Acorn Box with Screw Lid

Version 1

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Acorn Box With A Screw Lid

The following document describes the steps in making a small box that is fluted on the outside and has a ornamented lid which screws into the base. The rose engine used in this project is a Lindow Rose Engine using their Double Eccentric Dome Chuck with the Segment Stop, a Universal Cutting Frame, Drilling Frame with the eccentric cutting head (ECF), and the Threading Attachment.

A ½" round rubber and a 24 sine rosette are also used for ornamenting the lid.

Before starting the project it is also suggested that the following attachments are read and understood.

Page 19 **Attachment C** – Adjust headstock to top dead center using an adjustable level.

Page 20 **Attachment D** – Checking the blank both axially and radially.

Page 21 **Attachment E** – Find exact center height of the Universal Cutting Frame.

Page 22 **Attachment F** – Find exact center height of the eccentric cutting head.

Page 24 **Attachment G** - To ensure both the slides on the Double Eccentric Dome Chuck are level.

Page 25 **Attachment H –** Accurately setting the radius of the eccentric cutting head.

The steps in making the box are:

a. Design the shape of the threaded box on paper to calculate the necessary dimensions and angles to cut the flutes on the base, and shape and ornament the lid.

b. Prepare the wood blank for the box, and cut the wood in two for the base and the lid.

c. Base – remove the inside and cut a female thread. Make a threaded waste holding block with the same size male thread.

d. Top – cut a tenon, and cut a male thread to match the female thread cut in c. above. Make a threaded waste holding block with the same size female thread.

e. Screw a waste holding block into the base, and 1. shape the base designed in a. above., and 2. cut the flutes on the outside of the base.

f. Screw a waste holding block onto the lid, and shape and ornament the lid.

1. Designing the box.

a. To assist in setting up the RE to ornament the outside of lid and base of the box the first step is to design and document the size and shape of the box. Once the design is on paper the correct dimensions and angles can be calculated for the double eccentric dome chuck, the sliderest, and the radius of the ECF cutting head.

b. First, draw the exact size and shape of the box on tracing paper as a side view or section drawing. In this project the final size of the box (base and lid) is 2" diameter and 2 5/8" high.

c. Explanation of the base:

I. Determine the size of the rim and also the foot of the base and draw both the rim (s t) and foot (u v) on a paper. Draw a line (c1 c2) through the rim and foot bisecting both lines. This is the center line of the box. Using a compass draw a partial circle (s u) that connects both left hand edges of the rim and foot and mark the center point of the compass (y).

II. Draw a line through the center point (y) parallel to the rim. On this line measure the distance from the center line to the center point (y) of the compass.

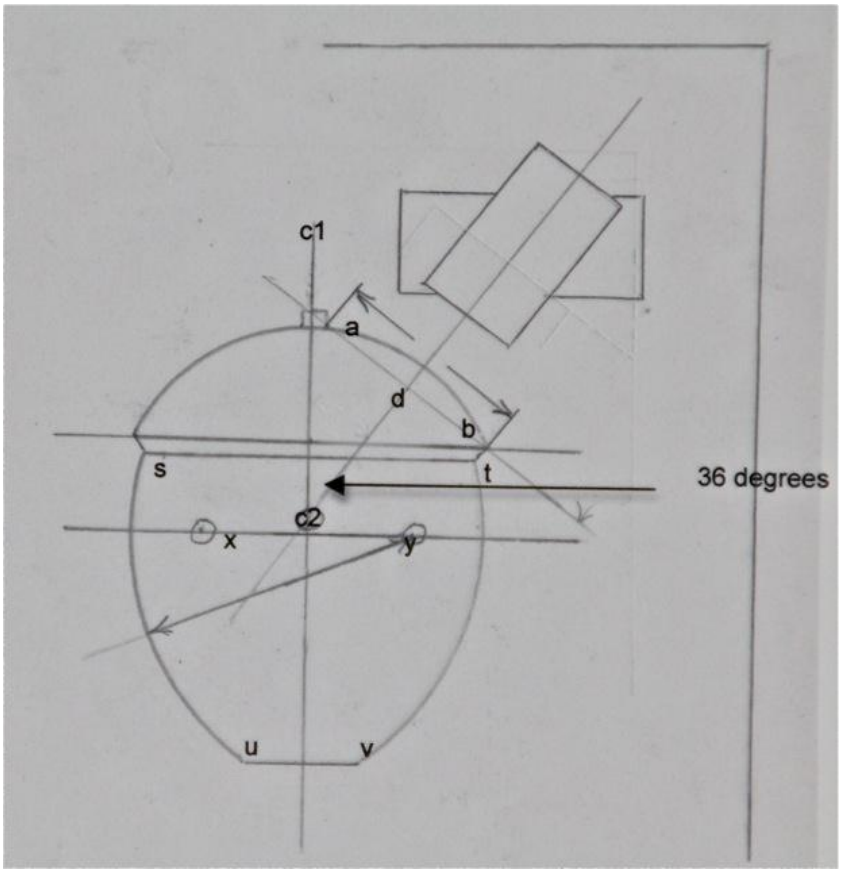
III. Make another mark on this line, using the same distance calculated in II. above, from the center line. Use a compass at this point (x) to draw a partial circle for the other edge of the base (t v).

IV. To ornament the base two measurements are required for the double eccentric dome chuck. First is the offset i.e. **center line (c1 c2) to y = 0.6",** and second, the distance that the cutter is set from the rim i.e. **rim (s t) to the line x y = 0.41".**

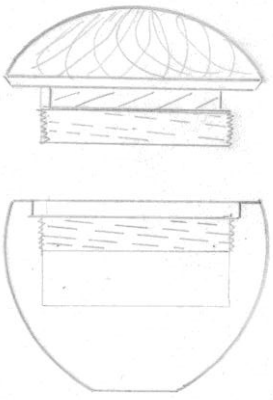
d. Explanation of the lid.

I. To ornament the lid two measurements are required. First is the radius of the ECF cutting head, and second the number of degrees that the sliderest is set at.

II. Draw a line between the two points (a b) where the cutter tip is used to shape the lid.
III. Measure the distance between these two points, which is 1.15".
IV. Mark the center point (d) on this line. Each half is **0.575".**
V. Draw a line from this center point (d) perpendicular to the line (a b) to the centerline of the acorn (c2).
VI. Measure the angle (c1 c2 and c2 d) by laying the base of a protractor on the centerline (c1 c2) with the center point of the compass on c2. The protractor will give a direct reading for the protractor on the Hardinge sliderest when using the ECF. This angle measures **36 degrees**.



The diagram below shows how the lid is screwed into the base.

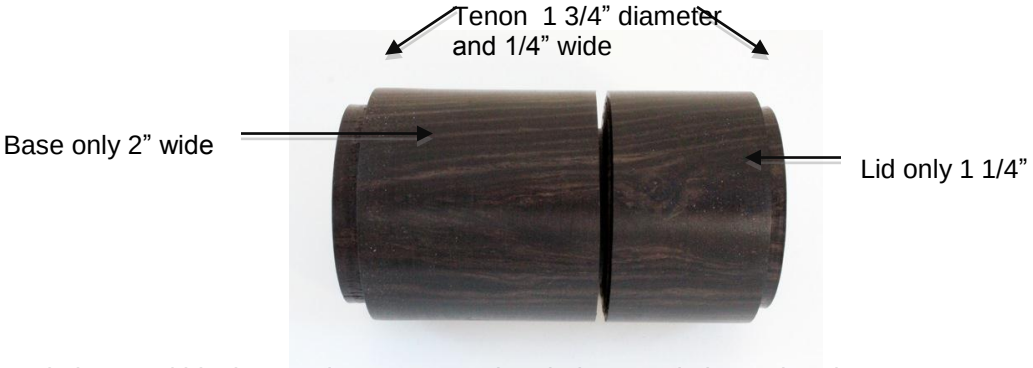


e. Before fluting the base it should be cut to shape on a traditional lathe. To ensure the shape is close it is useful to cut out a template of the shape of the base. Transfer the outline of the base from tracing paper to a card or stencil stock to make the templates.

2. Preparing the box for ornamenting.

a. Preparing the wood.

Cut a piece of wood approximately 2 1/8" square and 3 3/4" long. Round the wood to its largest diameter, which will be about 2". Cut a 1 ¾" diameter 3/16" wide spigot at each end that will fit into a holding chuck.



b. Mark the wood blank to cut into two. Use the Lindow RE, lathe, or bandsaw to separate the lid from base.

Note: Every time the sliderest is moved it is important to use a square to ensure it's aligned correctly.

3. Hollowing and threading the base.

Step 1 … Hollowing the inside of the base.

a. Install the base in the holding chuck.

b. Set the headstock at top dead center, and check the base both axially and radially. Refer to **Attachment C** and **Attachment D** respectively.

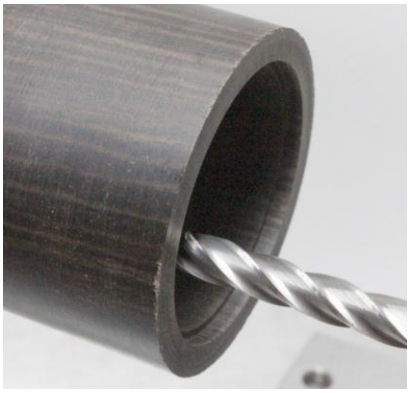
c. Move the sliderest inline with the holding chuck and use a square to ensure the sliderest is 90 degrees to the RE base.

d. Install the Drilling Frame on the sliderest. Install a *¼" 4 flute single end mill* (end mill) in an end mill holder, and screw the end mill holder into the Drilling Frame.

e. Place the bottom of the end mill on the top surface of the rim and smooth the surface. Cut the length of the base to 2".

f. Using the end mill bore out a hole in the wood blank approximately ¾" deep, and 1/4" for the side of the base. Slow the RE down for the final cuts. Leave the bottom of the hole flat, or use a lathe to round the bottom of the hole.

g. Cut a groove just inside of the rim 0.125" deep and 0.050" wide.



Step 2 … Installing the threading components

a. Select the 8 tpi threaded bobbin and indexer. Ensure the threaded bobbin is correctly attached to the indexer, and is set at the 1 2 3 4 marked on the edge of the indexer.

b. Install components of the threading attachment to the rear end of the spindle. First, install the mounting block with the lever to the right. Second, install the 8 tpi brass chaser into the holder leaving the chaser a loose fit, and slide the indexer/threaded bobbin on the spindle. Finally, use the lever to gently lift the brass chaser up so that its threads just engage with the threads of the threaded bobbin.

c. Tighten the indexer against the spindle. Install a 1/8" or 3/16" cutter with a 60-degree cutting angle in a fly cutter and insert in the Drilling Frame.

Step 3 … Threading the base – First Lead

a. To determine depth of the thread for an **internal** thread refer to Attachment A – Lindow Thread Calculator.

b. For 16 tpi the depth of the cut for an **internal thread** is 0.038" (70% of Sharp V for internal thread). Use this depth even though 8 tpi is being used.

c. Move the cutter in from the rim about 1/8". Move the cutter slowly towards the far side, or to the right of the hole so that the point of the cutter is nearly touching the side. Move the drilling frame spindle by hand slightly up and down and adjust the sliderest so the point of the cutter is barely scraping the side. Set the dial on the sliderest to zero.

d. The process here is to start threading from the inside of the base to the rim. Start turning the spindle so that the base travels towards the sliderest. This is known as a 'climb' cut, where at the area of the cut, the cutter is going in the same direction as the base.

e. Move the cutter into the base where the threading will start i.e. about 3 to 4 threads (approx. 1/2"). ***It is important not to move this adjustment again.***

f. As a trial run move the spindle so that the cutter moves towards the rim. Ensure the cutter stops just outside of the base. Move the spindle back to where it started.

g. Move the cutter towards the side by 0.038", turn on the drilling frame and start cutting the thread. When the cutter is outside of the base move the cutter away from the side, and stop the cutter.

h. That completes the first lead.

Step 4 … Threading the base – Second Lead

a. Return the spindle back to where the first lead started.

a. Rotate the spindle until the marking 1 2 3 4 appears on the indexer.

b. Remove the shoulder bolt holding the threaded bobbin to the outer metal ring. Do not loosen the outer metal ring.

c. Turn the threaded bobbin ***clockwise*** until the shoulder bolt hole appears next to the 2 4 marking. Screw the shoulder bolt back into the threaded bobbin.

d. Cut the second thread at the same depth of 0.038".

e. That completes the second lead for the base.

4. Preparing, and threading the lid

Step 1 … Cutting and ornamenting the tenon

a. Install the lid in the holding chuck.

b. Check the lid both axially and radially. Refer to **Attachment D**.

c. Install the Drilling Frame with the *¼" 4 flute single end mill*.

d. Move the sliderest inline with the holding chuck and use a square to ensure the sliderest is 90 degrees to the RE base.

e. Place the bottom of the end mill on the top surface of the rim and smooth the surface. Cut the lid to a length of 1 1/4".

f. To calculate the final diameter for the tenon that will be used for the external thread refer to Attachment A – Lindow Thread Calculator. Again, 16 tpi is used.

g. Using a digital caliper measure the diameter inside of the base from thread to thread.

h. The calculation of the diameter for the external thread is:

Internal diameter of the female thread + (2 x 70% of Sharp V for Internal Thread)

Internal diameter of the female thread + (2 x 0.038")

In this project:

Internal diameter = 1.6"
Threads Per Inch = 16
70% of Sharp V for Internal Thread = 0.038"
Diameter for External Thread = 1.6" + (2 x 0.038")
= 1.6" + 0.076"
= 1.676".

i. Using the end mill cut a shoulder 1.676" diameter and 5/16" in depth.

j. Use the fly cutter with the 1/8" flat cutter to cut a groove about 0.070" deep by the shoulder.

k. Use a fly cutter with the 3/16" 45-degree cutter to cut a chamfer on the inside of the rim.

Step 2 … Threading the tenon – first lead

a. To determine depth of the thread for an **external** thread refer to Attachment A – Lindow Thread Calculator.

b. For 16 tpi the depth of the cut for an **external thread** (Depth Of Sharp 'V' Thread) is 0.055". Use this depth even though 8 tpi is being used.

c. Move the cutter in from the rim about 1/8". Move the cutter slowly towards the tenon so that the point of the cutter is nearly touching the side. Move the drilling frame spindle by hand slightly up and down and adjust the sliderest so the point of the cutter is barely scraping the side. Set the dial on the sliderest to zero.

d. Move the cutter out so that it is just not touching the tenon. ***It is important not to move this adjustment again.***

e. As a trial run move the spindle so that the cutter moves towards along the tenon until it reaches the groove. Move the spindle back to where it started.

f. Move the cutter in towards the tenon by 0.055", turn on the drilling frame and start cutting the thread. When the cutter moves into the groove set the depth back to zero, and stop the cutter. Return the cutter to the beginning of the first thread.

g. That completes the first lead.

Step 3 … Threading the tenon – Second Lead

a. Rotate the spindle until the marking 2 4 appears on the indexer.

b. Remove the shoulder bolt holding the threaded bobbin to the outer metal ring. Do not loosen the outer metal ring.

c. Turn the threaded bobbin ***clockwise*** until the shoulder bolt hole appears next to the 1 2 3 4 marking. Screw the shoulder bolt back into the threaded bobbin.

d. Rotate the spindle until the cutter is again not touching the end of the tenon. Cut the second thread at the same depth of 0.055".

e. Cut a thread along the tenon until the cutter reaches the groove.

f. Return the spindle to the beginning of the movement.

g. That completes the second lead.

Note: If the lid does not fit tightly against the base the thread on the tenon may be longer that the thread in the base. To correct the problem cut a groove at the bottom of the thread in the base.

Step 4 – Ornamenting the base

a. Return the spindle to the beginning of the movement, and replace the Threading Attachment with the spindle collar.

b. Install the Universal Cutting Frame with the carbide cutters and align the cutting head to the center of the mandrel. Refer to **Attachment E**.

c. Set the headstock at top dead center, and check the base both axially and radially. Refer to **Attachment C** and **Attachment D** respectively.

d. Select a rosette and rubber, and ornament the base of the tenon.

5. Preparing threaded waste blocks

Note: Threaded waste blocks will be used to hold the lid and the base whilst ornamenting each piece. These blocks can either be made of wood or plastic. To determine depth of the thread refer to the Attachment A and Attachment B – Lindow Threading Calculator.

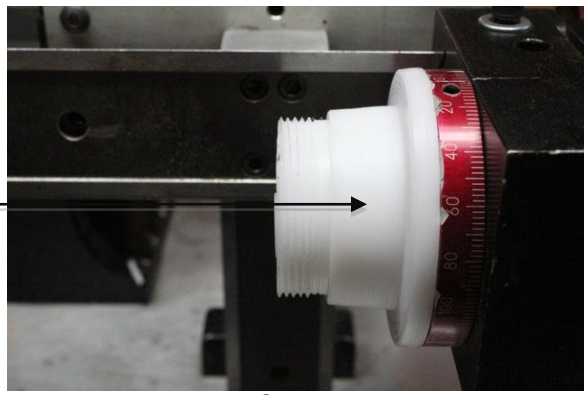
Step 1 - Preparing wood for the waste blocks

a. Cut two pieces of wood approximately 2 1/4" square and 1 1/2" long. Round the wood to its largest diameter. Cut a 1 ¾" diameter 3/16" wide spigot at one end of each waste block.

Step 2 - Threading the waste blocks

a. Base waste block .... cut a male thread on a tenon as described in Section 4 to match the female thread in the base. Also, cut a ¾" x 16 thread through the middle of the waste block to thread on the Phasing Chuck. The gap is required to allow space for the UCF to flute the top of the rim.

5/8" gap with a diameter of less than the diameter of the base should be cut between the last thread and top of the waste block.



b. Top waste block … cut a female thread as follows:

I. To calculate the final diameter for the bore that will be used for the internal thread refer to Attachment B – Lindow Thread Calculator. Again, 16 tpi is used.

II. Using a digital caliper measure the diameter outside of the tenon of the lid from thread to thread.

III. The calculation of the diameter for the internal thread is:

External diameter of the male thread - (2 x 70% of Sharp V for Internal Thread)

External diameter of the male thread - (2 x 0.038")

In this project:

External diameter = 1.676"
Threads Per Inch = 16
70% for Internal Thread = 0.038"
Diameter for External Thread = 1.676" - (2 x 0.038")
= 1.676" - 0.076"
= 1.6".

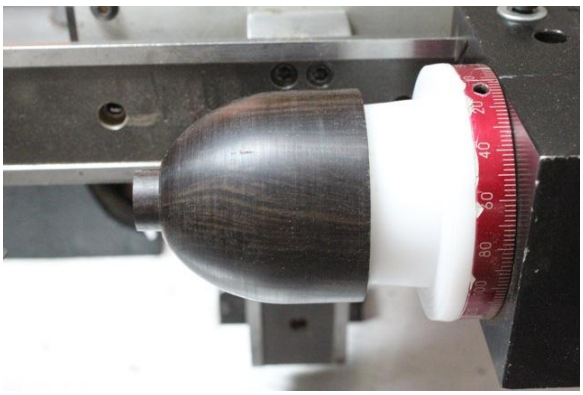
IV. Using the end mill cut a hole 1.6" diameter and 3/4" in depth.

c. Cut a thread in the waste block as described in Section 3.

6. Cutting the base to shape.

a. Thread the lid onto the base and shape the base using the template created in Section **1. Designing the box e.**

b. Below is the final shape with a tenon ½" diameter and 3/8" wide.



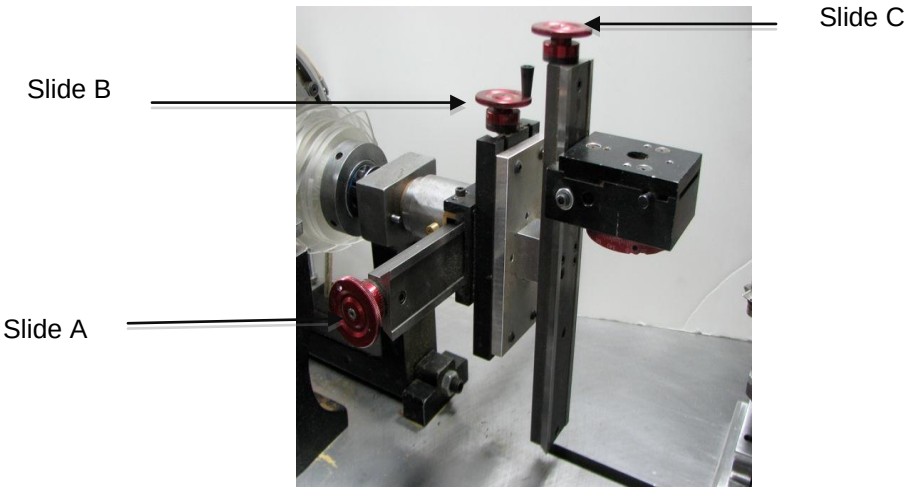
7. Ornamenting the base.

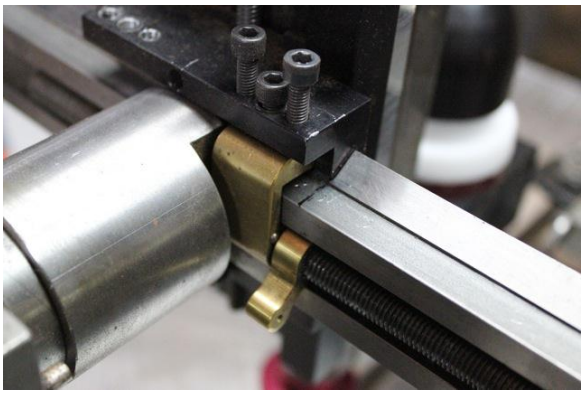
Step 1 – Installing the double eccentric chuck.

a. Install the double eccentric chuck with the dome chuck on the RE. Adjust all slides so that they are all lined up central with the mandrel. Slide B will not be touched again during this project.

b. Lock the headstock at top dead center. Refer to **Attachment C**.

c. Ensure the Double Eccentric Chuck is aligned correctly. Refer to **Attachment G**.





d. When the Slide A is inline with the mandrel mark the slide with a fine marker to denote the center point.

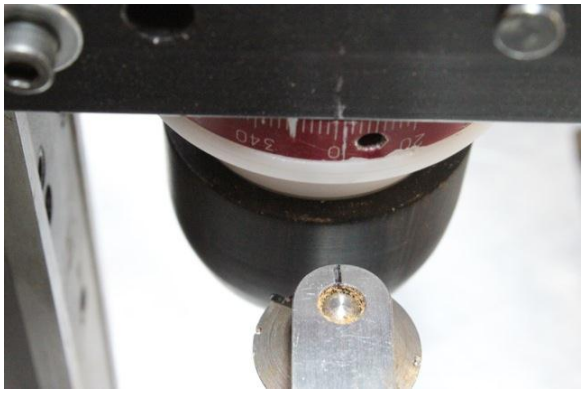
Step 2 – Installing the base blank

a. Screw the ¾”-16 holding chuck onto the base, and set the index wheel to zero degrees.

Hint: ***Always*** *lock the index wheel with the set screw on the side when installing or removing from the Index Chuck. If not, the teeth on the aluminum index wheel inside the index chuck will be stripped.*

Step 3 – Installing the Universal Cutting Frame

a. Install the Universal Cutting Frame on the sliderest and position the sliderest perpendicular to the base blank. Ensure the UCF cutting head is horizontal, and centered to the index head spindle on the dome chuck (zero degrees on the Index Chuck).



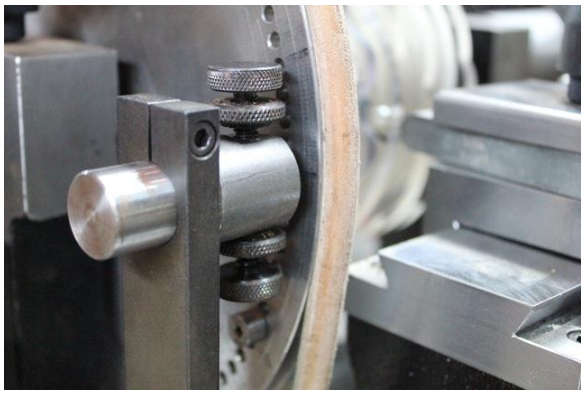
Step 4 – Installing the Detent

a. First install the Detent arm with the screw adjusters.

b. Install a metal stop in the index wheel and adjust the lower adjustment bolt so that the tenon is not removed by the cutting head.

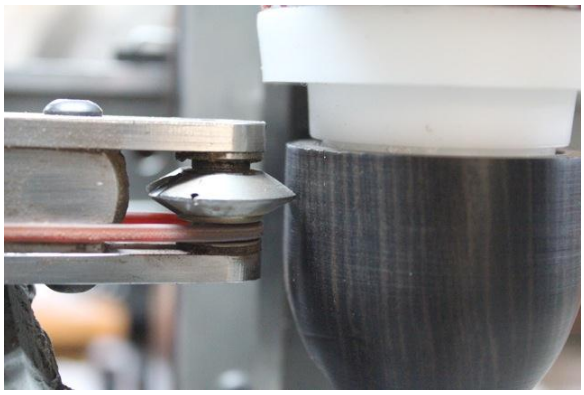
c. Swing the base to ensure the base stops at the correct level position, otherwise make fine adjustments to the lower adjustment bolt.

Note: As there is no rim on the base a stop on the top is not necessary.

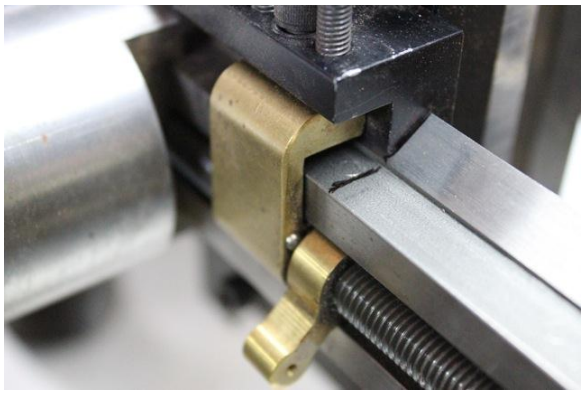


Step 5 - Positioning the base for ornamenting.

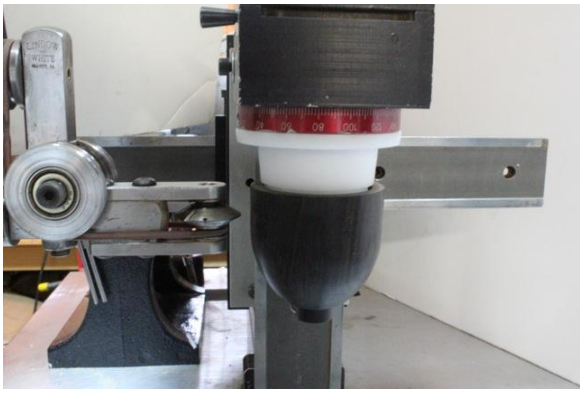
a. Move the base up or down, using the red adjustment wheel (Slide C) to first move the cutter to the top of the rim. Then use the red adjustment wheel (Slide C) to move the base up so that the cutter is 0.41" from the rim. This calculation was from Section **1. Designing the box c.**

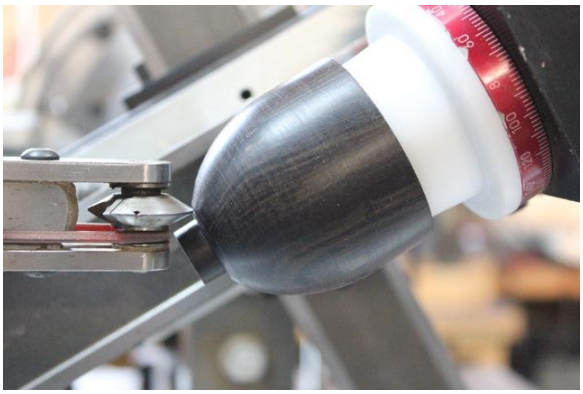


b. Use the red adjustment wheel (Slide A) move the base towards the cutter by the offset amount of 0.6". This was calculated in Section **1. Designing the box c.**



c. Swing the base from top to bottom ensuring the cutting head follows closely to the contour of the base. Use the same red adjustment wheel to make minor changes. Set the Hardinge sliderest dial to zero.





Step 6 - Cutting the flutes.

a. This particular base will have 24 flutes set at 15 degrees apart. Before cutting the flutes ensure the index chuck is set to zero degrees as the starting point.

b. Swing the base up and down to ensure the movement is smooth.

   i. Turn on the cutting frame and bring the cutting head in slowly until a flute is cut. Note the depth of cut used.

   ii. Turn off and retract the cutting head.

   iii. Carefully move the index by 15 degree counter-clockwise and make another cut to the same depth.

iv. If the sides between the first and second flutes are not sharp, or have flats between them, it will be necessary to deepen the cut and repeat steps i. thru iii.

Note: After a flute is cut a good technique is to finish the cut by just a few thousandths of an inch.

v. Once the depth has been established repeat i. thru iii. until all 24 flutes have been cut. This completes the outside of the base.

vi. Finally, examine all flutes for flat spots. If there are flat spots select the worst flat spots and re-cut by a few thousandths deep until they disappear. Use this depth to cut all the flutes.

vii. Remove the metal stop from the index wheel.

viii. Completed fluted base.

Step 7 - Finishing the bottom of the base.

a. Remove the Double Eccentric Chuck and replace with a holding chuck and install the waste block with the base in the RE holding chuck.

b. Move the UCF with the carbide cutters inline with the base, and use the cutter to square off the base.

c. The base is complete.

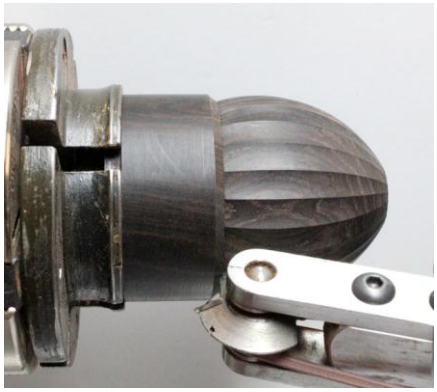
8. Ornamenting the top.

Step 1 – Cutting a chamfer on the lid rim

a. Install the holding chuck with the lid blank.

b. Check the lid blank both axially and radially. Refer to **Attachment D**.

c. Position the sliderest with the UCF at an angle to cut a slight chamfer on the corner of the lid rim.



Step 2 – Sliderest and Eccentric Cutting Frame (ECF)

a. Refer to **1. Designing the box d.** for the measurements and angle to first, shape the lid and second, ornament the lid.

ECF cutter radius is **0.575" + 0.125 = 0.600".** Refer to **Attachment H** on setting the ECF radius.

Note: *Remember: you must add the .125" for one half each of the two cutters when measuring off of the buttons with your calipers. For instance, if you are using dial calipers they will read .600" for this exercise. If you're using digital calipers you can set the ABS for .125" and read it at the .575".*

Sliderest angle – **36 degrees**

Step 3 – Rounding the lid.

a. Screw the top waste block in the RE holding chuck and screw the lid in the waste block.

b. Check the lid blank radially. Refer to **Attachment D**.

c. Install the ECF with an end mill and remove the ¼" tenon.

d. Replace the end mill with the eccentric cutter head with a 60 degree cutter.

e. Move the base of the sliderest to be perpendicular to the headstock and, using the sliderest protractor, set the top slide to be at an angle of 36 degrees.

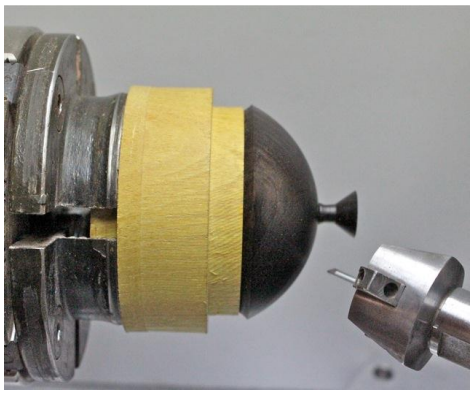
f. Set the radius of the eccentric cutter head to 0.600"

g. Manually rotate the cutter so that the cutter is inline with the rim.

h. Turn on the cutter and slowly move it towards the lid.

i. The cutter should just touch the rim by the chamfer and also should leave a small tenon on the lid. The bottom slide can then be turned inward till the desired depth is reached and the shape of the lid has been formed by the ECF.

j. For the best surface slow down the rotation of the lid to finish the shape.



Step 4 – Ornamenting the lid.

a. *Important step* …first, check the correct height of the ECF to ensure a consistent pattern. **Refer to Attachment F**.

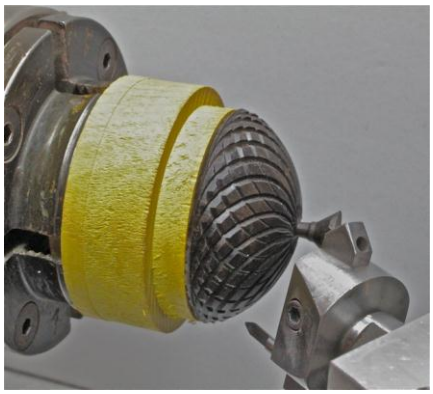
b. Unlock the headstock and insert the ½" round rubber in the valley of the 24 sine rosette. Ensure the headstock rocks the same distance either side of top dead center.

c. Use a dial indicator against the headstock to identify the lowest point in the valley.

d. Set the rubber in a valley and slowly move the cutting frame in so that a circle is just cut. Set the sliderest dial to zero. Move the cutting frame in and cut a circle about 0.020" to 0.030" deep.

e. Move the cutting frame away from the lid and move the rosette to the next valley and use the dial indicator for the lowest point. Move the cutting frame in and cut a circle about 0.020" to 0.030" deep.

f. Repeat this process and cut a series of 24 circles around the top.



Step 5 – Reduce the lid tenon.

a. Install the UCF and reduce the tenon on the lid.

b. This completes the lid.

9. Completed Box

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Attachment A - Lindow Thread Calculator

Calculates The Diameter for External Thread

Thread Per Inch TPI	External Thread Depth: Depth of Sharp V Thread	Internal Thread Depth: 70% of Sharp V for Internal Thread	Pitch
4	.215	.150	.250
8	.110	.075	.125
12	.072	.050	.083
16	.055	.038	.0625
24	.036	.025	.042
32	.027	.019	.031
36	.024	.017	.028
48	.018	.013	.021

1. Internal Diameter of Female Thread _____
2. Threads Per Inch _____
3. 70% of Sharp V for Internal Thread _____
4. Diameter for External Thread #1 + (2 x #3) _____

Note: If the dial on the cross slide is marked for diameter it will show double the number on the chart in order to reach a full depth cut.

Sample

1. Inside Diameter	1.125
2. TPI	16
3. 70% for Internal Thread	0.038”
4. Diameter for External Thread	1.125” + (2 x 0.038) = 1.125” + 0.076” = **1.201”**

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Attachment B - Lindow Thread Calculator

Calculates The Diameter for Internal Thread

Thread Per Inch TPI	External Thread Depth: Depth of Sharp V Thread	Internal Thread Depth: 70% of Sharp V for Internal Thread	Pitch
4	.215	.150	.250
8	.110	.075	.125
12	.072	.050	.083
16	.055	.038	.0625
24	.036	.025	.042
32	.027	.019	.031
36	.024	.017	.028
48	.018	.013	.021

Calculation Method:

1. Outside Diameter of Male Thread _____
2. Threads Per Inch _____
3. 70% of Sharp V for Internal Thread _____
4. Bore Diameter for Internal Thread #1 - (2 x #3) = _____

Note: If the dial on the cross slide is marked for diameter it will show double the number on the chart in order to reach a full depth cut.

Sample:

1. Outside Diameter	1.201”
2. TPI	16
3. 70% for Internal Thread	0.038”
4. Bore Diameter for Internal Thread	1.201” - (2 x 0.038”) = 1.201” - 0.076” = **1.125”**

Attachment C – Adjust headstock to top dead center using an adjustable level.

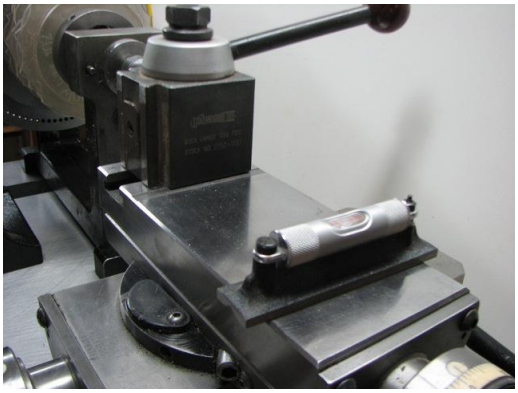


Figure 1 - Adjustable Level on the sliderest

First, place an adjustable level (Starrett No 78 used here) on the bed of the sliderest and adjust the bubble to its center. Then place the adjustable level on top of the headstock, and move the knurled adjustment nut (Figure 3), that adjusts the headstock, to move the headstock to top dead center.

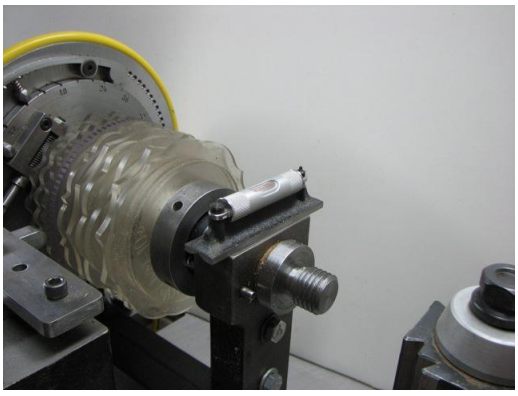


Figure 2 - Adjustable Level on the headstock

Use the knurled adjustment nut at the top of the spring to bring the headstock to top dead center.
The bolt is used to stop the headstock from rocking.

Use the knurled nut at the bottom of the spring to adjust the spring pressure.

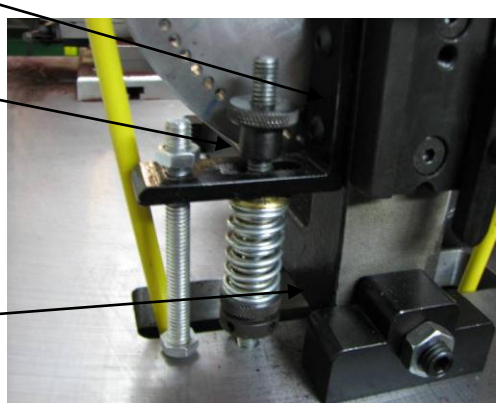


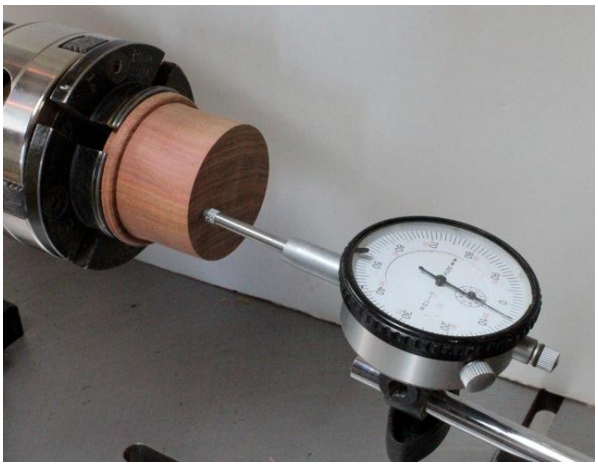
Figure 3 – Rocking Headstock Lock and Spring Adjustment

Attachment C – Adjust headstock to top dead center using an adjustable level. (Contd.)

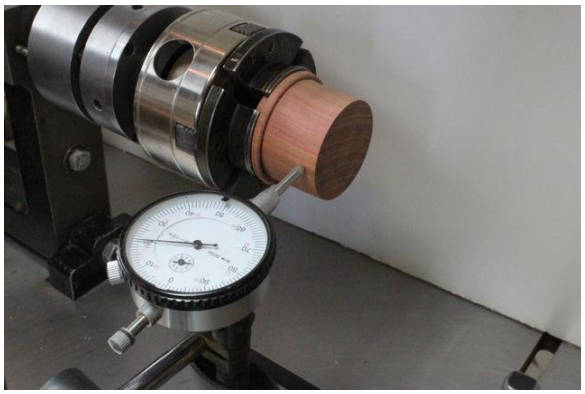
Rotate the rosette, move the rubber into a valley of the rosette, and lock the rubber down. Move the Crossing Wheel by hand to ensure there is no play, and the rubber is firmly in the valley of the rosette. Adjust the rubber to remove the play, if any. Move the rosette to the other side (180 degrees) and again check there is no play in the Crossing Wheel. Adjust the rubber accordingly. Adjust the spring pressure (Figure 3) to ensure the rosette is held firmly against the rubber.

Attachment D – Checking blank both axially and radially.

a. Axially - place a dial indicator against the face of the blank and turn the headstock spindle. If the leveling chuck is in alignment axially there will be minimal movement of the indicator. If the leveling chuck needs to aligned identify which square-headed bolt needs to be loosened and the opposite bolt that needs to be tightened. Use a 3/8” flat wrench to make both adjustments. Repeat the process until there is minimal movement of the indicator.



a. Radially - place a dial indicator against the spindle of the blank and turn the headstock spindle. If the leveling chuck is in alignment radially there will be minimal movement of the indicator. If the leveling chuck needs to be aligned identify which allen screws needs to be loosened and the opposite screw that needs to be tightened. Use a 1/8” allen wrench to make both adjustments. Repeat the process until there is minimal movement of the indicator.



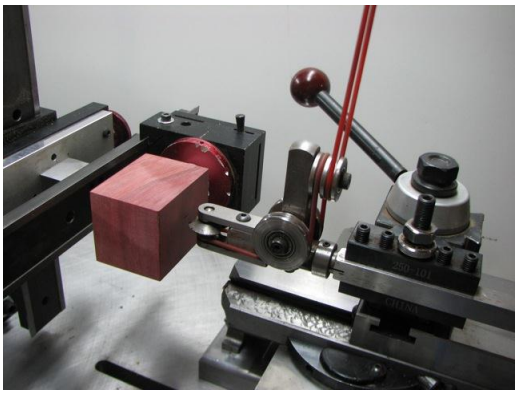
Attachment E – Find exact center height of the Universal Cutting Frame.

a. This is an important step to ensure the height of the Universal Cutting Frame is at the exact center of the spindle.

b. Install a rubber in a 24 sine rosette.

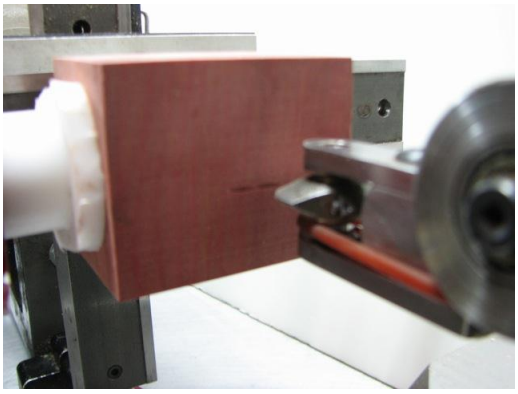
c. Install the holding chuck on the spindle and tighten a piece of flat stock in the holding chuck

d. Move the Universal Cutting Frame slightly to one side of the center line and make a small cut.



e. Move the rosette 12 times (180 degrees) and make another cut. Both cuts should be at the same height.

f. If not, adjust the Universal Cutting Frame by loosening the tool post lever and adjust the Universal Cutting Frame up or down to correct the difference. Make two more cuts to check the new adjustment.



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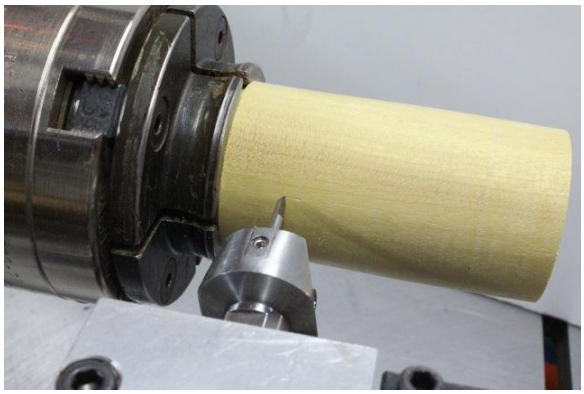
Attachment F – Find exact center height of the eccentric cutting head.

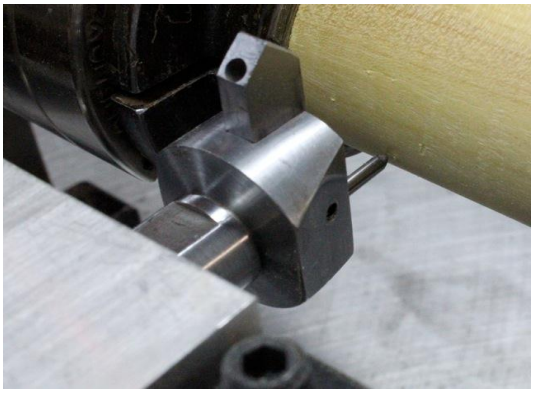
Center height on the side of a cylinder

a. On the sliderest install the Drilling Frame and the eccentric cutting head with the 60 degree cutter. Move the sliderest to be 90 degrees, perpendicular to the cylinder.

b. Rotate the cutter to the top of its movement, top dead center, and move the cutter in until it scratches a fine line. Set the sliderest dial to zero.

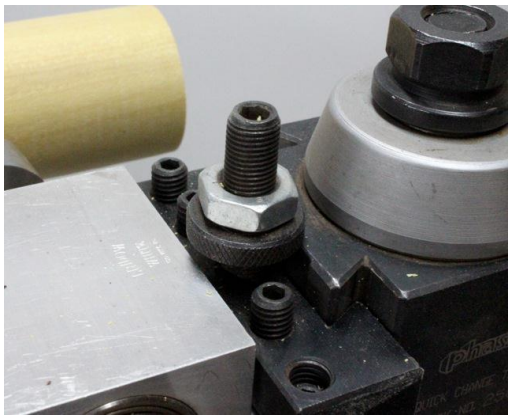


c. Rotate the cutter 180 degrees until it is at the bottom of its movement and move the cutter in until it scratches a fine line the side of the cylinder.



d. If the sliderest dial reads zero then the eccentric cutting head is at center height. If not, calculate which direction the Drilling Frame has to move to be on center and use the adjustment nut to move the eccentric cutting head up or down.

- if the cutter scratches a line before zero then the Drilling frame must be moved down.
- if it scratches the line after zero then the Drilling Frame must be moved upward.



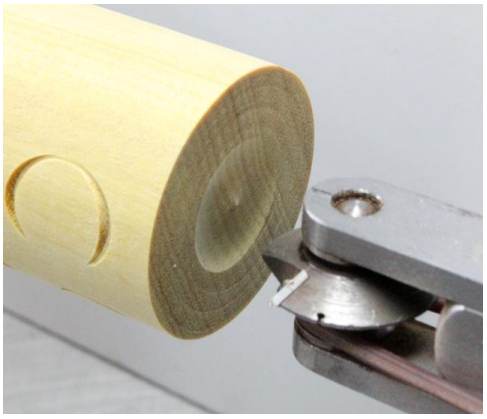
e. The following photo is where the pattern is on center, too low (Drilling Frame too high), and too high (Drilling Frame too low).

Center height on the end of a cylinder

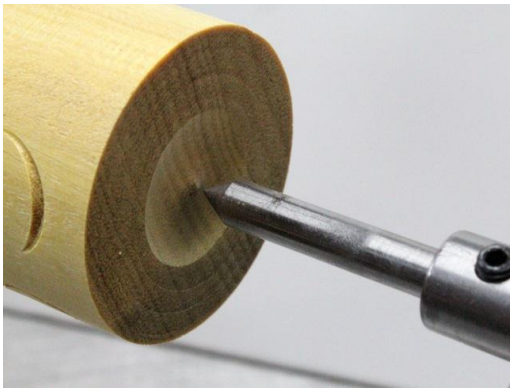
a. Move the sliderest to be inline to the cylinder, and square to the RE top.

b. Method 1.

I. Using the UCF cut the end of the cylinder to shape a dimple in the middle of the cylinder.



II. Install the Drilling Frame and insert a ¼" end mill holder that has a rod with a sharp point installed in it. If the extra length is not needed a pointed cutter can also be used in a collet.



III. The two sharp points should meet. If not, calculate which direction the Drilling Frame has to move to be on center and use the adjustment nut to move the Drilling Frame up or down.

c. Method 2.

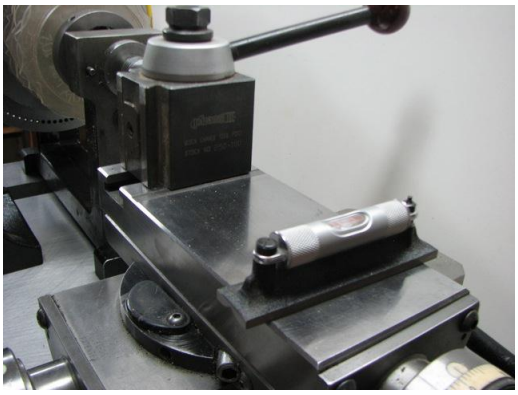
I. In a holding chuck install a cylinder that has a sharpened point. Use a Drilling Frame with the ¼" end mill holder and the rod with the sharp point.

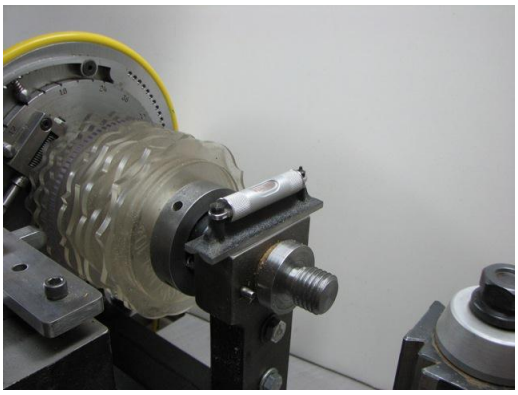
II. The two sharp points should meet. If not, calculate which direction the Drilling Frame has to move to be on center and use the adjustment nut to move the Drilling Frame up or down.

Attachment G - To ensure both the slides on the Double Eccentric Dome Chuck are perpendicular and level.

On the Double Eccentric Dome Chuck there are two slides both of which have to be level with the table when the headstock is at top dead center. First, install the chuck on the mandrel, and set the detent on the Crossing Wheel to 24.

First, place an adjustable level (Starrett No 78 used here) on the bed of the sliderest and adjust the bubble to its center. Then place the adjustable level on top of the headstock, and move the knurled adjustment nut, that adjusts the headstock, to move the headstock to top dead center.

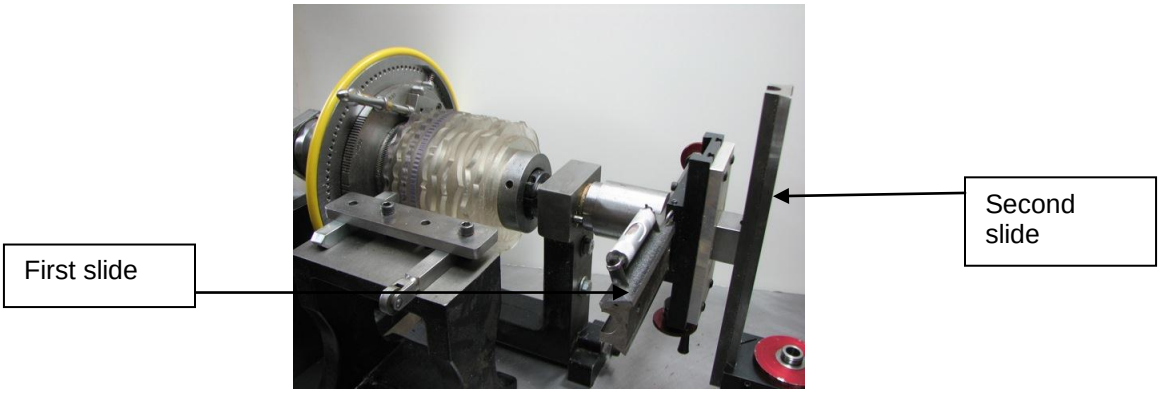




Use the knurled adjustment nut at the top of the spring to bring the headstock to top dead center.

First slide – move a 45 degree rubber into the valley of a 24 sine rosette. Move the Double Eccentric Dome Chuck so that the first slide is close to being level with the headstock. Place the adjustable level on the headstock and check that the headstock is top dead center and the rubber is in the valley of the rosette. Place the adjustable level on the top of the first slide (Figure 1). If the first slide is not level use the key to turn the Crossing Wheel worm until the first slide is level with the headstock.

Figure 1 – Leveling the Dome Chuck first slide



Second slide - move the rosette 6 bumps (or 25% of the rosette). This should make the second slide level with the headstock (Figure 2). Place the adjustable level on the headstock and check that the headstock is top dead center, then place the adjustable level on the side of the second slide. If the second slide is not level there are two ways to adjust the slide. Either loosen the four screws at each corner of the aluminum plate, or loosen the four bolts holding the second slide to the center of the aluminum plate. There is more adjustment using the first method.

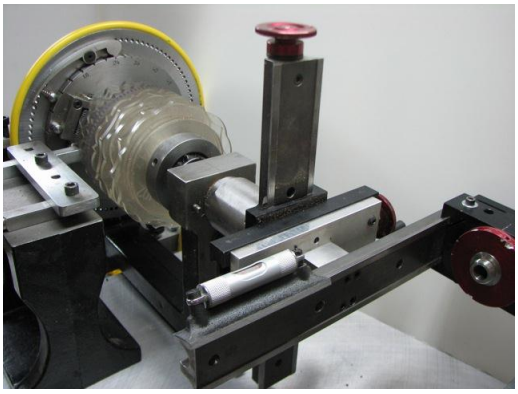


Figure 2 – Leveling the Dome Chuck second slide

Attachment H – Accurately setting the radius of the eccentric cutting head.

a. To accurately set the eccentric cutting head to cut the correct radius it is important to understand what dimensions need to be added to cut the correct radius.

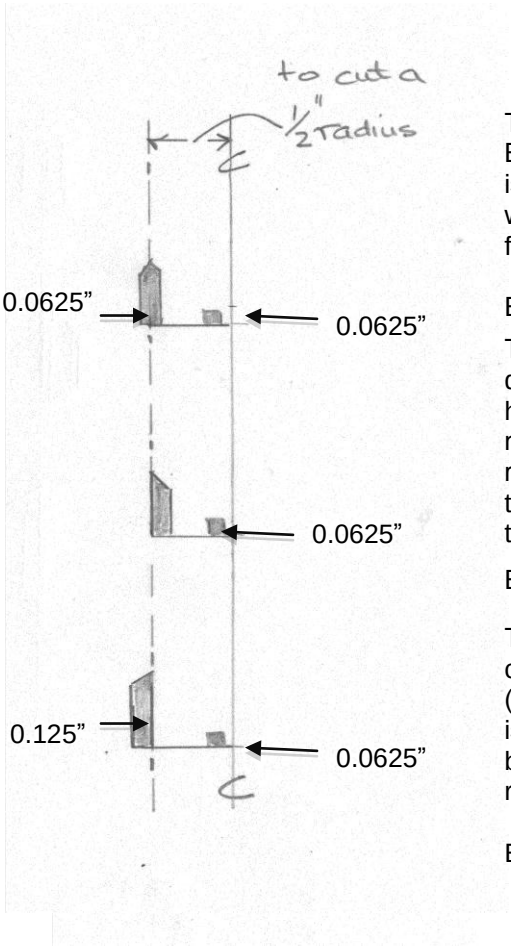
b. First, on the eccentric cutting head the two 1/8” buttons located at the center of the Eccentric Cutter are used for setting the radius. Since they are 1/8” in diameter the edge from which calipers will measure is 0.0625” from the center point. This dimension is always added to the planned radius. In others words the measurement on the calipers will be .0625” more than the actual radius of the cutter.

c. Secondly, the other dimension to be added depends on the type of cutter used. See below for three cutter examples.

d. In all projects add the following to the planned radius:

I. 1/8” center point cutter … add 0.125”.
II. 1/8” right hand 45 degree cutter … add 0.625”.

III. 1/8” left hand 45 degree cutter … add 0.188”.



All three examples below will cut a 0.5” radius or 1” diameter circle.

The first example is the 1/8” center point cutter. Because half the diameter of the cutter (0.0625”) is outside the 0.5” radius this dimension is added, with the distance (0.0625”) the two buttons are from the centerline, to the planned radius.

Example: 0.5” + 0.0625 + 0.0625 = 0.625”

The second example is the 1/8” right hand 45 degree cutter. (Note Here that a right hand cutter has the cutting edge on the left side.) Because none of the cutter diameter is outside the 0.5” radius therefore only the distance (0.0625”) the two buttons are from the centerline is added to the planned radius.

Example: 0.5”+0.0625”=0.5625”

The third example is the 1/8” left hand 45 degree cutter. Because all of the diameter of the cutter (0.125”) is outside the 0.5” radius this dimension is added, with the distance (0.0625”) the two buttons are from the centerline, to the planned radius.

Example: 0.5” + 0.125” + 0.0625” = 0.688”