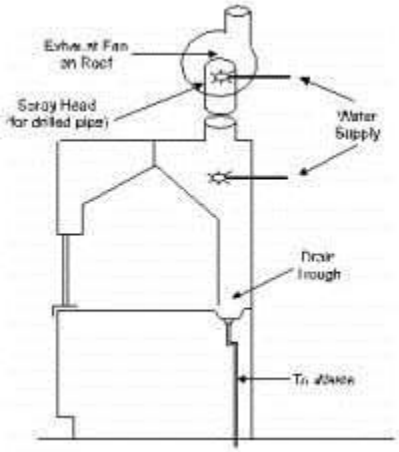


AUXILIARY AIR FUME HOODS

Auxiliary air fume hoods are also known as "supplied air" hoods. They use an outside air supply for 50% to 70% of the hood's exhaust requirements. This type of hood is designed to reduce utility costs and conserve energy. The face velocity of an auxiliary air fume hood may vary.

Special Fume Hoods

Special fume hoods are necessary when working with certain chemicals and operations. Examples of special fume hoods include the following:



Perchloric Acid Fume Hoods

These fume hoods have a water spray system to wash down the entire length of the exhaust duct, the baffle, and the wall. The water spray is used periodically or after each use to remove any perchloric acid or organic material that may have accumulated.

Walk In Hoods

These fume hoods have single vertical sashes or double vertical sashes and an opening that extends to the floor. These hoods are typically used to accommodate large pieces of equipment.

Radioisotope Hoods

These hoods are labeled for use with radioactive materials. The interior of these hoods is resistant to decontamination chemicals. If special filtration is necessary with these fume hoods, contact EHSRM.

Canopy Hoods

These hoods capture upward moving contaminants and are good for heat-producing operations. Workers may be exposed to contaminants if they work under the hood, however.

Fume Hood Safety Considerations

The potential for glass breakage, spills, fires, and explosions is great within a fume hood. Due to the chance for fires or explosions, fume hoods should be located towards the back of a laboratory, away from primary and secondary exits. Practice safe work habits when working with fume hoods, including the following:

- Air Flow and Ventilation:
    - Employee traffic in front of a fume hoods or opening/closing laboratory doors can interfere with hood performance. Ensure that there is sufficient aisle space in front of fume hoods.
- Fume Hood Type:
    - All fume hoods are not appropriate for all types of work.
    - Ensure that hazardous chemicals are used in the proper type of hood. For example, use perchloric acid only in fume hoods specifically designed for perchloric acid.

Fume Hood Use and Care

To ensure safety and proper fume hood performance, follow these guidelines:

- Use a fume hood when working with chemicals or procedures that may produce hazardous fumes or vapors.
- Know how to properly operate a fume hood before beginning work. Inspect the fume hood before starting each operation to ensure it is working.
- Place equipment and chemicals at least six inches behind the fume hood sash. This practice reduces the chance of exposure to hazardous vapors.
- Do not allow paper or other debris to enter the exhaust duct of the hood.
- Do not store excess chemicals or equipment in fume hoods.
- Do not block the baffle area of the fume hood.
- Elevate any large equipment within the hood at least three inches to allow proper ventilation around the equipment.
- When working in a fume hood, set the sash at the height indicated by the arrow on the inspection sticker. The only time the sash should be completely open is while setting up equipment.
- Wear personal protective equipment, as appropriate.

- Do not alter/modify the fume hood or associated duct work.
- Clean up spills in the hood immediately.

IMPORTANT: If a power failure or other emergency occurs (e.g., building fire or fire within the fume hood), close the fume hood sash and call for emergency assistance.

Fume Hood Inspections

Fume hoods should be tested at least annually. Fume hoods should also be tested in the following circumstances:

- When an employee requests an inspection
- When a procedural change requires a hood classification upgrade
- After major repair work
- After a fume hood is moved

EHSRM performs fume hood inspections and testing monthly. The test includes an inspection of the hood system, airflow measurements, and an assessment of the use of the fume hood. The calibration procedure used at Texas State University is RMS-05.02 “Constant Flow Fume Hood Calibration”. If you suspect a problem with your fume hood, please contact EHSRM.

Exhaust Fan Maintenance

The exhaust fans that operate to pull air through the fume hoods receive maintenance twice a year.

Spill Response

Spills are likely whenever chemicals are used. Personnel should be trained and equipped to handle most of the spills in their work area. Contact EHSRM for assistance or advice about a chemical spill.
Spills that endanger the community or environment must be reported to the San Marcos Fire Department who has a hazardous waste response capability – (HAZMAT Team).

Spill Prevention and Planning

- Prevention is the best safety strategy for any environment. Use safe handling procedures and be aware of the potential hazards associated with chemicals. For example, before working with any chemicals, review the appropriate MSDSs.
  Be prepared to respond to a chemical spill. To prepare for a potential spill, follow these guidelines:
- Develop and periodically review written procedures for an emergency response plan.
- Keep a fully stocked chemical spill response kit available.
- Know the location and proper use of cleanup materials.
- Know how to turn off equipment, heat sources, electrical panels, etc.
- Review appropriate MSDSs.

Spill Response Kit

- Work areas that contain potentially hazardous chemicals should have a chemical spill response kit. This kit should include the following:
- Disposable laboratory/surgical gloves
- Disposable vinyl gloves
- Safety goggles
- Absorbent (e.g., spill pillows, vermiculite, litter box filler, etc.)
- Plastic scoop
- Plastic trash bags
- Hazardous waste tags to identify cleanup debris for disposal

Responding to Chemical Spills

The following sequence provides a brief overview of proper chemical response procedures:

- Notify others in the immediate area that a spill has occurred. Evacuate the area if necessary.
- Attend to injured and exposed people.
- Identify the spilled chemical(s).
- Based on the hazards and the personal protective equipment needed (e.g., respiratory protection), determine if you can safely clean the spill or if assistance is necessary. (Most spills can be cleaned safely by the people who were using the chemical, assuming they are knowledgeable about the chemical.)
- If you determine that you can safely clean the spill without emergency assistance, follow these guidelines:
- Wear appropriate protective clothing and equipment.
- Have another person stand by during the cleanup.
- Clean up the spill and collect all wastes for proper disposal.
- Ventilate the area, as necessary, before it is reoccupied.
- Decontaminate reusable cleanup supplies such as scoops, rubber boots, etc.
- Restock the chemical spill kit and return it to the normal storage location.

Do not take unnecessary risks with chemical spills. Call UPD (primary responder) by dialing 911 whenever a spill involves the following:

- Large volume of spilled material
- Very hazardous material
- Very hazardous conditions (e.g., fire, explosion, toxicity, etc.)
- Strong odor
- Personnel injury or exposure

For additional emergency response procedures, review the Lamar University Contingency Plan and Emergency Response Procedures.

Chemical Storage

Proper chemical storage is as important to safety as proper chemical handling. Often, seemingly logical storage ideas, such as placing chemicals in alphabetical order, may cause incompatible chemicals to be stored together.

General Guidelines

Follow these guidelines for safe chemical storage:

- Read chemical labels and MSDSs for specific storage instructions.
- Store chemicals in a well-ventilated area; however, do not store chemicals in a fume hood.
- Maintain an inventory of all chemicals in storage.
- Return chemical containers to their proper storage location after use.
- Store glass chemical containers so that they are unlikely to be broken.
- Store all hazardous chemicals below eye level.
- Never store hazardous chemicals in a public area or corridor.

Separating Hazardous Chemicals

In addition to the guidelines above, there are storage requirements for separating hazardous chemicals. Because an alphabetical storage system may place incompatible chemicals next to each other, group chemicals according to their hazard category (i.e., acids, bases, flammables, etc.).

Follow these guidelines to ensure that hazardous chemicals are stored safely:

- Separate acids from bases. Store these chemicals near floor level.
- Isolate perchloric acid from organic materials. Do not store perchloric acid on a wooden shelf.
- Separate highly toxic chemicals and carcinogens from all other chemicals. This storage location should have a warning label and should be locked.
- Separate acids from flammables.
- Do not keep peroxide-forming chemicals longer than twelve months.
- Do not allow picric acid to dry out.
- If flammables need to be chilled, store them in a laboratory-safe refrigerator, not in a standard refrigerator.
- Flammables should be stored in a flammable storage cabinet.
- Store reactive materials separate from corrosives or flammables.
- Store Nitric acid (reactive and corrosive) separately from other acids and flammables.

Chemical Classifications and Segregation

The following table provides examples of incompatible chemicals:

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Chemical Classifications and Segregation

The **Omnibus Plan** for Lamar University provides the segregation and color code program we use to store chemicals in labs. The following table provides examples of incompatible chemicals

CHEMICAL	IMCOMPATIBLE WITHE
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid

Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Cyanide	Acids
Fluorine	Most other chemicals
Nitrates	Sulfuric Acid
Oxygen	Oils, grease, hydrogen, flammable liquids, solids, or gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils,
Sodium	Carbon tetrachloride, carbon dioxide, water
Sulfides	Acids

Chemical Compatibity Chart

Below is a chart adapted from NFPA regulations which demonstrates how chemicals should be stored by hazard class. This chart is not complete but it will aid in making decisions about storage. For more complete information please refer to the MSDS for the specific chemical.

Group/ Code	Color	Hazard Class	Storage Location	Special Instructions
G	Grey, Green, Orange	General	On shelves or in cabinets	Presents no more than moderate hazard in any of categories. For general chemical storage.
B	Blue	Health Hazard	On shelves or in cabinets	Toxic if inhaled, ingested or absorbed through skin. Store in a secure area.
Y	Yellow	Reactive	On shelves or in cabinets	Reactive & oxidizing reagents. May react violently with air, water or other substances. Store away from flammables or combustibles.
R	Red	Flammable	In flammable storage cabinet	Store in area segregated for flammable reagents.
W	White	Corrosive/ Contact Hazard	*In corrosive storage cabinet	May harm skin, eyes, & mucous membranes. Store away from red, yellow, and blue coded reagents.

*Within this storage group you must segregate acids and bases. In addition, nitric acid is always to be stored alone.

- Storage location should clearly indicate which group/code is stored in that location. Each shelf or cabinet should indicate the color.
- Groups should always be separated by a vertical divider not horizontal divider. (see diagrams below)
- Each chemical container should be clearly labeled by its storage color.
- Ideally liquids should be isolated by secondary containment.

1: **Correct**

G-Grey Storage	B-Blue Storage	Y – Yellow Storage
G-Grey Storage	B-Blue Storage	Y – Yellow Storage

1: **Incorrect**

W-White Storage	B-Blue Storage	Y-Yellow Storage
R-Red Storage	Y-Yellow Storage	Y-Yellow Storage

Chemical Storage System

Required: Chemicals must be returned to the location they were originally found. Chemicals must be kept segregated according to the color coding system.

Note: Chemicals should be labeled with either a color strip on the label or a sticker to help indicate the color code to which they belong. Shelves and cabinets are also labeled so that chemicals can be returned to the proper location.

VERY Important: 1. YELLOW, [redacted], and WHITE Storage must *NEVER* be mixed.

****

General Storage – Grey/Green/Orange

Flammable Storage – Red

Health Hazard Storage – Blue

Reactive/Oxidizing Storage – Yellow

Corrosive/Contact Hazard Storage – White (Acids/Bases are to be kept separately – Nitric Acid is to be stored by itself as Yellow Storage.)

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For Questions Contact: Environmental Health & Safety @ 5-3616

Shipping & Receiving Chemicals

The U.S. Department of Transportation regulates the shipment of hazardous materials. Anyone who packages, receives, unpacks, signs for, or transports hazardous chemicals must be trained and certified in Hazardous Materials Transportation. Warehouse personnel, shipping and receiving clerks, truck drivers, and other employees who pack or unpack hazardous materials must receive this training. Contact Materials Management for more information on shipping or receiving hazardous chemicals.

End of Section

SECTION 13

HAZARDOUS WASTE DISPOSAL

Section 13 of the safety manual provides hazardous waste safety guidelines and procedures. The following topics are covered.

1. Hazardous Waste & Texas State
2. Hazardous Waste Definitions
3. Types of Hazardous Waste
4. Containers, Tags, & Collection
5. Minimization & Substitution
6. Segregation
7. Special Concerns
8. Contingency Plan
9. RCRA Hazardous Waste Training

Hazardous Waste & Lamar University

Hazardous waste disposal is governed by the EPA and the Texas Commission on Environmental Quality (TCEQ) through State and Federal regulations. The purpose of environmentally sound disposal methods is to prevent harm to the water, land, and air.

Lamar University complies with hazardous waste disposal regulations by means of the Hazardous Waste Management Program. The Environmental Health, Safety & Risk Management office (EHSRM) administers this program.

Penalties of Noncompliance

Noncompliance with any hazardous waste regulation may result in substantial fines and penalties for the University. The University may be cited or fined for numerous types of violations ranging from improperly labeling a waste container to intentionally disposing of hazardous waste incorrectly.

Role of EHSRM Hazardous Waste Coordinator

The EHSRM Hazardous Waste Coordinator administers the Hazardous Waste Management Program at Lamar University. Compliance with this program is very demanding — it requires full cooperation by all campus entities. The main focus of this program is chemical waste management (Hazardous, Class 1 and Class 2 Industrial). The program does not include procedures for the management of radioactive, infectious, biological, or municipal solid waste.

EHSRM-Hazardous Waste Coordinator collects, and stores hazardous waste (less than 90 days) until it is shipped for final disposal. The Office also maintains permanent records (manifests) of all disposed waste.

Hazardous Waste Definitions

Container Accumulation Area(s) (CAAs)
Designated by EHSRM to be used for the storage of hazardous wastes (less than 90 days) prior to shipment to an offsite permitted waste disposal facility.

Disposal
The proper disposition of Hazardous, Class 1 and Class 2 Industrial waste at a permitted treatment, storage or disposal (TSD) facility in compliance with all applicable TCEQ and EPA regulations.

Generator
Any person, by site, who produces hazardous waste or industrial solid waste; any person who possesses hazardous waste or industrial solid waste to be shipped to any other person; or any person whose act first causes solid waste to become subject to regulation. Generators accumulate waste in Satellite Accumulation Areas.

Hazardous Waste
Any solid waste material listed or identified in Title 40 Code of Federal Regulations, Part 261, Subpart D or exhibiting the characteristics of ignitability, corrosively, reactivity, or TCLP toxicity also defined in 40CFR Part 261 Subpart C. Tables containing the listing and characteristics of

hazardous wastes are shown in these subparts and in the University's Waste Analysis Plan, Attachment B.

Mixed Waste
A radioactive waste that is also a hazardous waste.

Satellite Accumulation Area(s)
A storage location at or near the point of generation where hazardous waste initially accumulates. The SAA are limited to storage of less than 55 gallons.

Solid Waste
Any garbage, refuse, sludge from a waste treatment plant, water treatment plant, or air pollution control facility or other discarded material. Solid waste can be solid, liquid, semi-solid, or contained gaseous material resulting from industrial, municipal, commercial, mining and agricultural operations, and from community and institutional activities.

Types of Hazardous Waste

An item is considered waste when the owner determines that the material is no longer useful and needs to be discarded. A detailed description of the wastes generated at the University is in the Waste Analysis Plan.

An item is considered to be hazardous waste if it meets one or more of the following characteristics:

- **Mixture contains a listed hazardous waste and a non-hazardous waste.**
- **Material meets the definition of one of the following:**
- **Ignitability (flashpoint < 60oC or supports combustion)**
- **Reactivity (e.g., water reactives, cyanides, explosives, unstable chemicals)**
- **Corrosively (ph < 2 or > 12.5)**
- **TCLP toxicity (e.g., pesticides, heavy metals, organic compounds, see Waste Analysis Plan, Attachment B.)**
- **Material is listed in 40CFR 261, Subpart D, (see Waste Analysis Plan, Attachment B.)**
- **Material is not excluded from regulations.**

Individual departments are responsible for properly identifying the hazardous waste they generate and for following University disposal procedures.

Departments should contact the EHSRM office for assistance if necessary to characterize hazardous waste through process knowledge or chemical analysis.

Containers, Tags, & Collection

Proper containment, tagging, collection and disposal are essential to the success of the Hazardous Waste Program. The following sections discuss these areas.

Filling Containers

Hazardous waste collection containers must be in good condition, must not leak, and must be compatible with their hazardous contents. All containers must have suitable screw caps or other secure means of closure. EHSRM provides 5-gallon and 30-gallon HDPE High Density polyethylene carboys and drums that meet most of these compatibility requirements. The carboys and drums meet DOT Shipping requirements and are UN and NA rated.

If you are reusing a container to accumulate waste, destroy the original product label. EPA regulations require that waste containers be labeled with the identity of the contents, and the words "Hazardous Waste". EHSRM provides hazardous waste I.D. tags that meet these requirements. EHSRM will add the accumulation start date when the waste is picked up from the department and transported to the CAA(s).

IMPORTANT: Never overfill hazardous waste containers. Expansion and excess weight can lead to spills and extensive environmental exposure.

- Allow about two inches of head space in 5-gallon containers.
- Fill closed head drums (larger than 5 gallons) to leave approximately four inches of space.
- Hazardous waste containers for solids are generally rated by their weight capacity and volume capacity.
- Take care not to exceed the weight capacity of a solid container.
- Weight is generally not a problem for jars and open head cans (5 gallons or less), but it can be a problem for open head drums (larger than 5 gallons). Depending on weight requirements, you may fill containers for solids within two inches of the closure.

IMPORTANT: Keep all waste collection containers closed except when adding or removing material.

Completing Tags

When a container first receives waste it is necessary to attach a waste tag. Follow these guidelines for completing hazardous waste tags:

1. Use full chemical names or common names. Chemical formulas or abbreviations are not acceptable.
2. List all chemical components in the waste container, including water. Long lists may be continued on a second tag.
3. Indicate the approximate percent concentration of the chemicals, especially potentially explosive materials such as picric acid and nitro compounds.
4. Add the building name and room number to the tag where indicated.
5. Attach the tag to the container.

Collection and Disposal

EHSRM collects waste from generators upon notification. Specific details concerning waste pickup procedures are in containers with improper caps, leaks, outside contamination, or improper labeling **will not be picked up** until these problems have been corrected. Improper disposal methods for hazardous chemical waste include the following:

- Disposal down the drain.
- Intentional evaporation in a fume hood.
- Disposal in the regular trash.
- Leaving the waste in the generator's work area.

Once the waste is picked up by EHSRM it is transported to the Container Accumulation Area. The Hazardous Waste Specialist will add the proper waste code and pickup date to the label. The waste container's information will be added to the transporter log as inventory control.

Disposing of Empty Containers

EPA and TCEQ (40CFR 264.170, and TAC 335.41(f), TAC 335.508(2)) regulations stipulate that empty containers must meet the following requirements:

- Containers must not contain free liquid or solid residue.
- Containers must be triple rinsed (place the rinsate in an approved waste container).
- Product labels must be defaced or removed.
- Container lids or caps must be removed.
- Aerosol cans must be at atmospheric pressure or punctured.

IMPORTANT: Containers that do meet these requirements will be picked up for disposal by EHSRM.

Waste Source Reduction Techniques

Use the following techniques to reduce waste sources:

- Purchasing and Inventory Control
- Use computerized tracking systems to manage purchasing and control inventory.
- Maintain current inventory records to prevent overstocking and to monitor the shelf life of remaining chemicals.

    - Develop a campus-wide chemical exchange network to promote chemical sharing and avoid redundant purchases.
    - Negotiate with suppliers to gain volume discounts, flexible delivery schedules, and delivery of fewer small-sized containers without cost penalties.
    - Purchase quantities for immediate use only. Do not order quantities to obtain a special unit cost savings.
    - Obtain compressed gases from vendors who accept return of empty or partially full cylinders.
    - Include waste generation as criteria in equipment selection.
    - Rotate chemical stocks to use chemicals before their shelf-life expires.

Chemical Usage

- Use lab procedures that assure the integrity of chemical quality.
- Reduce spills and waste by pre-weighing chemicals for undergraduate use.
- Require proper labeling of all secondary containers. Replace all deteriorating labels on primary and secondary containers.

- Substitute less hazardous chemicals whenever possible (e.g., biodegradable scintillation cocktails instead of xylene or toluene-based cocktails).
- Minimize the use of heavy metals (e.g., silver, chromium, mercury, barium, cadmium, and lead).
- Substitute alcohol or electronic thermal monitors for mercury thermometers.
- Use "No-Chromix", detergents, or enzymatic cleaners to clean laboratory glassware.
- Minimize solvent waste by recycling or substitution.

Waste Minimization Techniques

Follow these techniques to reduce hazardous waste:

- Do not mix different types of waste.
- Do not put non-hazardous waste, such as a mixture of water, sodium bicarbonate, and acetic acid, into a waste container of hazardous waste.
- Do not combine inorganic heavy metal waste with organic solvents waste.
- Segregate halogenated waste solvents from non-halogenated waste solvents.
- Segregate waste streams by storing them in separate waste containers. Store waste containers separate from reagent containers being used to avoid accidental contamination.
- Decontaminate empty containers to make them non-hazardous.
- Neutralize dilute acids and bases to make them non-hazardous and suitable for drain disposal (i.e. as long as no heavy metals are in solution).
- When possible, redesign experimental protocols so that harmful byproducts are detoxified or reduced.
- Recycle chemicals via purification.
- Eliminate mercury compounds from laboratory experiments.

Use small scale experimentation or testing processes (microscale) or double up students in laboratory exercises.

Special Concerns

Employees who generate hazardous waste must maintain and control their hazardous waste accumulation areas. Special concerns for hazardous waste include the following:

- Unneeded chemicals that are to be discarded must be handled and managed as hazardous waste.
- Unknown chemical waste will be picked up by the EHSRM however the University will incur additional charges to the
- Department for the chemical analysis to determine the proper disposal method. If possible identify unknowns at the point of generation.
- Gas cylinders (including lecture bottles) are extremely difficult to discard. They should be returned to the manufacturer or distributor whenever possible. Cylinders that cannot be returned should be tagged as hazardous waste as soon as possible.
- Photographic chemicals containing silver may not be placed in the sanitary sewer. They must be disposed of as hazardous waste.
- Developer, paint waste, oil, paint rinse water, detergents, degreasers, and any other chemical cannot be disposed of in the sanitary sewer or storm sewer. These are prohibited for disposal by the City's Industrial Waste Water Permit issued to the University.

Training

Training is provided by the EHSRM Hazardous Waste Coordinator to the Department Heads. The Department Head ensures that training records are maintained and provides training to students and refresher training as needed. Training includes generator requirements (waste containers, labels, secondary containment, and spill kits) waste pickup procedures, and spill response procedures.

End of Section

SECTION 14

FACILITY AND GROUND SAFETY

This section Provides agriculture safety guidelines and procedures. The following topics are covered.

1. Pesticide Chemical Safety
2. Fuel Storage
3. Towing Safety

Pesticide Chemical Safety

This section discusses agricultural chemical safety for pesticides, including rodenticides, insecticides, herbicides, etc. Pesticides are chemicals that protect crops and livestock from rodents, insects, disease, or weeds. They also control pests that endanger human health. Because pesticides are poisonous, they can be extremely dangerous to humans. Before applying commercial pesticides, always ensure your safety, the safety of others, and the safety of the environment.

There are several government agencies that govern the use of commercial pesticides. For more information on pesticide usage, contact one or more of the following groups: Texas Department of Agriculture, Texas Department of Health, Structural Pest Control Board, Texas Natural Resource Conservation Commission (TNRCC), and Environmental Protection Agency (EPA).

General Pesticide Safety

The following sections provide general or specific guidelines for handling pesticides. To help reduce the hazards associated with pesticides:

- Do not transport, mix, or use chemicals unless you can summon help, if needed.
- Keep an ample supply of water nearby to flush exposed areas, if a spill occurs.
- Check all pesticide equipment before you use it to ensure proper working condition.
- Read pesticide labels carefully. Follow the label directions when mixing, applying, storing, or disposing of pesticides.
- Wear personal protective equipment to prevent dermal, inhalation, and mucous membrane exposure.
- Do not eat, drink, or smoke when handling pesticides.
- Launder clothing and bathe after working with pesticides to ensure that all chemicals are removed from clothing and skin.
- Observe assigned reentry intervals. Always wear the appropriate protective clothing when entering fields before the reentry date.
- Always handle pesticides downhill from wells, cisterns, sink holes, ditches, or standing water.
- Do not apply pesticides when rain is imminent or if wind could affect the spraying area.
- Triple-rinse spray equipment and empty containers. Apply the rinse water to the treated field.
- Properly dispose of empty containers.

Preparing to Apply Pesticides

Preparation is essential for chemical safety. Follow these steps to properly prepare for pesticide application:

Plan Ahead

Always read chemical labels before attempting to work with pesticides. Prepare for a possible emergency by maintaining a personal decontamination site, a chemical spill kit, and by knowing the proper first aid procedures associated with your pesticide.

Move Pesticides Safely

Careless chemical transportation can cause spills and contamination. Do not carry pesticides in an enclosed area, such as a car. Be sure to secure the pesticides to prevent shifting or bouncing. In addition, never leave your vehicle unattended when transporting chemicals.

Select Appropriate Personal Protective Equipment

Regardless of the pesticide's toxicity, always wear a long-sleeve shirt and pants when working with pesticides. Wear additional protective equipment, as necessary.

- Select Application Equipment
- Choose suitable equipment to properly apply pesticides. Before using the equipment, inspect it for good working order.
- Provide Prior Notification
- Before applying pesticides, inform all people in or around the application area. Notification allows people to protect themselves from harmful chemicals.

Mixing Pesticides

- Always read and carefully follow label directions when mixing pesticides. Even if you are familiar with a particular chemical, reread the label to ensure that you have the latest safety information. In addition, follow these guidelines for mixing pesticides:
- Wear Personal Protective Equipment
- Always wear protective gear when handling hazardous chemicals.
- Work in a Safe Area
- The pesticide mixing and loading area should be well ventilated, well lighted, and downhill from any water sources. Concrete slabs are ideal for mixing chemicals since they allow for easy cleanup.

Measure Chemicals Correctly

Measure and mix pesticides carefully. Never mix different pesticides except as directed by the label or chemical manufacturer. Do not use more chemical than prescribed by the pesticide label. The overuse of pesticides is illegal, and may result in the following:
Higher pest control costs

- Pesticide residue in food
- Groundwater pollution
- Pesticide resistance
- Pour Pesticides Carefully
- **Always wear a face shield and take care not to splash chemicals when pouring pesticides**. Never use your mouth to siphon pesticides.

Applying Pesticides

When you apply pesticides, you are responsible for protecting yourself, other people, and the environment. Follow these guidelines when applying pesticides:

Minimize Exposure

Even mildly toxic chemicals can harm you if you use them daily. Take care to minimize your exposure to any chemical. Avoid working in pesticide spray, mist, or runoff. Always work with another person when working with hazardous chemicals.

- Avoid Applying Pesticides in Sensitive Areas
- Avoid spraying pesticides near beehives or areas that humans normally occupy (e.g., schools, playgrounds, hospitals, etc.).
- If you must apply pesticides in sensitive areas, do so when the weather is calm and when people are not around.
- Avoid Pesticide Drift, Runoff, and Spills
- Pesticides that fall outside the targeted application area can be very hazardous. Choose weather conditions, equipment, and chemicals that do not lend themselves to these hazards.

Avoid Equipment Accidents

Equipment accidents are often caused by poor maintenance and improper work habits. Avoid equipment accidents by following all operating instructions.

Pesticide Storage and Disposal

Always try to use all the pesticide in your application tank. If pesticides remain, use them on other target locations. After emptying the tank, clean and store the equipment.

The following summary of EPA storage criteria should be followed for pesticides labeled with the signal words DANGER, POISON, or WARNING, or the skull and crossbones symbol. These procedures and criteria are not necessary for the storage of pesticides classed as less toxic (CAUTION word on the label) or for those registered for use in the home or garden.

Site Storage

- Locate where flooding is unlikely.
- Locate where runoff will not contaminate any water system.

Storage Facility

- Dry, well ventilated, separate room, building, or covered area with fire protection (e.g., dry chemical fire extinguisher).
- Secured by fence and/or locked doors.
- Signs on rooms/buildings to provide hazard warning (e.g., DANGER, POISON, and PESTICIDE STORAGE).
- Movable pesticide equipment is labeled as contaminated and not removed from the site until decontaminated.
- Provision is available for the decontamination of personnel and equipment; contaminated water disposed of as excess pesticide; contaminated runoff collected and treated as excess pesticide.

Operational Procedures

- Store pesticide containers in rows with the labels plainly visible.
- Place contents from damaged containers in sound containers.
- If relevant, segregate pesticides by formulation.
- Store rigid containers in an upright position, with tight lids/bungs, off the ground, in a manner to permit access and inspection.
- Maintain a complete inventory indicating the number and identity of containers.
- Check containers regularly for corrosion and leaks.
- Keep suitable absorbent (e.g., vermiculite) on hand in case of spills.

Safety Precautions:

- Inspect pesticide containers for leaks before handling them.
- Do not allow unauthorized personnel in the storage area.
- Do not store pesticides next to items intended for consumption by animals or humans.
- Do not eat, drink, smoke, or chew tobacco where pesticides are present.
- Do not store beverages, food, eating utensils, or smoking material in the storage or loading areas.
- Wear rubber gloves while handling containers of pesticides.
- Wash hands immediately after handling pesticides. Remove contaminated protective clothing immediately; extra sets of clean clothing should be nearby.

Disposal:

Unused or outdated pesticides must be disposed as hazardous chemicals.

IMPORTANT: Never leave pesticide containers at a field site. Be sure to account for every container used, and safely dispose of empty containers.

NOTE:
Store herbicides separately from other pesticides. Some herbicides may volatilize and contaminate the pesticides.

Pesticide Cleanup

Always thoroughly clean all pesticide equipment as soon as you are through with it. Leaving pesticide residue in mixing, loading, or application equipment can result in accidental injury or death to livestock or people or unwanted contamination of plants or soil.
Clean the inside and outside of pesticide equipment, including nozzles. Dispose of contaminated rinse water as directed on the chemical label.

IMPORTANT: Do not allow pesticide rinse water to contaminate water supplies.

Antidotes

Time is of the essence when pesticide overexposure occurs. However, using an antidote kit may not be the best course of action. Unless a physician has stated that an antidote is needed, it should not be administered. Some antidotes such as atropine can be poisonous if misused. A prescription may even be necessary to acquire the antidote. You may be able to get a local physician to write the prescription, prepare a written protocol regarding the use of the antidote, and train pertinent employees about how and when to administer the antidote.

If medical assistance is available locally through a hospital, physician, or ambulance service, you should call 911 or take the individual directly to the nearest emergency treatment center instead of maintaining an antidote kit on site.

End of Section

SECTION 15

VEHICAL SAFETY

The following topics are covered.

1. General Vehicle Safety
2. Accidents
3. Alternative Fueled Vehicles
4. Railroad Crossing
5. 15-Passenger Van Safety
6. Bicycle Safety

General Vehicle Safety

Motor vehicle accidents are the leading cause of death and crippling injury in the United States. Traffic safety laws are important components of vehicle safety, but the most important aspect of vehicle safety is the driver.

IMPORTANT: All Lamar University employees who operate a motor vehicle for company business (whether a company vehicle, rental vehicle, or personal vehicle) must possess a valid state driver's license for their vehicle's class.

The Lamar University Police Department (LUPD) is responsible for regulating moving vehicles and bicycles on university property. To ensure driving safety, follow these driving practices:

- Never drink and drive. Driving while under the influence of alcohol or drugs is strictly prohibited.
- Obey all traffic laws, signs, and signals.
- Respond to dangerous driving conditions as appropriate.
- Maintain a safe distance between your car and any car in front of you. Allow at least one car length for each 10 MPH (e.g., three car lengths if you are driving 30 MPH).
- Keep your eyes moving to avoid fatigue, especially if you plan on driving for a long period.
- Always use your turn signal to indicate your intended action.
- Leave yourself an "out" by either driving in the lane with a shoulder, driving in the middle lane of a multi-lane road, or following other vehicles at a safe distance.

Defensive Driving

By taking defensive driving courses, employees can promote driving safety and lower their insurance rates. The principles of defensive driving include the following:

Knowledge:

Know your vehicle and know the law.

Control:

Always maintain control of your vehicle. To improve your control, perform routine vehicle maintenance and respond to road conditions as appropriate.

Attitude:

Be willing to obey all laws and be willing to yield to all other vehicles and pedestrians.

Reaction:

Respond to driving conditions appropriately. Do not impede your reaction time by driving when tired or under the influence of alcohol or drugs.

Observation:

- Be aware of potential accidents and take preventive measures. Always try to anticipate the actions of other drivers.

- Common Sense:
- Do not risk your safety to save time. Do not respond to rude or obnoxious drivers by violating traffic laws.

Distracted Driving

Lamar University is committed to ending the epidemic of distracted driving, and have created the following rules, which apply to any employee operating a company vehicle or using a company-issued cell phone while operating a vehicle:

- Employees may not use a hand-help cell phone while operating a vehicle whether the vehicle is in motion or stopped at a traffic light. This includes, but it not limited to, answering or making phone calls, engaging in phone conversations, and reading or responding to emails, instant messages, and text messages.
- If employee needs to use their phones, they must pull over safely to the side of the road or another safe location.

Additionally, employees are required to:

- Turn cell phones off or put them on silent or vibrate before starting the car
- Consider modifying voice mail greetings to indicate that you are unavailable to answer calls or return messages while driving
- Inform clients, associates and business partners of this policy as an explanation of why calls may not be returned immediately

Backing Vehicles

Backing a large vehicle can be very difficult. Try to avoid backing whenever possible. If you must back a vehicle, follow these guidelines:

- Get out of the vehicle and inspect the area you want to back into.
- If possible, have someone outside help guide your vehicle into position.
- If your vehicle does not automatically sound a horn when in reverse, sound the horn once before moving backwards.
- Back slowly and check your mirrors often.

Accidents

If you are ever involved in a vehicle accident, follow these guidelines:

- Check for injuries. If anyone is injured, immediately call the police and EMS (911).
- If there are no injuries, you are blocking traffic, and your car can be driven, move the car to a safe location nearby. (If the accident occurs on a freeway lane, ramp, shoulder, median, or busy metropolitan street, you must move your car if it is safe and possible to do so.)
- If you cannot move your car, try to warn oncoming traffic to prevent other accidents:
- Raise your hood.
- Turn on your hazard lights.
- Light flares.
- Exchange the following information with other drivers involved in the accident:

- Name, address, and phone number
- Vehicle identification number, license number, and description
- Insurance information
- Driver's license number
- Call the police in the following circumstances:
- Someone is injured.
- A car cannot be moved.
- A driver is intoxicated.
- A driver has no insurance.
- A driver leaves the scene of the accident without exchanging information.

Alternative Fueled Vehicles

Although liquid hydrocarbon fuels, such as gasoline, are efficient and easy to handle, they are a finite energy source and a cause of various pollution problems. Alternative fuels, however, such as compressed natural gas and propane, are widely available and offer few emission problems. Based on these findings, the Clean Air Act of 1990, and the Energy Policy Act of 1992, Texas State University is developing a fleet of alternative fueled vehicles.

NOTE:

Alternative fueled vehicles must be refueled by trained personnel. Employees should not refuel their alternative fueled vehicles themselves.

Compressed Natural Gas

Compressed natural gas (CNG) is a plentiful domestic fuel that is very affordable. Seventy cents of natural gas possesses the same amount of energy as one dollar of gasoline. CNG also produces low tailpipe emissions, no evaporative emissions, and low refining energy. Unfortunately, however, CNG requires bulky gas cylinders and higher cost vehicles. CNG vehicles must be tested and inspected annually for corrosion, pressure, and possible gas leaks.

Propane

Propane is a by-product of gasoline, but it can also be extracted from natural gas. Propane offers slow evaporative emissions and virtually complete combustion. When filling propane tanks, operators should allow at least 10% free space for gas expansion. Safety valves should also discharge to the atmosphere and not to enclosed spaces.

Railroad Crossing

In 2010 there were 1,824 train-vehicle accidents which resulted in 616 fatalities at railroad crossings in the United States. Compared with other types of collisions, train/motor vehicle crashes are 11 times more likely to result in a fatal injury. On the average, there are more train-car fatalities each year than airplane crashes. Unfortunately, driver error is the principal cause of most grade crossing accidents. Many drivers ignore the familiar tracks they cross each day, and some drivers disregard train warning signals and gates.

All public highway-rail grade crossings are marked with one or more of the following warning devices:

- Advance warning signs indicate that a railroad crossing is ahead. These signs are positioned to allow enough room to stop before the train tracks.
- Pavement markings may be painted on the pavement in front of a crossing. Always stay behind the stop line when waiting for a passing train.
- Flashing lights are commonly used with cross bucks and gates. Stop when the lights begin to flash and the gate starts to lower across your lane. Do not attempt to cross the tracks until the gate is raised and the lights stop flashing?
- Railroad cross buck signs are found at most public crossings. Treat these signs as a yield sign. If there is more than one track, a sign below the cross buck will indicate the number of tracks at the crossing.
- ¡IMPORTANT!
- You must stop at least 15 feet from a train track when: (1) warning lights flash; (2) a crossing gate or flag person signals an approaching train; (3) a train is within 1500 feet of the crossing; or (4) an approaching train is plainly visible and in hazardous proximity.

Follow these guidelines when you encounter a railroad crossing:

- Always expect a train.
- When approaching a crossing, LOOK, LISTEN, and LIVE.
- Be sure all tracks are clear before you proceed. Remember, due to their large size, it is easy to misjudge the speed and distance of an oncoming train. If you have any doubts, stop and wait for the train to pass.
- Watch for vehicles, such as school buses, that must stop before train tracks.
- Never race a train to a crossing.
- Always stop for flashing lights, bells, and gates. Never drive around a gate. (State law requires pedestrians to stop when a railroad crossing gate is down.)
- Do not allow yourself to be boxed in on a track with cars in front and behind you.
- Never stop on train tracks. If your car stalls on train tracks, call 911 immediately. If a train approaches, abandon the car and run away from the tracks.
- When driving at night, look low to the ground for moving trains. (One third of all train-car collisions occur at night when cars run into moving trains.)
- Watch out for a second oncoming train after the first train has passed.

15-Passenger Van Safety

Fifteen-passenger vans, which make up 0.25 % of the passenger vehicle fleet, are frequently used to transport school sports teams, vanpools and other groups. Although they are involved in a proportionate number of fatal accidents compared to their percentage in the fleet, they are involved in a higher rate of single-vehicle accidents involving rollovers than other passenger vehicles.

Various factors have been associated with vehicle rollover, particularly occupancy level and vehicle speed. The rollover rate for fully loaded 15-passenger vans is about three times the rollover rate of vans with fewer than 5 passengers.

Fully loading a 15-passenger van causes the center of gravity to move rearward and upward, which increase the vehicle's rollover propensity and could increase the potential for driver loss of control in emergency maneuvers.

The following recommendations should be followed when driving a 15-passenger van:

- The number of passengers, including the driver, should be no more than eleven.
- All passengers must use the lap/shoulder belt system at seating positions were installed.
- All cargo is prohibited on the roof of the van.
- Cargo inside the van must be stacked no higher than the top of the van seats.
- Towing with a 15-passenger van is prohibited.
- Anytime the van is operated with less than ten passengers, all passengers must sit as far forward in the vehicle as possible.

Bicycle Safety

In 2009 there were 630 fatalities and 51,000 injuries among cyclists in the U.S. Cyclists must take precautions when driving on city and University streets. Follow these safety precautions when riding a bicycle:

- Always obey all traffic laws: Stop at stop signs.
- Ride in the correct direction on one-way streets.
- Stop at railroad tracks when the warning signals are operating.
- When riding with other cyclists, ride single file in traffic.
- When bike lanes are available, use them. If bike lanes are not available, stay as far right as possible on the street pavement. Watch for opening car doors, sewer gratings, debris, etc. Do not ride on sidewalks.
- Use hand signals when turning or changing lanes.
- Wear a helmet that is approved by ANSI or the Snell Memorial Foundation. (Head injuries account for 75% of all cycling fatalities.)
- If riding at night, make sure your bicycle has reflectors on the rear, front, spokes, and pedals. Wear bright, reflective clothing.

End of Section

SECTION 16

GROUND MAINTANACE SAFETY

The following topics are covered.

1. Grounds Maintenance Safety
2. General Lawn Safety
3. Hand Tools
4. Mower Safety
5. Chain Saw Safety
6. Power Blower
7. Trimming Equipment
8. Chemical Products

General Lawn Safety

Lamar University spends considerable time, effort, and money on grounds maintenance. From flower care, to lawn care, tree trimming, and leaf blowing, Texas State University employees are responsible for safely maintaining the grounds on campus. Gardening tools and mechanical lawn care devices, such as lawn mowers, power blowers, and chain saws, present special safety concerns for grounds maintenance personnel.

Common landscaping accidents include the following:

- Cuts, lacerations, or amputations from whirling mower blades.
- Bruises or broken bones from flying projectiles.
- Burns from hot equipment parts
- Electrical shock from faulty grounding or defective electrical cords
- Back strain from improper equipment usage
- Slips, trips, and falls

Regardless of the type of landscape equipment you use, follow these basic guidelines to ensure optimum safety:

- Read the equipment owner's manual.
- Use the right equipment for the job at hand.
- Inspect the equipment before each use.
- Know how to control and stop the equipment quickly.
- Wear personal protection equipment, as necessary:
- Eye protection
- Hearing protection
- Long pants
- Sturdy shoes
- Work gloves
- Apply sunscreen to exposed areas of skin.
- Be careful to avoid fatigue and heat stress
- Refer to the General Safety chapter in this manual for more information):
- Drink plenty of water
- Take breaks
- Do not operate powered equipment if you are tired, sick, or taking medication.
- Take special precautions when working with electrical equipment. If you are using an extension cord, take care not to accidentally cut it.
- Do not smoke around gas powered equipment. Allow hot equipment to cool before refueling.
- Make sure that all guards are in place and in good condition

IMPORTANT: Keep pedestrians and bystanders at least 30 feet away when using power equipment.

Hand Tools

Although garden hand tools tend to be safer than powered equipment, common gardening tools, such as rakes, shovels, and hoes cause thousands of injuries each year. Follow these guidelines for using garden hand tools.

- Keep hand tools in good condition. Replace split or rotten handles. Keep blades sharp.
- Buy quality tools that fit your needs and your build. For example, if you are tall, choose tools with handles that are long enough to prevent you from stooping over your work.
- Never leave a rake, shovel, or hoe on the ground facing up. Foot injuries from exposed metal and head injuries from handles that pop up unexpectedly are the main hazards associated with these tools.

Mower Safety

Mowers are the most common type of lawn care equipment. To avoid injury with power mower equipment, you must pay close attention to your surroundings. Whether you use a riding mower or a walk-behind mower, follow these guidelines for lawn mower safety:

- Conduct a pre-mowing inspection of the lawn and remove any debris, rocks, limbs, or other items that could become a projectile. Look for concealed hazards such as holes.
- Keep hands and feet away from moving blades.
- Fill the tank with gas before beginning work. (By filling the tank initially, you can avoid having to fill the tank later when it is hot.)
- Replace loud or faulty mufflers.
- Shut off the engine before unclogging, servicing, or adjusting the mower and before removing the grass bag. For added protection, remove the ignition wire before working on the machine.

Riding Lawn Mowers

In addition to the general guidelines for mower safety, follow these guidelines for riding lawn mower safety:

- Before starting the engine, make sure the transmission is out of gear and the mower blade clutch is disengaged.
- Never allow extra riders on the lawn mower.
- Slow down when turning and when working on slopes. Mow up and down slopes rather than across them.
- Always look behind you before backing.
- If you hit a large rock or stump, stop the mower and inspect the blades and shaft. Replace damaged blades.
- Never leave a running lawn mower unattended. Before leaving the seat, park the mower on a flat area, disengage the mower blades, and remove the ignition key.

Walk-Behind Mowers

In addition to the general guidelines for mower safety, follow these guidelines for walk-behind mower safety:

- Wear sturdy shoes with good traction. Never wear sandals around walk-behind mowers.
- Do not bypass the safety device that stops the blade when the operator releases his/her grip on the handle.
- Mow across slopes rather than up and down slopes.
- Work slowly and patiently when mowing tall grass or tough weeds. Forcing the mower may cause repeated clogs and engine stalls.
- Never leave a running mower unattended. If you stop momentarily, cut the throttle to idle and make sure the mower will not roll away.

Chain Saw Safety

Chain saws are ideal for trimming trees and cutting fallen limbs into smaller pieces. Unfortunately, chain saws are associated with many serious injuries each year. Common chain saw hazards include the following:

- Chain cuts
- Falling trees and limbs
- Strains and sprains
- Burns

To avoid injury, you must respect chain saw hazards and handle chain saws skillfully. In addition to general lawn safety guidelines, follow these instructions for safely using chain saws:

- Stay alert while sawing. Most injuries occur below the waist when the operator is not paying attention.
- Do not use a chain saw alone. Have someone else stand nearby in case of an emergency.
- Choose and inspect your chain saw carefully:
- Use the correct size chain saw for the job at hand.
- Ensure that the chain is sharp and the tension is taut.
- Ensure that smaller chain saws have a safety tip to prevent kickbacks. (Kickbacks cause one third of all chain saw injuries.)
- Wear a hard hat to protect you from falling limbs.
- Always operate a chain saw with two hands.
- Limbs that are at shoulder height or higher present a special safety problem. Use a ladder so that the saw is at a lower and safer position relative to your body.
- Never allow the tip of a running chain saw to touch the ground. This could cause a serious kickback injury.
- To avoid kickback injuries; stand to the side of a running chain saw. Do not stand directly behind it.
- Move brush and limbs as you work to maintain a clear operating area.
- Never force a chain saw through a limb.
- Never stand on a log or limb while cutting it.

Power Blower

Because power leaf blowers produce air gusts up to 200 mph, you must follow all manufacturers' safety precautions. Always walk towards your work when using a power leaf blower. Do not back away from your work.

Trimming Equipment

Follow these safety guidelines for trimming equipment such as hedge trimmers, string trimmers, grass shears, and edger's:

- Avoid touching rocks, debris, and gravel with trimming equipment. These items could cause a serious injury if a kickback occurs.
- Make sure all screws and chains are tight. Vibrating equipment can cause screws to loosen.
- Walk towards your work. Do not back away from your work when using a trimmer.
- Always wear eye and ear protection
- Chemical Products

End of Section

SECTION 17

ENVIROMENTAL MANAGEMENT

Environmental Management on campus involves managing the impact that we have on the environment. The Environmental Health, Safety and Risk Management (EHSRM) office reviews and drafts environmental policy and programs to assist the University with improving compliance, pollution prevention, environmental education, and stewardship.

Environmental impacts are well regulated by both the Texas Commission on Environmental Quality (TCEQ) and the Environmental Protection Agency (EPA). EHSRM has developed programs to help the campus comply with the regulations and reduce its impact on the environment.

Hazardous Waste Program

The intent of the Lamar University Hazardous Waste Management Program is to protect water, land, and air by providing a means to handle and dispose of hazardous waste using environmentally sound methods. The program helps employees at Lamar University determine what is considered a hazardous waste, how to label and store the waste, and ultimately what is needed to have the waste disposed.

End of Section