W. W. Hansen Experimental Physics Laboratory

STANFORD UNIVERSITY
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Gravity Probe B Relativity Mission

Proto-qual Vibration Test Procedure
GMA Assembly (25110)

GP-B P0588 Rev.-

12 June, 2000

_____

Prepared by: L Sokolsky Date
Test Director

_____

Approved : G. Asher Date
GMA Manager

_____

Approved : D. Ross Date
Quality Assurance

_____

Approved : B. Muhlfelder Date
Hardware Manager

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1 SCOPE

This Op Order is for protoflight random vibration testing of the GMA assembly (25110). The GMA will be mounted onto its vibration fixture using flight bracketry . The caging and spinup lines will be clamped using a GSE bracket, which is integral to the vibration fixture. The GMA EMI Frame will be installed for the test. The test is to be performed in the LMSS Bldg 181 environmental lab.

2 TEST INFORMATION

- Proper care should be taken in handling the GMA. Cleanliness must be preserved. The GMA must be kept bagged at all times, with the exception that the bag may be opened in order to bolt the GMA to the fixture, and to instrument the GMA with accelerometers.
- Temperature: 15-26 ° C
- Humidity: not critical

2.1 Cleanliness

2.1.1 Normal lab environment when GMA is bagged

2.1.2 Class 1000 Clean room when valves are open to atmosphere (use clean bench)

2.2 ESD precautions

2.2.1 None required.

2.3 Use of connector savers

2.3.1 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
SU QA_____time & date ONR_____ time & date

2.4 Personnel, QA, and Documentation

2.4.1 Test Director

2.4.2 The Test Director (TD) shall be Larry Sokolsky 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 Manager shall also sign off the completed "As-Built" procedure.

2.4.3 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.

2.4.4 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 and Payload Technician Manager's approval.

2.5 Red-line Authority

2.5.1 Authority to redline (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 Technician Manager shall be required, if in the judgment of the TD or QA Representative, experiment functionality may be affected.

3 APPLICABLE DOCUMENTS

3.1 Documents

Document number	Rev	Title
25110	C	Gas Management Assembly
25493-101	-	Side Support Bracket Assy
25494-101	-	End Support Bracket Assy
25108-101	-	MLI Support Frame
SK14079	-	GMA Vibration Fixture
MIL-STD-1540	C	Test requirements for launch, upper-stage and space vehicles.
F277277	4.3	Science Payload Specification-GP-B

3.2 Flight Parts

F/N	Description	Part Number	Rev	Serial Number
1	**GMA Assembly**	**25110**		
2	**Side Support Bracket Assy**	**25493-101**		
3	**End Support Bracket Assy**	**25494-101**		
4	**MLI Support Frame**	**25108-101**		
5	**Bolts**	**NAS9203-34H**		

3.3 Test Equipment

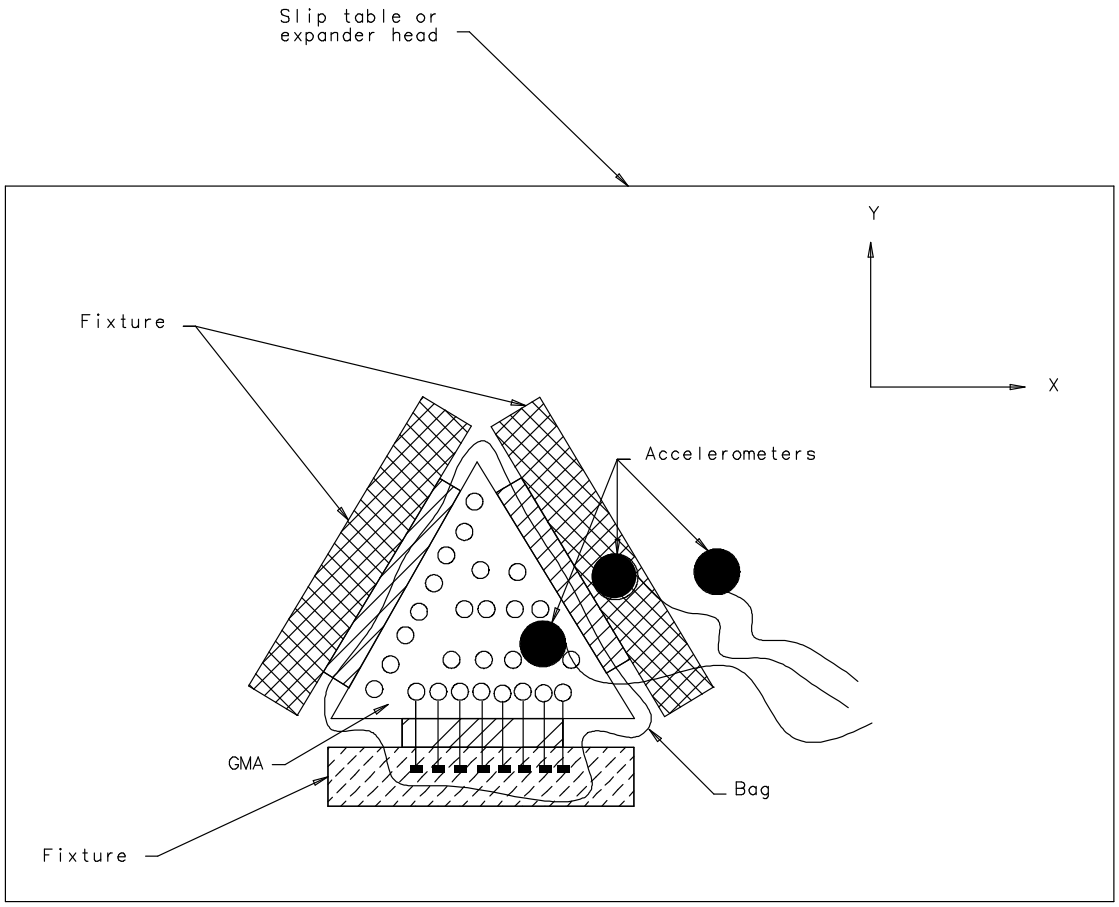
Equipment	Model and Serial Number	Calibration
Shaker		
Vibration Controller		
Accelerometer		
Accelerometer		
Accelerometer		
Accelerometer		

4 RANDOM VIBRATION TEST OF GMA

4.1.1 QA (Dorrene Ross or appointee) to attend testing _____.

4.1.2 Testing will be done at Lockheed Martin Bldg. 181. Accelerations in the shake axis will be recorded at the fixture. See Figure 1 for sketch of test set-up. Z-axis test will be done on vertical shaker, and X and Y-axis tests will be done on slip table. Note that axis definitions are different than space vehicle coordinate axes due to skewed mounting of GMA on space vehicle and uniform random vibration spectrum in all directions.

Figure 1
Test Set-Up (from above)



4.1.2.1 Z Axis Shake

4.1.2.1.1 Bolt GMA fixture to expander head in Z-axis configuration. Torque bolts to 290 in-LB Torque_____ Witness_____

4.1.2.1.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.

4.1.2.1.3 Run Z-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____

4.1.2.1.4 Bolt GMA brackets (F/N 2,3) to fixture using shop bolts. Torque to 85 in-lb_____(QA).

4.1.2.1.5 Bolt GMA to brackets using titanium bolts (F/N 5). Torque bolts to 85_____(QA). Attach F/N 4 to GMA

4.1.2.1.6 Tie down S1-S4 and C1-C4 lines with fixture bracket. Torque bolts to 85_____(QA).

4.1.2.1.7 Vibrate GMA in Z direction to –12 dB protoqual levels.

4.1.2.1.8 Approve resulting spectrum and cross axis responses for flight item (Table 8).

4.1.2.1.9 Vibrate GMA in Z direction to 0 dB protoqual levels (Table 7).

4.1.2.1.10 4.1.2.1.10 Approve resulting spectrum and cross axis responses for flight item (Table 8).

4.1.2.1.11 Remove GMA from fixture

4.1.2.1.12 Attach all plots to back of procedure.

4.1.2.2 X Axis Shake

4.1.2.2.1 Bolt GMA fixture to slip table in X-axis configuration. Torque bolts to 290 in-LB Torque_____ Witness_____

4.1.2.2.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.

4.1.2.2.3 Run X-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____

4.1.2.2.4 Bolt GMA brackets (F/N 2,3) to fixture using shop bolts. Torque to 85 in-LB_____(QA).

4.1.2.2.5 Bolt GMA to brackets using titanium bolts (F/N 5). Torque bolts to 85 _____(QA). Attach F/N 4 to GMA

4.1.2.2.6 Tie down S1-S4 and C1-C4 lines with fixture bracket. Torque bolts to 85_____(QA).

4.1.2.2.7 Vibrate GMA in X direction to –12dB protoqual levels.

4.1.2.2.8 Approve resulting spectrum and cross axis responses for flight item (Table 8).

4.1.2.2.9 Vibrate GMA in X direction to 0 dB protoqual levels (Table 7).

4.1.2.2.10 Approve resulting spectrum and cross axis responses for flight item (Table 8).

4.1.2.2.11 Remove GMA from fixture

4.1.2.2.12 Attach all plots to back of procedure.

4.1.2.3 Y Axis Shake

4.1.2.3.1 Bolt GMA fixture to slip table in Y-axis configuration. Torque bolts to 290 in-LB Torque_____ Witness_____

4.1.2.3.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.

4.1.2.3.3 Run Y-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____

4.1.2.3.4 Bolt GMA brackets (F/N 2,3) to fixture using shop bolts. Torque to 85 in-LB_____(QA).

4.1.2.3.5 Bolt GMA to brackets using titanium bolts (F/N 5). Torque bolts to 85 in-LB_____(QA). Attach F/N 4 to GMA

4.1.2.3.6 Tie down S1-S4 and C1-C4 lines with fixture bracket. Torque bolts to 85_____(QA).

4.1.2.3.7 Vibrate GMA in Y direction to –12 dB protoqual levels.

4.1.2.3.8 Approve resulting spectrum and cross axis responses for flight item (Table 8).

4.1.2.3.9 Vibrate GMA in Y direction to 0 dBprotoqual levels (Table 7).

4.1.2.3.10 Approve resulting spectrum and cross axis responses for flight item (Table8).

4.1.2.3.11 Remove GMA from fixture

4.1.2.3.12 Attach all plots to back of procedure. Bolt 2.6 in valve fixture to slip table in Y-axis configuration. Torque bolts to 90 in-LB
Torque_____ Witness_____

Table 7
0 dB Random Vibration Spectrum

Frequency (Hz)	Protoqual level (g^2/Hz)
20	0.00265
150	0.02
600	0.02
2000	0.0018
Composite (grms)	**4.3**

Duration: 60 ±5 seconds
Spec: ±3 dB, 20 Hz to 2000 Hz
RMS: ± 10%

Table 8
Approval of Vibration Spectrum for Flight Valves

Direction	Test Director Approval
X	
Y	
Z	

5 PROCEDURE COMPLETION

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

_____ date: _____
GMA Test Director

Discrepancies if any:

Approved: _____ date: _____
GMA REE

Approved: _____ date: _____
QA Manager

6 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.
- Part numbers and serial number of GMA assembly and components