GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION

P0520

LOW TEMPERATURE TEST OF CAGING THE GYROS IN PROBE C

November 3, 1999

Prepared by: Chris Gray

Program Responsibility	Signature	Date
Chris Gray Operation Engineer		
Robert Brumley Gyroscope R. E.		
John Mester Caging System R. E.		
M. Taber Payload Test Director		
Dorrene Ross GP-B Quality Assurance		
S. Buchman GP-B Hardware Manager		

NOTES:
Level of QA required during performance of this procedure:
X Stanford QA Representative
X Government QA Representative

All redlines must be approved by QA

Revision Record:

Rev	Rev Date	ECO #	Summary Description

Acronyms and Abbreviations:

Acronym / Abbreviation	**Meaning**
GSE	Ground Support Equipment
QA	Quality Assurance Personnel
SMD	Science Mission Dewar

Table of Contents

A **Scope**

This procedure is intended to be used to functionally test the caging circuit in Probe C at Low Temperature for Gyros 1 & 2 or Gyros 3 & 4, depending on the orientation of Probe C.

B **Requirements Verification**

B.1 Requirements Cross Reference: N/A

B.2 Expected Data for verification per requirement: N/A

C **Configuration Requirements**

Probe C is integrated into the SMD per dwg 65113-1C34292 and oriented horizontal for phase C testing. Probe C should be in the following orientation before caging Gyro1 and/or Gyro 2: **-X**. Probe C should be in the following orientation before caging Gyro3 and Gyro 4: **-Y**.

D **Hardware Required**

D.1 Flight hardware required

Description	No. Req'd
65113-1C34292 Probe C / SMD Assy.	1

D.2 Commercial test equipment

Manufacturer	Model	Serial Number	Calibr. Exp. Date
Alcatel Helium Leak Detector	180t		N/A
Met One particle detector	100L		
RGA Leybold Transpector			

D.3 Mechanical/Electrical Special test equipment

Description	Part No.	Rev. no.	Serial No.	Certification Date
DDC Suspension System				
Absolute Pressure Transducer				
Keithly Electrometer	617		400929	11/01/99
Caging Control Unit				

D.4 Tools

Description	No. Req'd
Wrenches as required	

D.5 Expendables

Description	Quantity
Ni VCR gaskets	As required
High Pressure He Gas 6.0 Grade	1

E **Procedures Required**

Procedure Name	Procedure No.
Levitation of Gyroscopes in Probe C	P0481
GSE Caging Ballast System Installation	P0621
GSE Caging Commissioning	P0625

F **Equipment Pretest Requirements:** N/A

G **Personnel Requirements**

Qualified personnel are: Robert Brumley, Ken Bower, Bruce Clarke, David Hipkins, John Mester, and Chris Gray.

H **Safety Requirements**

H.1 High Pressure Gas

H.1.1 Care should be taken when working with high pressure gas. Slowly increase pressure at the regulator and vent gas in high pressure lines before disassembly.

I **General Instructions**

I.1 Redlines can be initiated by Chris Gray and Robert Brumley and must be approved by QA.

I.2 Any nonconformance or test anomaly should be reported by a Discrepancy Report. Refer to the Quality Plan, P0108, for guidance. Do not alter or break test configuration if a test failure occurs; notify quality assurance.

I.3 Only the following persons have the authority to exit/terminate this test or perform a retest: Chris Gray, Robert Brumley, Mike Taber, and Russ Leese.

J **References and Applicable Documents:** N/A

Op. Order No._____
Date Initiated_____
Time Initiated_____

K Operations

K.1 Connect DDC System to appropriate suspension lines for the corresponding Gyro or Gyros (Gyro circuit 3 & 4) which will be caged. Use Procedure P0481.

K.1.1 Ensure that the bridge on the DDC or DDC's are functioning properly . Another person should gently tap on the SMD support ring while someone is monitor the bridge on the DDC. It should be obvious that the gyroscope rotor is free.

K.2 Connect the Keithly Electrometer (or Electrometers if verifying Gyro's 3 & 4) to the appropriate gyroscope ground plane connector on the top hat of Probe C.

Gyroscope #1: CG18
Gyroscope #2: CG28
Gyroscope #3: CG38
Gyroscope #4: CG48

The Electrometer is connected to the "Ground Plane" per Figure 1. One end of the connection is connected to the "Ground Plane" and the other end of the circuit is connected to the Probe C Ground. ESD Wrist straps should be used during this operation.

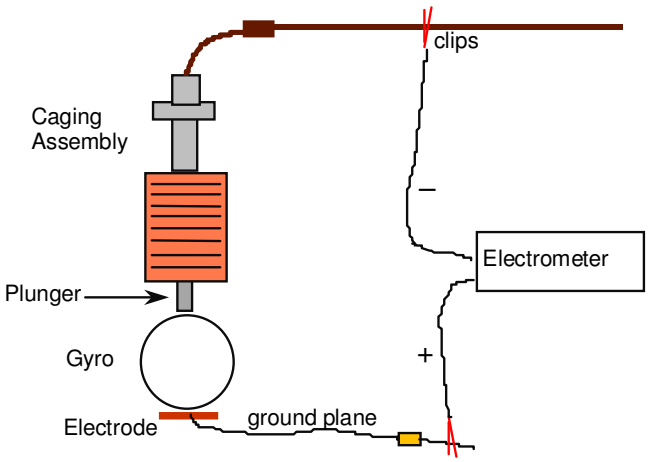

Figure 1

K.3 Verify that the GSE Caging Unit and manifold have been leak tested per P0625.

K.4 Confirm the Helium bottle connected to the GSE Caging Unit is certified as 6.0 He.

K.5 Confirm that the RGA connected to the top hat of Probe C (@P9), is functioning properly.

K.6 Start up the Alcatel 180t (or equivalent) leak detector and calibrate for He. Connect the leak detector to V7 on the GSE Caging manifold. V7 should be closed.

K.7 Connect a clean, high pressure manifold to V6 on the GSE Caging Unit. Connect the a pre fabricated tee manifold with VCR fittings to the other end of the High Pressure manifold. **Do NOT** connect the Tee end of the manifold to the ballast tanks until a cleanliness test has been preformed.

K.8 Close V5 and V7 on the GSE Unit. Monoitor the output on one of the three VCR fittings on the fabricated Tee using a MET ONE particle monitor. Record the background number of particles per 1 minute particle detector cycle in Table 1. Open V6 and purge filtered nitrogen into V8 on the GSE Unit and record the number of particles per 1 minute particle detector cycle.

K.9 Repeat K.9 for the other two VCR fittings on the fabricated Tee which will connect to the ballast tanks.

No.	Time	Background	Flow (PSI)	# Particles
1				
2				
3				

Table 1

K.10 Connect the VCR fittings to the ballast tanks after verifying particle testing. Continue flowing nitrogen through the manifold while making the connections to ensure cleanliness.

K.11 Leak check the manifold from V6 to the Ballast tank valves through V7.

K.12 Open the metering valve, V2, V3, V5, V6 on the GSE Caging Unit. Note that V4, V8, and V7 should be CLOSED.

K.13 Pump down the manifold using the leak detector by opening V7 and cycling the leak detector. After the manifold is evacuated, close V7 and vent the manifold by increasing the GSE Caging Unit regulator so He can purge thru the manifold.

K.14 Purge the GSE Caging Unit's manifold two more times by repeating K.13.

K.15 Set the regulator on the Helium gas supply bottle to 185 PSI. Set the GSE Caging Unit's regulator to approximately 10 PSI.

K.16 Record the initial (uncaged) position of the DDC bridge. The posistion is in microinches.

X=_____ Y=_____ Z=_____ Gyro #_____

X=_____ Y=_____ Z=_____ Gyro #_____

Note: The second line is only to be used if caging two gyroscopes simultaneously (i.e. Gyros 3 and 4)

K.17 Verify the valves are in the following state:

V1	→	Open	_____
V2	→	Open	_____
V3	→	Open	_____
V4	→	Closed	_____
V5	→	Closed	_____
V6	→	Open	_____
V7	→	Closed	_____
V8	→	Closed	_____
Metering Valve	→	Closed	_____
GSE Regulator	→	Open 10 psi	_____
He Bottle Reg.	→	Open 185 psi	_____
Ballast valves (VG1,VG2,VG3/4)	→	Closed	_____

K.18 Open valve on the ballast tank for the appropriate gyro to be caged.

Caging Gyro 1	→	Ballast Tank valve VG1
Caging Gyro 2	→	Ballast Tank valve VG2
Caging Gyros 3 and 4	→	Ballast Tank valve VG3/4

K.19 Open V7 and start pumping on the Caging GSE Ballast System. Open the appropriate valves on Probe C while the leak detector is pumping on the GSE manifold and ballast circuit.

Probe C Top Hat Caging valve legend:

Gyro 1	→	CG5 and CG6
Gyro 2	→	CG3 and CG4
Gyro 3 and 4	→	CG1 and CG2

K.20 Pump the GSE and Probe C caging circuit to a pressure ~ < 1 X 10^{-3}.

K.21 Record the DDC bridge position again.

X=_____ Y=_____ Z=_____ Gyro #_____

X=_____ Y=_____ Z=_____ Gyro #_____

Note: The second line is only to be used if caging two gyroscopes simultaneously (i.e. Gyros 3 and 4)

K.22 Check to ensure the valves are in the following state:

V1	→	Open	_____
V2	→	Open	_____
V3	→	Open	_____
V4	→	Closed	_____
V5	→	Open	_____

V6	→	Open	_____
V7	→	Closed	_____
V8	→	Closed	_____
Metering Valve	→	Closed	_____
GSE Regulator	→	Open 10 psi	_____
He Bottle Reg.	→	Open 165 psi	_____
Caging probe C (CG1 & 2 or CG 3 & 4 or CG 5 & 6)	→	Open	_____
Ballast valves (VG1or VG2 or VG3/4)	→	Open	_____

K.23 One person needs to constantly monitor both the DDC bridge and the Electrometers while the pressure is increasing in the caging circuit. The pressure should be increased in 10 psi increments and recorded in Table 2.

K.24 Start the software on the Leybold RGA system and monitor AMU 4. Note the average amplitude of the Mass 4 peak: _____

K.25 Slightly open the metering valve on the GSE Caging Control Unit and record the Absolute pressure that you are beginning the caging . Now slowly increase the GSE Caging Control regulator in 5 psi increments. Adjust the metering valve as necessary to control the time it takes the pressure to change at the Absolute Pressure indicator. Make sure the person watching the DDC and Electrometer is recording the measurements for approximately every 10 psi change.

K.26 Once the caging has touched the rotor, continue increasing the pressure to 165 psia.

K.27 After achieving the 165 psia target pressure, close the appropriate valve on the caging ballast manifold.

Caging Gyro 1	→	Ballast Tank valve VG1
Caging Gyro 2	→	Ballast Tank valve VG2
Caging Gyros 3 and 4	→	Ballast Tank valve VG3/4

K.28 If possible, continue to supply 165 PSIA to the caging ballast manifold as a back-up the the VCR Nupro valve.

K.29 Check the Mass 4 average amplitude on the Leybold RGA system. Note the amplitude of the Mass 4 peak: _____

RECORD OF CAGING CHECK

Gyroscope # _____
Caging Valve CG_____

Pressure (psid)	Resistance	Gyroscope Position [X Y Z] microinches	Notes
Pressure (psid)	Resistance	Gyroscope Position [X Y Z] microinches	Notes

K.25

Test completed.

Completed by: _____

Witnessed by: _____

Date: _____
Time: _____