EML2322L – MAE Design and Manufacturing Laboratory

Tips for Working Efficiently on the Project

The following tips offer suggestions for working more efficiently on the course project. The goal is to execute your designs as quickly as possible while ensuring your safety.

1. **Continue to plan your work and work your plan.** For this phase of the project ensure your group meets regularly before lab to review individual task assignments so everyone comes to lab ready to start working immediately. The most prepared groups get first choice of machines in the lab, so use this to your advantage. In addition, remember it is rarely productive to pair up members on tasks in the lab (such as creating motor mounts, wheel hubs, assembling the robot frame, or building manipulators); if assistance is needed, take advantage of the TAs. The final and perhaps most helpful tip for planning your work and working efficiently is to bring part drawings to office hours and discuss with a TA how to make each part so you are well informed and prepared when you come to lab that week.

2. **Complete paperwork outside of lab so you can maximize the time spent during lab working on the project.** Complete purchase orders and engineering change notice forms outside of lab and come to the TA office hours (or email your TA or Mike) to get your questions answered before lab rather than during lab. This enables you to complete your project sooner and maximizes the time available for testing and modifications.

3. **Print working copies of drawings for reference in lab.** Project prototyping begins the week groups submit their revised DR3 in lab. Consequently groups need to print working copies of detail drawings for all non-OTS (i.e. custom) parts manufactured in lab and all assembly drawings, since the original drawings will be in the design report notebooks and therefore unavailable for reference. Bring copies of **all** non-OTS detail drawings each week in the event equipment bottlenecks necessitate unplanned schedule changes.

4. **Use 80/20 wisely.** If using 80/20 for your design, use a tape measure and your cut list to try and find the pieces you need already cut to length. Be reasonable with your tolerances, as most pieces don't require ± 0.020" tolerances on their lengths. If you don't find the pieces you need, locate the next larger size and minimize the amount of material cut off each piece (so longer pieces are reusable for many semesters). When cutting 80/20, mark cuts offline (i.e. away from the bandsaws) on a worktable with a sharpie and cut multiple pieces at once by stacking up to four pieces in the vise horizontally. Combining 80/20 cuts with other groups also saves time, as does using the second bandsaw setup in the lab for 80/20.

5. **Familiarize yourself with the hand tools provided in the laboratory toolboxes.** Many students coming into the course have not worked with many hand tools, so we put together a **brief overview of the common hand tools provided in each laboratory toolbox**.

6. **AWJ manufacturing.** **If your parts qualify**, take advantage of the opportunity to submit them for manufacturing using the AWJ process. As you can read, AWJ is an automated method for cutting precision sheetmetal parts that cannot be easily manufactured using the

manual equipment in the lab. If you take time to submit parts for manufacturing using this machine, you must follow the submission instructions noted in the AWJ Design Guide, or your parts will not be cut and you will have to make them manually.

7. **Sheetmetal tips. (1) Bring printed sheetmetal templates to lab.** The required sheetmetal drawing template includes an unfolded view of the part. Print and cut out a full scale drawing and bring it to lab to greatly reduce the time required to layout the part on the sheetmetal blank. **(2) Use the digital calipers on the sheetmetal table to measure the thickness of sheetmetal (wear gloves because the sheetmetal is SHARP). (3) Always use the smallest piece of material that is large enough to make your desired part** (small pieces of leftover sheetmetal are located in the plastic bins under the sheetmetal table). **(4) Use a magnet to check if a workpiece is made of steel.** Please let the TAs help.

8. **Study for the tapped hole quiz so you can use the CNC milling machine to drill and tap the holes in the face of your second wheel hub.** Review the **Example Tapped Hole Quiz** with your group and ask any questions. When you reach the point where your group is ready to drill and thread the holes in your second hub, each member will be given a tapped hole quiz (with a different fastener size than the example linked above). If every member passes, the TA will help your group use the CNC for creating the threaded holes; otherwise, your group must make the holes using one of the manual milling machines, as you did earlier in the semester. Prepare for the quiz so you can save your group 30 minutes of work.

9. **Understand how the testing procedure in the lab works and plan accordingly.** The newer-style control boxes with the PlayStation transmitters operate on different frequencies, which means groups can test as soon as they are ready and without interruption from other groups. This ability to test independently and simultaneously is a significant change from previous semesters when only one group at a time could test and groups were forced to share controllers, so use this additional testing time to your advantage. We also provide simple switch boxes which allow groups to test basic function of motors without using a control box.

10. **All groups will have exactly the same amount of work time for the project.** To be fair to every student in the course, no group will be allowed additional work time outside of class, as completing the objective within the allotted time is a project objective. Groups are welcome to come to TA hours to work on the "administrative" portion of the project (i.e. POs, ECNs, part redesigns, design modifications, etc.) or to practice on the machines, but robot parts cannot be worked on outside of your formal lab period. Likewise, do not open your storage bins before your lab period formally starts and stop work in time to put your project away and on the shelf before your lab period formally ends.

11. **Have a backup plan in case a machine you need is being used.** Again, our common goal is to get your designs prototyped as quickly as possible. However, sometimes the machine you need may be occupied by other students. Relevant examples are the mills and lathes during the first week of manufacturing when 4 groups in each section need to make motor mounts and wheel hubs. Because of equipment limitations it will sometimes be necessary to work on a part out of sequence so you can make progress on the project until the machine you need is available. In these cases please let a TA know so they can ensure you have priority access at the next available machine opening (even if it's the following week). If

your group is inconvenienced by this more than once, please let Mike know so he can better schedule future semesters; he wants you to have a good experience and values your feedback.

12. **Don't rely on only "your" TA to answer questions.** There is a lot happening in the lab during the prototyping phase, as up to 16 students may be working on 16 different tasks and machines! ***ALL TAs are available to answer ANY questions you have***, so don't feel like you need to wait for YOUR TA every time you have a question. Yes, your TA will be the most knowledgeable about your design (and as such, is probably the best to ask about design changes), but ALL the TAs are knowledgeable and always eager to help. (At least they should be, or we need to find new TAs ☺!)