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Gravity Probe B Relativity Mission

**Proto-qual Vibration Test Procedure
2.5" and 6" Vacuum Valves (3179 and 3223)**

GP-B P0482 Rev.-

8 April 1999

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| Prepared by: L Sokolsky Test Director | Date |
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| Approved : D. Bardas Vatterfly REE | Date |
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| Approved : S. Buchman Hardware Manager | Date |
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| Approved : B. Taller Quality Assurance | Date |
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| Approved : J. Janicki Safety | Date |
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| Approved : K. Shaul Flight Sciences | Date |
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1 1. GENERAL DESCRIPTION

This Op Order is for protoflight random vibration testing of the Stanford 2.5” Vacuum Valves (S/U 3179) and 6” Vacuum Valves (S/U 3223). The valves will have protective covers over the vatterfly section to prevent contamination. These covers are integral to the shake fixture hardware, and will be delivered pre-attached to the valves to the shake facility. In addition, the valves will be bagged. The tests will be conducted with the valves at ambient pressure. Because of the over-center design of the valves, leakage during vibration is not an issue as long as the valves pass their acceptance pressure test, so a leak test will not be part of this vibration procedure.

2 2. APPLICABLE DOCUMENTS

| <u>Document number</u> | <u>Rev</u> | <u>Title</u> |
|------------------------|------------|---|
| 3179 | B | Valve, Vacuum, 2.5” |
| 3223 | A | Valve, Vacuum, 6” Large Vatterfly Valve, Random Vibration Fixture Small Vatterfly Valve, Random Vibration Fixture 2.5” Valve Cover, Top 2.5” Valve Cover, Bottom 6” Valve Cover, Top 6” Valve Cover, Bottom |

3 PARTS

3.1 Take Delivery of Parts from Stores

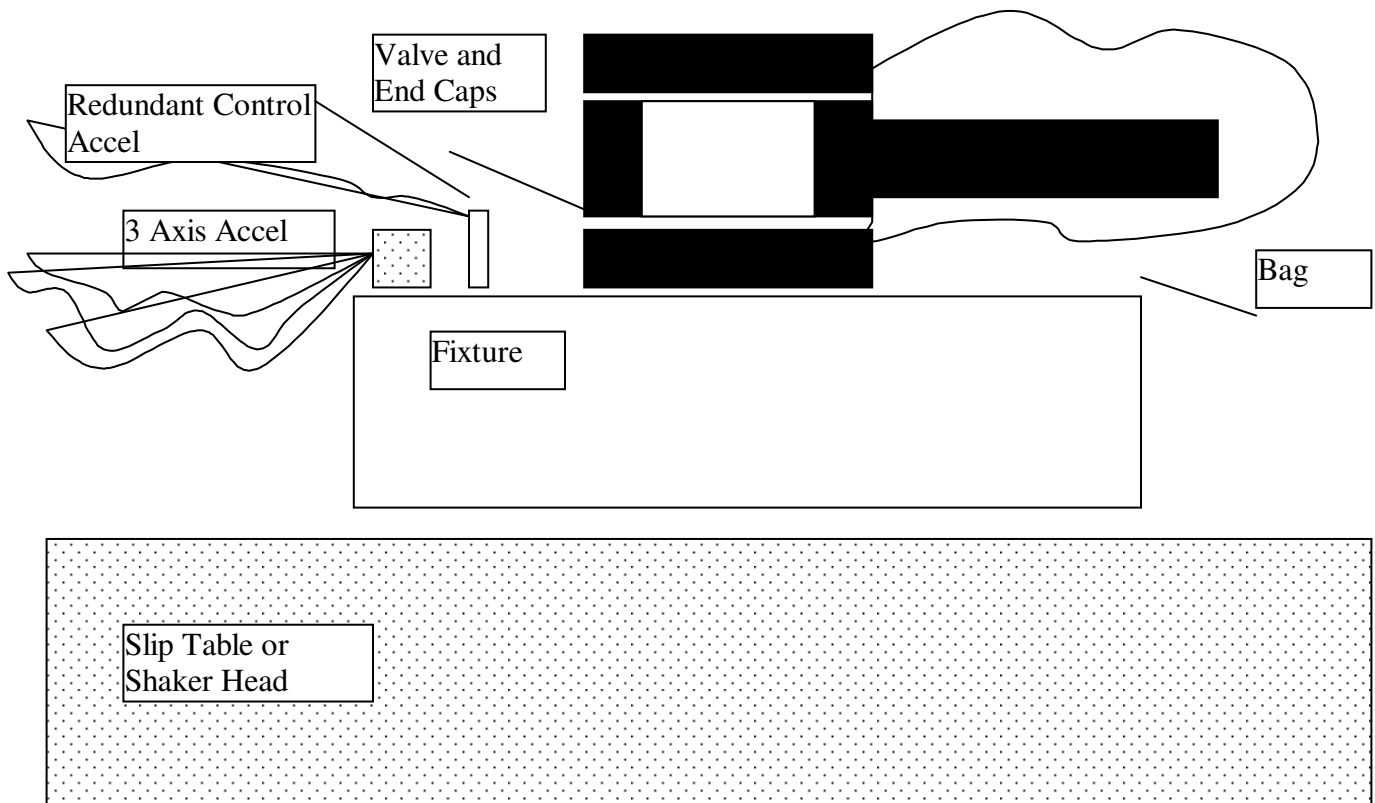
3.1.1 Accept the following parts from Stores:

| Quantity | Part number | Rev |
|----------|-------------|-------|
| 4 | 3179 | _____ |
| 2 | 3223 | _____ |

3.2 Random Vibration Test of Valve, Vacuum, 2.5" 3179 (4 items)

- 3.2.1 QA (Ben Taller or appointee) to attend testing _____.
- 3.2.2 Testing will be done at Bell Technologies. Accelerations in the shake axis will be recorded at the fixture. See Figure 1 for sketch of test set-up. Test can be done either on slip table or on vertical expander head cube adapter, per lab discretion and test director approval _____.

**Figure 1
Test Set-Up**



3.2.2.1

3.2.2.2 X Axis Shake

- 3.2.2.2.1 Bolt fixture 8A01681GSE to slip table in x-axis configuration. Torque bolts to 90 in-lb Torque_____ Witness_____
- 3.2.2.2.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.
- 3.2.2.2.3 Run x-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____
- 3.2.2.2.4 Bolt 2.5” valve to fixture 8A01681GSE. Torque to 90 in-lb. Record torques in Table 1.
- 3.2.2.2.5 Vibrate valve in X direction to protoqual levels (Table 7).
- 3.2.2.2.6 Approve resulting spectrum and cross axis responses for flight item (Table 8).
- 3.2.2.2.7 Remove valve from fixture
- 3.2.2.2.8 Repeat 3.2.2.1.4 thru 3.2.2.1.7 for each valve.
- 3.2.2.2.9 Attach all plots to back of procedure.

**Table 1
Torque Values for 2.5 in Valves (X-axis)**

| 2.5 in Valve S/N | Torque Value | QA Witness |
|------------------|--------------|------------|
| | | |
| | | |
| | | |
| | | |

3.2.2.3 Y Axis Shake

- 3.2.2.3.1 Bolt fixture 8A01681GSE to slip table in y-axis configuration. Torque bolts to 90 in-lb Torque_____ Witness_____
- 3.2.2.3.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.
- 3.2.2.3.3 Run x-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____
- 3.2.2.3.4 Bolt 2.5” valve to fixture 8A01681GSE. Torque to 90 in-lb. Record torques in Table 2.
- 3.2.2.3.5 Vibrate valve in Y direction to protoqual levels (Table 7).

- 3.2.2.3.6 Approve resulting spectrum and cross axis responses for flight item (Table 8).
- 3.2.2.3.7 Remove valve from fixture
- 3.2.2.3.8 Repeat 3.2.2.2.4 thru 3.2.2.2.7 for each valve.
- 3.2.2.3.9 Attach all plots to back of procedure.

**Table 2
Torque Values for 2.5 in Valves (Y-axis)**

| 2.5 in Valve S/N | Torque Value | QA Witness |
|------------------|--------------|------------|
| | | |
| | | |
| | | |

3.2.2.4 Z Axis Shake

- 3.2.2.4.1 Bolt fixture 8A01681GSE to slip table in x-axis configuration. Torque bolts to 90 in-lb Torque_____ Witness_____
- 3.2.2.4.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.
- 3.2.2.4.3 Run x-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____
- 3.2.2.4.4 Bolt 2.5" valve to fixture 8A01681GSE. Torque to 90 in-lb. Record torques in Table 3.
- 3.2.2.4.5 Vibrate valve in Z direction to protoqual levels (Table 7).
- 3.2.2.4.6 Approve resulting spectrum and cross axis responses for flight item (Table 8).
- 3.2.2.4.7 Remove valve from fixture
- 3.2.2.4.8 Repeat 3.2.2.3.4 thru 3.2.2.3.7 for each valve.
- 3.2.2.4.9 Attach all plots to back of procedure.

**Table 3
Torque Values for 2.5 in Valves (Z-axis)**

| 2.5 in Valve S/N | Torque Value | QA Witness |
|------------------|--------------|------------|
| | | |
| | | |
| | | |

| | | |
|--|--|--|
| | | |
|--|--|--|

3.3 Random Vibration Test of Valve, Vacuum, 6" 3223 (2 items)

3.3.1 QA (Ben Taller or appointee) to attend testing _____

3.3.2 Testing will be done at Bell Technologies. Accelerations in the shake axis will be recorded at the fixture. See Figure 1 for sketch of test set-up. Test can be done either on slip table or on vertical expander head cube adapter, per lab discretion and test director approval _____.

3.3.2.1 X Axis Shake

- 3.3.2.1.1 Bolt fixture 8A01681GSE to slip table in x-axis configuration. Torque bolts to 90 in-lb Torque_____ Witness_____
- 3.3.2.1.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.
- 3.3.2.1.3 Run x-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____
- 3.3.2.1.4 Bolt 2.5" valve to fixture 8A01681GSE. Torque to 90 in-lb. Record torques in Table 4.
- 3.3.2.1.5 Vibrate valve in X direction to protoqual levels (Table 7).
- 3.3.2.1.6 Approve resulting spectrum and cross axis responses for flight item (Table 8).
- 3.3.2.1.7 Remove valve from fixture
- 3.3.2.1.8 Repeat 3.3.2.1.4 thru 3.3.2.1.7 for each valve.
- 3.3.2.1.9 Attach all plots to back of procedure.

**Table 4
Torque Values for 2.5 in Valves (X-axis)**

| 2.5 in Valve S/N | Torque Value | QA Witness |
|-------------------------|---------------------|-------------------|
| | | |
| | | |

3.3.2.2 Y Axis Shake

- 3.3.2.2.1 Bolt fixture 8A01681GSE to slip table in y-axis configuration. Torque bolts to 90 in-lb Torque_____ Witness_____
- 3.3.2.2.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.

- 3.3.2.2.3 Run x-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____
- 3.3.2.2.4 Bolt 2.5" valve to fixture 8A01681GSE. Torque to 90 in-lb. Record torques in Table 5.
- 3.3.2.2.5 Vibrate valve in Y direction to protoqual levels (Table 7).
- 3.3.2.2.6 Approve resulting spectrum and cross axis responses for flight item (Table 8).
- 3.3.2.2.7 Remove valve from fixture
- 3.3.2.2.8 Repeat 3.3.2.2.4 thru 3.3.2.2.7 for each valve.
- 3.3.2.2.9 Attach all plots to back of procedure.

Table 5
Torque Values for 2.5 in Valves (Y-axis)

| 2.5 in Valve S/N | Torque Value | QA Witness |
|------------------|--------------|------------|
| | | |
| | | |

3.3.2.3 Z Axis Shake

- 3.3.2.3.1 Bolt fixture 8A01681GSE to slip table in x-axis configuration. Torque bolts to 90 in-lb Torque_____ Witness_____
- 3.3.2.3.2 Bond 3 axis accelerometer and redundant accelerometer to fixture.
- 3.3.2.3.3 Run x-axis fixture trial to protoqual level (Table 7). Approve resulting spectrum and cross-axis responses. Test Director_____
- 3.3.2.3.4 Bolt 2.5" valve to fixture 8A01681GSE. Torque to 90 in-lb. Record torques in Table 6.
- 3.3.2.3.5 Vibrate valve in Z direction to protoqual levels (Table 7).
- 3.3.2.3.6 Approve resulting spectrum and cross axis responses for flight item (Table 8).
- 3.3.2.3.7 Remove valve from fixture
- 3.3.2.3.8 Repeat 3.3.2.3.4 thru 3.3.2.3.7 for each valve.
- 3.3.2.3.9 Attach all plots to back of procedure.

Table 6

Torque Values for 2.5 in Valves (Z-axis)

| 2.5 in Valve S/N | Torque Value | QA Witness |
|-------------------------|---------------------|-------------------|
| | | |
| | | |

Table 7
Random Vibration Spectrum

| Frequency (hz) | Protoqual level (g²/hz) |
|-------------------------|---|
| 20 | 0.016 |
| 50 | 0.10 |
| 800 | 0.10 |
| 2000 | 0.016 |
| Composite (grms) | 11.2 |

Duration: 90 seconds
 Spec: ± 3 dB, 20 hz to 2000 hz
 RMS: $\pm 10\%$

**Table 8
Approval of Vibration Spectrum for Flight Valves**

| S/N | Direction | Test Director Approval |
|-------------|------------------|-------------------------------|
| 4 in | X | |
| | Y | |
| | Z | |
| 4 in | X | |
| | Y | |
| | Z | |
| 4 in | X | |
| | Y | |
| | Z | |
| 4 in | X | |
| | Y | |
| | Z | |
| 6 in | X | |
| | Y | |
| | Z | |
| 6 in | X | |
| | Y | |
| | Z | |

4 CLOSURE

4.1 Return valves to Stores.

4.2 QA to verify all operations complete. _____