VLBA ACQUISITION MEMO #151

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To: VLBI Group

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Subject: Recorder "pretest" - Methods for checking recorder performance

Introduction

A "pretest" has been designed to verify the performance of the recorder. It would be advantageous to automate these tests as far as possible. Some of the tests need only be occasionally performed while others should be frequently performed as noted.

Pretest (for MKIIIA and VLBA with differences noted)

0] Visual inspection - Perform a complete visual inspection of the transport.

Search for grooves in the critical areas - see attached Figure. Also, check that the reel tables are not grossly misaligned so that the tape is always scraping the reel flanges.

1] Tape angle - Perform after changes/repairs that necessitate recalibration.

Playback any recording in the reverse direction and carefully slide a feeler gauge between the precision plate and the tape where it passes over the screw insert for mounting the lower headblock assembly. Find the gauge that just shifts the tracking. The distance between the tape edge and the precision plate in the vicinity of the headstacks should be between

1.5 and 4.5 mils.

2] Forward-reverse shift - Perform at least one per experiment session.

Measure the forward-reverse shift in tape position by peaking on a recorded track in the forward and then in the reverse direction and measuring the difference in absolute head position. This shift should be less than 50 microns. (If possible, check at the beginning, middle and end of the tape.)

3] 270-135 speed shift - Perform at least once per experiment session.

Measure the shift in tape position by peaking on a recorded track at 270 inches/sec and then at 135 inches/sec and measuring the difference in absolute head position. This shift should be less than 20 microns. Check in both forward and reverse.

4] 14" - 7" vacuum shift - Perform occasionally - since this test cannot be automated with MKIIIA.

Measure the tape shift with vacuum pressure from 7 to 14 inches. The shift should be less than 15 microns. Check in both forwards and reverse.

5] Tape flip test - A check on LVDT zero-point calibration.

Record with head 15 (VLBA head 18) at -350 microns (calibrated position) and measure the shift in playback with tape "flipped" over (exchange takeup and supply reels). Since the recorded track should be in the center of the tape the shift (flip - normal) should be 120 ±80 microns. (For systems calibrated with a calibration tape - for "new" calibration method the flip - normal shift should be less than 80 microns.)

6] LVDT Scale calibration test - Perform at least once per experiment session.

Record with heads 14, 15, and 16 at zero calibrated position[1]. Playback with head 15 and check that tracks are reproduced by head 15 at -698.5, 0, and +698.5 microns with less than 10 microns error. Then with the read head fixed at zero, record with head 15 at -698.5, 0, and +698.5 microns and verify the separation of these recorded tracks with the read head.

7] Record margin check - Perform frequently at nominal vacuum and occasionally at vacuum margins.

Record a forward mode C pass with odd heads followed by reverse pass with even tracks at the same calibrated head position (same index number). Measure the error rates on all tracks. If forward tracks have a higher error rate it may be due to a worn headstack or an overwrite problem. [Overwrite can occur with record current set too high in conjunction with record cross-talk between adjacent heads in the stack.] If reverse tracks have a higher error rate it may be due to head saturation (again reducing record current may help).

Check by recording 8 Mb/s at 270 and 4 Mb/s at 135. Verify error rates at 135 playback. Also check at low vacuum (7") and high (14") vacuum for both records speeds. Remember to return vacuum to the nominal 9" after tests.

8] Tape shift with head position - Cannot be checked on VLBA without optical sensor.

If a headstack is worn in a non-uniform manner or damaged, the position of either headstack may alter the tape path. This can be checked by playing back a recorded track, moving the record headstack plus and minus 1400 microns and verifying that the tracking is affected by less than 10 microns. In a similar fashion the influence of the read head can be checked by moving the read head during recording and verifying that the recorded track was not influenced by the position of the read head.

[1] If any of heads 14, 15, or 16 are unusable, 3 other consecutive heads may be used.

9] Log results and return to Tom Buretta/Haystack

Recorder Serial #_____ Station _____

Date of Tests _____ Performed by _____

0] Visual Inspection: Evidence of grooves in critical areas Y N

Reel table alignment O.K. Y N

1] Tape angle: Distance from tape edge to plate _____mils

2] Forward-reverse shift:

3] 270-135 speed shift: Forward _____microns

Reverse _____microns

4] 14" - 7" vacuum shift: Forward _____microns

Reverse _____microns

5] Tape flip test: Flip - normal _____microns

6] LVDT cal. test Read LVDT error _____microns

Write LVDT error _____microns

7] Record margin check: Worst combination PER _____

Record Head # _____

Repro. Head # _____

Speed _____inches/sec

Direction _____

Vacuum _____inches

Write voltage _____volts

8] Tape shift: by read head motion _____microns

by write head motion _____microns

Calibration constants: Please copy lines from (EXPER file

10] Tracking repeatability test - Perform at least once per experiment session.

When peaking software becomes available it will become possible to follow a recorded track for a forward and reverse pass from the beginning to the end of a tape. Results could be plotted or perhaps compared with the results stored in a previous "test" file and the differences summarized.

11] Density margin check - for VLBA recorders - Perform once per session.

Measure the error rates at increased and reduced longitudinal density on all tracks. With Fuji H621 tape, error rates under 1% should be obtained from 27,000 to 67,000 bpi. Record and playback using 8 MHz sample rate with tape speeds from 135 to 330 ips. Difficulty in reaching high density may indicate poor head to tape contact or poor head performance.

BRIEF DESCRIPTION OF THE REASONS FOR, AND THE THEORY BEHIND TESTS.

0] Visual inspection

VLBA Acquisition Memo #121 gives the sensitivities of tracking to mechanical misalignments and imperfections. The presence of grooves in the critical edge guiding region is the most serious problem as the grooves can produce non-repeatable tracking.

1] Tape angle

VLBA Acquisition Memo #124 shows that the sloping sides of the vacuum column produces a bias torque that produces a tape angle of 85 arcseconds so that the tape should move away from the precision plate by an amount of 2.5 mils at the location of the headstacks. Measuring the tape angle provides a check on the mechanical alignment of the transport. The most common misalignments are:

1] A tapered capstan roller.
2] Tilted headstacks.
3] Strained or bent precision plate.

If the tape angle is zero the tape edge contact extends along a line extending almost to the headstack area. The machine will track differently and a large machine interchange signature will result.

2] Forward-reverse shift

Asymmetries in mechanical alignment are the primary cause for a forward-reverse shift, although anisotropies in the tape's elastic constants can also produce a significant forward-reverse shift (see VLBA Acquisition Memo #129). Components before the capstan affect the forward shift while components after the capstan affect the reverse shift.

3] 270-135 speed shift

At high speed, the tape is subject to additional forces due to air entrapment. Any shift in tracking with speed is a measure of tension variations across the tape (due to alignment errors and capstan taper) which result in asymmetries in the air entrapment loading.

4] 14"-7" vacuum shift

A shift in tracking with vacuum pressure is another indication of tension variation across the tape. Also, changing the vacuum moves the position of the loop in the vacuum column (since the reel servo is a first order servo) and this produces small shift (see VLBA Acquisition Memo #123) which can be greatly magnified by the presence of grooves in critical areas.

7] Record margin check

If there is a problem with head to tape contact it will become more evident when the transport is operated at different speeds and tape tension. Tension variation across the tape will be aggravated at low vacuum and high speed so that poor head to tape contact may become evident on an edge track. Whether a spacing loss develops depends on the head profile and the tension. VLBA Acquisition Memo #141 gives some computed tape profiles.

Note on limits

The limits given in this memo are based partly on mechanical specifications and partly on experience. If the recorders are upgraded to use an idler/roller (mode 3 operation in Acquisition Memo #132) the limits will be made more stringent.

A list of VLBA Acquisition Memos related to these tests:

Memo #/Date	Subject	Author
121 24FEB89	Tracking Offset sensitivity to Capstan axis alignment	A.E.E. Rogers
122 24FEB89	Tracking offset sensitivity to capstan taper Angle	A.E.E. Rogers
123 24FEB89	First order model for recorder tracking	A.E.E. Rogers
124 24FEB89	Theory of vacuum loop and tape path	A.E.E. Rogers
126 24FEB89	Variation of the tracking sensitivity with the angle the tape makes with the precision plate	A.E.E. Rogers
129 13APR89	Model for the Tracking Offset Dependence on Tape Defects	A.E.E. Rogers
132 13MAR89	Various Operating Modes of the Model 96 and Sensitivity to Machine Alignment and Tape Defects	A.E.E. Rogers
137 12APR89	Draft Recommendations for Improvement to Model 96 Mechanical Performance	A.E.E. Rogers
141 18APR89	Head to Tape Contact Profiles: Computation of Inter-changeability of Various Tapes	A.E.E. Rogers

Memo #/Date	Subject	Author
143 01MAY89	Summary of what we have learned during recorder mechanical study	A.E.E. Rogers
146 05MAY89	Head to tape contact at 270 IPS	A.E.E. Rogers
147 16MAY89	Measured Head Profiles	A.E.E. Rogers
152 05JUN89	A magnetic circuit model for the VLBA headstack	A.E.E. Rogers

New Calibration Procedure

Date	Subject	Author
28APR89	Draft high-density head position calibration procedure	A.R. Whitney

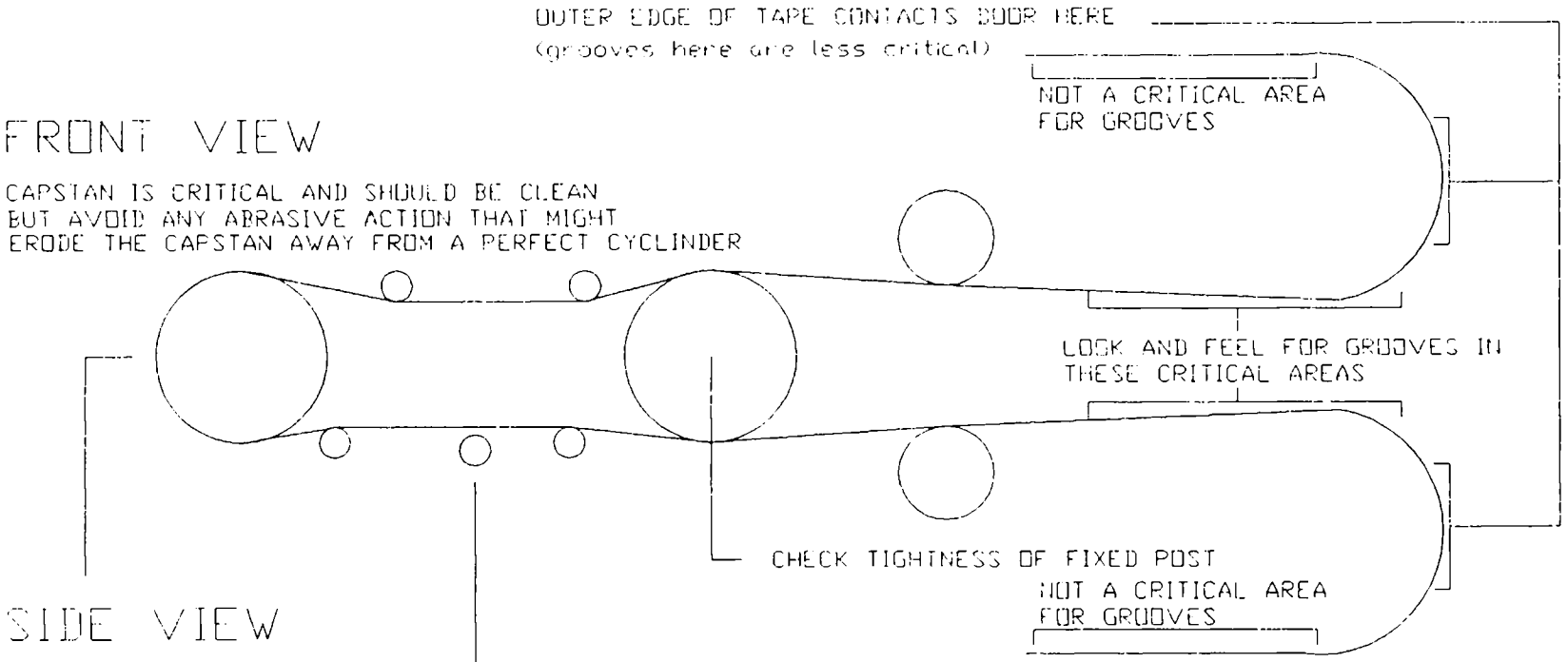

FIG. CRITICAL TRANSPORT ALIGNMENT CHECKS