STEREO BOOM Vibration Test Procedure
Document # IMP-562-DOC

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REVISION: DRAFT
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TBD'S as of this DRAFT:
-Unresolved Methodology on Force Limit Implementation
-Label all Axes
-Determine Accelerometer Locations

1. **OBJECTIVE**
The objective of this vibration test is to subject the STEREO Boom (hereafter referred to 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 or Protoflight BOOM, included the Boom Tube Assembly, SMA Pin Puller Release Device, Cables, and mass dummies replacing instruments. The UUT will be deployed following vibration testing to verify functionality.

Test will be performed Wyle Labs (Mountain View, CA) the Summer of 2003.

This test procedure to be used for both the Flight and Protoflight units. The difference between the two tests regiment is the hardware configuration of the particular assemblies and only the Protoflight unit will be subjected to Sine Strength testing.

2. **PERSONNEL**
    Test Attendees:

        Test Conductors _____
                                (UCB) Donakowski/Turin/Jackson/Ullrich

        Test Engineer _____ _____
                                (Wyle Labs) Jack Eagan

3. **REFERENCE DOCUMENTS**
        APL Document APL 7381-9003 Rev A
        UCB STEREO/IMPACT Boom Verification Plan

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.

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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 Boom Assy Deployment (testing to occur following testing at UCB)
❑ No significant change in pre- and post- sine sweep signatures
❑ No permanent deformations, movements, or degradations.
❑ No loss of connectivity of cable harness (measured before and after each test)

Verification will consist of visual inspections, inspection of accelerometer output data, and acceptable functional deployement. 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 Boom Assy, Cables, and Mass Dummies in lieu of Instruments. (Items removed/not in place for Vibration Testing include Thermal Blankets, Thermal Mounting Isolators, and Instruments.)

All Flight Items are in final Flight configuration.

7. TEST ABORT AND REAL TIME ACTIVITY ASSESSMENT

Testing shall continue with goal of one-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, 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 test is not compatible with this procedure.

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

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8. TEST PREPARATION ACTIVITIES at UCB/SSL

Initials	Description.
	Complete assembly of Boom. Photograph.
	Test Deployment of complete assembly.
	Install UUT on vibration fixture, torque fasteners, as shown in Addendum E. Photograph.
	Double bag UUT, leaving access to accelerometer locations and leads to internally mounted accelerometers
	Transport UUT and support hardware to test facility.

INSPECTION POINT
INSTRUMENT IS COMPLETE AND READY FOR SHIPMENT TOTESTING FACILITY

INSPECTION POINT   DATA RECORDED BY: _____

9. 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: _____

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Table 1: Accelerometer Sensitivity

Accel S/N	Sensitivity (pC/g @ 100Hz)		
	X	**Y**	**Z**

INSPECTION POINT   DATA RECORDED BY: _____

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Sketch UUT and accelerometer locations in following drawings.

INSPECTION POINT   DATA RECORDED BY:

DEPLOYABLE TUBE SECTIONS

4X MOUNTING PADS

X AXIS
(DEPLOYMENT DIRECTION)

FIXED TUBE
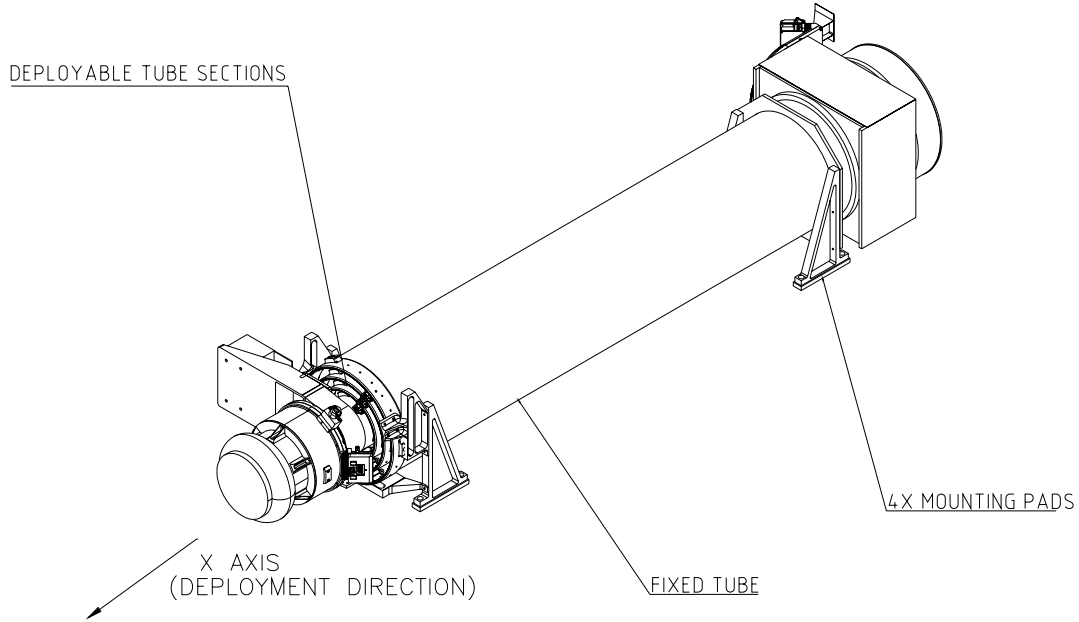
NOTE:
-Label Thrust and Lateral Axes
-Show all accelerometer locations

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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.

Record Run# in the check boxes below:

Protoflight Unit

X	Y	Z	*Description*
			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.

Flight Units

X	Y	Z	*Description*
			Verify torque of vibration fixture fasteners.
			Verify proper mounting of accelerometers.
			Prepare **Sine Survey #1 per Addendum D**. Load and verify control settings. Annotate data with appropriate Run#.
			Perform **Sine Survey #1**. Note any prominent resonance features.
			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 #2**. Load and verify control settings. Annotate data with appropriate Run#.
			Perform Sine Survey #2. 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 to be made to check hardware status. Test runs to be aborted when hardware appears anomalous. Following each run, bolt torque 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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12. TEST DISPOSITION AND SUMMARY NOTES

Event #	Who	NOTES

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ADDENDUM A: VIBRATION SPECIFICATIONS   PROTOFLIGHT UNIT

Testing Sequences

Testing to be performed in 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

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ADDENDUM B: VIBRATION INPUTS: Sine Strength Test

(Protoflight Unit ONLY)

Thrust 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
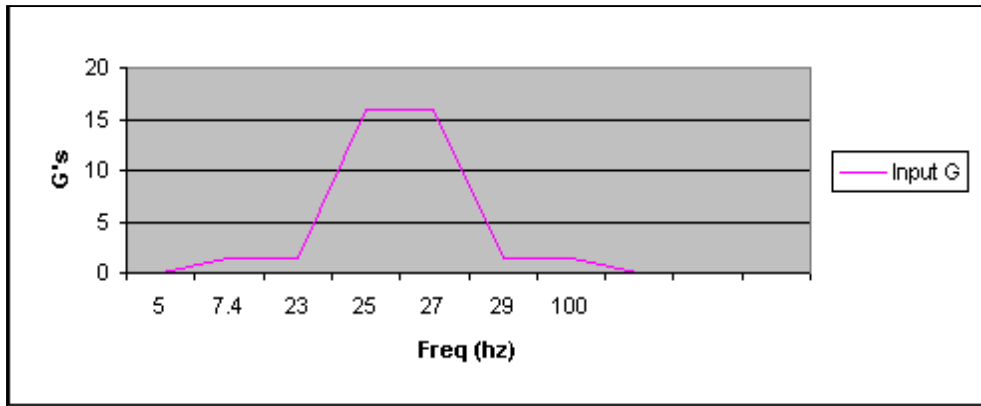
Lateral Axes

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

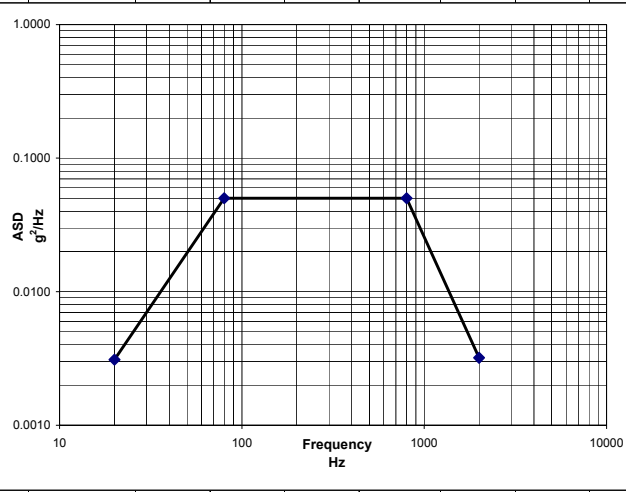| **STEREO BOOM VIBRATION TEST PROCEDURE**	**IMP-562-DOC**
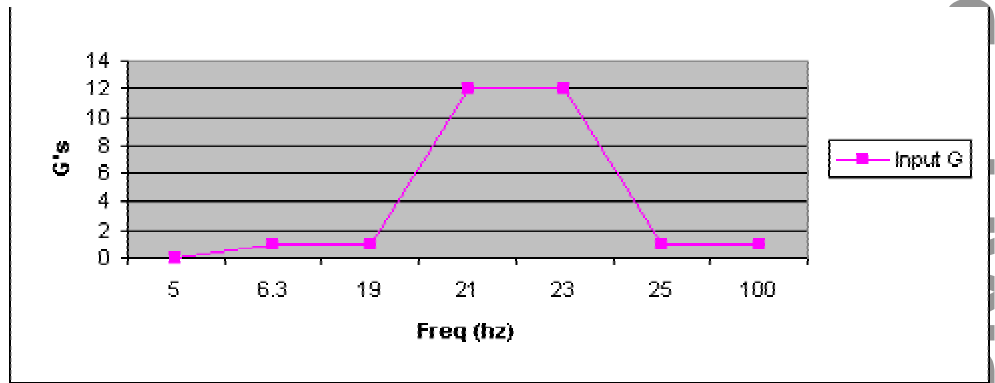
ADDENDUM C: VIBRATION SPECIFICATIONS

VIBRATION INPUTS: RANDOM Vibration
Flight and Protoflight Units
All three Axes

	Random Vibration Specification							
	STEREO BOOM							
	REF: APL 7381-9003 REV A							
	Duration: 60 Seconds							
	Axis: Parallel to S/C Mounting Panel							
				Slope		Acceleration		
FREQ(Hz)	**ASD(G²/Hz)**	**dB**	**OCT**	**dB/OCT**	**AREA**	**Grms**		
20	0.0031	*	*	*	*	*		
80	0.0500	12.08	2.00	6.04	1.31	1.14		
800	0.0500	0.00	3.32	0.00	37.31	6.11		
2000	0.0032	-11.94	1.32	-9.03	54.11	**7.36**		

	Random Vibration Specification							
	STEREO BOOM							
	REF: APL 7381-9003 REV A							
	Duration: 60 Seconds							
	Axis: Perpendicular to S/C Mounting Panel							
				Slope		Acceleration		
FREQ(Hz)	**ASD(G²/Hz)**	**dB**	**OCT**	**dB/OCT**	**AREA**	**Grms**		
20	0.0063	*	*	*	*	*		
80	0.1000	12.01	2.00	6.00	2.63	1.62		
800	0.1000	0.00	3.32	0.00	74.63	8.64		
2000	0.0065	-11.87	1.32	-8.98	108.42	**10.41**		
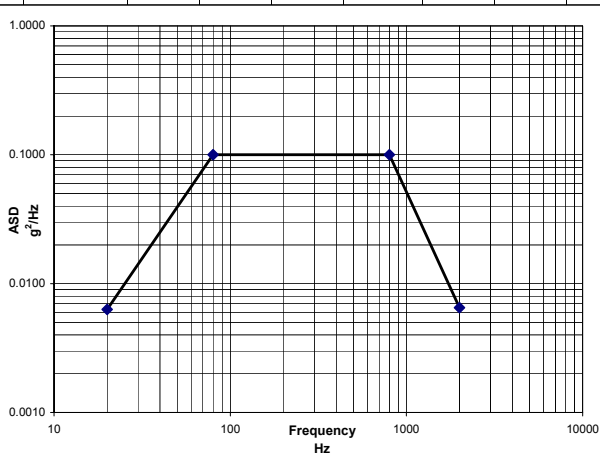
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Addendum D: Vibration Specifications Acceptance Testing (Flight Units)

- **Testing Sequencing**

a.	Mounting on Vibration Table
b.	Visual Inspection
c.	Sine Survey #1
d.	Random Vibration
e.	Sine Survey #2
f.	Visual Inspection
g.	[Repeat, other two axes]

- **Sine Survey**

Frequency (Hz)	Acceleration
5-2000	0.1 g

(All Axes)

Rate: 4 Octaves/Minute

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ADDENDUM E: HARDWARE CONFIGURATION