

High-Precision Optical Path Alignment (ST908)

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.

High-Precision Optical Path Alignment (ST908)

The optical path alignment procedure described in the instruction manual supplied with the laser machine is intended only to make laser firing possible over the entire work area; it does not address the slant of the cut edge during cutting.

This document explains how to align the optical path so that the laser beam strikes the workpiece perpendicularly.

Note: Depending on the model and production lot, the images in this document may differ from the actual machine. Interpret them accordingly.

Note: The method described in this document does not guarantee that the cut edge will be perpendicular to the workpiece. Perpendicularity is ultimately judged visually by the operator.

Note: This high-precision optical path alignment procedure indicates the steps to follow; it does not guarantee a result within a limited number of operations. Fine adjustment must be repeated many times (until you judge the result to be acceptable). For this reason, the time and labor required cannot be stated in advance. As a general rule, the larger the machine, the more time the work takes. The time required also depends heavily on the machine's installation environment.

Note: If the work is ended with the adjustment only half completed, the slant may become even greater, or optical path problems may make proper processing impossible. Once this alignment has been started, it may take a considerable amount of time to bring the machine into a proper condition, depending on the condition of the machine and the ability of the operator. Secure sufficient working time before starting the work.

Note: This document does not describe the relationship between the rotation direction of the adjustment screws and the angle when changing the angle of each mirror. This is because the relationship between the rotation direction of the adjustment screws and the change in mirror angle differs by model and lot. Check the machine's instruction manual, or turn the adjustment screws yourself during adjustment and confirm how the optical path changes. Because the work in this document requires fine angle adjustment, we recommend proceeding by confirming the angle changes yourself — it takes extra effort, but it lets you get a feel for the relationship between screw rotation and angle change.

Procedure

(1) Preparing for Optical Path Alignment

Prepare the machine so that the laser optical path can be checked.

1. Adjusting the Laser Output

When performing optical path alignment, set the laser firing time and the laser output that apply when the Pulse button on the control panel is pressed.

Setting the laser firing time

Set the firing time with "Laser Set" on the control panel.

Press the function button.



Use the arrow buttons to move to "Laser Set+".



Press the Enter button.

Then set the LaserSet value to approximately 25 to 40.



Use the arrow buttons to set the LaserSet value. The left/right arrow buttons move between digits, and the up/down arrow buttons increase or decrease the value.

Once it is set, press the Enter button.

Then press the Esc button to return to the normal screen.

Caution: When testing, if the laser output is too weak to leave a mark, raise the "Laser Set" value above 40%. Conversely, if the beam feels too strong, lower the value.

Setting the laser output

Set the laser output with "MaxPower" on the control panel. Set the MaxPower value to 99.0 [%].

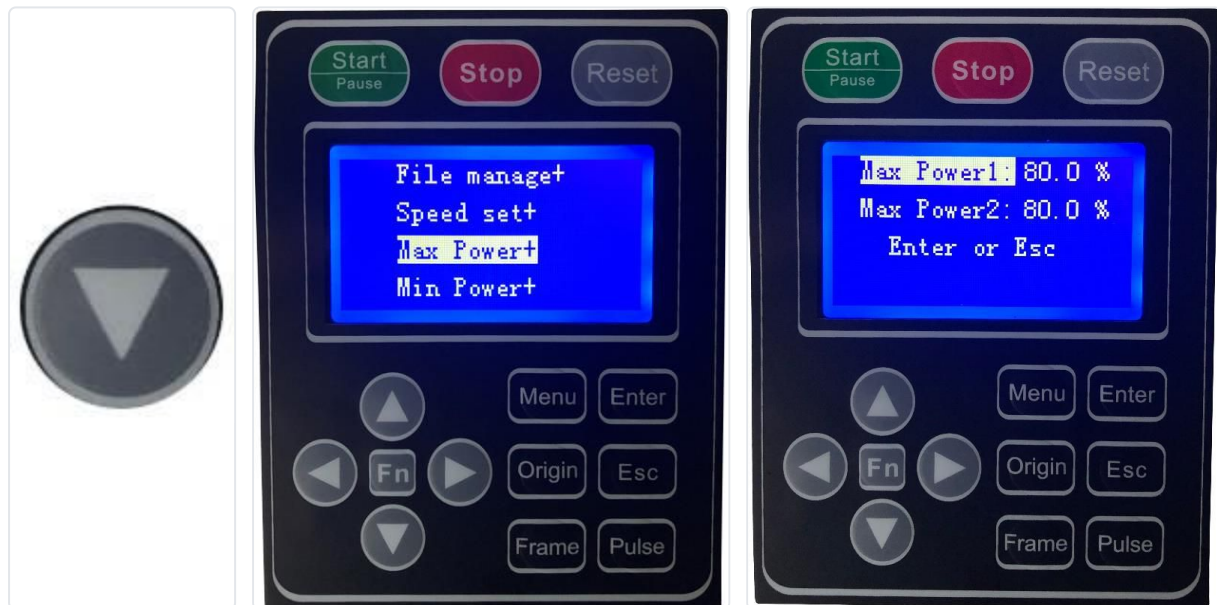
Press the menu button.



Use the arrow buttons to move to "Max Power+".

Press the Enter button.

Use the arrow buttons to set "Max Power1" to 99.0. Do not change "Max Power2".

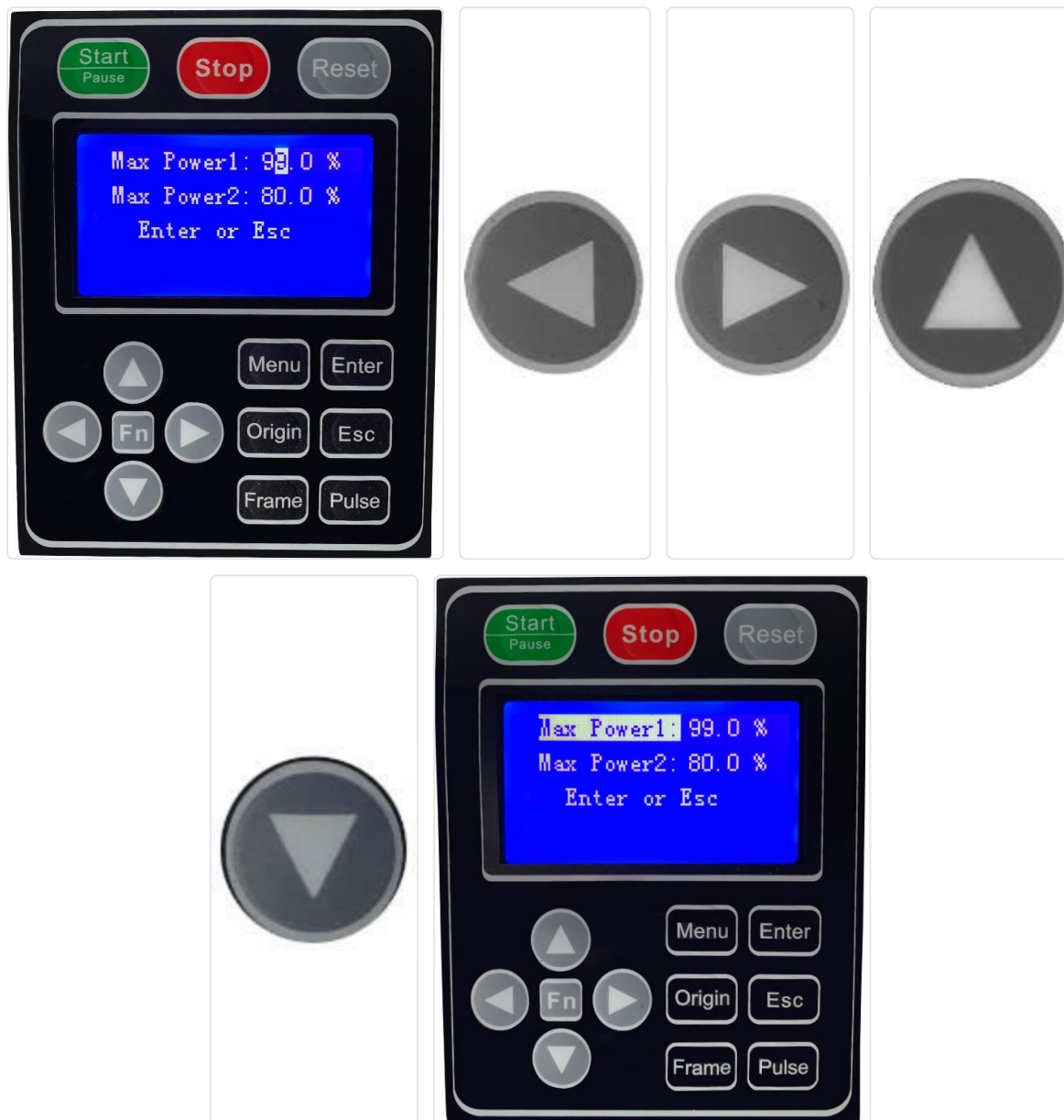


With "Max Power1" shown highlighted (reverse video), press the Enter button to make the value editable.

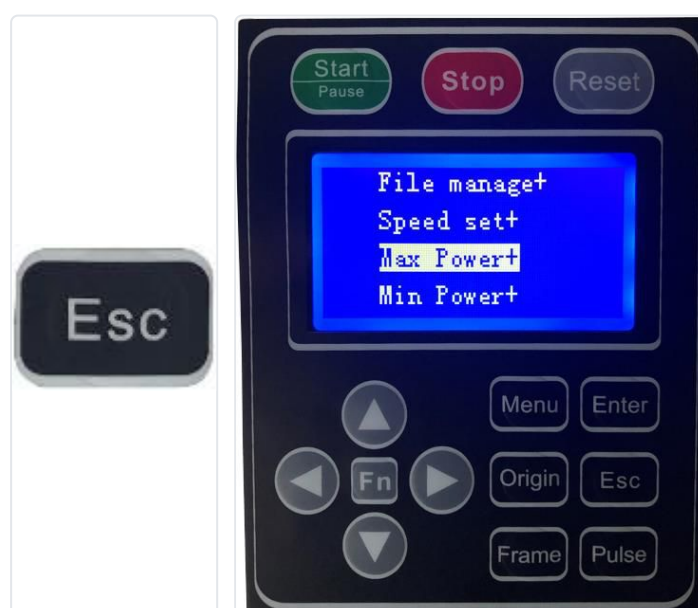
The left/right arrow buttons change the digit being edited.

The up/down arrow buttons raise or lower the value of the current digit. The currently selected digit is shown highlighted (reverse video).

After changing the setting, press the Enter button.



Press the Esc button twice to return to the normal screen.



The laser firing time and laser output settings are now complete.

2. Placing a Magnet on the Safety Switch

Place a magnet on the safety switch so that the laser can be fired with the machine's top door open.

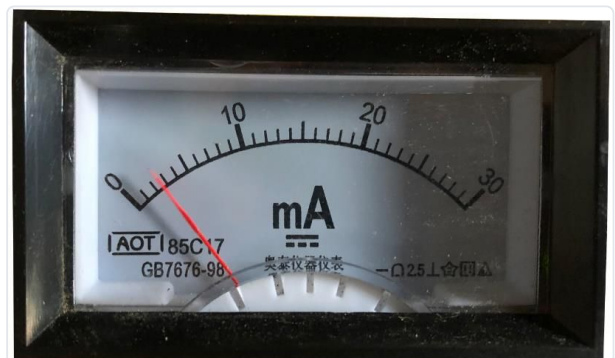
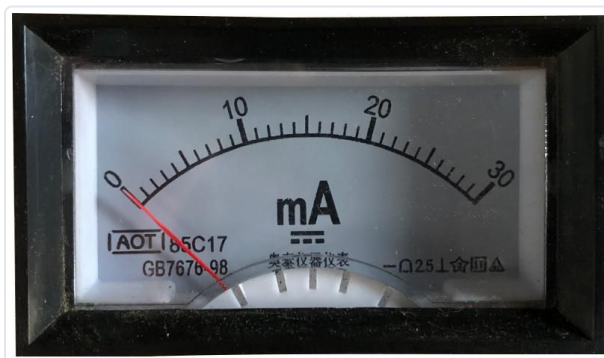


After placing the magnet, press the Pulse button on the control panel and check that the laser fires.

Warning: When the Pulse button is pressed, the laser fires with the upper top door open. Pay close attention to safety in the vicinity of the machine.

Use the ammeter to confirm that the laser is firing.

When you press the **Pulse** button on the control panel, the needle moves for an instant and then returns to zero.



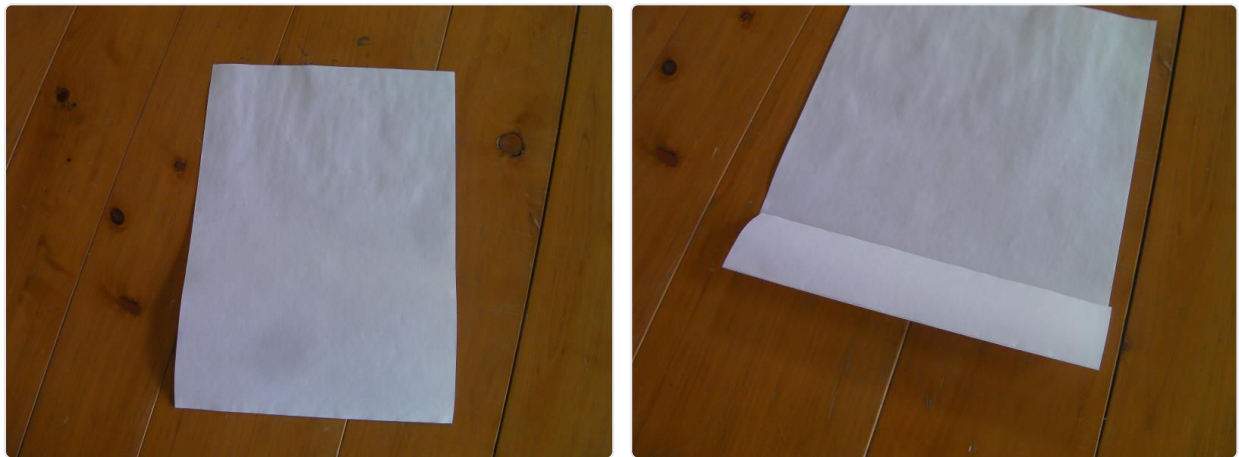
Caution: If the needle does not return to zero promptly while the **Pulse** button is held down, redo the laser firing time setting. Normally the needle swings only momentarily, to a position of about 5 mA.

3. How to Make Paper Strips for Burn-Mark Checks

The optical path is checked by firing the laser at a strip of paper and examining the burn mark it leaves.

Use ordinary copy paper for the strips. Paper that is too thin, too thick, or easily flammable is not suitable. Colored or patterned paper makes burn marks hard to see, so plain copy paper or something similar is best. Avoid reusing paper that has already been printed on.

Cut the copy paper into strips roughly 3 cm to 4 cm wide. The width does not need to be measured precisely, but strips that are too wide or too narrow are awkward to work with.

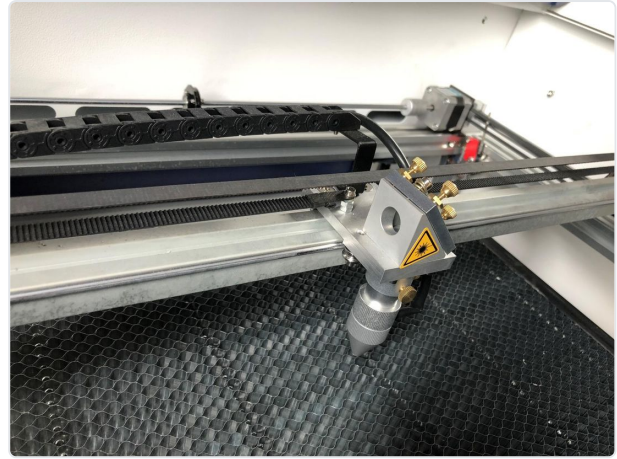
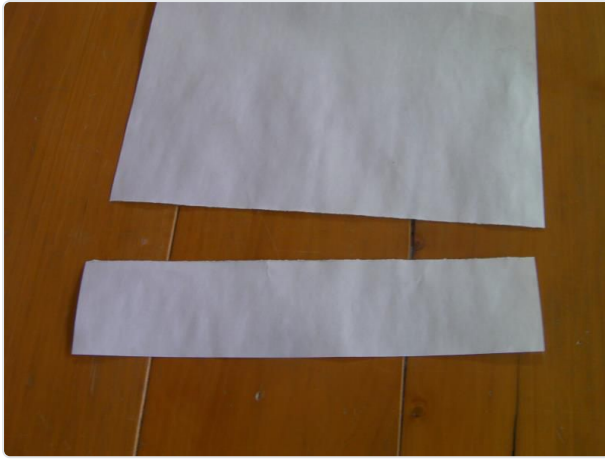


Use A4 copy paper — plain and unused is preferable. Cut it into strips roughly 3 cm to 4 cm wide.

There is no need to use scissors; simply crease the paper and tear it along the fold. It does not matter if the strips are somewhat uneven in shape.

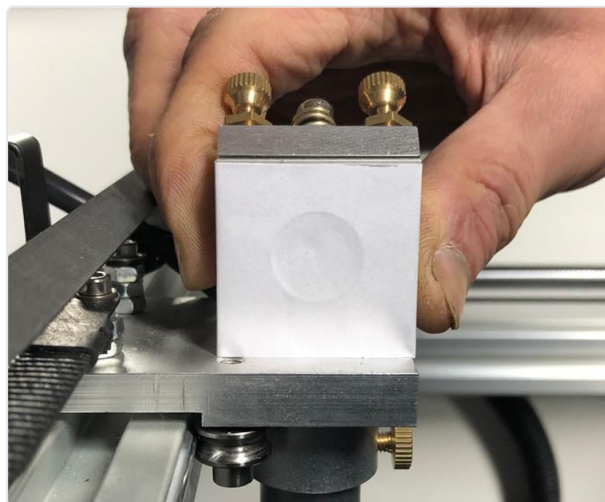
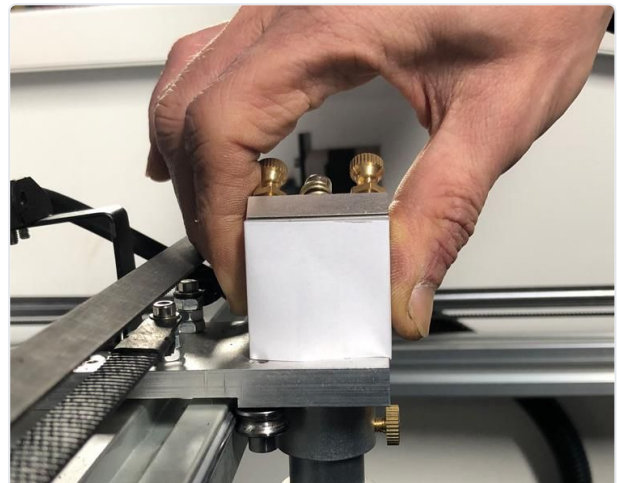
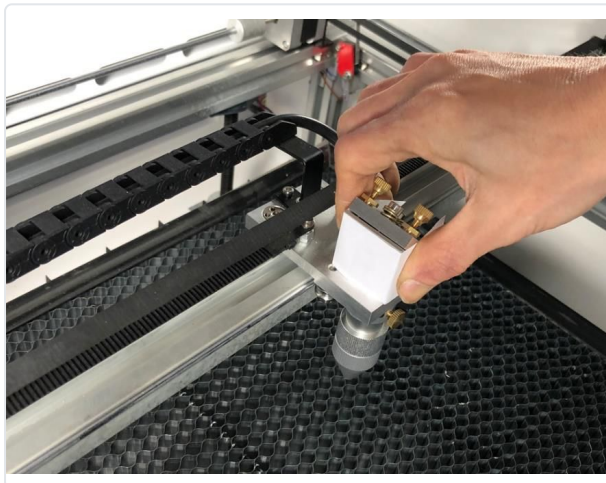
4. How to Check Burn Marks in Front of the Third Mirror

Check where the laser beam passes through the round hole in front of the third mirror on the laser head.



Place a paper strip made as described in "3. How to Make Paper Strips for Burn-Mark Checks" over the round hole.

Press lightly over the whole strip so that the outline of the round hole is imprinted on the paper.



Each strip will be used for several burn-position checks, so start from one end of the strip.

Hold the paper against both sides of the laser head. Pull the strip slightly backward so that it sits as flat and tight as possible, with no slack or wrinkles.

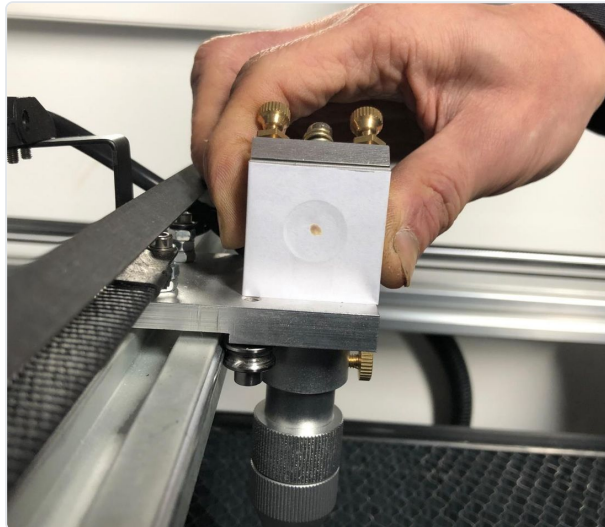
Once the outline of the round hole has been imprinted, hold the strip firmly in place so the impression does not shift.

If the strip moves and the imprint of the round hole shifts out of position, slide the strip over slightly and start again.

Even a slight shift will prevent you from getting a correct result.

While holding the paper strip in place, press the **Pulse** button on the control panel.

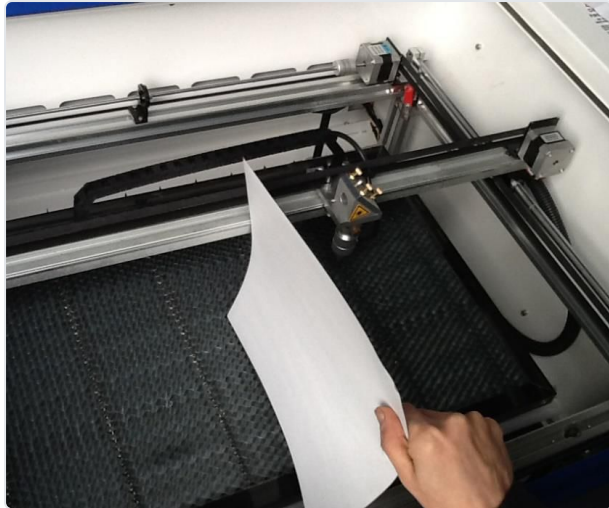
The laser fires and leaves a burn mark. If no burn mark appears, press the **Pulse** button two or three times.



Warning: The laser beam passes close to your hands. Take great care not to block the beam with any part of your body.

Caution: If the optical path is poorly aligned, the beam may fall outside the paper strip and, depending on its path, could strike the hand holding the strip. Because the laser beam can come into contact with your body, if you are unsure where the optical path lies, hold a larger sheet of paper in front of the laser head, fire the laser, and confirm roughly where the beam arrives.

If the laser does not enter the round hole in front of the third mirror, roughly adjust the optical path at this stage.



A burn mark is acceptable as long as it is visible to the naked eye. If the paper flares up (too strong) or no mark appears (too weak), go back to "Setting the Laser Firing Time" and change the **Laser Set** value.

If the paper flares up, reduce the value. Note that reducing it too far will stop the laser from firing at all.

If you have to press the **Pulse** button many times before a burn mark appears, increase the value. Setting a much larger value all at once can set the paper on fire, so raise the value in steps of about 3, checking the burn mark as you adjust.

Ideally, a single press of the **Pulse** button should leave a clearly identifiable burn mark. Adjust the **LaserSet** value while checking the burn marks.

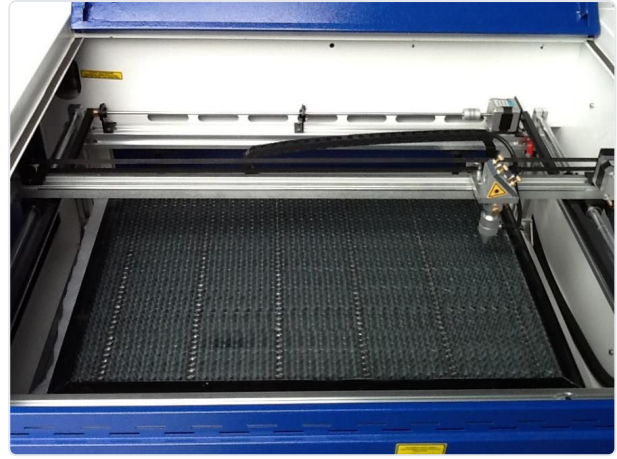
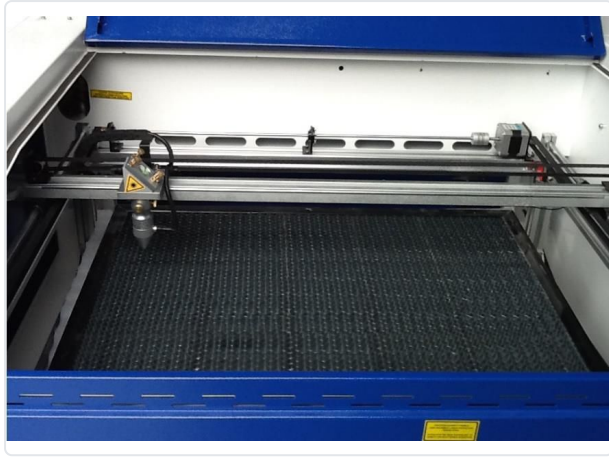
(2) Adjustment Across the Entire Work Area

After completing "(1) Preparing for Optical Path Alignment," check the optical path and adjust it so that the beam passes through the same point over the entire work area.

1. X-Axis Direction

Align the optical path in the X-axis direction.

The X-axis optical path is judged by comparing the results with the laser head positioned at the right and at the left. If the burn-mark positions differ between the right and left positions, adjustment is required.

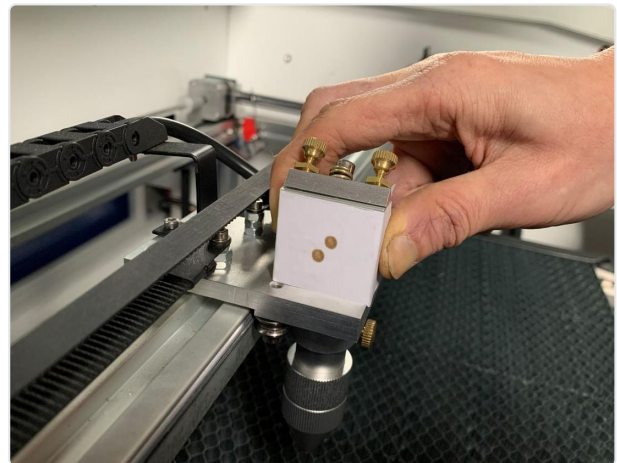
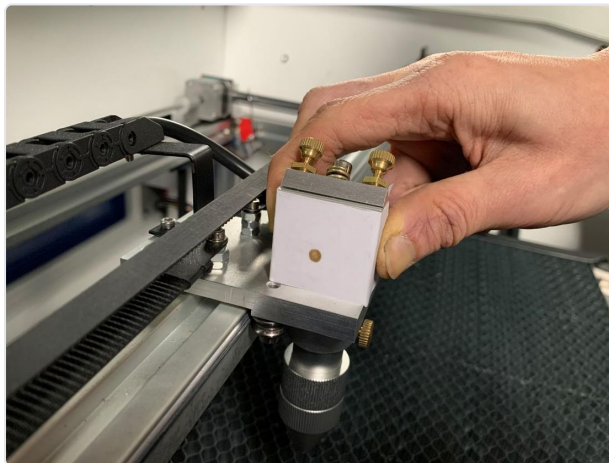


Laser head at the left side / Laser head at the right side.

First, check the burn mark with the laser head at the left side.

After making a burn mark on the paper strip in front of the third mirror, move the laser head to the right, taking care not to let the strip shift out of position.

Once the head has been moved to the right side, fire the laser again to make a second burn mark.

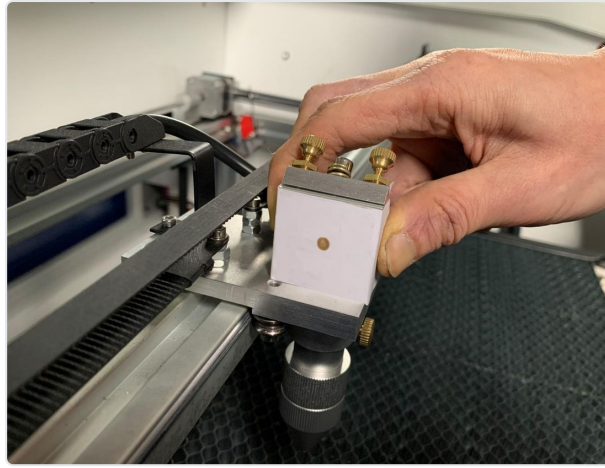


Laser head at the left side. Then move the laser head to the right. Laser head at the right side: burn mark, together with the burn mark made when the head was at the left.

If the burn-mark positions differ between the right and left positions of the laser head, the angle of the second mirror is at fault.

In this procedure, the goal is to make the burn marks for the right and left positions coincide — regardless of where on the strip those marks fall.

If the right and left burn marks do not coincide, refer to the machine's instruction manual and adjust the angle of the second mirror until they match. The method for adjusting the second mirror angle varies by model.

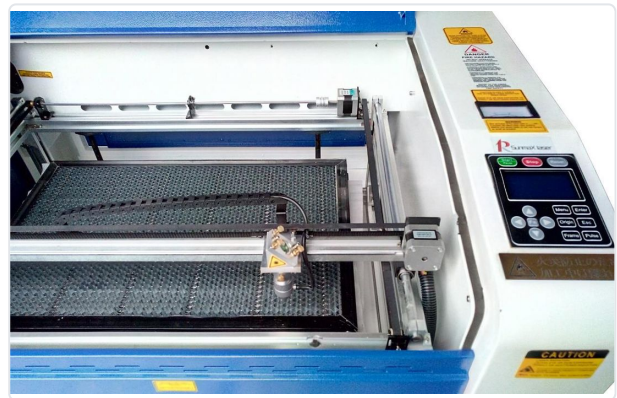


Coinciding burn marks — overlapping the burn mark made when the laser head was at the left.

2. Y-Axis Direction

Align the optical path in the Y-axis direction.

The Y-axis optical path is judged by comparing the results with the laser head positioned at the rear and at the front. If the burn-mark positions differ between the front and rear positions, adjustment is required.



Laser head at the rear / Laser head at the front.

First, check the burn mark with the laser head at the rear.

After making a burn mark on the paper strip in front of the third mirror, move the laser head toward the front, taking care not to let the strip shift out of position.

Once the head has been moved to the front, fire the laser again to make a second burn mark.



Laser head at the rear. Then move the laser head to the front. Laser head at the front: burn mark, together with the burn mark made when the head was at the rear.

If the burn-mark positions differ between the front and rear positions of the laser head, the angle of the first mirror is at fault. When the burn marks are offset between front and rear, the first mirror is misaligned.

To adjust the angle of the first mirror, hold a paper strip in front of the second mirror and check the offset between the rear and front laser-head positions. Adjust the angle of the first mirror until the offset is eliminated.



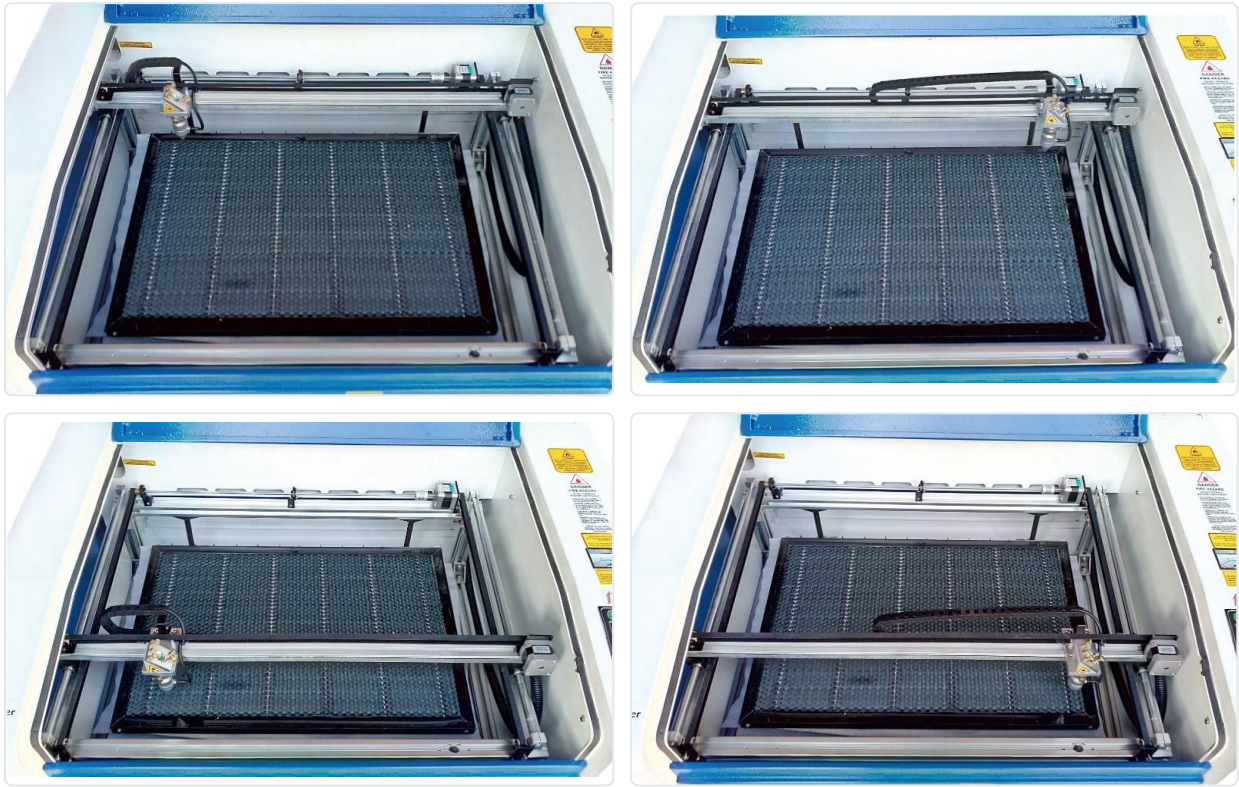
Laser head at the rear. Then move the laser head to the front. Laser head at the front: first mirror, second mirror.

If the burn marks in front of the second mirror coincide for the rear and front positions, they will also coincide in front of the third mirror.

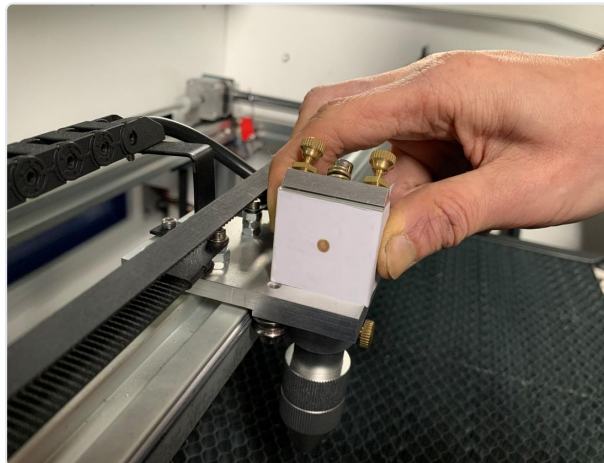
In this procedure, the goal is to make the burn marks for the front and rear positions coincide — regardless of where on the strip those marks fall.

3. Full-Area Check

Once both the X-axis and Y-axis adjustments are complete, confirm that the burn marks fall on the same single point at the four corners of the work area (rear left, rear right, front left, and front right).



Rear left / Rear right / Front left / Front right.



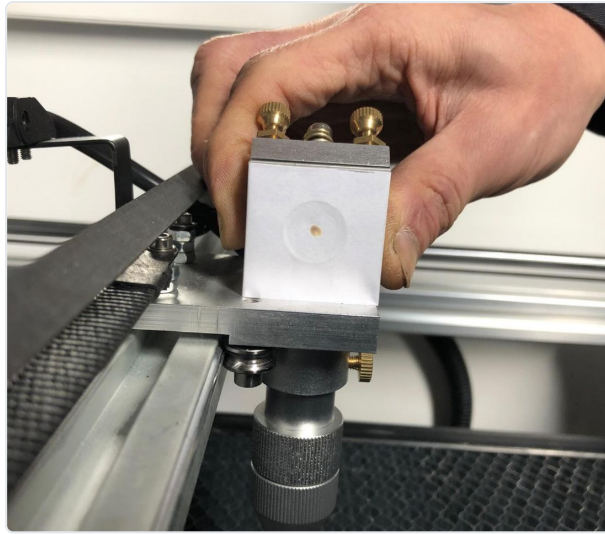
Adjust so that all burn marks coincide at the four corner positions.

(3) Centering the Beam in Front of the Third Mirror

After completing "(1) Preparing for Optical Path Alignment" and "(2) Adjustment Across the Entire Work Area," check the optical path and adjust it so that the beam comes to the center of the round hole in front of the third mirror.

If the burn mark is already at the center of the round hole of the third mirror, the procedure "(3) Centering the Beam in Front of the Third Mirror" is not required. Proceed to "(4) Adjusting the Third Mirror."

The burn mark is at the center of the round hole.



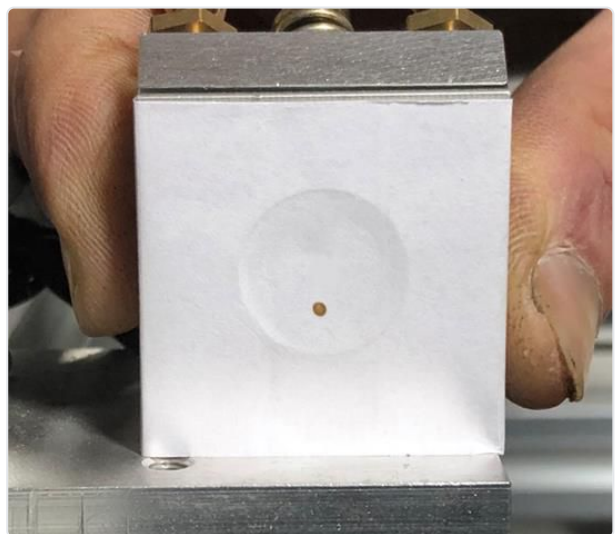
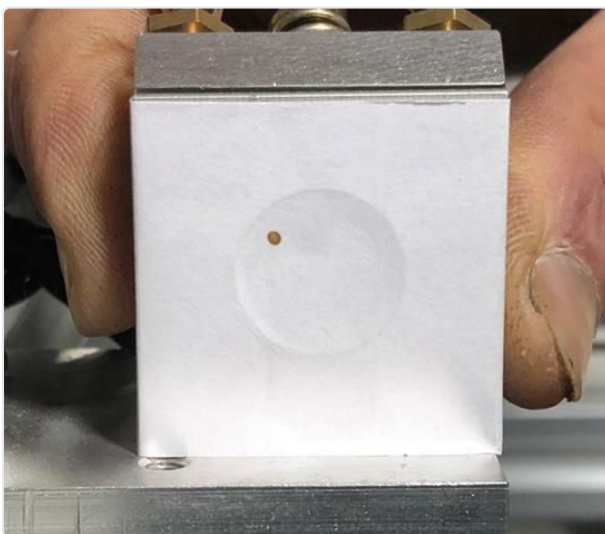
1. Height Adjustment

Adjust the beam position in the height direction.

Even if the mark is not centered in the left-right direction, this step is unnecessary as long as it is centered in the height direction.

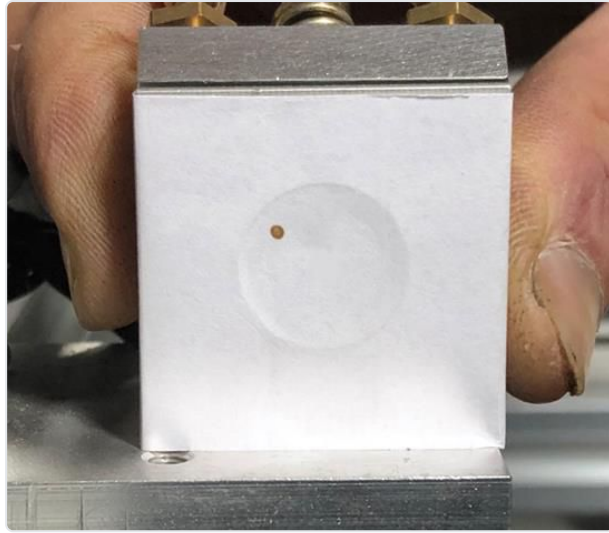
In the following example, the mark is not at the vertical center, so adjustment is required.

In the following example, the mark is at the vertical center, so "1. Height Adjustment" is not required. Proceed to "2. Left-Right Adjustment."



The height is adjusted by changing the position of the laser tube.

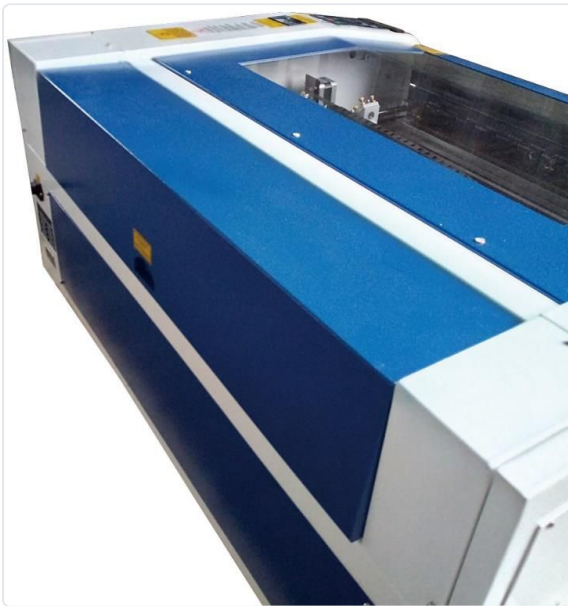
First, measure the amount of height change required from the burn mark.



Measure the vertical distance from the center of the round hole.

In the example above, if the vertical distance between the burn mark and the center of the round hole is 3 mm, the laser tube height must be lowered by 3 mm.

Open the rear door.



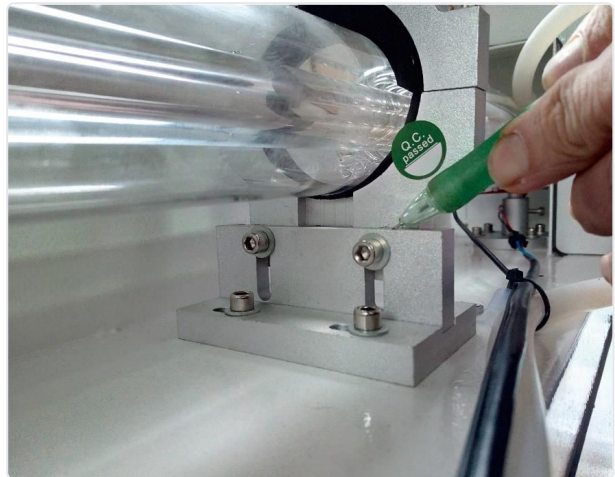
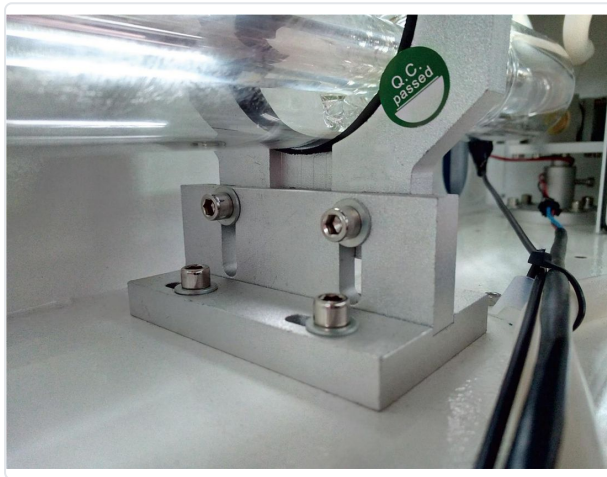
Note: The shape of the laser tube and of the machine body varies by model, but the procedure is the same.

The laser tube is secured by two mounting bases.

Note: The shape of the mounting bases varies depending on the model and production lot. Whichever type of mounting base is fitted, the principle and the procedure are the same. Read the instructions in terms of the actual mounting base on your machine.

Mounting base.

The mounting base allows height adjustment by loosening its two hex screws.



(Loosening the hex screws allows the base to move up and down. / Hex screws / Make a mark.)

Adjust the height of each of the two mounting bases. Change the height by exactly the vertical distance between the burn mark and the center of the round hole.

Making a mark with a mechanical pencil or similar and aligning to it makes the height adjustment more accurate.

Caution: The laser tube is secured by two mounting bases. If you change the height of only one mounting base, the laser tube will be tilted, which makes optical path alignment difficult. When changing the height, always change the height of both mounting bases.

After changing the height of the mounting bases, perform "(2) Adjustment Across the Entire Work Area." Align the optical path so that the burn marks land on the same point across the entire work area.

If the coincident burn mark now falls at the vertical center, the adjustment is OK.

If it does not reach the vertical center, fine-tune the mounting base height again and repeat "(2) Adjustment Across the Entire Work Area," iterating until the mark comes to the vertical center.

This work may require many rounds of fine adjustment. In some cases a single height adjustment is enough. As a rule, the larger the machine's work area, the more difficult and time-consuming this

becomes.

Repeat the adjustment until the mark reaches the vertical center.

Caution: Always confirm that the burn marks coincide over the entire work area. An adjustment that is correct only at one spot within the work area will not allow proper processing.

2. Left-Right Adjustment

Adjust the beam position in the left-right direction.

This step requires that "1. Height Adjustment" has already been completed.

If the burn mark is at the center of the round hole, this step is not needed. Proceed to "(4) Adjusting the Third Mirror."

In the following example, the mark is not at the left-right center, so adjustment is required.

In the following example, the mark is at the center of the round hole, so "2. Left-Right Adjustment" is not necessary.

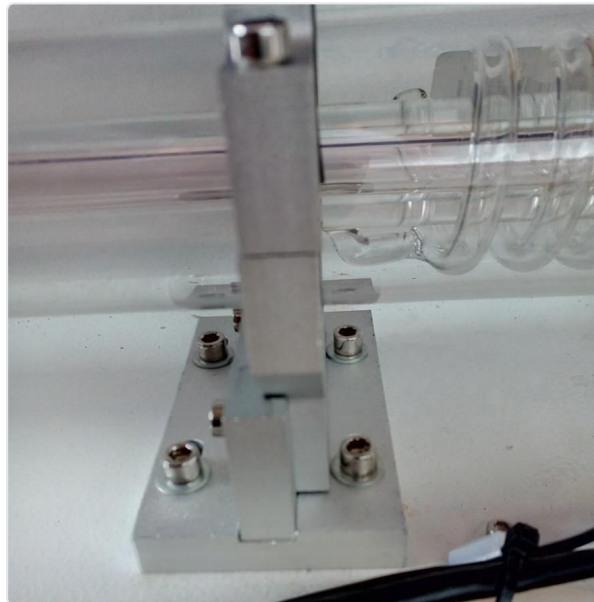
The left-right adjustment is made by changing the position of the laser tube.

First, measure the amount of left-right change required from the burn mark.

(Measure the left-right offset from the center of the round hole.)

In the example above, if, for instance, the left-right distance between the burn mark and the center of the round hole is 3 mm, the laser tube must be moved by 3 mm.

Open the rear door.



(Mounting base)

Note: The shape of the laser tube and of the machine body varies by model, but the procedure is the same.

Note: The laser tube is secured by four mounting bases.

Note: The shape of the mounting bases varies depending on the model and production lot. Whichever type of mounting base is installed, the procedure is the same. Substitute the actual mounting base on your machine as appropriate when following these steps.

The mounting base allows left-right adjustment by loosening its four hex screws.



(Loosening the hex screws allows the base to move left and right. / Make a mark.)

Adjust each of the two mounting bases in the left-right direction. Change the position by exactly the left-right distance between the burn mark and the center of the round hole.

Making a mark with a mechanical pencil or similar and aligning to it makes the left-right adjustment more accurate.

Caution: The laser tube is secured by two mounting bases. If you change the left-right position of only one mounting base, the laser tube will be tilted, which makes optical path alignment difficult. When changing the left-right position, always change the position of both mounting bases.

After changing the left-right position of the mounting bases, perform "(2) Adjustment Across the Entire Work Area." Align the optical path so that the burn marks land on the same point across the entire work area.

If the coincident burn mark now falls at the center of the round hole, the adjustment is OK.

If it does not reach the center of the round hole, fine-tune the left-right position of the mounting bases again and repeat "(2) Adjustment Across the Entire Work Area," iterating until the mark comes to the center of the round hole.

This work may require many rounds of fine adjustment. In some cases a single left-right adjustment is enough. As a rule, the larger the machine's work area, the more difficult and time-consuming this becomes.

Repeat the adjustment until the mark reaches the center of the round hole.

Once the burn marks coincide with the center of the round hole over the entire work area, the adjustment is complete.

Caution: Always confirm that the burn marks coincide over the entire work area. An adjustment that is correct only at one spot within the work area will not allow proper processing.

(4) Adjusting the Third Mirror

After completing "(3) Centering the Beam in Front of the Third Mirror," check the optical path and adjust the angle of the third mirror.

To adjust the angle of the third mirror, check the position of the burn mark made after the beam passes through the focusing lens. Follow the steps below.

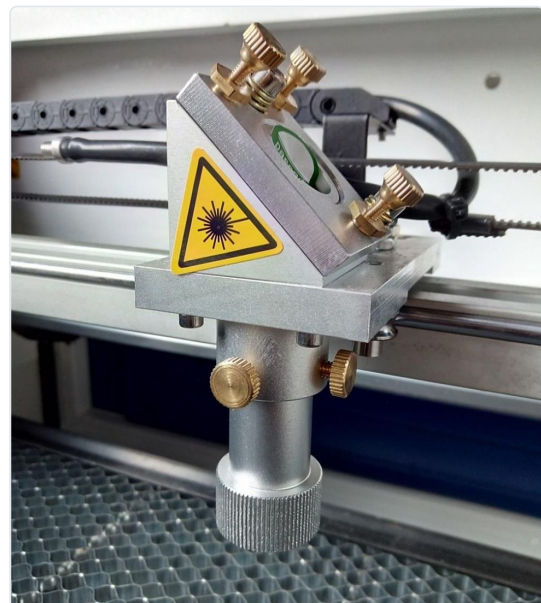
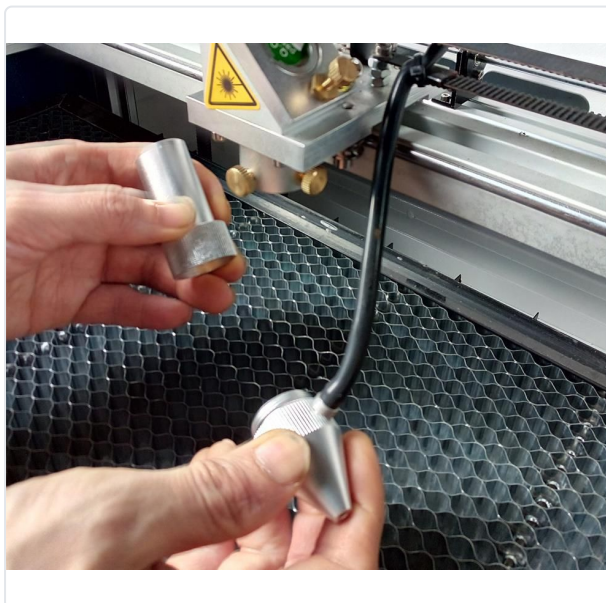
1. Removing the Nozzle

Loosen the fixing screw of the laser head cylinder and pull the laser head cylinder out.



(Loosen the fixing screw of the laser head cylinder. / Pull out the laser head cylinder.)

After pulling out the laser head cylinder, remove the nozzle.

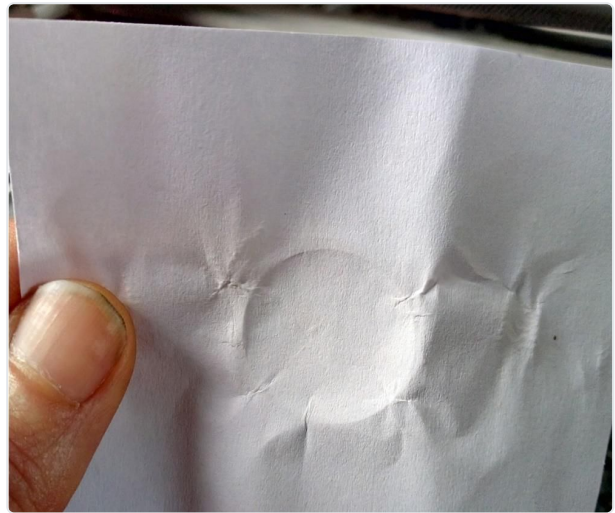
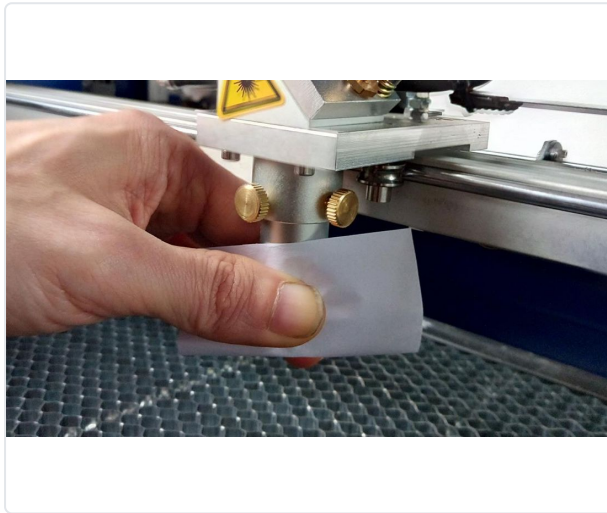


Attach only the laser head cylinder back onto the laser head.

2. Checking the Optical Path

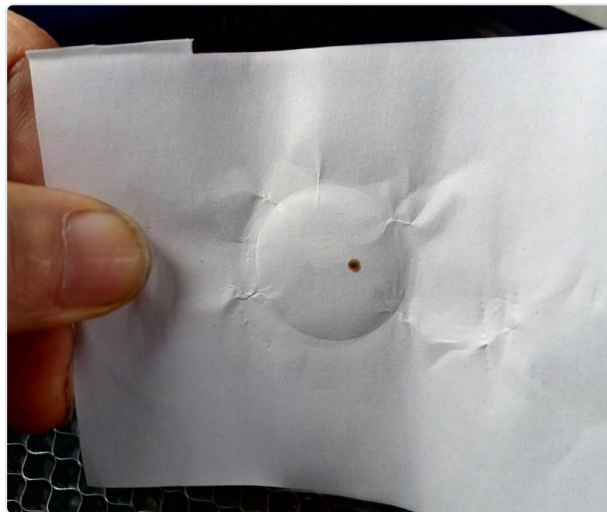
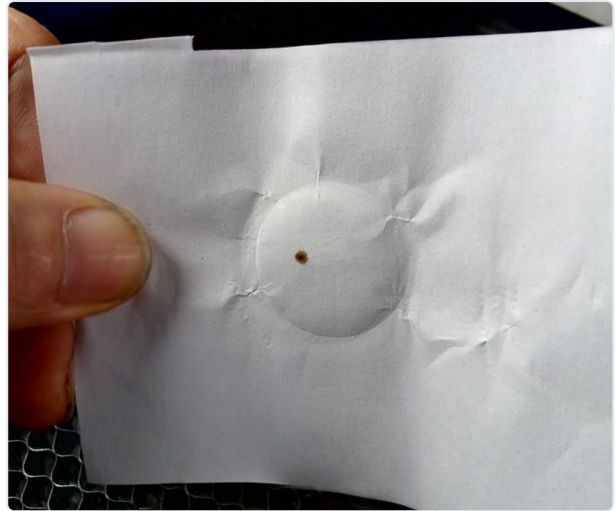
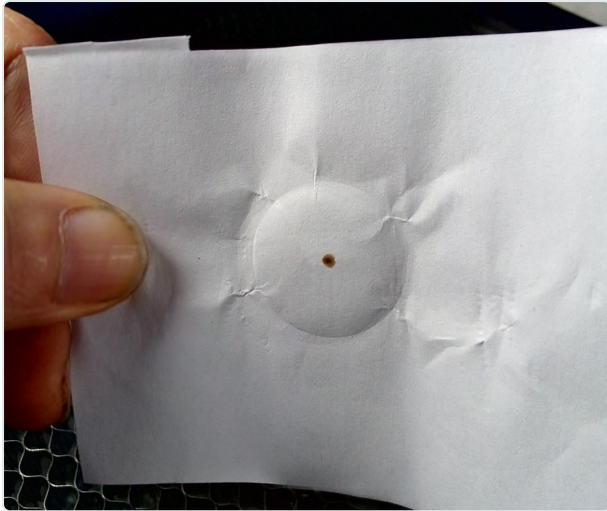
Hold a paper strip for checking the burn mark against the bottom face of the laser head cylinder and fire the laser.

As in "(2) Adjustment Across the Entire Work Area," press the paper against the cylinder so that the round outline of the laser head cylinder is imprinted on it.



Fire the laser in this state and check the position of the burn mark.

As shown in the figure below, the burn mark should fall at the center of the circle.



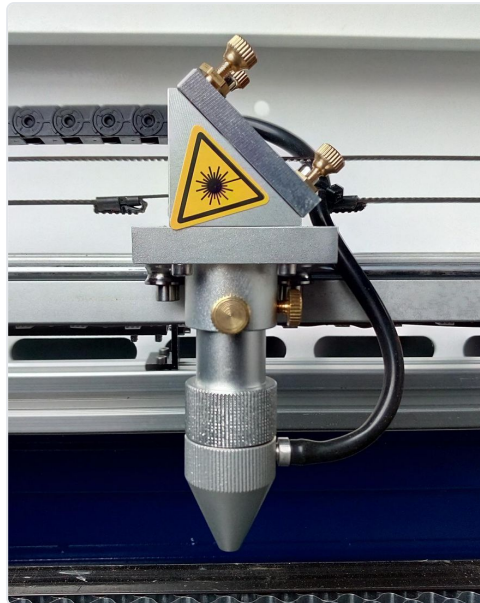
If the burn mark is not at the center of the circle, adjustment is required.

The position of the burn mark is changed by changing the angle of the third mirror.



Once the burn mark falls at the center of the circle, the adjustment is complete.

Reattach the nozzle and the autofocus unit to restore the machine to its original condition.



(5) Checking Perpendicularity

The perpendicularity of the laser beam is checked by firing the laser at the side face of a thick wooden board.

For this check, change the "Laser Set" setting on the control panel to zero.

1. Change the "Laser Set" Setting to Zero

The firing time is set with "Laser Set" on the control panel.

Press the function button.



Use the arrow buttons to move to "Laser Set+".



Press the Enter button.

Then set the Laser Set value to zero (0 ms).

The Laser Set value is entered with the arrow buttons: use the left and right arrow buttons to move between digits, and the up and down arrow buttons to increase or decrease the value.

After entering the value, press the Enter button. Then press the Esc button to return to the normal screen.

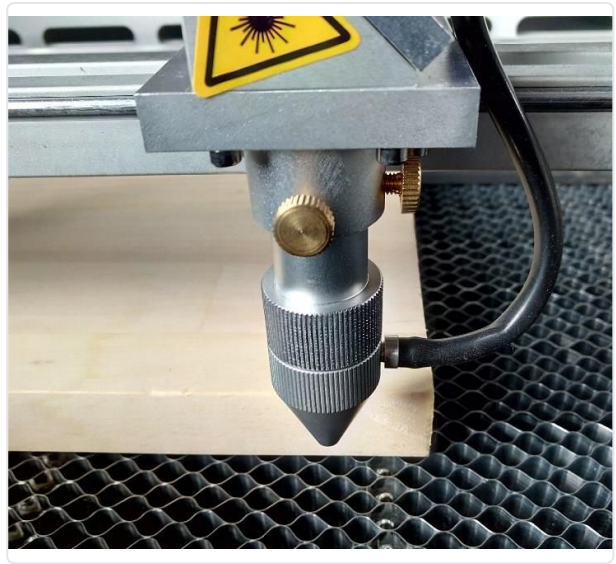
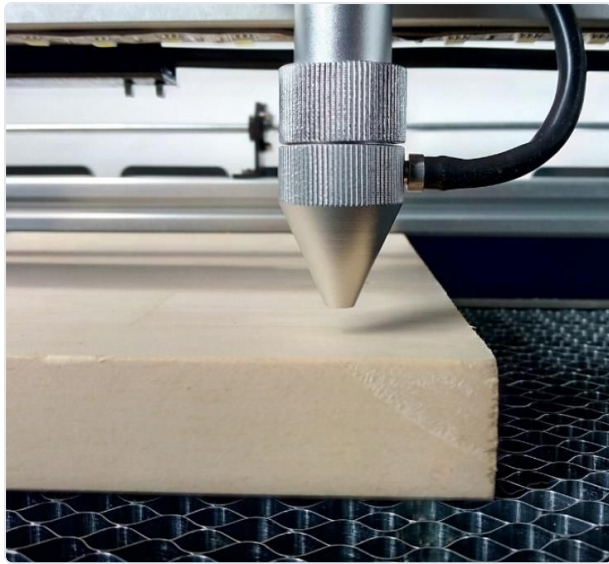
2. Check Perpendicularity

To check that the laser beam is perpendicular to the material being processed, it is best to use the actual material and the actual data that will be used in production.

If for some reason the actual material cannot be used, perpendicularity can be checked using a thick wooden board. A board about 2 cm thick or more makes the result easier to read.

When checking with a wooden board, follow the procedure below.

First, focus the beam on the surface of the board.

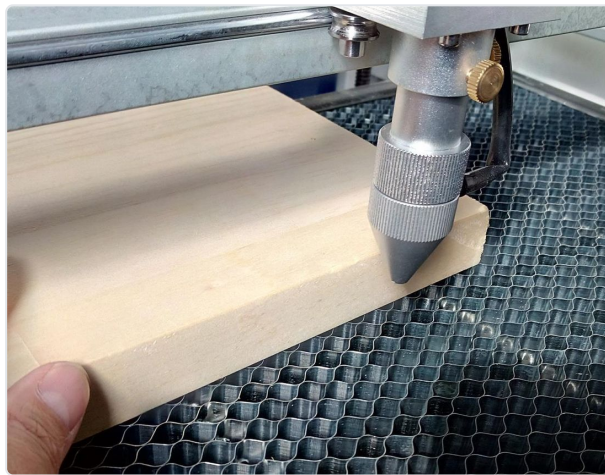


Begin by checking the left-right tilt.

With the laser beam not striking the board, press and hold the "Laser" button on the control panel so that the laser keeps firing.

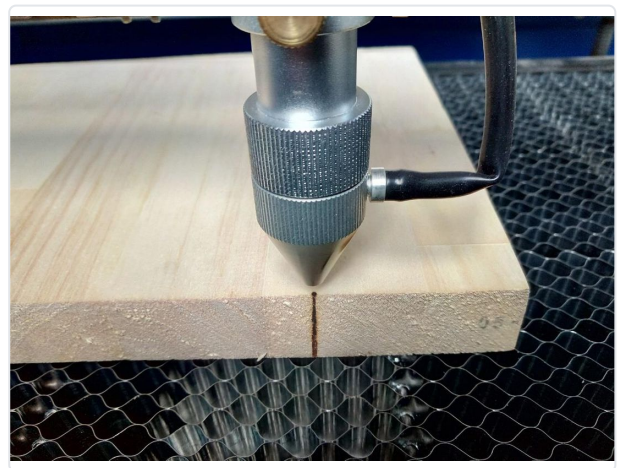
(Move the board back, away from under the laser nozzle, so that it is not struck by the beam even while the laser is firing.)

While firing the laser, move the board toward the front and make a burn mark on the side face of the board.



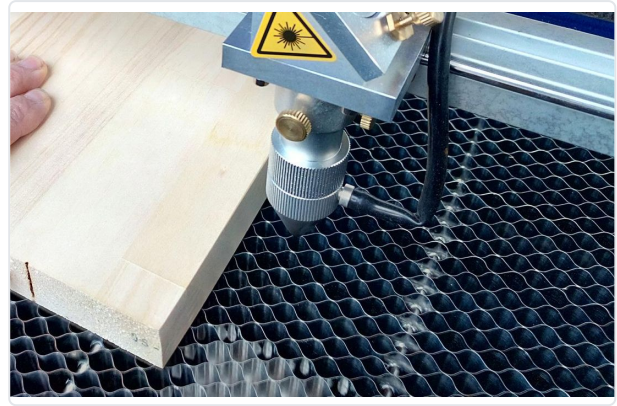
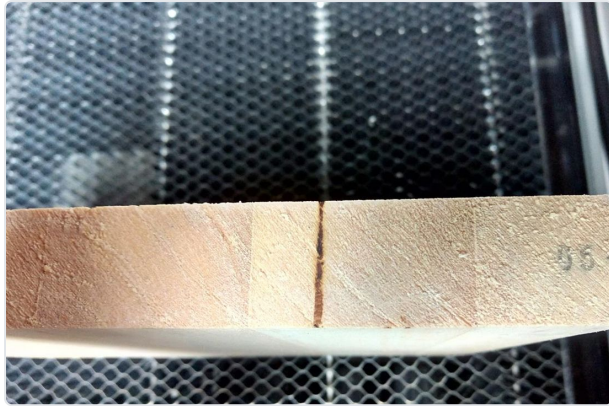
(With the laser beam not striking the board, press the "Pulse" button. / Slowly move the board toward the front.)

Move the board slowly forward, and once a burn mark has been made on the side face of the board, stop the laser output and check whether the burn mark is vertical.



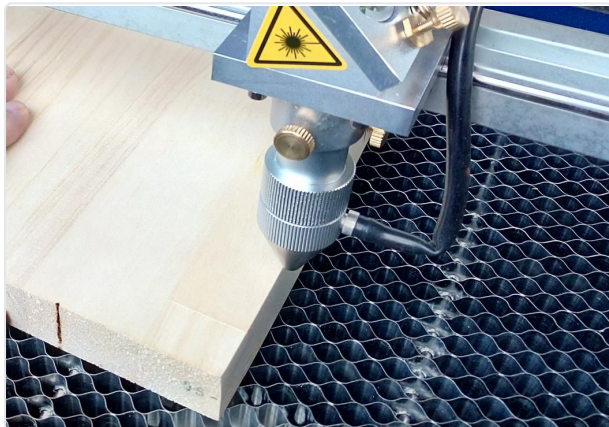
Check whether the burn mark is vertical.

Next, check the tilt in the front-back direction.



Slowly move the wooden board from left to right.

Move the board slowly to the right, and once a burn mark has been made on the side face of the board, stop the laser output and check whether the burn mark is vertical.



Check whether the burn mark is vertical.

(6) If the Beam Does Not Become Perpendicular

If the beam is still tilted after all of the adjustments up to (5), first fine-tune the angle of the third mirror so that the beam becomes perpendicular.

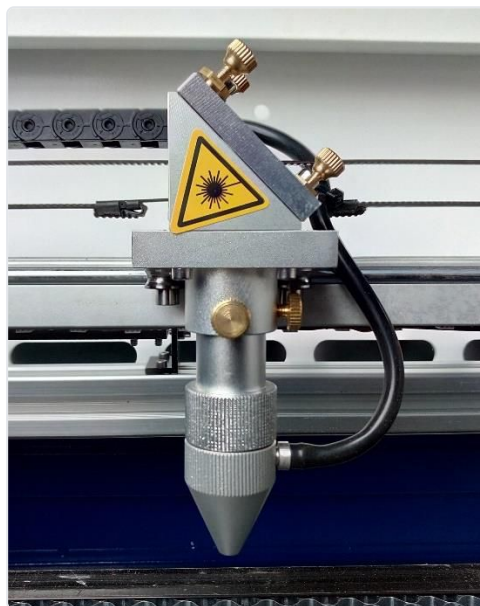
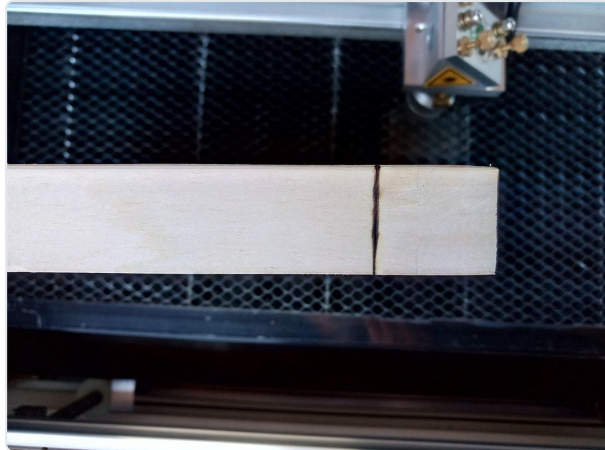
If fine-tuning the third mirror alone does not make the beam perpendicular, the cause may be a mechanical accuracy problem. Try the following.

1. Check That the Laser Head Cylinder Is Secured

If the laser head cylinder is tilted, the laser will not be emitted perpendicularly.

The laser head cylinder may be tilted, or it may not be firmly secured. Loosen the laser head cylinder once and then secure it again.

Loosen the fixing screw, move the laser head up and down, and then tighten the screw again.



2. Check the Focus Lens

If the focus lens is mounted at an angle, the laser will not be emitted perpendicularly.

Referring to the machine instruction manual, remove the focus lens and check the lens and its mounting.

- When mounting the focus lens, check that no fine debris or similar particles are caught between the lens and the laser head cylinder.
- Check that the lens is not mounted in the wrong orientation. The focus lens is a plano-convex lens: the convex side faces up and the flat side faces down.
- Check that the silicone ring is not installed incorrectly. Viewed from the top of the laser head cylinder, the order is lens, silicone ring, then retaining ring.
- Check that the lens has no scratches, chips, or cracks, and that the surface coating is not peeling off. A problem with the lens itself can prevent the beam from being perpendicular.

3. Check the Table for Tilt

If the table on which the workpiece is placed is tilted, the beam will appear to be tilted with respect to the workpiece even though the laser is being emitted perpendicularly.

If the table is tilted, correct it.

Note: Since it is not known whether the laser machine itself is level, when checking with a level or spirit level, use the level measured on the X-axis and Y-axis rails as the reference for checking the levelness of the table.

4. Changing the Beam Position Just Before the Third Mirror

If steps 1 to 3 above do not improve the situation, it may be necessary to change the beam position just before the third mirror.

Because of variations in the machining accuracy of the laser head itself, the optical path may have to be brought to a position slightly offset from the center of the round hole, rather than to the center as done in "(3) Centering the Beam in Front of the Third Mirror."

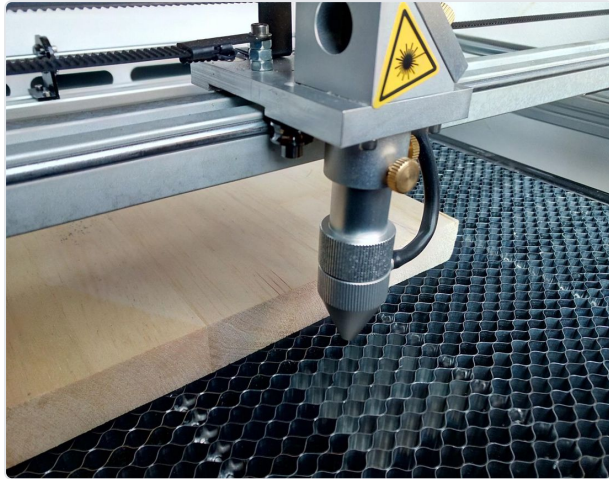
Since this is caused by variations in the machining accuracy of the laser head itself, how far the beam should be offset from the center is not known. It differs from machine to machine, so adjustment is required.

The direction of the offset can be determined from the checks performed in "Checking Perpendicularity."

To adjust the optical path with an offset from the center of the round hole, fine-tune the offset amount (the distance from the center of the round hole) while repeating "(2) Adjustment Across the Entire Work Area," "(4) Adjusting the Third Mirror," and "(5) Checking Perpendicularity," and continue until the laser beam is perpendicular.

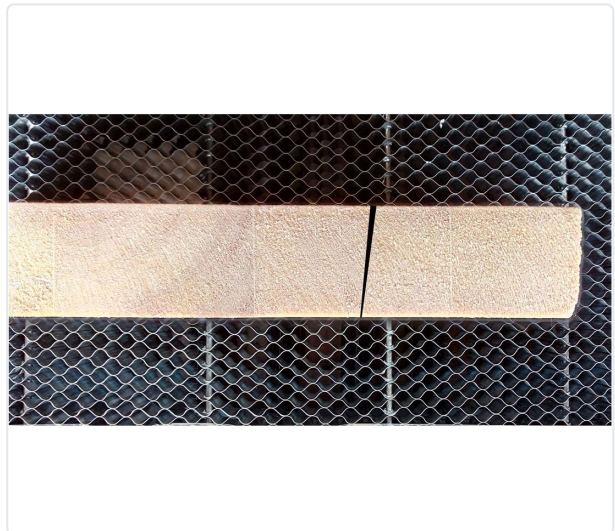
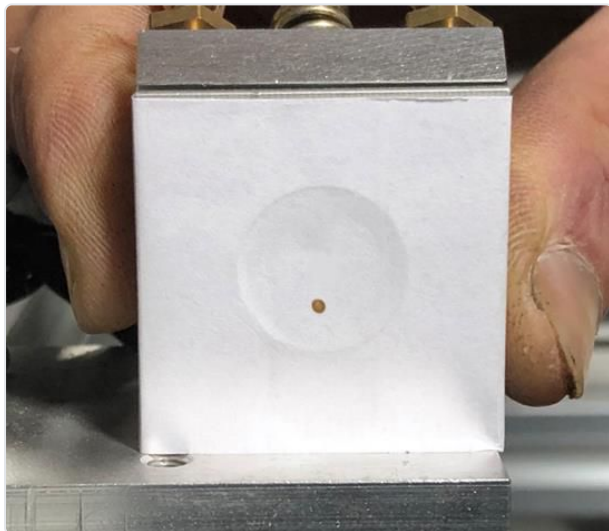
When making the tilt assessments below, attach the nozzle and adjust the third mirror so that the laser is emitted from the nozzle. If the laser strikes and reflects inside the laser head cylinder, proper adjustment is not possible.

Assessing the Tilt When Moving the Wooden Board from Back to Front



When the side face of the board is viewed from the front and the laser beam tilts to the right as it travels downward:

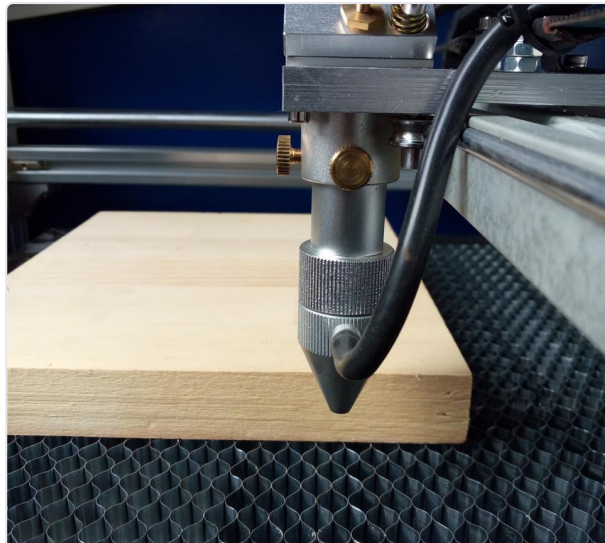
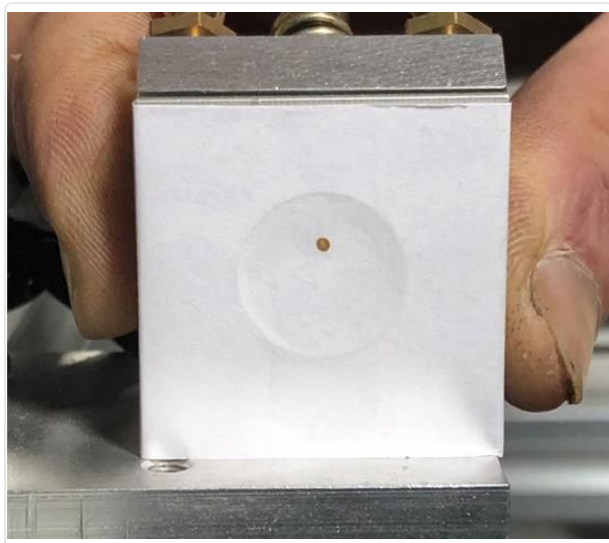
Shift the point where the beam passes through the round hole in front of the third mirror downward.



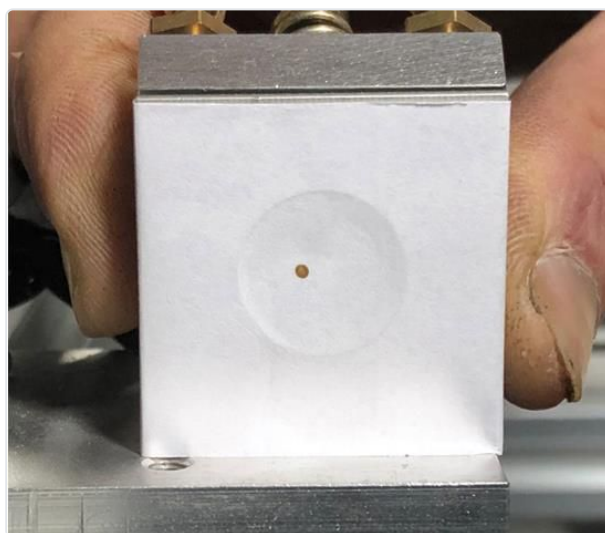
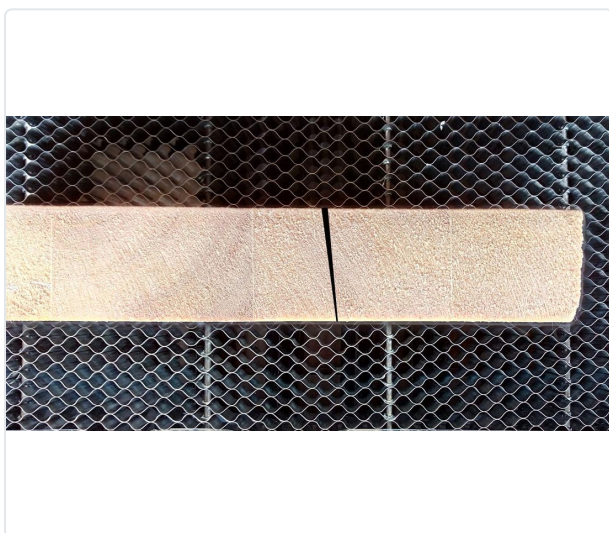
When the side face of the board is viewed from the front and the laser beam tilts to the left as it travels downward:

Shift the point where the beam passes through the round hole in front of the third mirror upward.

Assessing the Tilt When Moving the Wooden Board from Left to Right as Seen Facing the Machine

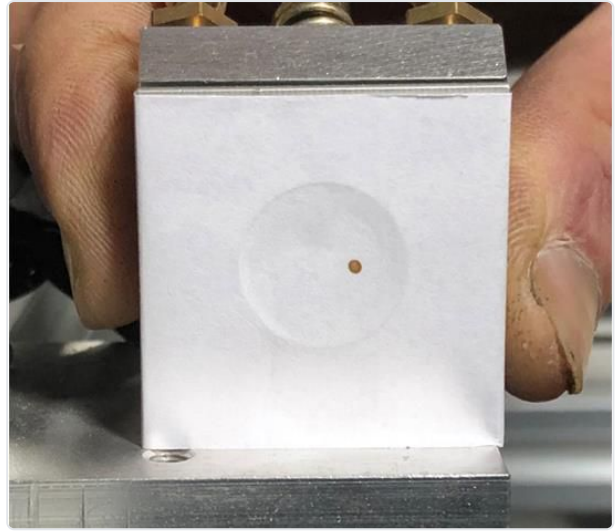
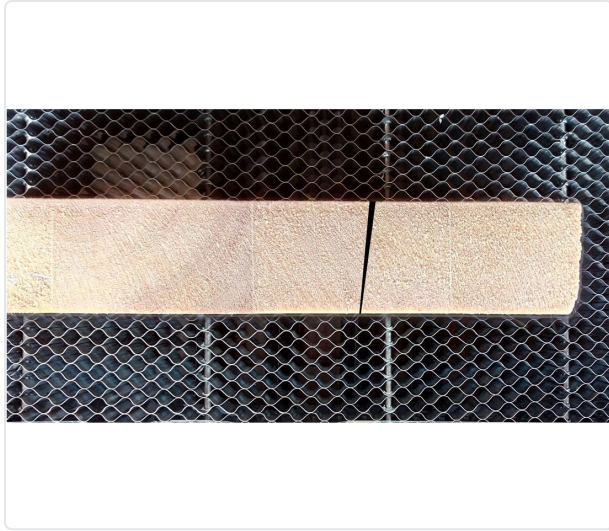


When the side face of the board is viewed from the front and the laser beam tilts toward the back as it travels downward:



Shift the point where the beam passes through the round hole in front of the third mirror toward the back.

When the side face of the board is viewed from the front and the laser beam tilts toward the front as it travels downward:



Shift the point where the beam passes through the round hole in front of the third mirror toward the back.

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