Machine Shop Safety Handout

Build 2009

The Basic Rules

1. Never work in the shop without a mentor present.
2. Do not work in the shop if you are tired, sick or in a hurry – this almost always ruins the work, and often results in injury.
3. Eye protection is essential. Always wear safety glasses in the shop
4. Remove or secure anything that might get caught in moving machinery. Rings, necklaces, long hair, watches, bracelets and loose clothes that get caught in tools can drag you along.
5. 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..
6. Keep your hands away from sharp tools. Make sure that nothing that you do will cause you to be cut.
7. If you're unsure about the safe operation of a tool or any aspect of a job – ask for help! Have your mentor work with you on the use of a tool until you feel comfortable with it.
8. 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.
9. Do not bring food or snacks into the shop. Drinks brought into the shop must be capped.
10. Report injuries to your mentor
11. Never indulge in horseplay in the shop areas.

Machine Safety Guidelines

1. Think through the entire job before starting. Ask for help if you have questions.
2. 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.
3. 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.
4. Properly lubricate cutting tools.
5. 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!
6. 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.
7. A hard hammer should not be used to strike a hardened tool or any machine part. Use a soft-faced hammer.
8. Keep the floor around machines clean, dry and free from trip hazards. Do not allow chips to accumulate.

Drill Press Safety Guidelines

1. Wear safety eye protection while drilling.
2. Do not use the shop drill press until properly trained by your mentor.
3. WARNING!! Drill bits, center drills, spot facers, deburring tools, counterbores, and reamers can be extremely sharp. Be aware of the location of the tool when changing workpieces. If you come into contact with the tool, you may get cut severely! Report all injuries immediately!

4. Make certain that the workpiece is securely clamped to the table of the drill press. Failure to check may result in items being caught up on the tool bit. These items will spin violently on the tool bit, causing bodily injury!
5. 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.
6. Always clean drill shank and/or drill sleeve, and, spindle hole before mounting.
7. Remove taper shank tools from spindle or sleeve with a drill drift and hammer.
8. Always remove the drill chuck key, or, the drill drift from the spindle immediately after using it.
9. Before powering spindle up, make certain all loose hand tools, drifts, chuck keys, and measuring tools have been removed from the machine and put in the proper location, especially chuck wrenches!
10. Always try to support part on parallels or a backing board when drilling thru material.
11. Run drill at correct RPM for diameter of drill bit and material. Ask shop personnel for the correct RPM.
12. Don't use a dull or cracked drill. Inspect the drill before using.
13. Don't drill with too much pressure.
14. Never attempt to measure parts or clean the machine while the drill bit is rotating.
15. If the workpiece begins to vibrate, or the cutter makes excessive noise, stop cutting immediately.
16. When drilling a deep hole withdraw the drill bit frequently to clear chips and lubricate the bit.
17. The chips produced through drilling can also be razor sharp and if not properly formed, can be excessively long. Use extreme caution when removing chips! Remove chips with air or a brush, never by hand.
18. Ease up on drilling pressure as the drill starts to break through the bottom of the material.
19. If the drill binds in a hole, stop the machine and turn the spindle backwards by hand to release the bit.
20. Let the spindle stop of its own accord after turning the power off. Never try to stop the spindle with your hand.
21. Never try to loosen the drill chuck while the power is on.
22. Never clean a machine while it is in motion!!

Additional Milling Machine Safety Guidelines

1. Milling cutters can be extremely sharp. When changing tools, always wrap the cutter in a rag. Do not touch the cutting edges with your bare hands. NEVER touch a rotating tool bit.
2. Remove the collet tightening wrench immediately after using it.
3. WARNING!! Make certain that the workpiece is securely fixtured and that all components of the fixture are securely fastened to the table. Because of the enormous forces involved in milling, failure to check security may result in items being flung from the setup causing bodily injury. If you are not sure if your setup is safe, have your shop supervisor check it out before you begin cutting. Pay extra attention to the position and angle of toe clamps.
4. Check that table or spindle locks are off before engaging the associated power feed.
5. Calculate the proper spindle speed and table feed rate before beginning a cut. Make certain to use a proper safety factor for the rigidity of the set up and the condition of the tooling. If you are not sure about your calculations, ask your mentor!

6. The spindle must be completely stopped before attempting to change from low gear to high gear or vice versa. Conversely, speed selection within a gear range should only be done with the spindle running.
7. Before powering spindle up, make certain that the milling cutter, its tool holder, and the spindle, are free of the workpiece and will not run into any of the fixturing components. Also, make certain all loose hand tools, spindle wrenches, chuck keys, and measuring tools have been removed from the machine and put in the proper location.
8. Make certain that the feed direction being used does not result in a climb milling operation. If you are not sure of what constitutes a climb milling operation, or what the consequences of that operation can be, consult your shop supervisor.
9. Make certain that the milling cutter is rotating in the proper direction before beginning a cut, otherwise the milling cutter will burn up.
10. Do not attempt to take a heavier cut than the cutter or the workpiece setup can handle. If you are not sure what the proper depth of cut is, ask your supervisor!
11. Apply all coolants to the tool bit in a safe manner. The use of spray bottles is highly recommended. REPORT ALL OIL AND GREASE SPILLS IMMEDIATELY! These are an extreme slip hazard!!
12. If the workpiece begins to vibrate, or the cutter makes excessive noise, stop cutting immediately.
13. Use the milling machine spindle brake to stop the spindle after the power has been turned off.
14. Before cleaning the mill remove cutting tools from the spindle to avoid cutting yourself.

Lathe Safety Guidelines

1. Do not use the shop lathe until properly trained by your mentor.
2. Before changing tools or lathe chucks, make certain that the power to the drive motor is shut down. Do not simply shut off the spindle. If you are not sure of the procedure for changing tools or chucks, ask you supervisor for detailed instructions.
3. Make sure that the chuck, driveplate, or, faceplate is securely tightened onto the lathe spindle.
4. When removing the chuck, driveplate, or faceplate do not use machine power.
5. When installing the chuck, driveplate, or faceplate do not use machine power.
6. Move the tool bit a safe distance from the collet or chuck when inserting or removing work.
7. WARNING!! Make certain that the workpiece is securely clamped in the lathe chuck or face plate. Failure to check may result in items being thrown from the lathe causing bodily injury. If you are not sure if your setup is safe, have your shop supervisor check it out before you begin cutting.
8. Remove chuck key from chuck immediately after using.
9. Before powering spindle up, make certain that the tool holder, the carriage, and all cross slides will not run into the chuck jaws. Also, make certain all loose hand tools, chuck wrenches, chuck keys, and measuring tools have been removed from the machine and put in the proper location especially chuck wrenches.
10. Turn chuck or faceplate through by hand before turning on the power to be sure there is no binding or clearance problem.
11. Don't run the machine faster than the proper cutting speed – consult a speed and feed table to determine the best speed.

12. The spindle must be completely stopped before attempting to change from low gear to high gear or vice versa. Conversely, speed selection within a gear range should only be done with the spindle running.
13. 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.
14. Always clamp the toolbit as short as possible in the toolholder to prevent it from breaking or chattering.
15. Set the toolbit on the centerline of your work to prevent work from climbing over tool or cutting above center and dragging.
16. Always make sure that the toolbit is sharp and has the proper clearance. Ask for assistance making adjustments.
17. The chips produced in the lathe can also be razor sharp and if not properly formed, can be excessively long. Use extreme caution when removing lathe chips! Always use a brush to clean a machine.
18. 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.
19. 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.
20. Never attempt to measure parts or clean the machine while the workpiece is rotating. Stop the machine before taking measurements.
21. Never reach over the machine while the chuck is rotating.
22. If work is turned between centers, make sure that proper adjustment is made between centers and that the tailstock is locked in place.
23. If work is being turned between centers and expands due to heat generated from cutting, readjust centers to avoid excessive friction.
24. Don't cut work completely through when turning between centers.
25. Before cleaning the lathe remove tools from the tool post and tailstock.

Band Saw Safety Guidelines

1. Do not use the shop saws until your mentor has trained you how to use them.
2. WARNING!! Loose clothing, long hair, personal stereo wires and jewelry may become entangled in rotating equipment leading to serious injury or death! Make certain that such articles are removed or securely fastened to avoid entanglement.
3. Saw blades can be extremely sharp. Saw blades are also made out of steel that is very spring like in nature. If you are not careful when handling the blades, they may spring out and you may get cut severely! Report all injuries immediately!
4. The upper guide and guard should be set as close to the work as possible, at least within 1/4 inch.
5. 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.
6. 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.
7. The spindle must be completely stopped before attempting to change drive belt position on the motor and spindle pulleys. The belt should always be level and not cross from one pulley level to another.
8. Before powering the saw up, make certain all loose tools have been removed from the machine and put in the proper location.

9. Use extreme caution when removing chips! Always use a brush to clean the saws. Do not use compressed air to blow the chips off of the machine or your clothes. Never clean the saw while the blade is moving.
10. Since the vertical band saws do not have power feed, you will have to feed stock into the blade by pushing with your hands. ALWAYS KEEP IN MIND THAT IF YOUR HANDS SLIP, YOU MAY GET CUT! Keep your hands out of a direct line with the blade! If possible, push the material with a block of wood, and keep your hands behind the block.
11. When sawing thin pieces of metal or small parts, saw into a wood block before beginning to cut your workpiece. The close fit of the wood block around the saw blade will prevent the small parts from getting pulled into the saw.
12. WARNING!! Make certain that the workpiece is properly supported before beginning to cut. As the cut is completed, part of the workpiece may have to sag to prevent pinching the saw blade. Under these conditions, the part may fall the floor. Watch that hands, feet, power cords, or other items will not be struck by the falling part. If you are not sure that your setup is safe, have your mentor check it out before you begin cutting.
13. Never cut materials harder than brass or aluminum on the vertical band saw.
14. Apply coolants (rarely needed on our saws) to the blade in a safe manner. The use of spray bottles is highly recommended.
15. Watch for oil or grease spilled on the floor. This is an extreme slip hazard and needs to be reported immediately!
16. DO NOT attempt to cut round stock while holding the material in your hand! The saw will grab on the material and spin it causing a loss of control. You may get injured severely! Always hold round stock clamped in a V block.
17. If the workpiece begins to vibrate, makes excessive noise, or the saw blade gets jammed, stop cutting immediately.
18. If the saw stalls in a cut, turn the power off and reverse the blade by hand to free it.
19. If the band breaks, immediately shut off the power and stand clear until the machine has stopped.
20. Never attempt to measure parts while they are still on the saw, always remove them to a safe location.
21. MAKE CERTAIN THAT THE SAW BLADE HAS COME TO A COMPLETE STOP BEFORE ADJUSTING THE SAW GUIDES!

Abrasive Machine Safety Guidelines

1. Do not use the shop grinders or sanders until your mentor has trained you
2. Make certain that the tool rests are set to within 1/16” of the abrasive media. If this clearance is not maintained, the workpiece can easily be pulled into the media. This will happen so fast that you may not have time to leave go and your hand may get pulled into the grinder. If the piece goes around the wheel, it will come out as a projectile. You may be in its path. Additionally, the media may disintegrate and become additional shrapnel for you to deal with. IF YOU HAVE ANY DOUBTS ABOUT THE CONDITION OF THE MACHINE, REPORT IT TO YOUR MENTOR!!!
3. Before powering the machine up, make certain all loose tools have been removed from the machine and put in the proper location.
4. Abrasive machines remove material at an incredibly rapid rate. You must pay extreme attention to what you are doing! Use a pair of pliers to hold small pieces for grinding. If your hand comes into contact with the media, you WILL get cut severely! It is not uncommon for these cuts to go to the bone! Report all injuries immediately!

5. Hold work securely while grinding, use the toolrest to support the work when off-hand grinding on bench or pedestal grinders.
6. WARNING! Newly ground pieces will be extremely HOT. Do not touch freshly ground pieces until they have cooled. You may need to periodically cool pieces in a waterbath to finish a grinding job.
7. Always use a brush to clean the machines. Never clean the machines while the media is moving.
8. Since the abrasive machines do not have power feed, you will have to feed stock into the blade by pushing with your hands. ALWAYS KEEP IN MIND THAT IF YOUR HANDS SLIP, YOU MAY GET CUT! Keep your hands out of a direct line with the media if possible. If it is not possible, push lightly and be careful.
9. Never wear gloves while using the bench machines. Gloves can very easily get caught, pulling them into the machine and taking your hand with them!
10. Never cut wood, plastic, brass, aluminum, or other soft materials with a grinding wheel. These materials will melt, and the slag will flow into the pores of the wheel, ruining the wheel. Should this inadvertently happen, please report this condition immediately so that repairs can be attempted before someone gets hurt.
11. Soft materials should only be abrasively machined on the belt or disk sander. The media on these machines should be changed if it becomes loaded or worn. Ask your supervisor if you are not certain of the condition of the equipment.
12. 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.

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. Do not use solvents around hot metal surfaces and flames.
5. Do not smoke or light flames in areas where solvents are used and stored.
6. Report and clean up any spills immediately.
7. Do not pour any chemicals down the drain. Waste containers are available in the solvent cabinet.
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 your mentor.
11. Develop and maintain good personal hygiene habits. Remove protective equipment and wash thoroughly after contact with solvents.

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.

Requirements for the Safe Operation of Robots

1. SAFETY GLASSES MUST BE WORN AT ALL TIMES WHEN WORKING WITH THE ROBOTS! Failure to comply may result in dismissal from the lab. The compressed air used in the robots is supplied at high pressure. Also, the robots are capable of rapid moves that can break equipment. Ruptured air lines or demolished equipment are both hazards to unprotected eyes.
2. The robots are not to be operated without a mentor in the immediate area.
3. NEVER PLACE ANY PART OF YOUR PERSON WITHIN THE WORK ENVELOPE OF THE ROBOT WITHOUT FIRST DISABLING THE ROBOT ARM!! Persons caught standing in the work envelope of a robot with an active arm MAY BE DISMISSED FROM THE LAB.
4. WARNING!! The robots have rotating equipment associated with their drive systems. Loose clothing, long hair, personal stereo wires and jewelry may become entangled in rotating equipment leading to serious injury or death! Make certain that such articles are removed or securely fastened to avoid entanglement.
5. It is very easy to become totally engrossed in the programming or in manually aligning the robot. This makes it very important that you always keep in mind where your body is placed and where your coworkers are. In an error situation, the robot can make incredibly rapid and unexpected moves. If you or your coworkers are in the wrong place at the right time, you or they will be in danger of serious physical injury. Pay particular attention that heads are not in the work envelope.
6. Frequently a glue applicator is used in conjunction with the robots. Depending on the material being joined, the adhesive being used may be either a hot melt or a cyanoacrylate (SuperGlue). Each of these adhesives has its own set of hazards. When they are in use, give the robots the extra respect they deserve. REMEMBER, the adhesive dispensers operateunder pressure. Component failure in these systems could result in adhesives being sprayed randomly. Wear your safety glasses.
7. The robots are also frequently used with the various conveyor systems and assembly machines in the lab. Each of these pieces of equipment has moving parts generally activated by compressedair. Because of this, a pinch hazard exists on each of these devices. WATCH WHERE YOU PLACE YOUR HANDS!!
8. A robot is only as smart as the person programing it. If you tell it to move to the wrong point, it will (try) to go there. If a person or object is in the way, damage will be done. -- THE FIRST TIME A PROGRAM IS RUN, DO SO AT A SLOW SPEED. -- NEVER RUN A PROGRAM WITHOUT FIRST CHECKING THE WORK ENVELOPE FOR OBSTRUCTIONS.
9. THE OPERATOR MUST KEEP ONE HAND NEAR THE EMERGENCY SHUT DOWN SWITCH AT ALL TIMES WHEN THE ROBOT IS OPERATING!!

If you do not know how to operate a machine or do not fully understand the instructions you have been given, ask your mentor until you are certain about what is required. IF YOU DON'T KNOW, ASK!

In signing this statement, I acknowledge that I have carefully read and fully understand the serious nature of working with machine tools. I also realize that other, undefined hazards will always exist in the machine shop environment therefore, MY OWN SAFETY IS ULTIMATELY MY OWN RESPONSIBILITY.

Signature: _____

Date: _____

Print Name: _____