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7 August, 2001

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To: Distribution

From: Thomas Buretta

Subject: Evaluation of Capstan Noise for Model 96 Tape Transport

Rebuilt Capstan motors for Model 96 tape transports are routinely tested upon receipt at the NRAO Correlator in Socorro, NM. The testing procedure was developed by Steve Durand and all testing was performed by him. The capstans in this discussion are rebuilt by PTC Engineering of Temecula, California. Steve indicated that about one in ten of the rebuilt capstans generated sufficient internal noise to render them unusable for correlator playback. The capstans in question were sent back to PTC Engineering for evaluation and in all cases, the interference could not be detected in the testing procedure at PTC. Steve Durand requested assistance from Haystack, providing us with a rejected capstan and a complete set of the testing procedures and results of the tests for the defective unit. The capstan in this discussion is referred to as NRAO No.41.

Since satisfactory playback performance is the ultimate goal of capstan noise, I played back a pre recorded tape, recorded at Westford at 80 ips, Mode C. I performed six peak/parity cycles and logged the three best. Parity counts were typically from 200 to 800 with 30 to 40% of the tracks with sync slips. I repeated the same tests with six different capstans; five of which were rebuilt by PTC Engineering. One of the six rebuilt capstans tested (No.AD90) had parity and sync slip counts comparable to NRAO No.41. All the remaining capstans produced excellent parity counts with no sync slips. This lead me to the conclusion that a certain percentage of capstans rebuilt by PTC were unacceptable for reproduce use.

I examined the capstans that were on the Haystack correlator drives and found only Drive 5 with a rebuilt capstan. Mike Titus mentioned that Drive 5 was his poorest performing drive producing the highest parity errors. I asked Mike to run morning tests at two speeds in both directions and produce fringe plots of all scans. I then replaced the capstan with the best rebuilt capstan I had and asked Mike to run the same morning tests. After comparing the two sets of fringe plots, it was found that there was absolutely no difference between them. The conclusion is that the poor playback performance of Drive 5 is not caused by a noisy rebuilt capstan.

I shuttled capstans NRAO NO.41 and No.AD90 for 65 hours at 270 ips using two tape drives and repeated the above reproduce test. Both capstans parity and sync slip counts improved to between 75 and 400 with fewer than 10% of the tracks with sync slips. An additional 70 hours of shuttling resulted on only slight improvement over the 65 hour figures.

A motor noise test to detect brush interference, suggested by Steve Durand, was performed on capstan NRAO No.41 and the original Haystack Acquisition capstan. The DC voltage and AC ripple was compared

at 80, 160, and 320 ips. The only significant difference between the two capstans was a 10.0ms AC component of 50mv on NRAO No.41 at 80 and 320 ips. There was no evidence of excessive spikes from brush noise.

The reproduce spectra was observed with a spectrum analyzer using the same pre recorded tape described above. Recorded and unrecorded spectra was observed at 80 and 160 ips. Reproduce bandwidth and signal to noise were observed at 80 and 160 ips. All spectra were clean with no evidence of interference attributed to capstan noise.

In an attempt to duplicate one of Steve's spectra plots as closely as possible, (a plot which exhibited excessive noise in amplitude and frequency) Dan Smythe wrote a program to set up the Mk4 Formatter for all 1's recording. A section of tape was recorded with all ones in both directions at speeds of 80 and 160 ips with the Haystack Acquisition capstan installed. The all ones recorded spectra was observed at 80 and 160 ips playback with the Haystack capstan and NRAO No.41. There was virtually no difference in any of the plots and none of the noise shown in Steve's plot was evident.

The final test was to record a random signal at 80 and 160 ips with USNO No.41 capstan installed and play back with the same capstan. All recordings had excellent eye patterns and error counts were mostly 0's or single and low double digits.

We found none of the interference and noise evident in the literature supplied by Steve Durand. The only conclusion I can make is that the initial 130 hour run in during my parity checking was sufficient to bring NRAO No.41 capstan beyond its noise interference threshold. Further testing of capstan AD90 will be done on a time available basis.

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