GRAVITY PROBE B

PROCEDURE FOR

PAYLOAD VERIFICATION

(PTP) 15.12 ECU: FLUX FLUSH - FINAL FLUX FLUSH PRIOR TO LAUNCH PSVECUFLXFL

Procedure No. P0542, Rev. A

11/15/02

Prepared by: *M. Taber*, *D. Meriwether*

Approvals:

Program Responsibility	Signature	Date
D. Meriwether Test Author		
M. Taber Cryo Operations Manager		
B. Muhlfelder ProgramTechnical Manager		
D. Ross GP-B Quality Assurance		
C. Gray GMA		
R. Brumley Payload Manager - Technical		

NOTES:
Level of QA required during performance of this procedure:
_X_ SU QA Representative
_X_ Government QA Representative

- SU QA must be notified at least 24 hours before beginning this procedure.
- ONR must be emailed at least 24 hours before beginning this procedure.
- Test Configuration is not to be changed or broken without approval of QA.
- A Quality Assurance representative or their designated representative shall be present during this procedure and shall review any discrepancy noted during assembly or test.
- Any red lines to the procedure shall require the approval and initial of the Test Author and SU QA prior to implementation.
- Upon completion of this procedure, Quality Assurance shall certify his/her concurrence that the effort was preformed and accomplished in accordance with the prescribed instructions by signing and dating.
- Discrepancies shall be recorded in a D-log or as a DR per Quality Plan P0108

Revision Record:

Rev	Rev Date	ECO #	Summary Description
A	11/15/02	1396	Updated to conform with S0637, Rev. -

Acronyms and Abbreviations:

Acronym / Abbreviation	Meaning
ECU Monitor Mnemonics	
BE_XXXXX_XXXXXX	Binary Word Monitor
CE_XXXXX_XXXXXX	Current Monitor
DE_XXXXX_XXXXXX	Digital Word Monitor
TE_XXXXX_XXXXXX	Temperature Monitor
TE_XXXXX_X**GT**XXX	GRT TYPE Thermometer
TE_XXXXX_X**PT**XXX	PRT TYPE Thermometer
TE_XXXXX_X**ST**XXX	SDT TYPE Thermometer
TE_XXXXX_XXXXX**D**	Dewer located Thermometer
TE_XXXXX_XXXXX**P**	Probe located Thermometer
TE_XXXXX_XXXXX**Q**	Quartz Block located Thermometer
VE_XXXXX_XXXXXX	Voltage Monitor
AC	Alternate Current
Closed Loop	Hardware Controlled
Command	Software response indicating command sent
Current	Commanded Heater Amperage
DC	Direct Current
Open Loop	Software Controlled
Power	UV Lamp Power Supply readout
Pressure	GMA Pressure Sensor readout
Range	UV Lamp Power Hi Lo Range readout
Signal	UV Lamp Intensity readout
Temperature	Thermometer readout
Voltage	Commanded Heater Voltage

CCCA	Command & Control Computer Assembly
CSTOL	Colorado Spacecraft Test and Operations Language
ECU	Experimental Control Unit
EPS	Electrical Power Subsystem
FU	Flight Unit
FSW	Flight Software
FTP	file transfer protocol
GMA	Gas Management Assembly
GP-B	Gravity Probe B
ICD	Interface Control Document
MOC	Mission Operations Center
MSS	Mission Support Software

OASIS-CC	Operations and Science Instrument Support - Command and Control
ONR	Office of Naval Research
PDU	Power Distribution Unit
QA	Quality Assurance
RTC	Real-Time Commands
SPC	Stored Program Commands
TCP/IP	Transmission Control Protocol over Internet Protocol
Tlm	Telemetry
UPS	Uninteruptable Power System
VAC	Volts AC

A Scope

This document details the GP-B's Science Gyroscopes Trapped Magnetic Flux Flushing procedure. The purpose of this operation is to reduce the Science Gyroscope's trapped magnetic flux. The major components used during this operation are the Oasis-CC based Pod G, the ECU Flight Unit, the GMA Flight Unit, the ECU's Thermal Control PID Algorithm, the QBS (H-05P & H-06P) and Vacuum Shell (H-08P & H-09P) Heaters and their associated temperature monitors.

B Requirements Verification

B.1 Requirements Cross Reference

- This operation will assist in reducing the measured trapped flux on the science gyroscopes below 9 microgauss.
- SCIT-01 Para. 8.2.3

B.2 Expected Data for verification per requirement.

- TCAD analysis of the ECU telemetry as displayed and recorded during the test.
- Record and Printout of Ground Support Temperature Monitoring.

B.3 Success Criteria

- Heating the QBS to 13 K and then lowering the QBS temperature in a ramp until the Gyro's are below superconductive temperature

C Configuration Requirements

C.1 Verify pumping line connected to LV1 and ready for valve opening _____QA _____Cyro Team.
Verify GMA GSE is connected to GMA to support test _____QA

_____GMA team

C.2 The ECU shall be provided with a 1553 connection and a timing signal (10 Hz).

C.3 The Aft ECU shall be attached via cables to the Forward ECU, Top Hat, FEE Base Plate, Cross Flange & Dewar Support ring. Ref: Drawing 5856124, Payload Cable Interconnect Diagram

C.4 The Forward ECU shall be attached via cables to the Aft ECU, Probe Top Hat, Dewar Top Plate & FEE Base Plate. Ref: Drawing 5856124, Payload Cable Interconnect Diagram

C.5 Flight hardware required;

Description	No. Req'd
GP-B Space Vehicle	1
Flight ECU – Fwd	1
Flight ECU – Aft	1

C.5 Commercial test equipment

Manufacturer	Model	Serial Number	Calibr. Exp. Date

C.6 Mechanical/Electrical Special test equipment

Description	Part No.	Certification Date

C.7 Tools

Description	No. Req'd
8 mm tape drive	1

C.8 Expendables

Description	Quantity
8 mm tape	1

D Software Required

D.1 Flight Software

Flight Software Name	Version No.
MSS (Mission Support Software)	3.3.1

D.2 CSTOL Scripts

CSTOL Script Name	Version No.
Gma_setup	V 1.2

D.3 SPC Scripts

SPC Script Name	Version No.

D.4 Test Support Software

Test Software Name	Version No.
Oasis (Operating System Software)	V 2.4.5
Framex (front end software)	Framexs

E Procedures Required

Procedure Name	Procedure No.
(PTP) 15.12 ECU: Flux Flush - Final Flux Flush Prior to Launch PSVECUFLXFL	P0542, Rev. A, 12/11/02

F Equipment Pretest Requirements

Equipment	Test Required	Proc. No.	Test Performed Date	By
FLIGHT Fwd ECU	FLIGHT Certification	ecu_box_tlm.prc	4/17/01	JT / HDM
FLIGHT Aft ECU	FLIGHT Certification	ecu_box_htr.prc	4/17/01	JT / HDM

G Personnel Requirements

G.1 As a general requirement, all operations involving flight equipment require at least two persons at all times.

G.2 The test leader for this procedure is Dr. Dave Murray <cell: 650-619-0761>, or his appointed representative.

G.3 The Cryo Operations Manager for all activities conducted on the Flight Dewar is Dr. Mike Taber <cell: 650-996-8761>, or his appointed representative. The Cryo Operations Manager is also responsible in general for the coordination of all payload tests involving the Flight Dewar, and will therefore schedule appropriate times for the performance of this procedure.

G.4 The Stanford Quality Assurance representative is Dorrene Ross <cell: 510-673-9101> or her appointed representative.

G.5 The Office of Naval Research representative is Richard Gurr <cell: 706-815-1221; email: gurrr@onr.navy.mil> or his appointed representative.

G.6 The following personnel are qualified to perform this procedure using the FIST Ops test set:

Dave Meriwether <cell: 650-387-1871>

Thomas Wai <Phone 650-354-5644; pager: 650-845-1677>

H Safety Requirements

H.1 Standard safety practices to ensure safety of personnel and prevent damage to equipment shall be observed during performance of this test.

H.2 Read the CARD's[1] appropriate to ECU Operations before running this test.

H.3 Grounded wrist straps are to be worn prior to removal of connector caps or covers and during cable mating/demating operations.

I General Instructions

I.1 Test operators shall read this procedure in its entirety and resolve any apparent ambiguities prior to beginning this test.

I.2 This procedure operates systems throughout the GP-B satellite. Knowledge of the systems effected, caution in their operation and attention to information displayed must be applied at all times during these operations or Flight Hardware damaged may result.

I.3 This procedure shall be conducted on a formal basis to its latest approved and released version.

I.4 Tests will be conducted under the environmental conditions existing in the LMMS Sunnyvale.

I.5 This procedure operates Flight Hardware. All use of software associated with this procedure must conform to the GP-B Configuration Control process.

I.6 In order to expedite test operations, unless specifically noted, the sequence in which major sections or subsections are preformed may be altered at the discretion of the Test Leader or his representative.

[1] Constraints and Restrictions Document

I.7 Upon completion of the test, all data on Pod G under the directory and sub-directories where the test results are recorded shall be transferred to a data archive. The data shall be ingested by TDP and the TCAD results reviewed by the Test Author.

Op. Order No._____

Date Initiated_____
Time Initiated_____

K. Operations

WARNING!

This procedure heats the QBS and Vacuum Shell. Diligence must be taken at all times during the procedure to monitor the lead Bag temperatures. Under No Circumstances is the Top of the Lead Bag to get warmer than 7 K.

K.1 Ensure that Pod G is in it's default configuration, as specified in Configuration Requirements.

K.2 Bring up the GP-B Space Vehicle in its nominal power up.

K.3 Bring up the Flight SRE (power SRE A oscillator and the aft SRE A)

K.4 Bring up the Side A Flight ECU.

K.5 Set ECU Mux 1-4 to a gain of 2.

K.6 Set calibrations to a gain of two.

K.8 Switch to IOC 32 K format. Wait 100 seconds

K.9 Switch to Flux Reduction sample table (no science gyro grts sampled) wait 60 seconds.

K.10 Open LV1. Confirm valve open _____.

K.11 Vent GMA to space

K.11.1 Run gma_setup.prc & configure for launch

K.11.2 Command Open GMA Valve V29

K.11.3 Wait 30 minutes

K.12 Start flowing 2 sccm gas through the P1A line.

K.12.1 Command Open GMA Valves V1, V3 and then V25

K.12.2 Wait 5 minutes.

K.13 Stop GMA flow to space,

K.13.1 Command Closed GMA Valve V29

K.13.2 Wait 5 minutes

K.14 Set the Side A and Side B QBS Heater Mode to 83 (DCOL mode).

K.15 Set the QBS Temperature Safemode test to 15K

K.15.1 Enable the QBS Temperature Safemode Macro

K.15.2 Wait 5 minutes

K.16 Load the Command Gen SPC script created from the Parameter Gen Script ecu_pid_Instance_5@7_31_02@10_36_26_PM.xls

K.17 Activate the QBS Application (Config_App3 =1) and Vacuum Shell Application (Config_App5 =1), (SIA heating cycle "07057: ECU100_Flux_Flush. Monitor temperatures in real time using 2 K format.)

K.18 Monitor the GP-B temperature and wait 37.5 hours for the PID Algorithm implementation to run it's course.

K.19 Disable the QBS Application (Config_App3 =0) and QBS Application (Config_App5 =0),

K.20 Set the Side A and Side B QBS Heater Mode to 82 (Off mode).

K.20 Wait 5 minutes

K.21 Stop GMA gas flow.

K.22 Command Open GMA Valve V29 then Close V25, then Close V3, then Close V1

K.23 Wait 5 minutes

K.23 Command Close GMA then V29

K.24 End test.

L Flux Time and Temperature Profile

The tables below give numeric values for the expected test results of the Quartz Block and Vacuum Shell Temperature Control data. The graph on the next page is a graphic representation of these two tables' data combined. Use these data to monitor test progress.

Quartz Block Temperature Control:

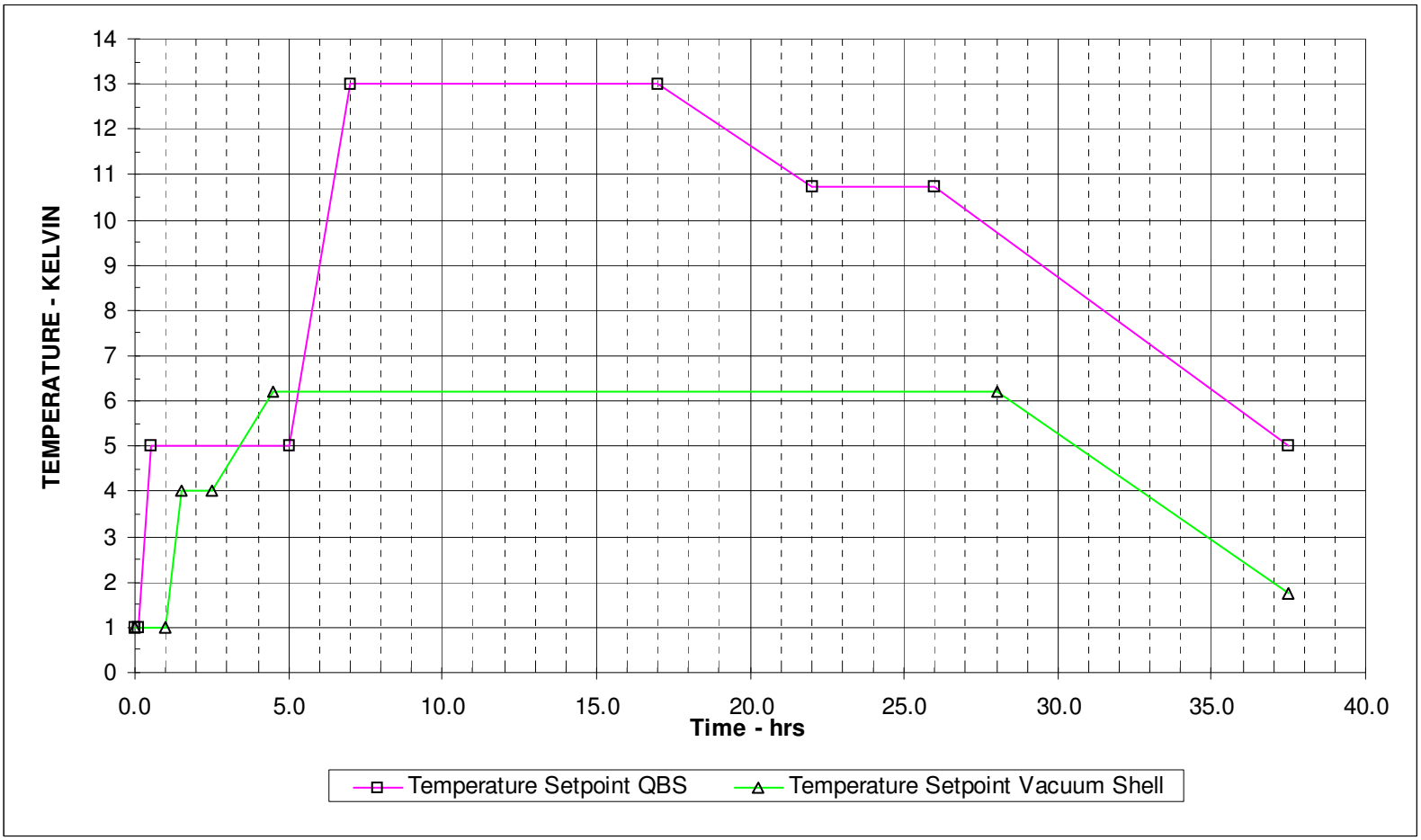
Heaters: H05P and H06P (heat applied simultaneously by the PID algorithm)
Thermometer for temperature control: T10P

				QBS			
Segment	Type of Control	Slope	Duration hours	Temperature Setpoint QBS	**Initiation Time**	**Completion Time**	
-				1		0	
1	Fixed	-	0.1	**1.0**	**0**	**0.1**	**Hold Init**
2	Ramp	10	0.4	**5.0**	**0.1**	**0.5**	**Ramp C/O**
3	Fixed	-	4.5	**5.0**	**0.5**	**5**	**Hold C/O**
		0.45					
4	Ramp	4	2	**13.0**	**5**	**7**	**Ramp up**
5	Fixed	-	10	**13.0**	**7**	**17**	**Hold**
6	Ramp	-0.45	5	**10.75**	**17**	**22**	**Ramp dwn**
7	Fixed	-	4	**10.75**	**22**	**26**	**Hold**
8	Ramp	-0.5	18	**5.0**	**26**	**37.5**	**Ramp dwn**
Off						**37.5**	**End**

Vacuum Shell Temperature Control:

Heater: H08P and H09P (heat applied simultaneously by the PID algorithm)
Thermometer for temperature control: T13P (A - side)

				Vacuum Shell			
Segment	Type of Control	Slope	Duration hours	Temperature Setpoint Vacuum Shell	**Initiation Time**	**Completion Time**	
-				1		**0**	
1	Fixed	-	1	**1.0**	**0**	**1**	**Hold Init**
2	Ramp	0.6	1	**4.0**	**1**	**1.5**	**Ramp C/O**
3	Fixed	-	1	**4.0**	**1.5**	**2.5**	**Hold C/O**
4	Ramp	1.1	2	**6.2**	**2.5**	**4.5**	**Ramp up**
5	Fixed	-	23.5	**6.2**	**4.5**	**28**	**Hold**
6	Ramp	-0.34	16	**1.75**	**28**	**37.5**	**Ramp dwn**
Off						**37.5**	**End**



Test completed.

Completed by:_____
Witnessed by:_____
Date:_____
Time:_____

Test Leader:
Date:
Time:

Quality Engineer:
Date:
Time: