VLBA ACQUISITION MEMO #269

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To: VLBA Data Acquisition Group

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Subject: Accelerated tape wear tests

In order to try and understand the tape edge damage problem, I have run some recorder tests using a single 23" long tape loop. The geometry is shown in Figure 1. Some posts are added which act as air bearings at high tape speed (as long as they are kept clean). The reel servos are disabled by disconnecting the plug (A57 or J1) to the sensor/LED assembly.

The results of running the loop are encouraging because it can be run for at least an hour for the full range of speeds up to 360 IPS and vacuums up to 20" without any apparent edge damage. The wear acceleration factor is about 9,000 and at 360 IPS there are 56,000 passes (many years of continuous running a full tape) in an hour. The lack of damage is, however, contingent on maintaining a clean tape path. The discouraging part is that any dirt in the edge contact areas produces immediate damage by what looks clearly like a melting of the edge. An example of such damage is shown in Figure 2. Just how much and what kind of dirt is a problem that is still poorly determined, but the following observations have been made so far:

1. Sometimes the loop will suddenly fail with edge damage. Upon inspection there is some hard sticky brown dirt build-up on either the precision plate or front door. Examination with the microscope shows the edge against the dirt to be the one damaged.

2. Running another tape until dirt forms, prior to running the loop, results in rapid failure of the loop.

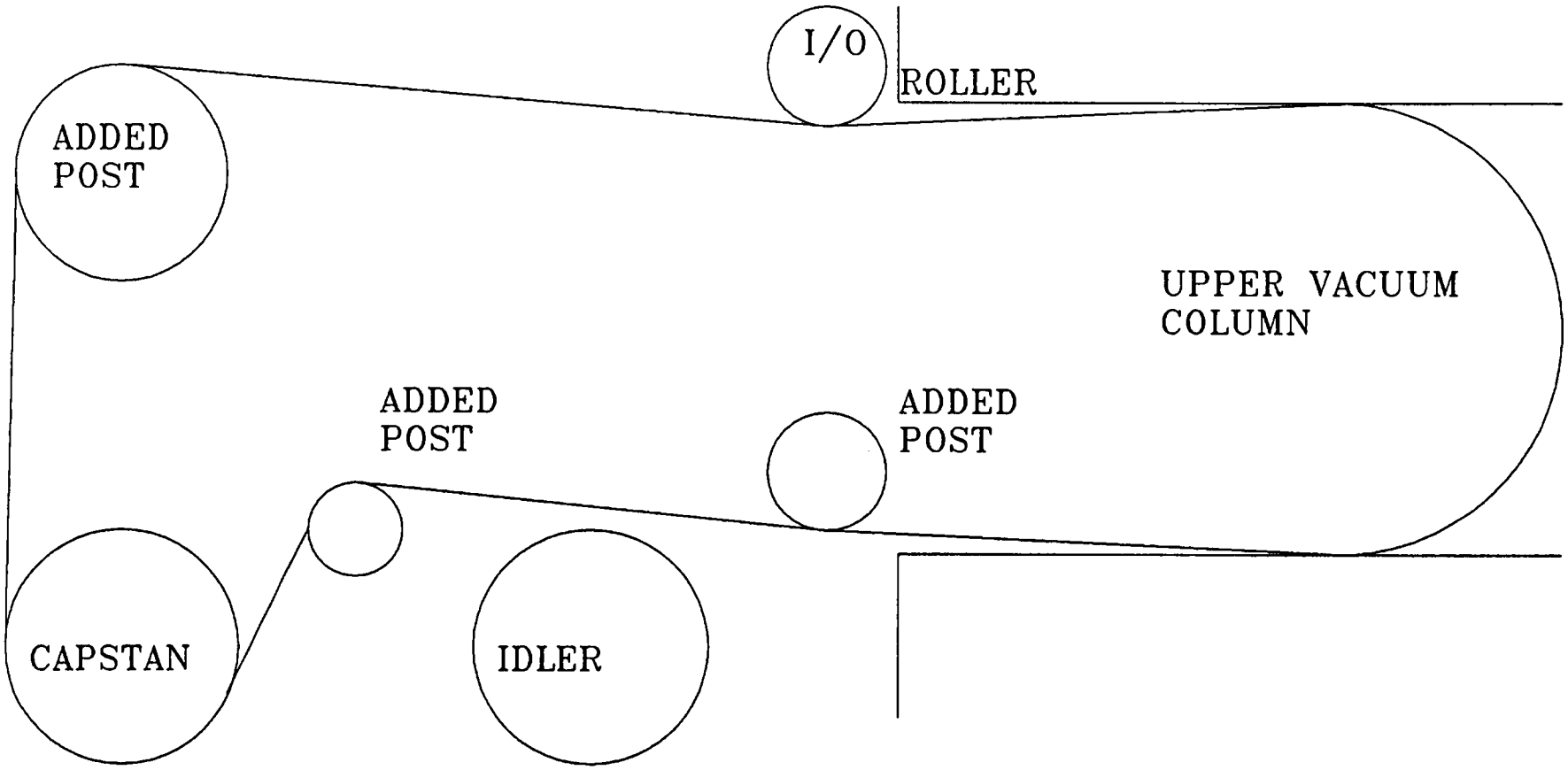
3. The direction of flow of the melted tape edge is always towards the backcoat. That is, the backcoated side is thickened and has a protruding lip (see Figure 2A). Examination of edge damaged tapes shows the same trend. Reversing the loop so that the oxide is facing the vacuum reverses the flow direction.

4. The sensitivity to edge damage of the loop with dirt increases with speed above 100 IPS. At 80 IPS it is hard to damage the tape no matter how much dirt is present. There doesn't seem to be much dependence on vacuum.

5. There is often a low pitched noise (like the old vacuum honk but much softer) associated with there being dirt in the path. An audio monitor might possibly serve as a warning device or even be used for automatic shut-down.

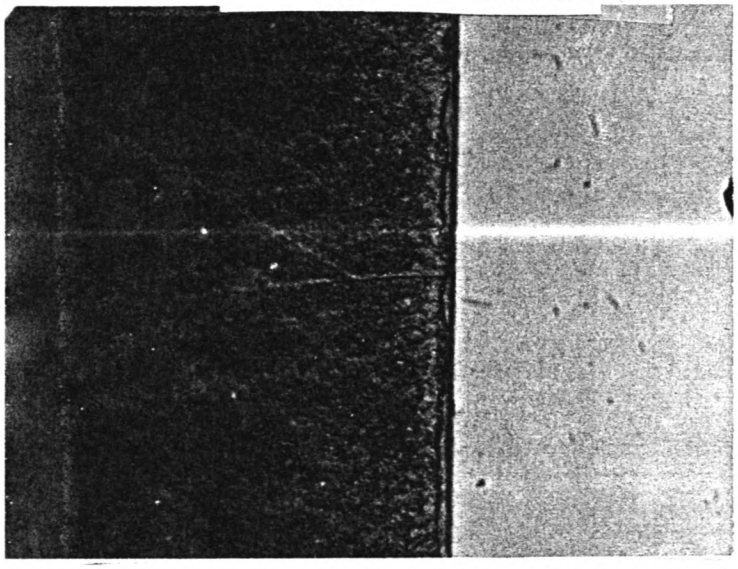
What is the fix?

For the moment, keep the vacuum column edge contact areas clean (inspect them with a magnifier) and minimize high speed running. We are examining the properties of various surfaces in the hope that we can find a material that doesn't wear, has a high heat conductivity, low friction, and doesn't like to catch dirt. A thin coat of diamond is one such surface which might perform well. Another is a specially treated alumina surface known as "Tufram" (a trade name of the General Magnaplate Corp., Linden, N.J.).



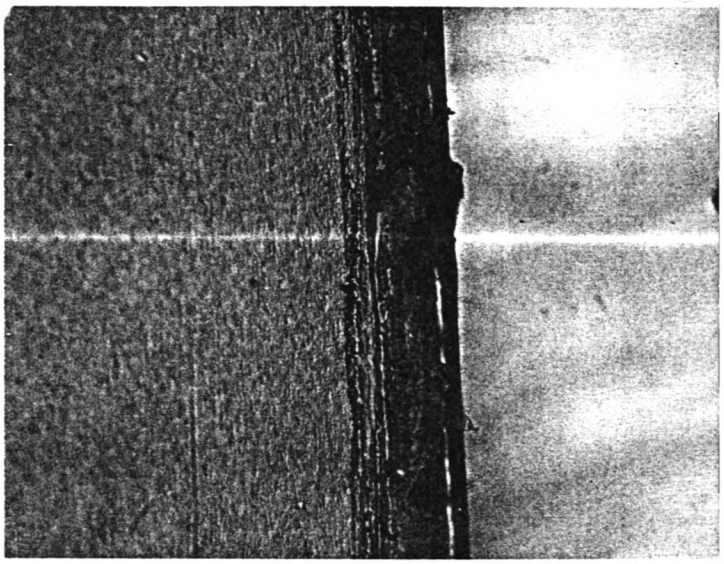
NOTES: 1] ADDED POSTS USING EXISTING TAPPED HOLES
2] HEADBLOCK ASSEMBLY IS REMOVED
3] LOOP SHOULD BE ABOUT 23" LONG
4] LOWER VACUUM COLUMN IS SEALED WITH SMALL FIXED LOOP

Figure 1. Schematic of tape loop



INNER EDGE X640 BACKCOAT EDGE NEAR PP

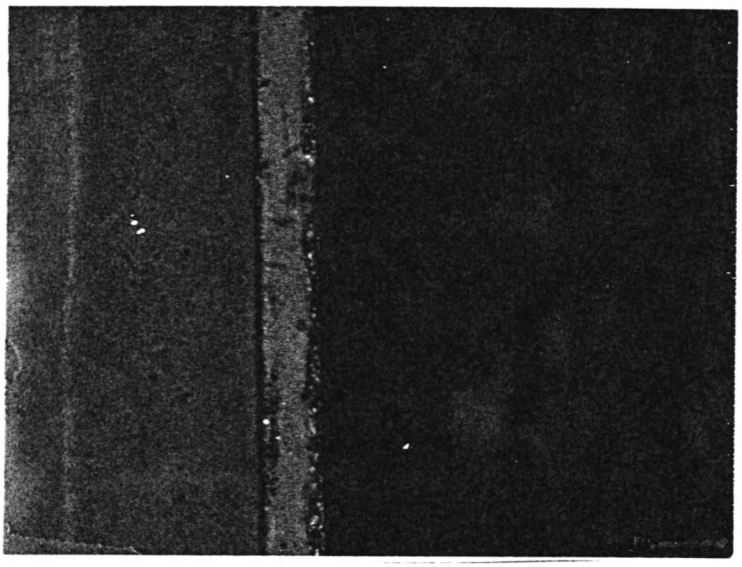
Figure 2A. Side view of tape which developed bumpy pack in normal use.



3M X160 SEVERELY MELTED

Figure 2B. Side view of tape edge damaged by dirt in "loop" tests.

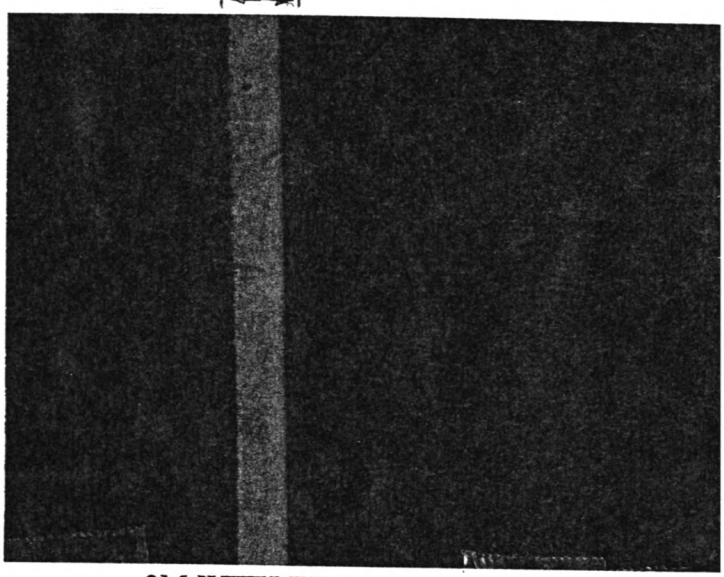
X640



3M EDGE 12 HRS X 9000 AT 160 10"

Figure 2C. Top view of tape edge which was undamaged in 12 hrs. of accelerated testing.

X640 18 µm



3M WITH EDGE FLOW

Figure 2D. Side view of severe edge damage showing a thickening of 3M 13 µm tape to 18 µm in "loop" tests.