Stanford University
W.W. Hansen Experimental Physics Laboratory
Gravity Probe B Relativity Mission
Stanford, California 94305-4085

GP-B Telescope "Position Image Divider Assembly (IDA) on Telescope" P0336 Rev -

September 22, 1998

Prepared: _____ Date _____
Ken Bower, Telescope Assembly

Approved: _____ Date _____
Jason Gwo, Telescope Assembly

Approved: _____ Date _____
Lynn Huff, Responsible Engineer

Approved: _____ Date _____
John Lipa, Telescope Manager

Approved: _____ Date _____
Sasha Buchman, Hardware Manager

Approved: _____ Date _____
Ben Taller, Quality Assurance

POSITION IDA ON TELESCOPE

- for SUGP-B dwg#25091
- follows *Position Forward Plate Assembly on Metering Tube/Baseplate Assembly* (SUGP-B P0375) and *Position IDA Pad on IDA* (P0303)
- also use *GP-B Telescope Image Divider Assembly (IDA) General Alignment and Bonding Procedures* (SUGP-B P0282) for procedures concerning safety; personnel; work area requirements; fixture cleaning and acceptance; flight part inspection, handling, storage, and cleaning; redline authority; and sign-off and recording requirements.

CAUTION:

- The flight parts used in this operation are heavy, delicate, and somewhat irreplaceable with multiple critical surfaces that can be easily damaged or contaminated by normal handling. Compliance with the above defined safe handling practices is critical.

CAUTION:

- If at any time during this procedure flight hardware is not live monitored, verify that all flight hardware is seismically secured and protected against airborne contamination. This precaution is especially important during this operation due to the size and dimensions of the Telescope Main Optics Assembly.

WARNING:

- Some of the solvents, detergents, and/or bonding agents used in this procedure may be flammable, toxic, or reactive. Consult P0282 for information about specific chemicals.

1) Verify the cleanliness of all fixturing.
2) Obtain in advance three custom spacers to be attached to the 'Horseshoe Assembly' (a subset of OID dwg#103-0083C). The height of the spacers is dependent upon the thickness of the IDA pad (SUGP-B dwg#25398) used in P0303.
3) Assemble the Horseshoe Assembly (OID dwg#103-0083C subassemblies 1,2,3,5,7, 8, and 620-0059D only).
4) Place the Telescope Main Optics Assembly in a vertical position in a cleared area on a small stack of cushioning clean room wipes (VWR TWTX609).
5) Compare SUGP-B dwg#25091 and OID dwg#800-0068A to determine clocking. The clocking is only required for future hardware clearances, so a visual alignment is sufficient.
6) Place 3 small pieces (~4cmsq.ea.) of 2 mil woven nylon 'orange' shim stock on the top surface of the Metering Tube, spaced to align with parts 3 and 7(x2) on the horseshoe assembly.
7) Place the three custom spacers obtained in step 2 on top of the orange shims.

8) *This is a high risk operation and extreme care should be taken.* Carefully place the horseshoe assembly over the telescope so that parts 3 and 7(x2) rest upon the spacers. This operation will require two qualified flight part handlers per P0282, one to handle the horseshoe assembly and one to monitor and protect the telescope from accidental contact. Use care to ensure that no part of the horseshoe assembly contacts any part of the telescope at this time. Adjust the position of the spacers slightly as required for proper alignment. At this point, the telescope must be constantly live monitored against accidental or seismic shock.
9) Install the centering screws in part 7(x2) of the horseshoe assembly and bring them into contact with the OD of the Forward Plate. Adjust the nut on part 8 to allow the spring force to press the detent against the OD of the Forward Plate.
10) Using a nylon shim stack as a feeler gauge, measure the gap between the OD of the Forward Plate and the ID of the horseshoe. Adjust the centering screws until the gap is constant to within 2 mils. Always loosen one screw before tightening the other to prevent pinching of the Forward Plate.
11) Install part 4(x3) of the Horseshoe Assembly using Teflon bumpers which contact the top groove in the Metering Tube. Tighten the screws until the Telescope is secured to the Horseshoe Assembly. Recheck the centering and repeat steps 10 and 11 as required.
12) Turn on the light source for the 7" OID Autocollimator (AC). Using a retroreflector (Melles Griot 02CCH015), verify that the return image is focused to better that five arc-seconds (~2 arc-sec typ.). Adjust any of the 15+ degrees of freedom in the AC assembly as required.
13) Transfer the Telescope/Horseshoe Assembly under the AC as shown in OID dwg#800-0049C and install mounting bolts and nuts - do not tighten at this time. This is a very heavy assembly (~30 lbs.) and two handlers will be required. Use care to prevent any part of the Telescope from contacting any part of the AC supporting structure.
14) Install the leveling screws into the horseshoe and adjust them as required such that the return image from the forward plate is centered (best effort, <2 arc-sec minimum) in the readout monitor of the AC. Tighten the mounting nuts at this time. Use care to not tighten any combination of leveling and mounting screws such that the horseshoe assembly will be bent. This process will require multiple attempts to keep the image centered during the tightening process. The telescope is now seismically secured.
15) Verify the cleanliness of all fixturing.
16) Install Detector Holder Blocks (OID dwg#'s 572-0066A and 572-0061A) and Microscope Holders (OID dwg# 572-0065B x2) as shown in dwg#800-0068A.
17) Assemble 2 CCD cameras with the custom microscopes (OID dwg#800-0059B) and install them onto the holders as shown in dwg#800-0068A. Hook up monitors to the two cameras.

18) Prepare 2 Alignment Module DPA's (use SUGP-B dwg# 25076, omitting DMA's and their affiliated hardware). Install and correctly clock an 'o+o reticle' in each transmitted channel.
19) Install one Alignment Module DPA in each Detector Holder Block as shown in dwg#800-0068A. Adjust the position of each camera as required such that the reticle pattern is focused on the CCD camera monitors. It may be necessary to provide external lighting for this operation.
20) Carefully install two locating bars (OID dwg#'s 506-0029A and 506-0028A) as shown in dwg#800-0068A. Use care to ensure that the Forward Plate is not contacted by these parts.

21) Verify the cleanliness of all fixturing.
22) Place 3 small pieces (~4cmsq.ea.) of 2 mil woven nylon 'orange' shim stock on the top surface of the Forward Plate in the IDA Pad bonding area, equally spaced.
23) Carefully place the IDA w/Pad (SUGP-B dwg#'s 25089, 25398) on top of the orange shims as shown in dwg#800-0068A. Use care to protect both bonding surfaces from damage. Adjust the three contact screws on the locating bars such that each contacts the IDA as shown in dwg#800-0068A.
24) Verify that the return image from the Forward Plate is still centered in the readout monitor of the AC. Repeat steps 12 through 14 as required.
25) Keeping the IDA in constant contact with the plane of the Forward Plate and three contact points on the locating bars, adjust the contact points while monitoring the images in the CCD monitors. Make multiple small adjustments until a point of light can be seen in the center (<10% of the radius) of all four o's in the reticle images and all four points are of apparently equal intensity (not quantifiable, use eyesight and judgment). *This alignment will require many very small iterative adjustments and is critical to fix the optical axis of the telescope -- be patient!*
26) Repeat step 24. Repeat step 25 if any changes are required.
27) Remove the IDA and orange shims from the Forward Plate.
28) Verify the cleanliness of all fixturing.
29) Using a bright light inspection process, verify the cleanliness of the top surface of the Forward Plate and bottom surface of the IDA Pad per P0282.
30) Bond the to IDA w/Pad to the Forward Plate using *Bonding Procedures for Fused-Quartz Components* (SUGP-B P0218).
31) Monitor the images in all three monitors and make adjustments as required within a few minutes. Continue to monitor the bond for one hour.
32) Allow to cure at least 48 hours before disturbing telescope.

Attachments: SUGP-B dwg#'s 25089, 25398, 25091, 25076; OID dwg#'s 103-0083C, 620-0059D, 800-0068A, 572-0061A, 572-0066A, 572-0065B, 800-0059B, 800-0049C