# VLBA ACQUISITION MEMO #142

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*Area Code 508*
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To: VLBA Data Recording Group

From: Alan E.E. Rogers

Subject: Tape Strain: Determination of the best tape tension for thin tape

1] Present operation with 25 micron tape at 10 inches of water

Ten inches of water with a loop radius of 1.3 inches (see Acquisition Memo #124) produces tension in the tape of 0.5 lbs. which in turn produces a longitudinal strain of 0.07% (see Acquisition Memo #134 - see Figure 3 - whose strain axis labels should be doubled while Figure 2 of Acquisition Memo #129 is correctly labelled). The reel pack builds up a strain in the thickness direction of 0.2% at the hub of a 14-inch reel (see Figure 2 of Acquisition Memo #129). On its passage through the transport the tape is bent to a radius of 0.35 inches going over the input-output rollers or posts which produces a maximum strain of 0.14% at the outer edge (tension) and inner edge (compression). The strain around the vacuum loop is 0.04% and around the capstan 0.09%. Passage over the headstack produces the greatest strain and using the theory of Acquisition Memo #141, we can calculate the radius of curvature going over the headstack from Figure 2 to be 5000 $\mu$m and hence the maximum strain is 0.25%. The pressure on the headstack is about 7 lbs/per square inch assuming a 10 degree full wrap angle and a 300 micron headstep width (see Acquisition Memo #141). The force on the edge of the tape in the vacuum columns (see Acquisition Memo #124) is 0.01 lbs and the radius of curvature of the contact is about $10^6$ microns as illustrated in Figure 1. The pressure will flatten the arc (like a tire flattens under the weight of the car) until the contact length L is sufficient to result in strains that balance the total force, i.e.,

$$\frac{L}{4R} \approx \frac{F}{tLY}$$

where

| | | | |
|---|---|---|---|
| | L | = | contact length |
| | R | = | radius of curvature of arc before flattening (≈40") |
| | t | = | tape thickness (0.001") |
| | Y | = | Young's modulus ($7 \times 10^5$ lbs/sq") |
| | F | = | force (0.01 lb) |

from which we can estimate L to be about 0.05", a strain of 0.03% and a pressure of 200 lbs/sq".

2] Going to 13 $\mu$m thick tape

In order to meet the VLBA recording time specification of 12 hours per tape we will almost certainly have to use thinner tape. Figure 2 illustrates the recording path along with the strains and pressures for 25 $\mu$m and 13 $\mu$m tape being run with the same tension. Running 13 $\mu$m tape at the same tension as the thicker tape will maintain the same pressure on the heads which may be required to minimize head clogging, minimize spacing loss, and maintain the "self-cleaning" effect. Also the increased longitudinal strain reduces dropouts from tape non-uniformities which produce poor head to tape contact. However, the reel pack strain is increased unless 13 $\mu$m tape has a higher elastic modulus in the thickness direction. Also the pressure on the precision plate is increased by $\sqrt{2}$. If it is not important to maintain the same pressure on the heads then it might be desirable to reduce the tension by a factor between one and two.

Enclosures: Figure 1. Tape Guiding Region
Figure 2. Strains and Pressures on Tape for 25 Micron Tape

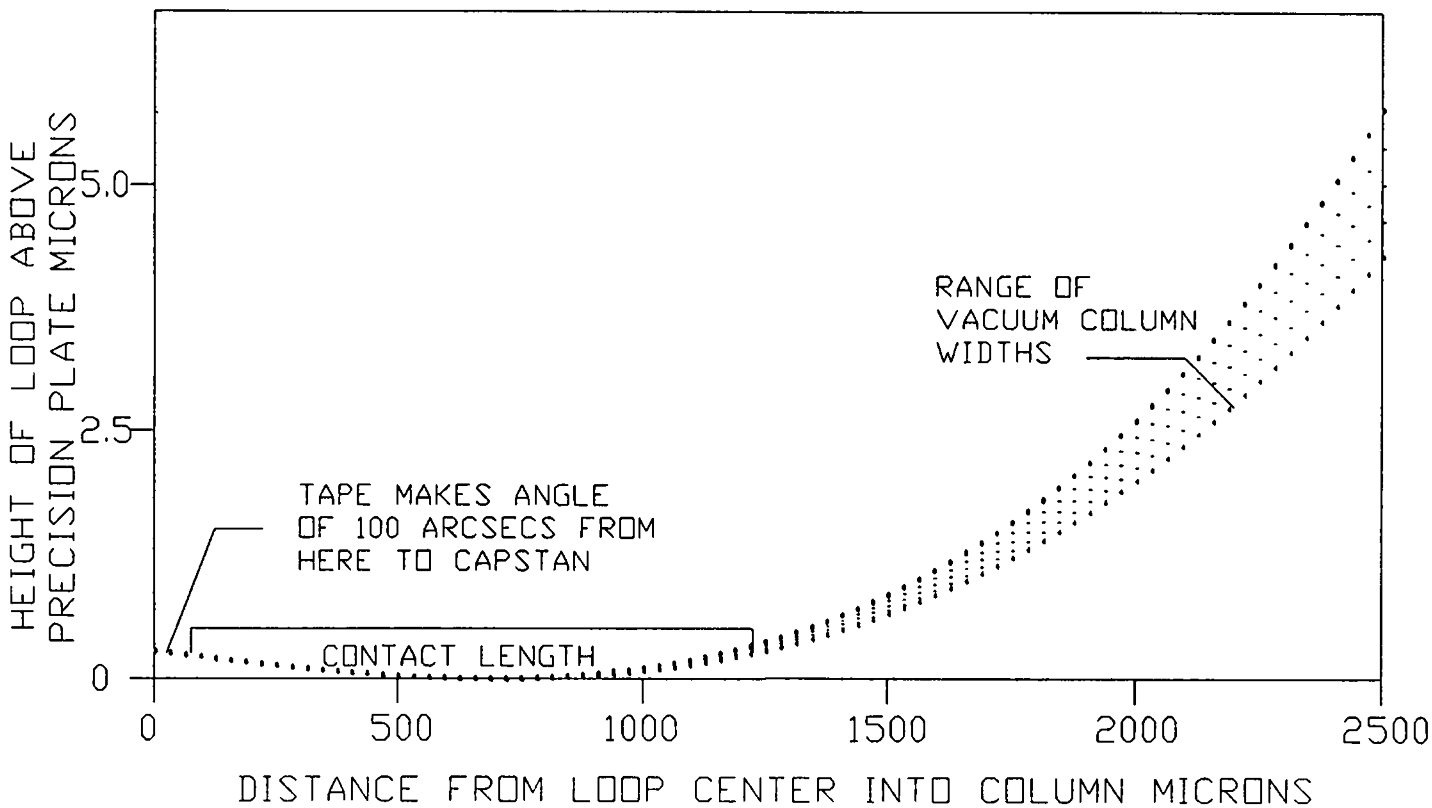


FIG 1 TAPE GUIDING REGION

FILE:LOOP1.DWG

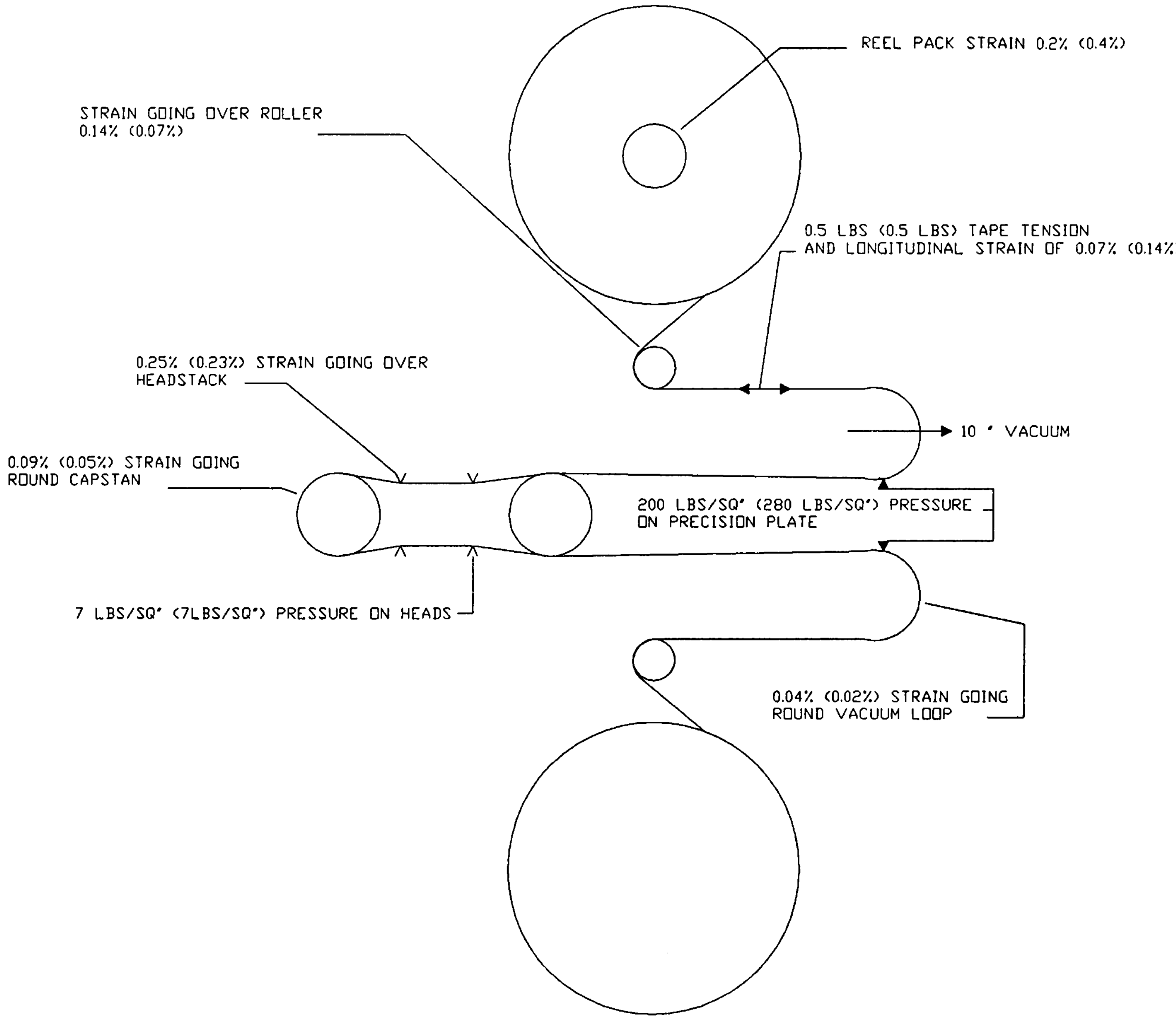


FIG 2 STRAINS AND PRESSURES ON TAPE FOR 25 MICRON TAPE

NUMBERS IN () ARE FOR 12 MICRON TAPE

FILE:STRAINS.DWG