

WallyScope

Important Overview

PLEASE READ!!

Here are the main steps involved in the use of the WallyScope for measuring dynamic vertical tracking and stylus rake angles. These **VERY GENERALIZED** steps are detailed in the instructions to follow. Review them before commencing with the following instructions as they will help you form a general understanding of the entire process.

1. Prepare the tonearm and cartridge for analysis
2. Using low power lens, **PROPERLY** position the WallyScope relative to the cantilever
3. Switch to mid-power lens and re-confirm proper orientation of WallyScope
4. Take first measurement - angle of cantilever to stylus inside edge
 - a. *MUST apply 4-point angle in proper order*
5. Take second measurement - angle of cantilever to stylus outside edge.
 - a. *MUST apply 4-point angle in proper order*
6. For Shibata or Replikant stylus you will take only **ONE** measurement - angle of cantilever to stylus contact edge
7. Enter measurement(s) into WallyTools online calculator
8. Put WallyScope Trimmed Record on platter and prepare for second image with low-power lens
9. **S-L-O-W-L-Y** turn platter by hand and take images
10. Measure angle of cantilever to record surface
11. Enter angle into WallyTools online calculator to get dynamic stylus rake angle

THERE ARE MANY PITFALLS THAT WOULD CAUSE THE USER TO TAKE INACCURATE MEASUREMENTS IN THIS PROCESS. THIS IS WHY IT IS SO IMPORTANT TO READ THE FOLLOWING INSTRUCTIONS IN THEIR ENTIRETY AND FOLLOW THEM CAREFULLY.

IMPORTANT NOTE ON ADJUSTING SRA & VTA

In our video series of The 7 Alignment Targets for Vinyl Playback Optimization, we discuss the difference between and details of Stylus Rake Angle (SRA) and Vertical Tracking Angle (VTA). Please watch!

The common “wisdom” of adjusting your tonearm height for SRA/VTA states that as you raise the arm, the sound will become brighter and more bass lean. As you lower the arm, the bass will sound heavier.

THIS IS NOT WHAT CHANGING SRA AND VTA SOUNDS LIKE

What you are hearing when you raise and lower the tonearm are the sonic attributes of changing vector forces in the tonearm. Your tonearm will perform its best with a level armwand. Avoid getting more than 1° from this target (azimuth can go up to 2.5° depending upon stylus profile) and make any changes to SRA/VTA at the headshell using a corrective shim. Contact WAM Engineering for corrective shims or make your own shimming method, using the WallyReference Front/Back Blade to confirm the angle of the corrective shim in use.

Optimal VTA is 18° with the stylus under friction. This is what most cutterheads cut at after lacquer springback and vertical modulation pre-distortion are taken into account. Anywhere from 15° to 20° VTA on playback is excellent.

Optimal SRA is less certain as playback rake angle *HAS NEVER BEEN SCIENTIFICALLY STUDIED*. The only paper written on the subject was not detailed enough to be peer reviewed and their claim of 92° being the optimal angle did not articulate whether this is to be measured statically or dynamically. Given what we know of the rake angle most engineers cut at (typically between $\sim 85^{\circ}$ to 90°) plus the effect of lacquer springback, it is plausible that the optimal range for SRA is between 90° and 93° .

Until we perform a controlled study on SRA at WAM Engineering and release it for peer review, this is the best available information we know of. Further, it is highly likely that VTA is more important than SRA (watch for our videos on this) so we suggest if you have to err with one of the two parameters, err in favor of VTA.

If you can get within these two target ranges, you are optimizing your playback performance in these important parameters. Getting your cartridge's SRA and VTA to equal the effective cutting rake and vertical modulation angles used to cut the lacquers which made your record will result in greater sonic clarity, focus, transient speed, inner detail, soundstaging and imaging.

WALLYSCOPE v1.0 INSTRUCTIONS

Use the WallyScope to determine your cartridge's dynamic Stylus Rake Angle (SRA), Vertical Tracking Angle (VTA) and assess for even stylus wear and general condition of the stylus.

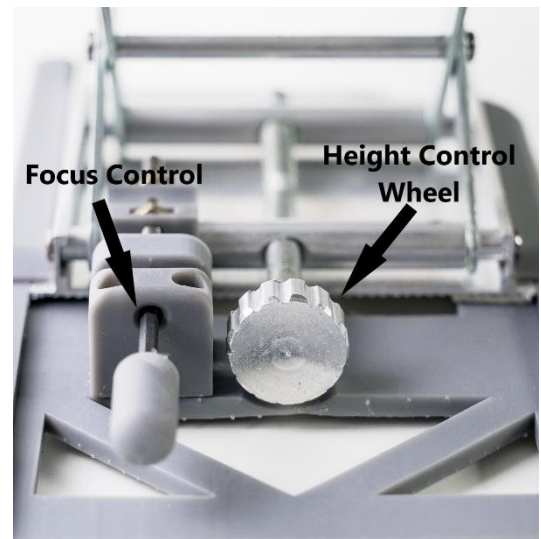
REQUIREMENTS

- PC or Mac to interface with camera
- Stable and rigid surface to support WallyScope
- WallyReference Dual Axis blade (optional, but highly suggested)



OTHER PARTS

1. USB thumb drive with camera software loaded
2. 3.0 USB cable
3. Micrometer Calibration Slide
4. WallyScope Trimmed Record
5. WallyScope carrying case



PLAN YOUR MEASUREMENTS

Measuring your cartridge's dynamic SRA & VTA is one of the first steps in the cartridge setup process. See our video titled "WallyTools Cartridge Setup Process - An Overview" on the WallyTools YouTube channel for detail. The process of measuring dynamic SRA & VTA involves two images of the stylus/cantilever assembly at different magnification levels. Having the cartridge mounted to the

tonearm is NOT necessary for the first image but is essential for the second image.

If there is not sufficient space for the WallyScope on your turntable stand and the turntable cannot be moved to a location where the WallyScope will have space to be positioned, the first image MUST be taken of the stylus/cantilever assembly with the cartridge removed from the headshell and laying upside down on a stable and level surface. The second image – which MUST be taken with the cartridge mounted to the tonearm – can be taken with a quality cell phone camera or other digital camera if the WallyScope cannot be placed into proper position for the image. This second image can then be processed and measured in the WallyScope camera software.

The rigidity of the table, shelving or surface you place the WallyScope on will have a direct impact on the quality of the images, particularly at higher magnification levels. Solid and heavy support is best. A level support is essential. Do not have the WallyScope sitting at an incline.

Go to the WallyScope Tutorial Video page on the wallyanalog.com website for more helpful information.

TONARM PREPARATION

Use the WallyReference Dual Axis blade to perfectly level the headshell with the surface of the record before proceeding with measurements. This allows you to have a confirmed REFERENCE from where you can always return the tonearm. It also gives you an absolute reference measurement for your cartridge which allows you to quickly and easily move the cartridge to other tonearms without having to re-measure with the WallyScope.

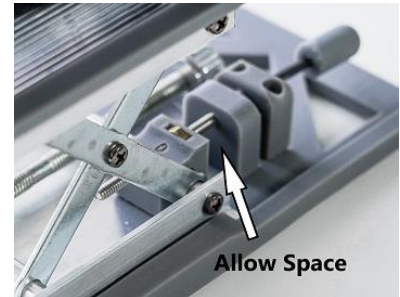
Knowing your cartridge's dynamic SRA & VTA at a level headshell allows you to make a quantifiable and substantiated claim with your dealer or manufacturer should it be required. In other words, unless you KNOW that your cartridge has been perfectly leveled before measuring your SRA & VTA, it is impossible to be certain that the measurement has not been influenced by an out-of-level headshell.

Do NOT trust the armwand to level the headshell. We have seen many instances of the headshell being out of parallel with the armwand. If your tonearm has a removable fingerlift, consider removing it now so it does not become an obstruction when positioning the lens.

As mentioned above, do not allow the headshell to go more than 1° off of level as it will introduce changes in vector forces that will impact sonic performance. If the angular correction needed for your cartridge is beyond 1°, WAM Engineering can make a custom shim for your cartridge that will allow your cartridge to achieve ideal SRA & VTA under playback conditions.

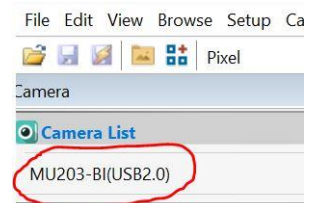
WALLYSCOPE SETUP AND ALIGNMENT INSTRUCTIONS

1. Wet clean your stylus, preferably with a short bristled brush
2. Install camera software for your PC or Mac from the USB thumb drive
3. Connect camera to your computer with the supplied USB 3.0 cable
4. Install cartridge either on the headshell (no need to worry about proper overhang and cantilever alignment) or place it upside down on a stable surface high enough for the WallyScope lens to reach it. A short stack of heavy hardcover books works fine for this purpose. If cartridge is mounted to headshell, place tonearm on armrest and keep it there for the first image.
 - a. **IMPORTANT:** if you are placing the cartridge upside down for observation, the on-screen image of the cartridge should be oriented so the cantilever will be on the left side of the image and the connection pins on the right. Do this with the “Flip” function outlined in Step 18.
5. Rotate the 2x magnification lens into position. This is the lens with the Aiming Mount affixed to it. You will feel a “click” when it is in position.
6. Keeping a respectful distance between the WallyScope and the cartridge, raise the height of the WallyScope by turning the Height Control Wheel so the lens is about at the same height as the cantilever.
7. Install Allen keys into the focus and left/right axis controls. When you start the imaging process, you want the ability to use these controls in both directions, so you should not start out at the far end of the excursion limits. Turn the Allen keys so that the extent of each of the controls is not at the excursion limits of the left/right or focus controls.
8. Install the Aiming Bar on the Aiming Mount
 - a. Rotate the Aiming Mount on the lens
 - b. Slide Aiming Bar onto the Aiming Mount
 - c. Rotate Aiming Bar back to vertical position

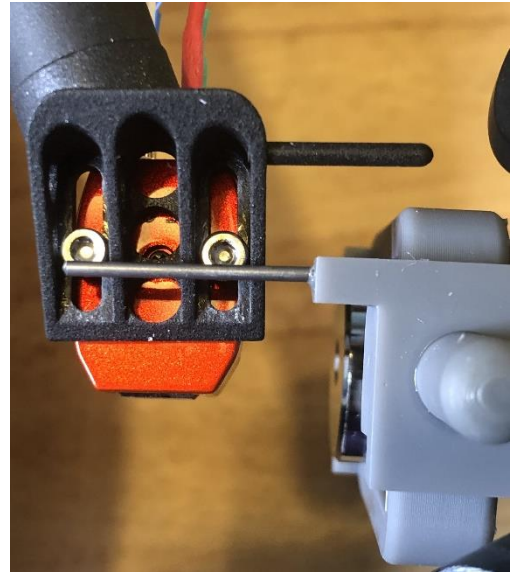
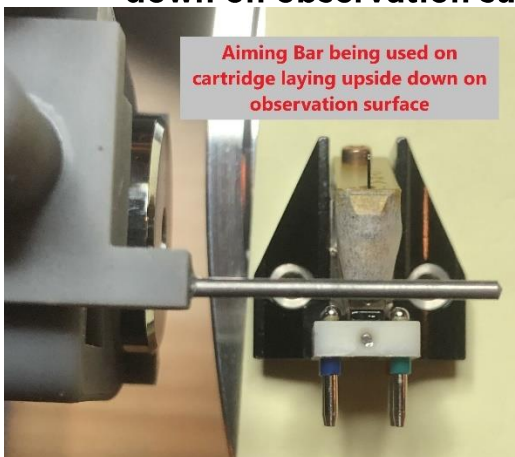


**VERY IMPORTANT:
AVOID THE AIMING
BAR FROM COMING
INTO CONTACT
WITH THE
CARTRIDGE,
FINGERLIFT OR
HEADSHELL AT ALL
TIMES**

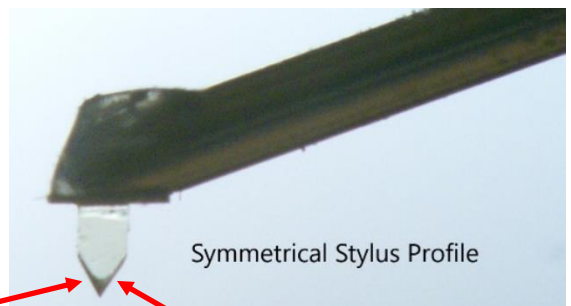
9. Start the software and select the camera model near the top left of the screen in the “Camera List”. A live image will appear on the screen.
10. Approaching with great caution, slide WallyScope into position with the cartridge until you can see a blurry image of the cartridge. Don’t worry about sliding WallyScope perfectly into position. Fine adjustments are made later.



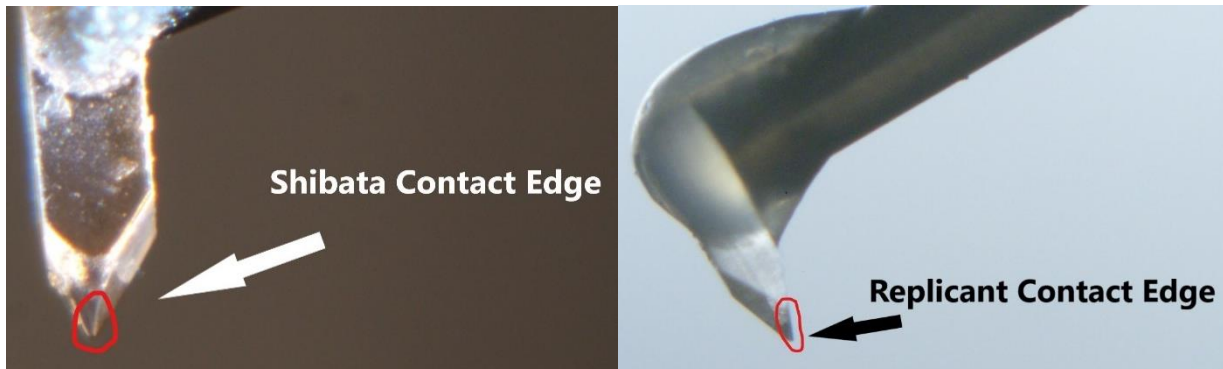
11. Adjust the Height Control Wheel as necessary to have the stylus/cantilever assembly roughly in the center of the screen. Do not worry about having stylus/cantilever in focus at this point.
12. If the cartridge is mounted to a tonearm, avoid the Aiming Bar from contacting the fingerlift or headshell.
 - a. In some cases where the cartridge is mounted to the tonearm, the Aiming Mount may come into contact with the fingerlift before the cartridge can come into focus. In this case, simply spin the Aiming Mount on the lens so it can be moved out of the way of the fingerlift.
13. To ensure the accuracy of your measurements it is important that the WallyScope be aligned such that the camera's perspective is perfectly perpendicular to the cantilever. Use Aiming Bar to roughly align with cartridge's headshell screws – do NOT align to the headshell.
 - a. Take care to view from directly above the Aiming Bar so that you can confirm it is aligned with the headshell screws (if cartridge is mounted to tonearm) or screw holes (if cartridge is laying upside down on observation surface).



14. With everything now aligned, remove the Aiming Bar to ensure the safety of your cartridge. At this point, the cartridge should NOT be touched or moved until the first set of images have been taken.
15. Finalize the alignment and focus of the WallyScope using the fine focus, left/right control and Height Control Wheel. The stylus/cantilever assembly should be in the center of the screen.
16. Spin the lens carousel to use the 4x lens (red stripe). You will feel a “click” when it is in position. As you spin the carousel, watch that the Aiming Mount does not come into contact with the fingerlift. If necessary, spin the Aiming Mount on the lens so it does not contact the fingerlift.
17. Re-adjust the focus (you will have to back AWAY from the cantilever – clockwise turn), Height Control Wheel and left/right control as necessary to get the stylus/cantilever back into focus and filling the screen as much as possible. If your stylus has a symmetrical profile (e.g., micro-ridge, line contact, hyper elliptical, elliptical, etc.) concentrate the focus on the stylus’s “inside” and “outside” edges.



- a. If you have a Shibata or Replikant stylus design, concentrate the focus on the groove contact edge of the stylus. If you have a Shibata stylus, you may have to use the 10x (yellow stripe) lens in order to get the contact edge into view. More information for Shibata measurements below.



18. The image of the stylus/cantilever assembly should have the stylus in the bottom left of the screen with the cantilever running to the right out of the frame. This orientation is important for the measurement process to come. If necessary, use the “Flip” function from the “Camera” menu bar tab on the left of the screen to achieve this perspective. See photo above of the “Symmetrical Stylus Profile” for an example of this orientation.



- a. **VERY IMPORTANT:** If the cantilever is in focus on the end closest to the stylus but out of focus on the right side of the frame, then either you have not done well with your Aiming Bar or the cantilever is not perpendicular to the cartridge body (this is a common occurrence). It is crucial to the accuracy of this image to fix this situation. If the left AND right top (or bottom) edges of cantilever are not equally in focus, the WallyScope needs to be rotated so that it is perfectly perpendicular to the cantilever.
- b. Use focus to get the left-most side of cantilever perfectly in focus.
- c. Next, using the focus control, determine whether backing away or moving toward the cartridge improves the focus of the right-most side of the cantilever.
- d. If the right side of the cantilever comes into focus when you BACK AWAY from the cartridge using the fine focus (clockwise rotation of the focus control), the entire WallyScope will have to be revolved in a clockwise direction; i.e., when looking straight down on the WallyScope from above, slightly twist the WallyScope clockwise.
- e. Conversely, if the right side of the cantilever comes into focus when you move the lens CLOSER to the cartridge, the WallyScope should be revolved counter-clockwise.
- f. Take your time to get this step done well.

ILLUMINATION AND EXPOSURE

1. The WallyScope camera is very sensitive to ambient lighting. Normal room lighting will often be enough to provide an excellent image from which measurements can be made without the use of spot lighting. In some cases – in particular at 10x magnification – extra illumination will be necessary and spot lighting, such as gooseneck lamps or flashlights, can be employed. However, it is very important to avoid overexposure of the stylus or cantilever as this will distort the image and cause inaccurate measurements to be taken. An overexposure will look like a “hot” or very bright reflective area of the stylus or cantilever. If you have this situation, decrease and/or re-orient the lighting on the cartridge.
2. Feel free to experiment with the “Exposure and Gain” function on the menu bar. In most cases, we find it unnecessary to use but occasionally it can be useful to improve the image.
3. Changing the background color with a sheet of white or colored paper or other colored object will often increase contrast and improve image detail. Experimentation can be helpful, especially at higher magnification.
4. Shibata contact edges can be particularly challenging to illuminate properly. We find best results using spot lighting (and usually the 10x lens) with the spot lighting aiming at the leading edge of the stylus (the part that leads when playing in the groove). When the lighting is right, the contact edge will suddenly “pop” as it reflects light back at the lens. Be careful not to overexpose this contact edge with too much lighting. It should be a gentle illumination, not a “white-hot” glow. See example above at step 17a.

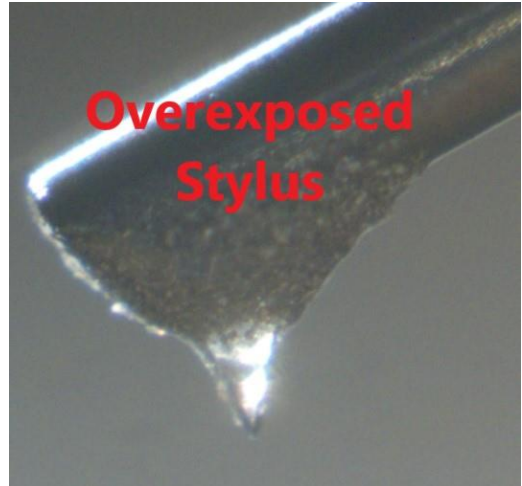
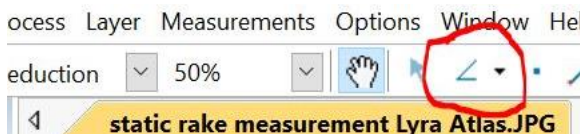
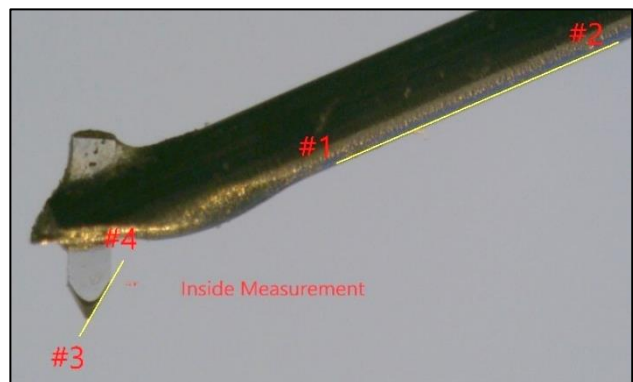


IMAGE 1 of 2 - TAKING MEASUREMENTS

1. For Shibata or Replikant stylus profiles, skip this section.
2. With your stylus/cantilever assembly now in the proper orientation on the screen, exposure optimized and focus concentrating on the stylus “inside” and “outside” edges, take your first image by clicking the “Snap” button. You will now notice that a second tab has appeared at the top. The first tab is the live image from the WallyScope and the second tab is your photograph. Click the new photograph tab.



3. Using the 4 Point Angle function, set point #1 at the left side of the cantilever and point #2 at the right side of the cantilever. Point #3 snap starts near the base of the stylus tip and #4 ends at the top of the inside



edge of the stylus. This is the "Inside Measurement". Don't worry about perfect placement of the lines. They will be fixed later.

4. Lay down your second 4 Point Angle. Again, start point #1 at the left end of the cantilever and set point #2 at the far right of the cantilever. Set point #3 near the tip of the stylus and point #4 at the top of the outer edge of the stylus. This is your "Outside Measurement".

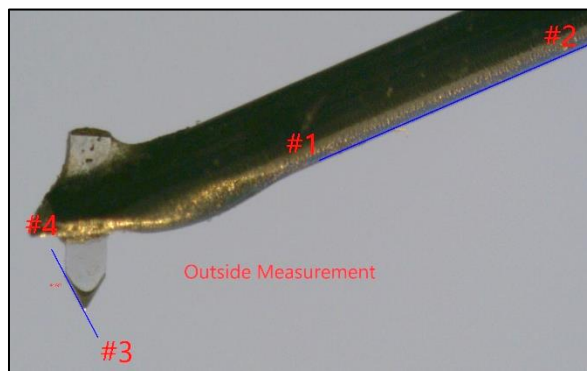
5. Click on the "handling tool" and do your



best to adjust the lines you've

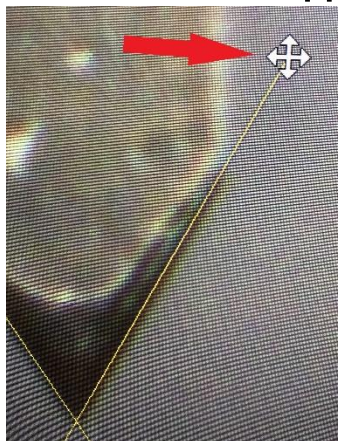
just laid down for maximum accuracy. When you hover over the very ends of each line the "white

cross" should appear that allows you to click and move the drop point.



6. For greater detail, digitally zoom into the image by holding down the "Ctrl" button and spinning your mouse wheel. Alternatively, you can use the Zoom function at the top menu.

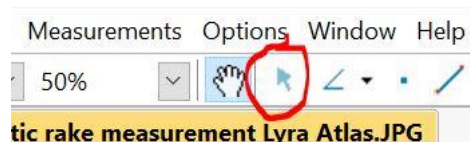
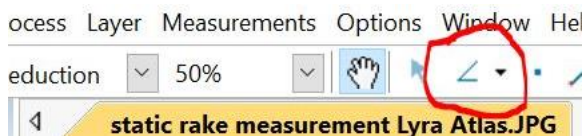
7. You now have your first two measurements to enter into the "Contact Edge To Cantilever Angle" WallyScope Calculator (<https://www.wallyanalog.com/wallyscope-calculator>) found two-thirds down the website page.



Contact Edge To Cantilever Angle	
Inside Angle	40 degrees
Outside Angle	95 degrees
Contact Edge To Cantilever Angle	
67.50 degrees	

SHIBATA/REPLIKANT MEASUREMENT

1. *Skip this section if you have a symmetrical stylus profile.*
2. With your stylus/cantilever assembly now in the proper orientation on the screen, exposure optimized and focus concentrating on the groove contact edge of the stylus, take your first image by clicking the "Snap" button. You will now notice that a second tab has appeared at the top. The first tab is the live image from the WallyScope and the second tab is your photograph. Click the new photograph tab.
3. Use the 4 Point Angle tool to measure the relationship between the contact edge and the cantilever. Place point #1 at the left end of the cantilever and point #2 at right end of the cantilever. Point #3 at the bottom of the contact edge and point #4 at the top of the contact edge.
4. Click on the "handling tool" and do your best to adjust the lines you've just laid down for maximum accuracy. When hovering over the

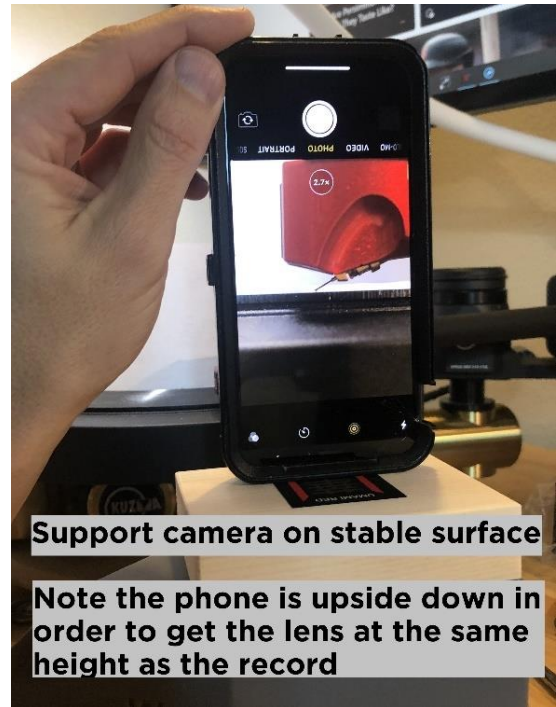


very ends of each line a “white cross” appears that allows you to click and move the drop point. Photo example above.

5. For greater detail, digitally zoom into the image by holding down the “Ctrl” button and spinning your mouse wheel. Alternatively, you can use the Zoom function at the top menu. (Photo above)
6. Enter this angle as the first data point in the WallyScope Calculator (<https://www.wallyanalog.com/wallyscope-calculator>) in the “Contact Edge to Cantilever Angle” field at the bottom of the page.

IMAGE 2 of 2 – MEASURING DYNAMIC CANTILEVER ANGLE

1. Cartridge must be mounted to the headshell for this step. **CONFIRM** proper vertical tracking force is set. Proper overhang/cantilever alignment is not important.
2. **IMPORTANT:** *If WallyScope cannot be put into position near the turntable, use a digital camera or a quality cell phone camera for this image and follow this step #2. Otherwise, if you CAN position the WallyScope for the image, skip this step #2.*
 - a. *Clean lens and stabilize the camera/cell phone on something rigid*
 - b. *Camera/phone lens MUST be at same height as stylus/cantilever assembly. Do NOT aim downward or upward at it to get the shot. You may need to hold your cell phone upside down to be at the proper height. The photo can be rotated in the WallyScope software to its upright orientation.*
 - i. *The lens is at the right height when you cannot see the surface of the record, but if you raise the camera/phone by about 2-4mm you can begin to see it. If you have to raise the lens more than that to see the surface of the record, the camera is too low.*
 - c. *Take caution to have the image from a perspective that is perpendicular to the cantilever.*
 - i. *Consider taping a 3 to 4 inch cut piece of a drinking straw to the top of the headshell that is butted up to the cartridge screws (as explained in the WallyTools Webinar on Measuring Dynamic SRA on the WallyTools YouTube channel). **ADJUST VTF TO COMPENSATE FOR THE ADDED MASS.** Use this straw as an aiming bar that should be perpendicular to the back surface of the cell phone.*

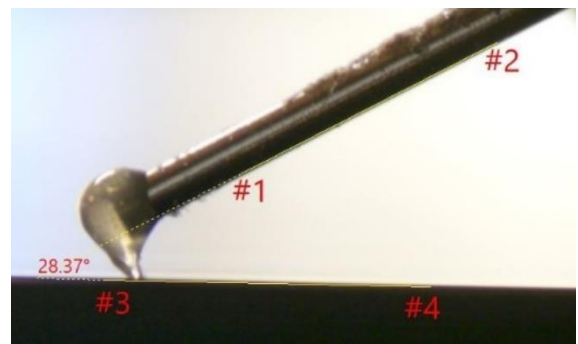


- d. *If you cannot maintain focus on the cantilever, try eliminating background detail by placing a strip of paper taped into a circle and placed on the record.*
- e. *Images taken by camera/phone should be loaded to the computer with the WallyScope software (easiest may be to email the photo to yourself from the phone and open email browser on computer). Find the photo files in the WallyScope software using the "File/Open Image" top menu function. Opening the file will cause a new tab to be created in the software for each photo which will then allow measurements to be taken on the photos.*



f. *Skip to step 5*

3. Use lowest power 2x lens.
4. Confirm proper WallyScope alignment by reinstalling the Aiming Bar. Remove Aiming Bar once done.
5. Place the WallyScope Trimmed Record - labeled side up - on the platter.
6. Lower stylus to the very edge of the Trimmed Record.
7. Confirm orientation of stylus/cantilever assembly has stylus on left and pointing downward and cantilever extending rightward in the frame. If not, make the change using the left menu "Flip" function.
8. Bring the cantilever into focus. Because the stylus is at the very edge of the Trimmed Record, the record edge should fall mostly into focus as well. If both are not in focus, move stylus closer to the edge of the Trimmed Record.
9. S-L-O-W-L-Y hand-spin the platter and press the "Snap" button while it is moving. Go to the new tab just created for this photo.
10. **NOTE:** If the cantilever was in focus during the setup but the photo turned out too blurry to lay down good measurement lines, the exposure time may be too long. Less than 150ms should be a short enough exposure time to get reasonably sharp edges along which measurement lines can be laid. On the "Exposure & Gain" section on the left-hand menu, try a combination of decreasing exposure time, increasing or changing the direction of your illumination on the cantilever and/or increasing the Gain setting. Getting these three elements right will significantly help improve the image.
11. Take 3-5 photos in the same manner. The cantilever responds to changes in drag causing the cantilever angle to change very slightly. An average measurement from multiple photos will ensure accuracy.
12. Using the 4 Point Angle tool, set point #1 at left end of cantilever, point #2 at right end of cantilever, point #3 at the record level near the stylus and point #4 further to the right on the record surface.



13. Use the "handling tool" to adjust the lines as necessary. Zoom in on the image if necessary. Enter this Dynamic Cantilever Angle into the WallyScope Calculator (<https://www.wallyanalog.com/wallyscope-calculator>)
14. With the Dynamic Cantilever Angle and the Contact Edge to Cantilever Angle now entered, your dynamic SRA is revealed by the calculator.

Dynamic Stylus Rake Angle

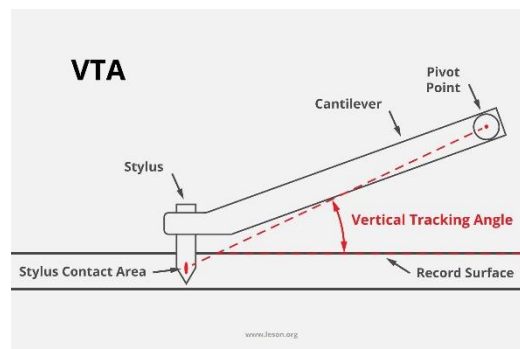
Dynamic Cantilever Angle
 degrees

Contact Edge To Cantilever Angle (from above calculator)
 degrees

Dynamic SRA
91.00 degrees

WHAT TO DO NOW?

1. **STYLUS TIP COMPENSATION:** A true VTA measurement is made by determining the angular relationship between the surface of the record and a line drawn between the stylus tip and the cantilever pivot, **NOT** between cantilever and record surface as you are instructed to do above. The process for determining the line between stylus tip and cantilever pivot is beyond the purview of these instructions as it is a complex process. However, we can use an adjustment factor to compensate for this difference. Because the stylus tip is not on the centerline of the cantilever, when measuring the cantilever angle as you have already done, you should add an adjustment factor based upon your cantilever type. Find your cantilever type below and add the adjustment factor to your cantilever angle measurement. The result is your dynamic VTA.



Cantilever Type	Adjustment Factor
Aluminum (with Bend near Tip)	0.5°
Aluminum (straight)	1.2°
Boron (Japanese made)	1.7°
Boron (Swiss made)	2.3°
Ruby/Diamond/Sapphire/Zirconium	1.7°
Diamond (integral stylus/cantilever)	3.5°

2. **THE GOAL:** Both SRA and VTA should be in their respective target ranges
 - a. Dynamic SRA - 90° to 93° with 92° ideal
 - b. Dynamic VTA - 15° to 20° with 18° ideal
3. **THE COMPROMISE:** As mentioned above, if both parameters cannot be in the targeted ranges, err towards benefiting VTA, but do not go less than ~89° on SRA. Many cartridge bodies will come into contact with the record before EITHER targeted range can be achieved. In most cases, this will not merit a warranty claim with the manufacturer unless they have specifically identified one or both parameters within their product specifications.
4. Adjust tonearm no more than 1° by changing the height of the tonearm. Do NOT allow the arm to travel more than 1° from level as it will introduce changes in tonearm vector forces. Additional angular correction should be done with a corrective shim, available from WAM Engineering. Alternatively, you could fashion one of your own from materials at hand (use VERY rigid materials only such as ceramics, rigid polymers or metals) and use the

WallyReference Front/Back Blade to confirm the angular impact of your corrective shim.

- a. See appendix table for relationship between height changes required to achieve a 1° angular change given various tonearm lengths.

5. With the exception of tangential trackers, “S” or “J” shaped armwands and tonearms with an offset yoke (i.e., horizontal bearing is at an angle to the armwand), changing tonearm height will change azimuth angle. For your interest, use the SRA Change Impact to Azimuth Calculator on the WallyTools website for more information. Never use visual means to find ideal azimuth angle. Ideal azimuth angle can only be determined via electrical measurement of crosstalk.



BEST PRACTICES AND OTHER ITEMS

1. Take 3-4 photos of each of the two image perspectives in order to compare and average the results from each to ensure consistency and accuracy. Make changes to background color, illumination or fine focus between each photo.
2. The 10x lens is available for very close up images. Because the 10x lens is much longer than the 4x lens, it is best to align subject in frame using 4x and then increase distance of the 4x lens from the cartridge using the focus control to make room for the 10x lens to rotate in place without coming into contact with the cartridge. Large-bodied cartridges may not allow 10x lens close enough to get stylus into focus.
3. 10x lens can be used to view the stylus head-on to assess for even stylus wear
4. The micrometer calibration slide is included for your interest in the event you wish to measure dimensions at the micron level. Follow the Amscope Help document, section 15.2 for the calibration process.
5. It is possible to perform dynamic SRA measurements using a single image. To do this use the 4x lens to image the stylus with cartridge mounted to tonearm and stylus on the trimmed record. Instead of measuring the relationship between the stylus and the cantilever and the cantilever and the record, you will measure the relationship between the stylus and the Trimmed Record. This process is recommended for experienced users only and should not be done with Shibata styli. Follow the same steps for laying the measurement lines as noted above but points #1 and #2 should be on the Trimmed Record instead of the cantilever with #1 on the left and #2 to the right. You can use the “Contact Edge to Cantilever Angle” calculator for your final results since the Trimmed Record replaces the cantilever angle in this measurement.

ENJOY ANALOG FOREVER!!!

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APPENDIX

Change in Tonearm Height = 1° Change in SRA & VTA

Tonearm Effective Length	Tonearm Height Change = 1° SRA & VTA Change
220	4.2mm
230	4.4mm
240	4.5mm
250	4.7mm
260	4.9mm
270	5.0mm
280	5.2mm
290	5.3mm
300	5.5mm
310	5.7mm
320	5.8mm
330	6.0mm
340	6.2mm
350	6.3mm