WallyReference v2.0

For use with all tonearm types

Watch the WallyReference Instructional Video Playlist on WAM Engineering's YouTube channel before attempting to use the WallyReference.

youtube.com/@WAM-Engineering/playlists

May 2024 Note: Video series to be updated to reflect changes to the v2.0 version in summer of 2024.

These WallyReference instructions will help you to:

- **Confirm your tonearm's headshell is perfectly parallel to the record surface on two axes. (Page 6)**
    - **If your cartridge was built to perfection, this alone would be enough to ensure your cartridge will play at its ideal SRA, VTA and azimuth. Unfortunately, this is <u>almost never the case</u>. 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 & VTA, use WallyReference to offer your cartridge <u>*IDEAL*</u> SRA/VTA alignment (Page 7)**
    - **"Native" SRA & VTA is determined 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 for SRA & VTA taken.**
- **Following electronic measuring for ideal azimuth, use WallyReference to find the optimal left/right headshell angle (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/VTA and azimuth angles (Page 9)**

IMPORTANT NOTE FOR *UNSTABLIZED* UNIPIVOT TONEARM USERS

"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. WallyReference can measure azimuth angles ONLY on fixed bearing tonearms or unipivots <u>with a rigid stabilizing mechanism</u>.

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 even include the note whether this is to be measured statically or dynamically. Given what we know of the rake angle most engineers cut at (typically between 80° 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 have to work with. It is highly likely that VTA is more important than SRA (more on this in later videos) 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. 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.

DUAL AXIS BLADE

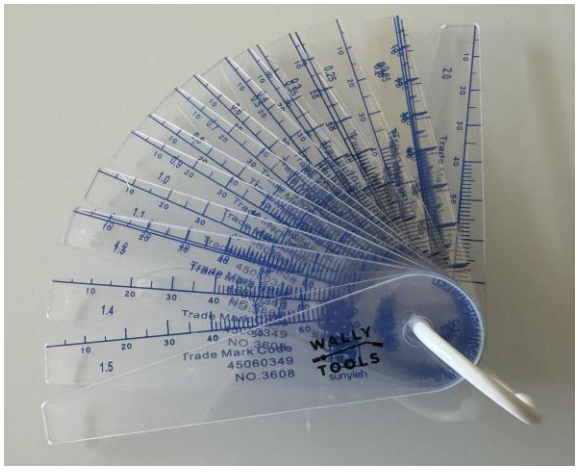
Provides confirmation that the headshell is perfectly parallel to the surface of the record on two axes. This is an essential starting point – a REFERENCE – to ensure the accuracy and repeatability of your cartridge's ideal SRA, VTA and azimuth settings. It is vital to confirm both axes are level *simultaneously* since changing one axis angle can change the other axis angle as well.

FRONT/BACK (SRA & VTA) BLADE

Once the cartridge's native SRA and VTA has been determined by microscopy, the front/back blade allows the user to set and measure the tonearm angle (or tonearm + corrective shim) for ideal SRA & VTA without influence of the left/right (azimuth) angle.

LEFT/RIGHT (azimuth) BLADE

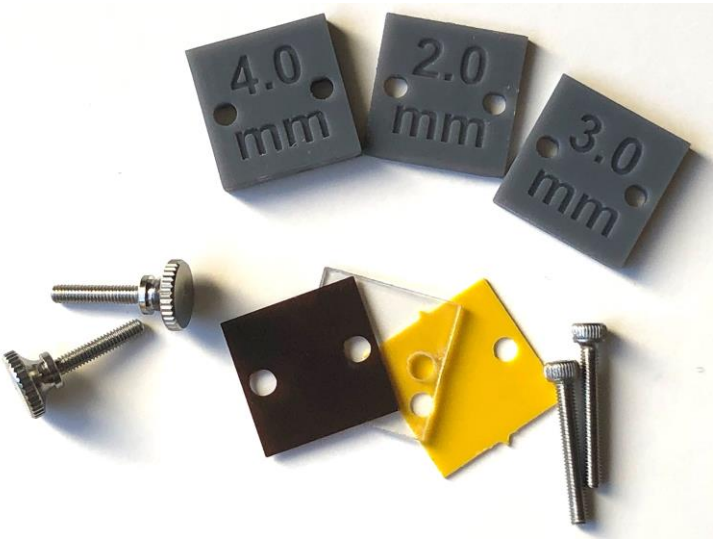
Following the raising or lowering of the tonearm to achieve ideal SRA/VTA, this blade allows a re-levelling of the headshell on the left/right axis without influence of the front/back axis. It also allows measurement of the azimuth angle once azimuth has been determined electrically.



FEELER GAUGE

The feeler gauges are used to measure the angle for the front/back and left/right blades up to 2° with a resolution as fine as 0.05°

IMPORTANT: Always keep feeler gauge flat and free of bends, dimples and damage.



STACKING SHIMS AND HEADSHELL SCREWS

Stacking shims are used to keep the height of the WallyReference blades at the same as your cartridge when under nominal vertical tracking force (VTF) load. They can also be used to measure angles of the Front/Back or Left/Right Blades in excess of 2°

Clear shim = 1mm
Yellow shim = 0.5mm
Brown shim = 0.25mm
Grey shims (embossed): 2mm, 3mm & 4mm
12mm & 18mm screws

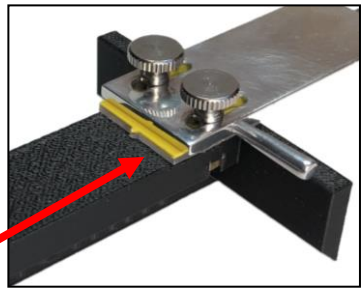
35mm RULER

The 35mm ruler is used to measure the height of the cartridge when under nominal VTF load

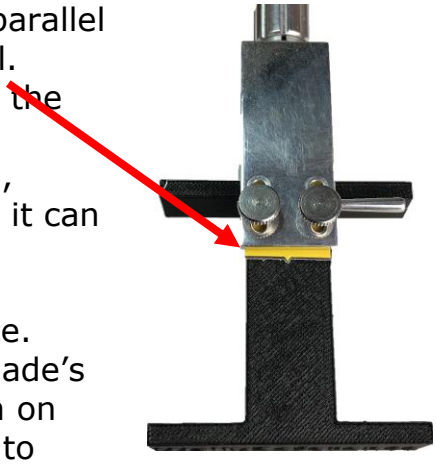
LEVELING THE HEADSHELL

1) Install your cartridge in middle of the headshell slots (alignment not necessary)
2) Set the vertical tracking force (VTF) at the mid-level of the cartridge manufacturer's recommended range.
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 35mm 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 not 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 Stacking Shims between the WallyReference and headshell to match the exact height of the cartridge. For example, if the height of the cartridge measures 17.75mm, use the WallyReference (15mm height), one 2mm shim, one yellow shim (0.5mm) and one brown shim (0.25mm) to equal the total of 17.75mm height.
   a) Align the central body of the WallyReference to be parallel with the headshell, i.e., not skewed in the headshell.



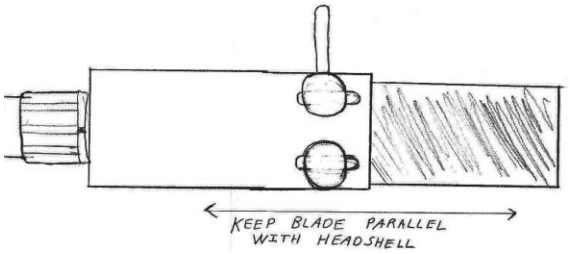
6) Lower WallyReference onto record, keeping away from the lead-in area of the record.
   a) If your cartridge is heavier than the WallyReference, increase tracking force or add weight on top of it so it can lower to record.
7) With your eye at record level, view the Dual Axis WallyReference blade where 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. You may have to press down on the record to eliminate any warps that will make leveling impossible.
   a) An adjustment to the tonearm height can cause a change to azimuth angle and vice versa. 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. You can now be assured that the cartridge can be perfectly level to the record surface on both axes once mounted on the headshell.

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 WallyScope or other low-powered microscopy to achieve ideal SRA & VTA for your cartridge
   b) Use electronic measurement process to maximize your cartridge's stereo separation. Measure the resulting azimuth 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 SRA & VTA

*This step is performed when mounting a cartridge for which the ideal SRA/VTA correction is **already known**. A "SRA/VTA correction" is any angular change from level headshell required to achieve targeted ranges for SRA and VTA (see page 3 above)*

1) Install the front/back (SRA/VTA) WallyReference blade. Use enough stacking shims between WallyReference and headshell to match the exact height of the cartridge (steps 4 & 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 a flat 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) Change the height of the tonearm and/or add corrective shims to achieve the SRA/VTA correction required to optimize your particular cartridge.
   a) If you have added a corrective shim, increase height of tonearm to accommodate its nominal thickness
   b) Every 1mm that one corner of the blade lifts above the surface of the record equals a 1° angle from a level headshell.
   c) Use the Feeler Gauge to determine the maximum thickness that will fit under the lifted corner of the blade without resistance. The thickness of that feeler gauge equals the angle. Keep your finger on the

corner of the blade that touches the record so as to not allow the feeler gauge to lift the blade off the record and thereby nullify the measurement.

d) If the angle is greater than 2°, simply use the 2mm, 3mm or 4mm Stacking Shim PLUS the Feeler Gauge to measure the angle.

5) You are done with the SRA/VTA alignment process. Document the measured angle in the *Ideal front/back blade angle* column on the table at the end of these instructions.

NOTE: TONEARM HEIGHT CHANGES CAN AFFECT LEFT/RIGHT (AZIMUTH) ANGLE

Changes in tonearm height can cause unintended changes to the azimuth angle of the headshell. This is less of a concern for arms with an offset yoke (see inset photo) but such arms are still somewhat at risk of having changes to tonearm height also change the azimuth angle.

MEASURE IDEAL AZIMUTH ANGLE

1) Once maximum stereo separation has been determined using WallyAzimuth or other electronic method, remove cartridge and install the left/right (azimuth) axis WallyReference blade. Use enough stacking 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 flat record
4) Measure the left/right (azimuth) angle of the blade/headshell
   a) Every 1mm that one corner of the blade lifts above the surface of the record equals a 1° angle from a level headshell
   b) Use the Feeler Gauge to determine the maximum thickness that will fit under the lifted corner of the blade without resistance. The thickness of that feeler gauge equals the angle. Keep your finger on the corner of the blade that touches the record so as to not allow the feeler gauge to left the blade off the record and thereby nullify the measurement.
   c) Generally, azimuth angles greater than 2.0° (Replikant stylus) to 2.6° (Japanese stylus) should not be used in practice as the risk of the stylus coming into contact with the junction of the record land (surface) and groove is significantly increased.
   d) If the angle is greater than 2°, simply use the 2mm, Stacking Shim PLUS the Feeler Gauge to measure the angle.
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/VTA & 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/VTA) and left/right (azimuth) WallyReference blades to the tonearm with the appropriate stacking shims to replicate the height of the cartridge and - using the Shim Gauges and 35mm Ruler – 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/VTA or azimuth for your cartridge again until it is re-tipped or repaired by the manufacturer.

GENERAL NOTES:

- Always use stacking shims to get the height of the WallyReference blades to be identical to the height of your cartridge when measured under its appropriate vertical tracking force.
- Avoid using the WallyReference blades close to the outer edge of the record as many records get thinner in this area and therefore will give inaccurate results when using a blade against this tapered record surface area.
- 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 Feeler Gauge. This also sometimes helps to remove record warps.
- Use a combination of the Stacking Shims and the Feeler Gauge when measuring gaps greater than 2mm 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 the SRA & VTA and azimuth of your cartridge.
- 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° of angle off of a level headshell
- We discourage adjusting the tonearm height for varying record thicknesses. The difference between the thickest and thinnest records is around 1.1mm. On a 9” tonearm, a 1.1mm difference will be the equivalent about 0.25° change in SRA/VTA and even less on longer tonearms. A 0.25° SRA/VTA change is at or under the limit of perceptibility on even the best systems. 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. Our engineering software analysis of the mechanical impact of changes to SRA/VTA suggests that if you are hearing a change in as little as 1mm tonearm height changes, you are hearing the effects of changes to tonearm vector forces, not SRA & VTA.
- Contact us if you have any questions

ENJOY ANALOG FOREVER!!! ***- Wally Malewicz***

wallyanalog.com / wallyanalogtools@gmail.com

SRA/VTA vs. ARM HEIGHT CHANGE RELATIONSHIP

Effective Length (mm)	Tonearm Height Change = 1° (1mm) SRA/VTA Change
220	4.2mm
230	4.4mm
240	4.6mm
250	4.7mm
260	4.9mm
270	5.0mm
280	5.2mm
290	5.4mm
300	5.5mm
310	5.7mm

For tonearms that do not have an offset yoked horizontal bearing (see above for photographic description): the *SRA/VTA Change to Azimuth Calculator* on wallyanalog.com will tell you how much azimuth is affected by tonearm height changes

ANALYSIS RESULTS

Cartridge Name	Date	VTF (gms)	Cartridge Height (mm)	Ideal front/back blade angle*	Ideal Azimuth Angle	L/R Blade rotated clockwise or counterclockwise?**

** A 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*