

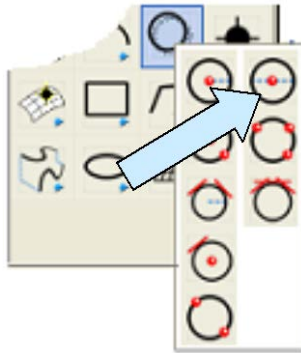
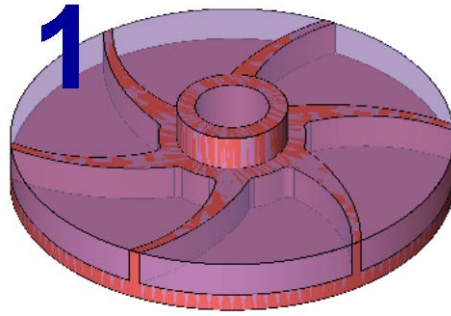
# KEYCREATOR 3D Direct Modeling Software

## KeyCreator Lesson KC8216

### 2D Machining an Impeller- Part1

In this exercise and exercise KC8217 we're going to create the impeller illustrated to the right and then produce tool paths to machine it.

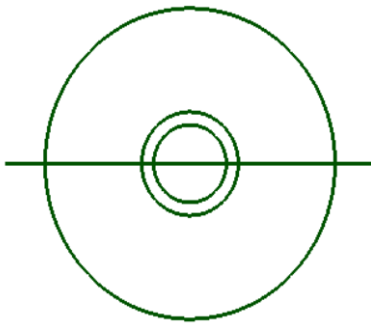
Although the part looks fairly complex, we can machine the entire shape with simple 2D tools.



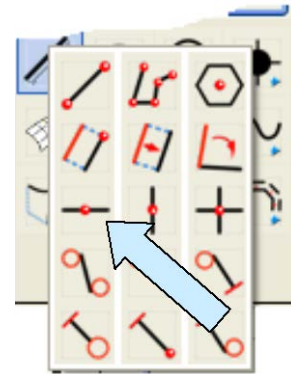
Start with a new file in View 1. (The Top View.)

Create 3 circles all centered at the origin.  
The diameters are 6 inches, 1.5 inches, and 2 inches.

Next, click on the CREATE HORIZONTAL LINE Icon.  
Using the CtrMid Option, click on one of the circles.



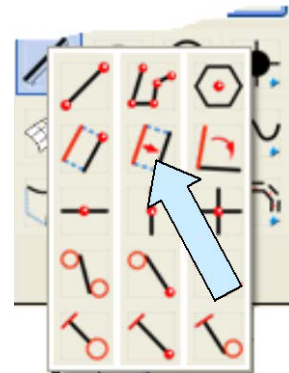
Your screen should look like this:



Next, click on the CREATE LINE PARALLEL AT A DISTANCE Icon.

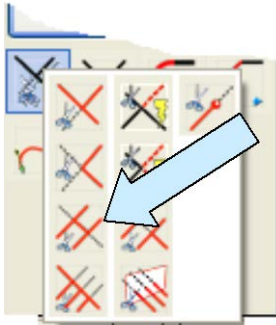
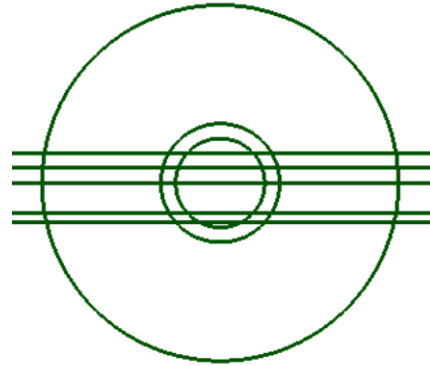
Type 0.25 for the Distance. Click on the horizontal line and just above it. Then, click on the new line and just above it.

Click on the BACKUP Button. Type 0.5 for the Distance.  
Click on the original horizontal line and just below it.  
Click on the BACKUP Button. Type 0.15 for the Distance.  
Click on the bottom horizontal line and just below it.



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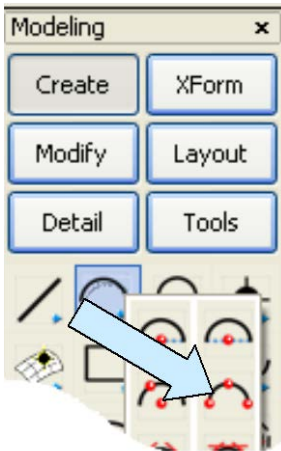
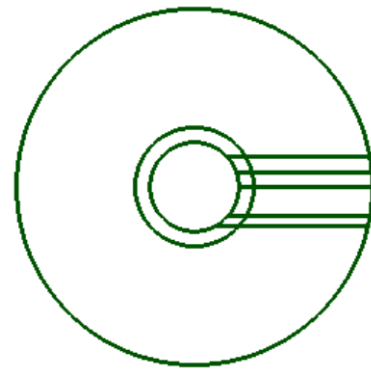
Your screen should look like this:



Next, click on the TRIM DOUBLE Icon.

Then, click on the top line between the 6 inch and 1.5 inch circles on the right side. Then, click on the right side of the 1.5 inch and the right side of the 6 inch circle. Repeat this with each of the lines.

When you are done, your screen should look like this:



Now, click on the CREATE ARC BY 3 POSITIONS Icon.

Using the EndEnt Option, click on the left end of the top horizontal line.

Then, using the CtrMid Option, click on the second horizontal line from the top.

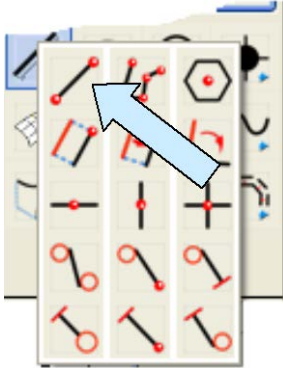
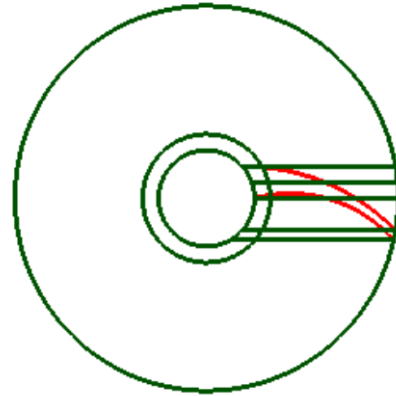
Next, using the EndEnt Option, click on the right end of the second horizontal line from the bottom.

Make a second arc using:

1. The left end of the second horizontal line from the top.
2. The center of the second horizontal line from the top.
3. The right end of the bottom horizontal line.

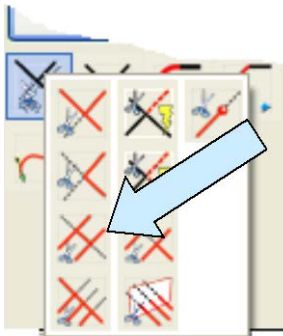
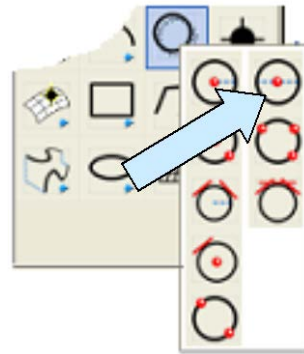
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Your screen should look like this:



Click on the CREATE LINE BY END POSITIONS Icon. Using the EndEnt Option, click on the left ends of the two arcs that you just created.

Next, using the CREATE CIRCLE BY DIAMETER Function, create a second 6 inch diameter circle centered on top of the existing one.

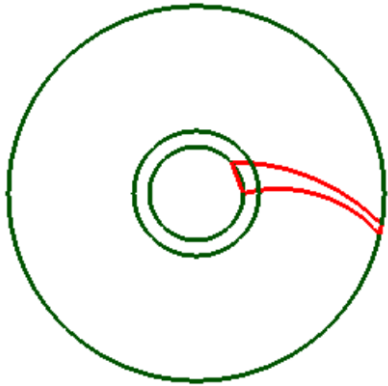


Now, click on the TRIM DOUBLE Icon. Click on one of the 6 inch circles between the right ends of the two arcs and then click on the two arcs.

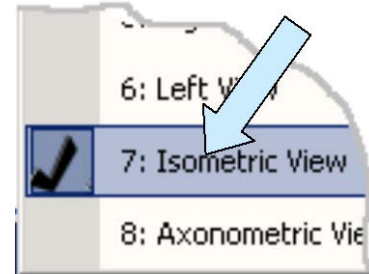
Now, take a moment to delete all of the horizontal lines on the screen.



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You will now have three circles and a profile for one impeller arm comprised of three arcs and a line.



Switch to the Isometric View. (View 7.)



Next, click on the EXTRUDE Icon.  
A Dialog Box appears.

Type 1 for the Length and hit the ENTER Key.  
Select the 1.5 inch circle and hit the ENTER Key.  
Click on the upward-facing vector.

Click on the BACKUP Button.  
Type 0.5 for the Length and hit the ENTER Key.  
Select the profile of the impeller arm and hit the ENTER Key.  
Click on the upward-facing vector.

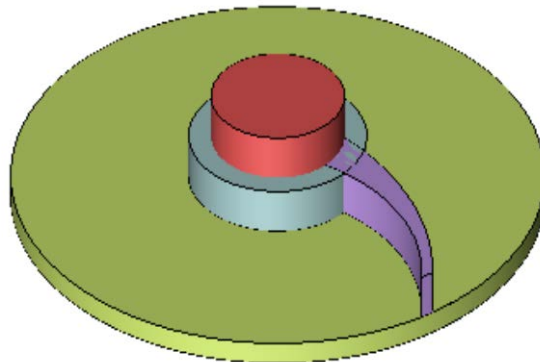
Next, click on the 2 inch circle and hit the ENTER Key.  
Click on the upward-facing vector.

Finally, click on the BACKUP Button.

Type 0.25 for the Length and hit the ENTER Key.

Select the 6 inch circle and hit the ENTER Key. Click on the downward-facing vector.

Your screen should look like this: (I've shown the solids in different colors.)



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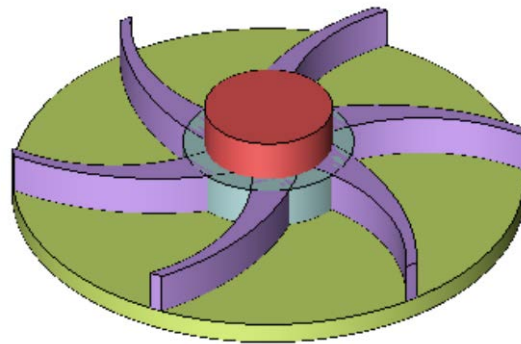


Click on the XFORM ROTATE COPY Icon.

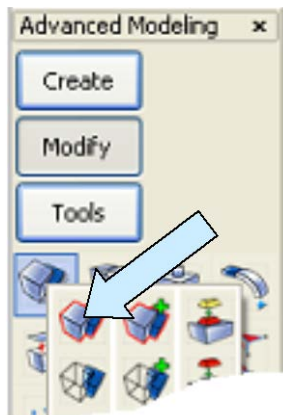
Select the impeller arm solid and hit the ENTER Key.  
Type 5 for the Number of Copies.

Using the CtrMid Option, click on the top circular edge of the pancake cylinder and the bottom circular edge.

Type 60 for the Angle and hit the ENTER Key.



You will now have all six impeller arms.



Click on the BOOLEAN UNION Icon.

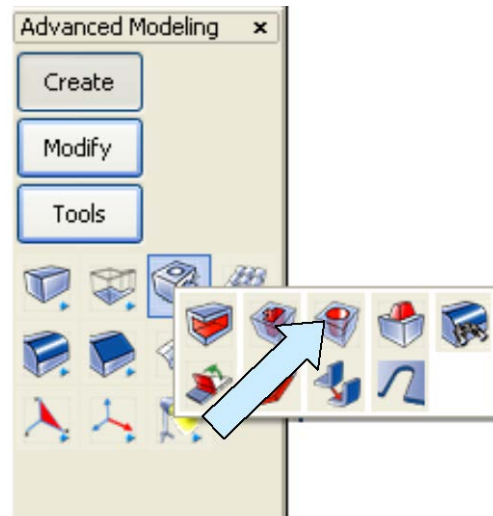
Click on the large disk. Then, click on the ALL DSP Option and then on the All Option. Hit the ENTER Key.

Click on the DRILL Icon.  
A Dialog Box appears.

Type 1 for the Diameter and use the Through Option. Hit the ENTER Key.

Click on the topmost circular face of the part.

Then, using the CtrMid Option, click on the circular edge of that face.

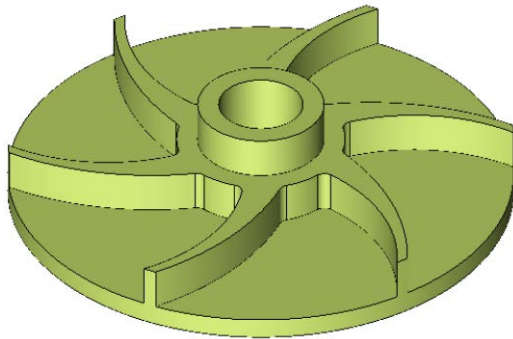
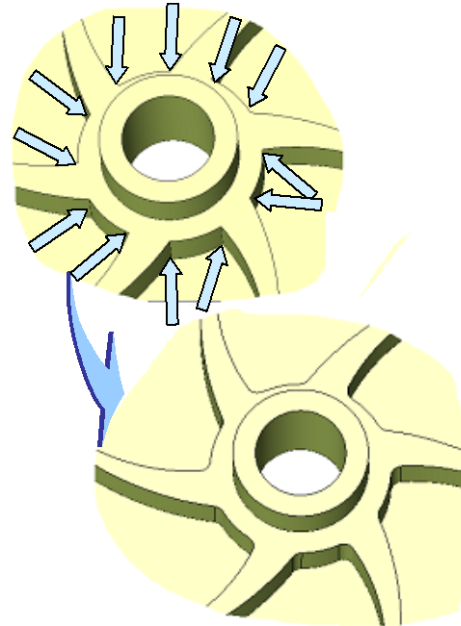


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Finally, click on the CONSTANT RADIUS BLEND Icon. A Dialog Box appears. Type 0.125 for the Radius.

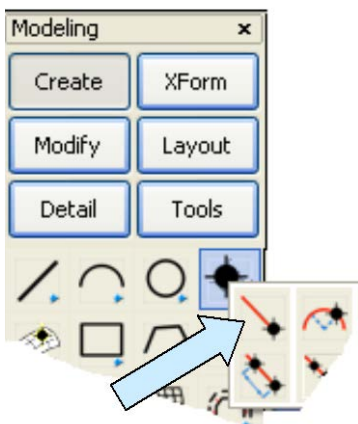
Create a blend at each of the vertical intersections of the impeller arms and the 2 inch diameter hub. (There are a total of twelve blends.)



Your completed part should look like this:

## Creating Corners

Let's do one more thing before creating our tool paths. Click on the CONSTRUCTION PLANE Icon and type 1 for the Construction Plane.



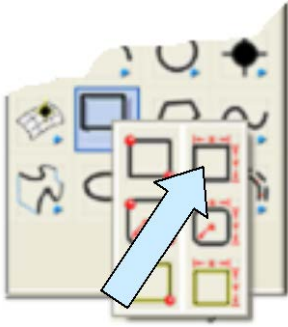
Next, click on the CREATE POINT AT POSITION Icon.

Click on the Offset Option on the Conversation Bar. Using the CtrMid Option, click on the topmost circular edge of the part as the reference position.

Then, type  $-3.5$  for the X value,  $-3.5$  for the Y value, and 0 for the Z value.

Repeat this process, this time using the center of the bottom circular edge as the reference position. Type 3.5 for the X value, 3.5 for the Y value, and 0 for the Z value.

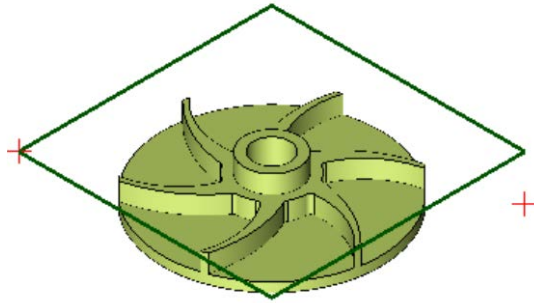
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Click on the CREATE RECTANGLE BY WIDTH HEIGHT Icon. Use the MidCtr Anchor Option.

Type 7 for the Width and 7 for the Height.  
Using the CtrMid Option, click on the topmost circular edge of the part.

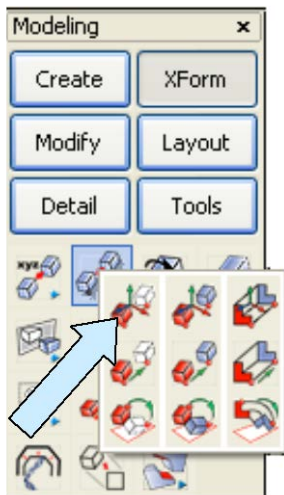
Your screen should now look like this:



## Repositioning the Geometry

Now in many of our basic lessons, we purposely build all of our solid geometry extending downward from a plane that passes through the origin of the file. This makes setting up Z values for machining very easy since the depth of any pocket exactly matches the vertical distance from the origin.

Our current part has been constructed with the main 0.25 thick disk extending downward from the origin in the file and the rest of the geometry protruding above. We could work with this by adjusting the necessary Z values in our routines; however, it is much simpler to quickly reposition all of the current geometry in the file so that we can ignore this.



To do this, click on the XFORM OLD NEW MOVE Icon.

Make sure all of the geometry including the two points and square are completely displayed.

Click on the ALL DSP Option and then on the ALL Option.  
Hit the ENTER Key.

Using the CtrMid Option, click on the topmost circular edge of the part. Hit the ENTER Key.

Now, click on the KeyIn Option. Hit the ENTER Key three times and everything repositions so that the top center position of the part lies at the origin of the file.

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## Planning the Machining Steps

We're going to create six different tool paths to machine this part from a block of metal that is 7 inches square by 1.25 inches high.

Here is a list of the tool paths and what they will do:

<u>Tool Path Name</u>	<u>Description</u>
-----------------------	--------------------

<b>Rough1</b>	Removes Material around the 1.5 diameter hub down to the top of the impeller arms.
<b>Rough 2</b>	Removes material around 6 inch diameter rim
<b>Rough 3</b>	Removes bulk of material between impeller arms.
<b>Diameter Clean</b>	Makes a finishing pass around 6 inch diameter rim
<b>Arm Clean</b>	Makes a finishing pass on the vertical wall of each arm.
<b>Bore1</b>	Creates the rough bore in the hub.

Now obviously in a real production situation there would additional work needed to create a finished part. For instance, the rough bore would be made to slightly less than the 1 inch diameter and the hole might then be reamed to finish size.

We might also make additional finishing passes on some of the other surfaces. For the purposes of this exercise, we'll stick to the six operations listed above.

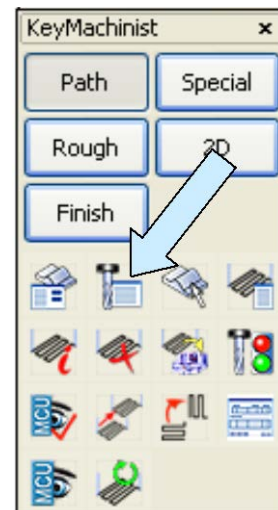
## Specifying the Tools

Click on the TOOL LIST Icon.

A Dialog Box appears.

We need to specify three different Flat End Mills for this project.

The diameters will be 0.75, 0.5, and 0.25 and when you are done, select the 0.75 diameter end mill as the current active tool.



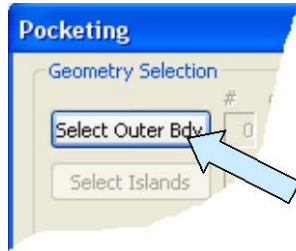
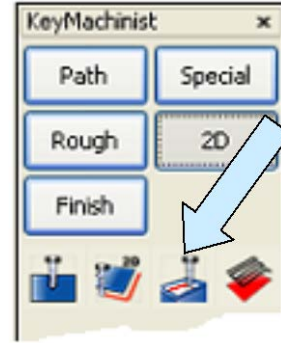


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## Creating the Roughing Tool Paths

Click on the 2D POCKET Icon.

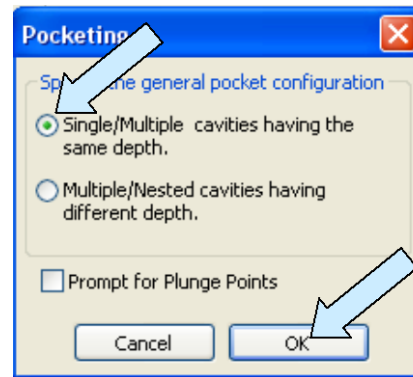
The first sheet of the Pocketing Dialog Box appears. Since your tool is already selected, click on the NEXT Button.



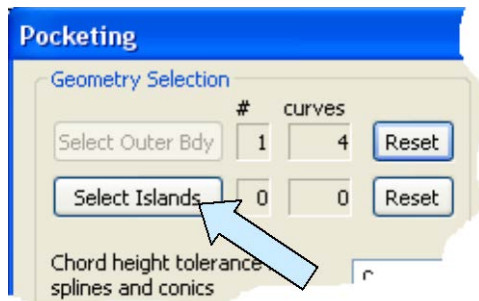
The second sheet of the Dialog Box appears. Click on the Select Outer Bdy Button.

A small Dialog Box appears. Click on the Single/Multiple Cavities Having the Same Depth Option and hit the ENTER Key.

**Note: For the next operations, you should have the Restrict Chain Select and Enable Quick Chain Options selected in TOOLS/OPTIONS/SELECT.**



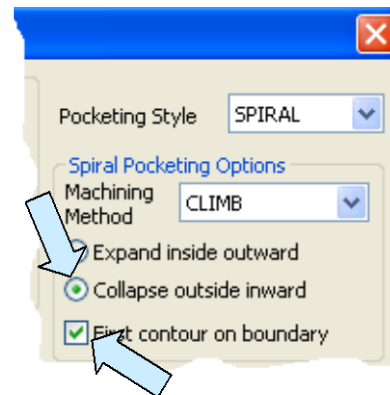
Click on the Chain Option. Move the cursor over the 7x7 square and click on it when it highlights. Then, hit the ENTER Key. You are returned to the main Dialog Box.



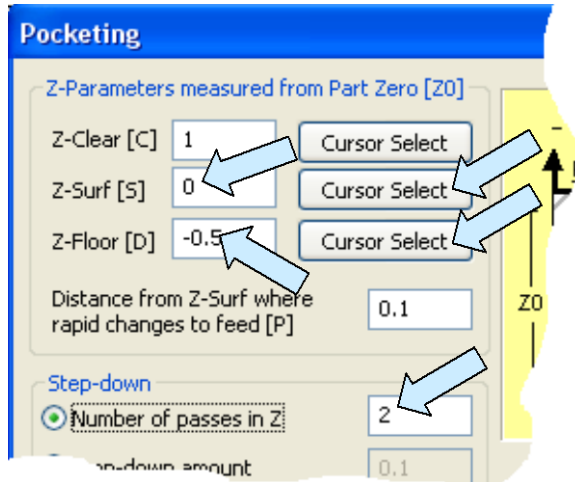
Click on the Select Islands Button. Using the Single Option, click on the topmost circular edge of the part and hit the ENTER Key twice.

Click on the Collapse Outside Inward Option.

Click to place a check on the First Contour on Boundary Option. Then, click on the NEXT Button.



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The next sheet of the Dialog Box appears.

Click on the Cursor Select Button for the Z-Floor.

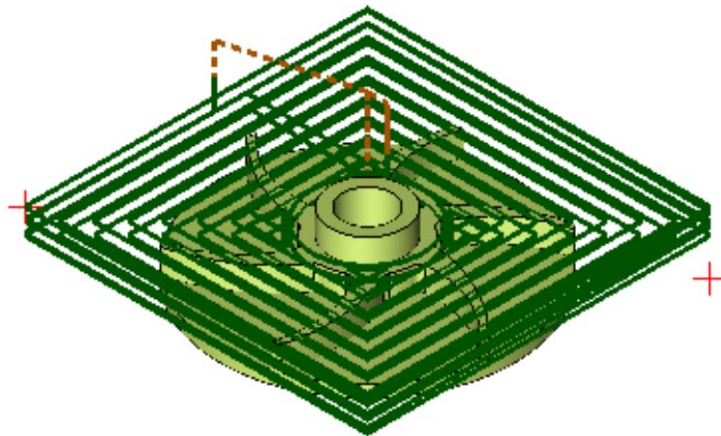
Using the CtrMid Option, click on the bottom circular edge of the 1.5 inch diameter hub. Notice that a value of -0.5 appears in the field.

If you click on the Cursor Select Button for the Z-Surf and using the CtrMid Option, click on the top circular edge of the 1.5 diameter hub, you get a value of 0 which is correct since this is the origin of the file.

Next, type 2 for the Number of Passes in Z. Now, click on the CREATE PATH Button.

Type "Rough1" for the Tool Path name and click on the CREATE Button.

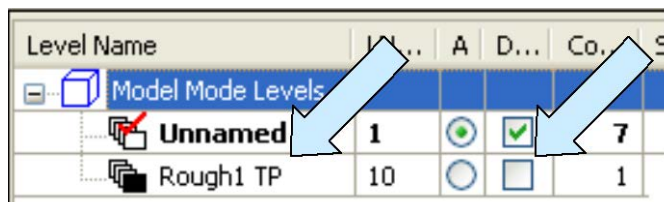
Your tool path should look like this:



Take a moment to move the Rough1 Tool Path to level 10 in your file.

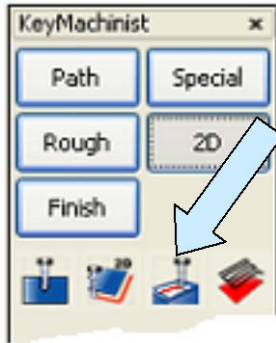


Click on the TOGGLE SPLITTER Icon.



Name the level "Rough1 TP" and remove it from the display.

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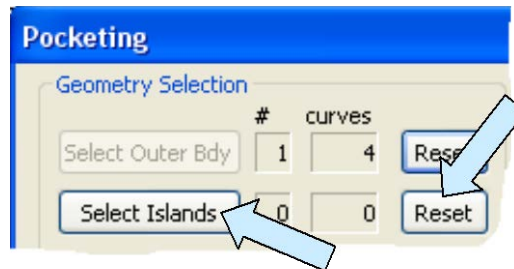
Click on the 2D POCKET Icon again.

The first sheet of the Pocketing Dialog Box appears. Click on the Select New Tool Button. Then, select the 0.5 Dia Flat End Mill.

You are returned to the original Dialog Box. Click on the NEXT Button.

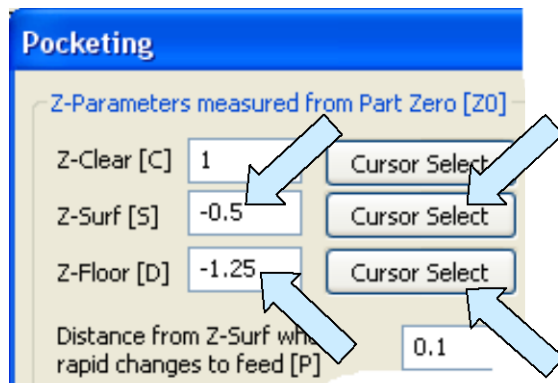
The second sheet of the Pocketing Dialog Box appears. We're going to use the same Outer Body so leave that alone.

Click on the RESET Button to the right of the Select Islands Button.



Use the Single Option and click on the bottom-most circular edge of the part. Hit the ENTER Key twice.

We'll use the Collapse Outside Inward Option and place a check on the First Contour on Boundary Option. Then, click on the NEXT Button.



The next sheet of the Pocketing Dialog Box appears.

We'll use 2 passes in Z again.

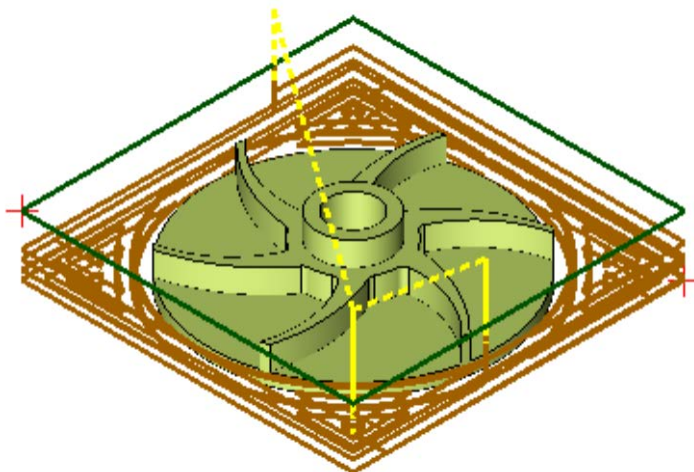
Click on the Cursor Select Button to the right of the Z-Surf Button. Using the CtrMid Option, click on the bottom edge of the 1.5 inch diameter hub.

Next, click on the Cursor Select Button to the right of the Z-Floor Button.

Using the CtrMid Option, click on the bottom-most circular edge of the part.

Your Z-Surf value should now be -0.5 and the Z-Floor value should be -1.25 as shown above. Click on the CREATE PATH Button. Type "Rough2" for the name and click on the CREATE Button.

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Your tool path should look like this:

Move this tool path to level 20 and rename the level "Rough2 TP." Then, remove the level from the display.

If you were to run these two tool paths right now, you would get a rotor blank that would look like this:

Save this file. Let's call it "KC8216." We'll use it to start our next lesson KC8217 where we continue creating tool paths to machine the arms and center bore hole.

