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

READJUSTMENT AND REASSEMBLY OF FLIGHT GMA SOLENOID VALVES

GPB ENGINEERING PROCEDURE

P0686 Rev A

August 28, 2000

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 readjustment and reassembly of the GMA Flight Solenoid valves. Adjustments need to be made to preserve a gap between the solenoid rod and the spool pin (see DR 305). A replacement poppet will also be added to retrofit the valves to the new design. Finally, the microswitch that indicates valve closure will also be readjusted (see DR 306). The solenoids will be adjusted and assembled according to data gathered in procedure P0679.

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 10 clean room, or a clean hood in class 1000 clean room when valves are open to atmosphere.

2.2 ESD precautions

None required.

2.3 Use of Connector Savers

2.3.1 Connector savers will be used on all electrical connections.

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

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 G. Asher.

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
25110	B	GMA Assembly
25111	A	Caging Component Assembly
25112	B	Spinup Component Assembly
25113	C	Regulator Component Assembly
26211-101	B	Solenoid Valve Assembly
26231	–	Shims
P0578	AB	Assembly of Gas Flow Hardware into GMA
P0679	AB	Measurement of Solenoid valves
P0499	–	Probe Fastener Staking

3.2 Test Equipment

Equipment	Model and Serial Number	Calibration
Solenoid Control Box		P0621
Solenoid Test Fixture		
Epoxy	2143D	

3.3 Flight Parts

Description	Model and Serial Number	Comments
Shim washer	26231	
Replacement Poppet	3257672-1	
Poppet Guide with Guide Bushing installed	26204 3257677-1	
Collar	26325	
Screws	NAS1352C08H10	

4 READJUSTMENT OF MICROSWITCHES AND LATCHING SHIMS

Started on: _____

4.1 If necessary, remove the solenoid from the valve body.

4.2 Loosen the jam nut that locks the microswitch in place.

4.3 Install the solenoid on the Solenoid Test Fixture using the correct number of shims from Table 1, screws, washers, and wing nuts.

4.4 Connect the solenoid to the Solenoid Control Box (Patch Panel) using connector saver.

4.5 Cycle the solenoid open and closed 5 times while observing latch function.

4.6 If necessary, add or remove shims at engineer's discretion to optimize latch function and reinstall on fixture.

4.7 Cycle the valve again until satisfied with latch function. Leave the solenoid closed.

4.8 Record the number of shims used in Table 1.

4.9 Slowly turn the microswitch into the valve until the LED on the patch panel turns off.

4.10 Turn the microswitch in another 1/4 turn and lock down with the jam nut.

4.11 Cycle the valve open and closed 5 times to insure proper microswitch function.

4.12 If the microswitch fails to properly indicate an open valve, back the microswitch off 1/8 of a turn and cycle again. Repeat until microswitch is working correctly.

4.13 Place a small amount of epoxy on the jam nut to stake it into place according to P0499.

4.14 Repeat steps 4.1 – 4.13 for all solenoids.

5 REASSEMBLY OF SOLENOID VALVES

Started on: _____

5.1 Remove lower component of valve and install guide bushing in poppet guide according to instructions in Honeywell memo (see appendix A).

5.2 Spool pins should all be pulled to the upper end of their travel to keep them from interfering with poppet installation. Valves with no spool installed should be assembled normally. The upper components will be installed later.

5.3 Make sure to match lower components with appropriate body.

5.4 Insert new poppet with the spring on it into valve body.

5.5 Place smaller O-ring (2-011) on bottom, along with O-Ring retainer.

5.6 Install bottom cap using original screws (at 20 in-lbs torque), making sure to align poppet in poppet guide. **Do not force cap at any time**.

5.7 Check the installation by carefully pressing the spool pin onto the poppet and feeling the spring force. If spool not installed, visually inspect the poppet pin and press with a Q-tip.

5.8 If necessary, install the spool and top cap as per P0578. Use grease if necessary

5.9 Check the measurement of the depth of the spool pin of 6 random valves. It should be .105" ± .002. If it is not, compare the "Ridge to Pin" measurement with P0679 and adjust shimming accordingly.

5.10 Place the number of shims indicated in Table 2 around the ridge of the valve body. If solenoid does not appear in Table 2, no external shimming necessary

5.11 Place the number of shims determined in section 4 (recorded in Table 1), plus the number shims indicated in Table 2 into the bottom of the solenoid. Use 0.010 inch shims where appropriate.

5.12 Place the wave spring and then the thick washer into the solenoid.

5.13 Carefully place the solenoid on the valve body, making sure that it is setting on the shims.

5.14 Install new collar on solenoid with new, longer screws.

5.15 Tighten screws (to 25 in-lbs) to hold solenoid in place.

5.16 Repeat steps 5.3 – 5.13. for all solenoid valves.

Measurements from step 5.9:

6 TABLES

6.1 Table 1

Solenoid	Final Gap Measurement	Number of shim needed	Actual Number of shims used
A	0.0110	0	
A1	0.0094	2	
A5	0.0086	1	
A7	0.0081	2	2
B	0.0095	6	
H	0.0083	1	
J	0.0109	1	

L	0.0125	1	
M	0.0124	3	
N	0.0093	3	
T	0.0112	2	
V	0.0098	3	
A11	0.0060	3	
E	0.0058	0	
P	0.0054	1	
S	0.0065	2	
W	0.0066	0	
A10	-0.0005	3	
A2	-0.0019	1	
A3	0.0014	2	
A4	0.0001	1	
A6	0.0001	4	
A8	0.0039	2	
A9	-0.0059	2	
C	0.0038	2	
D	0.0044	3	
F	-0.0059	2	
G	-0.0034	2	
K	0.0032	2	
Q	0.0020	3	
R	0.0027	3	
U	0.0041	2	
X	0.0031	3	
Y	0.0032	2	
Z	0.0005	2	

6.2 Table 2

Solenoid	Shims needed
A10	plus .010
A11	plus .005
A2	plus .010
A3	plus .010
A4	plus .010
A6	plus .010
A8	plus .005
A9	plus .015
C	plus .005
D	plus .005
E	plus .005
F	plus .015
G	plus .015
K	plus .005
P	plus .005
Q	plus .010
R	plus .010
S	plus .005
U	plus .005
W	plus .005
X	plus .005
Y	plus .005
Z	plus .010

7 PROCEDURE COMPLETION

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

_____ date: _____
R. Stephenson, GMA Engineer

Discrepancies if any:

Approved: _____ date: _____
G. Asher, GMA REE

Approved: _____ date: _____
R. Leese, QA Representative

Approved: _____ date: _____
D. Ross, QA

8 DATA BASE ENTRY

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

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

- Part numbers and serial numbers of Caging Units and their components

APPENDIX A: HONEYWELL BUSHING INSTALLATION MEMO

Honeywell

Engines and Systems
Tempe, Arizona

Coordination Memo:

COMPANY:	Stanford University	**ENGR. CHRONO:**	FP&S:GPBS:0003:08070
ATTENTION:	Gideon Asher	**CA CHRONO:**	
VIA:	Ed McFarland, Jr.	**DATE:**	August 7, 2000
FROM:	John Ebaugh	**REPLY TO:**	
REFERENCE:		/ / **REQUEST**	/ X / **INFORMATION**
		/ / **REPLY TO:**	

SUBJECT:	**GRAVITY PROBE B SOLENOID VALVE – INSTALLATION/SWAGING PROCEDURE FOR BUSHING (P/N3257677-1)**

The following procedure was developed by Honeywell. Honeywell rep assisted Stanford GMA team members with initial installations. GMA team members have successfully used this procedure.

1 *Place bushing (Honeywell P/N 3257677-1) into bottom cap (aka Stanford Dwg. 26204 "Poppet Guide") with the large diameter end of the bushing going in first.*

2 *Use depth micrometer to verify bushing is installed all the way against the shoulder of the cap. This depth should be 0.262 ± 0.020 inches. Note this dimension for comparison in step 6.*

Customer Distribution: **Vendor Distribution:** **ES Distribution:**

Gideon Asher B. King

3 *Insert bushing installation tool (Honeywell P/N 3257771-1) into cap so that the end of the tool with a hole in it will slide over the small diameter of the bushing.*

4 *Position the above described arrangement of the cap, bushing, and tool on a flat, solid surface.*

5 *Restrain the arrangement in position with one hand while applying a sharp strike to the tool with a 4 to 8 ounce ball peen hammer.*

6 *Verify the bushing has been securely swaged by inverting the cap and tapping it on the working surface. If it appears to be secure, repeat measurement from step #2 and compare. Dimension should be within 0.005 inches. If bushing comes out of the cap or measurement indicates movement towards coming out, repeat entire procedure until secure.*