Important Note: When using Manufacturing Mode in Pro/ENGINEER, a Manufacturing Info window sometimes obscures the prompt line. You need to move this window out of the way so you can read the prompts!

Basic Start Up Procedure:

In Part mode, create a work piece to be used for machining purposes. Make it 3 wide, 2 tall and 7.75 long.

Go to Manufacturing mode. Do a FILE - NEW – MANUFACTURING and set the type to NC-Mill. The system wants the reference model, so select your lower die block (the one with the locks). Then MFG MODEL – ASSEMBLE – Workpiece. When assembling, offset the flat surface on the die block (at the bow) to be .125" below the top surface of the work piece.

Select MFG Setup – Workcell. The following dialog box appears.
Pick on the icon next to NC Machine. A dialog box appears as shown.

Pick on the Cutting Tools tab to create the tooling needed for this project.
Select the tool icon in the Cutting Tool Setup box.

Add in a tool to Pocket 10 (set with Settings Tab), Name FLAT1, Cutter Dia .5 and Length 4 and Apply.

Generate the following tools:

<table>
<thead>
<tr>
<th>Pocket</th>
<th>Corner Radius</th>
<th>Diameter</th>
<th>Length</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>0</td>
<td>.5</td>
<td>3</td>
<td>FLAT1</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>.375</td>
<td>2.5</td>
<td>FLAT2</td>
</tr>
<tr>
<td>12</td>
<td>.125</td>
<td>.25</td>
<td>1.75</td>
<td>BALL1</td>
</tr>
<tr>
<td>13</td>
<td>0 (angle 3)</td>
<td>.1875</td>
<td>2</td>
<td>TAPER1</td>
</tr>
</tbody>
</table>
Pick *File – Done* when finished.

Back at the Operation Setup dialog box, set up 0,0,0 and a retract plane (.25 inches above workpiece). The coordinate system is in the upper right corner of the workpiece. When creating a coordinate system, place it at the top left corner of the workpiece (viewed from the front view assuming the part shown above is in the isometric view). Positive X goes towards the right, Positive Y goes towards the back, Positive Z goes up.

![Operation Setup dialog box](image)

Showing machine coordinate system:
Mill Volume Creation:
*Mfg Setup - Mfg Geometry - Mill Volume – Create*, give name, you are asked to select a plane to define the upper direction, select the top of your retract plane, then select *Sketch*. The sketch plane is .125" below the bottom of the aft die lock. Offset the edges .38" outside the work piece. Remember, the tool always stays inside the mill volume (by default). This will allow us to the profiling of the block with the 3/8" mill and not the 1/2". Upon extruding, make the top of the volume and top of the work piece be the same. Trim the volume with the reference part.

Select Shade from the Mill Volume

Looking at the underside of the shaded mill volume, this is what you should see. This is what needs to be machined. Notice that the volume does not include the entire volume of the hull.

View showing the Work piece, Lower Die Block and trimmed Mill Volume. Notice the elliptical region near the bottom of the boat. This is because the mill volume does not include this area of the boat bottom.
Question 1. What is the depth of the mill volume? Note that this much of the work piece must be above the fixture!

Rough Milling Operation:

Select Volume and check to make sure Tool, Parameters, Volume, Start and End are checked. Select Done.

Select your tool (FLAT1).

Set the MFG PARAMS.
Set the following:
   - Cut Feed         20 ipm
   - Step Depth       .25
   - Step Over        .2
   - Spindle Speed    3000
   - Clear Distance   .125

Question 2. What is the default SCAN-TYPE? (This refers to the MFG PARAMS above). What is the definition of this? What is the default ROUGH_OPTION? What is the definition of this? (See help pages). Exit the editor.

After exiting the editor, select Done.

Select your mill volume.
You are prompted for a datum point for the tool's original location. Create a point two inches above the top surface in the center of the part (use Offset Csys) using the Enter Points when prompted.

Use the same point for the tool's final location.

It is now time to Play Path using Screen Play. The dialog box for play will appear. Use the play button in the Play Path dialog box to show the tool path. The result should be similar to what is shown below.

If the tool is not shown at PNT0 then choose SEQ SETUP and check the box for Start and End again. Repaint the screen and re-run the path.

We want to print out a color picture of the toolpath as shown above. First turn the background in Pro/ENGINEER to white. Use UTILITIES – COLORS – SYSTEM - SCHEME – Black on White and uncheck the Blended Background box.

Cut (alt-print scrn) and Paste (Edit – Paste) into Word and save the word file.

Do an NC Check to double check tool path as a shaded image. This starts up VERICUT.

Be patient while the model loads, then zoom out (in Vericut) until the entire model fits in the window.

We need to change some colors first.
To change the background color to white do the following:

Select **FILES – COLORS - DEFINITION**
Select on **BACKGROUND** button
Select **PICK** Button
Select **255 255 255 WHITE** from **RGB PICK LIST**
Select **PREVIEW** and **OK**

To change to colors on the part, do the following:

Select **FILES – COLORS - ASSIGNMENT**
Select **STOCK - GREEN**
Select **CUT 1 – CYAN**

Now start the simulation by picking the big green button in the lower right corner of the screen.

Re-run the tool path if necessary and Cut and Paste this into the same word document that you just saved with the simulation picture. Size these so both fit on one page. Use the Crop tool to do this. Center your work and add your name.

Exit VERICUT back to Pro/ENGINEER.

To write out the APT code to disk, select **Done Seq** under the **NC SEQUENCE** menu and Under the **MACHINING** menu choose **CL Data - Output - Operation (select current operation) - File – Done**. This file name is important as it is the .ncl file defining the toolpath. **Done Output** takes you back to the MACHINING menu.

If you wish to add additional machining operations to the Operation, you simply need to select **NC Sequence – New Sequence** to add additional tool paths. This will become important for future labs.
On the back of the color output (or add to the document using word), write out the answers to Questions 1 and 2.

Generate and print out the .inf file (7 pages) containing all of the manufacturing information. 
INFO – MANUFACTURING – Manufacturing Model.

Staple these sheets (Color output, Manufacturing Model info.) together in the order produced and submit for grading.