VLBA ACQUISITION MEMO #282

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To: VLBA Data Acquisition Group

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Subject: Additions to head flying model and comparison with measurements

Using the relations

$$R = (p + L)/\theta \tag{1}$$

$$h = \Delta\left(L^2/(2R)\right) \tag{2}$$

and differentiating with respect to θ, tension and L

$$h = \frac{L^2}{2(p+L)}\left[\alpha + \frac{p\theta}{2(p+L)}\left(F - \frac{2\Delta L}{P}\right)\right] \tag{3}$$

where

- α is the change in tape angle - due to pressure increase before head
- F is the fractional reduction in tape tension
- ΔL is the reduction in effective length - due to pressure build-up at film entrance
- h is film thickness at entrance ~ overall film thickness

From VLBA Acquisition Memo #264.

$$\alpha = \left[\frac{6\mu V}{T\phi^2}\right] ln(1 + B\phi/Z) \tag{4}$$

$$F = (C-T)/C \tag{5}$$

where

C = contouring tension

T = operating tension

Now if we assume that entrance region approximates a foil bearing (from theory by Eshel)

$$\begin{aligned} \Delta L &\sim (2hR)^{1/2}/2 \\ &\sim (p+L)^{1/2}\, h^{1/2}\, \theta^{-1/2}\, 2^{-1/2} \end{aligned} \tag{6}$$

so that the "threshold" term depends on the film thickness. In Memo #264 I guessed at an effective length reduction due to finite length over which pressure builds up and then remains constant. Substitution of ΔL into the first equation for h gives a quadratic equation from which

$$h = A + B^2/2 - (B/2)(B^2 + 4A)^{1/2} \tag{7}$$

where

$$A = \frac{L^2}{4(p+L)^2}\left(2\alpha(p + L) + p\,\theta\,F\right) \tag{8}$$

and

$$B = \frac{L^2}{4(p + L)^2}\left(2\,(P + L)\,\theta\right)^{1/2} \tag{9}$$

Figure 1 shows the measured flying heights of various heads along with calculated flying heights for these heads. The calculations are based on equation 7, unless this film thickness cannot be supported, in which case the film thickness is given by the bearing theory of Memo #264. While the theoretical curves generally have the same shape as the measurement curves, the theory predicts less variation in the flying threshold between heads than observed. This suggests that other factors such as:

a) air leakage via the "glue lines" (gap between heads);
b) irregularities in the contour across and along the headstack;

may be having a significant effect on the air bearing.

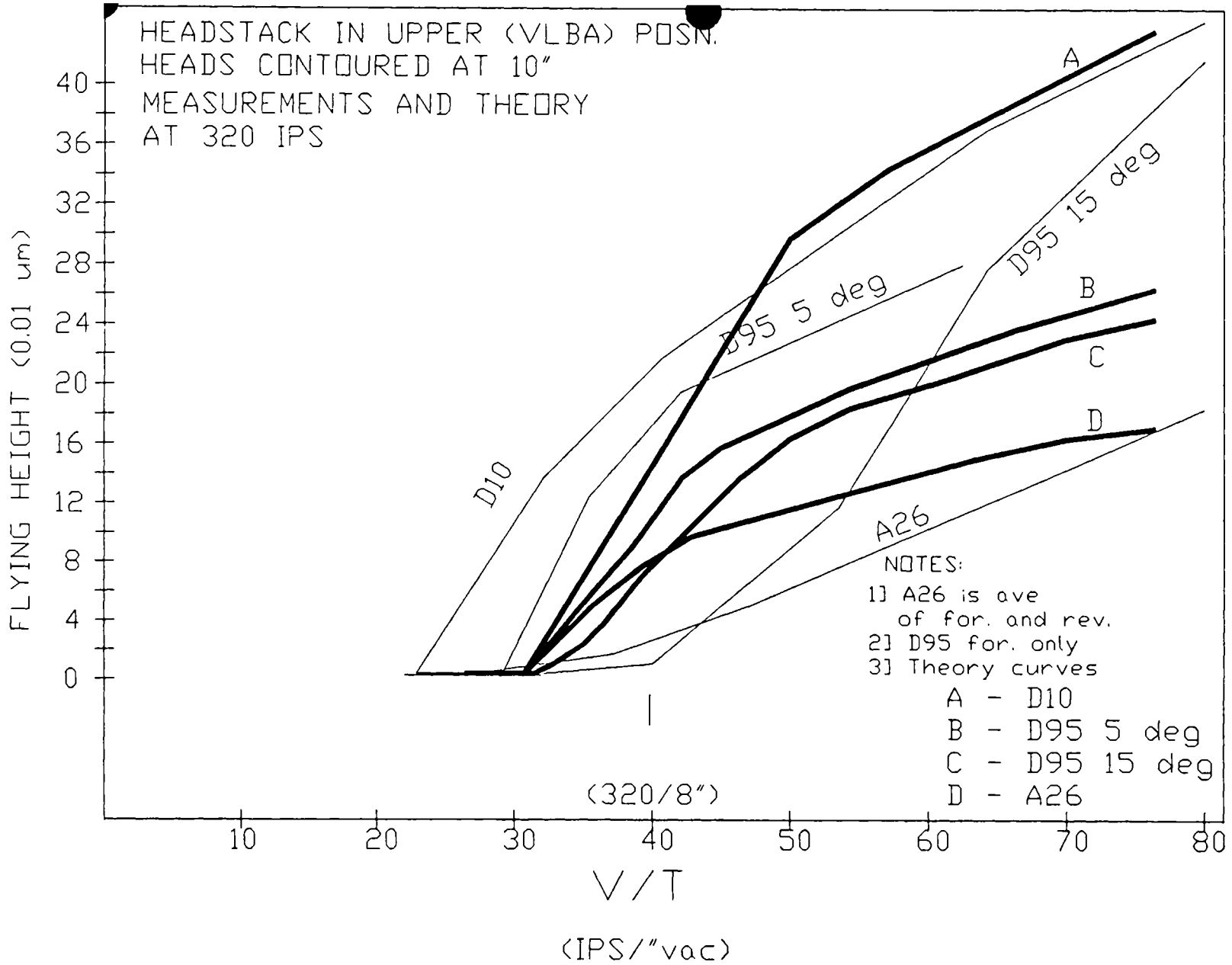

FIGURE 1. Some of the measurements vs theory (of memo 264) for 320 IPS and parameters of headstacks tested