Department of Mechanical Engineering

Safety Guidelines & Forms

1: DME Shop Safety Handbook/Guidelines

University of Hawaii
Department of Mechanical Engineering
Machine Shop Safety Handbook

August 25, 2008

The Basic Rules

1. Never work alone.
At least two adults must be in the shop when power tools are being used.

2. Never work when you are impaired.
This includes when you are too tired, stressed or hurried to work carefully.

3. If you cannot do a job safely in this shop, don't do it.
There are limits to what we can build here.

4. Always wear closed-toe shoes in the shop.
Tools, chips and fixtures are sharp, and often hot. Shoes will help protect your feet from injury Leather shoes are preferred when welding.

5. Eye protection is essential. Always wear safety glasses when working or cleaning tools.
Prescription glasses sold in the US with plastic lenses meet ANSI Standard Z87.1 for safety.

6. Remove or secure anything that might get caught in moving machinery.
Rings, necklaces, long hair and loose clothes that get caught in tools can drag you along.

7. Keep your hands away from sharp tools.
Make sure that nothing that you do will cause you to be cut.

8. Dust, chemicals and smoke can be dangerous - work in well-ventilated areas, minimize contamination and use appropriate protective equipment.

9. If you're unsure about the safe operation of a tool or any aspect of a job - ask for help! ***Have shop staff check you out on a tool the first time you use one with which you are unfamiliar.***

10. Clean up after yourself.
Before you leave the shop each day all tools must be returned to the toolbox, the machine cleaned and wiped down and the floor swept. Leave 10-15 minutes for cleanup.

Information about the Holmes 348 Shop

The Student Machine Shop in Holmes 348 or the assembly area in Holmes 140 are available to Mechanical Engineering students, staff and faculty working on University projects. Everyone must read this safety handout and attend a safety workshop before using the tools in the shop.

The goal of this handout is to summarize the risks that are inherent in metalworking and to provide some guidelines for working safely. It is **not** intended to be a machining training manual. The first step in preventing personal injury or machine damage is to make sure that you know how to operate the equipment you will be using correctly. **If you are unsure - ask!**

Because it is a communal area, used by so many people, it is important to keep the shop clean and orderly. This means that every user must clean the machines and work areas they use, and put away all tools and material before leaving the shop.

Inattention, hurried work, horseplay, bad judgment, fatigue, improper clothing, defective tools, and poorly secured workpieces cause most accidents. Avoid accidents by following all of the rules in this handout and asking for help if you are unsure about the safest approach.

Disregarding shop rules, working unsafely or leaving a mess will result in suspension of shop privileges.

These rules apply to the entire shop area in Holmes 348 and the project assembly area in Holmes 140.

In an Emergency:

Call 956-6911 in an emergency. The shop is in Holmes Hall Room 348 and the Assembly Area is in Holmes Hall Room 140.

Shop Hours:

Regular hours: M-F 8-12, 1-3. Access to the student shop may be limited during scheduled classes, and holidays.

By special permission during busy periods, the shop may be opened by T.A.'s or other staff in the evening or on weekends. Contact shop staff for additional information.

General Safety Guidelines

1. Do not attempt to remove foreign objects from the eye or body. Report to the student health service for medical treatment. If chemicals get in the eye(s), wash eye(s) for 15 minutes in an open flow of water before proceeding for medical treatment. Notify campus security at 956-6911.
2. Avoid excessive use of compressed air to blow dirt or chips from machinery to avoid scattering chips. Never use compressed air guns to clean clothing, hair, or aim the gun at another person.
3. Machines must be shut off when cleaning, repairing, or oiling.
4. Do not wear ties, loose clothing, jewelry, gloves, etc. around moving or rotating machinery. Long hair must be tied back or covered to keep it away from moving machinery. Hand protection in the form of suitable gloves should be used for handling hot objects, glass or sharp-edged items.
5. Wear appropriate clothing for the job (i.e. do not wear short sleeve shirts or short pants when welding).
6. Do not work in the shop if you are tired or in a hurry - this almost always ruins the work, and often results in injury.
7. Never indulge in horseplay in the shop areas.
8. All machines must be operated with all required guards and shields in place.
9. A brush, hook, or special tool is preferred for removal of chips, shavings, etc. from the work area. **Never** use your hands to clean cuttings - they are sharp!
10. Keep your fingers clear of the point of operation of machines by using special tools or devices, such as, push sticks, hooks, pliers, etc. **Never use a rag near moving machinery**.
11. A hard hammer should not be used to strike a hardened tool or any machine part. Use a soft-faced hammer.
12. Keep the floor around machines clean, dry and free from trip hazards. Do not allow chips to accumulate.
13. Think through the entire job before starting. Ask for help if you have questions.
14. Before starting a machine, always check it for correct setup and always check to see if machine is clear by operating it manually, if possible.
15. **Do not drink alcoholic beverages before or during work in the machine shop area. Do not bring food or snacks into the shop.**
16. If you have not worked with a particular material before, check the hazardous materials data sheets for any specific precautions to be taken while working with the material. Also, ask the shop personnel before cutting any unusual material.
17. Heavy sanding, sawing, grinding and painting should only be done in well-ventilated areas. Use face masks.
18. Follow all appropriate precautions when working with solvents, paints, adhesives or other chemicals. Use appropriate protective equipment.
19. Check the power cords and plugs on portable tools for damage before using them.
20. Always store oily rags in an approved metal container.

Drill Press Safety Guidelines

1. Run drill at correct RPM for diameter of drill bit and material. Ask shop personnel for the correct RPM.
2. Always hold work in a vise or clamp to the drill table.
3. Use a correctly ground drill bit for the material being drilled. Shop personnel can help select the correct bit.
4. Use the proper cutting fluid for the material being drilled. Ask the shop staff about the appropriate fluid for the material you are machining.

5. Remove chips with a brush, never by hand.
6. Ease up on drilling pressure as the drill starts to break through the bottom of the material.
7. Don't use a dull or cracked drill. Inspect the drill before using.
8. Don't drill with too much pressure.
9. Always try to support part on parallels or a backing board when drilling thru material.
10. **Never** place taper shank tools such as large diameter drills or tapered shank reamers in a drill chuck. Only straight shank tools such as standard drills can be clamped in chucks.
11. Always clean drill shank and/or drill sleeve, and, spindle hole before mounting.
12. Remove taper shank tools from spindle or sleeve with a drill drift and hammer.
13. **Never** try to loosen the drill chuck while the power is on.
14. Lower the drill spindle close to the table when releasing the drill chuck or taper shank drill to reduce the chance of damage should they fall onto the table.
15. **Never clean a machine while it is in motion!!**
16. If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
17. **When drilling a deep hole withdraw the drill bit frequently to clear chips and lubricate the bit.**
18. **Always remove** the drill chuck key, or, the drill drift from the spindle **immediately after using it.**
19. Wear safety eye protection while drilling.
20. Let the spindle stop of its own accord after turning the power off. **Never try to stop the spindle with your hand.**
21. Plexiglass and other brittle plastics can be difficult to drill. Ask the shop superintendent for advice on drill and coolant selection when drilling these materials.

Lathe Safety Guidelines

1. Make sure that the chuck, driveplate, or, faceplate is securely tightened onto the lathe spindle.
2. When removing the chuck, driveplate, or faceplate do not use machine power.
3. When installing the chuck, driveplate, or faceplate do not use machine power.
4. Move the tool bit a safe distance from the collet or chuck when inserting or removing work.
5. Don't run the machine faster than the proper cutting speed - consult a speed and feed table to determine the best speed.
6. In setting up the tool holder place it to the left side of the compound slide to prevent the compound slide from running into the chuck or spindle attachments.
7. Always clamp the toolbit as short as possible in the toolholder to prevent it from breaking or chattering.
8. Always make sure that the toolbit is sharp and has the proper clearance. Ask for assistance making adjustments.
9. If any filing is done on work revolving in the lathe, file left handed to prevent slipping into the chuck. Never use a file without a handle.
10. If work is turned between centers, make sure that proper adjustment is made between centers and that the tailstock is locked in place.
11. If work is being turned between centers and expands due to heat generated from cutting, readjust centers to avoid excessive friction.
12. Do not grasp or touch chips or turnings with your fingers, but get rid of them using a blunt instrument. It is safer to turn off the lathe before clearing chips then to leave it running.
13. Set the toolbit on the centerline of your work to prevent work from climbing over tool or cutting above center and dragging.
14. Don't cut work completely through when turning between centers.

15. **Remove chuck key from chuck immediately after using.**
16. Turn chuck or faceplate through by hand before turning on the power to be sure there is no binding or clearance problem.
17. Stop the machine before taking measurements.
18. Before cleaning the lathe remove tools from the tool post and tailstock.
19. Wear eye protection.

Milling Machine Safety Guidelines

1. Work must be clamped securely in a vise and vise clamped tightly to the table, or, work must be clamped securely to the table.
2. Do not take climb milling cuts on the shop's mills unless instructed to do so.
3. Make sure cutter is rotating in the proper direction before cutting material.
4. Before running machine the spindle should be rotated by hand to make sure it is clear for cutting.
5. Make sure the power is off before changing cutters.
6. Always use the proper cutting fluid for the material being cut.
7. Never run the machine faster than the correct cutting speed.
8. Make sure that the machine is fully stopped before taking any measurements.
9. Always use cutters which are sharp and in good condition.
10. Don't place anything on the milling machine table such as wrenches, hammers, or tools.
11. Always stay at the machine while it is running.
12. Don't take too heavy a cut or use too rapid a feed.
13. **Remove the collet tightening wrench immediately after using it.**
14. If at all feasible rig a guard or shield to prevent chips from hitting other people.
15. Use the milling machine spindle brake to stop the spindle after the power has been turned off.
16. **Before cleaning** the mill remove cutting tools from the spindle to avoid cutting yourself.
17. Wear eye protection.

Band Saw Safety Guidelines

1. The upper guide and guard should be set as close to the work as possible, at least within **1/4 inch**.
2. If the band breaks, immediately shut off the power and stand clear until the machine has stopped.
3. Examine blade before installing to see if it is cracked, do not install a cracked blade.
4. Use the proper pitch blade for the thickness of the material to be cut. There should be at least 2 teeth in the material when cutting aluminum, and three teeth when cutting steel.
5. Check the speed table for the material that you are cutting. Do not run the band saw too fast or the blade will wear out quickly.
6. If the saw stalls in a cut, turn the power off and reverse the blade by hand to free it.
7. Wear eye protection.

Grinding Safety Guidelines

1. Abrasive wheel machinery shall not be operated without the appropriate guards in place.
2. Toolrests on bench or pedestal grinders shall be set no more than 1/16 inch from the wheel.
3. Never use a wheel that has been dropped or received a heavy blow, even though there may be no apparent damage. Such wheels may be weakened or unbalanced enough to fly apart on startup.
4. **Stand to one side when starting a grinding machine**. Damaged wheels will sometimes fly apart, and this is most likely to happen when the machine is being started. Stand to the side so that you will not be in-line with the debris.
5. Do not grind on side of wheel unless wheel is specifically designed for such use.
6. Do not use excessive pressure while grinding.
7. Report to the area supervisor immediately any cracked, broken or otherwise defective wheels.
8. Have the area supervisor mount and balance new wheels.
9. Keep the grinding wheel dressed. Dressing a small amount frequently is better than having to dress a lot later and will allow the wheel to cut faster, cooler and with a better surface finish. Dressing is cleaning and smoothing the surface of the grinding wheel.
10. Hold work securely while grinding, use the toolrest to support the work when off-hand grinding on bench or pedestal grinders.
11. Do not grind aluminum. Aluminum dust is explosive. Grinder is for grinding steel only.
12. Wear safety shields or safety glasses when grinding on bench or pedestal grinders.

Table Saw Safety Guidelines

1. Special training is required before using the table saw. You may not operate it without permission from the shop supervisor.
2. Stand to one side, never directly in line with, of work being fed through the saw.
3. Use the proper blade for the material and type of cut. Do not use a rip blade for cross cutting, or, a crosscut blade for rip sawing. Do not use a plywood blade for anything but plywood.
4. Inspect the blade before using it, to make sure it is the proper blade and is sharp and free from cracks.
5. **Never** allow your fingers to get near the blade when sawing. Use a pusher stick to rip narrow pieces of stock. Don't use pusher stick to remove scrap. For scrap removal, shut off machine and wait until blade stops, then remove scraps.
6. **Appropriate guards must be in place at all times.** Never remove the blade guard. Ask one of the shop personnel for help if you think the guard is in the way.
7. If the piece of material you are cutting is large, get someone to assist in tailing-off for you. Never try to do it alone. Tailing off refers to supporting a large workpiece by supporting it underneath with your hands.
8. If you are tailing-off for someone else let them guide the work through the saw. You should just support the work without influencing the cut.
9. Never reach over the saw to obtain something from the other side.
10. When shutting off the power, never attempt to stop the saw quickly by shoving anything against the blade. Make sure the saw has stopped before leaving it.
11. Never make any adjustments to the saw while it is running. Turn off the power, unplug the power cord and make sure the saw is completely stopped before attempting to adjust it.
12. Do not allow material to collect on or around the saw table. **Sweep up sawdust and material scraps regularly** while working to minimize chances of slipping or stumbling.
13. Make sure that you clean up thoroughly around the saw before leaving the area. If you don't you could be the cause of someone else having an accident.
14. The circular blade of the table saw should be set to **1/8 inch above the work.**
15. Wear eye protection.

Power Hand (Skill) Saw Safety Guidelines

1. Unplug the tool before making any adjustments.
2. Before using any power tool, inspect it to make sure the cord is not damaged in any way, that the ground pin is intact, and that the blade is sharp and undamaged.
3. Do not use the saw in a wet area.
4. Do not run the extension cord across walkways where people might trip over it or where the cord may be run over and damaged.
5. Keep your head out of the path of particles thrown out by the blade. Wear eye protection.
6. Disconnect the power cord before cleaning, changing blades, or making any adjustments to the saw.
7. When it is necessary to raise the guard for certain types of cuts, use the guard lever.
8. Never wedge, wire, or otherwise jam the guard to prevent it from working. **This is a particularly dangerous practice and will cause your permission to work in the machine shop to be revoked immediately!!!**
9. Wait until the saw stops before lifting it from a cut.
10. Before setting the saw down, make sure the guard is closed, as the blade may still be turning.
11. Don't carry the saw with your fingers on the switch trigger.
12. Don't pull the saw backwards in a cut if you can avoid it.
13. Use the proper blade for the type of cut to be made.
14. Do not use the cord to move or drag the saw.
15. Do not use the power hand saw for cuts if you cannot keep a firm and secure grip on the saw and the material being cut. A hand saw is still the best for some kinds of work and often faster.
16. Before cutting small workpieces shop personnel should be consulted.
17. Adjust the depth of cut 1/8" greater than the material thickness.

Disc and Belt Sander Safety Guidelines

1. Do not operate sanders without the guards in place.
2. On the disc sander always use the downward motion side of the disc to sand. Never the upward motion side as this can throw your part upwards with tremendous force.
3. Always attempt to place your work against the rest on the disc and belt sanders.
4. On the horizontal belt sander, always sand, so that the belt motion is away from you.
5. Do not operate machines with torn or ripped belts or disks.
6. **Do not sand any material that will give off a dangerous dust. Such materials as berylium or copper berylium alloys must not be sanded or filed. Asbestos must not be sanded. Asbestos is an ingredient of brake shoes and pads.**
7. Wear eye protection.

Welding Safety Guidelines

1. **Shop staff approval is required before using any welding equipment.**
2. Welders, assistants, and anyone else in the welding area shall wear glasses or shields of recommended shades during welding operations.
3. The welder is responsible for erecting a screen around the welding area to protect other personnel in the shop from eye injury.
4. Inspect all welding equipment to be used, prior to each use, for possible damage.
5. Avoid handling oxygen bottles with greasy hands, gloves or rags. Fatal explosions have resulted from this cause.
6. Always strap tanks to a welding cart or a fixed object. Never allow a gas cylinder to be free standing. Replace the safety cap on all cylinders when not in use.
7. When arc welding, make sure work and/or work table is properly grounded.
8. Do not arc weld in a wet area.

9. Be alert to possible fire hazards. Move the object to be welded to a safe location, or, **remove all flammable materials from the work area.**
10. Never weld in the same area where degreasing or other cleaning operations are performed.
11. Keep suitable fire extinguishing equipment nearby and know how to operate it.
12. Shut off the cylinder valves when the job is completed, release pressure from the regulators by opening the torch valves momentarily, and back out regulator adjusting valves. Never leave the torch unattended with pressure in the hoses.
13. Utilize all protective equipment and clothing. Do not arc weld with any part of the body uncovered, the arc light is actinic light (excessive ultraviolet) and will cause burns similar to severe sunburn.
14. Never weld inside drums or enclosed spaces without adequate ventilation, or, the use of airline respirators or self-contained breathing apparatus.
15. Check the ventilation system before starting to weld and periodically thereafter to insure adequate performance. **Welding fumes should not be allowed to get into the rest of the shop working areas.**
16. Never cut or weld any container that has held explosive or flammable materials. Use prescribed methods for cleaning or flooding.
17. Never use wrenches or tools except those provided or approved by the gas cylinder manufacturer to open valves. Never use a hammer to open or close valves.
18. Abide by any other safety measures required for each particular type of welding.
19. Allow for proper ventilation when brazing or soldering. The fluxes are acidic and toxic.
20. Do not weld on painted, galvanized or greasy, oily metals. Not only can the fumes be toxic, but the welds will not be satisfactory and will fail in use.

Safety Guidelines for Working with Solvents, Resins and other Chemicals

1. Learn about the chemicals that you are planning to use before opening them. Read the instructions and MSDS sheet. Consult shop staff or EH&S if you have any questions.
2. Use water-based cleaners instead of solvents where possible.
3. Avoid skin contact. Wear latex gloves.
4. Work in a fume hood if possible or in a well ventilated area.
5. Do not use solvents around hot metal surfaces and flames.
6. Do not smoke or light flames in areas where solvents are used and stored.
7. Report and clean up any spills immediately.
8. Only use solvents in well ventilated areas - do not work with them in confined, unventilated areas.
9. Do not drink alcoholic beverages or take medications containing alcohol before or during working with solvents. Alcohol in the bloodstream sometimes causes synergistic reactions with various solvents that can lead to loss of consciousness, and even possibly, death.
10. Report any ill effects and skin disorders to the area supervisor.
11. Develop and maintain good personal hygiene habits. Remove protective equipment and wash thoroughly after contact with solvents.
12. Fumes from paints, solvents, adhesives can drift into the shop. Work with staff to minimize these problems.
13. Mix resins in small batches.
14. Wear eye protection.

Safety Guidelines for Heavy Sanding of Wood and Foam

1. Sand in a well ventilated areas away from other machines, only on the patio with the doors to the shop closed.
2. Use a vacuum to collect dust while sanding to prevent the dispersal over a large area.

3. A dust mask must be worn.
4. Safety glasses must be worn when sanding.

Guidelines for Cleaning

1. Turn off power to the machine before cleaning. This will avoid accidentally starting the machine and injuring yourself.
2. Remove cutting tools. Take out drill bits, mills and remove lathe tools to reduce the chances of getting cut. On the table saw lower the blade completely.
3. Put away all hand tools and other items around the tool so that you don't make them dirtier.
4. Clean chips from the tool, the chip pans. Recycle clean chips where possible.
5. Put a light coat of way oil on the machine ways. Ask staff to show you where this oil is kept.
6. Sweep the floor in the area where you have been working.
7. Do not over use compressed air. Do not blow air into the bearing surfaces, and do not scatter chips all over the shop. Sometimes a shop vacuum works better than the air gun.
8. Report missing, broken or damaged tools to shop staff.
9. Spend five minutes on general cleaning around the shop. We're all in this together.

2: Acknowledge of the Training Form

I _____ have read the Department of Mechanical Engineering Machine Shop Safety Handbook and participated in a training session with Mr Lewis Moore on _____.

_____

Sign date

_____

Lewis Moore, Shop Safety Instructor date

3: Assumption of Risk Forms

3.1: General Form

University of Hawaii
Mechanical Engineering Department
2540 Dole Street, Holmes 302
Honolulu, Hawaii 96822

ASSUMPTION OF RISK AND RELEASE

Name of Course/ Activity: _____

Instructor in Charge: _____

I have received, read and fully understand the written safety and other rules and precautions that are a part of the requirements for my participation in the above referenced course/activity, as well as those explained to me by my instructor(s), and I agree to strictly observe them; and

I do for myself, my heirs, executors, and administrators hereby accept full responsibility for and indemnify, release, and discharge the University of Hawaii, its officers, agents, and employees from any and all claims of actions for property damage, and/or personal injury which may result from my failure to abide by these safety rules and precautions, or from any inherent risks inside course/activity.

_____Date: _____
Student/Participant – **print and sign**

_____Date: _____
Cosignature of parent or guardian If student/participant is under 18 years of age – **print and sign**

3.2: Form for ME 481 & ME 482

UNIVERSITY of HAWAI'I® MĀNOA

Department of Mechanical Engineering

ASSUMPTION OF RISK, RELEASE, AND INDEMNITY AGREEMENT

Class: ME 481/482 Design Project I / II, **Semesters:** Fall 2013 / Spring 2014

I am fully aware and acknowledge that there are inherent dangers and risks involved in the Class/Activity which include, but are not limited to: supervised and unsupervised use of tools, instruments and machinery in labs and workshops; design, fabrication and testing of prototype vehicles on and off-campus, on and off-road racing, travel to and from competition and events.

I understand that the University of Hawaii does not provide health insurance or otherwise indemnify individuals with respect to injuries or other liabilities arising out of participation in the Class/Activity.

I have received, read and understand any and all written materials and safety guidelines setting forth the requirements for my participation in the Class/Activity and I agree to strictly observe them.

In consideration of being permitted to participate and in full recognition of the inherent dangers and hazards in this Class/Activity and during transportation to and from off-campus locations, I voluntarily assume full responsibility for any loss, property damage or personal injury or illness, including death, that may be sustained as a result of my participation. I, for myself, my heirs, personal representatives or assigns, hereby RELEASE, WAIVE,DISCHARGE and COVENANT NOT SUE the University of Hawaii, its Board of Regents, officers, employees and agents (collectively referred to hereinafter as "the University") from any and all claims resulting in property damage or personal injury or illness or death arising from my participation in the Class/Activity or growing out of or caused by my acts or omissions during my participation in the Class/Activity.

I also agree to DEFEND, INDEMNIFY AND HOLD HARMLESS the University from and against any and all claims, demands and actions or causes of action, on account of financial loss, damage to personal property, or personal injury, illness or death which may result from my participation is the Class/Activity.

I have read the Assumption of Risk, Release, and Indemnity Agreement and understand that I am giving up substantial rights, including the right to sue. I acknowledge that I am signing the agreement freely and voluntarily.

I agree that if any portion is held invalid, the remainder will continue in full legal force and effect.

_____

Signature (Co-signature of parent or guardian required if under 18 years of age.) Date

_____

Print Name

4: COE Safety Guidelines

College of ENGINEERING
UNIVERSITY OF HAWAI'I AT MĀNOA

Safety Guidelines and Laboratory/Workshop Practices

- **All students are required to take a one hour lab safety class per laboratory.**
- **All students are required to complete and sign an *Assumption of Risk, Release, and indemnity Agreement* form for each laboratory in which they work.**
- **Undergraduates and Graduates are prohibited from working alone with equipment in high risk laboratories. Office work on desks within these Laboratories is permitted.**
- **In case of a fire, immediately leave the laboratory/workshop and pull the closest fire alarm. Do not use the elevators. Call x66911 from a safe place outside the building.**
- **In case of an accident, call x66911 or have someone call and provide the following information: your name, location, nature of emergency.**
- **Smoking, eating, and drinking are prohibited in laboratories/workshops.**
- **The College Safety Committee will be responsible for updates to individual laboratory/workshop policies and adjudicating cases of infringement of safety guidelines, such as working alone in a high risk laboratory/workshop.**

Safety is an integral and important part of your education, your work, and your life!
Periodic, unannounced laboratory/workshop inspections will be conducted. If any student is caught working alone, in a high risk laboratory/workshop they could face a ban on access to all high risk laboratories/workshops for two months.