

MAE Student Shop

TA Instructions and Procedures

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Please obey the following guidelines when working as a TA in the student shop and ask any questions you have about them in person, via e-mail (mjb@ufl.edu), or by phone ((352) 225-1619).

General Guidelines

1. **Purpose.** The goal of the shop is to create a productive environment in which students can safely manufacture and modify parts without injury or equipment damage.
2. **Users.** The MAE Student Shop is only for use by MAE students and faculty working on projects which provide tangible educational benefit. Students from other departments are not allowed to use the MAE Student Shop unless they are working jointly with our students or faculty on a project (such as IPPD or MIL).
3. **Materials.** Facility users must provide their own materials. Our sawing capability is limited, so instruct users to order appropriate sized stock or find another place to spend excessive time cutting larger pieces to the necessary size. ***In general, raw material should require 20 minutes or less to cut/prepare.*** Never machine materials like ceramics, nickel or cobalt based alloys (i.e. titanium, inconel), graphite, asbestos, etcetera because of the high cutting forces or hazardous dust. If unsure about the ability to safely cut a particular material, ask Mike or err on the side of caution and say no.
4. **Tooling.** ***Lab tooling is only for use with non-ferrous materials; users must buy all tools necessary for cutting ferrous materials.*** When helpful, give students a copy of the handout titled [Common Tools for Cutting Ferrous Metals](#). Inspect each tool the students use and never allow students to enter any of the facility cabinets. Broken or damaged tools must be noted on the [Broken Tooling List](#) and replaced with **identical quality** items from McMaster-Carr or MSC; if unsure about replacement, ask Mike. Once replaced, cross out the student's name on the [Broken Tooling List](#). Students which refuse to replace broken tools will be banned from using the shop. MAE will pay for any tools accidentally broken by TAs.
5. **Know our limits.** While we should always strive to help the users, some jobs are just not appropriate for our shop due to our limited resources. The policy is that *a part should require less than three hours of facility use*. Exceptions to this rule can be made at our discretion **if other students aren't waiting to use the equipment**. Highly complex parts, or those which are better suited for production shops should be sent there; in these cases give students a copy of the [Local Machine Shops](#) document. When we feel a job cannot be handled with our resources or experience, politely say so, and if necessary, send the student to talk with Mike or a more experienced TA. Never exceed your level of comfort / experience when supervising.
6. **Be disciplined but polite.** When supervising you are responsible for the safety of the students using the facility. While you should always be polite and respectful, you **MUST** enforce the necessary level of discipline. **Priority should always be given to student's safety and equipment respect.** Always exhibit a strong command presence and remember that YOU are in charge, not the argumentative graduate student complaining that another TA let him cut his 304 stainless steel part without a drawing, while wearing flip flops, and holding the part by hand. If there is a problem you don't feel comfortable with, send the student to speak with Mike, but never compromise these operational guidelines.
7. **Never allow students to work unsupervised.** If you need to take a break to use the restroom or talk to Mike, firmly (yet politely), tell the students to halt work until you return.
8. **Ensure the shop is always left clean.** It is your responsibility to enforce the level of cleanliness expected from the students. One should never be able to tell what type of material a

student was working with after (s)he leaves the shop. If a student consistently does not clean their workstation, they are no longer welcome to use the facility. The TAs are ultimately responsible for the cleanliness of the shop and are expected leave the shop clean and organized at the end of every day. When the trash is 3/4 full, tie the bag closed, place it outside the double doors in the flower bed, and replace the liner.

Operating Procedures

1. **Rules for operation.** All rules enforced in DML are enforced in the shop (i.e. long pants, proper shoes, safety glasses, no jewelry, long hair tied back, etc.), NO EXCEPTIONS. In addition, there will be times when the shop feels crowded and you will need to tell students to wait outside until someone leaves and you can help them. There will also be times when you cannot help everyone at once and you will need to tell students working on the machines to stop and wait for your assistance before continuing. Again, never allow students to do anything that makes you uncomfortable, even if they said Mike or another TA has done it with them before. Arrive at least 5 minutes before your section to facilitate a smooth TA transition. If the following TA is late, firmly ask the students to stop work until the next TA arrives.
2. **Usage log.** All students must sign the [Usage Log / Roster](#) hanging on the main door so we can track facility use statistics and ensure only MAE students are using our shop.
3. **Equipment reservations.** Students are allowed to reserve a limited number of equipment use blocks during each week (as noted on the sign-up sheets in the TA notebook). Do not allow students to sign up on the following week's equipment reservation schedule unless (s)he was not able to sign up for the current week. If a student is more than 5 minutes late to their reservation, place a box around their name on the sign-up sheet and allow another student to use the machine; if the student who made the reservation never shows up, cross out their next appointment for preventing someone else from getting work done. Priority is given to EML4502 (Senior Design Lab) students via use of the equipment sign-up sheets.
4. **Drawings.** If students have no drawing(s), they cannot work in our shop. Drawings don't have to be computer generated, but they do need to be legible and correct so as to not waste time deciphering them or repeating work due to errors in them. If students have poor drawings, provide feedback, force them to make hand corrections before allowing them to continue, and insist they correct the drawings before their next work session. Stated another way, ***the student shop is for educational purposes, so if students can't make use of the education received up to this point, they don't need to use it.*** Students should never be allowed to use their laptop or phone in lieu of a printed part drawing; send them to the Reitz Union if necessary.
5. **Basic proficiency.** Always pay close attention to students in the shop to gauge their level of proficiency; you should not need to babysit students. If a student's low level of proficiency requires excessive attention and keeps you from effectively supervising the others, kindly tell them to sign up for an equipment training session on the [Machine Training Signup Sheet](#). Training sessions will be conducted Tuesday or Thursday mornings when there are three or more students signed up. When a training session is complete, cross the names off the signup sheet. In extreme cases, you will need to tell a student (s)he does not possess the personality or skillset to use our facility safely and that (s)he will have to find another shop or another person to make the part(s); this is always a better option than allowing a student to injure themselves or damage our equipment. NEVER let anyone who is not a TA train students on the machines.

6. **Slow times.** When work is slow, perform and mark off items on the [Maintenance Checklist](#); please do not routinely use slow shop hours as a study hall, as that is disrespectful and makes me look bad when the chairman passes through with visitors.
7. **Miscellaneous safety points.** All rules enforced in DML are enforced in the shop. Never work alone in the shop, as no one will be able to help if you have an accident. In addition, now that the waterjet machine is installed and functioning, its occasional use will create some startling loud noises, so be forewarned and warn all students using the shop during those times.

Student Shop Equipment and Tooling Tips

The following list contains important knowledge TAs should possess when working in the shop and solutions to common problems. Reviewing this list each semester and adding to it should facilitate TA knowledge transfer.

A. Lathe:

1. Ensure lathe spindle switch (lever) is OFF before turning the main power switch ON so the lathe spindle doesn't suddenly start rotating
2. Ensure lathe gearbox selector handles are **fully** engaged before turning the machine ON each time (partial engagement grinds gears)
3. When using boring bars, the bars should stick out of the tool holder as short as possible to reduce vibration. Use the largest boring bar that will fit the pilot hole diameter. Only TAs or highly competent students are permitted to use boring bars. Use larger insert nose radii (0.030" +) for roughing cuts and smaller nose radii (0.005" to 0.015") for finishing work. For roughing, start with a depth of cut (DOC) equal to the nose radius and increase only if setup is rigid enough (not producing poor surface finish). For finishing, just like in turning, use lighter DOC to produce required finish and tolerance.
4. When using the part-off tool, the insert blade should extend out of the holder as short as possible to reduce vibration. For deeper parting it's necessary to start with the blade extended a short amount (i.e. 1") and stop and extend it further as necessary. Always feed by hand and apply cutting oil frequently. Only TAs or highly competent students are permitted to use the part-off tool.
5. If a part is large, the chuck jaws may be reversed to allow clamping of larger parts; change the jaws back to original configuration at the end of the work session; always keep the top jaws matched to their master jaws by matching the stamped jaw numbers (1,2, 3). For larger diameter workpieces, remember to adjust the spindle speed according to the speed chart
6. Familiarize yourself with the different tools and accessories in the lathe cabinet
7. Remind students to clean behind the machine
8. Maximum depth of cut in aluminum is 0.100" on the radius in nonferrous materials and 0.050" on non-hardened metals (i.e. metals which pass [the file test](#)).

B. Milling Machine:

1. NEVER load endmills in drill chucks, as the radial forces will cause them to be released
2. ALWAYS clamp drills larger than 1/2" in collets, not drill chucks; be careful to never clamp on the small fillet between the shank and drill body
3. Remind students to loosen the friction locks before moving the table or saddle
4. Familiarize yourself with additional tool locations and use (smaller center drills, countersinks, spare drills/edge finders/tap guides/taps, reduced shank drills, annular cutters, hole saws, vise jaws/workholding, micro drill chuck, rotary vise)

5. If the spring loaded tap guide sticks, tap it firmly on its side against something rigid
6. Know how to prevent drills from screaming (slower speeds and higher feeds)
7. When cutting slots, drill a pilot hole for the endmill to enter
8. When boring with an endmill, drill a pilot hole at least $\frac{1}{2}$ the diameter of the final size, use the MILLING spindle speed, and feed SLOWLY with the quill handle
9. There are infinite ways to securely clamp workpieces; Google is your friend for new ideas; consult with Mike or a senior TA concerning challenging workholding methods

C. Roll-In Vertical Bandsaw:

1. Do not allow students to over feed the saw, knocking teeth off the blade (if they do, tell them to buy a replacement blade and note it on the replacement tool list); you will rarely need to open the feed control value more than $\frac{1}{4}$ of a turn
2. Keep feed constant when cutting parts with non-uniform cross sections
3. Thicker material (3"+) must be cut on the Marvel during TA hours or by appointment
4. All saw blades should point TOWARDS the user and DOWN

D. Do-All Vertical Bandsaw:

1. Do not allow students to cut radii smaller than 6" because the twist can break the blade
2. Do not allow students to over feed the part, knocking teeth off the blade (if they do, tell them to buy a replacement blade and note it on the replacement tool list).
3. Do not allow students to change the speed of the bandsaw; it is set for cutting steel sheetmetal, so the speed will work for all materials which should be cut in that shop.
4. A larger tooth pitch is used for softer materials (plastics and wood). Do not use a fine TPI blade to cut soft materials.

E. Drill Press:

1. Use $\frac{1}{4}$ " increments when drilling and begin with a center drill
2. Always show students how to clamp parts (i.e. don't just hand them a clamp and leave)
3. Make sure students are setup each time so they don't risk drilling into the vise/table
4. Students should never drill holes larger than $\frac{1}{2}$ " on the drill press

F. Sander and Grinder:

1. Ensure the pedestals remain properly adjusted so there is less than $\frac{1}{8}$ " clearance between the pedestals and the grinding wheels
2. Tell students to be gentle on both machines, as they are NOT for bulk material removal; the grinding wheel can shatter and the sanding disk can overheat and tear with excessive force

G. Miscellaneous:

1. If you notice broken, damaged or missing tooling, PLEASE WRITE IT IN ON THE APPROPRIATE PAGE ON THE [BROKEN TOOLING LIST](#) SO WE CAN REORDER!
2. Spend time familiarizing yourself with the locations of items in the student shop
3. If a DRO stops measuring/displaying properly, make sure the power and encoder cables are fully seated into their sockets, turn DRO off and back on, reference *Troubleshooting DRO Readout Errors* handout if that doesn't provide a solution then ask Mike
4. Students must provide taps under #6 or M4
5. Only TAs or highly competent students are permitted to use boring bars or part-off tools.
6. Do not give students carbide or 4 flute endmills
7. Add ideas for shop improvement or additional tooling to the *EML2322L TA Projects* Google sheet

H. **Replacement Supply Locations:**

1. Beige/turquoise cabinet: cutting tools (endmills, taps, dies, large drills for the lathe tailstock, etc.) and accessories like tapping handles
2. Left-most vertical gray cabinet: cleaning and safety supplies, larger drills for use in collets on the mills, replacement standard drills for the drill index on the mill table
3. Right-most vertical gray cabinet: metrology tools and accessories like parallels
4. Familiarize yourself with, and refer to [Student Shop Cabinet Contents Sheet](#)

PERSONAL & FACILITY SAFETY HIGHLIGHTS

To remain in the facility, students **MUST**:

1. **Wear EYE PROTECTION at all times**
2. **Wear PROPER FOOTWEAR**
3. **Wear LONG PANTS**
4. **Be respectful to staff, machines, and tooling**

Before using any equipment in this facility, students **MUST**:

1. **Remove all loose clothing** that might get caught in moving machinery
2. **Remove all jewelry** from hands and wrists
3. **Tie back hair** longer than shoulder length
4. Have in their possession and be familiar with the **Equipment Safety Sheets** for every machine they use
5. **Ask a TA before using any machine or tool EACH work session**

When using any equipment in this facility students **MUST**:

1. **NEVER bring anything within 6" of the cutting zone while the machine is ON**
2. **NEVER touch cutting chips** with their bare hands
3. **Debur all parts IMMEDIATELY** after cutting
4. **ALWAYS use gloves when working with sheetmetal, EXCEPT when working on powered machines** (like the bandsaw and drill press)

Finally, PLEASE remind students to:

1. **INSPECT tools before and after use and REPORT broken tools to lab staff**
2. **Leave each machine, table and tool CLEANER than they found it**
3. **Understand you are NEVER TOO BUSY TO ANSWER THEIR QUESTIONS**

LATHE SAFETY HIGHLIGHTS

When using the lathe:

1. **NEVER** leave the chuck key in the chuck
2. **ALWAYS** be mindful of protruding chuck jaws (when applying oil, etc.)
3. **NEVER** risk bringing the cutting tool into contact with the chuck jaws; rotate the part by hand to ensure adequate clearance at position nearest to the chuck
4. **Be careful not to accidentally slam the TAILSTOCK into the workpiece or into the stop block**
5. **ALWAYS** verify the spindle is rotating the proper direction (CCW) and use caution when operating the power switch to avoid accidentally engaging reverse
6. **ALWAYS** ramp GENTLY into contact with the workpiece each time and in general, limit cut depths to 0.100" per pass
7. **ALWAYS** use proper filing technique: use slower spindle speeds (< 300 rpm); hold file in left hand; don't apply much force; allow the machine to do the work

Miscellaneous points:

- **Slide chip tray in and out gently (it can be easily damaged)**
- **Calipers should remain in their storage boxes when not in someone's hand**
- **Inspect tools before and after use and report broken tools to lab staff**
- **Do not wipe the oil off the machine's guideways when cleaning**

MILLING MACHINE SAFETY HIGHLIGHTS

When using the milling machine:

1. **NEVER** handle cutting tools without a rag to protect your hand(s)
2. **ALWAYS** lock the spindle in the upper-most position before changing tools and perform collet changes over the plastic table covers (NOT the vise!)
3. **ALWAYS** check the speed range (HI/LO) and tool clearance before turning the machine on; verify spindle direction (CW) as the tool begins to rotate
4. **NEVER** change the mills between HI & LO range (ALWAYS ask a TA)
5. **ALWAYS** adjust spindle speeds while the machine is running
6. **ALWAYS** wait for the spindle to stop **COMPLETELY** before taking measurements or cleaning the part
7. **ALWAYS** ramp **GENTLY** into contact with the workpiece each time and in general, limit cut depths to 0.100" per pass

Miscellaneous points:

- **Be careful not to drop the precision parallels on the floor or into the vises;** return them to their storage box immediately after clamping your workpiece
- **When not in your hands, calipers should be in their storage boxes**
- **Inspect tools before and after use and report broken tools to lab staff**
- **Do not wipe the oil off the machine's guideways when cleaning**

ROLL-IN BANDSAW SAFETY HIGHLIGHTS

When using the Roll-In bandsaw:

1. **NEVER wear gloves** as they could get caught on the moving teeth and pull your hands into the moving blade, causing severe injury
2. **NEVER cut materials that might be hardened, such as steel alloys, files, hardened guideways, stainless steel, etc;** any material that cannot be cut easily with a standard hand file should never be cut in a bandsaw; use an abrasive cutoff saw instead
3. **The upper guide and guard should be set to within ¼" of the workpiece.** Adjust the guard with the machine turned off
4. **ALWAYS bring the blade into contact GENTLY with the workpiece**
5. **Do not push the blade into the workpiece hard enough to cause chatter**
6. **If the band breaks, immediately shut off the power and stand clear until the machine stops**
7. **Always bring the blade into contact with the material before engaging the gravity feed.** The proper procedure is as follows: (1) firmly clamp the workpiece in the vise; (2) turn on the saw so the blade is rotating; (3) gently bring the moveable saw blade into light contact with the workpiece by rotating the hydraulic feed knob; (4) keep your hand on the feed knob while the cut is being made; (5) retract the blade carriage after the workpiece is cut but before the blade passes the remaining stock in the vise; (6) return the carriage to its original (starting) position; (7) turn off the saw.

Miscellaneous points:

- The bandsaw is a slow cutting machine; do not overfeed the work, as this will quickly destroy the teeth on the blade and cause the blade to break

VERTICAL BANDSAW SAFETY HIGHLIGHTS

When using the vertical bandsaw:

1. **NEVER wear gloves** as they could get caught on the moving teeth and pull your hands into the moving blade, causing severe injury
2. **NEVER cut materials that might be hardened, such as steel alloys, files, hardened guideways, stainless steel, etc;** any material that cannot be cut easily with a standard hand file should never be cut in a bandsaw; use an abrasive cutoff saw instead
3. **The upper guide and guard should be set to within ¼" of the workpiece.** Adjust the guard with the machine turned off
4. **Use a push block for small work** so if your hand slips off it will not swing into the blade
5. **ALWAYS bring the workpiece into contact GENTLY with the cutting blade**
6. **Do not push the workpiece into the blade hard enough to cause chatter;** slow down and find a more rigid manner in which to support/clamp the work in the saw
7. **If the band breaks, immediately shut off the power and stand clear until the machine has stopped**

Miscellaneous points:

- The bandsaw is a slow cutting machine; do not overfeed the work, as this will quickly destroy the teeth on the blade and cause the blade to break
- The bandsaw cannot cut small radii (< 6" radius), so don't try, because doing so will twist the blade so much that it will break

DRILL PRESS AND HAND DRILL SAFETY HIGHLIGHTS

When using the drill press and hand drill:

1. **Always wear safety glasses**
2. **Always clamp the workpiece in a vise or directly to the table.** Never rely on your hands to hold the part to be drilled, as the drill bit can snatch the workpiece causing injury.
3. Use a center punch or center drill for all holes on either the drill press or hand drill.
4. Run drills at an appropriate speed for the diameter of the drill bit and material.
5. Use cutting fluid when drilling holes.
6. **Do not use excessive force** when drilling; let the drill bit do the work.
7. If the drill binds in a hole, turn the machine off and turn the spindle backwards by hand to release the bit.

Miscellaneous points:

- Never place a drill bit in the wrong location in the drill index. If unsure of the drill bit size measure it with a pair of calipers. Inspect drills before and after use.
- When drilling holes, withdraw the drill bit frequently to properly evacuate chips.
- Reduce drilling pressure as the drill bit breaks through the bottom of the material

SANDER & GRINDER SAFETY HIGHLIGHTS

1. **NEVER wear gloves** as they could get caught on the moving abrasive wheels and pull your hands between the spinning wheel and the moving blade, causing severe injury
2. **NEVER cut non-ferrous metals** (like aluminum) with a grinding wheel
3. **ONLY use the portion of the disk sander that pushes the workpiece down against the table;** NEVER use the other half of the sanding disk
4. **ALWAYS keep the workpiece pushed firmly against the table;** NEVER try to support the part “free handed” against the sanding or grinding wheel, as this can cause severe injury if the part gets pulled between the sanding disc and the table
5. **ALWAYS keep the table / pedestal within 1/8” of the sanding / grinding wheel** so small parts can’t slide between the gap, causing serious injury
6. **Hold small parts securely with locking pliers** to prevent the user from losing control of the workpiece and launching it across the room
7. **ALWAYS be gentle with the workpiece;** NEVER push it hard or you will overheat the sanding disk or grinding wheel (which can explode); if necessary, use a can of water to cool down the part as you work with it