OVLBI-ES MEMO NO. 34

Recorder Acceptance Tests Report

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1 Introduction

Acceptance tests for the VLBA tape recorders were performed on 19 and 20 August 1992 at the Signatron factory in Lexington Massachusetts. NRAO representatives were Larry D'Addario and Randy Hudson. Tests were conducted with Signatron representatives John Eschle and Nicholas Leary.

Approximately 20 hours were required to complete the tests on the two tape machines. This time included an initial discussion of the tests between Signatron managers and NRAO representatives.

2 Tests Performed

Tests were performed under control of a PC running a version of the VLBA control software which had been translated into PC compatible code by the Russian OVLBI group. There were some inconsistencies in the software but they were not the fault of the translation

Two recorders were tested, and they were assigned the serial numbers 1 and 2.

Test signals were supplied by a VLBA Formatter using MKIII data-replacement mode. Signatron supplied the Formatter. Details of the setup can be found in [1].

Two bulk-erased tapes were available for the Read/Write tests and a pre-recorded alignment tape, which was sent directly to Signatron from George Peck in Soccoro, was used for the playback-only tests.

All data analysis was done with the Formatter quality-analysis module. Track locations were determined using the TDC 'Peak' command and monitoring the track 'power output' on the *TAPE HEAD* screen.

2.1 Bypass Tests

The recorder was set up to record but with no tape loaded. All tracks were checked with the formatter quality analysis module for proper track identification and parity errors. All track channel numbers were the expected ones, time was properly decoded on all tracks, and no parity errors were reported.

The results were identical for both machines.

2.2 Calibration Tests

2.2.1 Vacuum Cal

The Vacuum sensor screen readout was calibrated using the procedure outlined in [6]. This calibration affects only the screen display and is purely a matter of convenience, it was done first to aid in later tracking tests. (see sec. 2.4)

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2.2.2 LVDT Cal

The first test involving tape motion used the pre-recorded tape to calibrate the LVDT head position sensor and to determine the forward and reverse tape offsets.

Using a procedure similar to those outlined in [2] and [5], the tape was first played in the forward direction at 135 ips. The LVDT cal values were left at their previous nominal values. Track 18 was found and peaked. The heads were moved in a positive direction until track 19 was found and peaked. A correction factor was computing by dividing the indicated distance that the head had to be moved by the known distance between tracks (698.5 microns). A new LVDT (positive) cal value was computed by dividing original LVDT (positive) cal value by the correction factor.

The heads were then moved in the negative direction so that track 17 was being read by head 18. A similar procedure was used to calculate a new LVDT (negative) cal value. The new cal values were then entered into the screens and the head positioning was verified to be correct.

2.2.3 Offset Determination

Once the LVDT was calibrated, the tape was run in the forward direction while track 18 was monitored and peaked every 1000 feet or so. The absolute head position was recorded for each peaking. The head postions were averaged. The actual head position (−55 microns) at which the tape was recorded was subtracted from the mean indicated head position to get the forward tape offset.

The tape was then run in reverse and a similar procedure was used to measure the mean absolute head position. The recorded head position (+55 microns) was then subtracted from the mean indicated head position to get the reverse tape offset.

2.3 Playback Test

The calibration tape and Formatter quality analysis module were used to check playback error rate in the forward and reverse directions. Error rates were measured over a 1-second interval. If an unusally high error rate was detected, it was noted and the same track was checked again to account for possible burst errors. Complete data for these tests is reported in [1].

A separate run was performed on recorder serial #1 and all tracks were checked. On recorder #2 this test was combined with the tracking tests and only the center and near-edge tracks were sampled. For recorder #1 the error rates were read only once unless a burst error was detected while for recorder #2 the error rate was measured at several locations along the tape at various levels of vacuum and at both 135 ips and 270 ips.

Recorder #	For/ rev	Track #	Error rate
1	F	1	1.2×10^{-5}
1	F	18	0
1	F	34	2×10^{-6}
1	R	1	7.8×10^{-5}
1	R	18	0
1	R	34	4×10^{-6}
2	F	1	3×10^{-6}
2	F	18	1×10^{-6}
2	F	34	1×10^{-5}
2	R	1	0
2	R	18	0
2	R	34	0

Table 1: Read performance – pre-recorded test tape at 135 ips.

At 135 ips the mean error rate for all tracks on recorder #1 was 1.4×10^{-5} while the mean error rate for the sampled tracks on recorder #2 was 6.8×10^{-6}. Table 1 summarizes the performance of the recorders. The error rates for recorder #2 are averages of 3 readings.

2.4 Tracking Tests

The pre-recorded alignment tape was played at both 135 ips (4.5 MHz bit rate) and 270 ips (9.0 MHz bit rate) to determine if tape position shifted due to the change in tension at the two speeds. The tape was also played at several levels of vacuum and track position was also monitored to determine if tape position was affected. These test are outlined and explained in [7].

	Recorder #1		Recorder #2	
	Vacuum inches	rel posn microns	Vacuum inches	rel posn microns
Nominal	9.0	0.0	9.2	0.0
Minimum	7.5	+1.8	8.2	+2.7
Maximum	12	-0.2	13.5	+1.4

Table 2: Tracking shift with vacuum change

Changes in tracking due to vacuum variations are summarized in table 2.

For recorder #1 changing forward speed from 135 ips to 270 ips caused a nominal track shift of −9.4 microns. Track shift with speed change was measured at 3 points along the length of the tape in both the forward and reverse direction for recorder #2. The mean track shift was −4.1 microns for the forward direction and −1.6 microns for the reverse. All measurements show much less shift than the limits suggested in [7].

2.5 Read/Write Tests

A bulk erased tape was mounted and was recorded on several tracks at 270 ips and 9.0 MHz data rate. The pattern of tracks recorded in both the forward and reverse directions were those suggested in [5]. All recorded tracks were played back and the parity error rate checked. If an unusually large error rate was noted then the same track was checked several more times to determine if the problem was a burst or a bad track. All measurements were recorded. The tracks used for these tests are shown in table 3.

Track Index	Position microns	Tracks Used	
		for	rev
5	−110	even	odd
6	−55	even	odd
7	0	all	none
8	+55	none	all

Table 3: Tracks used for Read/Write tests

For the first recorder (#1), the write voltage was varied to determine if it had any effect on error rate. It did not, but it was discovered that the actual write voltage (as set by the TDC WVOLT command) was double the voltage displayed by the *RECORDER PARAMETERS* screen.

It was determined that 9 volts was just large enough to consistently saturate the tape on machine #1 so that value was used in the tests (this is displayed as 'WRITE VOLT 4500' by the *RECORDER PARAMETERS* screen. The same write voltage was used on machine #2.

No major errors were found in the Read/Write tests. That is, no tracks were inadvertently overwritten nor were any tracks missed. On playback, all tracks identified properly and occasional spot checks of time were consistent with the recording time.

Track Index	Recorder #1		Recorder #2	
	Worst Track	Error Rate	Worst Track	Error Rate
5 for	10	1.6×10^{-4}	12	1.6×10^{-4}
5 rev	7	1.1×10^{-4}	13	8.3×10^{-5}
6 for	6	7.5×10^{-5}	20	8.1×10^{-5}
6 rev	19	3.7×10^{-5}	21	1.2×10^{-4}
7 for	27	5.5×10^{-5}	3	1.4×10^{-4}
8 rev	29	1.1×10^{-4}	29	1.2×10^{-4}

Table 4: Worst performing tracks

Error rates are summarized in table 4. If a burst error was suspected, one or more subsequent readings were taken. If subsequent readings showed an error rate over 10 times better than the first, then it was assumed the first reading was a burst and is not reported in the summary. If subsequent readings showed error rates greater than one tenth the error rate of the suspected burst reading, then the rates were averaged, and if that reading constituted the worst track, it is reported here. If an edge track (0 or 35) showed the highest error rate, then the next worst track is reported.

Complete data is available in [1].

3 Conclusion

The recorders worked. We bought them.

References

[1] John Eschle. *Acceptance Test Plan for VLBA Acquisition Recorders.* SIG-2-00000-25, Signatron Document no. 00225. 18 August 1992.

[2] *VLBA Recorder Headstack Calibration.* 4 Dec 1991.

[3] George Peck, Alan Rogers. *Recorder Test Procedures.* VLBA Acquisition Memo no. 289, 13 Sept. 1991.

[4] George Peck. *Instructions for Use of VLBA Calibration Tape.* Personal Communication, 1992.

[5] George Peck. *Additions to the Suggested Performance Tests for VLBA Recorders.* Personal Communication, 1992.

[6] George Peck. *Calibration of the VLBA Recorder Vacuum Sensor.* Personal Communication, 25 Mar. 1992.

[7] A. Rogers, R.J. Cappallo, H.F. Hinteregger, D.L. Smythe, A.R. Whitney. *Recorder pretest – Methods for Checking Recorder Performance.* VLBA Acquisition Memo no. 151, Haystack Observatory, Westford MA. 20 June 1989.

[8] Ronald W. Heald *VLBA Tape Drive Control (TDC) Program.* 10 Feb. 1988.