

Complete Teardown, Cleaning/Lubrication, and Reassembly of the Olympus BH2-SVR Mechanical XY Stage

Revision 1



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Introduction

The microscopes in the Olympus BH-2 line (BHS, BHSU, BHT, and BHTU) have largely been replaced in the professional and clinical world, due to their advancing age and the lack of repair parts from Olympus. A great many of these microscopes were produced in their day, and because of this are they readily available on the used market for very reasonable prices. Thanks to their excellent build quality and solid optical performance, these scopes are now very popular with hobbyists, providing an affordable, high-quality alternative to the Chinese-made scopes prevalent today.

The mechanical stage on a typical BH-2 scope has been worked very hard over its life, and proof of this can often be seen where the black anodized coating on the stage surface has worn through to expose the underlying metal. Most of these old BH-2 stages would benefit greatly from a complete teardown, cleaning/lubrication, and reassembly, to address any issues caused by thickened grease, dirty slides, and worn or misadjusted positioning racks.

Scope of this Document

This document describes the complete teardown, cleaning/lubrication, and reassembly of the BH2-SVR (right-hand version) mechanical stage used on the Olympus BH-2 series of microscopes. This basic procedure can also be applied to the BH2-SVL (left-hand version) stages, with some modifications.

Tools Needed

The following tools are needed to service the BH2-SVR mechanical stage:

- Allen wrench or driver, 0.9mm / .035" (item 8 [Appendix 2](#))
- Allen wrench or driver, 1.3mm / .050" (item 9 of [Appendix 2](#))
- Allen wrench or driver, 2.5mm (item 10 of [Appendix 2](#))
- Electric heat gun (item 11 of [Appendix 2](#))
- Screwdriver set, JIS (item 12 of [Appendix 2](#))

A Few Words about JIS Screws

Screws with JIS heads are frequently found in much of the equipment designed and manufactured in Japan. JIS screws look very much like standard Phillips screws, but they differ in that JIS screws were designed to not cam-out under torque, whereas Phillips screws were designed to intentionally cam-out, as a means to limit the torque applied to the fasteners. Because of this crucial difference in the geometry of the two screw types, JIS screws will be damaged by standard Phillips drivers if too much torque is applied. JIS screws can usually be identified by the presence of a single dot, or

by an "X", stamped into one of the four quadrants of the cross-point depression (see [Figure 1](#)).

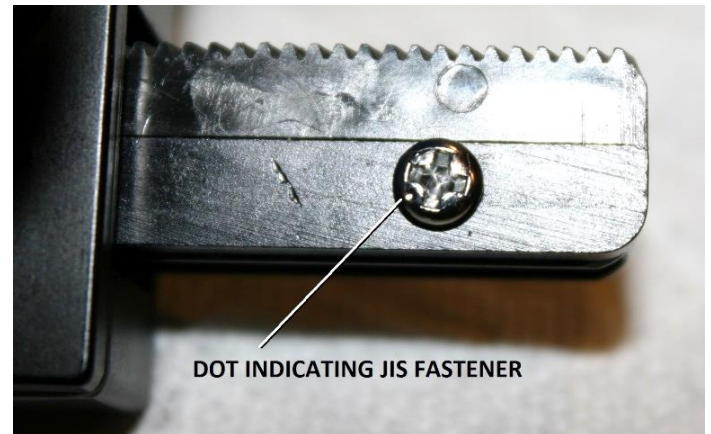


Figure 1 – Head of a typical JIS screw

Supplies Needed

The following supplies are needed to service the BH2-SVR mechanical stage:

- Cleaning solvent (see [Recommended Solvents](#) section below)
- Cotton swabs
- Grease (see [Recommended Lubricants](#) section below)
- Loctite® 242 thread locker (item 7 of [Appendix 2](#))
- Tissues, oil-free

Recommended Lubricants

The Olympus BH-2 service manual (see the [Original Olympus Documentation](#) section in this document) recommends using grease in the X-axis and Y-axis slide mechanisms of the BH2-SVR stage. However, based on their decades of experience servicing BH-2 equipment in the field, many microscope repair technicians recommend omitting the grease entirely from the X-axis and Y-axis slides, in order to reduce the fouling of the mechanisms which can occur if dust and debris (such as glass particles) accumulates in the greased slides. Although this document supports their recommendation that grease be omitted from the X-axis and Y-axis slides, grease may be applied to the slides per the Olympus guidance, at the risk of requiring more frequent maintenance to keep the slides clean and freely moving. As a compromise, light, synthetic machine oil may be used in the slides instead of grease. Regardless of whether or not grease is used in the X-axis and Y-axis slides, grease or oil should always be used in the coaxial positioning assembly, and grease should also be used in the locking thumbscrew assembly. The type of grease recommended for the coaxial positioning assembly depends on the desired feel of the positioning knobs. For a lighter feel (which is often preferred by cytology technicians, for instance), Dow Corning Molykote® 44 (item 4 of [Appendix 2](#)) can be used as a

lubricant. For a heavier feel (which is often preferred by hematology and pathology technicians), Plastilube Brake Grease (item 5 of [Appendix 2](#)) is recommended instead. Either of these greases may be used in the locking thumbscrew assembly. Both types will remain stable and serviceable for many years to come.

Recommended Solvents

Some type of cleaning solvent will be needed to remove the old grease from the various components of the BH2-SVR mechanical stage. Solvents that can be used are acetone, diethyl ether, heptane, hexane, mineral spirits, turpentine, and xylene.

Safety Considerations with Solvents

Regardless of which solvent is chosen, make sure that adequate ventilation is present during the cleaning process, and that any necessary personal protective equipment is utilized to minimize exposure. Consult the MSDS sheet before using any unfamiliar solvents. Many of the solvents listed above are flammable, and their vapors may represent an explosion hazard if mishandled. Whichever solvents are chosen, be sure to follow all manufacturer's instructions and safety precautions.

Solvent Compatibility with Parts and Finishes

Many solvents will damage the finish of painted surfaces (isopropyl alcohol or 409 Cleaner may be safely used to clean most painted surfaces). Additionally, many solvents will dissolve or damage plastic parts. Do not allow untested solvents to contact the plastic positioning knobs or X-Y positioning racks, as these parts may be damaged by exposure to these solvents. Before using any solvent to clean plastic parts, test a small amount of the solvent in an inconspicuous area of the part (such as inside the knob) to ensure compatibility with the plastic. Never use xylene to clean nylon parts, as xylene dissolves nylon. Isopropyl alcohol and trichloroethylene will cause swelling of nylon due to solvent absorption. The list of solvents generally considered safe for nylon includes acetone, diethyl ether, heptane, mineral spirits, naphthalene, and turpentine.

Common Problems with the BH2-SVR Stage

A few of the more common problems with the BH2-SVR mechanical stage are discussed below.

Both Axes Move when Either Knob is Rotated

One issue sometimes seen with the BH2-SVR mechanical stage is when both X and Y stage movement occurs whenever either the X or Y positioning knob is

rotated. The two positioning knobs mount onto two coaxial positioning shafts in the coaxial positioning assembly, which are lubricated with grease to allow them to freely rotate relative to the brass shaft support (which is held rigid to the sliding stage frame via the T-mount). As the grease on the positioning shafts ages, it gets progressively thicker and gummier, making the positioning shafts harder and harder to rotate within the brass shaft support. This thickening of the grease can be felt in the X and Y positioning knobs, which become harder to turn as the grease ages and thickens. As time goes by and as the grease continues to thicken, a point can be reached where the brass shaft support receives enough torque from the rotation of the positioning shafts to eventually come loose from the T-mount. When this happens, the brass shaft support is then free to rotate along with the two positioning shafts, and since all three are gummed together by the thickened grease, turning one of the two positioning knobs causes the other positioning knob to turn as well. This results in stage movement in both axes whenever either positioning knob is turned. The fix for this condition is to remove the coaxial positioning assembly from the sliding stage frame, disassemble it and clean the thickened grease from the various components, and then reassemble (with fresh grease throughout) and reinstall it onto the sliding stage frame.

Hysteresis in One or Both Mechanical Axes

Another common issue with the BH2-SVR mechanical stage can be seen whenever one or both of the positioning racks have noticeable mechanical backlash with their associated pinion gears. This can happen either as a result of wear of the plastic positioning racks, or due to improperly adjusted positioning racks. When present, this backlash causes noticeable hysteresis in the affected axes of stage movement that can be easily seen through the eyepiece, especially when observing with the higher power objectives. Visual observations will reveal that the positioning of the observed specimen does not respond immediately to rotation of the affected positioning knobs (i.e., a noticeable lag will be seen when the knob rotation is changed from one direction to the other), or that the position is unduly affected by vibration of the equipment. This can be annoying at best, and at worst can render the stage unusable. Fortunately, this can usually be corrected by performing an adjustment of the offending positioning racks, as described in the [Adjust the X-Axis Positioning Rack](#) and [Adjust the Y-Axis Positioning Rack](#) sections of this document.

Stiffness in One or Both Mechanical Axes

Stiffness in one or both mechanical axes may be caused by thickened grease in the coaxial positioning mechanism or in the slides, by positioning racks that are poorly adjusted, or by position knobs which are improperly adjusted for tension. Stiffness caused by thickened grease may be corrected by disassembling, cleaning/lubricating, and reassembling the affected mechanism per the [Teardown/Reassembly of Mechanical Stage](#) section of this document. Stiffness caused by improperly adjusted positioning racks or knob tension may be corrected by performing the adjustments in the [Adjust the X-Axis Positioning Rack](#), [Adjust the Y-Axis Positioning Rack](#), and [Adjust the Tension of the Knobs](#) sections of this document (as appropriate).

Erratic Positioning of One or Both Mechanical Axes

Dirt, debris, and contamination in the plastic positioning racks, or in the teeth of their associated pinion gears, can cause stiff and/or erratic positioning of the affected axes, which can render the stage unusable. Problems caused by dirt, debris, or contamination can be corrected by a thorough cleaning of the affected components. Erratic motion of one or both mechanical axes can also be caused by dirt, debris, and contamination (such as glass particles) within the X-axis and Y-axis slide mechanisms. The design of the X-axis and Y-axis slides is such that, when the mechanisms are positioned to the mechanical extremes, the bearing balls are exposed on the bottom such that any debris can be readily cleared from the slide mechanisms. Any oil or grease present in these slides will tend to trap glass fragments or other particles, making them much more difficult to clear. Per the previous discussion, it is best if the slide mechanisms remain free of any grease, thereby preventing any debris that falls into the slide mechanisms from accumulating in the grease and fouling the mechanisms.

Damage to the X and Y Positioning Racks

Physical damage to the plastic positioning racks (i.e., damage to the rack teeth and/or hairline cracking of the rack itself) can cause stiff and/or erratic positioning of the affected axes. Hairline cracks in the X-axis and Y-axis positioning racks can cause erratic positioning or the inability of the mechanical stage to hold the desired slide position. If the specimen is positioned such that the teeth of the pinion gear are meshed with the cracked part of the rack, the affected axis may move slightly in either direction when the positioning knob is released, making it nearly impossible to maintain the

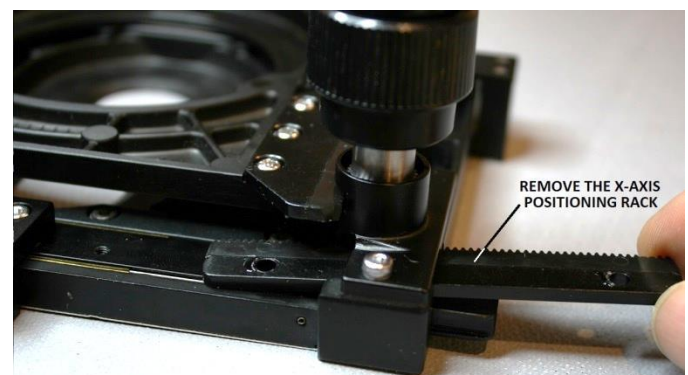
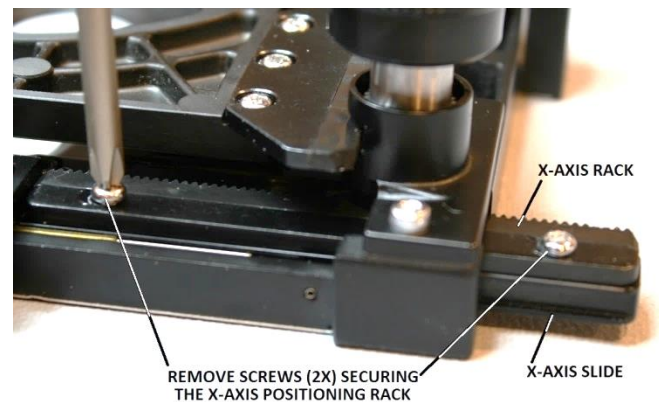
desired viewing position. This effect is most noticeable when observing with a 100X objective, and will likely be less objectionable, or maybe not even be noticeable when viewing through the lower-power objectives. In the case of more severe cracks, the slide position may actually jump or hang up, or a bump may be felt in the positioning knob, as the pinion gear runs through the cracked part of the rack. The only way to repair these conditions is to replace the damaged positioning racks. Refer to [Appendix 2](#) for third-party, machined brass replacements for the original Olympus X-axis and Y-axis plastic racks (items 2 and 3).

Teardown/Reassembly of Mechanical Stage

The procedure for disassembling, cleaning/lubricating, and reassembling the BHS-SVR mechanical stage is described in the sections below. During the teardown of the BH2-SVR mechanical stage, be sure to bag and tag the various components, to prevent their loss and to facilitate their proper identification during later reassembly.

Remove the X-Axis Positioning Rack

Use a suitable JIS screwdriver to loosen and remove the two M3x8 JIS screws securing the X-axis positioning rack in place on the X-axis slide (see [Figure 2](#)). Remove the (now loose) X-axis positioning rack (see [Figure 3](#)).



Remove the Y-Axis Positioning Rack

Use a suitable JIS screwdriver to loosen and remove the three M3x6 JIS screws securing the Y-axis positioning rack in place on the stationary base (see [Figure 4](#)). Remove the (now loose) Y-axis positioning rack (see [Figure 5](#)).

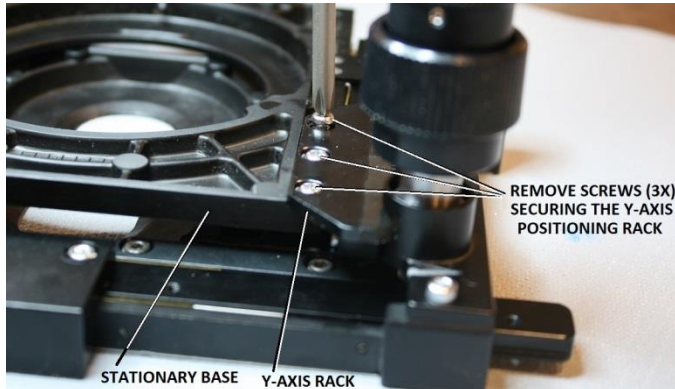


Figure 4 – Remove screws for the Y-axis positioning rack

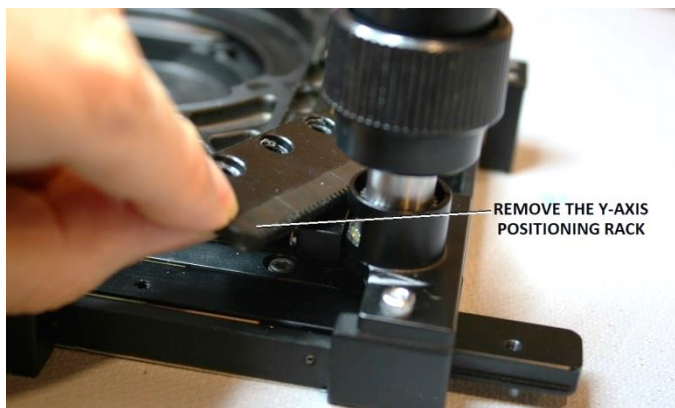


Figure 5 – Remove the Y-axis positioning rack

Remove the Coaxial Positioning Assembly

Use a 2.5mm Allen wrench or driver to remove the two M3x8 hex socket-head cap screws securing the coaxial positioning assembly to the sliding stage frame (see [Figure 6](#)), and remove the (now loose) coaxial positioning assembly (see [Figure 7](#)).

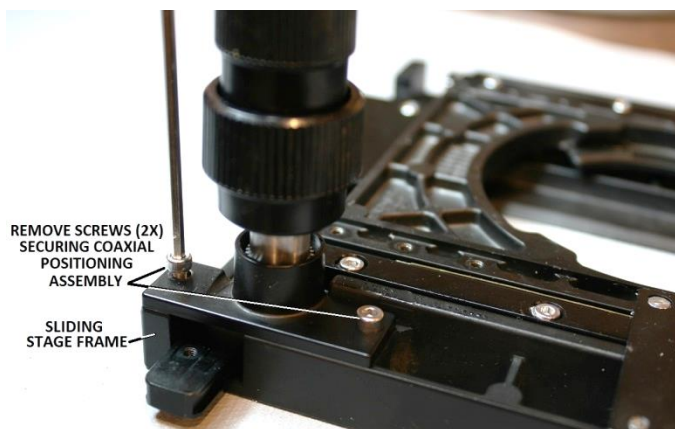


Figure 6 – Remove screws for positioning assembly

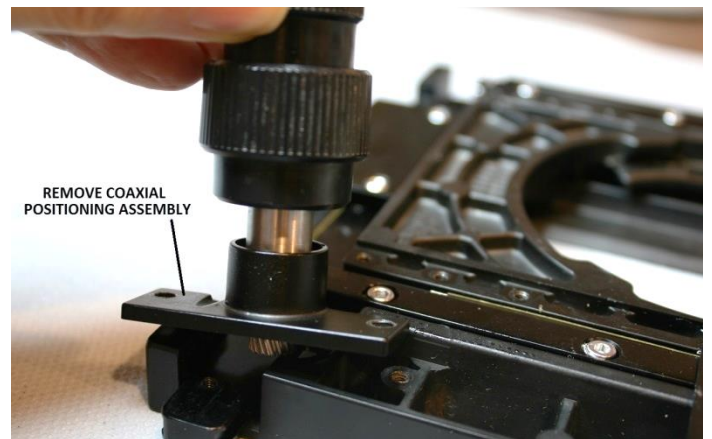


Figure 7 – Remove the coaxial positioning assembly

The complete coaxial positioning assembly is shown in [Figure 8](#).

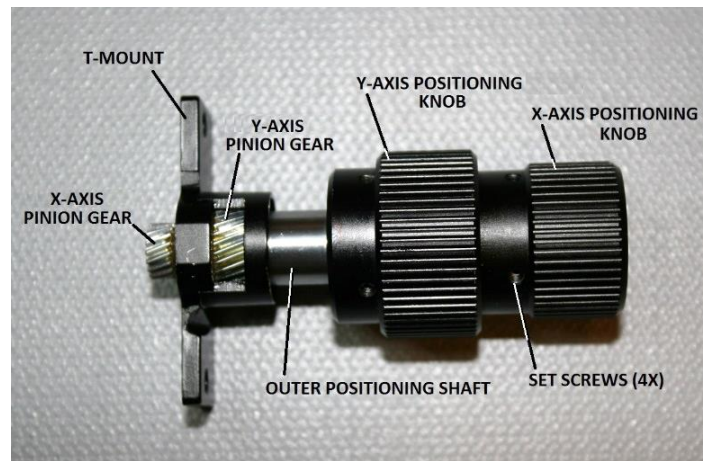


Figure 8 – The coaxial positioning assembly

Disassemble the Coaxial Positioning Assembly

Use a 1.3mm (.050") Allen wrench or driver to loosen the two M2.6x10 set screws securing the X-axis positioning knob to the inner positioning shaft (see [Figure 9](#)).

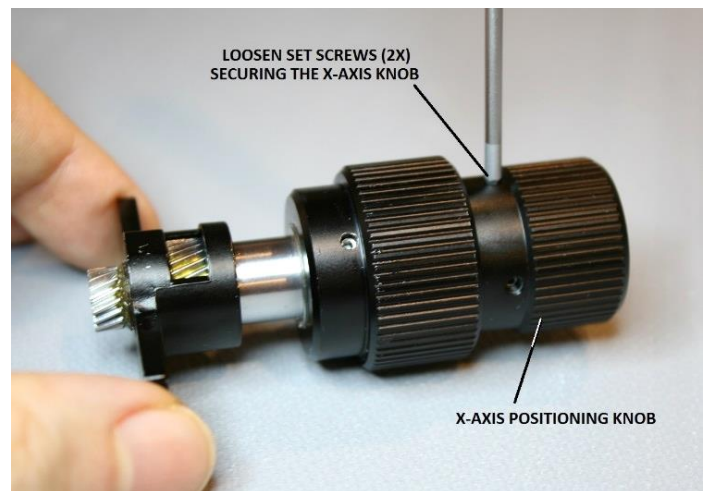


Figure 9 – Loosen set screws for the X-axis knob

Unscrew and remove the X-axis positioning knob from the inner positioning shaft by rotating it counter-clockwise (see [Figure 10](#)).

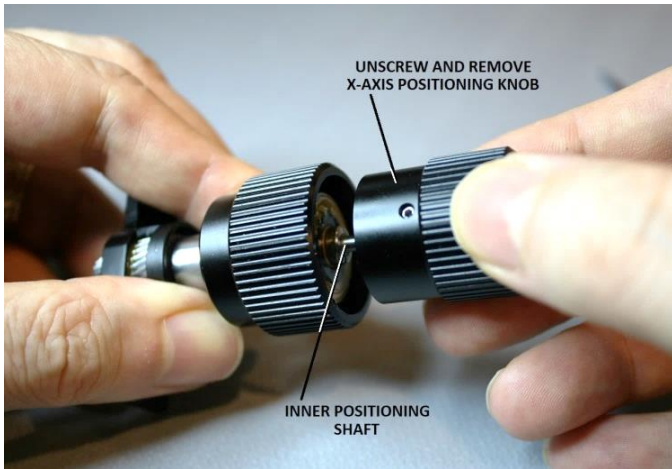


Figure 10 – Unscrew and remove the X-axis knob

Unscrew and remove the slotted retaining ring from the X-axis positioning shaft (see [Figure 11](#)).



Figure 11 – Unscrew and remove slotted retaining ring

Remove the nylon friction washer found under the X-axis positioning knob (see [Figure 12](#)).

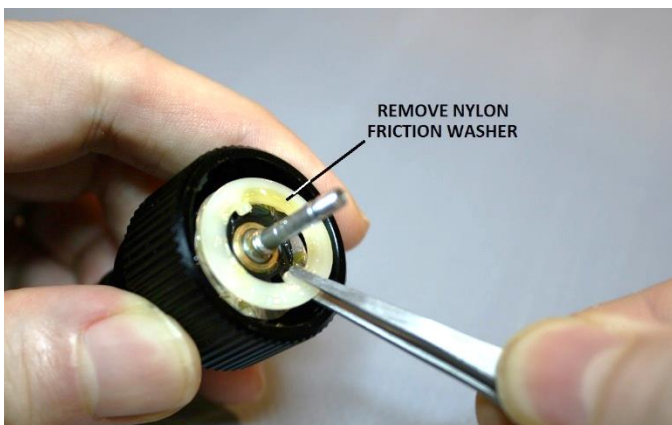


Figure 12 – Remove nylon washer under the X-axis knob

Remove the metal wave washer found under the nylon friction washer (see [Figure 13](#)).

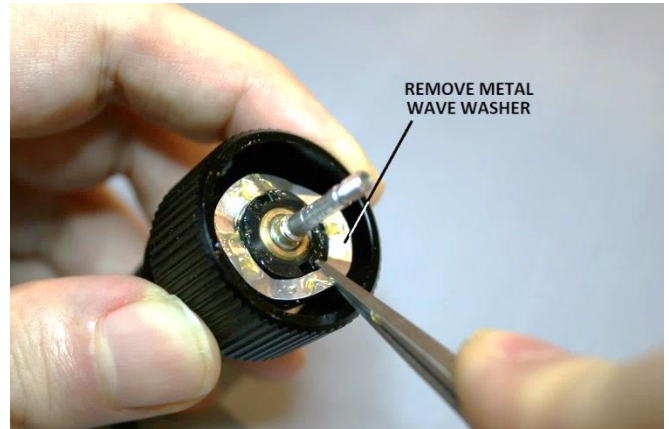


Figure 13 – Remove wave washer under the nylon washer

Use a 1.3mm (.050") Allen wrench or driver to loosen the two M2.6x5 set screws securing the Y-axis positioning knob to the outer positioning shaft (see [Figure 14](#)).

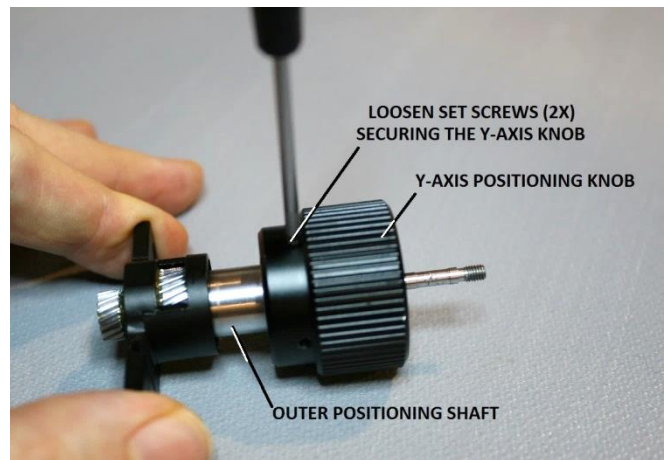


Figure 14 – Loosen set screws for the Y-axis knob

Unscrew the Y-axis positioning knob from the outer positioning shaft by rotating it clockwise (see [Figure 15](#)) until the threads are fully disengaged (see [Figure 16](#)).



Figure 15 – Unscrew the Y-axis knob from the outer shaft



Figure 16 – Y-axis knob disengaged from the outer shaft

Use a .9mm (.035”) Allen wrench or driver to loosen the two M2x3 set screws securing the washer-backing disk onto the brass shaft support (see [Figure 17](#)).

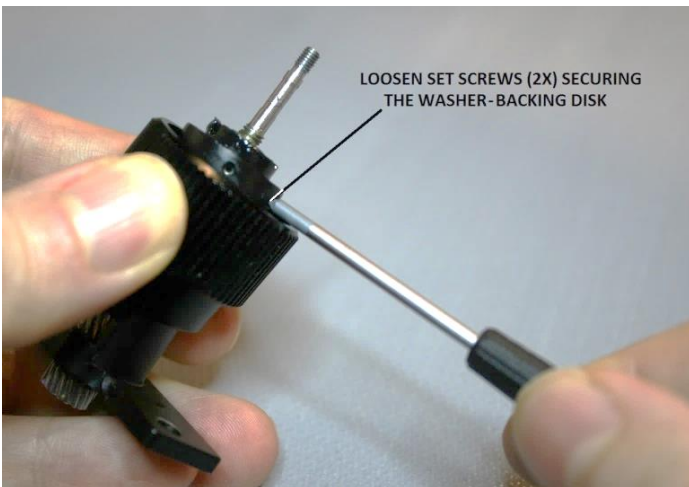


Figure 17 – Loosen set screws for washer-backing disk

Unscrew and remove the washer-backing disk from the brass shaft support (see [Figure 18](#)).



Figure 18 – Unscrew and remove the washer-backing disk

Remove the metal wave washer found beneath the washer-backing disk (see [Figure 19](#)).

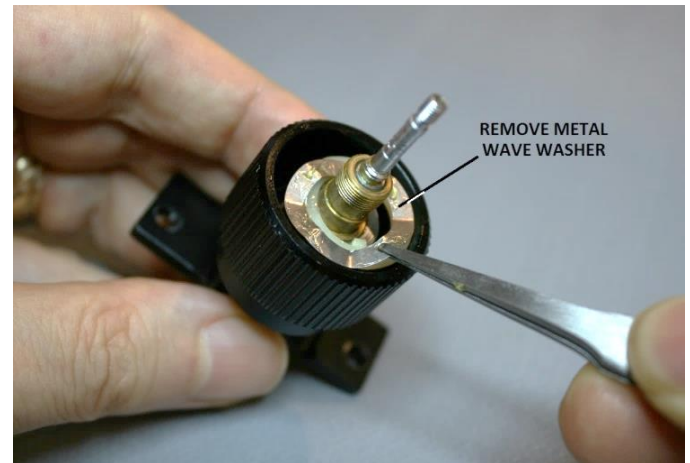


Figure 19 – Remove metal washer under the backing disk

Remove the nylon friction washer found beneath the metal wave washer (see [Figure 20](#)).



Figure 20 – Remove nylon washer under wave washer

Grasp the Y-axis positioning knob and pull it, together with the (hollow) outer positioning shaft, free of the brass shaft support (see [Figure 21](#)).



Figure 21 – Withdraw the Y-axis knob and the outer shaft

Figure 22 shows the Y-axis positioning knob and outer positioning shaft, after removal from the brass shaft support.

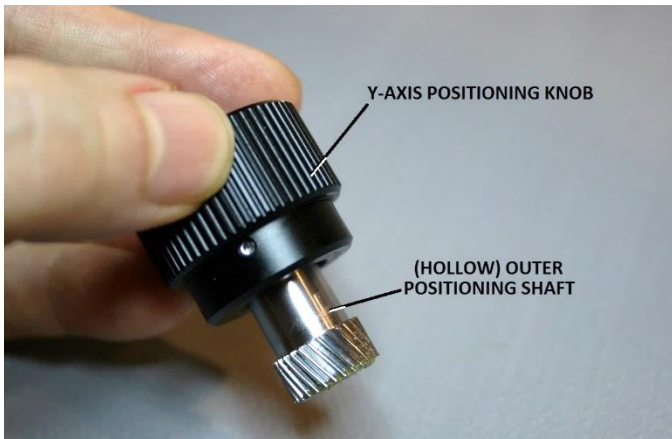


Figure 22 – The Y-axis knob and the outer shaft

Figure 23 shows the brass shaft support, T-mount, and inner positioning shaft (with X-axis pinion gear), as seen after the Y-axis knob and outer positioning shaft have been removed.

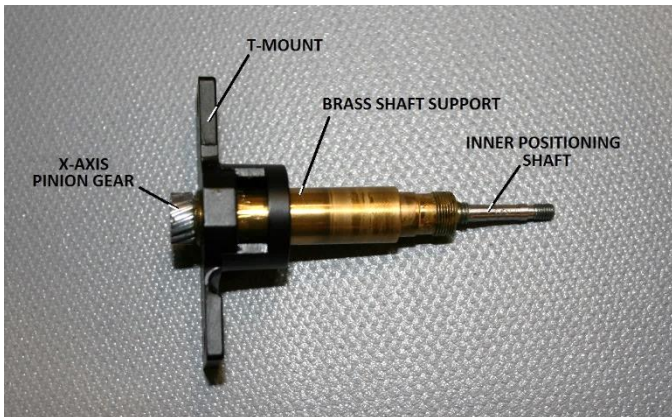


Figure 23 – Without Y-axis knob and outer shaft

Grasp the outer positioning shaft and withdraw it from the Y-axis positioning knob (see Figure 24).

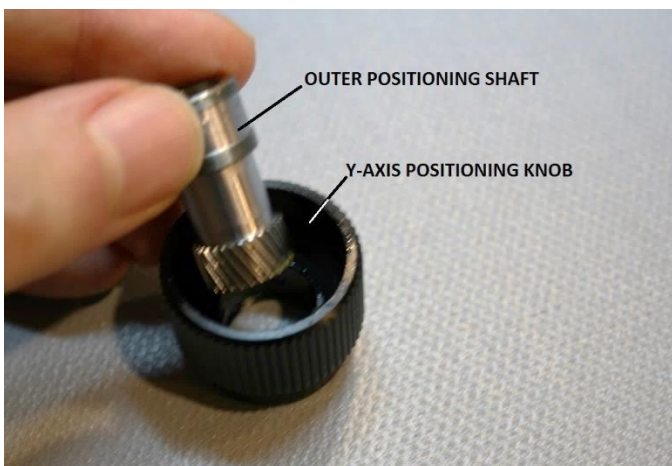


Figure 24 – Withdraw outer shaft from the Y-axis knob

Grasp the X-axis pinion gear at the end of the inner positioning shaft and withdraw the shaft from the brass shaft support (see Figure 25).

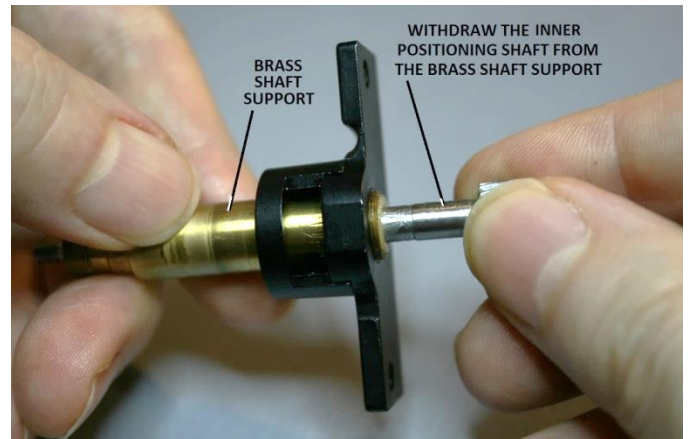


Figure 25 – Withdraw inner shaft from the shaft support

A small nylon bearing washer should now be visible either on the bottom of the brass shaft support (see Figure 26), or on the top of the X-axis pinion gear. This washer provides a low-friction bearing for the X-axis pinion gear on the inner positioning shaft.

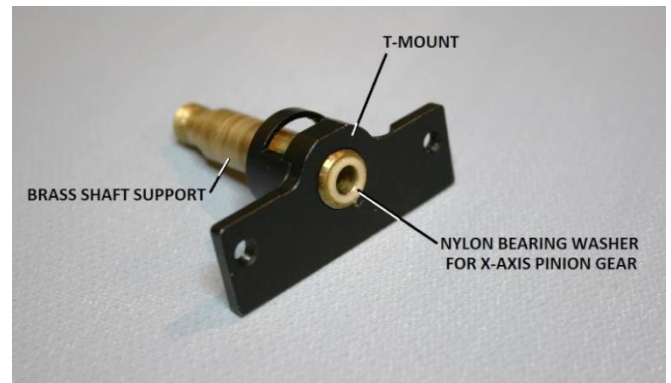


Figure 26 – Bottom view showing nylon bearing washer

Carefully remove the small nylon bearing washer (see Figure 27).

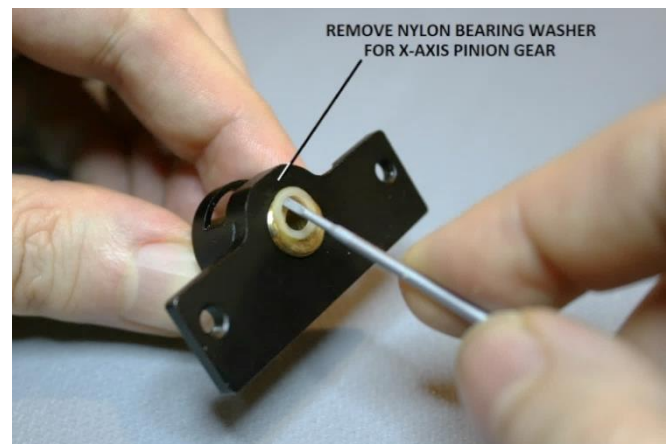


Figure 27 – Carefully remove the small nylon washer

A nylon washer should be seated in the recess of the T-mount (on top of the base flange of the brass shaft support), which acts as a low-friction bearing for the Y-axis pinion gear. Remove this washer (see [Figure 28](#)).



Figure 28 – Carefully remove the large nylon washer

Use pliers with non-marring jaws (or conventional pliers and a piece of silicone or other “grippy” rubber) to grip the brass shaft support without marring the surface finish (see [Figure 29](#)), and loosen it from the T-mount¹.

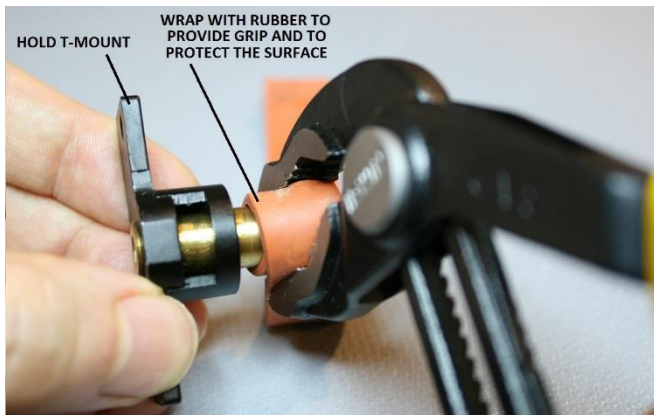


Figure 29 – Safely gripping the brass shaft mount

Unscrew the brass shaft support (see [Figure 30](#)).



Figure 30 – Separate brass shaft support from T-mount

Clean the Coaxial Positioning Components

Use a suitable solvent (e.g., acetone) to clean the old grease from the various components of the coaxial positioning assembly. Use a cotton swab wetted with the solvent to thoroughly clean the inner bores of the brass shaft support and the hollow outer shaft. The components of the coaxial positioning assembly are shown in [Figure 31](#).



Figure 31 – Components of coaxial positioning assembly

Reassemble the Coaxial Positioning Assembly

Partially screw the brass shaft support into the tapped hole of the T-mount (see [Figure 32](#)).

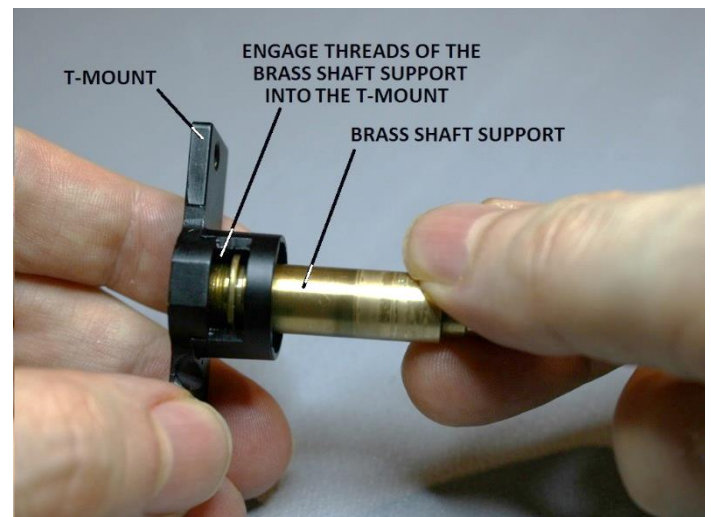


Figure 32 – Engage shaft support into T-mount threads

Carefully apply blue Loctite® to the exposed threads of the brass shaft support (see [Figure 33](#)), being careful to not get any of the Loctite® inside the center bore of the brass shaft support. Use pliers with non-marring jaws (or conventional pliers and a piece of silicone or other “grippy” rubber) to grip the brass shaft support and tighten it down (see [Figure 29](#)).

¹ These parts do not necessarily have to be separated, but they can be more easily and thoroughly cleaned of old grease if they are separated.



Figure 33 – Apply Loctite® to threads before tightening

Lightly grease both sides of the large Y-axis nylon bearing washer and place it over the brass shaft support and seat it onto the base flange of the brass shaft support, in the recess of the T-mount (see [Figure 34](#)).

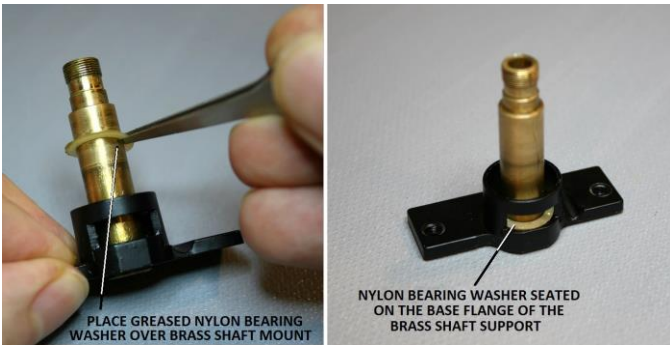


Figure 34 – Reinstall the large nylon bearing washer

Lightly grease both sides of the small nylon bearing washer and place it in position on the bottom surface of the brass shaft support (see [Figure 35](#)). The grease will hold the washer in place during the subsequent reassembly steps.

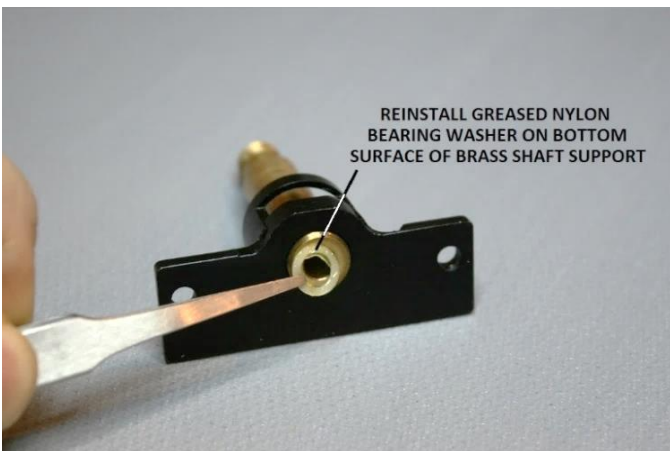


Figure 35 – Reinstall the small nylon bearing washer

Lightly grease the inner positioning shaft and slide it into the bore of the brass shaft support (see [Figure 36](#)).

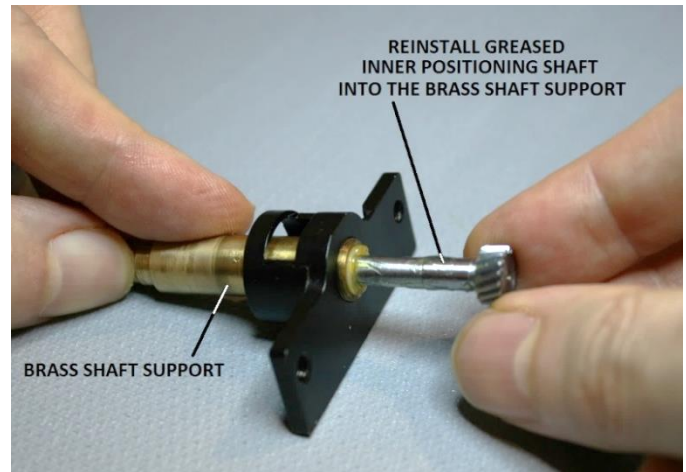


Figure 36 – Reinstall inner shaft into brass shaft support

Screw the slotted retaining ring onto the inner positioning shaft and snug it down to hold the inner positioning shaft in the brass shaft support (see [Figure 37](#)).



Figure 37 – Reinstall the slotted retaining ring

Insert the outer positioning shaft into the Y-axis positioning knob (see [Figure 38](#)).

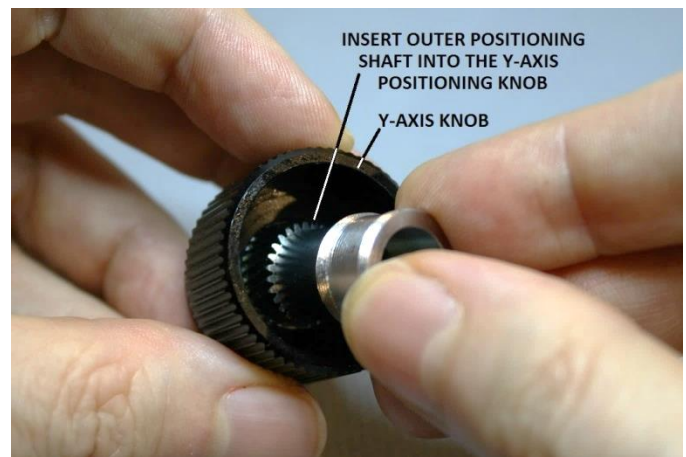


Figure 38 – Insert the outer shaft into the Y-axis knob

Engage the threads of the outer positioning shaft with the threads in the Y-axis positioning knob (see [Figure 39](#)).



Figure 39 – Engage the threads of outer shaft with knob

Lightly grease the cylindrical outer surface of the brass shaft support and carefully slip the (hollow) outer positioning shaft (with the attached Y-axis positioning knob) over the greased brass shaft support (see [Figure 40](#)).

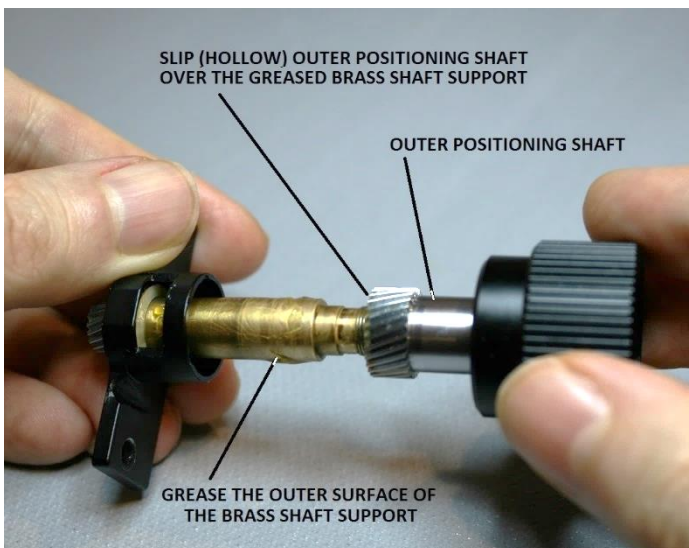


Figure 40 – Reinstall outer shaft onto brass shaft support

Apply grease to the peaks of one of the metal wave washers (see [Figure 41](#)). Set the washer-backing disk on the work surface, with the side with the threads in the bore facing down (i.e., the non-threaded side facing up) and place the greased wave washer (with the greased side down) over the washer-backing disk (see [Figure 42](#)). The grease will hold the wave washer in place on

the washer-backing disk during the subsequent reassembly steps.

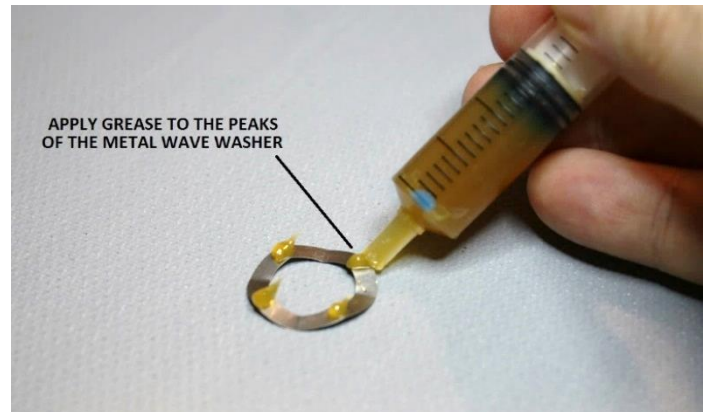


Figure 41 – Apply grease to the peaks of wave washer

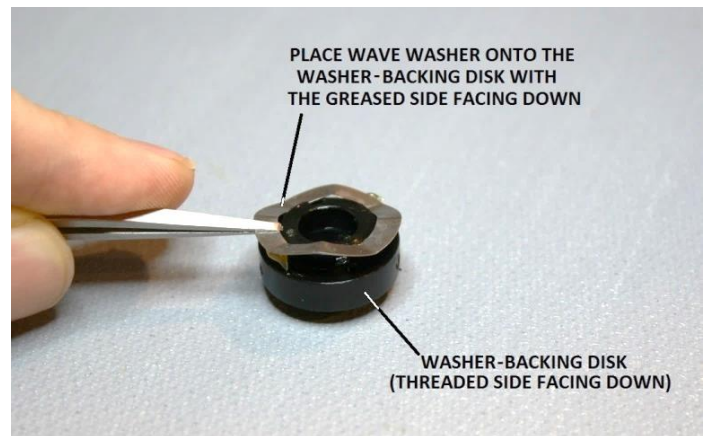


Figure 42 – Place greased wave washer onto backing disk

Apply grease to the top peaks of the metal wave washer (see [Figure 43](#)) and place a nylon friction washer on the wave washer, engaging the two tabs of the nylon washer with the notches in the washer-backing disk (see [Figure 44](#) and [Figure 45](#)). The grease will hold the nylon friction washer in place during the subsequent reassembly steps.

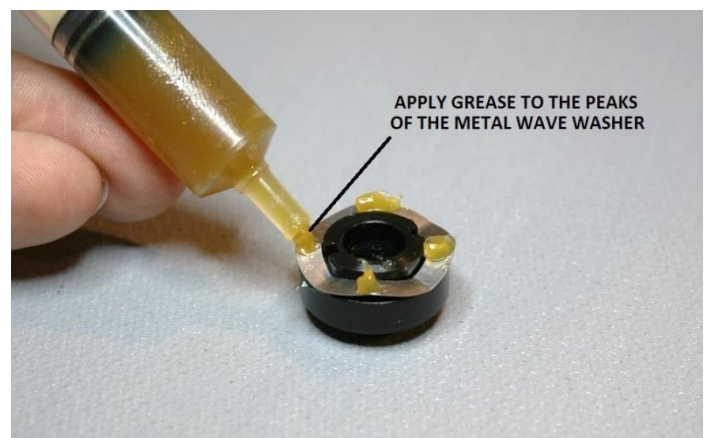


Figure 43 – Apply grease to the peaks of the wave washer

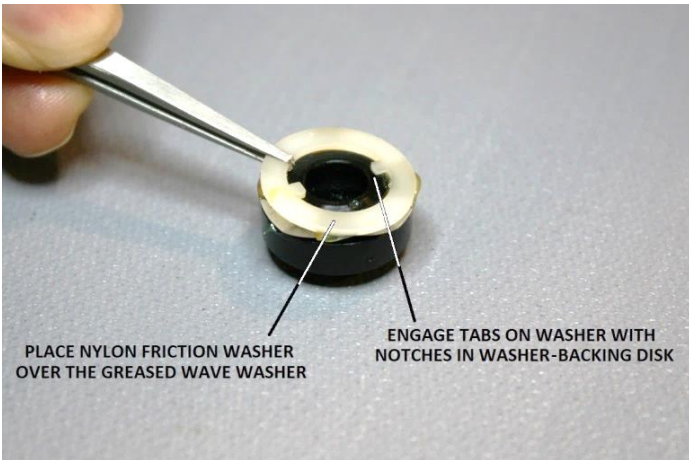


Figure 44 – Reinstall the nylon washer over wave washer

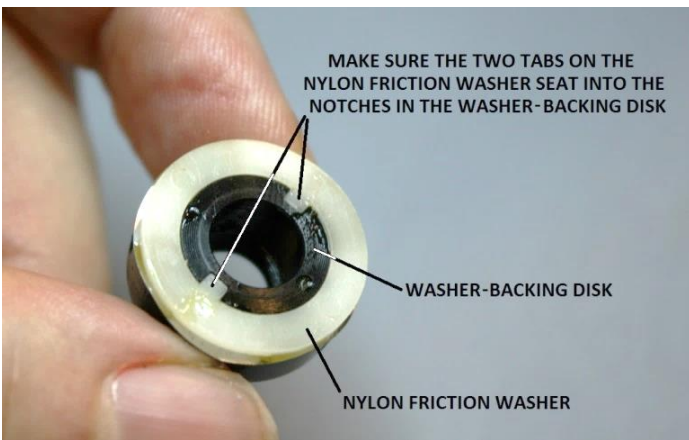


Figure 45 – Washer tabs engaged with notches

Lightly grease the exposed top side of the nylon friction washer (see [Figure 46](#)).

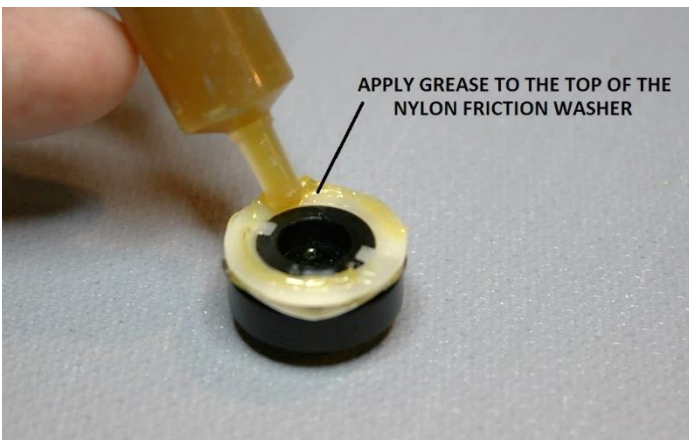


Figure 46 – Apply grease to the top of the nylon washer

Hold the washer-backing disk oriented such that the nylon friction washer is on the top (so that the washers do not fall off or come out of place) and lower the inner positioning shaft into the hole in the washer-backing disk (see [Figure 47](#)).

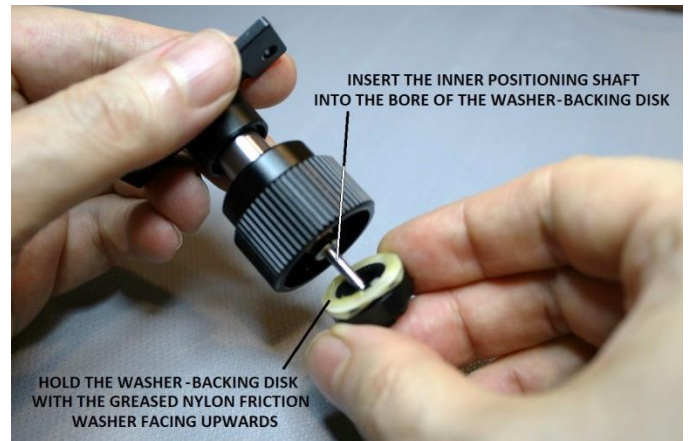


Figure 47 – Reinstall the backing disk with washers

Carefully screw the washer-backing disk onto the brass shaft support and snug it down a bit (see [Figure 48](#)), making sure that the tabs on the nylon friction washer remain engaged with the slots in the washer-backing disk as you do so.



Figure 48 – Screw backing disk onto brass shaft support

Use a 0.9mm (.035") Allen wrench or driver to tighten the two M2x3 set screws to secure the washer-backing disk onto the brass shaft support (see [Figure 49](#)).



Figure 49 – Tighten the set screws on the backing disk

Snug the Y-axis positioning knob against the nylon friction washer beneath the washer-backing disk by rotating it counter-clockwise (see [Figure 50](#)).



Figure 50 – Snug Y-axis knob against the nylon washer

Apply grease to the peaks of the remaining metal wave washer (see [Figure 51](#)) and place it with the greased side down over the exposed side of the washer-backing disk (see [Figure 52](#)). The grease will hold the metal wave washer in place during the subsequent reassembly steps.

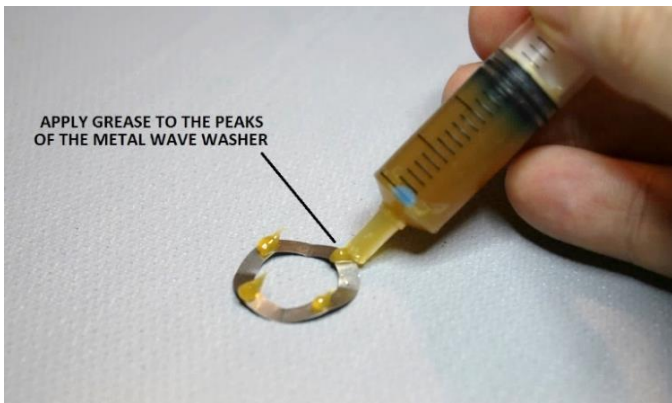


Figure 51 – Apply grease to the peaks of wave washer



Figure 52 – Reinstall wave washer onto the backing disk

Apply grease to the peaks of the metal wave washer (see [Figure 53](#)) and place the remaining nylon friction washer onto the greased wave washer, engaging the tabs of the nylon friction washer with the notches in the washer-backing disk (see [Figure 54](#)). The grease will hold the nylon friction washer in place during the subsequent reassembly steps.

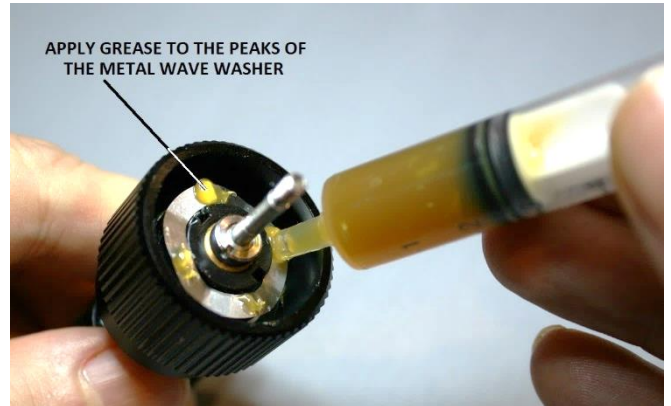


Figure 53 – Apply grease to the peaks of the wave washer

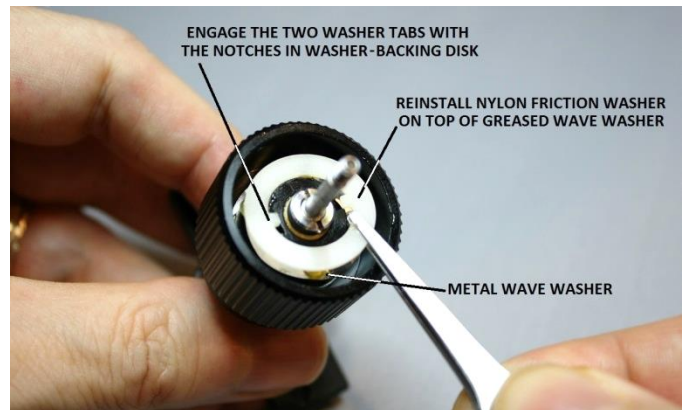


Figure 54 – Reinstall the remaining nylon washer

Lightly grease the exposed top side of the nylon friction washer (see [Figure 55](#)).



Figure 55 – Apply grease to the top of the nylon washer

While holding the assembly with the nylon friction washer facing upwards, screw the X-axis positioning knob onto the inner positioning shaft and snug it down to hold the washers in place (see [Figure 56](#)).



Figure 56 – Screw the X-axis knob onto the inner shaft

Use a 1.3mm (.050”) Allen wrench or driver to snug the two M2.6x10 set screws in the X-axis positioning knob, to prevent the knob from turning on the inner positioning shaft (see [Figure 57](#)). These set screws will be loosened again at a later point when the tension of the X-axis positioning knob is adjusted for the desired feel.

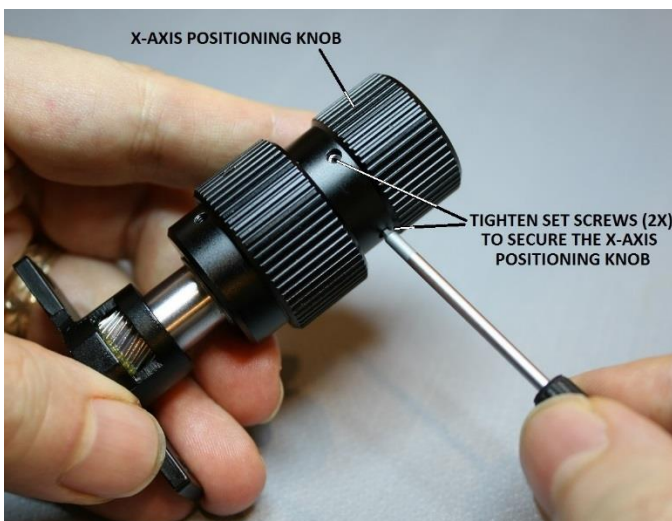


Figure 57 – Tighten set screws for the X-axis knob

Use a 1.3mm (.050”) Allen wrench or driver to snug the two M2.6x5 set screws in the Y-axis positioning knob, to prevent the knob from turning on the outer positioning shaft (see [Figure 58](#)). These set screws will be loosened

again at a later point when the tension of the Y-axis positioning knob is adjusted for the desired feel.



Figure 58 – Tighten set screws for the Y-axis knob

Remove the Locking Thumbscrew Assembly

Unscrew and remove the locking thumbscrew assembly from the front of the BH2-SVR mechanical stage (see [Figure 59](#) and [Figure 60](#)).

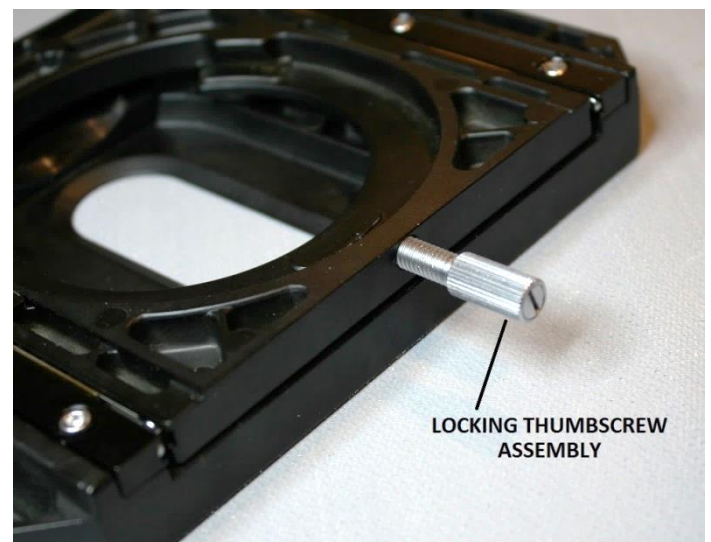


Figure 59 – Location of locking thumbscrew assembly

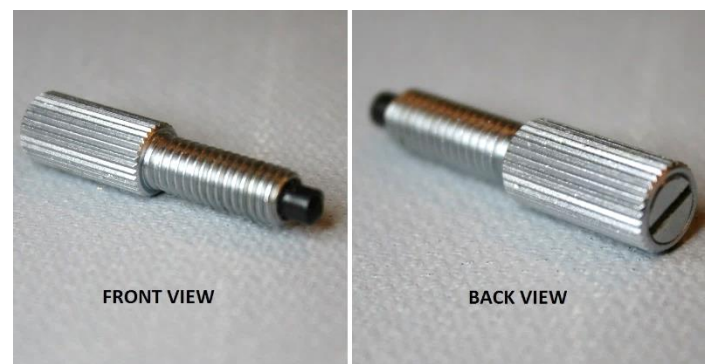


Figure 60 – The locking thumbscrew assembly

Test the Action of the Locking Thumbscrew Assembly

Test the freedom of motion of the spring-loaded tip of the locking thumbscrew assembly by depressing the plastic tip inward and releasing it, to see how well the tip springs back out when the pressure is released (see [Figure 61](#)).

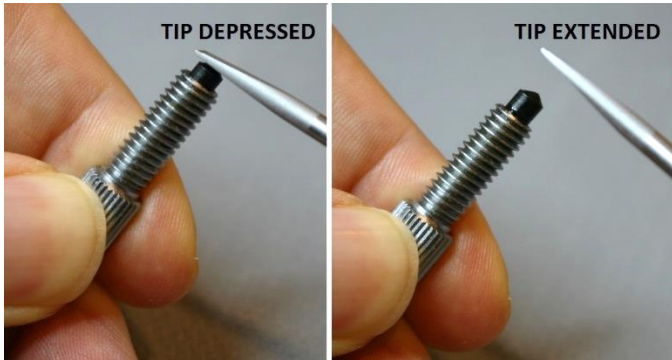


Figure 61 – Test the plastic tip extension

If the return action of the retractable tip is acceptable, lightly grease the threads of the locking thumbscrew and reinstall it into the front of the BH2-SVR mechanical stage (see [Figure 59](#)), then skip ahead to the [Test the Feel of the Slide Mechanisms](#) section of this document. Otherwise proceed as described below.

Disassemble the Locking Thumbscrew Assembly

Grip the knurled end of the locking thumbscrew assembly in one hand, and use the other hand to loosen the slotted end-screw using a suitable slotted screwdriver (see [Figure 62](#)). If necessary, apply gentle heat with a heat gun to loosen any dried grease holding the end screw in place (be careful to not melt the plastic tip) and secure the knurled end of the thumbscrew in a suitable vise to allow the end screw to be removed.

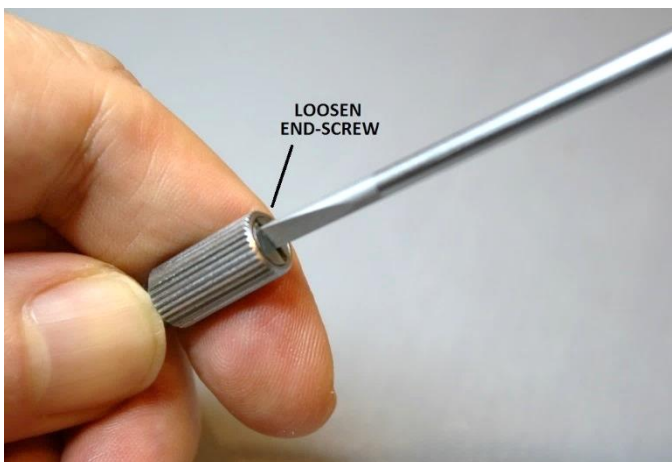


Figure 62 – Loosen the slotted end-screw

Remove the slotted end-screw, being careful when doing so to prevent the spring behind the end-screw from shooting out and getting lost (see [Figure 63](#)).

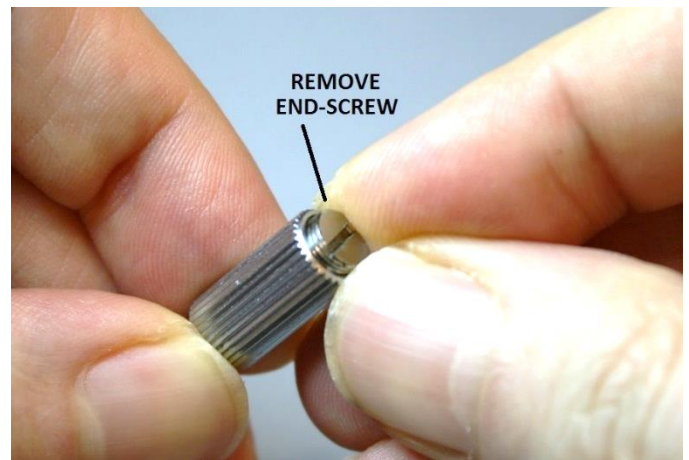


Figure 63 – Carefully remove the slotted end-screw

After removing the slotted end-screw, grasp the tip-extension spring and withdraw it from the knurled end of the thumbscrew (see [Figure 64](#)).

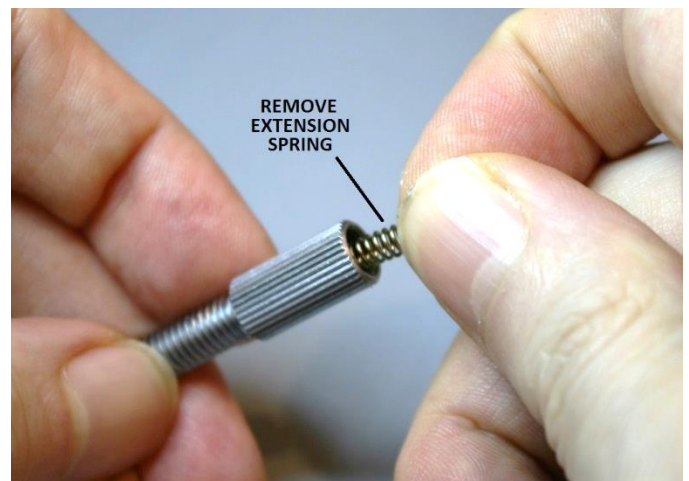


Figure 64 – Remove the tip-extension spring

To remove the tip assembly from the thumbscrew, first press the protruding plastic tip down on the work surface, to press the tip up into the threaded end of the thumbscrew (see [Figure 65](#)).

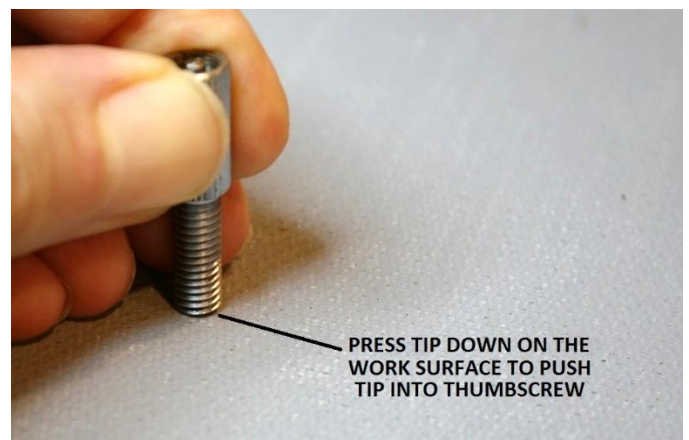


Figure 65 – Press plastic tip up into the thumbscrew

Next, use a blunt-tipped tool of some sort to press the plastic tip further into the threaded end of the thumbscrew (see [Figure 66](#)), until the metal rod protrudes from the knurled end of the thumbscrew (see [Figure 67](#)). If necessary, apply gentle heat with a heat gun to first loosen the thickened grease (be careful to not melt the plastic tip).

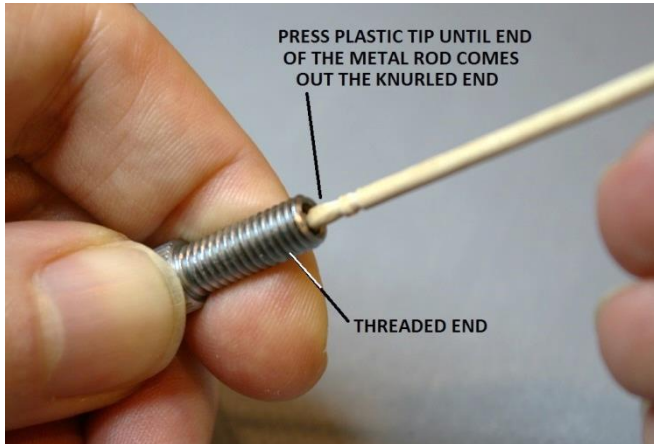


Figure 66 – Press plastic tip into the threaded end

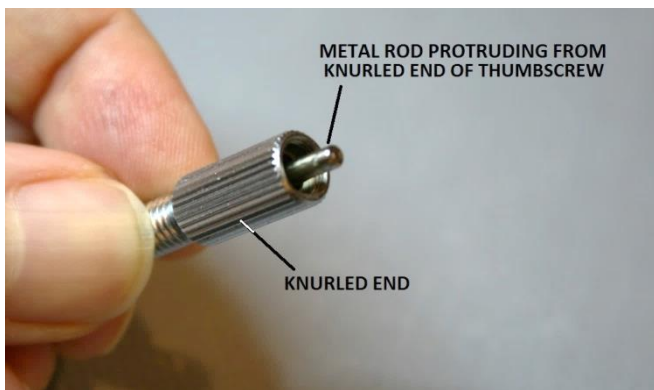


Figure 67 – Metal rod protruding from knurled end

Use needle-nose pliers to grasp the protruding metal rod and pull the tip assembly free of the thumbscrew (see [Figure 68](#)).

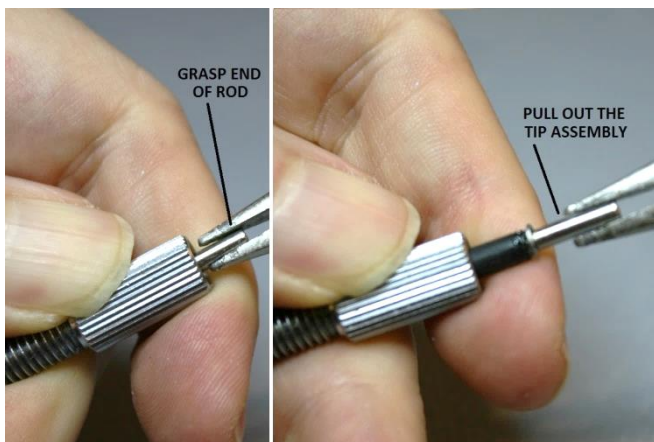


Figure 68 – Pull the metal rod out the knurled end

If the metal rod comes out and the plastic tip remains stuck in the thumbscrew bore, use a suitable blunt tool to press the plastic tip out the knurled end of the thumbscrew. Once it comes out, slip the plastic tip back onto the metal rod. The tip assembly is shown in [Figure 69](#).

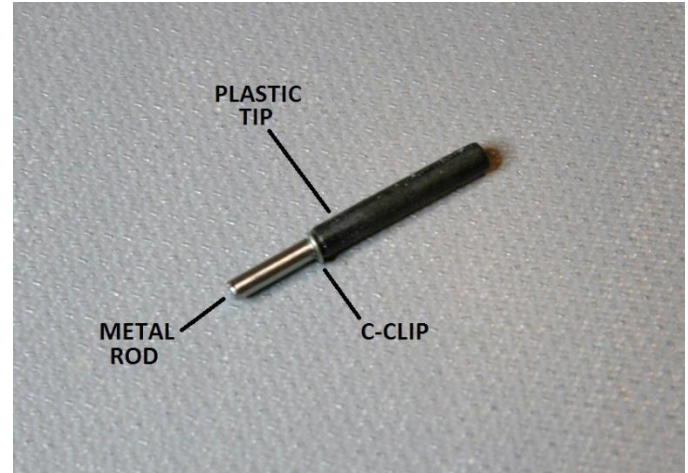


Figure 69 – The complete tip assembly

[Figure 70](#) shows the various components of the locking thumbscrew assembly. Note that the tip assembly has not been disassembled in this photo.

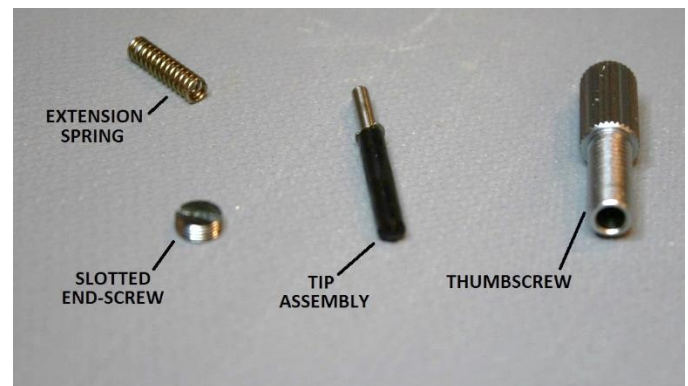


Figure 70 – The components of the thumbscrew assembly

Use a cotton swab dipped in a suitable solvent (e.g., acetone) to clean the old grease from the bore of the thumbscrew. Use a dry tissue or rag to thoroughly wipe the old grease from the plastic tip. Be careful using solvents to clean the grease from the plastic tip, as the plastic may swell or dissolve with exposure to some types of solvents.

Reassemble the Locking Thumbscrew Assembly

Coat the plastic tip with fresh grease and apply a bit of fresh grease into the bore in the knurled end of the thumbscrew. Insert the plastic tip of the tip assembly into the bore of the knurled end of the thumbscrew (see [Figure 71](#)).

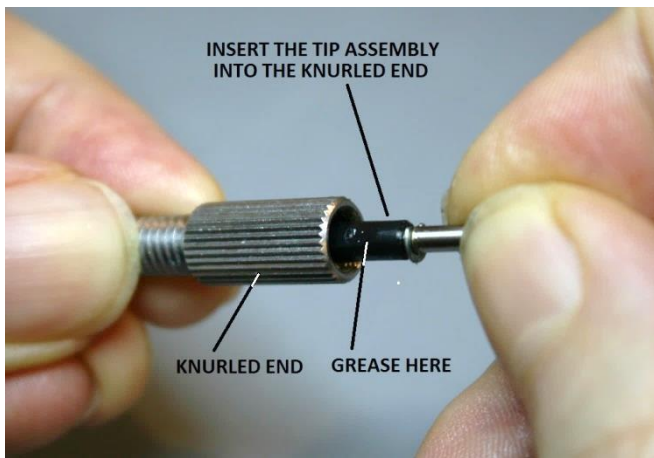


Figure 71 – Reinstall tip assembly into the thumbscrew

Press the metal rod protruding from the knurled end of the thumbscrew down onto the work surface to push the plastic tip of the tip assembly into the bore of the thumbscrew (see [Figure 72](#)).

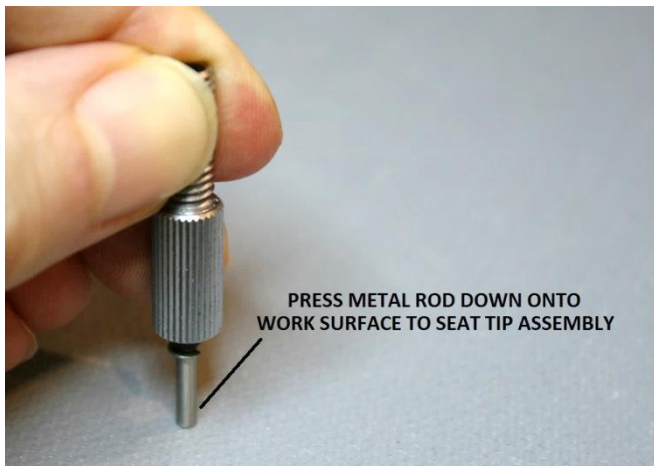


Figure 72 – Press the plastic tip into thumbscrew bore

Use a suitable blunt tool to press the exposed end of the metal rod until the tip assembly fully seats into the thumbscrew bore and the plastic tip protrudes from the threaded end. Wipe away any visible grease that was pushed out by the plastic tip (see [Figure 73](#)).

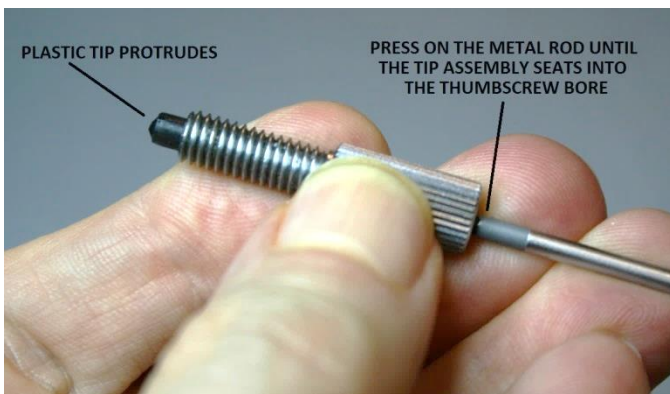


Figure 73 – Press rod until the plastic tip fully protrudes

Insert the tip-extension spring into the bore of the knurled end of the thumbscrew, placing it over the end of the metal rod of the tip assembly (see [Figure 74](#) and [Figure 75](#)).

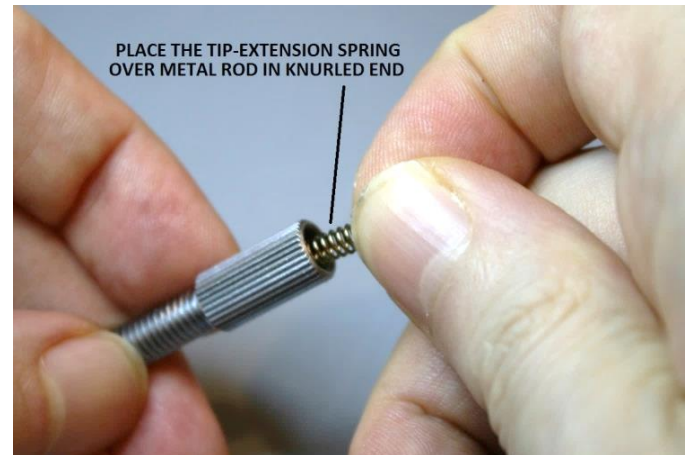


Figure 74 – Install tip-extension spring over the metal rod

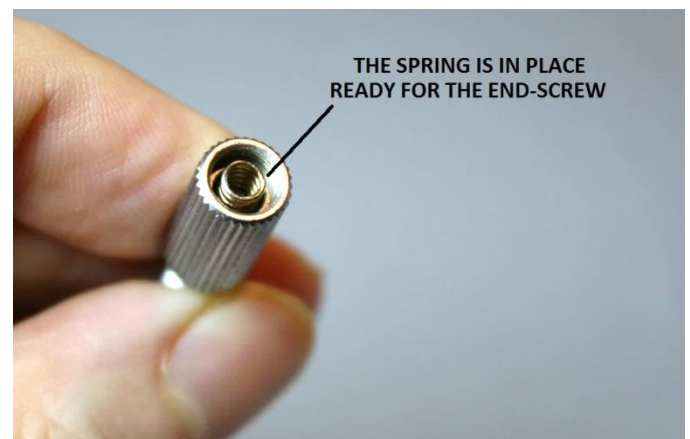


Figure 75 – The extension spring in the proper position

Carefully depress the tip-extension spring and reinstall the slotted end-screw into the knurled end of the thumbscrew (see [Figure 76](#)). Use a suitable slotted screwdriver to tighten the end screw (see [Figure 77](#)).

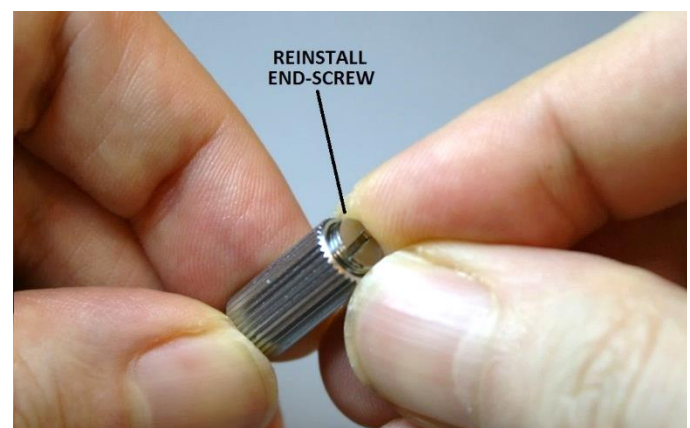


Figure 76 – Compress spring and reinstall the end-screw

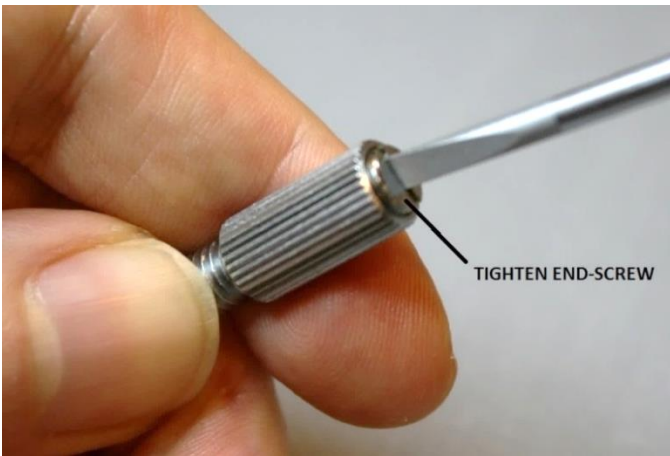


Figure 77 – Tighten the end-screw

Lightly grease the threads of the locking thumbscrew assembly and reinstall it into the tapped hole in the front of the BH2-SVR mechanical stage (see [Figure 59](#)).

Test the Feel of the Slide Mechanisms

With the coaxial positioning assembly and positioning racks removed from the stage, test the freedom of motion of the two axes of stage movement. In both axes, the stage should move freely throughout the normal range of motion without excessive friction, grittiness, or binding. If it does not, proceed with the teardown, cleaning/lubrication, and reassembly procedure below to correct this condition. If the motion is acceptable in both axes, skip ahead to the [Reinstall the Coaxial Positioning Assembly](#) section of this document.

Remove the Y-Axis Scale Pointer Carrier

Use a suitable JIS screwdriver to remove the two small JIS screws securing the Y-axis scale pointer carrier to the scale pointer bracket (see [Figure 78](#)).

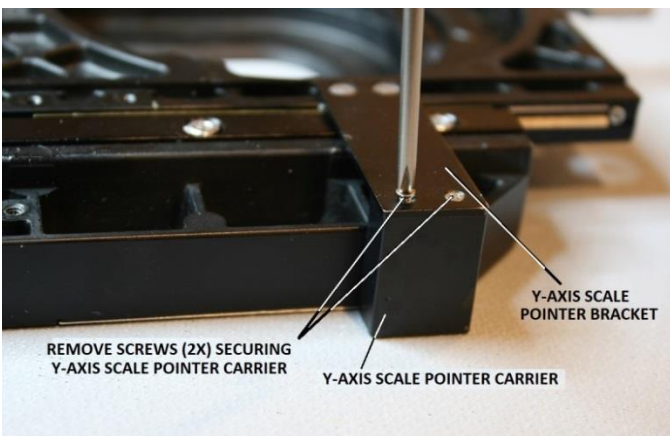


Figure 78 – Remove screws securing scale pointer carrier

Remove the (now loose) Y-axis scale pointer carrier (see [Figure 79](#)).

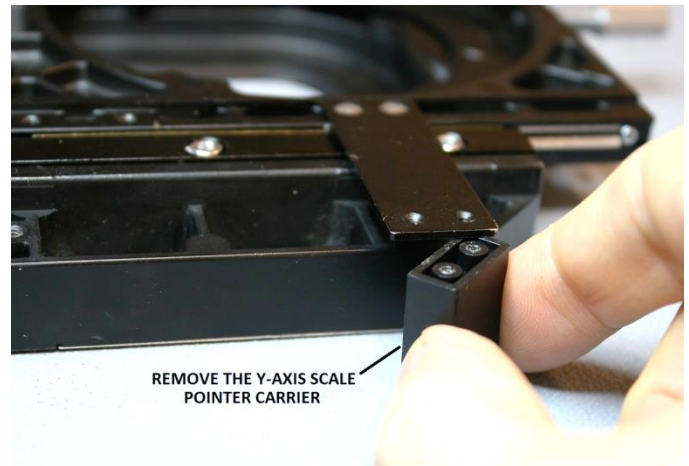


Figure 79 – Remove the Y-axis scale pointer carrier

Remove the Specimen Carrier

Use a 2.5mm Allen wrench or driver to remove the two M3x8 hex socket-head cap screws securing the specimen carrier to the X-axis slider (see [Figure 80](#)) and remove the (now loose) specimen carrier (see [Figure 81](#)).

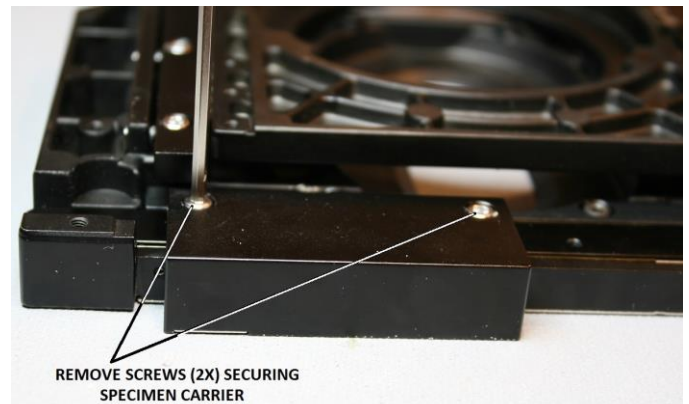


Figure 80 – Remove screws securing the specimen carrier

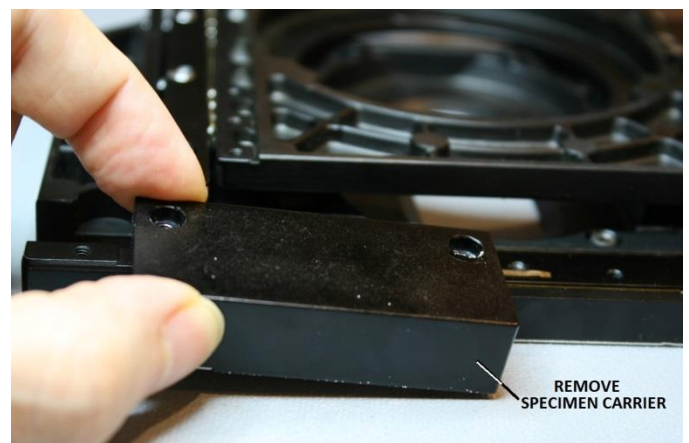


Figure 81 – Remove the loose specimen carrier

Carefully remove any brass shims from the top of the X-axis slide (or from the bottom of the specimen carrier) that may be present (see [Figure 82](#)).



Figure 82 – Remove brass shims (if preset) from slide

Disassemble the Y-Axis Slide Mechanism

Use a 2.5mm Allen wrench or driver to loosen the three M3x8 hex socket-head cap screws securing the Y-axis guide on the left-hand side of the stage. Turn these screws just to the point where they break loose, but do not loosen them any further at this point (see [Figure 83](#)).

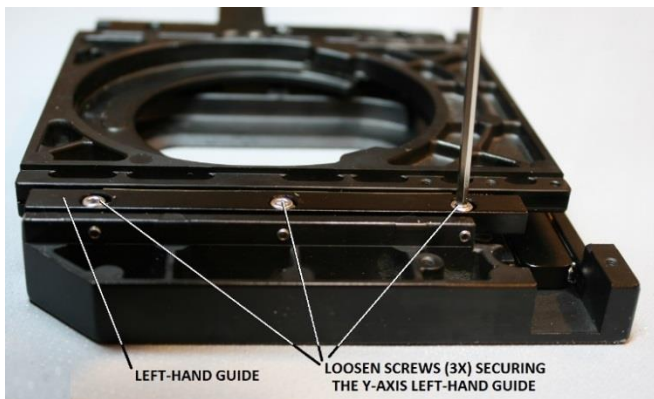


Figure 83 – Loosen screws securing the left-hand guide

Use a 1.5mm Allen wrench or driver to loosen the three M3x6 lateral-adjustment set screws for the left-hand guide. Do not remove these set screws, just back them out to the point where their tips no longer protrude from the tapped holes in the sliding stage frame (see [Figure 84](#)).

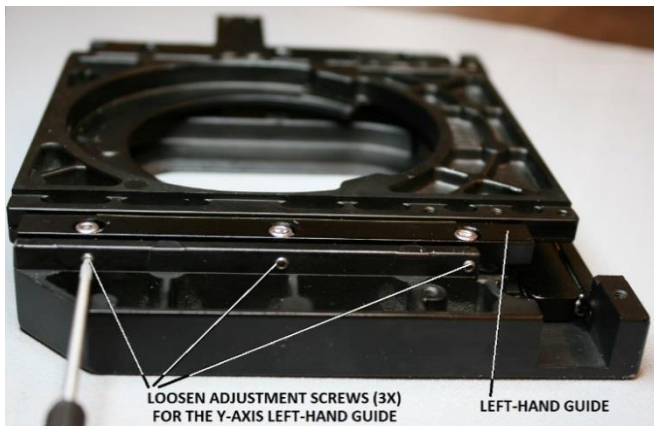


Figure 84 – Loosen set screws for the left-hand guide

With the three set screws backed out, use a 2.5mm Allen wrench or driver to remove the three M3x8 hex socket-head cap screws securing the left-hand guide to the sliding stage frame (see [Figure 85](#)).

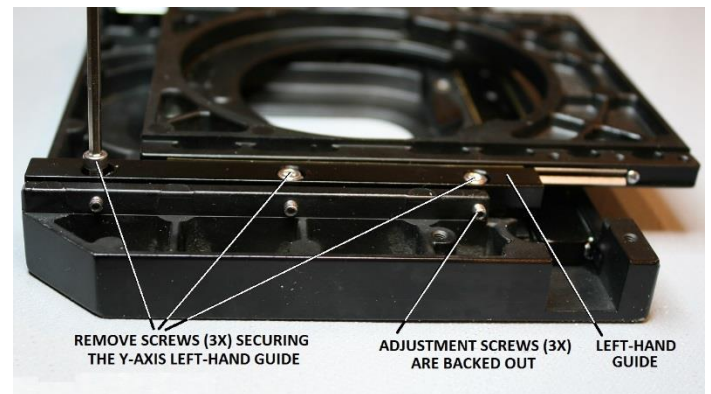


Figure 85 – Remove screws securing the left-hand guide

Carefully lift and remove the Y-axis left-hand guide from the sliding stage frame (see [Figure 86](#)).



Figure 86 – Lift and remove the left-hand guide

Carefully remove the eight Y-axis left-hand bearing balls (see [Figure 87](#)).

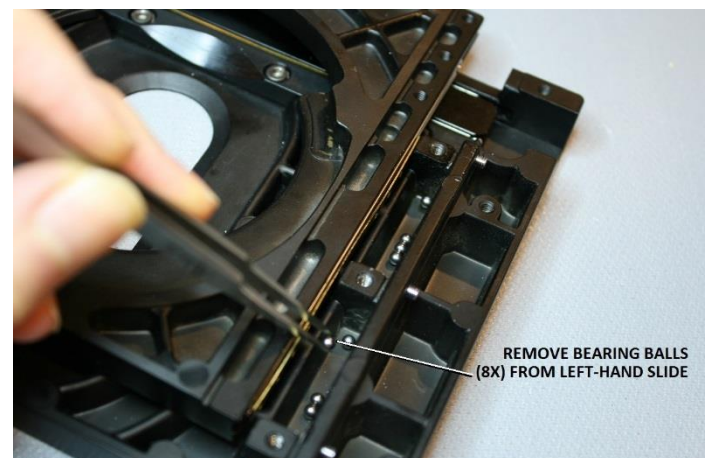


Figure 87 – Remove bearing balls from left-hand slide

Remove the Y-axis left-hand ball cage (see [Figure 88](#)).

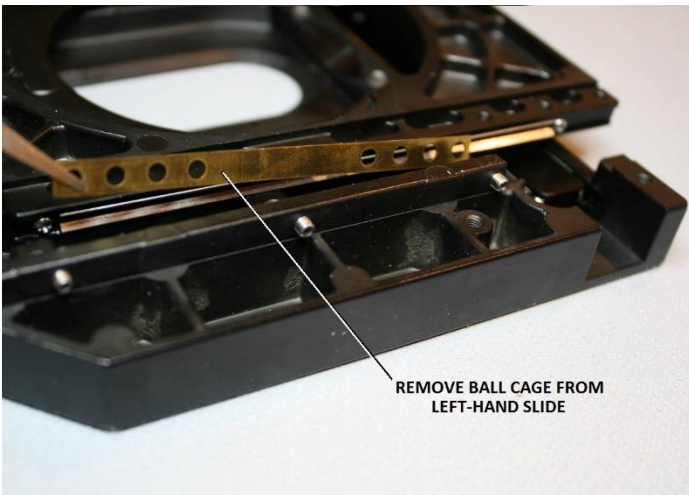


Figure 88 – Remove ball cage from the left-hand slide

Carefully lift and remove the stationary base from the sliding stage frame (see [Figure 89](#)).

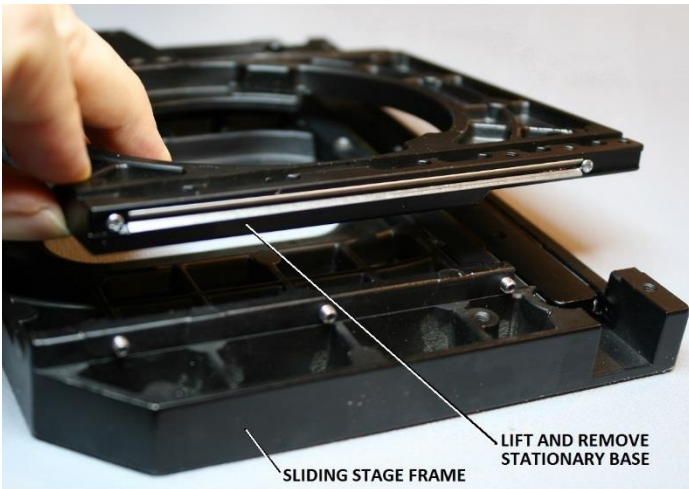


Figure 89 – Lift and remove the stationary base

Carefully remove the eight Y-axis right-hand bearing balls (see [Figure 90](#)).



Figure 90 – Remove bearing balls from right-hand slide

Remove the Y-axis right-hand ball cage (see [Figure 91](#)).

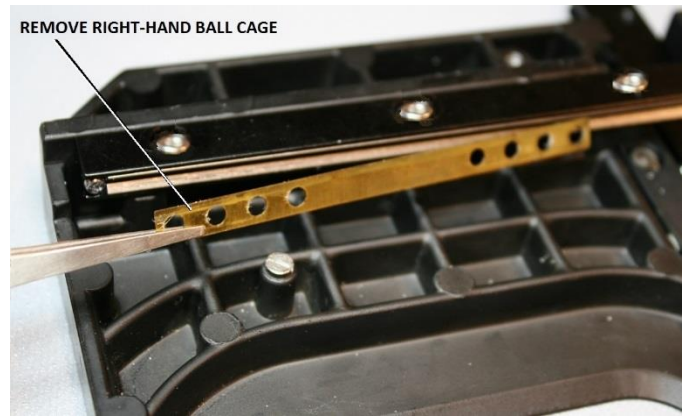


Figure 91 – Remove the right-hand ball cage

Use a 2.5mm Allen wrench or driver to remove the three M3x8 hex socket-head cap screws securing the Y-axis right-hand guide to the sliding stage frame (see [Figure 92](#)).

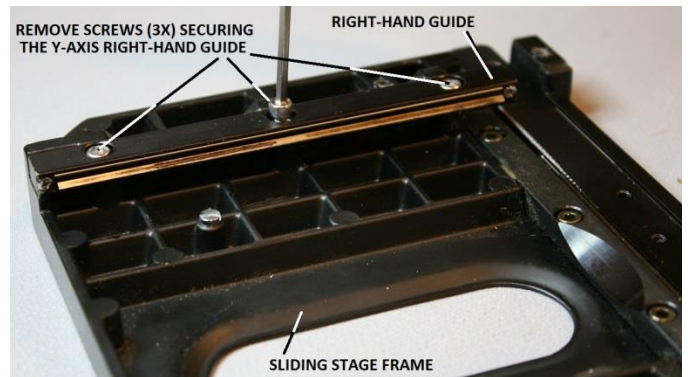


Figure 92 – Remove screws securing right-hand guide

Lift and remove the Y-axis right-hand guide from the sliding stage frame (see [Figure 93](#)).

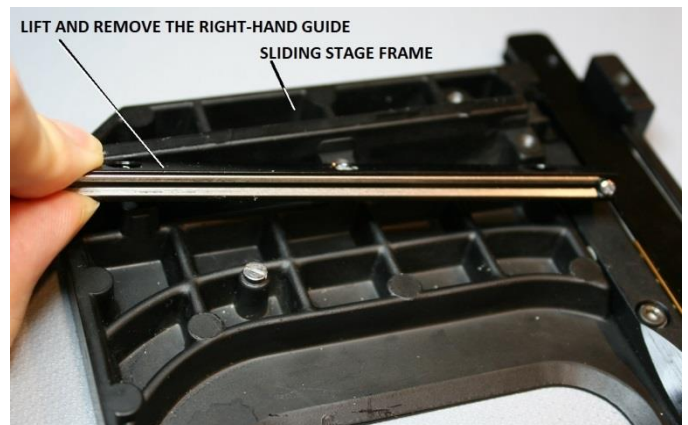


Figure 93 – Lift and remove the right-hand guide

Carefully remove the precision guide rails from the Y-axis left-hand and right-hand guides, and from both sides of the stationary base, being careful not to bend or damage the guide rails during the process (see [Figure 94](#), stationary base shown).

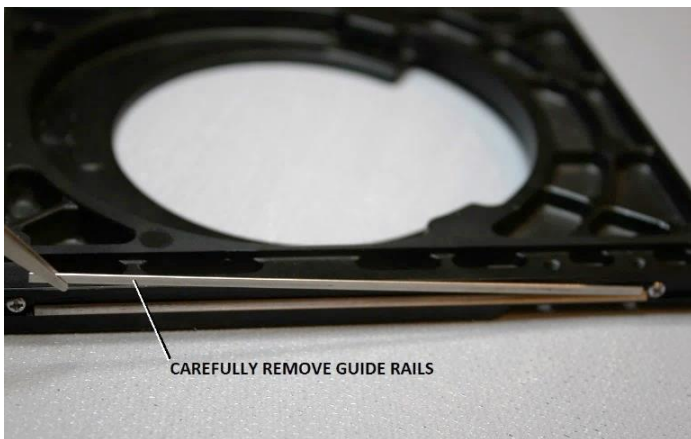


Figure 94 – Remove the guide rails for cleaning

Using a suitable solvent (e.g., acetone) clean any grease or oil residue from the various Y-axis slide parts. The components of the Y-axis slide mechanism are shown in [Figure 95](#).

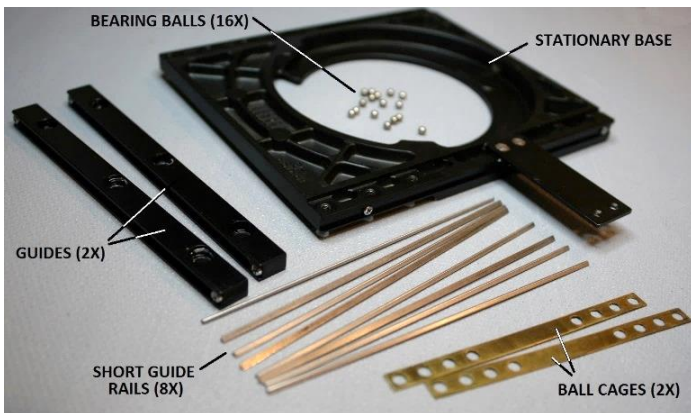


Figure 95 – The parts of the Y-axis slide mechanism

Disassemble the X-Axis Slide Mechanism

Use a 2.5mm Allen wrench or driver to remove the four M3x6 hex socket-head cap screws securing the X-axis guide to the sliding stage frame (see [Figure 96](#)).

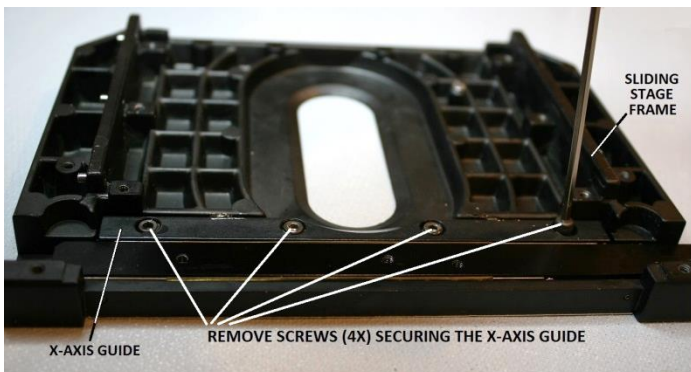


Figure 96 – Remove four screws securing the X-axis guide

If necessary, use the blade of a small slotted screwdriver to break the two glue bonds holding the

X-axis guide in place on the sliding stage frame (see [Figure 97](#)).

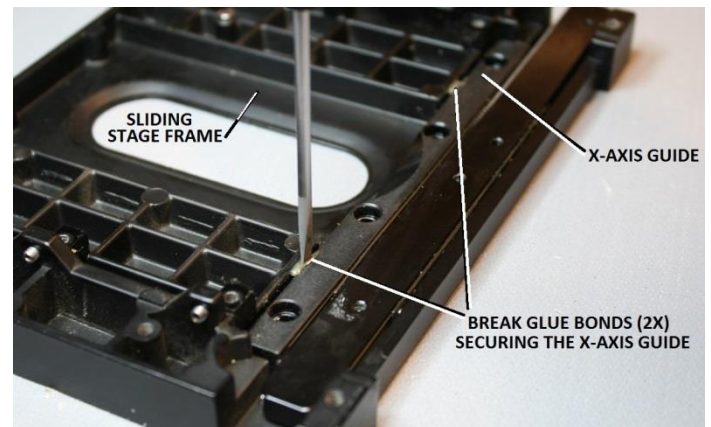


Figure 97 – Break glue bonds securing the X-axis guide

Lift and remove the (now loose) X-axis guide (see [Figure 98](#)).

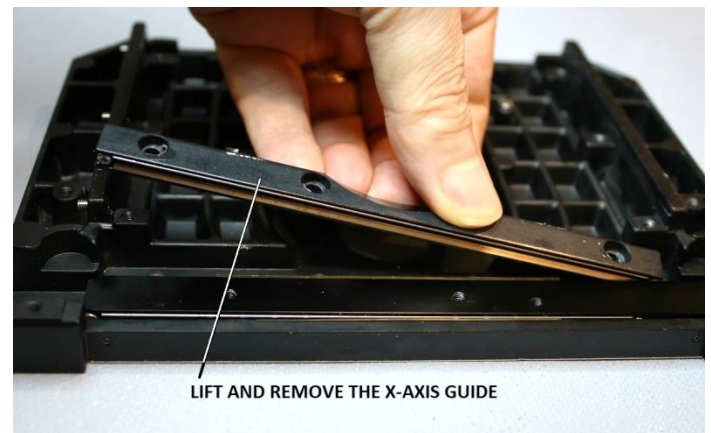


Figure 98 – Lift and remove the X-axis guide

Carefully remove the eight X-axis front bearing balls (see [Figure 99](#)).



Figure 99 – Remove bearing balls from the front of slide

Remove the X-axis front ball cage (see [Figure 100](#)).

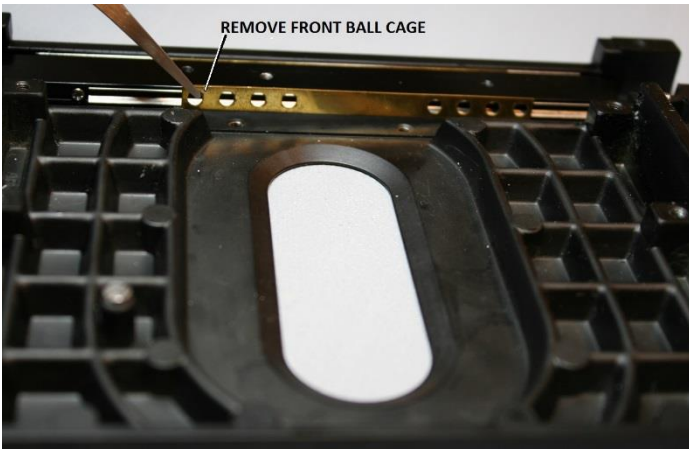


Figure 100 – Remove the X-axis front ball cage

Lift and remove the X-axis slide from the sliding stage frame (see [Figure 101](#)).



Figure 101 – Lift and remove the X-axis slide

Carefully remove the eight X-axis rear bearing balls (see [Figure 102](#)).

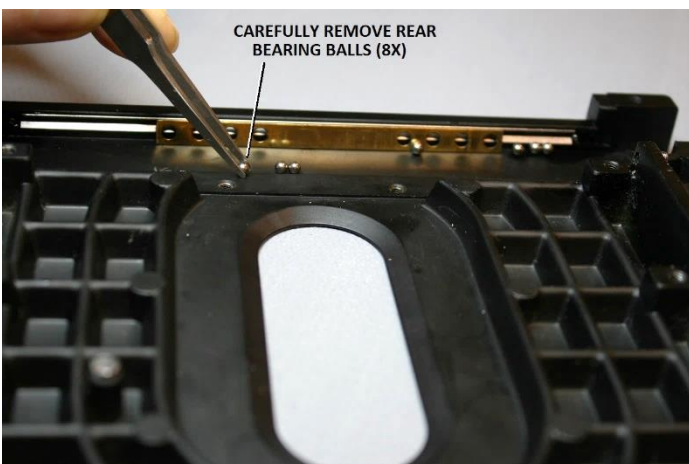


Figure 102 – Remove bearing balls from the rear of slide

Remove the X-axis rear ball cage (see [Figure 103](#)).

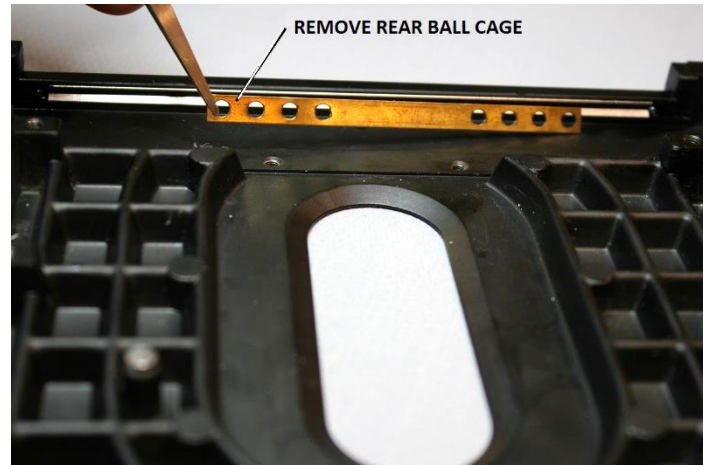


Figure 103 – Remove the X-axis rear ball cage

Carefully remove the four precision guide rails from the side grooves in the X-axis slide (see [Figure 104](#)).

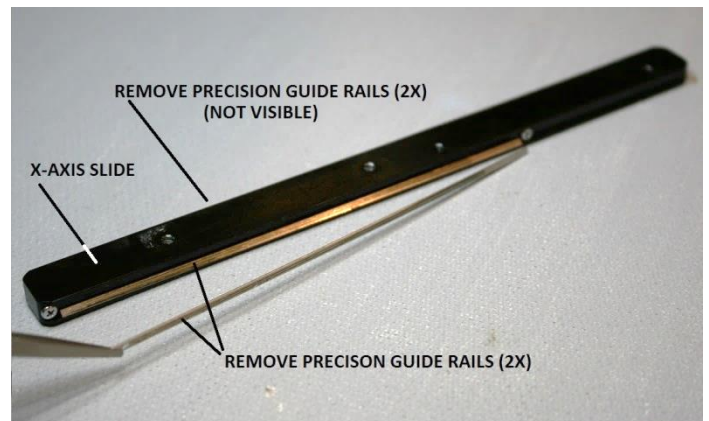


Figure 104 – Remove the guide rails from the X-axis slide

Carefully remove the two precision guide rails from the side groove in the X-axis guide (see [Figure 105](#)).

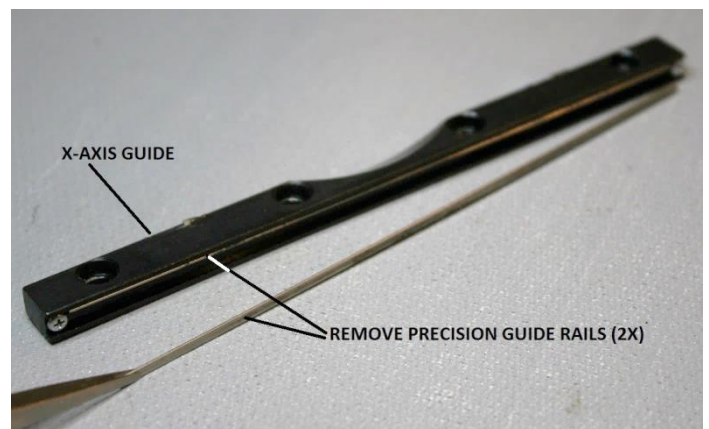


Figure 105 – Remove the guide rails from the X-axis guide

Carefully remove the two precision guide rails from the rear groove of the sliding stage frame (see [Figure 106](#)).

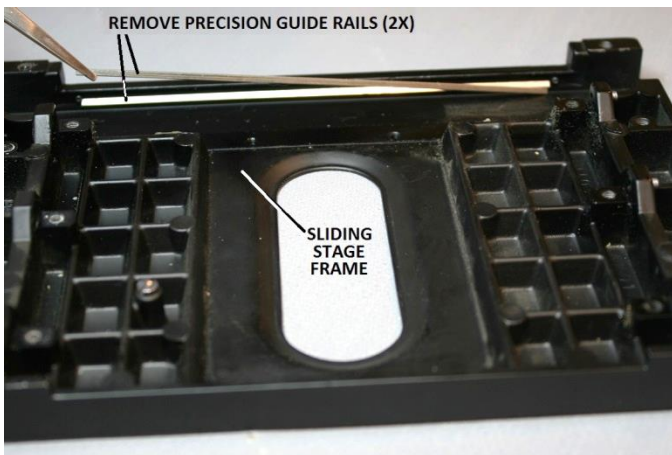


Figure 106 – Remove guide rails from sliding stage frame

Using a suitable solvent (e.g., acetone), clean any grease or oil residue from the X-axis slide parts (see [Figure 107](#)).

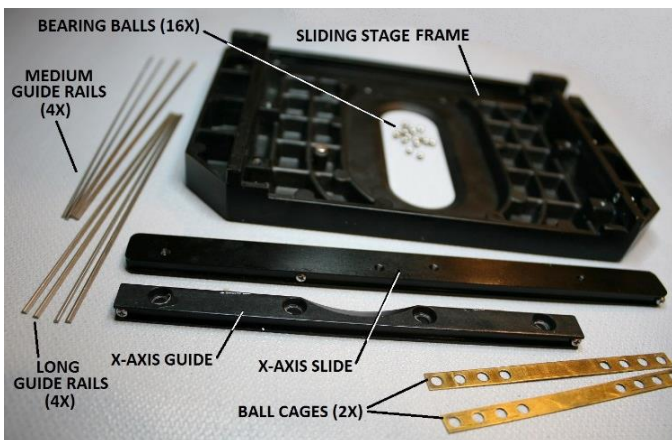


Figure 107 – The parts of the X-axis slide mechanism

Reassemble the X-Axis Slide Mechanism

Reinstall two of the long precision guide rails into the inside corners of the rear groove in the sliding stage frame, per [Appendix 1](#) of this document (see [Figure 108](#)).

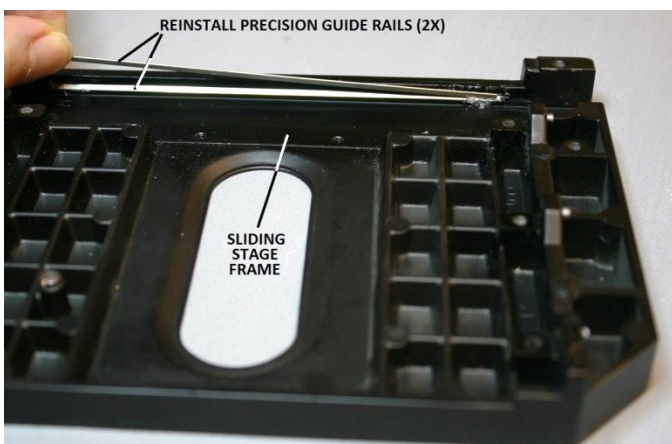


Figure 108 – Reinstall guide rails in sliding stage frame

Orient the sliding stage frame vertically² for the subsequent reassembly steps (see [Figure 109](#)).

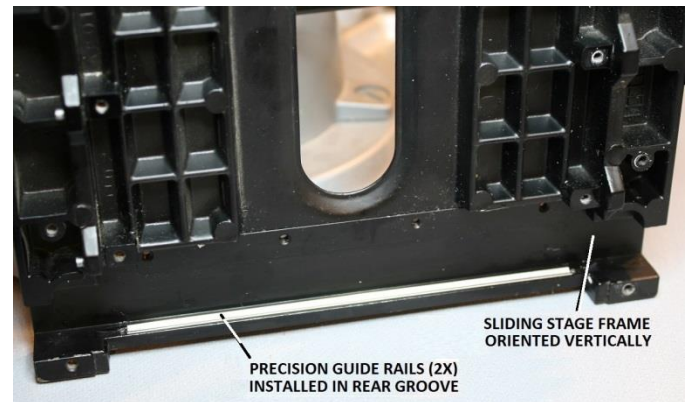


Figure 109 – Oriented vertically with guide rails in place

Place a ball cage on top of the X-axis rear precision guide rails in the sliding stage frame (see [Figure 110](#)).

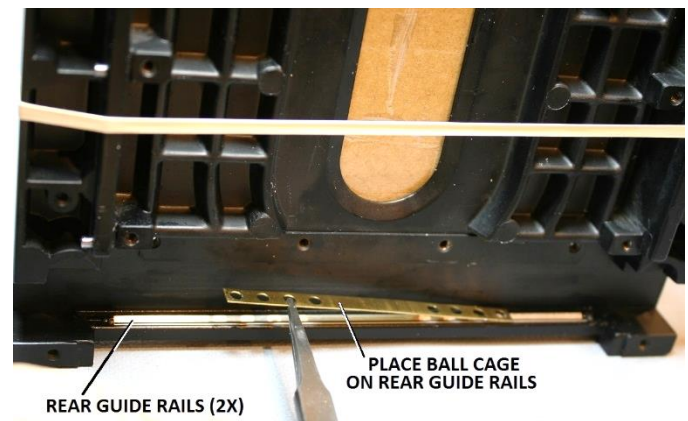


Figure 110 – Place a ball cage on the rear guide rails

Carefully place eight bearing balls into the holes of the X-axis rear ball cage³ (see [Figure 111](#)).

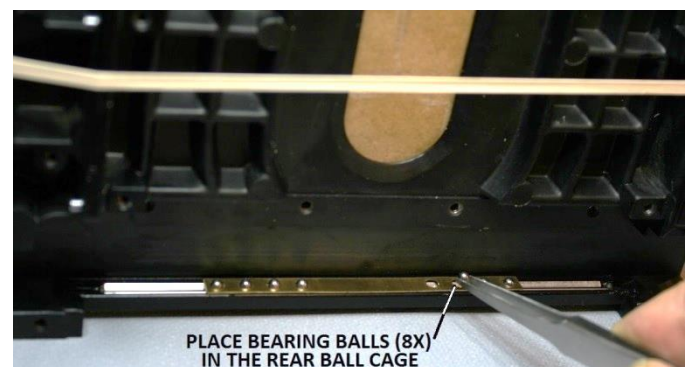


Figure 111 – Place bearing balls in the rear ball cage

² Be sure to secure the stage in the vertical orientation, since parts will likely be lost (and bad words will be said) if the stage falls over during the subsequent reassembly steps. A rubber band works well for this.

³ Although not recommended, grease may be applied to the bearing balls, per the Olympus service documentation.

Reinstall the four medium-length precision guide rails into the inside corners of the side grooves in the X-axis slide, per [Appendix 1](#) of this document (see [Figure 112](#)).

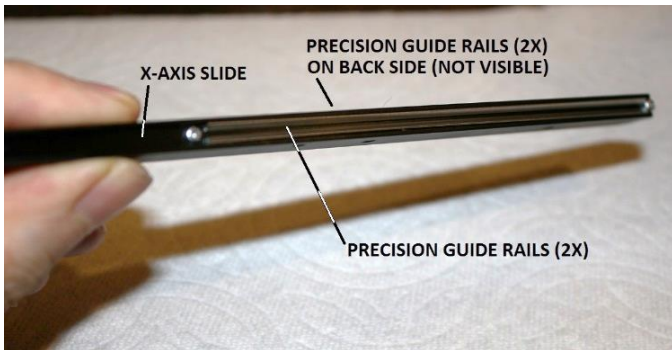


Figure 112 – Reinstall medium guide rails into X-axis slide

Carefully place the X-axis slide on top the bearing balls on the rear precision guide rails (see [Figure 113](#)), making sure to orient the slide such that the holes on the slide are as shown in the photo⁴.



Figure 113 – Place X-axis slide onto the rear bearing balls

Place a ball cage on the precision guide rails on the top (front) of the X-axis slide (see [Figure 114](#)).

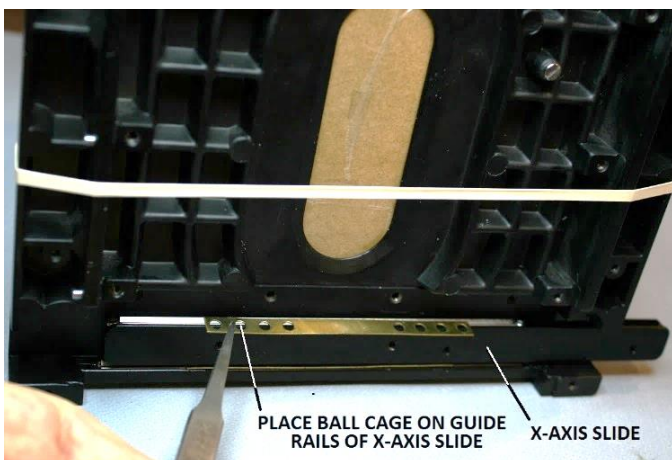


Figure 114 – Place a ball cage on the front guide rails

Carefully place eight bearing balls into the holes of the X-axis top (front) ball cage⁵ (see [Figure 115](#)).

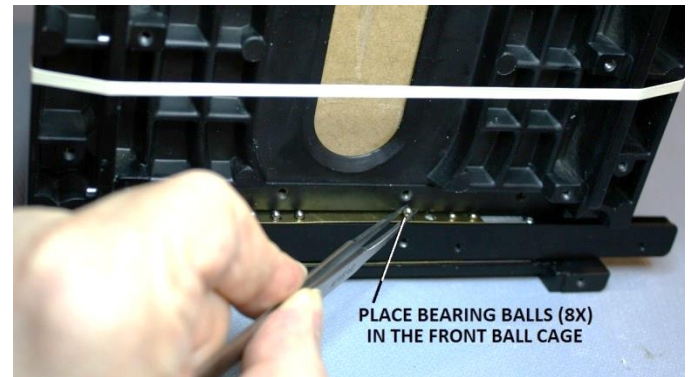


Figure 115 – Place bearing balls in the front ball cage

Reinstall the remaining two long precision guide rails into the inside corners of the side groove of the X-axis guide, per [Appendix 1](#) of this document (see [Figure 116](#)).

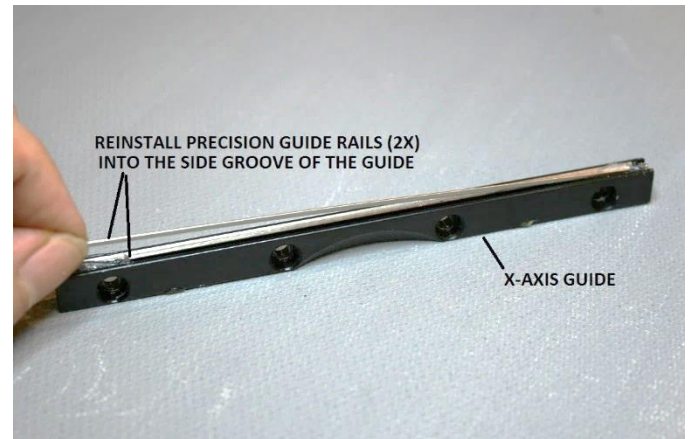


Figure 116 – Reinstall guide rails into the X-axis guide

Carefully place the X-axis guide on top of the bearing balls sitting on the top (front) guide rails of the X-axis slide (see [Figure 117](#)).

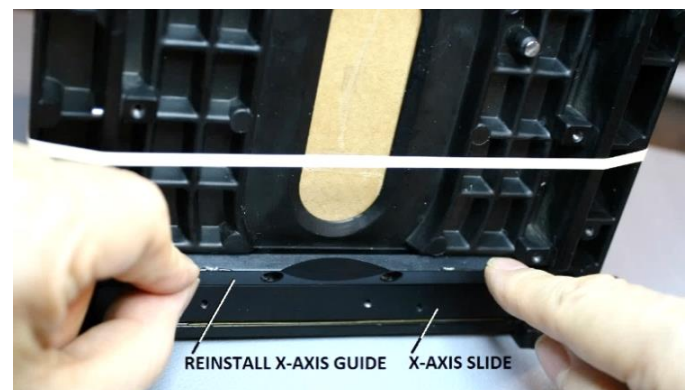


Figure 117 – Place X-axis guide onto the X-axis slide

⁴ If you don't do this, bad words will once again be said when you realize later that you must disassemble *everything* and start over to correct this.

⁵ Although not recommended, grease may be applied to bearing balls per the Olympus service literature.

Use a 2.5mm Allen wrench or driver to loosely reinstall four M3x6 hex socket-head cap screws to hold the X-axis guide in place (see [Figure 118](#)).

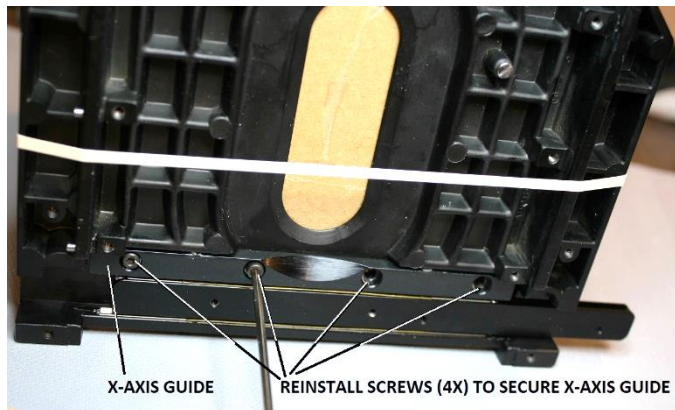


Figure 118 – Reinstall screws to secure the X-axis guide

Lay the sliding stage frame flat on the work surface. Use a small slotted screwdriver, with the tip placed in the gap between the X-axis guide and the sliding stage frame, to apply a lateral force to each end of the X-axis guide (towards the X-axis slide), to eliminate any lateral (Y-axis) play in the X-axis slide. Use a 2.5mm Allen wrench or driver to tighten the corresponding M3x6 screws, while holding this lateral force, to secure the guide in position (see [Figure 119](#)). Do the same thing for the center two screws.

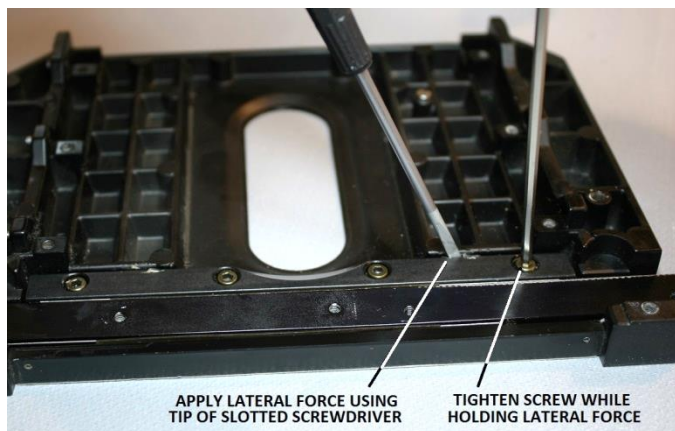


Figure 119 – Secure X-axis guide with no lateral play

After all four of the screws have been tightened, test the feel of the X-axis slide throughout its full range of travel. Repeat the above procedure, using less lateral force, if stiffness, binding, or grittiness is felt anywhere as the X-axis slide is moved throughout its full range of travel.

Reassemble the Y-Axis Slide Mechanism

Reinstall two of the short precision guide rails into the inside corners of the side grooves of both the Y-axis

guides, per [Appendix 1](#) of this document (see [Figure 120](#), one guide shown).

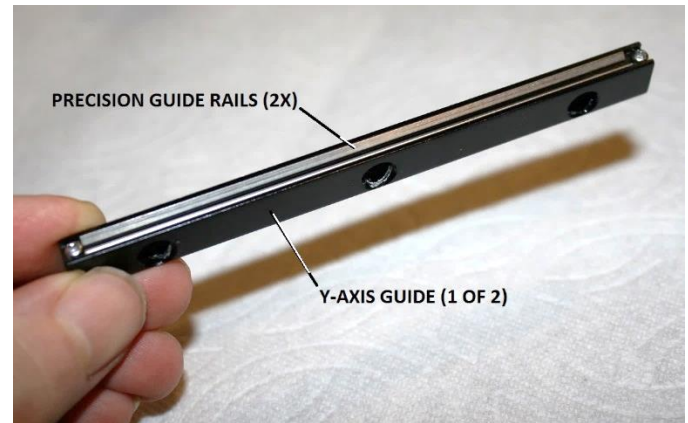


Figure 120 – Reinstall guide rails into the Y-axis guides

Orient the sliding stage frame vertically for the subsequent reassembly steps (see [Figure 121](#)). Place the Y-axis left-hand guide in position on the sliding stage frame (see [Figure 121](#)).



Figure 121 – Place the left-hand guide in position

Use a 2.5mm Allen wrench or driver to reinstall three M3x8 hex socket-head cap screws to secure the Y-axis left-hand guide to the sliding stage frame (see [Figure 122](#)).

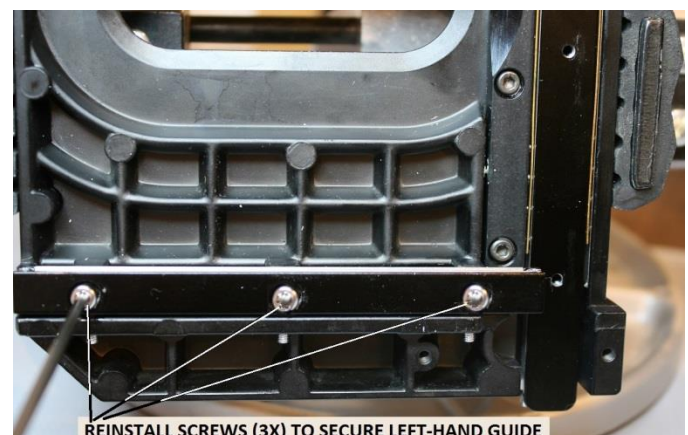


Figure 122 – Secure left-hand guide to sliding stage frame

Place a ball cage on the exposed precision guide rails of the Y-axis left-hand guide (see [Figure 123](#)).



Figure 123 – Place ball cage on the left-hand guide rails

Carefully place eight bearing balls into the holes of the Y-axis left-hand ball cage⁶ (see [Figure 124](#)).



Figure 124 – Place bearing balls in the left-hand ball cage

Reinstall four of the short precision guide rails into the inside corners of the side grooves of the stationary base, per [Appendix 1](#) of this document (see [Figure 125](#)).

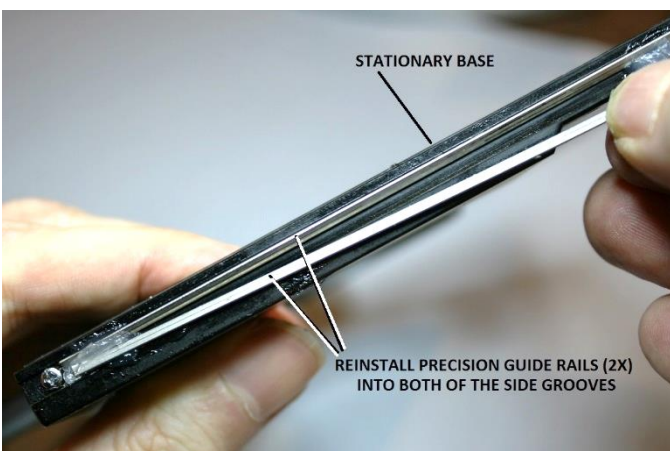


Figure 125 – Place guide rails into the stationary base

Carefully lower the stationary base onto the exposed bearing balls of the Y-axis left-hand guide (see [Figure 126](#)).

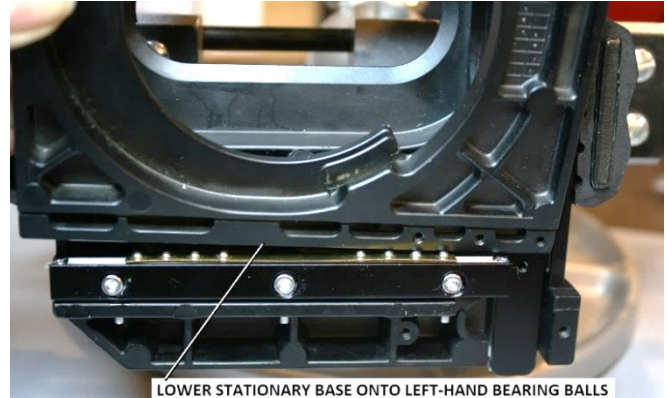


Figure 126 – Lower stationary base onto left-hand guide

Place a ball cage behind the Y-axis scale pointer bracket and on top of the exposed Y-axis right-hand precision guide rails of the stationary base (see [Figure 127](#)).



Figure 127 – Place ball cage onto right-hand guide rails

Carefully place eight bearing balls into the holes of the Y-axis right-hand ball cage⁷ (see [Figure 128](#)).

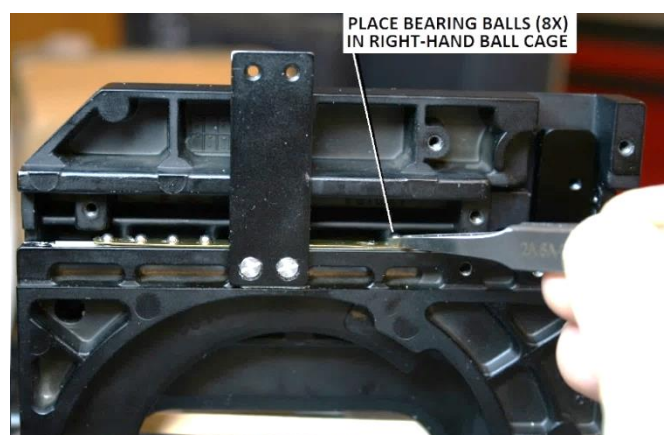


Figure 128 – Place bearing balls in right-hand ball cage

⁶ Although not recommended, grease may be applied to the bearing balls, per Olympus service literature.

⁷ Although not recommended, grease may be applied to the bearing balls, per Olympus service literature.

Carefully place the Y-axis right-hand guide (with two precision guide rails installed in the side groove per [Appendix 1](#) of this document) behind the Y-axis scale pointer bracket and on top of the bearing balls sitting on the right-hand precision guide rails of the stationary base, per [Figure 129](#).

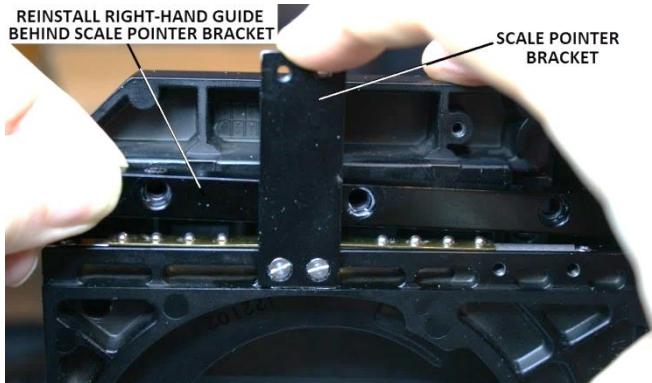


Figure 129 – Reinstall right-hand guide behind bracket

Use a 2.5mm Allen wrench or driver to reinstall three M3x8 hex socket-head cap screws to secure the Y-axis right-hand guide to the sliding stage frame (see [Figure 130](#)).

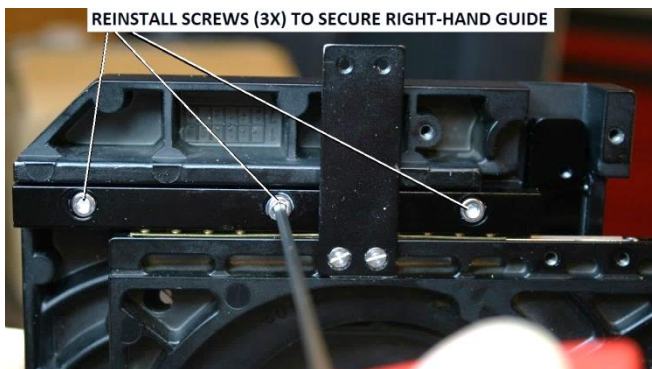


Figure 130 – Reinstall screws to secure right-hand guide

Carefully lay the stage flat. Use a 2.5mm Allen wrench or driver to adjust the three M3x8 screws securing the Y-axis left-hand guide to the sliding stage frame to the point where they are just slightly loose (see [Figure 131](#)).

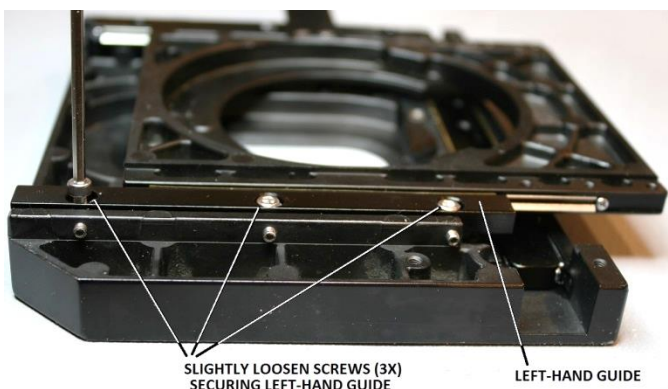


Figure 131 – Slightly loosen screws securing the left guide

Use a 1.5mm Allen wrench or driver to adjust the three M3x6 set screws on the Y-axis left-hand guide for free (non-binding) motion of the stationary base, without any lateral play in the X-axis (see [Figure 132](#)).



Figure 132 – Adjust set screws for no lateral play

Use a 2.5mm Allen wrench or driver to tighten the three M3x8 screws to secure the left-hand guide rail to the sliding stage frame (see [Figure 133](#)).

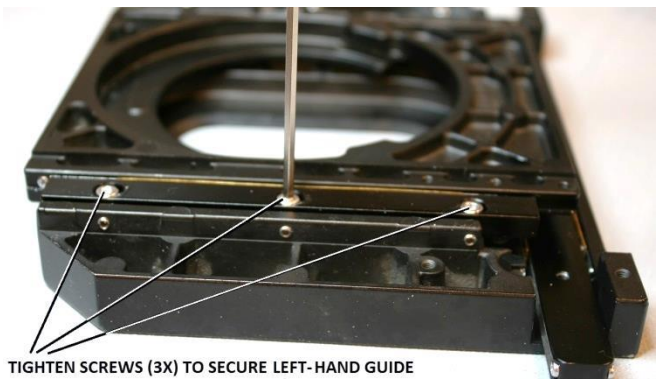


Figure 133 – Tighten screws to secure the left-hand guide

Reinstall the Specimen Carrier

Reinstall any brass shims onto the X-axis slide that were present under the specimen carrier when the specimen carrier was originally removed (see [Figure 134](#)).



Figure 134 – Reinstall any shims for the specimen carrier

Place the specimen carrier in position on the X-axis slide, aligning the holes in the specimen carrier with the tapped holes in the X-axis slide (see [Figure 135](#)). Be careful to not dislodge the shims from the X-axis slide.



Figure 135 – Place the specimen carrier in position

Use a 2.5mm Allen wrench or driver to reinstall two M3x8 hex socket-head cap screws to secure the specimen carrier onto the X-axis slide (see [Figure 136](#)).



Figure 136 – Secure the specimen carrier in position

Reinstall the Y-Axis Scale Pointer Carrier

Hold the Y-axis scale pointer carrier in position on the scale pointer bracket, aligning the holes in the bracket with the tapped holes in the carrier (see [Figure 137](#)).

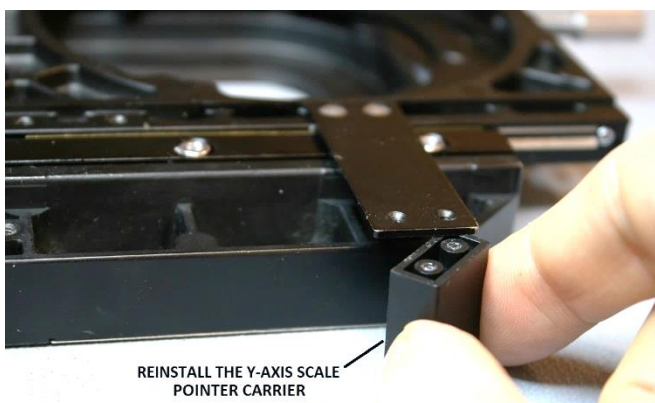


Figure 137 – Place the Y-axis pointer carrier in position

Use a suitable JIS screwdriver to reinstall the two small JIS screws to secure the Y-axis scale pointer carrier to the scale pointer bracket (see [Figure 138](#)).

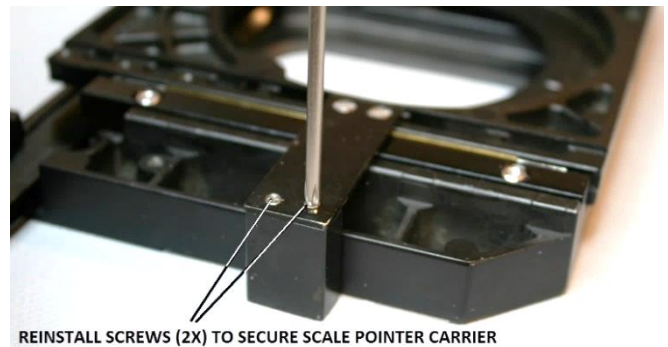


Figure 138 – Reinstall screws to secure scale carrier

Reinstall the Coaxial Positioning Assembly

Hold the coaxial positioning assembly on the sliding stage frame such that the two holes align with the tapped holes in the sliding stage frame (see [Figure 139](#)).

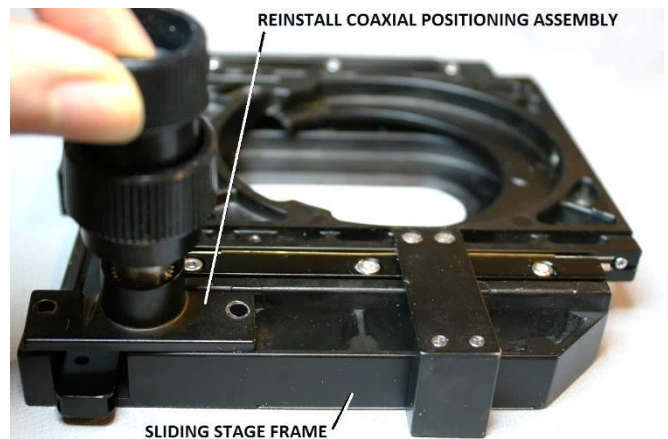


Figure 139 – Hold coaxial positioning assembly in place

Use a 2.5mm Allen wrench or driver to reinstall two M3x8 hex socket-head cap screws to secure the coaxial positioning assembly to the sliding stage frame (see [Figure 140](#)).

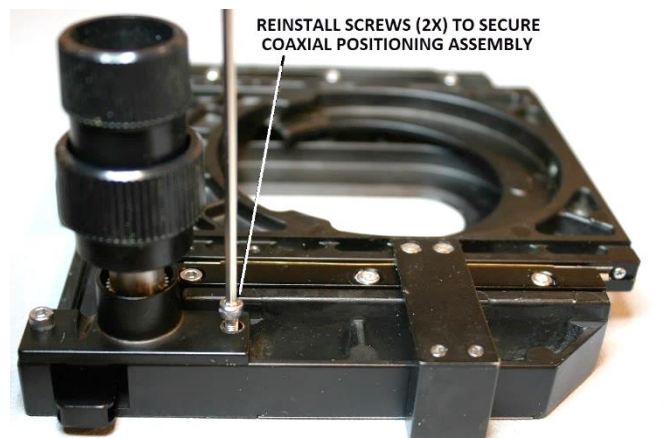
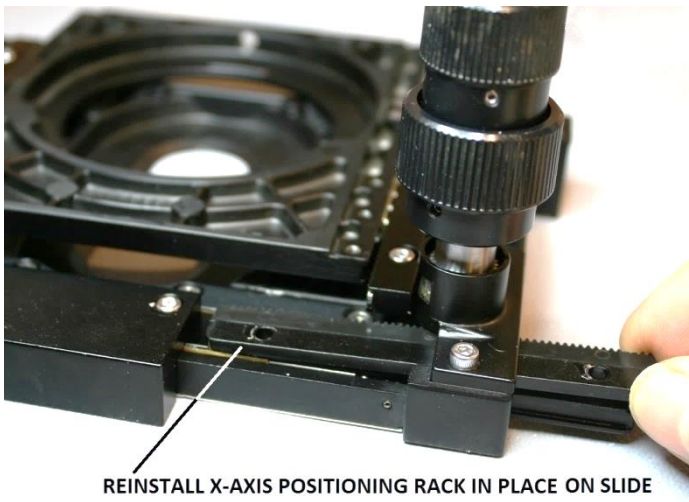


Figure 140 – Secure the coaxial positioning assembly

Reinstall the X-Axis Positioning Rack

Hold the X-axis positioning rack in place on the X-axis slide such that the holes in the positioning rack align with the tapped holes in the slide (see [Figure 141](#)).



REINSTALL X-AXIS POSITIONING RACK IN PLACE ON SLIDE

Figure 141 – Place the X-axis positioning rack on slide

Use a suitable JIS screwdriver to loosely reinstall two M3x8 JIS screws to secure the X-axis positioning rack in place (see [Figure 142](#)). Tighten the screws until they are just slightly snug.

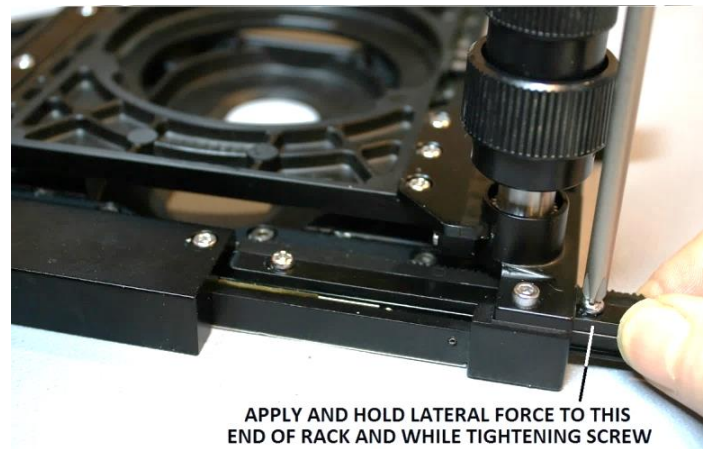


REINSTALL SCREWS (2X) TO SECURE THE X-AXIS POSITIONING RACK TO X-AXIS SLIDE

Figure 142 – Reinstall X-axis positioning rack screws

Adjust the X-Axis Positioning Rack

Turn the X-axis positioning knob to position the X-axis slide such that the right-most end of the positioning rack is meshed with the pinion gear. Use a suitable JIS screwdriver to loosen the M3x8 screw near that end of the positioning rack. Apply a lateral force to the positioning rack, to press the rack into mesh with the pinion gear (do not apply excessive force) in order to eliminate any mechanical backlash. While holding this lateral force, tighten the screw to secure the right-most end of the rack in position (see [Figure 143](#)).



APPLY AND HOLD LATERAL FORCE TO THIS END OF RACK AND WHILE TIGHTENING SCREW

Figure 143 – Adjust right-most end of the X-axis rack

Turn the X-axis positioning knob to position the X-axis slide such that the left-most end of the positioning rack is meshed with the pinion gear. Use a suitable JIS screwdriver to loosen the M3x8 screw near that end of the positioning rack. Apply a lateral force to the positioning rack, to press the rack into mesh with the pinion gear (do not apply excessive force) in order to eliminate any mechanical backlash. While holding this lateral force, tighten the screw to secure the left-most end of the rack in position (see [Figure 144](#)).



APPLY AND HOLD LATERAL FORCE TO THIS END OF RACK WHILE TIGHTENING SCREW

Figure 144 – Adjust left-most end of the X-axis rack

With the X-axis slide positioned such that the left-most end of the X-axis positioning rack is meshed with the pinion gear, use one hand to hold the X-axis positioning knob (to prevent it from turning) and grasp the specimen carrier with the other hand. Try to gently move the specimen carrier back and forth in the X-axis direction (see [Figure 145](#)). There should be no discernable backlash (i.e., free play) in the specimen carrier. If there is noticeable backlash, loosen the M3x8 screw on that end of the X-axis positioning rack and repeat the above procedure to eliminate the backlash.

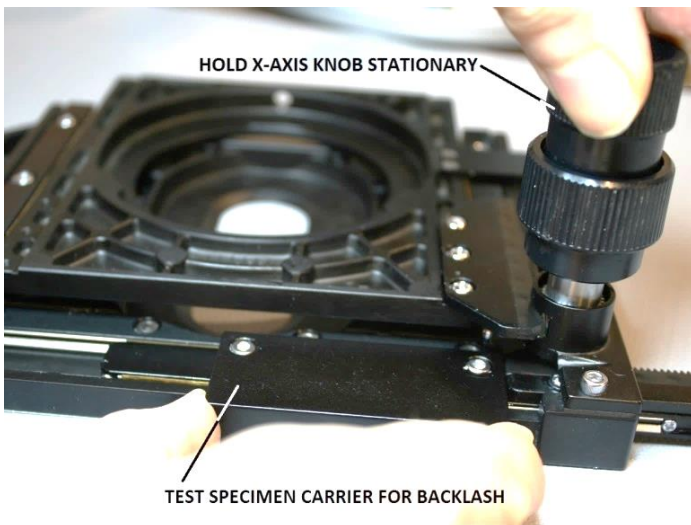


Figure 145 – Test mechanical backlash at left-most end

Turn the X-axis positioning knob to position the X-axis slide such that the right-most end of the X-axis positioning rack is meshed with the pinion gear. Use one hand to hold the X-axis positioning knob stationary (to prevent it from turning) and grasp the specimen carrier with the other hand. Try to gently move the specimen carrier back and forth in the X-axis direction (see [Figure 146](#)), observing for any noticeable mechanical backlash (i.e., free play) in the mechanism. There should be no discernable backlash in the specimen carrier. If backlash is found to be present, loosen the M3x8 screw on that end of the X-axis positioning rack and repeat the adjustment procedure detailed above to eliminate the backlash.

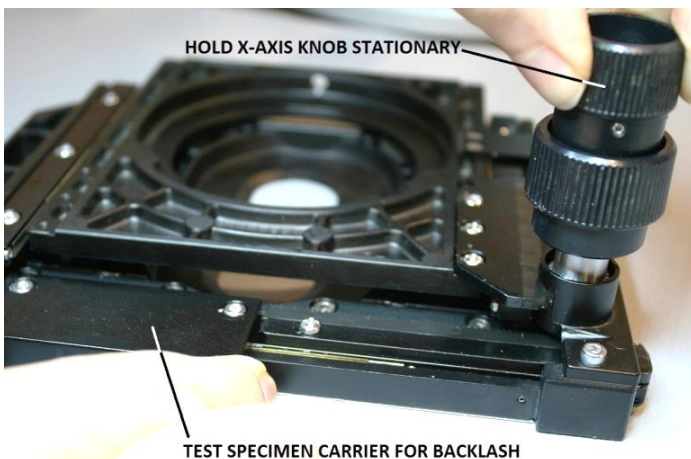


Figure 146 – Test mechanical backlash at right-most end

Reinstall the Y-Axis Positioning Rack

Hold the Y-axis positioning rack in place on the stationary base such that the three holes in the positioning rack align with the tapped holes in the stationary base (see [Figure 147](#)).



Figure 147 – Hold the Y-axis positioning rack in place

Use a suitable JIS screwdriver to loosely reinstall three M3x6 JIS screws to secure the Y-axis positioning rack to the stationary base (see [Figure 148](#)). Tighten the two outside screws until they are just slightly snug, and leave the middle screw slightly loose for now.

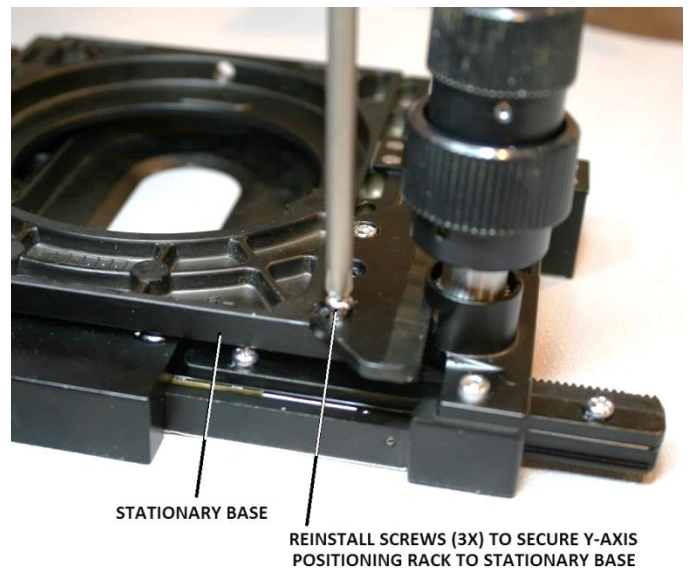


Figure 148 – Reinstall the Y-axis positioning rack screws

Adjust the Y-Axis Positioning Rack

Turn the Y-axis positioning knob such that the rear-most end of the Y-axis positioning rack is meshed with the pinion gear. Use a suitable JIS screwdriver to loosen the rear-most M3x6 screw in the positioning rack. Apply a lateral force to the positioning rack, to press the rack into mesh with the pinion gear (do not apply excessive force) in order to eliminate any mechanical backlash. While holding this lateral force, tighten the rear-most screw to secure the rack in position (see [Figure 149](#)).

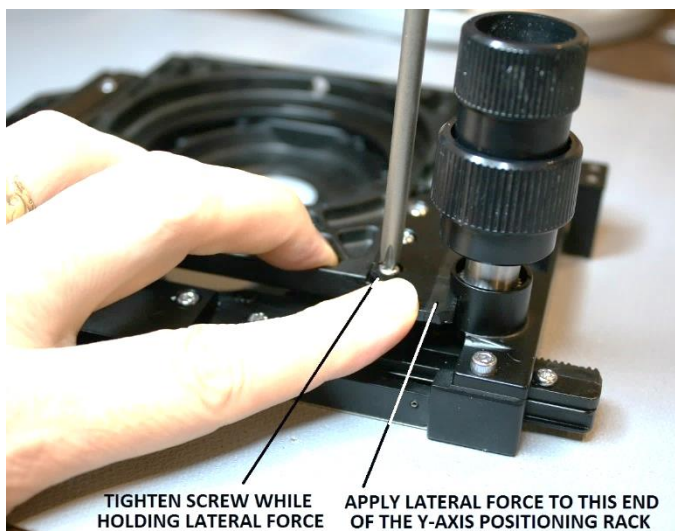


Figure 149 – Adjust the rear-most end of the Y-axis rack

Turn the Y-axis positioning knob to position the stationary base such that the front-most end of the Y-axis positioning rack is meshed with the pinion gear. Use a suitable JIS screwdriver to loosen the front-most M3x6 screw in the positioning rack. Apply a lateral force to the positioning rack, to press the rack into mesh with the pinion gear (do not apply excessive force) in order to eliminate any mechanical backlash. While holding this lateral force, tighten the front-most M3x6 screw to secure the rack in this position (see [Figure 150](#)). Tighten the center M3x6 screw for the Y-axis positioning rack.

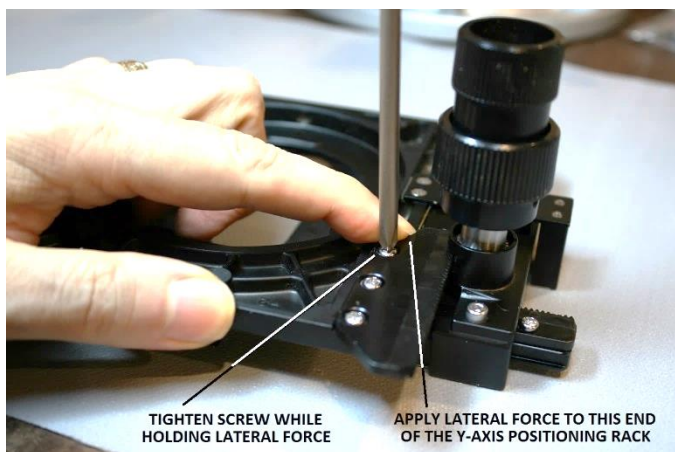


Figure 150 – Adjust front-most end of the Y-axis rack

With the sliding stage frame positioned such that the front-most end of the Y-axis positioning rack is meshed with the pinion gear, use one hand to hold the Y-axis positioning knob (to prevent it from turning) and grasp the stationary base with the other hand. Try to gently move the stationary base back and forth in the Y-axis direction (see [Figure 151](#)). There should be no discernable backlash (i.e., free play) in the stationary

base. If there is noticeable backlash, loosen the M3x6 screw on that end of the positioning rack and repeat the above procedure to eliminate the backlash.

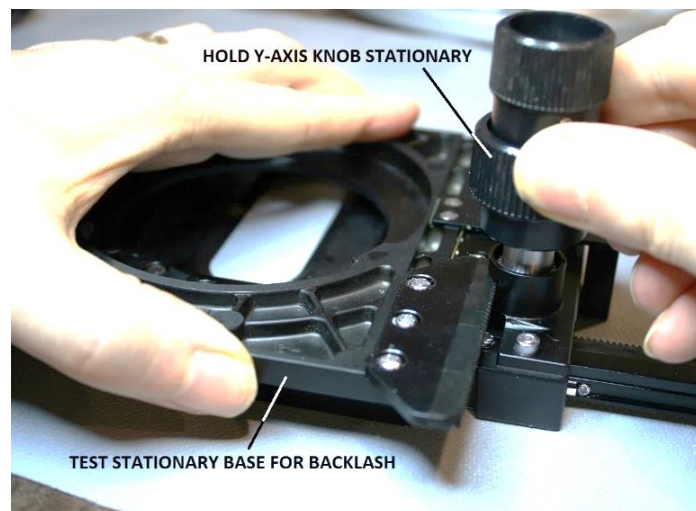


Figure 151 – Test mechanical backlash at front-most end

Turn the Y-axis positioning knob to position the sliding stage frame such that the rear-most end of the Y-axis positioning rack is meshed with the pinion gear. Use one hand to hold the Y-axis positioning knob (to prevent it from turning) and grasp the sliding stage frame with the other hand. Try to gently move the sliding stage frame back and forth in the Y-axis direction (see [Figure 152](#)). There should be no discernable backlash (i.e., free play) in the sliding stage frame. If there is noticeable backlash, loosen the M3x6 screw on the rear-most end of the positioning rack and repeat the above procedure to eliminate the backlash.

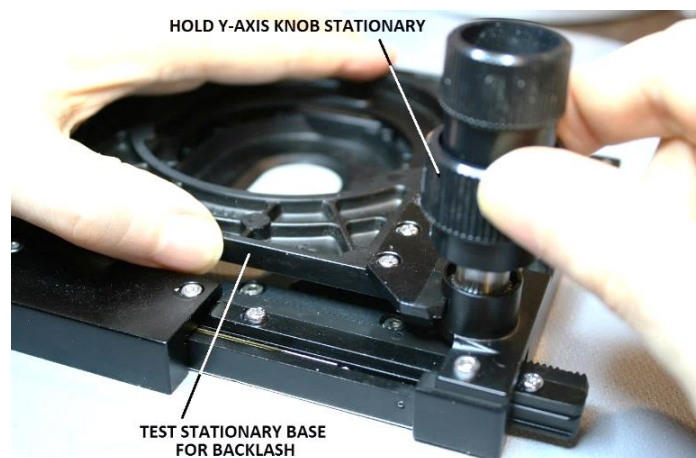


Figure 152 – Test mechanical backlash at rear-most end

Adjust the Tension of the Knobs

Adjust the X-Axis Knob Tension

Reinstall the BH2-SVR mechanical stage onto the stage-mounting dovetail of the substage condenser holder on

the microscope stand. Test the action of the X-axis positioning knob. If the action feels too loose or too tight, use a 0.9mm (.050") Allen wrench or driver to loosen the two M2.6x10 set screws securing the X-axis knob (see [Figure 153](#)).

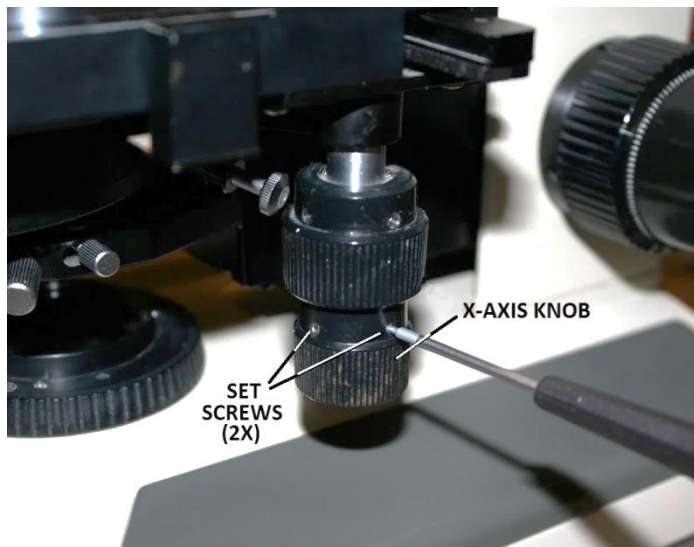


Figure 153 – Loosen set screws on the X-axis knob

If the action is too loose, hold the X-axis slide stationary with one hand and rotate the X-axis knob clockwise approximately ¼ turn (as seen from below the knob) with the other hand (see [Figure 154](#)). If the action is too tight, hold the X-axis slide stationary with one hand and rotate the X-axis knob counter-clockwise approximately ¼ turn (as seen from below the knob) with the other hand (see [Figure 154](#)).

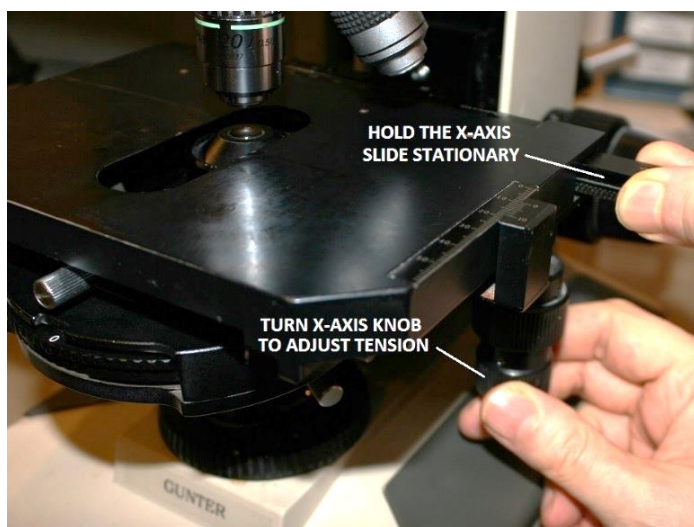


Figure 154 – Adjust the tension of the X-axis knob

Tighten the two M2.6x10 set screws to secure the X-axis knob in this position (see [Figure 153](#)). Re-test the feel of the X-axis positioning knob and repeat the above

adjustment steps as necessary until the desired feel is achieved.

[Adjust the Y-Axis Knob Tension](#)

Test the feel of the Y-axis positioning knob. If the action feels too loose or too tight, use a 0.9mm (.050") Allen wrench or driver to loosen the two M2.6x5 set screws securing the Y-axis knob (see [Figure 155](#)).

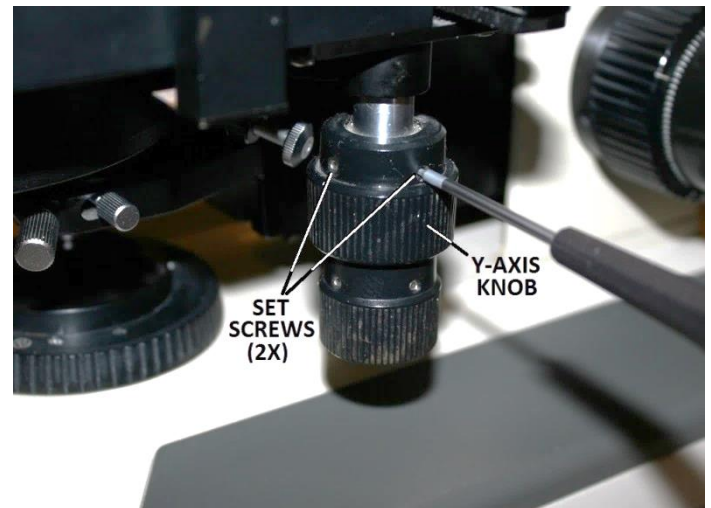


Figure 155 – Loosen set screws on the Y-axis knob

If the action is too loose, hold the sliding stage frame stationary with one hand and rotate the Y-axis knob clockwise approximately ¼ turn (as seen from above the knob) with the other hand (see [Figure 156](#)). If the action is too tight, hold the sliding stage frame stationary with one hand and rotate the Y-axis knob counter-clockwise approximately ¼ turn (as seen from above the knob) with the other hand (see [Figure 156](#)).

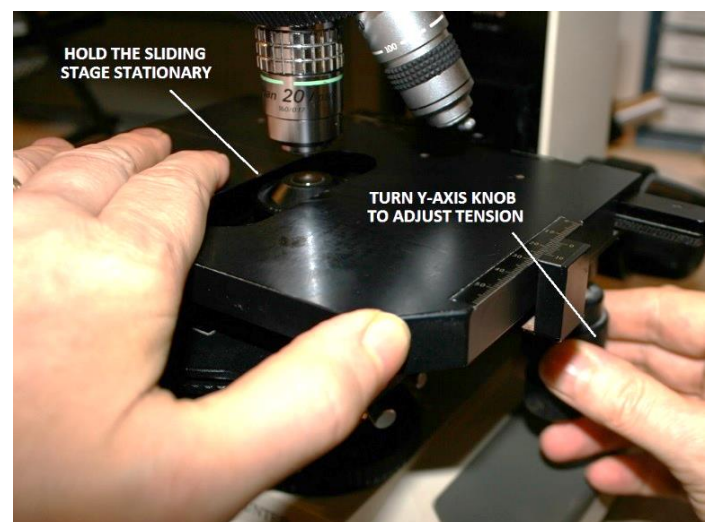


Figure 156 – Adjust the tension of the Y-axis knob

Tighten the two M2.6x5 set screws to secure the Y-axis knob in this position (see [Figure 155](#)). Re-test the feel of the Y-axis positioning knob and repeat the above

adjustment steps as necessary until the desired feel is achieved.

If Tension Cannot Be Made Loose Enough

If the action of one or both of the positioning knobs cannot be made loose enough to satisfy the operator's preference, check the following things.

Grease in the Coaxial Positioning Assembly

The grease used in the coaxial positioning assembly may be too heavy for the application. The only way to correct this condition is to disassemble the coaxial positioning assembly, clean out all of the existing grease, and reassemble with a lighter type of grease (or even with a light, synthetic machine oil).

Grease in the Mechanical Slides

The grease used in the mechanical slides may be too heavy for the application. The only way to correct this condition is to disassemble the mechanical slides, clean out all of the existing grease, and reassemble with a lighter type of grease (or even with a light, synthetic machine oil). Or better still, do not use any lubrication of any type in the X-axis and Y-axis mechanical slides (see earlier discussion regarding lubrication of the mechanical slides).

Positioning Racks Improperly Adjusted

Either one or both of the positioning racks may have been adjusted such that there is too much interference between the teeth of the positioning rack and the mating pinion gear. This condition can be corrected by readjusting the affected positioning racks per the procedures described in the *Adjust the X-Axis Positioning Rack* and *Adjust the Y-Axis Positioning Rack* sections of this document, as appropriate.

Ready for Return-to-Service

The BH2-SVR mechanical stage is now ready for service and may be reinstalled onto the circular stage-mounting dovetail of the microscope stand.

How to Contact the Author

Please feel free to direct any questions or comments regarding this document (or BH-2 microscopes in general) to the author, at the following email address: carlh6902@ieee.org

Original Olympus Documentation

A scanned PDF of the *Olympus Research Microscope Series BH2 (BHS) Repair Manual* is available for download at various microscope-related hobbyist sites

on the internet, and can be found by searching for the title in an internet search engine, such as Google.

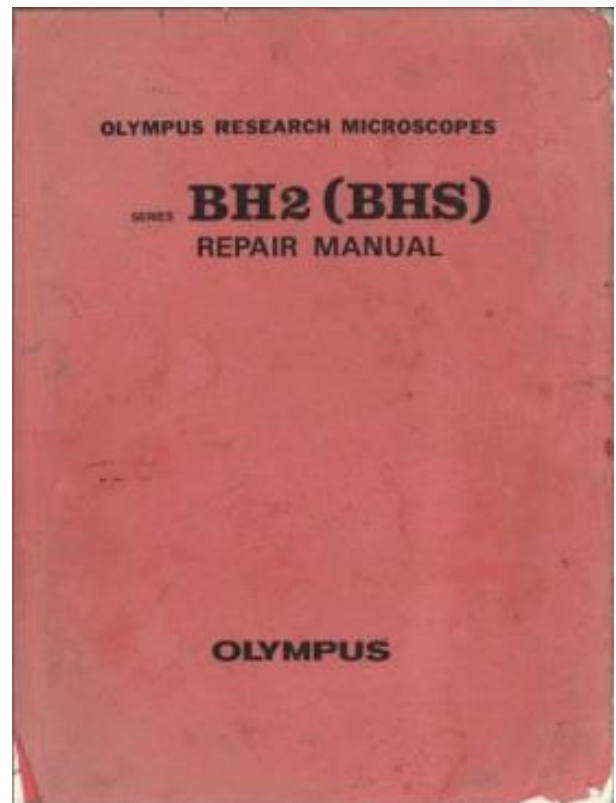


Figure 157 – Olympus BH2 (BHS) repair manual

Appendix 1 - Installing the Precision Guide Rails in the Slide Mechanisms

Description of the Slide Mechanisms

The X-axis and Y-axis slides in the BH2-SVR mechanical stage employ precision guide rails and bearing balls to allow the slides to move between the fixed guides with very little friction. The bearing balls on either side of the slides are supported at four equidistant points around their circumference by four precision guide rails, and it is the bearing balls rolling in these “tunnels” created by the four precision guide rails that allow the slides to move with very little friction.

Figure 158 shows an end (profile) view which is representative of the basic slide mechanism used in the BH2-SVR mechanical stage. The movable slide (in the center) is supported on both sides with bearing balls, which are in-turn supported on their outer sides by the left and right guides, which are fixed in position to the sliding stage frame. The bearing balls on both sides of the slide roll on the exposed faces of four precision guide rails (two in the slide and two in the guide), as shown in the image below. Note that the motion of the slide in this image would be into and out of the page.

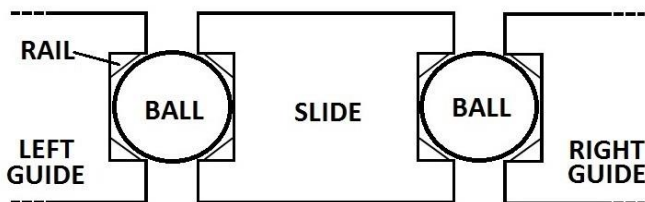


Figure 158 – Profile view of a typical slide mechanism

Placement of the Precision Guide Rails

During reassembly of the slide mechanisms in the BH2-SVR mechanical stage, the precision guide rails must be seated into the inside corners of the side grooves in the various components (i.e., slides or guides), as shown in the end profile view of **Figure 159**. This example view shows the X-axis slide with two precision guide rails installed into the inside corners of both of the side grooves.

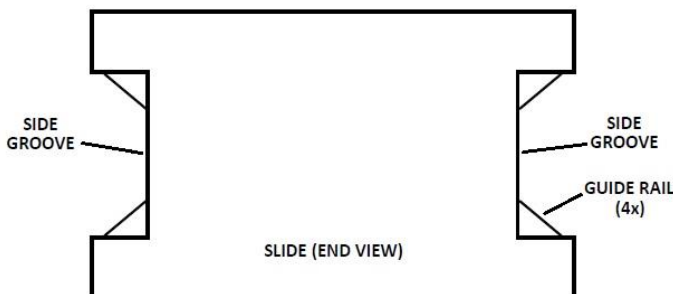


Figure 159 – Orientation of precision guide rails

Orientation of Precision Guide Rails in Side Grooves

Note that the precision guide rails are manufactured such that their cross-sectional profile forms a right-triangle, as can be seen in **Figure 159**. It is critical when installing these guide rails that they be placed such that the two sides which form the 90° angle are placed into the 90° inside corners of the side grooves, and that the side of the triangle that forms the hypotenuse is facing outwards, providing a suitable low-friction surface for the bearing balls to roll on.

Holding Precision Guide Rails in Place for Reassembly

During reassembly of the BH2-SVR mechanical stage, the precision guide rails will need to be held in place in the side grooves of the guides and slides (see **Figure 159**) until the slide mechanisms have been fully reassembled. The precision guide rails do not need to be permanently staked in place, since the bearing balls will hold the precision guide rails in place once the slide mechanisms have been reassembled (see **Figure 158**). Since the precision guide rails do not need to be permanently staked in place, do not use any adhesive of any kind on the precision guide rails, otherwise the adhesive could end up on the exposed bearing surfaces of the precision guide rails, thereby fouling the rolling tunnel for the bearing balls and preventing free motion of the slide.

Rather than utilizing adhesive to hold the precision guide rails in place, the precision guide rails can instead be held in place during reassembly by applying heavy grease to the ends of the slides and/or guides (in the inside corners of the side grooves) and then pressing the precision guide rails firmly into this grease as they are reinstalled into position (making sure to properly orient them per the profile view in **Figure 159**).

After the precision guide rails have been placed into position and pressed into the heavy grease, any remaining visible grease should be thoroughly removed before proceeding further with reassembly of the BH2-SVR mechanical stage. Refer to the detailed procedure on the following page for the suggested reassembly method for the precision guide rails. Note that this description shows one of the Y-axis guides as an example, but this same procedure should be used to reassemble the precision guide rails into all of the slide parts for the X-axis (i.e., the X-axis slide and X-axis guide) and for the Y-axis (i.e., the two Y-axis guides and the stationary base).

Clean the Old Grease from the Parts

Before beginning reinstallation of the precision guide rails into the guide, use a suitable solvent (e.g., acetone) to clean all traces of any oil or grease from the precision guide rails (see [Figure 160](#)) and from the side groove of the guide. Note that there are two small screws at the ends of the guide, and these may be temporarily removed to facilitate cleaning if desired.



Figure 160 – Remove all old grease from the parts

Apply Heavy Grease to the Ends of the Guide

After any oil or grease has been thoroughly removed from the various components, apply heavy grease, such as Dow Corning Molykote 111 (item 5 of [Appendix 2](#)), to the inside corners of both ends of the groove in the side of the guide (see [Figure 161](#)).

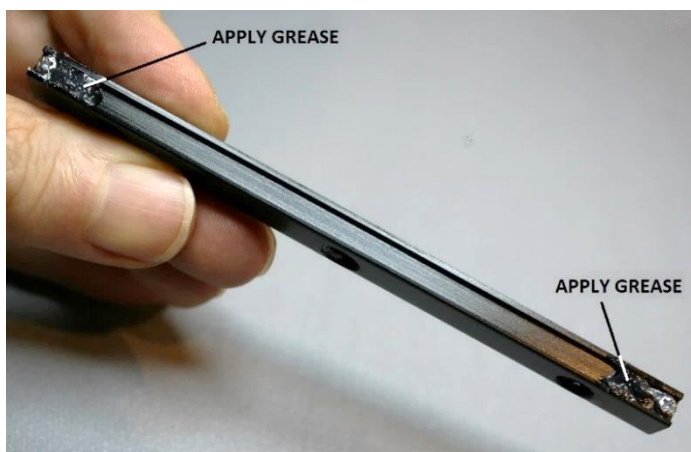


Figure 161 – Apply grease to the ends of the guide

Set the Precision Guide Rails into the Greased Guide

Place two of the appropriate precision guide rails into the inside corners of the side groove of the guide (being sure to properly orient the guide rails as shown in [Figure 159](#)) and press the precision guide rails down firmly at the ends to thoroughly embed them in the heavy grease (see [Figure 162](#)).

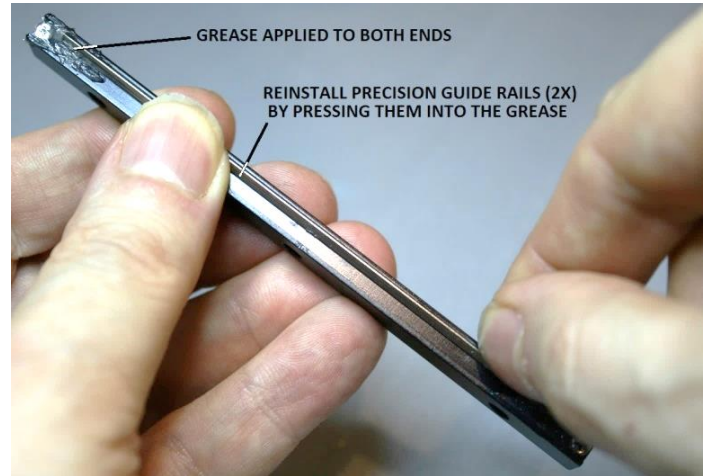


Figure 162 – Place guide rails into side groove of guide

Clean Remaining Grease after Reinstalling Guide Rails

After the precision guide rails have been set in place and pressed firmly into the grease, any visible traces of the grease should then be removed from the guide and from the precision guide rails. The best way to do this is to use dry cotton swabs to scrub the grease away. The fresh grease should easily come off with dry cotton swabs. Do not use any solvent here, as the solvent may run under the precision guide rails and foul the grease holding them in place. Carefully work from the inside out when cleaning with the cotton swabs, to avoid transferring the grease further onto the precision guide rails. Keep at this until all visible traces of grease have been scrubbed from the various parts. Thorough removal of this grease is important, since any exposed grease can lead to an accumulation of dust and debris which might eventually foul the slide mechanism.

The Prepared Guide is Now Ready to be Reinstalled

The prepared guide, with the precision guide rails installed in the side groove (and held in place by the heavy grease), is now ready to be reinstalled in the appropriate place on the BH2-SVR mechanical stage (see [Figure 163](#)).

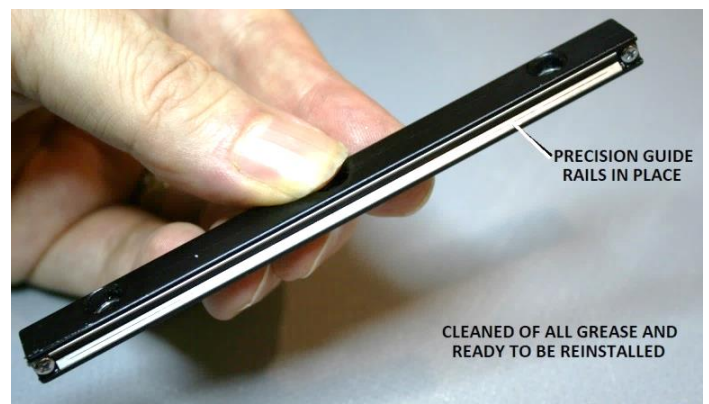


Figure 163 – The prepared guide ready to be reinstalled

Appendix 2 - Replacement Parts, Supplies, and Tools Referenced in this Document

Parts, Supplies, and Tools

Table 1, Table 2, and Table 3 list specific information for the various parts, supplies, and tools discussed in this document. These tables list only the items that may be difficult to source locally. The pricing and availability listed below is accurate as-of July 2017, but is subject to change without notice.

Item	Description	Manufacturer	Mfg. Part #	Vendor	Vendor #	Price
1	Bearing balls, stainless steel, 3mm	various	---	Amazon	---	\$5.25
2	Position rack, east-west, brass	J.C. Ritchey Co LLC	JC#130	J.C. Ritchey Co LLC	JC#130	\$80
3	Position rack, north-south, brass	J.C. Ritchey Co LLC	JC#131	J.C. Ritchey Co LLC	JC#131	\$80

Table 1 – Parts for servicing the BH2-SVR mechanical stage

Item	Description	Manufacturer	Mfg. Part #	Vendor	Vendor #	Price
4	Grease, Molykote® 44 (medium), 28g	Dow Corning	Molykote 44	Amazon	---	\$6.95
5	Grease, Molykote® 111, 150g	Dow Corning	Molykote 111	Amazon	---	\$17.87
6	Grease, Plastilube Brake (heavy), 35ml	ATE	700014	Amazon	---	\$8.40
7	Loctite® Blue, 0.2oz	Henkel	242	Amazon	---	\$5.42

Table 2 –Supplies for servicing the BH2-SVR mechanical stage

Item	Description	Manufacturer	Mfg. Part #	Vendor	Vendor #	Price
8	Allen driver, .9mm (.035")	Wiha	26309	Amazon	---	\$7.83
9	Allen driver, 1.3mm (.050")	Wiha	26313	Amazon	---	\$6.75
10	Allen driver, 2.5mm	Wiha	33437	Amazon	---	\$8.59
11	Heat Gun, electric, 1500W	Drill Master	---	Harbor Freight	96289	\$12.99
12	Screwdriver set, JIS, 4 pieces	Hozan	JIS-4	Amazon	---	\$19.66

Table 3 – Tools for servicing the BH2-SVR mechanical stage

Sources for Parts, Supplies, and Tools

Table 4 lists the contact information for the vendors referenced in Table 1, Table 2, and Table 3.

Vendor	URL	Telephone	Toll Free	email
Amazon	www.amazon.com	---	---	---
Harbor Freight Tools	www.harborfreight.com	---	1-800-423-2567	---
J.C. Ritchey Co. LLC	www.ritcheymicroscopeservice.com	740-862-9252	---	ritcheymicroscopeservice@hotmail.com

Table 4 – Vendor Listing