

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

GP-B Telescope
“Position Reticle Plate on Telescope”
P0373 Rev -

January 26, 1998

Prepared: _____ Date _____
Ken Bower, Telescope Assembly

Approved: _____ Date _____
Lynn Huff, Responsible Engineer

Approved: _____ Date _____
John Lipa, Telescope Manager

Approved: _____ Date _____
John Turneaure, Hardware Manager

Approved: _____ Date _____
Ben Taller, Quality Assurance

POSITION RETICLE PLATE ON TELESCOPE

- for SUGP-B dwg#25091
 - follows *Position Detector Package Holders on Telescope* (SUGP-B P0339)
 - also use *GP-B Telescope Image Divider Assembly (IDA) General Alignment and Bonding Procedures* (SUGP-B P0282).
- 1) Verify cleanliness of all fixturing.
 - 2) Assemble the Mounting Plate (OID dwg#620-0069) onto custom 18” legs and base plate to build the large custom support for step 4. Clamp the structure to the optical table to prevent potential seismic damage.
 - 3) Remove any cameras and camera fixturing remaining from prior assemblies. If electronics are installed on the telescope, use ESD protection. If necessary, relocate any cabling to a location where it will not interfere with step 5.
 - 4) Remove the telescope from underneath the 7” aperture autocollimator used for positioning the detector reflectors and package holders. Do not remove the telescope from the ‘horseshoe’ fixturing (OID dwg#620-0059). Use **great** care to prevent any damage or contamination to the telescope and any hardware mounted on it. If electronics are installed, use ESD precautions.
 - 5) Install the Telescope with horseshoe fixturing into the large custom support. If necessary, the telescope may be parked temporarily with its baseplate resting only on surfaces or fixturing designed to prevent damage or contamination to bonding surfaces. **During this transfer, one flight part handler must at all times closely monitor the telescope to prevent tipping or bumping, both of which could result in catastrophic damage to the telescope and/or electronics.**
 - 6) Assemble the following hardware into an alignment fixture shown in the attached sketch (from bottom to top): 1) a custom platform consisting of five parts to elevate and position the alignment fixturing over the IDA, 2) a Newport 460A x-y translation stage, 3) a custom adapter plate, 4) a Melles-Griot 07TRT001 rotation stage, 5) a Melles-Griot 07GOH006 Goniometric stage, 6) a Newport 360-90 right angle bracket, and 7) a Newport ULM-TILT Laser Mount.
 - 7) Verify cleanliness of all fixturing.
 - 8) Install two custom reticle locating fixtures onto the ‘horseshoe’. Use great care to prevent contamination or damage to flight parts during this operation.
 - 9) Install the alignment fixturing assembly from step 6 onto the ‘horseshoe’. Install the DOI model 271 Alignment Scope in the laser mount and tightly secure it with the lock screw and additional Kapton tape as desired. Use care to prevent contamination or damage to flight parts during this operation.
 - 10) Roughly center the x-y and goniometric stages. Focus the Alignment Scope on the bottom surface of the channel B plate of the IDA. Adjust the x-y stages such that the view of the Alignment Scope includes the ‘back’ (square) end of the Channel B Roof Prism (SUGP-B dwg#25068).

- 11) In autocollimation mode, adjust the ULM-TILT stage such that the Alignment Scope is normal to the top surface of the IDA to within 15 arc seconds. Lock the adjustment screws and recheck normality.

SUGP-B P0373 Rev -
K.Bower

- 12) Focus the Alignment Scope on the beam dividing edge of the Channel B roof prism. This will be very difficult to do as the roof prism provides a near perfect reflection. However, by adjusting light intensity and position, it will be possible to locate the ends of the edge (on the 'pointy corners' of the roof prism). Use care to distinguish between false images caused by multiple internal reflections between the roof prism and channel B plate, which will be fainter. Use care to prevent damage to flight parts while manipulating light sources.
- 13) Using the goniometric stage, sweep the Alignment Scope view back and forth along the edge of the prism. Adjust the rotation and x-y stages (iteratively) such that the crosshair of the Alignment Scope traces a path coincident with the roof edge to <math><0.001''</math> end to end (<math><7</math> arc-minutes).
- 14) Return the goniometric stage to zero and verify normality of the Alignment Scope to the IDA.
- 15) Verify cleanliness of all fixturing.
- 16) Place a piece (~5cmsq.) of 2mil 'orange' shim stock over the center of the Channel B Plate to protect surfaces during initial alignment.
- 17) Place Reticle Plate (SUGP-B dwg#25446) on shim on top of IDA and roughly position and clock it as shown in SUGP-B dwg#25091 (the quadrant with the clocking mark on the reticle pattern should point between the two detector holders). Use care to prevent damage to flight parts.
- 18) Adjust the reticle plate and positioning rods such that the reticle is centered with respect to the IDA to within 0.020'' (verify with shims against outer diameter of IDA) and the reticle plate is solidly positioned against the rods.
- 19) Focus the Alignment Scope on the reticle pattern. Adjust lighting as required to achieve a high contrast image.
- 20) Using the goniometric stage, sweep and focus the Alignment Scope such that both ends of the reticle pattern are visible. Clock the Reticle plate such that the pattern is parallel to the sweep of the Alignment Scope crosshair to <math><0.002''</math> (<math><5</math> arc-minutes) end-to-end. Adjusting the x-y stage to make the sweep coincident with the pattern will make verification easier and more accurate, but is not required.
- 21) Remove the Reticle Plate and shim. Verify the cleanliness of all fixturing. Recheck that the sweep of the Alignment Scope crosshair is parallel to the roof edge.
- 22) Bond Reticle Plate to IDA using *Bonding Procedures for Fused-Quartz Components* (SUGP-B P0218).

- 23) Monitor the reticle position with respect to the IDA and the reticle pattern with respect to the Alignment Scope crosshair sweep and make adjustments as required within a few minutes.
- 24) Allow bond to cure at least 48 hours before disturbing telescope.
- 25) Verify clocking of reticle pattern with respect to Alignment Scope crosshair sweep.
Record any variance -- this data will be very difficult to recover once fixturing has been disassembled.
- 26) Remove reticle locating and alignment fixturing. Use care to prevent damage to flight parts.

Attachments: SUGP-B dwg#'s 25446, 25068, 25091; OID dwg#'s 620-0059, 620-0069;
Assembly Sketch