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Gravity Probe B Relativity Mission

Science Telescope Test Readiness Review

GP-B P0258 Rev -

January 29, 1998

**Prepared by: Sei Chun
Systems Engineer**

Date

**Approved by: Suwen Wang
Engineer**

Date

**Approved by: John Lipa
Manager, Science Telescope Development**

Date

**Approved by: George "Mac" Keiser
Chief Scientist**

Date

**Approved by: Bob Schultz
Chief Systems Engineer**

Date

**Approved by: B. Taller
Quality Assurance**

Date

**Approved by: J. Turneure
Hardware Manager**

Date

Science Telescope Test Readiness Review

Date & Time: January 29, 1997, 10:00 AM to noon

Location: GP-B conference room

Purpose:

To ensure that the test article hardware, test facility, ground support personnel, and test procedures are ready for testing, data acquisition, reduction, evaluation, and control.

Scope:

The Science Telescope Test Readiness Review (TRR) will encompass all Science Telescope (ST) flight hardware. The ST flight hardware includes the completed Telescope Assemblies and their components.

Agenda:

- Requirements Traceability Status
- Procedure Status
- Test Personnel Status
- Test Resources Status
- Test Support Software Status

Review Team:

John Turneure	Hardware Manager
John Lipa	Manager, Science Telescope Development
Suwen Wang	Engineer
George "Mac" Keiser	Chief Scientist
Ben Taller	Quality Assurance
Bob Schultz	Chief Systems Engineer
Ken Hooper	Review Leader
Paul Ehrensberger	TRE IPT Leader (ex officio)
Ed Ingraham	ONR (ex officio)

Objectives:

- Confirm that in-place test plans and procedures meet verification requirements and specifications.
- Confirm that sufficient and detailed resources (of the right type) are allocated to the test effort.
- Examine detailed test procedures for completeness and safety during test operations. Note who is in charge of the test operations and test article and who is in charge of the facilities.
- Determine the critical test personnel who are authorized to perform test.
- Confirm that test support software is adequate, pertinent, and verified (validated for intended use).
- Confirm that all interfaces with the test article, test equipment, and facilities, especially power, data, instrumentation, etc., are adequate, safe, and in accordance with the test procedure. Ensure the customer, witnessing agents, test personnel, quality assurance, and support personnel understand the objective of the test and the parameters that are critical for successful operation.
- Confirm that the documentation has proper traceability.
- Confirm that test equipment has been appropriately calibrated.

Exit Criteria:

The following items identify the categories of items to be checked; the individual checks are enumerated in the attached checklists:

- Do the test procedures verify all applicable requirements?
- Have test personnel received training in test operations procedures?
- Are resources available to adequately support the planned tests as well as contingencies, including failed hardware replacement?
- Has the test support software been demonstrated to handle test configuration assignments, and data acquisition, reduction, evaluation, control, and archiving?

Assembly Document Status:

- P0336 "Position Image Divider Assembly on Telescope", P0374 "Position Metering Tube on Base Plate, P0375 "Position Forward Plate on Metering Tube" are in preparation - not needed for TRR
- P0116 Temperature Sensor Assy Procedure is referenced in dwgs 23179, 23180, and 23532 (all temperature sensor (sub-)assemblies), but may be obsolete - not needed for TRR

Attachments:

- A. Manufacturing Flow Diagrams
- B. Requirements Verification Matrix
- C. Document Status Checklist
- D. Test Personnel Status Checklist
- E. Test Resources Checklists and Test Support Software Checklist
- F. Action Item List

A. Science Telescope Manufacturing Flow

Fabrication & Assembly

General Assembly Procedures (used in most of the assembly procedures):

P0282 GP-B Telescope IDA, General Alignment and Bonding Procedures

P0300 Surface Cleaning for BP, TM, PM, CP, and SM

P0218 Bonding Procedure for Fused-Quartz Components

Assembly Sequence :

P0283 GP-B Telescope IDA, Set Up Basic IDA Assembly Fixtures

P0284 GP-B Telescope IDA, Align Channel B Plate with Laser

P0289 GP-B Telescope IDA, Align Channel A Plate with Laser

P0288 GP-B Telescope IDA, Position Beam Splitter on Beam Splitter Holder

P0285 GP-B Telescope IDA, Position Channel B Roof Splitter on Channel B Plate

P0290 GP-B Telescope IDA, Position Beam Splitter Assembly on Channel A Plate

P0286 GP-B Telescope IDA, Position Channel B Reflectors on Channel B Plate

P0291 GP-B Telescope IDA, Position Channel A Roof Splitter on Channel A Plate

P0287 GP-B Telescope IDA, Position Image Divider Housing on Channel B Plate

P0292 GP-B Telescope IDA, Position Channel A Reflectors on Channel A Plate

P0293 GP-B Telescope IDA, Position Image Divider Housing/Channel B Assembly on Channel A Plate

P0294 GP-B Telescope IDA, Position Left and Right Relay Lenses on IDA Channel B

P0295 GP-B Telescope IDA, Position Left and Right Relay Lenses on IDA Channel A

P0303 GP-B Telescope IDA, Position IDA Pad on IDA

P0364 GP-B Telescope "Determine Metering Tube Length"

P0374 GP-B Telescope, Position Metering Tube on Base Plate

P0375 GP-B Telescope Position Forward Plate on Metering Tube

P0336 GP-B Telescope, Position Image Divider Assembly on Telescope

P0337 GP-B Telescope, Position Detector Package Holder Pads on Telescope

P0338 GP-B Telescope, Position Detector Reflectors on Telescope

P0339 GP-B Telescope, Position Detector Package Holders on Telescope

P0373 GP-B Telescope, Position Reticule Plate on Telescope

P0340 GP-B Telescope, Position Temperature Sensor Blocks on Telescope

P0344 GP-B Telescope, Position Clamp Supports on Telescope

Test Plan

P0254

P0220 Integration of Science Telescope and Telescope Test Probe

Telescope Probe and Artificial Star Integration

P0221 Integration of Telescope Test Probe and Test Dewar

P0222 Science Telescope and Artificial Star #2 Alignment

P0225 Science Telescope Wide Field Scan Measurements at Room Temperature

P0223 Artificial Star #2 Servo Alignment

Telescope Measurements at Room Temperature

P0225 Science Telescope Wide Field Scan Measurements at Room Temperature

P0224 Artificial Star #2 Wide Field Scan

P0227 Science Telescope Narrow Field Scan Measurements at Room Temperature

P0226 Artificial Star #2 Narrow Field Scan

P0228 Artificial Star #2 Focal Scan Procedure

P0223 Artificial Star #2 Servo Alignment

P0229 Science Telescope Field of View Scan

P0230 Science Telescope Fine Scans

P0223 Artificial Star #2 Servo Alignment

P0231 Science Telescope Room
Temperature Saturation Range

P0232 Science Telescope Room
Temperature Perpendicularity Readout
Axes

P0233 Science Telescope Room
Temperature Linearity Test

Test Plan (continued)

P0254 (cont.)

P0234 Science Telescope Cool Down

Telescope Measurements at 4K

P0235 Science Telescope Wide Field Scans, 4K

P0242 Transfer Liquid Helium into Telescope Test Dewar

P0224 Artificial Star #2 Wide Field Scan

P0236 Science Telescope Narrow Field Scans, 4K

P0242 Transfer Liquid Helium into Telescope Test Dewar

P0226 Artificial Star #2 Narrow Field Scan

P0249 Telescope Focal Scan at 4K

P0237 Science Telescope Field of View Scans, 4K

P0242 Transfer Liquid Helium into Telescope Test

P0248 Measurement of Misalignment of Optical Center from Center of Aperture Stop

P0230 Science Telescope Fine Scans

P0242 Transfer Liquid Helium into Telescope Test Dewar

P0223 Artificial Star #2 Servo Alignment

P0238 Science Telescope Saturation Range at 4K

P0239 Science Telescope Perpendicularity of Readout Axes at 4K

P0240 Science Telescope Linearity Test at 4K

P0241 Science Telescope Strehl Ratio Test at 4K

P0245 Science Telescope Scale Factor Calibration

P0246 Change of Orientation of Reflecting Surface from Room temperature to Low

P0247 Change of Optical Transmissibility from Room temperature to Low

P0243 Science Telescope Test, Warm up

P0244 Deintegration of Science Telescope from Test Probe

B. Science Telescope Verification Matrix

Twelve Fundamental Science Requirements (T002)

¶	Title	Text & Comments	Method	Verification Plan	RE	ECD
7.	Science Telescope (ST)	After appropriate filtering and calibration, the ST's (and accompanying electronics') resolution error and deviation from linearity shall not exceed 3.0 marcsec within the central range of ± 60 marcsecs and shall be stable to 0.1 marcsec. The noise properties and biases shall be consistent with the requirements stated in requirement 8A below.	A	The method of verification will through analysis (S0299) using supporting test data.	S Wang	3/98

Science Telescope Requirements from the System Design & Performance Requirements Spec. (T003)

¶	Title	Text & Comments	Method	Verification Plan	RE	ECD
7.	Science Telescope System (ST)					
7.1	Description	The Science Telescope consists of a fused quartz Schmidt/Cassegrainian type telescope with primary, secondary, and tertiary mirrors, an image dividing assembly consisting of a beam splitter for splitting the beam into the orthogonal axes and of two roof prisms, and eight fully redundant cryogenic detectors for collecting the photons. The readout system consists of a cryogenic pre-amplifier and ambient temperature electronics for processing the signals from the detectors that are used in determining the pitch and yaw angular deviations of the SV from the guide star. Pointing control (see Section 19) is possible with digital sampling of this readout.				
7.2	Range					
7.2.1	Field of View and Full Intensity Range					
7.2.1.1	Maximum Field of View	The fused quartz ST shall have a field of view, including the effects of telescope misalignment, such that less than 5% of the light from any star lying at an angular separation greater than 92 arc sec from the telescope null point reaches any of the photodetectors, regardless of the satellite roll phase.	T	P0237 Science Telescope Field of View Scans, 4K	S Wang	3/98

¶	Title	Text & Comments	Method	Verification Plan	RE	ECD
7.2.1.2	Minimum Full Intensity Range	The fused quartz ST shall have an minimum full intensity range, including the effects of telescope misalignment, so that at least 95% of the light from any star lying at an angular separation less than 28 arc sec from the telescope null point reaches the photodetectors.	T	P0237 Science Telescope Field of View Scans, 4K	S Wang	3/98
7.2.1.3	Minimum Field of View with Usable Signal	The fused quartz telescope shall have a field of view, including the effects of telescope misalignment, so that at least 10% of the light from any star lying at an angular separation of less than 60 arc sec from the telescope null point on either of the axes reaches one of the photodetectors on that axis. <i>Note: The purpose of this requirement is to guarantee a minimum telescope field of view for the acquisition of the guide star. If the telescope meets requirement 7.2.1.2 above, and the image size at the plane of the aperture stop has a radius of 20 arc sec, then approximately 14% of the light will reach one of the photodetectors at an angular separation of 60 arc sec.</i>	T	P0237 Science Telescope Field of View Scans, 4K	S Wang	3/98
7.2.2	Saturation Range	The fused quartz ST shall have a range of monotonic response (i.e., range over which the output signal monotonically increases with increasing angular deflection) of at least ± 1 arcsec.	T	Telescope acceptance test. P0238 Science Telescope Saturation Range at 4K	S Wang	3/98
7.2.3	Linear Range	The fused quartz ST shall meet the linear range and error requirements of T002 7. <i>These requirements come from T002, Reqmt. 7.</i>	A	Verification will be through analysis S0299 using supporting data.	S Wang	3/98
7.2.4	Stability	The linearity and resolution of the telescope system shall be stable to 0.1 marcsec over the year.	A	S0299	M Keiser & S Wang	3/98
7.3	Orthogonality	The two readout axes of the ST shall be orthogonal to each other to within 1 degree.	T	Telescope acceptance tests P0239 Science Telescope Perpendicularity of Readout Axes at 4K	S Wang	3/98
7.4	Scale Factor					
7.4.1	Scale Factor Calibration	After initial ground calibration, the scale factor shall be known to within 20%.	A,T	Payload acceptance test Test and analysis in P0245 Science Telescope Scale Factor Calibration and room temperature scale factor measured in (P0245) and window tests.	S Wang	5/98

Science Telescope Requirements from the Science Payload Spec. (PLSE-12)

¶	Title	Text & Comments	Method	Verification Plan	RE	ECD
3.7.1.4.3	Reticle Plate	The reticle plate at the front of the telescope shall be in accord with the ICD drawing 25446, "Plate, Reticle"	I	Inspection of part against drawing 25446 Plate, Reticle	L Huff	3/98
3.7.1.4.3.1	X-Y Location of Reticle Pattern Center	The x-y position of the reticle pattern center with respect to a point determined by the intersection of the nominal Roll Axis with the reticle plate plane shall be measured to 0.25 mm (0.01 inch).	A,T	Verified at SIA level Reticle position relative to telescope base will be measured at RT (P-Doc TBS) Analysis to extrapolate to LT (S-Doc TBS)	M Sullivan	5/98
3.7.1.4.3.2	Z Location of Reticle Reflecting Plane	The Z location of the Reticle Reflecting Plane relative to Gyroscope #1 shall be known to within 0.5 mm.	A,T	as above	M Sullivan	5/98
3.7.1.4.3.3	Rotation of Reticle Pattern	The reticle pattern rotation about the z-axis relative to the readout loop planes shall be known within 1.1_degree (see EM No. ATCS 215, 6/20/96).	A,T	as above	M Sullivan	5/98
3.7.1.4.3.4	Orientation of Reflecting Surface	The perpendicular to the reflecting surface of the reticle plate shall be parallel to the telescope optical axis within 10 arcsec and be known to within 5 arcsec.	T	Measured at LT in P0246 Orientation of Reflecting Surface	S Wang	3/98
3.7.1.4.3.5	Reflectivity	The reflecting surface of the reticle shall have a reflectivity of greater than or equal to 70% (intensity).	I	Inspection of vendor supplied data	L Huff	3/98
3.7.1.4.4.1	Telescope					
3.7.1.4.4.1.2	Optical	The attachment of the Telescope to Quartz Block shall not increase the image size (full width at half power maximum) by more than 20% at the SIA operating temperature.	A,T	Verified during PL test using AS3 Analysis written by Larry Sokolsky "Relativity Mission Telescope Thermal Distortion Studies" (GPB-100367)	T Acworth	12/99

3.7.1.6	Science Telescope					
3.7.1.6.1	Prime Item Definition	<p>Definitions:</p> <p>ST Science Telescope QB Quartz Block ICD Interface Control Document or Interface Control Drawing</p> <p>The ST consists of a fused-quartz assembly including a primary, a secondary and a tertiary mirror, two roof prisms, and appropriate beam splitters and mirrors to convert a single plane wave beam of light from a distant star into 8 spots of light at the output ports. The intensities of the spots vary as the star is displaced from the telescope centerline in either axis in such a way that the Telescope Readout Electronics can use the variation to produce a signal corresponding to the magnitude and direction of the displacement. <i>Reference PCB#301</i></p>				
3.7.1.6.1.1	Prime Item Diagram					
3.7.1.6.1.2	Interface Definition					
3.7.1.6.1.2.1	Functional Interfaces	The ST shall mechanically interface to the quartz block as described in section 3.7.1.6.1.2.4. It shall interface thermally by contact with the quartz block, radiatively with any radiation coming through the windows, and conductively through the detector cables, which mate with the probe connectors. It shall interface optically with the guide star wavefront coming through the windows and with the photodetectors of the Telescope Readout Electronics.	I	Inspect to drawing 25091 TELESCOPE ASSY	B Taller	3/98

3.7.1.6.1.2.2	Signal Interfaces	<p>The ST shall output to the Telescope Readout Electronics eight optical signals as listed below.</p> <p>Positive Pitch Axis Alternate Positive Pitch Axis Negative Pitch Axis Alternate Negative Pitch Axis Positive Yaw Axis Alternate Positive Yaw Axis Negative Yaw Axis Alternate Negative Yaw Axis</p> <p>The detailed electrical interface to the probe with identification of the electrical function is given in Section 3.7.6.2.2.</p>	I	Verified as byproduct of P0239 Science Telescope Perpendicularity of Readout Axes at 4K	S Wang	3/98
3.7.1.6.1.2.3	Thermal Interfaces	The telescope shall meet the thermal interface requirements of Section 3.7.2.5.2.4.	A,T	To be verified by analysis (by Shad Shokralla) and in Payload thermal testing	J Turneure	(TBS)
3.7.1.6.1.2.4	Mechanical Interfaces	The mechanical interface of the telescope to the quartz block shall meet the positioning and alignment requirements of Section 3.7.1.4.1 and mechanical attachment requirement of Section 3.7.1.4.4.1.1.	I	Inspect to drawing 25091 TELESCOPE ASSY	J Gwo	3/98
3.7.1.6.2	Characteristics					
3.7.1.6.2.1	Performance					
3.7.1.6.2.1.1	Perpendicularity of Readout Axes	The perpendicularity between the two readout axes shall meet the requirement of Section 7.3 of T003. <i>T003 spec: < 1 deg.</i>	A,T	Data collected in P0230 Science Telescope Fine Scans, and analyzed in P0239 Science Telescope Perpendicularity of Readout Axes at 4K	S Wang	3/98
3.7.1.6.2.1.2	Field of View	<i>T003 spec: a half cone angle > 1 arcmin. Reference PCB# 262</i>				
3.7.1.6.2.1.2.1	Misalignment of Optical Center from Center of Aperture Stop	The misalignment of the optical center of the telescope is defined to be the angle between the direction to a distant star which centers the image of the star on both of the image splitting roof prisms and the direction to a distant star which centers the image of the star on the center of the aperture stop. This misalignment shall be less than 10 arc sec.	A,T	Combination of P0237 Science Telescope Field of View Scans, 4K and P0248 Measurement of Misalignment of Optical Center from Center of Aperture Stop	S Wang	3/98
3.7.1.6.2.1.2.2	Maximum Aperture Stop	The aperture stop shall have a radius so as to exclude at least 95% of the light from any star at an angle greater than 82 arc sec from the direction which centers the image of a distant star on the center of the aperture stop.	A,T	P0237 Science Telescope Field of View Scans, 4K	S Wang	3/98

3.7.1.6.2 .1.2.3	Minimum Aperture Stop for 95% of the Light	The aperture stop shall have a radius so as to include at least 95% of the light from any star at an angle less than 38 arc sec from the direction which centers the image of a distant star on the center of the aperture stop.	A,T	P0237 Science Telescope Field of View Scans, 4K	S Wang	3/98
3.7.1.6.2 .1.2.4	Minimum Aperture Stop for 10% of the Light	The aperture stop shall have a radius so as to include at least 10% of the light from any star at an angle less than 70 arc sec from the direction which centers the image of a distant star on the center of the aperture stop.	A,T	P0237 Science Telescope Field of View Scans, 4K	S Wang	3/98
3.7.1.6.2.1.3	Unsaturated Range	The unsaturated range shall meet the requirements of Section 7.2.2. <i>Section 7.2.2 spec: monotonic response over half cone angle of > 1 arcsec.</i>	A,T	Data collected in P0230 Science Telescope Fine Scans, and analyzed in P0238 Science Telescope Saturation Range at 4K	S Wang	3/98
3.7.1.6.2.1.4	Linear Range	The linear range and linearity shall meet the requirements of T003 Section 7.2.3 assuming a model function to map signal into angle.	A	Verification is through analysis (S0299) using supportinh test data.	S Wang	3/98
3.7.1.6.2.1.5	Strehl Ratio	The Strehl Ratio shall be $\geq 72\%$.	A,T	Data collected in P0230 Science Telescope Fine Scans, and analyzed in P0241 Science Telescope Strehl Ratio Test at 4K	S Wang	3/98
3.7.1.6.2.1.6	Optical Transmissibility	The power transmissibility collectively to all of the photodetectors shall be greater than or equal to 20% of the total light incident on the clear aperture of the telescope over an optical bandwidth from 400 nm to 1000 nm.	A,T	Absolute measurement will be made at RT P0359 Change will be measured at LT in P0247 Test of Change of Optical Transmissibility from Room Temperature to Low Temperature	J Gwo & S Wang	3/98
3.7.1.6.2.1.7	Reticle Plate	The reticle plate shall meet the requirements of Section 3.7.1.4.3.	I	see 3.7.1.4.3	J Gwo	3/98

C. Science Telescope Requirements Verification Documents Checklist

Science Telescope Fabrication & Assembly

Document	Revision Date	Author	Title	Written	In Database	Approval Status
P0151	5/25/95	M Sullivan	Detector Package for Telescope Assy Procedure	4	4	Approved
P0193	1/23/97	L Huff	Testing Configurations for Aspheric Primary Mirror	4	4	Approved
P0218	4/15/97	J Gwo	Bonding Procedure for Fused-Quartz Components	4	4	Approved
P0251	6/18/97	S Wang	Integration of Science Telescope & Telescope Test Probe for Cryo Focal Test	4	4	Approved
P0252	6/18/97	S Wang	Cryo Focal Position Measurement of Science Telescope for Cryo Focal Test	4	4	Approved
P0253	7/8/97	S Wang	Deintegration of Science Telescope and Telescope Test Probe after Cryo Focal Test	4	4	Approved
P0282	6/30/97	K Bower	GP-B Telescope IDA General Alignment and Bonding Procedures	4	4	Approved
P0283	6/30/97	K Bower	GP-B Telescope IDA, Set Up IDA Assembly Fixtures	4	4	Approved
P0284	6/30/97	K Bower	GP-B Telescope IDA, Align Channel B Plate with Laser	4	4	Approved
P0285	6/30/97	K Bower	GP-B Telescope IDA, Position Channel B Roof Splitter on Channel B Plate	4	4	Approved
P0286	6/30/97	K Bower	GP-B Telescope IDA, Position Channel B Reflectors on Channel B Plate	4	4	Approved
P0287	6/30/97	K Bower	GP-B Telescope IDA, Position Image Divider Housing on Channel B Plate	4	4	Approved
P0288	6/30/97	K Bower	GP-B Telescope IDA, Position Beam Splitter on Beam Splitter Holder	4	4	Approved
P0289	6/30/97	K Bower	GP-B Telescope IDA, Align Channel A Plate with Laser	4	4	Approved
P0290	6/30/97	K Bower	GP-B Telescope IDA, Position Beam Splitter Assembly on Channel A Plate	4	4	Approved
P0291	6/30/97	K Bower	GP-B Telescope IDA, Position Channel A Roof Splitter on Channel A Plate	4	4	Approved
P0292	6/30/97	K Bower	GP-B Telescope IDA, Position Channel A Reflectors on Channel A Plate	4	4	Approved
P0293	6/30/97	K Bower	GP-B Telescope IDA, Position Image Divider Housing/Channel B Assembly on Channel A Plate	4	4	Approved
P0294	6/30/97	K Bower	GP-B Telescope IDA, Position Left and Right Relay Lenses on IDA Channel B	4	4	Approved
P0295	6/30/97	K Bower	GP-B Telescope IDA, Position Left and Right Relay Lenses on IDA Channel A	4	4	Approved
P0303	6/30/97	K Bower	GP-B Telescope IDA, Position IDA Pad on IDA	4	4	Approved
P0336		K Bower	GP-B Telescope, Position Image Divider Assembly on Telescope			In-prep
P0337	7/18/97	K Bower	GP-B Telescope, Position Detector Package Holder Pads on Telescope	4	4	Approved
P0338 A	7/18/97	K Bower	GP-B Telescope, Position Detector Reflectors on Telescope	4	4	Approved
P0339	7/18/97	K Bower	GP-B Telescope, Position Detector Package Holders on Telescope	4	4	Approved
P0339 A	12/31/97	K Bower	GP-B Telescope, Position Detector Package Holders on Telescope	4	4	Approved
P0340	7/18/97	K Bower	GP-B Telescope, Position Temperature Sensor Blocks on Telescope	4	4	Approved
P0341	7/18/97	K Bower	GP-B Telescope, Position Clamp Supports on Telescope	4	4	Approved
P0361	9/15/95	J Gwo	Base Plate/Tertiary Mirror/Primary Mirror Assy and Corrector Plate/Secondary Mirror Assy	4	4	Approved
P0373	1/26/98	K Bower	GP-B Telescope, Position Reticule Plate on Telescope	4	4	Approved
P0374		K Bower	GP-B Telescope, Position Metering Tube on Base Plate			In-prep

P0375		K Bower	GP-B Telescope Position Forward Plate on Metering Tube			In-prep
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Note: Original versions of P0338 and P0339 were used on ST#2, rev A will be used on ST#3

Science Telescope Test

Document	Revision Date	Author	Title	Written	In Database	Approval Status
P0220	6/16/97	S Wang	Integration of Science Telescope and Telescope Test Probe	4	4	Approved
P0221	6/10/97	S Wang	Integration of Telescope Test Probe and Test Dewar	4	4	Approved
P0222	6/10/97	S Wang	Science Telescope and Artificial Star #2 Alignment	4	4	Approved
P0223	6/10/97	S Wang	Artificial Star #2 Servo Alignment	4	4	Approved
P0224	6/13/97	S Wang	Artificial Star #2 Wide Field Scan	4	4	Approved
P0225	6/16/97	S Wang	Science Telescope Wide Field Scan Measurements at Room Temperature	4	4	Approved
P0226	9/5/97	S Wang	Artificial Star #2 Narrow Field Scan	4	4	Approved
P0227	9/5/97	S Wang	Science Telescope Narrow Field Scan Measurements at Room Temperature	4	4	Approved
P0228	9/5/97	S Wang	Artificial Star #2 Focal Scan Procedure	4	4	Approved
P0229	9/8/97	S Wang	Science Telescope Field of View Scan	4	4	Approved
P0230	11/14/97	S Wang	Science Telescope Fine Scans	4	4	Approved
P0231	12/3/97	S Wang	Science Telescope Room Temperature Saturation Range	4	4	Approved
P0232	11/17/97	S Wang	Science Telescope Room Temperature Perpendicularity Readout Axes	4	4	Approved
P0233	11/21/97	S Wang	Science Telescope Room Temperature Linearity Test	4	4	Approved
P0234	11/21/97	S Wang	Science Telescope Cool Down	4	4	Approved
P0235	11/21/97	S Wang	Science Telescope Wide Field Scans, 4K	4	4	Approved
P0236	11/21/97	S Wang	Science Telescope Narrow Field Scans, 4K	4	4	Approved
P0237	11/21/97	S Wang	Science Telescope Field of View Scans, 4K	4	4	Approved
P0238	12/3/97	S Wang	Science Telescope Saturation Range at 4K	4	4	Approved
P0239	11/24/97	S Wang	Science Telescope Perpendicularity of Readout Axes at 4K	4	4	Approved
P0240	11/24/97	S Wang	Science Telescope Linearity Test at 4K	4	4	Approved
P0241	11/24/97	S Wang	Science Telescope Strehl Ratio Test at 4K	4	4	Approved
P0242	11/24/97	S Wang	Transfer Liquid Helium into Telescope Test Dewar	4	4	Approved
P0243	11/24/97	S Wang	Science Telescope Test, Warm up	4	4	Approved
P0244	12/3/97	S Wang	Deintegration of Science Telescope from Test Probe	4	4	Approved
P0245	1/23/98	S Wang	Science Telescope Scale Factor Calibration	4	4	Approved
P0246	1/27/98	S Wang	Change of Orientation of Reflecting Surface from Room Temperature to Low Temperature	4	4	Approved
P0247	1/27/98	S Wang	Test of Change of Orientation of Optical Transmissibility from Room Temperature to Low Temperature	4	4	Approved
P0248	1/27/98	S Wang	Measurement of Misalignment of Optical Center from Center of Aperture Stop	4	4	Approved
P0249	1/28/98	S Wang	Telescope Focal Scan at 4K	4	4	Approved
P0254	1/13/98	S Wang	Science Mission Telescope Test Plan	4	4	Approved

Additional Documents

Document	Date	Author	Title	Written	In Database	Approval Status	Dwg Ref
P0057 A	9/29/94	J Lockhart	GP-B Magnetic Control Plan - Science Mission	4	4	Approved	4
P0059 C	6/19/94	M Keiser	GP-B Contamination Control Plan (Probe B)	4		In-rvw	4
P0080	9/5/97	J Lockhart	Cryogenic Magnetic Screening Procedure	4	4	Approved	4
23200-118 C	8/5/97	B Taller	DRAWING TREE, TELESCOPE ASSY, SM	4	N/A	Approved	N/A
25091	12/19/95	L Huff	TELESCOPE ASSY	4	N/A	Approved	N/A

D. Science Telescope Test Personnel Status Checklist

Test Conductors / Inspectors for the Science Telescope Test Facilities:

Each test procedure document identifies the personnel certified to perform the procedure (this includes Suwen Wang and Ken Bower for procedures P0220 and P0244, and only Suwen for all other test procedures).

The quality assurance witness is Ben Taller

Qualified Test Directors for Science Telescope:

John Lipa

Procedures Requiring Director Approval

#	Title
P0220	Integration of Science Telescope and Telescope Test Probe
P0221	Integration of Telescope Test Probe and Test Dewar
P0244	Deintegration of Science Telescope from Test Probe

E. Science Telescope Test Resources Checklists

Instruments requiring calibration

Item Description	ID / Serial Number	Calibration Date	Available
Power meter (instruments for absolute optical transmissibility and reticle location)	Newport 1830-C	certified	yes

Instruments not requiring calibration

Item Description	Reason
Thermometers and controllers, Hand held multimeters, Oscilloscopes	only used for rough guidance

Facilities

Item Description
Telescope Assembly clean room
MGP clean room (either class 1000 or both class 1000 and class 10 rooms - with precision manipulators)
Artificial Star #2
Artificial Star #2 lab
telescope probe cart
PC (Pentium #1)
Centris 650 computer with data acquisition system
Telescope test probe #2
Telescope test dewar
Telescope lab hoist
Zygo interferometer (optional)

Test Support Software

Software Product	Environment	Version	Controlled	Demonstrated
LabView	Macintosh	3.1.1	N/A	4
ScanStar	Macintosh	1.0		4
FocusScan	Macintosh	1.0		4
IntensityScan	Macintosh	1.0		4
LabView	PC	3.1.1	N/A	4
nChanTemp	PC	1.0		4
SigmaPlot	PC	2.00	N/A	4
Igor Pro	Macintosh	2.0.2	N/A	4

F. Science Telescope Test Readiness Review - Action Items

Those is **bold** need to be completed before the TRR can be certified as completed - the others must be completed before the acceptance review.

Items 1, 2, and 10 must be completed before testing may begin.

Items 9 and 11 must be completed before post-cryo testing may begin.

#	Action	Assignee	ECD	Status
1	Obtain all signatures for procedures P0220 through P0249, P0254	Reviewers/ S Wang	1/30	Done
2	Make special tape backup for test software and give it to Mae	S Wang	1/29	Done
3	Update P0059 Contamination Control Plan, Master	M Keiser	2/5	Done
4	Find out when P0151, P0218 and P0338A can be released	K Hooper	1/30	Done
5	Research the status of open DR	B Taller	1/30	Done
6	Find out when Jason can clarify whether P0300 is applicable	S Chun	4/30	Closed P0361 is applicable.
7	Status and provide ECD for P0116	D Bardas	7/15	Doron's responsibility to write ECD 7/15/98
8	Find where bias requirement verification is captured in DPA testing	S Chun	1/30	Done - at TRE fwd elec
9	Checkout P-Doc and title for post-cryo testing (to measure absolute optical transmissibility, and reticle location)	J Gwo	3/12	Done P0359 for optical transmission approved on 5/6/98
10	Update P0221, P0222, and P0244 to indicate that test director approval is required prior to testing	S Wang	1/30	Done
11	Identify calibration status of equipment used in post-cryo testing (see item 9 above)	J Gwo	3/12	Done
12	Submit requirement and verification method changes to PCB	S Chun	2/6	Done
13	Complete P0336, P0374, & P0375	K Bower	6/12	Open