

Magnus VLF

Z-stage Upgrade

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Revision History

Revision	Date	Author	Comments
A	09 Feb 2005	R.Bouchal/A.Blignaut	First official release
B	12 April 2005	R Bouchal	Production release (no changes)
C	July 8, 2005	M.Herbert	Note changed in section 5.4-2.
D	Dec 22, 2005	A.Blignaut	Note added to section 6 to set the base thickness parameter to 0.

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1. Z-STAGE UPGRADE PREREQUISITES

- The Magnus VLF must have the Thermal 2 head chiller tube upgrade already installed. If not, the large junction block at the entry of the flex track interferes with the push cylinder on the new Z-stage.
- The carriage must have the holes already pre-drilled for the Z-stage upgrade. All early production and later devices should have the pre-drilled carriages, but the beta devices will not.

2. RELATED DOCUMENTS

- Z-stage assembly (Creo part number 500-01579C)
- Z-stage kit (Creo part number 518-00570A)

3. PARTS / TOOLS REQUIRED

- Z-stage kit for semi-automatic devices (Creo part number 518-01065A)
- Z-stage kit for automatic devices (Creo part number 518-01066A)
- 100x microscope **or** the tilt viewing tool and procedure 719-00424A
    - 690-00225A: Tilt viewing tool (lenticular), 2400 dpi and 1200 dpi
    - 690-00226A: Tilt viewing tool (lenticular), 2540 dpi and 1270 dpi
- Calipers (digital preferred)

4. THEORY OF OPERATION

The new Z-stage moves the head in the axis of the imaging beam to allow for repositioning of the head for different plate thicknesses.

The basic operation involves the positioning of an angled wedge (2 degrees) by means of a stepper motor and lead screw device. Once the wedge is positioned, an air cylinder, which is attached to the thermal head guide rod, clamps the wedge up against a hard stop. Consequently the head is clamped into a predetermined position based on the position of the wedge. The 2-degree angle on the wedge allows for roughly a 29:1 ratio of movement of the wedge compared to the movement of the head. This advantage affords a fine control of the end position of the head with minimal accuracy necessary on the wedge control.

The head guide rod is located in a matched set of four plastic guides forming the V-groove. The new head guide rod has a very smooth, hard chromed finish to minimize wear of the V-groove.

The 5th point support uses the head's regular button, which is supported on the carriage by the 5th point pivot assembly. This pivot assembly consists of a set of small cam followers

mounted to a pivot frame to allow for slight angular misalignment. The two cam follower bearings roll on the annular surface area of the head's 5th point button.

When a device is initialized, the Z-stage moves to the appropriate location based on the loaded plate thickness and a NVS parameter (**set mh zstagezero**). The Z-stage will stay locked until a different plate thickness is selected. See Table 1 for some of the Z-stage NVS parameters.

Table 1: Z-stage NVS parameters

Name	Active	Default	Unit
ZstageGain	0.4	0.4	-
ZstageSPM	1127.559	1127.559	steps/mm
ZstageMSR	4	4	microsteps/step
ZstageZero	0	0	mm

5. UPGRADE PROCEDURE

5.1 Recording the current device status

1. Using calipers, measure the thickness of a medium size plate used by the customer. Take several measurements in different areas to get an average measurement.
2. Load the plate you have just measured (or another one from the same batch).
3. Type `>>plot edge` to find the plate edge position and call this **x**.
4. Type `>>carriage moveto x+100` to move the carriage 100 mm inboard of the edge of the plate.
5. Type `>>head install on` and record the focus error for later use.
6. Type `>>carriage moveto x+300` to move the carriage further into the plate and record the focus error value again.
7. Type `>>carriage init` to move the carriage to the home position
8. Run a diagnostic plot 28 (2-pixel (20-micron) horizontal lines).
9. Use a 100x microscope (or the tilt checking tools) to measure any saw tooth pattern for tilt at the swath boundaries. If there is, record this now. This will be used later when checking the head tilt.

5.2 Removing the head

10. Initialize the carriage:
    `>>carriage init.`
11. Move the carriage to the 1000 mm position for the best head access:
    `>>carriage moveto 1000`

12. Turn the device power off and turn the air supply off at the pressure regulator shut off valve.

13. On automatic devices, open the front hood, rear hood, and the door in the middle of the device. Also remove the center laser panels, the load table rails, and the unload table panels.
    On a manual device, open the rear hood and remove the center of the table section.

14. If there is an ejector on the right side of the device (engine manifold side), open the ejector lid, slide the ejector unit forward, and raise the ejector table.

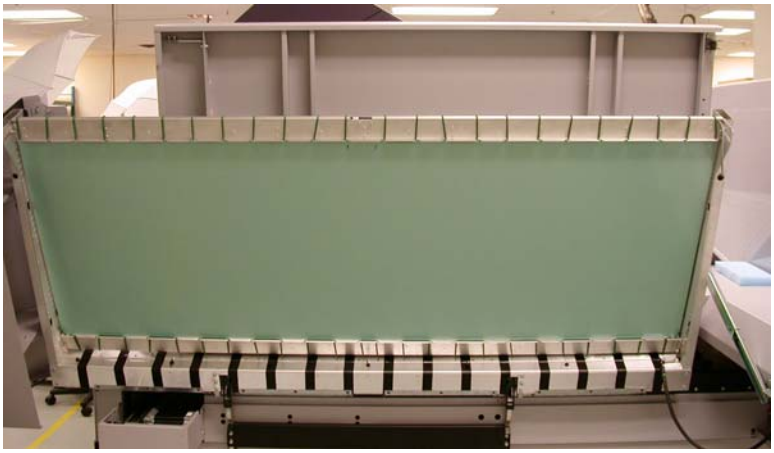


Figure 1: Ejector lid and table up

15. Move the drum vacuum unit to access the engine manifold panel.

16. Remove the engine manifold side panel to gain access to the manifold and the flex track.

Note: Wear an anti-static wrist strap when handling the head and related electronics.

17. Remove the head from the carriage and carefully place it somewhere where you can work on it easily. Use toweling to catch and clean up any coolant that is spilled when disconnecting the tubes.

18. Remove the six screws and remove the adapter plate from the carriage. Wipe the adapter plate clean before making the measurement in the next step.

19. Using calipers, measure the distance from the underside of the old adaptor plate where it contacts the carriage surface to the top of the 5th point button pad where the button sits (after cleaning any grease). Note this measurement for later use.

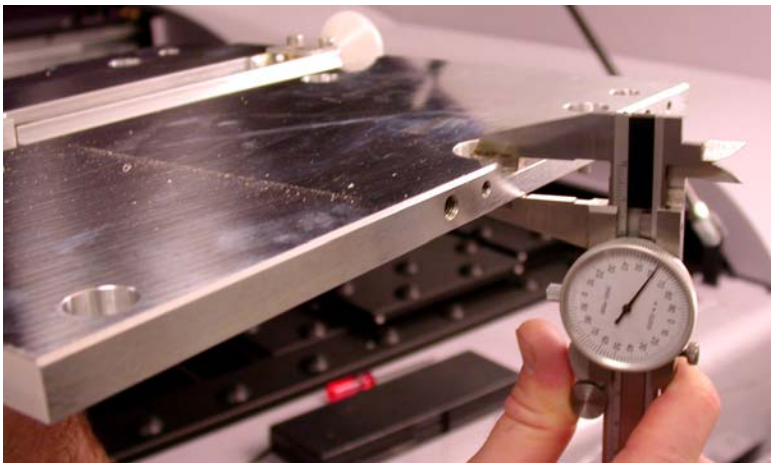


Figure 2: Adapter plate measuring point

5.3 Installing the cables and tubes

The new Z-stage needs a red and black 5/32-inch tube from the head to the engine manifold. It also needs two cables from the GENINE board in the power box (one for the home/away sensor and the other for the motor driver).
Some customer devices may have the upgrade cables and tubes already installed—they will be neatly rolled up and secured with a cable tie to the end of the flex track. A single action solenoid valve will also be installed on the engine manifold for this purpose. If they are not installed, follow these steps to install them:

1. Remove the flex track from the carriage where the two brackets connect by removing the two screws connecting the brackets.

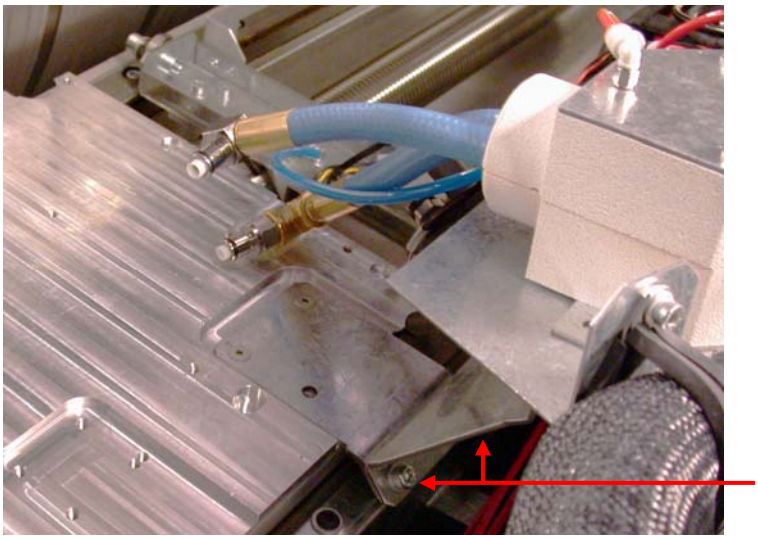


Figure 3: Flex track mounting screws

To make it easier to slide the cables and tubes into the flex track, lay it flat towards the manifold side of the device.

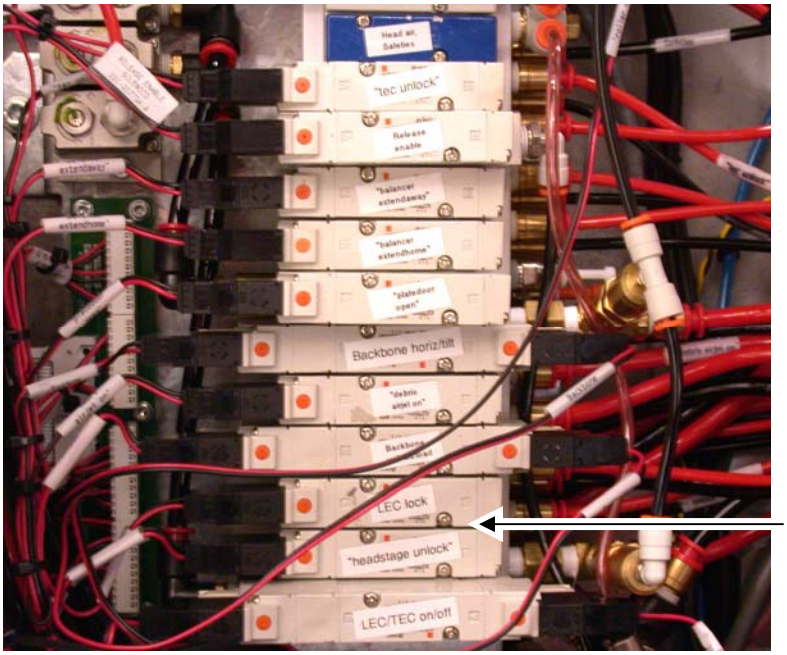
Feed a spare piece of tube through the cable side of the flex track from the carriage to the disconnected end at the side of the device. This will be used to pull the cables into the flex track.

Tape the cable connectors to the end of the spare tube and pull them into the flex track to the carriage.

Note: Make sure that you attach the GENINE connectors. The head connectors must be left at the loose end of the flex track.

2. Make a second pass with the spare piece of tube to pull the new tubes into the tube side of the flex track.

3. Install the 'Z-stage unlock' solenoid valve on the engine manifold in the slot second from the bottom of the manifold assembly. Attach the black and red tubes that you just fed through the flex track.



'Z-stage unlock' solenoid

Figure 4: Engine manifold

4. Attach the flex track to the carriage. See Figure 3.
   At this point, check that the hole in the bracket (the one that the flex track mounts to) lines up with the thread in the carriage. If not, remove the bracket and drill the hole bigger until they line up.



Figure 5: Hole alignment

5. Remove the power box panel.
6. Route the GENINE connectors along the cable duct underneath the flex track, around the frame at the side of the device, and into the power box. Fasten them neatly in place with a cable tie.

In the power box:

7. If you are upgrading a Magnus VLF that does not have GENINE 0 installed, you must first install the GENINE board, the terminator, and the canbus cable. See Figure6 for installation location.

8. Mount the Z-stage motor resistor bracket above the GENINE board (use existing holes).

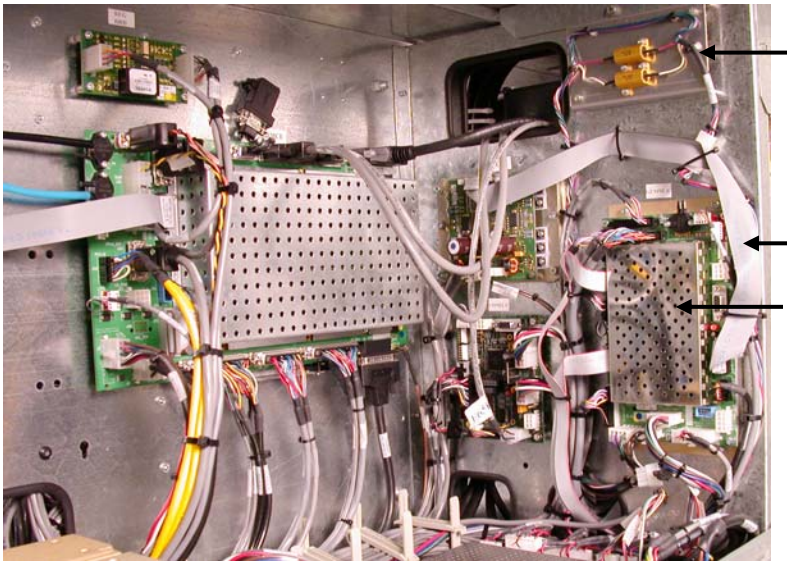


Figure 6: Power box

9. Connect one of the bracket cables to the GENINE 0 board as labeled, and connect the other cable to one of the new cables you routed from the carriage.

10. The other routed cable connects to the GENINE 0 board as labeled.

11. Secure all cables neatly with a cable tie.

12. Install power box panel.

5.4 Upgrading the carriage

1. Clean the carriage surface with isopropyl alcohol and a lint-free cloth.

2. Install the new Z-stage mounting plate onto the carriage surface using five M5x14 screws with belleville washers and two M5x14 screws without washers and two M5 x 20 screws without washers. The screws without washers go in the 4 holes next to the carriage rod. Torque all screws to approximately 9 Nm.

Note: Push down (away from the drum) on the reference surface to dowels (the machined slots in the carriage) to ensure proper alignment of the head later.

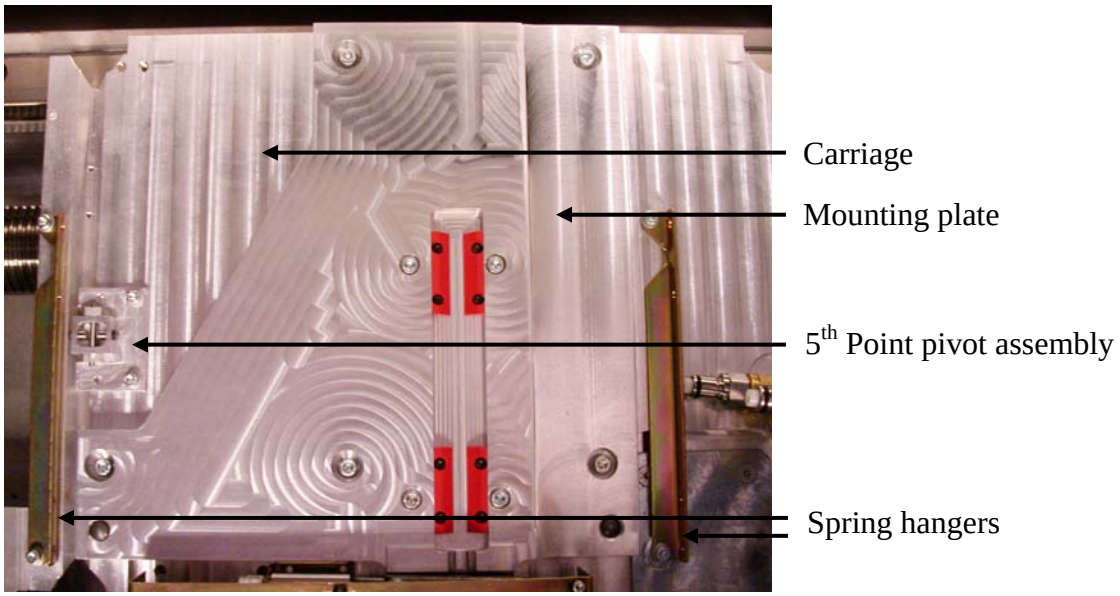


Figure 7: Carriage assembly

Before installing the 5th point pivot assembly, you need to adjust its thickness to be as close as possible to the measurement taken of the old adapter plate. This will be the starting point for setting the head tilt. To adjust the thickness:

3. Use calipers to measure from the bottom of the pivot plate to the top of the cam followers. Use the supplied flat steel shim for a more accurate measurement (measure the entire thickness and subtract the thickness of the steel shim).

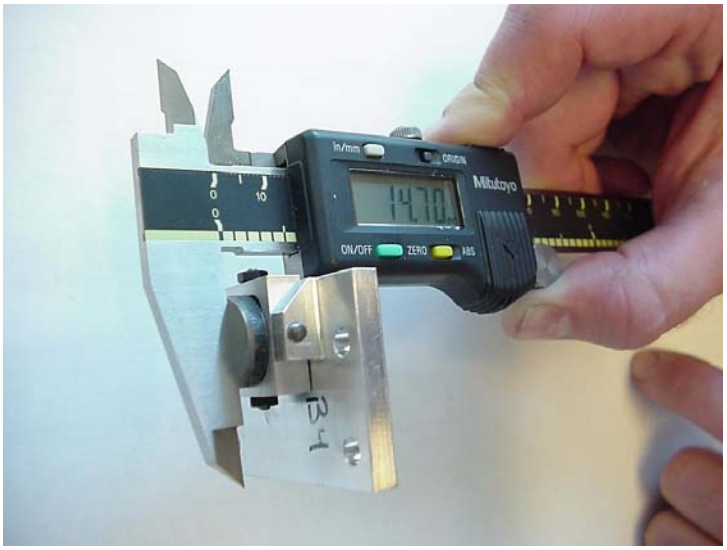


Figure 8: Measuring the 5th point pivot assembly thickness

Add shims (supplied in the kit) to get the measurements as close as possible. Later adjustment of these shims may be necessary in case the guide rod height of the carriage surface is very different from the old adaptor plate.

4. Install the 5th point pivot assembly using two M4x10 screws and belleville washers. Place the shims between the pivot plate and the carriage.

5. Install the spring hangers using M4x10 screws and belleville washers. See Figure 7 for the orientation of the spring hangers.

Note: The only location where you need the longer M4x16 screw.

5.5 Upgrading the thermal head

Note: Wear an anti-static wrist strap when working with the thermal head.

1. Remove the old flexure plates by removing the M4 screws holding them in place on the sides of the head and slide the plates out of the head.

2. Cut the cable ties on the side handles and slide the handles into the head.

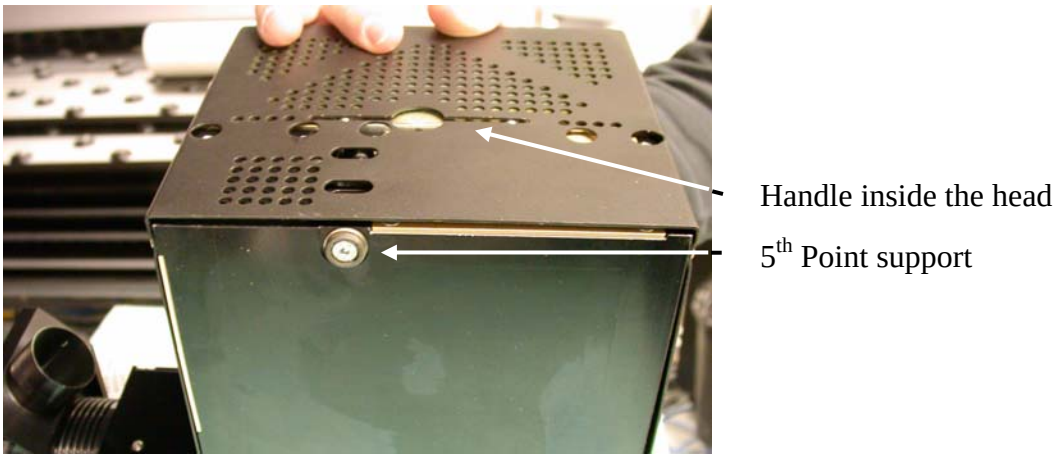


Figure 9: Thermal 2 head 5th point

3. Install the new spring hangers where the flexure plates were removed.

   On the side with the 5th point support, add several M4 washers to each screw when installing the spring hanger—the washers act as shims to prevent the spring hanger from deforming the sheet metal on the outside of the head (usually 3 or 4 washers are sufficient).

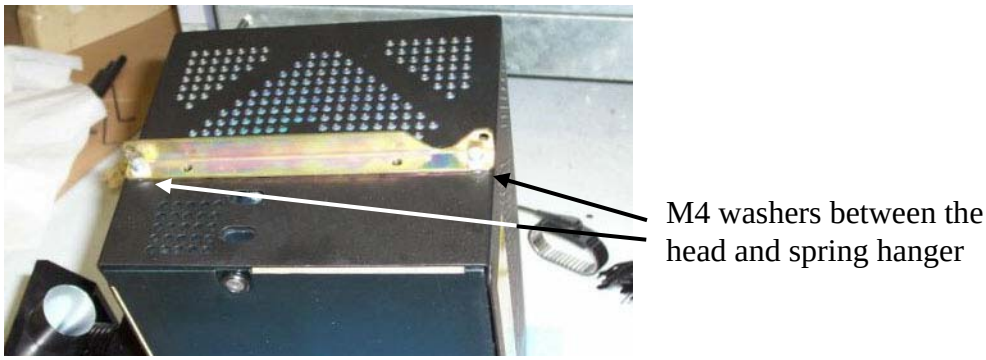


Figure 10: Thermal 2 head spring hanger – 5th point side

   On the connector side, temporarily remove the air jet tube from its channel to loosen up the tube and slide the hanger in underneath it.

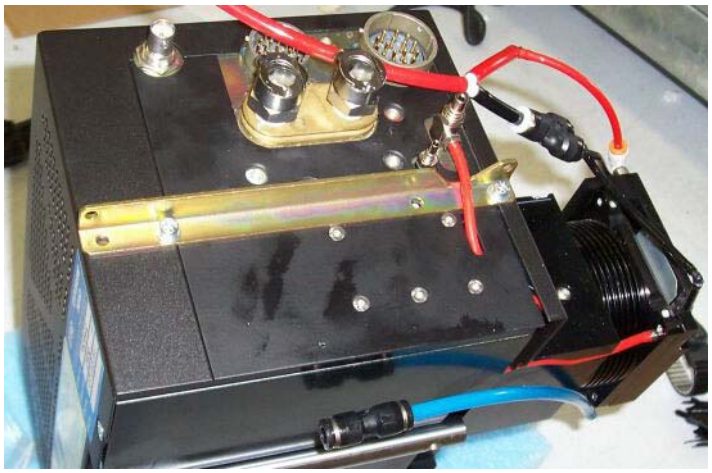


Figure 11: Thermal 2 head spring hanger – connector side

4. Remove the old head guide rod and clean the grease from the area with isopropyl alcohol and a lint-free cloth. Use the same screws to install the new head guide rod in its place—do not put grease on the new rod and do not over-tighten the screws.
   The new head guide rod has a smooth, hard chromed surface to minimize wear on the plastic guides on the carriage.

5. Clean all other contact surfaces with isopropyl alcohol and a lint-free cloth.

5.6 Installing the thermal head

Note: Wear an anti-static wrist strap when working with the thermal head.

1. Carefully place the head guide rod into the V-groove on the carriage and lower the 5th point support carefully onto the top of the 5th point assembly installed on the carriage. As a reference when lowering the head, the 5th point side of the head should be in line with the half circle–shaped recess in the carriage as shown below.

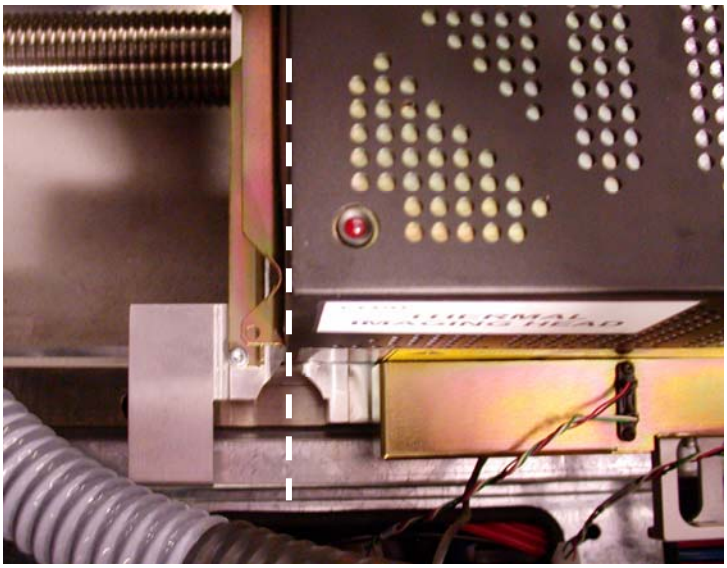


Figure 12: Head placement

The head should move forward and backward quite freely and should not rock when you push down on the 5th point side of the head. You should also not be able to twist the head on the carriage.

Note: The range of forward to backward motion for the head is only 1mm to 1.5 mm. Do not push it too far or the 5th point support may fall off the needle roller assembly on the carriage.

If you push the head backwards and release it, it should slide forwards under its own weight. If it does not, check for the following:

- Check that it is sitting on the 5th point properly.
- Check that it is seated in the V-groove.
- Check that no air lines or cables are stuck under the head.

2. Before installing the extension springs, use pliers to bend open the spring end loops a little. This will make installation of the springs easier.



Figure 13: Extension spring end loop opened a little

3. Starting with the 5th point side, install the four extension springs between the spring hanger brackets on the head and the spring hanger brackets on the carriage. The easiest way to do this is to use a 4 mm ball end hex key to pull the springs over the hangers.

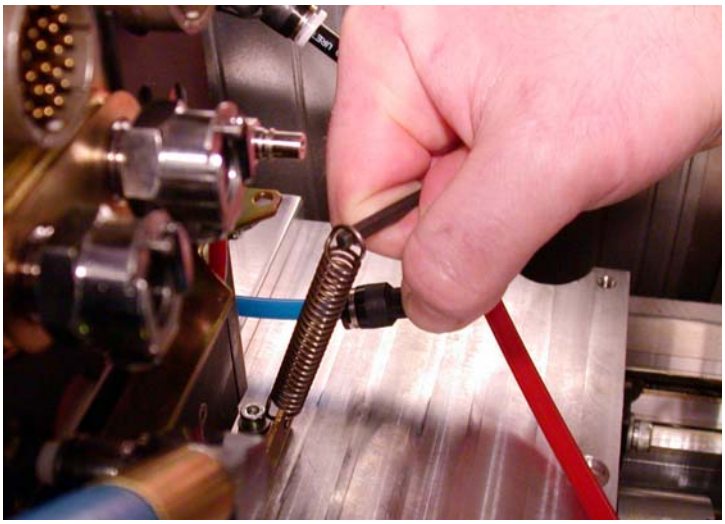


Figure 14: Spring installation

4. Check that the head still moves forward and backward with very little force.
5. Replace the O-rings on the coolant tubes and connect the head tubes and cables as you would in a normal head installation.
6. Install the debris removal nozzle.
7. Place five 0.1 mm shims onto the nose of the clamp cylinder's pull pin (measure the shim stack with calipers before placing them on the pull pin and record this for later use). The shim pack thickness may need to be adjusted later.

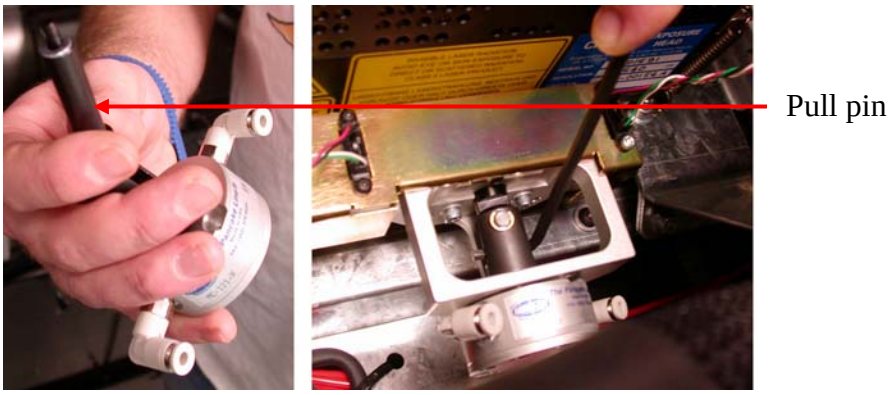


Figure 15: Clamp cylinder installation

8. Carefully put the clamp cylinder into place without losing or moving the shims and screw the pull pin into the end thread on the head's guide rod (the whole clamp cylinder will spin). To tighten the pull pin, use a hex key (4 mm or 5 mm) in the rod end of the cylinder as leverage. The pull pin should be as tight as possible, but take care not to break off the M4 thread.
9. Install the two M5 screws holding the clamp cylinder.
10. On the clamp cylinder, plug in the two air tubes from the Z-stage unlock cylinder. Make sure that it is safe to do so and temporarily turn on the air supply to check that the clamp cylinder is in its normal state—rod extends and moves the head towards the drum. If not, change the orientation of the tubes and turn off the air supply again.

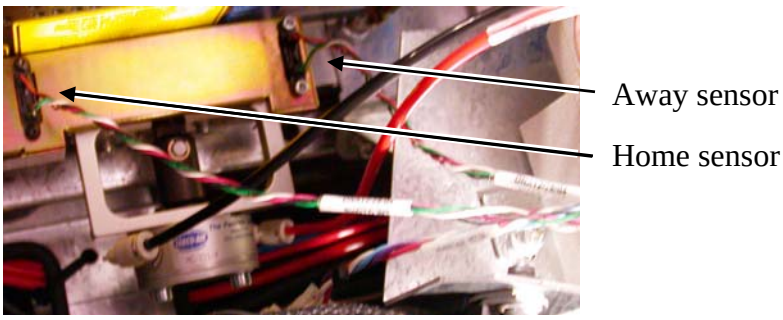


Figure 16: Home and away sensors

Tip: The label on the clamp cylinder is usually on top with the black tube on the left and the red tube on the right.

11. Plug in the motor cable and the home/away sensors to their respective cables.

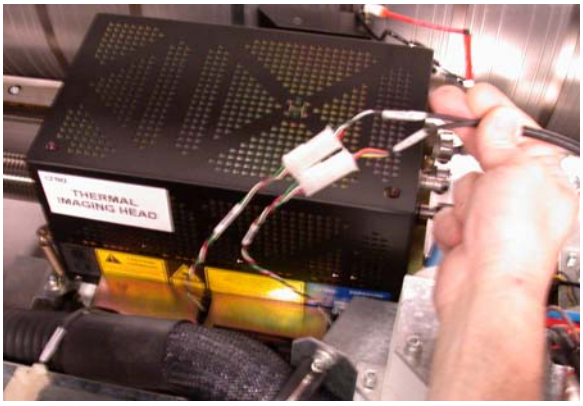


Figure 17: Z-stage cable connections

12. Install the debris removal nozzle assembly.
13. Slowly spin the drum by hand to make sure it does not interfere with the head in any way. You may need to release the leading edge clamps (LECs) manually at the engine manifold to spin the drum.
14. Neatly secure all cables and tubes in place with a cable tie to prevent interference with any moving parts.
15. Install all panels, install the load and unload tables, close the front and rear hoods, reposition the drum vacuum unit, and lower the ejector table and top panel.

6. CALIBRATING THE Z-STAGE

Ideally, we want to set the head focus to +50. This will allow for any abnormalities or bubbles in the plates. The greater the positive number, the further the head is from the plate. For example, a focus error of –18 means the head is closer to the plate than a focus error of +18.

Before turning on the power and air to the Magnus VLF, all panels must be installed or closed and the device must be safe to operate.

1. Turn on the power to the device. Turn on the device air supply at the regulator unit.
2. To enable the Z-stage option, type `>>access dev`.
3. Change the option status by typing `>>option zstage enable`.
4. Load a plate of the same size and batch as the first plate you used at the beginning of the procedure.
5. Type `>>cassette validate off` to speed up the initialization sequence.
6. Type `>>init` to initialize the device.
7. Type `>>drum move 30` to get the laser on the plate surface.

8. Type `>>zstage init` .
9. After the message **command complete**, type `>>zstage` to ensure that the home sensor is tripped and it is at the 0 position.
10. Type `>>zstage unlock` .
11. After the message **command complete**, type `>>zstage move 0.280` where 0.280 was the plate thickness measured before the Z-stage upgrade.
12. After the message **[Engine] ZStage: 'Move' Complete**, type **`>>`**`zstage lock` .
13. After the message **command complete**, move the carriage to approximately the middle of the plate.
14. Type `>>head install on` and record the focus error.
15. If the focus error is between +199 and –199, go to step 17. If it is not, proceed to the next step.
16. Repeat steps 9 to 14 by changing the plate thickness entered in step 10 by 0.100 mm.

    For example, reposition the head to 0.380mm. If it is still out of range, then reposition the head to 0.480 mm and so on until the focus error is within range. If you get to a high plate thickness like 0.680 mm and the error is still out of range, then try going down to 0.180 mm or lower—but not below zero. If that does not work, check for the following possible problems:

    - Check that the auto focus laser is actually on the plate and not on the drum or clamps.
    - Check that the head is moving correctly and that the clamp cylinder is properly screwed into the head guide rod.
    - Check that the clamp cylinder is working properly.

17. Calculate what the actual shim stack should be using the following formula (ensure you use the correct + and – sign convention):

    (actual plate thickness – Z-stage position) + (signal focus error) = adjustment

    Example 1, if the actual plate thickness = 0.280 mm, the Z-stage position = 0.380 mm, and the signal focus error = –0.130 mm, the shim adjustment will be (0.280 mm – 0.380 mm) + (–0.130 mm) = –0.230 mm. Because (–0.230 mm) is negative, you must remove shims to move the head away from the plate surface.

    Example 2, if the actual plate thickness = 0.280 mm, the Z-stage position = 0.180 mm, and the signal focus error = 0.145 mm, the shim adjustment will be (0.280 mm – 0.180 mm) + (0.145 mm) = 0.245 mm. Because (+0.245 mm) is positive, you must add shims to move the head closer to the plate surface.

18. Remove the clamp cylinder and add or subtract the calculated shim amount. These shims are nominally 0.100 mm thick, but measure the whole shim stack to be sure, as they will vary a bit.

19. Carefully replace the clamp cylinder.

20. Repeat steps 5 to 13. The focus error should now be between –100 and +100. The remaining error can be removed by using the NVS parameter **set mh zstagezero** to the amount that is left.
    For example, if the focus error is –18 microns, type `>>set mh zstagezero +0.068` to move the head further away from the plate.

21. Type `>>zstage init`

22. Type `>>zstage position` . The Z-stage position command automates the whole moving of the head to the correct position. It uses the value of the thickness of the loaded plate plus the Z-stagezero parameter to position the head to the correct place.

23. The focus error should now be +50 (±10) microns. Move the carriage over a few hundred millimeters and repeat steps 5 to 13. Record the focus error measurement.

Note: It is acceptable and not uncommon to get slightly different focus errors at different points on a plate.

24. Type `>>set focus basethickness` . This parameter must be set to 0 for heads that are installed with a Z-stage. Failing to do so will result in an error with multiple plates detected on the drum.

6.1 Burning in the Z-stage

The Z-stage uses engineered plastic guides forming a V-groove with a hard chromed steel head guide rod that slides approximately 1.5 mm back and forth. Tests have shown that the wear of these components is approximately 14 microns in depth. The wear rate is high in the first few hundred cycles and rapidly decreases after that (we have tested up to 650,000 cycles and wear beyond the first few thousand cycles was almost negligible). Therefore, we recommend running the Z-stage in for as many cycles as time allows. To do this, run a loop script from service shell as described below:

1. Set the current plate thickness to 0.6 mm.
   The plate thickness is set to an unrealistically high value to ensure that the Z-stage moves through its complete range of travel.

2. Go to the service shell scripts page and start a new loop script.

3. Type **zstage init** , check the **wait for** box, and copy and paste the **command complete** line from a previous command in service shell.

4. In the next box, type **zstage position** , check the **wait for** box, and copy and paste the **command complete** line from a previous command in service shell.

5. Save this loop and set the number of cycles between 200 and 1000 (as many cycles as time permits).

6. Run this script until it is complete.

6.2 Adjusting the head tilt

The head tilt may need to be readjusted as a result of the new Z-stage components that were added to the carriage. The shims that were added to the 5th point assembly were calculated to bring the tilt adjustment as close as possible to the original value. However, the head guide rod and support slide tolerances will vary from the original components and the tilt adjustment will need to be redone.

The allowable tilt on the swath is roughly 2 microns at the end of the swath—this equates to approximately 0.28 mm (0.011 in.) at the 5th point support. Therefore, if the 5th point is within 0.28 mm, the tilt error should not be visible. Because this is difficult to measure, we run a plot 28 pattern (2-pixel (20-micron) horizontal lines) and view the edges of the swath with a 100x microscope to see if there is a saw tooth pattern.

The distance between the guide rod and 5th point is 175 mm and half of the swath width is 1.25 mm—a ratio of 175/1.25 or 140:1. This means that 0.002 mm (2 µm) at the swath equates to 0.002 mm*140 = 0.28 mm (0.011in.) at the 5th point support. Take note which direction the saw tooth pattern is leaning to avoid going the wrong way when adjusting the shim pack.

1. Set the current loaded plate thickness back to the actual thickness (0.280 mm in these examples).
2. Type `>> zstage init`.
3. Type `>>zstage position`.
4. Type `>>carriage init`.
5. Run a diagnostic plot 28.
6. Unload this plate and process it.
7. Check the plate using a 100x microscope (or the tilt checking tools) at the edges of the swath for tilt as outlined in the paragraph above.
8. If necessary, adjust the shims underneath the 5th point support assembly (the shims supplied are 0.002 in., 0.003 in., 0.006 in., and 0.012 in.). Take care during the removal and installation of the head.
9. Repeat steps 1 to 7 until the tilt has been set adequately.

6.3 Updating the customer's software

Due to certain imposition software programs that will override plate thickness settings in the workstation front-end software, customers frequently do not have the correct plate thickness entered into their software. This data is critical for the Z-stage to correctly position the head and must be corrected.

Measure the actual thickness of all the customer's plates and enter these numbers in the software. The workstation front-end software must also have all the plate settings changed to show the correct plate thicknesses.

7. FINAL TESTING

As a last test, ask the customer to send some of their real files through their workflow. Run several different thicknesses of their plates to force the Z-stage to move. Check in service shell that the Z-stage is moving to the correct locations and that no errors are reported.

If possible, ask the customer to run some of the newly imaged plates on press to make sure there are no imaging problems due to the stage upgrade.

8. DISABLING THE Z-STAGE OPTION

If the installation is not successful, you must manually position the head at a nominal focus error value and disable the Z-stage option.

Note: Ensure that you have the laser off or you are wearing laser eye protection when servicing the head.

To disable the Z-stage option:

1. Disconnect the stepper motor lead screw from the sliding wedge by disconnecting the M2 screw bolting the rod end into the sliding wedge.
2. Move the sliding wedge to an approximate position and lock the push air cylinder.
3. Perform a normal **head install on** routine to use the head's auto focus laser as a measuring device and iterate these steps to get it to the desired focus error value.
4. When the focus error value is set, disable the Z-stage option in service shell:
   ```
   >>option zstage disable
   ```