



W. W. Hansen Experimental Physics Laboratory  
STANFORD UNIVERSITY  
STANFORD, CALIFORNIA 94305 - 4085

Gravity Probe B Relativity Mission

## Detector Package Assembly Test Readiness Review Completion Certificate

### GP-B P0261

### February 6, 1998

\_\_\_\_\_  
Signed \_\_\_\_\_ 3/27/98 \_\_\_\_\_  
**Prepared by: Sei Chun** **Date**  
**Systems Engineer**

\_\_\_\_\_  
**Approved by: John Goebel** **Date**  
**Telescope Readout Electronics Responsible Engineer**

\_\_\_\_\_  
**Approved by: Paul Ehrensberger** **Date**  
**Telescope Readout Electronics Integrated Product Team Leader**

\_\_\_\_\_  
**Approved by: B. Taller** **Date**  
**Quality Assurance**

\_\_\_\_\_  
**Approved by: Bob Schultz** **Date**  
**Chief Systems Engineer**

\_\_\_\_\_  
**Approved by: J. Turneure** **Date**  
**Hardware Manager**

## Detector Package Assembly Test Readiness Review

Date & Time: February 6, 1998, 8:00 to 9:30 A.M.

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 Detector Package Assembly Test Readiness Review (TRR) will encompass all Detector Package Assembly (DPA) flight hardware. The DPA flight hardware includes the completed Detector Package 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
Paul Ehrensberger	DPA Product Team Lead
John Goebel	DPA Test Lead
Bob Farley	Engineer
Ben Taller	Quality Assurance
Bob Schultz	Chief Systems Engineer
Sei Chun	Systems Engineer
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.

TRR Exit Criteria:

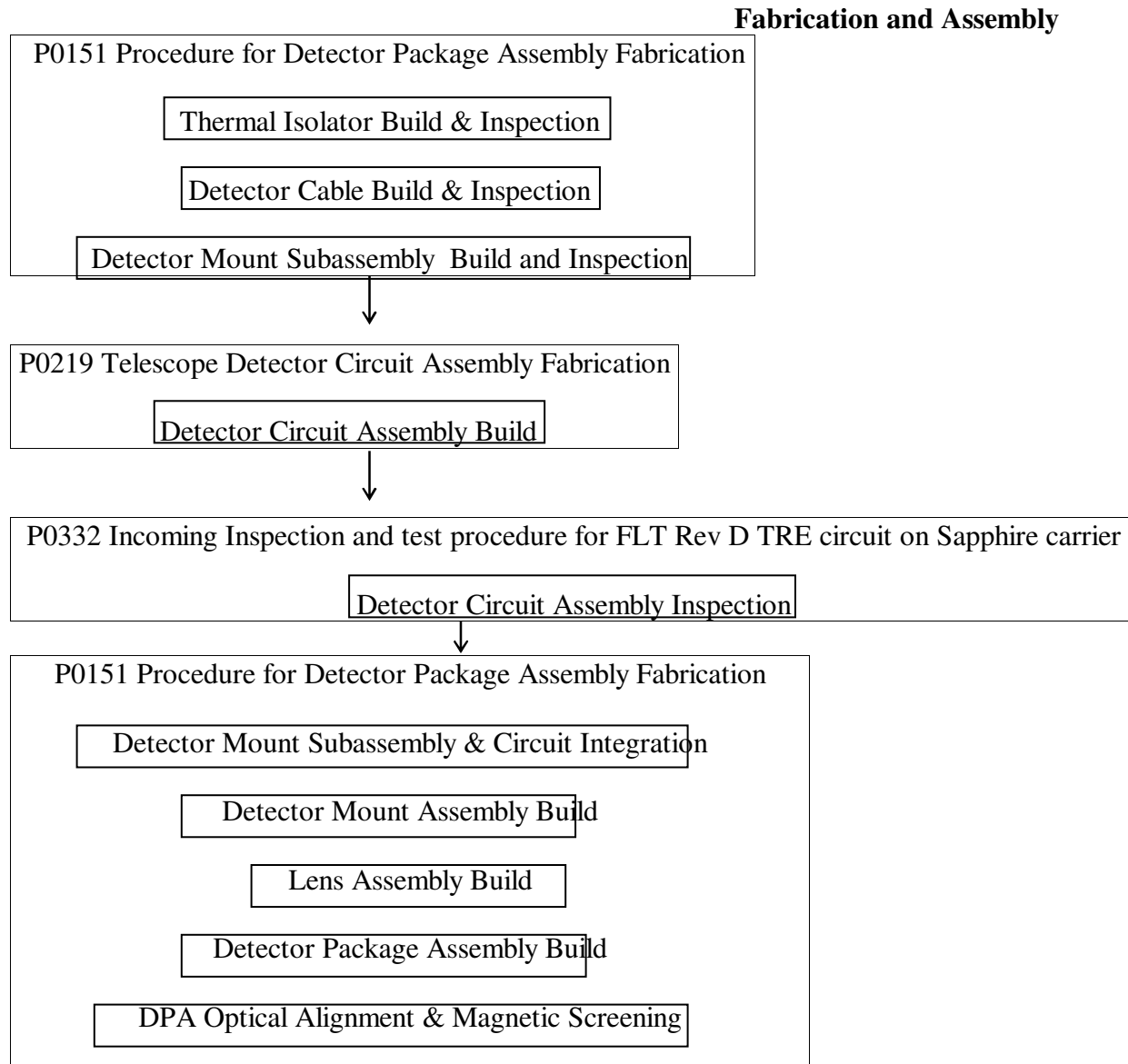
The following items identify the categories of items to be checked; the individual checks are enumerated in the attached checklists:

- Do the test procedures verify all applicable requirements?
- Have the test procedures been “dry-runned”? Do they indicate satisfactory operation?
- 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?

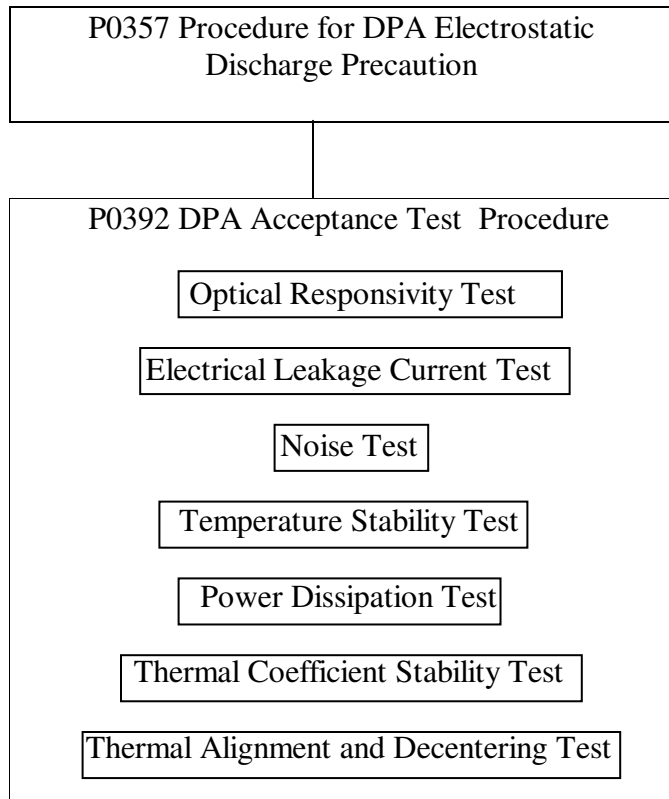
**Attachments:**

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

## A. DPA Manufacturing and Test Flow Diagram



**Test**



## B. Detector Package Assembly Verification Matrix

### Telescope Readout Electronics Specification PLSE-13 Part #3

Paragraph	Title	Text & Comments	Method	Verification Plan	✓
3.2.5	Telescope Detector Mount Assembly	See attached Doc. Text File for an overview of this section.			
3.2.5.1	Vibration Environment	Protoqual @ LN <sub>2</sub> 77K	S,T	P0358 DMA vibration test procedure S-Doc TBS	
3.2.5.2	Detector Package Alignment				
3.2.5.2.1	Pitch/Roll Yaw	<= 10 arcmin <=30 arcmin	I	Inspect vendor data	
3.2.5.2.2	Defocus	<=500 μm	I	Inspect vendor data	
3.2.5.2.3	Decenter	<=500 μm	T	P0392: Thermal Alignment and Decenter Test	
3.2.5.3	Platform Temperature Variation at Roll Frequency, as defined in T003, 7.6.2	<= 2 mK	A,T	Payload level verification	
3.2.5.4	Deleted				
3.2.5.5	Electrical Lead Resistance	<= 100 ohms	T	P151- Detector Mount Subassembly Build	
3.2.5.6	Base Temperature				
3.2.5.6.1	Base Operational Temperature	2-6 K	N/A		
3.2.5.6.2	Base Test Temperature	2 - 290 K	N/A		
3.2.5.6.3	Base Bakeout Temperature (survive)	340 K	T	P0151	
3.2.5.7	Deleted				
3.2.6	Detector Thermal Output				
3.2.6.1	Total Telescope Detector Power (All Detectors)	<=6 mW (1.5 mW/platform)	T	P392: Power Dissipation Test	
3.2.7	Detector Base Operational Temperature Range				
3.2.7.1	Operational Temperature range at 10 fA, 10 pA, and 1 microAmp Photo Current Levels	6K - 2K	N/A	Header	
3.2.7.2	Operational Temperature Range at 10 pA Current Level	300K - 2.0 K	N/A	Header	

3.2.13	Telescope to Telescope Detector Interface	<p>Large Picture available in Doc. Text File.          Assuming:          65-50% Strehl ratio          0.4 - 1.0 micron wavelength          &gt;=70% photons shall fall on the detector          53-21% transmission efficiency          -/+ 60 arcsec ST field of view          Worst case Guide Star (V711 TAURI)          80% photodetector efficiency          Expected photo-current = 12 fA per detector when telescope is centered          Scale Factor <math>\geq 18 \cdot 10^{(-18)}</math> Amp/marcsec per detector</p>			
3.2.18	TRE Detector Performance Requirement				
3.2.18.1	External Quantum Efficiency at 400 to 900 nm wavelength	>70%	S,A,T	P0392: Optical Responsivity test one flight unit will be tested over several wavelength and use similarity for other flight units. S-Doc TBS	
3.2.18.2	External Quantum Efficiency at 550nm wavelength	>70 %	T	P0392: Optical Responsivity test	
3.2.18.3	I_Dark	<0.01 fA@ 80 K	T	P0392: Electrical Leakage Current Test Measure w/o light and at V_detB=4.0V @ 80 K	
3.2.18.4	Diameter of Photoactive Area	0.8 mm	I	P332	
3.2.18.5	Deleted				
3.2.18.6	Operating Temperature (Si JFETs)	80 K $\pm$ 10 K	T	P0392 : Temperature Stability Test Measure without light and at V_detB=4.0V @80 K with all components	
3.2.18.7	Random Noise	<50 e rms/(0.1 sec read)	T	P0392: Noise test	
3.2.18.8	Temperature Stability	<440 e/(read)/K	T	P0392: Thermal Coefficient Stability Test	

### C. Detector Package Assembly Requirements Verification Documents Checklist

#### Detector Package Fabrication & Assembly

Document	Revision Date	Author	Title	Written	In Database	Approval Status	Dwg Ref	Flow Ref	Verif Ref
P0151	11/26/97	P.Ehrensberger	Procedure for Detector Package Assembly Fabrication	✓	✓	Approved	✓	✓	✓
P0219	11/22/97	P.Ehrensberger	Telescope Detector Circuit Assembly Fabrication	✓	N/A	Approved	N/A	✓	N/A
P0332	11/18/97	H. Dermroff	Incoming Inspection and test procedure for FLT Rev D TRE circuit on Sapphire carrier	✓	✓	Approved	N/A	✓	✓

#### Detector Package Test

Document	Revision Date	Author	Title	Written	In Database	Approval Status	Dwg Ref	Flow Ref	Verif Ref
P0392	2/12/98	J. Goebel	Detector Package Assembly (DPA) Acceptance Test Procedure	✓	✓	Approved	N/A	N/A	✓
P0358	4/3/98	J. Goebel	Telescope Detector Mount Assembly Vibration testing	✓		In-Review	N/A	N/A	✓

#### 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	✓	✓	Approved	✓
P0059 C	6/19/94	M. Keiser	GP-B Contamination Control Plan (Probe B)	✓	✓	In-Review	✓
P0080	8/1/92	J. Lockhart	Cryogenic Magnetic Screening Procedure	✓	✓	Approved	✓
P0357	2/10/98	H. Demroff	Procedure for DPA Electrostatic Discharge Precaution	✓	✓	Approved	N/A
23200-119 D	3/5/98	B. Taller	DRAWING TREE, DETECTOR PACKAGE KIT, SM	✓	✓	Approved	✓
25712-103	11/27/97	M. Sullivan	DETECTOR PACKAGE KIT, CHANNEL A	✓	✓	Approved	✓
25712-104	11/27/97	M. Sullivan	DETECTOR PACKAGE KIT, CHANNEL B	✓	✓	Approved	✓



## D. Detector Package Assembly Test Personnel Status Checklist

### Test Conductor / QA

The test conductor is John Goebel

The QA personnel are Ben Taller and Phil Unterreiner

### Test Director

Paul Ehrensberger

### Procedures Requiring Director Approval

#	Title
P0392	Detector Package Assembly (DPA) Acceptance Test Procedure
P0358	Telescope Detector Mount Assembly Vibration Test Procedure

## E. Detector Package Assembly Test Resources Checklists

### Instruments Requiring Calibration

Item Description	ID / Serial Number	Calibration Date	Available
NIST 100W tungsten filament lamp	EPIR-1086	1984	✓
NIST Silicon Photodiode	D213	9/30/97	✓
Tek 744A Oscilloscope	B041929	2/09/98	✓
Tek 420A Oscilloscope	B051297	2/09/98	✓
Tek 540A Oscilloscope	B011828	2/25/98	✓
Silicon Diode Thermometers	BC557T	7/96	✓
HP3458A Multimeter	2823A16067	2/10/98	✓
Germanium Temperature Sensor	N/A	N/A	✓
LakeShore DRC93CA Controller	17483	2/11/98	✓

### Non-standard Test Equipment

Electrical Ground Support Equipment			✓
-------------------------------------	--	--	---

### Facilities

Item Description
Cedar Rm 13
Varian Rm 202
Large Scale Magnetics Facility

### Test Support Software

Software Product	Version	Controlled	Demonstrated
Engineering Test Unit Software (Optical Response.vi, Noise.vi, Leakcurrent.vi, ThermalTest.vi)	1.0	✓	✓
Lab View data acquisition software	4.1	✓	✓
Mathcad	3.1	✓	✓
SQUID	3.4	✓	✓
GPIB Driver NI-488	7.1.3	✓	✓
KaleidaGraph	3.0.4	✓	✓

**F. Action Item Closure Status**

#	DPA status meeting Action Items (1/30/98)	Assignee	ECD	Status
1	Get vibration environment from Gayload, Ken Shaul	Ehrensberger	2/2/98	Open
2	Clarify Defocus and Decenter requirement (PLSE-13 Pt 3 Para 3.2.5.2.2 & 3.2.5.2.3)	Chun & Sullivan	2/2/98	Closed
3	Verify proposed deletions are covered in the higher level (3.2.5.5 to 3.2.5.6.3)	Chun	2/5/98	Closed
4	Update P0392 to include thermal test to verify 3.2.6.1	Goebel	2/5/98	Closed
5	Update P0392 to test quantum efficiency (3.2.18.1) on one flight unit over several wavelength and use similarity to verify other flight units (all flight units tested at 550nm for 3.2.18.2)	Goebel	2/5/98	Closed
6	Complete ECO for 23200-119B drawing tree, Detector Pkg Kit, SM	Turneuare	2/5/98	Closed
7	Add to P0151 step to have each completed DPA magnetically screened	Ehrensberger	2/5/98	Closed
8	Identify and train additional personnel to witness testing	Taller	2/17/98	Closed
9	Collect Cal data	Goebel	2/17/98	Closed
10	Complete Test support SW list and special backup for configuration control	Chun/Coleman	2/17/98	Closed
11	Review additional documents needed for TRR package	Ehrensberger	2/5/98	Closed
12	Prepare PCB package for DPA requirement and verification change	Chun	2/5/98	Closed
#	DPA TRR Action Items (2/6/98)	Assignee	ECD	Status
1	Get a list of factors contributing bias requirements, i.e. - power ripple - platform temperature variation etc.	Ehrensberger	2/25/98	Closed
2	Get vibration environment from Gayload, Ken Shaul and prepare a plan for vibration testing	Ehrensberger	7/31/98	Open
3	Revise P0392 to explicitly identify test temperature during the duration of the testing (80+/- 10 K)	Goebel	2/25/98	Closed
4	Consider making all test at three different temperatures (70 K, 80 K and 90 K) perhaps on representative unit	Goebel Ehrensberger	2/25/98	Closed
5	Add the continuity check to P0151 to include EMI shield	Sullivan	2/11/98	Closed
6	Release P0357 before the test starts	Demroff	2/11/98	Closed
7	Release P0392 before the test starts	Goebel	2/25/98	Closed
8	Supply calibration data and complete calibration before testing	B Taller	2/25/98	Closed
9	Certify EGSE	Fujimoto	6/30/98	Closed

>All the action items except the number two need to be closed before the testing.