Newcastle, WA, USA, 717-852-7700, atrservice.com

Simplified Tape Recorder Alignment

Demagnetize and Clean Tape Path

SETTING PLAYBACK LEVEL

1. Thread the Alignment Tape
Thread the ANKO LAB alignment tape, tails out. The first tone is 1 kHz for level setting. Set the REPRO gain potentiometer on all tracks to read **0 VU** in REPRO mode.

2. Set Reproduce Head Azimuth with 10 kHz Tone
Play the 10 kHz tone and adjust the **REPRO HEAD AZIMUTH** to achieve maximum needle deflection on all channels. All meters should peak simultaneously.

For precise **playback EQ alignment**, refer to our **Magnetic Flux Alignment System (MFS-1)**.
For precise azimuth alignment of a two-track system, use a two-channel oscilloscope or compatible plug-in software to match channel phase. This is strongly recommended for high-quality reproduction and recording (e.g., electrical summing, X-Y plot, etc.).

3. Recheck 1 kHz Tone
Replay the 1 kHz tone and, if necessary, readjust the REPRO gain potentiometer to **0 VU**.

4. Adjust Reproduce HF with 10 kHz Tone
Play back the 10 kHz tone again and adjust the **REPRO HF** potentiometer to **0 VU**. This ensures minimal interaction between the REPRO gain and HF equalizer controls.

5. Play Back Low-Frequency Tones (100 Hz and 50 Hz)
Note that LF levels may exceed **0 VU**. Higher tape speeds may produce higher indicated levels. Adjust LF at **50 Hz** to approximately **+1 to +2 VU**; some machines may reach up to **+2.5 VU**. This variation is normal and is caused by **low-frequency fringing effects**, which depend on reproduce head geometry, condition, and machine configuration.

6. Check for Flat Response Using Chromatic Sweep
During playback of the chromatic sweep (1 kHz through 16 kHz), VU meter indications should vary only slightly. Significant deviations indicate a response anomaly.
Skip this step if your alignment tape does not include a chromatic sweep.

SETTING RECORD LEVEL

7. Load Blank Tape and Set Record Levels
Remove the alignment tape and thread a blank reel. Arm all tracks for recording. Apply a **1 kHz tone at +4 dBu (1.23 V RMS)** to all recorder channels and set the **RECORD GAIN** controls to **0 VU**.

8. Set Bias with 10 kHz Tone (15 IPS)
Using RTM or ATR Master Tape, apply a 10 kHz tone to all tracks. Adjust the **BIAS ADJ.** control by slowly turning counterclockwise (CCW) until the VU meter peaks.
From that peak point, turn the control clockwise (CW) until the signal drops:

- **2.0 VU** for SM911
- **3.0 VU** for ATR Master or SM900

Repeat for all tracks.

9. Adjust Record Gain with 1 kHz Tone
Apply a 1 kHz tone to all channels and readjust the **RECORD GAIN** controls to **0 VU**.

10. Set Record Head Azimuth with 10 kHz Tone
Apply a 10 kHz tone and adjust the **RECORD HEAD AZIMUTH** for maximum output and simultaneous meter peaking.
For two-track machines, verify phase coherence using a two-channel oscilloscope or appropriate software.

11. Final 1 kHz Record Gain Check
Apply a 1 kHz tone and confirm that all RECORD GAIN controls remain at **0 VU**.

12. Low-Frequency Check (100 Hz and 50 Hz)
Switch the generator to **100 Hz and 50 Hz**. Confirm that recording levels correspond to the previously established playback LF behavior, taking fringing effects into account.
Do not attempt to force the 50 Hz level to 0 VU—a low-frequency rise is a natural characteristic of the reproduce head and tape interface.

If you have any questions, please do not hesitate to contact us. We are happy to assist.

Appendix

Understanding Low-Frequency Fringing, Bias, and Head Geometry

This appendix explains why **low-frequency playback behavior and high-frequency roll-off observed during alignment are physical characteristics of the tape/head interface**, not defects in the calibration tape. It also clarifies the **proper role of bias** in the alignment process.

1. Low-Frequency Fringing Effects

What Is Fringing?

At low frequencies (long wavelengths), the magnetic field sensed by the reproduce head extends beyond the nominal gap area. This phenomenon—commonly referred to as **low-frequency fringing**—causes an apparent rise in reproduced level, most noticeable at **100 Hz and especially 50 Hz**.

Why LF Levels Rise

The magnitude of LF fringing depends on multiple variables:

- Reproduce head gap geometry and inductance
- Track width and effective magnetic aperture
- Tape speed
- Tape formulation
- Head condition and tape-to-head contact
- Reproduce electronics loading and EQ topology

Because these parameters vary from machine to machine, **low-frequency playback level is not a fixed, universal value**.

Important Consequence

For this reason:

- **No fixed low-frequency compensation is applied** to IEC reference calibration tapes
- Apparent LF rise should be **observed and documented**, not “corrected” to zero

Attempting to force 50 Hz or 100 Hz to 0 VU will typically degrade midband accuracy and overall tonal balance.

2. Calibration Tape Philosophy (IEC Context)

IEC reference calibration tapes are designed to provide a **known magnetic flux reference**, not a pre-equalized playback result.

Key points:

- Calibration tapes are recorded **mono across the full effective width of the tape**
- They are **geometry-independent by design**
- They intentionally do **not compensate for machine-specific fringing behavior**

The calibration tape reveals how a given machine behaves; it does not impose a correction model.

3. Bias Adjustment and Its Relationship to Frequency Response

What Bias Controls

Record bias primarily affects:

- High-frequency linearity
- Harmonic and intermodulation distortion
- Noise performance

Bias is **not a low-frequency correction control**.

Bias and Apparent LF Behavior

Changing bias alters tape magnetization dynamics and effective head loading. As a result:

- Over-biasing may exaggerate perceived LF anomalies
- Under-biasing may artificially extend HF response at the expense of stability

Bias must therefore be set **strictly by the specified high-frequency over-bias drop**, not by attempting to flatten LF playback response.

4. Separation of Variables: Electronics vs Tape/Head Interface

Proper alignment requires separating **electronic calibration** from **mechanical and magnetic effects**.

Recommended Alignment Order

1. **Establish electronic reference** at the reproduce head
2. Verify reproduce EQ independent of tape motion
3. Play the calibration tape to observe:
    - True LF fringing behavior
    - True HF gap loss
    - Tape-to-head interaction effects

Only after electronics are correctly aligned can tape-based behavior be meaningfully interpreted.

5. Role of Magnetic Flux Reference Alignment

Aligning reproduce electronics using a **direct magnetic flux reference at the head** allows:

- Accurate EQ alignment without transport variables
- Clear distinction between electronic response and physical tape effects

Once electronics are correctly referenced, the calibration tape becomes a **diagnostic tool**, revealing real-world performance limits rather than masking them.

Summary

- Low-frequency rise at 50 Hz and 100 Hz is **normal and expected**
- Fringing behavior varies by machine and cannot be universally compensated
- Bias affects HF behavior first; LF changes are secondary and indirect
- Calibration tapes reveal physics — they do not correct it

This approach ensures alignment results that are **repeatable, standards-compliant, and physically meaningful**.