

Universal Phonograph Alignment Protractor

UPAP - USER GUIDE by Robin Miller ©2021

The Universal Phonograph Alignment Protractor (UPAP) is the most practical & precise tool available for adjusting phonograph turntables for lowest distortion, lowest stylus wear, and lowest permanent groove damage. "Universal" because for tonearms of 8in~15in length, it accommodates changing among cartridges, headshells, or styli. In only seconds

for a QUICK CHECK or minutes for FULL ALIGNMENT, the UPAP gauges stylus **azimuth**, spindle **overhang**, and **offset angle**. Its multi-arc design ensures tip motion is optimally perpendicular to both Left & Right groove modulations, critical for best sound. *Unlike paper protractors, you view from underneath to align the stylus.* The UPAP is rigidly constructed of metal reinforced fiberglass for dimensional stability and long life, and it has instructions below summarized on top. For skating, resonance, and other setup, see the author's book *The Better Sound of the Phonograph*.



The mirror Universal Phonograph Alignment Protractor UPAP finely aligns any tonearm 8~15in (200~375mm) pivot to tip.

Alignment instructions...

Note A: Once fully aligned, pickup(s) mounted in their headshell(s) may be freely interchanged, or confirmed anytime with a Quick Check.

Note B: Immobilizing the platter from spinning avoids the stylus scratching the UPAP. We recommend trimming stretched Saran Wrap \ Cling Film \ StretchTite to grip stylus gently while avoiding scratching the UPAP.

Note C: From the front, adjust so the cantilever's reflection is parallel with the target centerline, as shown below nearing fine alignment. **CAUTION: the stylus & cantilever are fragile, so handle gently to avoid damage.**

FULL ALIGNMENT PROCEDURE for new arm \ cartridge \ stylus ^{Note A}

1) Measure the tonearm's length pivot-to-stylus-tip to select letter A~K for this arm. 2) Place the UPAP on the spindle, and aim the arrow for that arm's letter at the arm's pivot. Lock the platter using removable tape. ^{Note B}

3a) Viewing the cartridge from the front, **gently place the stylus tip nearest the dot of the alignment grid A~K.** ^{Note C} For many turntables with integrated fixed pivot tonearms, alignment is adjusted at two cartridge headshell mounting screws. *Lift the stylus off the UPAP's surface when loosening or tightening screws to avoid damaging the stylus or the UPAP.*

3b) Bouncing a flashlight beam off the UPAP to the underside of the cartridge, **verify cartridge azimuth is plumb**, observing in the mirror-like surface no dog-leg angle between the real and reflected images. Adjust by twisting a removable headshell at its connector after loosening its locking screw. *If headshell is fixed, add a shim between the headshell and the appropriate cartridge mounting ear.* Viewed in a magnifier or smartphone, the cantilever (the delicate arm holding the disk contacting tip) should also appear plumb, showing no dogleg angle with its reflection.

3c) **Set tip overhang** atop the dot of tonearm grid A~K. After just loosening the cartridge mounting screws of the headshell's slotted holes, slide the cartridge fore or aft as needed, then snug the mounting screws. *For fixed-mount "P" tonearms, the arm's pivot must be moved at its base.*

3d) **Adjust stylus offset angle** by aiming (yawing) the cartridge so the cantilever overlays the bold centerline of grid A~K. Many cartridge bodies have irregular shapes, so refer only to the angle of the cantilever along its full length with respect to the target center-line, as reflected in the mirror-like UPAP. Viewed from directly in front, carefully aim the cartridge in the headshell so the cantilever & tip appear precisely in line, or appear evenly obscured by the grid's center line side-to-side (nearly so in image at right). Recheck the tip is still on the grid's tip dot, and gently tighten all screws.

QUICK ALIGNMENT CHECK (easy verification done in seconds) ^{Note A}

1) For your tonearm's pre-measured pivot-to-stylus length A~K, place the UPAP on the spindle, and sight the pivot opposite that letter's arrow.

2) Lock platter from spinning with removable tape. ^{Note B} Check overhang by resting the stylus gently on the dot of the tonearm aligning target. ^{Note C}

3) Bounce a flashlight beam off the UPAP to the cartridge's underside, focused on the stylus & cantilever. Use a magnifier (or smartphone view) to observe from directly in front the cantilever's reflection in the UPAP's mirrored surface. As shown below, see that the stylus' cantilever falls on the grid's center line, or is obscured by the line evenly side-to-side.

If the stylus fails a Quick Check, it must be fully aligned, as at left.



WHY TURNTABLE SYSTEMS NEED USER ALIGNMENT?

Compared to the simplicity playing digital media, analog records require more care. A well-recorded disk's ultimate quality is baked in its groove, awaiting users to extract it properly. *Its sound when mastered was quality controlled using a finely aligned cartridge.* Alignment, tracking pressure, skating etc. are *not* disk defects, but *the responsibility of the user/installer.* Precise stylus alignment results in *better* sound of less distorted audio; →

a century more recorded history, less processed, and mostly not available digitally; the *romance* of placing a microscopic rock in a half-mile-long rut!

The UPAP has multiple arc alignment for tonearms 8~15in in length. Without alignment, mistracking can contribute several percent of harsh distortion. The UPAP design is based on the widely accepted Löfgren-A (Baerwald) alignment where the stylus is perfectly tangent to the groove at two radiuses, where tracking distortion is zero %. Everywhere else across the disk, distortion is optimal. Shown below right, a 9in tonearm can be optimized for zero-to-0.67% maximum distortion – even less for longer arms. So-called “Sibilance” is minimized in the inner groove. *With no double work, as either UPAP zero-error radius aligns for the other.*

Issues beyond the UPAP are tonearm tracking pressure, variable skating compensation, and Stylus Rake or Vertical Tracking Angle (SRA or VTA) for tips other than spherical. These issues are in the author’s companion technical reference book in the cover illustration below.

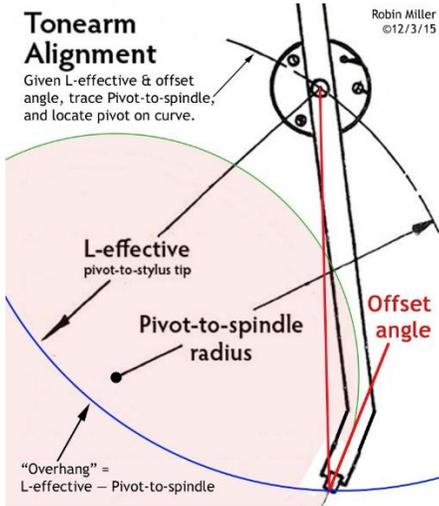
The book and its *Update* also have free solutions for checking speed. For optimizing tonearm-stylus resonance that causes feedback, groove hopping, muddy bass, and rumble. Fixing too weak or too pronounced high frequencies, set by capacitive loading. The best methods for skating compensation. The sound of well-recorded disks can only be wrecked by these replay errors, but users attending to them are rewarded by the best quality, low coloration distortion, and low wear of both stylus and disks.

UPAP SPECIFICATIONS (subject to change without notice):

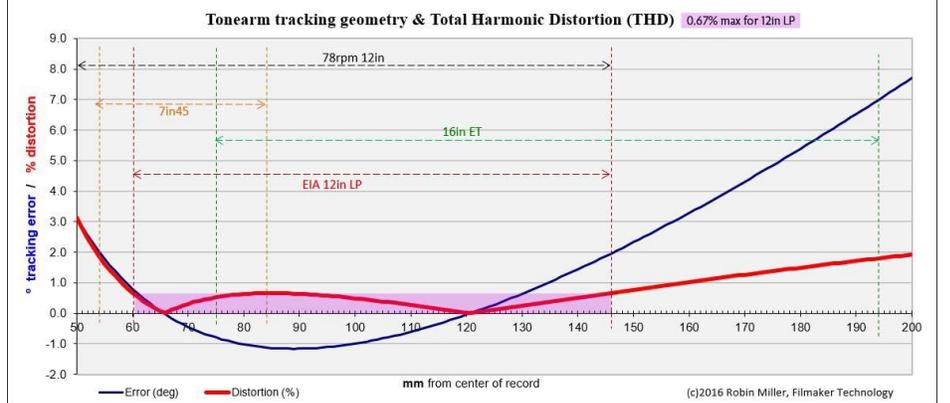
- Precision instrument of durable metal-reinforced fiberglass;
- Multi-arc protractor used by audio professionals for low distortion;
- Overhang & Offset Angle targets for effective length, pivot to stylus tip, of consumer 8in (20cm) to pro transcription length 15in (37.5cm);
- Mirror-like finish for viewing the stylus cantilever from under cartridge;
- Thickness same as a record so no error from thin paper or thick plastic block; plated spindle hole for dimensional integrity over instrument life;
- User Guide with instructions for Quick Check (takes only seconds) and Full Alignment for any change of arm, headshell, cartridge, or stylus;
- Size 8in x 7in (200 x 175mm); weight 3oz (85g), black mirror finish.

AVAILABILITY & SUPPORT to purchase, or for assistance...

...after reading these instructions, email enquire@filmmaker.com with “UPAP” as the subject. This User Guide may be updated from time to time at www.filmmaker.com/papers.htm. The original UPAP purchaser is protected by a limited 90da warranty. Other alignment tools, choosing a replacement stylus, and maker projects in *The Better Sound of the Phonograph* at amazon.com/dp/0692903119 and other booksellers.

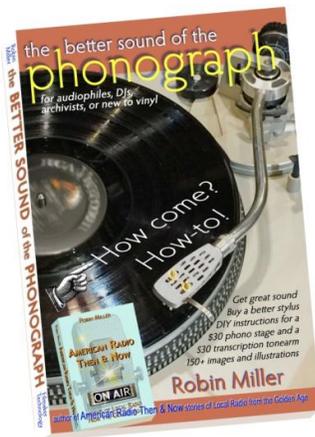


Arm/cart/stylus: 9in (225mm) tonearm - optimal tracking distortion			Optimized use: 12in LP					*Eff length = on a line from pivot to stylus tip				Robn Miller				
meas'd			Optimize for		Secondary use: 78s ending LP limit (48mm typical), 7in45 ending LP inner limit		**DIN 57.5-146mm									
Effective Length*	Groove minRad	Groove maxRad	Tonearm Alignment		Angular Offset	Linear Offset	Stylus overhang	Pivot to Spindle	Inner Null	Outer Null	max tracking	Total Harm.	Distortion			
225.00	60.000	146.00	← inputs		Date	results→					10in 78	7in 45	12in LP	16in ET		
mm	mm	mm			3/23/2022		24.461	93.167	18.357	206.64	65.664	120.670	48-121mm	54-84mm	60-146mm**	75-194mm
						deg	mm	mm	mm	mm	mm	mm	1.34%	1.39%	0.67%	1.80%



Geometry for aligning a pivoted tonearm, where mounting a 9in tonearm is boxed green at right.

The red curve in pink box shows an optimally aligned 9in tonearm adds distortion between zero~0.67% max. Proper replay calls for reducing distortion produced by the stylus tip shape and wrong skating compensation.



Robin Miller is an audio engineer & sound conservator with more than 60 years in recording and mixing films and television specials. With Filmmaker Technology he designs and integrates studios and publishes about audio

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