Machining Stone Seals (UVZH)

RSD-SUNMAX Series

SUNMAX LASER

About this document: This is an English translation of the Japanese original prepared by SUNMAX LASER for reference purposes. In case of any discrepancy, the Japanese original shall prevail. Specifications are subject to change without notice.

Machining Stone Seals

Alignment Using the Red Pointer

- This document assumes that the RSD-SUNMAX-UVZH laser machine has been set up correctly.
- This document assumes that EzCad2, the control software for the RSD-SUNMAX-UVZH, has been installed correctly.
- This document does not cover how to create data. Please prepare outline data for the seal face.
- This document describes machining stone (gemstone / semi-precious stone) seals such as crystal, amethyst, agate, jade, and lapis lazuli, using the red pointer for alignment.
  Note that with the RSD-SUNMAX-UVZH, the red pointer cannot be seen visually on most stone seal blanks. For this reason, a sheet of blank paper (copy paper in this document) is used as an aid.

About the machining methods described in this document

This document explains two machining methods. Their preparation and settings are identical, but the way the focus is set on the seal blank during engraving differs.

In **machining using a height gauge**, a height gauge is used to precisely set the focal distance before machining starts, and the number of repetitions determined by the blank material is set for machining.

In **machining with visual focal distance adjustment**, the state of the laser irradiation is checked visually during machining, and engraving proceeds while the focal position is adjusted as required.

As a general rule, we recommend using "machining with visual focal distance adjustment."

"Machining with visual focal distance adjustment" is a method in which the state of the laser irradiation on the seal face is judged visually and the focal distance is fine-tuned, so a certain amount of experience with the work is required. In addition, depending on the blank material and the data content, it can be difficult to check the engraving depth during machining, which also takes experience. However, machining can be completed quickly and efficiently.

By contrast, "machining using a height gauge" is a method that allows machining through mechanical settings and operations, in order to avoid the "experience" required by "machining with visual focal distance adjustment" and the variation in quality caused by differences in operator skill. However, stone blanks may differ in composition even when they look identical, so a fixed set of values and steps will

produce variation in engraving depth. The settings and procedures given in this document are no more than a rough guide. Also, if the precise focal distance measured with the height gauge at the start of machining is even slightly off due to measurement error or similar, that alone can affect the final result, and the final engraving depth will vary.

Judging the state of the laser irradiation on the seal face for "machining with visual focal distance adjustment" can be learned by practicing on a few blanks. You will also get a feel for the engraving depth by repeating the machining.

Machining Data

The explanation in this document uses the figure below (circumferential text: SUNMAX LASER Co., Ltd. / inner text: Representative Director's seal).

The data is an .ai file saved in "Japanese Illustrator 3" format.

Any outline data file format that EzCad2 can import can be machined.

The outline data does not have to be at actual size.

> **Caution:** Make sure that the outline paths do not overlap. If there are duplicate lines, the seal face cannot be machined correctly.

> **Caution:** Make sure that all paths are closed. Open paths will not be engraved.

Preparation

Before machining a stone seal blank, check the EzCad2 settings.

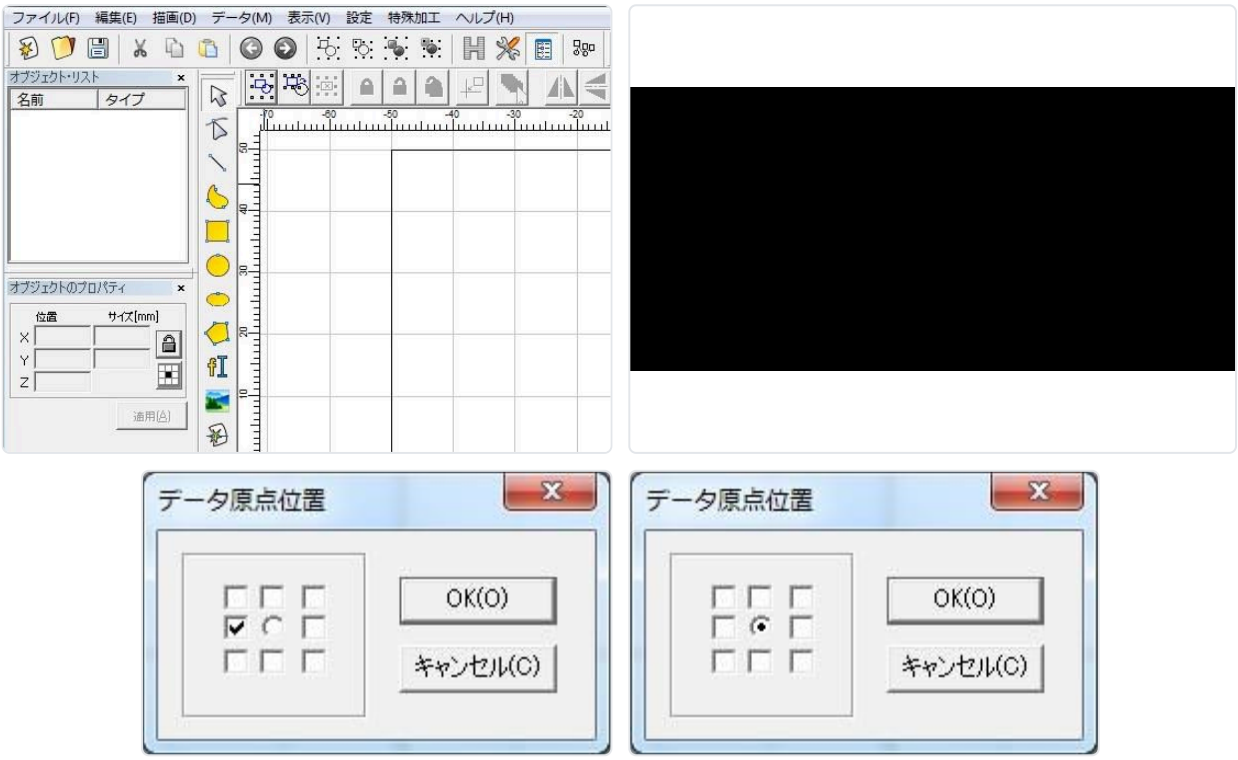
This does not have to be done for every job, but if the settings are not correct the machining position will be misaligned.

(1) Laser settings

Refer to the separate "User Manual.pdf" (6.4.1.4 Setup method) and configure and adjust the settings so that the data content matches the machining result.

(2) Setting the data origin

Set the data origin to the center.



If the data origin is not at the center, click the button to set it to the center.

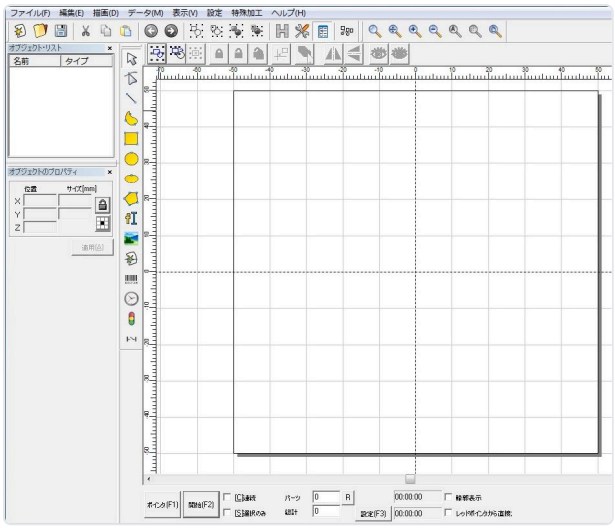
Callouts: "O Center" / "X Other than center" / "Click" / "Select Center and click OK"

(3) Checking the red pointer settings

Separately from the red pointer setting described in "(1) Laser settings" above, check the red pointer settings that are used for positioning when producing seals.

Check the settings using the following procedure.

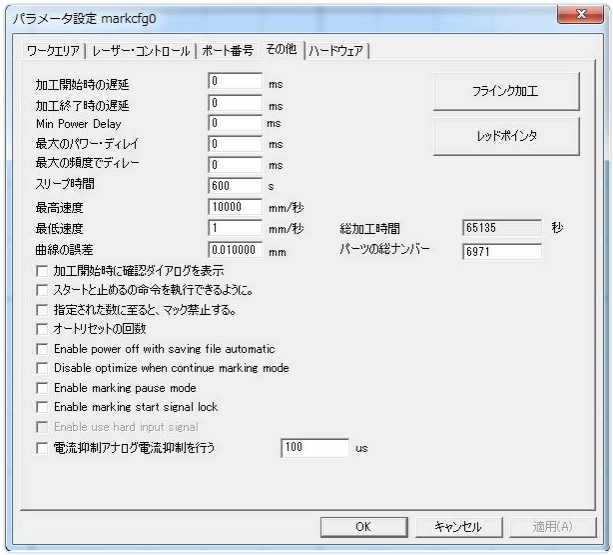
Click the settings button at the bottom of EzCad2.



Callout: "Click here"

The "Parameter Setting" dialog appears. Click the "Other" tab.

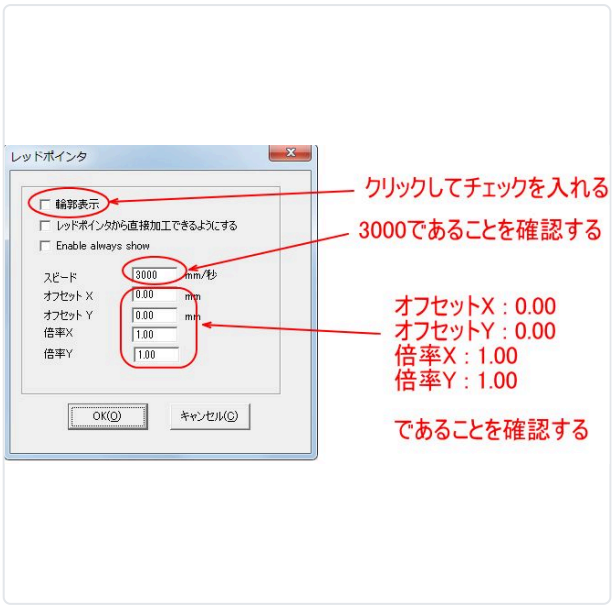
After clicking the "Other" tab, click the "Red pointer" button.



Callouts: "Click here" / "Click here"

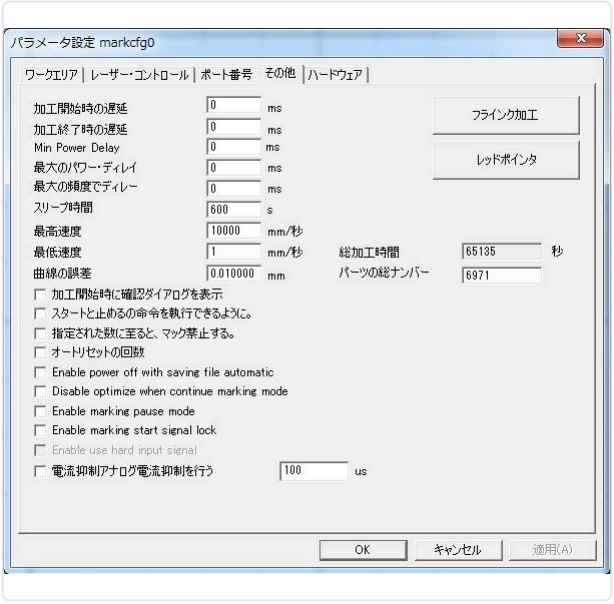
When you click the "Red pointer" button, the "Red pointer" dialog appears. Change the settings as follows.

- Click "Show contour" to select the check box.
- Set "Speed" to 3000. (3000 is the default value.)
- Confirm that Offset X and Y are 0.00 and that Ratio X and Y are 1.00. If the values differ, alignment will not be possible, so change them.



When you have finished, click the OK button.

The "Red pointer" dialog closes and the "Parameter Setting" dialog is displayed again. Click OK there as well.



This completes the change of the red pointer settings.

(4) Precise focal distance measurement using a height gauge

To perform machining using a height gauge, accurately measure the focal distance specific to your machine. If you perform machining in which the focal distance is adjusted visually, a height gauge is not required and this step is not necessary.

Use a height gauge with a measuring range of approximately 0 to 450 mm or greater. A common 0 to 300 mm gauge cannot be used. Analog or digital types may be used.

When measuring the precise focal distance with a height gauge, follow the procedure below.

This becomes the reference for "machining using a height gauge." If the measurement is not performed properly, machining using a height gauge will not be possible at all, so carry out every step carefully.

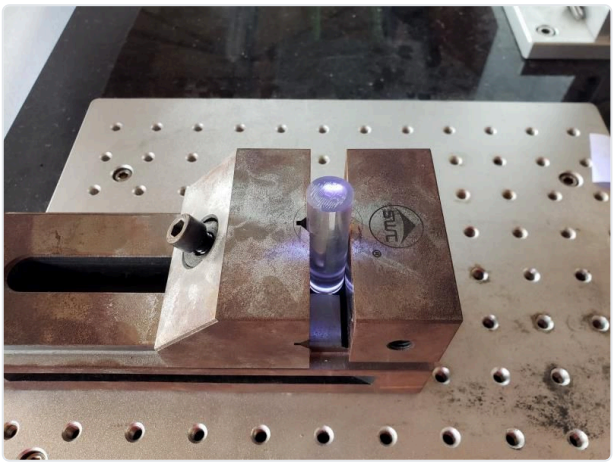
1. Check the focal position visually using a seal blank

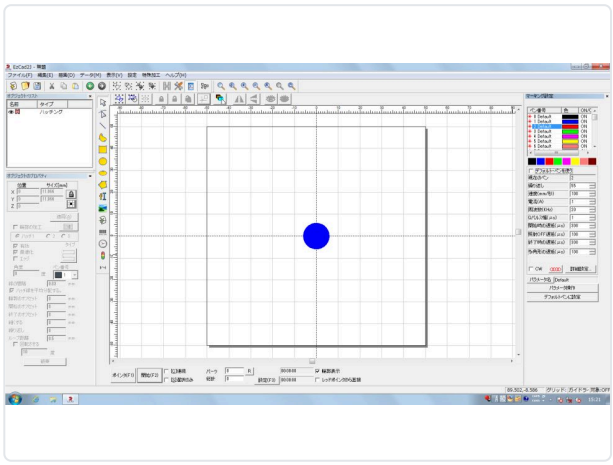
Clamp the blank in the vise, fire the laser, and find the focal distance.

Transparent, hard crystal (clear quartz) is the most suitable blank to use. Colored quartz is also acceptable. Materials such as lapis lazuli, on which the way the light appears is difficult to judge, cannot be used. Also, even if transparent, blanks made of resin or other materials that melt with heat cannot be used.

While irradiating the seal face with the laser, move the laser head up and down to find the position where the light is brightest. Refer to "How to change the focal position during machining" and "How to check for the correct focal position" in "Machining with visual focal distance adjustment" and adjust accordingly.

Perform this work quickly. As engraving progresses, the height of the seal face becomes unclear, so decide the position on the first pass whenever possible.



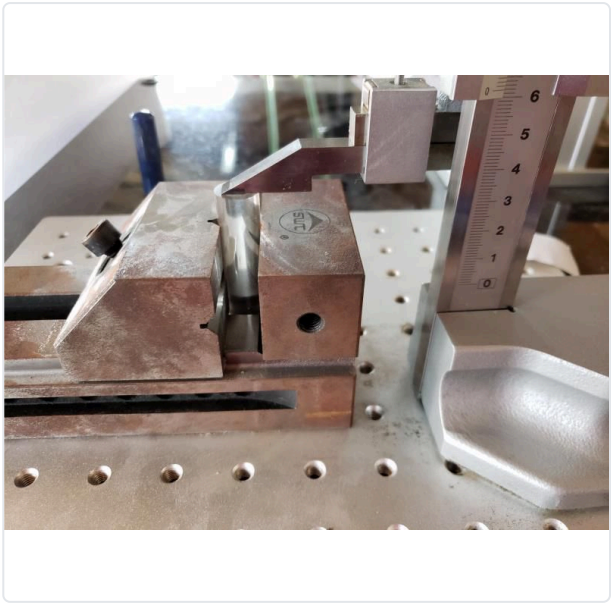


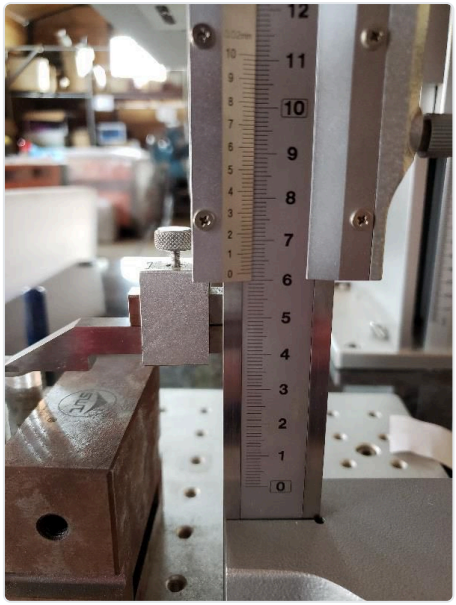
Machining data in the form of a circle that fits within the size of the seal face makes it easier to check.

2. Measure the height of the seal face

Measure the height of the seal face using the height gauge.

Because the purpose is to measure the distance between the seal face and the reference position of the laser head, the numerical value of the distance from the table to the seal face is not important. With a digital type on which a zero point can be set, it is easier to set the seal face height to 0. With an analog type, if the scale can be moved, move it so that the seal face height is a round number.





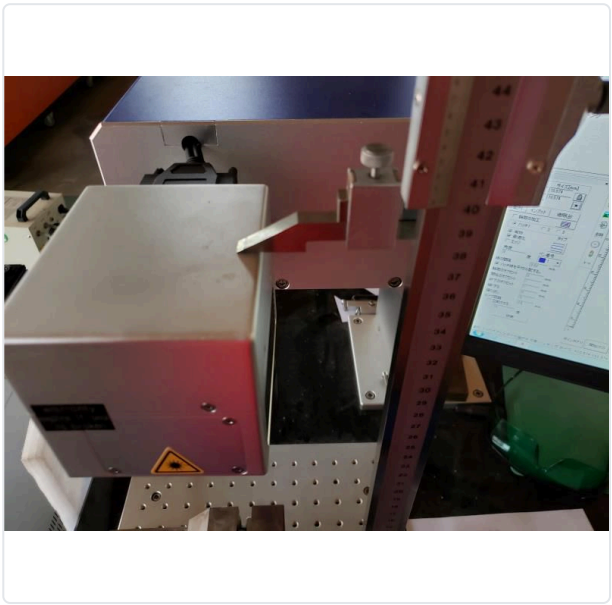
Note down the measured value of the seal face height.

3. Measure the height of the laser head

Measure the height of the top of the laser head.

Because the laser head itself is not manufactured to a high degree of precision, you must always measure at the same location with the height gauge.

In this document, the measurement is taken at the right-hand end, centered front to back. This position is referred to as the "reference measuring position."



Make a note of the measured height of the top surface of the laser head.

4. Calculate the reference focal distance

Calculate the difference between the measured height of the top of the laser head and the measured height of the seal face.

Reference focal distance = height of the top of the laser head - height of the seal face

In the example in this document, the reference focal distance came to 337.02 [mm].

From here on, focusing is performed based on this reference focal distance.

The focal length of the machine is normally indicated as approximately 200 [mm], but that value represents the distance between the workpiece and the lower edge of the camera cover. When measuring with a height gauge, the measuring point is the top surface of the laser head, so the value is larger.

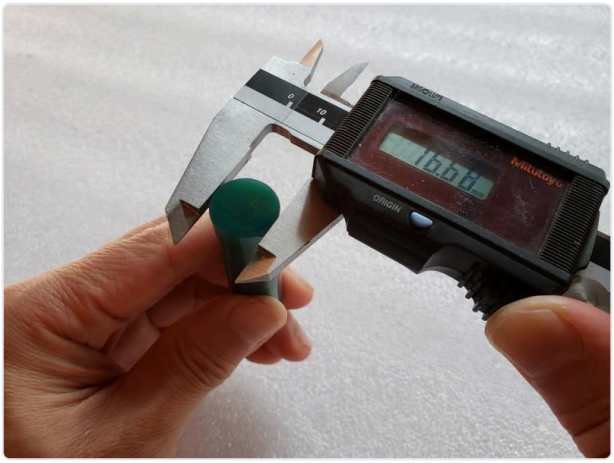
Procedure

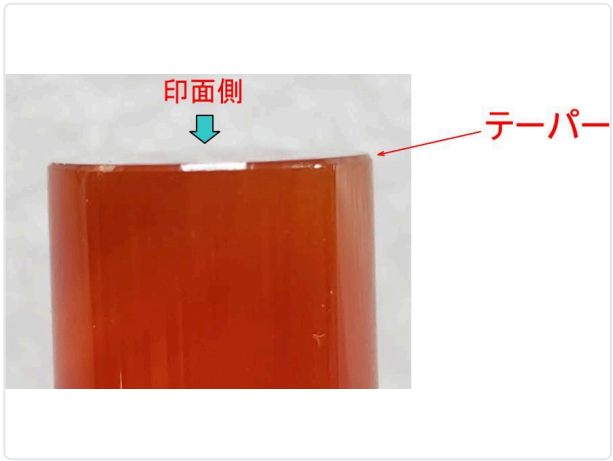
Machining is performed according to the following procedure.

(1) Measuring the size of the seal face

Measure the diameter of the seal blank to be machined with calipers.

Stone seal blanks are generally not very precise, and the readings can vary depending on where you measure, so measure the diameter at the end on the seal-face side. Also, since the blank is not perfectly round, take several measurements while rotating the seal blank. If the shape is distorted, the seal face must be treated as an ellipse.

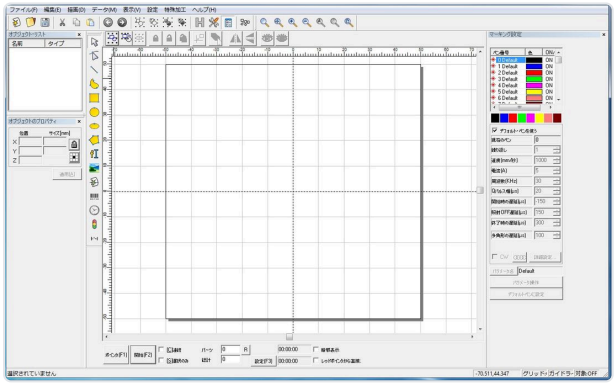




In addition, depending on the seal blank, the edge of the seal face may be tapered, in which case the diameter of the seal face is smaller than the diameter of the seal blank.

With a tapered seal blank, the diameter of the seal face cannot be measured with calipers. The taper width is normally about 0.2 mm. Subtract taper width x 2 from the measured diameter of the seal blank to obtain the size of the seal face.

If the taper width is unknown, measure an approximate value for the time being and adjust it later as required.



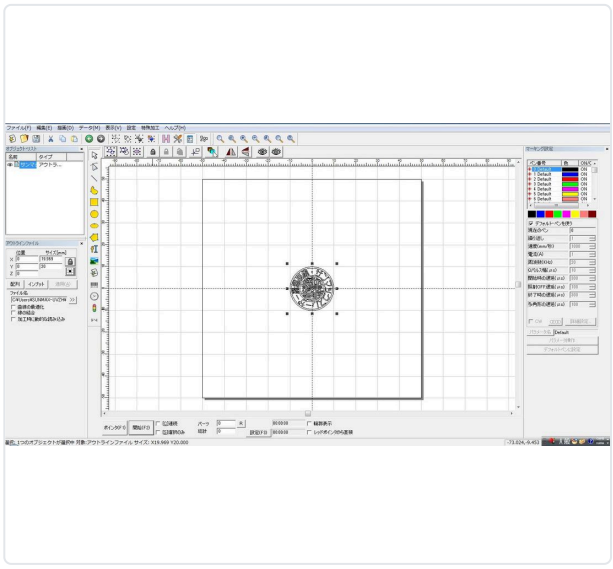
(2) Importing the outline data

Import the data in EzCad2.

To import, click "Outline data."

You can also import from the menu by selecting "File" - "Import outline data," or "Draw" - "Import outline data."

Import outline data



Select the "Centering" check box

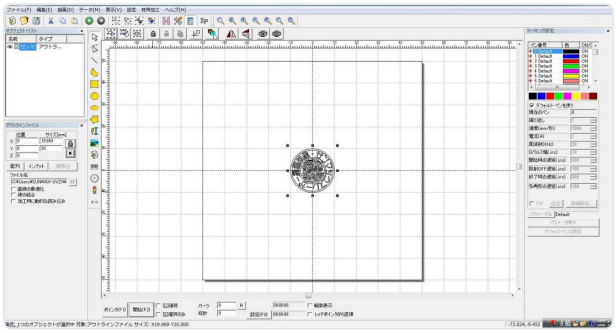
Seal data

(3) Editing the data

Edit the data so that it can be used as seal face data.

1. Display the entire seal face enlarged

Select the seal face data, then click "Show entire selected object."



Show entire selected object

2. Setting the pen number

Depending on the situation, the imported outline data may be displayed in a pen color other than black. If it is drawn in a color other than the black pen, change the pen number.

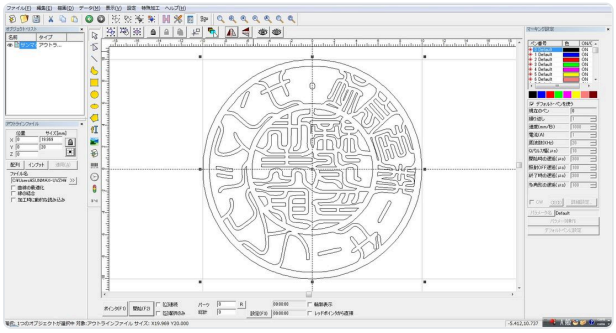
To change the pen number, select the data and click the black button.

Click black

3. Mirroring the seal face

To turn the design into a seal face, mirror it horizontally. If the data was already mirrored horizontally before importing, this step is not necessary.

To mirror the seal face horizontally, select the data and click the "Mirror horizontally" button.



Mirror horizontally

4. Setting the seal face size

Set the data to the actual size of the seal face.

Measure the seal blank and match the size of the data to the actual dimensions of the seal face.

To change the size of the data, select the data, enter the size, and click "Apply."

(1) Enter the size of the seal face

(2) Click

> **Caution:** This is the size of the seal face, not the size of the seal blank. Take care when the seal face is tapered.

> **Caution:** In the figure above, position X and position Y are (0, 0), but in practice the values may differ depending on the seal face size.

> **Caution:** Set the size to two decimal places.

> **Caution:** If the seal blank is distorted and cannot be regarded as a perfect circle, size X and size Y will be different values. Align the orientation of the seal blank and the data when making the setting.

> **Caution:** Note that if you forget to click the "Apply" button, the size setting will not take effect.

5. Setting the position of the seal face

Center the data.

Select the data and click the "Centering" button.

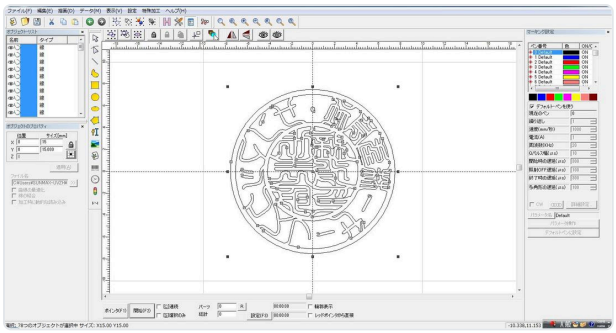
* Perform this step if the data has shifted off center as a result of the size setting or similar operations. If it has not shifted, simply proceed to the next step.

Centering

6. Ungrouping

When outline data has been imported, the data is grouped, so ungroup it.

Select the data and click the "Ungroup" button.

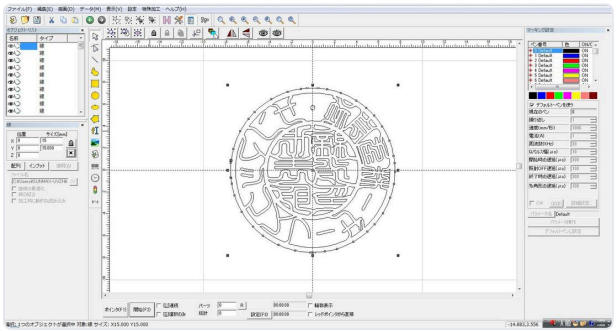


Ungroup

7. Changing the outer frame to the green pen

Change only the outermost frame to the green pen.

To change the pen number of the outer frame, select only the outermost path and click the green button.

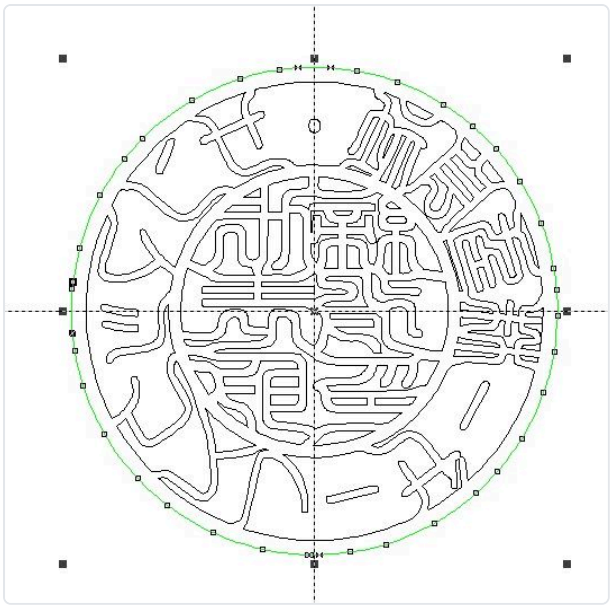


Click green

8. Regrouping the seal face

Group only the inner black-pen portion.

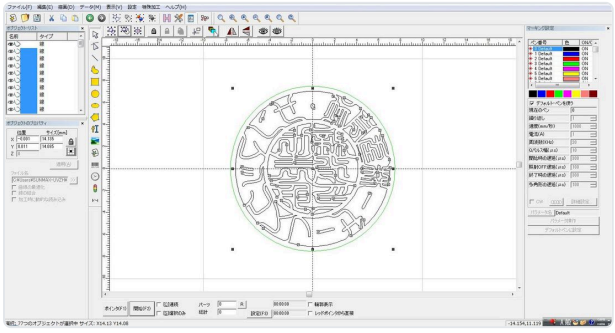
First, click the outermost green-pen object with the mouse to select it.



Click only the green-pen outer frame to select it

It can also be selected from the object list

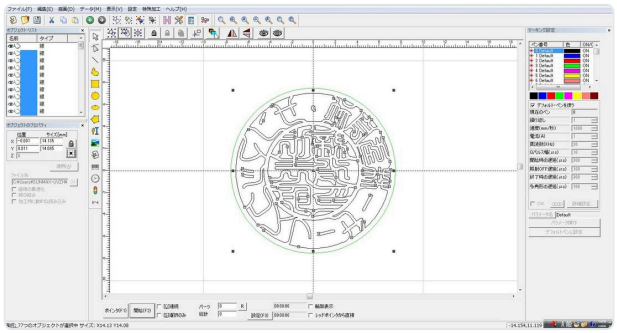
Next, click the "Exclusive select" button.

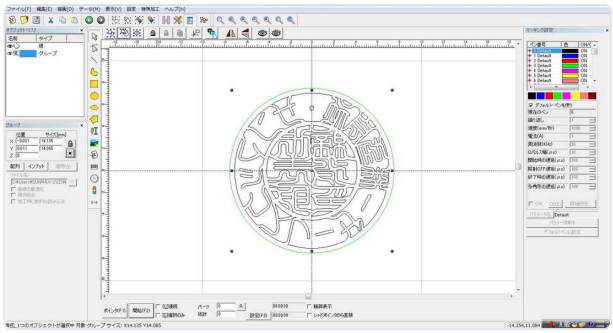


All objects other than the outer frame are selected.

Click Exclusive select

Click the "Group" button to group them.





Click Group

(4) Machining settings

Configure the machining settings for the pen used for hatching.

Only the blue pen (pen number 1) is used for hatching.

1. Standard setting values

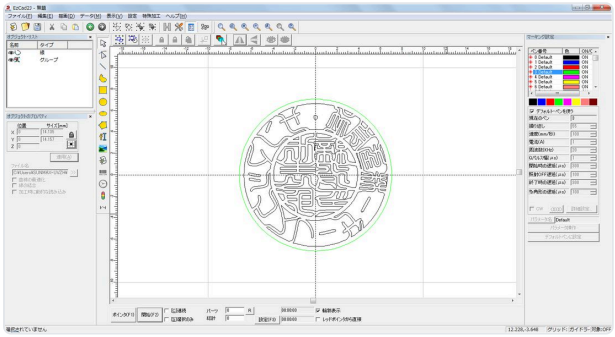
The standard machining setting values for the blue pen are listed in the table below.

RSD-SUNMAX-UVZH	Setting value
Pen number	1 (blue)
Repeat	3
Speed (mm/sec)	100
Current (A)	1
Frequency (kHz)	20
Q pulse width (μs)	1

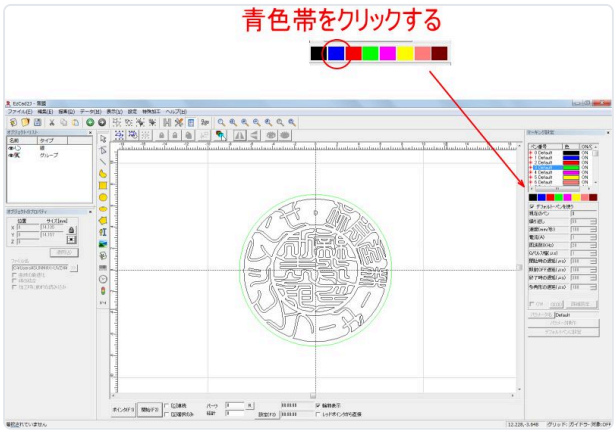
2. Registering and loading the blue pen parameters

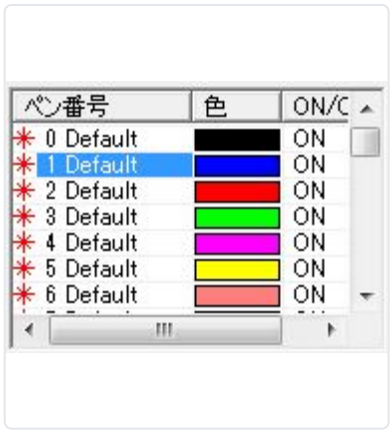
Save and load the parameters for the blue pen. If they have already been saved, registration is not required, so proceed to "3. Loading the blue pen parameters."

First, deselect all objects. Clicking an empty area of the design screen leaves nothing selected.



With no object selected, click the blue selection band to select the blue pen.





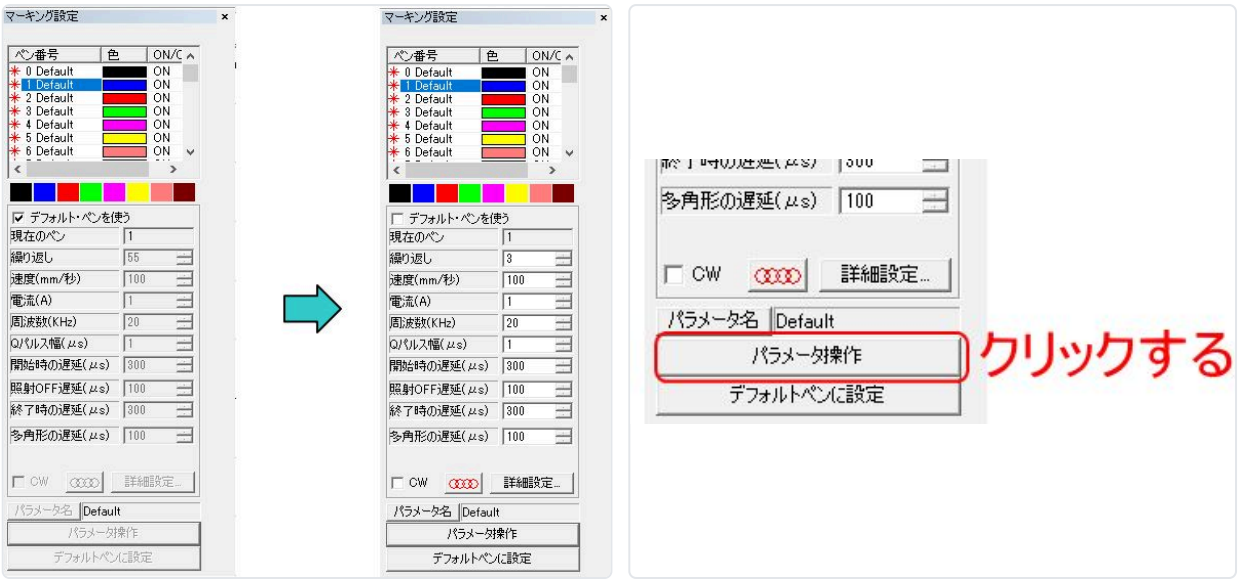
When you click it, the blue row in the list above becomes selected (highlighted).

In this state, enter the standard setting values.

If the "Use default pen" check box is selected, click it to clear the check box before making the settings.

Once you have entered the standard setting values, perform the parameter operation and save them.

Click the "Parameter operation" button to display the "Parameter operation" dialog box.

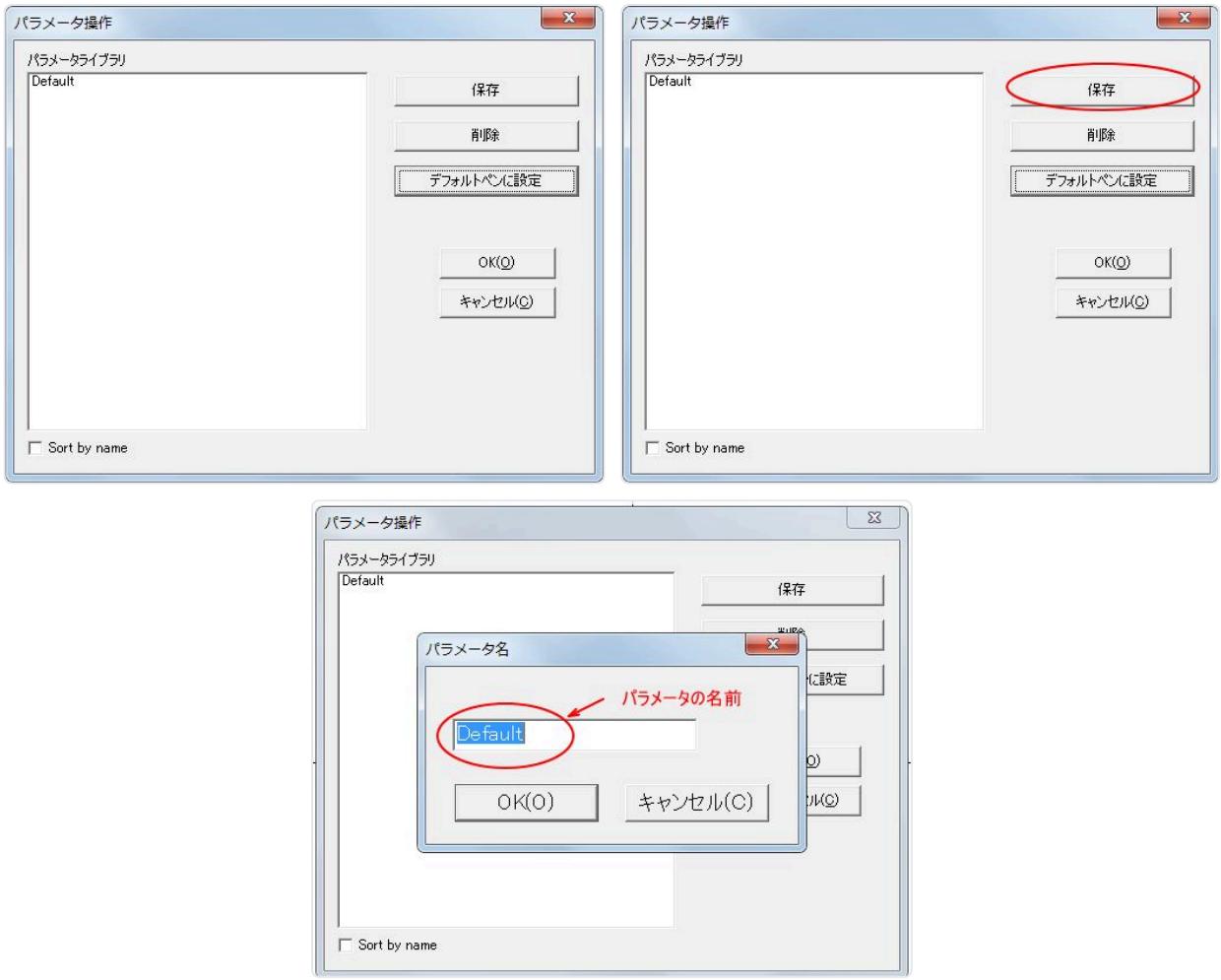


When the Parameter Operation dialog appears, save the current pen settings for use with stone seals.

First, click **Save**.

When you click the **Save** button, the Parameter Operation dialog appears. Enter a name for the parameter set.

The contents of the parameter library may differ from the figure at left, depending on how your system is configured.

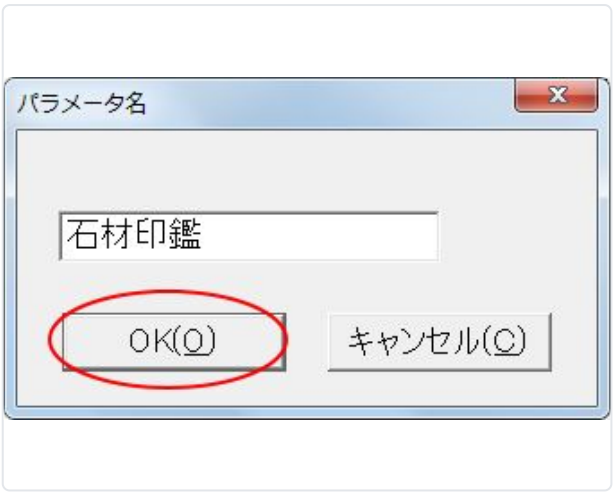


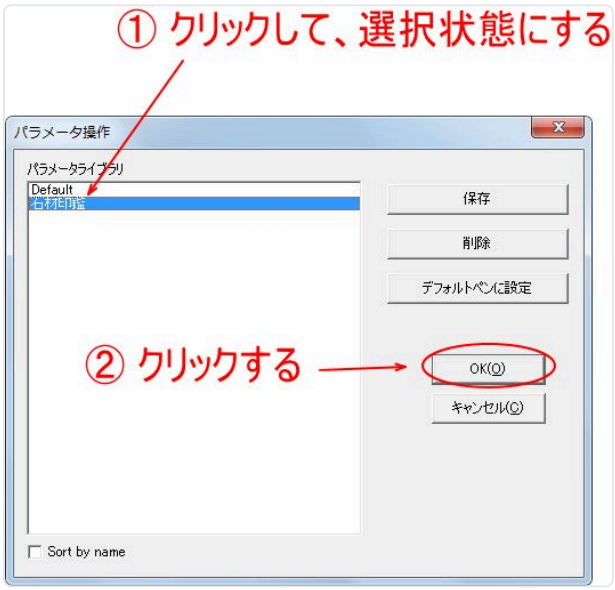
As an example, save the parameters under the name "Stone Seal". After entering the name, click **OK**.

The name you added appears in the parameter library.

Once it has been saved, apply the saved data to the blue pen that is currently displayed.

Click "Stone Seal" to select it, then click **OK**.





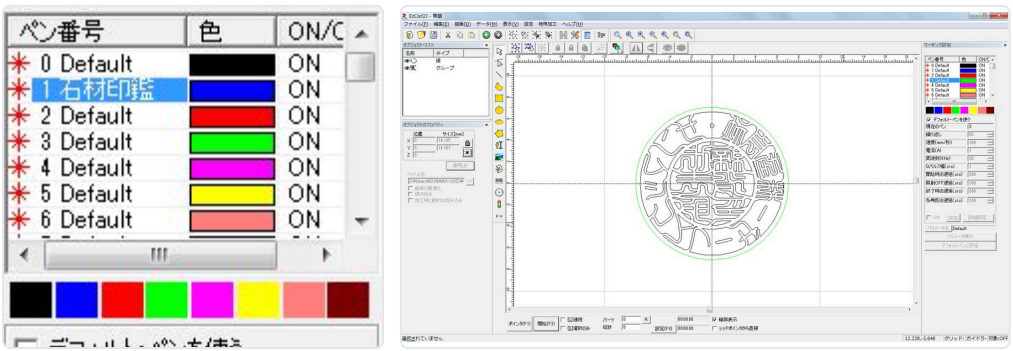
The name of the blue pen changes from Default to "Stone Seal".

When you have finished configuring the blue pen, proceed to "Hatching settings".

3. Loading the blue pen parameters

Load the parameters for the blue pen. If you have already performed "2. Registering and loading the blue pen parameters", loading is already complete, so proceed to the next section, "Hatching settings".

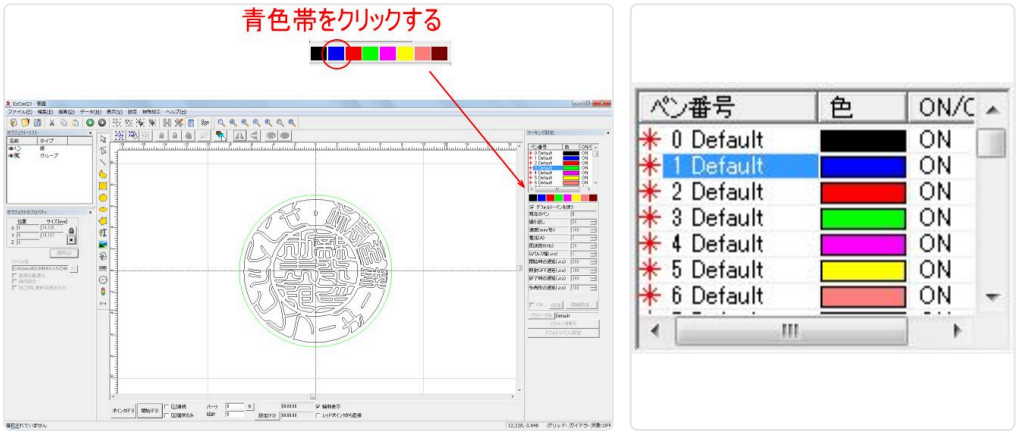
First, deselect all objects. Clicking an empty area of the design screen clears the selection.



With no object selected, click the blue color band to select the blue pen.

When you click it, the blue row in the list above becomes selected (highlighted).

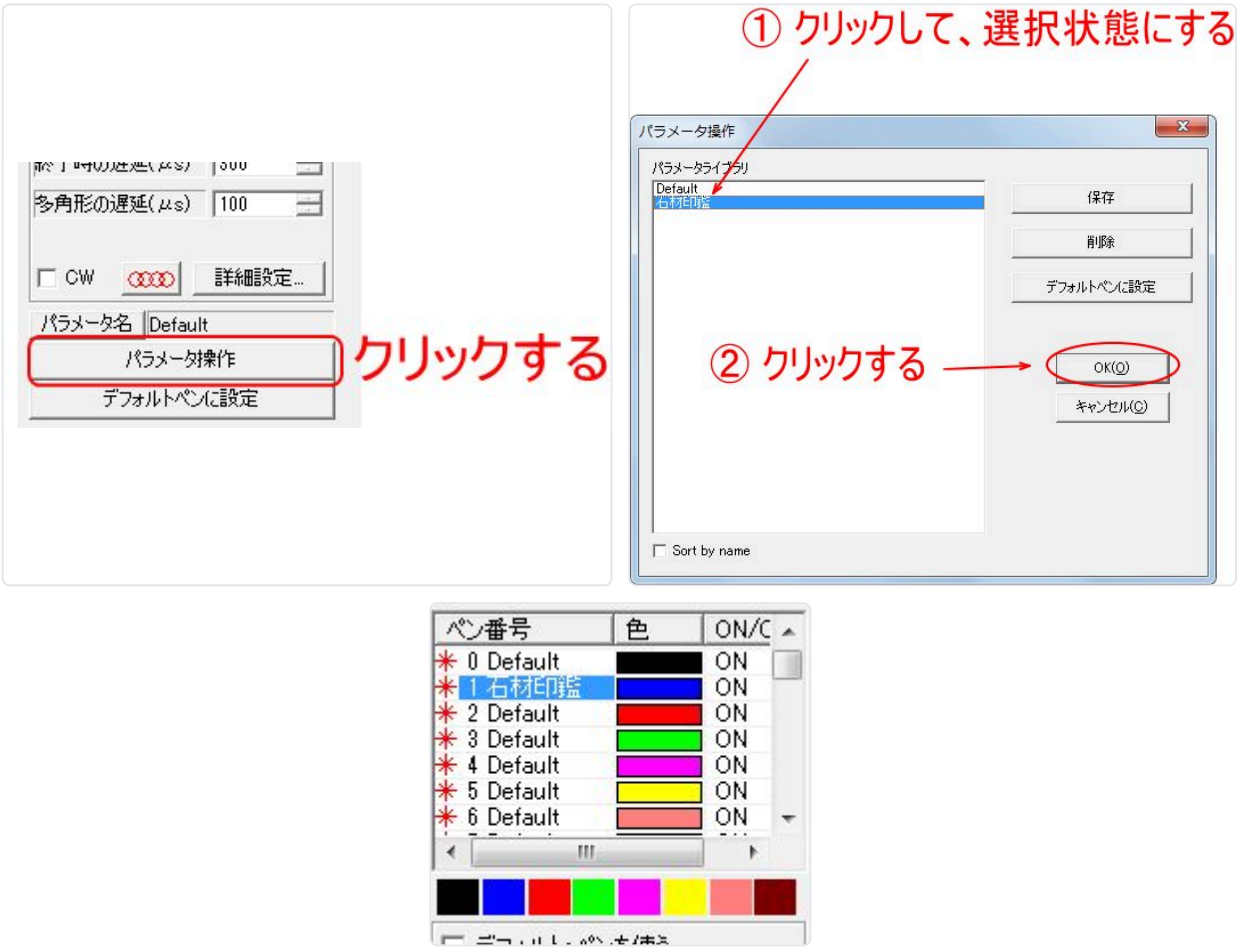
If **Use Default Pen** is checked, click it to clear the check box.



Click the **Parameter Operation** button to display the Parameter Operation dialog.

When the Parameter Operation dialog appears, click the stone-seal parameter set in the parameter library, then click **OK**. In this manual, the parameter set named "Stone Seal" is used as an example.

The name of the blue pen changes from Default to "Stone Seal".



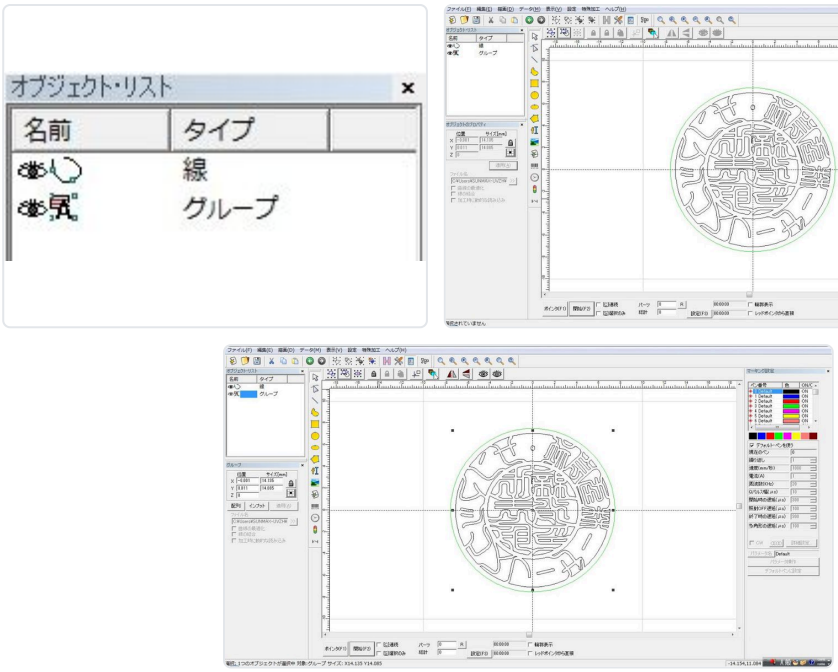
(5) Hatching settings

Configure the hatching settings using the following procedure.

1. Select the black pen area

The black pen area is grouped, so click the group in the object list to select it.

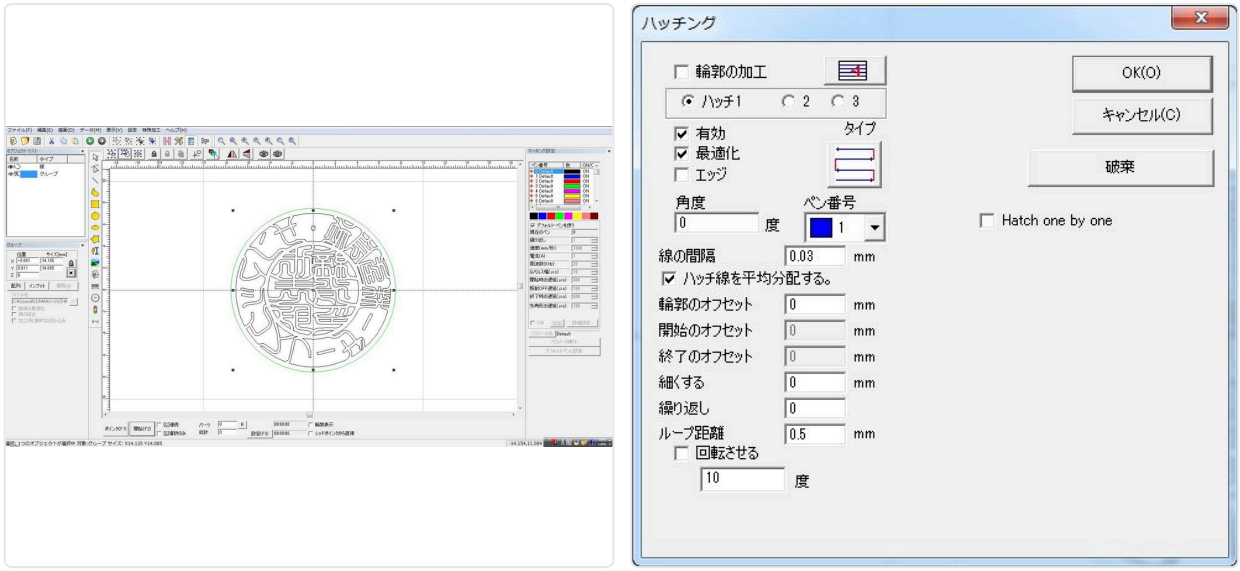
Click here



2. Configure the hatching

Click the **Hatch** button to display the Hatch dialog.

Click here



Configure the Hatch dialog as follows.

Contour machining

Leave **Contour machining** unchecked so that contour machining is not performed.

Hatch 1

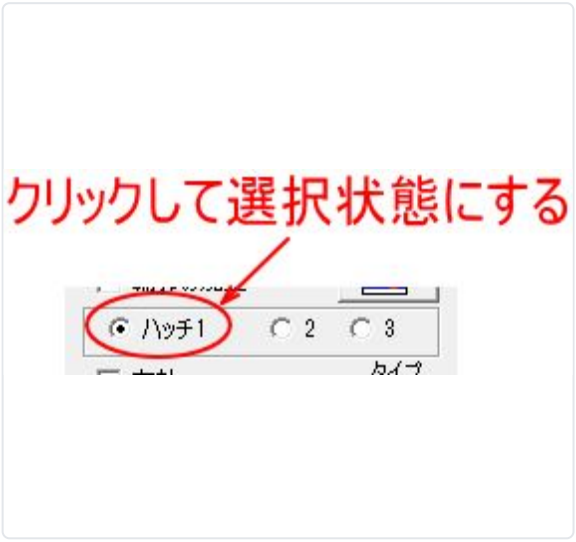
Click **Hatch 1** and configure it as shown below.

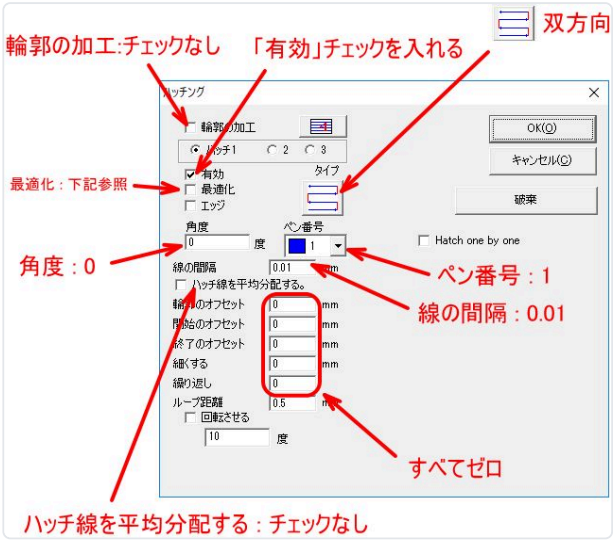
Do not check

* **Optimize**: When this option is checked, travel movement during machining is optimized, which can shorten machining time. It is effective when engraving very fine detail, such as on corporate seals.

However, depending on the data content and the seal blank, enabling optimization may prevent a satisfactory machining result.

As a general rule, we recommend always machining with this option checked, and clearing the check box and re-machining only if a problem occurs.



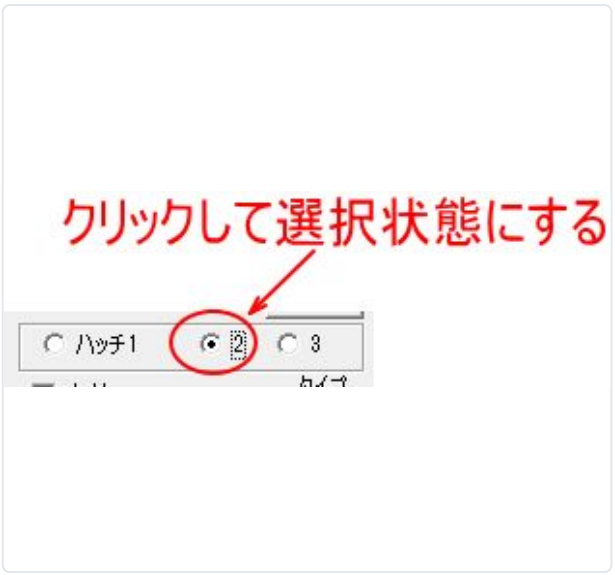


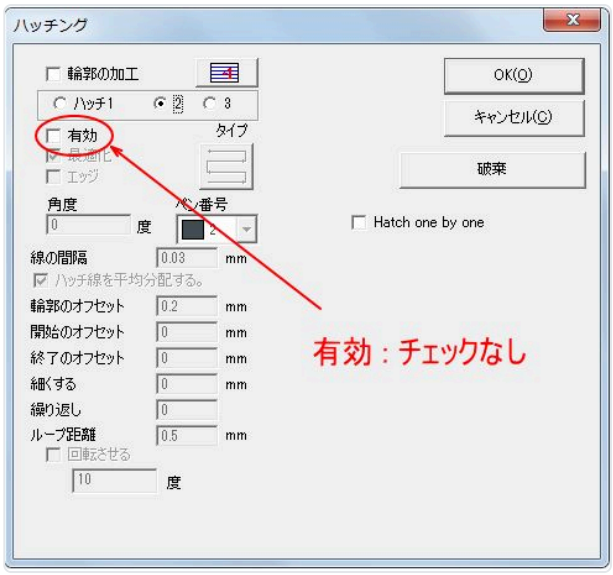
Hatch 2

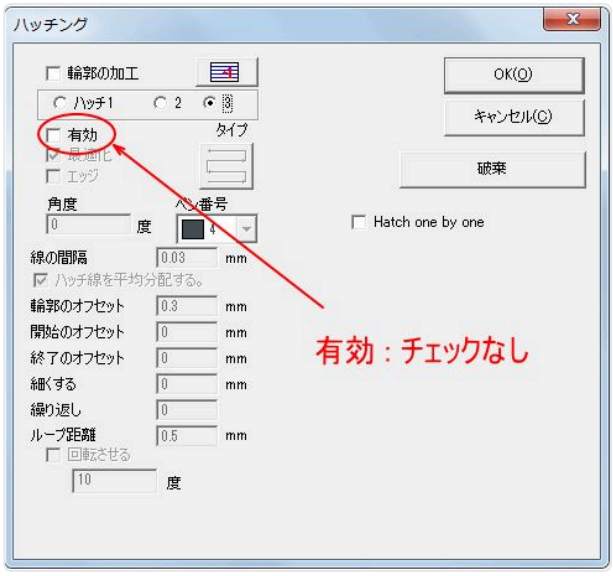
After configuring "Hatch 1", click **Hatch 2** and configure it as shown below.

Hatch 3

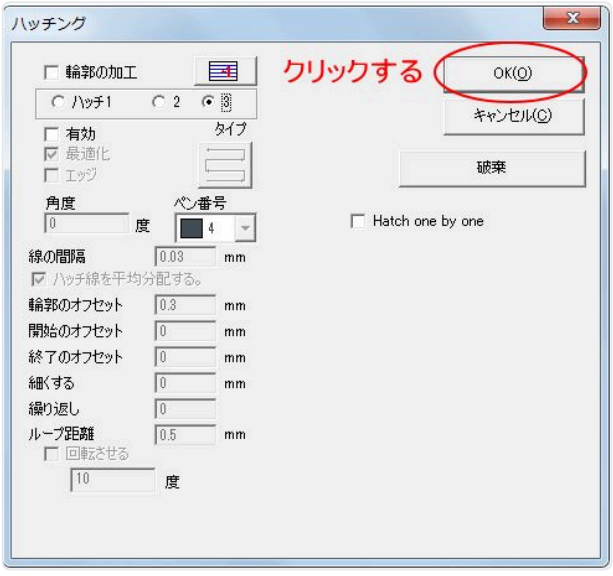
After configuring "Hatch 2", click **Hatch 3** and configure it as shown below.

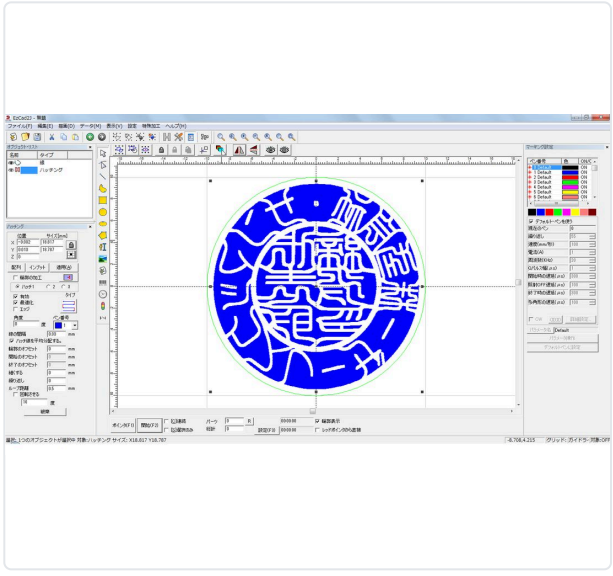






After setting Hatch 1 through Hatch 3, click **OK**.





This completes data creation.

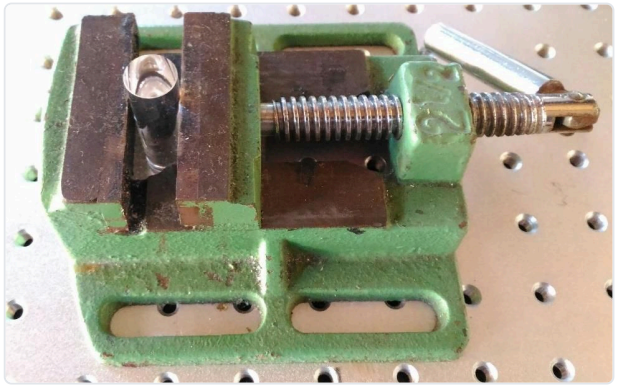
(6) Positioning

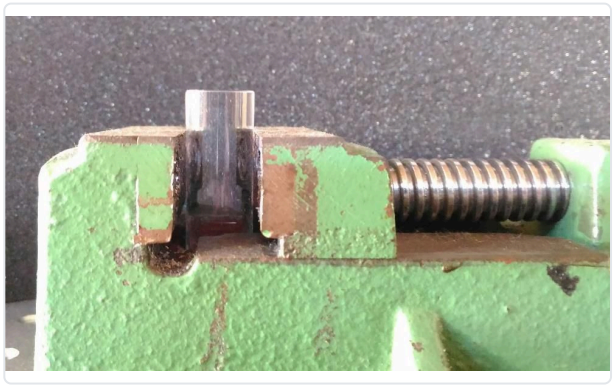
Perform positioning.

1. Securing the seal blank

Secure the seal blank with a vise or similar fixture. Any device may be used as long as the blank can be held vertically. In this document, a vise is used to secure the seal blank.

> **Caution:** Secure the blank so that the seal face is not tilted.

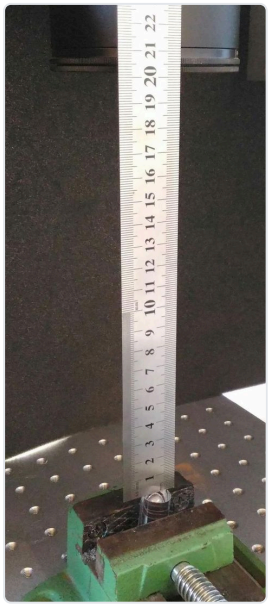




Secure the blank so that the seal face is not tilted.

2. Focusing

Once the seal blank is secured, set the focal distance. Focusing with a ruler is only approximate. If you will be machining using a height gauge, there is no need to perform focusing at this point.



3. Wiping the seal face

Wipe the seal face to be engraved with ethanol or a similar solvent. If adhesive residue from labels or stickers remains, or if fingerprints or oils are present, proper machining may not be possible.

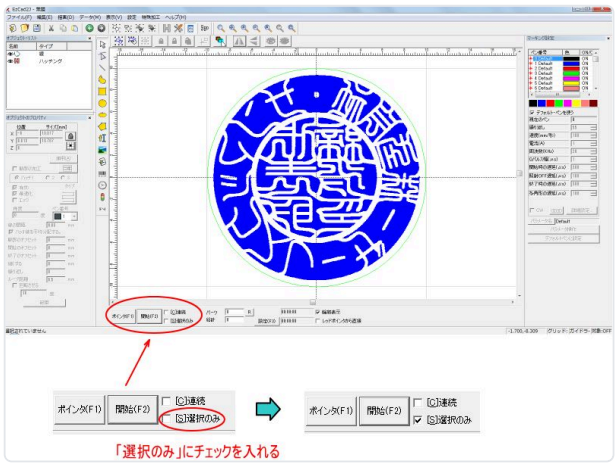
After wiping, do not touch the seal face unnecessarily.

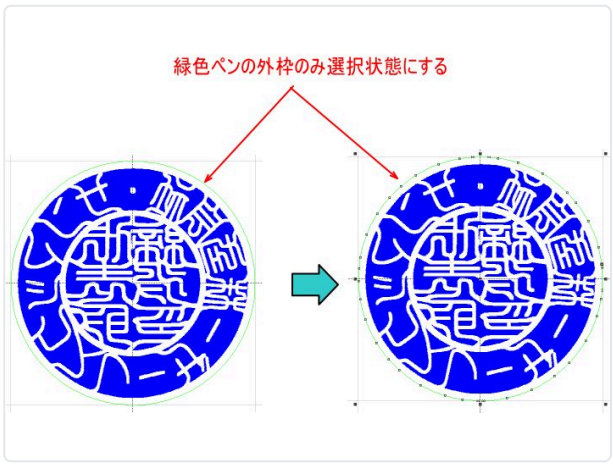
4. Turning on the red pointer

Perform this step after "Preparation" - "(3) Checking the red pointer settings" described earlier has been completed.

First, select the **Selected Only** check box at the bottom of EzCad2.

Next, click "Line" in the object list so that only the outer frame drawn with the green pen is selected.

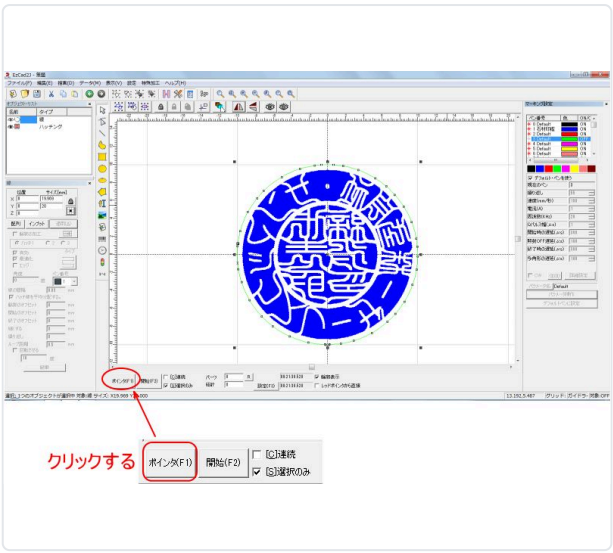


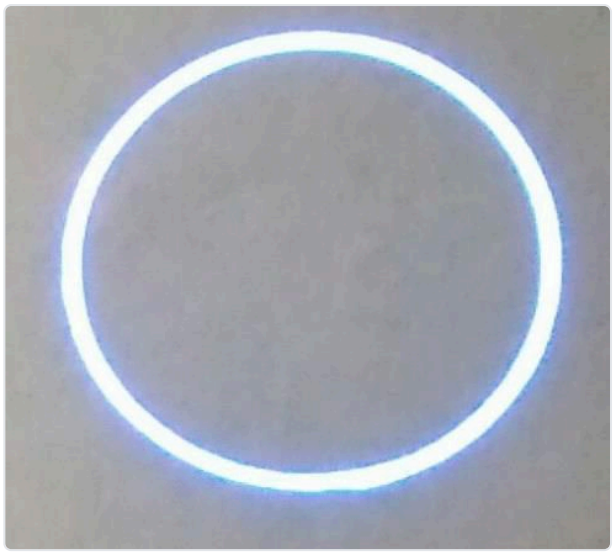
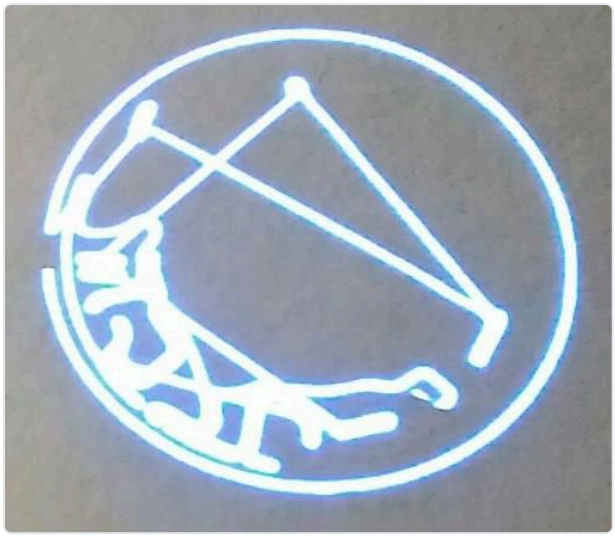


Then click **Pointer**.

When you click **Pointer**, only the outer frame of the green pen lights up, following the shape of the outline. (In this document the data is for a round seal, so it is displayed as a circle.)

Note that if only the green pen outer frame is not displayed, or if the **Selected Only** check box is not selected, areas other than the green pen outer frame will also be shown by the red pointer.



Left: only the green pen outer frame. Right: areas other than the green pen outer frame are also specified, or the **Selected Only** check box is not selected.

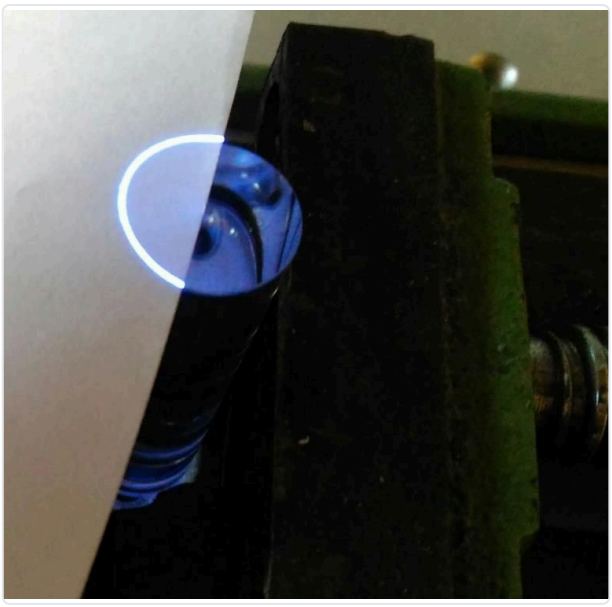
5. Positioning

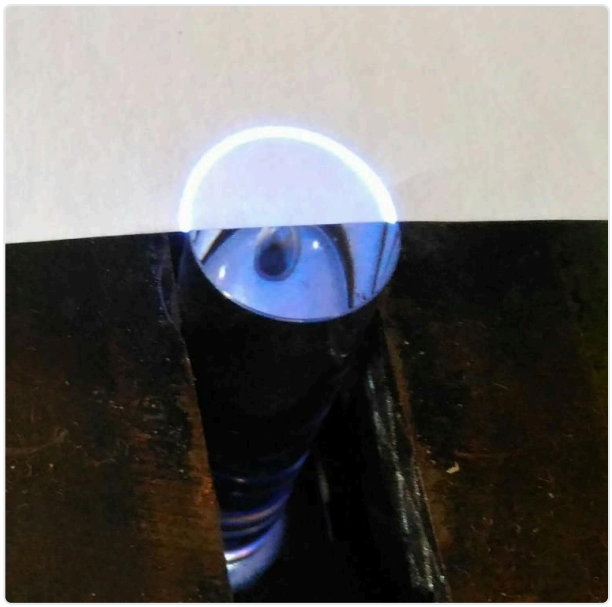
Move the seal blank to align it with the circular frame indicated by the red pointer.

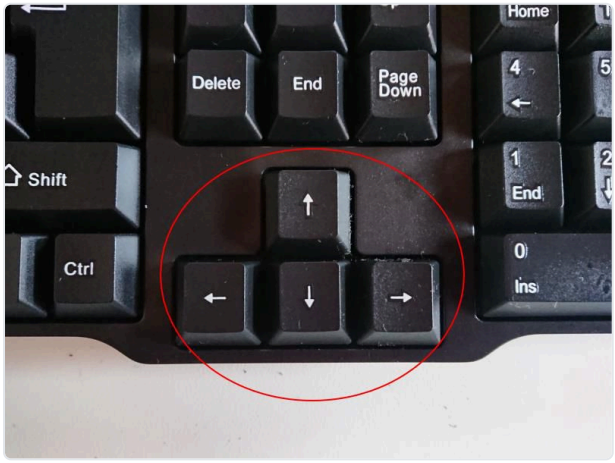
Perform rough positioning so that the outer shape of the seal blank matches the red pointer.

Because the position of the red pointer cannot be seen as-is, use a sheet of copy paper or similar so that the red pointer can be seen partially, as shown in the figure below. Then use the up/down and left/right arrow keys to adjust until the red pointer coincides with the outer circumference of the seal blank.

Align the position so that the light is even at every point along the outer circumference of the seal blank.







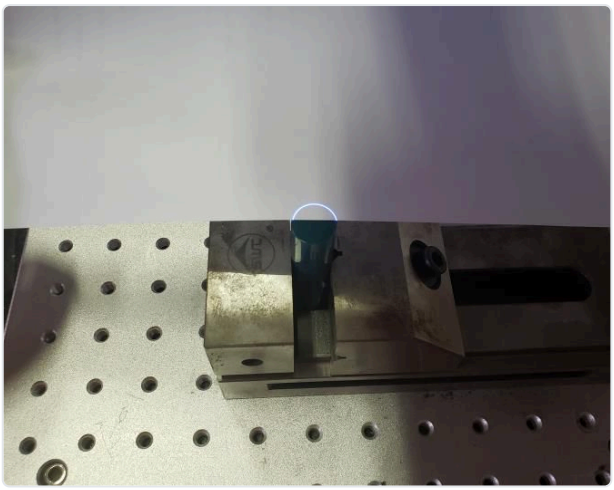
Use the keyboard arrow keys to move the red pointer position for fine adjustment.

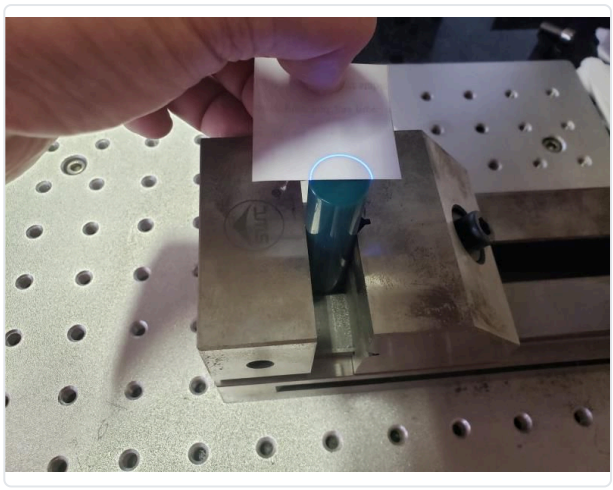
Move the red pointer with the up/down and left/right arrow keys.

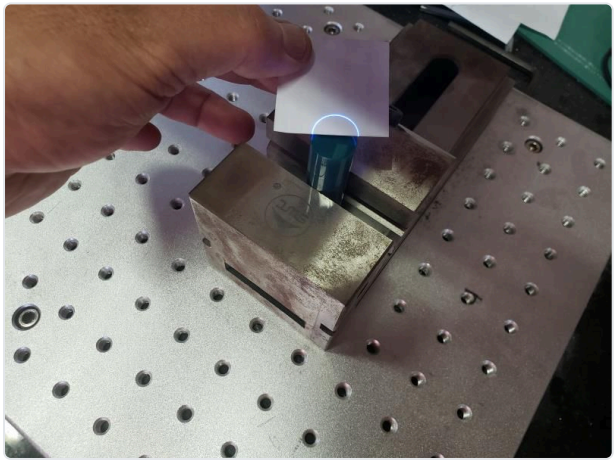
Even when the light strikes the outer circumference of the seal blank perfectly evenly, the position may shift slightly due to parallax once machining is performed.

To keep such deviation to a minimum, observe the following points.

(1) Use a sheet of white paper without wrinkles to show the red pointer. Also, A4 copy paper may be too large and awkward to handle, so cutting the paper to roughly 40 mm square improves visual accuracy.



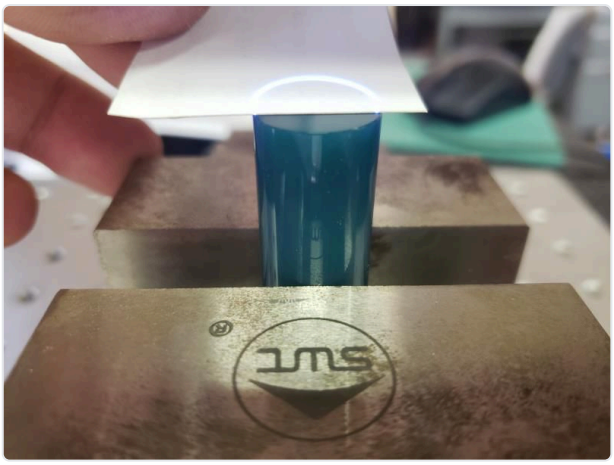
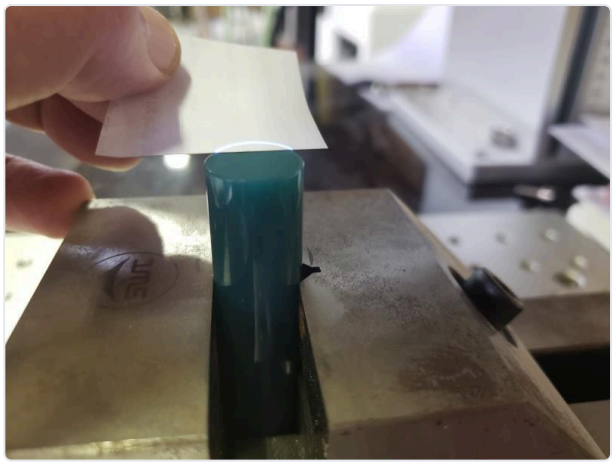
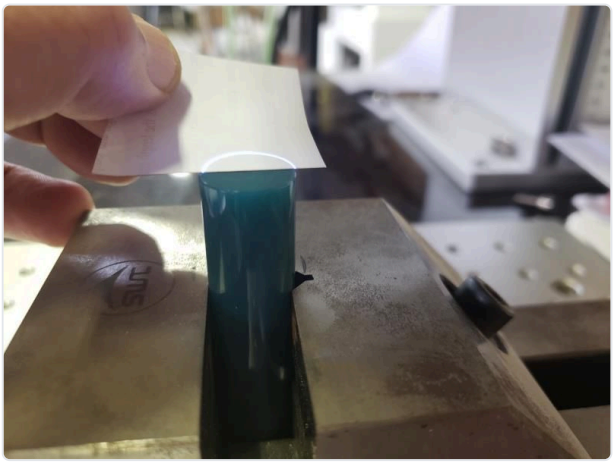
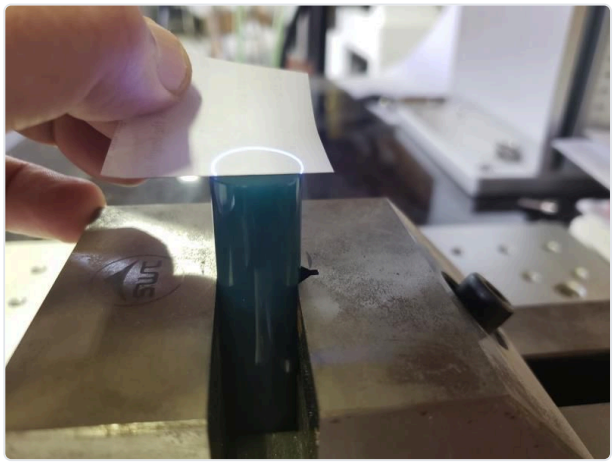
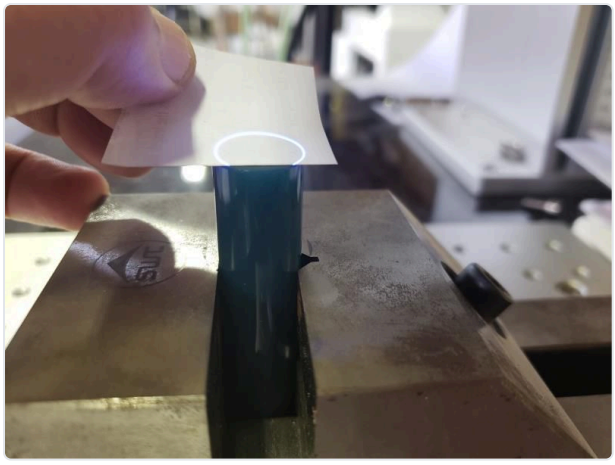




(2) Do not look at the seal face from above; check it from the side, as close to level with the seal face as possible. Looking down from above may prevent you from noticing a gap between the white paper and the seal face. In addition, with a seal blank whose face is tapered, not only is the outline of the seal face itself hard to make out, but visual error also becomes larger depending on how the light strikes it.

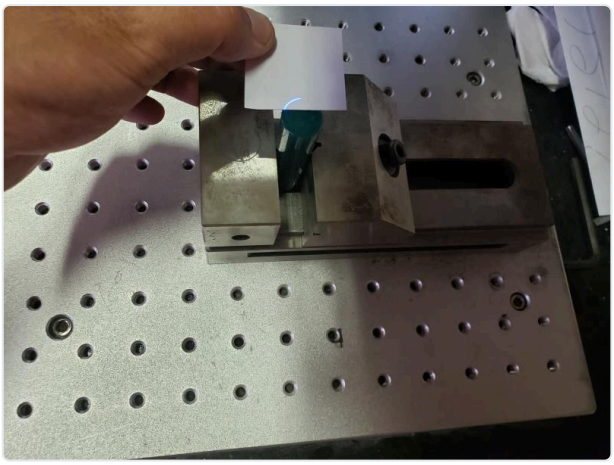
Aligning the position by looking down from above results in larger error.

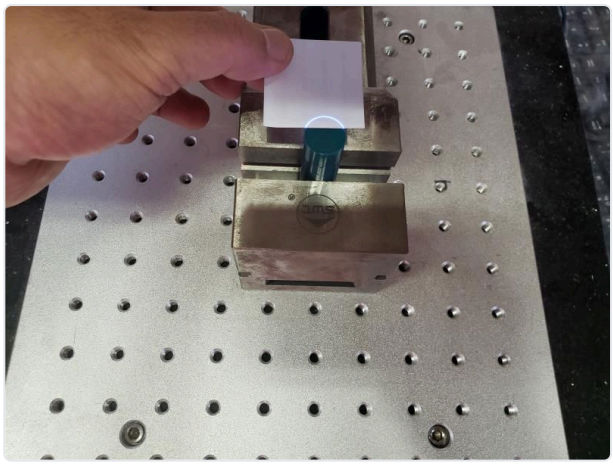
Check from the side, nearly level with the seal face, as shown here. The tapered portion of the seal face can then also be checked correctly.

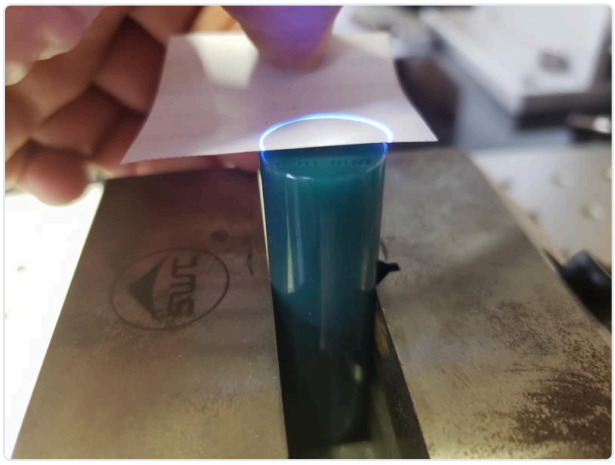






(3) Move the piece of paper from the far side toward the front so that the whole outline matches. Checking the entire circumference improves accuracy.

(4) Do not check only from the front; check from the side of the machine in the same way.







Left: checking from the front. Right: checking from the side.

When checking from the side, the operator should move to the side of the machine and view the seal blank straight ahead. Tilting your head and peering in from the side does not work well.

(5) Always keep the white paper in close contact with the seal face. If there is a gap between the seal face and the white paper, the red pointer will appear displaced.

(6) Finally, hold a strip of paper against the sides of the seal blank (front, back, left and right) and check the light that appears on the paper. When the front/back pair and the left/right pair each show the same light pattern, positioning is complete.

* If no light strikes the paper at all on either the front/back or the left/right side, temporarily increase the size of the green pen slightly (by about 0.2 mm) and check again.

Left / Right

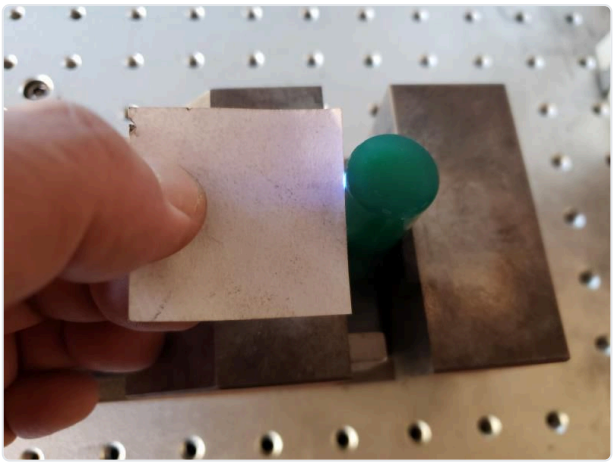
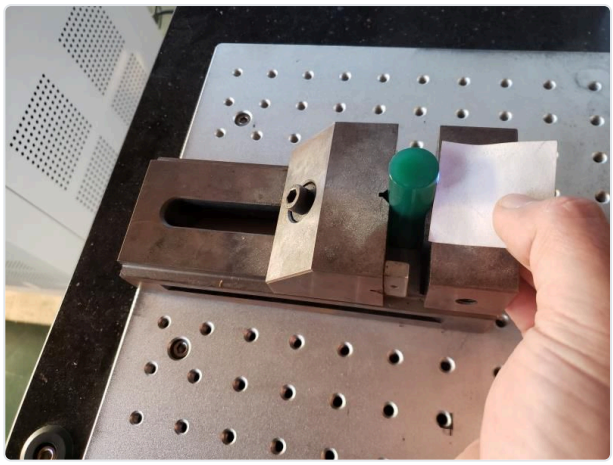
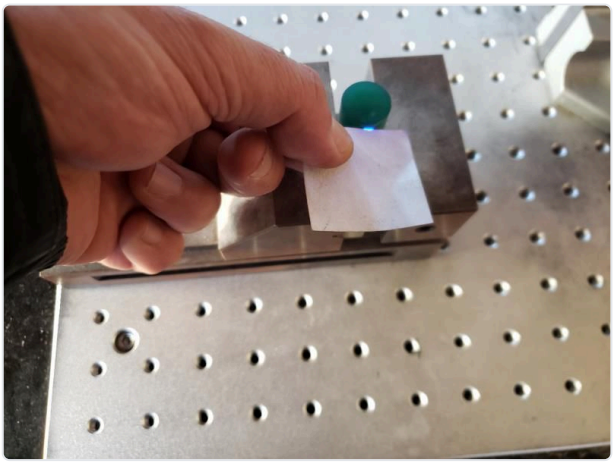
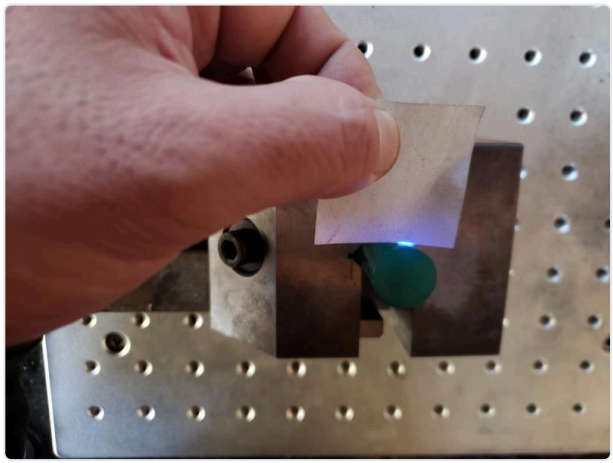
Applied from the left Applied from the right

If the light on the left paper strip and on the right paper strip looks the same, it is OK.

Front / Back

Applied from the front Applied from the back

If the light on the front paper strip and on the back paper strip looks the same, it is OK.

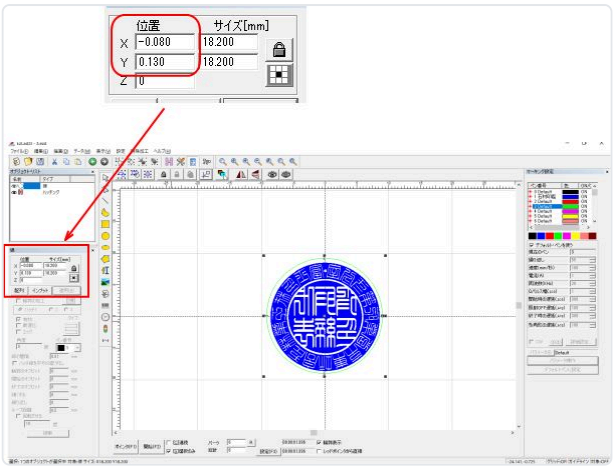





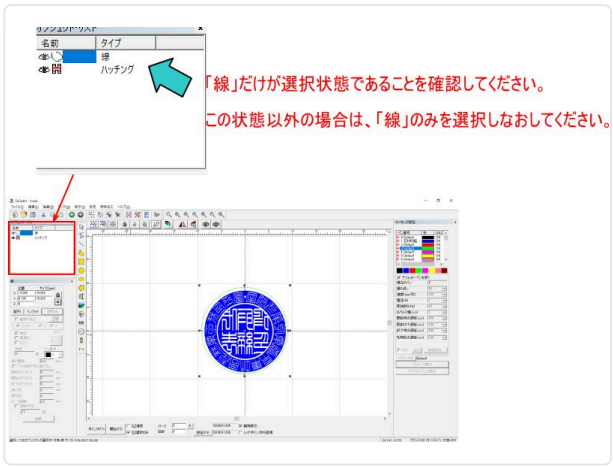
(7) Move the seal face data as a whole. In the work performed with the paper strips in steps (1)–(6), when you pressed the arrow keys to shift the position, the only item that actually moved was the selected green pen — the seal face design data itself did not move. First make a note of the current position, return the green line to the center, and then move the entire data to the noted position.

As an example, assume that the positioning in steps (1)–(6) resulted in an X position of −0.080 and a Y position of 0.130.

* This assumes that only the green pen is selected. If you operate EzCad after steps (1)–(6), the selection state will change, so take care.

Confirm that only the line is selected, then note down the X and Y position values.
In this example, X = −0.080 and Y = 0.130.

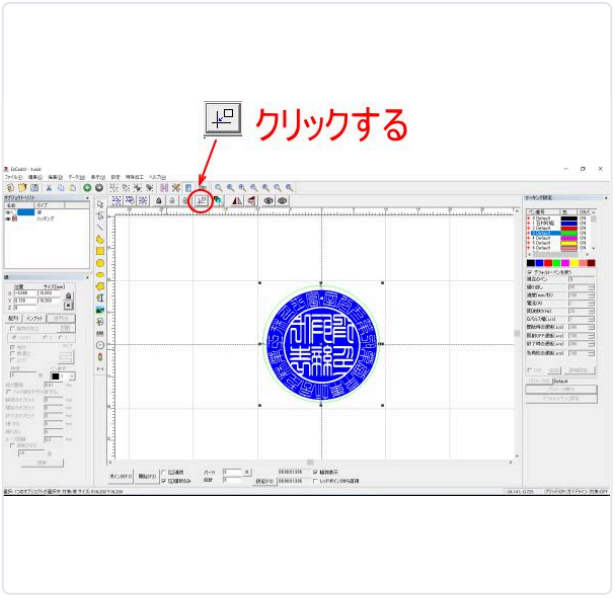


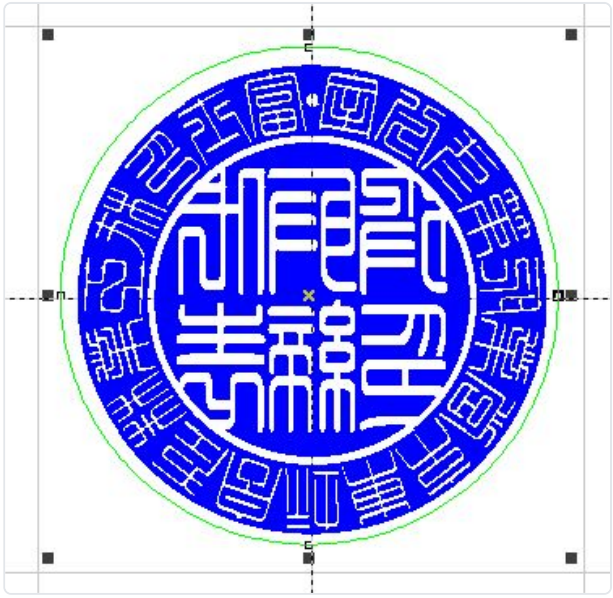


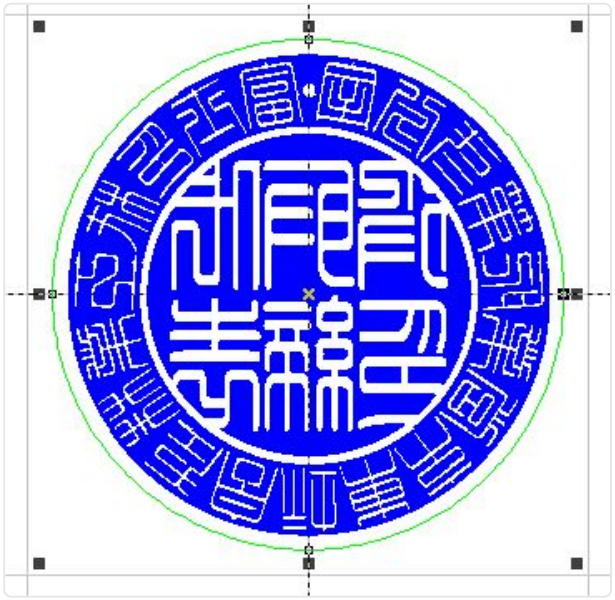
Once you have noted the values, click "Centering" on the toolbar to move the green pen to the center.

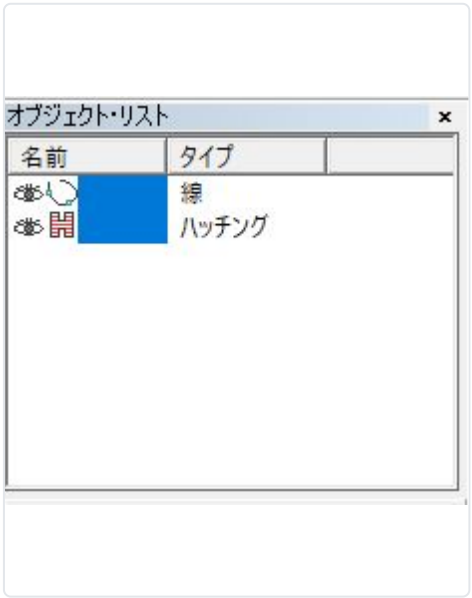
After centering the green pen, select everything, including the seal face data. Drag with the mouse to enclose the entire seal face.

Confirm that both "Line" and "Hatch" in the object list are selected.





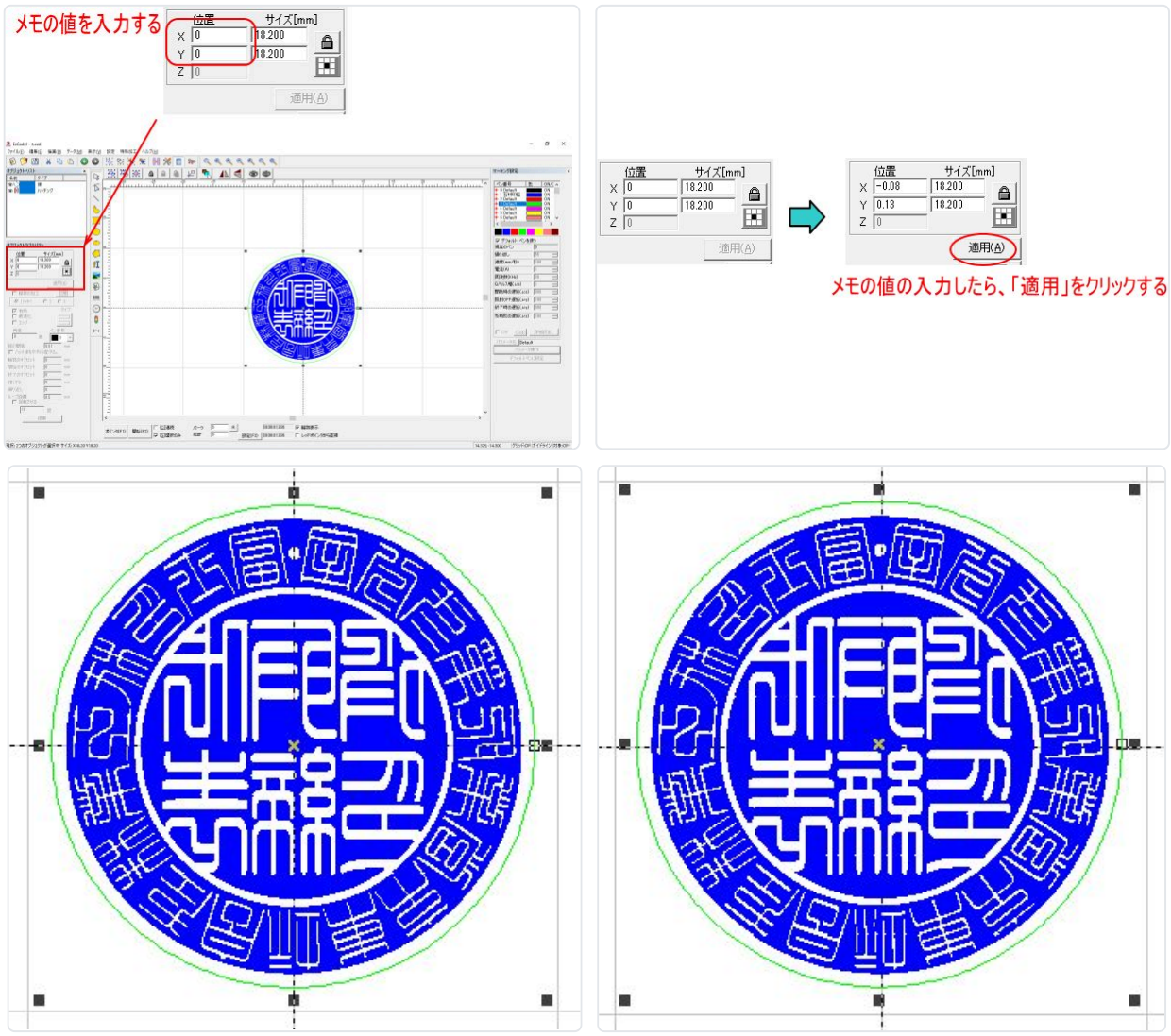




With the entire data selected, enter the X and Y positions you noted earlier and click "Apply".

When you click Apply, the entire seal face moves to that position.

This completes the positioning work.



(7) Machining

Once the seal blank has been positioned, proceed with machining.

There are two methods for machining a seal.

The first method uses a height gauge to set the focal distance precisely and machines the blank according to the procedure for each seal blank material. This method requires the extra effort of measuring the focal distance, but it does not require experience and a consistent finish can be expected.

The second method checks the focal position visually and adjusts the focal distance as needed while machining. This requires a little practice, but there is no need to measure the focal distance precisely and the machining time is usually shorter. Note, however, that with some seal blank materials the focal distance is difficult to adjust (the focal position is hard to identify), so care is required.

For the method using a height gauge, proceed to "Machining using a height gauge".

To machine while adjusting the focal distance visually as you go, proceed to "Machining with visual focal distance adjustment".

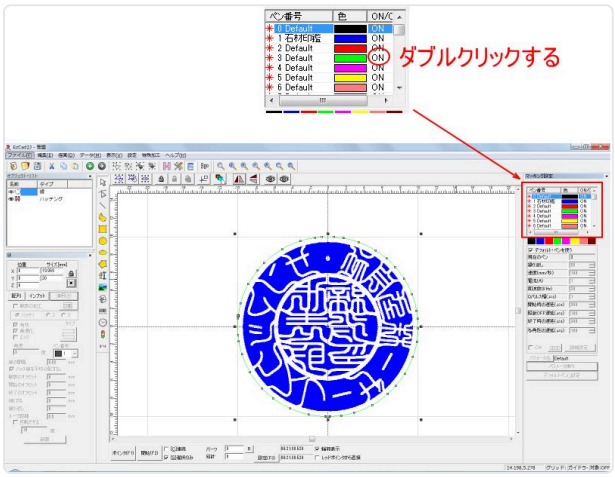
(8) Machining using a height gauge

When setting the focal distance with a height gauge and then machining, first carry out "Precise focal distance measurement using a height gauge" and determine the "reference focal distance" in advance.

Start machining with the following procedure.

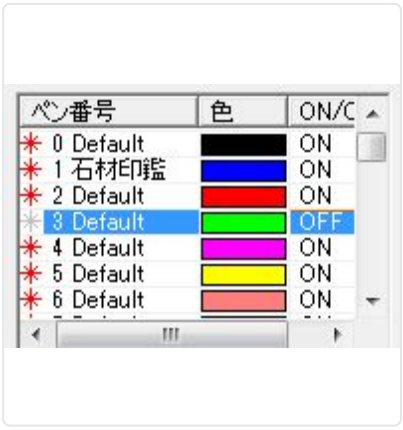
1. Turn the green pen machining OFF

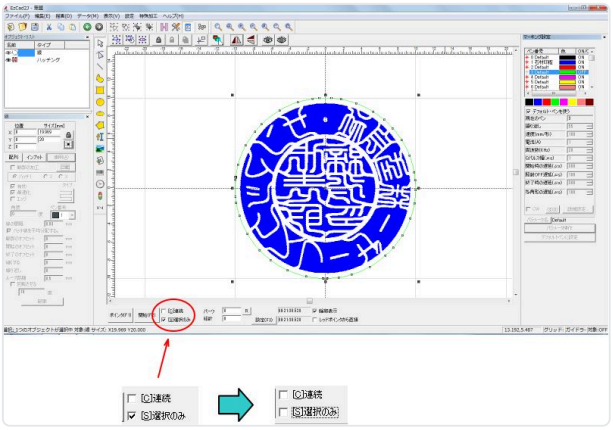
Set the outermost frame of the green pen so that it is not machined.
Double-click ON/OFF for the green pen in the pen list to toggle the setting.



2. Clear the "Selected Only" check box

Click "Selected Only" to clear the check box.





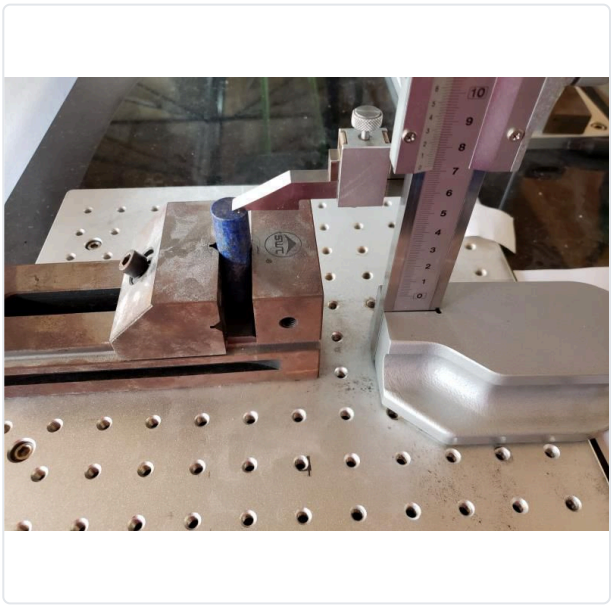
3. Fix the seal blank in place and set the focal distance

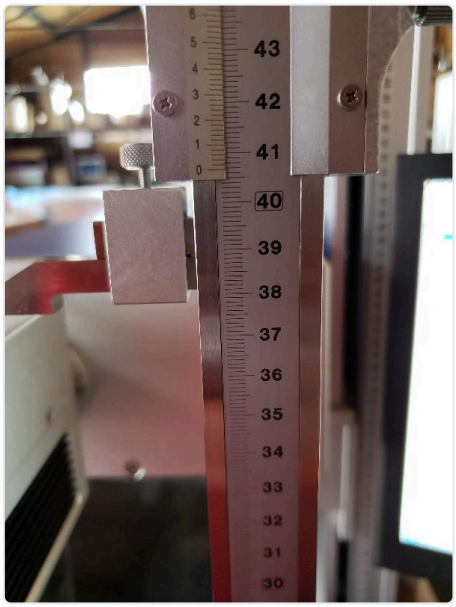
Fix the seal blank in place and, using the height gauge, set the distance between the surface of the seal face and the top surface of the laser head to the "reference focal distance".

First, fix the seal blank and measure the height of the seal face.

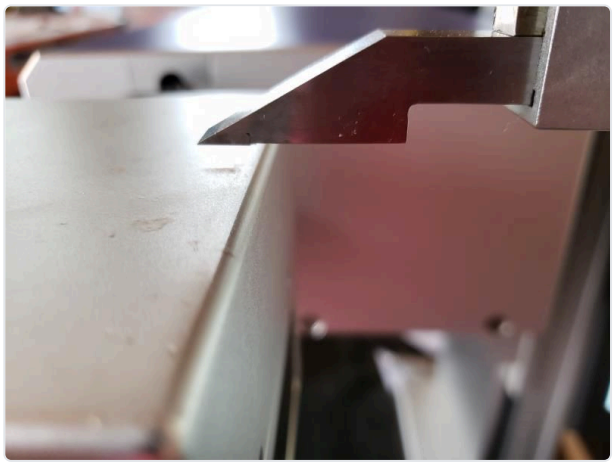
Since the purpose is to measure the distance between the seal face and the reference position of the laser head, the numeric value of the distance from the table to the seal face is not important. With a digital type on which the zero point can be set, it is easier to understand if you set the seal face height to 0. With an analog type as well, if the scale can be moved, move it so that the seal face height becomes a round number.

Next, move the slider to a height equal to the measured seal face height plus the "reference focal distance", and lock it in place with the set screw.



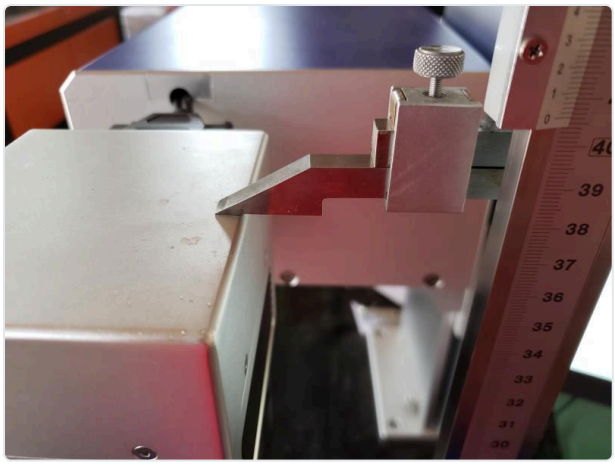


Operate the laser head elevation handle to lower the head so that the top surface of the laser head comes below the measuring face of the height gauge. Then move the height gauge to the "reference measuring position".



Next, operate the machine's elevation handle (turn it clockwise) to raise the laser head. Turn it slowly and carefully as you raise it.

Then bring the measuring face of the height gauge into firm contact with the top surface of the laser head.



Once the two surfaces are in contact, the head is essentially at the "reference focal distance," but recheck it to be more accurate.

To recheck, loosen the set screw of the height gauge, raise the measuring face slightly, then lower it back down so that the measuring face touches the surface (this is the height gauge's proper measuring method), and confirm the distance.

If the value differs from the "reference focal distance," turn the machine's elevation handle to fine-tune it.

Repeat the cycle of raise the measuring face slightly → lower it and measure → if it is off, fine-tune with the elevation handle, until the head is exactly at the "reference focal distance."

Keep the error within 0.05 mm.

4. Start machining

The machining procedure differs depending on the material of the seal blank.

The sequence is: machining (specified number of passes) → elevation handle operation (rotation by a specified angle) → machining (specified number of passes), and so on. According to the material of the seal blank, "machining (specified number of passes)" and "elevation handle operation (rotation by a specified angle)" are repeated.

The machining procedures for the main stone materials are shown in the table below.

Machining procedure table by stone material (reference values)

Seal blank	Set 1 Repeat count	Rotation angle (counterclockwise)	Set 2 Repeat count	Rotation angle (counterclockwise)	Set 3 Repeat count	Rotation angle (counterclockwise)	Set 4 Repeat count
Citrine topaz	4	–	–	–	–	–	–
Crystal	4	45	4	–	–	–	–
Amethyst	2	–	–	–	–	–	–
Red agate	6	30	6	30	6	–	–
Aventurine	3	–	–	–	–	–	–
Agate	6	45	6	–	–	–	–
Tiger's eye	2	–	–	–	–	–	–
Lapis lazuli	6	30	6	30	6	–	–
Rose quartz	2	–	–	–	–	–	–
Green agate	3	45	3				

"Repeat count" is the setting value for the specified number of machining passes. See "Machining (specified number of passes)."

"Rotation angle (counterclockwise)" is the rotation angle of the handle when the elevation handle is operated to lower the laser head. Always turn it counterclockwise. See "Elevation handle operation (rotation by a specified angle)."

A "set" is the combined procedure of "elevation handle operation (rotation by a specified angle)" and "machining (specified number of passes)." Proceed through them in order: 1, 2, 3, and so on.

For set 1 only, the elevation table is not lowered, because you begin from the state in which the height gauge has been used to set the "reference focal distance."

Where "–" appears in the table above, there is no further step, meaning machining has finished.

Example) For Crystal in the table above, machining finishes in two sets. [repeat machining → lower → repeat machining] completes the job.

* The settings in the table are reference values. If the machined result is too shallow or too deep, change the setting values as appropriate. Even for the same material, the finished depth may differ from blank to blank. Watching the condition of the seal face during machining, you may need to add machining passes or stop machining partway.

* Materials whose composition is not uniform (those with patterns), such as amethyst and lapis lazuli, will have an uneven machined surface.

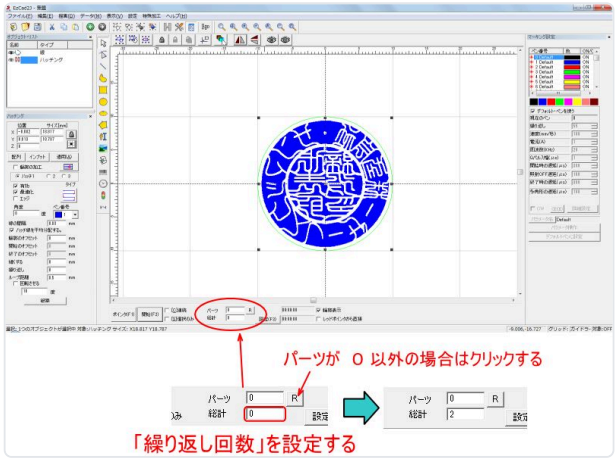
* When machining a stone that is not in the table above, you must first establish the settings. For example, even a stone such as "citrine," which is a variety of crystal (quartz), is not necessarily the same as the "Crystal" listed in the table above simply because the names are similar.

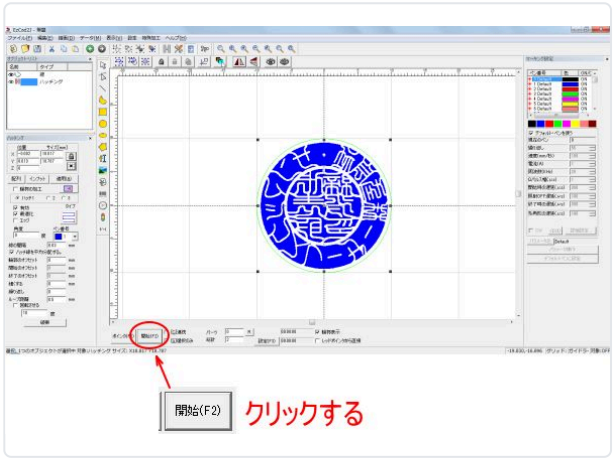
- Crystal and quartz are rock crystal. Amethyst is purple quartz. Aventurine is aventurine quartz. Even so, their setting values in the table above are different.
- Agate is *menou* in Japanese. In the table above as well, the setting values for Agate, Red agate, and Green agate are each different.

5. Machining (specified number of passes)

Enter the "Repeat count" value from the "Machining procedure table by stone material" in [Total], and start machining.

At this point, if [Parts] shows a value other than zero, click [R] to reset it to 0. If it is not set to 0, machining will not run for the number of passes set in [Total].





After setting the repeat count, click [Start] to begin machining.

> **Caution:** Machining starts immediately when you click, so take care.

When machining has finished, proceed to the next step, "Elevation handle operation (rotation by a specified angle)."

If there is no next step in the "Machining procedure table by stone material," machining is complete. Check the finish of the seal blank.

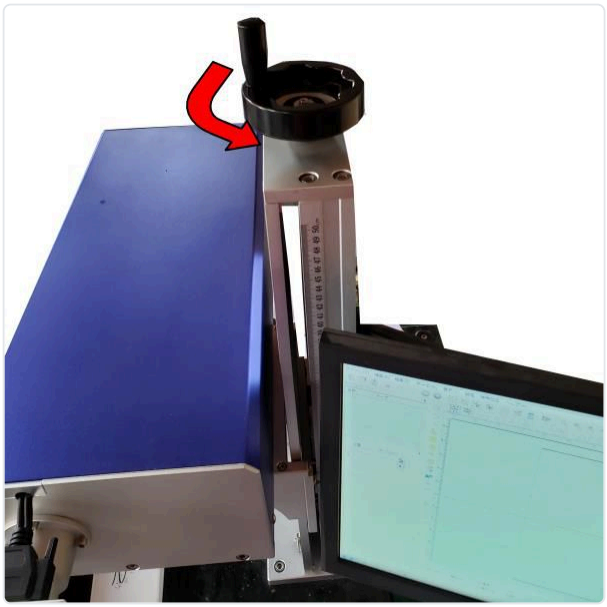
If the machined result is too shallow, perform additional machining.

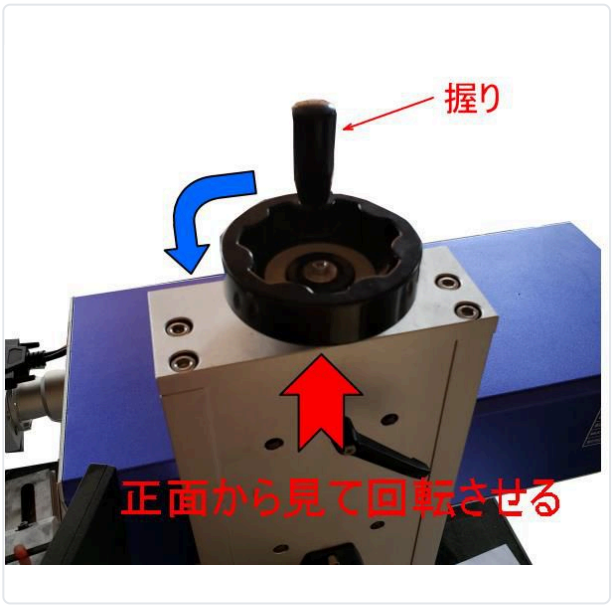
Once the proper depth has been machined, proceed to "After machining."

6. Elevation handle operation (rotation by a specified angle)

Turn the elevation handle by the angle specified in the "Machining procedure table by stone material" to lower the laser head.

The direction of rotation is always counterclockwise (to the left) as seen from above.





The angle does not need to be measured precisely. The rotation angle is basically 45° or 30°, so setting it by eye is acceptable. When setting it visually, move yourself so that the handle grip faces you, then turn it.

After turning the elevation handle, perform "Machining (specified number of passes)."

* Note that it is easy to forget to reset [Parts] to 0 for the next machining run.

(9) Machining with visual focal distance adjustment

Machining caution

> **Caution:** With the RSD-SUNMAX-UVZH, the range in which the beam is in focus and can apply sufficient laser power to the workpiece is extremely narrow. A difference of only about 0.1 mm in focal distance changes the engraving depth and alters the finished result. Consequently, even if the correct focal distance is set at the start of machining, the focal distance drifts away as repeated passes cut deeper, leading to machining that takes longer than necessary or that fails to reach the required depth.

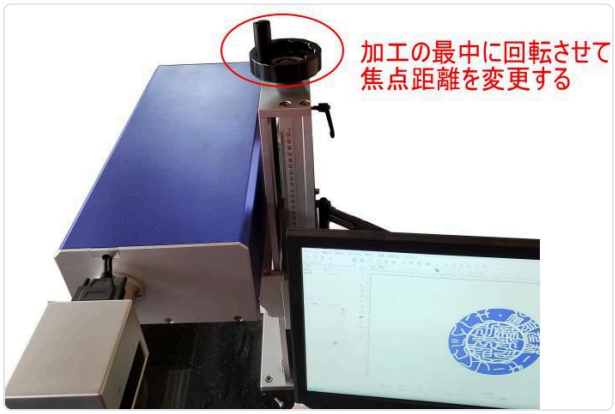
The focal distance specific to each RSD-SUNMAX-UVZH machine is specified in millimeters, but in practice it is a parameter that should be set in 0.1 mm increments. Because of the mechanism, however, the laser head position cannot be set accurately in 0.1 mm increments. For this reason, once machining has started, you must observe the machining condition and fine-tune the height manually.

When machining a seal, check the condition of the seal face during machining, adjust the focal distance dynamically, and control the finish by increasing or decreasing the number of machining passes.

Note that the job does not complete itself automatically once machining has started.

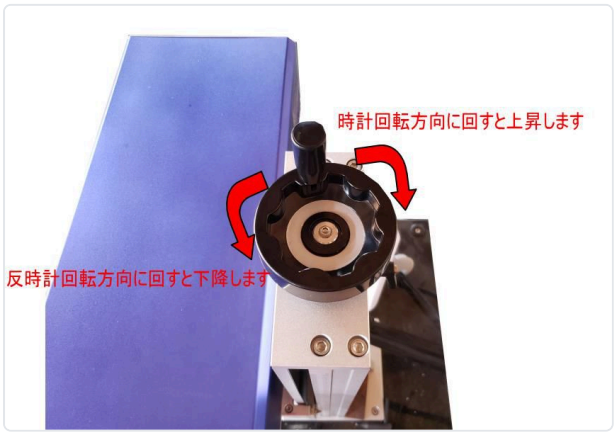
How to change the focal position during machining

Adjust it by turning the elevation handle during machining.



Seen from above the machine, turning the handle clockwise raises the head and increases the focal distance; turning it counterclockwise lowers the head and decreases the focal distance.

One full turn of the handle changes the height by 4 mm.



A 45° rotation moves the head 0.5 mm up or down, so adjustments during machining amount to roughly 10° to 30° of rotation.

As soon as machining starts, watch the machining condition and turn the handle clockwise or counterclockwise to move the head up and down to the position where the laser strikes most strongly. Do this as quickly as possible.

After this adjustment at the start of machining, continue to observe the machining condition and turn the handle counterclockwise to lower the head, bringing the focal distance closer in step with the depth of the engraved surface.

How to check for the correct focal position

The correct focal position is the position at which the laser strikes the workpiece most strongly and acts on it most powerfully. Raising and lowering the focal distance while the laser is firing changes the following conditions.

(1) Brightness

- At the correct focal distance, the workpiece (seal face) glows most brightly.

(2) Sound

- When engraving a stone seal blank, the laser spot pulverizes minute particles of stone. Therefore, at the correct focal distance, the sound emitted from the machined surface is loudest.

(3) Smoke

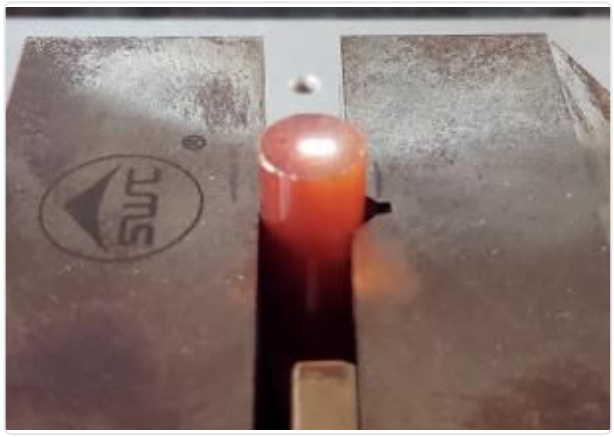
- When a stone seal blank is engraved at the correct focal distance, a thin wisp of smoke rises.

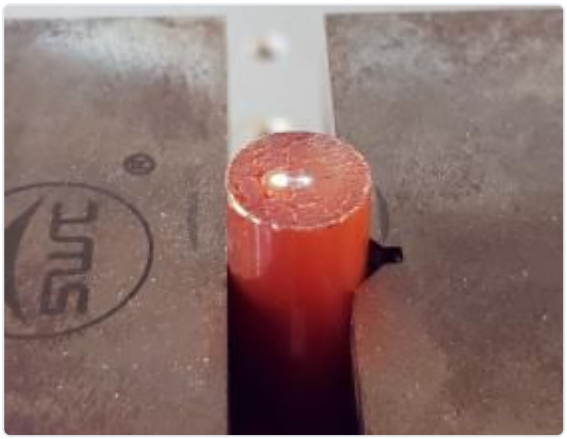
Judging by (1) and (2) above and fine-tuning the focal distance makes proper machining possible.

If you feel there is little change even when the handle is turned over a certain range, you are most likely at a position away from the correct focal distance. Near the correct focal distance, even a slight rotation angle causes a large change in the condition of the laser spot.

Example

In focus (bright)　　Out of focus



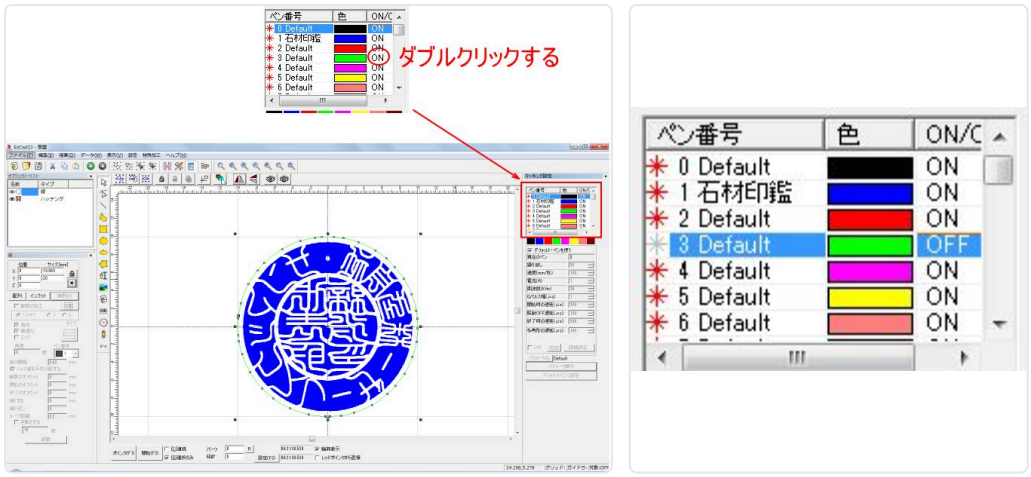


Start machining using the procedure below.

1. Turn machining OFF for the green pen

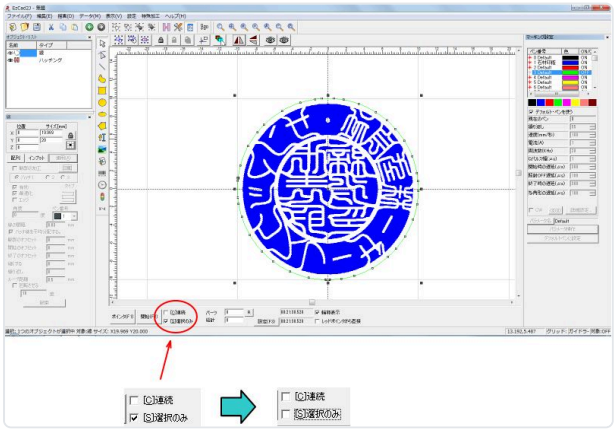
Set the outermost frame drawn with the green pen so that it is not machined.

Double-click the ON/OFF setting of the green pen in the pen list to toggle the setting.



2. Clear the "Selected Only" check box

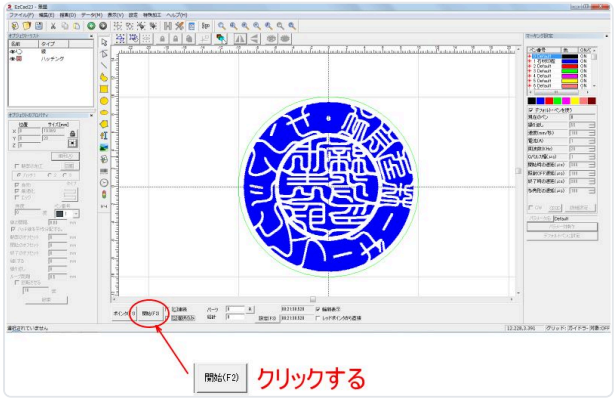
Click "Selected Only" to clear the check box.



3. Start machining

Click the "Start" button to begin machining.

> **Caution:** Machining starts immediately when you click, so take care.



Once machining has started, first operate the elevation handle to set the correct focal distance.

In addition, as machining progresses and the engraving becomes deeper, the focal distance shifts. Adjust it as needed with the elevation handle.

4. Start machining (second pass)

When the first pass is finished, check the finish of the seal face (the engraving depth). Normally, a stone seal does not reach an adequate depth in a single pass.

Click the "Start" button again to machine the piece once more. At this time, never move the position of the blank being machined. If you move it, repeat machining will no longer be possible.

After starting the second pass, adjust the focal distance manually again.

5. Start machining (third and later passes)

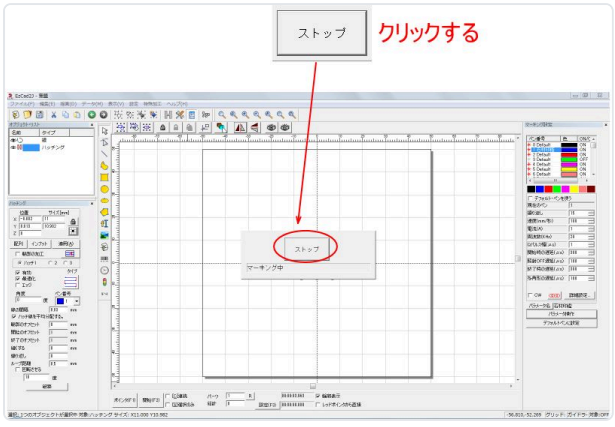
When the second (and each later) pass is finished, check the finish of the seal face (the engraving depth). If the depth is appropriate for a seal, remove the blank. If it is still too shallow, repeat machining again.

Repeat machining until an appropriate depth is reached.

The engraving result varies with how the focal distance is adjusted and with the material and color of the blank.

If an appropriate focal distance is maintained, quartz normally reaches a depth appropriate for a seal after about 5 to 8 repeated passes. Materials that are harder to engrave, such as lapis lazuli, require more passes than quartz.

If the focal distance is set correctly, an appropriate depth is reached within the total number of passes listed for each blank in the machining procedure table for that stone, or fewer (it may take longer depending on variations in the composition of the blank).



Typical engraving depths for seals are as follows.

Personal seal	0.7 mm to 1.0 mm
Corporate seal	0.6 mm to 0.9 mm

* If you set the focus correctly at the start of the first pass and then do not change the focal distance afterward (or keep changes to a minimum), the engraved cross section acquires a taper as the seal face becomes deeper, which increases the strength of the seal face. This occurs because the focal distance shifts as engraving proceeds, softening the edges of the seal face data.

If you want to increase the strength of the seal face, try machining without deliberately adjusting the focal distance.

Note, however, that machining takes longer (the number of repeat passes increases).

If you want to check the condition during machining, or if sufficient depth has been reached, stop machining part way through.

After checking the condition, click "Start" again if you want to engrave deeper.

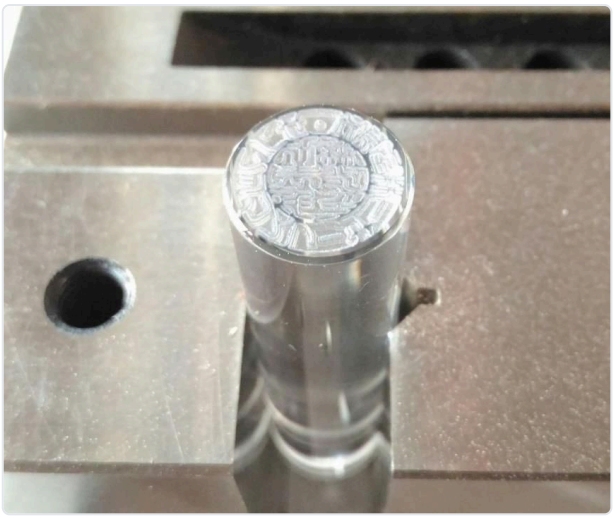
> **Warning:** During machining the laser spot emits extremely bright light. Avoid looking at it directly with the naked eye.

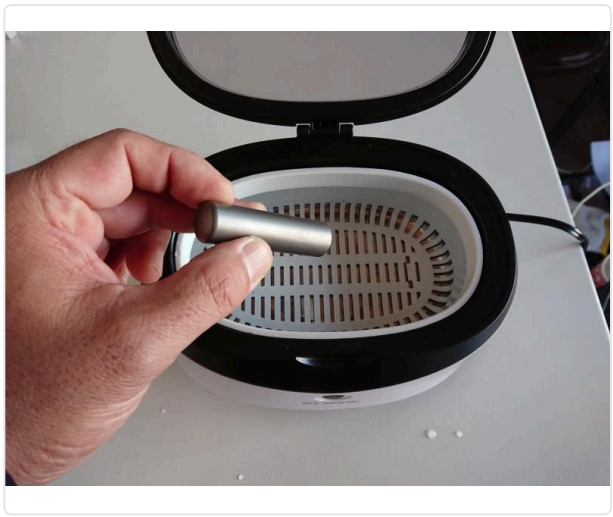
Once you have machined to an appropriate depth, proceed to "After machining."

(10) After machining

When machining is finished, perform the following work.

- When machining is finished, remove the blank from the vise or other fixture that was holding it. The blank may be hot after machining, so take care.
- Clean the machined face of the blank using an ultrasonic cleaner or similar equipment.
- If you do not have an ultrasonic cleaner, wash the seal face with water using a toothbrush or similar. Use a soft brush and rub lightly with a circular motion.





Example of a machined white quartz piece

* Depending on the blank, lightly wiping the surface with ethanol is also acceptable.
