STANFORD UNIVERSITY
W.W. HANSEN EXPERIMENTAL PHYSICS LABORATORY
GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

SUMMARY OF GYROSCOPE CHECKOUT IN PROBE C

GP-B SCIENCE MISSION PROCEDURE
P0550 Rev A

October 23, 2000

PREPARED	_____	_____
	R. Brumley, Gyroscope RE	Date
APPROVED	_____	_____
	B. Clarke, Gyroscope Verification	Date
APPROVED	_____	_____
	C. Gray, Gyroscope Verification	Date
APPROVED	_____	_____
	D. Ross, Quality Assurance and Safety	Date
APPROVED	_____	_____
	S. Buchman, Hardware Manager	Date

REVISION HISTORY

Rev	Date	Comments
-	6/7/99	
A	10/23/00	Change title from 'Analysis and Summary of RT Gyroscope Testing Results in Probe C' to 'Summary of Gyroscope Checkout in Probe C' Change procedure to incorporate minor redlines from the previous run. Main structure of the procedure has not been changed. Update to reflect the new Gyro #4 (FQH58 + 95FH03)

1. SCOPE

This procedure reduces and summarizes the data taken during either the RT (P0178) or LT (P0632) checkout of the gyroscopes in Probe C.

2. REFERENCES

2.1 Plans and Procedures

P0481	Levitation of Gyroscopes in Probe C
P0505	RT Spinup of Gyroscopes in Probe C
P0516	Gyro Slow Spin Test
P0410	Pumpdown and Leak check
P0433	Complete Instrumentation Checkout
P0435	Verification of UV Charge Control in Probe C
P0565	UV Charge Control Checkout Procedure
P0536	Gyroscope Caging Tests
P0520	Low Temperature Test of Caging Gyros in Probe C
P0178	RT Gyroscope Checkout
P0632	LT Checkout of Gyroscopes in Probe C

3. GENERAL REQUIREMENTS

3.1 Environmental Requirements

3.1.1 Cleanliness

This procedure may take place in the Class 1000 cleanroom in the HEPL building. Minimum protective garments for personnel working in the clean rooms shall be the standard Tyvek clean room apparel. All activities taking place within this room must be in accordance with the guidelines established by the cleanroom manager.

3.1.2 Particulate Contamination

All connectors shall be inspected and verified free of particulate contamination before they are mated to Probe C. It is also desirable to keep the probe in general clean and free of particulate contamination.

3.1.3 Magnetic Contamination

All parts and tools shall be cleaned using methods consistent with achieving Mil Spec Level 100 cleanliness. In addition, all parts shall be maintained at level 100 cleanliness per GP-B Magnetic Control Plan, Science Mission (P0057). Take all necessary precautions to keep tools and handling equipment free of particulate contamination.

3.2 Test Personnel

3.2.1 Test Director

The test director for this procedure shall be Robert Brumley, or his appointed replacement.

3.2.2 Personnel

The following personnel have received extensive training in the testing of GP-B gyroscopes and are qualified to perform this procedure.

- David Hipkins
- Bruce Clarke
- Chris Gray
- Robert Brumley
- Dr. Sasha Buchman

See section 3.4 for details on the requirements for Quality Assurance notification and witnessing of this procedure.

3.2.3 Minimum Personnel

No activity shall be performed on the science mission probe without at least two people in the room, i.e. at least one person to perform the procedure and one person to observe the procedure.

3.3 Safety

3.3.1 Hardware Safety -- General

It is important to be cognizant at all times of the position of the probe. Be extremely careful not to accidentally bump into the probe. If any connector does not connect smoothly and securely, do not try to force it. Instead, remove the connector and inspect it to find the reason for the difficulty. Great care must be taken during at all times during the performance of this procedure.

3.3.2 Electrostatic Discharge

Grounded wrist straps shall be worn at all times when mating or demating to an electrical connector on Probe C.

3.3.3 Personnel Safety

All operations shall take place according to Stanford University safety guidelines. Any person observing a situation, which they deem unsafe, shall report the fact immediately to the test director. The Quality Assurance representative shall be responsible for monitoring that all activities are performed in a safe manner.

3.4 Quality Assurance

- Stanford QA must be notified at least one hour before beginning this procedure.
- ONR QA must be notified at least one hour before beginning this procedure.
- D. Ross (or her designate) must be present to monitor the completion of this procedure.

This procedure shall be conducted on a formal basis to its latest approved and released version. The QA Program Engineer shall be notified of the start of this procedure. A Quality Assurance representative

designated by D. Ross shall review any discrepancy noted during test. Redlines shall be approved by the QA representative. The QA representative will nominally be Russ Leese. Upon completion of this procedure, the QA Program Engineer, D. Ross or R. Leese, shall certify his of her concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating the appropriate approval line at the end of the procedure.

3.5 Red-Line Authority

Authority to red-line (make minor chances during execution) this procedure is given to the qualified personnel listed in section 3.2.2. All redlines must be approved by the QA representative. In addition, approval by the Hardware Manager shall be required if, in the judgement of the test director or the QA representative, experiment functionality may be affected.

3.6 Electrical Connections

When mating to any flight connector, the following items are required:

- A grounded ESD strap must be worn by any person handling a connector on Probe C
- Inspect both connectors being mated to ensure that there are no particles that might interfere with the mate.
- Each mate and demate of flight connectors must be logged in that connector's mate/demate log sheet. Note that these log sheets have already been started for all suspension lines.

4. REQUIRED EQUIPMENT

There is no required equipment for this procedure. It is only the post analysis of data.

5. INITIAL CONDITIONS

Before beginning this procedure, it is necessary to complete the rest of the room-temperature checkout of gyroscopes in Probe C travel sheet. This procedure will analyze and summarize the data obtained in the tests.

6. DATA ANALYSIS

Complete the GYROSCOPE PERFORMANCE SUMMARY below using the following table as a guide.

Line #	ITEMS	METHOD
1 - 3	• Total Number of Suspensions attempted • Minimum Continual Suspension Time • Number of ASD's caused by Gyroscope After 1st Levitation	Examine DDC log file to determine these values. The cause for any ASD must be determined on a case-by-case basis. Enter the appropriate values in the Gyroscope Performance Summary.
4 –5	• Initial Rotor Potential • Rotor Charge (delta from Initial)	Examine the DDC charge file data to determine both the system calculated initial charge as well as delta charge. Enter the appropriate values in the Gyroscope Performance Summary.

6 - 7	• Rotor Freedom of Motion: Single Axis • Rotor Freedom of Motion: Three Axis	Enter the appropriate values in the Gyroscope Performance Summary from P0178 (RT) or P0632 (LT) "As Built".
8 - 9	• Spindown rate in housing center at 1 µtorr • Spindown rate off-center at 1 µtorr	Examine the frequency vs time data from P0178 (RT) or P516 (LT) to determine spindown rates. Enter the appropriate values in the Gyroscope Performance Summary.
10 - 11	• UV charge control functionality in "+" direction. • UV charge control functionality in "-" direction.	Enter the appropriate values from P0435 (RT) or P0565 (LT) "As Built" in the Gyroscope Performance Summary.
12	Gyroscope Caging Success Rate	Determine the success rate from P0536 (RT) or P0520 (LT) "As Built" and enter the appropriate vale in the Gyroscope Performance Summary.

GYROSCOPE PERFORMANCE SUMMARY

Gyroscope Position Number: _____ Gyroscope Serial Number:_____

#	Item	Requirement	Result	Pass/Fail	Notes
1	Total Number of Suspensions attempted	< 10			
2	Minimum Continual Suspension Time	> 12 hours			
3	Number of ASD's caused by gyroscope after 1st levitation	< 3			
4	Initial rotor potential	< 50 V			
5	Rotor Charge (delta from Initial)	< 50 V			
6	Rotor Freedom of Motion: Single Axis	400 μinches			
7	Rotor Freedom of Motion: Three Axis	(fill in per P0178 or P06232)			
8	Spindown rate in housing center at 1 μtorr	< 2 mHz/hr			
9	Spindown rate off-center at 1 μtorr	< 2 mHz/hr			
10	UV charge control functionality in "+" fixture bias direction.	> 10 fA/μWatt			
11	UV charge control functionality in "-" fixture bias direction.	>30 fA/μWatt			
12	Gyroscope Caging Success Rate	100%			

7. PROCEDURE COMPLETION

Record completion of this procedure in the traveler, as appropriate.

Record any abnormalities or deviations from this procedure in the D-Log. If the QA representative decides it is appropriate, open a Discrepancy Report to document the event.

This test has been completed according to the procedure contained herein. All redlines used have been integrated into this document.

Test Director: (print)	(sign)
(optional) **Test Engineer:** (print)	(sign)
(optional) **Test Engineer:** (print)	(sign)
QA Representative: (print)	(sign)