**STEREO SWEA Vibration Test Procedure**
**Document # IMP-583-DOC**

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**Revised By:  J. McCauley**
**Approved by:  D. Curtis**
**REVISION:  -**
**DATE:  9 September 2004**

### 1.  OBJECTIVE

The objective of this vibration test is to subject the STEREO SWEA (hereafter referred to as the Unit Under Test, UUT) to Flight vibration levels, qualifying the general mechanical integrity of the UUT at the component level, and verifying the UUT is capable of maintaining functionality following vibration.

The UUT will be the fully assembled Flight SWEAs (FM1 and FM2), including the Pedestal, pedestal circuitry, SWEA detector, and SMAR Door Device, as well as, the STE-D detector assembly.  The UUT will be given a CPT prior to and following vibration testing to verify functionality.  The SWEA survival heater will be powered ON for vibration testing as it is during launch.

Test will be performed for the Flight Model SWEAs (FM1 and FM2) by Quanta Labs (Santa Clara, CA) October of 2004.

### 2.  PERSONNEL

Test Attendees:

Test Conductors _____
(UCB)Curtis/McCauley

Test Engineer _____ _____
(Quanta Labs)

### 3.  REFERENCE DOCUMENTS

APL Document APL 7381-9003 Rev A
UCB STEREO/IMPACT Boom Verification Plan
IMP-578-DOC STEREO Boom FM1 Vibration Report
IMP-582-DOC STEREO Boom FM2 Vibration Report

### 4.  VIBRATION TEST LEVELS

The vibration spectrums, levels, and durations for this test will be per Addendums.  Test shall be run in all three axes, applied independently.

Flight Units will be vibrated as provided in APL Document #7381-9003, "STEREO Environmental Definition, Observatory, Component and Instrument Test Requirements."   The random spectra will be generated to match the accelerometer data received from the STEREO Boom vibration tests (See IMP-578-DOC STEREO Boom FM1 Vibration Report or IMP-582 STEREO IMPACT Boom Vibration Report [Attached]).

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### 5. PASS/FAIL CRITERIA

UUT has successfully passed vibration testing if the unit is not degraded mechanically, functionally, or structurally. Success criteria shall consist of:

- No lost of functionality in SWEA or STE-D function or utility between pre- and post-vibration CPTs. Comprehensive Performance Tests (CPTs) will be performed at UCB/SSL before testing commences and after testing is complete.
- No significant change in pre- and post- sine sweep signatures
- No permanent deformations, movements, or degradations
- No anomalies in the SWEA survival heater as seen on monitoring equipment during test.
- No loss of connectivity of cable harness (measured before and after each test), conductivity must be maintained

Verification will consist of visual inspections, inspection of accelerometer output data, and acceptable functional CPTs. Note: it is not possible to codify a completely comprehensive PASS/FAIL Criteria for this type of Vibration Data. Test Conductor along with UCB/SSL STEREO Project Manager shall evaluate all test data.

### 6. REQUIRED HARDWARE ITEMS FOR TEST

UUT Consisting of SWEA Assembly with STE-D Assembly attached. (Items removed/not in place for Vibration Testing include Thermal Blankets.)

All Flight Items are in final Flight configuration.

### 7. TEST ABORT AND REAL TIME ACTIVITY ASSESSMENT

Testing shall continue with the goal of a one (1) day test cycle. Minor anomalies will be evaluated and, where prudent, fixed or alleviated in an attempt to continue testing. Examples of minor anomalies include temporary loss of accelerometer data, minor problems with hardware (cable movement) or problems with shaker facility. Disposition of minor anomalies will be made by Test Conductors at test site.

Significant anomalies will result in abort of further testing. Abort decisions will be made only after consultation with STEREO Project Manager. The UCB Test Engineer has authority to stop testing if deemed damage may be occurring to the hardware, the testing equipment functioning is suspect, output data is questionable, or the test is not compatible with this procedure.

All anomalies shall be reported as part of standard Project Problem/Failure Reporting.

### 8. POST-VIBRATION TESTING at SSL

UUT success in vibration testing will be demonstrated at SSL after the completion of this test sequence by:

- CPT of SWEA without anomalies
- CPT of STE-D without anomalies

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## 9. TEST PREPARATION ACTIVITIES at UCB/SSL

| Initials | Description. |
|---|---|
| | Complete assembly of UUT.  Photograph. |
| | Install UUT Test Harness.  Perform CPT of SWEA and STE-D Instruments |
| | Double bag UUT, leaving access to accelerometer locations and leads to internally mounted accelerometers.  Photograph. |
| | Transport UUT and support hardware to test facility. |

**\*INSPECTION POINT\***
**INSTRUMENT IS COMPLETE AND READY FOR SHIPMENT TO TESTING FACILITY**

**\*INSPECTION POINT\*   DATA RECORDED BY:** _____

## 10. PRE-TEST ACTITIVIES at FACILITY

Prior to the start of each axis test:

| X | Y | Z | Description. |
|---|---|---|---|
| | | | Properly orient Vibration Table for test. |
| | | | Install control accelerometer on Vibration Table.  Mark up figure to show actual placement.  Label accelerometer **CTL**. |
| | | | Prepare **Table Sine Survey**.  Load and verify control settings.  Annotate data with appropriate Run#. |
| | | | Perform **Table Sine Survey**.  Note any prominent resonance features. |
| | | | Perform RANDOM Vibration Run to verify working of table. |
| | | | Perform any other vibration runs at discretion of Test Conductor on empty vibration table.   As a minimum, a Sine Survey and Random shall be performed to ensure adequacy of software, electronics, and the table itself. |
| | | | Mount UUT vibration fixture plate to Vibration Table. |
| | | | Install all fasteners in vibration fixture plate. |
| | | | Verify torque of all fasteners. |
| | | | Install accelerometer on UUT, locations per Figure 1.  Mark up figure to show actual placement.  Label accelerometers. |
| | | | Attach cables from accelerometers to recording amplifiers. |
| | | | Verify response of all accelerometers. Verify accelerometer assignments in system controller.  Record accelerometer sensitivity in Table 1 below. |
| | | | Photograph vibration configuration. |
| | | | Assign run numbers for each vibration event and record. |

**\*INSPECTION POINT\*   DATA RECORDED BY**: _____

**Table 1: Accelerometer Sensitivity**

| Accel S/N | Sensitivity (pC/g @ 100Hz) | | |
|---|---|---|---|
| | X | Y | Z |
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**\*INSPECTION POINT\*   DATA RECORDED BY:** _____

**Sketch UUT and accelerometer locations in following drawings**.
Note:  A minimum of 6 accelerometers recording output data should be used.

**\*INSPECTION POINT**\*   DATA RECORDED BY: _____
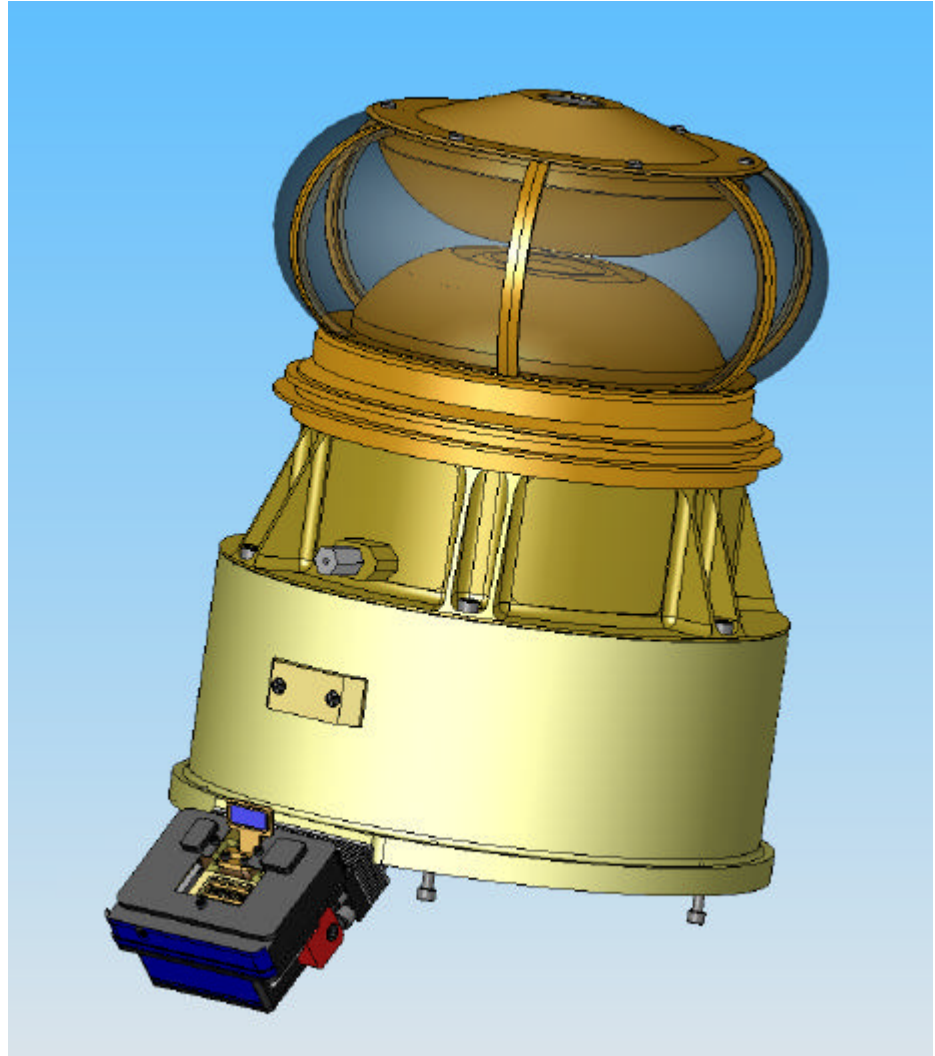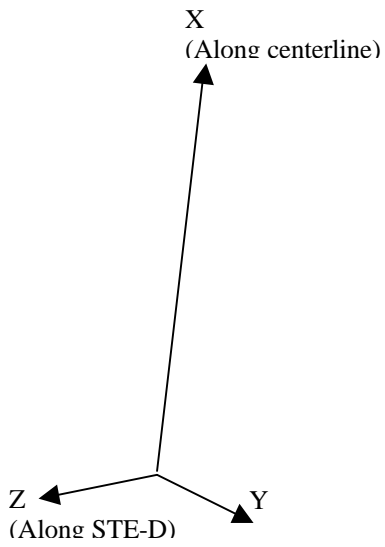
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## 10. VIBRATION TESTING

Choice of axis sequence is optional. Following satisfactory inspection of UUT on table, perform vibration testing per spectrums and sequencing listed in Addendum A. The UUT is to be "powered as launched" during vibration testing. Attach Harness to ETU IDPU, 28V supply, and monitoring equipment for all runs. Monitor current for transients.

Record Run# in the check boxes below:

| X | Y | Z | Description |
|---|---|---|---|
| | | | Install vibration fixture for Boom onto vibration table. |
| | | | Install UUT on vibration fixture, torque fasteners, as shown in Addendum E. |
| | | | Verify torque of vibration fixture fasteners. |
| | | | Verify proper mounting of accelerometers. |
| | | | Prepare **Sine Survey #1 per Addendum A**. Load and verify control settings. Annotate data with appropriate Run#. |
| | | | Perform **Sine Survey #1**. Note any prominent resonance features. |
| | | | Prepare **Sine Strength Test per Addendum B**. Load and verify control settings. Annotate data with appropriate Run#. |
| | | | Perform **Sine Strength Test**. Calculate g loads on any resonance features. |
| | | | Prepare **Sine Survey #2**. Load and verify control settings. Annotate data with appropriate Run#. |
| | | | Perform **Sine Survey #2**. Compare to Preliminary. |
| | | | Prepare **Random Vibration per Addendum C**. Load and verify control settings. Annotate data with appropriate Run#. |
| | | | Perform **Random Vibration**: ramp slowly to full level (-12, -9, -6, -3, 0 dB). Dwell for acceptance duration per Addendum A at 0 dB. |
| | | | Prepare **Sine Survey #3**. Load and verify control settings. Annotate data with appropriate Run#. |
| | | | Perform Sine Survey #3. Compare to Sine Survey #1. |
| | | | Record notes in the table on following page. |

## 11. ON-SITE INSPECTIONS

Before, during, and after each vibration run, visual inspections are to be made to check hardware status. Test runs are to be aborted when hardware appears anomalous. Following each run, bolt torque measurements for bolts holding the UUT to the vibration plate shall be made to verify no backing out of bolts.

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**Table 2:  Vibration Test Notes**

| Time | Log# | Accel# | Feature Frequency | Feature Amplitude | Q | g | Notes |
|---|---|---|---|---|---|---|---|
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**Table 2: Vibration Test Notes**

| Time | Log# | Accel# | Feature Frequency | Feature Amplitude | Q | g | Notes |
|---|---|---|---|---|---|---|---|
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| **STEREO SWEA VIBRATION TEST PROCEDURE** | **IMP-583-DOC, Rev. -** |
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## 12. TEST DISPOSITION AND SUMMARY NOTES

| Event # | Who | NOTES |
|---|---|---|
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### ADDENDUM A:   VIBRATION  SPECIFICATIONS: SINE SURVEY
### Protoflight and Flight Units

#### Testing Sequences

Testing is to be performed in the following order; identical sequence in all axes.  Axes order optional.

| | |
|---|---|
| a. | Mounting on Vibration Table |
| b. | Visual Inspection |
| c. | Sine Survey #1 |
| d. | Sine Strength Test |
| e. | Sine Survey #2 |
| f. | Random Vibration |
| g. | Sine Survey #3 |
| h. | Visual Inspection |
| i. | [Repeat, other two axes] |

#### Sine Survey (All Axes)

| Frequency (Hz) | Acceleration |
|---|---|
| 5-2000 | 0.1 g |

Rate:  4 Octaves/Minute

### ADDENDUM B: VIBRATION INPUTS: SINE STRENGTH TEST
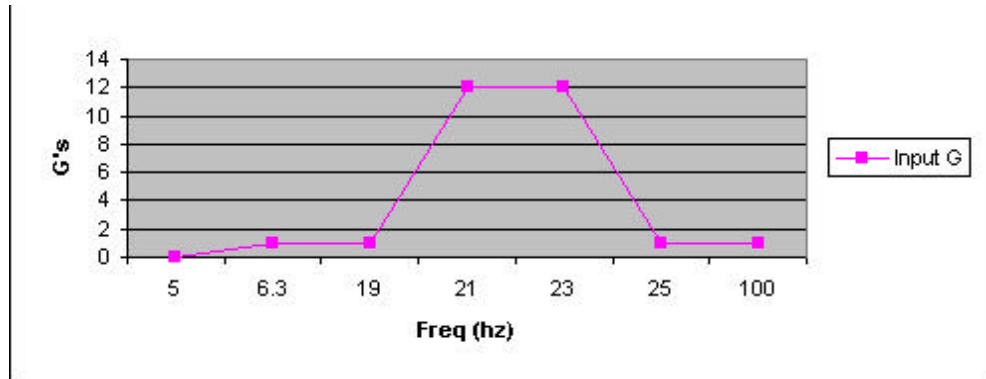**Protoflight and Flight Units: 4 Octaves/Minute**

Thrust Axis (X-axis)

| Freq | G |
|------|------|
| 5-7.4 | [.5" DA] |
| 7.4 | 1.4 |
| 23 | 1.4 |
| 25 | 16 |
| 27 | 16 |
| 29 | 1.4 |
| 100 | 1.4 |
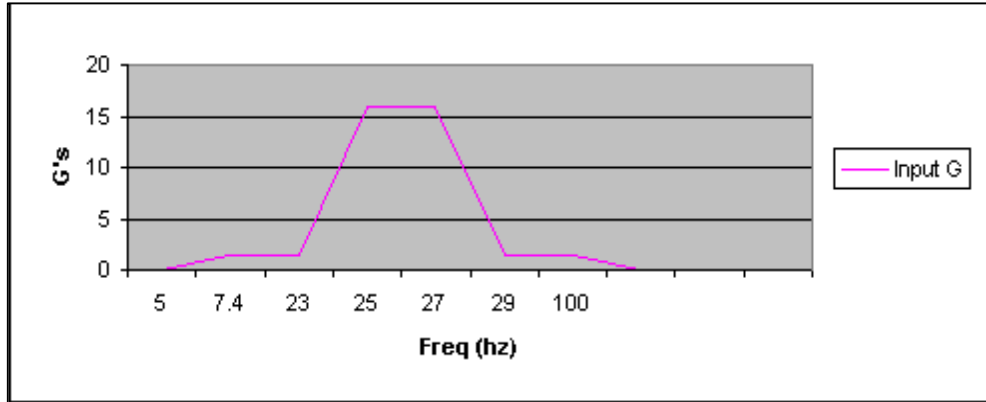


Lateral Axes

| Freq | G |
|------|------|
| 5-6.3 | [.5" DA] |
| 6.3 | 1 |
| 19 | 1 |
| 21 | 12 |
| 23 | 12 |
| 25 | 1 |
| 100 | 1 |

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### ADDENDUM C:  VIBRATION INPUTS:  RANDOM VIBRATION SPECTRA

From IMP-582-DOC STEREO Boom FM2 Vibration Report, Rev. -

**Table 1: Random Vibration Levels X-axis**

| Frequency (Hz) | PSD Level |
|---|---|
| 20 | 0.01 g^2/Hz |
| 20 to 70 | +4.7 dB/oct |
| 70 to 90 | 0.07 g^2/Hz |
| 90 to 110 | +21.8 dB/oct |
| 110 to 140 | 0.3 g^2/Hz |
| 140 to 500 | -5.5 dB/oct |
| 500 | 0.03 g^2/Hz |
| 500 to 2000 | -2.4 dB/oct |
| 2000 | 0.01 g^2/Hz |

Overall Amplitude = 8.54 g rms
Duration = 60 seconds
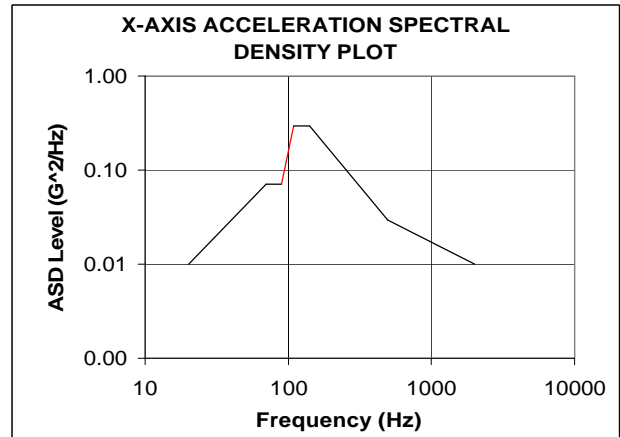


**Table 2: Random Vibration Levels Y-axis**

| Frequency (Hz) | PSD Level |
|---|---|
| 20 | 0.01 g^2/Hz |
| 20 to 70 | +9.4 dB/oct |
| 70 to 90 | 0.5 g^2/Hz |
| 90 to 150 | -9.5 dB/oct |
| 150 to 300 | 0.1 g^2/Hz |
| 300 to 2000 | -3.7 dB/oct |
| 2000 | 0.01 g^2/Hz |

Overall Amplitude = 9.70 g rms
Duration = 60 seconds
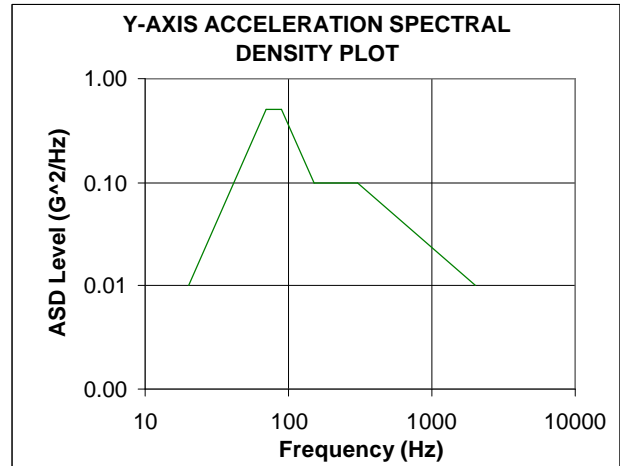


**Table 3: Random Vibration Levels Z-axis**

| Frequency (Hz) | PSD Level |
|---|---|
| 20 | 0.01 g^2/Hz |
| 20 to 50 | +5.3 dB/oct |
| 50 | 0.05 g^2/Hz |
| 50 to 80 | +23.6 dB/oct |
| 80 to 90 | 2.0 g^2/Hz |
| 90 to 150 | -24.8 dB/oct |
| 150 to 500 | 0.03 g^2/Hz |
| 500 to 2000 | -2.4 dB/oct |
| 2000 | 0.01 g^2/Hz |

Overall Amplitude = 9.88 g rms
Duration = 60 seconds
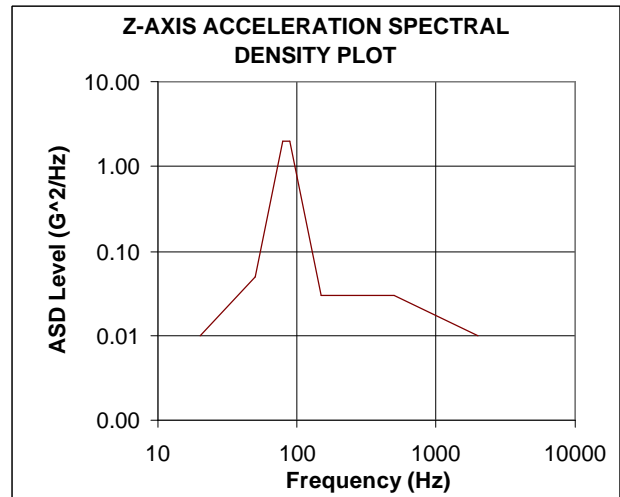
**ADDENDUM E:  HARDWARE CONFIGURATION**