	Engineering Department Fabrication Shop	**SOP # 1**	
		Revision #	
		Implementation Date	8/25/2014
Page #	1 of 16	**Last Reviewed/Update Date**	
SOP Owner	Uriel de Luna	**Approval by Shop Manager**	

Fabrication Shop
Safety Operating Standards

Citation created: 7/24/2014

Contents

Emergency Phone Procedures

-Police, Fire, and Medical emergency dial 9-1-1
-If you are unsure about the seriousness of a situation, dial 41991 or (619)594-1991 to speak with a 24-hour dispatcher in Public Safety.

In case of a fire
-Activate nearest fire alarm and call SDSU Police.
-Only use fire extinguisher for small fires.
-Evacuate building, closing doors to contain fire. DO NOT USE ELEVATORS. Assemble at your building's evacuation assembly point unless otherwise instructed.
-Remain at evacuation assembly point and do not re-enter building until authorized by emergency personnel.

Other Campus Phone Numbers:

- **Environmental health and Safety**, 46778 or (619)594-6778
  Chemical, Biochemical spills; toxic fumes
- **Radiation Safety**, 46879 / 46098 or (619) 594-6879 / (619)594-6098
  Radiation spills
- **Physical Plant**, (619) 594-44754
  Custodial services, utility problems. Main work control will redirect after hours.
- **Public Safety**, 41991 or (619)594-1991, (dial 9-1-1 for emergencies)
  University Police

Safe Operating Procedure

Purpose

The fabrication Shop SOP is intended to provide general safety guidance for power-driven (including manually operated) stationary machines and equipment used to shape and/or form metal, wood, or other materials by cutting, impact, pressure, electrical or other processing techniques. These types of machines present a number of potential hazards, which must be recognized and controlled to minimize the risk of operator injury.

Relevant Standards

Following are common, recognized standards for safe machine operation. The content of this SOP is drawn from these standards.

- 29 CFR 1910, Subparts O, (Machinery and Machine Guarding), Q (Welding, Cutting, and Brazing), and R (Special Industries), United States Occupational Safety and Health Administration (OSHA)
- ANSI B11.0, Safety of Machinery – General Requirements and Risk Assessment, American National Standard Institute (ANSI)
- NFPA 79, Electrical Standard for Industrial Machinery, National Fire Protection Association (NFPA)

Hazard Overview

-Hazardous Materials

In an emergency or if anyone is in danger call SDSU Police, dial 9-1-1. Move away from the site of the hazard to a safe location. Alert others to stay clear of the area.
If outdoors, go indoors. Close doors and windows. Notify emergency personnel if you have been exposed or have information about the release.

For emergency chemical information (Material Safety Data Sheet):
Material Safety Data Sheets (MSDS) contain chemical emergency information. Become familiar with the MSDS to understand chemical hazards in the shop. Know where the location of the Nearest Eye Wash stations and First Aid Supplies are before using shop equipment.

For more information
1-800-451-8346 (3E Company)
Follow the instructions of emergency personnel.

-Machine Hazards

Potential hazards of operating machines and equipment are numerous. Some of the most obvious recognized hazards are from machine motion. Hazardous motion is characteristic of the point-of-operation of the machine, but can also be found in other areas such as behind, to the side, or above a machine.

- Rotating motion of collars, couplings, cams, clutches, flywheels, shaft-ends, set screws, spindles, etc., can be dangerous by gripping clothing or forcing arms/hands or other body parts into dangerous positions. Rotating parts can also create nip points when two adjacent moving parts are in close proximity (e.g., two cogs, two rolling bars, chain and sprocket, etc.); or a rotating part is in close proximity to a fixed point.
- Reciprocating machine motions are also hazardous. A worker may be injure by back-and forth or up-and-down motion when struck by or caught between moving and stationary parts (e.g., saw blades, knives, etc.).

Transverse machine motion (movement in a straight, continuous line) is another recognized hazard because a worker may be struck or caught in a pinch or shear point by moving parts.

In addition to machine motion, examples of other machine hazards may include:

- Chemical hazards resulting from the product being handled (e.g., toxic fumes emitted from metals, wood dusts, etc.) or the machine itself (e.g., contact with or inhalation of cutting oil mists or cleaning compounds, etc.).
- Ergonomic factors, such as stresses put on the body from awkward positions, repetitive motions, excessive reaching, vibration, heaving lifting of materials or products, etc.
- Fire due to dust accumulations, electrical sparks or arcs, hot surfaces, open flames, etc.
- Tissue damage caused by contact with extremely cold or hot parts of the machine or material being manipulated.
- Excessive noise, which can cause hearing loss or interfere with the ability to communicate during machine operation.
- Eye or skin damage caused by contact with UV light, particularly with machines using laser technology.
- Eye damage caused by foreign objects emitted from the machine (e.g., dust particles, shavings, sparks, etc.)
- Potential for injury resulting from dropping or ejection of a work piece from the machine during operation.

Safe operation of machinery and equipment necessitates that all foreseeable hazards are controlled. Effective control is achieved through a risk assessment process.

Risk Assessment Overview

The ANSI B11.0 standard states, "The outcome of completing the risk assessment process should be:

- *A clear understanding of risk(s) including the potential severity of harm and the probability of the occurrence of harm;*
- *Machinery with risks reduced to an acceptable level;*
- *Risk reduction measures appropriate to the circumstances;*
- *"Documentation of the risk assessment."*

The ANSI B11.0 risk assessment process consists of several steps. For the purposes of this SOP, the following steps are emphasized:

1. Identify the tasks and hazards
2. Assess the initial risk
3. Reduce the risk to a feasible and acceptable level
4. Validate the solutions

As previously described, a number of different machine hazards are possible, ranging from those inherent to the machine itself to hazards created by the operator or environment in which the machine is located. Take into consideration different tasks, operator experience, operating modes, and failure scenarios. It is important to identify potential receptors, as well; who or what may be harmed? It may be helpful to review experiences related to past near-miss incidents, literature from trade organizations, and other information sources to ensure thorough evaluation of hazard.

Tasks to be considered may include:

- Machine installation and assembly
- Start-up and change-over
- Various modes of operation
- Various feedstock materials, considering both dimensions and material of construction
- Maintenance, cleaning, and repairs
- Shutdown
- Troubleshooting, clearing jams, etc.

Hazards to be considered may include:

- Mechanical
- Energy sources (e.g., electrical, pneumatic, hydraulic, etc.)
- Unexpected start-up or shut-down, or automatic repeat cycles
- Exposures to harmful substances or environments (e.g., chemical exposures, hot/cold surfaces, sharp edges, vibration, noise, dusts and fumes, etc.)
- Unstable loads, stocks, finished products, etc.
- Other

Hazard evaluation is a dynamic process that needs to be repeated in response to any number of factors that could influence the hazards, e.g., changes in equipment use or design, operator experience, workspace configuration or design, etc.

Citation created: 7/24/2014

Assessment of Initial Risk

Once the hazards and potential receptors are identified, it is important to assess the degree of relative risk in terms of the severity of harm and the probability of occurrence. Once this has been determined, appropriate risk reduction strategies can be selected to minimize the severity of harm or likelihood of an adverse event. To the extent feasible, the goal is to implement controls that come as close to achieving a "remote" likelihood of occurrence and "minor" consequences.

Some things to consider include how quickly the hazard presents and operator reaction time, the duration and frequency of exposure to the hazard, reliability of controls and safety devices, experience of the operator, machine history, number of persons exposed to the hazard, etc.

Risk Reduction

There are a number of possible risk reduction strategies, some being more preferred than others when there is more than one option. Following are machine hazard risk reduction strategies. When possible, the most preferred option should be selected and implemented (in other words, when guarding is feasible).

- Elimination or substitution through inherently safer design. Examples include: automated material handling, substitution of less hazardous chemicals/fluids, reduced mechanical force/energy, elimination of pinch points by increasing clearances, etc.
- Guards or safeguarding devices. Examples include: barriers, interlocks, presence sensing devices, two-handed controls, etc.
- Awareness devices. Examples include: lights, beacons, strobes, computer warnings, signs, labels, beepers, horns, sirens, fences/barrier tape, etc.
- Training and safe work practices/procedures. Examples include: written operating, maintenance, and repair procedures, employee training, employee demonstration of competency, on-going evaluation of employee operating performance, etc.
- Personal Protective Equipment (PPE). Examples include: safety glasses, face shields, ear plugs, protective footwear, helmets, respirators, etc.

- When selecting risk reduction measures, keep in mind incentives that may exist or be created for the operator to defeat or circumvent a risk reduction measure. This may occur if the risk reduction measure slows down production, interferes with the ability to complete the task, it is difficult or cumbersome to use or implement, etc.

Student/ Faculty Machine Shop Safety Rules

Machining operations are very dangerous. Think. Use common sense. Be careful.

1.Safety

1.Safety Glasses:

Safety glasses must be worn at all times while in shop facilities.

2.Clothing:

Rotating spindles can catch clothes, hair, gloves and jewelry.

When using machines with rotating spindles, do not wear long sleeves, pull back long hair (but do not braid), and remove jewelry and anything else that could get caught in the spindle. Do NOT wear gloves.

Long sleeves, long hair, or jewelry can get caught in the spindle and pull you right into the spindle. Do not braid your hair because if your braided hair gets caught, all your hair gets pulled towards the spindle instead of just a few hairs.

Sandals are not allowed in the machine shop.

3.Hearing Protection:

Use ear protection if you are using a loud machine.

4.Buddy system:

Never machine alone. There must always be someone nearby in case you get hurt.

2.Training

Do not operate a machine until you have been trained. Other qualified users can give training. Read the machine's Operator Manual and/or Technical manual before operating the machine.

Do not disturb someone while they are using a machine. Wait until they have finished machining. Machining is very dangerous and can require concentration. If you interrupt somebody they could make a mistake that leads to an accident.

1.Lighting

DC lamps must always be turned on when using any rotating machines. The main fluorescent lights in the machine shop run off the 110 V, 60 Hz electrical supply and effectively strobe at 60 or 120 Hz. Machines that rotate at harmonics of 60 Hz will appear to be stationary. For this reason, all rotating machines in the shop have a DC lamp beside them. Use the lamps! Otherwise you might try to reach for a spindle that looks stationary but is rotating.

3.Cleanup

1.Tools must be put away. You are not the only user of the shop. You will waste other peoples' time if you don't put tools away in the correct place.

2.Clean up! When you finish using a machine, clean the machine thoroughly. Coolant should be wiped off and all the chips cleared. If appropriate, lubricate the machine and tools. Leaving machines dirty is rude to the next user and is also bad for the machines. Coolant and chips can get into the moving parts of the machine and cause rust and wear.

3.Return all tools, fasteners, and materials to their proper location when you finish work or at the end of the day. Do no leave tools out overnight.

4.If you are last to leave, check that everything is order. If necessary, sweep the floor and put anything left out away.

4.Machine use

Most machines have rules posted beside them. Read them.

1.Coolant: cutting fluid must be used during all cutting, machining, turning, tapping, and drilling operations to promote proper chip removal and prolong tool life.

2.Precision instruments (micrometers, rulers, etc.) should never come into contact with each other or with any other surface of equal or greater hardness. i.e. Never put a micrometer on a metal surface. Precision instruments are ground very carefully. Any scratches on their surface make them less accurate and can make them useless.

3.Tool and machine damage must be reported to Mike Lester. If you break a tap, drill, or end mill, order more if they are needed.

5.Food

No food in the shop. Drinks must be in containers with non-spill lids.

CNC Vertical Mill
Standard Operating Procedure 'SOP'

- Keep all guards in place while operating the machine.
- While operating the milling machine allow no one else to touch it.
- Keep hands away from moving cutting tools.
- Do not make measurements of the stock while the milling machine is powered.
- Do not allow large quantities of chips to accumulate around the work piece or machine table. After stopping the machine, use a brush or rag to remove all excess chips from the mill bed and stock.
- Use a rag or Kevlar gloves to handle sharp cutting tools.
- Cutting tools must be securely fastened in the machine spindle with the proper accessory. Never try to tighten cutting bits or tools by hand.
- Do not power the machine to tighten or loosen cutting bits or tools.
- Use appropriate speeds and feeds for the type and size of cutter being used and the material being machined.
- Make sure the cutting tool is clear of the work piece before starting the machine.

	Engineering Department Fabrication Shop	**SOP # 1**	
		Revision #	
		Implementation Date	8/25/2014
Page #	13 of 16	**Last Reviewed/Update Date**	
SOP Owner	Uriel de Luna	**Approval by Shop Manager**	

Lathe
Standard Operating Procedure 'SOP'

- All stock must be properly secured in the lathe chuck or mounted prior to the machining process taking place. Use the correct sized clamp or vise for the stock being machined.
- Turn the chuck or faceplate by hand to ensure there is no binding or danger of the work striking any part of the lathe.
- Check to ensure the cutting tool will not run into the chuck or lathe dog. If possible, feed away from the chuck or dogs.
- Before starting the lathe, ensure the spindle work has the cup center imbedded; tail, stock and tool rests are securely clamped; and there is proper clearance for the rotating stock.
- Prior to starting the lathe, ensure that small diameter stock does not project too far from the chuck without support from the tail stock center.
- When using wood, do not mount a split work piece or one containing knots.
- When roughing stock, do not force the tool in the work piece or take too big a cut.
- The operator must always be aware of the direction and speed of the carriage or cross-feed prior to engaging the automatic feed.
- Never leave the key in the chuck. Do not let go of the key until it is free of the chuck and secured in its proper designated place.
- Select turning speed carefully. Large diameter stock must be turned at a very low speed. Always use the lowest speed to rough out the stock prior to final machining.
- The correct speed and feed for the specific material and cutting tool must be used. Stop the machine before making adjustments or measurements.
- Do not remove metal or wood chips from the table or stock by hand. Use a brush or other tool to properly remove chips or shavings from the table or stock.
- Never attempt to run the chuck on or off the spindle head by engaging the power.
- Do not leave tools, bits or excess pieces of stock on the lathe bed.
- All belts and pulleys must be guarded. If frayed belts or pulleys are observed, the lathe must be taken out of service and the belts or pulleys replaced.
- Stop the machine immediately if odd noise or excessive vibration occurs.

- Only properly sharpened drill bits and cutting tools in good condition should be used. Dull drill bits and chipped or broken cutting tools must be removed from service.
- When an operator has finished working on the lathe, and before leaving the lathe for any reason, the power must be shut off and the machine must come to a complete stop.
- When an operator observes an unsafe condition with the lathe or stock being worked, the operator must report it immediately to the Shop Manager and the lathe shall be taken out of service until the problem has been corrected.

Prototrak
Standard Operating Procedure 'SOP'

- Know the location of start and stop switches or buttons and keep the drill press table free of tools and other materials.
- Use only properly sharpened drill bits, sockets and chucks in good condition. Remove dull drill bits, battered tangs, or sockets from service.
- Do not remove by hand metal or wood chips from the table or stock. Use brushes or other tools to properly remove chips.
- Do not attempt to oil the machine or make adjustments to the work while the drill press is in motion.
- Do not insert a drill chuck key into the chuck until the power is shut off and the machine has come to a complete stop.
- All belts and pulleys must be guarded; if frayed belts or pulleys are observed, the drill press must be taken out of service and the belts or pulleys must be replaced.
- All stock must be properly secured with a vise or clamps prior to a machining process.
- If the stock slips in the vise or clamp, the operator must not attempt to hold the work with his/her hand or try to tighten the vise/clamp while the machine is in motion. Shutdown the power to the machine prior to re-tightening the loose stock.
- Use the correct speed and drill for the type of stock being machined.
- Use the appropriate bit for the stock being machined. Bits with feed screw or extremely long bits should not be used.
- The drill bit should be mounted the full depth and in the center of the chuck.
- Position the table and adjust the feed stroke eliminating the possibility of the bit striking the table.
- Feed the bit smoothly into the work. If the hole being drilled is deep, withdraw the bit frequently to remove shaving on the bit.
- Never attempt to remove a broken drill with a center punch or hammer.
- When an operator has finished working on the drill press, and before leaving the drill press for any reason, the power must be shut off and the machine must come to a complete stop.
- When an operator observes an unsafe condition on the drill press, or stock that is being worked on, they must report it immediately to the Supervisor and the press will be taken out of service until the problem has been corrected.

Vertical Bandsaw
Standard Operating Procedure 'SOP'

- Ensure the guard doors are closed and the blade is properly adjusted prior to turning on the machine.
- Set the band saw at the appropriate speed for the type of stock being machined.
- Check to ensure the band saw blade is sharpened
- Check to ensure the band saw is correct for the type of stock and correct speed being used.
- Allow the saw to reach full set speed prior to cutting stock.
- Do not force stock into the saw blade. Let the speed of the blade cut stock appropriately.
- Make "release" cuts before cutting long curves.
- Plan saw cuts to avoid backing out of curves in the stock.
- Never push a piece of stock with hands in front of the saw blade. Use a push stick. Keep hands at a safe distance on either side of the stock being machined.
- Use a push stick or board to push small or irregular sized stock. Small work pieces can also be secured with a tabletop vise or clamp.
- All round stock must be secured in a tabletop vise or clamp prior to starting the cut.
- Hold the stock flat on the table prior to starting the cut.
- If the saw blade binds on a piece of stock, turn the saw off and wait until it comes to a complete stop before attempting to remove the blade from the stock.
- Do not allow large quantities of chips to accumulate around the work piece or drill press table. After stopping the machine, use a brush or rag to remove all excess chips from the drill press table and stock.
- When you finish make sure the machine comes to a complete stop and Ensure area is left in clean condition and any waste is removed.

	Engineering Department Fabrication Shop	**SOP # 1**	
		Revision #	
		Implementation Date	8/25/2014
Page #	17 of 16	**Last Reviewed/Update Date**	
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Belt & Disk Sander
Standard Operating Procedure 'SOP'

- Access to Emergency Stop buttons
- Ensure the machine and area is clean and free from obstacles.
- Ensure all guards and adjustable table on disc sander are secured and correctly fitted.
- Never use without extraction and appropriate dusk mask.
- Never attempt an operation if you are unsure of what you are doing.
- Never use for more than one operation at any one time- belt sanding or disc sanding.
- Ensure the on –off switch works correctly.
- Check that the sanding belt & disc are installed correctly.
- Adopt a comfortable stance appropriate to the operation that you are performing.
- Ensure work is held correctly and sitting firmly on right hand side of disc table
- Use firm, forward pressure without overloading the machine.
- When you finish make sure the machine comes to a complete stop and Ensure area is left in clean condition and any waste is removed.