EML2322L – MAE Design and Manufacturing Laboratory

TA Outline (Lathe & Mill Training)

- Remind students to sign in the attendance roster **in the proper location**
- Improper Shoes: students receive an '**S**' next to their name in roster; return for another lab
- No Safety Sheets: students receive an '**SS**' next to their name in roster; provide a lab copy
- No Long Pants: students receive a '**P**' next to their name in roster; return for another lab
- Student work groups are not yet assigned
- Split class in half: 2 groups train on mill, 2 groups train on lathe; then switch.
- Safety glasses required; aprons optional
- Remove **ALL** jewelry, watches & bracelets; tuck in or remove loose clothing; tie hair back

Lathe Training

A. Basic machine operation and nomenclature:
   - X & Z-axes, spindle, chuck, headstock, tailstock, carriage, cross slide, tool post, tool holder **(students should know this from the HW so ask for their participation)**
   - DRO on all axes are graduated in thousands of an inch; everything in this shop is in thousandths, so start thinking in thousandths; **typical laser printer paper is .003″**
   - machine safety: not a workbench; tools fall off carriage and headstock

B. Clamping the workpiece
   - chuck safety: **CHUCK KEY**; placing spindle in neutral; protruding jaws (NEVER reach around chuck); clamp on at least 1″ of mat'l; explain cutting zone; leave space around operator

C. Clamping and setting up the tool
   - rotate tool post; show tip of carbide cutting insert; set relief angles (~5°) for facing/turning; use plastic ruler for height setup (ALWAYS on center); **rotate chuck by hand to check clearance**; mark workpiece with sharpie to ensure you don't cut too close to the chuck jaws

D. Selecting speed & turning machine on:
   - Select HI/LO range with machine off; typically use HI but make sure speed control is set to the LOW end of the range (2-3 on the knob)
   - Ensure spindle rotates CCW as viewed from tailstock; rotate spindle switch CCW as well

E. Cutting
   - touch off GENTLY using RH rule; zero DRO; take off 0.020″ in TURNING & FACING
   - demonstrate use of power feeds: controls levers; reversing direction
   - everyone participates in the manual & power cutting procedures outlined above
   - while students do this, review the safety sheet and cover the rest of the rules about the lathe you missed up to this point: i.e. **keep hands out of the cutting zone, 0.100″ max. depth of cut on the RADIUS, never grab or remove chips by hand, proper filing technique,** etc.

F. Cleanup (SPOTLESS—we can never expect better than they see during this training session); **DEMAND students pull out and push in chip trays GENTLY;** careful with corners on machines during cleaning; spray rags, not machines; ***TRY NOT TO wipe off guideways with cleaner or rag, as that removes the oil which is crucial for proper lubrication***

Milling Machine Training

A. Basic machine operation and nomenclature:
   - X, Y & Z-axes; spindle; tool mounts in spindle; part mounts in vise and moves around
   - DRO on all axes are graduated in thousands of an inch; everything in this shop is in thousandths, so start thinking in thousandths; **typical laser printer paper is .003″**
   - table safety: not a workbench, tools roll off, never cover tools w/rags

B. Discussion of tools/tool safety
   - Show tool; identify cutting edges & shank; proper handling w/rag, show chipped cutter

C. Installing & removing tools (1 TA talks, 1 TA shows; everyone either installs or removes tool)

D. Clamping workpieces:
   - Explain how to align parts in vise; show parallels in boxes; **show different heights**
   - Clean vise before using; always move rag/hand **away** from cutter
   - Clean parallels before using because **they are slippery and dropped easily**
   - Explain the parallels are **PRECISION** tools and to be treated as such. Don't leave them sitting on the tables, place them back in the box when not in use. **NEVER drop them in the vise but gently lower them into position.**
   - Apply ~5 lb force to vice handle; use a plastic hammer to tap workpiece into full contact with parallels; then apply ~40 lbs on vice handle; remove parallels; remove vise handle
   - **Never run the cutter into the vise or bring it into extremely close proximity**

E. Selecting speeds & turning machine on:
   - Select HI/LOW range with machine turned off; **TAs only during entire semester**
   - ON/OFF switch: direction matches range, **never flip into reverse w/o stopping spindle**
   - Turning spindle on: **safe starting distance from workpiece, verify CW rotation every time, adjust spindle speed while machine is running**

F. Manual cutting:
   - Lock spindle clamp; touch off on workpiece **very** gently **(get down at eye level w/bottom of tool)**
   - zero Z axis; show vernier dial and locking nut; explain each graduation is 0.001″
   - move off part **(show and emphasize RH rule)**; set depth of cut in air (.010″)
   - **ramp gently into workpiece w/ hand on table;** increase feedrate while hand is on table
   - demonstrate use of power feed: speed knob to 0; select joystick direction; ramp gently into contact and across workpiece w/hands on table & joystick; set knob back to zero; put power feed joystick in neutral; **NEVER switch direction without completely stopping table**
   - everyone participates in the manual cutting procedures outlined above; demonstrate power feed, focusing on safety; allow students to cut using the power feed **if time allows**
   - while students do this, review the safety sheet and cover the rest of the rules about the mill you missed up to this point: i.e. **keep hands out of the cutting zone, 0.100″ max. depth of cut, don't remove chips by hand,** never leave a running machine unattended for any reason, etc.

G. Cleanup (SPOTLESS—we can never expect better than they see during this training session); careful with corners on machines during cleaning; spray rags, not machines; ***TRY NOT TO wipe off guideways with cleaner or rag, as that removes the oil which is crucial for proper lubrication***

- During the training make sure students are highlighting the most important points in the safety sheets so you keep their attention. **Make an example of anyone not following along.**
- Make sure students understand the difference between the pneumatic controls & the power switch.