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STANFORD, CALIFORNIA 94305-4085

GMA FUNCTIONAL HEALTH TEST

P0743 REV –

7 July, 2000

GPB SCIENCE MISSION PROCEDURE

PREPARED: _____ date: _____
D. Avaloff, Test Engineer

APPROVED: _____ date: _____
R. Stephenson, Test Director

APPROVED: _____ date: _____
G. Asher, GMA Manager

APPROVED: _____ date: _____
D. Ross, Quality Assurance

APPROVED: _____ date: _____
B. Muhlfelder, Hardware Manager

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1. GENERAL DESCRIPTION

This procedure describes the functional health test for the flight GMA. The health test will include the functionality of all the solenoid valves (caging and spin up), verification of the pressure requirements at each pressure sensor, a temperature servo test and verification that the GMA delivers the required flow rates.

2. TEST INFORMATION

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

2.1 Safety

The pressure in any part of the GMA must never exceed the rated pressure of any individual component to withstand that pressure. The GSE equipment will incorporate a pressure relief valve to ensure that the pressure in the GMA or GSE will not exceed 3000 psi. See Fig. 1.

2.2 Cleanliness

2.2.1 Normal lab environment when valves are capped and bagged

2.2.2 Class 10 clean room or clean bench in a class 1000 room.

2.3 ESD precautions

2.3.1 None required.

2.4 Use of Connector Savers

2.4.1 Connector savers will be used on all gas and electrical connections.

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

QA Notified:_____ ONR Notified:_____

2.5 Procedure Pass-Fail Criteria

2.5.1 All the solenoid valves must open and close.

2.5.2 The flow and pressure parameters required for a successful spin up of the gyroscopes must be verified. These are called out in individual procedure sections. All requirement values have a tolerance of +/- 10%.

2.5.3 The temperature control hardware and software must be able to stabilize the temperature of the GMA at T=20 C +/- 10.

2.6 Personnel, QA, and Documentation

2.6.1 The Integration and Test Director (ITD) shall be R. Stephenson or an alternate that he shall designate. The ITD has overall responsibility for the implementation of this procedure and shall sign off the completed procedure and relevant sections within it. The GMA Manager shall also sign off the completed *As-Built* procedure.

2.6.2 Integration Engineers and other personnel. All engineers and technicians participating in this procedure shall work under the direction of the ITD who shall determine personnel that are qualified to participate in this procedure. Participants in this procedure are to be R. Stephenson and D. Avaloff and C Gray.

2.6.3 QA. 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 Payload Technical Manager will determine the appropriate changes in the procedure, with the QA Manager's approval.

2.7 Red-line Authority

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

3. DOCUMENTS AND EQUIPMENT

3.1 Applicable Documents

Document number	Rev	Description
Dwg. 25110	B	GMA Assembly
Dwg. 25212	B	Spin Up Assembly
Dwg. 25213	C	Regulator Assembly
Dwg. 25111	B	Caging Assembly

3.2 Test Equipment

Equipment	Model and Serial Number	Calibration
Vacuum Pump		
Helium Leak Detector	ASM 180 T (Or equivalent)	G142
Helium 4 Gas @ 3000psi		
Helium 3 Gas @ 3500psi		
Engineering ECU		
Impedance Simulation Manifold	See Fig. 2	
Connector Savers	Electrical and Gamah	
High Pressure Regulator Manifold for Helium 4	See Fig. 1	
*Chart Recorder for Engineering ECU		
Caging GSE		

* If possible.

3.3 Flight Parts

3.3.1 Flight GMA, S/N 001 already in clean room.

4. PREPARING SPIN UP GMA FOR TESTING

Started on:

4.1 Connecting Gas Supply to SD1

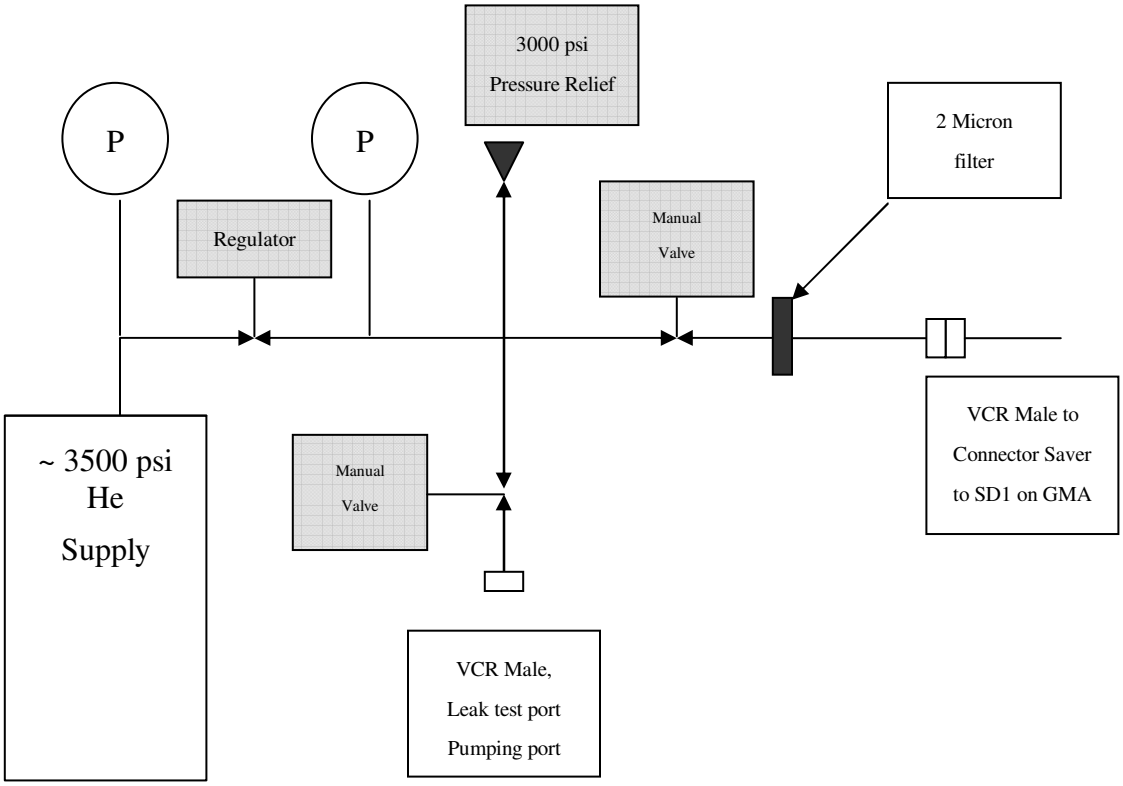

Fig. 1 Schematic of Helium gas supply manifold.

4.1.1 Place GMA into temperature chamber.

4.1.2 See Fig. 1. Attach regulator to He4 bottle and then attach He4 gas bottle line to SD1 through the connector saver.

4.1.3 Pump out the air between HPM2 and the regulator through the port on the regulator manifold. Pump to a pressure of 1 mTorr or less.

4.1.4 Pressure test connection: With HPM2 closed, open bottle regulator to 1000 psi and apply ethanol to all connections, check for bubbles. Repeat for 2000 and 3000 psi. Leave regulator set to deliver 3000 psi.

4.1.5 The following steps assume a pressurized GMA as outlined in paragraph 9. There should be enough He4 gas in the supply bottles to run this test without recharging through HPM2 from the external He4 supply manifold.

4.2 Connecting External Vacuum Pump and Impedance Simulation Manifold to GMA.

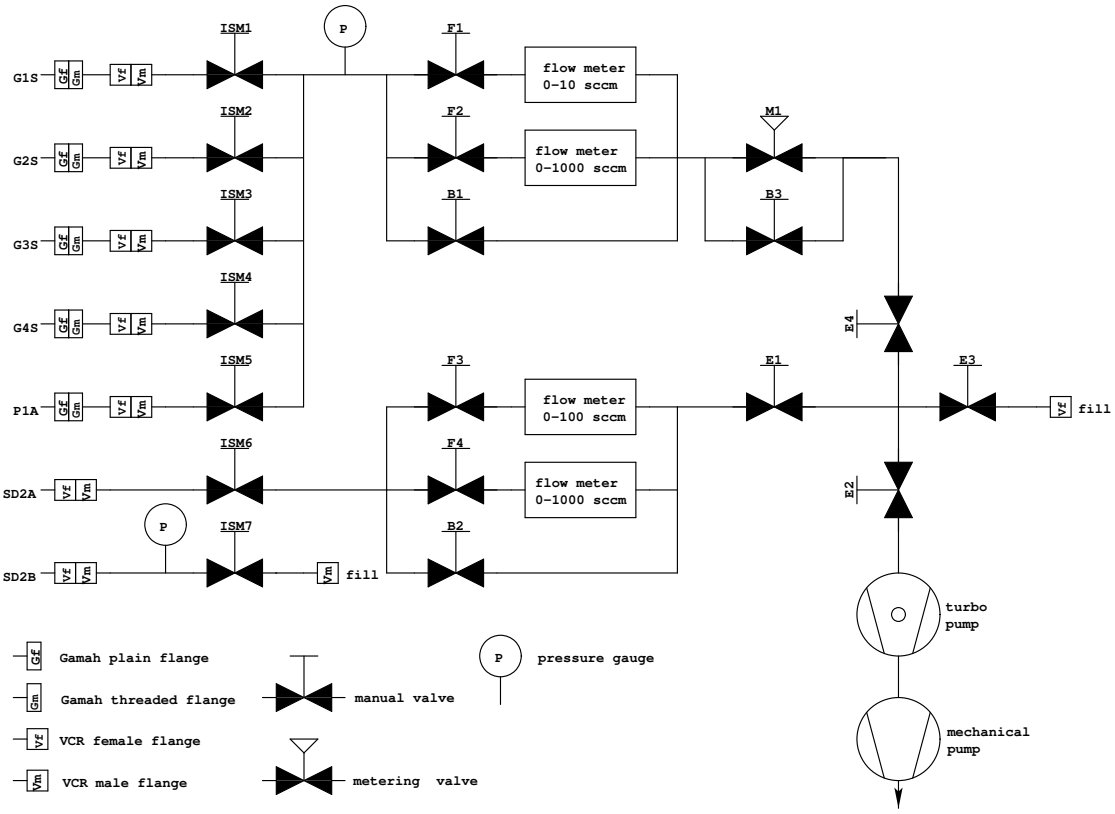

Fig.2 Schematic of Impedance Simulation Manifold (ISM) connected to Spin Up GMA

4.2.1 See Fig. 2. Attach manifold to G1S-G4S and P1A through the connector savers. Then attach manifold to SD2A and SD2B through the connector savers. Leak test all the connections made to the GMA through the ISM7 and/or the E3 valve on the manifold.

4.2.2 Valve off leak detector and start the manifold pump. Open all of the manual valves on the ISM except for ISM7, F1-F4, and E3. Open HPM3. Pump the ISM to a pressure of 1mTorr or less. This is the starting configuration for the ISM.

4.2.3 Verify that metering valve on the ISM is set correctly for gyro impedance at 700 scc/m (see P0586).

4.3 Connecting Engineering ECU to GMA

4.3.1 Verify that the pressure transducer cables are connected to SP1-SP9 and CV1-4 through connector savers.

4.3.2 Verify that the solenoid cables are connected to SV1-24 and CV1-4 through connector savers.

4.3.3 Verify that SP1-SP9 and CP1-4 are being correctly read by the engineering ECU.

4.3.4 Connect chart recorder to engineering ECU to monitor SP1-9 and CP1-4.

4.4 Configuration of GMA before Functional Health Test

4.4.1 We are assuming the GMA is in its pressurized state as outlined in paragraph 9.

5. TESTING SOLENOID VALVES

Started on:

5.1 Verifying Spin Up Module Solenoid Valves of GMA with Engineering ECU

5.1.1 Close manual valves ISM1-6 on the ISM (Fig. 2).

5.1.2 The 6 N/O valves and SV6 are already closed. Close all the others.

5.1.3 Open all 24 SV in turn, starting with SV1, for 10 seconds and then close it again. Verify the open and closed state with the engineering ECU.

5.1.4 Open the manual valves ISM1-6 on the ISM.

5.2 Verifying Caging Module Solenoid Valves of GMA with Engineering ECU

Started on:

5.2.1 Connect caging GSE to the CD1 port on GMA. Connect plugs to G1C, G2C and G3C/G4C ports. Leak test all connections through the CD2 port on the GMA by opening

CV1, CV2, CV3 and CV4. After the leak test is completed CV1, CV2, CV3 and CV4 should be closed and the leak detector removed from the CD2 port.

5.2.2 CP1-4 should now read close to 15 psia. Set the delivery pressure on the caging GSE to 200 psi. All of the following valve actions should be confirmed with the engineering ECU.

5.2.3 Open CV5, record pressure at CP5: _____.

5.2.4 Open CV1, record pressure at CP1: _____. Close CV1.

5.2.5 Open CV2, record pressure at CP2: _____. Close CV2.

5.2.6 Open CV3, record pressure at CP3: _____. Close CV3.

5.2.7 Close CV5. Open CV4. CP5 should drop to zero again.

5.2.8 Open CV1A, CP1 should drop to 15 psia. Close CV1A.

5.2.9 Open CV2A, CP2 should drop to 15 psia. Close CV2A.

5.2.10 Open CV2A, CP3 should drop to 15 psia. Close CV3A.

5.2.11 Close CV4. Disconnect caging GSE from GMA.

6.0 VERIFY GMA TEMPERATURE CONTROL COMPONENTS AND FUNCTIONS

6.1 Verify Silicon Diodes

6.1.1 Check the temperature readings of all 6 diodes on the GMA with the engineering ECU and compare to ambient temperature.

6.2 Verify Thermistors

6.2.1 Check the temperature readings of all 6 thermistors on the GMA with the engineering ECU and compare to ambient temperature.

6.3 Verify Temperature Control and Set Temperature to 22 C.

6.3.1 Set the ambient temperature around the GMA to 15 C. Set the feedback control temperature setpoint to 20 C. Monitor the temperature of each diode and thermistor as the setpoint is reached. Are the parameters within requirement i.e. 22 C =/- 10 C? Probably need a chart recorder for this part.

6.3.2 Leave the GMA at the required setpoint temperature of 22 C for the pressure and flow tests that follow.

7.0 FUNCTIONAL TEST; SPACE VEHICLE GMA TESTING COMMAND SEQUENCE 4

Started on:

7.1 Baseline Configuration

7.1.1 Open SV9, SV12, SV15, SV18, SV21, and SV24. All other valves closed. The GMA is now in its baseline configuration. Verify the configuration.

7.2 Space Spin Up Functional Test

7.2.1 Allow a 1 second delay between the opening of valves. Open SV1, SV3, SV5 and then SV23. Telemeter SP1, SP2, SP3A, SP4 and SP9 and verify that they are nominal (+/- 10 % of previously set values) in 1 second intervals for 1 minute. Record the final readings in Table 15. (How long should bypass be open for purging the lines? TBD)

7.2.2 Close SV23. Close B1 and B3 on the ISM and open F2. Verify that the metering valve M1 on the ISM is at the correct setting for gyro impedance (700 scc/m flow). Open SV7. Telemeter SP5 for 10 seconds at 1 second intervals. Verify that pressure and flow are nominal. Record readings in Table 17. Close SV7.

7.2.3 Open SV8. Verify parameters. Close SV8.

7.2.4 Open SV10. Verify parameters. Close SV10.

7.2.5 Open SV11. Verify parameters. Close SV11.

7.2.6 Open SV13. Verify parameters. Close SV13.

7.2.7 Open SV14. Verify parameters. Close SV14.

7.2.8 Open SV16. Verify parameters. Close SV16.

7.2.9 Open SV17. Verify parameters. Close SV17.

7.2.10 Close SV1, SV3 and SV5. Open SV23. Open SV2, SV4 and SV6. Verify that the metering valve M1 on the ISM is at the correct setting for gyro impedance (500 scc/m flow). Telemeter SP1, SP2, SP3A, SP4 and SP9 and verify that they are nominal (+/- 10 % of previously set values) in 1 second intervals for 1 minute. Record the final readings in Table 16. (How long should bypass be open for purging the lines? TBD)

7.2.11 Close SV23. Open SV7. Telemeter SP5 for 10 seconds at 1 second intervals. Verify that pressure and flow are nominal. Close SV7.

7.2.12 Open SV8. Verify parameters. Close SV8.

7.2.13 Open SV10. Verify parameters. Close SV10.

7.2.14 Open SV11. Verify parameters. Close SV11.

7.2.15 Open SV13. Verify parameters. Close SV13.

7.2.16 Open SV14. Verify parameters. Close SV14.

7.2.17 Open SV16. Verify parameters. Close SV16.

7.2.18 Open SV17. Verify parameters. Close SV17.

7.2.19 Open SV23. Close SV2, SV4 and SV6 in 10 second intervals. Close SV23.

7.2.20 Return ISM to starting configuration.

Table 15 Pressure Readings from R1.

Pressure Sensor	Requirement Psia	Final Reading Psia	Verify	Comments
SP1	3000			
SP2	450			
SP3A	7			
SP4	0-1			
SP9 (Torr)				

Table 16 Pressure Readings from R2.

Pressure Sensor	Requirement Psia	Final Reading Psia	Verify	Comments
SP1	3000			
SP2	450			
SP3A	7			
SP4	0-1			

SP9 (Torr)				

Table 17 Flow and Pressure in the Gyroscope Circuits from R1, inlet pressure 3000 psi

Solenoid Valve	**Requirement Flow scc/m**	**Flow Reading scc/m**	**Comments**
Pressure Sensor	**Requirement Pressure Torr**	**Pressure Reading Torr**	**Verify**
SV7	700		
SP5			
SV8	700		
SP5			
SV10	700		
SP6			
SV11	700		
SP6			
SV13	700		
SP7			
SV14	700		
SP7			
SV16	700		
SP8			
SV17	700		
SP8			

Table 18 Flow and Pressure in the Gyroscope Circuits from R2, inlet pressure 3000 psi

Solenoid Valve	Requirement Flow scc/m	Flow Reading scc/m	Comments
Pressure Sensor	**Requirement Pressure Torr**	**Pressure Reading Torr**	**Verify**
SV7	500		
SP5			
SV8	500		
SP5			
SV10	500		
SP6			
SV11	500		
SP6			
SV13	500		
SP7			
SV14	500		
SP7			
SV16	500		
SP8			
SV17	500		
SP8			

8.0 CLEANLINESS TEST

Started on:

8.1 Refer to Procedure P0710 by Aharon Halevy.

8.2 Sampling point or points TBD

9.0 PRESSURIZE GMA FOR STANDBY

Started on:

9.1 Close all N/O valves. Open all valves except SV6.

9.2 Close HPM2. Record SP1-SP4 in a logbook.

9.3 Once a week, check SP1-SP4 for deviations from nominal.

10 PROCEDURE COMPLETION

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

_____ date: _____
Integration Engineer

Discrepancies if any:

Approved: _____ date: _____
Test Director

Approved: _____ date: _____
GMA REE

Approved: _____ date: _____
QA