Rapid Prototyping Project

Machining Segment

Goal: Produce a PSU “Paper Weight” in ABS and Aluminum

Methodology:

1) Generate a virtual prototype
2) Print on the Dimension 3-D printer
3) Create tool paths using Pro/Manufacturing
4) Verify tool paths using Vericut
5) Postprocess tool paths for HAAS Minimill
6) Physically machine part
1) **Virtual Prototype:**

You will be given a piece of aluminum very close to the one shown on the right.

Model up a part using these dimensions. When you receive your actual piece you might have to make some slight dimensional modifications to the width as a long piece of stock was cut to roughly 3”. The height and depth will be exactly as shown.

Your block will be attached to a steel work holder, allowing you to do machining operations and in the end have a nicely finished paper weight.

This means the finished part should fit in inside the aluminum block.

After modeling the geometry as shown, make a copy of it to accurately represent the workpiece necessary in Pro/Manufacturing.

Produce an fully dimensioned A size drawing of the workpiece showing actual values.

Now you are ready to modify the original part file to represent your paper weight.
Your model tree will have one more feature than shown on the previous page as I used top-down techniques to define the geometry.

Create a sketched datum curve to define the “vertical” edges of the part. Note that the curve encompasses more area at the upper left and lower right corners of the block to allow room for the required text.

Define the upper surface of the block.
Use whatever method you want to create the top surface of your paper weight. The curves for this surface should be similar to:

Of course the curvature is not critical, but the must be **enough** curvature so that it is obvious that the surface is not flat. The goal is to generate a surface that is curved in all directions as shown:
Offset another surface from the one you just created. Define this surface to be 3/32" lower than the original. This surface will be used to locate the bottom of the PSU text.

We will eventually want to machine this surface without leaving any gaps where the text is located so as to be able to machine the text with a 1/8" tool. In Pro/MFG this will require a selectable surface with no “gaps”. To create this surface, first make a copy of the offset surface. When you paste it you will be asked for a dimensional value. Use 3/32" and your new surface will be at the same height as the original surface (Style 1 shown in the model tree). We don’t want to do air milling on this surface so we need to trim it. Use the edge off the bottom of the part (project and trim). Refer to Group FOR_SURFACE_MILL in the model tree below. See the last page of this document for additional hints on this operation.

The upper surface can be produced by either dong an Edit-Solidify (remove material) operation, or by selecting the top planer surface and then selecting Edit-Offset (replace surface feature).

Add a 3 degree draft to the side surfaces of the paper weight.

Next, create the extuded PSU text using the Text tool inside of sketcher. The font should be defined as “font3D” and the text height must be .9”. This should produce text which will allow a 1/8” diameter end mill to be used to cut the recess. It is important to note that this feature will be used to produce the plastic prototype on the Dimension printer but the actual machining of the letters will be done with a grooving operation following a sketched path.

Extrude the cut down to the second offset surface. Note that this text will have square edges at the bottom of the cut. Keep your text far enough inside the block so there is room for a round on the outside edge.
It is possible to put a .040” round on the inside bottom edges. A .0625” round will not work as the feature will fail on the upper corner of the S.

The reason for the rounds is so that the printed prototype will match that of the machined part. The rounds will be suppressed at a later time.

To define the path for the 1/8” tool to machined the PSU letters into the part use a Groove feature (Insert – Cosmetic – Groove). Sketch a trajectory for the 1/8” tool such that your sketched vectors essentially run down the center of the extruded letters as shown below. Note the ending locations. This text will not show up when printing your part on the 3-D printer. The groove features (PSU and your initials) MUST lie on the surface that was created for doing the surface milling operation as shown. Note the yellow lines defining the feature. When you do a Grooving NC sequence in Pro/MFG, the center of the tool path depth STARTS on this feature and works it’s way down from there.

Your initials will also be a Groove feature but this time use the Leroy Font when defining the geometry. These go in the lower left corner. A height of .3 should be sufficient.
2) Printing on the Dimension 3-D printer.

In order to print this part, first “shell” it, removing the bottom surface. A side wall thickness of .1875 should be sufficient as the part will be strong enough to handle, yet not waste build material. The “top” (Projected_to_Copy) surface should be offset at .25”. Note that the entire part will not directly shell to this thickness due to the tight radius curves in the text and around the edge. You will have to offset/merge surfaces then use this merged geometry to create a “cut” (solidify) similar to what you did in MET 306.

When creating the stl file, (File – Save A Copy, Type - stl) set the chord height to 0, and then use the value that Pro/E enters (minimum chord height). You file will be in the neighborhood of 2.2 megs.

Produce a drawing (full size) as shown on the following page.

Refer to the link to Requesting Dimension Prints on the main web page for MET 452 to have your part printed.

Suppress your offset/merged/solidified geometry for producing toolpaths.
Note: To check to make sure your .stl file is what you expect; In Pro/E start a new part file then select Insert – Shared Data from file and select the .stl file.
Hints:

When doing the surface trim, select the surface to be trimmed before selecting Edit – Trim.

You will not see the surface actually be removed until you actually do the surface replacement operation.