MKIV MEMO #130
VLBA ACQUISITION MEMO #348

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To: VLBA/Mk4 Recorder Group
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Re: Robust and Marginal Tapes: The Shape-of-Edge Difference, Extreme Wind and Shuttle Tests, High Tg Ampex Samples Looking Good

Abstract: An important optically observable difference between mechanically robust and mechanically marginal tapes has been noted. Tape manufacturers should be encouraged to try to produce the robust edge-shape consistently.

Definition of Robust and Marginal Tape

A robust tape is here defined as one that continues to pass, that is, not to form a bumpy pack as a result of, an extreme wind-test (20" vac = 4.4 N, 67.5 ips) after indefinitely long, repeated, extreme shuttling (4.4 N, 270 or 330 ips) between two self-packing reels.

A marginal tape is defined as one that has produced a bumpy pack at least once as a result of our standard wind-test (3.3 N, 67.5 ips), but which later continues to pass the standard test -- after unspecified, sometimes elaborate, corrective maneuvers.

Marginal and Robust Edge-Shapes and their Consequences

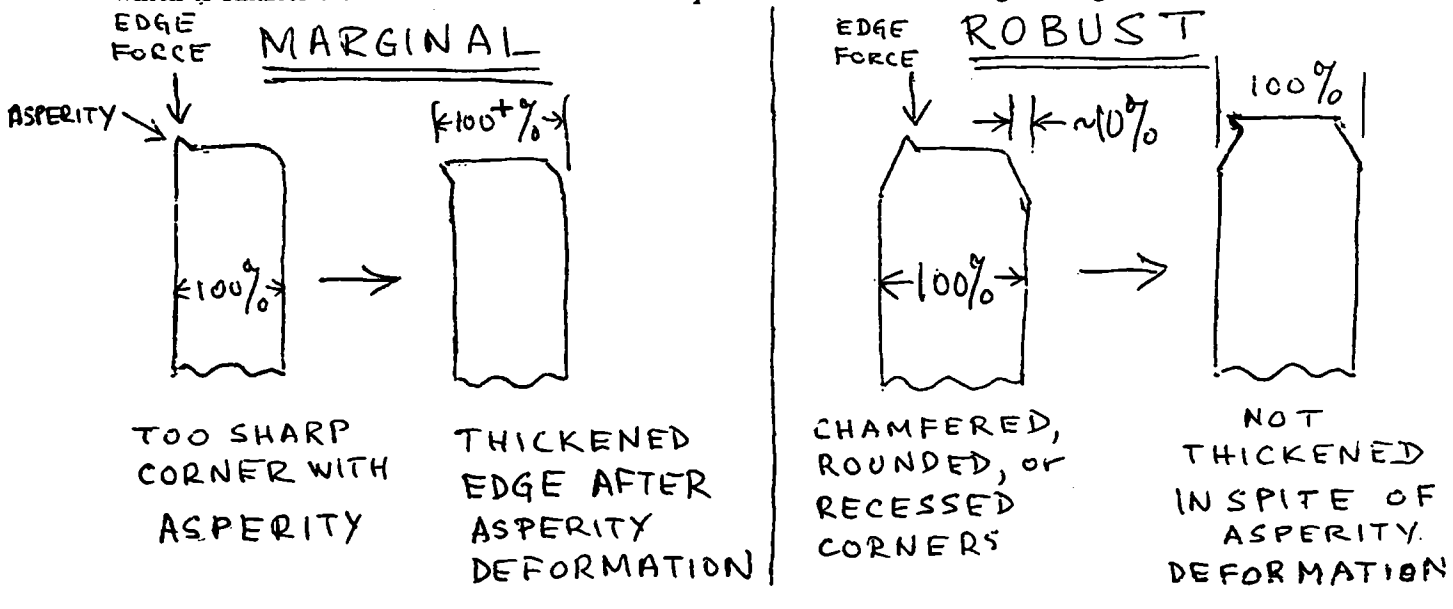
Marginal tape cross-sections exhibit at least one corner which is too sharp and is in the magnetic or back surface plane.

Sufficiently small asperities at such a corner undergo plastic deformation when a sufficiently large edge force is applied. On average, the edge is thereby slightly thickened (see diagram). This produces the marginal behaviour described above.

Note that plastic deformation of edge asperities is self-limiting and proportional to the maximum edge force applied. Therefore marginal edge-shape is a relatively minor, manageable, problem.

Low operating tension (down to a practical minimum of 1.1 N = 5" vac) would both minimize the plastic deformation of edge asperities and maximize the bump-free packing tolerance of edge thickened tapes.

Robust tape cross-sections exhibit four sufficiently rounded and/or recessed corners. A 10%-of-thickness corner recess seems to be enough to make the tape robust. The diagram shows how an asperity which is smaller than the corner recess can be squashed without thickening the edge.



Present Tapes Not Consistently Robust, Future Tapes Could Be

Many of the still active accelerated test tapes (ATTs) -- most of the Sonys -- are marginal, by the above definition. However, marginal tapes should not be cause for great alarm. They are not failed tapes, and there is no evidence that marginal tapes are unstable, that is, continue to lose mechanical margin. The present reality is that no brand is yet consistently robust. I think, with a little competitive effort, all three (3M, Sony, and Ampex) could be.

The Tortured Tapes, Examples of Robustness

One Sony (VLBA0013mfg#110065S1), one 3M (VLBA0100mfg#72051-04-24), and two new high Tg Ampex sample tapes were subjected to numerous prolonged extreme wind and shuttle tests.

The Sony and 3M tapes were preselected 'good'. The Sony tape is a retired ATT that had never failed a wind test; the 3M is new (from the latest batch of 25) and had already undergone a 'lifetime' (one week) of standard shuttling.

All standard and extreme tests were (are) conducted on drives with the fully upgraded tape path and with the relative humidity in the tape path forced below 30% by blocking the fan, closing front and rear doors, and allowing the air temperature in the tape path to rise to about 100 deg F. (In order to run at 20" vac the reel servo gain was increased but because the effective gain near the current limit is low in one direction the servo was on the verge of oscillation and reliable operation above 19.5" could not be obtained.)

Both the 3M and Sony tapes continued to pass the extreme wind test after both slow and fast shuttling at 4.4 N tension (2 days slow, 7 days fast).

Thus it is clear that very robust tapes do exist. I suspect but have not proven that most of the 3M tapes are robust.

Ampex Looking Good at Last

The high Tg Ampex samples also look very good.

It is obvious with 20/20 hindsight that the main Ampex problem was their misguided use of a room temp Tg binder.

The new samples have no trouble with extreme wind and shuttle tests as long as non-self-packing reels are used.

These tapes show no banding, unlike previous Ampex samples.

When wound onto a self-packing reel after extreme testing, however, a bumpy pack results. This behaviour is typical of marginal tapes when the standard (non-self-packing) takeup reel is replaced by a self-packing one.

This does not mean that the self-packing reel causes the tape to become marginal. The too sharp corners of the tape cross-section and the high edge force of the extreme tests do that.

The self-packing reel merely acts as detector of the marginal condition, by forcing the thickened edges to stack coherently on top of one another instead of scattering from side to side to avert pack instability.

The Ampex tapes are slit very cleanly, and in one sense too perfectly; three of four corners typically look too square.

It should be emphasized that these tapes, had they not been subjected to extreme testing, would undoubtedly have passed the ATT routine. Little more than fine tuning of the slitting process seems needed to make Ampex, or Sony, or 3M tape consistently robust.

There is a second reason to take another careful look at the high Tg version of the Ampex tape. If it behaves tribologically like the earlier version, it may provide a much longer headlife than the Sony or 3M tapes without compromising performance.