SU/GP-B P0585 RevA
Per ECO #1214

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

GMA ASSEMBELY LEAK TEST PROCEDURE

P0585 REV A

October 10, 2000

GPB SCIENCE MISSION PROCEDURE

PREPARED _____ _____
R. Stephenson, GMA Engineer Date

APPROVED _____ _____
G. Asher, GMA REE Date

APPROVED _____ _____
D. Ross, Quality Assurance Date

APPROVED _____ _____
B. Muhlfelder, Hardware Manager Date

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1 SCOPE

This procedure describes the leak check to be performed after assembly of the GMA on the Flight Mounting Plate. This assumes that the individual modules have already been thoroughly checked out in the Preliminary GMA testing procedure (P0662).

1.1 Acronyms

The following acronyms are used in this document

FTD	Functional Test Director
GMA	Gas Management Assembly for Science Mission
GMF	GMA Manipulation Fixture

2 REFERENCES

2.1 Plans and Procedures

P0059 GP-B Contamination Control Plan

2.2 Applicable Drawings

Drawing number	Rev	Description
25110	B	Gas management assembly
25111	B	Caging component assembly, flight GMA
25112	B	Spinup component assembly, flight GMA
25113	C	Regulator component assembly, flight GMA

3 GENERAL REQUIREMENTS

3.1 Environmental Requirements

This procedure will be conducted in the Stanford Class 10 or class 1000 Clean room in the HEPL facility.

3.1.1. Cleanliness

The clean room where this test takes place shall be maintained at the cleanliness levels per GPB Contamination Control Plan P0059. All parts and tools shall be cleaned at least to the cleanliness levels of the rooms where they are used for assembly or testing. In addition, all flight parts shall be maintained at level 100 cleanliness per GP-B Contamination Control Plan P0059. Take all necessary precautions to keep tools and handling equipment free of particulate contamination.

3.1.4. Electrostatic Discharge Control

Not Applicable

3.1.5 Use of connector savers

Connector savers will be used on all gas and electrical connections. Gas connections will also be fitted with end valves in order to prevent particle contamination.

3.2 Testing Personnel

3.2.1 Test Director

The Functional Test Director (FTD) shall be Rick Stephenson or his designate. He has overall responsibility for the implementation of this procedure and shall sign off the completed procedure.

3.2.2 Personnel

All engineers and technicians participating in this procedure shall work under the direction of the FTD who shall determine whether the person is qualified to participate in this procedure. Personnel participating in this procedure are Gideon Asher, Rick Stephenson, and/or others whom the FTD shall deem appropriate.

3.3 Safety

The QA Representative shall be notified prior to any major movement or test of the GMA (i.e., any movement other than rotations or minor adjustments)

3.4 Quality Assurance

Test shall be conducted on a formal basis to approved and released procedures. The QA program office shall be notified 24 hours prior to the start of this procedure. A Quality Assurance Representative, designated by Dorrene Ross shall be present during the procedure and shall review any discrepancies noted and approve their disposition. Upon completion of this procedure, the QA Program Engineer, Dorrene Ross or her designate, shall certify her 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.

ONR representative, and QA to be notified 24 hours prior to beginning this procedure

QA Notified:_____ ONR Notified:_____

Discrepancies will be recorded in a D-log or as a DR per Quality Plan P0108.

3.5 Red-line Authority

3.5.1 Authority to red-line

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

4 REQUIRED EQUIPMENT

4.1 Flight Hardware

- GMA assembly 25110

4.2 Ground Support and Miscellaneous Equipment

Equipment	Model and Serial Number	Calibration
Helium Leak Detector	ASM 180 T	G142
Pressure Gage	PGT-45L-30v/30	99050
Engineering ECU		
Pressure sensors readout (optional)	Read out panel	P0644
Solenoid Control Box (optional)	Patch panel	P0612
Pressure Gages		
Connector savers		
Pressure Gage Readout		
High Purity Helium Gas		

5 LEAK TEST

5.1 External Test Pass-Fail Criteria

5.1.1 Test Pass when the leak rate builds up slowly, see table below.

5.1.2 Test fail when the leak rate increase suddenly (spike) while the individual component is sprayed with Helium, see table below.

5.1.3 At no time should the external leak rate go above 1.0×10^{-6} sccs times the number of components under test.

5.2 Internal Test Pass-Fail Criteria

5.2.1 The internal leak rate should be no higher than 1.0×10^{-6} per valve.

5.3 Checking the caging lines.

		Initial when completed	Comments
5.3.1	Prepare GMA and Leak Detector for testing.		
5.3.1.1	Place connector savers and end valves on all caging lines (G3C, G2C, G1C)		
5.3.1.2	Connect leak detector to CD2.		
5.3.1.3	Close end valve on CD1.		
5.3.1.4	Using ECU, open all caging solenoids and insure that vacuum can be drawn. Then close all caging valves.		
5.3.1.5	If Leak Detector will not reach fine mode, close all solenoids and open incrementally to isolate the leak.		
5.3.1.6	Once leak is localized, use "Gross Leak Check" mode to find gross leak and fix it.		
5.3.1.7	Once vacuum is attained and background had become low (10^{-9}), close all solenoids except for CV5.		
5.3.2	Leak Test Downstream Solenoids		
5.3.2.1	Spray a small stream of helium around CV4 with a needle and watch for a leak. Leak rate may build slowly to 10^{-7} due to permeation. If this occurs, clean area with Nitrogen and continue. Watch for a sudden increase in leak rate, indicating a leak. Make sure to test bottom caps as well.		
5.3.2.2	Open CV4 and spray a small amount of Helium around CP4 and all solenoids in caging assembly, watching for leaks in the same manner as above.		
5.3.3	Leak testing upstream solenoids and pressure sensors.		
5.3.3.1	Open CV2 and spray a small amount of Helium around CP2, watching for		

	leaks in the same manner as above.		
5.3.3.2	Spray Helium on CV2 and CV2A, watching for leaks in the same manner as above		
5.3.3.3	Close CV2.		
5.3.3.4	Open CV1 and repeat steps 5.2.11-5.2.13 for CV1, 1A and CP1.		
5.3.3.5	Open CV3 and repeat steps 5.2.11-5.2.13 for CV3, 3A and CP3.		
5.3.3.6	Close CV4		
5.3.4	Leak testing the poppets		
5.3.4.1	Connect helium to CD2.		
5.3.4.2	Connect leak detector to G3C/G4C		
5.3.4.3	Open CV4 and CV2A and evacuate up to the Helium tank.		
5.3.4.4	Close CV4 and introduce ~1 atm Helium.		
5.3.4.5	Record leak rate after 10 minutes and close end valve		
5.3.4.6	Close CV2A and open CV4		
5.3.4.7	Record leak rate after 5 minutes and close end valve.		
5.3.4.8	Move leak detector to G2C		
5.3.4.9	Record leak rate after 5 minutes and close end valve.		
5.3.4.10	Move leak detector to G1C and record leak rate after 5 minutes. Close end valve.		
5.3.4.11	Move leak detector to CD1 and record leak rate after 5 minutes.		
5.3.4.12	Open CV4 and evacuate Helium. Then open other caging valves to draw a vacuum on entire assembly.		
5.3.4.13	Close all caging solenoids and end valves.		

5.4 Checking the Spinup Assembly:

		Initial when completed	Comments
5.4.1	Preparing Spinup Assembly for Testing.		
5.4.1.1	Attach leak detector to SD2B.		
5.4.1.2	Close end valve on SD2A		
5.4.1.3	Make Sure HPM3 is open, and HPM2 and HPM1 are closed. Use the ECU to make sure that SV5 and SV6 are closed.		
5.4.1.4	Place connector savers and end valves on all spinup lines G2S, G1S, G3S, G4S, and P1A.		
5.4.1.5	Using ECU, insure that all spinup assembly solenoid valves are open and a vacuum can be drawn. Then close all valves.		
5.4.1.6	If Leak Detector will not reach fine mode, close all solenoids and open incrementally to isolate the leak.		
5.4.1.7	Once leak is localized, use “Gross Leak Check” mode to find gross leak and fix it.		
5.4.2	Leak Check Spinup assembly		
5.4.2.1	Using ECU, close all spinup assembly solenoid valves.		
5.4.2.2	Using a needle, spray a small stream of Helium around HPM3, SP9, and SV24, watching for spikes in the same manner as above. Be sure to check the bottom caps as well.		
5.4.2.3	Open SV24, and leak check SV22 and SV23 and SV24 as in step 5.3.2.2.		
5.4.3	Leak test individual spinup lines		
5.4.3.1	Open SV22, SV11, and SV12.		
5.4.3.2	Leak test SV10, SV11, SV12, and SP6 as above.		
5.4.3.3	Close SV11 and SV12.		
5.4.3.4	Repeat steps 5.3.3.1-5.3.3.3 for SV8, SV9, SV7, and SP5.		
5.4.3.5	Repeat steps 5.3.3.1-5.3.3.3 for SV14,		

	SV15, SV13 and SP7		
5.4.3.6	Repeat steps 5.3.3.1-5.3.3.3 for SV17, SV18, SV16 and SP8		
5.4.4	Leak Check P1A line.		
5.4.4.1	Using ECU, open solenoids SV20 and SV21.		
5.4.4.2	Leak test SV19, SV20, SV21, and MTR3 as above.		
5.4.4.4	Leave the assembly at a vacuum for the next test.		

5.5 Checking the Regulator Assembly

		Initial when completed	Comments
5.5.1	Prepare Regulator assembly for testing.		
5.5.1.1	Assembly should still be set up from the end of test 5.3		
5.5.1.2	Make sure HPM2 is closed.		
5.5.1.3	Place connector saver on SD1 and close end valve.		
5.5.1.4	Using ECU, insure that all regulator assembly solenoid valves are open and a vacuum can be drawn through SD2B. Then close all regulator valves including HPM1.		
5.5.1.5	If Leak Detector will not reach fine mode, close all solenoids and open incrementally to isolate the leak.		
5.5.2	Leak test Regulator assembly.		
5.5.2.1	Open Solenoid SV5 and leak check REG3, SP3A, MTR1, and SV5 as above.		
5.5.2.2	Open Solenoid SV3 and leak check REG1, REG2, SP2, MTR1, SV4, and SV3 as above. Close SV3 and SV5		
5.5.2.3	Open Solenoid SV6 and leak check REG4, SP3B, MTR2, and SV6 as above.		
5.5.2.4	Open Solenoid SV4 and SV2 and leak check SP1, SF1, SV1, SV3, and HPM1		

	as above.		
5.5.2.5	Open HPM1 and leak check bottle fittings and HPM1 as above.		
5.5.2.6	Close all solenoid valves and HPM3, HPM1 and HPM2.		

5.6 Checking the Internal leakage

		Initial when completed	Comments Leak Rates
5.6.1	Preparing the Regulator assembly for testing.		
5.6.1.1	Assembly should be set up from last section 5.4.		
5.6.1.2	Attach helium source to SD1 (using a connector saver).		
5.6.1.3	Use ECU to close all spinup assembly solenoid valves.		
5.6.1.4	Close valve on Helium source nearest to the GMA and close off helium regulator completely.		
5.6.1.5	Open HPM3, SV24, SV22, HPM1, and all Regulator solenoids. Evacuate through SD2B.		
5.6.1.6	If Leak Detector will not reach fine mode, close all solenoids and open incrementally to isolate the leak.		
5.6.1.7	Open HPM2 to evacuate the lines up to the helium valve.		
5.6.1.8	When vacuum is established, close HPM2 and wait for the background to come down.		
5.6.2	Test Regulator Assembly poppets.		
5.6.2.1	Open the helium valve, and slowly open the regulator until the pressure reaches 0 psig (1 atm absolute).		
5.6.2.2	Close HPM1 and open HPM2 to verify 1 atm helium.		

5.6.2.3	CloseSV1 and SV2. Open HPM1. SP1 should read ~15 psia.		
5.6.2.4	Monitor the leak rate for 5 minutes and note final rate.		
5.6.2.5	Close SV3 and SV4 and wait for background to stabilize. Open SV1 and SV2. SP2 should read ~15 psia.		
5.6.2.6	Monitor the leak rate for 5 minutes and note final rate.		
5.6.2.7	Close SV5 and SV6 and wait for background to stabilize. Open SV3 and SV4. SP3 and SP3A should read ~7– ~15 psia.		
5.6.2.8	Monitor the leak rate for 5 minutes and note final rate.		
5.6.2.9	Close HPM2.		
5.6.3	Prepare Spinup assembly for testing.		
5.6.3.1	Unhook Leak detector from SD2B, and attach helium source there.		
5.6.3.1	Attach leak detector to G4S (using connector saver.		
5.6.3.2	Using ECU, open all spinup assembly solenoid valves and draw a good vacuum. Then close all valves.		
5.6.3.2	If Leak Detector will not reach fine mode, close all solenoids and open incrementally to isolate the leak.		
5.6.4	Test Spinup Assembly poppets.		
5.6.4.1	Close the valve on Helium lines closest to GMA and close the helium regulator.		
5.6.4.2	Open SV23, SV24, SV17, SV18 and HPM3.		
5.6.4.3	Evacuate system up to Helium lines.		
5.6.4.4	Close HPM3 and wait for background to come down.		
5.6.4.5	Open valve on Helium line.		
5.6.4.6	Slowly open regulator until pressure reaches 0 psig (1 atm absolute).		
5.6.4.7	Use ECU to make sure that SV14, SV 13, SV11, SV10, SV8, SV7, SV5 and		

	SV6 are closed.		
5.6.4.8	Close SV24 and open HPM3. SP9 should read ~15 psi.		
5.6.4.9	Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.10	Close SV23 and open SV24. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.11	Close SV 17 and open SV23. SP4 should read ~15 psi.		
5.6.4.12	Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.13	Close SV18 and open SV17. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.14	Close SV17 and move leak detector to G3S.		
5.6.4.15	Open SV15. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.16	Close SV15 and open SV14. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.17	Close SV14 and move leak detector to G2S.		
5.6.4.18	Open SV12. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.19	Close SV12 and open SV11. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.20	Close SV11 and move leak detector to P1A.		
5.6.4.21	Open SV21. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.22	Close SV21 and open SV20. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.23	Close SV20 and move leak detector to G1S.		
5.6.4.24	Open SV9. Monitor the leak rate for 5 minutes and note final rate.		

5.6.4.25	Close SV9 and open SV8. Monitor the leak rate for 5 minutes and note final rate.		
5.6.4.26	Close all end valves except G1S.		
5.6.4.27	Open all regulator and spinup solenoids in order to draw the helium from the GMA.		
5.6.4.28	Once a good vacuum is established, close all regulator and spinup solenoid valves and manual valves.		

6 PROCEDURE COMPLETION

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

Test Engineer _____ Date _____

Discrepancies if any:

RE _____ Date _____

Test procedure is as represented and the documentation is complete and correct:

QA Representative _____ Date _____

QA Program Engineer_____ Date _____

Copy discrepancies to D-Log and open Discrepancy Reports when required.

7 DATA BASE ENTRY

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

a) Name, number and revision of this procedure
b) An electronic copy of this document
c) A copy of the “as-built” procedure with data and pictures, when completed.