Bendix

Aerospace Systems Division

NO.	REV. NO
ATM-992	

PAGE ____ OF ____

DATE 5/17/71

Expected SIDE Vibration Environment on Array A2

A-19

During the Array A-2/HFE PDR held on 29 October 1970, BxA was assigned an action item to assess the vibration environments that the SIDE would be subjected to for the revised Subpackage II configuration with the HFE replacing the ALHT and verify that the previous Qualification Test levels have not been exceeded. This memorandum presents the engineering rationale and provides supporting test data that confirms that the SIDE is qualified for the Array A-2 SP-II configuration.

Prepared by: J. Maszatics

J. Maszatics

Approved by: J. McNaughton

J. McNaughton

S124

INTRODUCTION

The addition of the HFE to the ALSEP Array A-2 in July 1970 together with the deletion of the ALHT required that the original Array A SP-II stowage scheme be modified to include the addition of the HFE electronics and probes on a new subpallet assembly (see Figure 1A). Although the weight and CG of Array A-2 SP-II was not appreciably changed with this new configuration, BxA was requested at the A-2/HFE PDR to provide engineering rationale showing that the SIDE is still qualified since no additional testing would be conducted due to cost and schedule considerations. The purpose of the rationale is to demonstrate that the SIDE vibration environments on Array A-2 will not be significantly different from those observed on Array A.

DISCUSSION

To date four different ALSEP Subpackage 2 configurations (Arrays A, B, D-1, and D-2) have been subjected to design limit level vibration tests. The notation D-1 and D-2 will be used to distinguish between the Qual D Subpackage 2 configuration (D-1) and the re-qual configuration (D-2). Figure 1B shows schematically the above four and the A-2 configurations.

The basic difference between A and A-2 is the same as between B and D-1. The ALHT on A and B is removed and replaced by the HFE/subpallet assembly resulting in configurations A-2 and D-1. Therefore, some insight into the effect of the HFE upon the SIDE environment can be derived by comparing the ALSD environment for B and D-1.

Such a comparison is given in Figures 2 through 10 for the various vibration tests and coordinate axes. The curves shown are envelopes of response data in the direction noted. Each envelope is determined by four curves each (in-axis response at locations γ and δ and two cross-axis responses at location γ). Thus, the envelopes represent the maximum environment at the ALSD interface. Comparing the ALSD Array D environment with the Array B environment leads to the following conclusion:

> Replacing the ALHT with the HFE/subpallet assembly on Subpack 2 results in no significant changes to the ALSD environment except in the vicinity of 240 Hz for the x-axis response to L&B random vibration.

Subsequent to the LTA-11 acoustic tests conducted at NASA/MSC, the ALSEP vibration specifications were revised. Figure 11 shows the new (LTA-11) and the old (LTA-3DR) x-axis L&B design limit vibration spectrum for Subpack 2. Fortunately a significant reduction has been made in the vicinity of 240 Hz. At that frequency the power spectral density has been reduced by 75 percent. Also, a 60 percent reduction in L&B random vibration time (from 2.5 min/axis to 1.0 min/axis) has been specified. Hence, the following statements seem justified:

1. Replacing the ALHT with the HFE/subpallet on Subpack 2 and revising vibration specifications per the LTA-11 acoustic tests, causes no significant changes to the ALSD vibration environment.

2. If the configuration and environment differences between Arrays B and D-1 have no adverse effect upon the ALSD, then the same differences between Arrays A and A-2 will have no adverse effect upon the SIDE.

In addition to the above argument there are other facts which support the qualification status of the SIDE for the A-2 configuration.

A. The SIDE was qualified with Qual SA which was subjected to LTA-3DR requirements consisting of:

   1. Acceptance Vibration

      a. Sinusoidal sweep at 3/4 oct/min, 5-100 Hz (x, y, z)
      b. L&B random at 2.5 min/axis (x, y, z)
      c. Lunar descent random at 12.5 min/axis (x, y, z).

   2. Design Limit Vibration

      a. Sinusoidal sweep at 3/4 oct/min, 5-100-5 Hz (x, y, z)
      b. L&B random at 2.5 min/axis (x, y, z)
      c. Lunar descent random at 12.5 min/axis (x, y, z).

   3. Design limit shock, 15g/11 msec sawtooth, 3 per direction (+x, ±y, ±z)

   4. Design limit steady-state acceleration, 14g for 1 min (+x only).

Excluding shock and acceleration, the total Qual SA test duration was 141 min. The current (Array E) qualification test requirements total only 53 min, and excludes the acceleration test. Hence, the SIDE survived a much more severe qualification test, with respect to total duration, than it would if subjected to a current qualification test.

B. The SIDE on A-2 experienced the LTA-11 environments (sinusoidal and L&B random, only) at the acceptance level and passed the post test PIA.

C. The PSE was qualified as part of Qual SA, but has survived the Apollo 14 flight (Array C) without difficulty. Thus, demonstrating that although environmental differences do exist from one array to another, the margin of safety associated with the qualification test is sufficient to cover such differences.

D. The addition of silicone rubber grommets to the HFE/subpallet assembly adds a considerable degree of damping to the dynamic response of Subpack 2. Such grommets were not extensively used for Array D-1. The grommets were incorporated into the D-2 (and A-2) configuration and subsequent testing verified the above claim.

CONCLUSION

A comparison of Subpack 2 vibration response data indicates that the SIDE environment on Array A-2 will not be significantly different from the Array A environment. A partial verification of the above statement is derived from the fact that the SIDE has experienced flight acceptance testing, as part of the A-2 flight model, and passed the post test PIA.

A-2 SUBPACKAGE II

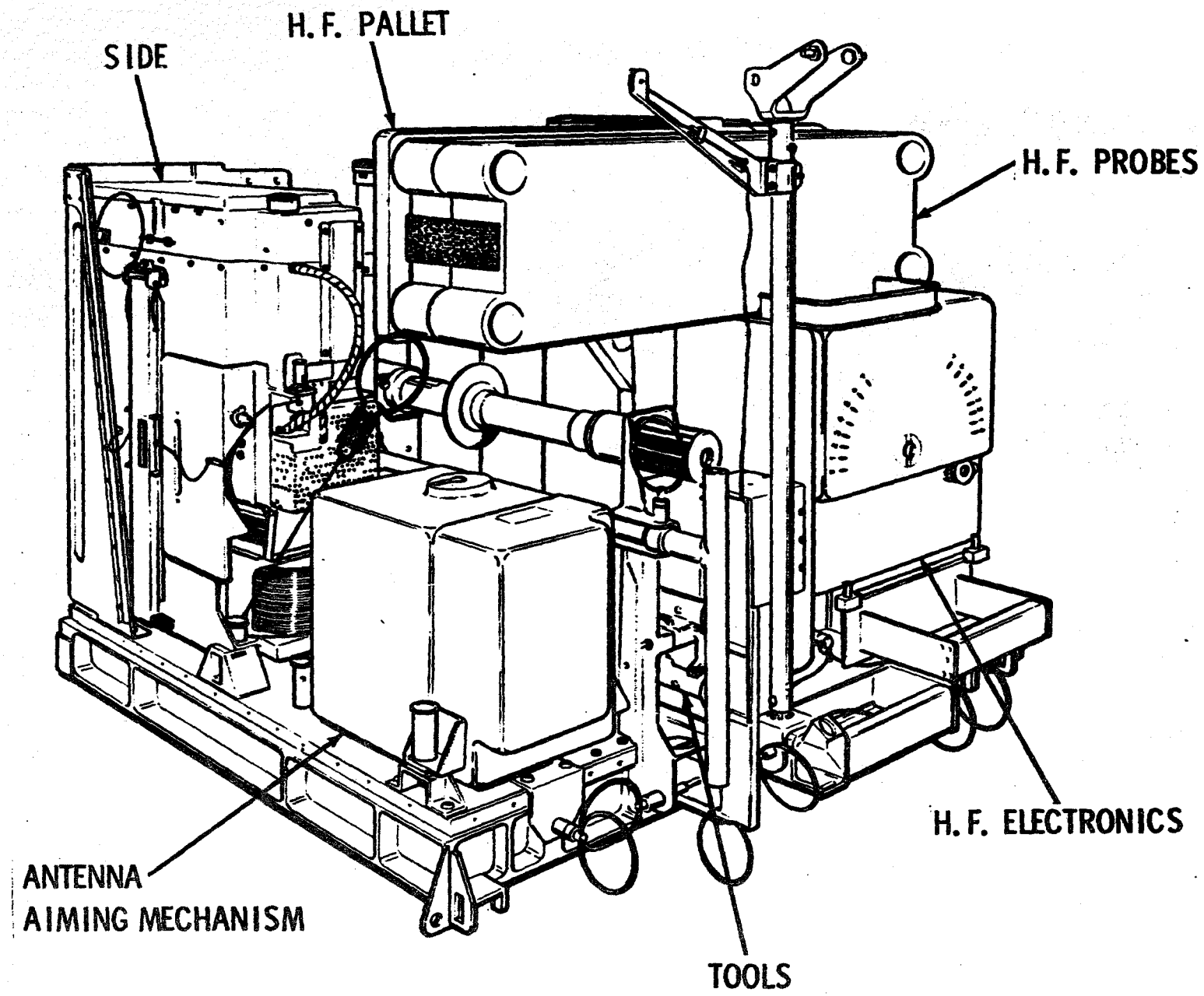
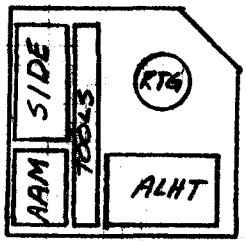


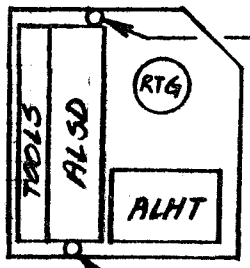
Figure la

ALSEP Subpack #2 Configurations

ARRAY - A (& C)



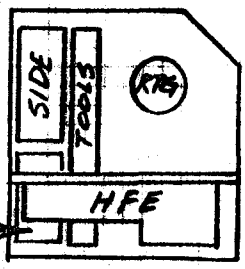
ARRAY - B



ACCELEROMETER LOCATION - δ

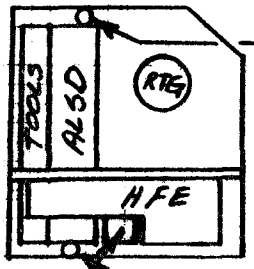
ACCEL. LOC. γ

ARRAY - A-2



AAM

ARRAY - D-1

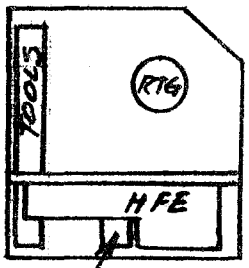


δ

AAM

γ

ARRAY - D-2



AAM

NOTE:
AAM = Antenna Aiming Mechanism

Fig. 1B

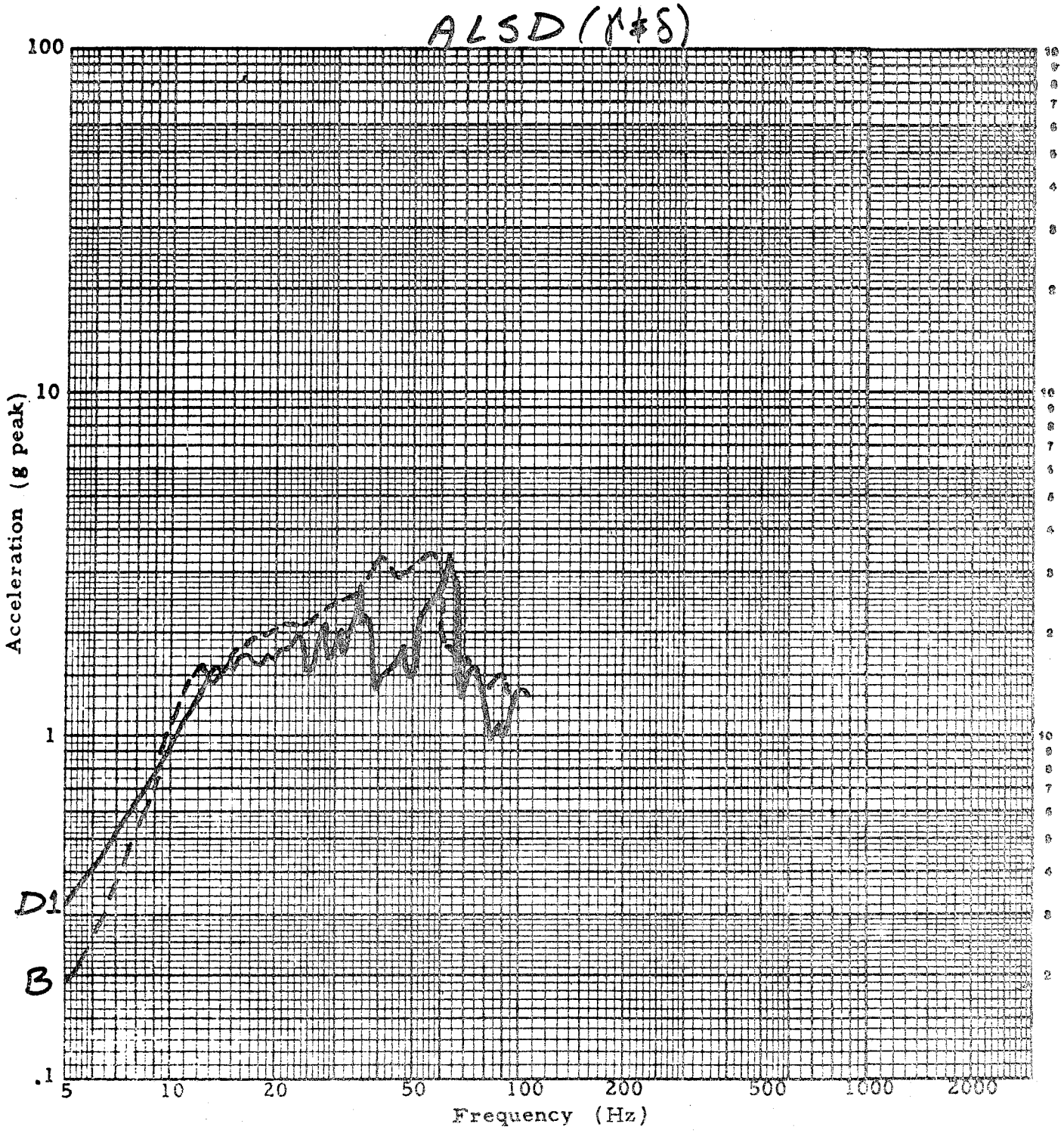
Bendix Aerospace Systems Division

Figure 2

SINUSOIDAL VIBRATION

Axis: Y

Sweep Rate:



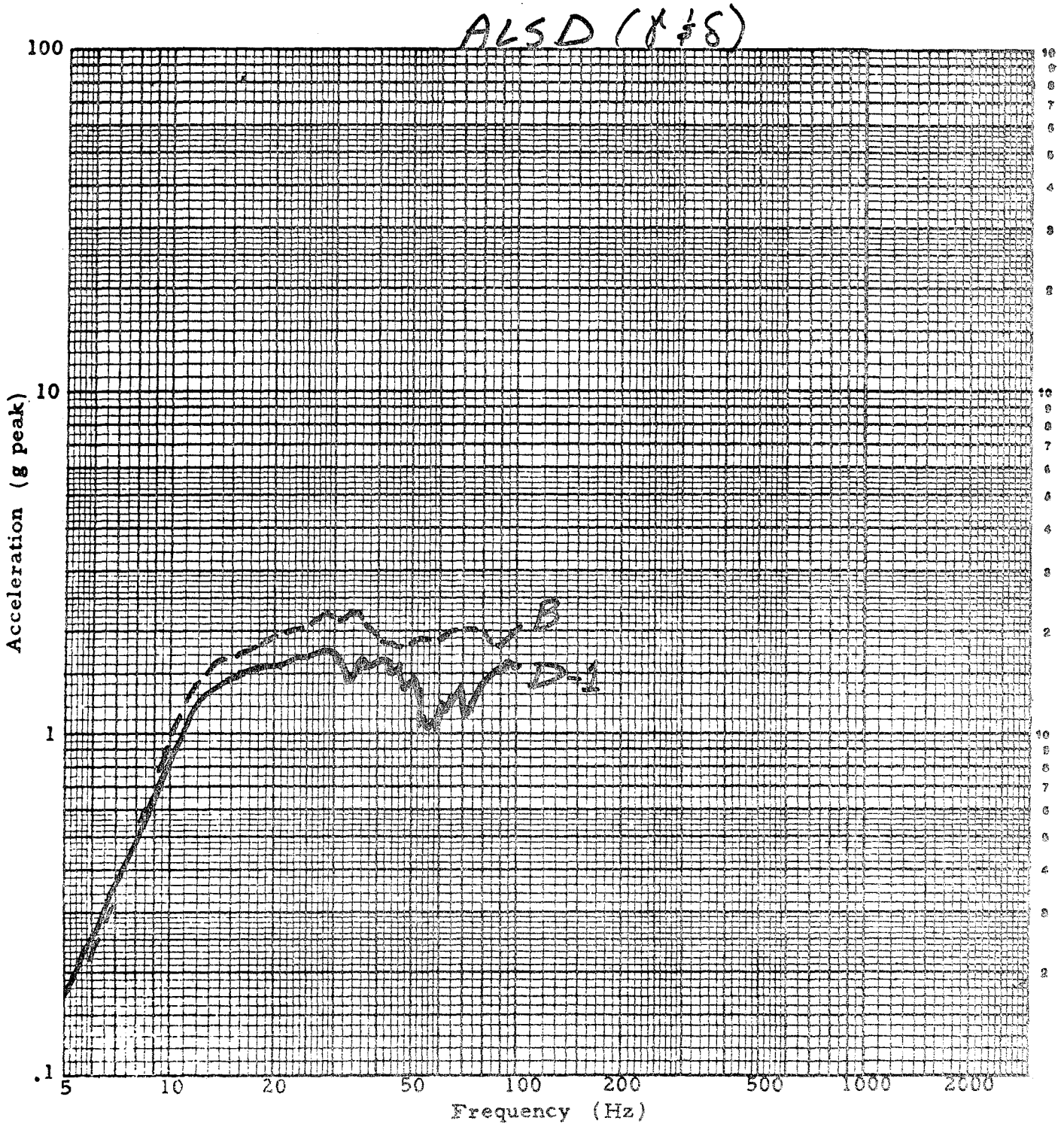
Bendix Aerospace Systems Division

Figure 3

SINUSOIDAL VIBRATION

Axis: Y

Sweep Rate:



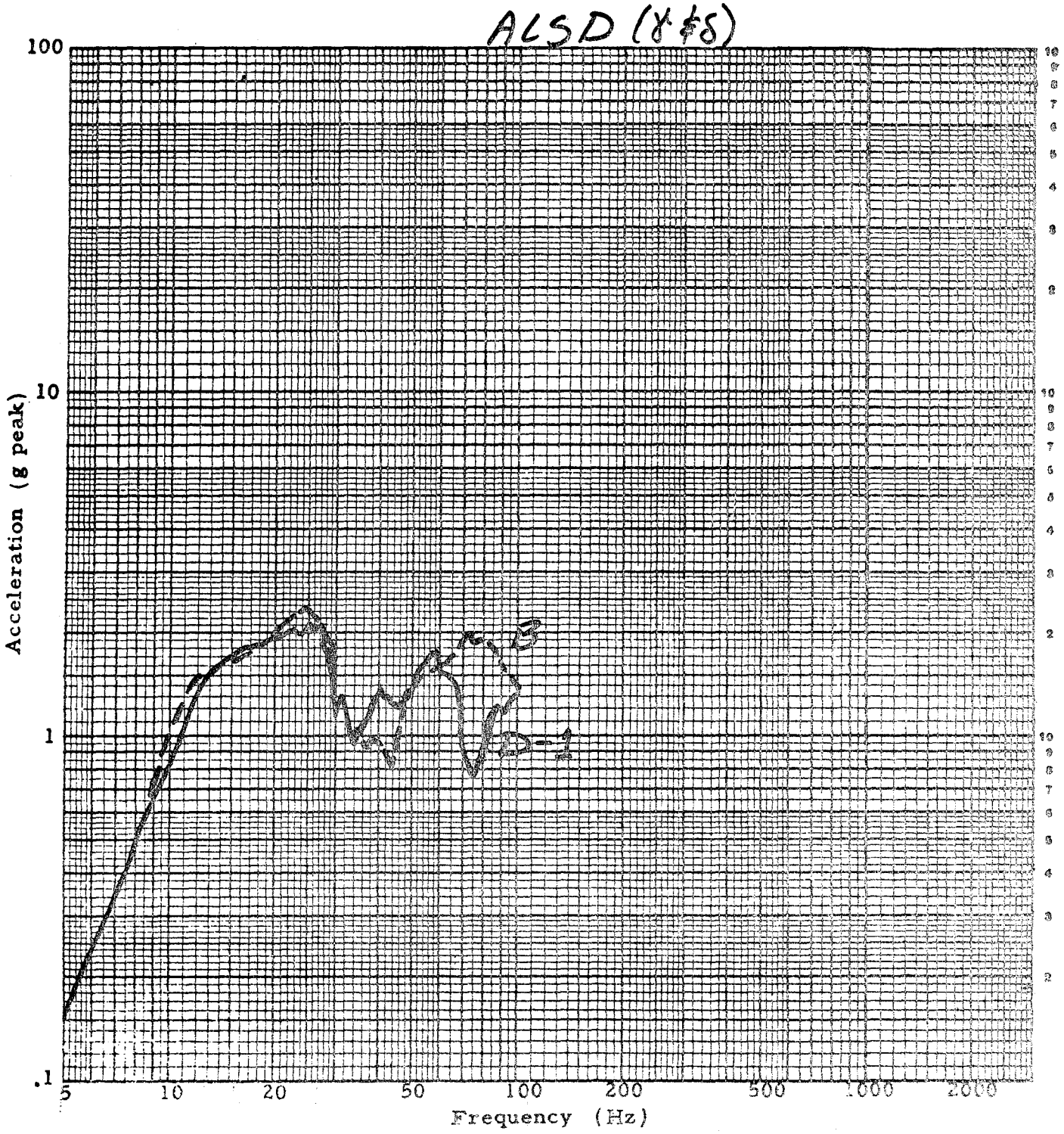
Bendix Aerospace Systems Division

Figure 4

SINUSOIDAL VIBRATION

Axis: Z

Sweep Rate:



Bendix Aerospace Systems Division

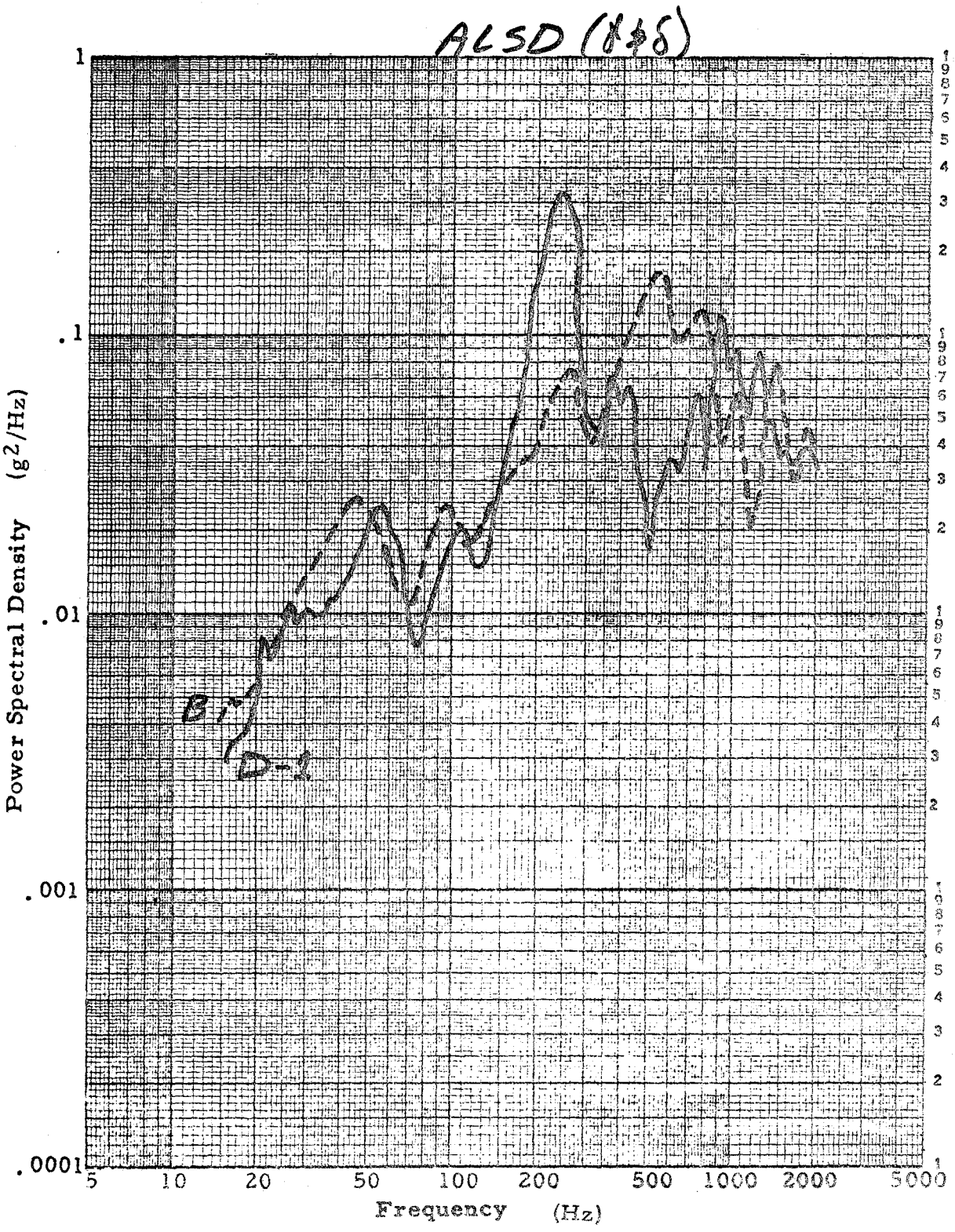
Figure

L+B

RANDOM VIBRATION SPECTRUM

Axis: X

Duration:



Bendix Aerospace Systems Division

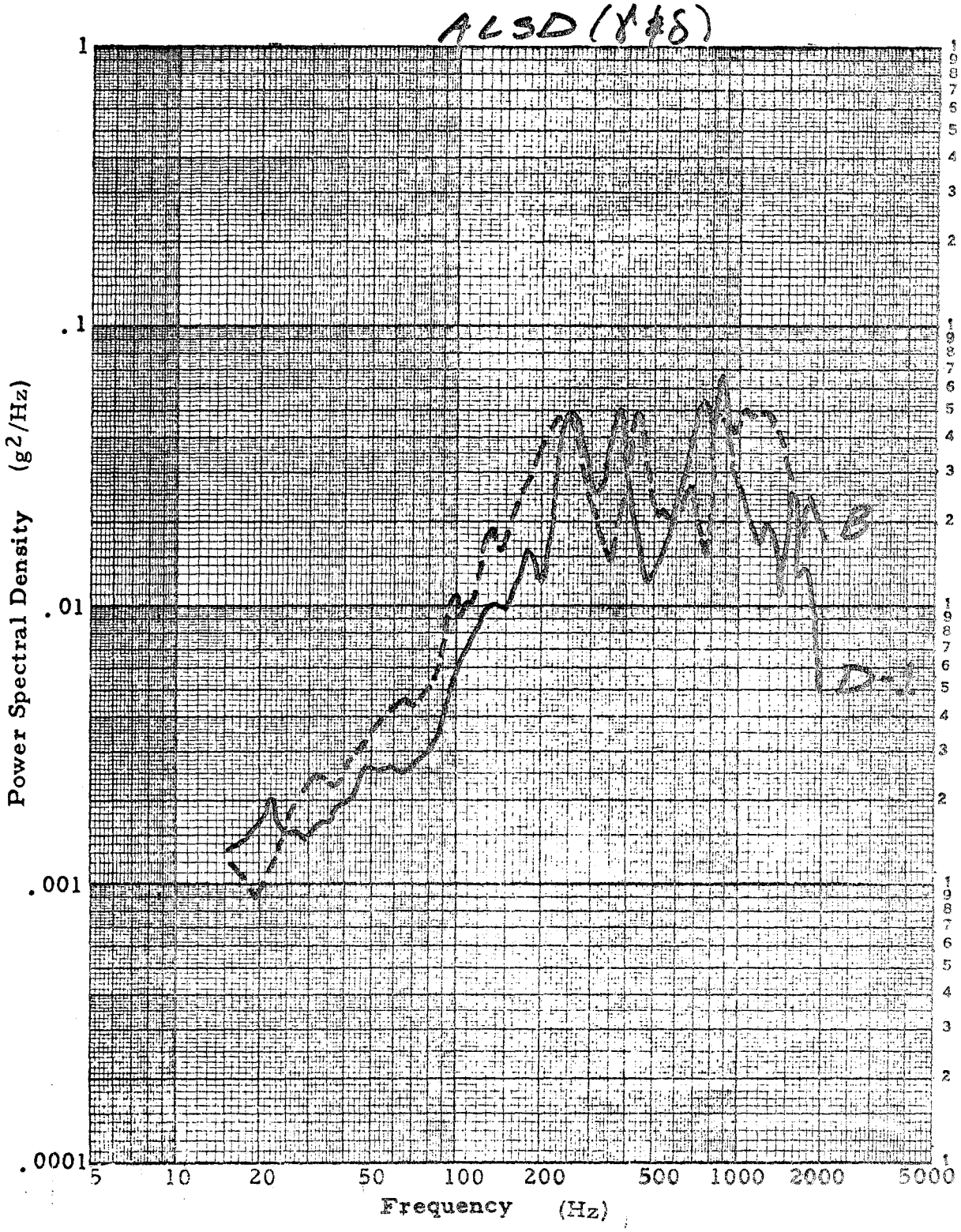
Figure 6

L4B

RANDOM VIBRATION SPECTRUM

Axis: y

Duration:



Bendix Aerospace Systems Division

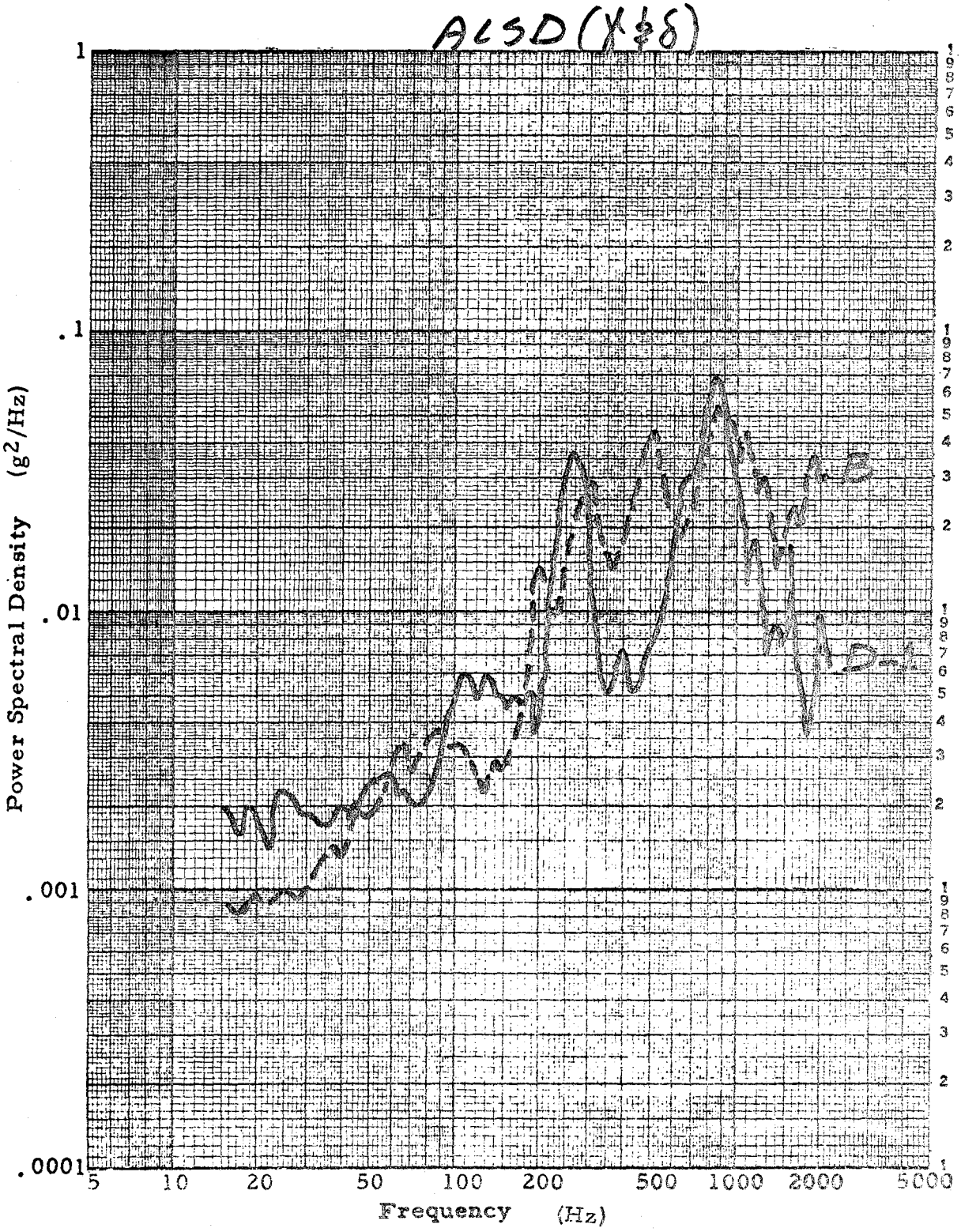
Figure 7

L & B

RANDOM VIBRATION SPECTRUM

Axis: Z

Duration:



440-91

Bendix Aerospace Systems Division

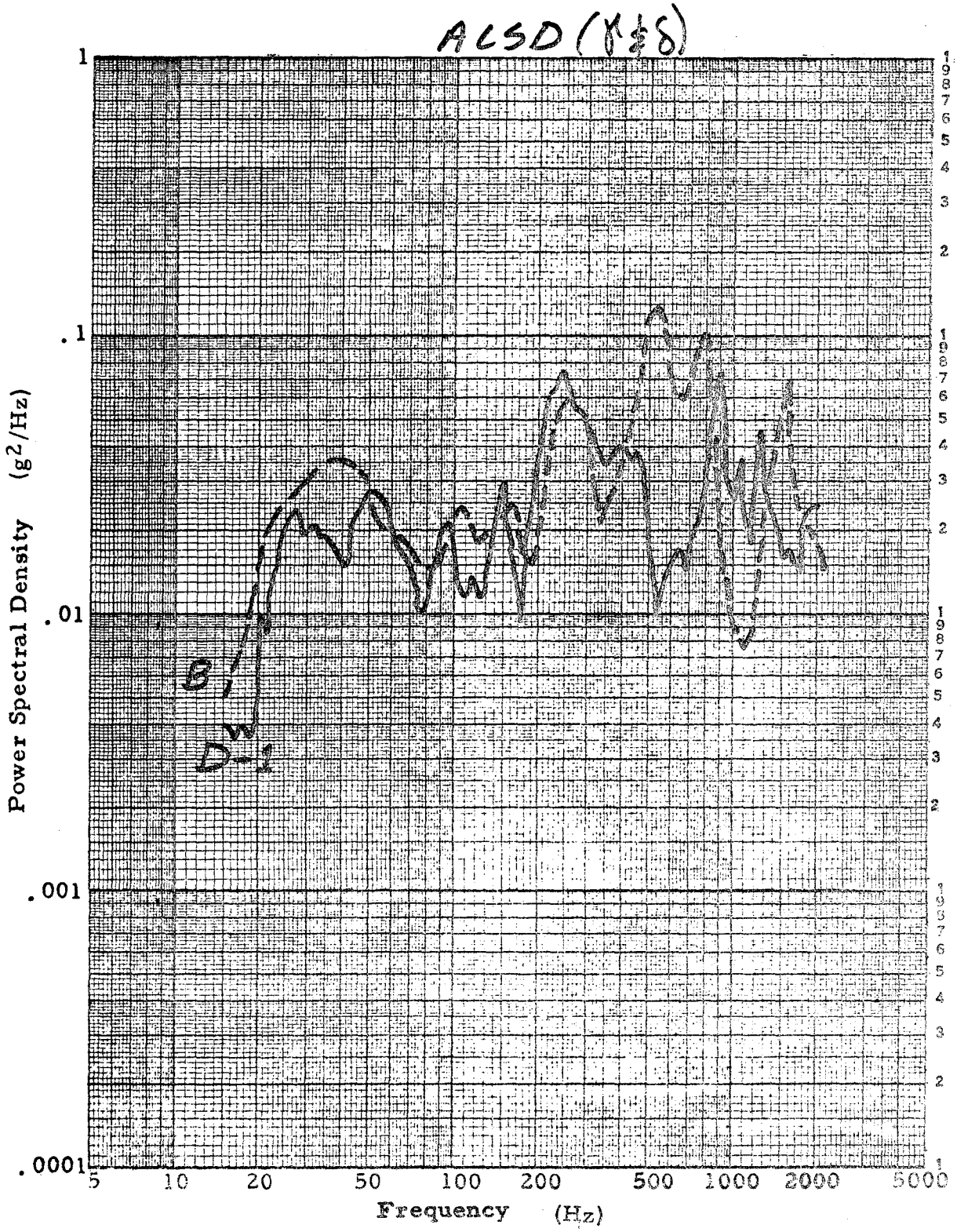
Figure 8

Lun. Des.

RANDOM VIBRATION SPECTRUM

Axis: X

Duration:



440-91

12 x 15

Bendix Aerospace Systems Division

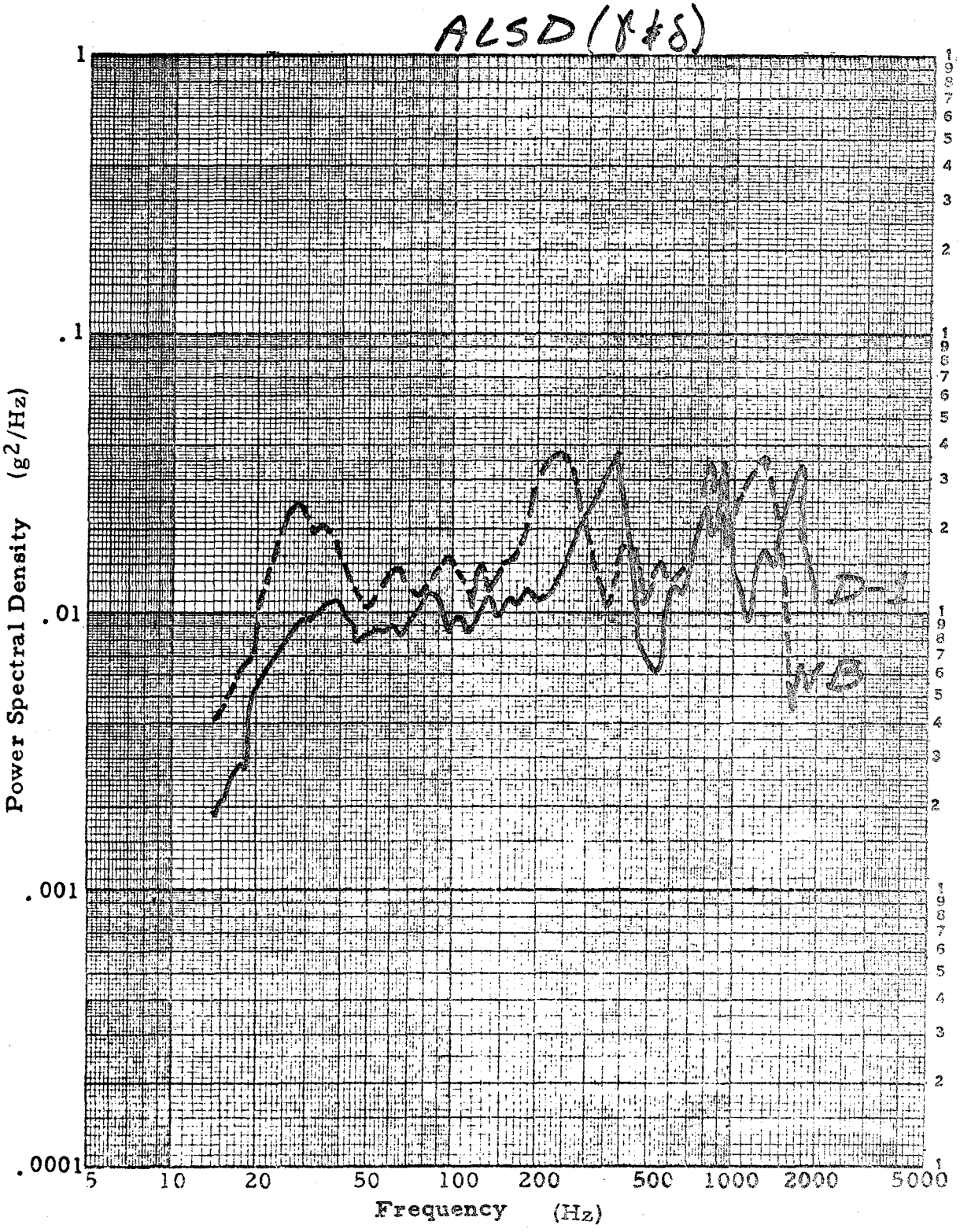
Figure 9

Lun. Des.

RANDOM VIBRATION SPECTRUM

Axis: Z

Duration:



440-91

Aerospace Systems Division

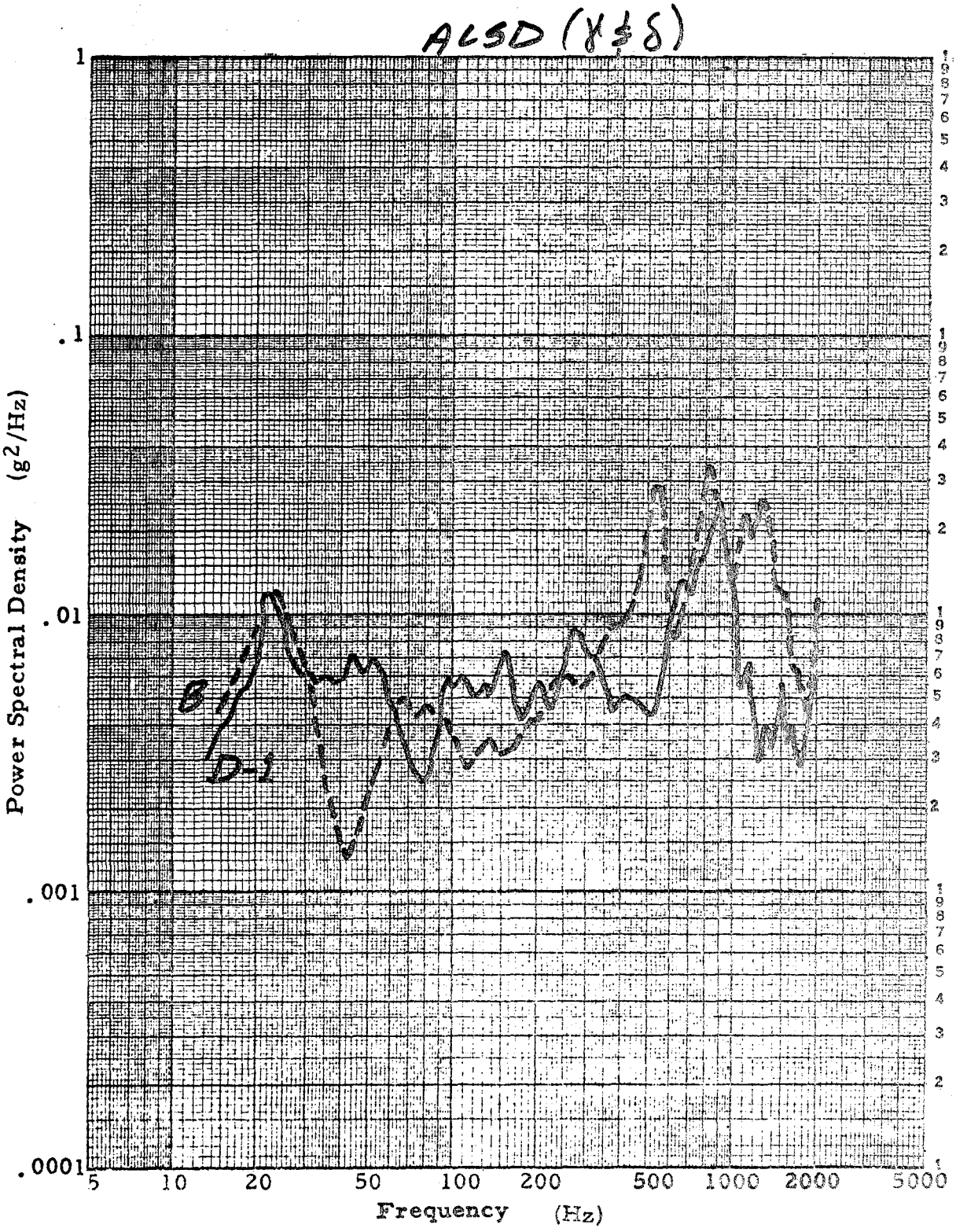
Figure 10

Lun. Des.

Axis: Z

RANDOM VIBRATION SPECTRUM

Duration:



440-91

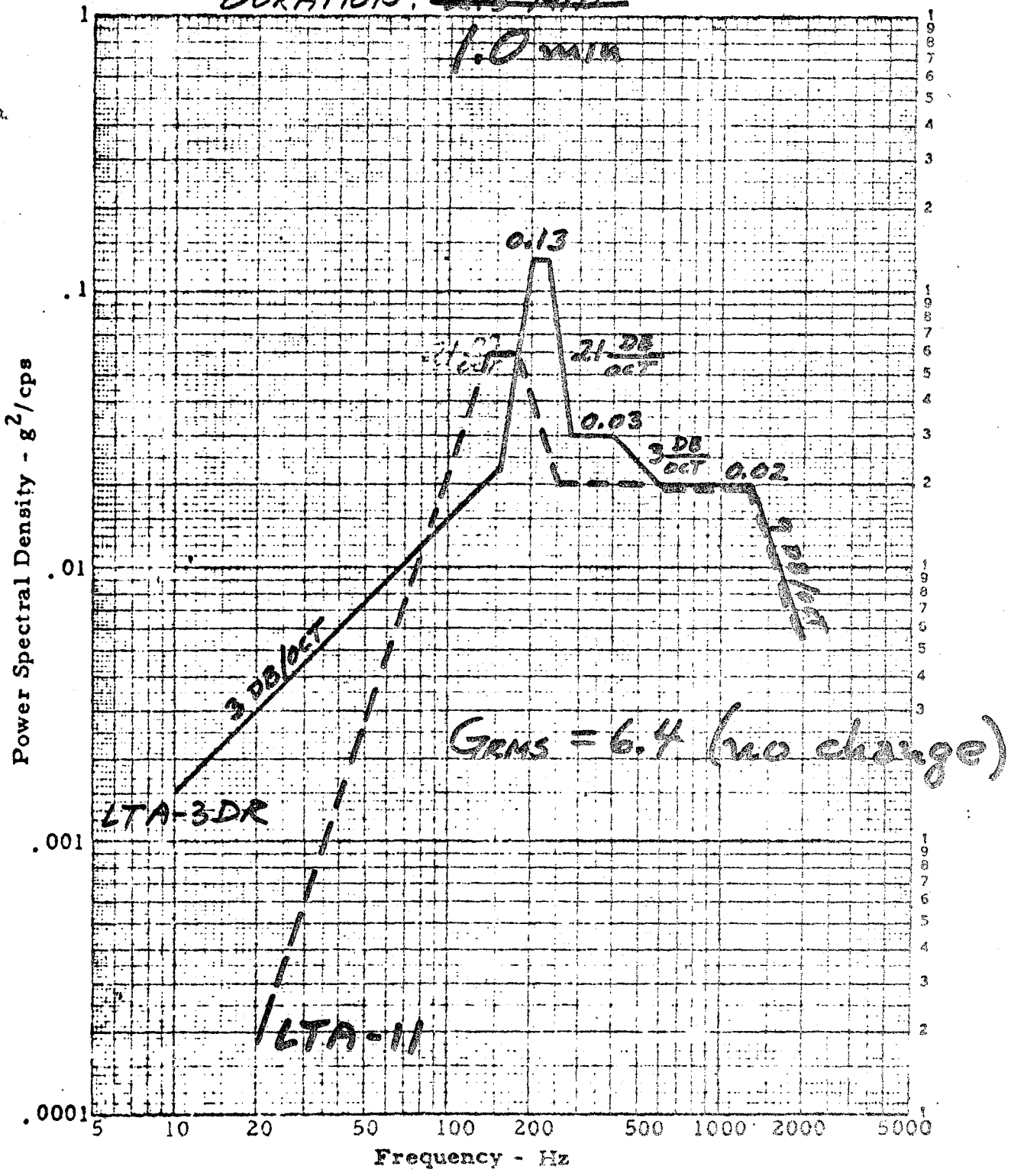
NOMINAL DESIGN LIMIT

RANDOM VIBRATION SPECTRUM

Test: L&B

Test Item: ALSEP Subpackage No2

Axis: X



Bendix
Aerospace Systems Division

Expected SIDE Vibration Environment on Array A2

ATM-992

PAGE _____ OF _____

DATE 6/3/71

The attached pages are changes in ATM-992, dated 5/17/71. Please make the appropriate changes.

Page 4 of 15 - Figure 1a

Page 5 of 15 - Figure 1b

SIDE