EML2322L – MAE Design and Manufacturing Laboratory

TA Outline (Assigned Parts)

- Remind students to sign the attendance roster **in the correct location**
- Improper Shoes: students receive an *'**S**'* next to their signature in the roster, are told to return for a later lab and that two violations count as an unexcused absence
- No Safety Sheets: students receive an *'**SS**'* next to their signature in the roster, are given a lab copy to use and are told to that two violations count as an unexcused absence
- Improper Pants: students receive a *'**P**'* next to their signature in the roster and are told to return for a later lab and that two violations count as an unexcused absence
- **Remember to remove all jewelry & watches, tuck in loose clothing, and tie back long hair**
- **Make sure all students are wearing glasses**; aprons are optional
- Part drawings were distributed and the tolerance table explained via e-mail
- Assign work groups (already e-mailed to students) and storage bins at the beginning of class

Milling Machine Part:

- All **surfaces should be finished** (i.e. machined) as listed under the drawing NOTES
- Review **tolerance table** with students (main purpose is to organize drawing)
- Discuss **nominal part/stock sizes** as they relate to general dimensions/tolerances
- Show proper use of **dial calipers** and cover ***Caliper Safety*** from the safety sheets
- Teach students about **workpiece deburring** using a vise, file and deburring tools

1. Face ½″ x 4″ **sides** (lock *spindle clamp*; don't need parallels; file edges after cutting each side)
2. Face 2″ x 4″ **sides** (use 1.625″ *parallels (2nd from right side)*; file edges after cutting each side)
3. Square off ½″ x 2″ ends so you can make a proper measurement (use parallels & **overhang left side** of the vise); perform light *finish cuts* at full **½″ depth of cut (DOC) axially and .020″ radially;** zero DRO on final pass on second side (don't take part out of vise); **ensure students place a hand on the table** to sense vibration when taking these cuts since they are deep
4. Finish machining 4″ length; **cut 0.100″ max in X per pass at full ½″ DOC; cut slowly with hand on table;** leave 0.020″ material in X direction for finish pass; zero DRO on final pass
5. Cut ¼″ slot in plate; zero the Z-axis; take 0.100″ deep *roughing cuts*; leave 0.020″ material in X & Z directions for finish pass at full ¼″ DOC; **cut slowly with hand on table**
6. Show students proper use of *cylindrical edge finder* to locate *feature datums*; rotate edge finder approx. 1000 rpm; **stop spindle before resetting the edge finder** with your finger**;** remember to **offset 0.1″** for the radius of the edge finder; demo on vise and let students find their two zeros.
7. Drill all 9 holes using *center drill* (1600 rpm); **explain purpose of center drill**
8. Drill 4 tapped holes thru using 0.157″ *tap drill* (1400 rpm); **explain tap chart**
9. Drill remaining 5 holes using 0.196″ *clearance drill* (1200 rpm); **explain clearance hole sizes**
10. Drill center mounting hole thru 1/64″ under 5/16″ (~0.298″, 700 rpm) in preparation to use *reamer*; **explain the purpose/use of the reamer**
11. Finish drilling shaft mounting hole using reamer (500 rpm, **stay in HI range**)
12. Use the *countersink* tool to finish the 4 clearance holes (500 rpm); use calipers to judge when the countersink diameter is close to 0.42″ (turn off machine when making measurements); **teach students to use *depth stop***
13. Tap the four threaded holes using the *spring loaded tap guide* and *10-24 UNC taper tap*; use oil; load tap guide in collet so you don't have to lower the Z-axis so far; remind students to reverse the tap often and **use air before final tap retraction**

14. Flip part on its side; use the cylindrical edge finder to locate the feature datums; drill the set screw hole (center drill; 0.157″ tap drill); **use this as a quiz to evaluate students' retention**
15. Tap set screw hole using a standard taper tap; be careful to stop before the threads end on the tap
16. Finish threading the hole all the way thru using a *10-24 UNC bottoming tap*
17. Debur & stamp team number into part **on a scrap board on the wooden mill table (not countertops)**; **call out *ears*** before striking the part the first time to forewarn others of the noise

Lathe Part:

- All **surfaces should be finished** (i.e. machined) as listed under the drawing NOTES
- Review **tolerance table** with students (main purpose is to organize drawing)
- Discuss **nominal part/stock sizes** as they relate to general dimensions/tolerances
- Show proper use of **dial calipers** and cover ***Caliper Safety*** from the safety sheets
- Explain **radius vs. diameter** motions on the lathe once you start machining the part

1. Clamp part with AT LEAST 1″ inside the chuck jaws and 2.5″ extending out of the chuck
2. Face end of workpiece (0.020″ should be sufficient; 600 rpm)
3. Turn OD along length of part so it's round; **discuss diameter tolerance with group**
4. Turn shoulder on end of workpiece; 0.100″ MAX depth of cut (DOC) **on the radius;** leave 0.010″ material in Z direction for finish pass to clean up the shoulder
5. Turn chamfers **using Z axis;** verify size using the dial calipers
6. Cut off workpiece 1/8″ oversize on Marvel bandsaw; **perform Marvel safety training; show students how to clamp parts in vise securely**
7. Cut 2″ OD of hub to proper length on the lathe (0.50″); debur edge using file **(be sure to reduce the speed to the slowest setting in HI range and file left-handed)**
8. Drill center hole thru workpiece; start with *center drill* (600 rpm so we don't spin the chuck too fast for the students); then **1/4″ drill** (600 rpm)
9. Drill center hole 1/64″ under 5/16″ (~0.298″) in preparation to use *reamer*; explain the process / purpose of reamer to the students (600 rpm)
10. Finish drilling center hole using reamer (500 rpm)
11. Drill and tap the 3 holes on face of hub using the TM-2 (program: ***LABHUB.NC)***:
    a. load and probe part **(make sure top surface of hub is flush with top of vise jaws)**
    b. drill thru using 0.157″ screw machine drill (it's a *split point drill*, so no need for center drill and it's shorter and stiffer than the normal *jobber drill*)
    c. use *rigid tapping* to automatically thread the 10-24 UNC holes the proper depth
12. FINISH PART ON MANUAL MILLING MACHINE
13. Clamp part on its side; use *conical edge finder* to locate the surface datums; drill the set screw holes (center drill followed by 0.157″ tap drill)
14. Tap the set screw holes using a *10-24 UNC taper tap*; load tap guide in collet so you don't have to lower the Z-axis so far; be careful to stop before the end of the tap bottoms out inside the hub center hole; **finish with *10-24 UNC bottoming tap***
15. Debur the tapped holes using extended length deburring tool & stamp team number into part **on a scrap board on the wooden mill table (not countertops)**; **call out *ears*** before striking the part the first time to forewarn others of the noise