Introduction:
This tutorial provides basic instructions for the use of the Universal Laser Systems “Versa Laser” laser cutter. Typical use of the laser cutter involves cutting thin pieces of balsa wood or light plywood for assembly into larger components. Workflow for fabricating a component with the laser cutter includes 3D modeling in CAD, DXF drawing creation, and component cut-out.

Figure 1: Example of laser cutter use for aircraft fuselage construction: a) the parts are cut on the laser cutter, and then b) assembled to form the component.

Figure 1 illustrates the use of the laser cutter to construct an aircraft fuselage. Any two-dimensional shape is easily cut with the laser cutter, allowing for flexible and intricate designs. Careful design of the component in CAD allows for rapid assembly once the constituent parts are cut. At times it is particularly helpful to design the component with interlocking tabs, allowing rapid, puzzle-like assembly.

The most commonly used materials cut with the laser cutter are balsa wood and light plywood. A variety of wood materials are available at online suppliers such as http://www.balsausa.com/.

All posted safety guidelines must be followed at all times. The current safety code is posted around N3D and available at http://engineering.nd.edu/groups/n3d/safety.

Before Cutting - create a DXF file:

Using Creo Parametric
1. Model: model your component, including all individual parts to be cut
2. Drawing: create new drawing and uncheck “use default template”
3. Select “Empty,” “Variable,” and enter the cutting area dimensions: 31.5” by 17.5”
4. Turn off displays for Plane, Axis, Point, and Csys Displays. It is necessary to remove any markings present on the drawing that will not be cut, including text, coordinate systems, drawing borders, etc.
5. Insert general view, use “no hidden” display style and “solid” tangent edges (multiple parts may be included)
6. Delete any notes or other items that appear in the drawing
7. Right click ➔ page setup ➔ paper size ➔ unclick “Show Format”
8. Save a copy as, set file type to “DXF”
9. Properties tab ➔ change “geometry” to “red”

**Using Inkscape**

Inkscape is a free software package for exporting DXF files from an illustrator environment if you do not have or do not know how to use Creo Parametric or other 3D modeling software: [http://inkscape.org/](http://inkscape.org/)

General sketching in Inkscape is straightforward. Important considerations for creating drawings for the laser cutter include:

- Make sure all lines are the same color (generally either black or red)
- Make sure no lines are duplicated when creating complex geometry. Duplicated lines will be cut multiple times on the laser cutter, potentially burning your material.

When you are ready to export your drawing, complete a “Save As” and set the file type to DXF.

To trace an image in Inkscape:

1. Copy paste image to Inkscape
2. Click Path on toolbar
   - Select Trace Bitmap
   - Select Brightness cutoff
   - check remove Background
   - Click update and ok
3. Select the traced out picture
   - “Shift+click red” (It will trace the edges red)
   - Click no fill

**Send DXF File to Print Queue:**

1. Transfer DXF file to the laser cutter computer using flash drive or Webfile
2. Open file in SolidWorks eDrawings
3. Verify that all lines are red and no outside border is present
4. File ➔ Print
5. Make sure printer name is “VLS6.60”
6. Under “Print range”, set Active sheet to “To scale (1 to 1)”
7. Under “Options”, set Style to “Color / grayscale”
8. Under “Options”, click “Line Weights...” and set the “Thin:” line weight to 0.05
9. Click “Show Preview” and ensure part looks correct
**Cutting The Part:**

1. Open UCP from the Desktop
2. Click “Settings”
   a. Click “Manual Control”
   b. Select “Red,” verify mode is “Vect” or “Rast/Vect”
   c. Select appropriate power and speed from Table 1
3. Click “Ok”
4. To relocate view:
   a. Click the relocate view icon:
   b. Drag the drawing using the blue square in the upper left corner of the drawing
5. Place your material on the laser cutter table (use masking tape to secure if necessary)
6. Turn on the vacuum system
7. Turn on the laser cutter
8. Click the green “play” button
   a. Hit pause on either the GUI or laser cutter if necessary
9. When finished, turn everything off and log out
General Troubleshooting:

- View gets messed up in the UCP GUI when relocating, etc.:
  - Close UCP, and re-print from SolidWorks eDrawings
- Laser cutter not recognizing that the lid is closed:
  - Wipe any dust/debris from the two proximity sensors at the corners of the lid
- Other
  - Try turning off the laser cutter and then restarting
  - Try restarting the computer

<table>
<thead>
<tr>
<th>Material</th>
<th>Thickness</th>
<th>Power</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balsa</td>
<td>1/16&quot;</td>
<td>40 %</td>
<td>60 %</td>
</tr>
<tr>
<td>Balsa</td>
<td>1/8&quot;</td>
<td>65 %</td>
<td>35 %</td>
</tr>
<tr>
<td>Balsa</td>
<td>3/16&quot;</td>
<td>75 %</td>
<td>25 %</td>
</tr>
<tr>
<td>Balsa</td>
<td>1/4&quot;</td>
<td>85 %</td>
<td>15 %</td>
</tr>
<tr>
<td>Light plywood</td>
<td>1/8&quot;</td>
<td>80 %</td>
<td>20 %</td>
</tr>
<tr>
<td>Basswood</td>
<td>1/8&quot;</td>
<td>90 %</td>
<td>10 %</td>
</tr>
<tr>
<td>Corrugated cardboard</td>
<td>3/16&quot;</td>
<td>80 %</td>
<td>20 %</td>
</tr>
</tbody>
</table>
Quiz Questions:

1. What file format is used for laser cutter parts?
   a) .STL
   b) .DWG
   c) .DXF
   d) .PDF

2. The color _____ is used for “geometry” when exporting the drawing file.

3. It is permissible to use masking tape to hold down the material being cut if necessary.
   a) True
   b) False

4. If you are unable to cut in VECT mode, what should you check first?
   c) Verify that not dust is present on the laser cutter latches. Wipe any dust/debris from the two proximity sensors at the corners of the lid.
   d) Ensure that the line thickness is set to 0.05.
   e) Restart the computer.
   f) Restart the laser cutter.

5. For general troubleshooting, a good first bet is to:
   a) Verify that not dust is present on the laser cutter latches. Wipe any dust/debris from the two proximity sensors at the corners of the lid.
   b) Ensure that the line thickness is set to 0.05.
   c) Restart the computer.
   d) Restart the laser cutter.

6. Which safety rules do not apply when using the laser cutter?
   a) Safety glasses must be worn at all times.
   b) At least one other person must be present at all times.
   c) The equipment and space must be respected by promptly cleaning up after use.
   d) None of the above: all posted safety guidelines for the machine shop must be followed at all times.

Deliverable:
Design a three dimensional assembly with interlocking pieces to cut out of cardboard on the laser cutter. Cut and assemble the parts and email a photo of the final assembly to the TA.