VLBA ACQUISITION MEMO # 310

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

HAYSTACK OBSERVATORY

WESTFORD, MASSACHUSETTS 01886

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Telephone: 508-692-4764
Fax: 617-981-0590

To: VLBA Data Acquisition Group

From: Alan E.E. Rogers

Subject: More on the abrasion of tape edges by reel flanges

More tests have been conducted to determine the nature and severity of contact between the tape edges and the reel flanges. The abrasion can be demonstrated by shimming a reel out by 60 mils so that the inner tape edge is now in fairly strong contact with the reel flange and observing the rapid build-up of deposits on the alumina plate nearest the contact. By using a light to observe the gap it is clear that moving contact only occurs at the rim (see VLBA Acquisition Memo #308). Tests shows that the amount of deposit build-up depends strongly on speed - increasing rapidly above 120 IPS and being hard to detect below 120 IPS. The vacuum setting appears to have no effect. Placing a sliding contact just beyond the rim of the reel to prevent the tape edge from touching the fast moving reel surface eliminates the deposits and provides further evidence that abrasion occurs only at the rim where there is very high velocity contact. Additional evidence is provided by micrographs of the tape edge clearly showing the abrasion in regions previously seen to be undamaged. Rim contact using the self-packing glass reel inflicts many small abrasions while the aluminum reels inflict larger damage at less frequent intervals. It is clear that the nature of the damage depends on the roughness of the rim. Applying a coating of Permalon 327 (PTFE in thermoplastic resin) eliminated the abrasion and presumably polishing or other treatment of the glass reel rims would also cure the problem.

While the feathered tape edge cannot resist static forces the dynamics are important. The contact speed at the rim is

$$V = V_0\left((R/r)^2 - 1\right)^{\frac{1}{2}}$$

where V_0 = tape speed
R = rim radius
r = pack radius

For the 14" reel V can reach 3 times the tape velocity or 990 IPS (~ 90 Km/hr). Calculations of dynamic forces (in a manner similar to Memo #233) the pressure against the edge on a rough surface is

$$P = aV^2K^2pw \sim 5000\,KPa \ \ (800psi)$$

where
α = amplitude of roughness (5µm)
$K = 2\pi/\lambda$
λ = scale size of roughness (~ 100 µm)
V = velocity (25 m/sec)
p = density (2000 kg/m^3)
w = bending scale (~ 200 µm)

can easily exceed the elastic limit for PET.

For normal reel alignment this "abrasion" mechanism is not a problem - but it does place some limits on how badly a reel can be distorted before a problem can exist. At present, fairly severe reel distortions can be produced in shipping due to the high accelerations present when a cannister is dropped. Investigations concerning the adequacy of the cannister to prevent excessive distortions are in progress.

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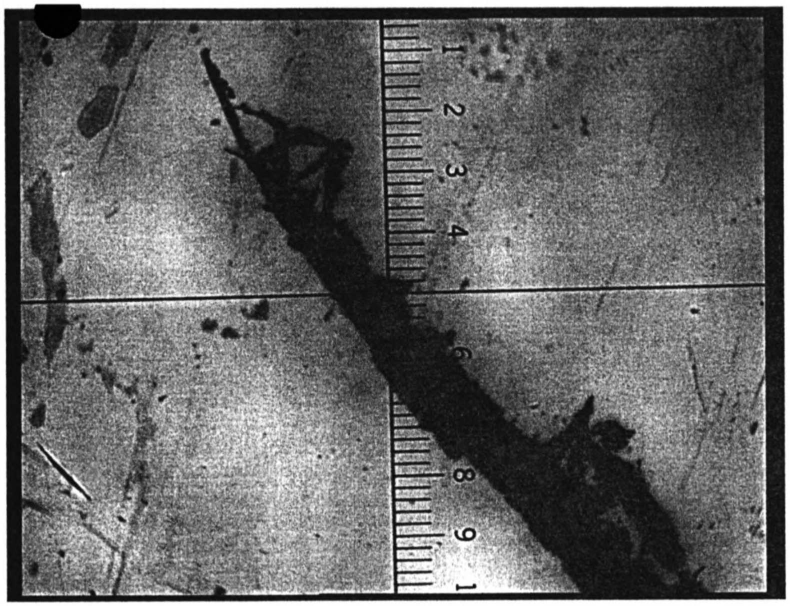
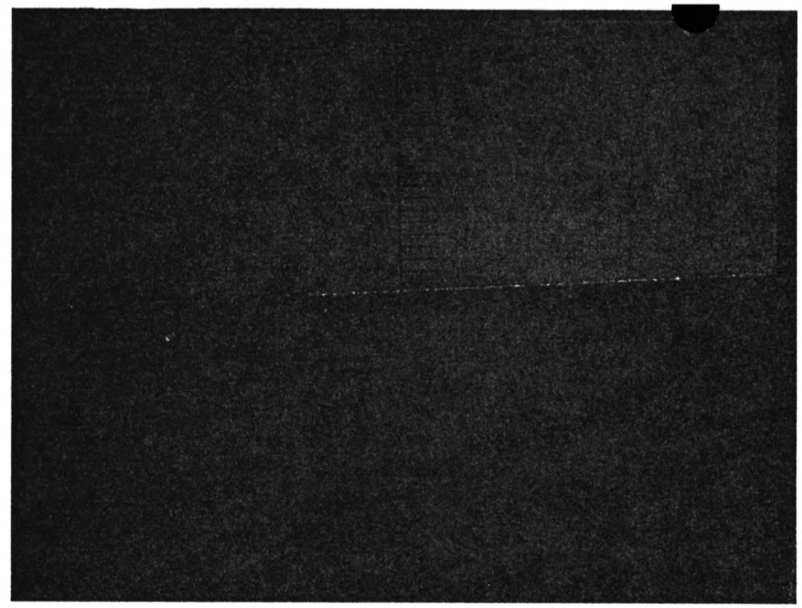
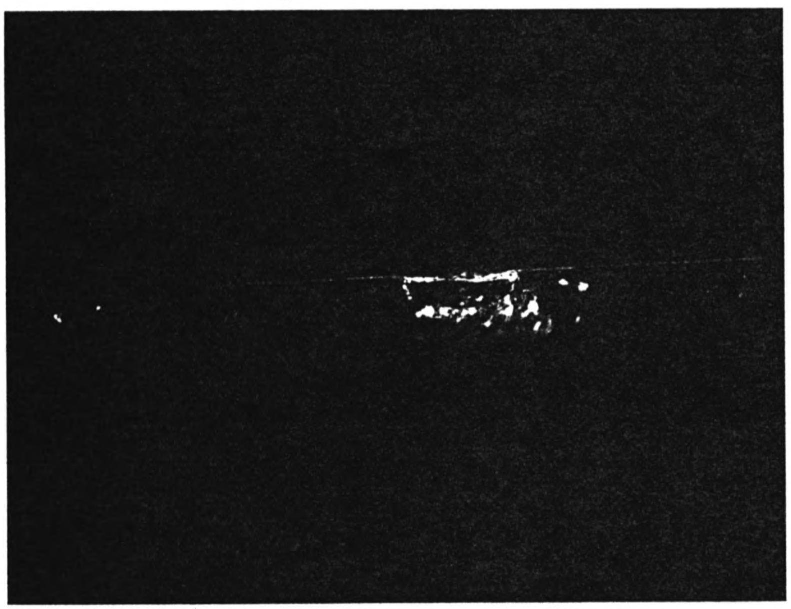


X50

SHAVINGS FROM EDGE RUNNING AGAINST METAL REEL

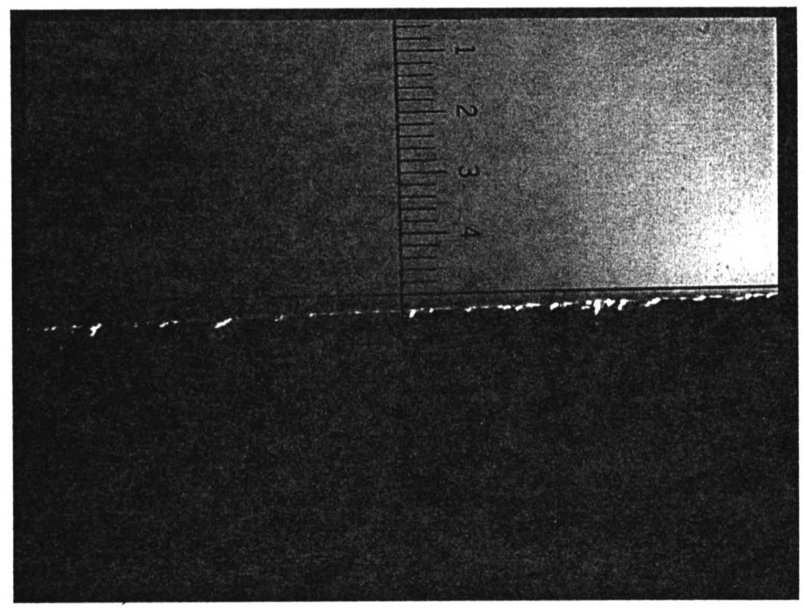


X400 GLASS REEL



X400 METAL REEL

EDGE ABRASION BACKCOAT - AREA PREVIOUSLY OK



X400

EDGE ABRASION - BACKCOATSIDE