

GRAVITY PROBE-B
PAYLOAD TESTING
PROCEDURE

(PTP) SIA FLUX FLUSH

P0582 Rev B

September 15, 1999

Originator

D. Murray

Approvals:

Mike Taber
Test Director

_ Date _____

Dave Murray
Test Director

_ Date _____

Dorrene Ross
GP-B Quality Engineer

_ Date _____

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Hardware Manager

_ Date _____

REVISION	ECO No.	PAGES	DATE
Original	-	All	September 15, 1999
A	1038	All. Update incorporating redlines for Probe-C use with gas flow into unlevitated Gyro #4 while levitating Gyros 1 and 3.	October 13, 1999
B	1039	Modify to allow for two part a) heating and b) cooling temperature control of quartz block using feedback heater control and with gas cooling of rotor prior to quartz block cooling.	October 19, 1999

A SCOPE

This procedure effects the heating of the entire SIA unit of the Probe for the purpose of flux flushing all SIA Components while using controlled helium gas to maintain Probe pressure and, optically cool rotor with spin-up gas inflow.

B CONFIGURATION

- B.1 Probe is integrated with SMD.
- B.2 Probe connectors I1, I5, I6 and I7 are cabled to FDAS.
- B.3 IR is off.

C REFERENCE DOCUMENTS

C.1 Procedures:

Procedure No. Title

None

C.2 Drawings

LMSC Drawing No. Title _____

None

C.3 Figures

None

C.4 Supporting documentation

- a) GP-B Magnetic Control Plan, LMMS-5835031
- b) SMD Safety Compliance Assessment, LMMS GPB-100153C
- d) SM Dewar FMECA, LMMS GPB-100333
- e) FIST Emergency Procedures SU/GP-B P0141
- f) SMD Final Assembly, LMMS 5833500

D SAFETY

D.1 In case of any injuries obtain medical treatment at:

LMMS **Call 117** Stanford University **Call 9-911**

D.2 Safety

The GP-B (FIST) Safety Plan, LMSC-F314447, discusses safety design, operating and maintenance requirements which the R&DD program office has adhered to. These requirements should be reviewed for applicability at any facility outside of R&DD (e.g. Stanford University) where FIST hardware is operated.

D.3 Hazards Analysis

The GP-B (FIST) Preliminary Hazards Analysis, LMSC-F314446, discusses hazards inherent in R&DD-developed FIST hardware in greater detail.

E EQUIPMENT

- E.1 Leakage Gas Pumping System (LGPS)
- E.2 Probe Pressure Measurement System (PPMS)
- E.3 Facility Data Acquisition System (FDAS)
- E.4 Gyro Suspension Equipment (DDC)

F PERSONNEL

The personnel certified to set up and perform this procedure are:

Dave Murray	Stanford University
Mike Taber	Stanford University

The persons authorized to create and sign-off on redline modifications of the procedure as it is performed are the test directors, M. Taber and D. Murray. The redlines will be reviewed and approved by the RQE during or after the performance of the redline.

G Quality Assurance

Quality Assurance engineering shall be notified at least 24 hours prior to the start of this procedure. In the event of a failure during the execution of testing, Quality Assurance shall be contacted. Any redlines made to this procedure shall be initialed by a program RQE prior to his/her final sign off.

Operation No.

Date

Time

H OPERATIONS

1. System Set Up:

- 1.1. Verify all SQUID controllers are off.
- 1.2. Verify IR system is off.
- 1.3. Verify Cables I2 and I3 and SQUID heaters cable is disconnected.
- 1.4. Verify Well is at vacuum, record pressure _____ Torr;
or record last measured value :
- 1.5. Record other special conditions:
- 1.6. Switch Facility DAS to scan list ASIA flux flush≡ (configuration 3K). The thermometer used for control is T10P [CN 121].
- 1.7. Verify temperature sensors for Filter 1&2 and Filter 3&4 are included in the data.

2. Levitate Gyros

2.1. Choose

- 2.1.1. Leave all Gyros unlevitated.
- 2.1.2. Perform procedure P0481 to levitate the following Gyros:

Gyro #1 Operations order No. ___	Completion Time _____
Gyro #2 Operations order No. ___	Completion Time _____
Gyro #3 Operations order No. ___	Completion Time _____
Gyro #4 Operations order No. ___	Completion Time _____

3. Establish Probe Pressure:

3.1. System Set Up:

- 3.1.1. Verify that the pumps SEP-1 and SEP-2 are on.
- 3.1.2. Verify that all spin up supply and exhaust valves are closed as indicated on the upper Control Panel.
- 3.1.3. Verify that the leakage gas turbo pump system is operational:
 - a) Pumps LGP-1, LGP-2, LGP-3, and LGP-4 are on.
 - b) Valves LGV-1, -3, -6, -7 are open and that LGV-8 (or -9) and LGV-10 are open.
- 3.1.4. Open or verify open LV1 (or LV2, as appropriate).

Note:

Opening of LV1 or LV2 is done by performing procedure P0580, A6-in. Vatterfly Valve Operation≡

3.1.5. Crack open the needle valve GSV-11 (located on pump station panel facing the Dewar) by about 5 units (25 units/turn).

Note:

Do not overtighten this valve when closing, finger tight will effect a good vacuum seal-off.

3.2. Establishing Requisite Flow in Bypass Mode:

3.2.1. Verify that GSG-4 reads <= 0.1 torr. If this is not the case do the following:

3.2.2. Briefly open AXV-8 and AXV-5 until GSG-4 bottoms out.

3.2.3. Verify GSV-4 and -5 are set at zero flow and switched to "off" with the "override" (amber) light on.

3.2.4. Open GSV-1 and GSV-6.

3.2.5.

3.2.6. Open the appropriate valve:

9 GSV-2	- for low flow rates	9 GSV-3	- for high flow rates
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3.2.7. Switch to "auto" mode of operation:

9 GSV4	- for low flow rates	9 GSV-5	- for high flow rates
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3.2.8.

3.2.9. Slowly turn up the flow control pot on GSV-4 (or -5) until the desired flow rate is shown on the controller readout.

VERIFY: Pressure rise is immediately noted on GSG-4.

Note:

A flow of 0.8 sccm should achieve a pressure of 1-2E-5 torr.

Note:

This now establishes the proper flow through the bypass valving GSV-6 and GSV -11 but no flow into Gyro yet.

3.2.10. Record flow rate _____ sccm Pressure _____ torr

3.3. **Setting Up Data Collection**

3.3.1. Ensure that all the above preparations for the spin up have been completed:

- a) A spin speed monitor is operational, e.g., an FFT program/DSP connected to an appropriate read-out device.
- b) The Gyros are stably suspended with an acceptable charge.
- c) The facility Data Acquisition System (DAS) is properly configured using:
 - a) Load the scan list "spinup data set" using (from Main Menu) :
 - b) [Other/f8]; [Data Configs/f3]
 - c) From menu select A6 = Spinup data set
 - d) At pause select [VDT/f8]
 - e) At query type AN
 - f) Use [Set D. C. Interval/f1] and set data cycle to 5 minutes.
 - g) Input comment to DAS using (from Main Menu): [Plot Menu/f4] and [Comment/f7]
 - h) Verify FDAS is acquiring data.

3.3.2. Verify SMD DAS is collecting data and that the lead bag temperature alarm is operating at <5.5 K setpoint.

3.3.3. Start recording data in Table 1.

3.4. **Starting the Spin Up Gas to Gyros:**

Note:

The bypass valve, GSV-6, will close automatically when the above is done.

3.4.1. When ready to start gas activate GSV-10.

Table 1 Spinup Pressures and Flows

Time	GSG-2(/3) CN (sccm)	GSG-4 CN (torr)	PPG-1 CN (torr)	PPG-2 CN (torr)	Comments

4. Recording the He partial pressure in the Probe (RGA/PPG-1) and ion gauge pressure (if applicable):

4.1. (RGA/PPG-1): _____ torr (He/He), PPG-2: _____ torr
Other: _____

5. Verification of QBS heater circuit(s) and temperature sensor(s).

5.1. Verify H05P Power Supply:

5.1.1. Connect/verify connected PS B #4 to H05P [CN 25].

NOTE:

DAS heater: AHtr QBS/a H05P [25]≡
DAS temperature: AQBS/a T10P [121]

5.1.2. Record Temperature T10P [121]: _____ K.

5.1.3. Use Monitor Data of DAS to monitor heater power CN=25.

5.1.4. Activate power supply B and set over voltage for output B4 at 2.0 v (leave current limit at default value 0.05a)

5.1.5. Apply 1V (~ 1-2 mW) to H05P [CN 25].

5.1.6. Verify that the DAS sees the power being applied to H05P

Record power: _____ mW.

5.1.7. Set H06P to 0.0 volts.

5.2. Verify H06P Power Supply:

5.2.1. Connect/verify connected PS B #3 to H06P [CN 26]:

a) DAS heater: Htr QBS/b H-6P [26]

b) DAS temperature: QBS/b T11P [122]

5.2.2. Use Monitor Data of DAS to monitor heater power CN=26.

5.2.3. Activate power supply B and set over voltage for output B3 at 2.0 v (leave current limit at default value 0.05a)

5.2.4. Apply 1V (~ 1-2 mW) to H06P [CN 25].

5.2.5. Verify that the DAS sees the power being applied to H06P

a) Record power: _____ mW.

5.2.6. Set the output of power supply B4 (and B3) to 0.0 volts.

6. Perform a Temperature Control Setup:

- 6.1. Go to menu Aother≡, submenu Aother-other≡.
- 6.2. Use Atemp ctl≡ setup (F6).
- 6.3. Select option AC≡ to enter the Temperature Control Setup.
 - 6.3.1. Set mode to auto (select 1). (If B3 is used in tandem, set it to manual).
 - 6.3.2. Set control constants (select 3) to:
 - a) ANew heater?≡ = Y.
 - b) AVoltage limit≡ = (Max = 19 V or 23 V if exchange gas is used).
Record value used: _____ V.
AProportional≡ = 0.1, Aoffset≡ = 10, Arate≡ = 0.
 - 6.3.3. If B3 is to be used repeat step 11.3.2 for which only the voltage limit will have meaning.
 - 6.3.4. Set temperature set point (select 2) 0.2 K above current temperature.
Record temperature set point: _____ K.
 - 6.3.5. Exit the feedback control setup mode (select 0).
- 6.4. Repeat steps 7.1 and 7.2 selecting AM≡ to set cycle time to 0.5 - 1.0 min. If necessary.
- 6.5. Verify temperature control is operating properly by observing DAS monitor.
- 6.6. Automatic set point control; prepare the two programs:
 - 6.6.1. Program A:
 - 6.6.2. Ramp to 13 K in 0.5 hour.
 - 6.6.3. Hold at 13K for 12 hours.
 - 6.6.4. Program B:
 - a) Ramp to 7K for 12 hours (0.5K/hr)
 - b) Change set point to 1K (zero power output)

NOTE:

Program is inserted using the following:

- a) At DAS program statement line ATsp_pb≡ (access by APAUSE≡, AEDIT tsp_pb≡) type in the requisite indicated data for automatic heat up and cool down (ref. Sample DATA statements).
 - b) Ensure statement at ARestore_tsp_a≡ or ARestore_tsp_b≡ (access with EDIT≡ Restore_tsp_a≡) in temperature set point program calls for the correct ATspp_a/b≡ reference line.
 - c) Use Aother≡ and Aother-other≡ and AAuto Set Pnt Ctr≡ and AT set pnt Init.≡ to activate the startup of set point Program AA≡ and enter start up time.
 - d) Chose initialization date and time: _____ .
- 6.6.5. Verify the data printout of temperature program is consistent with required operations.
 - 6.6.6. Verify PC DAS temp control is operating by observing the monitor output.
 - 6.6.7. Attach printout of the temperature set point generated in the above.

7. Recording RGA pressure (if applicable):

- 7.1. Record RGA and ion gauge pressures. RGA: _____ torr, LGG1: _____ torr.
- 7.2. Record cooldown data in Table 1.

8. Option to Adjust Temperature of Vacuum Shell to Reduce Gradients in Quartz Block

- 8.1. Set up Vacuum Shell heater H03P per Appendix B
- 8.2. Record set point used _____ K.
- 8.3. Record this set point in data table.
- 8.4. Adjust temperature set point as required.

9. Option to Pause Cooldown Temperature Profile:

- 9.1. When quartz block is at 9.5 K interrupt the cooldown program.
- 9.2. Continue suspension of cooldown for 1 hour.
- 9.3. Deactivate data collection from T01Q and T03Q, continue with data collection of T02Q
- 9.4. Restart cooldown program using new input per Section 6.7

9.4.1. Continue cooldown from present temperature to 7 K at 0.5K/hr

9.4.2. Change set point to 1K (zero power output)

10. Option to Cool Rotor with Spinup Gas Flow:

- 10.1. When Quartz Block has finished desired soak time; record:
Date/time _____
Soak duration _____ Hrs. at _____ K
- 10.2. Reduce flow to Gyro #4 gradually to 0.0 sccm by adjustment of GSV-4.
- 10.3. Switch flow path to Gyro #1 by closing GSV-9 and opening GSV-6
- 10.4. Raise flow from 0.0 to 0.1 sccm by adjusting GSV-4; record LGG1 _____ Torr.
- 10.5. Control flow required to bring Gyro #1 to 9.8 K.
- 10.6. When Gyro #1 reaches 9.8 K, deactivate Gyro #1 temperature sensor using AMon Data≡ + ADeactivate≡.
- 10.7. Immediately activate Temperature Control Program AB≡.
- 10.8. Maintain spinup gas inflow constant over remainder of cool down.

11. Final Operations:

- 11.1. At end of hour temperature program continue helium gas flow for 2 hours.
- 11.2. Record comment and judgement of appropriateness of SIA temperatures _____

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- 11.3. Power-off power supplies
 - 11.4. **Shutting down Spinup Flow:**

11.4.1. When the desired spin up speed has been reached, close the appropriate valve:

9 GSV-2 9 GSV-3

11.4.2. Open AXV-8 and AXV-5 to pump out excess gas in the supply manifold and the supply line in the probe. Occasionally close AXV-5 and monitor the rate of rise on GSG-4. Reopen AXV-5 if the pressure in the manifold rises above 1 torr. When GSG-4 stays below 1 torr with AXV-5 closed, close **both** of the appropriate supply and exhaust valves, GSV-7, -8, -9, or -10 and SEV-1, -2, -3, or -4.

CAUTION

Do not walk away with valves open between the probe and the spin up exhaust system. The spin up exhaust pumps are oil based and considerable back-streaming can occur into the probe if the probe is left exposed to these pumps in molecular flow conditions.

- 11.4.3. Close / verify closed AXV-5 and AXV-8.
- 11.4.4. Close GSV-1.
- 11.4.5. Set flow controller to "off" and turn flow control pot to zero.
- 11.4.6. Reset DAS:
 - a) Input comment to DAS using (from Main Menu): [Plot Menu/f4] and [Comment/f7]
 - b) Load original scan list, e.g., "Gyro test A using procedure of 13.c.ii
 - c) Set appropriate logging interval, e.g., 15 minutes.
 - d) Reinitiate scanning, use [Set D. C. Interval/f1].

12. **SIA Flux Flush completed.**

Completed By: _____
Witnessed By: _____
RQE : _____
Date: _____
Time: _____

	QBS					CRYOPUMP		VACUUM SHELL				
TIME	SET PNT T10P K	121 T10P K	88 T11P K	26 H06P W	25 H05P W	127 T15P K	31 H10P K	146 T13P K	27 H08P W	28 H09P W	GSV-4 Flow Sccm	COMMENTS

Appendix A

13. Manual Temperature Control Activation for QBS H06P/H05P:

- 13.1. Manual setting of set point:
- 13.2. Repeat the Temperature Control setup steps of Sec.2 below. and adjust the temperature set point to the desired value.

14. Perform a Temperature Control Setup:

- 14.1. Go to menu Aother≡, submenu Aother-other≡.
- 14.2. Use Atemp ctl≡ setup (F6).
- 14.3. Select option AC≡ to enter the Temperature Control Setup.
 - 14.3.1. Set temperature set point (select 2) 0.2 K above current temperature.
Record: _____ K.
- 14.4. Exit the feedback control setup mode (select 0).
- 14.5. Repeat steps 2.3 selecting AM≡ to set cycle time to 0.5 - 1.0 min. If necessary.
- 14.6. Verify temperature control is operating properly by observing DAS monitor.
 - 14.6.1. Observe the plotted temperature response to determine when the high temperature soak is complete (usually 3.5 hours minimum).
Date: _____, Time: _____.

Appendix B

15. Temperature Control Activation for Vacuum Shell:

16. Performing a Temperature Control Setup of Vacuum Shell H08P:

- 16.1. Go to menu Aother≡, submenu Aother-other≡.
- 16.2. Use Atemp ctl≡ setup (F6).
- 16.3. Select option AC≡ to enter the Temperature Control Setup.
 - 16.3.1. Set mode to Aauto≡ (select 1).
 - 16.3.2. Set control constants (select 3) to:
 - a) ANew heater?≡ = Y.
 - b) AVoltage limit≡ = (Max = 21 V); record value used: _____ V.
 - c) Proportional≡ = 0.05, Aoffset≡ = 15, Arate≡ = 0.
 - 16.3.3. Set temperature set point (select 2) 0.2 K above current temperature.
Record setpoint temperature: _____ K.
- 16.4. Exit the feedback control setup mode (select 0).
- 16.5. Repeat steps 7.1 and 7.2 selecting AM≡ to set cycle time to 0.5 - 1.0 min. If necessary.
- 16.6. Verify temperature control is operating properly by observing DAS monitor.

17. Temperature Control Activation for Vacuum Shell:

- 17.1. Setting of set point:
 - 17.1.1. Repeat the Temperature Control setup steps Sec. 4 (omitting steps 7.3.1 and 7.3.2) and adjust the temperature set point to the desired value.
Record value for T13P : _____ K.
- 17.2. Verify PC DAS temp control is operating by observing the monitor output.
- 17.3. Observe the plotted temperature response and determine when the temperature level has been reached.

Date: _____

Time: _____.