STANFORD UNIVERSITY
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GRAVITY PROBE B, RELATIVITY GYROSCOPE EXPERIMENT
STANFORD, CALIFORNIA 94305-4085

CALIBRATING THE GMA PRESSURE SENSORS AND THE ECU ENGINEERING UNIT

GP-B ENGINEERING PROCEDURE

P0807 Rev –

January 19, 2001

PREPARED	_____	_____
	R. Stephenson, GMA Engineer	Date
APPROVED	_____	_____
	B. Farley, Electronics Engineer	Date
APPROVED	_____	_____
	C. Gray, GMA REE	Date
APPROVED	_____	_____
	B. Bencze, Electronics Manager	Date
APPROVED	_____	_____
	D. Ross, Quality Assurance	Date

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1. SCOPE

This procedure calibrates the ECU Engineering unit for use with the GMA pressure sensors. The GMA will be first be evacuated and the zero point of the ECU EU set using trimpots loading with the sensors. Readings will then be taken at different in range pressures in order to determine the calibration coefficients for each sensor. These calibrations will be input to the ECU EU test set so that it can be used to read out actual pressures during flow testing of the GMA. Note: SP2 will not be calibrated in this procedure. A zero can be found, but data points can not be taken at this time. It will need to be calibrated off-line. Also, SP1 and CP1 – CP4 will not be as accurate, as the Nitrogen regulator will be the only source of pressure measurement. All data should be recorded in Table 1.

2. TEST INFORMATION

- Proper care should be taken in handling components, and their cleanliness must be preserved.
- Temperature: Room temperature
- Humidity: not critical

2.1 Cleanliness

2.1.1 Normal lab environment when components are double bagged.

2.1.2 Class 1000 clean room when GMA is closed. Use the clean hood when making connections to the GMA.

2.2 ESD precautions

None required.

QA to be notified prior to beginning this procedure

2.3 Use of connector savers

Connector savers will be used on all gas and electrical connections to the GMA flight hardware.

2.4 Personnel, QA, and Documentation

Personnel Integration and Test Director

The Test Director (TD) shall be Rick Stephenson or an alternate that he shall designate. The TD has overall responsibility for the implementation of this procedure and shall sign off the completed

procedure and relevant sections within it. The GMA REE shall also sign off the completed "As-Built" procedure.

Integration Engineers and other personnel. All engineers and technicians participating in this procedure shall work under the direction of the TD who shall determine personnel that are qualified to participate in this procedure. Participants in this procedure are to be R. Stephenson and D. Vanrenen, and B. Farley.

The test shall be conducted on a formal basis to approved and released procedures. The QA program office shall be notified of the start of this procedure. A Quality Assurance Representative, designated by D. Ross shall be present during the procedure (if deemed necessary) and shall review any discrepancies noted and approve their disposition. Upon completion of this procedure, the QA Manager, D. Ross, or her designate, shall certify their concurrence that the effort was performed and accomplished in accordance with the prescribed instructions by signing and dating in the designated place(s) in this document. Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108. If a re-test of any or all of the hardware is necessary, the TD will determine the appropriate changes in the procedure, with the QA Manager's approval.

2.5 Red-line Authority

Authority to red-line (make minor changes during execution) this procedure is given solely to the TD or his designate, or the GMA Manager, and shall be approved by QA. Additionally, approval by the Hardware Manager shall be required, if in the judgment of the TD or QA Representative, experiment functionality may be affected.

DOCUMENTS AND EQUIPMENT

3.1 Applicable Documents

Document number	Rev	Description
26202	B	GMA Pallet Harness
8A01545	B	GMA to ECU cables
25110	C	GMA Assembly

3.2 Test Equipment

Equipment	Model and Serial Number	Calibration
GMA Pallet Harness Engineering Unit	26202 Rev A	1/18/00
ECU Engineering Unit		1/17/01
Potentiometer Assembly		N/A
Absolute pressure gauge		
Alcatel Leak Detector		
Engineering cables from ECU to GMA Harness	8A01545	1/24/00
Wiring “pigtails”		1/18/00
Nitrogen Gas, Filtered		
Clean Pressure Regulator		

3.3 Flight Parts

Description	Model and Serial Number	Comments
GMA Assembly	25110 Rev C	

4 CALIBRATION OF SPINUP ASSEMBLY SENSORS

Started on: _____

4.1 Verify connector saver valves are installed on all GMA gas ports and are closed.

4.2 Connect leak detector to SD2A.

4.3 Purge nitrogen gas for 5 minutes at 10 psig.

4.4 Set regulator on nitrogen bottle to just over 0 psig. Connect filtered Nitrogen supply to SD2B.

4.5 Connect calibrated pressure sensor to Ballast Bottle assembly port.

4.6 Connect the GMA Pallet Harness to the GMA solenoid valves and pressure sensors according to drawing 25110 Rev C. Use connector savers.

4.7 Connect the Potentiometer Assembly to the GMA Pallet harness using the pigtails per diagram 1.

4.8 Connect the ECU EU to the GMA Pallet harness and initialize the ECU EU.

4.9 Open HPM3, Ballast Manual Valve, and connector saver valves at SD2A and Ballast Port. Close HPM1 and HPM2.

4.10 Close all GMA solenoid valves.

4.11 Open all SV's.

4.12 Evacuate this area of the GMA with the leak detector and check for leaks at the connections.

4.13 Adjust the potentiometers to obtain a count level between 1 and 200 counts for SP1-SP9.

4.14 Close SV1, 2, 3, 4, 5, and 6.

4.15 Introduce Nitrogen by closing the connector saver valve at SD2A and cracking the connector saver valve at SD2B open until SP5-SP9 read between 600 and 1500 counts. Allow to stabilize.

4.16 Record these values.

4.17 Continue to slowly raise the pressure until SP5-SP9 read between 2500-3500 counts. Allow to stabilize.

4.18 Record these values.

4.19 Continue to slowly raise the pressure until SP5-SP9 read between 3800-4094 counts. Allow to stabilize.

4.20 Record these values.

4.21 If necessary, evacuate the assembly and reintroduce Nitrogen until SP4 reads between 600 and 1500 counts.

4.22 Allow to stabilize and record values.

4.23 Continue to slowly raise the pressure until SP4 reads between 2500-3500 counts. Allow to stabilize.

4.24 Record these values.

4.25 Continue to slowly raise the pressure until SP4 reads between 3800-4094 counts. Allow to stabilize.

4.26 Record these values.

4.27 Close off Nitrogen supply and evacuate GMA.

4.28 Verify sensors return to 1-200 counts and close all solenoid valves.

4.29 Record the serial numbers of the sensors at each location.

5 CALIBRATION OF REGULATOR ASSEMBLY SENSORS

Started on: _____

5.1 Open SV5, 6, 22, and 24.

5.2 Introduce Nitrogen as above until SP3A and SP3B read between 600 and 1500 counts. Allow to stabilize and record values.

5.3 Continue to raise the pressure until SP3A and SP3B read between 2500 and 3500 counts. Allow to stabilize and record values.

5.4 Continue to raise the pressure until SP3A and SP3B read between 3800 and 4094 counts. Allow to stabilize and record values.

5.5 Close off Nitrogen supply and evacuate GMA to less than 15 psia.

5.6 Open SV's 5 – 24.

5.7 Introduce 15 psia Nitrogen to the GMA and close all solenoid valves.

5.8 Close connector saver valve at ballast bottle port and ballast manual valve. Disconnect pressure sensor.

5.9 Disconnect Nitrogen from SD2B and connect it to SD1.

5.10 Open HMP1 and HPM2.

5.11 Introduce Nitrogen as above until SP1 reads between 600 and 1500 counts. Allow to stabilize and record values. Pressure will be read from the bottle regulator. Add barometric pressure to the gauge reading (14.7 psi).

5.12 Continue to raise the pressure until SP1 reads between 2500 and 3500 counts if able. Allow to stabilize and record values (+14.7 psi).

5.13 Continue to raise the pressure until SP1 reads between 3800 and 4094 counts if able. Allow to stabilize and record values (+14.7 psi).

5.14 Close off valve on Nitrogen tank and open SV1 –SV6 and SV22 and 24.

5.15 Evacuate GMA to less than 15 psia at nitrogen bottle.

5.16 Close SV5 and SV6 and pressurize GMA to about 15 psia from nitrogen bottle and wait for it to stabilize.

5.17 Close HPM1 and HPM2 and SV1 – SV4.

5.18 Close connector saver valve at CD1 and move nitrogen bottle to SD2B.

5.19 Open SV22 and SV24 and pressurize GMA to about 15 psia.

5.20 Open SV5 and SV6 and let pressure stabilize.

5.21 Close all solenoids and connector saver valves and disconnect nitrogen and leak detector.

5.22 Record the serial numbers of the sensors at each location.

6 CALIBRATION OF CAGING ASSEMBLY SENSORS

Started on: _____

6.1 Verify all connector saver valves are closed, and connect the leak detector and the nitrogen supply to CD1 using a VCR tee.

6.2 Connect the absolute pressure gauge to CD2 and open connector saver valves at CD1 and CD2.

6.3 Open all CV solenoid valves and evacuate caging assembly.

6.4 Adjust all trimpots to read between 1 and 200 counts for CP1-CP4.

6.5 Close connector saver valve on CD2.

6.6 Introduce Nitrogen as above until CP1-CP4 read between 600 and 1500 counts. Allow to stabilize.

6.7 Record these values. Pressure measurement will be read from the bottle regulator. Add barometric pressure to the gauge reading (14.7 psi).

6.8 Continue to slowly raise the pressure until CP1-CP4 read between 2500-3500 counts. Allow to stabilize.

6.9 Record these values. (+14.7 psi)

6.10 Continue to slowly raise the pressure until CP1-CP4 read between 3800-4094 counts. Allow to stabilize.

6.11 Record these values (+14.7 psi).

6.12 Close the nitrogen bottle valve and evacuate caging assembly.

6.13 Verify CP1-CP4 return to 1-200 counts.

6.14 Pressurize caging assembly to about 15 psia and close all solenoid and manual valves and disconnect nitrogen and leak detector.

6.15 Record the serial numbers of the sensors at each location.

6.16 Disconnect the ECU EU and shut it down.

7 TABLE 1

Engineering Evaluation of ECU / GMA Pressure Gage Readouts using Flight Strain Gages and Potentiometer Offset Adjust.

ECU Identification: EU

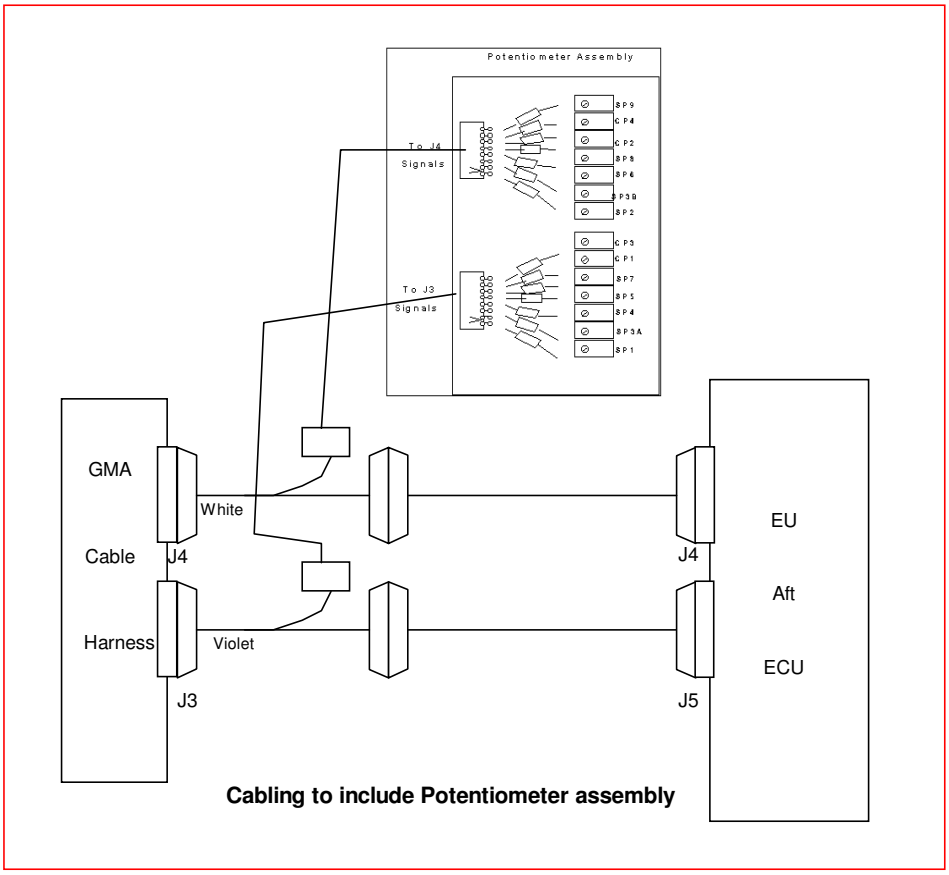
Connect the flight Pressure Gages to the harness connectors using connector savers. The gages are installed on The GMA assembly where the pressure can be adjusted and monitored using a calibrated pressure gage. Reduce the pressure to zero psia. Open the appropriate GMA valve for the gage being monitored. Observe the ECU output, and adjust the potentiometer to obtain a count level between 1 and 200 counts, Record the pressure reading and the displayed counts. Adjust the pressure to obtain a count level between 600 and 1500 counts, and record the values. Record two more sets of pressure readings, at approximately 2500 to 3500 counts and 3800 to 4094 counts. Pressure readings should be on scale between 0 psia and at least 80% of the Max P value. The order of sequencing through the gages and monitors may be altered as convenient.

				1-200		600-1000		2500-3500		3800-4094	
Pressure Monitor	Gage S/N	Max P psia	Pressure	DN	Pressure	DN	Pressure	DN	Pressure	DN	Time
SP5	986_____	5									
SP7	986_____	5									
SP6	986_____	5									
SP8	986_____	5									
SP9	986_____	5									
SP4	986_____	15									
SP3A	986_____	100									
SP3B	986_____	100									
CP3	986_____	250									
CP1	986_____	250									
CP2	986_____	250									
CP4	986_____	250									
SP2	986_____	1000									
SP1	986_____	4000									

Data collected by: _____ Date: _____ GMA Cable Harness: _____

Reference Pressure gage Identity: _____ Calibration Due: _____

8 DIAGRAM 1



Cabling to include Potentiometer assembly

9 PROCEDURE COMPLETION

The results obtained in the performance of this procedure are acceptable:

_____ date: _____
GMA Engineer

Discrepancies if any:

Approved: _____ date: _____
C. Gray, GMA REE

Approved: _____ date: _____
D. Ross, QA

10 DATA BASE ENTRY

The following data shall be entered into the GP-B DataBase:

- Name, number and revision of this procedure
- Date of successful completion of procedure.