

# Contents

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<b>Chapter 7</b>	<b>Tutorial</b>	<b>7-1</b>
Starting the Program . . . . .		7-2
Adjusting the Program Settings . . . . .		7-2
Using Undo . . . . .		7-3
Basic Drawing and Zooming . . . . .		7-4
More Zooming . . . . .		7-6
Selecting Parts of the Drawing . . . . .		7-8
Advanced Drawing and Editing . . . . .		7-10
Creating a Simple Dimensioned Part . . . . .		7-15
Creating a Complex Dimensioned Part . . . . .		7-17
Nesting Parts and Preparing for Cutting . . . . .		7-21
Importing and Converting a Drawing . . . . .		7-24
Importing and Converting a Picture . . . . .		7-26
Building a Computer Enclosure . . . . .		7-29
Cutting the Shapes . . . . .		7-29
Bending the Shapes . . . . .		7-32
Assembling the Shapes . . . . .		7-36
Finishing the Cabinet . . . . .		7-37

# 7

## Tutorial

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This chapter is designed to help you learn how to use the PlasmaCAM software in a way that is fun and easy. You learn by working through actual examples. The chapter contains examples to demonstrate important features of the software. You will probably want to work through the examples more than once, as well as trying your own similar projects.

You should already possess basic computer skills before attempting to learn the software from this manual. If you are not familiar with the general operation of a Windows-based personal computer, please seek to learn. You can learn from a class or from a friend. Your local bookstore can recommend any one of several excellent books available.

You should be versed with at least the following skills:

- Able to operate both the keyboard and mouse in commonly used ways
- Able to save and open files from the hard drive, and use file directories (folders).
- Able to start and operate basic Windows programs.


Most of this chapter focuses on familiarizing you with the software—not so much on how to operate the machine. **CHAPTER 5** contains the most information on actually operating the machine. It is good to experiment on your own, trying out different things in the software. However, be careful not to do this with the machine because of obvious dangers.

Many of the software's functions and capabilities are not covered in this chapter. As you become familiar with the software, take time to go through **CHAPTER 6**. Practice with all of the commands and settings described to fill in the gaps in what you have learned.

## Starting the Program

Before you can begin, you must have the program installed on your computer. Refer to **CHAPTER 4** for installation instructions.

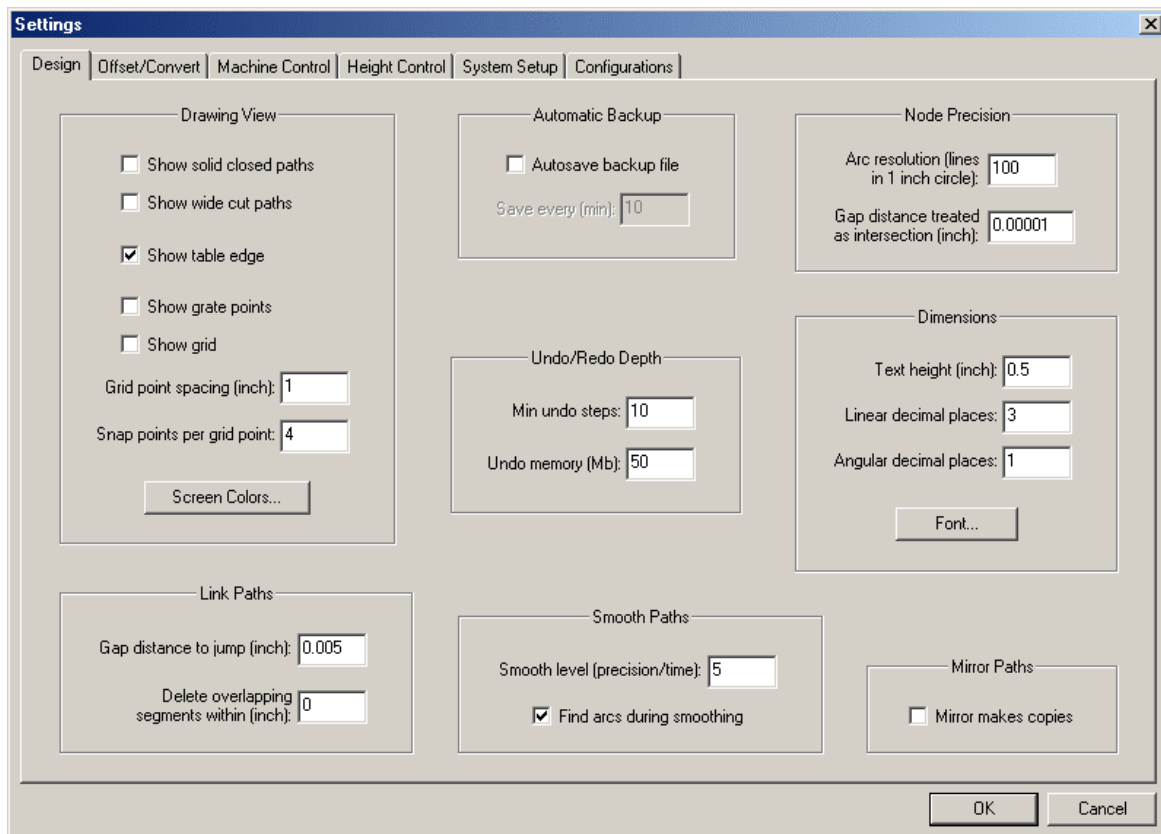
With your computer turned on and with Microsoft Windows running, click the **Start** button at the lower left corner of the screen. From the Programs menu, choose **PlasmaCAM > PlasmaCAM**.

After the program starts, make sure that the program window is maximized—that it fills the whole screen. If it is not, click the maximize button (  ) at the upper right corner of the window.

## Adjusting the Program Settings

You must have the program settings correctly set before doing any of the examples given in this chapter. Otherwise, some of the commands may not generate the expected results.

From the **SETTINGS** menu, choose *Settings*. Make sure that the units are set to “Inches” and “Degrees”, and that the standard machine size is set on the **System Setup** tab. Make sure the cutting area is set to “4ft x 4ft” on the **Machine Control** tab. Also make sure that everything is set according to what is shown below in the **Design** and **Offset/Convert** tabs:



**Settings**

Design | **Offset/Convert** | Machine Control | Height Control | System Setup | Configurations

**Convert to Cut Path**

Cutter kerf width (twice offset distance, inch): 0.06

Pierce lead-in length (inch): 0.15

☐ Move lead-in for best fit

Gap at end of loop (inch): 0.01

☐ Overcut to reduce undercutting

Max undercutting (inch): 0.04

☒ Minimize double cutting

Delete small holes below (inch): 0

Replace old cut paths and keep order within (inch): 0

**Cut Path Direction**

☐ Same as source

☒ Cut parts to right of paths

☐ Cut parts to left of paths

**Cut Path Order**

☐ Same as source

☒ Sweep across

☐ Minimize rapid travel

☐ Reduce heat

**Offset**

Above angle (deg): 150

☒ Chamfer outside corners

☐ Fillet outside corners

☐ Extend outside corners

Extend by (inch): 0.1

☐ Exclude crossovers

**Bend Line Conversion**

Notch length (inch): 0

Min bend material (inch): 0.2

Slot length (approx, inch): 0

Additional bend material (% of bend length): 20

OK Cancel

When you are done, click the **OK** button.

### **Using Undo**

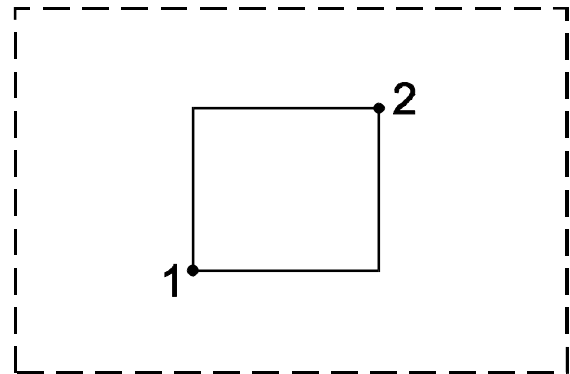
While you are working on the examples given in this chapter, you may accidentally do something differently than what is given in the instructions. This may result in the drawing being changed in a way that would require you to start the example over again. Rather than do this, use *Undo* from the *EDIT* menu to take back instructions. *Undo* does not affect program settings or zoom settings (see **CHAPTER 6** for more on *Undo*).



## Basic Drawing and Zooming

The picture shown at right represents the computer screen. The outer rectangle is simply the edge of the program's drawing area. These pictures will show you where to click with the mouse in order to draw the example shapes.

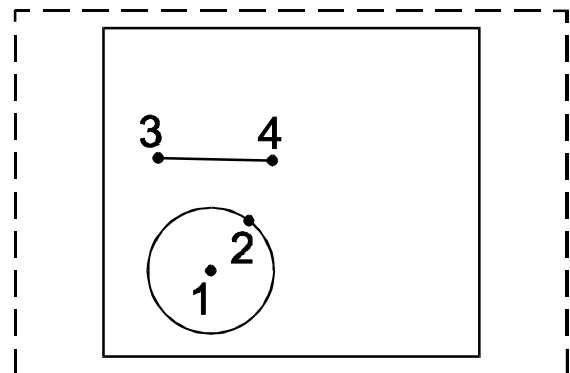
From the *DRAW* menu, choose *Rectangle*. Move the mouse to point 1 and left click (quickly press and release the left mouse button). Then move the mouse to point 2 and left click. As a result, a new rectangle is drawn on screen, appearing in green.



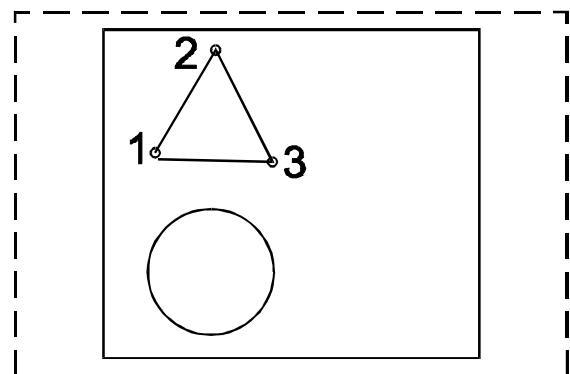
From the *VIEW* menu, choose *Zoom Extents*. This magnifies the drawing so that it fills the screen.

From the *DRAW* menu, choose *Circle*. Left click at point 1, then move to point 2 and left click.

From the *DRAW* menu, choose *Line(s)*. Left click at points 3 and 4. Then right click to end the command.



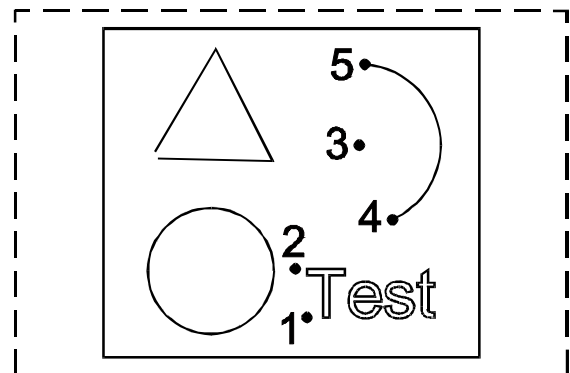
Press the spacebar on the keyboard to quickly repeat *Line(s)*. Left click at points 1 through 3, in order. When you are finished, right click to end the command.



From the *DRAW* menu, choose *Text*. Type in "Test" under **Text**. Under **Font**, choose "Arial" from the list. Then click **OK** at the bottom of the box. Left click at point 1 then 2.

From the *DRAW* menu, choose *Arc*. Left click at points 3 through 5, in order.

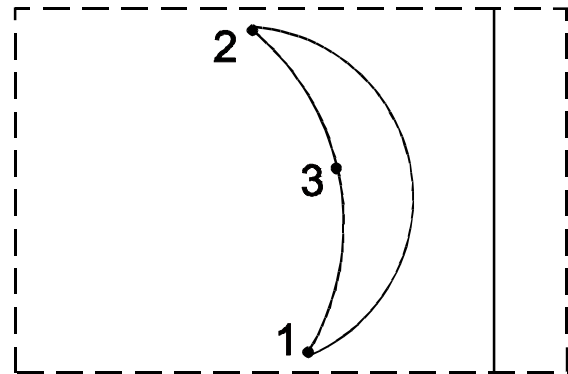
Notice that the arc just drawn is green, while the other shapes are different colors. Green indicates that the path is selected.



Since the arc was just drawn, it is automatically the only thing selected in the drawing (otherwise select it).

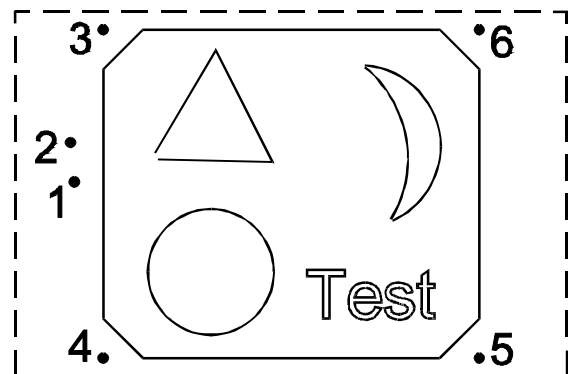
From the *VIEW* menu, choose *Zoom Selection*. This magnifies what is selected within the drawing (the arc) so that it fills the screen.

From the *DRAW* menu, choose *Bulge*. Left click at points 1 through 3, in order.

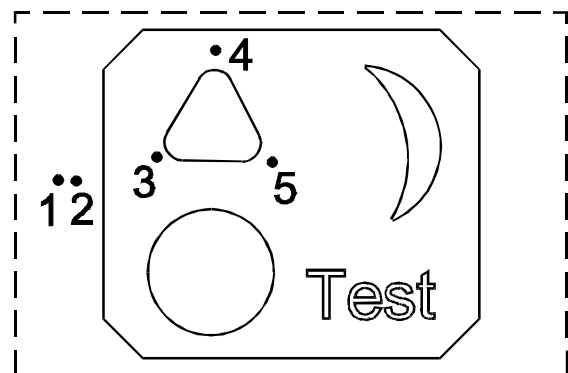


From the *VIEW* menu, choose *Zoom Previous*. This returns the magnification to the previous viewpoint.

From the *DRAW* menu, choose *Chamfer*. Left click at points 1 through 6, in order. (Points 1 and 2 set the size of the chamfer; click just inside the corners for the other points so the program knows what corners to chamfer.) Then right click to end the command.



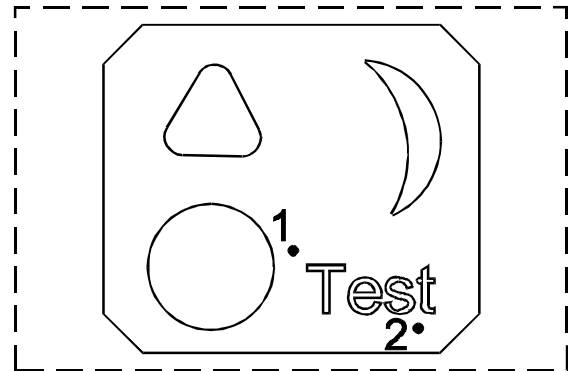
From the *DRAW* menu, choose *Fillet*. Left click at points 1 through 5, in order. (Points 1 and 2 set the radius of the fillet; click just inside the corners for the other points so the program knows what corners to fillet.) Then right click to end the command.



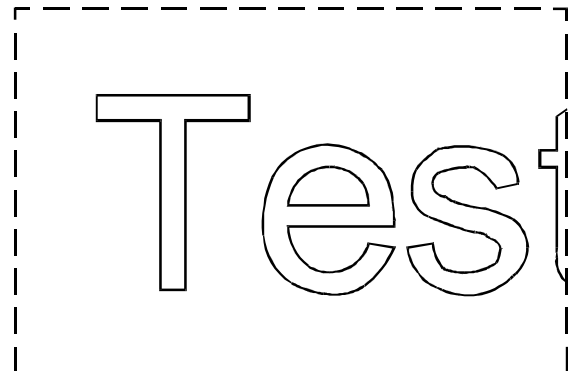
## More Zooming

You have already seen how *Zoom* commands on the *VIEW* menu can be used to magnify part of the drawing or show parts of the drawing that are hidden because they are off the screen. *Zoom Extents*, *Zoom Selection*, and *Zoom Previous* were all demonstrated in the previous examples. You will notice that other *Zoom* commands can be found on the *VIEW* menu.

Choose *Zoom Window* from the *VIEW* menu, and left click at points 1 and 2.



The region of the drawing contained within the window you drew is enlarged to fill the screen. Notice that next to *Zoom Window* in the *VIEW* menu is a keyboard shortcut key. The key gives you quick access to the command.



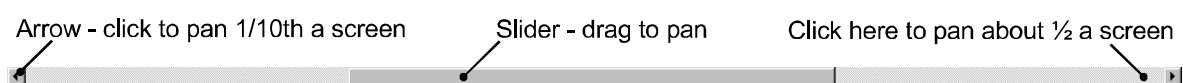
In addition to *VIEW* commands appearing on the menu, you can also use the arrow keys on the keyboard to pan around the drawing. For example, press the up arrow key.

The drawing view changes so that you can see what was above the previous view. Each press of an arrow key pans the drawing by  $\frac{1}{2}$  the screen width (or height). Experiment by pressing the arrow keys to pan around the drawing.



Press the F5 key on the keyboard when you are finished experimenting with the arrow keys, so the drawing is centered back on screen. (F5 is the keyboard shortcut for *Zoom Extents*.)

You can also use the scroll bars to pan around the drawing. The scroll bars can be seen at the bottom edge and the left edge of the drawing (bottom scroll bar is shown):

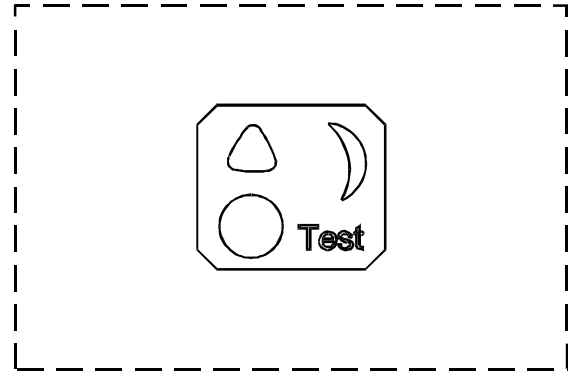


Experiment with the scroll bars by clicking on the arrows at the ends of the bars. You will notice that the field of view pans by about  $\frac{1}{10}$ th of the screen. If you click just inside of the

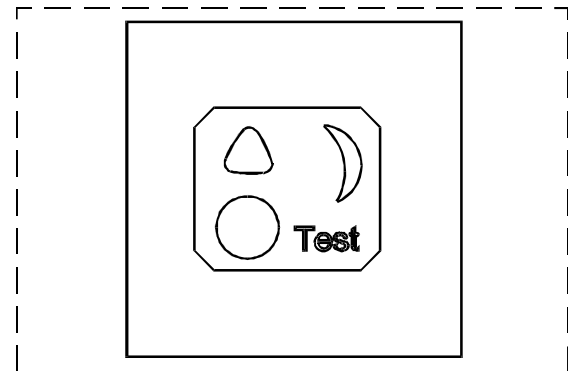
arrows, you will notice that the field of view pans by a greater distance. The most convenient way to use the scroll bars is to draw the slider (hold down the left mouse button over the slider and move the mouse to drag). This allows you to manually pan the drawing by the amount you desire.

Press the F5 key on the keyboard when you are finished experimenting with the scroll bars, so the drawing is centered back on screen.

From the *VIEW* menu, choose *Zoom Out*. This reduces the apparent size of the drawing by a factor of two, allowing you to see a larger area. (Zoom commands do not move or change the actual size of the drawing, they merely affect what parts of the drawing you see on screen.)



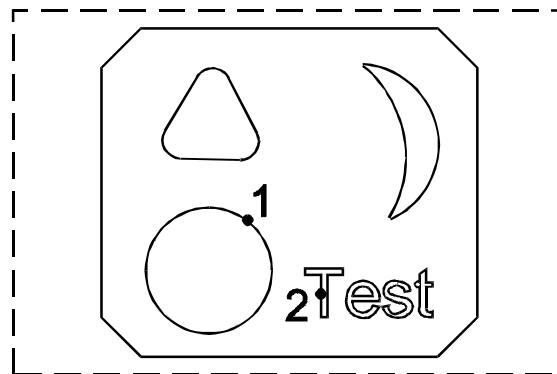
From the *VIEW* menu, choose *Zoom Table*. This frames the viewpoint so that you can see the entire 4ft x 4ft cutting area of the machine. The edge of the square cutting area is designated on screen by the gray box. Shapes that lie within this area can be cut out by the machine.



## Selecting Parts of the Drawing

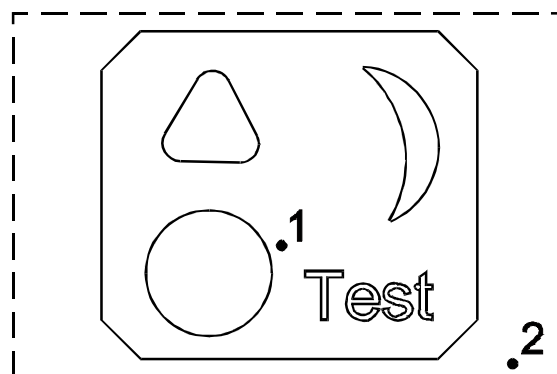
In order to use many of the PlasmaCAM commands, you must first select something in the drawing. For example, you can erase shapes by choosing *Delete* from the *EDIT* menu (or by pressing the Delete key on the keyboard). However, something first has to be selected so the program knows what to erase.

Press F5 on the keyboard (for *Zoom Extents*). Then use the mouse to left click on the circle in the drawing (point 1). Notice that the circle turns green. Now click on the letter “T” in the drawing (point 2). Notice that the letter turns green, while the circle returns to its normal purple color. Green indicates that a shape is selected. Notice that the status bar at the bottom of the window reads **1 paths are selected (9 nodes total)**. The letter “T” is a path made up of nine points; the status bar always tells you how many paths are selected in the drawing.



A fast way to select several paths at once is to use a selection window. For example to select all the letters at once, hold down the left mouse button at point 1. Then drag the mouse cursor over to point 2 and release the button. All of the letters turn green, indicating that they are selected.

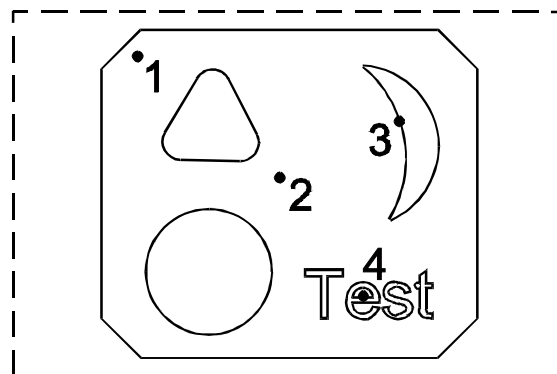
Notice that none of the large chamfered rectangle is selected, even though part of it was within the selection window. In order for a path to be selected by a window, it must lie entirely inside of the window.



Suppose you wanted to erase all of the letters except the hole inside of the “e,” as well as the rounded triangle and the inside arc of the moon shape.

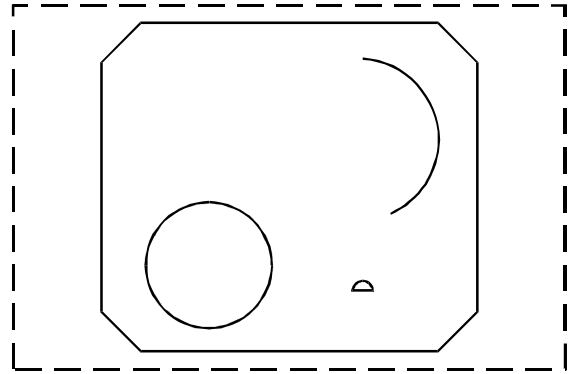
(If you are using the advanced design software, you will first have to select the “e” and then choose *Ungroup* from the *EDIT* menu.)

You can select and unselect multiple shapes by holding down the Ctrl key as you select. While holding Ctrl, drag a selection window from point 1 to point 2.



Still holding Ctrl, left click at points 3 and 4. Because the hole of the “e” was already selected, clicking on it while holding Ctrl causes it to become unselected.

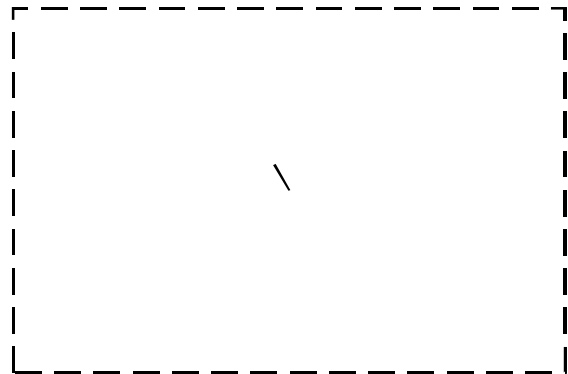
Press Delete to erase the selected shapes. Notice that all of the intended paths are now erased.



## Advanced Drawing and Editing

From the *FILE* menu, choose *New*. Click the **No** button to indicate you don't want to save the drawing.

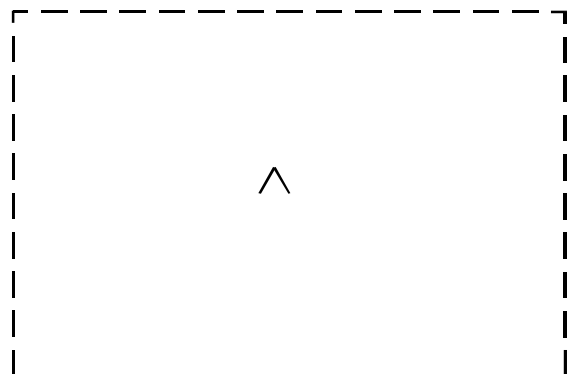
From the *DRAW* menu, choose *Line*. Type "24,24" and press the Enter key. (The text you type will appear in the status bar at the bottom of the screen.) Then type "<-60,4" and Enter. Press Escape to end *Line*. This draws a line in the cutting area to a point that is 4 inches away at downward angle of 60 degrees.



Since the new line is already selected, you don't have to select it to make a copy.

From the *DRAW* menu, choose *Copy*. Type "1,1" and Enter. Type "@0,0" and Enter. Press the Esc key to end *Copy*. Although you cannot see it, you just made a second copy of the line segment that lies exactly on top of the original. The coordinates you entered told the program to copy the line from a point to the same point.

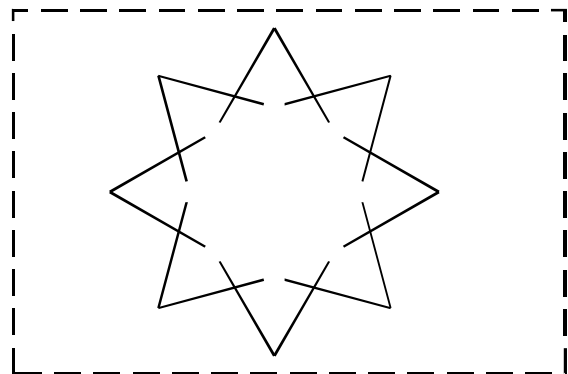
From the *EDIT* menu, choose *Mirror*. Type "24,24" and Enter. Type "@0,-1" and Enter. This changes the copy so that it is a mirror image of the original. The mirror line that was specified extended from the upper end point of the line to a point that was 1 inch directly below.



Select both line pieces by dragging a selection window around them. From the *DRAW* menu, choose *Array*. At the top of the dialog, check **Polar**. Enter "8" at **Number of rotated copies**. Also check **Adjust rotation angle to fill complete circle**. Then press **OK**. Type "24,18" and Enter.

Press F5 (for *Zoom Extents*).

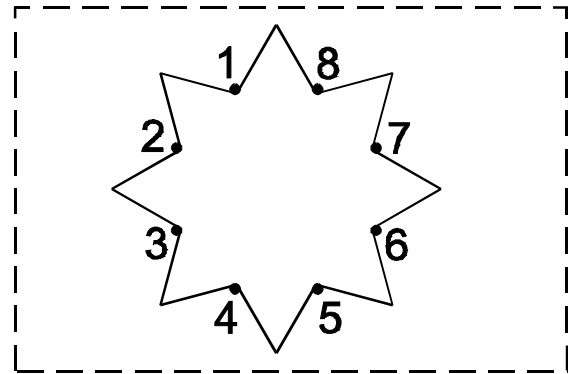
Among other things, this exercise demonstrates how you can type in coordinates to specify exact points in the drawing. The three types of coordinates used are absolute, relative and relative polar. Absolute coordinates simply specify an X,Y point in the drawing. Relative coordinates (preceded by "@" or "<") specify how the new point is to be positioned relative to the last point picked. If you do not have previous experience working with coordinates, see *COORDINATE SYSTEM* in **CHAPTER 6** for a detailed explanation.



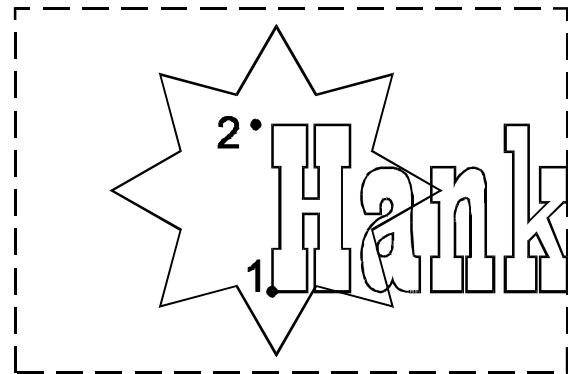
From the *DRAW* menu, choose *Fillet*. Type “0” and Enter. Then left click at points 1-8. Click just inside of the corners you want trimmed; then right click (or press Esc) to stop *Fillet*. If you accidentally click in the wrong place on one of the points, stop *Fillet* and choose *Undo* from the *EDIT* menu to take back the mistake. Then restart *Fillet*.

Note that *Fillet* (or *Chamfer*) does not actually add an arc segment if you type a radius of “0”. Instead, the line segments are simply trimmed at their intersection.

A couple of the line segments should still be selected from the last *Fillet* (otherwise select something). From the *EDIT* menu, choose *Link*. This joins all of the separate pieces together to form one continuous, closed path. Unselect the shape (left click anywhere in the drawing area); you will notice that the path is now purple, indicating that it is closed.

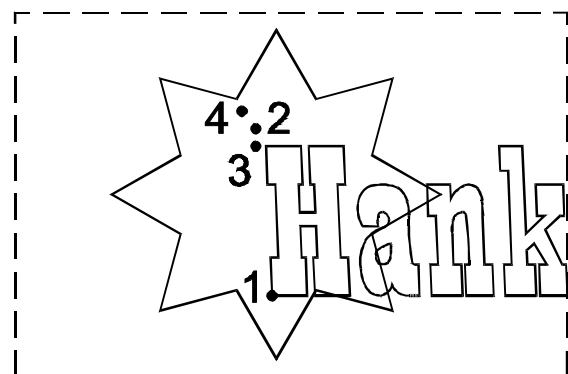


From the *DRAW* menu, choose *Text*. From the **Font** list, choose “Playbill.” (If this font is not available, try “Arial” or any other font you want to try.) Then type “Hank” at **Text**. Click the **OK** button. Left click at points 1 and 2.



From the *EDIT* menu, choose *Scale Height*. Click at points 1 and 2. Then move the mouse to observe how you can affect the height. Click at point 3 to make the text a little shorter.

From the *EDIT* menu, choose *Slant*. Click at points 1 and 2. Then move the mouse to observe how you can skew and slant the letters. Click at point 4 to make the text lean a little to the left.

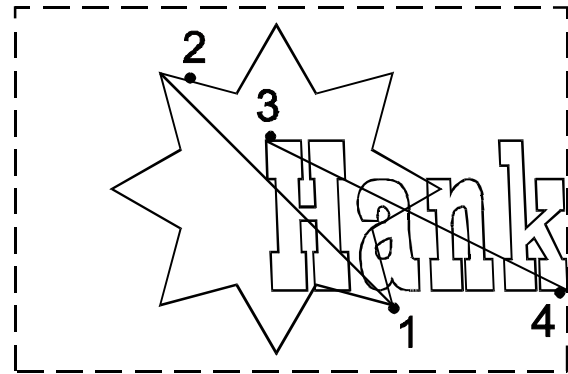




In the *SETTINGS* menu, check *Snap to Nodepoint*. You will notice the letter “N” appearing near the center of the status bar, indicated that this snap is activated.

From the *DRAW* menu, choose *Line(s)*. Left click near points 1 and 2. Right click to end *Line(s)*, then press the SpaceBar to repeat it. Left click near points 3 and 4.


When you click near a line segment, *Snap to Nodepoint* automatically causes you to pick exactly at the nearest endpoint of that segment. Snaps allow you to draw very accurately and quickly (see the *SNAPS* section in **CHAPTER 6**).



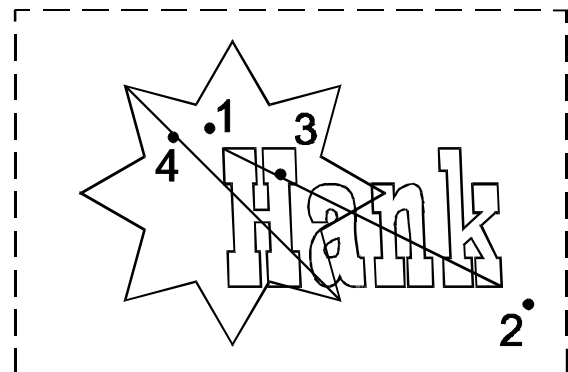
Press F5 (for *Zoom Extents*).

Drag a selection window around all of the letters—from point 1 to point 2.

From the *EDIT* menu, choose *Move*.

Click the middle mouse button (press  key or Shift+F10 on the keyboard if you don't have a middle mouse button.) A menu pops up from which you should choose *Midpoint Snap*. You know that you activated the snap if the center of the status bar now shows also the letter “M”.

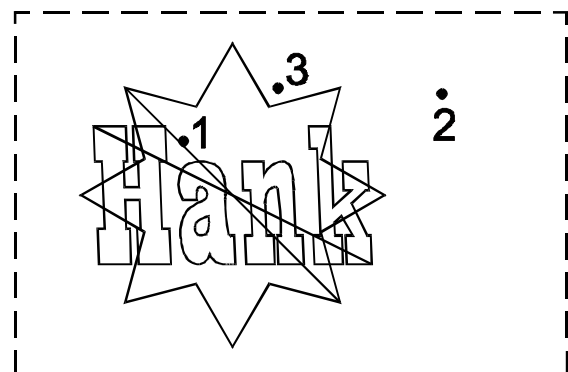
Left click at point 3. Type “M” (activate *Midpoint Snap* again, without opening the menu this time) and left click at point 4.



Now the text has been moved so that it is centered with the star.

From the *EDIT* menu, choose *Scale*.

Again choose *Midpoint Snap*, either by typing “M” or using the popup menu. Left click at point 1, then at point 2. Move the mouse to observe how you can change the size of the text. Left click at point 3 to make the text well sized for the star.

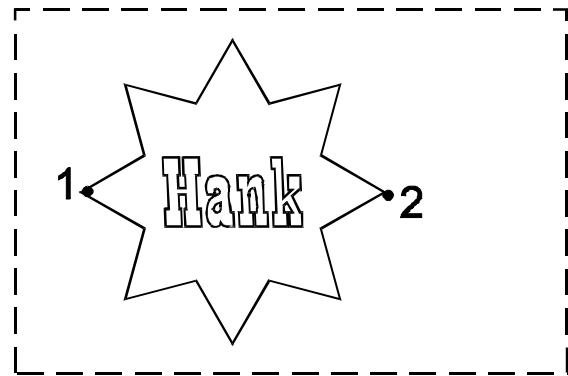


Select the two extra line segments, and from the *EDIT* menu, choose *Delete* (or just type the Delete key).

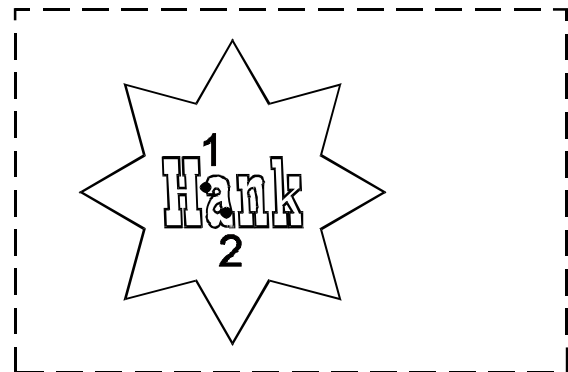
To make the star 10 inches across, drag a selection window around everything. From the *EDIT* menu, choose *Scale*. Left click at points 1 and 2. Then type “10” and Enter.

Press F5 (for *Zoom Extents*).

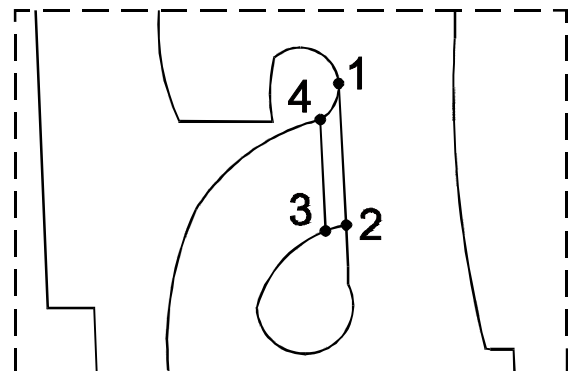
Unselect everything by clicking in the drawing area. To prove that the star is exactly 10 inches across, choose *Measure* from the *VIEW* menu. Left click near points 1 and 2. A message box indicates the distance you measured to be 10.000 inches. The star has been sized exactly because *Snap to Endpoints* was active when you scaled it.



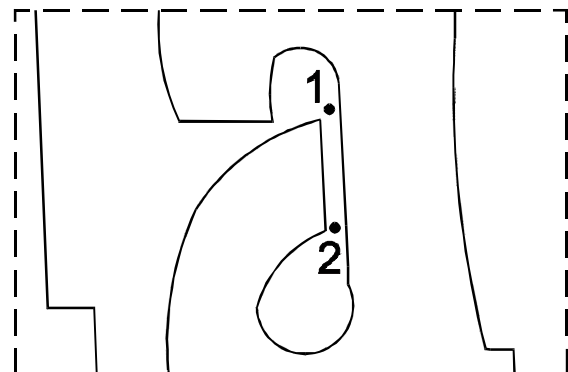
If you want to actually cut out this shape, you need to fix the letter “a”. Currently the letter has a hole inside of a hole. From the *VIEW* menu, choose *Zoom Window*. Left click at points 1 and 2.



From the *DRAW* menu, choose *Line(s)*. Left click at points 1 and 2. Right click to end *Line(s)*, then press the SpaceBar to repeat it. Left click at points 3 and 4. Because of *Nodepoint Snap*, these new lines should connect exactly to the existing parts of the “a” as shown. The lines should not overlap any parts of the “a,” otherwise the next step will not work.



From the *EDIT* menu, choose *Trim*. Left click at points 1 and 2 (until the “a” is cleaned up as shown). Then right click to end *Trim*.



Notice that *Trim* caused the “a” to be broken up into pieces, so that it is no longer one continuous closed path. In order for this letter to be cut out properly, it needs to be converted into a closed (purple) path again. A couple of segments of the letter should still be selected, so from the *EDIT* menu, choose *Link*. If you unselect the letter, it should now be purple. (If it is not, choose *Undo* for *Link* and closely inspect the trimmed corners to verify that no gaps or overlapping segments are present. Fix the letter and try *Link* again.)

Press F5 (for *Zoom Extents*).

From the *MACHINE* menu, choose *Convert to Cut Path*. Left click on point 1 (just outside of the perimeter), then right click to end the command. If you unselect everything, you will notice that all the paths have changed to blue. This means that they are cut paths that can be followed by the machine to actually cut the shape. Not only have the paths changed color, but they have also been offset from the original shape to compensate for the kerf width of the torch.

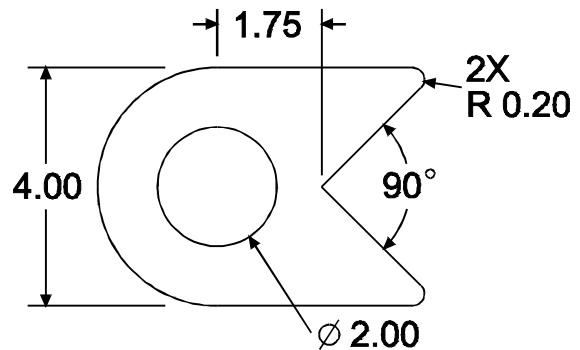


Furthermore, each path has a pierce start point that is off of the path, and a gap at the end of the path. If you repeatedly choose *Undo* and *Redo* (*EDIT* menu, or just press Page Up and Page Down keys), you can watch the shape as it changes from the original shape to the machine cuttable shape.

It is too early to actually cut out the shape, but you can simulate cutting of the shape. Make sure that you *Redo* all of the *Undos*, so that you have all machine paths again. All of the paths should be selected. From the *MACHINE* menu choose *Cut Preview*. Set **Cut Speed** to “1000”, **Time delay** to “1”, and press the **Start** button. *Cut Preview* demonstrates on screen how the shape will be cut out.

## Creating a Simple Dimensioned Part

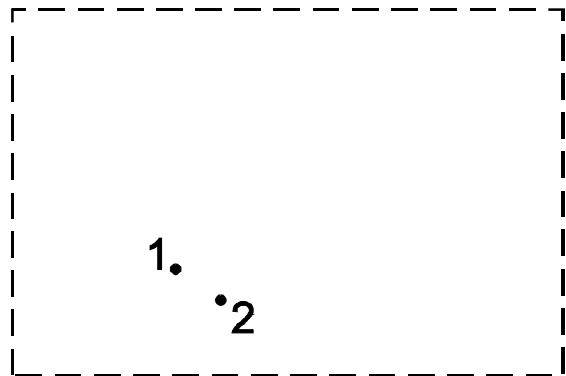
Suppose you wanted to make the part shown at right. Rather than just drawing the part by eyesight, you want it to be the exact same shape and size as what is shown.



From the *FILE* menu, choose *New* (you do not need to save the other file).

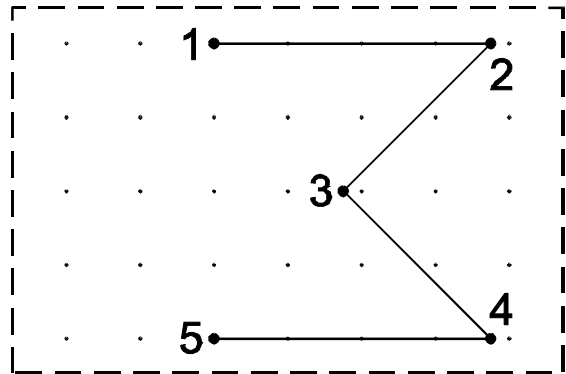
From the *SETTINGS* menu, check *Snap to Grid*. Make sure *Snap to Nodepoint* and *Snap Orthogonal* are not checked. Then choose *Settings*. Check **Show grid**. Enter “1” at **Grid point spacing** and “4” at **Snap points per grid point**.

From the *VIEW* menu, choose *Zoom Window*. Left click at points 1 and 2.



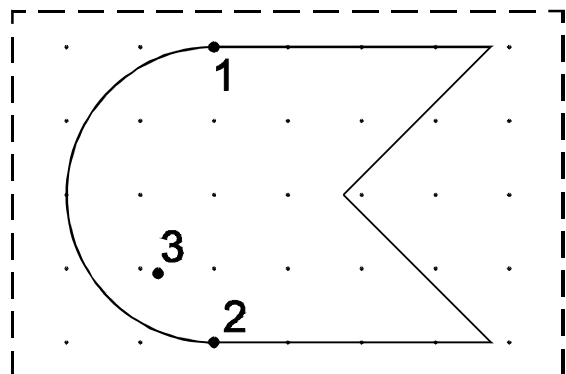
From the *DRAW* menu, choose *Line(s)*. Left click at points 1 through 5. Then right click to end the command.

Be sure to click in the right areas between the grid points so that the lines snap to the points that make them the right size, exactly as shown.



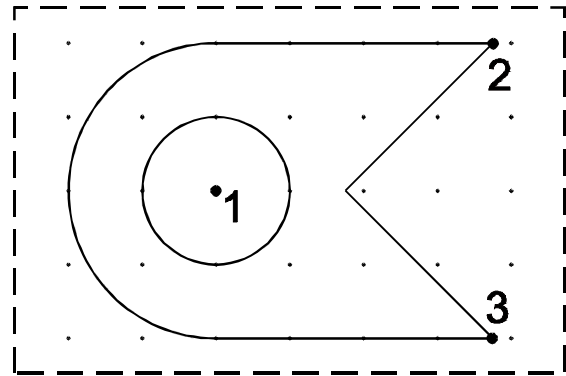
From the *DRAW* menu, choose *Bulge*. Left click at points 1 and 2. Next type in “2” and Enter. Then left click at point 3.

From the *EDIT* menu, choose *Link*.



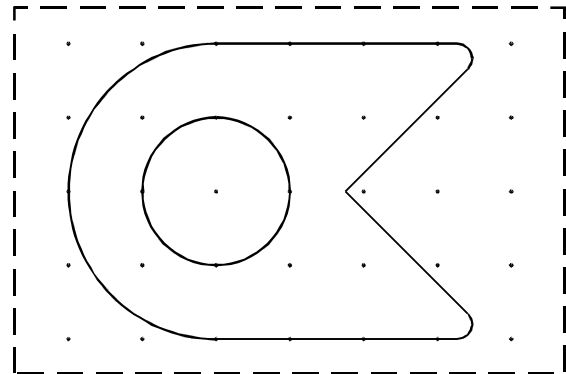
From the *DRAW* menu, choose *Circle*.  
Left click at point 1, then type “.2” and  
Enter.

From the *DRAW* menu, choose *Fillet*.  
Type “.2” and Enter. Left click at points 2  
and 3. Then right click to end the  
command.



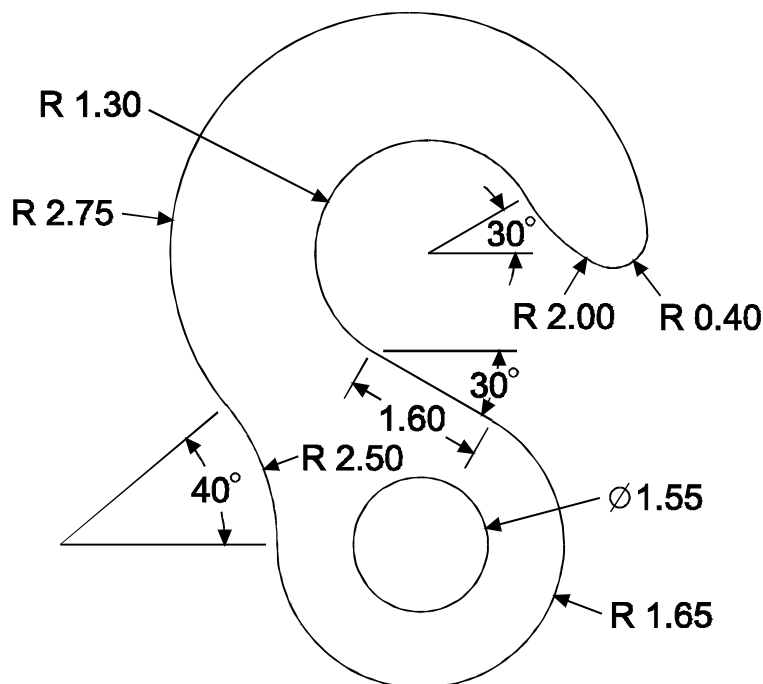
The part is now complete, and it should be  
the exact same dimensions as the desired  
part.

To cut the part, you would simply convert  
it to cut paths, place it where you want it  
on the table, and tell the machine to cut it.



## Creating a Complex Dimensioned Part

Suppose you needed to make the part shown at right to the exact dimensions given. If the drawing is not already available in a format that you can import, you can draw it directly in PlasmaCAM.

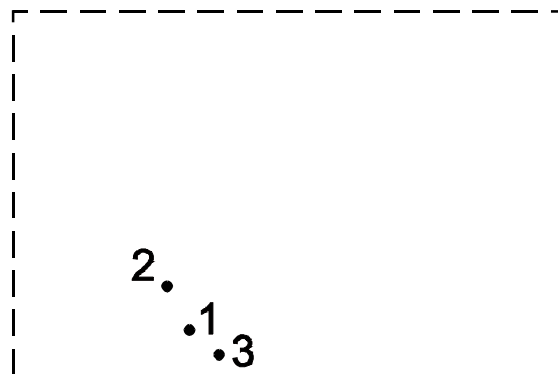



From the *FILE* menu, choose *New* (you don't need to save your changes).

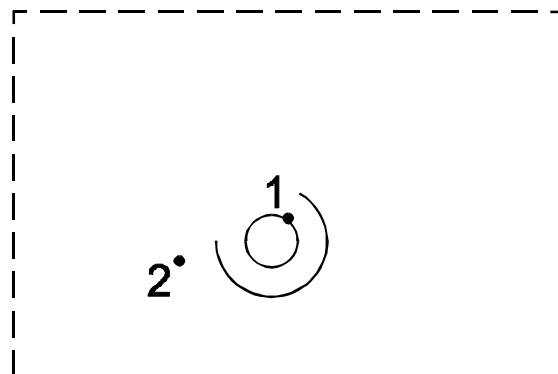
On the *SETTINGS* menu, make sure that *Snap to Nodepoint* is checked, and that *Snap Orthogonal* and *Snap to Grid* are unchecked.

From the *DRAW* menu, choose *Circle*. Type "1.55" and Enter, then left click at point 1.

From the *VIEW* menu, choose *Zoom Window*. Left click at points 2 and 3.

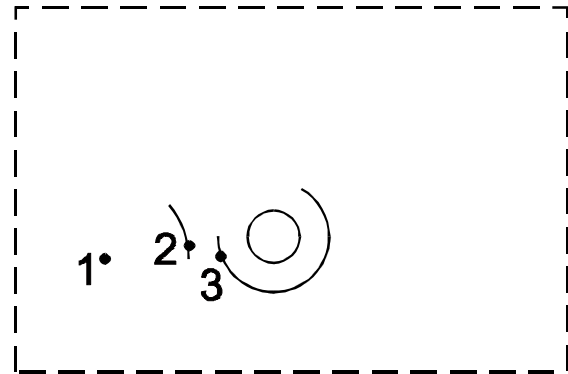


From the *DRAW* menu, choose *Arc*. Activate *Center Snap*. (Access the snaps by pressing the middle mouse button, the  key on the keyboard, or just the letter shortcut for the snap.) Left click at point 1, then type "1.65" and Enter. Next activate *Orthogonal Snap* (temporarily only) and left click at point 2. Finally, type "60" and Enter.



Press Spacebar to repeat *Arc*. Left click at point 1, then type “@2.5,0” and Enter. Type “40” and Enter.

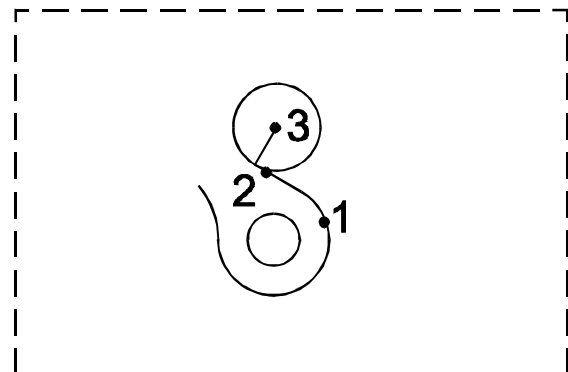
From the *EDIT* menu, choose *Move*. Activate *Endpoint Snap* and left click at point 2 (on the arc as shown). Activate *Endpoint Snap* again and left click at point 3.



From the *DRAW* menu, choose *Line(s)*. Activate *Endpoint Snap* and left click at point 1. Then type “<150,1.6” and Enter. Right click to end *Line(s)*.

From the *DRAW* menu, choose *Copy*. Left click at point 2, then left click at point 2 again. Right click to end *Copy*.

From the *EDIT* menu, choose *Rotate*. Left click at point 2, then type “90” and Enter.



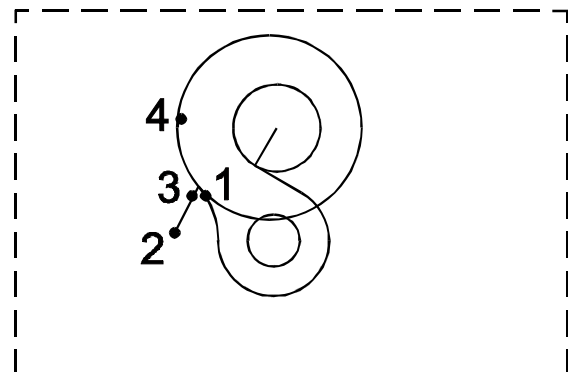
From the *EDIT* menu, choose *Scale*. Left click at point 2, then left click at point 3. Type “1.3” and Enter.

From the *DRAW* menu, choose *Circle*. Left click at point 3, then left click at point 2.

From the *DRAW* menu, choose *Line(s)*. Activate *Endpoint Snap* and left click at point 1. Then left click at point 2. Right click to end the command.

From the *DRAW* menu, choose *Circle*. Activate *Center Snap* and left click at point 1. Left click at point 3.

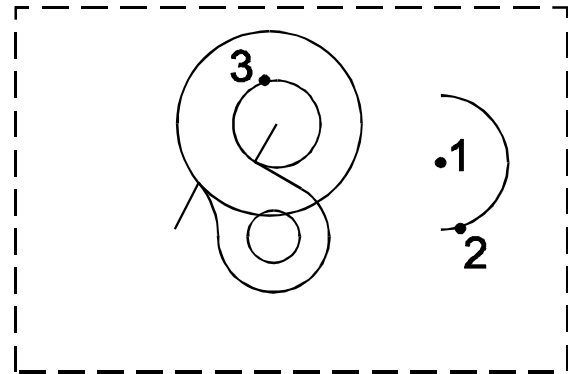
From the *EDIT* menu, choose *Rotate*. Left click at point 3, then type “180” and Enter.



From the *EDIT* menu, choose *Scale*. Left click at point 3. Activate *Center Snap* and left click at point 4. Then type “2.75” and Enter.

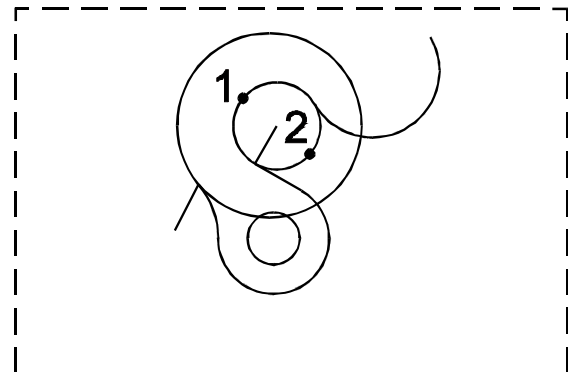
From the *DRAW* menu, choose *Arc*. Left click at point 1. Next type “@0,-2” and Enter. Then type “90” and Enter.

From the *EDIT* menu, choose *Move*. Activate *Endpoint Snap*, and left click at point 2 (on the arc). Then activate *Quadrant Snap* and left click at point 3.



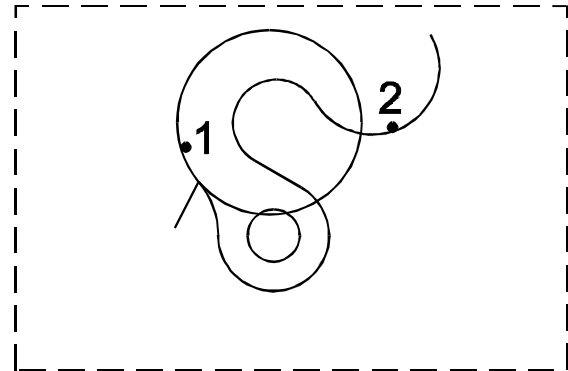
From the *EDIT* menu, choose *Rotate*. Activate *Center Snap* and left click at point 1. Then type “-60” and Enter.

From the *EDIT* menu, choose *Trim*. Left click at point 2 (you may have to click twice). Right click to end the command.



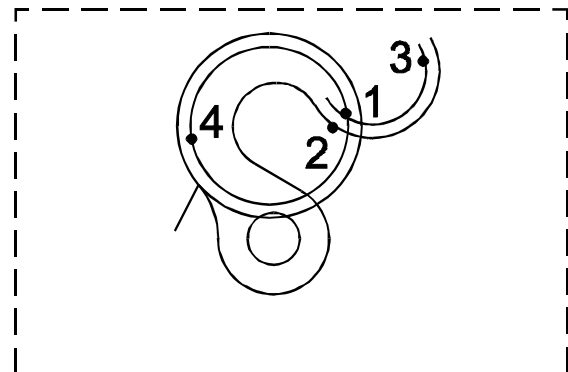
Select the big circle and arc (hold Ctrl and left click at points 1 and 2). From the *DRAW* menu, choose *Copy*. Left click anywhere on the screen, then type “@0,0” and Enter. Right click to end the command.

From the *EDIT* menu, choose *Offset*. Type “.4” and Enter. Left click at points 1 and 2, then right click to end the command.



From the *DRAW* menu, choose *Circle*. Activate *Intersection Snap* and left click at point 1. Then activate *Perpendicular Snap* and left click at point 2.

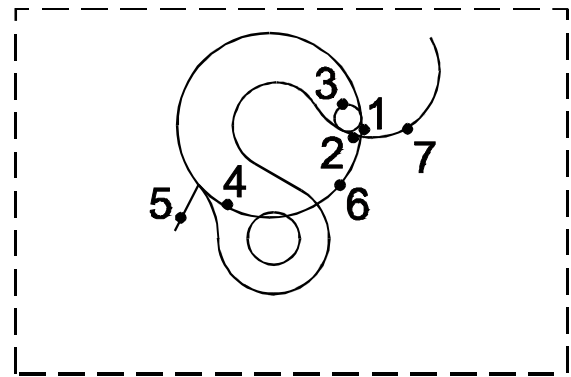
Select the two new construction arcs (hold Ctrl and left click at points 3 and 4). From the *EDIT* menu, choose *Delete*.





From the *EDIT* menu, choose *Trim*.  
Left click at points 1 through 4, then  
right click to end the command.

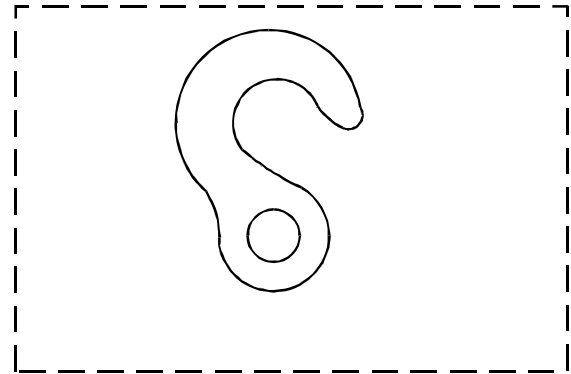
Select the extra construction shapes  
(left click at point 5; then hold Ctrl and  
left click at points 6 and 7 and others).  
From the *EDIT* menu, choose *Delete*.



Select everything in the drawing (you  
can use *Select all By* from the *VIEW*  
menu). From the *EDIT* menu, choose  
*Link*.

Notice that when you unselect the  
drawing, both the perimeter and the  
hole of the hook are purple, indicating  
that they are each closed loop paths.

From the *FILE* menu, choose *Save*.  
Type “Hook” and click **SAVE**.



## Nesting Parts and Preparing for Cutting

This example uses the hook drawn from the previous example, which instructed you to save the drawing. If you saved the hook, you can load it by choosing *Open* from the *FILE* menu. Find and select the file, then click the **Open** button.

On the *SETTINGS* menu, make sure that *Snap to Nodepoint* is checked, and that *Snap Orthogonal* and *Snap to Grid* are unchecked.

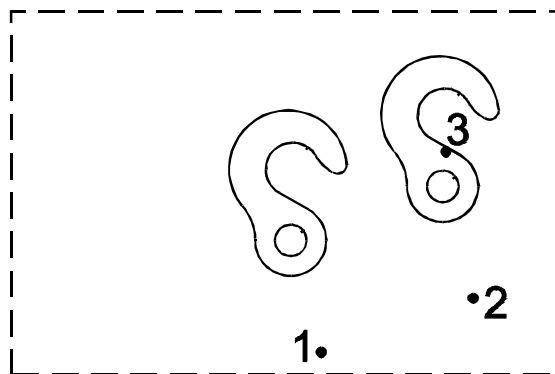
From the *MACHINE* menu, choose *Convert to Cut Path* and click just outside of the hook perimeter where you would want the pierce point to be located.

From the *VIEW* menu, choose *Zoom Extents*, then choose *Zoom Out*.

With everything selected, choose *Copy* from the *DRAW* menu. Left click at points 1 and 2, then right click to end the command.

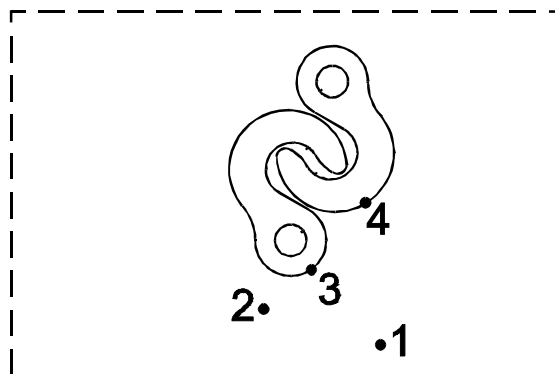
Notice that the original is still selected, not the new copy. To have the copy selected instead, you can choose *Undo* then *Redo* from the *EDIT* menu.

From the *EDIT* menu choose *Rotate*. Left click at point 3; then type “180” and Enter.

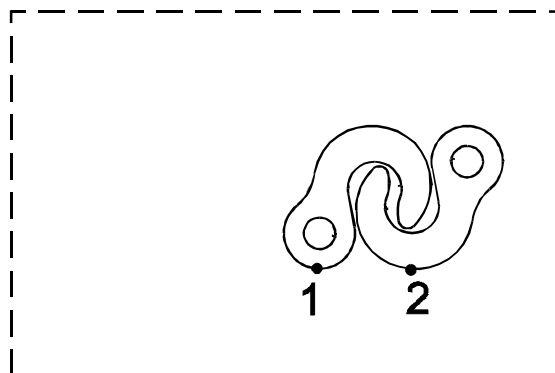


From the *EDIT* menu, choose *Move*. Left click at points 1 and 2. (The goal is to position the second hook inside of the first without them intersecting).

Drag a selection window around everything, so that both hooks are selected. From the *EDIT* menu, choose *Rotate*. Left click at point 3. Activate *Tangent Snap*, then left click at point 4. Type “0” and Enter.



Press Spacebar to repeat *Rotate*. Activate *Quadrant Snap* and left click at point 1. Activate *Tangent Snap* and left click at point 2. Type “0” and Enter.



From the *VIEW* menu, choose *Zoom Table*.

From the *EDIT* menu, choose *Move*. Activate *Quadrant Snap* and left click at point 1. Activate *Table Edge Snap* and left click at point 2 (on the edge of the cutting area).

Press Spacebar to repeat *Move*.

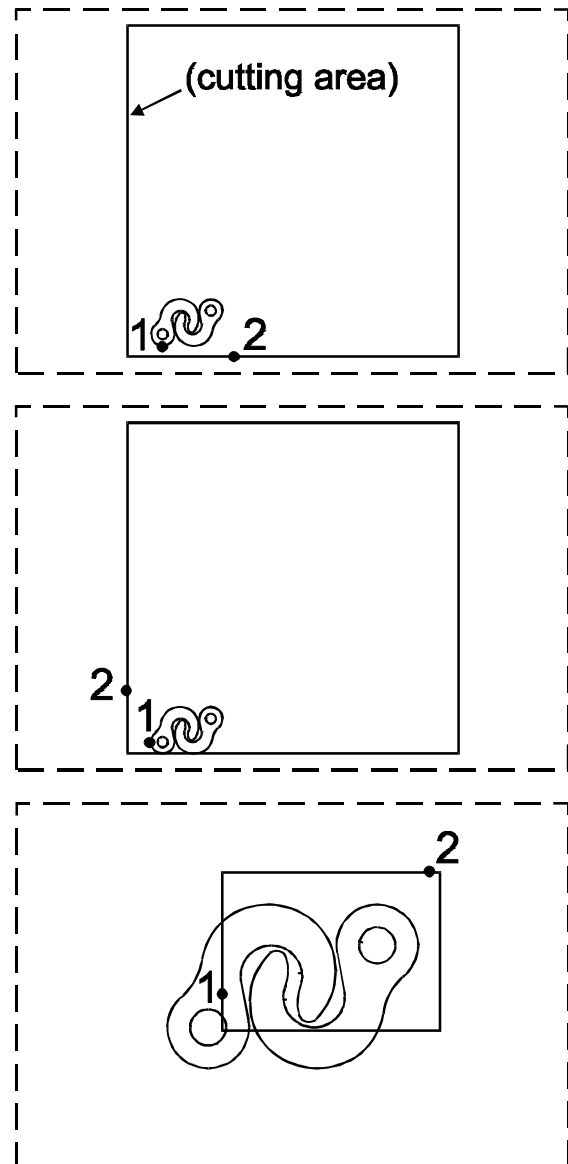
Activate *Quadrant Snap* and left click at point 1. Activate *Table Edge Snap* and left click at point 2 (on the edge of the cutting area).

From the *VIEW* menu, choose *Zoom Extents*. Then choose *Zoom Out*.

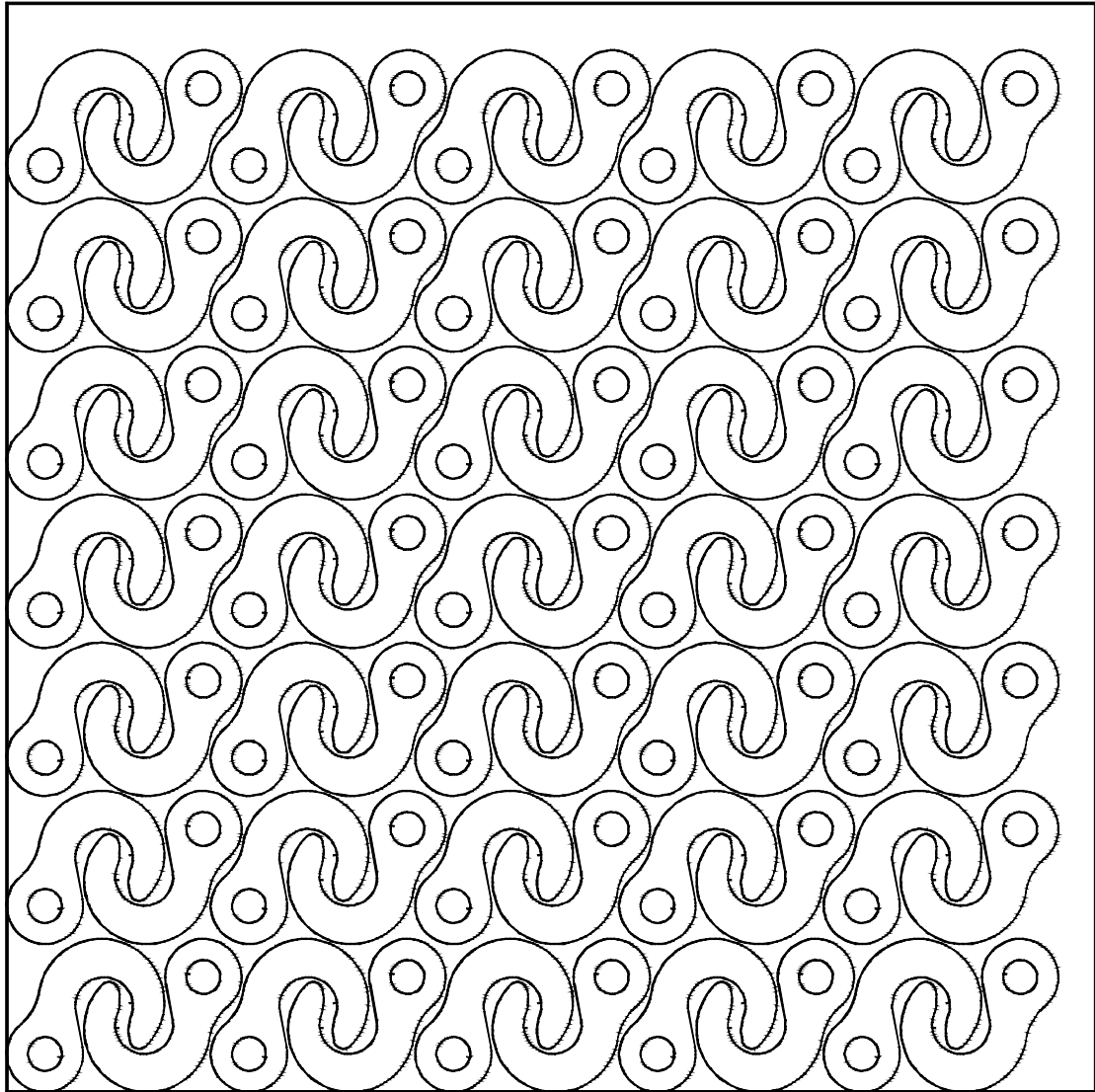
Select all parts of the hooks (drag a selection window).

From the *DRAW* menu, choose *Array*. Make sure that **Rectangular** is checked. Type “5” at **Number of horizontal copies** and “7” at **Number of vertical copies**. Next click the **OK** button. Left click at points 1 and 2, so that the next copies lie just to the right and top of the originals.

From the *VIEW* menu, choose *Zoom Table*.



Notice that a large number of hooks are well arranged for cutting:



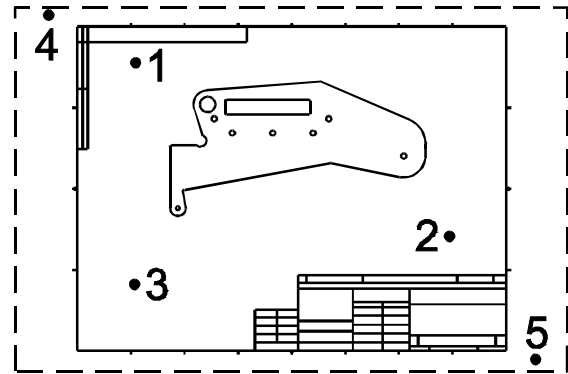
## Importing and Converting a Drawing

From the *FILE* menu, choose *New*; then choose *Import*. Make sure that “Autocad DXF files” is chosen from under **Files of type**. In the directory “Program Files\PlasmaCAM\Examples” (can be accessed from the “Examples” shortcut on the start menu) find and select the file “Side Plate.dxf”. Then click the **Open** button.

Drag a selection window around the shape within the drawing (drag from points 1 to 2). From the *EDIT* menu, choose *Move*. Left click at point 3 and then at point 1 to move the shape out of the drawing block.

Drag a selection window around the drawing block, from point 4 to point 5. From the *EDIT* menu, choose *Delete*.

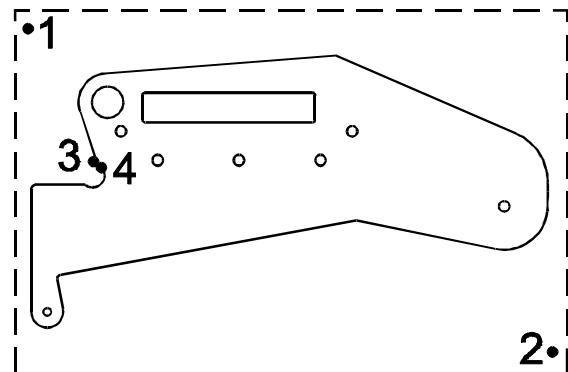
From the *VIEW* menu, choose *Zoom Extents*.



Drag a selection window around the entire shape, from points 1 to 2. From the *EDIT* menu, choose *Link*.

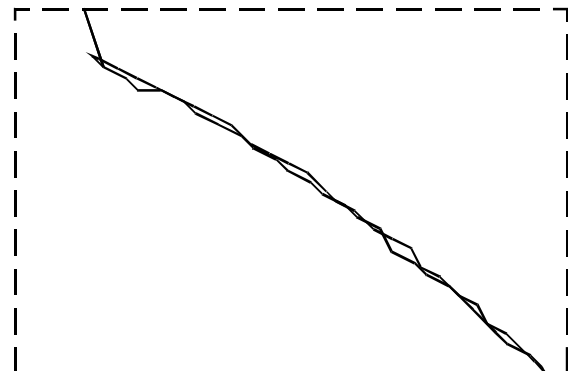
From the *MACHINE* menu, choose *Detect Intersections*. Notice that thousands of intersections are found.

From the *VIEW* menu, choose *Zoom Window*. Zoom in to closely examine the part perimeter (left click at points 3 and 4, repeat the command as needed).



Under close examination the shape appears very crude, with multiple overlapping jagged edges and gaps between pieces.

From the *SETTINGS* menu, choose *Settings* (or press Tab). Change **Gap distance to jump** to “0.01”. Change **Delete overlapping segments within** to “0.005.”



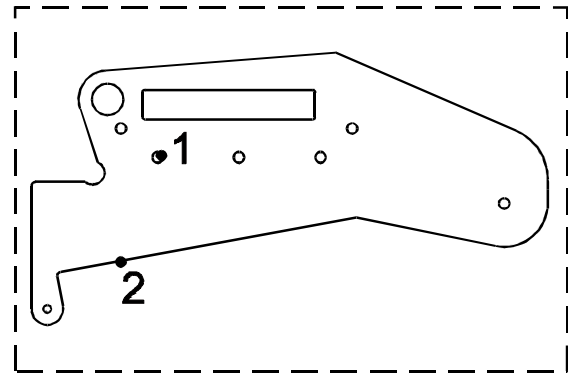
From the *VIEW* menu, choose *Zoom Extents*.

From the *EDIT* menu, choose *Undo* (take back *Link*).

Choose *Link* from the *EDIT* menu.

From the *MACHINE* menu, choose *Detect Intersections*. Notice that only a few intersections remain.

From the *VIEW* menu, use *Zoom Window* to magnify the area of heaviest intersections (point 1).



You can see that this path is one piece even though it intersects itself. From the *VIEW* menu, choose *Zoom Extents*.

Select the troublesome holes. Notice that the status bar reads “2 paths are selected.” From the *EDIT* menu, choose *Explode*. Now the status bar reads something like “214 paths are selected.” Everything selected has been converted into individual line segments.

From the *EDIT* menu, choose *Link*. Zoom in to the hole near 1 and draw a line to bridge the gap if it is still an open path, and *Link* again. Now everything is formed into complete closed paths that are free of intersections. Drag a selection window around all of the paths to select them. Although the shape is now properly joined together, you may have noticed that it is still made up of dense rough edges. If you select everything, the status bar reads something like “10 paths are selected (3591 nodes)”.

From the *EDIT* menu, choose *Smooth*. Type “.0007” and Enter. Now notice that the status bar reads something like “10 paths are selected (502 nodes total).” The number of nodes (and hence computer memory) required to store the shape has been reduced by almost 90%. The new smoothed shape is accurate to the original shape within  $\pm 0.0007$  inch (or whatever else you enter). *Smooth* also removes fine choppiness as it simplifies shapes. You will notice the improvement if you zoom in for a close look at any of the circles or arcs.

To prepare the part for cutting, choose *Convert to Cut Path* from the *MACHINE* menu (make sure nothing is selected first). Left click just on the outside edge of the perimeter where you want the cut to begin. The entire shape should be converted to cut paths.

Use *Cut Preview* from the *MACHINE* menu to see how the part will cut (click the **OK** button to preview).

Remember to change the linking settings (under *Settings* from the *VIEW* menu) back to what they were previously. Change **Gap distance to jump** to “.005” and change **Delete overlapping segments within** to “0” to disable.

## Importing and Converting a Picture

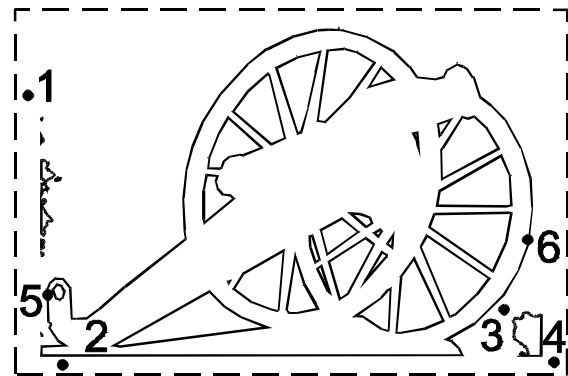
From the *FILE* menu, choose *New*; then choose *Import*. Make sure that “Bitmap files” is chosen from under **Files of type**. In the directory “Program Files\PlasmaCAM\Examples,” find and select the file “Cannon.bmp”. Then click the **Open** button.

A dialog box appears showing a preview of the cannon picture. (This file was made by scanning an actual photograph in black & white or line art mode.) Select white as the background color either by left clicking the white button or by left clicking over the white area of the preview. Click the **Next** button.

Enter “10” for the **Max speckle width** and “0.75” at Smoothing (pixels). Click the **Next** button.

Select the obvious fragments to erase. Drag a selection window from point 1 to point 2. Hold Ctrl and drag a selection window from point 3 to point 4. From the *EDIT* menu, choose *Delete*.

Select the entire shape by dragging a selection window from one corner of the screen to the other. To enlarge the cannon to a length of about two feet, choose *Scale* from the *EDIT* menu. Left click at point 5 and at point 6. Type “24” and Enter.



From the *VIEW* menu, choose *Zoom Out*.

From the *EDIT* menu, choose *Move* and move the shape so that it lies within the cutting area. (You can type “@2.5,3.5” and Enter for the second move point if you are not sure how to do this.)

From the *VIEW* menu, choose *Zoom Extents*. Notice that some of the shape—especially near the top of the cannon—consists of rough edges. This is because the top part of the picture was somewhat fuzzy.

Choose *Select*. Click **Path length** and click to select the first item in the list. Likewise, the smallest apparent hole in the cannon shape is shown in green, indicating that it is selected. You can experiment by selecting other items from the list and watching as the corresponding shapes turn green in the drawing. This shows that there are no remaining little pieces left in the drawing that are not supposed to be there. Click the **OK** button.

Again select the entire drawing and choose *Smooth* from the *EDIT* menu. Type “0.01” and Enter. Repeat *Smooth* and again type “0.01” and Enter. Notice that much of the unwanted fuzz has been removed from the image.

Use *Zoom Window* from the *VIEW* menu to magnify the upper part of the cannon's main wheel.

On the *SETTINGS* menu, make sure that *Snap to Nodepoint* is checked, and that *Snap Orthogonal* and *Snap to Grid* are unchecked.

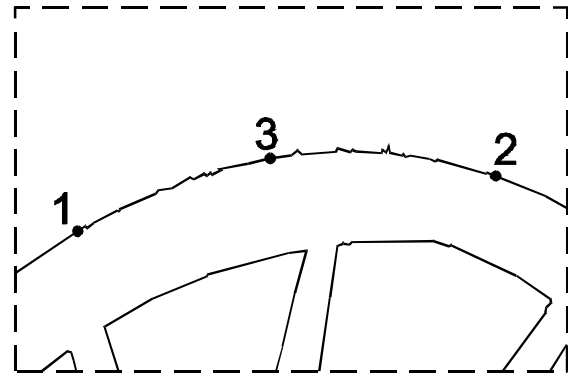
From the *DRAW* menu, choose *Bulge*. Left click at points 1 through 3.

From the *EDIT* menu, choose *Break*. Left click just to the left of point 1 and just to the right of point 2. Right click to end *Break*.

Select the fuzzy shape, not the new arc just drawn (left click near point 3).

From the *EDIT* menu, choose *Delete*.

Select the new arc and choose *Link* from the *EDIT* menu.

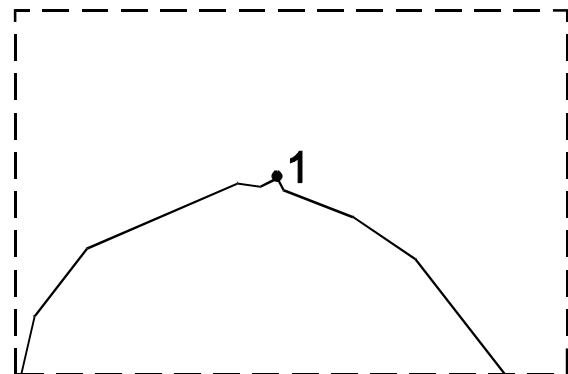


From the *VIEW* menu, choose *Zoom Extents* then *Zoom Window* to magnify the front of the cannon barrel as shown.

Make sure that nothing is selected.

From the *EDIT* menu, choose *Edit Path(s)*. Left click near point 1. Then press the Delete key. (This removes the small glitch from the shape.)

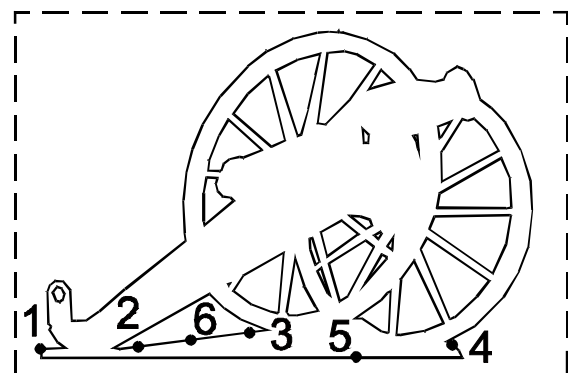
Experiment with *Edit Path(s)* by holding Ctrl and pressing the arrow keys.



From the *VIEW* menu, choose *Zoom Extents*.

From the *EDIT* menu, choose *Break*. Left click at points 1 through 4. Right click to end the command.

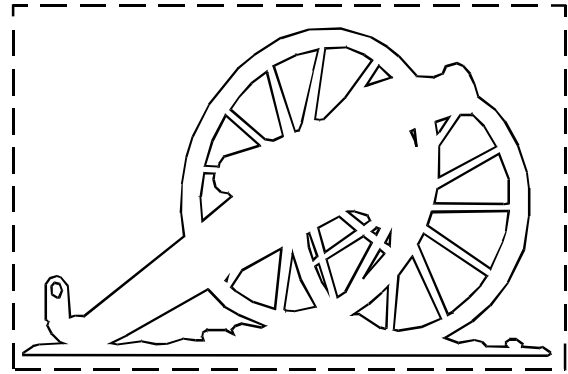
Select the bottom pieces (left click at point 5; then hold Ctrl and left click at point 6. From the *EDIT* menu, choose *Delete*.





Zoom in close to the bottom edge of the cannon. Then free-hand draw some realistic ground as shown using *Line(s)* from the *DRAW* menu. (Right click to end the command.)

Note that you can do zoom commands during other commands by pressing the keyboard shortcuts. Pan around the drawing using the arrow keys. Also experiment with *Zoom Window* and *Zoom Extents* while you are drawing in the lines.



The lines that you draw should connect exactly to the endpoints of the cannon perimeter (because of *NodePoint Snap*), and the drawing should not contain overlapping lines or intersections between lines—only what is required to complete the perimeter and lower hole as shown.

Before drawing the second point of the main bottom segment, activate *Orthogonal Snap* so that it is drawn horizontal.

When you are done drawing the ground, select the new shapes and choose *Link Segments* from the *EDIT* menu. The entire drawing should then be made up of closed paths, which are purple (unselect everything).

Finally, choose *Convert to Cut Path* from the *MACHINE* menu. Left click just outside of the perimeter where you want the cut to begin. The entire shape should be converted including all of the holes.

Note, this example does not demonstrate the ability to recognize arcs during the smoothing of a bitmap image. You may want to repeat this example, using arc recognition for a more rounded image.

Remember to change the linking settings (under *Settings* from the *SETTINGS* menu) back to what they were previously.

## Building a Computer Enclosure

*This project is no longer recommend for a modern computer. A simpler stand should suffice (if you provide adequate ventilation/filtration for the machine). We suggest doing this tutorial in the software for instructional purposes only—without actually cutting and building the project.*

This example project shows you how to build a filtered computer enclosure using the cutting table and a sample file. In order to make this project, you will need basic tools including a socket set and a box and pan brake. You will also need the following materials:

- (1) 4ft by 10ft sheet of 20 gauge steel
- (1) 25" by 29" piece of 10 gauge steel, optional (if you want to build the legs also)
- (50) #10 by 1/2" hex head self-tapping sheet metal screws
- (2) 16" by 19 1/2" air conditioner air filters
- (1) power strip (with surge suppresser)
- (1) 110 VAC fan, part # CR126-ND from Digi-Key Inc. 800-344-4539 for \$24.86, or like
- (1) 110 VAC power cord (safely wire to fan)

This project is fairly complex and should only be attempted by those who are experienced with sheet metal work and feel confident about building the project. Do not attempt the project until after you have become fairly familiar with the software and how to operate the machine. Some of the part geometry may have to be adjusted if the enclosure is to house an unusually sized PC.

### Cutting the Shapes

Follow the instructions given in **CHAPTER 5** for setting the torch geometry and timing. Verify that the kerf width of your torch is the number shown at **Cutter kerf width (twice offset distance)** under **Offset/Convert** of *Settings*, from the *SETTINGS* menu. Also, the **Cutter Location Adjustment** must be correctly set under **Machine Control**.

From the *FILE* menu, choose *Open*. In the directory "Program Files\PlasmaCAM\Examples," find and select the file "PC Enclosure.pcm". Then click the **Open** button.

All of the shapes needed to make the computer enclosure are carefully placed within a 4ft by 10ft area. (Except the legs, which you should select and *Delete* if you are not going to make them.)

The upper six parts are easiest to cut, so they will be cut first.

Select the entire drawing. From the *EDIT* menu, choose *Move*. Left click anywhere on the screen. Then type "@0,-72" and Enter. This moves everything down by 6ft so that the upper six parts can be cut within the table area.

Unselect everything in the drawing. From the *VIEW* menu, choose *Zoom Table*.

From the *MACHINE* menu, choose *Convert to Cut Path*. Left click just outside the perimeter of each of the upper six shapes, where you want the pierce points to be located. Use the zoom commands as necessary (even during *Convert to Cut Path*). When converting, be careful not to click inside the edge of a perimeter; this will cause the shape to be offset toward the inside.

The upper six shapes should all be blue now when not selected, including the holes. This signifies that the shapes are now actual cut paths. From the *FILE* menu, choose *Save As* to save the drawing as a new, temporary filename (otherwise you may overwrite the original file).

Position the sheet of metal on the cutting table, against the grate stops so that the upper shapes are cut out of the upper end of the sheet as shown on the computer screen (see figure below).

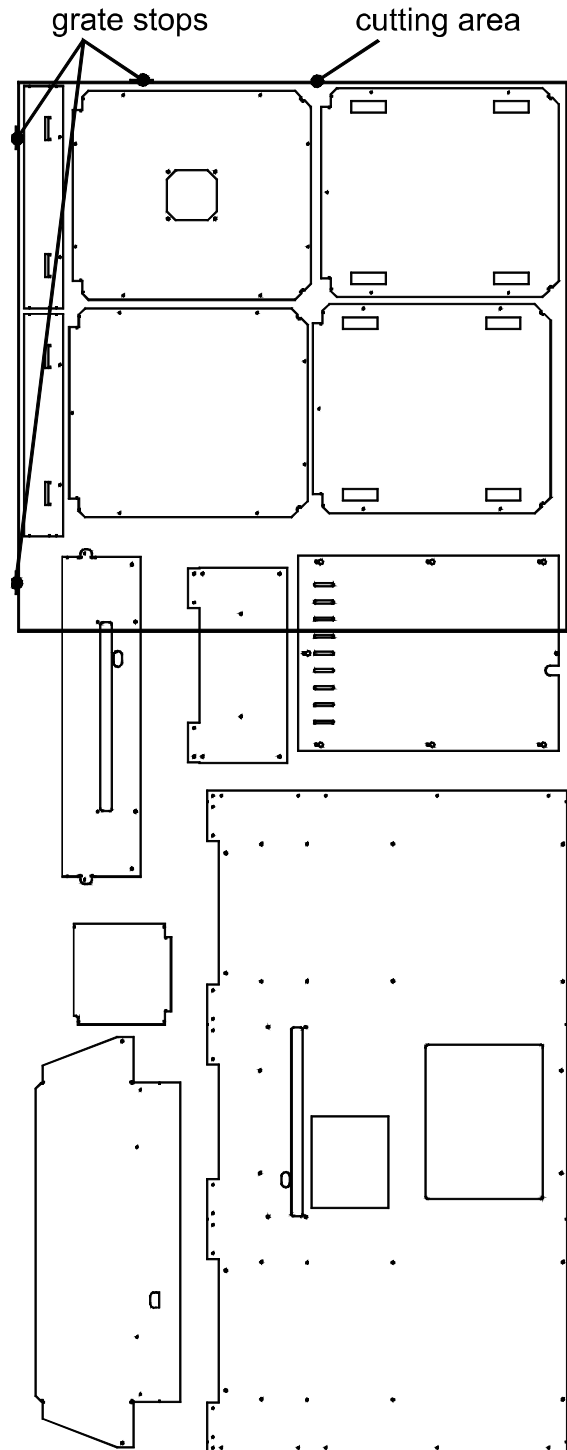
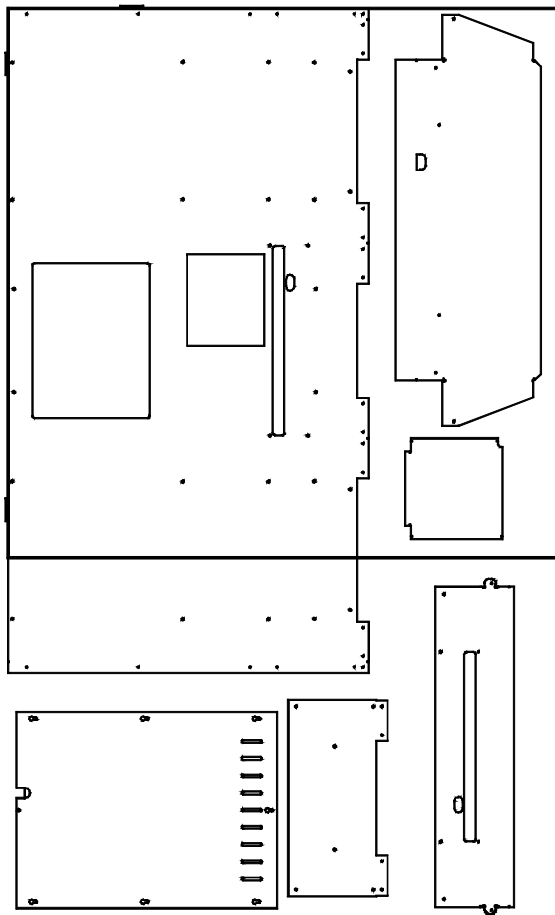
When the machine is ready, select one or more of the upper six shapes and choose *Cut* from the

*MACHINE* menu. (Drag a selection window around the shapes; this will also select the holes which have to be cut first.)

After the upper six shapes have been cut out of one end of the sheet as shown at right, select and delete them. (Drag a selection window around the shapes and choose *Delete* from the *EDIT* menu.)

Use *Select All By* from the *VIEW* menu to select everything in the drawing.

Choose *Rotate* from the *EDIT* menu. Type “24,-12” and Enter (this is the center of the 4ft by 10ft area). Type “180” and Enter.



Unselect everything and choose *Convert to Cut Path* from the *MACHINE* menu. Left click just outside the perimeter of each of the three shapes that lie within the cutting area (shown above left), where you want the pierce points to be located. (Click **Yes** to convert the large shape, even though you will not cut it as one piece; the pierce point location does not matter.)

Carefully remove the sheet from the machine and swing it end-for-end. Load the sheet into the machine again, making sure that it is securely positioned against the three grate stops.

Drag a selection window around the entire cutting area (only). Notice that this selects some of

the holes within the large shape, but not others. From the *MACHINE* menu, choose *Cut*. Again drag a selection window around the cutting area. This selects only the shapes that were just cut. Hold Ctrl and unselect the largest hole (a rectangle). Then choose *Delete*.

From the *VIEW* menu, choose *Zoom Extents*. Also check *Snap to Nodepoint* from the *SETTINGS* menu.

From the *EDIT* menu, choose *Break*. Left click at points 1 and 2. Right click to end.

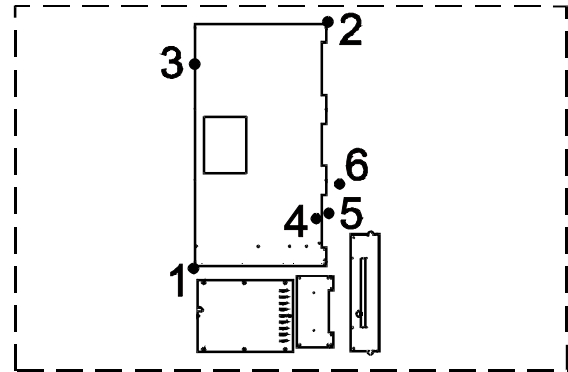
Left click at point 3 and choose *Delete*.

Choose *Rectangle* from the *DRAW* menu and left click at points 1 and 6.

Unselect the rectangle and use *Convert to Cut Path* to convert it (this also reconverts the holes on the inside). Select only the rectangle and choose *Delete*.

From the *EDIT* menu, choose *Offset*. Type in  $\frac{1}{2}$  the kerf width of the torch (as mentioned under *Cutting the Shapes* above) and left click at point 5. Right click to end *Offset*.

From the *VIEW* menu, choose *Zoom Window*. Left click at points 4 and 5 (around table edge).

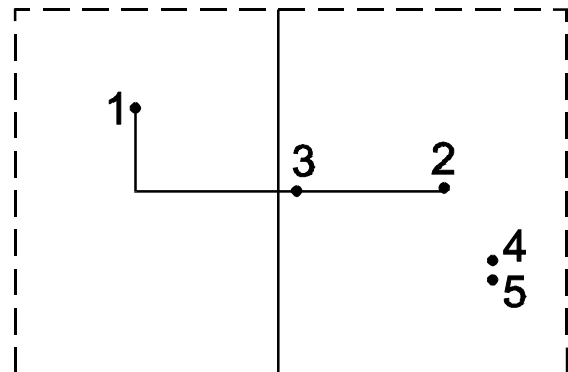


From the *DRAW* menu, choose *Line(s)*. Left click at point 1. Activate *Table Edge Snap* and left click at point 1. Activate *Orthogonal Snap* and left click at point 2. Right click to end the command.

From the *EDIT* menu, choose *Trim*. Left click at point 1. Right click to end *Trim*.

From the *EDIT* menu, choose *Scale*. Left click at point 3 then 2. Type “0.15” and Enter.

From the *DRAW* menu, choose *Copy*. Left click at point 4. Activate *Snap Orthogonal* and left click at point 5. Right click to end *Copy*.

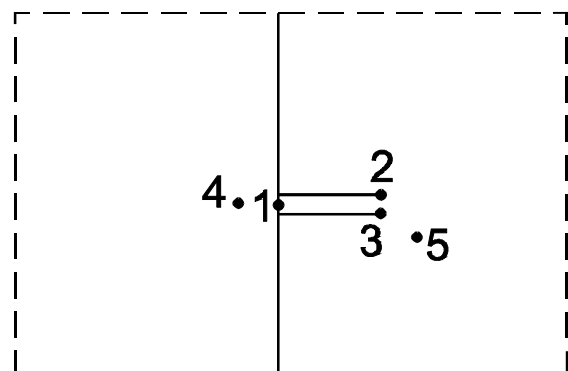


From the *EDIT* menu, choose *Trim*. Left click at point 1. Right click to end *Trim*.

The vertical lines should be selected; from the *EDIT* menu, choose *Link*.

Unselect everything in the drawing. From the *MACHINE* menu, choose *Convert to Cut Path*. Left click at points 2 and 3.

From the *EDIT* menu, choose *Stretch Points*. Left click at points 4, 5, 3 and 2.

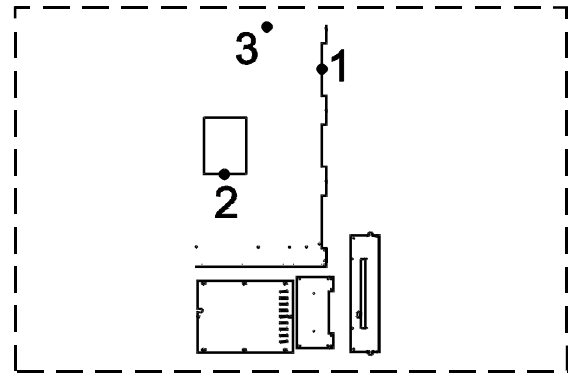


From the *VIEW* menu, choose *Zoom Extents*. Notice that only half of the perimeter of the large shape is left and that it is broken up into two cut paths.

Select the upper part of the perimeter (left click at point 1) and choose *Cut* from the *MACHINE* menu.

After the shape cuts, choose *Delete* from the *EDIT* menu.

Select everything in the drawing. From the *EDIT* menu, choose *Move*. Left click at point 2. Activate *Table Edge Snap* and left click at point 3.



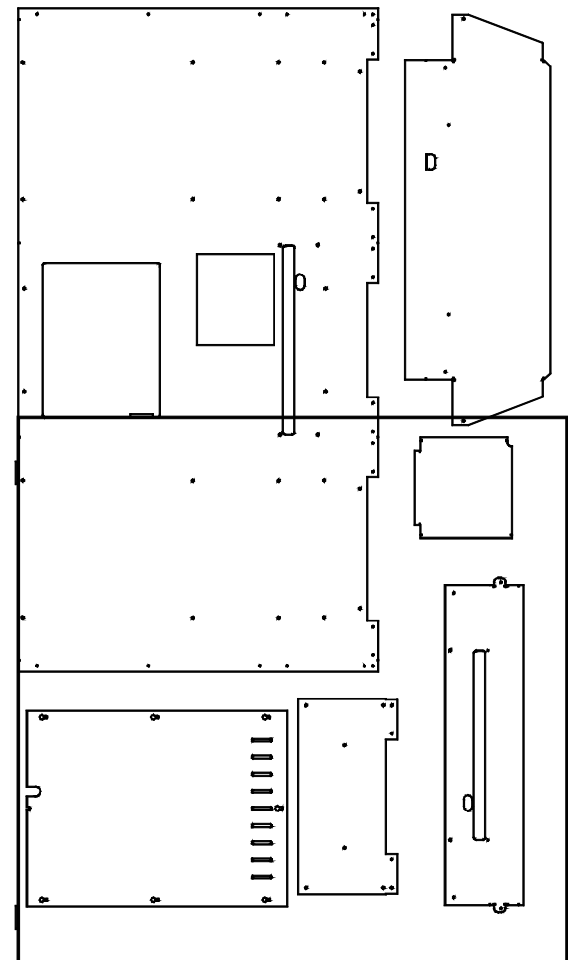
Lift and slide the sheet down the cutting table so that the edge of the large rectangular hole presses against the end grate stop, as shown. The sheet must be very carefully positioned against the grate stops so that the large shape is cut accurately.

With everything unselected in the program, choose *Convert to Cut Path* from the *MACHINE* menu. Convert the 3 complete shapes that remain to be cut at the lower part of the drawing.

Select everything in the drawing and choose *Cut* from the *MACHINE* menu.

Note that this example shows how to manually break up large shapes for cutting in separate cut subareas. See *Convert to Cut Path* in **CHAPTER 6** for information on how to have this done automatically.

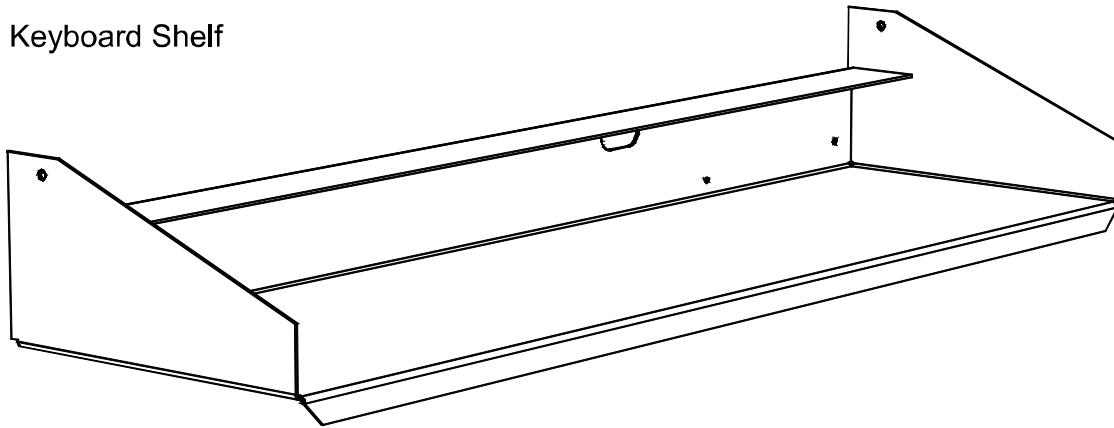
After you cut the shapes, remove the slag and deburr them. You may also need to counter-drill all of the holes of the smallest size so that they can be threaded by the sheet metal screws (experiment).



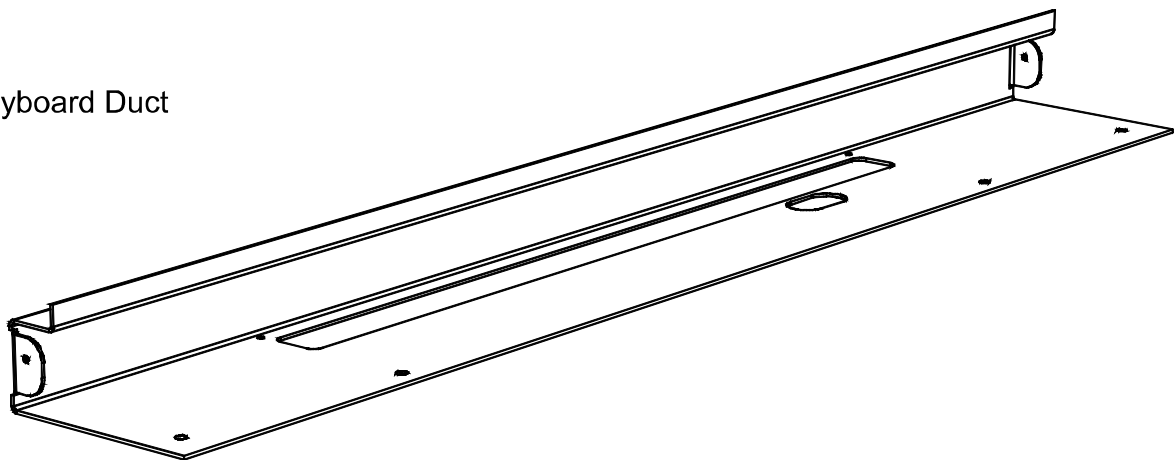
### ***Bending the Shapes***

Notice that most of the shapes have small grooves cut in various places along the edges. These grooves indicate where the bends need to be made. Use a box and pan brake to bend all of the pieces as required (90 degrees with 1/16 inch radius on all bends). The following illustrations show what the parts should look like after bending (except the two back panels, which are not bent):

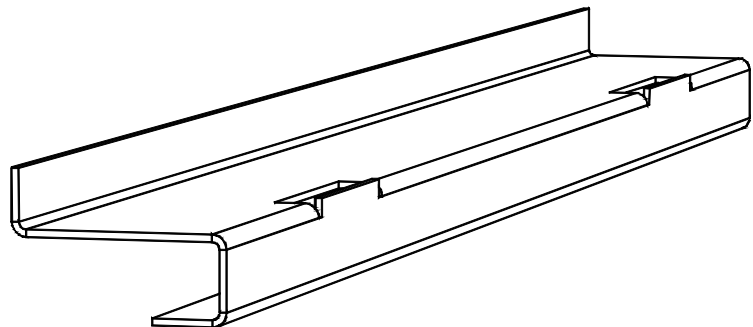
Keyboard Shelf



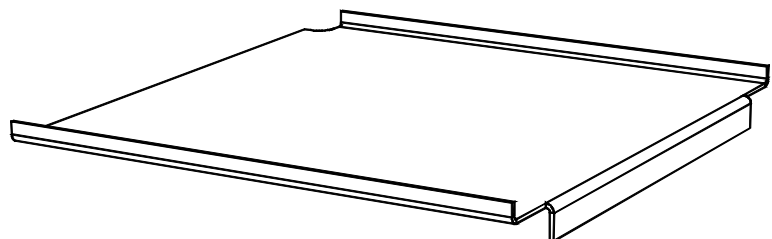
Keyboard Duct



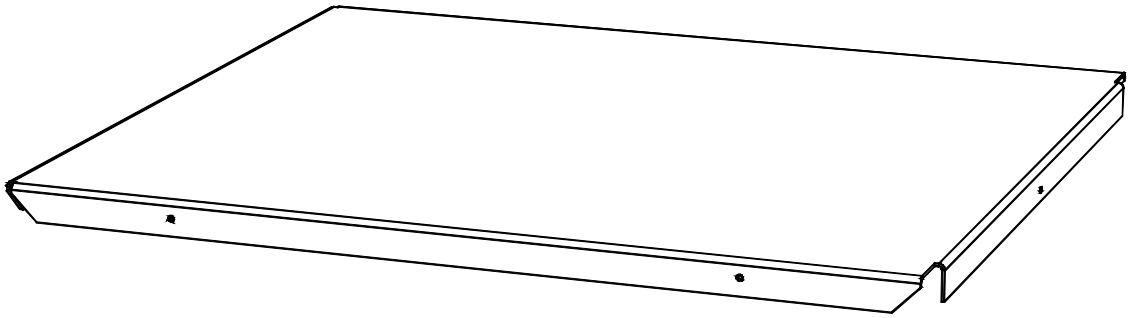
Filter Bracket (2)



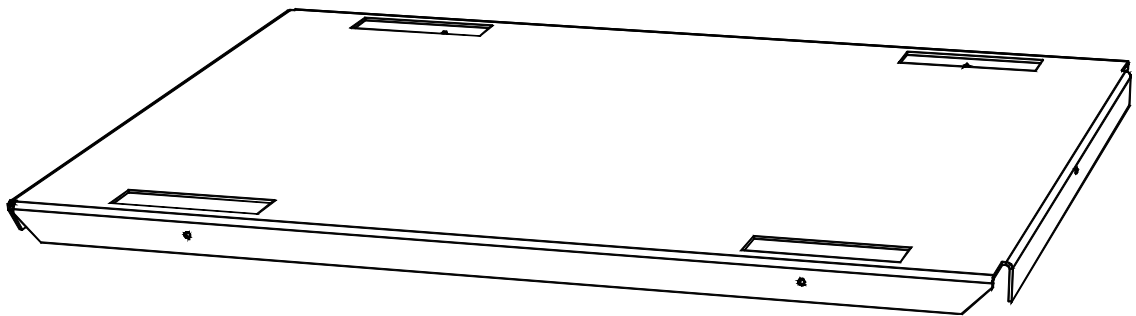
CPU Door



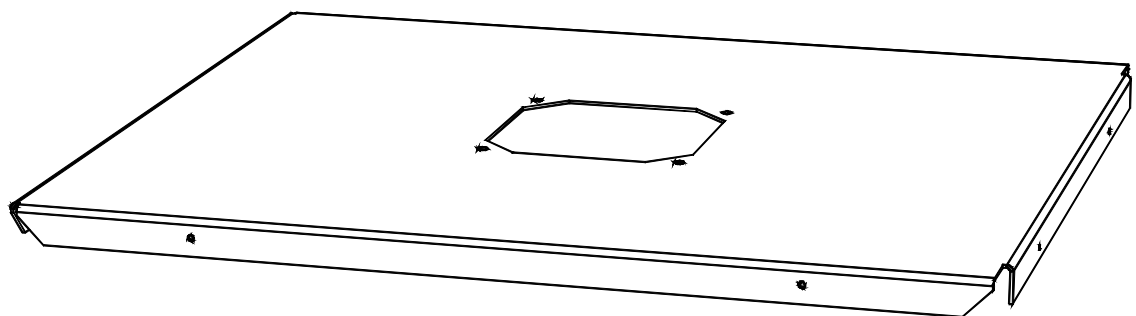
Top Cover



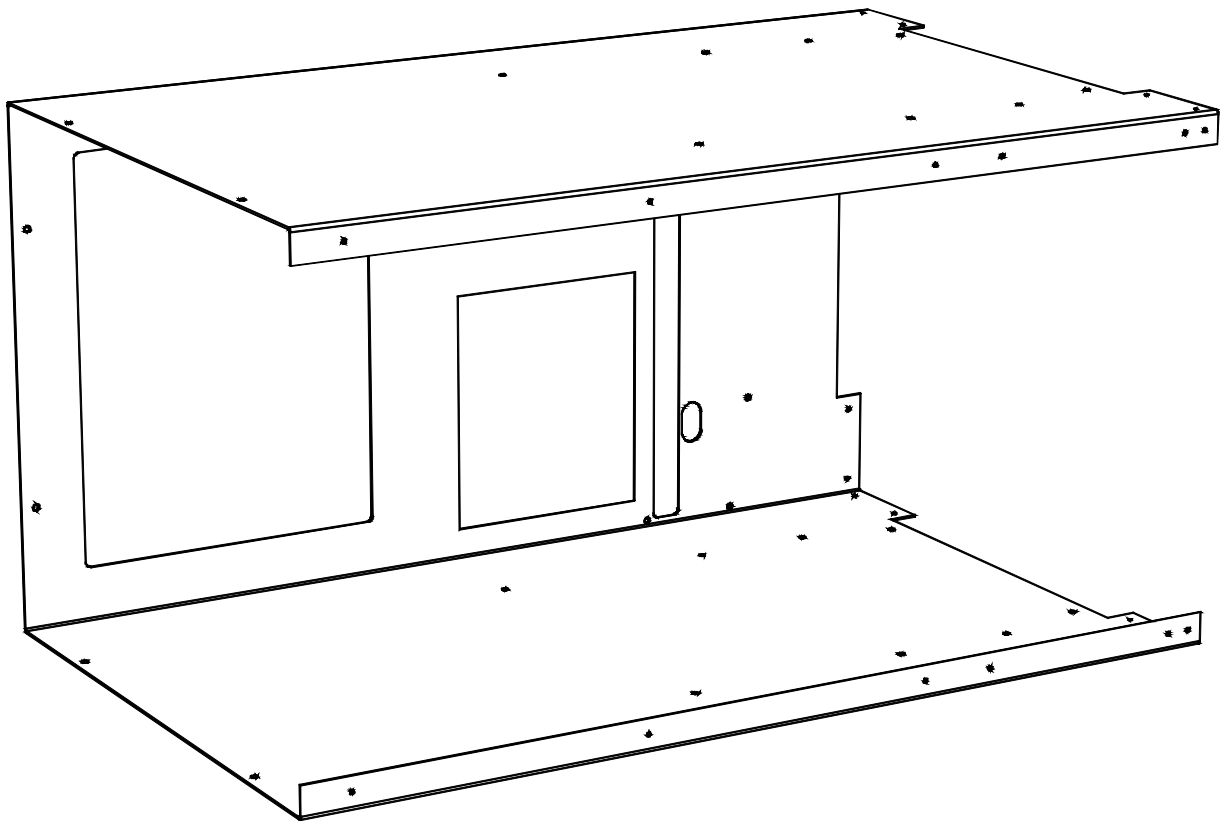
Middle Shelf (2)



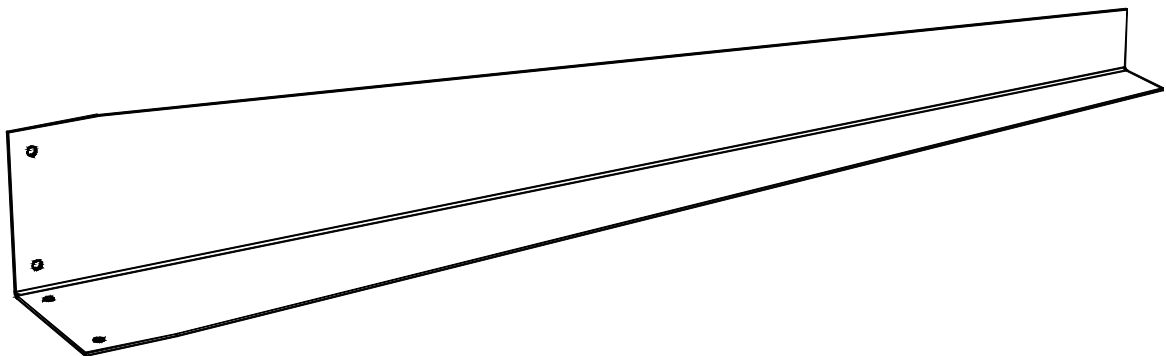
Fan Shelf



Main Cabinet



Optional Legs (4)

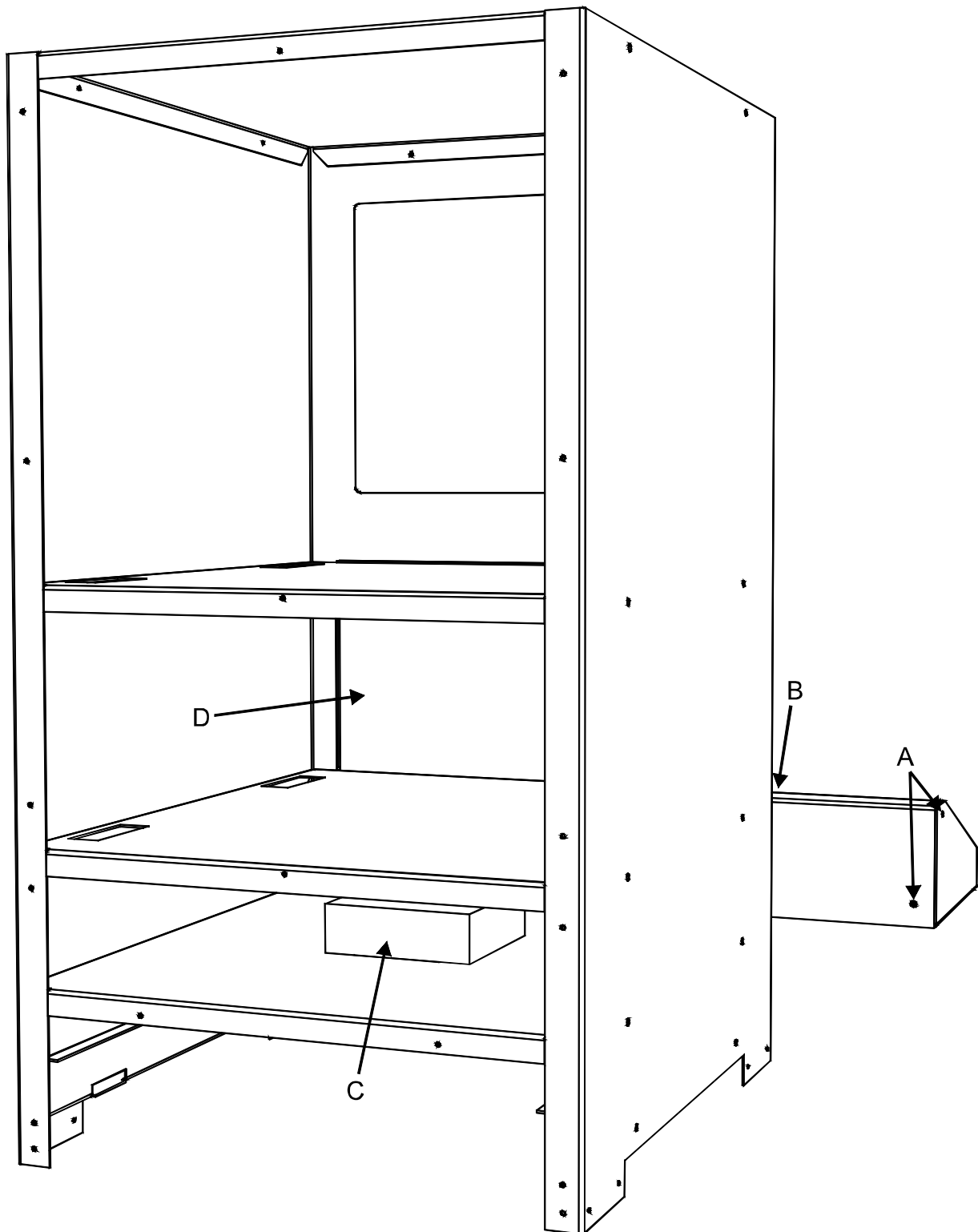




## ***Assembling the Shapes***

### **Keyboard Shelf**

Screw together the two halves of the external keyboard shelf as shown below using four screws,



driven through the holes at **A**, from the outside. Then screw the shelf to the main cabinet with four screws that are driven into the shelf from the inside of the cabinet, near **B**. The shelf should now be firmly attached to the cabinet.

### **Filter Brackets**

Screw the two filter brackets to the inside bottom of the cabinet, as shown. Each bracket is held by two screws, driven in from the outside of the cabinet.

### **Inner Shelves and Door**

Bolt the fan (at **C** above) to the lower fan shelf as shown. (The fan should already be safely wired to a power cord.) Screw the fan shelf in place inside the cabinet using four screws that are driven in from the outside of the cabinet, at the sides.

Set the sliding door (at **D** above) in place and screw in the two middle shelves using four screws each, driven in from the outer sides of the cabinet. Note that the door must be properly positioned before the shelves can be installed. You may also need to insert your computer's CPU before putting in all of the screws for the top shelf (paint everything first if this is the case).

Screw in the top cover using six screws that are driven in from the outside of the cabinet, at the sides and front.

### **Back Panels**

Screw the lower back panel to the cabinet and fan shelf as shown below using six screws (the lowest holes are reserved for the optional legs).

The main back panel is held in place and made easy to remove as shown below by eight screws which are driven only about half way into the back of the cabinet. The installed panel can be removed simply by lifting it and pulling it off of the enclosure.

### **Legs**

The optional legs can be attached to the main cabinet using four screws each. These screws are driven through the legs and into the 16 lowest holes on the cabinet and lower back panel. If the legs are not built and installed, the cabinet can simply rest on a table.

### ***Finishing the Cabinet***

When you are done assembling the cabinet, paint the outside of it.

Install your computer on the inside, carefully routing the wires through the holes that are provided. The keyboard shelf has been designed to hold both a standard keyboard and a mouse pad. The slot in the main back panel allows the power cords and parallel port cable to exit the cabinet.

Attach the power strip to the side of the cabinet using double-stick foam. You can use the power strip to switch on the computer, monitor, cabinet fan, and cutting table all at the same time.

