EML2322L – MAE Design and Manufacturing Laboratory

# TA Outline (Sheetmetal Demonstration)

*The following outline is intended as a guide to follow when giving the sheetmetal demonstrations to the lab students. Please use the highlighted nomenclature when speaking about the machines. The times in parenthesis are suggestions of the approximate time to spend on each topic.*

1. **General Definitions *(30 sec)*:**
   A. The term ***sheetmetal*** refers to material possessing a high surface area-to-thickness ratio.
   B. Sheetmetal thicker than ¼″ is termed ***plate*** in industry.

2. **Important Safety *(1 min, BE VERY SERIOUS)*:**
   A. **Always wear safety glasses** when operating sheetmetal equipment.
   B. **Always keep fingers clear of cutting edges** and machine clamps.
   C. **Be careful of sharp edges** on sheetmetal parts. **Every edge is RAZOR sharp** so always wear gloves to protect your hands when working using unpowered sheetmetal equipment.
   D. **NEVER operate a machine with more than one person**, as the slightest miscommunication can cause severe bodily injury or severed fingers. If you require assistance or have a question, **ASK A TA FOR HELP**, not another student.
   E. **Only cut flat material** (never round) that is 16 gage (.065”) or thinner.

3. **Part Layout *(1 min)*:**
   A. Begin by marking the workpiece to denote the operations used during fabrication.
   B. To denote a region that will be cut, use a solid line.
   C. For holes to be punched or drilled, mark the location with a cross.
   D. Bends are marked using dashed lines; denote each flange direction (i.e. *UP 45 degrees*).
   E. Mention students can save time when making sheetmetal parts by bringing printed 1:1 drawings which can be taped to the sheetmetal and used for quicker feature layout.

4. **Part Fabrication *(10 min)*:**
   A. Begin by using the ***hydraulic shear*** to cut the material to size. Align each cut line with the blade edge by sighting down the top of the cutting blade. Once aligned, ensure your fingers are out of the way and depress the activation switch using your left foot.
   B. With the rough shape cut out, the next step is to remove the corners; which is accomplished with the ***90-degree corner shear*** and ***the hand shear***. Align the corner to be removed with the blade’s edges. Hold the workpiece while keeping your fingers clear of the cutting zone and pull the handle down to shear the material. ***The shear handle can require pretty high force, so be careful of the handle when cutting thicker workpieces.*** Cut the remaining two corners using the ***yellow hand shear.***

C. It's important to punch holes before making any bends in the part. Once bends are made, most holes will be unreachable due to geometric constraints. To use the ***punch press***, first mark the center of the hole with a ***center punch*** to aid in punch alignment. To select the appropriate ***punch and die pair,*** turn the small handle on the right hand side of the punch press and rotate the turret until the proper punch is lined up. Return the small handle to its original position and firmly rock the turret to ensure it's locked in position. Locate the workpiece under the die by lining up the center mark with the small point on the bottom of the punch. Pull the handle down to punch through the workpiece and create the hole.

D. With the corners removed and holes punched, the sides of the box can be bent upwards using the ***beam brake.*** Align the bend line with the edge of the beam and lower the orange handles down to securely clamp the material. Next, rotate the ball-end handle to create the bend. As you make each bend use your eye or a protractor to determine when the bend angle is close to the desired value. When we try to bend the third side, the beam contacts the other sides previously bent, preventing us from bending our piece past (approx.) 45°. To achieve the desired angle, we must use the *finger brake.*

E. The ***finger brake*** operates like the *beam brake* shown previously, however it provides the ability to adjust the spacing of the dies used for bending. To move the dies, loosen their adjusting screws with a wrench, slide them into position and tighten the screws back down. Once the appropriate spacing is set, align the bend with the dies, secure the workpiece using the clamp and bend it to the desired angle.

F. Now that the box is complete, welding may be used to close the seams at the corners to make the part more rigid and better able to support external forces.

**5. Final Notes *(1 min)*:**

A. Sheetmetal fabrication can be a relatively quick and affordable way to make brackets, hoppers and manipulators. In contrast to our example part, machining a thin-walled box from a solid block of material would require significantly more time and the material cost would be much higher because most of the material would be converted to wasted chips on the milling machine.

B. If students are thinking about using sheetmetal parts on their designs, instruct them to show their ideas to the TAs, as the designs and sequence of operations are important in determining if the parts can be made on the equipment in our lab.

C. Ask students if they have questions about the demonstration or sheetmetal parts in general.