Head Height Alignment Methods

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1 Track location – methods to determine head height:

Several methods are possible for adjusting the head height. But first a warning: When you "play" tape normally on the heads, it wears a groove in the head face. If you can feel any groove when you run your fingernail across the head face at the point where the edge of the tape would lie, you should not adjust the head height unless you first have the heads relapped.

A second warning: The accuracy with which you can set the location of the recorded tracks on the tape is limited by the wander of the tape in the tape guides. Commercial tolerances in the tape width are typically around 100 µm. (How big is that? The "standard play" mastering tape has an overall thickness of 50 µm, so 100 µm is the thickness of two layers of tape.) In addition, the tape guide must have clearance between the widest possible tape and the narrowest possible guide, lest the tape bind and jam in the guides. So the guides are typically about 50 µm wider than the maximum tape width. Therefore the tape may be able to wander in the guides by as much as about 150 µm. This is 15 % of the track width for a 1 mm track, as used for instance for 24 tracks on 50 mm (2 inch) tape. This should temper your expectations for getting the recorded track to match the reproducing head "exactly".

1.1 Head-height adjusting tape.

In principle, one can adjust the head height by playing a specially made recording that has the tracks precisely located on it. Either the tones are recorded in the usual track locations, and the head height is adjusted to give maximum signal output; or they are recorded in the normally-unrecorded "guard band" between the tracks, and the head height is adjusted to give equal (rather small) output from the adjacent tracks.

In most head adjusting systems the several adjusting screws are interacting: that is, the "height" screw also affects the azimuth. So be sure that the azimuth is still correct after setting the head height.

The practical problem with commercially manufacturing such head-height adjusting test tapes is that there are four standard tape widths, and there are several standard track configurations used on each tape width. For instance, on 6.3 mm (1/4 inch) tape, there may be 1, 2, 3, 4, or 8 tracks. The 2-track systems (a very common analog mastering format) are made with three commonly-used different dimensions for the tracks, the center guard track, and the edge guard track. And a special recording head assembly is required to make each of these test tapes. So we have not made such tapes. But other methods are available for setting the head height.

1.2 Optical check of head core re tape path.

The recorded tracks should be centered on the tape. Since the tape is opaque, this is not directly visible. Professional re-lapping shops have special optical equipment, and know the dimensions from some reference point on the head assembly to the edge of a reference head core, so they can set the head height directly optically.

What can you do without this equipment? If you had a clear piece of tape, you could "play" it, and adjust the head height so the tracks are visually centered on the tape. With the older tape (before 1965 or so), you could make a clear tape simply by removing the tape coating with a solvent. With present binders, however, it is nearly impossible to remove the coating without destroying the tape.

There is, however, one other way. Most, if not all, heads have the cores symmetrically located between shielding elements, or between parts of the core mounting assembly. Thus by setting the head height so that the tape is symmetrically placed between the shields or core holders that are visible on either side of the tape, you have correctly set the head height.

1.3 "Edivue" recorded track, view with loupe or toolmaker's microscope.

A very satisfactory way to set the recording head height is to record a signal on the tape, "develop" the tape in a liquid containing fine magnetic particles, then measure the developed track positions with a loupe or a toolmaker's microscope. The correct height produces equal unrecorded guard bands at each edge of the tape. So you don't need to know any actual dimensions, just make the edge guard bands equal.

The clearest recording is made by using a square wave of about 2 kHz at 190 mm/s (7.5 in/s), with normal bias, and at a fluxivity around 250 nWb/m.

1.4 Record, reverse tape top-to-bottom (end-to-end), play with the recording head, and move the tape to see if the output increases.

Finally, if your system will play back from the recording head ("Sel-Sync"), and if your tracks are symmetrically located on the tape (as opposed, for instance, to the "Stereo Tape" consumer system which used tracks 1 and 3 of four, which are *not* symmetrically located), here is the method that takes the least special equipment.

Record a medium-high frequency (around 2 kHz at 190 mm/s) on two symmetrically located tracks. Play back these recordings *on the recording head,* and gently press the edge of the tape beside the recording head so as to move the recorded tracks upward, then downward, slightly off of the cores of the recording heads; that is, in a direction perpendicular to the direction of the tape travel. (We give directions for a tape transport that is mounted horizontally, so the plane of the tape itself is vertical.) If the system is tracking consistently, any pressure you apply to either tape edge will reduce the playback level of both tracks by about the same amount. When you stop pressing the tape edge, the level from both tracks should come back up to what it was before you pressed the edges. If this does not happen, the tape guiding is "dysfunctional", as they say.

Note on the test frequency to use: When you push the tape upward or downward on the head, it does two things: it moves the recorded track so that part of the track is no longer in contact with the head core, but is "off to the side", causing the reproduced level to drop, which is the effect you desire to see. It also distorts the tape is such a way as to change the effective azimuth, which you *don't* want to see. The lower the frequency, the less sensitive the system is to moving the recorder track off of the playback head core. On the other hand, the higher the frequency, the more sensitive it is to the azimuth change. As I recall, a test frequency around 2 kHz at 190 mm/s tape speed is a pretty good compromise.

If the guiding seems to be consistent, reverse the supply and takeup reels. The effect of this is that the track recorded on the head core 1 is played on head core 2, and vice versa. If the two recording heads (now used for playback) were symmetrically located under the tape, then the reversed recordings should still be symmetrically located over the heads. Play thru the recording heads, and displace the tape again, upward, then downward. The levels on the two tracks may or may not be equal — it doesn't matter. What matters is the *change* in level when you displace the tape. If displacement one way or the other causes the level to drop, then the head height is correct. If the level increases when you displace the tape *either* way, then the height is incorrect. Adjust the head height to bring the level *half way* back to the maximum, and repeat the "record, reverse reels, play, adjust half way" process until no adjustment is needed.

Keep the final recording as your test tape for setting the head height on this recorder/reproducer. Finally, play it from the normal playback head, and set its height for maximum output on both channels. If the playback head dimensions are not identical to those of the recording head, you may find that there is not a height setting at which the output is simultaneously maximum for both channels. In that case, use a compromise height at which the output is equally reduced from the maximum for both channels.