VLBA ACQUISITION MEMO # 364

National Radio Astronomy Observatory

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To: VLBA Data Acquisition Group

From: Clint Janes

Subject: The Accelerated Tape Test

The Accelerated Thin Tape Test was initiated March 1992, with 26 thin tapes to test the upgrades to the Metrum 96 recorder tape path and to test the survivability of the thin tapes themselves. The test called for shuttling the tape back and forth for 8 hours at 330 ips and 10" of water vacuum tension followed by a slow speed "wind test" at each of 8 remote test locations, Pie Town, Los Alamos, Kitt Peak, Fort Davis, Owens Valley, Brewster, North Liberty, and Socorro. After each remote test, the tape was returned to Haystack for similar testing to complete one test cycle. The goal was to perform 35 test cycles on each tape to simulate 5 years of usage. The wind test was removed from the procedure at the remote sites in October 1992.

Results by manufacturer

Ampex: At the end of May 1992, the first Ampex tape failed; and by July 1992, all eight Ampex tapes in the test had failed. The failures in general were attributed to tape edge deterioration apparently caused by overheating of the edge. The damaged edges cause the tape pack to bump up in an unrecoverable way.

Sony: Of the ten Sony tapes selected for the test, two failed early on; one was damaged on a misaligned tape recorder; the other bumped up from causes unknown to this writer. A third Sony tape failed in January 1993, when an edge was damaged apparently during shipment. The tape was shuttled with the damaged edge after which the tape edge was deformed through the entire pack. The shipping damage may have resulted from a faulty reel; more on this under "what was learned". Four tapes were removed from the tape sample in October, one because it was used for recording data by mistake, and the others to reduce the testing load on the remote sites. Of the three Sony tapes remaining in the test until completion, one, USNO1013, was cycled 36 times and survived even after having been tested on an unmodified drive by mistake on one occasion. The other two survivors received nearly 30 test cycles each with no reported failures.

3M: Eight 3M tapes were initially selected for the test; of these four failed: one failed in June 1992, after having been tested at high relative humidity; a second appeared to have been damaged by something in the tape path of the drive being used at

the time, but the cause was never conclusively identified; the third suffered the same fate as the Sony tape that was apparently damaged in shipment. Like the Sony tape failure, the third 3M tape failure may have resulted from a faulty reel. The fourth failed tape was received at a remote test site with spokes and a 25 mil separation between the tape pack and one of the flanges. Haystack marginally recovered the tape, but it was finally withdrawn from testing in March 1993, after 24 cycles. Four tapes were dropped from the sample in October to reduce the workload on the remote test sites, so that none of the original eight survived to the end of the test.

Four 3M tapes from a newer batch were added to the test in October 1992. Three of these were damaged during testing, but were recovered, so that all four survived to the end of the test with an average of 16 test cycles each. One was broken and spliced on two different occasions, one was received at Haystack with spokes, and one was damaged in shipment like the two tapes mentioned earlier. This time, the damaged edge was removed and the tape spliced early in the test procedure so that the tape was recovered.

What was learned:

1. Both Sony and 3M thin tapes are sufficiently robust to use for data collection on a long term basis on a modified tape drive.

2. The modifications to the Metrum 96 drive for thin tape are successful.

3. The tape path must be kept clean and aligned.

4. Thin tape may not be used in high relative humidity; the current conventional wisdom sets the limit at 45%.

5. The flange separation specification for the self-packing reel is important; if the flanges are too far apart at the opening to the reel, the pack may shift during shipment and expose a tape edge. The exposed edge is easily damaged; if that happens, damage can migrate through the entire tape pack. This lesson lead to the discovery that the flange separation of some of the NASA/Corning self-packing glass reels are not within specified limits.

6. If thin tape breaks, it can be successfully spliced.

7. Shipping is an important part of a tape durability test.

Improvements resulting from the test:

1. Instructions for tape drive operators were prepared on how to care for thin tape, VLBA Technical Report 14 Rev A.

2. Special tools such as the shim kit, a loupe, and an orange stick were distributed to the tape drive sites with instructions on checking tape reels for damage and drives for alignment.

3. The tape drive firmware was modified to reduce the occurrence of tape stretching and breakage. One change drops vacuum any time the servo is turned off; the other delays motion of the reel motors until the vacuum motor is brought up to speed.

4. Remote relative humidity sensing of the tape drive room has been added to every recording site.

5. Procedures on recovering a damaged tape have been developed.

6. A new shipping canister reduces impact forces experienced by the tapes during shipment.

7. All the takeup reels at recording sites are being replaced with glass reels which have a hub covering that provides an electrostatic cling to a tape end for easier loading.