Golden Ratio Gauge

Using Carbide Create to Create a Golden Ratio Gauge

I will demonstrate how to create a project to cut out a Golden Ratio Gauge using Carbide Create. I will be using version 652. As time goes by the Carbide Create versions may update but the basics of this procedure should work. You will need to modify the setup and sizes depending on what machine you have. I used a Shapeoko 3 XXL. If you have an XL you will need to turn the project 90 degrees. If you have a Standard you will have to resize the project to fit your machine. In the examples I will give you the math to figure out so you can make multiple sizes of the Golden Ratio Gauge. That will be covered in how to construct the four pieces of the gauge.

Why do I need a Golden Ratio Gauge? Well using a Golden Ratio Gauge will help you in designing projects in your shop. Using the Golden Ratio to design signs, wall hangings, art and practical objects will help make them ascetically pleasing to the human eye. Having the Golden Ratio Gauge you can investigate the things all around you to see if they conform to the Golden Ratio. Plus I think it is a fun project to create. Below I will help you design a Golden Ratio (Fibonacci) Gauge in both wood and Aluminum.

I used #6-32 X ¾” screws with nylon nuts and washers under each bolt bottom and nut. I used a wing nut on the top position so you can lock the gauge. You need to secure the bolt with the wing nut using super glue or something to keep it from turning when tightening the wing nut. The nylon nuts will allow you to tighten the gauge over time in case it gets loose.

List of Material Needed:

4 #6-32 ¾” Screws (I drilled 1/8” holes so the #6-32 screws fit snugly in the holes.)

8 #6 Washers

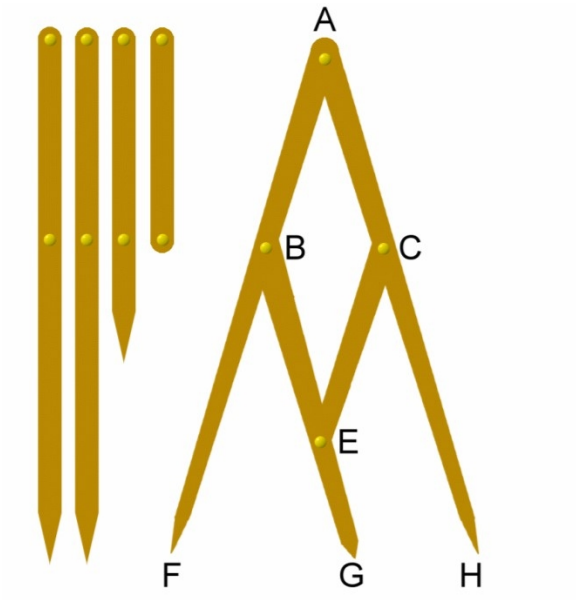
3 #6-32 Nylon Nuts

1 #6-32 Wing Nut

Reliabilt Kickplate #0311933 6” x 30” (For Alumniumn Version)

Use material of your choice, however thinner is better but don’t make it too thin or the gauge will be able to break easily. I used some 0.178” Plywood. I. For the Alumniumn I found a bottom door kick plate to use. I found a 24X 24” sheet of aluminum in Lowes but it was $48.00 and bent up. I found the alumniumn kick plate in another department for $25.00 and in a protective wrap and a little longer than

I need but I intend on making a smaller Golden Ratio Gauge out of the excess. The material size needed is 18” X 5.5” for the project.



Long Arms Quantity 2 Length X + (X times 1.618)= Length

X	X times 1.618

Middle Arm Quantity 1 Length is X times 1.618=Length

X times 1.618

X Link Arm Quantity 1 X= Desired Length. All others measurements based on this.

X

Construction of Golden Ratio Gauge Parts In Carbide Create

Three are 4 parts to a Golden Ratio Gauge

1. The X . Where X is any number you choose and all other parts are based on this measurement. In the example to come X=6” which makes a Golden Ratio gauge that can measure up to about 24”. By varying X you can make smaller or larger gauges.

2. The Middle Arm. The middle arm is X times 1.618= length

3 & 4. Two Outside Arms. The two outside arms are calculated by X + (X x 1.618)=Length

The Golden Ratio is the length from the top center of the hole to the bottom of the arm. These measurements are the length of the Golden Ratio but you must add some length for the physical construction of the gauge that will be covered later.

On the two long arms and middle arm you will add .25” to the overall length. This is to compensate for the rounded ends on these 3 pieces.

On the X link arm you will add .5” to the overall length. This is to compensate for the two .5” rounded ends on the ends of the piece.

The Golden Ratio arm length are from the center of the top hole to the bottom of the 3 arms and the center of the two holes on the link arm. This will become clear when we get to the construction.

Material Setup in Carbide Create for Plywood Version

1. Open Carbide Create. Click on the Job Setup Window.

2. Set Height and Width of project. For this project it is 5.5” Width and 18” Height. If you are using a hardwood be sure to orient the grain so the arms of the gauge follow the grain. If you cut with the short grain going across the arms it will be weak and could break. Plywood I used does not matter but the long grain of the face veneer is running in the 18” direction for ascetics. So to orient your grain it may require to rotate the project 90 degrees to get the long grain to run parallel with the arms long dimensions.

3. Set the thickness of your material. Be sure to measure it with a digital caliper. Then set the Toolpath Zero location to your preference. I set it to top.

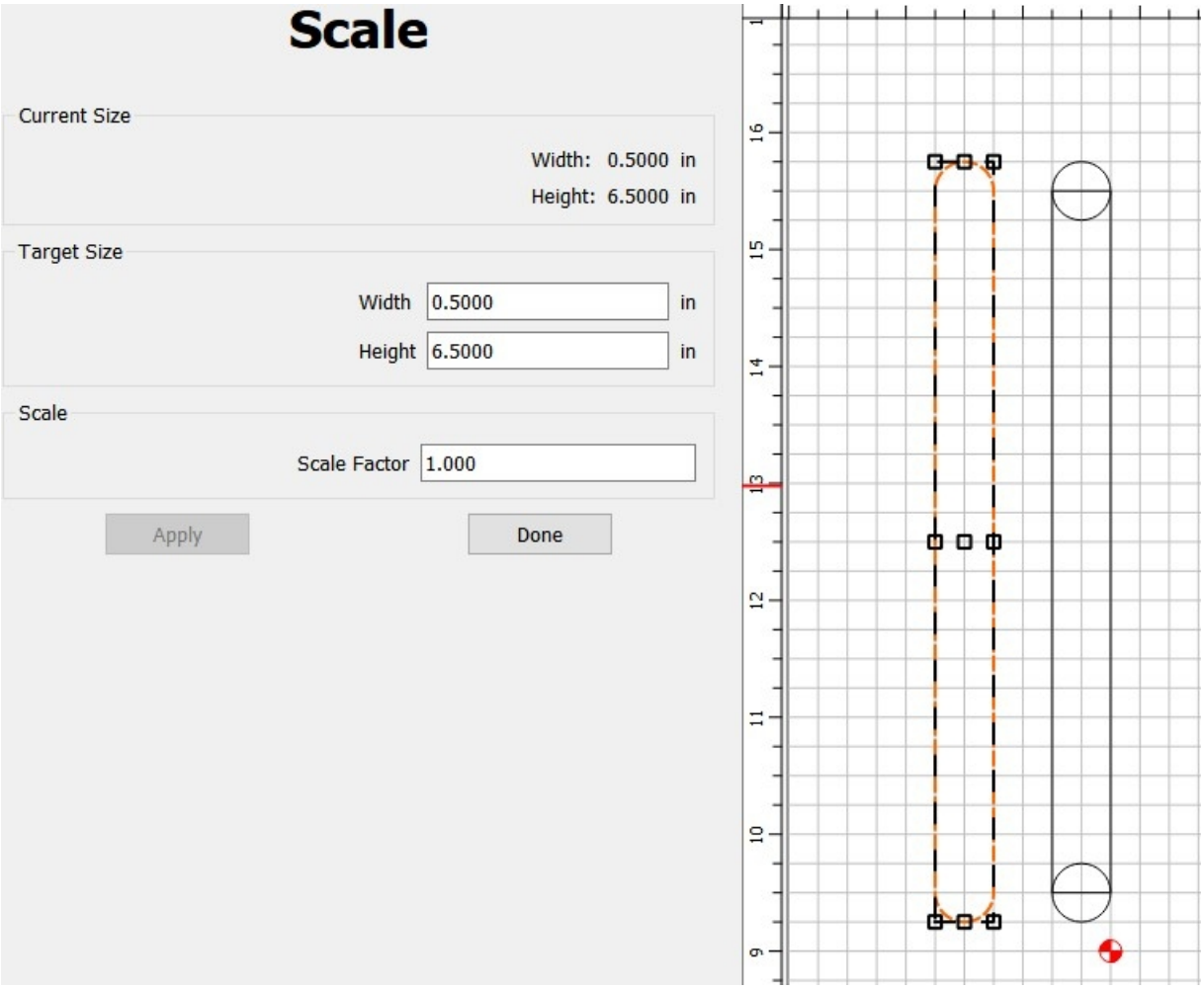
4. In the Job Setup set your material type, machine type, retract height and measurement unit. I am using inches. I set material type for softwood (plywood), Shapeoko 3, retract height for .5”, and inches for measurement. Change these parameters to your situation.

Construction of the 4 parts of the Golden Ratio Gauge

The X Link Arm Construction

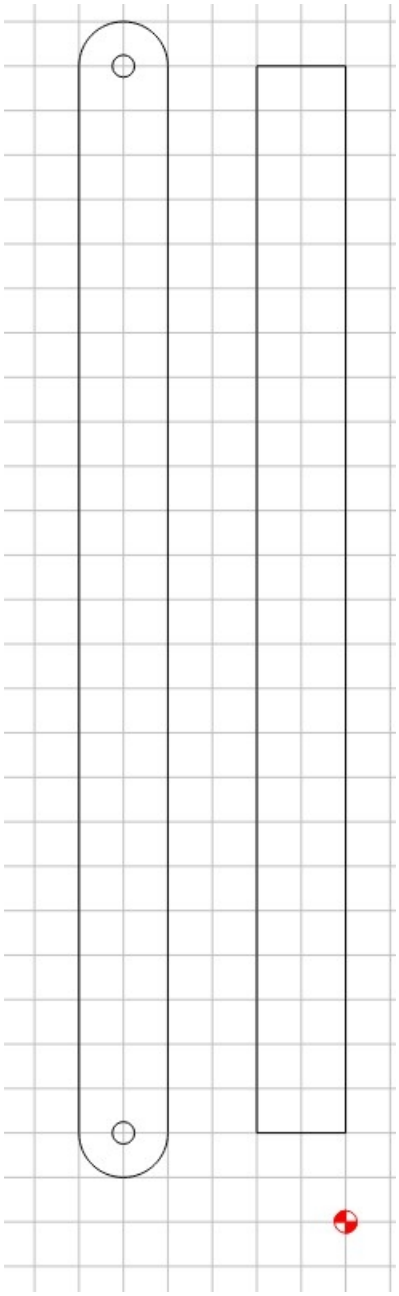
1. In the instructions I said X times 1.618 equals the Golden Ratio. The value for X is any value you want to make it. In this project X equals 6”. So all calculations are based on 6” x 1.618. To construct this gauge there are 1/8” holes and I rounded the ends of the two long arms and the middle arm and the X piece. So you have to compensate for this in the total length of the parts. In the case of the two long arms you add .25” to the Golden ration for the round end I added. On the middle arm you also add .25” to the Golden Ratio and .5” for the X piece because there are two 1/8” holes in it.

2. To start with we will construct the X piece which is 6” + .5” = 6.5”. I will construct several boxes to assist with alignment of all the parts. The first box is .5” x 6”. Then be sure you have set snap to grid in the View pull down. I set a .25” grid spacing to aid in assembling the parts of the pieces. Select the top left node of the rectangle and align it with the grid. This will aide in aligning the two .5” circles (radius .25”). Create two .5” circles (radius .25”). Move one of the circles to snap to grid so half of the circle is above and below the top of the rectangle. Then move the other circle to the bottom and let it snap to grid so half of the circle is above and below the bottom of the rectangle. The circles will be .25” above and .25” below their respective lines. Select all 3 objects and do a Boolean Union to create a new object that is 6.5” tall and .5” wide. Check this by selecting the Scale tool with the new object selected and you should see the measurements. For this object since it is an even number of .25” grid spaces it should work.



3. This created the X link that is .5” wide and 6.5 inches tall. I will add two 1/8” (0.0625” radius) circles in the center of what was the .5” (.25” radius) circles and that will make the X=6” X link part.

4. Here is the picture of the X link with the 1/8” holes that are exactly 6” apart on center. The rectangle next to the Link is for reference and is .5” wide by 6” high. X=6”. Be sure to select the two 1/8” holes and the X Link and group them. This is important so you don’t lose any of the parts when you move the object around so make the other 3 parts. Move the .5” x 6” rectangle off the material and save it for later in constructing the other parts.

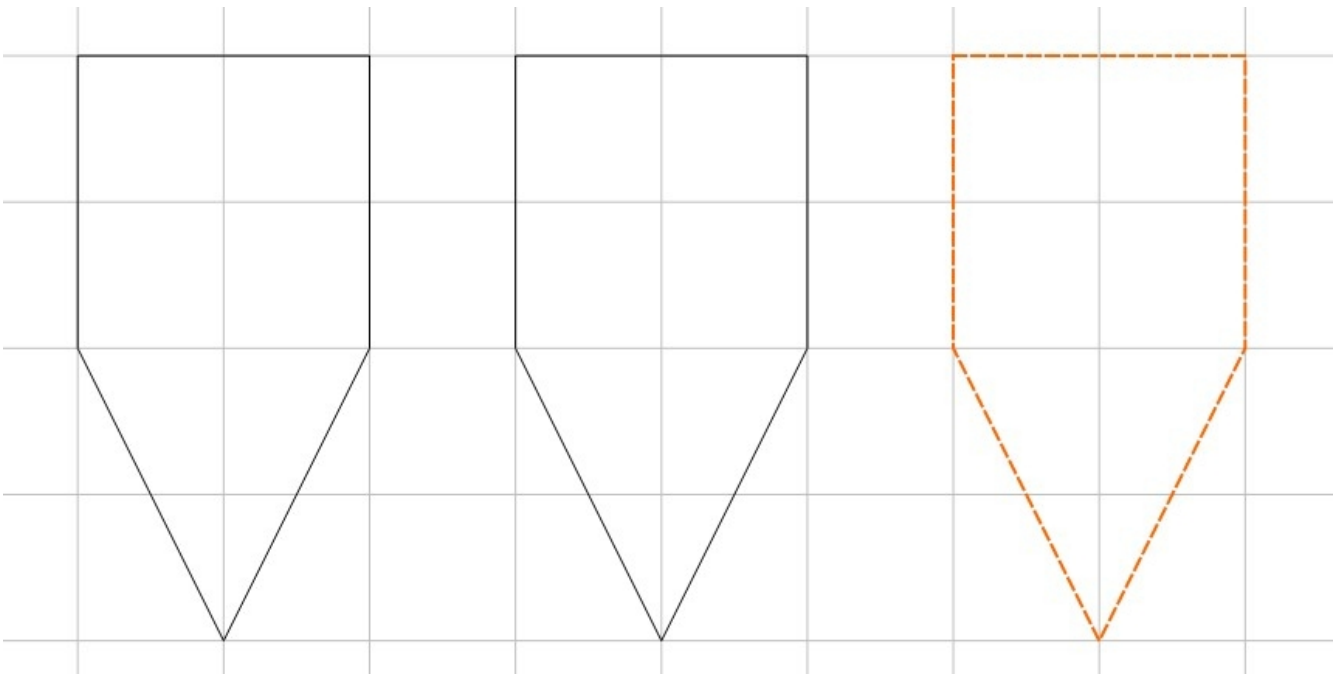


The Middle Arm Construction

1. The next piece to make is the middle arm.

2. The middle arm is X times 1.618. In this case X=6” so

6 times 1.618=9.708. Because I will be adding a rounded end to the top of the arm you need to add .25” to the over all length of the middle arm. So the total length of the finished middle arm will be 9.958. To create the finished piece I will need to create a poly line object that 1” tall and makes a point at the bottom side. Then copy and paste one more copy totaling 2. The other polyline will be used for the two long arms later. The picture is hard to see but each of the polyline objects are .5” wide by 1” tall.



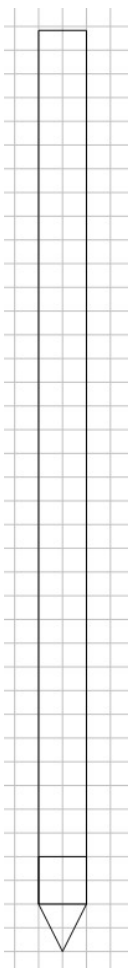
3. The next thing to do is create a rectangle that the middle arm length and .5” shorter than the Golden Ratio measurement to compensate for the .5” point when we use Boolean Union to join the rectangle to the polyline object.

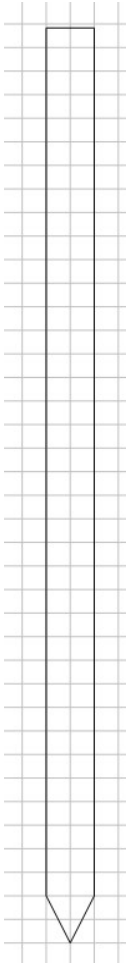
4. So the middle arm Golden Ratio length is 6 times 1.618=9.708 to compensate for the diamond shaped tip subtract .5” from this length. 9.708”-.5”=9.208. After creating the rectangle snap it to the grid by bottom left node and move one of the polyline objects so it snaps .5” above the bottom the the rectangle resulting in the point aligning with the bottom of the rectangle with a .5” overhang. Since

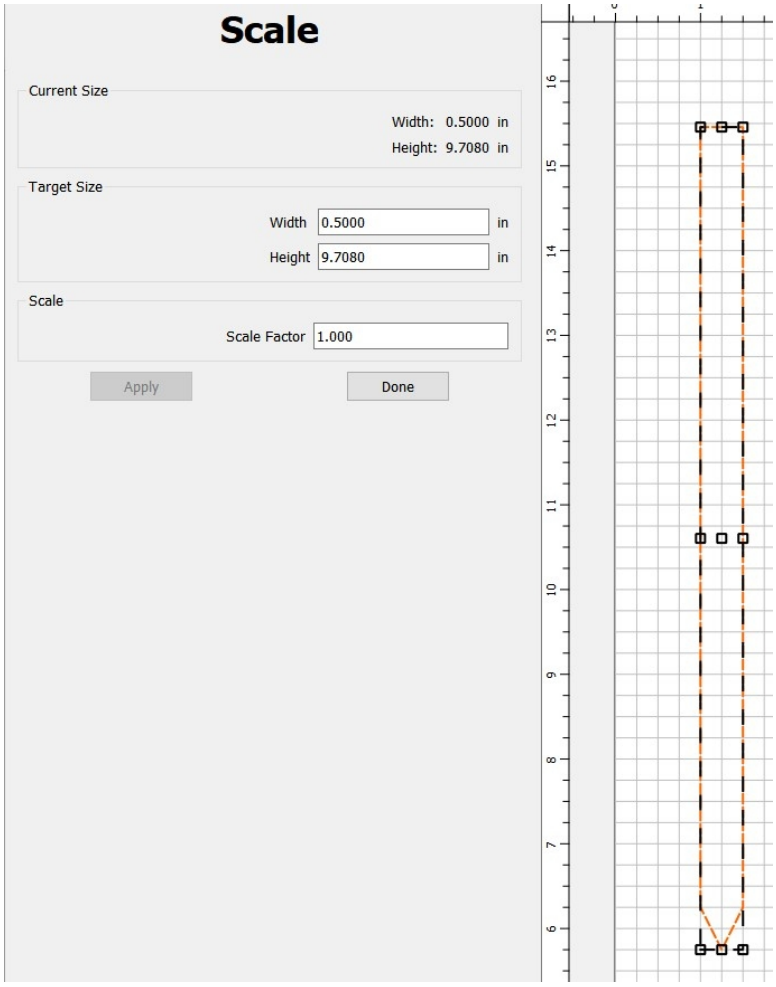
this rectangle is not a multiple of .25 the top will not be aligned with the grid. We will add a .5” (.25” radius) circle to the top to complete the middle arm later.

5. The left picture shows the rectangle snapped to grid on bottom left node. The polyline object is snap to grid .5” above the bottom of the rectangle. The middle picture is the Boolean Union and the right picture is showing the new object selected and the Scale selected showing the object is 9.708” in height. The middle arm should be 9.708” long before adding a rounded top. Next we will add the .5” circle to the rounded end of the middle arm.

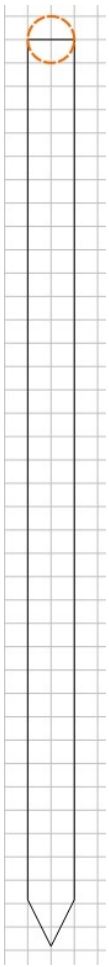
Left Pic Middle Pic Right Pic

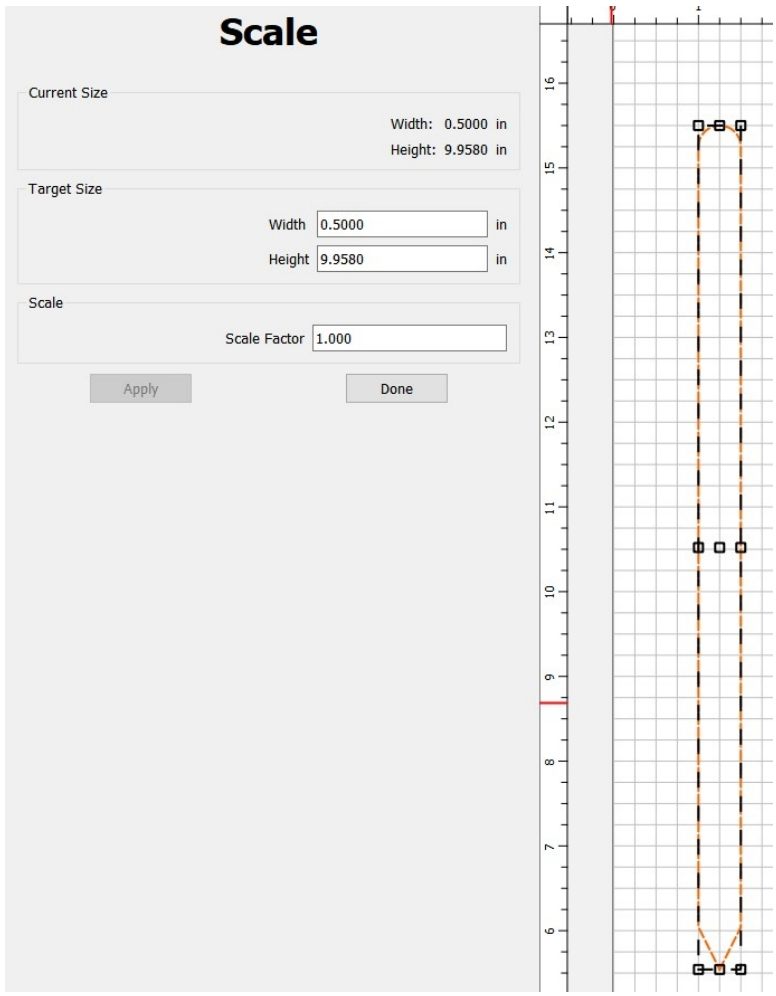




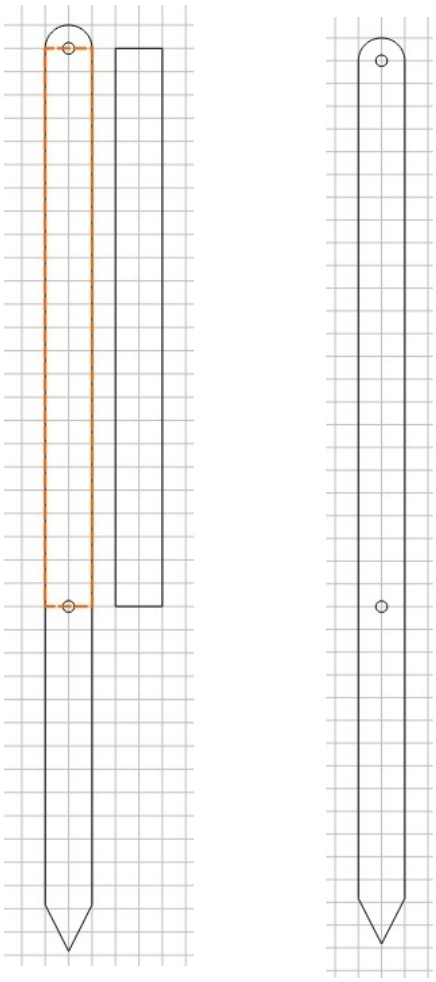


6. The new object should have the upper left node selected and snapped to the grid. Then move the .5” circle (.25” radius) and snap to grid so half of the circle is above and below the top of the middle arm object. Then perform a Boolean Union. The right picture shows the new object selected and the Scale selected showing the overall object length of 9.9580”. The 9.958” is the 9.708” + .25”=9.958”





7. Now that the outline of the middle arm is formed we will add two 1/8” circles (0.0625” radius) to the object that represent the X. Remember X=6”. So draw a 6” x .5” rectangle or use the one saved before to aid in placing the 1/8” circles in place. Make sure the upper left node of the object is snapped to the grid. Then move the 6” x .5” rectangle by its left upper node and snap it to the grid. This will help align the 1/8” holes. In the picture I copy and pasted the rectangle 6” x .5” on the right of the picture for illustration purposes, you do not need to do this. After placing the 1/8” circles select the 6” x .5” rectangle and move it off the material because you will use this rectangle later on the long arms. Now select the middle arm and the two 1/8” holes and group them. This is important so when moving the objects around you do not lose any parts. After all parts are created you can ungroup the objects to make the toolpaths easier to make.

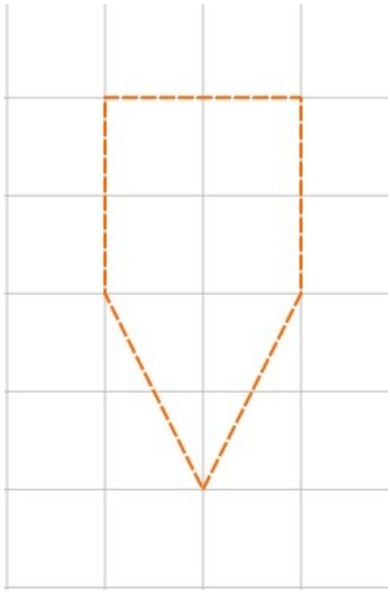


Long Arm Construction

1. Long Arm Construction The long arm is (X times 1.618)+X

2. In this case X=6” so

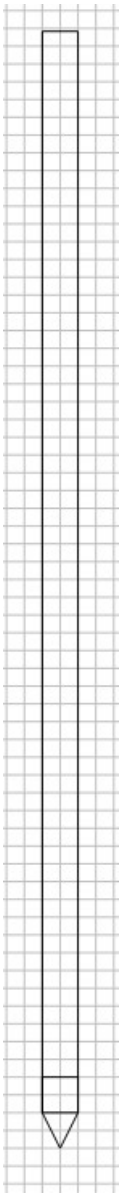
6 times 1.618=9.708+6=15.708. Because I will be adding a rounded end to the top of the arm you need to add .25” to the over all length of the long arm. So the total length of the finished middle arm will be 15.958 To create the finished piece I will need to create a poly line object that 1” tall and makes a point at the bottom side. This was created in earlier steps and copied. The picture is hard to see but each of the polyline objects are .5” wide by 1” tall.

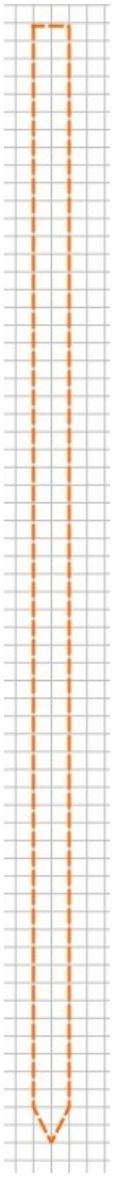


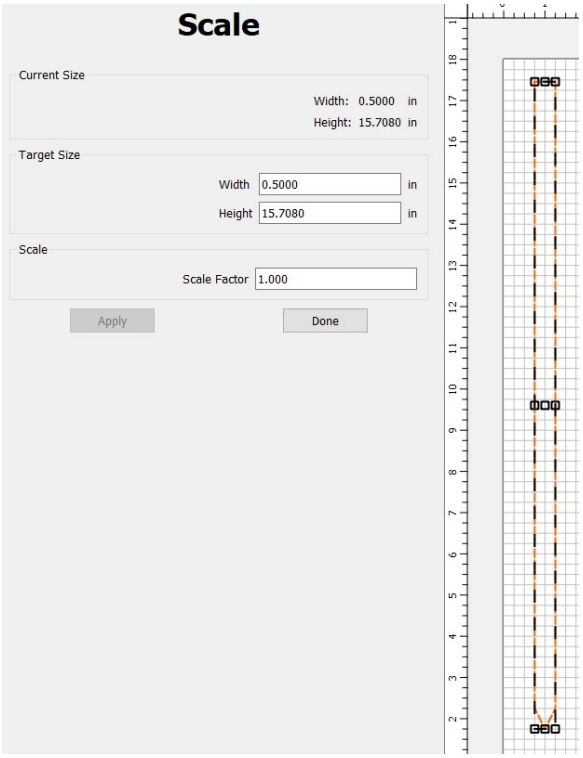
3. The next thing to do is create a rectangle that the long arms length and .5” shorter than the Golden Ratio measurement to compensate for the .5” point when we use Boolean Union to join the rectangle to the polyline object.

4. So the long arm Golden Ratio length is 6 times 1.618=9.708+6=15.708 to compensate for the diamond shaped tip subtract .5” from this length. 15.708”-.5”=15.208. After creating the rectangle snap it to the grid by bottom left node and move one of the polyline objects so it snaps .5” above the bottom the the rectangle. Then perform a Boolean union and check the measurement using Scale Function. The measurement should be 15.708”.

The left picture is the rectangle and the polyline object aligned. The middle picture is the Boolean Union of the rectngle and the polyline. The right picture is the new object selected the the Scale Function selected.

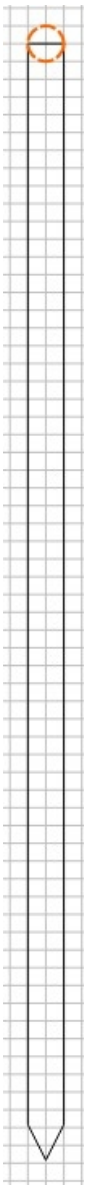


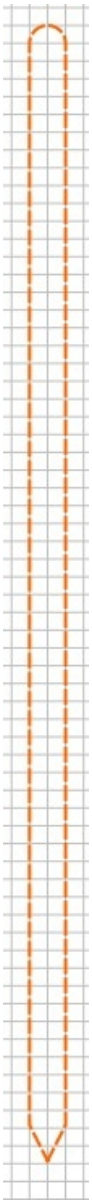


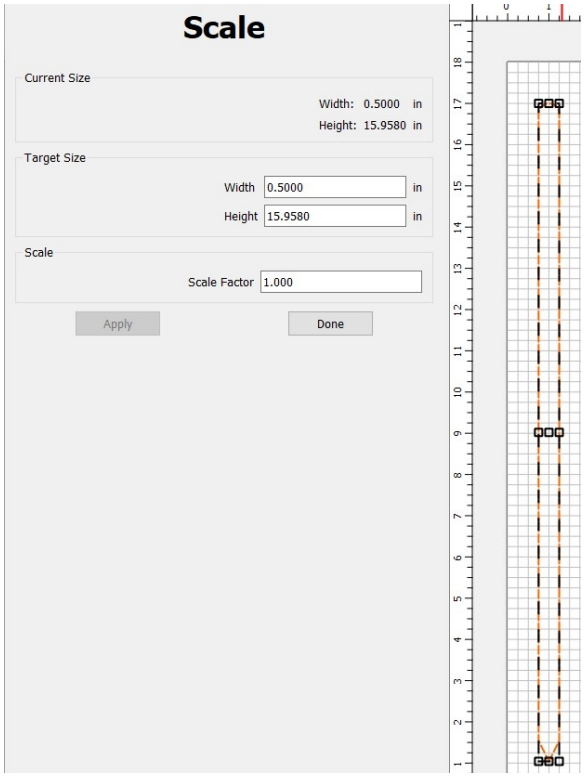


5 Now create a .5” circle (.25” radius). Move the Boolean Union object by the upper left node to snap it to the grid. Move the .5” circle over and let it snap to grid leaving .25” below and above the top of the Boolean Union object. Then select both the .5” circle and the Boolean object and select Boolean union. Then use the Scale Function to make sure the object is 15.958”.

The left picture is the Boolean Union and .5” circle snapped to grid. The middle picture is the Boolean Union and the .5” circle with Boolean Union. The right image is the Scale Function selected to verify the object is 15.958”.

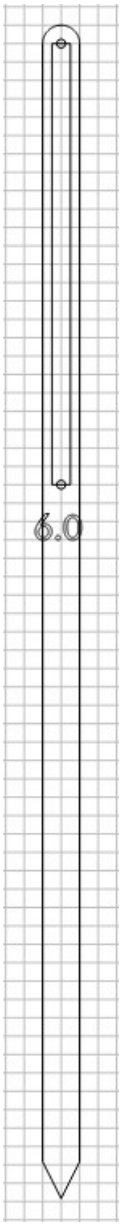


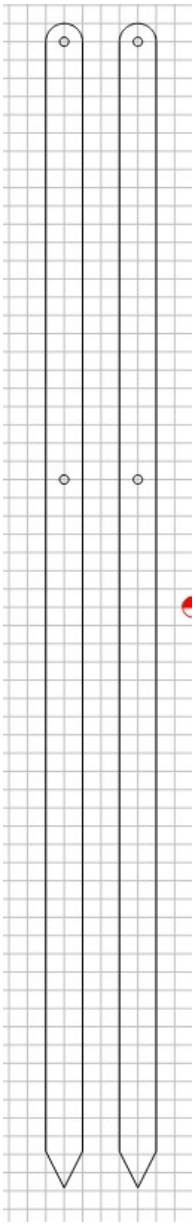




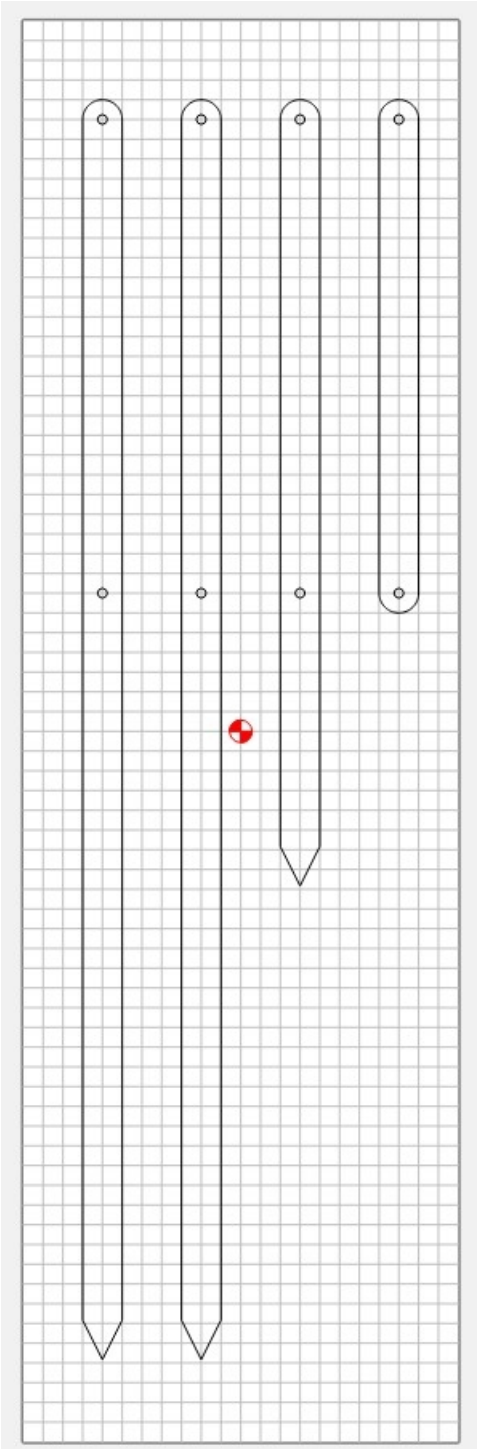
6. Now create two 1/8” circles (0.0625” radius). Create a rectangle that is .25” x 6”. Then move the .25” X 6” rectangle by the top center point into the new Boolean Union object and snap it to grid at the top of the previous rectangle. You will use this rectangle to align the two 1/8” circles. Move the .25” X 6” rectangle off the material and select the long arm and the two 1/8” circles and group them. The group is necessary so when moving the arm around you do not lose any of its parts. Now select the long arm and Ctrl C and then Ctrl V to duplicate the long arm making two long arms.

The picture on the left is the Boolean Union object with .25”x 6” rectangle and the two 1/8” circles placed. The left picture is the finished long arm duplicated.





7. The Carbide Create construction process is finished. Move your four created objects onto the material and arrange so they can be cut. It was important to group each object to avoid leaving parts behind when moving. I spaced the parts .75” apart so the cutting of one arm will not interfere with the cutting of the other arms. Once placed on the material please ungroup each object because during the tool path creation you need the parts ungrouped.



Creating Toolpaths for the Golden Ratio Gauge

There will be two Toolpaths for this project.

1. The 1/8” holes pocketed.

2. The arms cut out.

1. Ungroup all the objects on the screen. Select the eight 1/8” circles. You may need to enlarge the screen to get the small objects selected. Select the first 1/8” circle and hold down the shift key and move to the other 7 circles to select. If you had enlarged the screen you may need to continue to hold down the shift key and use your right mouse key and mouse wheel (Windows) and move around on the screen.

2. After the eight circles are selected go to the Toolpath and create a pocket tool path. I chose the #112 1/16” tool for this. Use the top as the starting depth (I chose to use top of material in setup). Then select use stock bottom so you cut all the way through. Name your toolpath and click OK.

3. Next select all four of the arms. Again you may have to scroll the screen smaller to select all four. Select the Toolpath and select the Contour. I selected the #251 ¼” down cut bit. I selected the #251 so I get a smooth top edge. The bottom edge will be protected by the painters tape and super glue if you chose that method to secure your stock. I chose start depth of 0 which was already set by my setup choosing the top of stock. Then select use stock bottom so the stock is cut through. Then select offset direction as Outside/Right. With the tape and super glue I did not need tabs. If you are choosing another method to hold the project you may need to add tabs. Name your tool path and select OK.

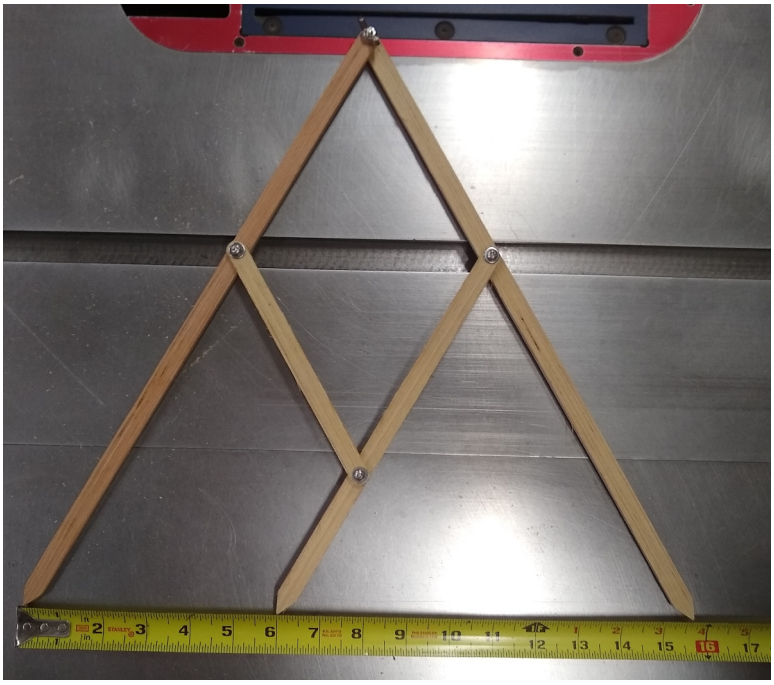
4. View your simulation to make sure you selected all 8 circles and all 4 arms to cut through. Then save your tool path. If you have a BitSetter you can save both tool paths together. If you do not have a BitSetter you will need to disable the arm cutout tool path and save the 1/8” holes as a separate tool path. Then after saving that tool path disable the 1/8” holes tool path and enable the arms cutout tool path and save it as a separate tool path.

5. Mount your stock on your machine. I used the tape and super glue method to avoid tabs and so that the arms would be held on make sure your tape and glue are under each arm. I used four lines of glue to avoid the cutout arms from flying off and being damaged.

6. Start your machine and cutout the project.

7. When the cutting is done remove the project and remove the individual parts. It may be necessary to clean up any fuzz on the parts prior to assembly.

8. Assemble your Golden Ratio Gauge using 4 #6-32 screws that are ¾” inch long. Put a washer under each screw and a washer under each nut. I used a wing nut at the top position but you can add the wing nut anywhere. This is so you can lock the gauge to take measurements and move the gauge around without losing your measurements. You will need to use super glue or epoxy to fix the bolt with the wing nut to keep it from moving during tightening.



Enjoy using the Golden Ratio Gauge.