



Create a Part - Section 1: Vector Drawing

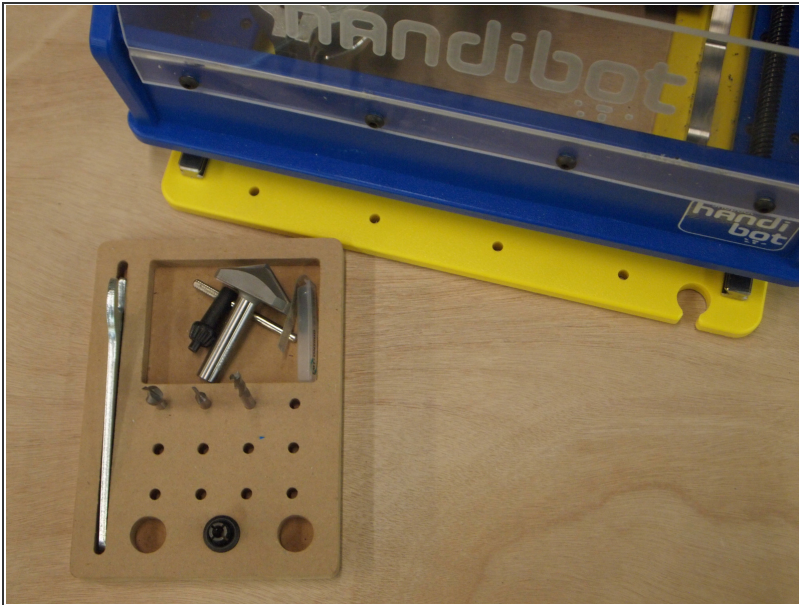
In this tutorial we will review the part creation process from design through cutting. The part will become a useful accessory for your Handibot. This will allow you to become familiar with the two main types of software used with the Handibot.

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INTRODUCTION

This guide is not intended to be an in depth review of the VCarve Pro software. For further tutorials of the features and techniques, please visit the [Vectric](http://www.vectric.com) website.

Step 1 — Materials Needed



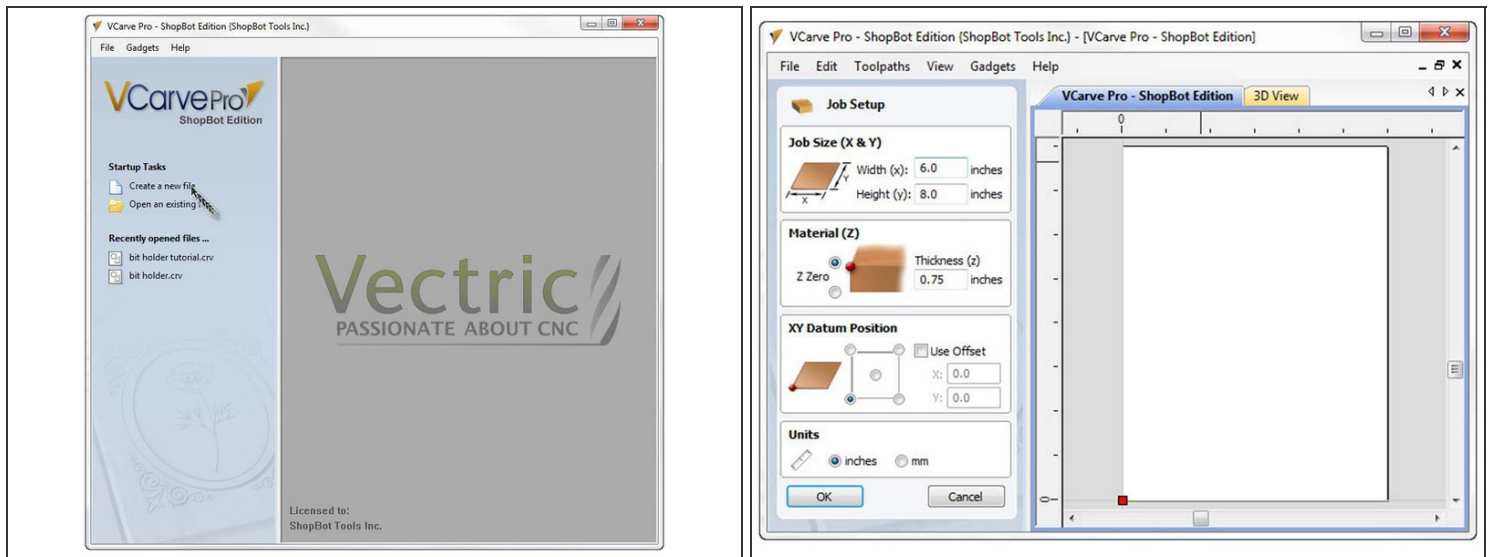
- For this part we'll need the following items:
- Handibot
- Computer with VCarve Pro and ShopBot 3 software loaded
- 1/4" Up cut end mill
- 12"x12"x3/4" plywood or similar material.

Step 2 — Design



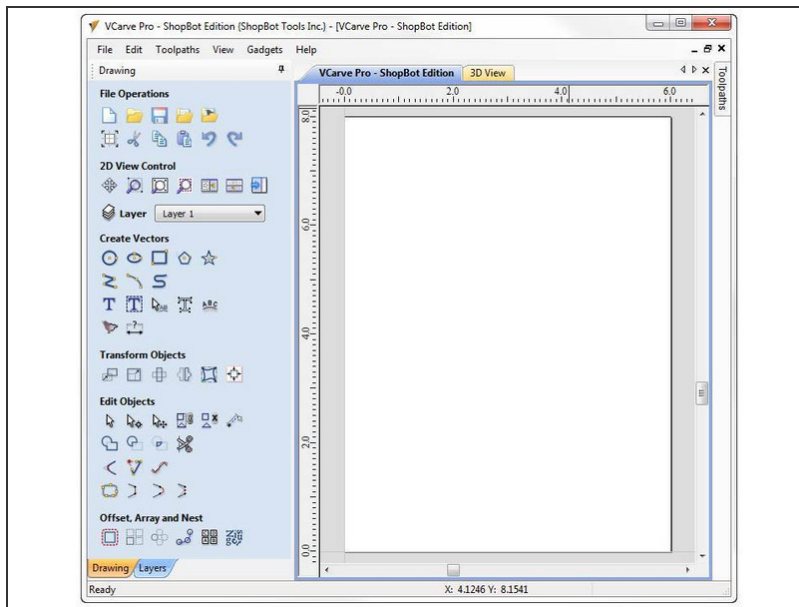
- We'll start by designing the part in VCarve Pro. This software uses mathematically defined vectors to create toolpaths which will then be sent to the Handibot in a format that it can read. Let's take a moment to review some of these terms.
- **Vector:** An entity with a defined direction and magnitude. These are commonly noted as a line starting from a defined point, going a defined direction for a defined distance. Vectors can be combined to create a variety of lines, curves, and shapes.
- **Toolpath:** The path of the tool (bit) during a cutting operation. The software uses the dimensions of the cutting head along with the vector information and user defined parameters to record what this path will be. Parameters that can be adjusted include offset from the vector, side of the vector to follow, and speed the tool will travel.
- **Post Processor:** A small program that converts one data language to another. Once you have created vectors and assigned toolpaths to them in VCarve Pro they will need to be saved in a format the Handibot will recognize. Selecting the appropriate post processor will allow the Handibot to follow the toolpaths that have been created.
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Step 3 — VCarve Pro Job Setup



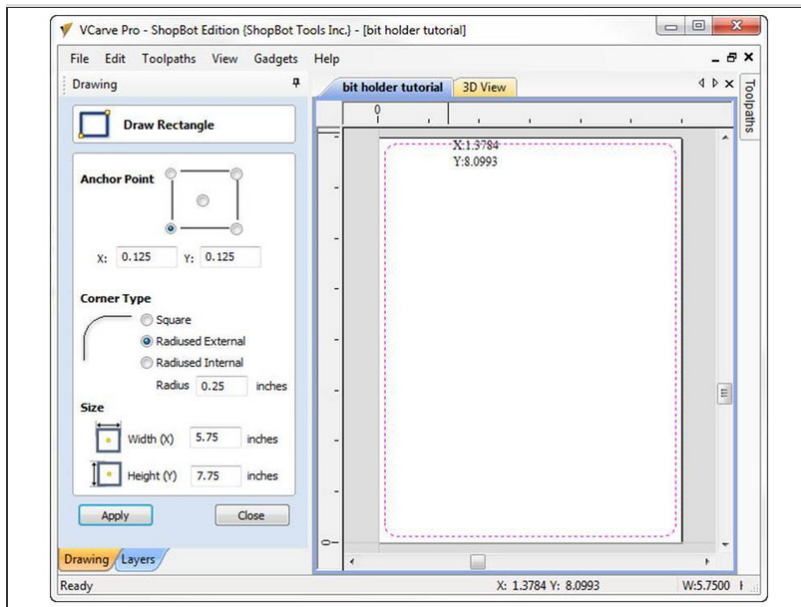
- Open VCarve Pro. From the option on the left select **Create a new file**.
- The Job Setup menu allows you to define the space and material you'll be cutting in. Set these values as defined here.
- The Handibot cutting area is 6 inches wide (x axis) and 8 inches tall (y axis). Placing these values in **Job Size** shows the boundary of this cutting area.
- The Handibot will be placed on top of the material it is cutting so the most accurate measurement for the Z zero position will be on top of the material. Make sure the upper option is selected in **Material (Z)**.
- The thickness of the material you've selected is defined here. It is good practice to measure the actual thickness of the material and record it here.
- The **XY Datum Position** defines where the zero point is for the part file. The bottom left option is usually the best choice as it coincides with the zero position of the Handibot. Select it here.
- Decide if you want to work in inches or millimeter units. For this project **Units** will be inches. Select Ok when you have defined all parameters.

Step 4 — Vector Drawing Screen



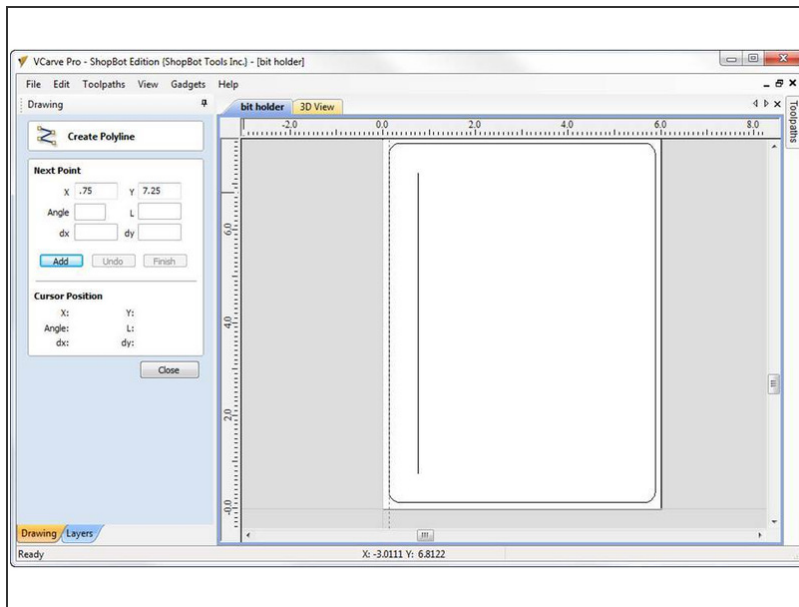
- Explore the pane on the left side of the VCarve Pro window.
- This is the **Drawing** side and has options for creating, importing, and modifying vectors. VCarve Pro is designed to allow the user to intuitively understand each option. Read through and look at each category. If an icons function is not obvious, hold the cursor over it and a brief description will appear.
- Take some time exploring the **Create Vectors** options. You can delete the vectors you create by clicking on them and pressing delete on your keyboard.
- The white rectangle in the view window represents the machinable material area set during **Job Setup**.
- Hold down the middle mouse button in the view screen to pan the image.
- Scroll with the mouse wheel to zoom in and out.
- To quickly return the full machinable area to center use the **F** key on your keyboard.

Step 5 — Create Rectangle Vector



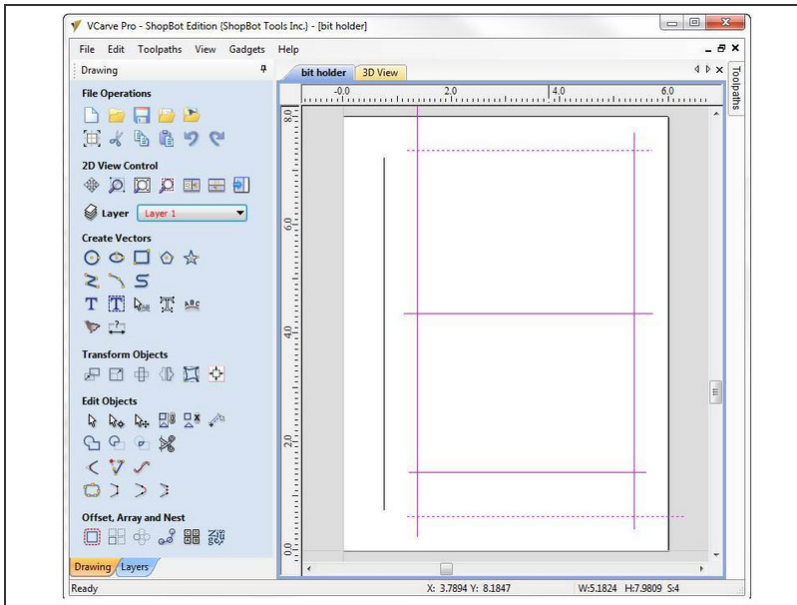
- The first vector shape is a rectangle that will define the edge of the final part. We want to make this part as large as possible without moving the Handibot on the material. Two factors influence the size of this rectangle: the movement area of the Handibot and the size of the bit used for cutting.
- This part will be cut with the 1/4 inch end mill. The Handibot's travel is measured at the center of the router, so at the limit of travel half of the bit will be in the movement area. Half of the 1/4 inch bit is 1/8 (0.125) of an inch. Use this information to create the first rectangle.
- Select the icon that looks like a rectangle under **Create Vectors** to open the **Draw Rectangle** pane. A rectangle can be created by clicking and dragging over an approximate area in the drawing area. In this case the rectangle needs to be precisely defined.
- The **Anchor Point** will be the bottom left corner. Define it at 0.125 for both X and Y axes.
- Add a radius to the corners under **Corner Type**. A value of 0.25 works well.
- Set the **Size** to 5.75" wide by 7.75" high for maximum part area.
- Select **Create** when you have defined all parameters.

Step 6 — Draw Wrench Slot Vector



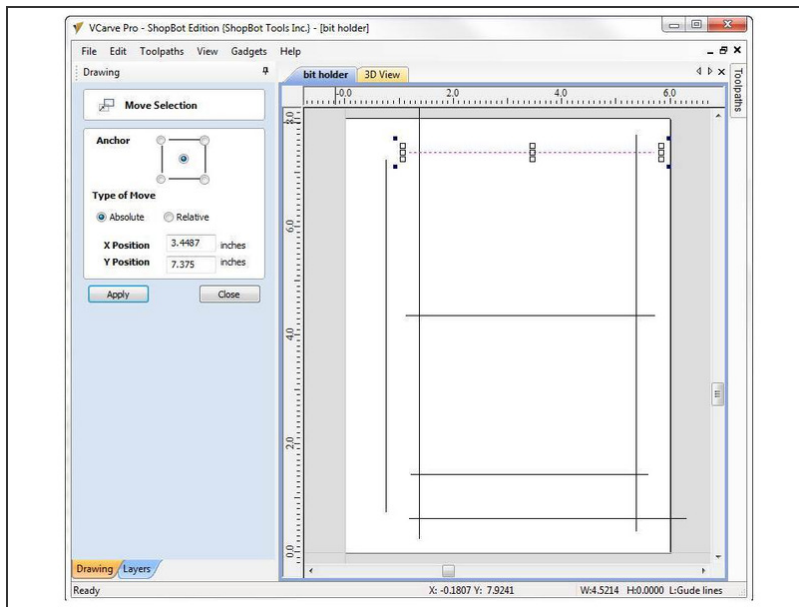
- The first feature this part will have is a slot for the collet wrench. The wrench is a little over 6" long and less than 3/16" thick. A simple line that is 6.25" long for the 1/4" bit to travel is the only vector needed.
- Select the icon that looks like a zig-zag line under **Create Vectors**. If you mouse over the icon, it says Draw Polyline.
- Define each point of this vector. Under **Next Point** fill in 0.75 for X and Y and click **Add**. Change the values to 0.75 for X and 7.25 for Y and click Add. Click on **Finish** and a line will appear.

Step 7 — Create Construction Lines



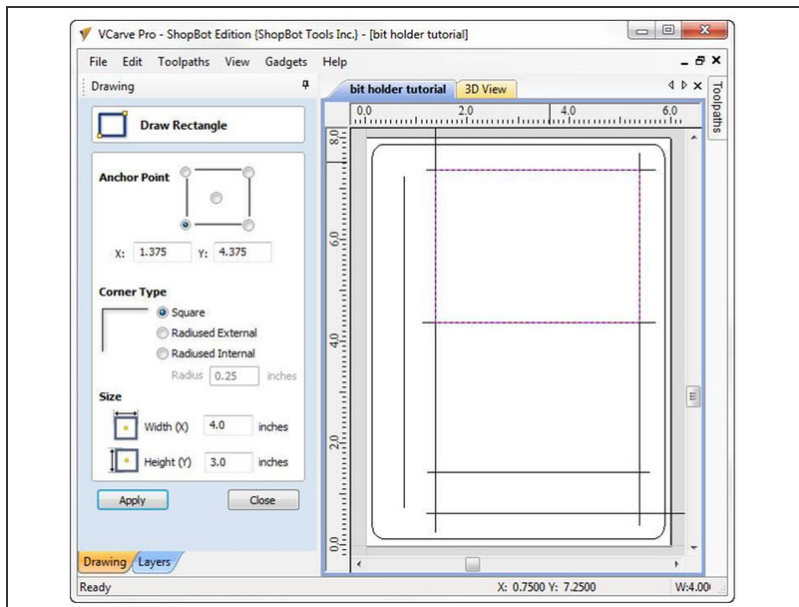
- Construction lines are vectors that will not be used in the final toolpathing operation. Instead, they are used to position other features on the part. VCarve Pro has a snap feature that can speed the placement and dimensioning of features. The cursor will change to indicate the type of snap that would occur.
- Click on the **Draw Polyline** icon.
- Instead of defining one point at a time, simply click in the drawing area at the approximate location of the start of the first line. After clicking move the mouse around and note that a line follows your cursor. Also note that the cursor icon will change as different relationships are noticed by the software.
- All of these lines need to be either horizontal or vertical. When dragging the line look for the cursor to turn to a circle with a line through it. This indicates that when you click again the line created will be parallel with one of the axes.
- After creating the first line segment, click on **Finish** under **Next Point**.
- Use this click, drag, click, finish technique to create all six lines in the approximate locations shown here. The next step will precisely position them.

Step 8 — Precise Positioning of Guide Lines



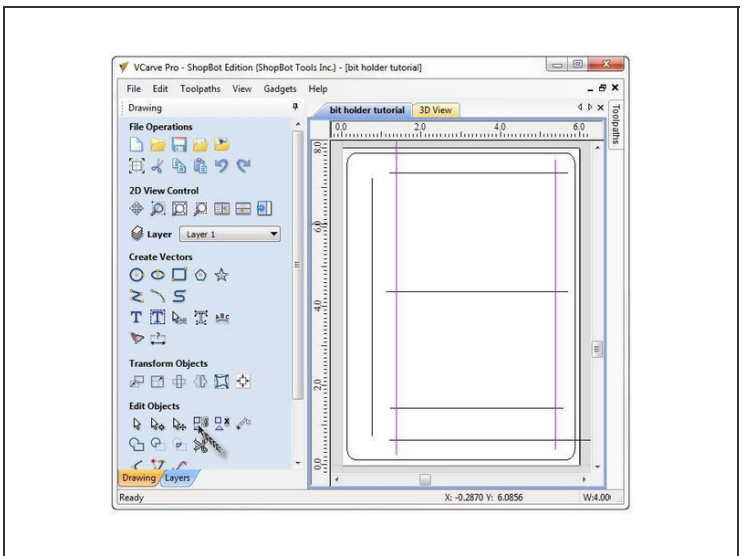
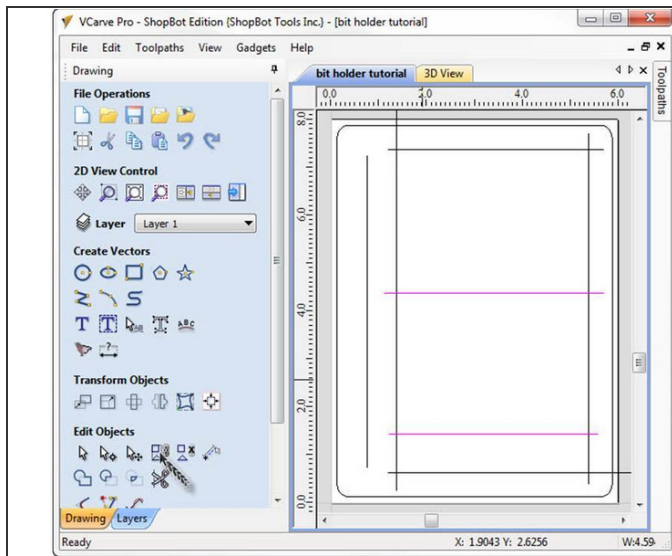
- VCarve Pro allows components to be moved to precise location using several methods. The most simple is **Move Selection**. It is the first icon under **Transform Objects**.
- Once in the **Move Selection** pane is open click on one of the construction lines. The X and Y positions will be noted in the pane.
- Change the X position to move vertical lines and the Y position to move horizontal lines.
- Move the vertical lines to at 1.375" and 5.375" on X.
- Move the horizontal lines to 0.625", 1.435", 4.375", and 7.375" on Y.

Step 9 — Create Rectangle Using Guide Lines



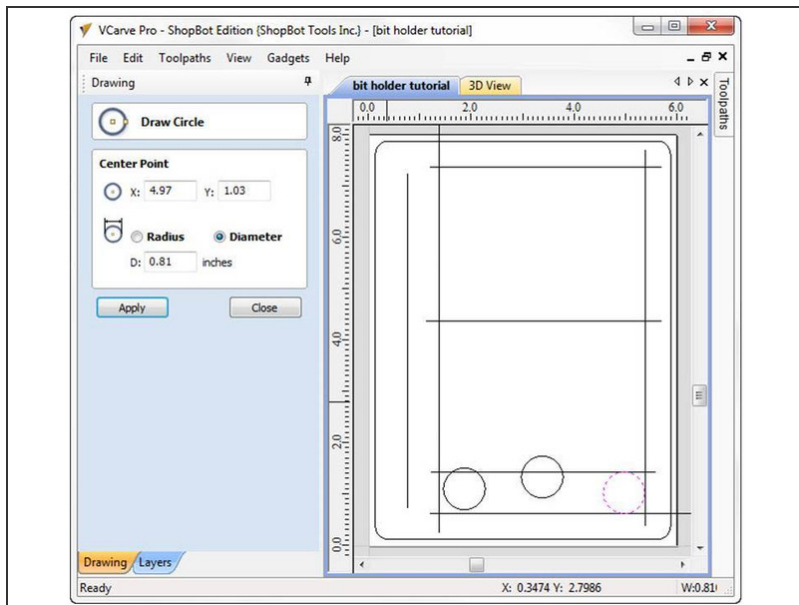
- Now that the construction lines are present they can be used to position objects.
- Click on the **Draw Rectangle** icon under **Create Vectors**.
- The upper rectangle formed by the guide lines will be used to form this rectangle.
- Hover the cursor near the upper left corner of this rectangle. The cursor will change to an X in a circle indicating an intersection.
- Click and hold when you see this symbol appear.
- Drag the cursor down to the lower right of the upper rectangle. When you see the cursor change to the intersection symbol, release the mouse key. A 4" by 3" rectangle has just been created.
- Click **Close** or the escape key to leave the **Draw Rectangle** pane.

Step 10 — Grouping Guide Lines



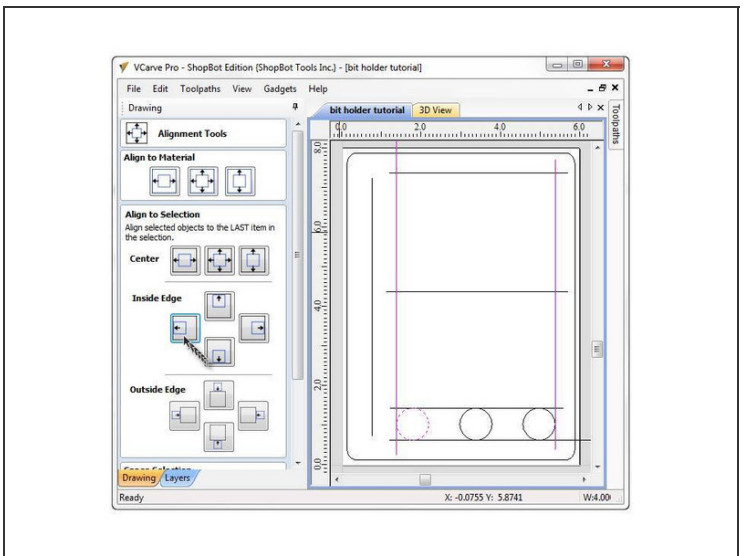
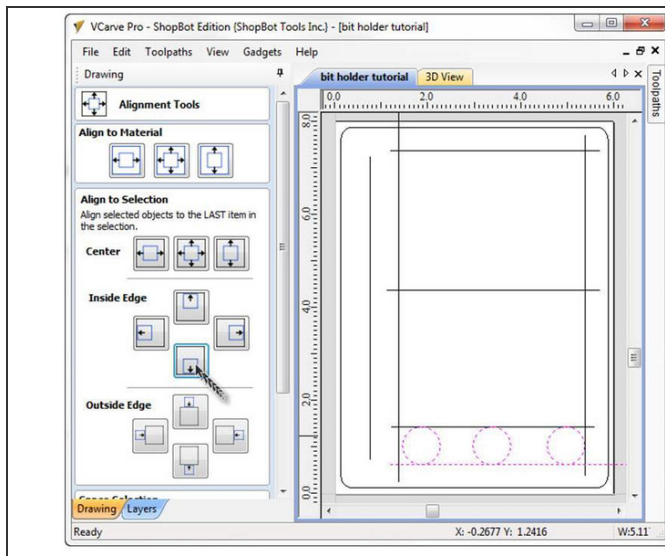
- Grouping objects allows one click to select multiple objects. This can be helpful when operation needs to be done to a several objects. It also allows objects to maintain their position relationships while being moved.
- The two vertical guide lines need to be grouped in this project. To do this, click on one then hold the **Shift** key and click on the other. Both lines should be highlighted.
- Now press the **Group selected objects icon**. It is the 4th icon from the left under **Edit Objects**. A quicker method is to press the “G” key on your keyboard. The two selected lines should change to solid magenta in color indicating grouped objects.
- Group the middle two horizontal lines using the same procedure.

Step 11 — Draw Collet Holes with Circle Tool



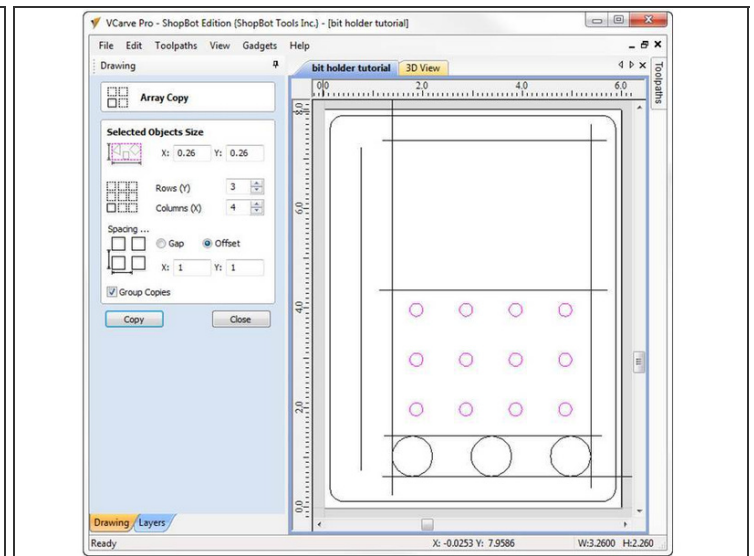
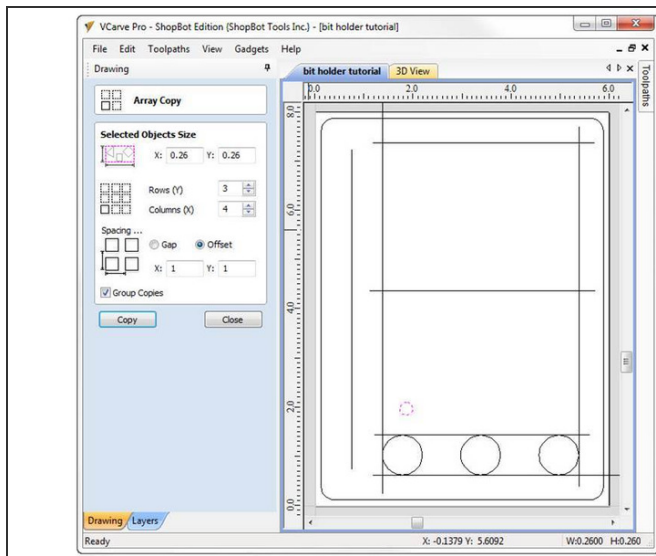
- The collets used on the Handibot router are 0.80" in diameter. A slight offset is needed to prevent binding.
- Click the **Draw Circle** icon under **Create Vectors**.
- Select the Diameter check box and enter 0.81 in the box and click the **Apply** button.
- Click in the lower rectangle between the guidelines to create three circles. It does not matter that you place them precisely, the next step will allow rapid relation positioning.

Step 12 — Position Collet Holes using Alignment Tools



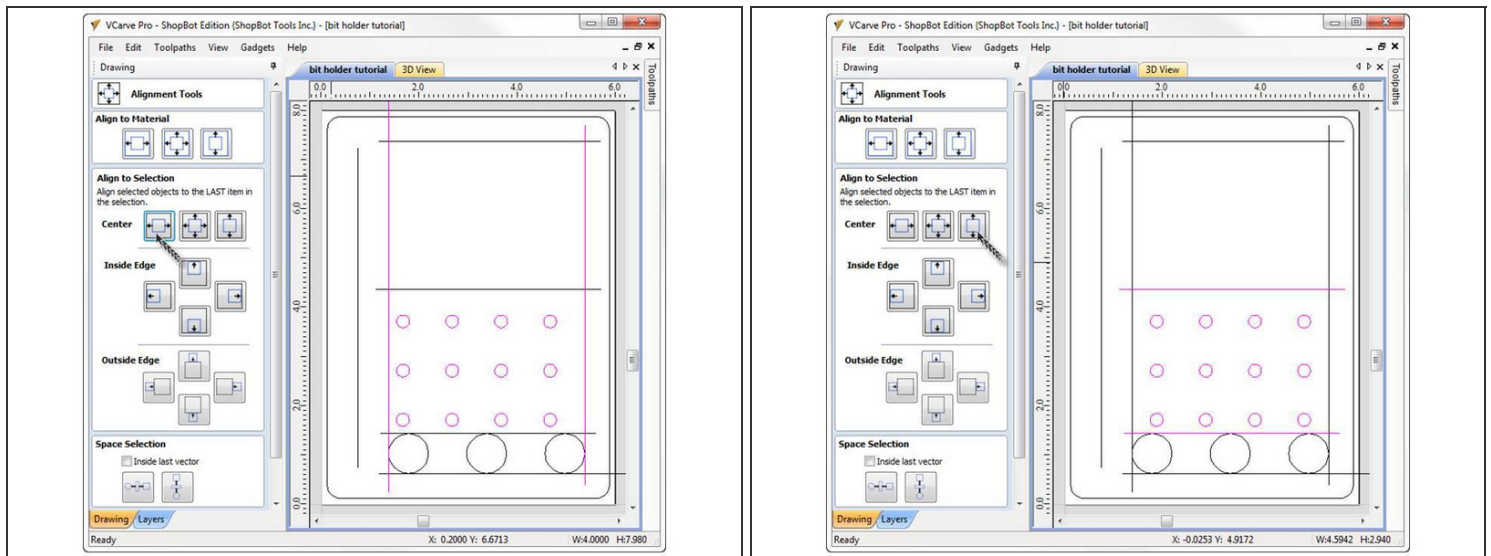
- Moving objects to precise alignment between different vectors is simple with VCarve Pro. Click on the **Align Selected Objects** icon under **Transform Objects**.
- Hold shift down and click on the three circles followed by the lowest horizontal guide line.
- Click on the lower icon in the **Inside Edge** portion of the **Alignment Tools** pane. The three circles should move so their lower edge is even with the line.
- Align the left most circle. Holding shift, click on the left circle and then the left vertical guide line. Note that both vertical lines light up because they are grouped. Click the left icon in under **Inside Edge**.
- Align the right circle using the same process by clicking the right **Inside Edge** button.
- Center the middle icon. Click on the center circle then the vertical guide line group. Click the left icon under **Center** on the **Alignment Tools** pane. This will center the middle circle between the two lines.
- Click **Close** to exit the **Alignment Tools** pane.

Step 13 — Create a Grid of Cicles



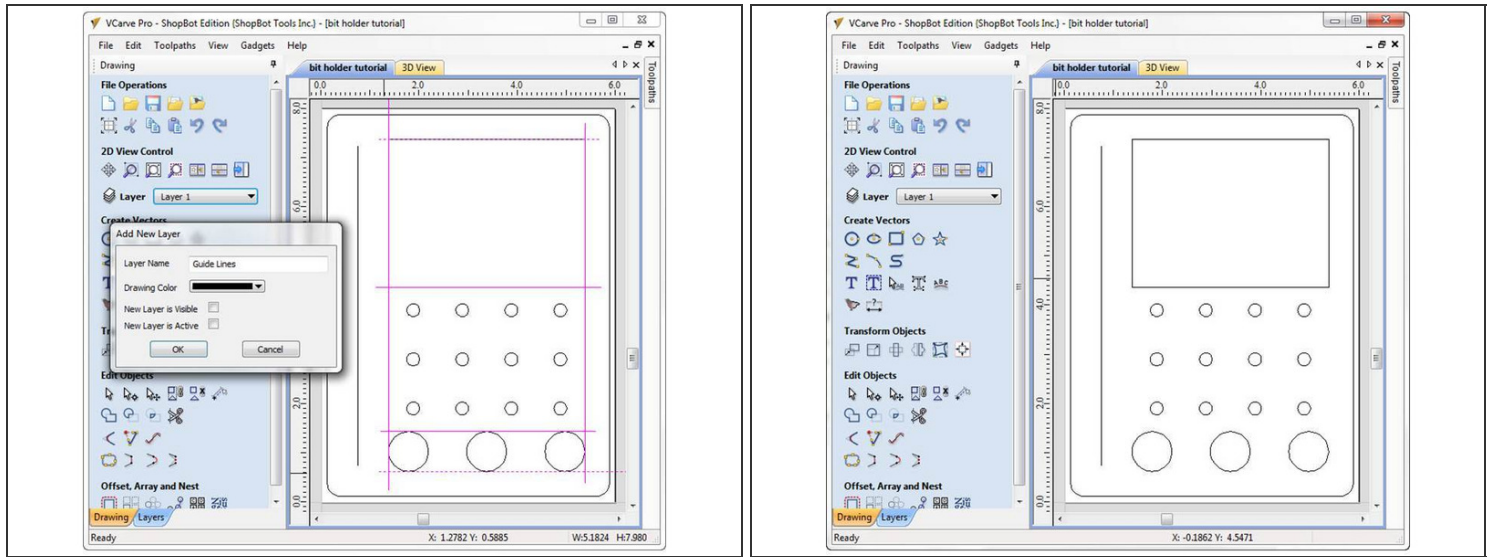
- Click on the **Draw Circle** icon and change the diameter to 0.26 inches and hit apply. Place the circle near the lower left of the middle rectangle formed by the guidelines. This forms the first of a grid, or array, of holes for bits.
- With the 0.26" circle selected, click on the icon with several open squares under **Offset, Array, and Nest** on the drawing pane.
- Choose 3 rows and 4 columns.
- Select the **Offset** option and use a value of 1.0" for both X and Y axes.
- Select the tick box for **Group Copies**. This allows all holes to be moved and selected as one unit.
- Click on **Copy** and you should see a grid appear similar to that on the screen.
- Close the **Array Copy** pane.

Step 14 — Center the grid using guidelines.



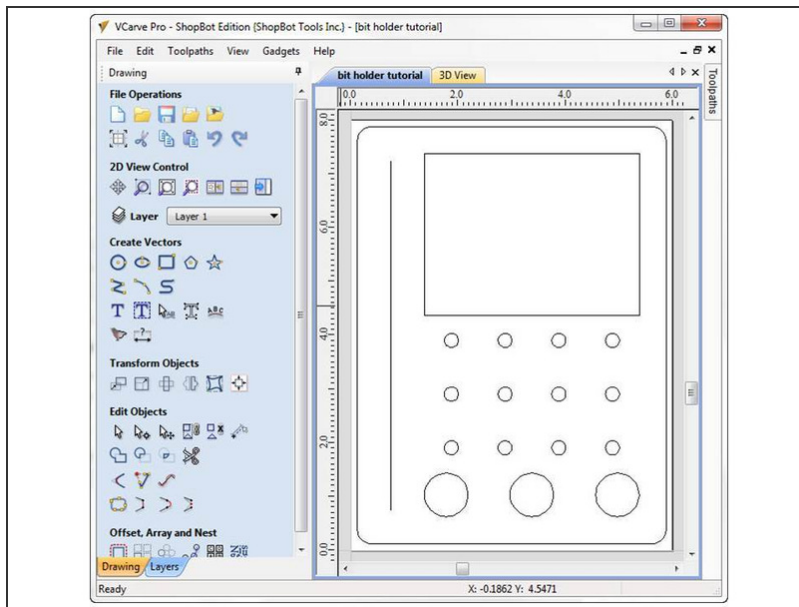
- Center this grid between the vertical construction lines using the **Align Selected Objects** icon under **Transform Objects**.
- Holding shift, first select the circle array and then the vertical lines. Click on left icon beside **Center**.
- Click in the any white area to deselect the vectors.
- Holding shift, first select the circle array and then the horizontal guide line group. Click on right icon beside **Center**.
- When the grid is centered, close the **Alignment Tools** pane.

Step 15 — Hiding Construction Lines



- The construction lines are no longer needed, but for future revision of the drawing they might be useful. This procedure will allow them to be hidden but accessed later.
- Select all of the construction lines by holding shift and clicking on each one.
- With you mouse, right-click near one of the lines and looks for the **Move to Layer** option.
- Select **New Layer**.
- Change the name of the layer to **Guide lines** and uncheck the **New Layer is Visible** box.
- Click **OK** to close the window and the guide lines will disappear.
- The guide lines layer can be turned on later by selecting **Layer** pull-down on the **Drawing** pane.

Step 16 — Drawing Complete



- Great job! The drawing portion is complete. All vectors needed for this part have been created. The next step is to assign tool paths to the vectors. Vcarve has a separate pane for toolpathing.
- Switching between the **Drawing and Toolpath** panes is simple. Under **2D View control** look for a box with a blue arrow. In the Drawing pane moving the cursor over this icon will show **Switch to toolpaths tab**.
- Clicking the tab will close the Drawing pane and open the Toolpaths tab on the other side of the VCarve Pro window.
- The next step of this project will assign toolpaths to these Vectors and save them in a format that the Handibot can use. Please go to the **Toolpathing and Part File Saving** tutorial.

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