W. W. Hansen Experimental Physics Laboratory

STANFORD UNIVERSITY
STANFORD, CALIFORNIA 94305 - 4085

Gravity Probe B Relativity Mission

GRAVITY PROBE PROGRAM PROCESS SPECIFICATION

ROTOR HANDLING AND DOCUMENTATION PROCEDURES

P0078 REV. A
ECO 586
June 17, 1997

Prepared by: Frane Marcelja Lapping and Polishing	Date
Checked by: George "Mac" Keiser Lapping and Polishing Manager	Date
Approved: Ben Taller Quality Assurance	Date
Approved: John P. Turneaure GP-B Hardware Manager	Date

ROTOR HANDLING PROCEDURES

In order to assure the rotor's integrity, a safe handling is a must. Moreover any contamination will adversely affect the process. We address these two aspects in a series of recommendations.

The fused silica rotors are produced by Speedring(and earlier by Davidson). They arrive well packed by UPS. The single crystal silicon rotors are manufactured by Ginzton Laboratory and are lightly wrapped in soft tissue. Both pass the incoming inspection, measurement and weighting.

Accident prevention practice:

(1) Do not remove the rotors from the protective packing before the initialization of the process.

(2) Always have prepared whatever is needed for the next step.

(3) When unpacking have the labeled box and wrapping cloth prepared. Then carefully remove the rotor from packaging and wash it. One would like to prevent as much as possible the contamination from the coarse grinding material to enter the subsequent lapping stage. **Note**: Low-lint cloth source is: TX4009 9 x 9" TEXWIPE Company, Upper Saddle River, NJ 07458.

(4) Diameter measurement should be performed very carefully by the micrometer. Any bumping or abrupt contacting may produce micro cracks. All our methods are mechanical, so keep in mind that it is necessary to handle the rotor as soft as possible.

(5) After any operation pack the rotor back into low lint cloth and into labeled protective plastic box. There should never be more than 1 (one) rotor out of the labeled box.

(6) The loading and unloading of the rotor in the lapping machine is another operation where there may be a chance of damage. We prefer the clamps to hold lapping heads as it is not easy to reliably hold three lapping heads under spring tension and load the rotor in between. But the clamps should stay secure Bring the rotor in contact with the right lap, release to the center, contact slowly with left lap and finally bring the back lap into contact.

Silicon is very easy to scratch in this operation. Always assure yourself that all operations have been completed before starting the next step: in this case that the clamp of the upper lap have been removed and that the upper motor has been fastened properly.

(7) Unloading: again one by one with the rotor always in center remove the laps and clamp them. Rotor should not be pushed by laps under spring tension from the central position.

(8) Washing: one has to wash both the rotor and gloves. So changing the hands wash with de ionized water spraying the rotor and the glove. This has to be done immediately, as any pausing can cause stains, which are hard to remove. If done immediately no other solvents than deionized water is needed.

Similar procedures are used in second and third stage, namely in polishing, but everything becomes more delicate as the surface is now much smoother. Again only deionized water is used. All handling is with gloves, but the gloves present now a source of contamination, specially when fresh. So we start with fresh gloves and wash them well with deionized water. The gloves we use have roughened surface and this is the source of glove particles, which tend to stick to the rotor.

After washing the rotor, it is necessary to remove the water on the surface, otherwise the stains left over from the deionized water would disturb the process or the measurement. Those are hard to remove, and so it is preferable to have some paper lint on the surface rather than stains. We use for drying a low lint commercial paper, Kim wipes EX-L. The sphere should be dry before placing it on Talyrond, as the three legs are not made of stainless steel and they will quickly rust at the wet contact. Unfortunately any hard contact is prone to damage the surface. This applies to any hard support and to measuring tips. The tips have to be put in contact extremely slowly and it may be advisable to use some kind of device for doing this if one does not have very steady hand. The LVDT tip is spring loaded and should be accompanied to make a contact. It also should be lifted when unloading the sphere. The diamond stylus used in Talyrond is also spring loaded but at small pressure it does not seem to cause any harm. On the other side the support legs are smaller steel spheres which can easily damage the surface if the sphere under its own weight is slided across the leg.