

STEREO IMPACT Boom FM1 Vibration Report

Document # IMP-578-DOC

Revision: A (Updated vibration envelopes for SWEA and STE Instruments)

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1. OVERVIEW

The STEREO Boom vibration tests for the flight model 1 (FM1) boom were conducted June 28, 2004 at Quanta Laboratories in Santa Clara, California. Dave Curtis, Jeremy McCauley, Robert Ullrich and Lancelot Braasch were in attendance for instrument handling, verification and test support. Ron Jackson and Jeremiah Tolbert attended to provide added support from Quality Assurance. Quanta Laboratories provided Test Engineer Sun Lian.

Tests were conducted in the X-, Z-, and Y-axis, where the X-axis is defined as along the boom deployment axis, the Z-axis is along the magnetometer mount, and the Y-axis is perpendicular to the mounting plane (See Figure 1). Test objectives, procedures and levels are defined and explained in IMP-562-DOC, STEREO BOOM Vibration Test Procedure, Revision A (Attached). The only exception of note was the use of an expander provided by Quanta Laboratories for the vertical orientation of the shake table rather than the configuration shown on Sheet 14 for the Y-axis tests.

All vibration runs were completed and no further testing is required. No degradation to the boom mechanically, structurally, or functionally was shown by post-test deployment of the boom or by subsequent stiffness testing.

Two dowel pins were found loose in the instrument bagging – one after the Z-axis and one after the Y-axis. These pins were replaced and staked to prevent them from dislodging in the future (See Attached PR-1010).

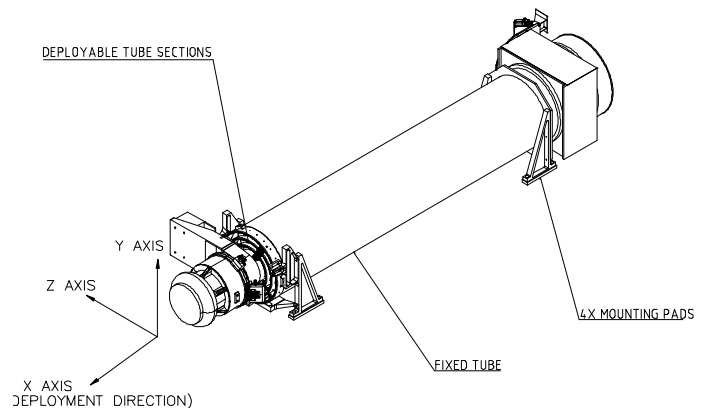


Figure 1: Definition of Shake Axes

2. REFERENCE DOCUMENTS (Attached):

- Quanta Laboratories Report Number QL-04-520 – Vibration Report
- UCB Document IMP-562-DOC, Rev. A – STEREO BOOM Vibration Test Procedure
- UCB Document PR-1010, STEREO Boom FM1 Vibration - Pins
- UCB Document PFR-1011, STE-U FM1 Vibration Anomaly - Door

3. PASS/FAIL CRITERIA

Post-vibration deployment of the boom assembly verified functionality was not lost in testing. Full deployment with actuation was completed July 14, 2004, during thermal vacuum testing. Post deployment inspections found no notable degradation mechanically or structurally.

Four set screws were found in the square housing around the actuator mechanism. Inspection found they came loose from the preload wedges for the tubes. Though the wedge had been allowed to loosen, the part is not necessary once the boom is fully stowed and did not produce any loss in structural rigidity. This part is merely a stop point when stowing the boom. Once the pinpuller is inserted, the stacer tip piece provides the required structure. This part will be staked before flight and therefore is not a design issue.

The Boom was vibrated with the MAG heater powered on (launch configuration) and the current monitored. There was no change in the current to the heater circuit during vibration.

Pre- and post-vibration CPTs were performed on the MAG and STE-U instruments. There were no anomalies in the MAG instrument CPTs. There was a problem with the post-vibration CPT of the STE-U instrument regarding the actuation of the door. Please reference: PFR1011.

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4. DYNAMIC TEST REQUIREMENTS FOR BOOM MOUNTED COMPONENTS

Accelerometers were attached in each position of an instrument that attaches to the STEREO BOOM and envelopes were created from the test data recorded.

4.1. 4.1. SWEA AND STE-D

The composite envelopes for the SWEA instrument from the FM1 and FM2 Boom vibration tests are as follows.

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

4.2. MAGNETOMETER

The Magnetometer instrument was attached for the vibration test.

4.3. STE-U

Though the FM2 STE-U instrument was vibrated attached to the Boom, envelopes were created in the event that the instrument requires further vibration testing. The composite envelopes from the FM1 and FM2 Boom vibration tests are as follows.

Table 7: Random Vibration Levels X-axis

Frequency (Hz)	PSD Level
20	0.01 g ² /Hz
20 to 70	+4.7 dB/oct
70 to 300	0.07 g ² /Hz
300 to 500	-2.0 dB/oct
500	0.05 g ² /Hz
500 to 2000	-3.5 dB/oct
2000	0.01 g ² /Hz

Overall Amplitude = 7.8 g rms
Duration = 60 seconds

Table 8: Random Vibration Levels Y-axis

Frequency (Hz)	PSD Level
20	0.01 g ² /Hz
20 to 140	+6.3 dB/oct
140 to 200	0.6 g ² /Hz
200 to 300	-17.1 dB/oct
300 to 500	0.06 g ² /Hz
500 to 2000	-3.9 dB/oct
2000	0.01 g ² /Hz

Overall Amplitude = 11.4 g rms
Duration = 60 seconds

Table 9: Random Vibration Levels Z-axis

Frequency (Hz)	PSD Level
20	0.01 g ² /Hz
20 to 60	+3.8 dB/oct
60 to 80	+24.1 dB/oct
80 to 110	0.4 g ² /Hz
110 to 160	-20.8 dB/oct
160 to 500	0.03 g ² /Hz
500 to 2000	-2.4 dB/oct
2000	0.01 g ² /Hz

Overall Amplitude = 7.56 g rms
Duration = 60 seconds

6. ACCELEROMETER PLACEMENT

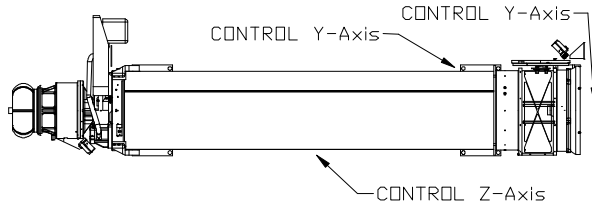


Figure 2: Control Accelerometer Placement

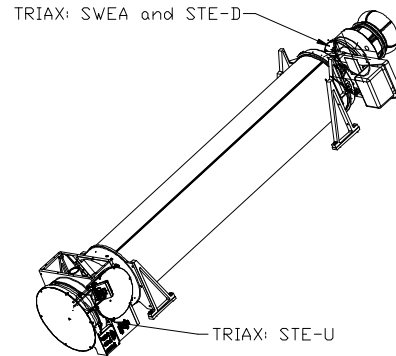


Figure 3: Accelerometer Placement

8. RELEVANT DATA

Selected data is included to depict the pre- and post-test signatures, the random vibration test levels, and the testing envelopes created for the boom mounted instruments. Filenames for the X-axis are as follows:

X RAN	X-Axis Random Vibration Test
X POST SINE	X-Axis Post Random Sine Signature
X PRE POST SINE	X-Axis Post Sine Strength and Pre Random Sine Signature
X PRE SINE	X-Axis Pre Sine Strength Sine Signature

Other axes are similar.

Full data is available for review upon request.