

Lab 1: Engineering Drawing, 3D Printing and Laser Cutting

BMEEn 2151 “Introductory Medical Device Prototyping”

Prof. Steven S. Saliterman

Contents

Exercise 1.1: Your First SolidWorks Drawing	2
<i>Getting Started</i>	<i>2</i>
<i>3D Print Your SolidWorks Part.....</i>	<i>2</i>
Label Your Parts	2
Organization	3
Printing.....	3
Exercise 1.2: Open Revolves and Sweeps.....	4
<i>Revolves and Sweeps.....</i>	<i>4</i>
3D Print Your SolidWorks Part.....	5
Exercise 1.3: Lofts	6
<i>Lofts Tutorial.....</i>	<i>6</i>
3D Print Your SolidWorks Part.....	6
Exercise 1.4: Sheet Metal	7
<i>Sheet Metal Tutorial.....</i>	<i>7</i>
Exercise 1.5: Sketch Blocks	8
<i>Sketch Blocks Tutorial.....</i>	<i>8</i>
Exercise 1.6 Laser Cutting MDF and Acrylic from a SolidWorks File	9
<i>Laser Cutting.....</i>	<i>9</i>
Exercise 1.7: Dimensioning (Optional Exercise).....	12
<i>DimXpert.....</i>	<i>12</i>

Exercise 1.1: Your First SolidWorks Drawing

Objective: familiarization with creating the following part features:

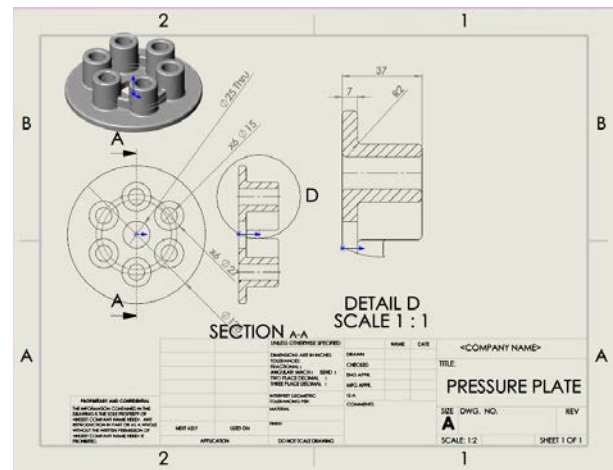
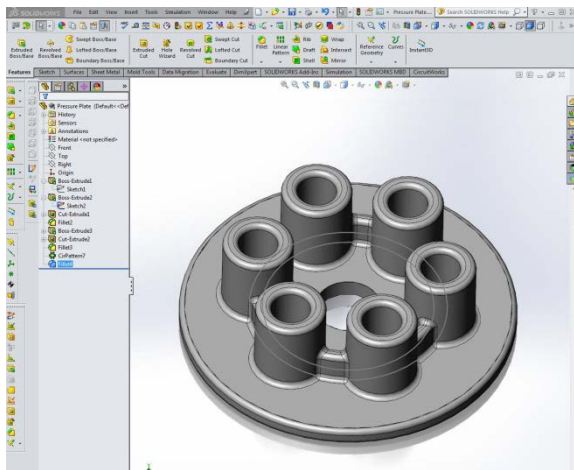
1. Sketches such as circles, lines and offsets.
2. Selecting a plane or surface for sketches.
3. Dimensioning.
4. Features such as extruded-boss and extruded cut.
5. Various views (perspectives), fill, and wire frame models.
6. Fillets.
7. Temporary axis.
8. Circular patterns.

...and drawing tasks:

1. View and hidden line removal.
2. Section and detail views.
3. Adding isometric view with filled surfaces.
4. Center lines and center marks.
5. Dimensioning and adding text.

Getting Started

Launch SolidWorks - Select “Resources” to open the Task Pane, select Tutorials and complete the “Getting Started” tutorial. Save and print your part and drawing, and place in your lab workbook. Your name and date should be in the title block.



3D Print Your SolidWorks Part

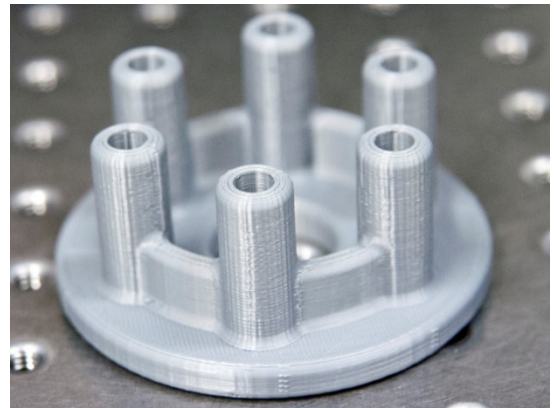
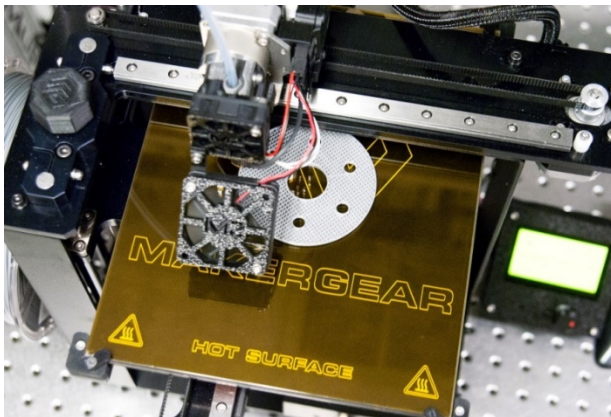
Label Your Parts

You may place your name on the bottom of each part that your 3D print before printing. To do this, open your part in Solidworks, rotate it so that the bottom is facing you, then select Features/Extruded Cut/Sketch/Text. Select the face, select a font and size, and type

your first initial and last name. You can locate the text by clicking on the face, and thus moving the text “dot” to that location. Size your font so that the lettering will be visible when printed. Exit the sketch and cut to a depth of 0.1”. Accept by clicking the green arrow, and you are done. Save as a .STL file and print. Your name will now appear on the bottom of your part, and safeguard it from being confused with someone else’s part, inadvertently being submitted by someone else, or being reused in a subsequent year. If you are having trouble with this, simply write your name with a marker pen on the bottom.

Organization

Be sure to keep all of your Solidworks files (parts, drawings, .STL, .DFX) in a single folder. This includes any optional tutorials you complete so that you can be credited for the work. At the time of the midterm, your folder, including the midterm exam part file, will be transferred onto our course thumb drive for grading. (If you have an Apple, bring a USB adaptor).



Printing

You may use a 3D FDM printer in Anderson Labs in Mechanical engineering or in the Medical Devices Center. Ask a supervisor to review policies and procedures, and to help you get started.

Exercise 1.2: Open Revolves and Sweeps

Objective: Familiarization with the following:

Sketching a revolve profile with lines, arcs, dimensioning, and trimming.

Adding dimensional relationships.

Creating a revolve.

Creating a sweep path and coincidental relationship.

Sweeping along the path.

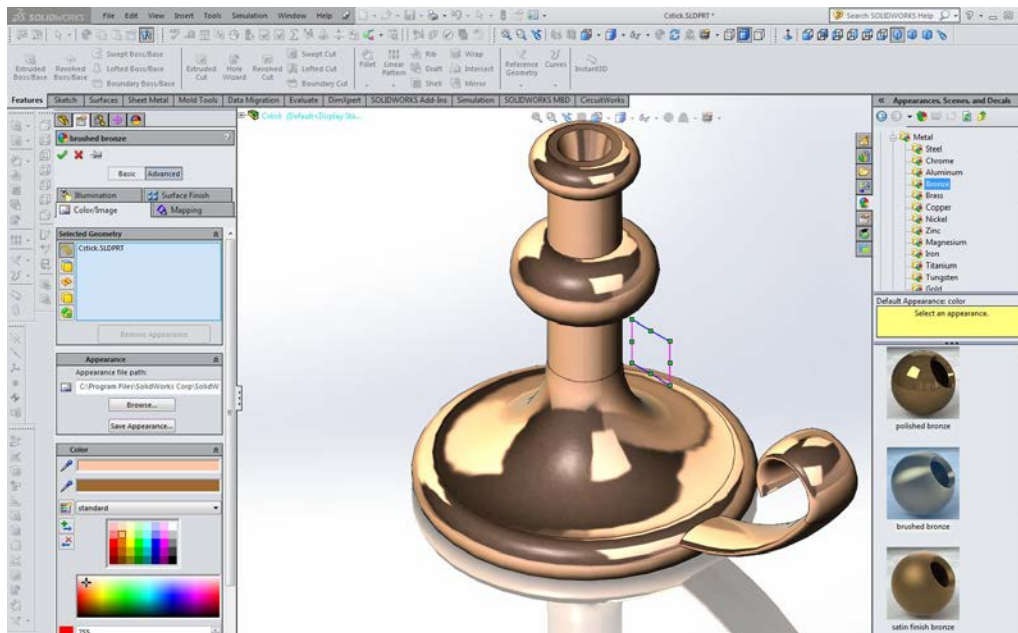
Making an extruded-cut with draft.

Making a transparent view to see the cuts.

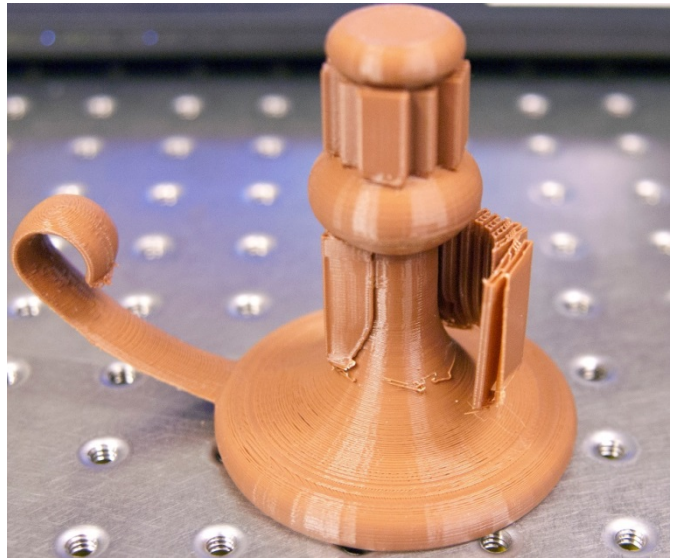
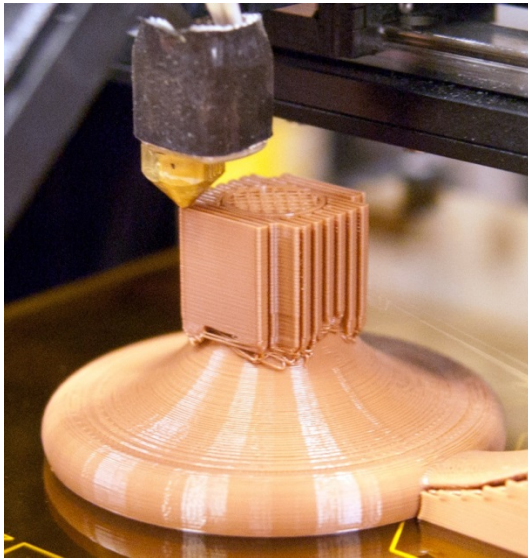
Making a Real View appearance.

Resolves and Sweeps

Launch SolidWorks and Select “Resources” to open the Task Pane, select Tutorials and complete the “Revolves and Sweeps” tutorial. Save and print your part and place in your lab workbook.



3D Print Your SolidWorks Part



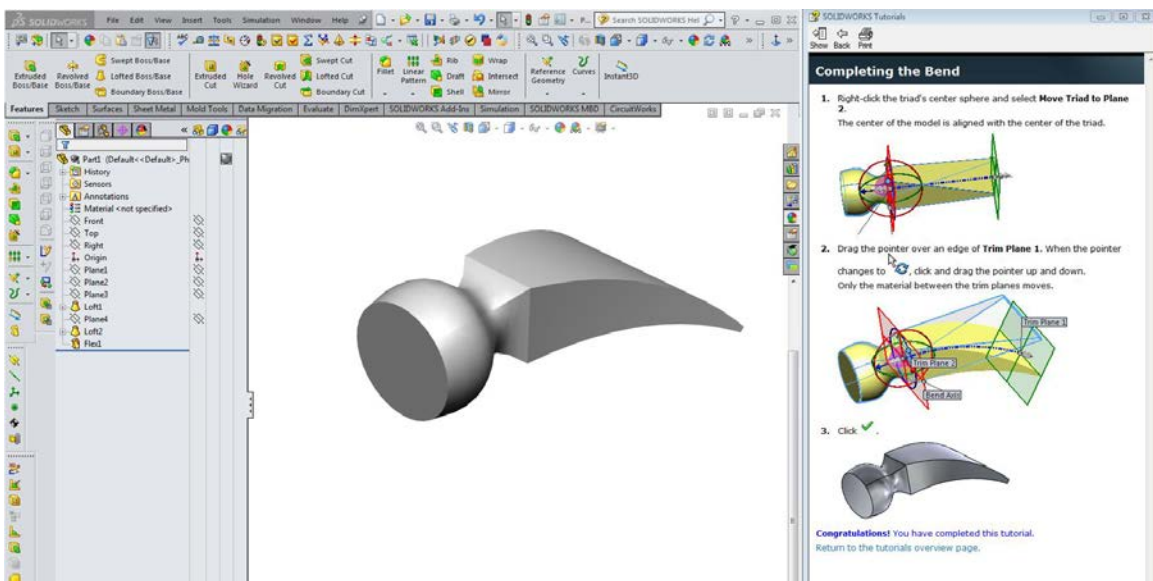
Exercise 1.3: Lofts

Objective: Familiarization with the following:

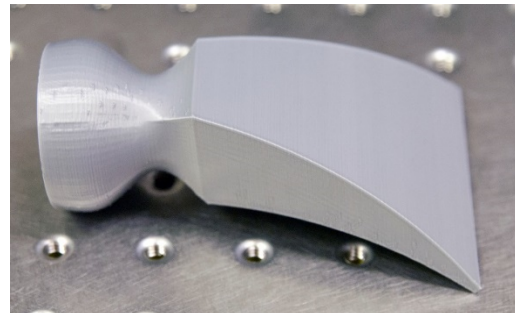
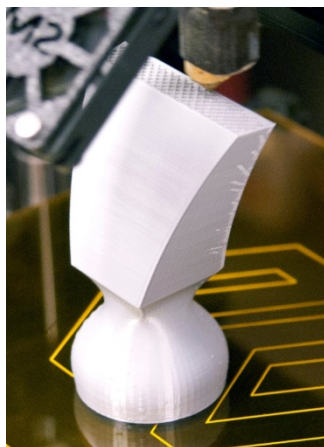
1. Creating parallel planes.
2. Sketching on specific planes and copying from one plane to another.
3. Lofted base-base feature and connecting profiles.
4. Flex feature, moving trim planes and bending material.

Lofts Tutorial

Launch SolidWorks - Select “Resources” to open the Task Pane, select Tutorials and complete the “Lofts” tutorial. Save and print your part and place in your lab workbook.



3D Print Your SolidWorks Part



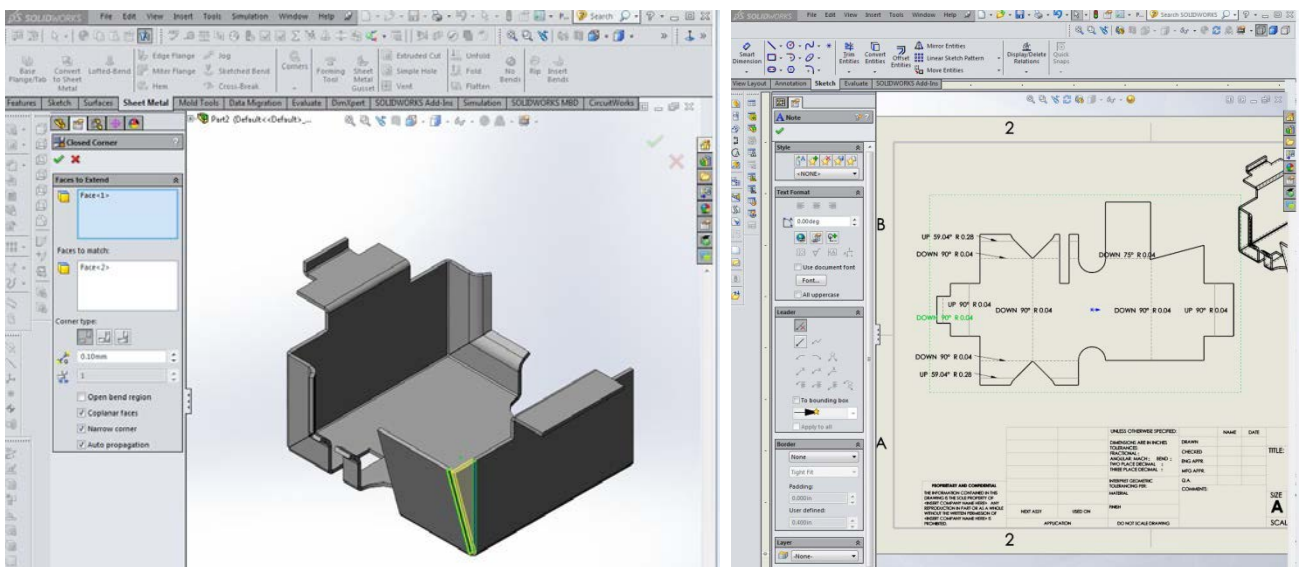
Exercise 1.4: Sheet Metal

Objective: Familiarization with the following:

1. Creating a base-flange.
2. Creating a path for a miter.
3. Mirroring geometry.
4. Creating an edge flange.
5. Mirroring a feature.
6. Adding a tab.
7. Bending with a sketched bend.
8. Unfolding to make a cut, refolding.
9. Flattening sheet.
10. Making a drawing and modifying the notes with leaders.

Sheet Metal Tutorial

Launch SolidWorks - Select "Resources" to open the Task Pane, select Tutorials and complete the "Sheet Metal" tutorial. Save and print your part and drawing, and place in your lab workbook. Your name and date should be in the title block.



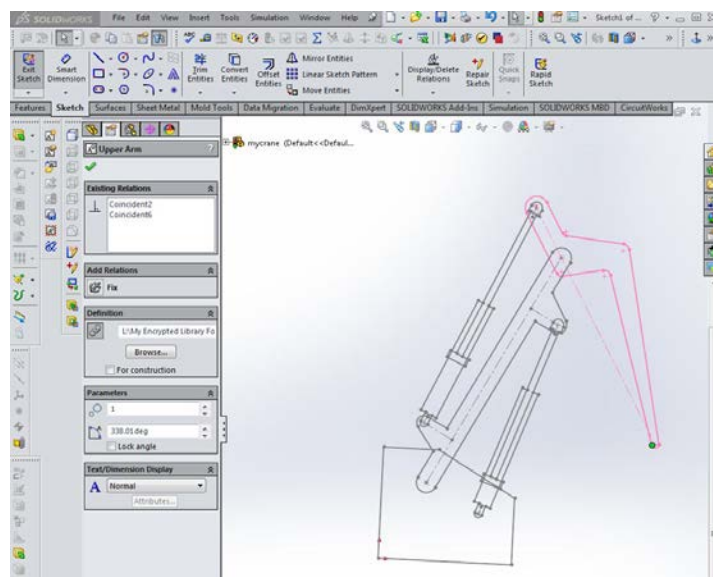
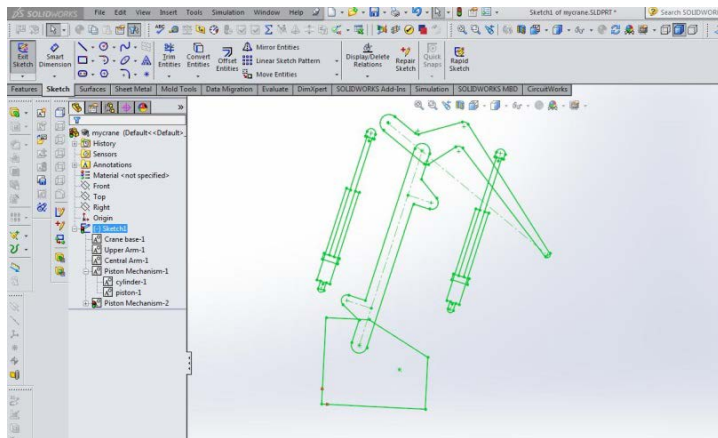
Exercise 1.5: Sketch Blocks

Objective: Familiarization with the following:

1. Making blocks.
2. Making relationships between blocks.
3. Demonstrating movement.
4. Saving, inserting, editing and renaming blocks.
5. Testing motion about coincident and colinear relationships.
6. Combining blocks as a new block.
7. Linking blocks with relationships.

Sketch Blocks Tutorial

Launch SolidWorks - Select “Resources” to open the Task Pane, select Tutorials and complete the “Sketch Blocks” tutorial. Save and print your part and place in your lab workbook.



Exercise 1.6 Laser Cutting MDF and Acrylic from a SolidWorks File

Objective: Familiarization with the following:

1. Creating a clean SolidWorks top view for laser cutting.
2. Saving SolidWorks drawing as a .DXF file for import into CorelDraw.
3. Preparing the drawing in CorelDRAW for cutting, raster and vector engraving.
4. Operation of the laser cutter, interface software and completion of an MDF board and acrylic plastic part.

This exercise can be completed in either the MDC or Anderson Student Innovation Labs. Start with the MDF board, and if all works well redo with the acrylic plastic. Review the following [Video Tutorial](#) and [Laser Cutter Tutorial](#) for more information.



Medical Devices Center



Anderson Labs

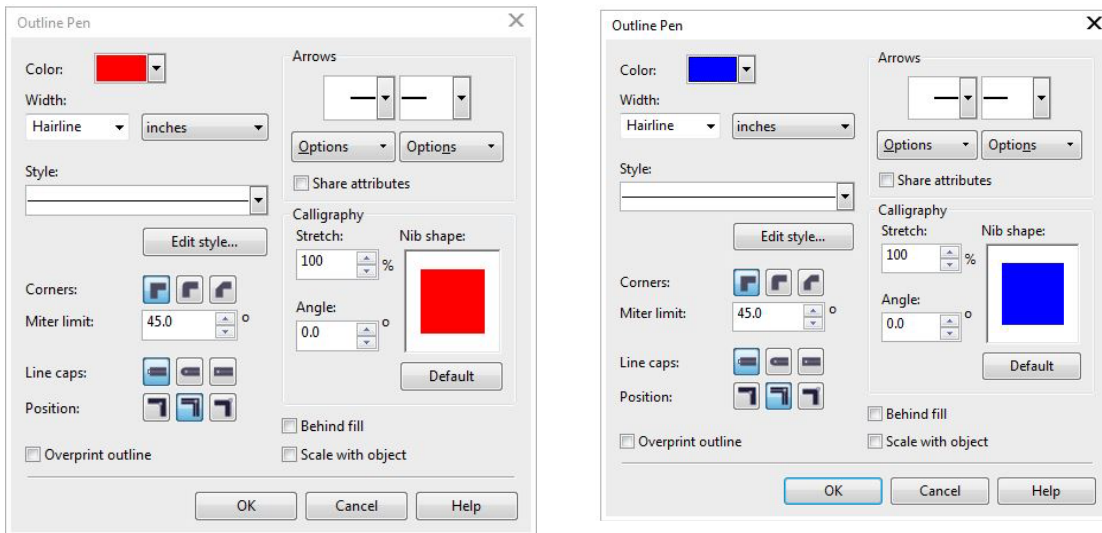
Launch SolidWorks and create a new part. Make a top view-only drawing of a part confined to an 8" square dimension. This is the size of the 1/8" MFD board or acrylic sheet that you will be working with. Include a few cutouts, items to raster etch (etching fills the outline or font), and vector etch (etched outline if no infill). Dimension your part and save. You may create a traditional drawing and save as well.

Create a new SolidWorks drawing, selecting "no formatting" and rename. Drag the top view only of your part into the workspace, and remove any extraneous elements such as crosshairs and centerlines (select each unwanted item and delete). Do not place dimensions on the drawing. Save the drawing, and save an additional file: "title.DXF" onto a thumb-drive.

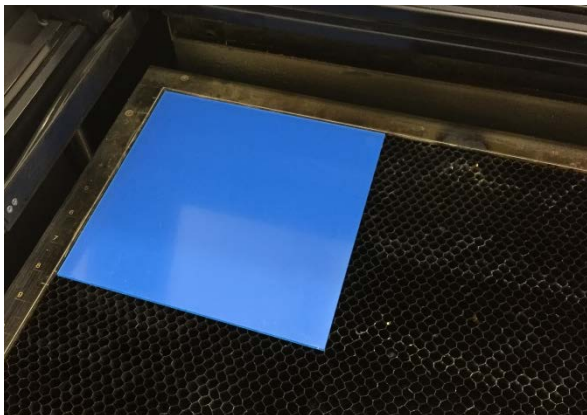
Laser Cutting

Launch CorelDRAW on the computer connected to the laser cutter. Open your file and inspect the drawing. (Select Create a New Document if not importing a SolidWorks file.) Select each object one at a time (or groups) and open the "pen" by double clicking the icon in the lower right-hand corner. Select **red and hairline** for a cut, **black** for raster engraving or **blue**

and hairline for vector engraving. Add your name somewhere by etching or vector engraving it. Save you work on your thumb drive as a CorelDRAW file.



Check that the vent is on. Place your 8" square x 1/8th thick stock into the laser cutter upper left-hand corner, and "focus" by setting the Z-height (upper and lower bed) with the gage:

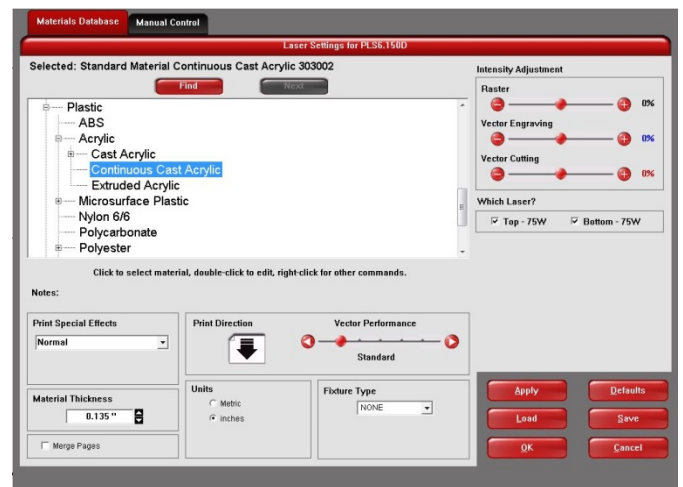
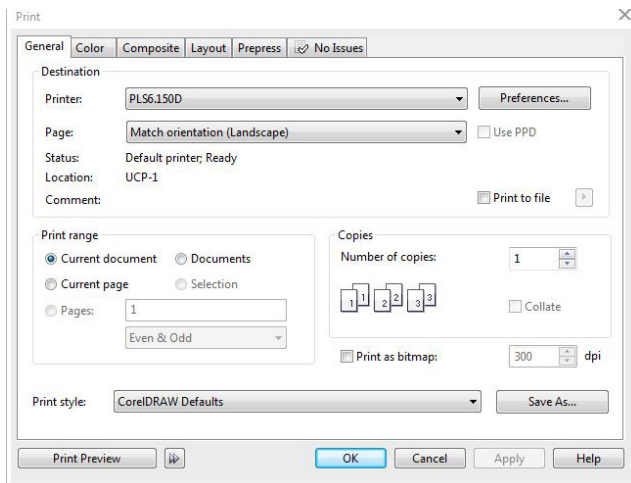


Z-jog control

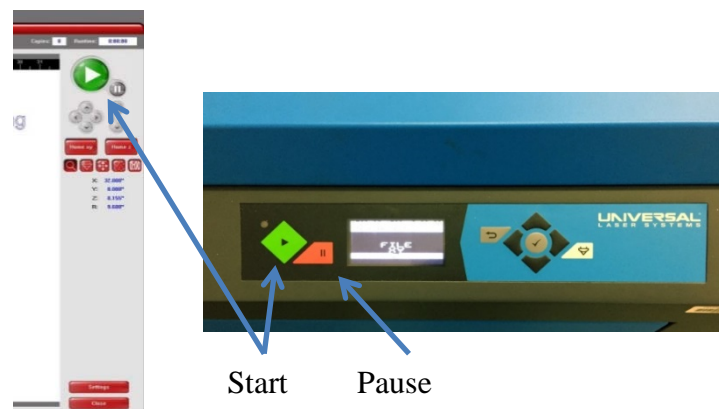
Focus



When ready to print select “Print” from the CorelDRAW “File” menu and in the following dialog select “Preferences.” The display is different in Anderson Labs vs. the MDC. In Anderson Labs, Select Medium Density Fiberboard (MDF) or Continuous Cast Acrylic depending on the material you are using. Add .01-.02” to the actual material thickness. You may also need to increase Vector Cutting from 5-10% if the material is not cutting thru. In the MDC, you must select specific settings from the Laser Cutter Settings Guide available near the printer or under “References” on the course website.



Select “Apply” and “OK” for the right then left displays above. Open the laser cutter interface program and you should see your part layout on the 18 x 32” laser bed surface outline. Your part should be positioned in the upper left. Be sure the door is closed and select print from either the software or machine. It will automatically stop when done. If necessary, you can stop by opening the door or selecting pause. Check that your cuts went thru before moving the work piece (press on the cut part with your finger). When done clean your workspace, close the door, save your files and close the software. Use the nearby fire extinguisher in the unlikely event that fire occurs.



Laser cut both an MDF board and acrylic plastic part. These can be from the same Solid-Works file or two totally different parts.

Exercise 1.7: Dimensioning (Optional Exercise)

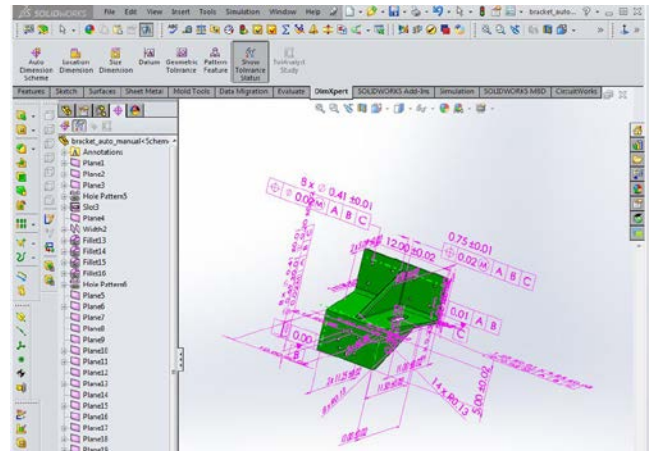
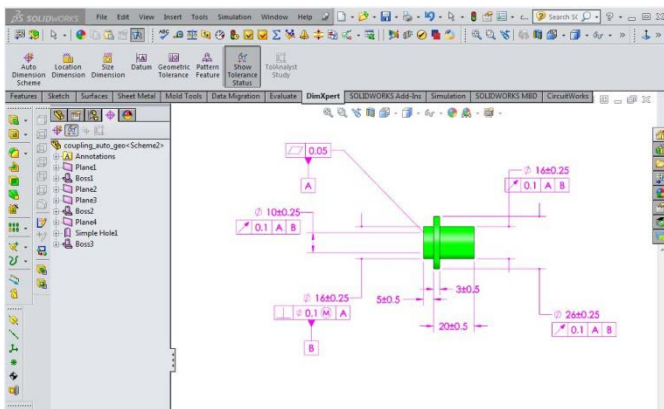
Objective: Familiarization with the following:

1. Selecting datum reference features from a part.
2. Making a drawing from the part.
3. Drawing sheet properties.
4. Adding views to the drawing.
5. Auto-dimensioning a turned part.
6. Prismatic vs turned dimensions.
7. Plus-minus vs Geometric tolerances.
8. Selecting primary, secondary and tertiary datums.
9. Automatic and manual dimensioning.
10. Using Create Width feature.

See the *Additional Material* course webpage, and under *Advanced Topics*, select the *Geometric Dimensioning and Tolerancing* lecture. The password is "Student."

DimXpert

Launch SolidWorks - Select "Resources" to open the Task Pane, select Tutorials and complete the "DimXpert" tutorial. Save and print your part and place in your lab notebook.



End of Engineering Drawing, 3D Printing and Laser Cutting Exercises