Bendix

Aerospace Systems Division

ALSEP Array E Component
Non-Operating Vibration Specifications

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This memorandum defines the non-operating vibration specifications for the ALSEP Array E experiments and other major subsystems.

Prepared by: J. Maszatics
J. Maszatics

Approved by: J. McNaughton
J. McNaughton

Approved by: L. R. Lewis
L. R. Lewis

INTRODUCTION

Specifications and test procedures require a preliminary definition of the design limit non-operating vibration levels applicable to the ALSEP Array E subsystems. Until system level analyses and tests are completed, such vibration specifications must be estimated using information available from qualification tests of Arrays A, B, C, and D.

DISCUSSION

Using vibration data recorded during tests conducted on Subpack #1 Arrays A, B, C, and D (Ref. 1 & 2); a set of vibration specifications (Ref. 3) were generated which apply to Array E Subpack #1 subsystems. These specifications are intended for the new experiments (LMS, LSG, and LSP/geophones) and for the new CSE components (LSP/CSE, PCU/PDU, DDP/MUX, and CD). Tables I, II, and III list the Array E Subpack #1 subsystem sinusoidal, L&B random, and Lunar Descent random vibration specifications, respectively. This specification does not include the effects of the LSG shock-vibration isolators.

Similarly, the Subpack #2 Arrays A and B vibration test data (Ref. 1 & 2) was utilized to establish a set of vibration specifications (Ref. 4) for the new Array E Subpack #2 subsystems (i.e., LEAM and Antenna Aiming Mechanism). Tables IV, V, and VI list the sinusoidal, L&B random, and Lunar Descent random vibration specifications, respectively, for the Array E subpack #2 subsystems.

The axes referred to in the tables are the ALSEP coordinate system.

The vibration levels listed in Tables I-VI differ somewhat from those of Ref. 3 and 4 due to NASA/MSC directed changes to the ALSEP system vibration specifications (Ref. 5). Test duration times have been reduced and test levels lowered at some frequencies. At other frequencies the new ALSEP specifications dictate an increase in subsystem vibration levels. Such increases have not been made because they would adversely impact the subsystem programs and are unwarranted due to the conservatism of the method of estimating the subsystem environments. It is intended that if changes are made, due to future system analyses or tests, they will consist only of decreases in environmental severity.

CONCLUSION

The vibration environments listed in Tables I-III for Subpack 1 and Tables IV-VI for Subpack #2 are recommended for inclusion into Array E specifications and test procedures for applicable subsystems. These environments are non-operating. Operating random vibration requirements, defined by references 3 and 4 and the Array E Statement of Work, and are applicable only to subsystems or components of subsystems.

The non-operating vibration specifications may be revised upon completion of system dynamic analyses and/or system engineering model tests.

REFERENCES

1. ATM-832, "ALSEP Qualification Design Limit Vibration Test Data Summary", 27 June 1969.

2. Bendix Aerospace Systems Division Letter No. 9712-25, "Engineering Vibration Test Results - Array D Subpack #1", 22 Sept. 1970.

3. Bendix Aerospace Systems Division Letter No. 9712-56, "Array E Subpack #1 Subsystem Dynamic Environment", 15 Oct. 1970.

4. Bendix Aerospace Systems Division Letter No. 9712-76A, "Array E Subpack #2 Subsystem Dynamic Environment", 2 Nov. 1970.

5. Bendix Aerospace Systems Division Letter No. 9712-147, "ALSEP Vibration Requirements", 7 Jan. 1971.

6. NASA/MSC Letter EH3/1-4/L101/B111/JAC, ALSEP Vibration Testing, dated 28 January 1971.

TABLE I - Array E Subpack #1 Subsystem Sinusoidal Vibration Specification

X-Axis:	5-20 Hz	0.20 in. d.a.
	20-34	4.0 g-peak
	34-50	0.07 in. d.a.
	50-65	9.0 g-peak
	65-100	4.0 g-peak
Y&Z-Axes:	5-17 Hz	0.20 in. d.a.
	17-54	3.0 g-peak
	54-80	0.02 in. d.a.
	80-100	6.5 g-peak
Sweep:	5-100-5 Hz	
Sweep Rate:	3 oct/min	
Tolerances:	± 10% (g & d.a.)	
	± 5Hz at step discontinuities	

TABLE II - Array Subpack #1 Subsystem L&B Random Vibration Specification

X-Axis:	20-40 Hz	± 6 db/oct
	40-150	0.08 g^2/Hz
	150-270	-6 db/oct
	270-2000	0.025 g^2/Hz
Y-Axis:	20-60	+6 db/oct
	60-200	0.06 g^2/Hz
	200-285	-6 db/oct
	285-2000	0.03 g^2/Hz
Z-Axis:	20-50	+9 db/oct
	50-150	0.035 g^2/Hz
	150-210	-3 db/oct
	210-2000	0.025 g^2/Hz
Duration:	1.0 min/axis	
Tolerances:	± 3 db (PSD)	
	± 10% (G_{rms})	

TABLE III. Array E Subpack #1 Subsystem Lunar Descent Random Vibration Specification.

X-Axis:	20-28 Hz	+6 db/oct
	28-86	0.05 g^2/Hz
	86-135	-6 db/oct
	135-2000	0.02 g^2/Hz
Y-Axis:	20-44 Hz	+3 db/oct
	44-127	0.04 g^2/Hz
	127-175	-9 db/oct
	175-2000	0.015 g^2/Hz
Z-Axis:	20-40 Hz	+3 db/oct
	40-160	0.04 g^2/Hz
	160-380	-6 db/oct
	380-2000	0.007 g^2/Hz
Duration:	12-1/2 min/axis	
Tolerances:	± 3 db (PSD)	
	± 10% (G_{rms})	

TABLE IV - Array E Subpack #2 Subsystem Sinusoidal Vibration Specification

X-Axis	5-17 Hz	0.20 in. d.a.
	17-29	3.0 g-peak
	29-50	0.06 in. d.a.
	50-75	9.0 g-peak
	75-100	3.0 g-peak
Y&Z Axes:	5-17 Hz	0.20 in. d.a.
	17-100	3.0 g-peak
Sweep:	5-100-5 Hz	
Rate:	3 oct/min	
Tolerances:	± 10% (g & d.a.)	
	± 5 Hz at step discontinuities.	

TABLE V - Array E Subpack #2 Subsystem L&B Random Vibration Specification

X-Axis:	20-40 Hz	+6 db/oct
	40-120	0.05 g^2/Hz
	120-145	+9 db/oct
	145-1000	0.090 g^2/Hz
	1000-2000	-3 db/oct
Y-Axis:	20-250 Hz	+3 db/oct
	250-1000	0.050 g^2/Hz
	1000-1500	+3 db/oct
	1500-2000	0.075 g^2/Hz
Z-Axis:	20-400 Hz	+3 db/oct
	400-2000	0.06 g^2/Hz
Duration:	1.0 min/axis	
Tolerances:	± 3 db (PSD)	
	± 10% (G_{rms})	

TABLE VI - Array E Subpack #2 Subsystem Lunar Descent Random Vibration Specification.

X-Axis	20-40 Hz	+3 db/oct
	40-140	0.025 g^2/oct
	140-200	+9 db/oct
	200-1000	0.07 g^2/Hz
	1000-2000	-3 db/oct
Y-Axis:	20-100 Hz	0.015 g^2/Hz
	100-300	+3 db/oct
	300-2000	0.045 g^2/Hz
Z-Axis:	20-240 Hz	0.010 g^2/Hz
	240-1000	+3 db/oct
	1000-2000	0.040 g^2/Hz
Duration:	12.5 min/axis	
Tolerances:	± 3 db (PSD)	
	± 10% (G_{rms})	