

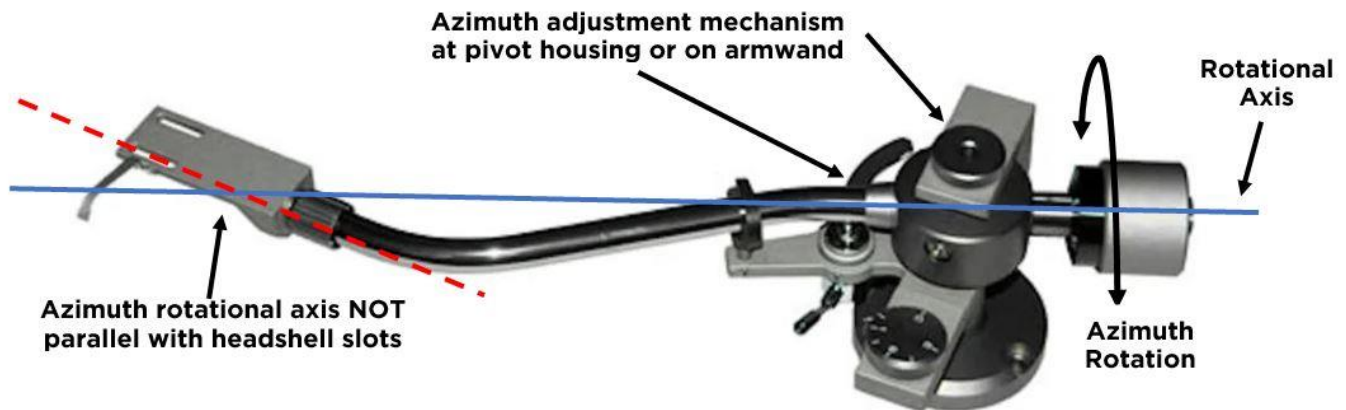
WALLYREFERENCE

TRUE AZIMUTH TONEARM INSTRUCTIONS

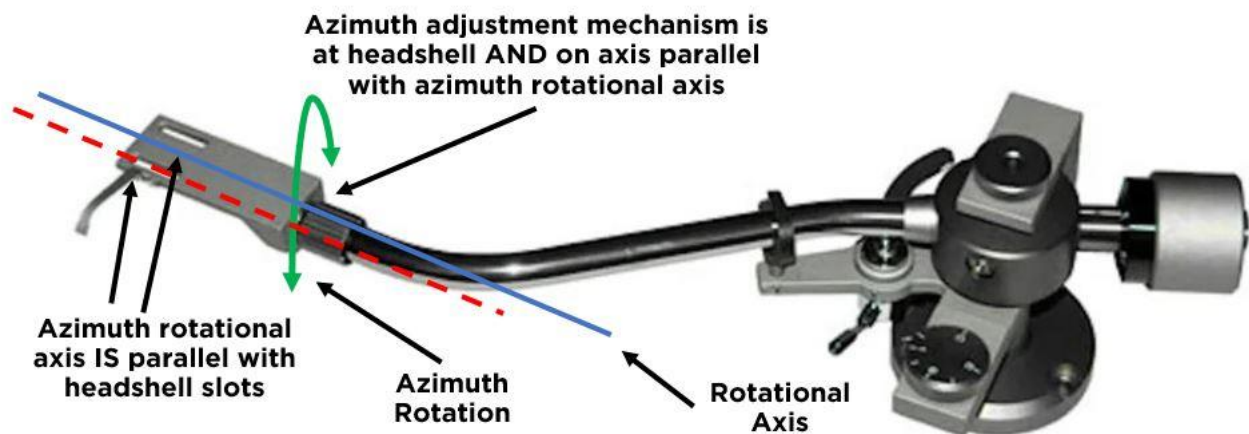
FOR TONEARMS WITH AZIMUTH ADJUSTMENT MECHANISM AT THE HEADSHELL OR NO AZIMUTH ADJUSTMENT AT ALL

IDENTIFYING INDIRECT AZIMUTH VS. TRUE AZIMUTH TONEARMS

Indirect azimuth (Type I) tonearms adjust azimuth on a rotational axis that is **NOT** parallel to the horizontal alignment of the cantilever or headshell slots.



By contrast, true azimuth (Type II) tonearms have the azimuth rotational axis parallel with headshell slots

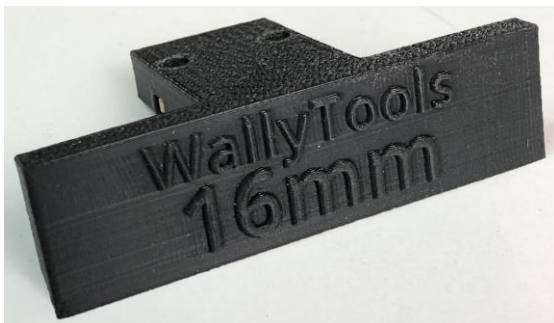




DUAL AXIS BLADE provides confirmation that the headshell is perfectly parallel to the surface of the record. This is an essential starting point – a Reference – to ensure the accuracy and repeatability of your cartridge's ideal SRA and azimuth settings. It is vital to confirm both axes are level *simultaneously* since changing one axis angle will invariably change the other axis angle as well. In other words, you don't truly know whether one axis is level unless you know BOTH are level to the surface of the record.



FRONT/BACK (SRA) BLADE: Once the Stylus Rake Angle (SRA) has been microscopically determined, the front/back blade allows the user to set and measure the tonearm angle for ideal SRA without influence of the left/right (azimuth) angle.



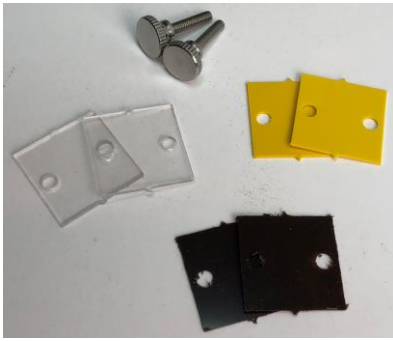
LEFT/RIGHT (azimuth) BLADE: Following the raising or lowering of the tonearm to achieve ideal SRA, this blade allows a re-leveling of the headshell on the left/right axis without influence of the front/back axis. It also allows measurement of the azimuth angle once azimuth has been determined electrically.

SHIM GAUGES

The shim gauges are used to measure the angle off of level for the front/back and left/right blades up to 1° with a resolution of as little as 0.125°

IMPORTANT: Always keep Shim Gauges flat and free of bends, dimples or damage.





SHIMS AND HEADSHELL SCREWS

Shims are essential for keeping the height of the WallyReference at the same as your cartridge when under nominal vertical tracking force (VTF) load.

Clear shim = 1mm

Yellow shim = 0.5mm

Brown shim = 0.25mm



25mm RULER

The 25mm ruler is used to measure the height of the cartridge when under nominal VTF load and to measure front/back blade and left/right blade angles greater than 1°



BLADE LIFT

When the tonearm height is raised such that the back of the front/back (SRA) blade comes off the surface of the record by more than 1° , it is not possible to fit the 25mm ruler under the headshell to take the measurement. The Blade Lift allows you to measure the blade tilt from the corner of the front/back blade that is furthest away from the pivot point.

These WallyReference instructions will help you to:

- **Confirm your tonearm's headshell is perfectly parallel to the record surface. (Page 5)**
 - If your cartridge was built to perfection, this alone would be enough to ensure your cartridge will play at its ideal Stylus Rake Angle (SRA) and azimuth. Unfortunately, this is almost never the case. Microscopy and electrical measurements are absolutely necessary for optimizing the performance of your cartridge.
- **Following microscopic inspection of your stylus and having determined your cartridge's *native* SRA, use WallyReference to find your cartridge's *IDEAL* SRA (Page 6)**
 - "Native" SRA is the stylus rake angle of your cartridge when the top surface of cartridge is perfectly level to the record, nominal VTF is applied, a photograph taken on an axis perfectly perpendicular to the horizontal alignment of the cantilever and proper geometric measurements taken.
- **Use WallyReference to re-level the left/right axis (azimuth) following adjustment of tonearm height to accommodate your cartridge's ideal SRA (page 8)**
 - Changes in tonearm height impact azimuth and must be compensated for
- **Following electronic measuring for ideal azimuth, use WallyReference to find the left/right headshell tilt (Page 8)**
 - This process offers a way to avoid ever measuring azimuth again for the cartridge regardless of how often it is moved to other tonearms
- **Quickly and easily move your cartridge to other tonearms with the same ideal SRA and azimuth angles (Page 9)**

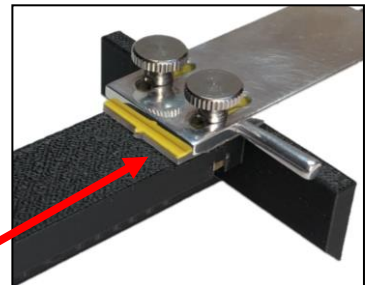


IMPORTANT NOTE FOR SOME UNIPIVOT TONEARM USERS

A solution for measuring azimuth angles on "rolling" unipivot tonearms is currently under development. "Rolling" unipivots (as opposed to unipivots designed with a rigid stabilizing mechanism) allow the pivot housing to rock atop the unipivot in a clockwise/counterclockwise manner along the axis of the armwand. Until the solution is available, current WallyReference owners can measure azimuth angles ONLY on fixed bearing tonearms or unipivots with a rigid stabilizing mechanism.

LEVELING THE HEADSHELL

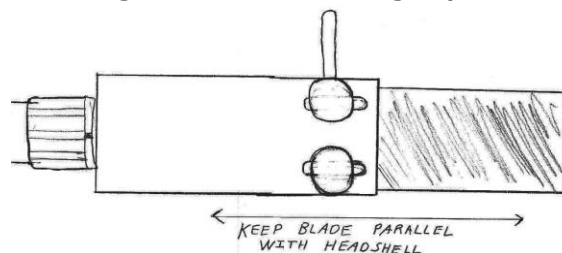
- 1) Install your cartridge in the middle of the headshell slots (proper alignment is not necessary). It is not necessary to connect the tonearm clips to the cartridge.
- 2) Set the vertical tracking force (VTF) at the mid-level of the cartridge manufacturer's recommended range or at your preferred VTF.
- 3) Place a warp-free record from your collection that is about average thickness on the platter. Install record clamp and engage vacuum hold down system, if applicable. Ensure the tonearm clips are not touching the record when the stylus is lowered to the record surface.
- 4) Use the WallyReference 25mm ruler and a magnifying glass to measure the height of the cartridge.
 - a) Measure from record surface to top of cartridge (bottom of the headshell) by placing the ruler as close as possible to, but avoid touching, the headshell or cartridge. Note the measurement to nearest 0.25mm.
 - b) Repeat this process on opposite side of the headshell. If the two readings are different, take average of the two. That is your cartridge height. Write this cartridge height figure to the nearest 0.25mm in the table at the end of these instructions.
- 5) Remove the cartridge and install the Dual Axis WallyReference using enough shims between the WallyReference and headshell to match the exact height of the cartridge. For example, if the height of the cartridge measures 18.75mm, use the WallyReference (16mm height), two clear shims (1mm each), one yellow shim (0.5mm) and one brown shim (0.25mm) to equal the total of 18.75mm in height.
 - a) Align the central body of the WallyReference to be parallel with the headshell, i.e., not skewed in the headshell.
- 6) Lower WallyReference onto record.
 - a) If your cartridge is heavier than the WallyReference, increase tracking force or add weight on top of it so it can lower to record.
- 7) With your eye at record level, view the Dual Axis WallyReference blade where it meets the record surface. Adjust tonearm height and azimuth so the Dual Axis blade's bottom edge is touching the record along its full length on both axes.
 - a) **Because of the tonearm's offset angle, an adjustment to the tonearm height will cause a change to azimuth angle.** You may have to adjust tonearm height and azimuth a couple times to get them both level.
- 8) The leveling process is complete. Remove the WallyReference gauge and install and align the cartridge using the WallyTractor. You can now be assured that the cartridge is perfectly level to the record surface on both axes.



- 9) You can stop here and ***hope*** that your cartridge was assembled at the factory to perfection. As explained above, this is EXCEEDINGLY rare regardless of the price of the cartridge. To ENSURE optimal performance from your turntable:
 - a) Use the WallySRA or other microscopic analysis process to **be certain** of your cartridge's "native" SRA and then use the ***Ideal SRA Calculator*** on wallyanalog.com to calculate the angle off of perfectly level to achieve your ideal stylus rake angle
 - b) Use WallyAzimuth or other electronic measurement process to **be certain** of your cartridge's ideal azimuth, measure tilt angle with WallyReference so as to make quick and easy work when re-mounting this cartridge to any tonearm (instructions for this below).

ADJUSTING HEADSHELL ANGLE FOR IDEAL STYLUS RAKE ANGLE

- 1) Install the front/back (SRA) WallyReference blade. Use enough shims between WallyReference and headshell to match the exact height of the cartridge (see step 5 above for example).
- 2) Align the central body of the WallyReference to be parallel with the headshell, i.e., not skewed in the headshell. Tighten screws.
- 3) Lower WallyReference onto record.
 - a) If your cartridge is much heavier than the WallyReference you may have to adjust the tracking force or add weights to allow the WallyReference to lower onto record.
- 4) Go to the "Ideal SRA Calculator" on the WallyTools website (<https://www.wallyanalog.com/ideal-sra-calculator>) and enter your cartridge's native SRA as determined by microscopic analysis (best to use WallySRA) and its compliance range. Document the results in the table at the end of these instructions in the *Ideal Front/Back Blade Angle* column.
- 5) Change the height of the tonearm to achieve the *Ideal Front/Back Blade Angle* from previous step. When starting this adjustment with the front/back blade level to the record surface, a negative number requires the tonearm to be lowered in height which will cause the front corner of the blade (point furthest away from the tonearm's pivot point) to lift off the surface of the record. A positive number requires raising the tonearm which will cause the back corner (closest to pivot point) to lift off the record surface.
 - a) To measure the angle of the blade, use the brown Shim Gauge for less than 0.5mm (same as 0.5°) angle, use the yellow Shim Gauge for 0.5mm to 1mm (0.5° to 1.0°) angle and use the 25mm Ruler for greater than 1mm (1.0°). Lay the Shim Gauge flat against the record and slide it under the blade until the Shim Gauge meets with slight resistance underneath the blade. Use a very light touch when inserting the Shim Gauge while applying downward pressure with your finger on the corner of the blade that is touching the



record so as to not allow the Shim Gauge to lift the blade off the record by even the smallest amount.

i) See the WallyReference Instructional Series Video #2 or #3 out of the 3 videos in the series on the WallyTools YouTube channel to see this process in action.

b) If the number is positive in an amount greater than 1mm, it will be impossible to use the 25mm ruler under the headshell to measure the angle. Use the Blade Lift underneath the BACK corner edge of the blade (the corner lifted off the record and closest to pivot point) so that the FRONT corner edge also lifts above the record. Measure the FRONT corner edge height above the record and apply the following formula:

- i) Blade Lift step height (1.5mm, 3mm or 4mm depending upon which step the blade is resting upon) MINUS height of the front corner of the blade from record EQUALS the blade angle.
- ii) If you need to use the 4mm level (top surface) of the Blade Lift it is VERY important that you do not push the Blade Lift underneath the WallyReference blade more than 1-2mm or it will begin compromising the accuracy of your measurements.



6) You are done with the ideal SRA alignment process. When you remove the WallyReference and install the cartridge you can be assured that the cartridge is mounted at an angle to achieve a perfect 92° SRA on a spinning record with modulated grooves.

RE-LEVELING HEADSHELL ON LEFT/RIGHT AXIS FOLLOWING CHANGE IN TONEARM HEIGHT

- 1) If the instructions above for ADJUSTING HEADSHELL ANGLE FOR IDEAL STYLUS RAKE ANGLE resulted in a change to tonearm height so that the front/back (SRA) WallyReference blade is no longer level to the record, the left/right axis (azimuth) ALSO changed and should be re-leveled before electronic measurements for finding ideal azimuth begin.
- 2) Install left/right (azimuth) axis WallyReference blade. Use enough shims between WallyReference and headshell to match the exact height of the cartridge.
- 3) Align the blade of the left/right (azimuth) WallyReference to be perpendicular to the headshell. Tighten screws.
- 4) Lower WallyReference onto record.
 - a) If your cartridge is much heavier than the WallyReference you may have to adjust the tracking force or add weights to allow the WallyReference to lower onto record.
- 5) When viewing the WallyReference blade at record level, adjust azimuth so the WallyReference blade's bottom edge is touching the record along its full length.
- 6) You are done with the leveling process. When you remove the WallyReference and install the cartridge you can be assured that the cartridge is perfectly level on the left/right (azimuth) axis regardless of the front/back (SRA) axis angle.

MEASURE IDEAL AZIMUTH ANGLE

- 1) Once ideal azimuth has been determined using WallyAzimuth or other electronic method, remove cartridge and install the left/right (azimuth) axis WallyReference blade. Use enough shims between WallyReference and headshell to match the exact height of the cartridge.
- 2) Align the blade of the WallyReference to be perpendicular to the headshell. Tighten screws.
- 3) Lower WallyReference onto record.
 - a) If your cartridge is much heavier than the WallyReference you may have to adjust the tracking force or add weights to allow the WallyReference to lower onto record.
- 4) Measure the angle of the blade using the brown Shim Gauge for less than 0.5mm (same as 0.5°) angle, use the yellow Shim Gauge for 0.5mm to 1mm (0.5° to 1.0°) angle and use the 25mm Ruler for greater than 1mm (1.0°). Lay the Shim Gauge flat against the record with arrow facing the blade and slide it under the blade until the Shim Gauge meets with a slight resistance underneath the blade. Use a very light touch when inserting the Shim Gauge while applying downward pressure with your finger above the corner of the blade that is touching the record so as to not allow the Shim Gauge to lift the blade off the record by even the smallest amount. AGAIN, USE LIGHT TOUCH WHEN INSERTING THE SHIM!
 - a) **See the WallyReference Instructional Series video #2 or #3 on the WallyTools YouTube channel to see this process in action.**

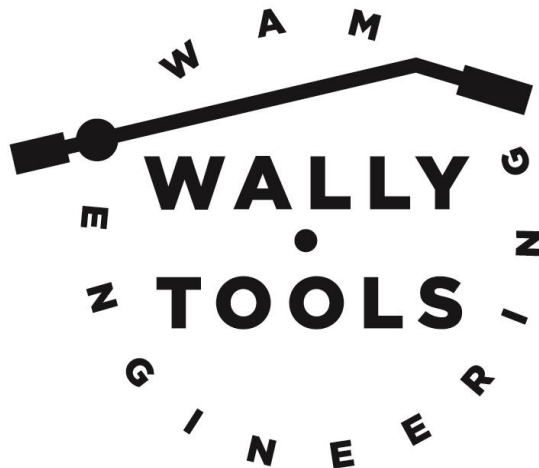
- 5) Document the measured angle in the *Ideal Azimuth Angle* column and document the tilt direction in the *L/R Blade rotated clockwise or counterclockwise?* column in the table at the end of these instructions.

MOVE CARTRIDGE TO ANOTHER TONEARM

As you have previously REFERENCED ideal SRA & azimuth blade angles with the WallyReference and documented the angles in the table below, you have a very quick, easy and accurate method to repeat an ideal cartridge mount. These measurements are replicated by mounting the front/back (SRA) and left/right (azimuth) WallyReference blades to the tonearm with the appropriate shims to replicate the height of the cartridge and - using the Shim Gauges, 25mm Ruler and Blade Lift – adjust the tonearm to achieve the targeted blade angles by repeating the steps noted above in these instructions. No need to directly re-measure SRA or azimuth for your cartridge again until it is re-tipped or repaired by the manufacturer.

GENERAL NOTES:

- Always use shims to get the height of the WallyReference blades to be identical to the height of your cartridge when it is under your chosen vertical tracking force.
- When using the Shim Gauges, use largest gauge possible (either 0.25mm or 0.5mm thick) that will fit under the edge of the blade.
- Always keep finger pressure on the opposite end of the blade to keep it from lifting off the surface of the record when using the Shim Gauges. This also sometimes helps to remove record warps.
- Use the 25mm ruler when measuring gaps greater than 1mm between the lifted corner of the blade and the record.
- DOCUMENT RESULTS in the table below. This allows you to know how to install the cartridge very quickly on any tonearm without remeasuring SRA and azimuth.
- When any of the single axis blades are NOT level to surface of record: each 1mm of distance between the record surface and blade tip equals 1 degree of angle off of a level headshell
- For those without a WallySRA or other method to optically confirm "native" stylus rake angle: *generally*, the SRA sweet spot will be at the parallel point or slightly lower at the tonearm base.
- We discourage adjusting the tonearm height for varying record thicknesses. The difference between the thickest and thinnest records is no more than 1mm. On a 9" tonearm, a 1mm difference will be the equivalent to a 0.23° change in SRA and even less on longer tonearms. A 0.23° SRA change is at the limit of perceptibility on most systems and only then on very fine contact stylus profiles. Therefore, we take the position that the small benefit achieved by constant adjustments for record thickness gets in the way of enjoying the music and, ultimately, puts extra wear on the adjustment mechanism itself.



ENJOY ANALOG FOREVER!!! - Wally Malewicz
wallyanalog.com / wallyanalogtools@gmail.com

SRA – AZIMUTH RELATIONSHIP

| Effective Length (mm) | Tonearm Height Change = 1° (1mm) SRA Change | Impact to Azimuth Angle |
|-----------------------|---|-------------------------|
| 220 | 4.2mm | 0.47° |
| 230 | 4.4mm | 0.44° |
| 240 | 4.6mm | 0.42° |
| 250 | 4.7mm | 0.40° |
| 260 | 4.9mm | 0.39° |
| 270 | 5.0mm | 0.37° |
| 280 | 5.2mm | 0.35° |
| 290 | 5.4mm | 0.34° |
| 300 | 5.5mm | 0.33° |
| 310 | 5.7mm | 0.32° |

The *SRA Change to Azimuth Calculator* on wallyanalog.com will tell you how much azimuth is affected by tonearm height changes. This calculator is important if you decide to change your SRA angle to something different than the WallySRA/WallyReference ideal figure because the results of your newly adjusted angle will not agree with the WallyReference Ideal SRA and will therefore have a negative impact on azimuth that can be measured and compensated for.

IMPORTANT NOTE: if you feel the playback performance is better at an angle other than the WallyTools' calculated Ideal SRA it is likely that the improvement in sound is actually a compensation for a systemic problem somewhere else in your audio system/room interaction or you may be basing the decision off of a flawed recording that has poor EQ or was cut at a severe cutterhead angle.

Indirect Azimuth (Type I) Tonearm Information:

Changes to azimuth impact SRA on indirect azimuth tonearms but not to the same degree that changes to SRA impact azimuth. Therefore, the chart above is not meant to be read in reverse; i.e., a 0.40° change in azimuth does NOT result in a 1° change in SRA.

For indirect azimuth tonearms use the Azimuth Change Impact to SRA Calculator to enter the amount azimuth is off from perfectly level and it will tell you how much to raise/lower your arm to keep SRA unaffected. If the result is less than 0.25mm change at the WallyReference blade or 1mm change at the tonearm base, an adjustment will not be necessary.

ANALYSIS RESULTS

| Cartridge Name | Date | VTF (gms) | Cartridge Height (mm) | Native SRA | Ideal front/back blade angle* | Ideal Azimuth Angle | L/R Blade rotated clockwise or counterclock wise?** | Adjust SRA for azimuth tilt (indirect azim. only)* |
|----------------|------|--------------|-----------------------------|---------------|--|---------------------------|---|---|
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**Negative number requires DECREASE in tonearm height from level (blade corner furthest away from pivot point lifts above record surface); Positive number requires INCREASE in tonearm height (blade corner closest to pivot point lifts above record surface)*

***When viewed from the front of the cartridge, "Clockwise" means the right blade corner is lifted off record. "Counterclockwise" means the left blade corner is lifted off record.*

**WATCH WALLYREFERENCE INSTRUCTIONAL VIDEO
SERIES ON THE WALLYTOOLS YOUTUBE CHANNEL**