Mechanical Engineering
Machine Shop Safety and Orientation Training
**Shop Safety**

1. Safety glasses are required at all times in the shop.
2. No one is allowed to work in the shop in sandals or short pants.
3. Don’t wear jewelry around moving equipment.
4. Long hair must be tied back.
5. Roll up long sleeves around moving equipment.
6. Ear protection, goggles, face shields, shop coats, and first-aid kit are available in the shop.
7. Be careful when handling vises, rotary table, indexer, chucks, or other heavy items to avoid dropping or back injuries.
8. Do not direct compressed air toward skin.
10. Shop is not properly equipped to handle sawdust or paint fumes.
11. If unsure How or Why – ASK!
12. Regular shop hours – 8:00-11:30, (11:30-12:30 Lunch), 12:30-5:00 Monday-Friday
   Summer shop hours – 7:30-11:30, (11:30-12:30 Lunch), 12:30-4:30 Monday-Friday

**Cleanup**

1. Brush chips off entire machine after each use. Shop-vacs can be used when chips are NOT long and stringy.
2. Do NOT use compressed air to blow chips off machines.
3. Wipe down machine with shop towels.
4. When using Koolmist coolant on milling machines, remove vises to clean off trapped coolant. This prevents rusting. Spray vice and mill with WD-40.
5. Sweep floor in affected area; Do not allow excess chips to build up on floor because they will migrate around the shop.
6. Mop floor if necessary to remove oil or coolant. Mop is located in welding area along with soap.
7. Put used shop towels in metal canister. Shake out ALL chips first.
8. Put ALL tools back in the proper place.
Welding Area

Usage
Undergrads may use the welding area without a mentor after they have received appropriate training. Check with shop supervisor first.

Pedestal grinder
Do not grind aluminum.
Do not wear gloves while grinding.

Bead Blaster
Turn off air after each use.
Do not bead blast oily or greasy parts.

Welders
Make sure the machines are set up according to the charts on the wall before welding. If you are not sure about the setting, ask shop manager or mentor first.

Gas Cylinders
Let shop manager know when tanks are getting low (200 psi) so replacement tanks can be ordered.

Cleanup
The welding area must be cleaned after each use.

Manual Lathes

1. Undergrads must have a mentor working with them when operating manual lathes.
2. Machines and work area must be cleaned after each use.
3. Never leave the lathe chuck key in the chuck.

During initial machining instruction, operator training should include the following:

- Which tools to use.
- Using a live center.
- Setting tool heights.
- Tools and tool holders (kept in drawers).
- Changing to collet chuck on lathe #1.
- Changing from high range to low range.
- Speed control (Change ONLY when lathe is running).
- Lead screw (engage only when lathe is NOT running).
- Speeds and feeds, power feeds (longitudinal and traverse).
- Z travel indicator.
- Setting and adjusting the compound rest.
- No long parts protruding out of headstock unsupported.
**HAAS CNC Lathe**

1. Undergrads must have a mentor with them at all times when operating CNC lathe.
2. The brown tool cabinet (Cabinet #1) contains tools to be used with CNC lathes only.
3. CNC lathe and work area must be cleaned after each use.
4. Lathe has laminated copy of operating instructions at machine.

*During initial machining instruction, operator training should include the following:*

- The spindle has no brake.
- How to transfer data from the computer to the lathe.
- Setting home position in Mastercamx5 when using tailstock.
- CSS vs RPM.
- Drilling with the carriage.
- Setting tool offsets (Turret Fwd or Rev).

**Shop Computers**

These (2) computers have Mastercam loaded in order to support machining with the CNC lathe and/or CNC mill. This is their sole use.

**Grey Cabinets**

These two cabinets (#2 and #3) contain tools and supplies available for shop usage. Shop towels and cutting oil are located on top of these cabinets.

*Tool sign-out sheet* – Tools must be signed out if taken out of shop, except when used in the design suite. Tools should be returned by COB each day.

**Russ’s Area**

This area including Bridgeport mill, Logan lathe, tool boxes, cabinets, corner area is generally off-limits to students.

**Light Brown Cabinet #5**

This cabinet contains measuring tools available for shop use.
HAAS CNC Mill

1. Undergrads must have a mentor with them at all times when operating CNC mill.
2. The red tool cabinet (#6) contains tools to be used with CNC mills only.
3. CNC mill and work area must be cleaned after each use.
4. Mill has laminated copy of operating instructions at machine.

During initial machining instruction, operator training should include the following:

- Spindle warm-up (after 3 days of no use)
- Setting part zeros
- Setting tool offsets, using feeler gauges properly.
- Jog screen working from axis zeros.
- Climb vs conventional milling
- Finish cuts.
- Coolant vs oil and coolant on floor.
- 4th axis setup.
- Loading vise on mill table.
- Zeroing origins.
- When importing files into Mastercam, import as .stp files.
- Save Solidworks drawings as solids and wireframes.
- Don’t leave cutters in the spindle overnight.
Manual Mills

1. Undergrads must have a mentor working with them when operating manual mills.
2. Mill accessories are in and on cabinet #7.
3. Machine and work area must be cleaned after each use.

During initial machining instruction, operator training should include the following:

- D.R.O’s (digital read only).
- Speed change (belts and high/low).
- Vise, hold down clamps, parallels, lead hammers, indicators.
- Do not leave vise sitting on mill and not bolted down.
- Tram, tilt head.
- Clamps.
- Edge finders.
- Filing, deburring parts.
- Finishes.
- Power feeds (x,y,z)
- Do not leave power feed speed-control dials turned up when finished with mill for the day.
- Quill feeds and depth stop.
- Boring head.
- Right angle head.
- Spindle key for collets.
- Keep chips swept back to avoid tracking throughout the shop.

Bridgeport CNC mill

1. Undergrads must have a mentor with them at all times when operating CNC mill.
2. CNC mill and work area must be cleaned after each use.
3. Mill has laminated copy of operating instructions at machine.

During initial machining instruction, operator training should include the following:

- Setting part origins
- Setting tool offsets
- Using feeler gauges properly
- Be aware of adding retract height to drilling operations in Mastercam
- Making sure head is trammed
- Climb cutting vs conventional cutting
- Use finish passes
Drill Presses

1. Drill press area must be cleaned after each use.

During initial machining instruction, operator training should include the following:

- Clamp parts before drilling, especially small or thin parts, such as sheet metal.
- Use cutting oil when drilling.
- Removing chuck or taper-shank drills with drift punches.
- Changing speeds
- Adjusting table heights.
- Quill stop
- T-nuts for Wilton drill press.
- Clamping the work piece
- Do not use end mills in the drill press
- When using cobalt drills, use high speed steel settings, not carbide for RPM’s.

Surface Grinder

1. Undergrads must have a mentor with them at all times when operating surface grinder.
2. Grinder and work area must be cleaned after each use.

During initial machining instruction, operator training should include the following:

- Wheel dresser
- Coolant
- Magnetic chuck
- Depth of cut
- Cleanup

Belt Sander

1. Do NOT use gloves while sanding.
2. Do NOT force parts into belt.
3. Parts can get caught between plate and belt.
4. OK for ferrous and non-ferrous materials
5. Clean after each use.
**Vertical Band Saw**

1. Select the **proper blade** for your application as follows:
2. 6-tooth blade for aluminum, brass, plastics
3. 18-tooth blade for steel and stainless steel
4. 24-tooth blade for ALL materials that are 1/8” or less (Especially steel and stainless steel)
5. The 6-tooth and 24-tooth blades are stored at the back of the band saw.
6. If necessary, install the correct blade in the band saw.
7. Set the blade tension.
8. Make sure that the blade guard is in place.
9. Adjust the upper blade guard so that it is about ¼” above the part to be cut.
10. Make sure that the band saw is set to the proper speed.

**NOTE: THE MACHINE MUST BE RUNNING TO CHANGE SPEEDS!**

11. Use constant, firm pressure when sawing. Don’t try and force the work piece through too fast. This may cause teeth to be stripped off the blade. There is a tube of wax that can be used for lubrication. Just press the tube into the saw blade while it is running and it will coat the blade.
12. When finished with the saw, **make sure** the blade for cutting steel is installed and the speed is set for steel.
13. Clean the band saw
14. If you are not sure of something, please ask before proceeding.

**Horizontal Band Saw**

1. Clean after each use.
2. Use of coolant
3. Speed setting (Adjust only when running)
4. Always leave machine set for cutting steel when done with saw.
5. Setting vise for angle cuts (Square up to blade after sawing angles)
6. Stock stop
**Center Drilling**
- Select a center drill similar in size to drill bit.
- RPM is relative to average diameter of tip and body sizes.
- Use cutting oil

**General Drilling**
- Holes up to ½” diameter do not have to be stepped up in size.
- Holes over ½” diameter should be stepped up roughly every ¼” in size.
- When drilling holes to be tapped – refer to chart in shop for drill size.
- When drilling holes to be reamed – leave 1/64” for reaming holes under ½”, 1/32” for reaming holes every ½”.
- Use cutting oil when drilling. Koolmist may also be used but it tends to run off immediately.
- When drilling acrylic, stick-wax or cutting oil both work best.
- Coolant not necessary for drilling cast iron.
- When drilling stainless steel, cobalt drill bits work best.
- When drilling sheet metal, always use Uni-bits.
- Make sure parts are properly clamped.

**Drills Available**
- Number drills - #1 to #60
- Letter drills – A to Z
- Fractional Drills – 1/16” to ½”
- ½” Shank Drills – 1/16” to ½”
- Morse Taper Shank Drills – ½” to 1 7/16”
- Cobalt drills – up to ½”
- Uni-bits – up to 1”
**Tapping**

- It is important to start **straight** into holes. This can be done with a tapping guide block or on the milling machines.
- Be sure to drill deep enough to allow room for chips to build up when tapping blind holes.
- Pipe taps – Tap down approximately 2/3 of tap threads and check for fit with fitting. Remember, the threads are tapered.
- Always use lubricant, except for cast iron.

**Reaming**

- Ream at 50% of drilling speed.
- For fits on holes ≤½” diameter, use 0.001” under for press fits and 0.001” over for slip fits. This is according to which reamers are available in the shop.
- A general rule of thumb for press fits is 0.001” of press for every 1” of diameter.
- Use lubricant when reaming.

**Counter Sinking**

- Most counter sinks in the shop are 82°. This matches the angle on the flat head screws that are stocked.
- Other sizes may be purchased, i.e. 60°, 90°, 100°.
- In addition to counter sinking for flat head screws, they are also used for deburring the edges of holes.

**Counter Boring**

- These tools are used for counter boring holes for the heads of Socket Head Cap Screws. They have pilots to guide them into existing holes.
RULES FOR STUDENTS WORKING IN
THE MECHANICAL ENGINEERING MACHINE SHOP

ALL STUDENTS
1. All new projects must be approved by the shop manager.

UNDERGRADUATE STUDENTS
1. Undergraduate students must complete the ‘mechanical engineering machine shop safety and orientation training’ and have a signed authorization sheet on file in the shop.
2. The following machines and equipment can be used without mentor supervision but only while the shop manager is in the shop:
   a. Belt sander,
   b. Pedestal grinders,
   c. Band saws,
   d. Welders.
3. Full time mentor supervision is always required to work on the following:
   a. Manual lathes and mills,
   b. CNC lathes and CNC mills,
   c. Surface grinder.

GRADUATE STUDENTS
1. Graduate students must have completed appropriate training on the shop equipment and have the approval of the shop manager before working in the shop.

IEW MENTORS
1. All IEW mentors must have completed appropriate training on the following before mentoring undergraduate students on this equipment:
   a. Manual lathes and mills,
   b. CNC lathes and CNC mills,
   c. Surface grinder.
2. The shop manager signs off on mentor training on each piece of equipment.

AFTER-HOURS MACHINING
See the Mindworks website for after-hours rules and guidelines:
http://www.webpages.uidaho.edu/mindworks/Machine_Shop/General_Shop_Info/shop_after_hours_guide.doc
Authorization for engineering students to begin working in the Mechanical Engineering Machine Shop requires orientation about the following:

- Shop Safety
- Cleanup
- Welding
- Tool Storage Cabinets
- Drill Presses
- Belt Sanders
- Band Saws
- Drilling
- Tapping
- Reaming
- Counter Sinks
- Counter Bores

A sign-up board is located in the Senior Design Suite (GJ108). Your name and the mentor’s name must both be on the board with the times signed up for.

15 MINUTE RULE - Any machine that is not being used within 15 minutes of the sign-up start time is then available to be used by another person.

A sheet with names of all students who have received basic training and are authorized to work in the shop will be posted at the entrances to the shop. This sheet starts over with a clean slate at the end of each Spring semester.

Authorization means that students can work on drill presses, belt sanders and pedestal grinders, band saws, and welders without mentor supervision as long as the shop manager is in the shop.

Full time mentor supervision is required to work on manual lathes and mills, CNC lathes and CNC mills, and surface grinder.

____________________________
Name of trainee (print)

____________________________
Name of mentor (print)

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Date