PART MINI-PROJECT ASSESSMENT

Name: Jacob Schroeder        Date: 10/10/07

1. How many hours did you spend on the part mini-project, including class time?
   What portion of these were devoted to (a) pre-CAD sketching/measuring/planning,
   (b) model development/detailing, and (c) project documentation?

   approx. 11 hours
   \[ 2 \text{ hrs sketching/measuring/planning} \]
   \[ 7 \text{ hrs model development} \]
   \[ 2 \text{ hrs documentation} \]

2. What are your two most important lessons learned about solid modeling in this project?
   - It is a huge help to start out with all the dimensions you need.
   - It is good to know what order you will build the model in, so that feature construction doesn't cause problems with other features.

3. Using the ME 301 grading rubric (1-4), analyze your performance in the following:
   1 - incomplete, major deficiencies       2 – complete, some deficiencies
   3 - complete, meets expectations        4 – exemplary, exceeds expectations

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<tr>
<th>Project Component</th>
<th>Self-Rating</th>
<th>Rationale</th>
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<tr>
<td>Pre-CAD Planning – Hand Sketches/Pictures Measurements/Datums Origin/Orientation</td>
<td>3</td>
<td>I had to go back and get more dimensions, but for the most part was able to calculate dimensions based on my sketch.</td>
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<tr>
<td>Solid Model Development</td>
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<td>Dimensioned Sketches</td>
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<td>Reference Geometry</td>
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<td>Selection of Features</td>
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<td>Sequencing of Features</td>
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<td>Accuracy of Final Product</td>
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<td>Project Documentation</td>
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<tr>
<td>Assumptions/Data</td>
<td>1</td>
<td>Documentation was very thorough and orderly. I had several discoveries which are explained throughout the process.</td>
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<tr>
<td>Illustration of Steps</td>
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<tr>
<td>Explanation of Steps</td>
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<td>Lessons/Discoveries</td>
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</table>
- Chamfer top of small holes
- Watch draft angles
Design Journal

File Name: Mini Project.SLDPRX
Description: Radiator Flange
Material: Cast Aluminum

- Origin is located at the center of the base of the part. This is because the part has a great deal of symmetry and this should allow us to get an accurate placement of the two bolt holes with respect to each other.
- The base is created on the ‘top’ or x-z plane
- Reference geometry (in this case, planes) will have to be added for the rear sweep feature, the tube feature, and some of the features around the base of the part.
- The major steps of my modeling approach are as follows:
  1. I will begin with a sketch of the base, because the rest of the part geometry will be largely dependent upon these dimensions.
  2. I will extrude the main shell feature of the part, as well as the tube feature.
  3. Once both of these are modeled, the shell feature can be applied to them both, so that there is a continuous hole throughout.
  4. The rear sweep feature can then be added to the part.
  5. The base can be created through a few extrusions.
  6. The webbing on the sides of the bases are added, with the help of an additional plane
  7. The O-ring groove is extrude cut and the bumps that will hold the O-ring in place are extruded.
  8. Chamfers and fillets are applied wherever necessary.

Assumptions

- The center of the bolt holes are directly in line with the interior surface of the base.
- Top of tube feature is tangent to the main body at an angle of 30 degrees.
- Tube is located at the midpoint between the two centers of curvature at the top of the main body.
- Surface fillets are 0.075 in around the tube and base of the main body, 0.050 in over the top of the faster hole tabs, and 0.020 in around outer edges and on the webs (where filleted)
- Base geometry is rotationally symmetric, however the two faster hole tabs are different. The tab under the tube extends to the plane on which the centerline of the tube lies. This makes it easier to cast the part.
- Rear sweep feature is centered on the same plane that the tube feature is centered on.
- Text does not necessarily need to be centered on curved surface.
- Shell thickness is constant for the whole part at 0.085 in.
Modeling Process

1. To begin with, simple sketch of the base is created as a foundation for the part. This part is not extruded immediately, as it would make shelling the body and tube difficult.

2. Next a feature is extruded that will serve as the main body of the part (right). It is then filleted to give it the rounded edges necessary (below).

*Note:* If the part is designed well, the dimensions of this feature can be changed as necessary and the rest of the part can more or less update automatically. However some repairs may have to be made. Nonetheless, it is nice not to have to start from scratch if something at the beginning isn’t just right.
3. Next the tube feature is created as a revolved feature on a new plane. This plane centers the tube between the two centers of curvature of the fillets at the top of the main body.

4. The shell feature is applied to the model, leaving both ends open.

5. Now, the base is finally extruded from the sketch we began with in step one.

Note: the base feature had to be created after the shell had been completed. Otherwise the shell would try to hollow out the base feature as well. This method simplified construction a great deal.
6. Next, the groove for the o-ring is cut extruded from the bottom surface of the part. This is done with a sketch on the bottom surface, with both lines simply offset from the inner edge of the base piece.

7. To create the back sweep feature, I used the same plane as the tube was sketched on, so that it would be centered. I sketched a path tangent to the surface of the part. I also had to open up another plane at 0.60 in above the top plane, where the feature would begin. On this plane I sketched the sweep shape. However, if the shape was only tangent to the surface, it would not work, because it caused zero thickness issues between the tube and the sweep. To solve this, I extended the shape sketch (below) into the body a little bit, so that it would be able to merge with the tube as well.
8. To add the feature at the top of the sweep feature, I opened up yet another sketch on the plane that runs vertically through the center of the tube. I used relations between the sketch and the sweep feature to help define it. To extrude it, it was easiest to extrude in both directions up to the side surfaces of the sweep feature.

9. Next, the taller tabs with the fastening holes were extruded. Though there are two tabs, they were extruded with one sketch on the top of the base feature.

Note: In order for the surface to stay connected to the curved body, the extrusion had to 'overlap' with some of the body, without extending into the hollow space.
10. To create the two webs on the sides of the base, a new plane was created for the sketch (below). This is parallel to the top plane. The sketch was made using a straight line tangent to the two larger curves, while the rest of the curves relied on equal relations to curves already existing on the base of the part. These were extruded to the required height.

11. Next, chamfers were added to the two faster holes and fillets of varying sizes were assigned to most of the edges.
Note: The application of fillets to some of the edges, such as on the corners above the webs proved somewhat tricky. However, changing the order in which fillets are applied makes a difference. Different orders give different results. For instance, if the fillet between the web and tab had been made before the small fillet on the edge of the web, the fillet on the tab would have rounded up high on the tab surface. However, since the edge of the web was filleted first, the fillet around the tab does not round up too high.

12. Four bumps like the one shown to the right were extruded from the top plane up to the surface of the o-ring gap. These are to hold the o-ring in place. It was simplest to use equal and coincident relations between these four bumps.

13. Finally, the label '5JJ G1' was added to the side of the part. This was done by using the 'text' sketch entity tool. To add text, you must select a curve on which the text will line up. For this case I had to create a new plane tangent to the line where the text sits and sketch a line on which I could use as a reference for the text. Then the text sketch could be extruded. In order to avoid zero thickness problems, the text was extruded out a little bit, as well as back to the surface of the main body.
ADDITIONAL VIEWS

Top view

Front View