Bendix

Aerospace Systems Division

ALSEP Qualification Design Limit Vibration Test Data Summary	NO. ATM-832 REV. NO. PAGE ____ OF ____ DATE 27 June 1969

This technical memorandum presents a condensation of the vibration data recorded during the ALSEP design limit qualification vibration tests.

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INTRODUCTION

Concern for the ALSEP subsystems and their dynamic environments, particularly those of arrays B and C for which prototype tests had been canceled; led to a requirement to instrument at the subsystem interfaces on the qualification hardware during vibration tests. A similar requirement applied to the fuel cask assembly, but for a different reason. Data from previous tests had shown the dynamic response characteristics of the cask assembly (including support structure) to be very inconsistent from one test article to the next. Since the ACA qualification test was the first such test using a "live" fuel cylinder, it was necessary to monitor the response of the cask during the test in order to avoid the risk of a serious failure.

Since the amount of data obtained from the qualification tests was voluminous, the intent of this report is to condense the data for easy reference for each major subsystem. This has been accomplished by presenting response envelopes for each of the three ALSEP orthogonal directions and for each vibration test. A response envelope is the maximum response in a given direction of a subsystem to a vibration environment regardless of direction of input or location of instrumentation about the subsystem interface. For example, the ALSD X-response envelope for launch and boost (L & B) phase random vibration input is determined by nine response curves — an in-axis and two cross-axis curves at each of three instrumentation locations. Thus, a total of eighty-one data curves associated with the ALSD interface is reduced to nine envelopes which show the worst response levels at each frequency.

DISCUSSION

The major ALSEP subsystems for which response envelopes were established are usually referred to by abbreviations. Table I lists these and their corresponding names.

Table II defines the ALSEP configurations (i.e. subpackages and arrays) in terms of the major subsystems. It is noted that subpackage 2 array C is identical in make-up to subpackage 2 array A. Hence, the qualification testing of array C did not include a subpackage no. 2.

Table III lists the subsystems and the corresponding instrumentation locations for each array. The locations are identified by numbers which are defined in references 1 through 5. As noted, all accelerometers were mounted as near as possible to the subsystem interface on the Bendix subsystem support side of the interface. The purpose of the instrumentation was to record the vibrational environment being transmitted to each subsystem by the Bendix hardware. It was not feasible and in many instances not possible to place instrumentation near every subsystem support point, but for all subsystems at least one (that which was expected to see the highest response levels) such point was monitored. The ACA instrumentation, from which data was used to establish ACA response envelopes, consisted of two tri-axial accelerometers located forward (-x) and aft (+x) on top (-z) of the cask near the tension bands. If the reader is interested in the exact instrumentation positions the information in Table III can be used to determine the appropriate test report (see references) from which such positions are exactly defined.

The nominal vibration input levels are given in Figures 1 through 9. These levels were applied to the system (i.e. subpackage or ACA) at its LM interface points. Sinusoidal and random vibration was specified for each system for the three orthogonal axes (ALSEP coordinate system) and for the launch and boost (L & B) flight phase and lunar descent (Lun. Des.) flight phase. For subpackages nos. 1 and 2, the sinusoidal specification represents a combination of the L&B and Lun. Des. environments.

Figures 10 through 159 show the vibration response envelopes for the various subsystems. In some cases, only in-axis data was available. These are noted on the figures. The ACA sinusoidal response data is not given due to the inconvenient scale factors of the data received from the vendor (see Ref. 6). However, the maximum ACA sinusoidal response values are listed in Tables IV and V.

Root-mean-square acceleration (G-RMS) levels for random vibration response curves (i.e. power spectral density - PSD) were not reduced for Qual. SA nor Qual. B. However, such data is available from Qual. C and Qual. ACA. The maximum G-RMS values for the ACA are given in Tables VI and VII for the L&B and Lun. Des. tests, respectively. Table VIII lists the maximum Qual. C G-RMS values for the PSE, CPLEE, and ASE for L&B and Lun. Des. tests. In Table VIII the axes refer to direction of response.

The CSE response data was based upon only one instrumentation location on Qual. B. Reference 7 discusses the results of a series of tests on "near" Qual. B hardware with rather extensive instrumentation in the vicinity of the transmitters.

REFERENCES

1. Bendix Aerospace Systems Division, TR 3159, "ALSEP Qual. SA Subpackage No. 1 Design Limit Vibration," 7 Oct. 1968.

2. Bendix Aerospace Systems Division, TR 3158, "ALSEP Qual.SA Subpackage No. 2 Design Limit Vibration," 18 Sept. 1968.

3. Bendix Aerospace Systems Division, TR 3235, "ALSEP Qual. B Subpackage No. 1 Design Limit Vibration," 25 Feb. 1969.

4. Bendix Aerospace Systems Division, TR 3257, "ALSEP Qual. B Subpackage No. 2 Design Limit Vibration," 27 March 1969.

5. Bendix Aerospace Systems Division, TR 3343, "ALSEP Qual. C Subpackage No. 1 Design Limit Vibration," 9 June 1969.

6. Bendix Aerospace Systems Division, ATR-200/BSR-2634 (Vol. 5), "Acceptance and Qualification Test on ALSEP Flight Qual. Fuel Cask Assembly," 4 June 1969.

7. Bendix Aerospace Systems Division, EATM-85, "PSEP Transmitter Vibration Environment," 23 May 1969.

TABLE I

Subsystem Abbreviations

ACA	ALSEP Cask Assembly
ALHT	Apollo Lunar Handling Tools
ALSD	Apollo Lunar Surface Drill
ASE	Active Seismic Experiment
CCGE	Cold Cathode Gage Experiment
CPLEE	Charged Particle Lunar Environment Experiment
CSE	Central Station Electronics
GIM	Gimbal Box-Antenna Aiming Mechanism
HFE	Heat Flow Experiment
LSM	Lunar Surface Magnetometer
PSE	Passive Seismic Experiment
RTG	Radioisotope Thermoelectric Generator
SWS	Solar Wind Subsystem
SIDE	Suprathermal Ion Detector Experiment

TABLE II

ALSEP Configurations

Subsystem	Subpackage No. 1			Subpackage No. 2		
	Array-A	B	C	A	B	C[1]
ALHT				x[2]	x	x
ALSD					x	
ASE			x			
CCGE		x				
CPLEE		x[2]	x			
CSE	x[3]	x	x[3]			
GIM		x[2]		x[2]		x
HFE		x				
LSM	x					
PSE	x	x[4]	x[4]			
RTG				x[2]	x	x
SWS	x					
SIDE				x[2]		x

[1]Same configuration as Array-A
[2]Only in-axis data recorded during tests
[3]No data recorded during tests
[4]Mass and c.g. model used on Qual. tests.

TABLE III

Test Instrumentation

Subsystem	Array	Subpackage	Instrumentation Location Nos.*
ALHT	A	2	4
ALSD	B	2	1, 2, 3
ASE	C	1	4,5
CCGE	B	1	5
CPLEE	B	1	2
	C	1	2,3
CSE	B	1	10
GIM	A	2	3
	B	1	1
HFE	B	1	6
LSM	A	1	1
PSE	A	1	6
	B	1	7
	C	1	1
RTG	A	2	1
	B	2	4

*accelerometers were located as near as possible to the subsystem interface on the "Bendix" side of the interface - see Ref. 1-5 for exact locations.

NOTE: The ACA envelopes were determined from tri-axial accelerometers located aft and forward on top of the cask (see Ref. 6).

TABLE IV

Maximum ACA Response to
L&B Sinusoidal Vibration

Input Axis	Response Axis	Maximum Acceleration	Frequency
x	x	7.0 g	34 cps
y	y	19.0	35
z	z	5.0	88

TABLE V

Maximum ACA Response to Lun. Des.
Sinusoidal Vibration

Input Axis	Response Axis	Maximum Acceleration	Frequency
x	x	5.6 g	32 cps
y	y	2.0	26
z	z	2.2	47

TABLE VI

Maximum ACA Response (G-RMS)
to L&B Random Vibration

Response Axis	Maximum G-RMS	Input Axis
x	10.5	z
y	11.8	z
z	12.8	z

TABLE VII

Maximum ACA Response (G-RMS)
to Lun. Des. Random Vibration

Response Axis	Maximum G-RMS	Input Axis
x	3.25	x
y	3.25	z
z	4.0	x

TABLE VIII

Maximum Qual. C Response (G-RMS)
to Random Vibration

	Max. G-RMS					
	L & B			Lun. Des.		
Subsystem	x	y	z	x	y	z
PSE	4.0	3.4	2.3	2.8	3.1	2.3
CPLEE	4.8	3.4	2.7	2.8	3.2	2.2
ASE	4.2	3.3	2.5	3.5	2.6	2.5

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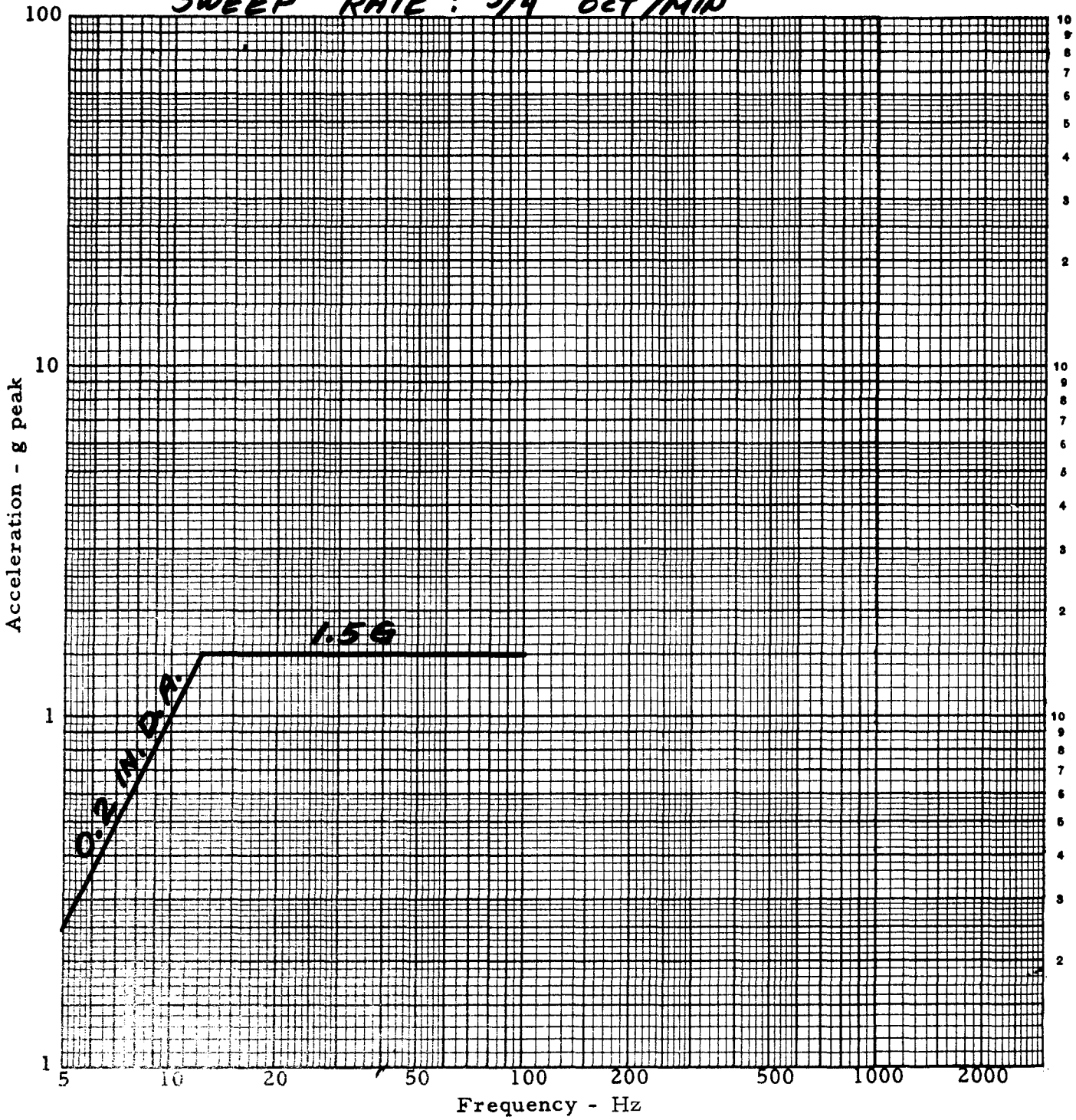
SYSTEMS TEST DEPARTMENT

NOMINAL
DESIGN LIMIT *

VIBRATION LEVELS

Test Item: ALSEP
~~Test Date~~: Subpackages 1 & 2
~~Serial Number~~:
Input Axis: X, Y, Z
~~Response Axis~~:

SWEEP RATE : 3/4 OCT/MIN



440-8 A

* combined L&B and Lun. Des.

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SYSTEMS TEST DEPARTMENT

NOMINAL DESIGN LIMIT L&B VIBRATION LEVELS

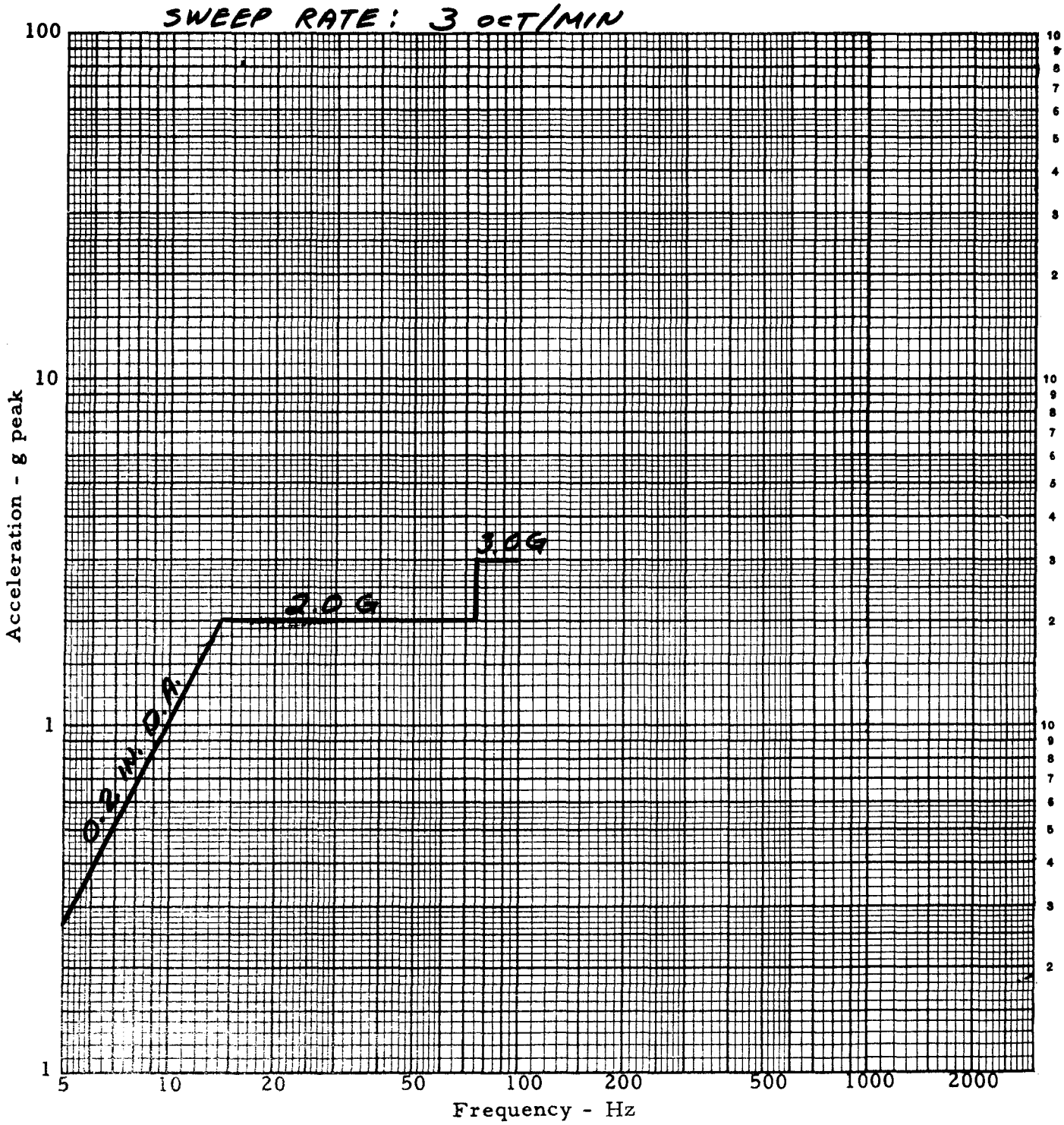
Test Item: ACA

~~Test Date:~~

~~Serial Number:~~

Input Axis: X, Y, Z

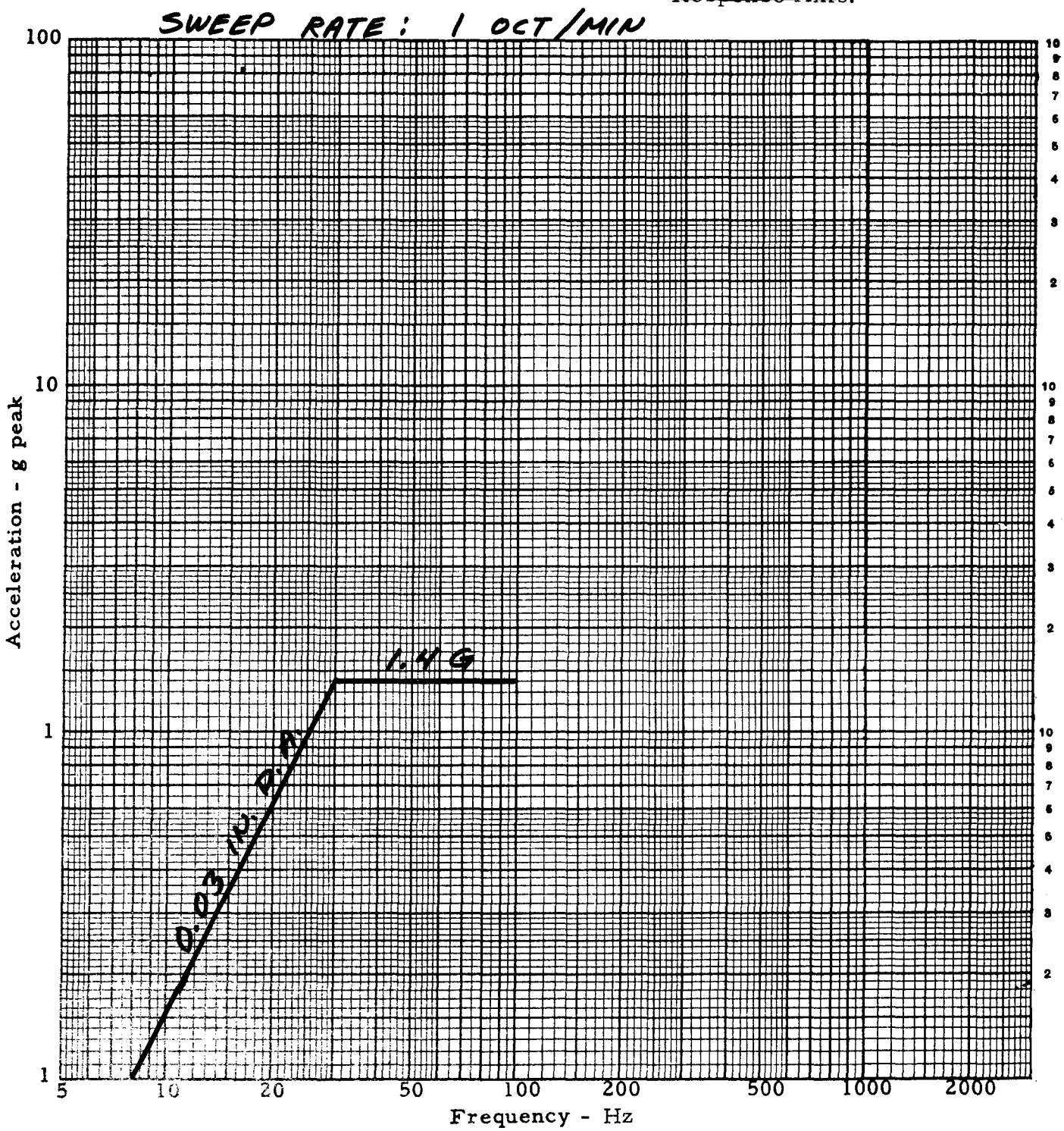
~~Response Axis:~~



NOMINAL DESIGN LIMIT LUNAR DESCENT VIBRATION LEVELS

Test Item: ACA
~~Test Date~~:

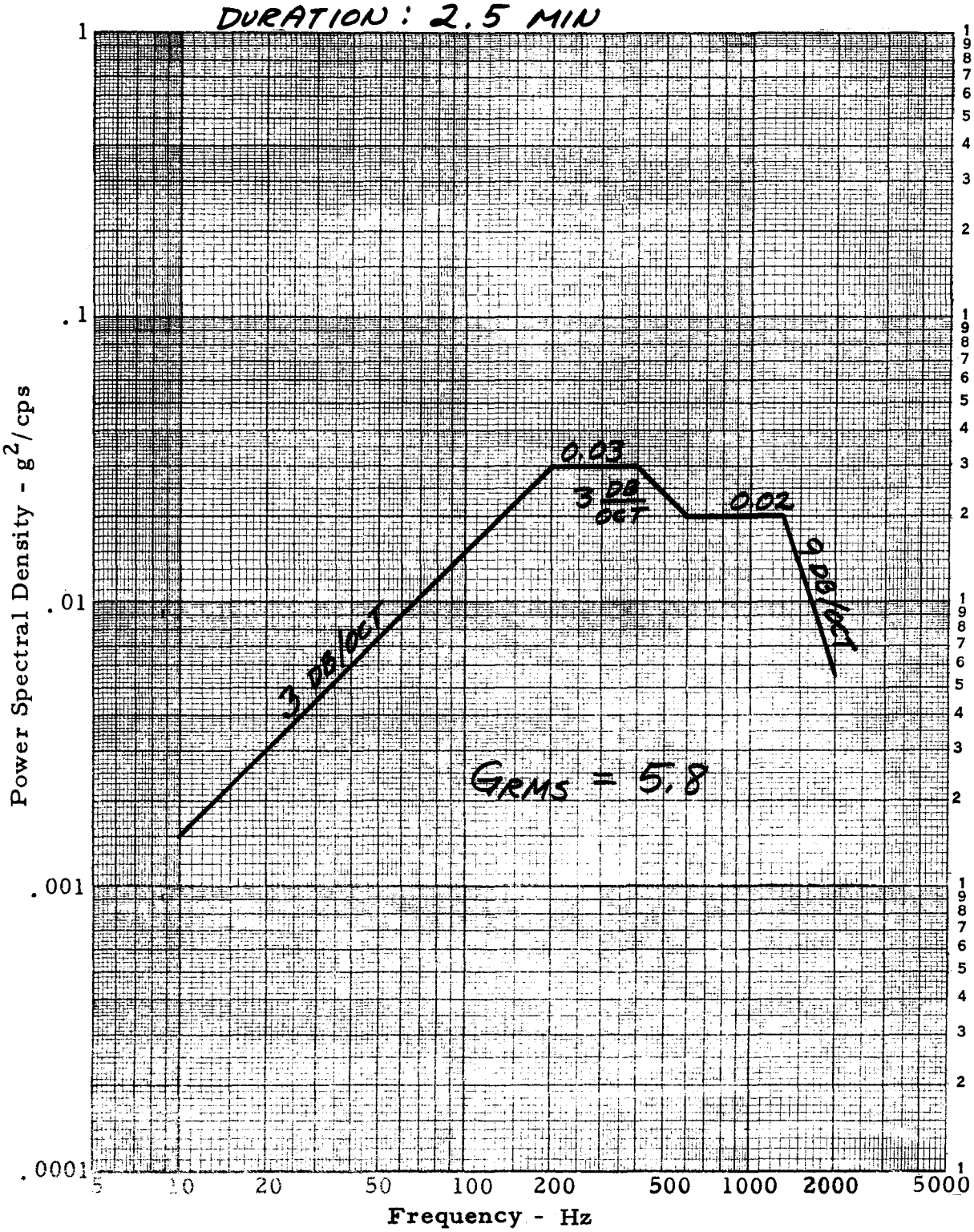
~~Serial Number:~~
Input Axis: X, Y, Z
~~Response Axis:~~



NOMINAL DESIGN LIMIT
RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: ALSEP Subpackage No 1
~~SN:~~
~~Test Date:~~
Axis: X

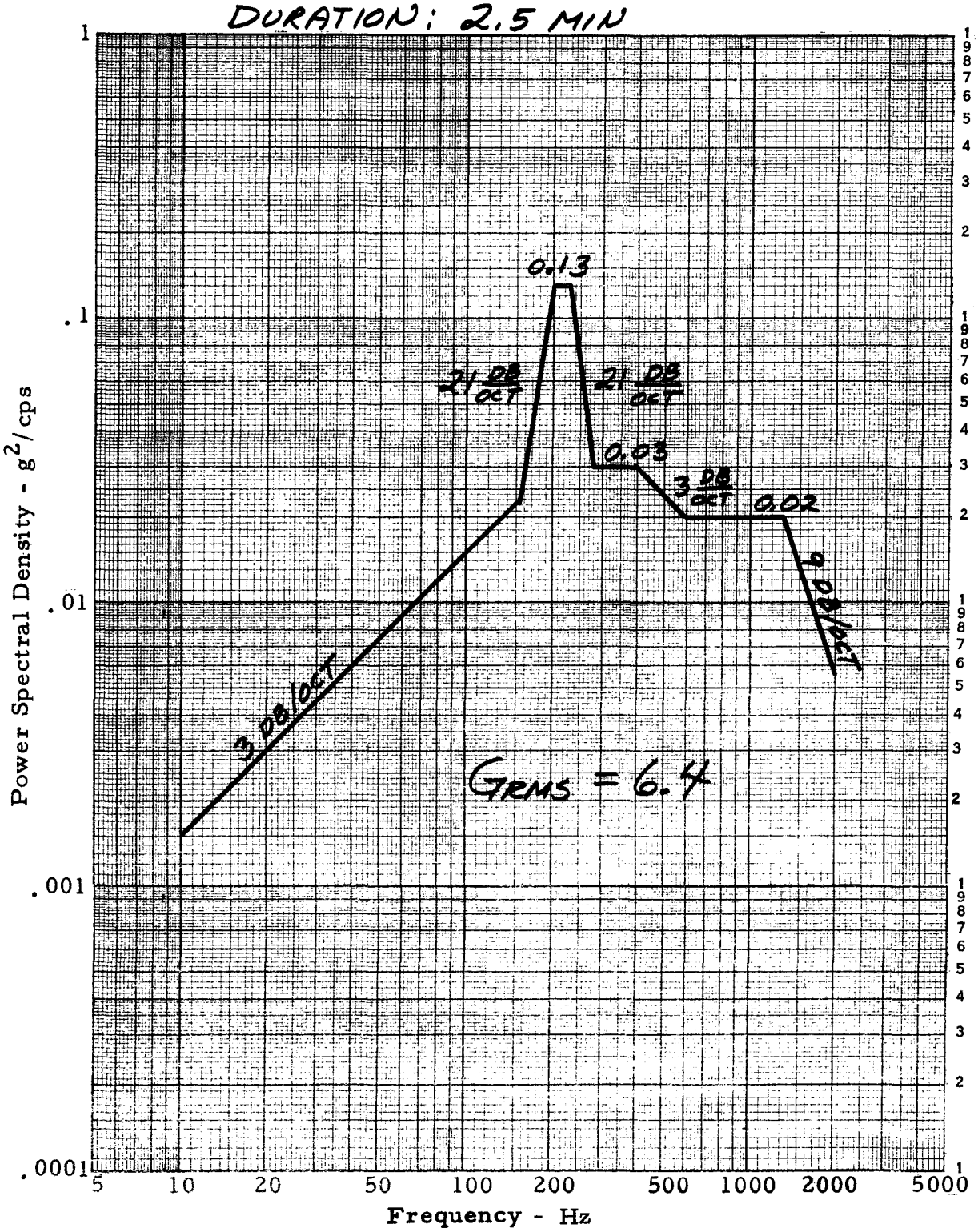
DURATION: 2.5 MIN



NOMINAL DESIGN LIMIT
RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: ALSEP Subpackage No2 ~~SN:~~
~~Test Date:~~ Axis: X

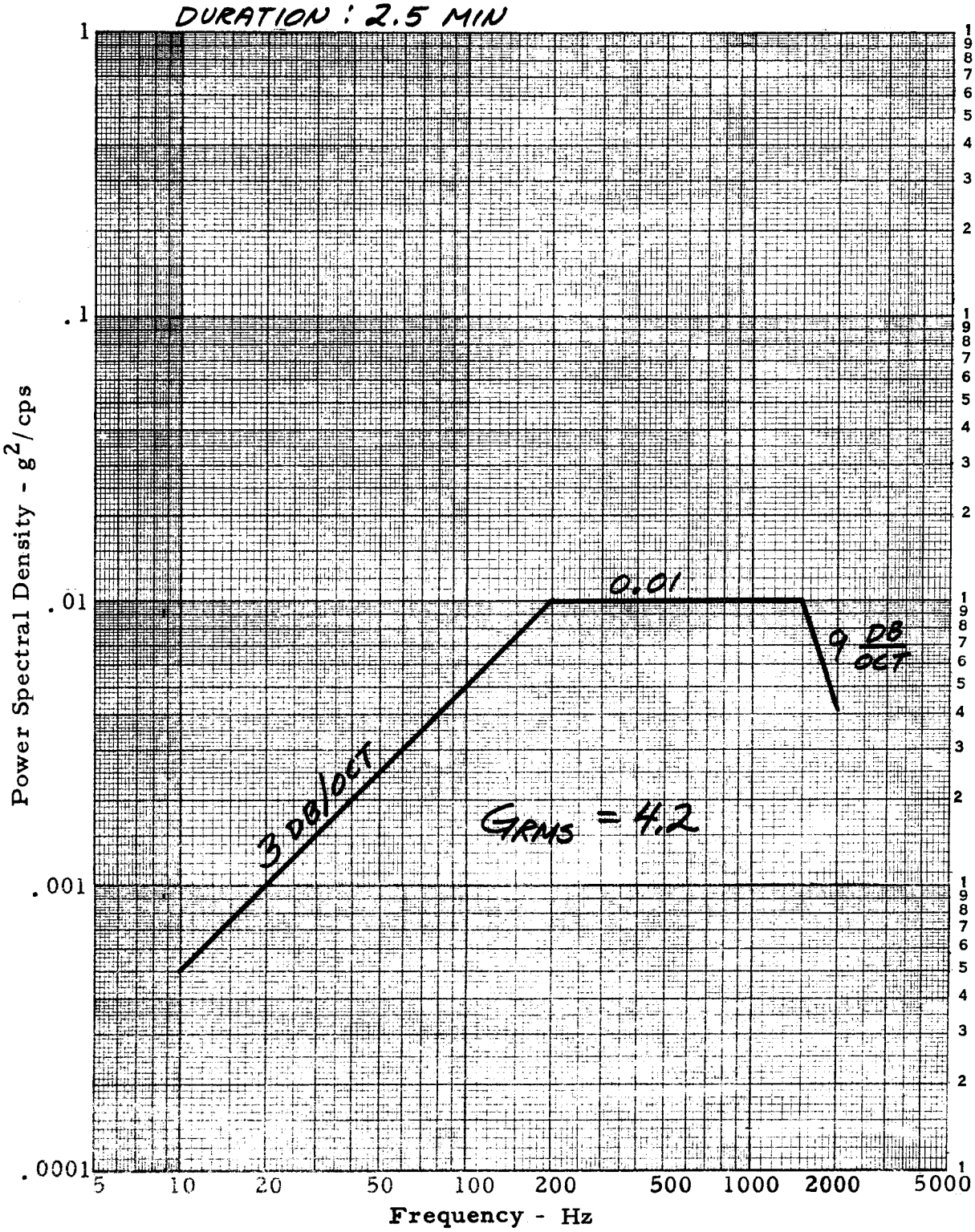
DURATION: 2.5 MIN



NOMINAL DESIGN LIMIT
RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: ALSEP Subpackage 1&2 ~~SN:~~
~~Test Date~~: Axis: Y

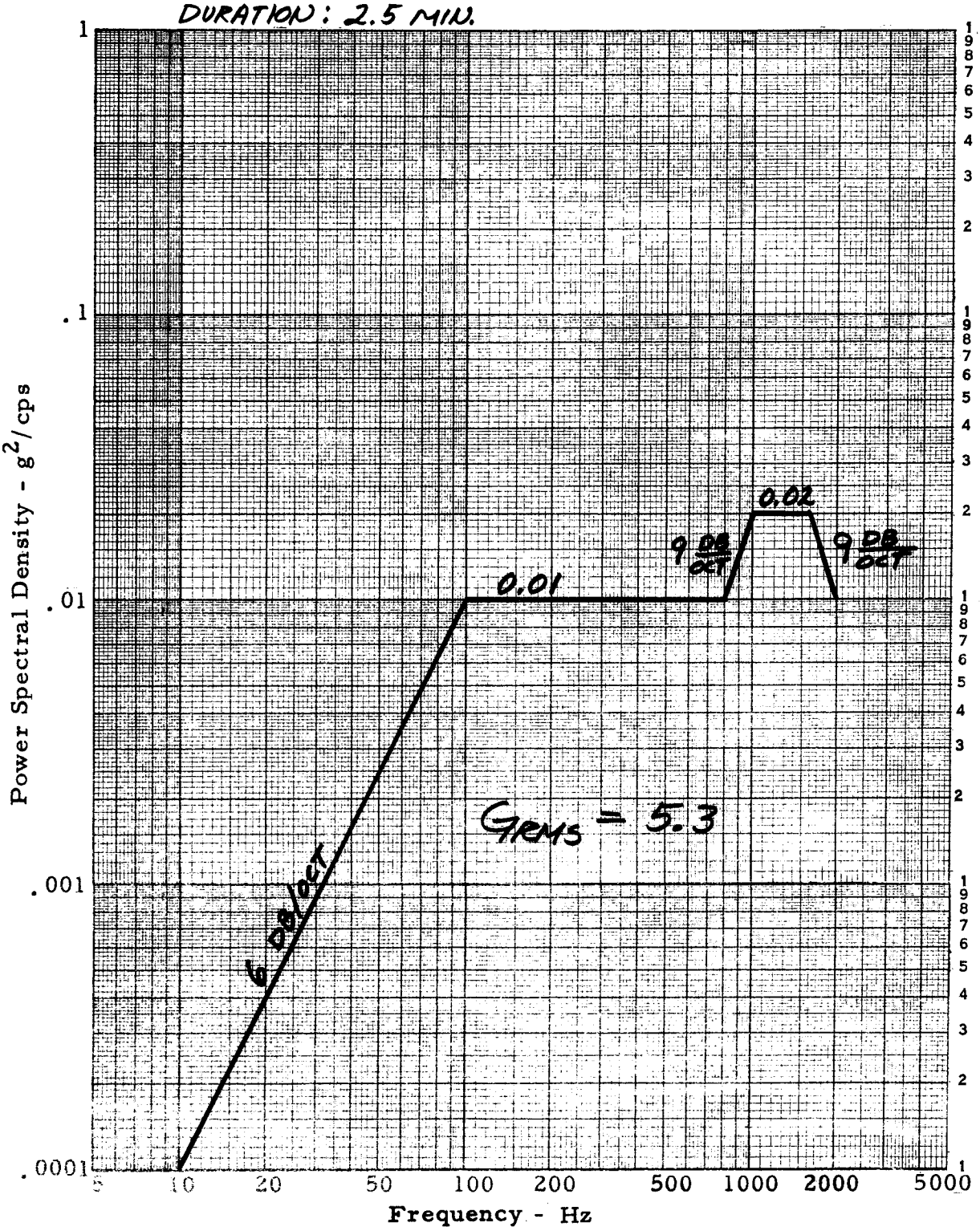
DURATION: 2.5 MIN



NOMINAL DESIGN LIMIT
RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: ALSEP Subpackage 1&2
~~Test Date:~~
~~SN:~~
Axis: Z

DURATION: 2.5 MIN.

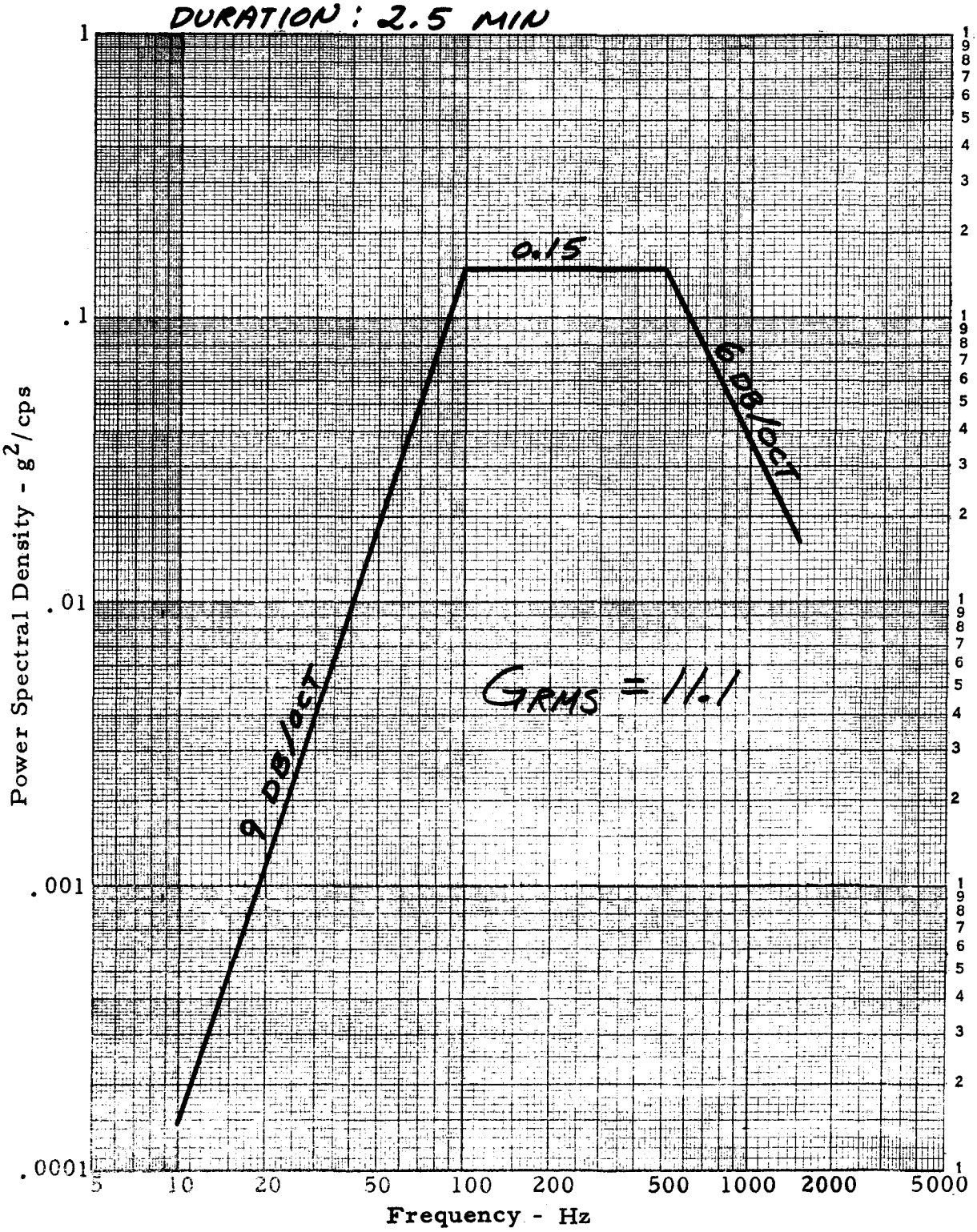


NOMINAL DESIGN LIMIT
RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: ACA
~~Test Date:~~

~~S/N:~~
Axis: X, Y, Z

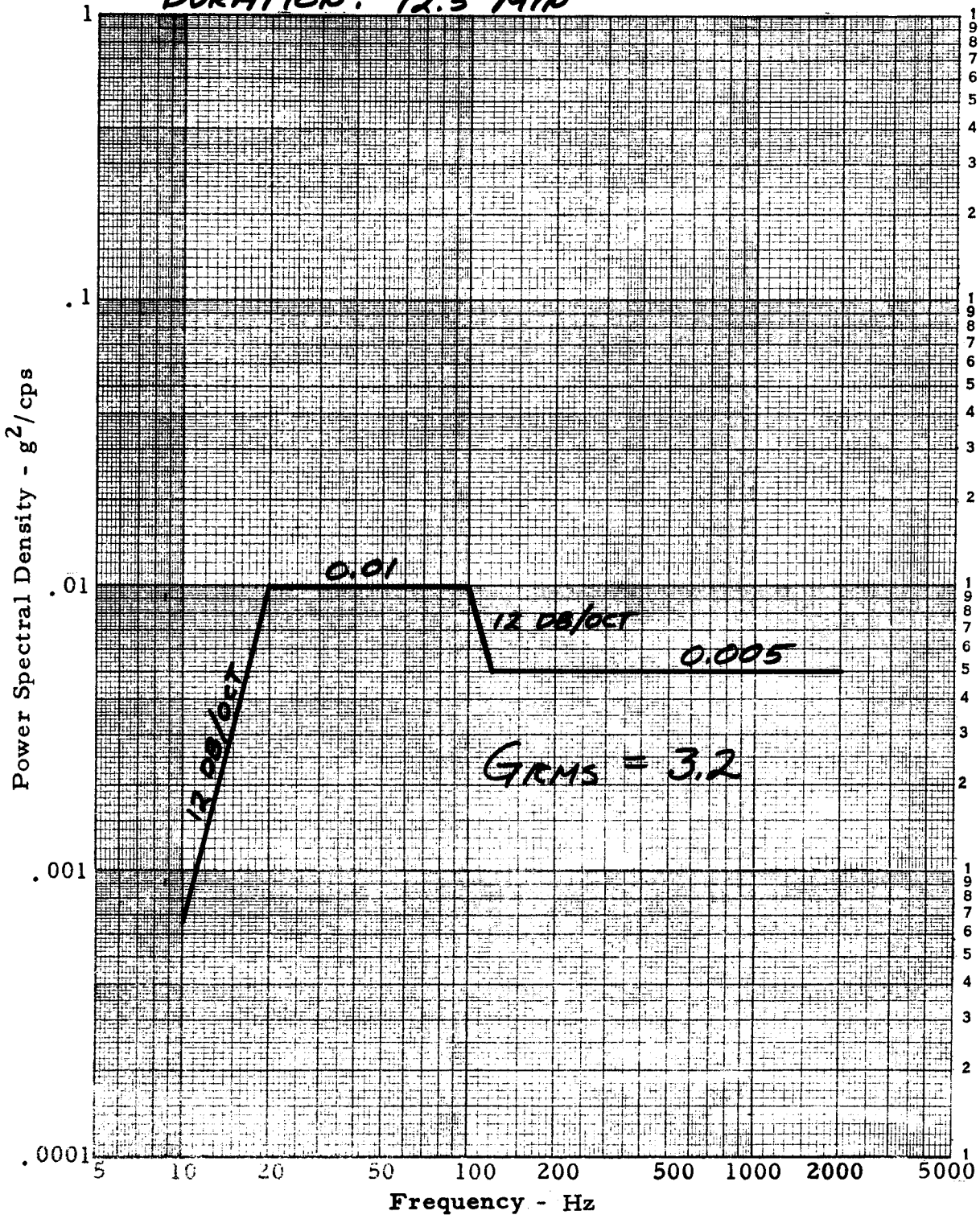
DURATION: 2.5 MIN



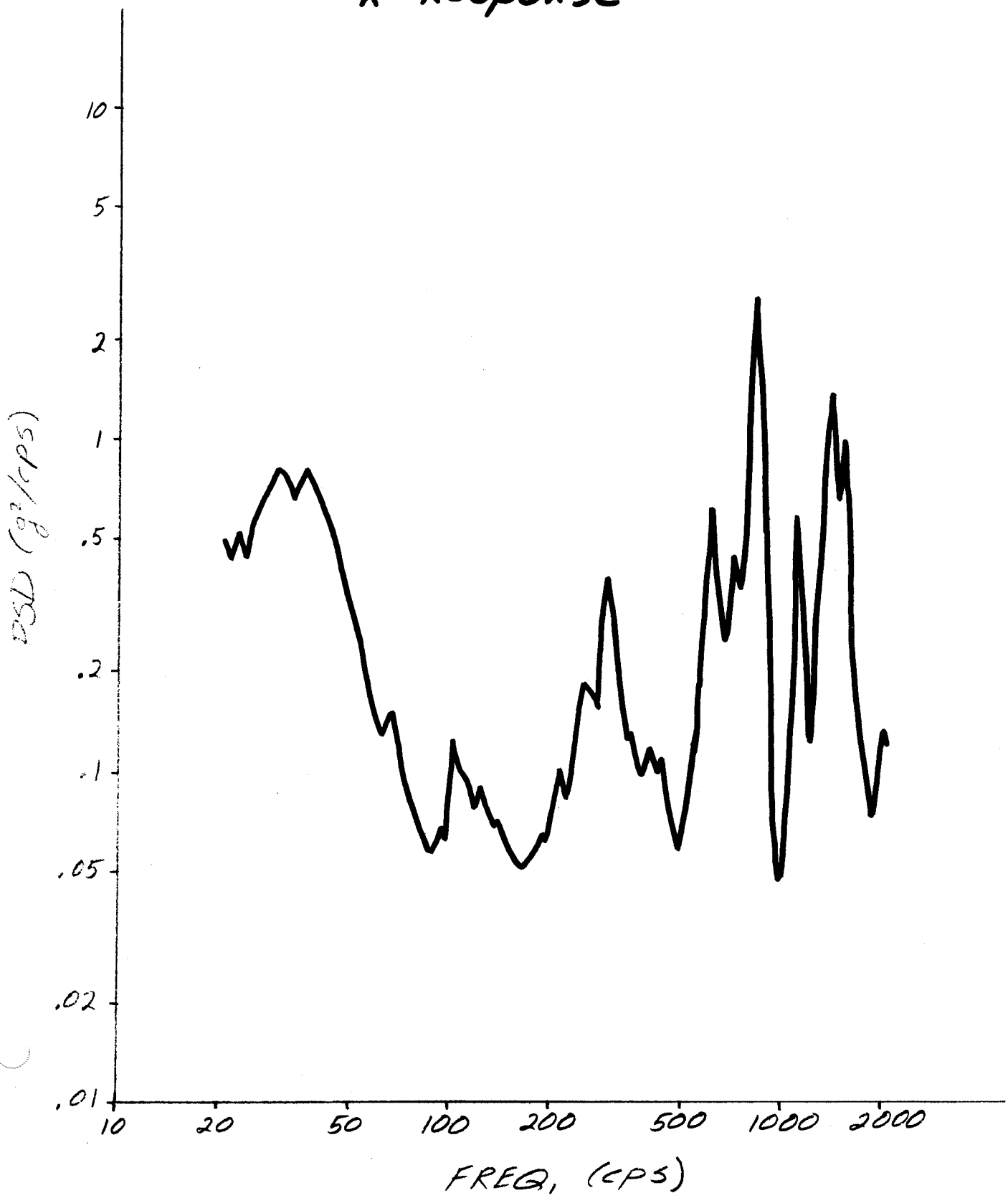
NOMINAL DESIGN LIMIT
RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: ALSEP Subpackage 1&2
~~Test Date:~~ ALSEP-ACA
Axis: X, Y, Z

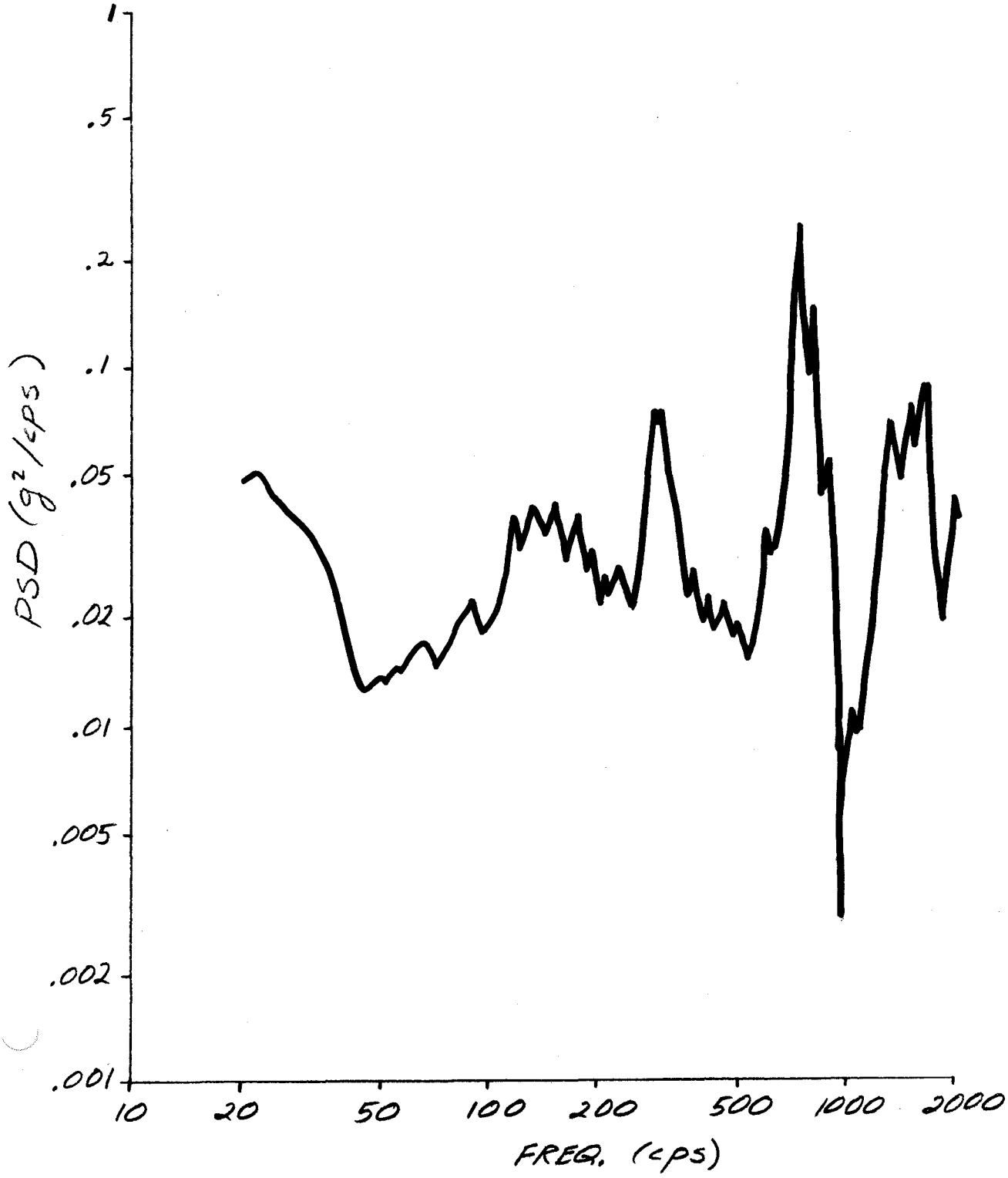
DURATION: 12.5 MIN



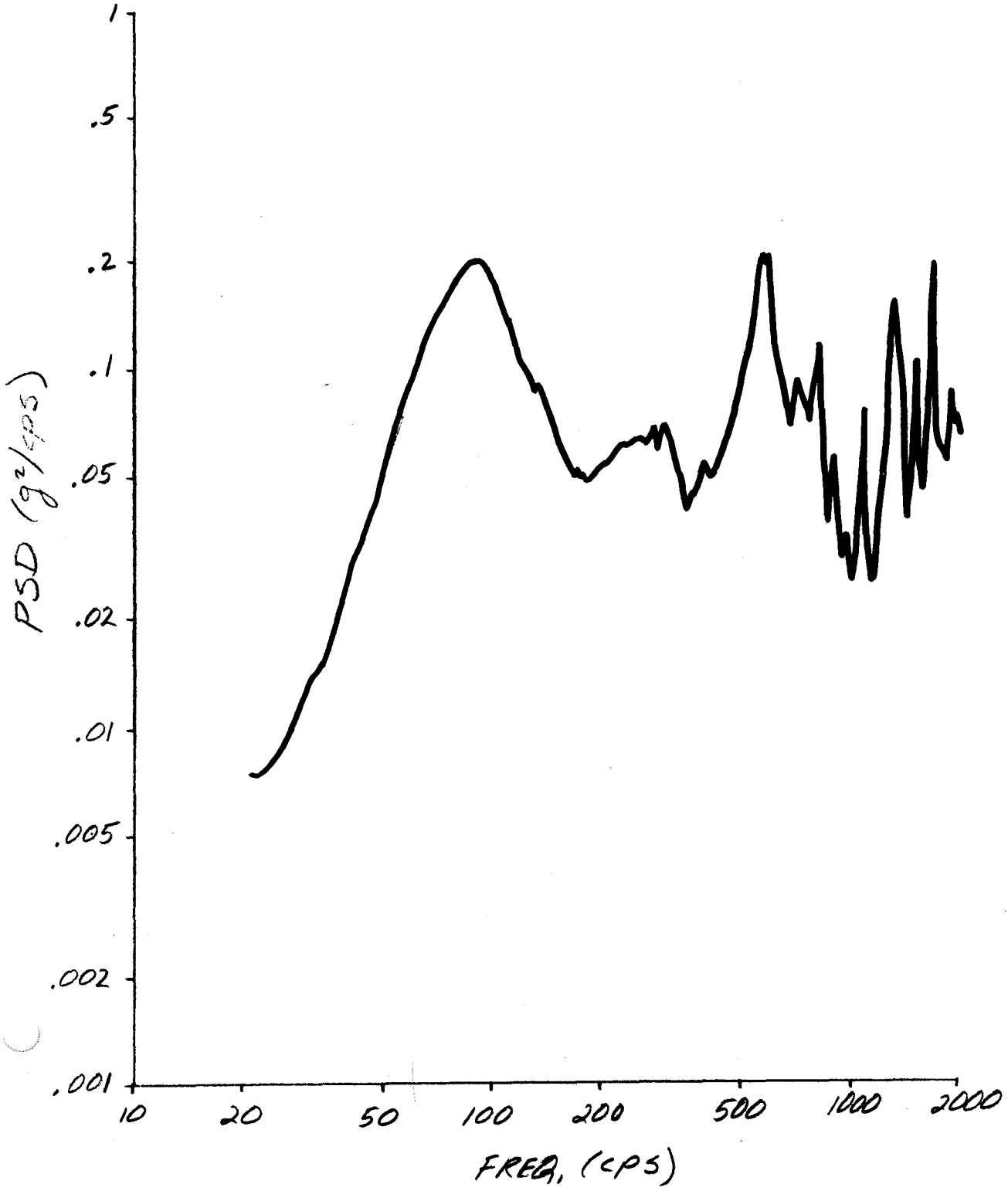
QUAL. ACA
L & B
X - Response



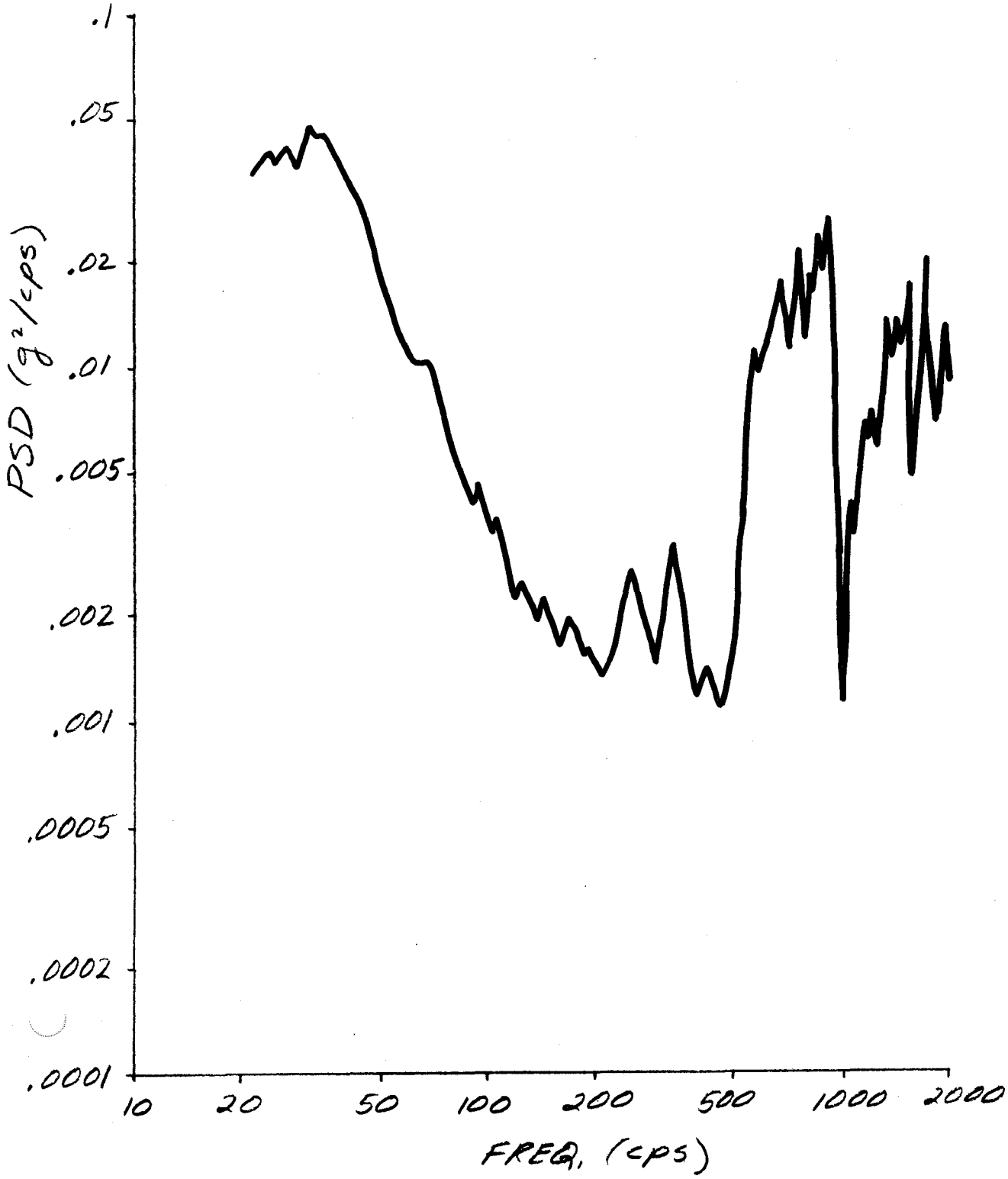
QUAL. ACA
L & B
Y-Response



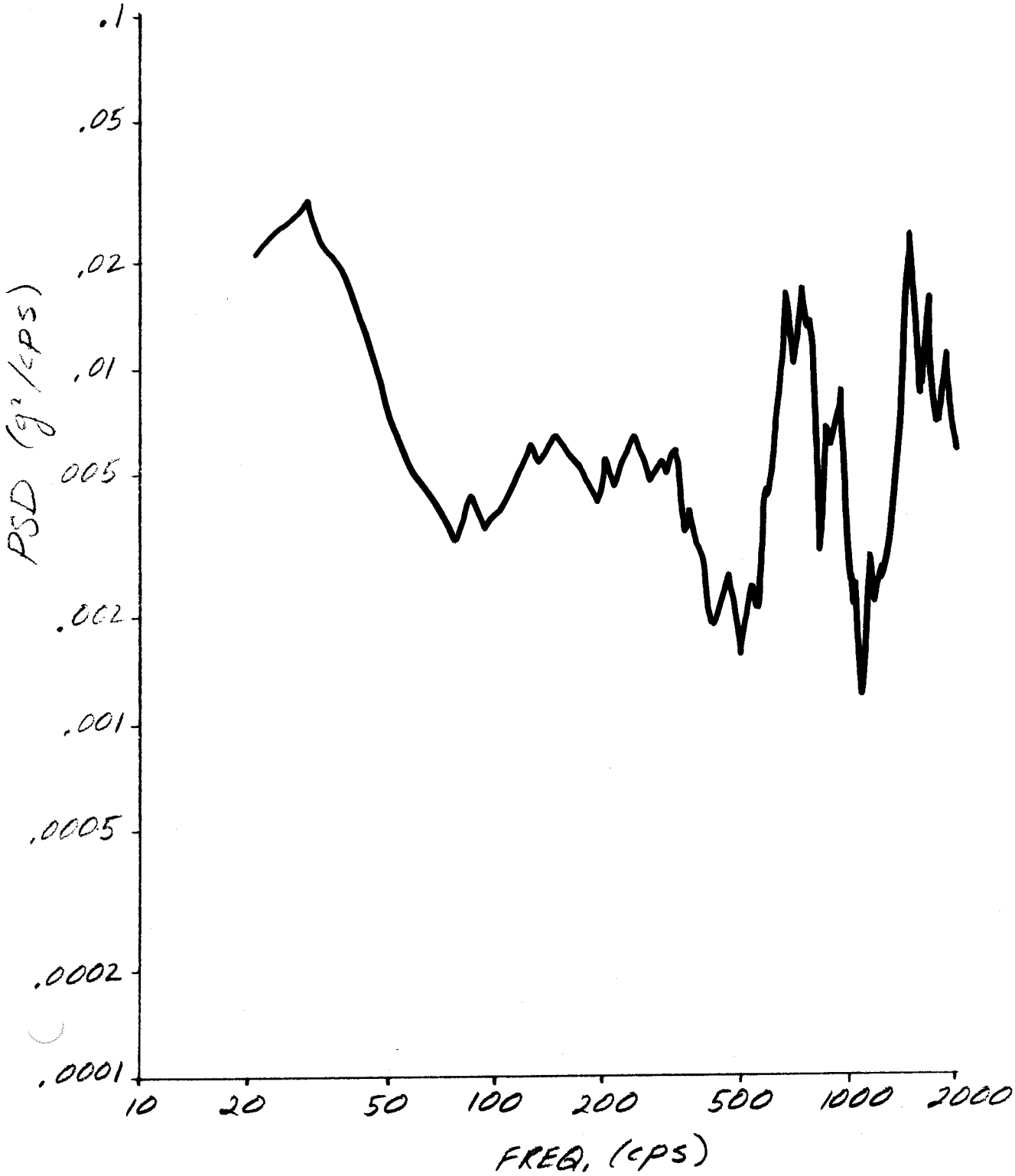
QUAL. ACA
L & B
Z-Response



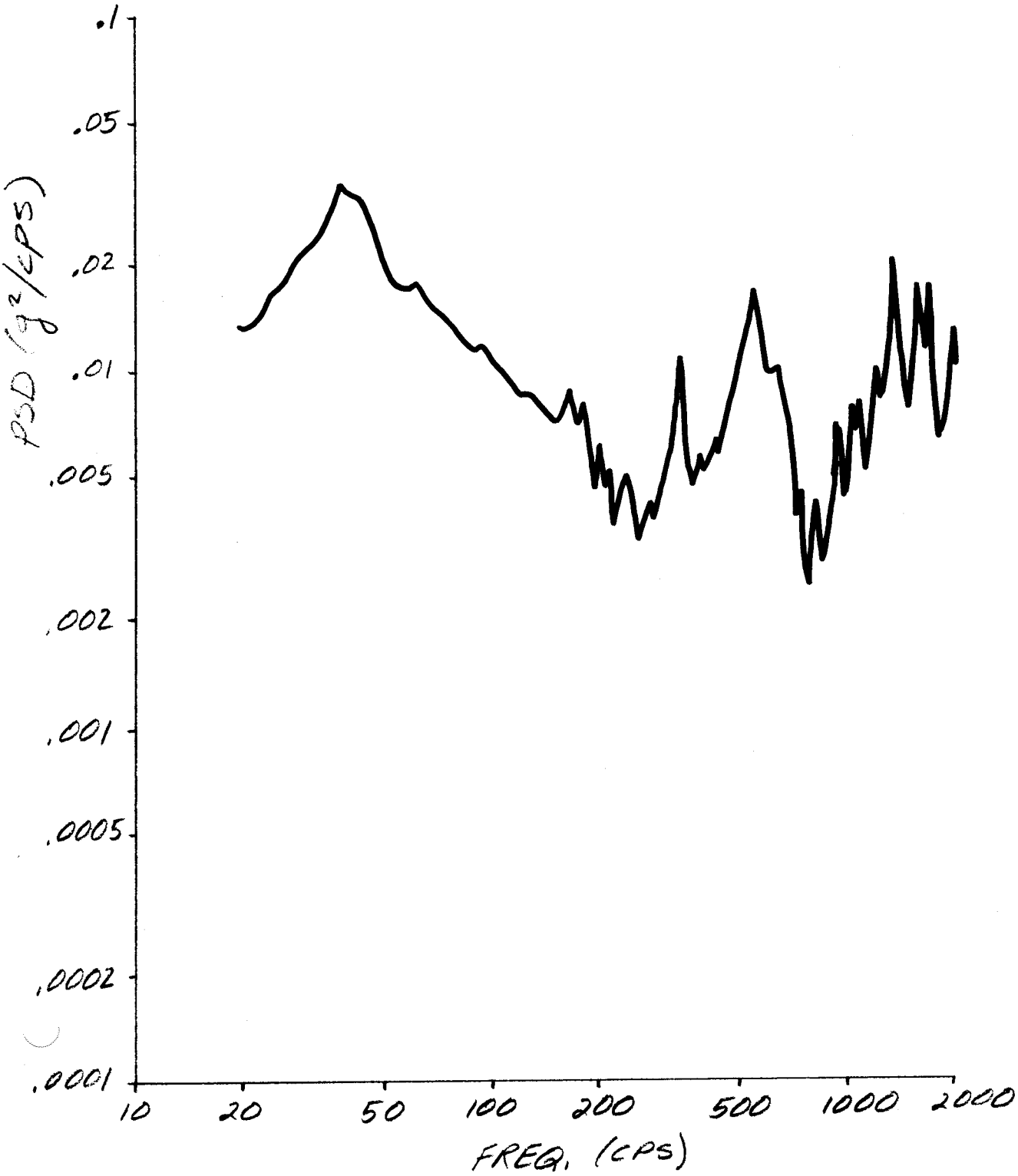
QUAL. ACA
Lun. Des.
X-Response



QUAL. ACA
Lun. Des.
Y-Response



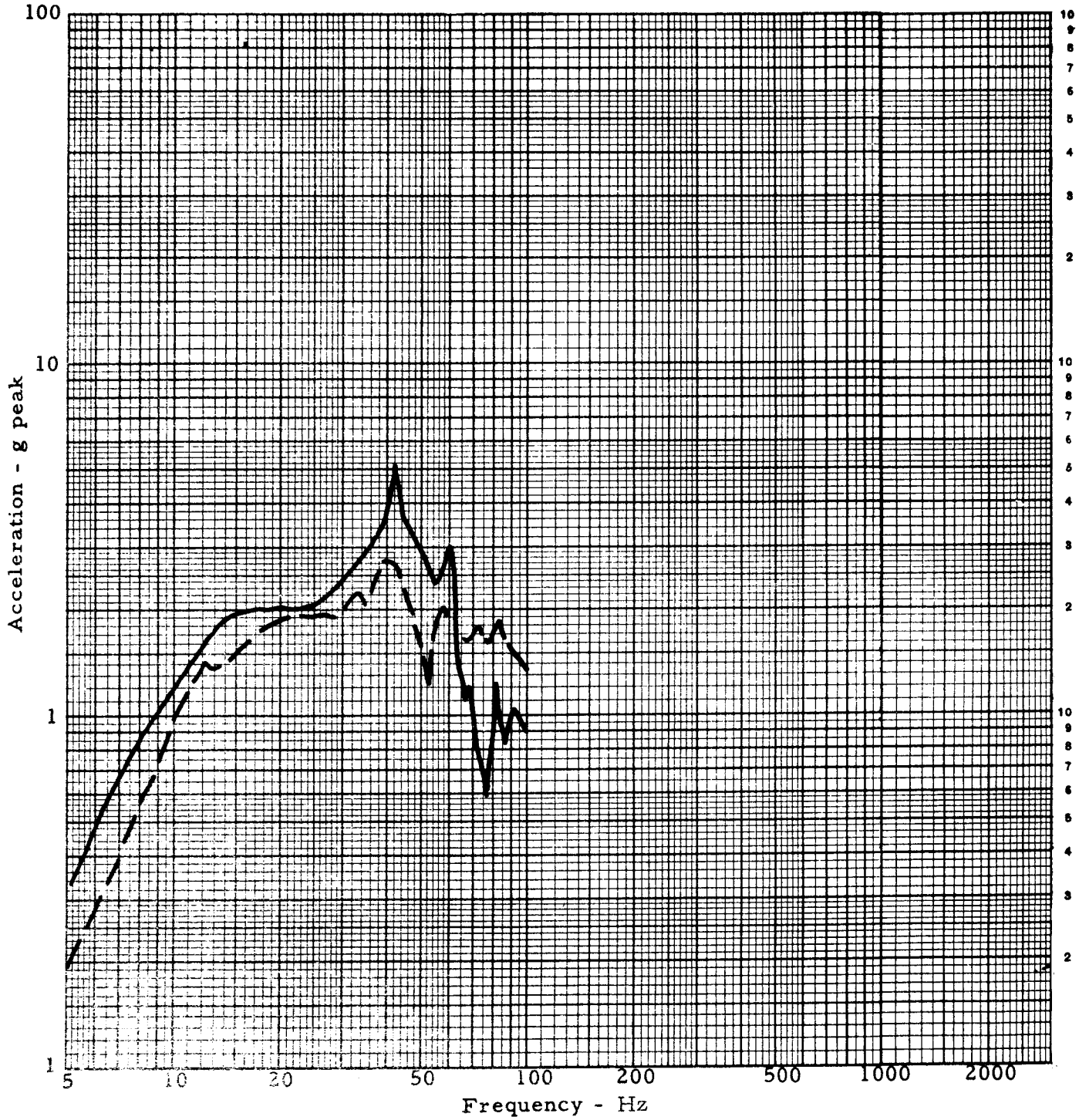
QUAL. ACA
Lun. Des.
Z-Response



VIBRATION LEVELS

Test Item: QUAL. 5A, in-axis ———
~~Test Date~~: QUAL. B, in-axis — — —
QUAL. B, cross-axis* • • • • •

Serial Number: ALHT
Input Axis:
Response Axis: X



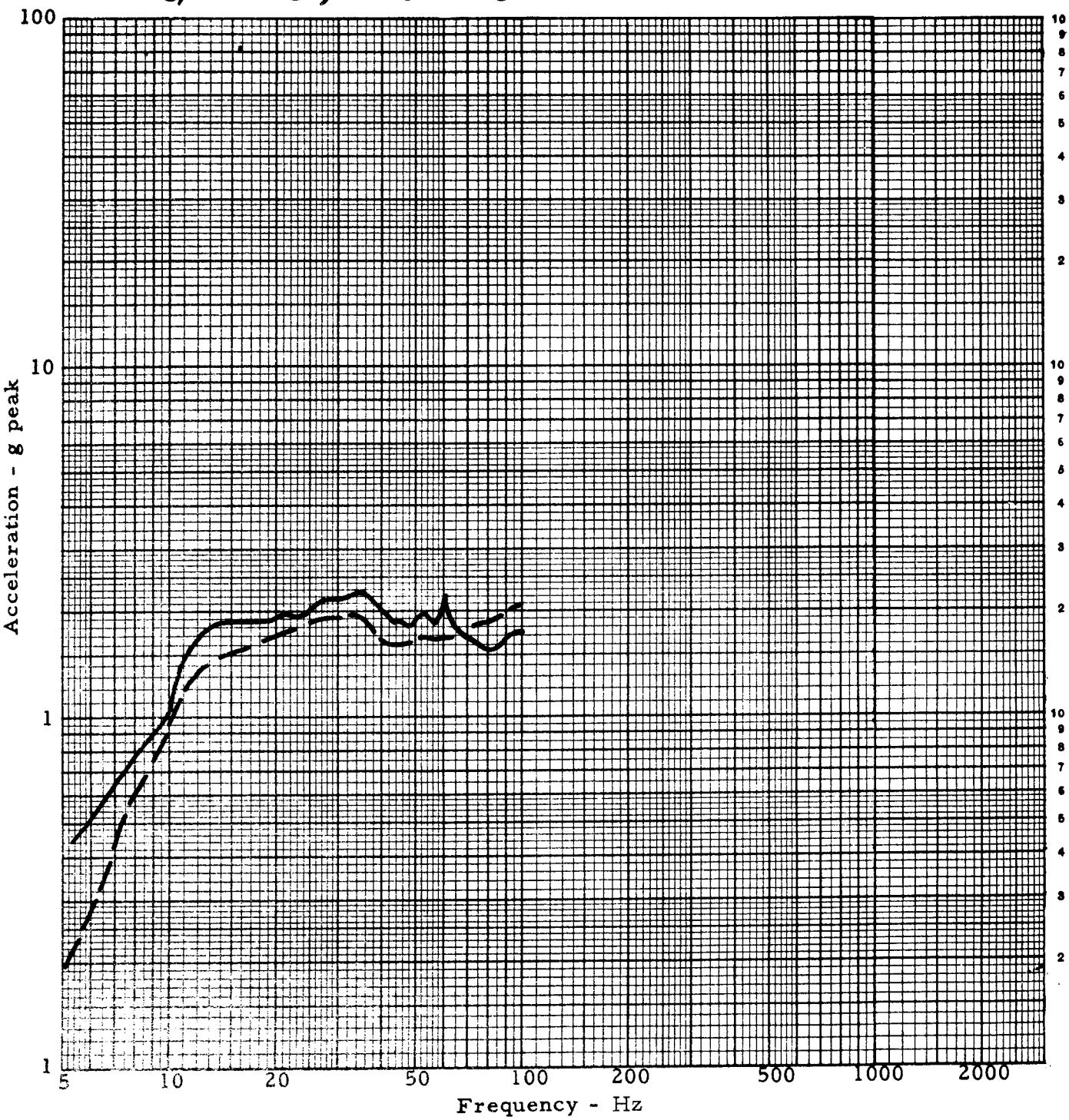
440-8 A

* shown only if greater than in-axis data

VIBRATION LEVELS

Test Item: QUAL. SA, IN-AXIS ———
~~Test Date:~~ QUAL. B, IN-AXIS — — —
QUAL. B, CROSS-AXIS* · · · ·

Serial Number: ALHT
Input Axis:
Response Axis: Y



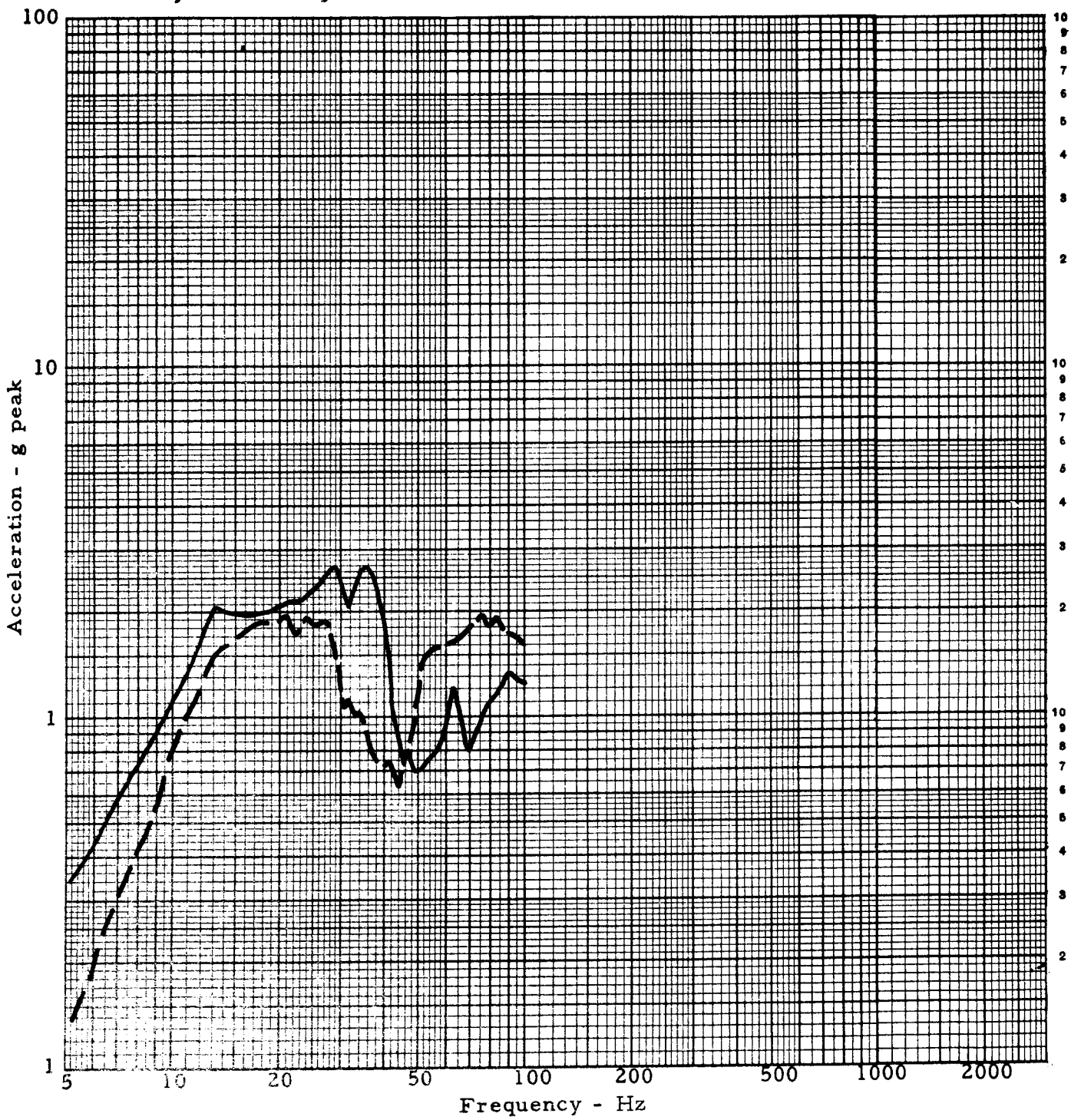
440-8 A

* shown only if greater than in-axis data

VIBRATION LEVELS

Test Item: QUAL. SA, IN-AXIS ———
~~Test Date:~~ QUAL. B, IN-AXIS — — —
QUAL. B, CROSS-AXIS* .....

Serial Number: ALHT
Input Axis:
Response Axis: Z

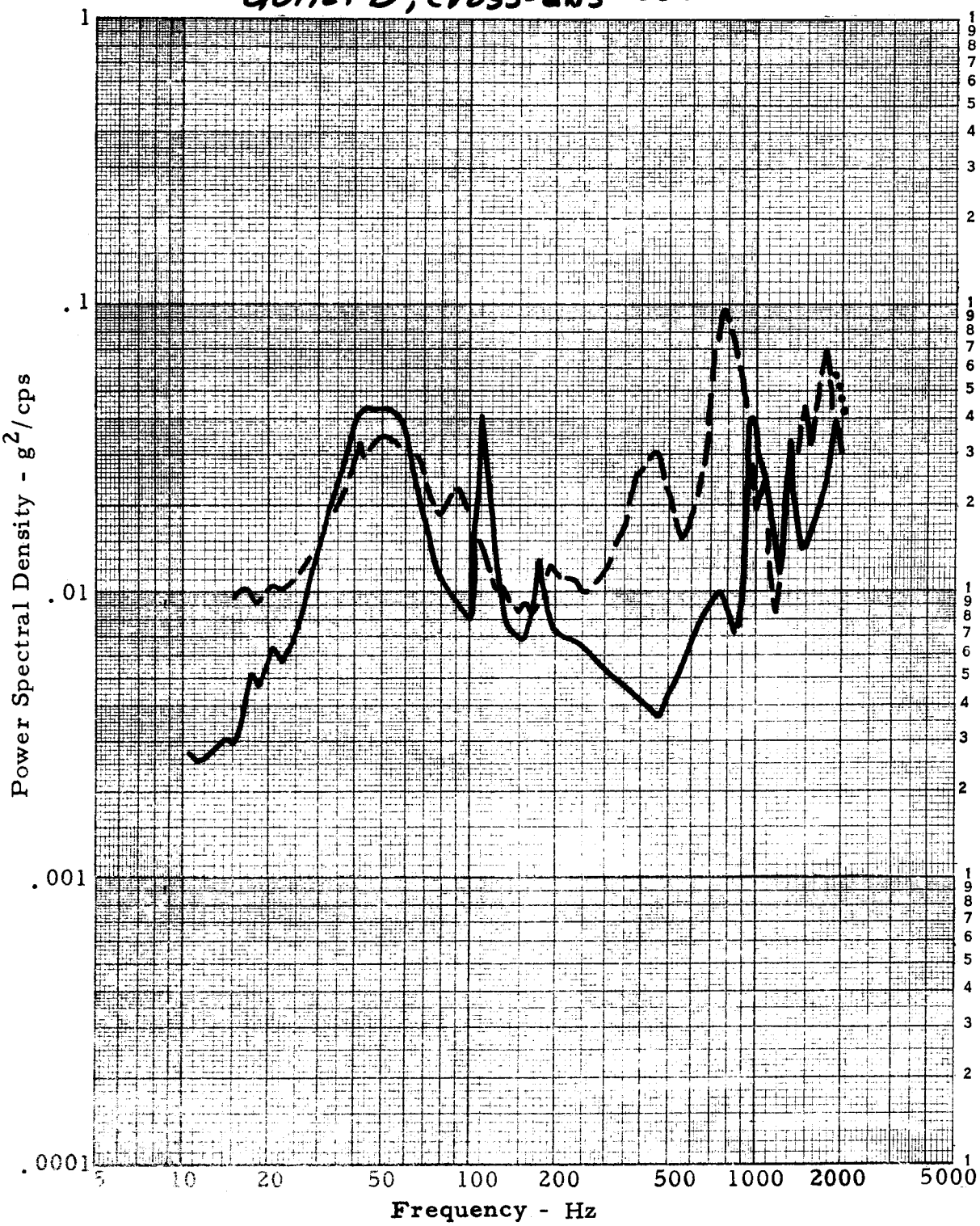


440-8 A

* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

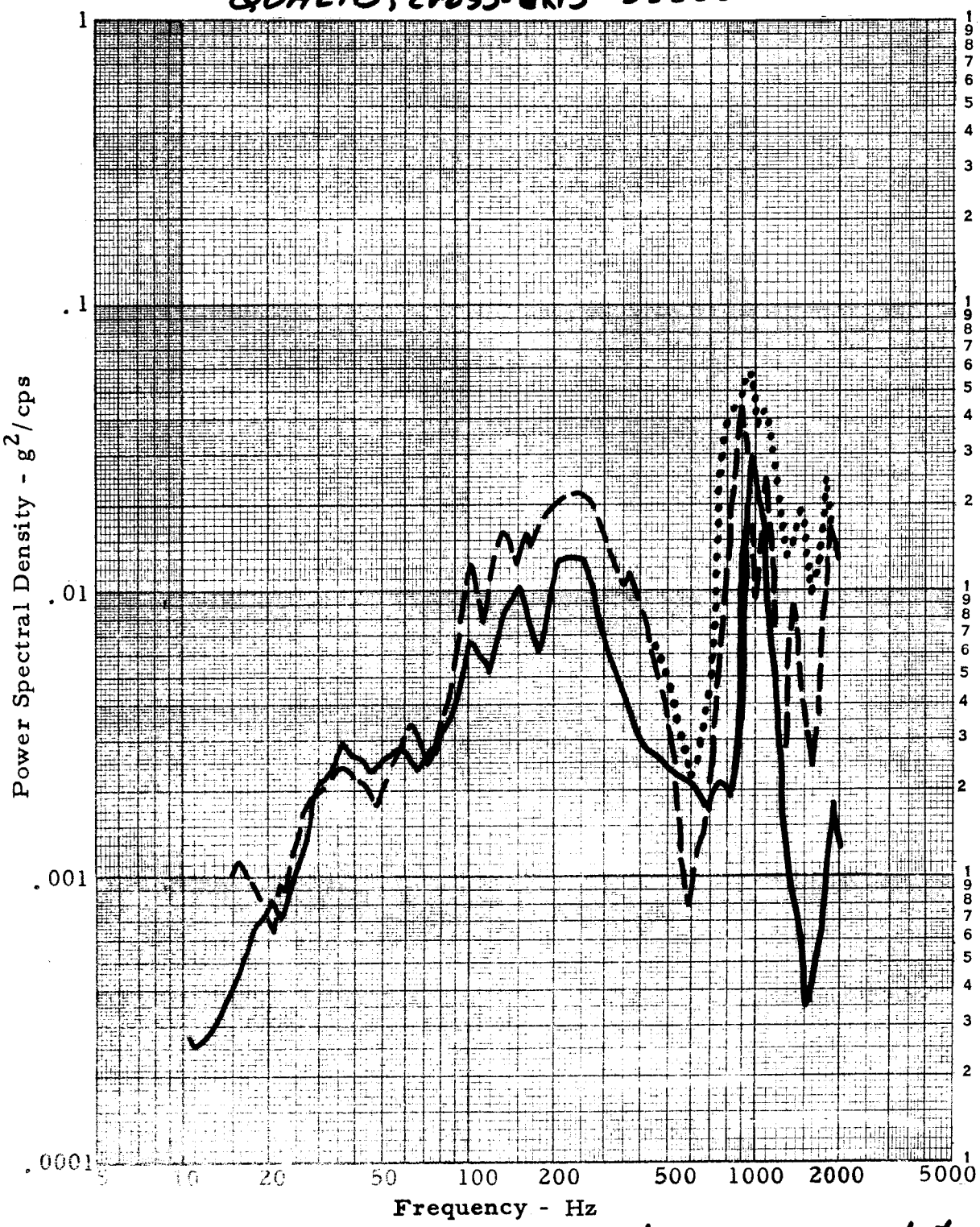
Test: L & B
Test Item: QUAL. 3A, in-axis ——— SN: ALHT
~~Test Date~~: QUAL. B, in-axis — — — Axis: X
QUAL. B, cross-axis* ●●●●●



* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

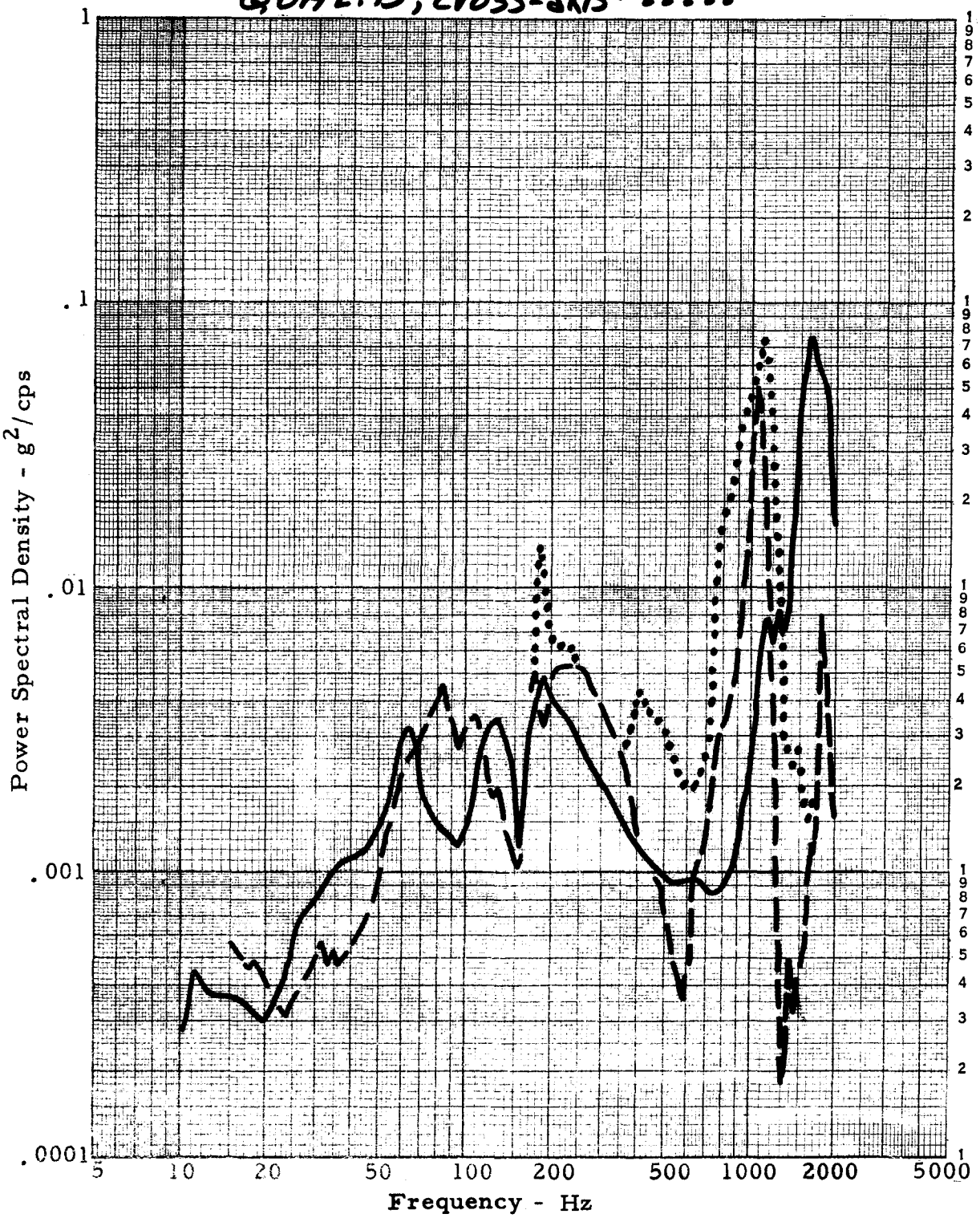
Test: L & B
Test Item: QUAL.SA, IN-AXIS ——— SN: ALHT
~~Test Date:~~ QUAL.B, IN-AXIS — — — Axis: Y
QUAL.B, CROSS-AXIS* - - - - -



* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

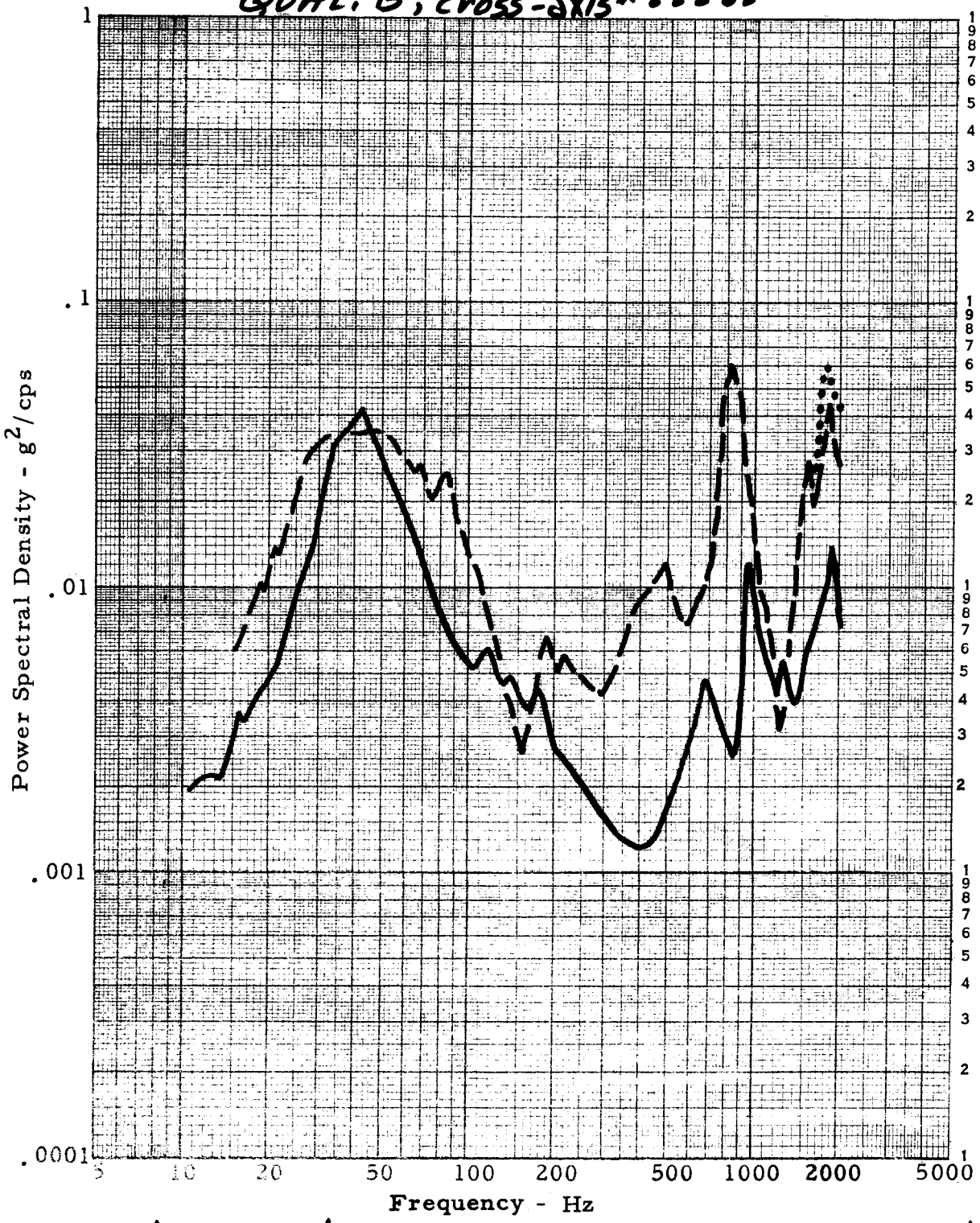
Test: L & B
Test Item: QUAL. SA, IN-AXIS ——— SN: ALHT
~~Test Date:~~ QUAL. B, IN-AXIS — — — Axis: Z
QUAL. B, CROSS-AXIS* .....



* shown only if greater than IN-AXIS data

RANDOM VIBRATION SPECTRUM

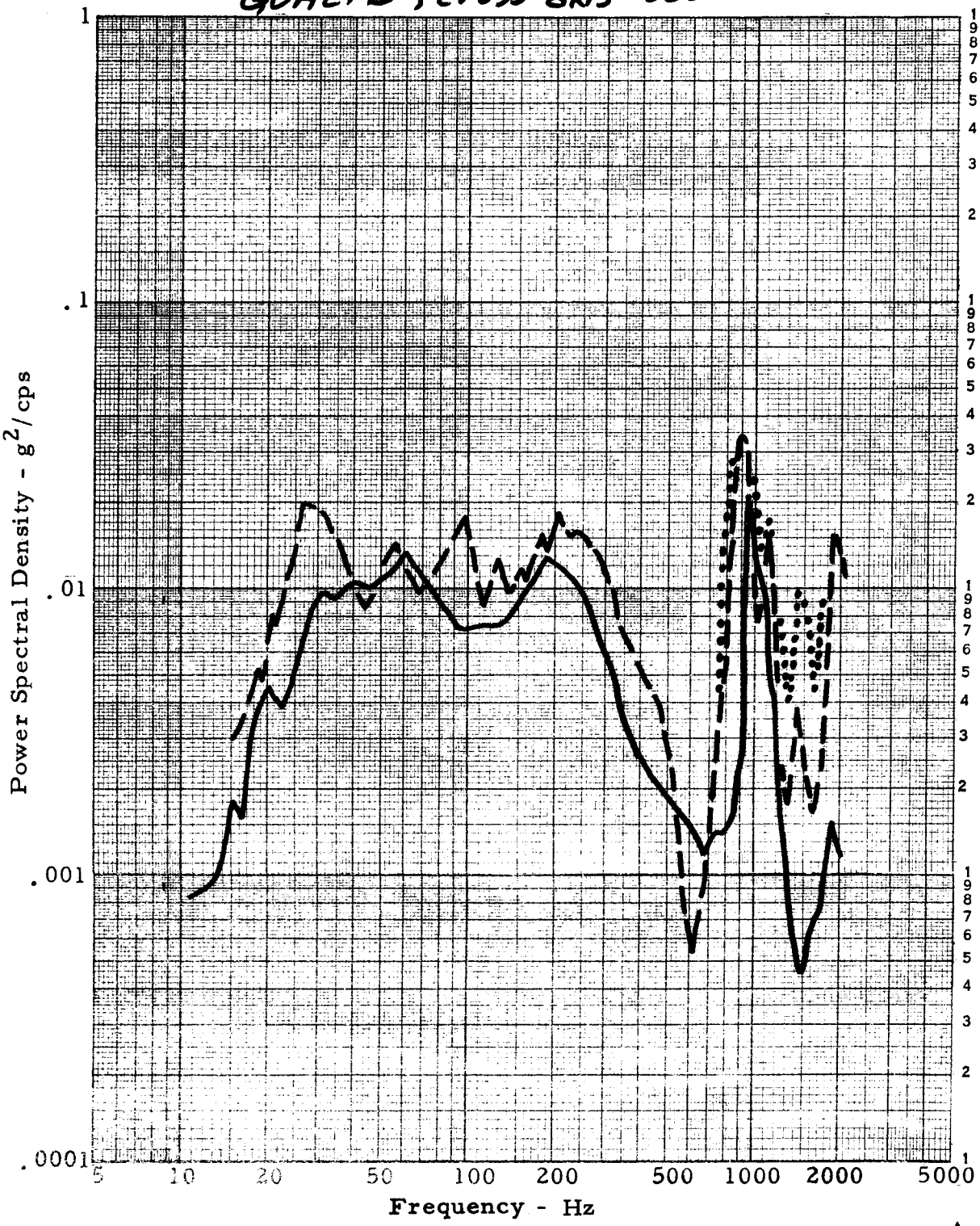
Test: Lun. Des.
Test Item: QUAL. SA, IN-AXIS ——— SN: ALHT
~~Test Date:~~ QUAL. B, IN-AXIS — — — Axis: X
QUAL. B, CROSS-AXIS* • • • • •



* shown only if greater than IN-AXIS data

RANDOM VIBRATION SPECTRUM

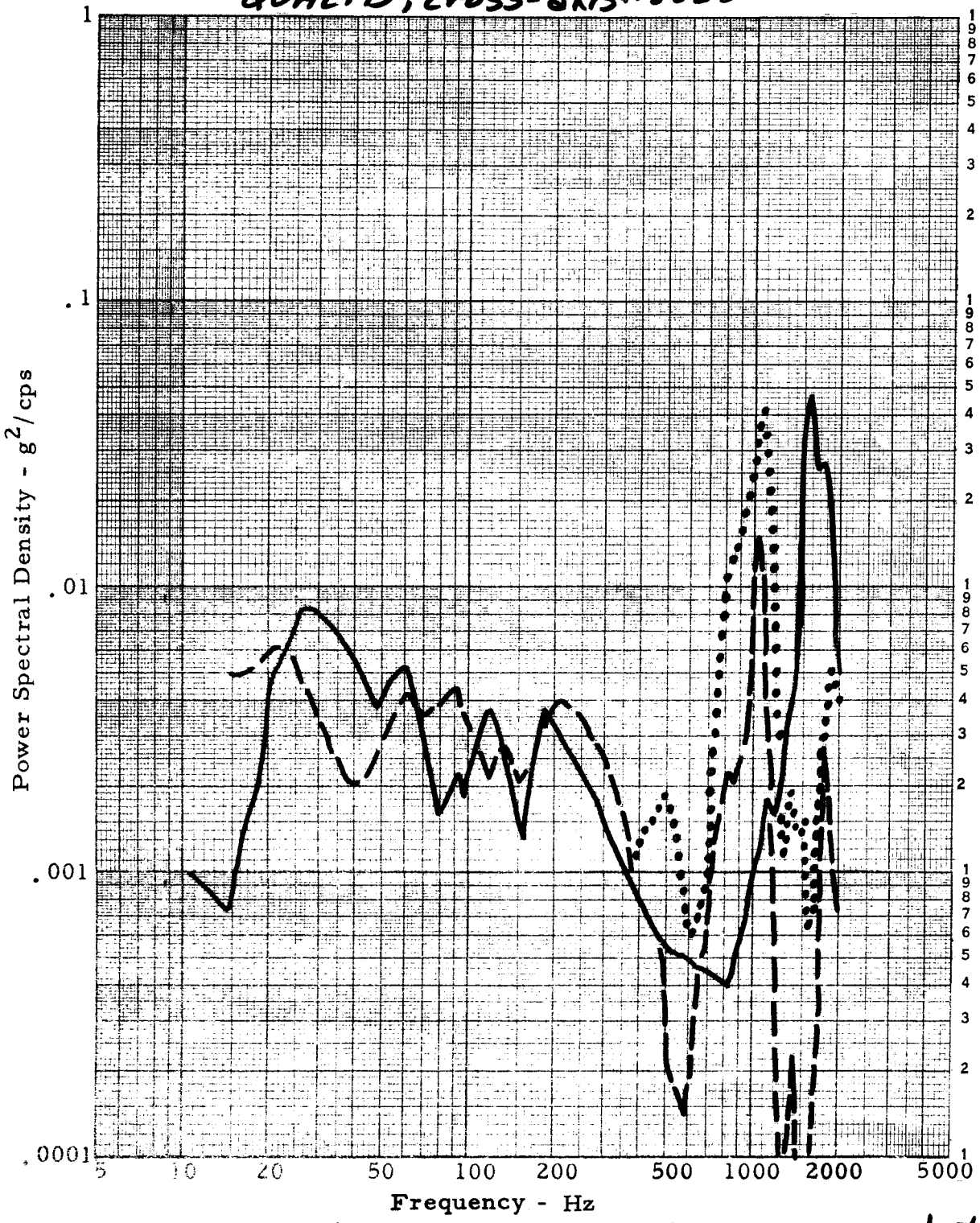
Test: Lun. Des.
Test Item: QUAL. 5A, IN-AXIS ——— SN: ALHT
~~Test Date:~~ QUAL. B, IN-AXIS — — — Axis: Y
QUAL. B, cross-axis* •••••



* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA, in-axis ——— SN: ALHT
~~Test Date:~~ QUAL. B, in-axis — — — Axis: Z
QUAL. B, cross-axis* ....

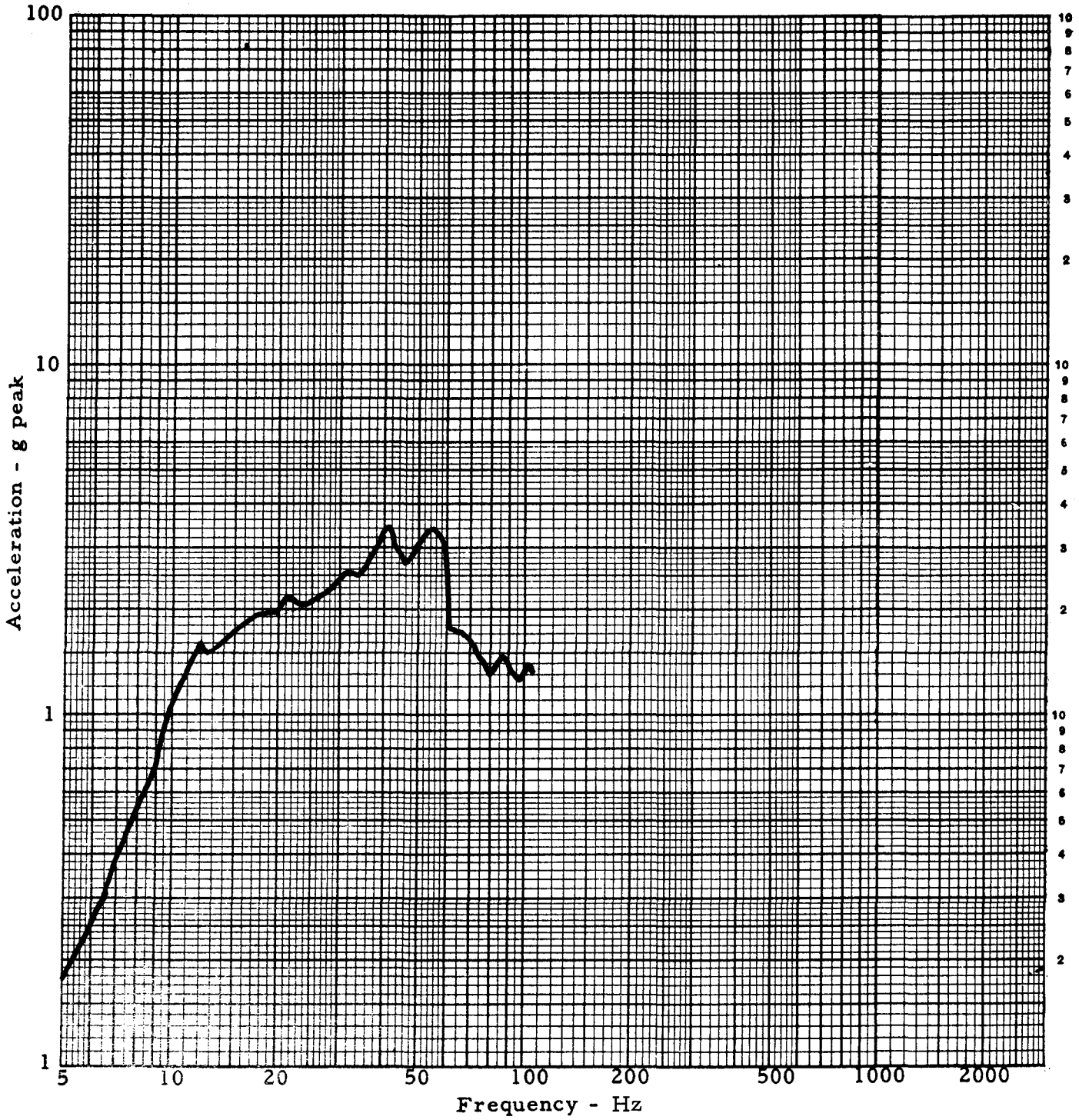


* shown only if greater than in-axis data

VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

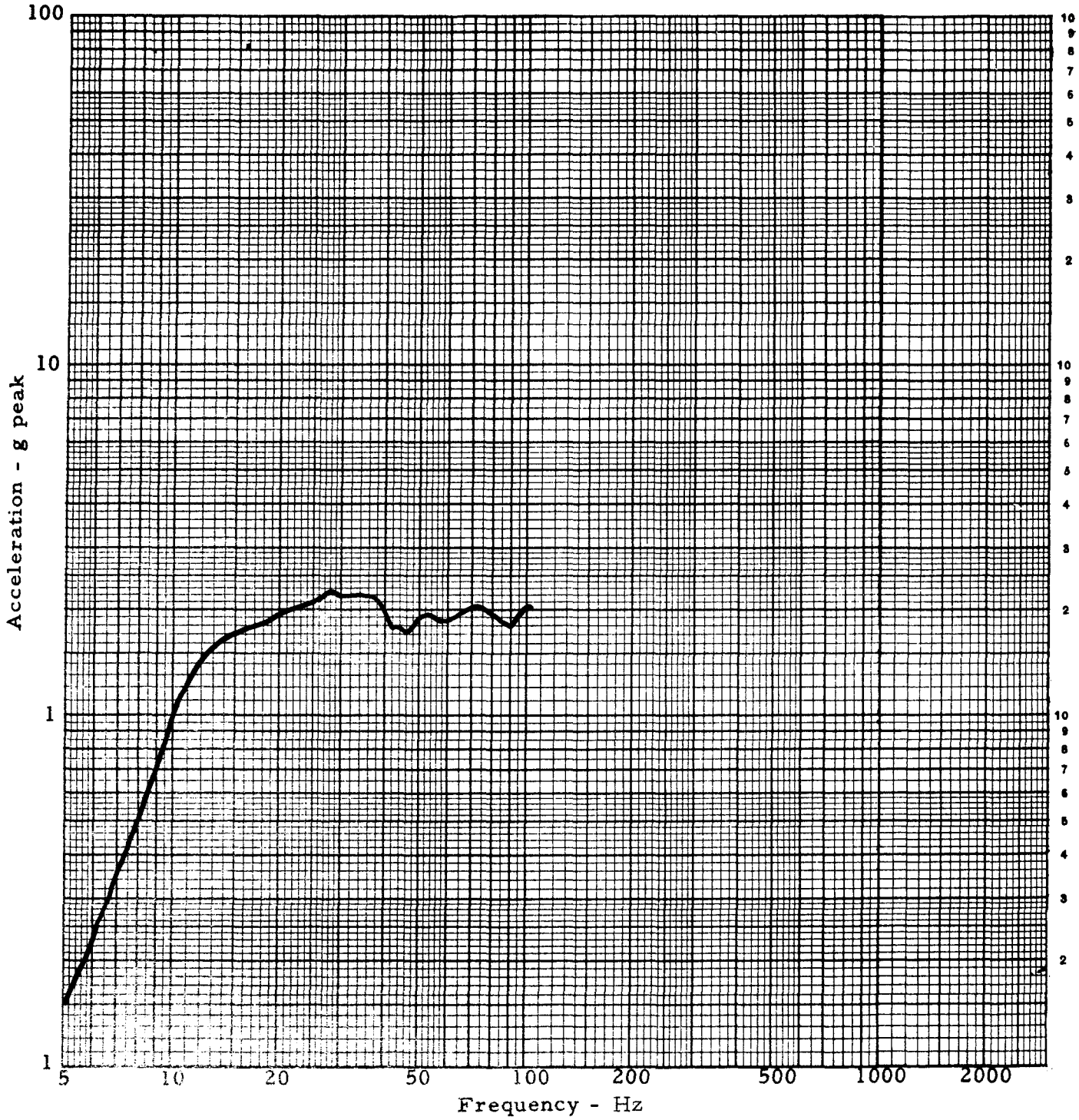
Serial Number: ALSD
Input Axis:
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

Serial Number: ALSD
Input Axis:
Response Axis: Y

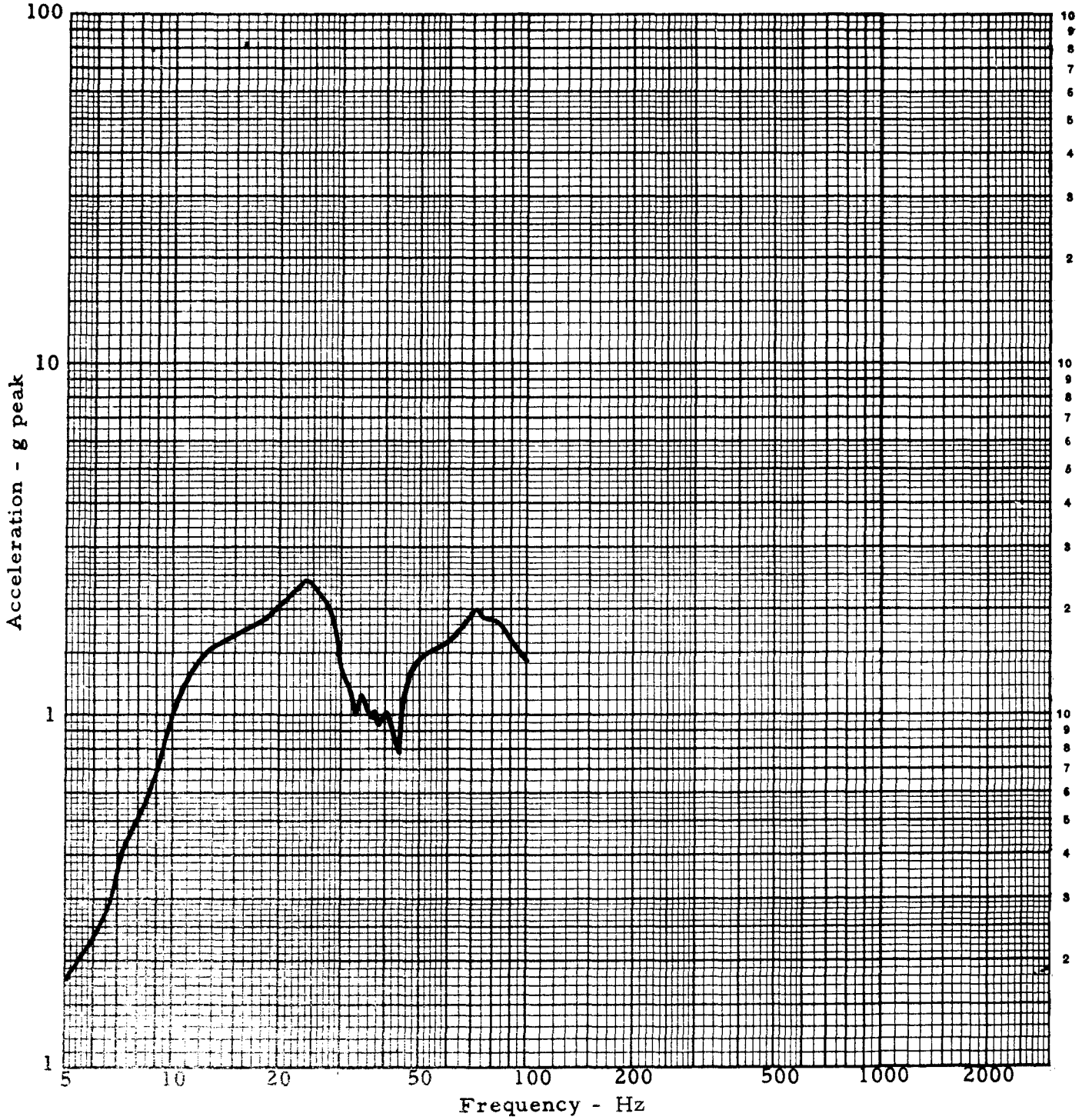


440-8 A

VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

Serial Number: ALSD
Input Axis:
Response Axis: Z

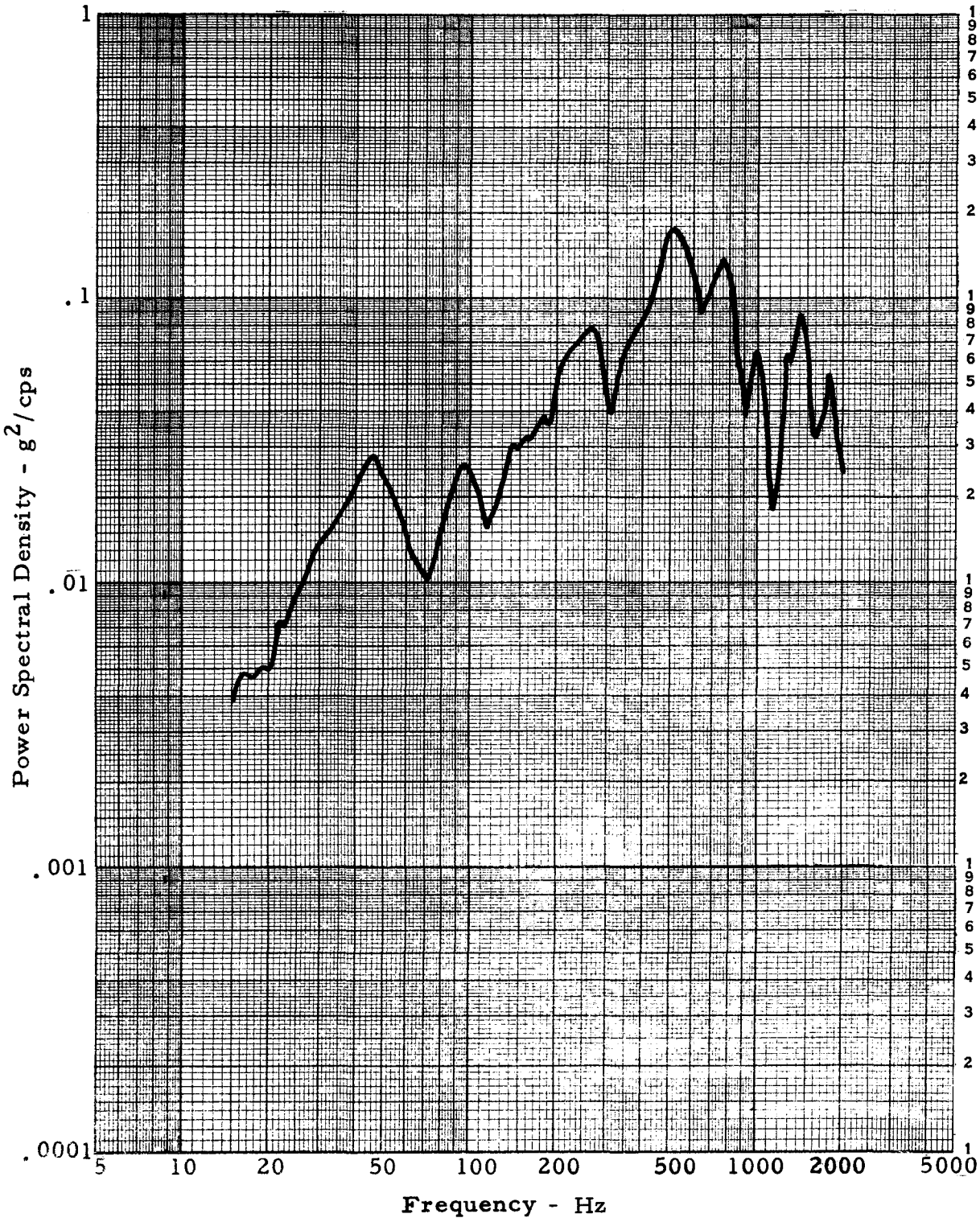


440-8 A

RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B
Test Date:

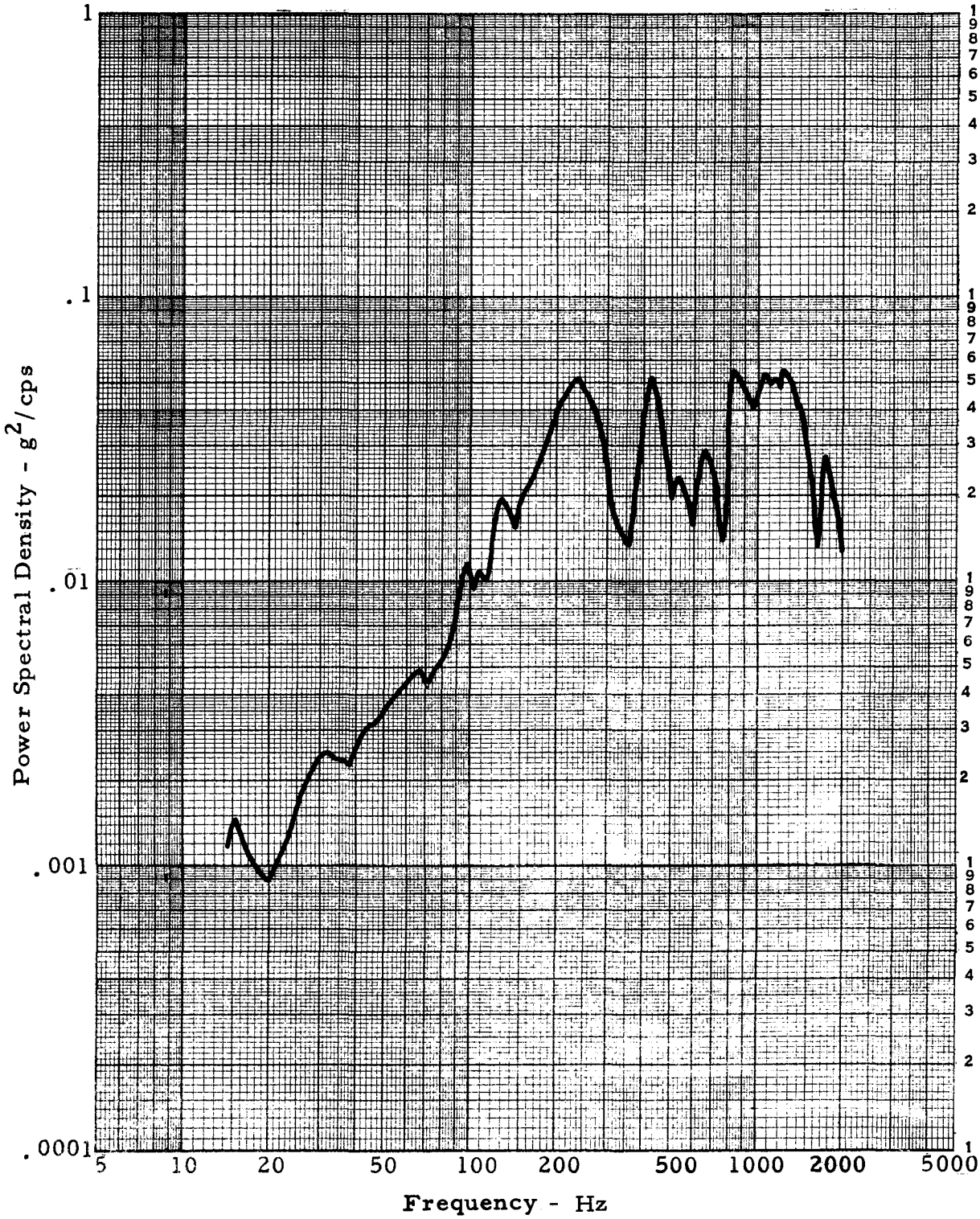
SN: ALSD
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

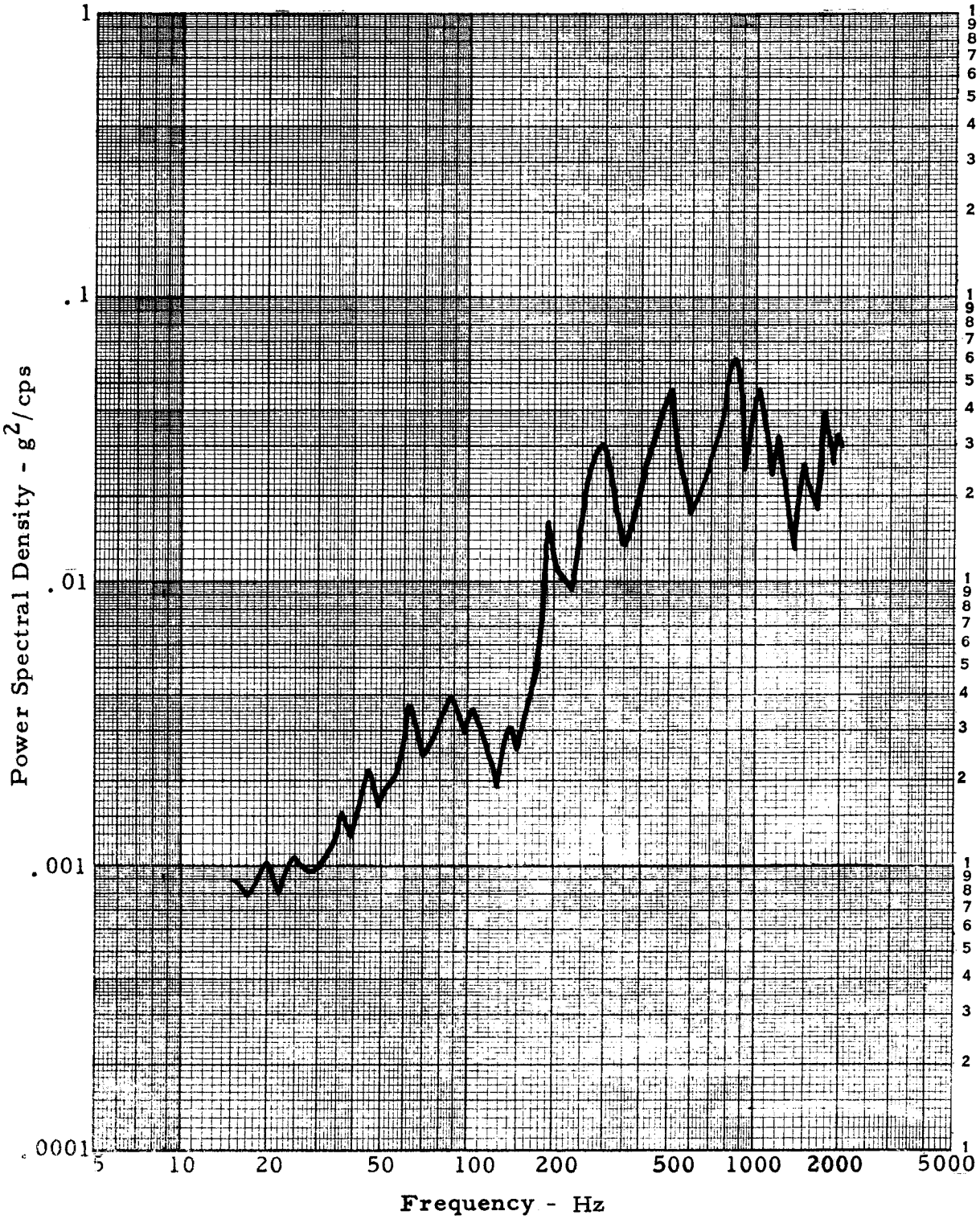
SN: ALSD
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

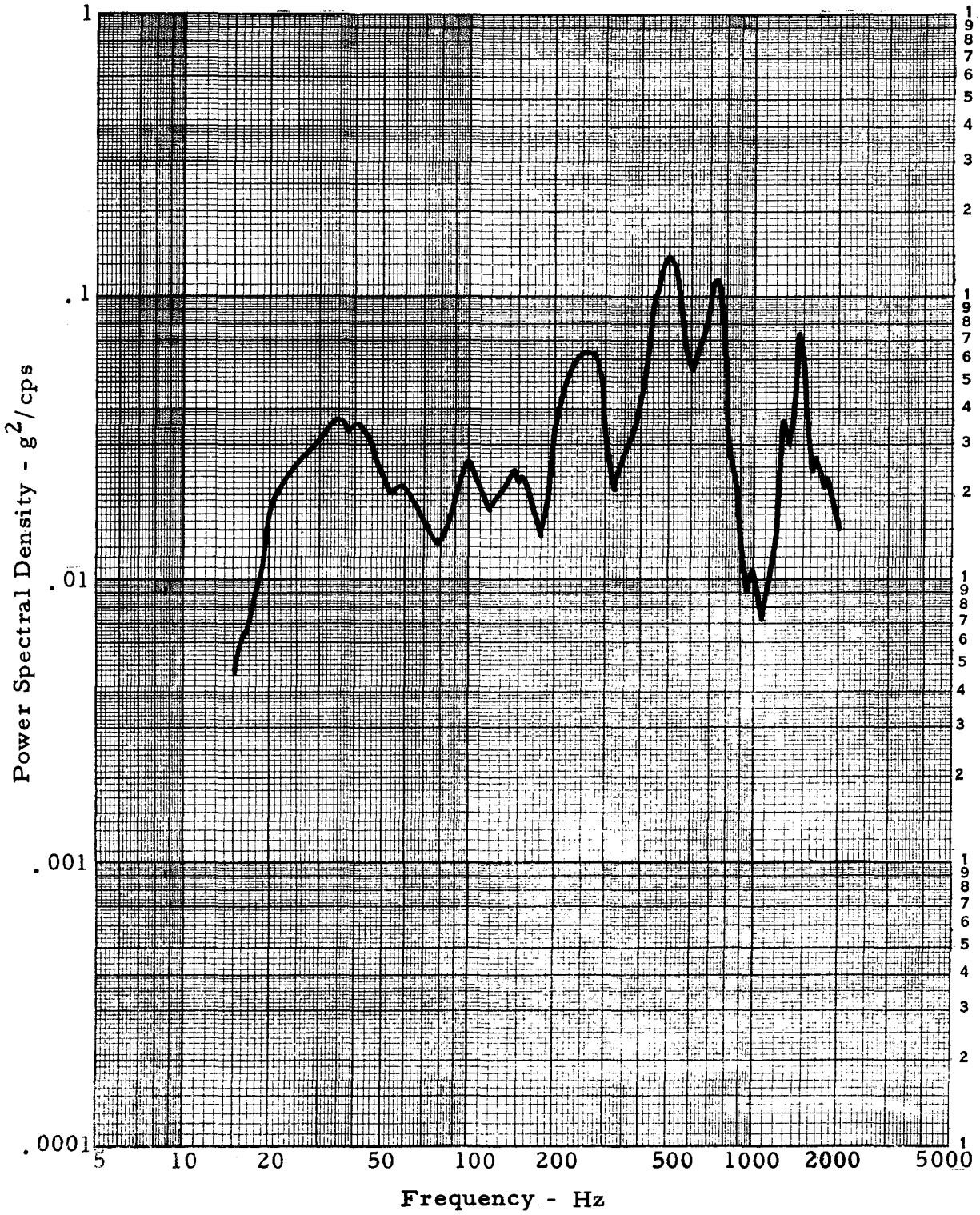
SN: ALSD
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

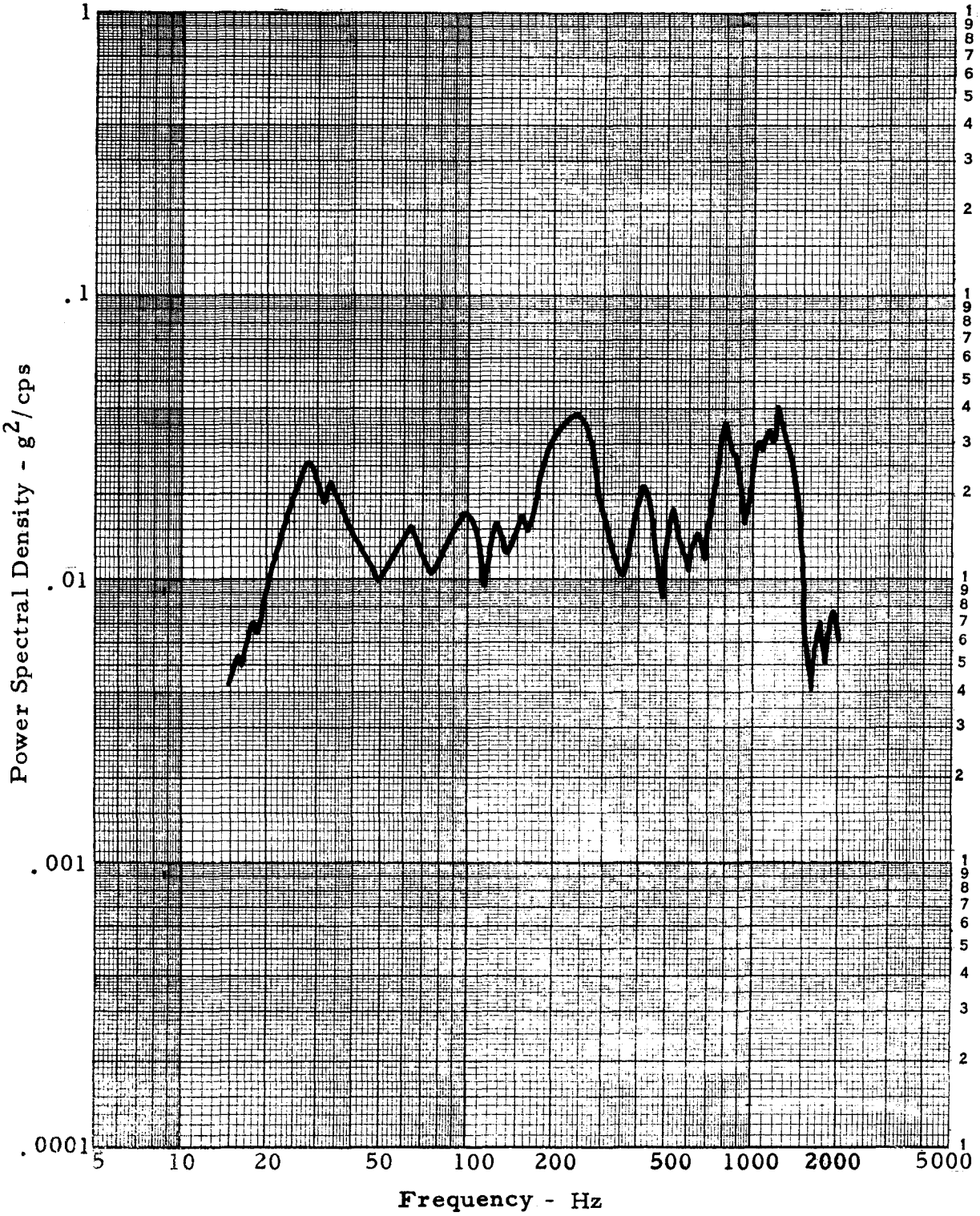
SN: ALSD
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

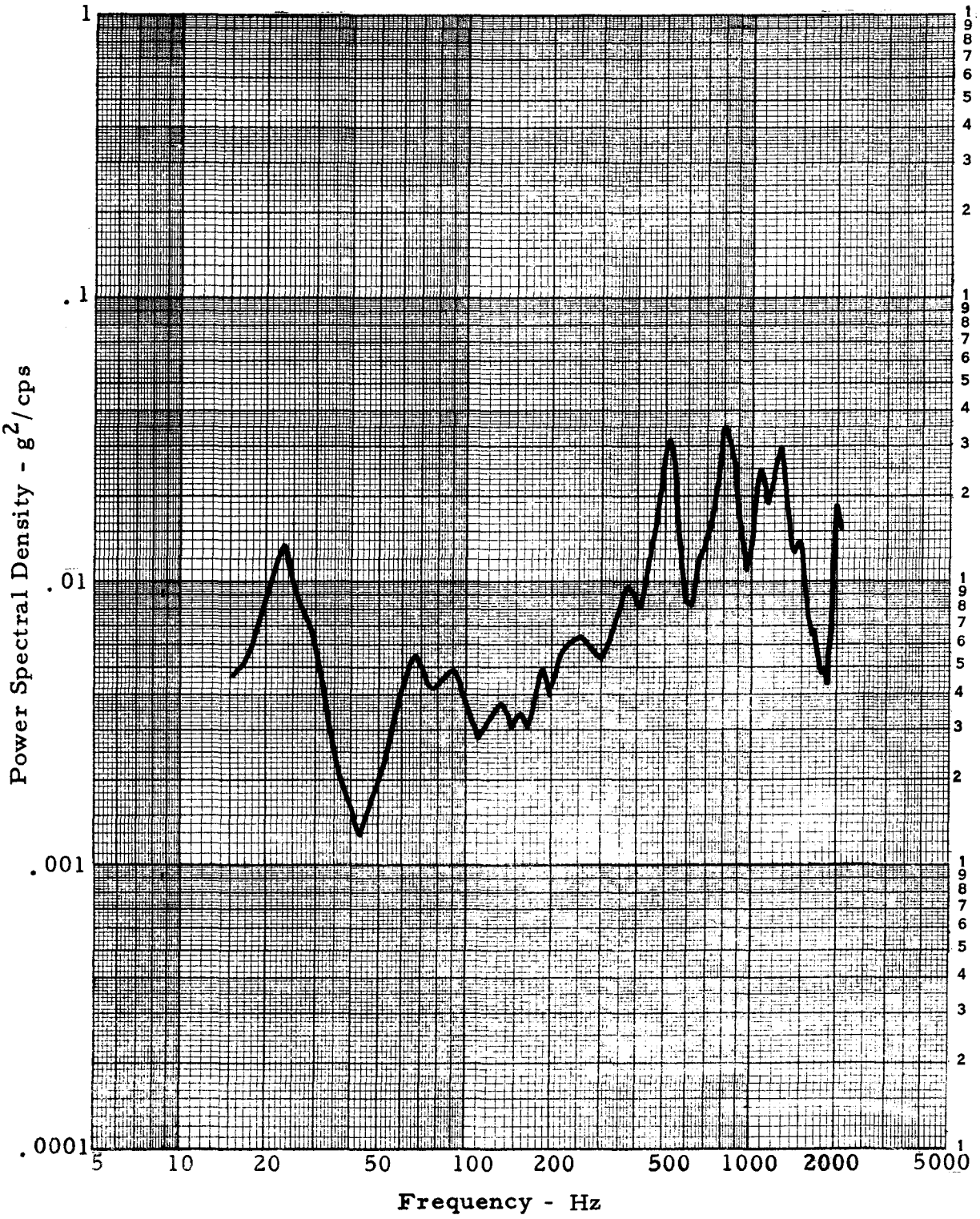
SN: ALSD
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

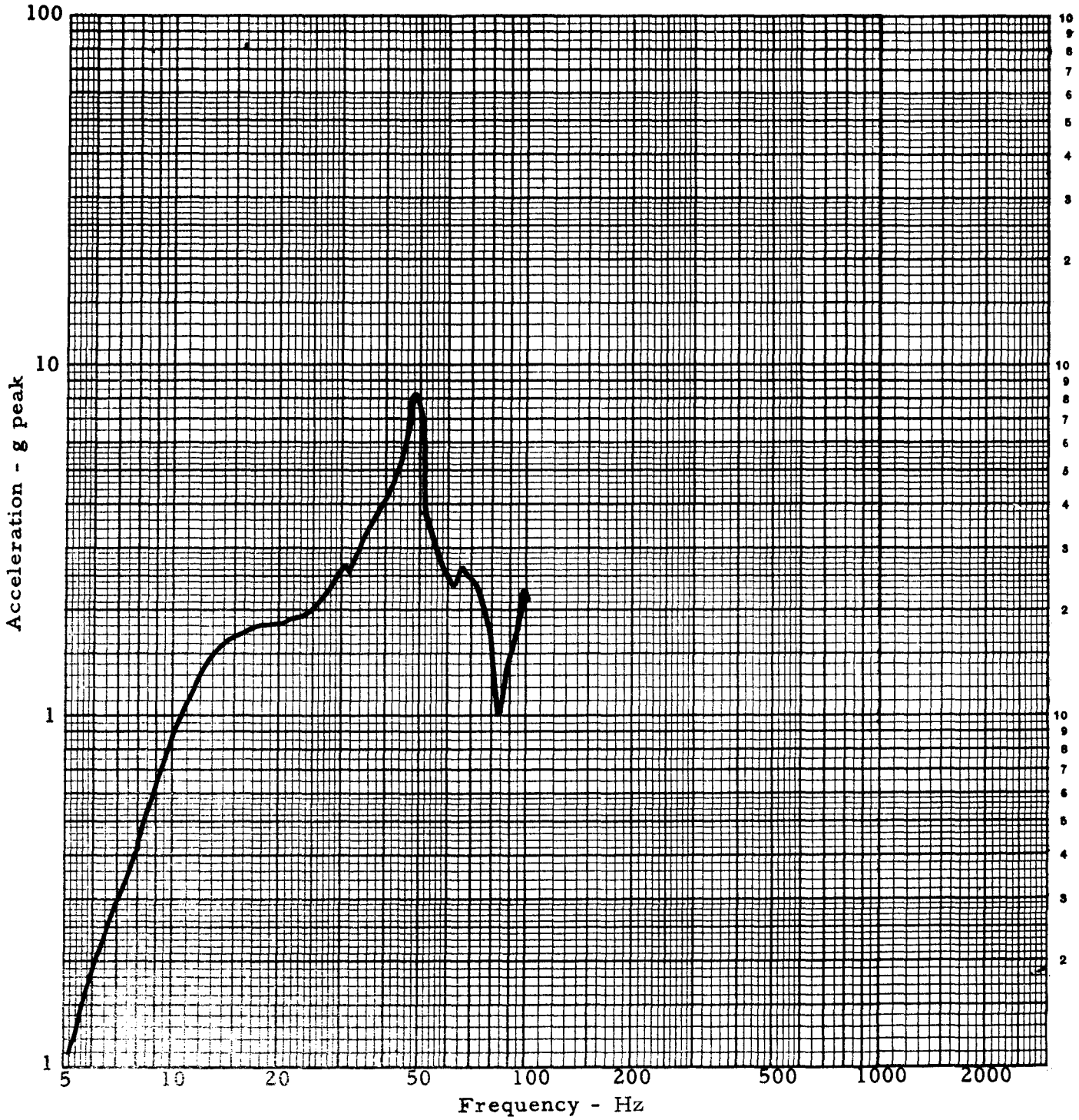
SN: ALSD
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. C
Test Date:

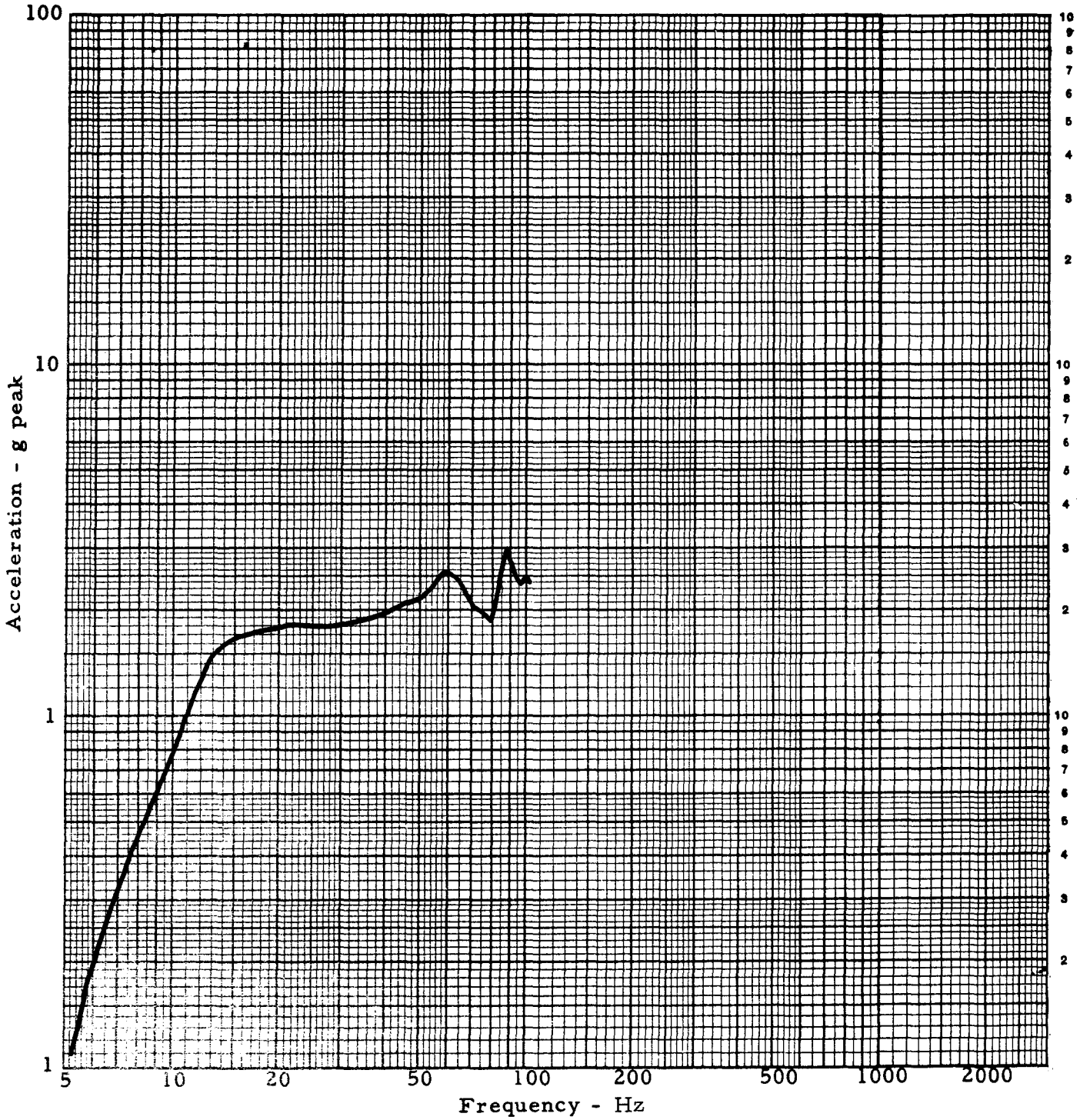
Serial Number: ASE
Input Axis:
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. C
Test Date:

Serial Number: ASE
Input Axis:
Response Axis: Y



440-8 A

VIBRATION LEVELS

Test Item: QUAL. C
Test Date:

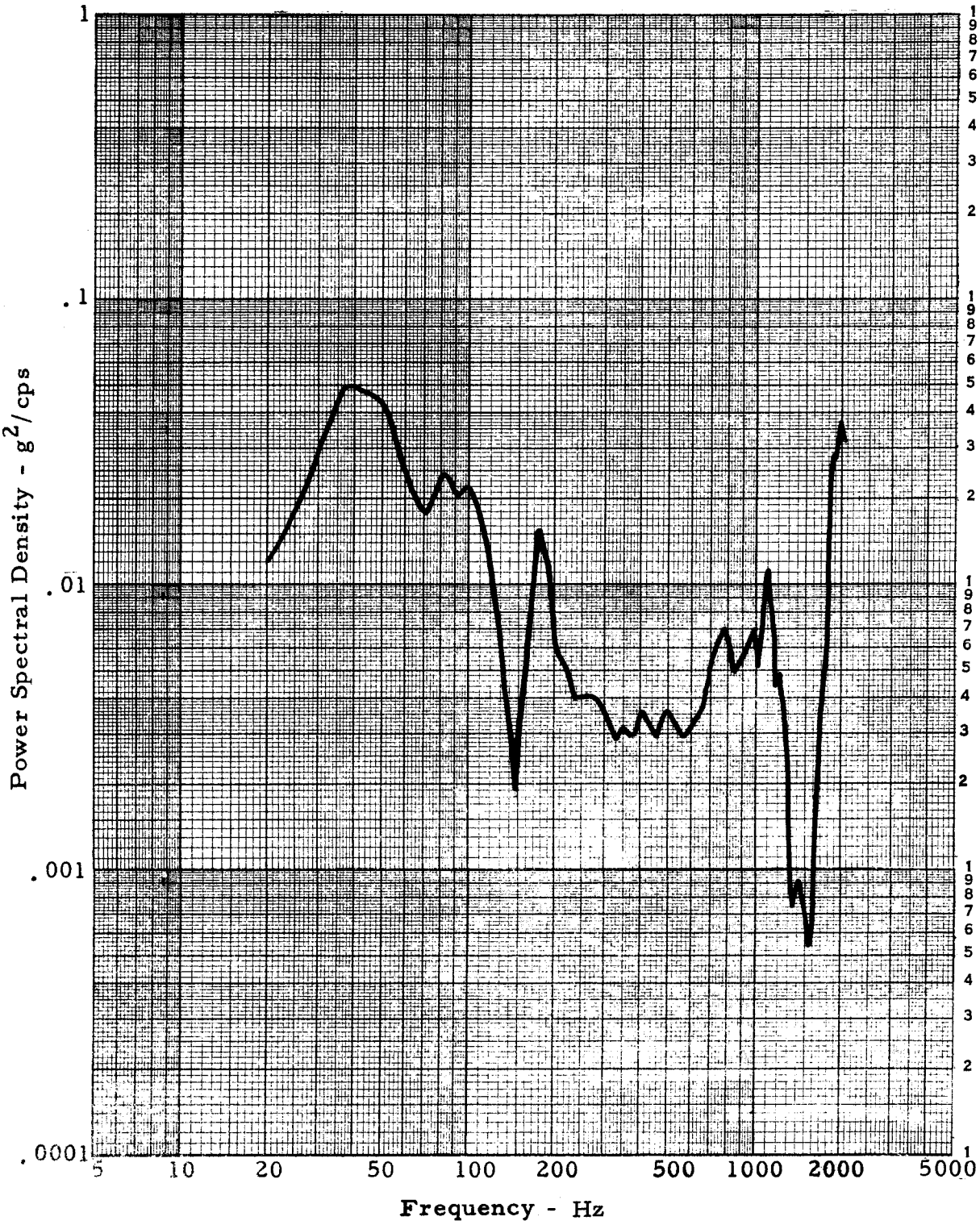
Serial Number: ASE
Input Axis:
Response Axis: Z

440-8 A

RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. C
Test Date:

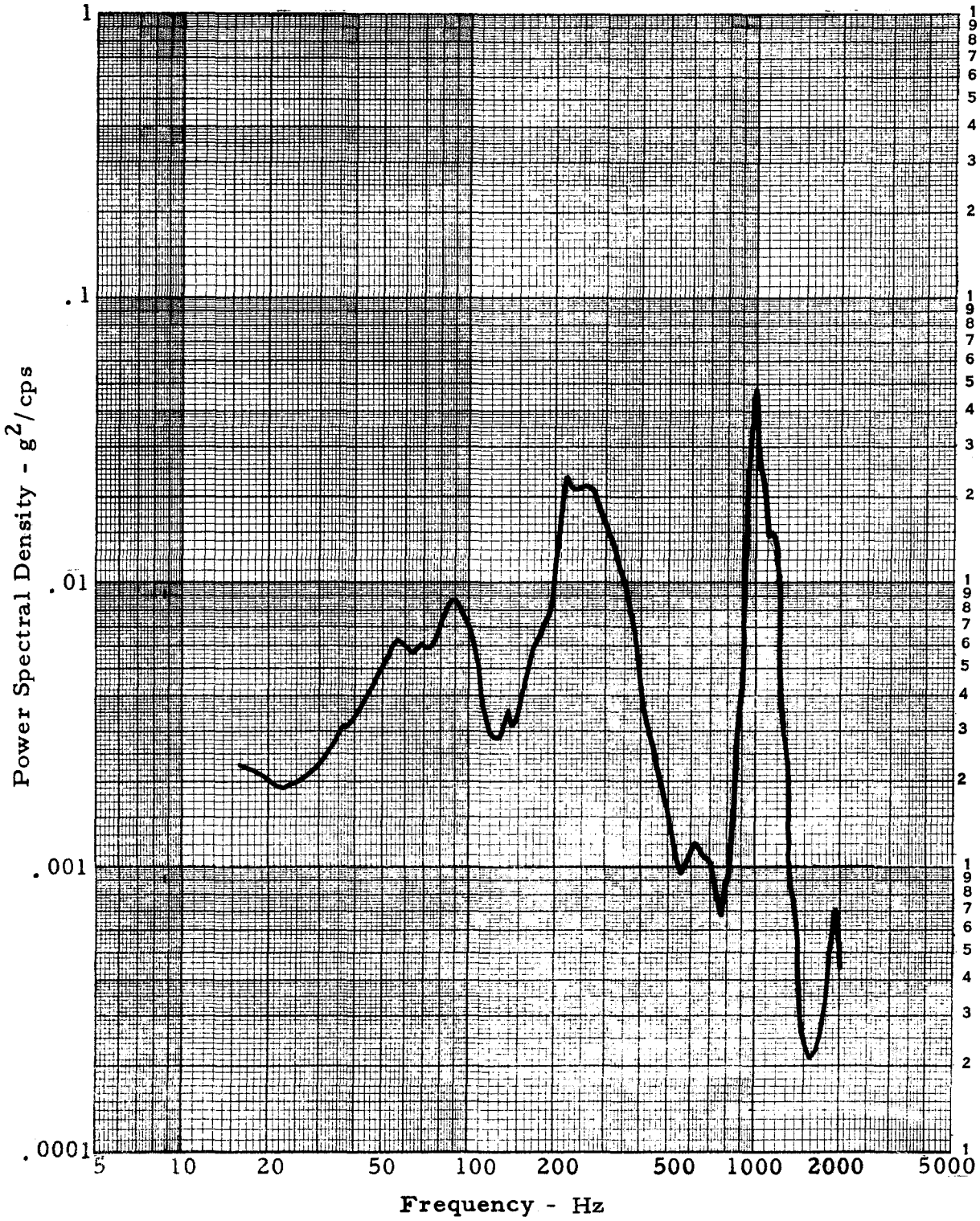
SN: ASE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL.C
Test Date:

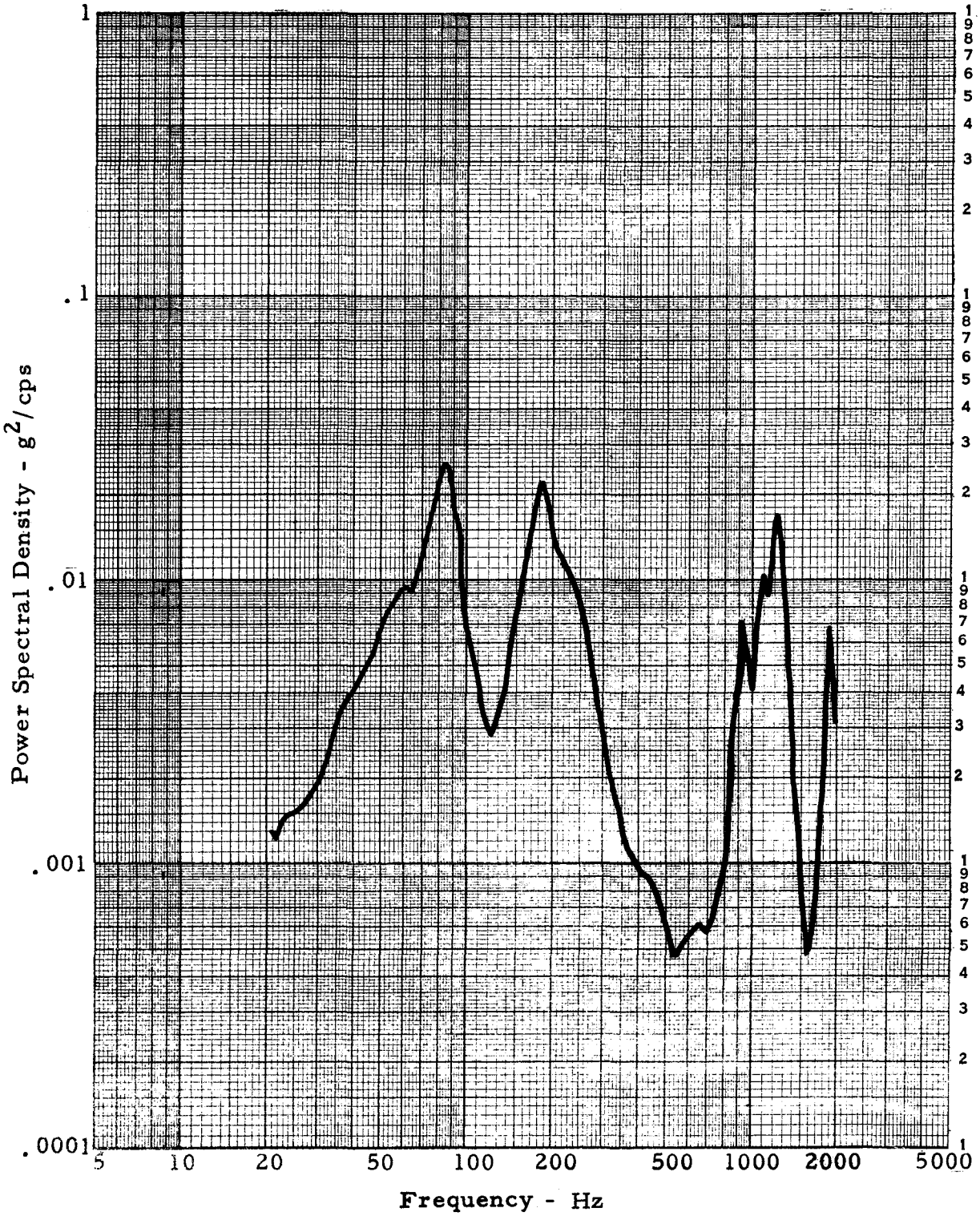
SN: ASE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. C
Test Date:

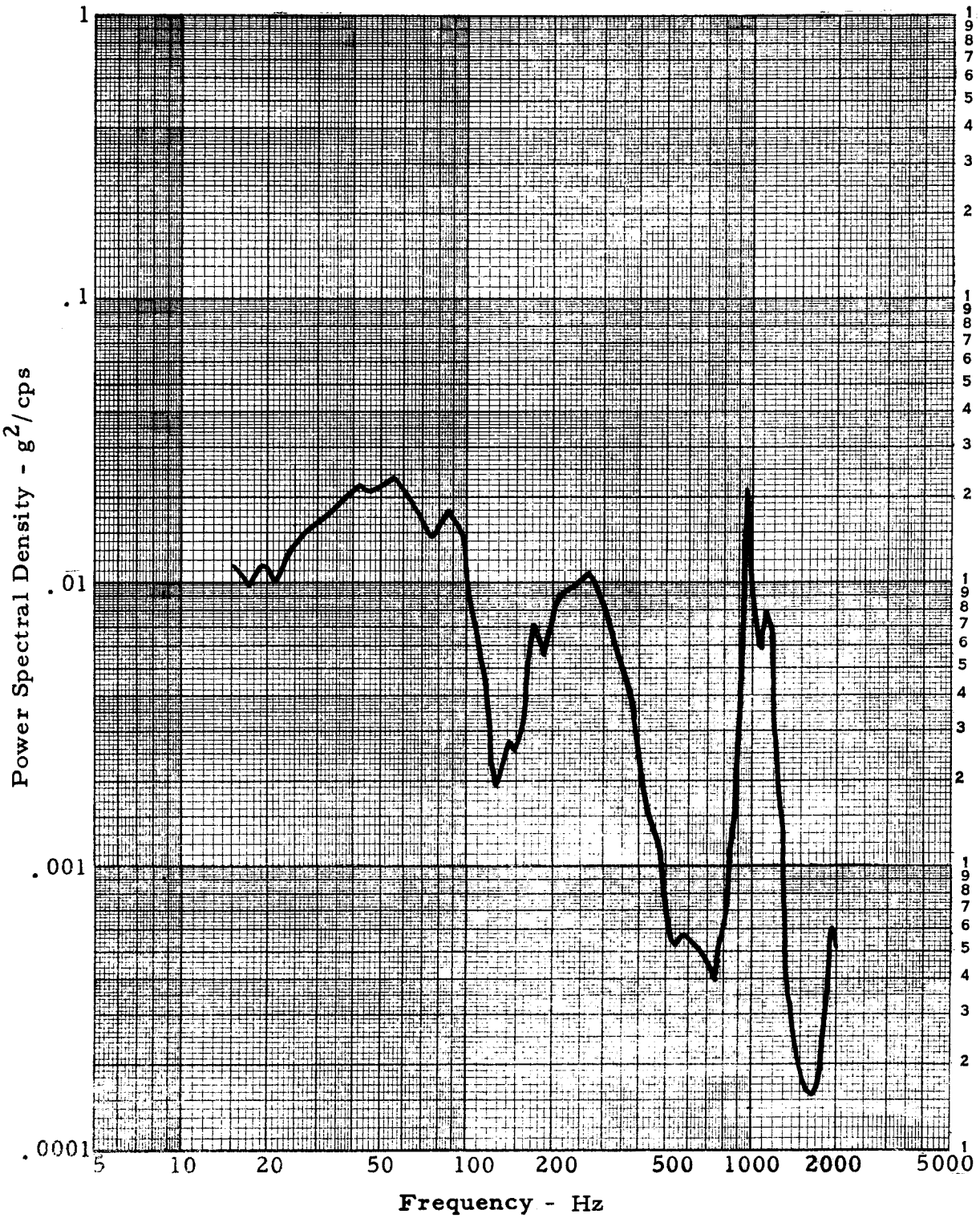
SN: ASE
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. C
Test Date:

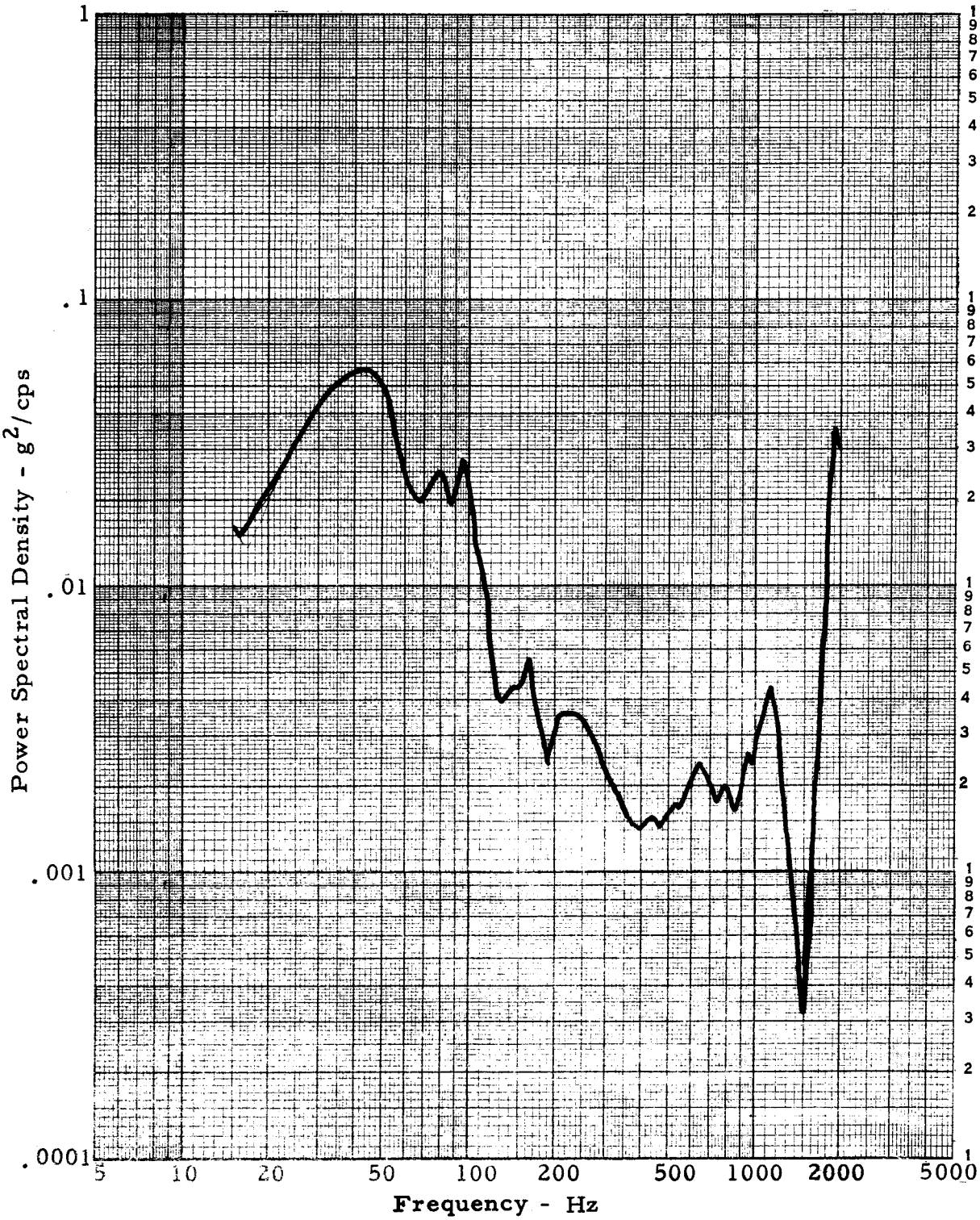
SN: ASE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. C
Test Date:

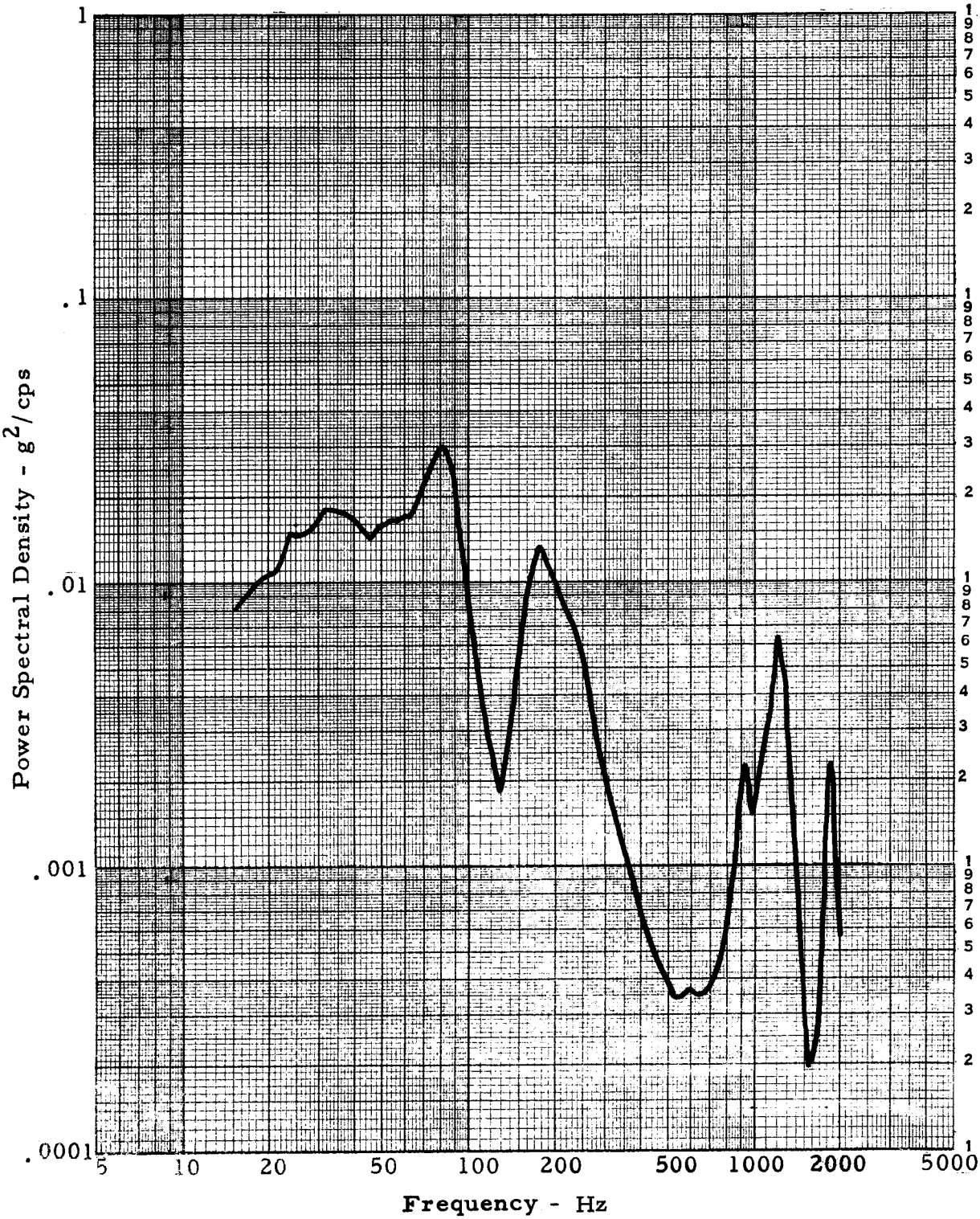
SN: ASE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. C
Test Date:

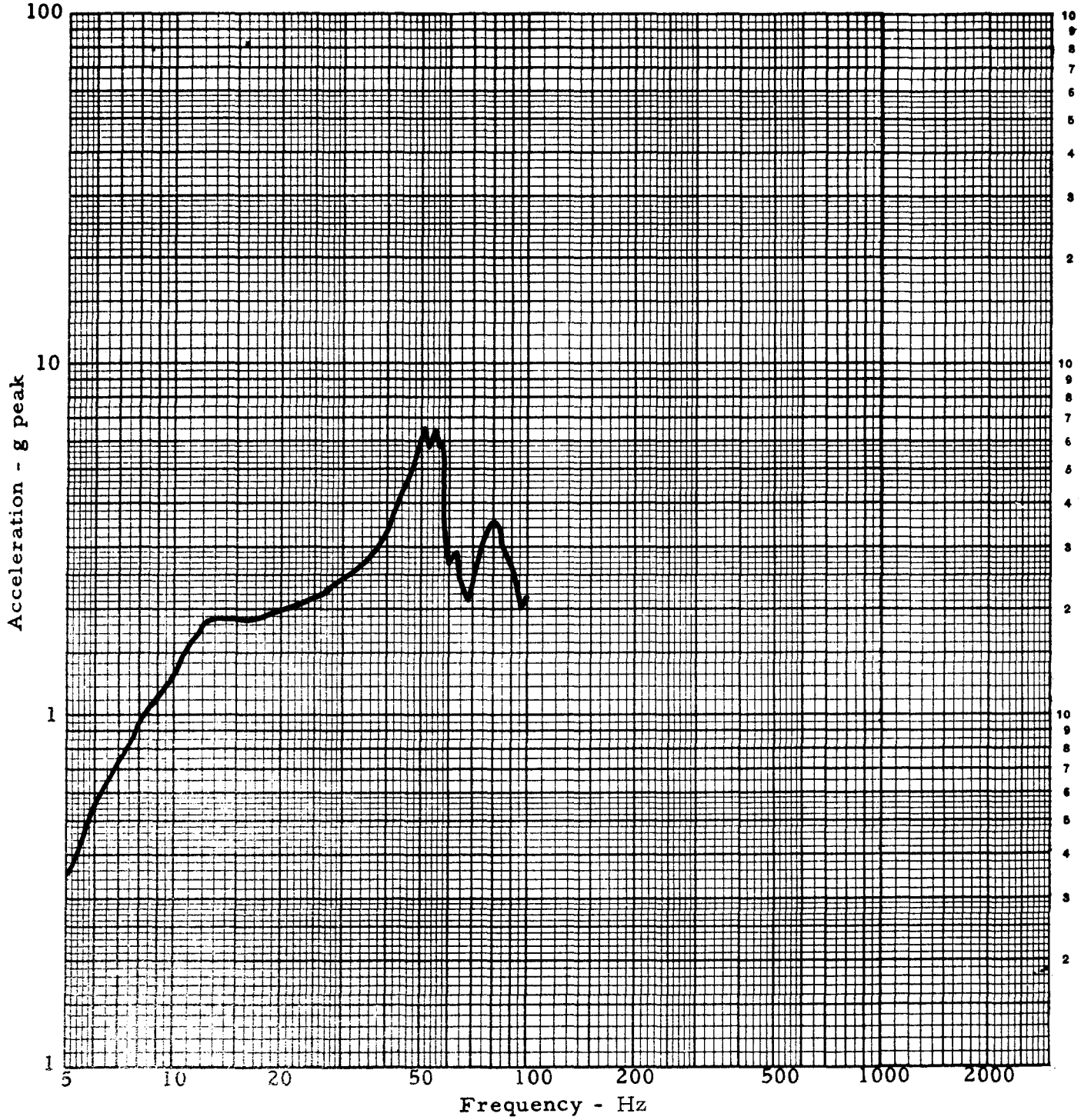
SN: ASE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

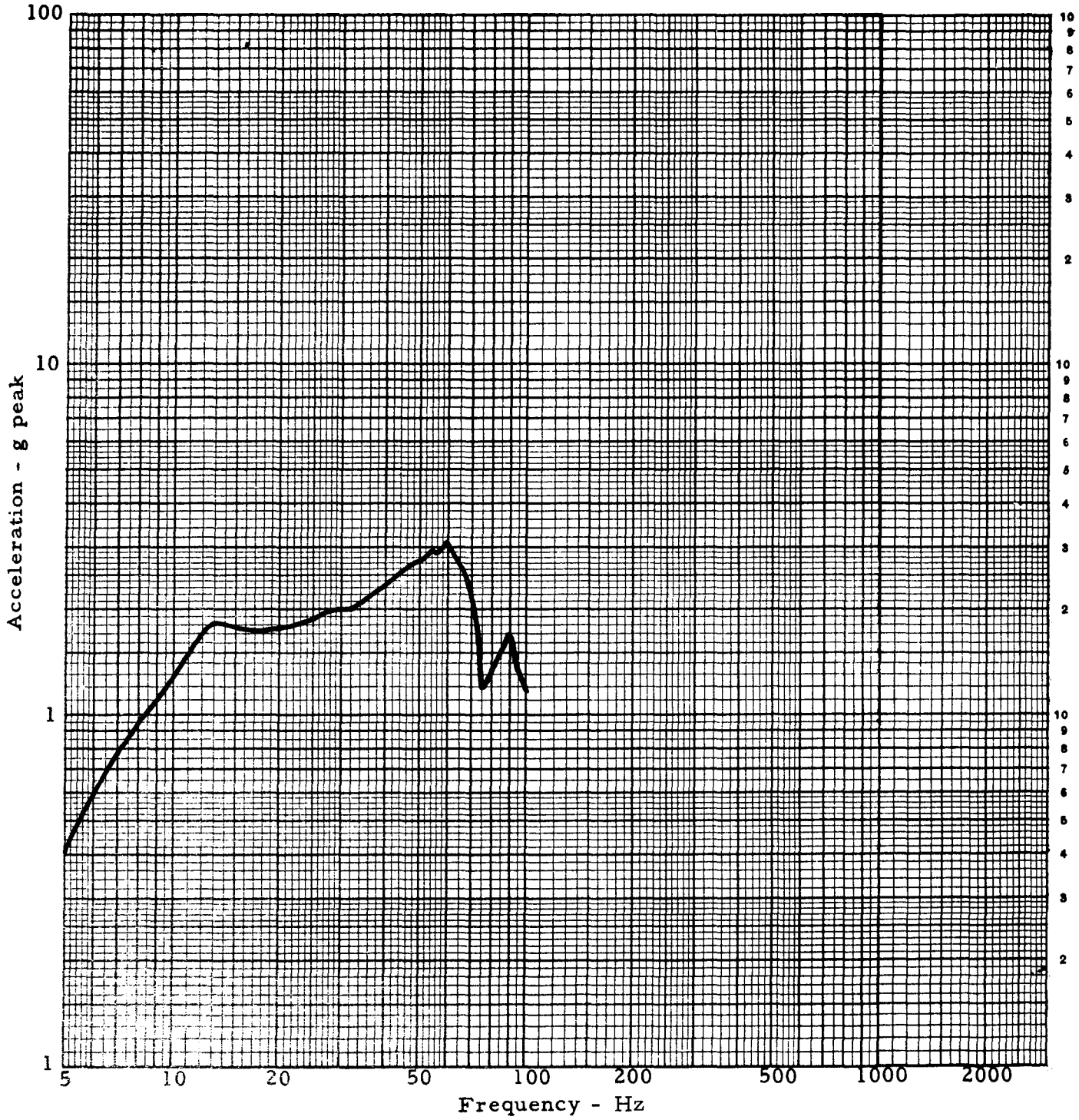
Serial Number: CCGE
Input Axis: X, Y, Z
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

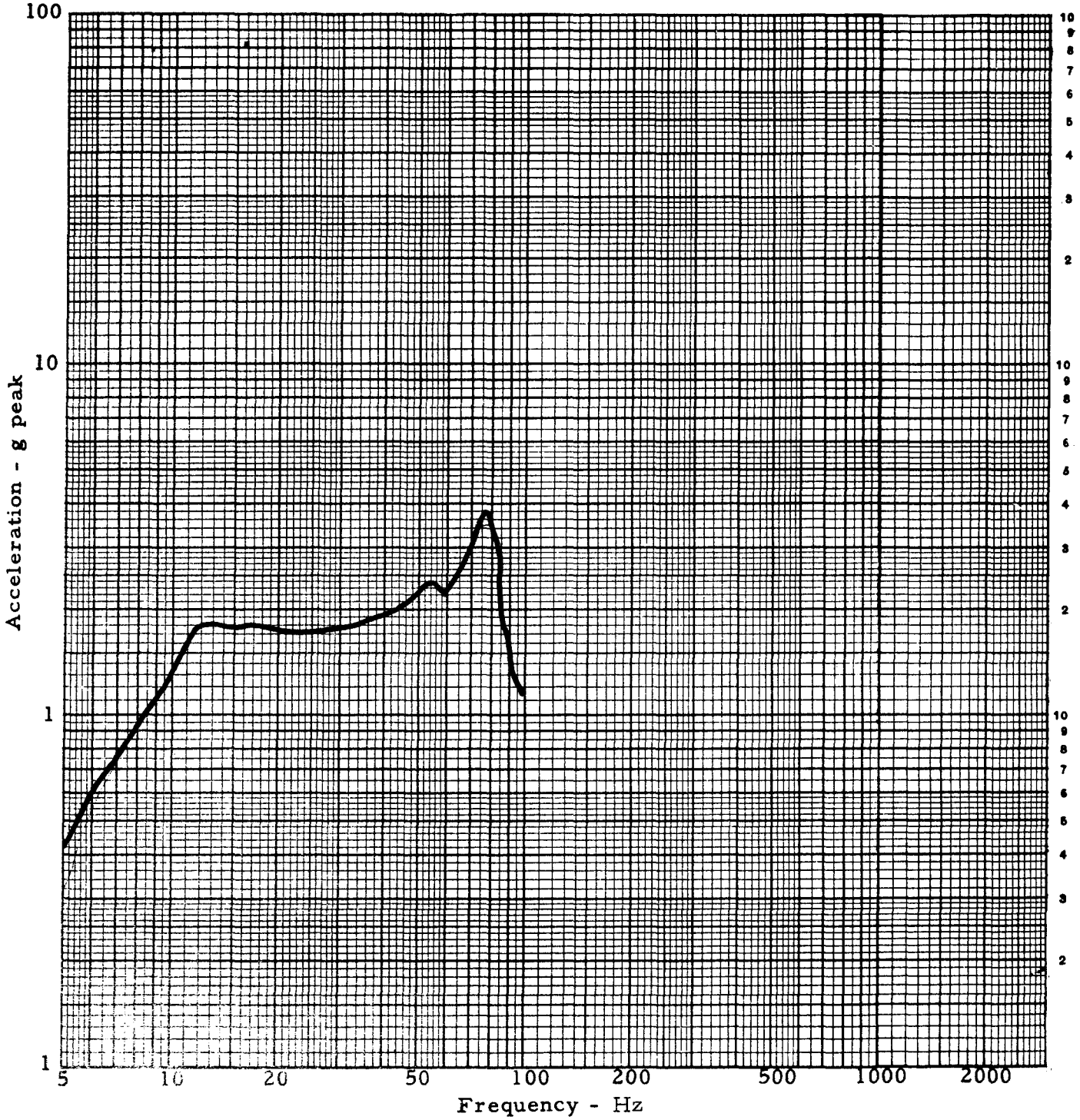
Serial Number: CCGE
Input Axis: X, Y, Z
Response Axis: Y



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

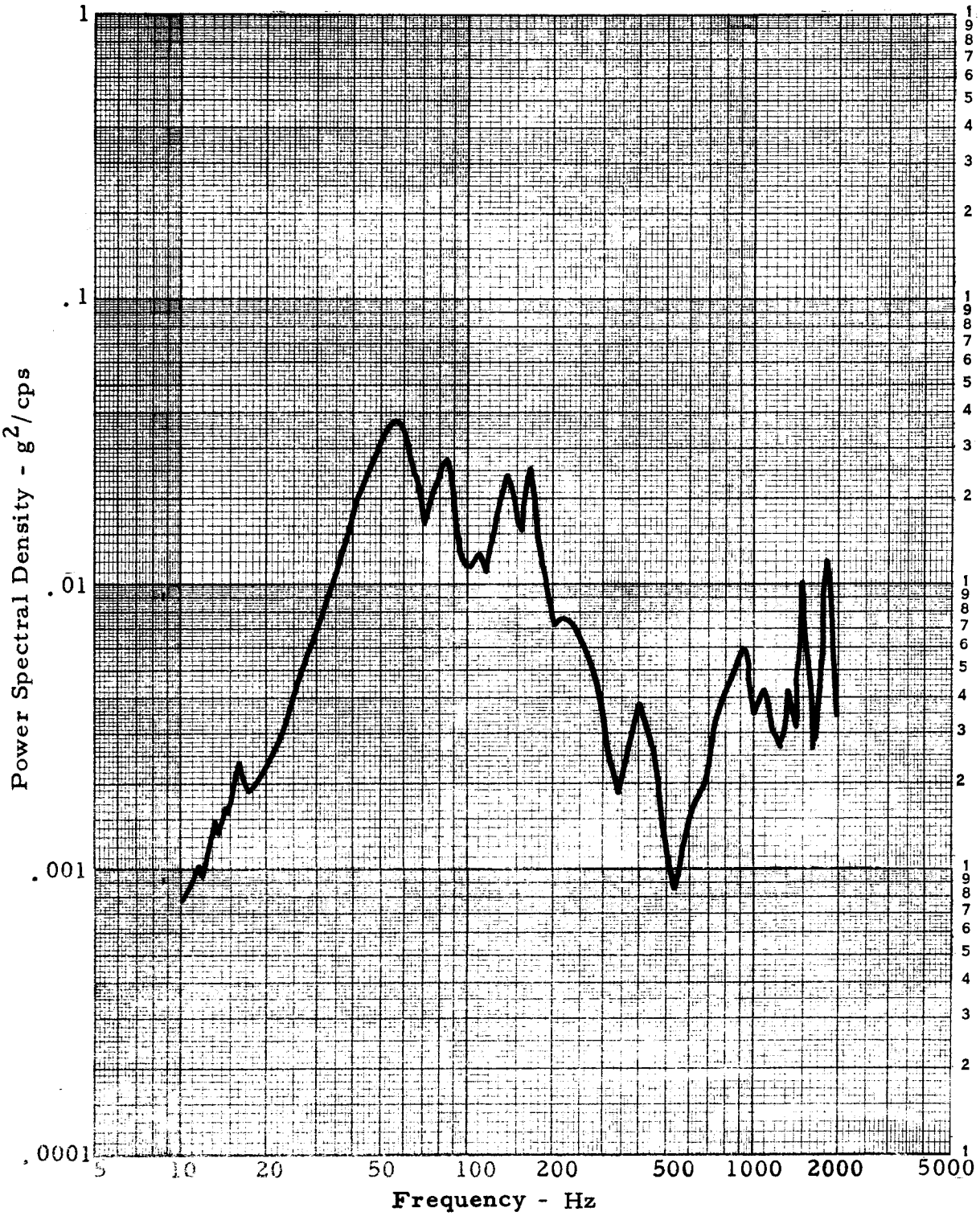
Serial Number: CCGE
Input Axis: X, Y, Z
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

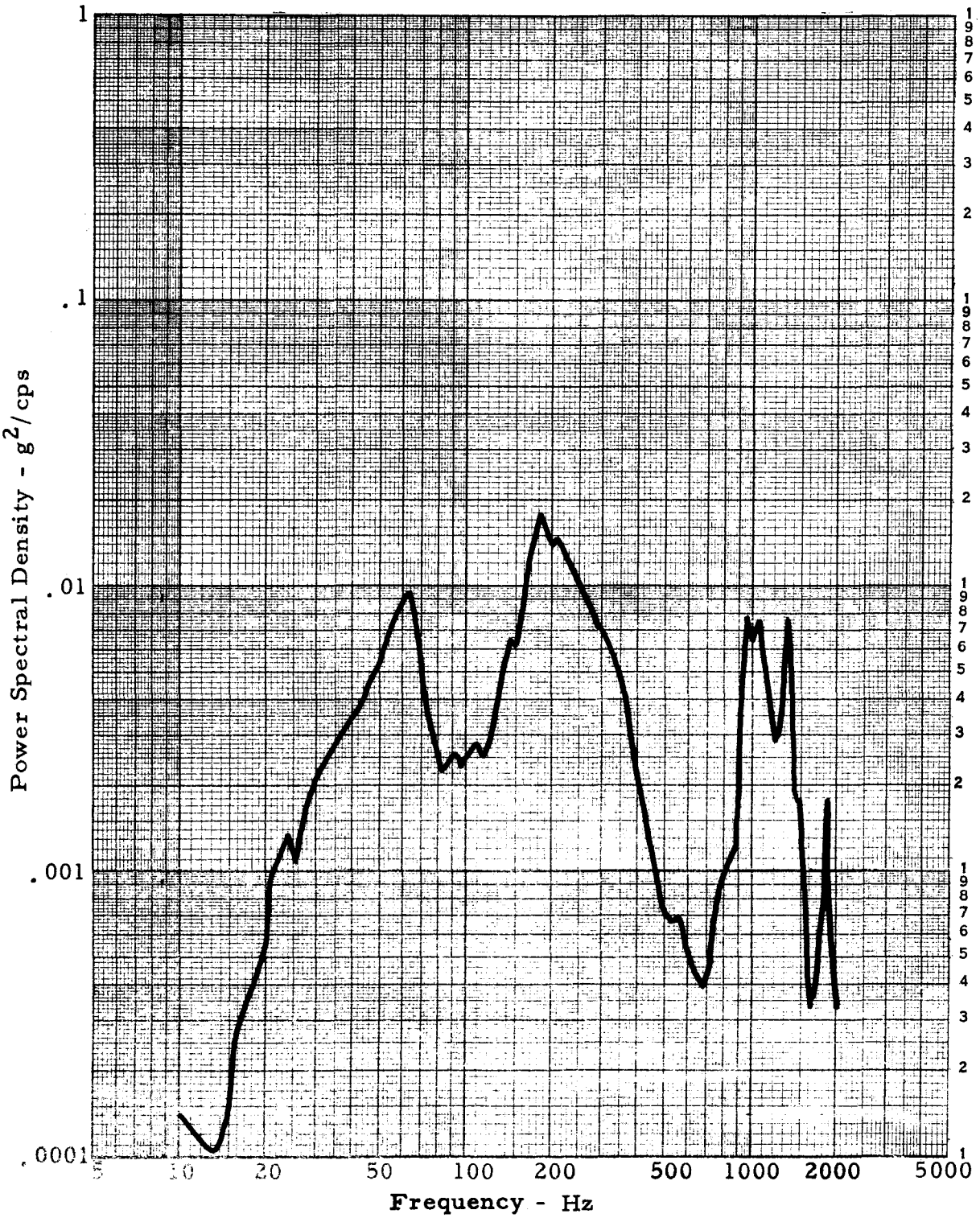
SN: CCGE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL.B
Test Date:

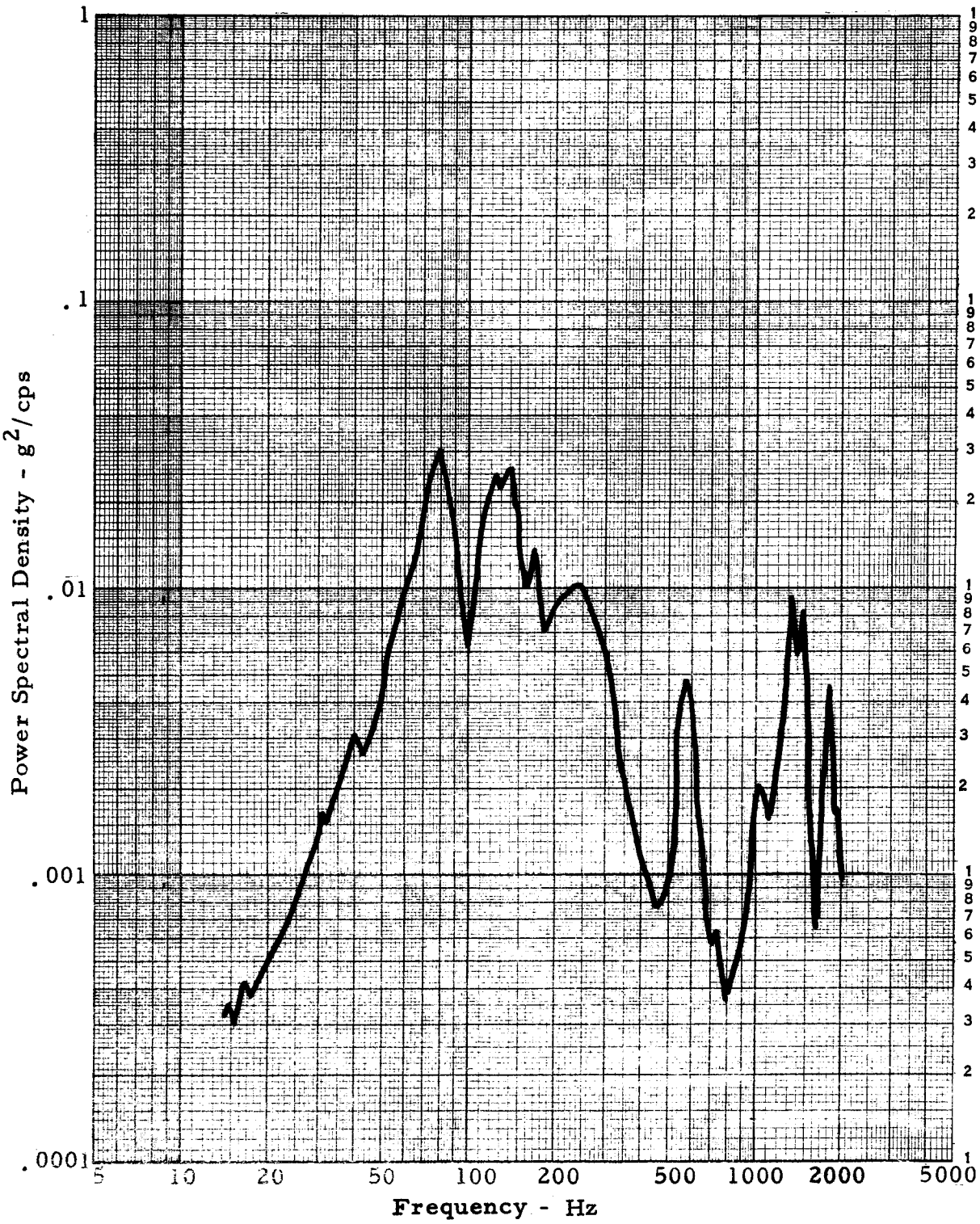
SN: CCGE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

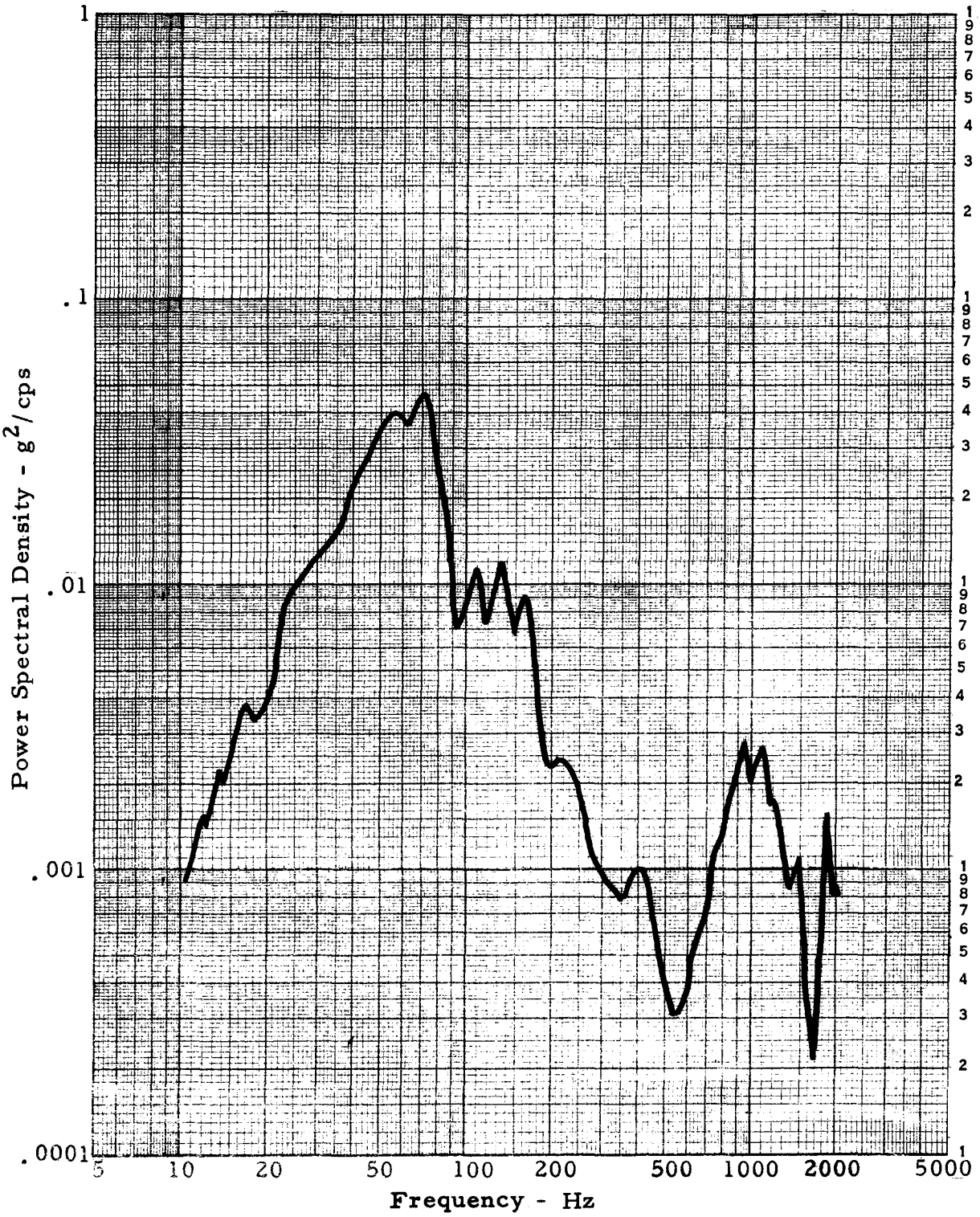
SN: CCGE
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

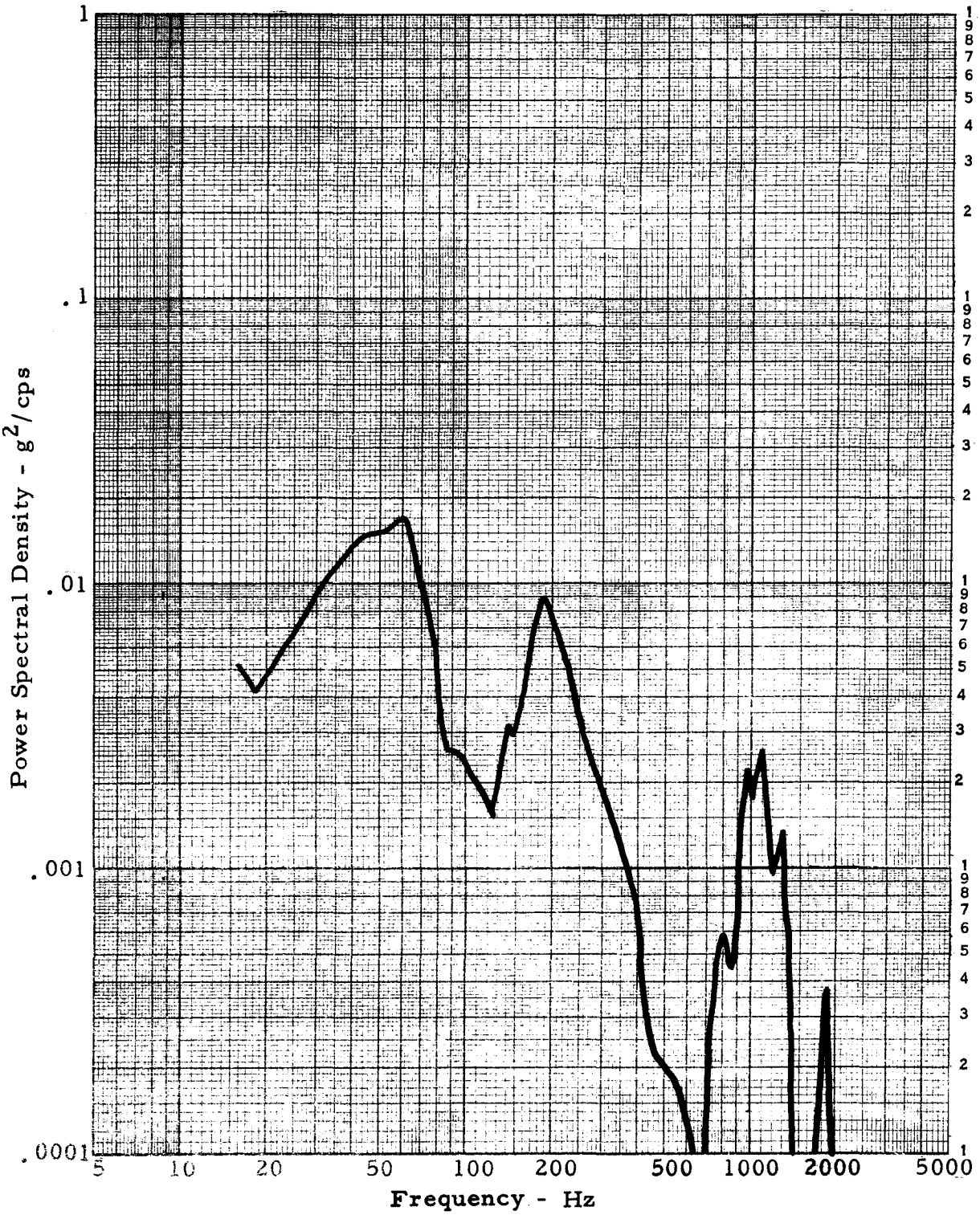
SN: CCGE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL.B
Test Date:

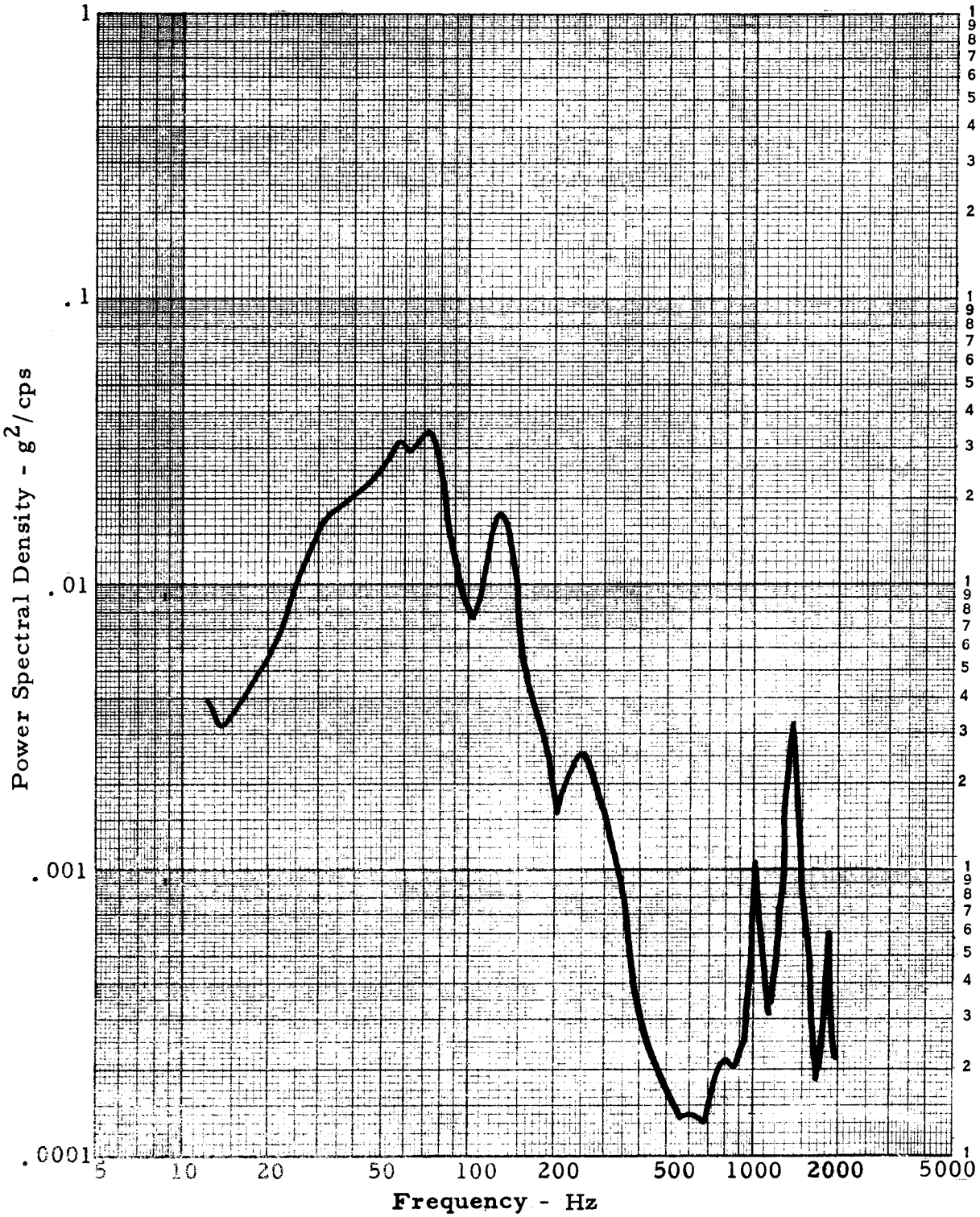
SN: CCGE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

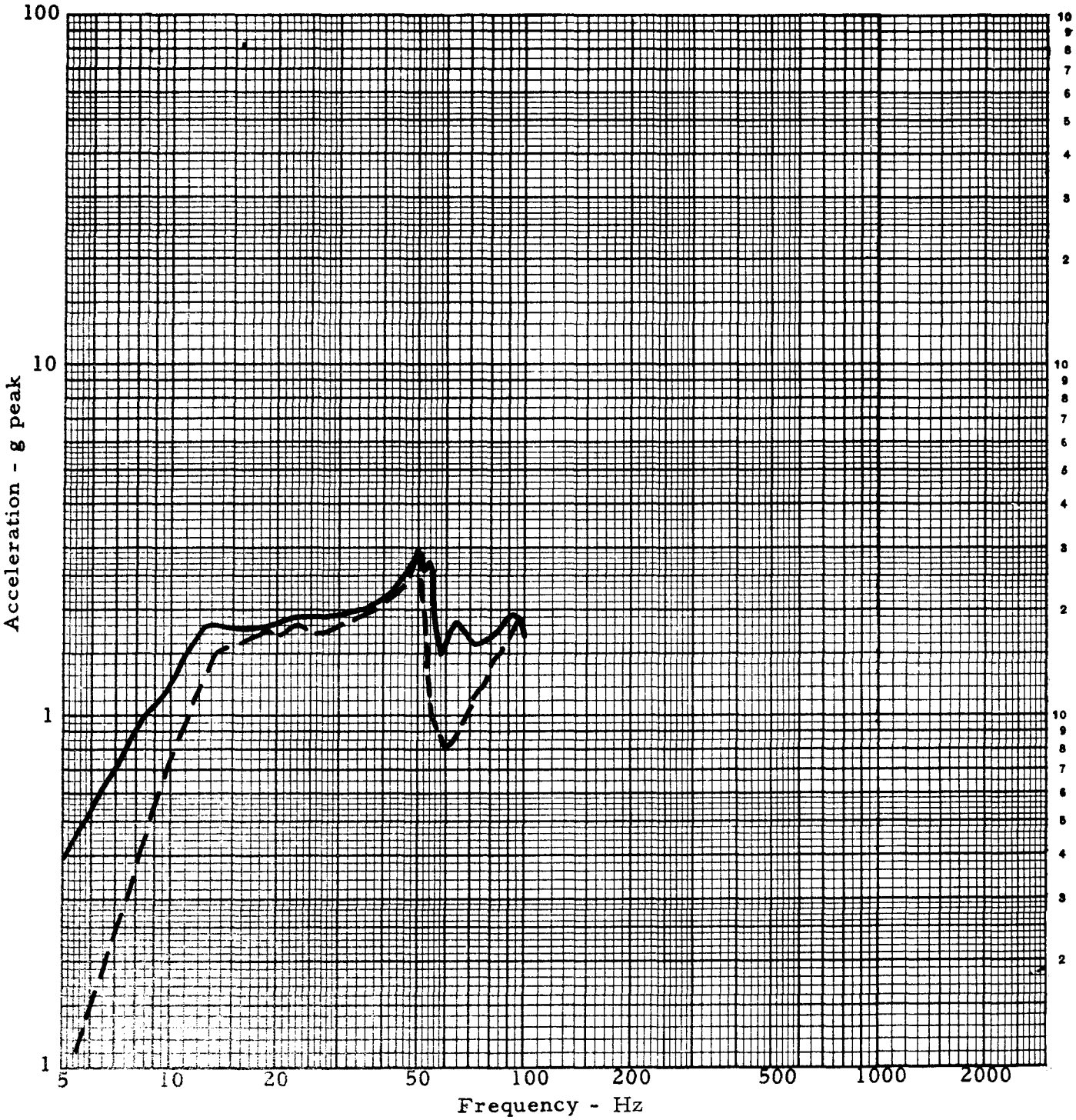
SN: CCGE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C - - - -
(LOC. 3)

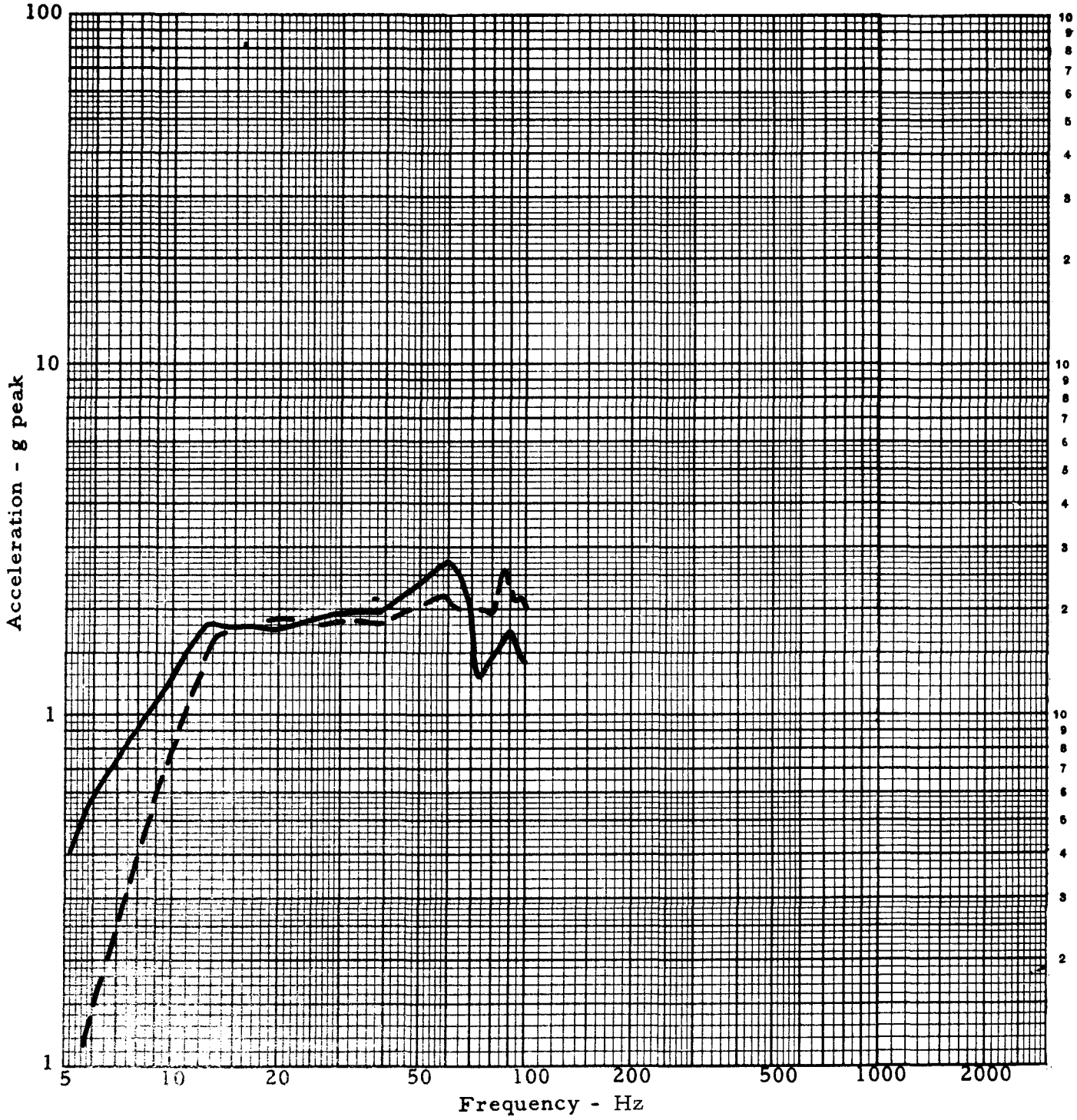
Serial Number: CPLEE
Input Axis: X (only)
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C — — —
(LOC. 3)

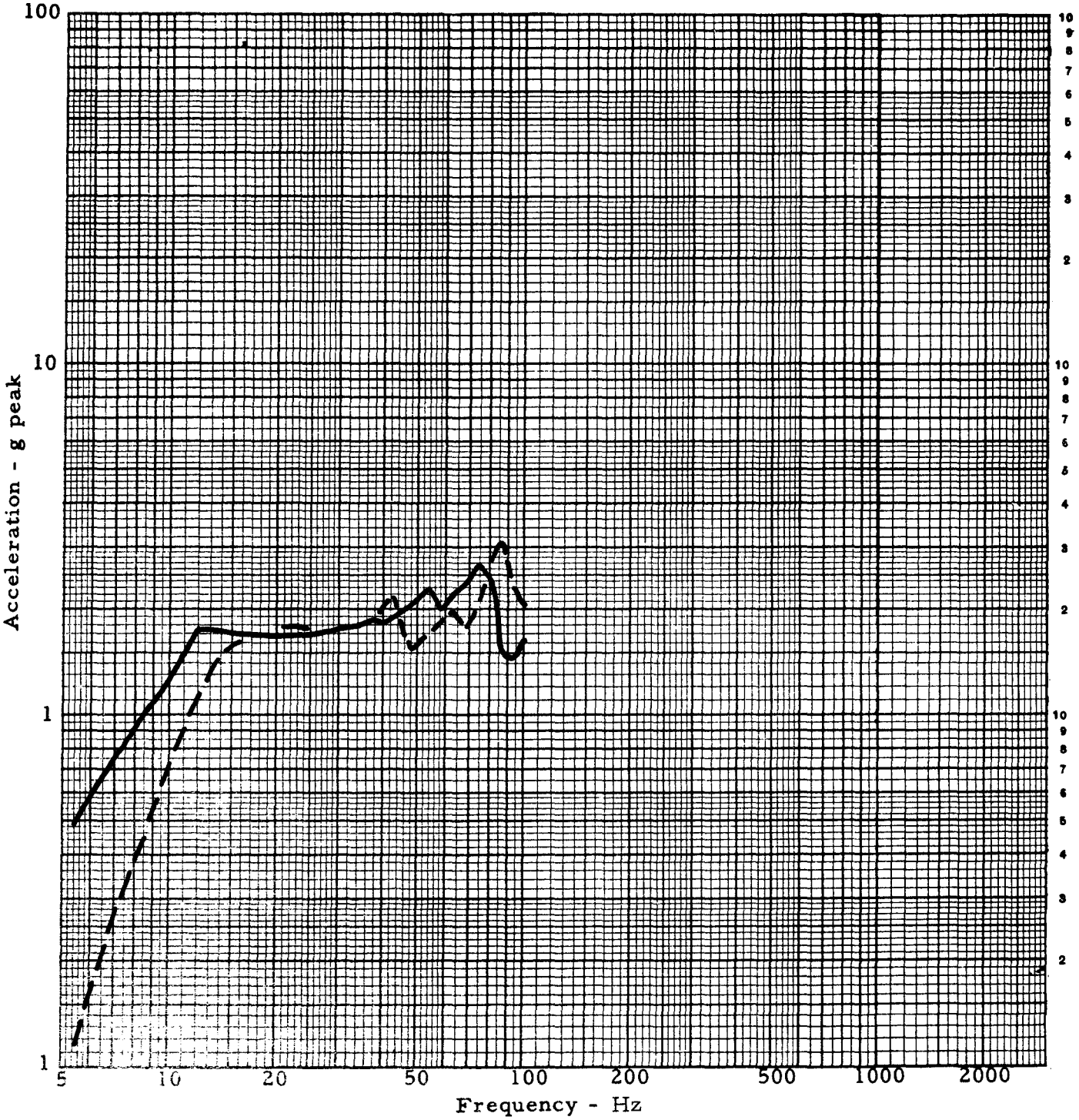
Serial Number: CPLEE
Input Axis: Y (only)
Response Axis: Y



VIBRATION LEVELS

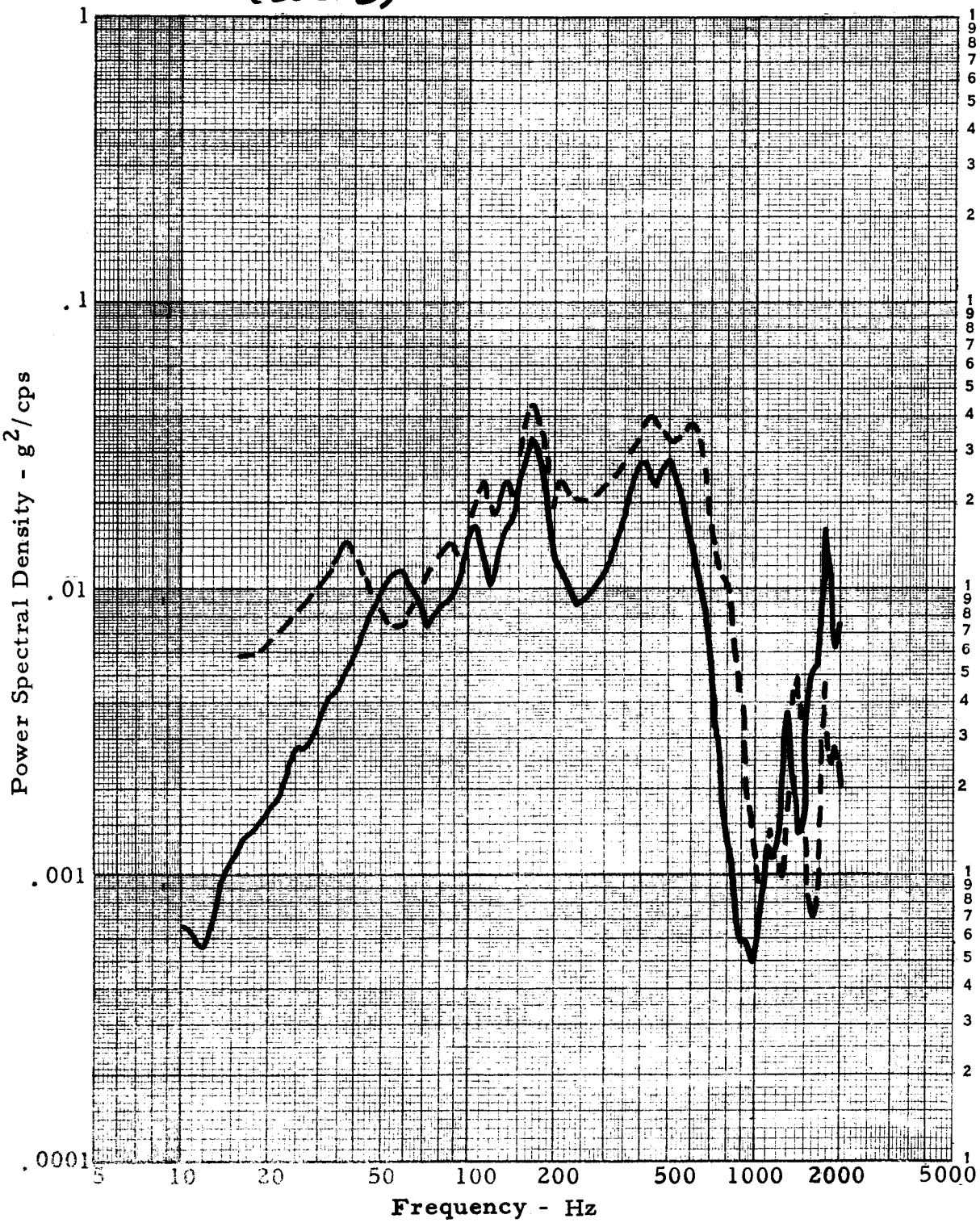
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C - - - -
(LOC. 3)

Serial Number: CPLEE
Input Axis: Z (only)
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B ———— SN: CPLEE
~~Test Date:~~ QUAL. C - - - - Axis: X
(LOC. 3)

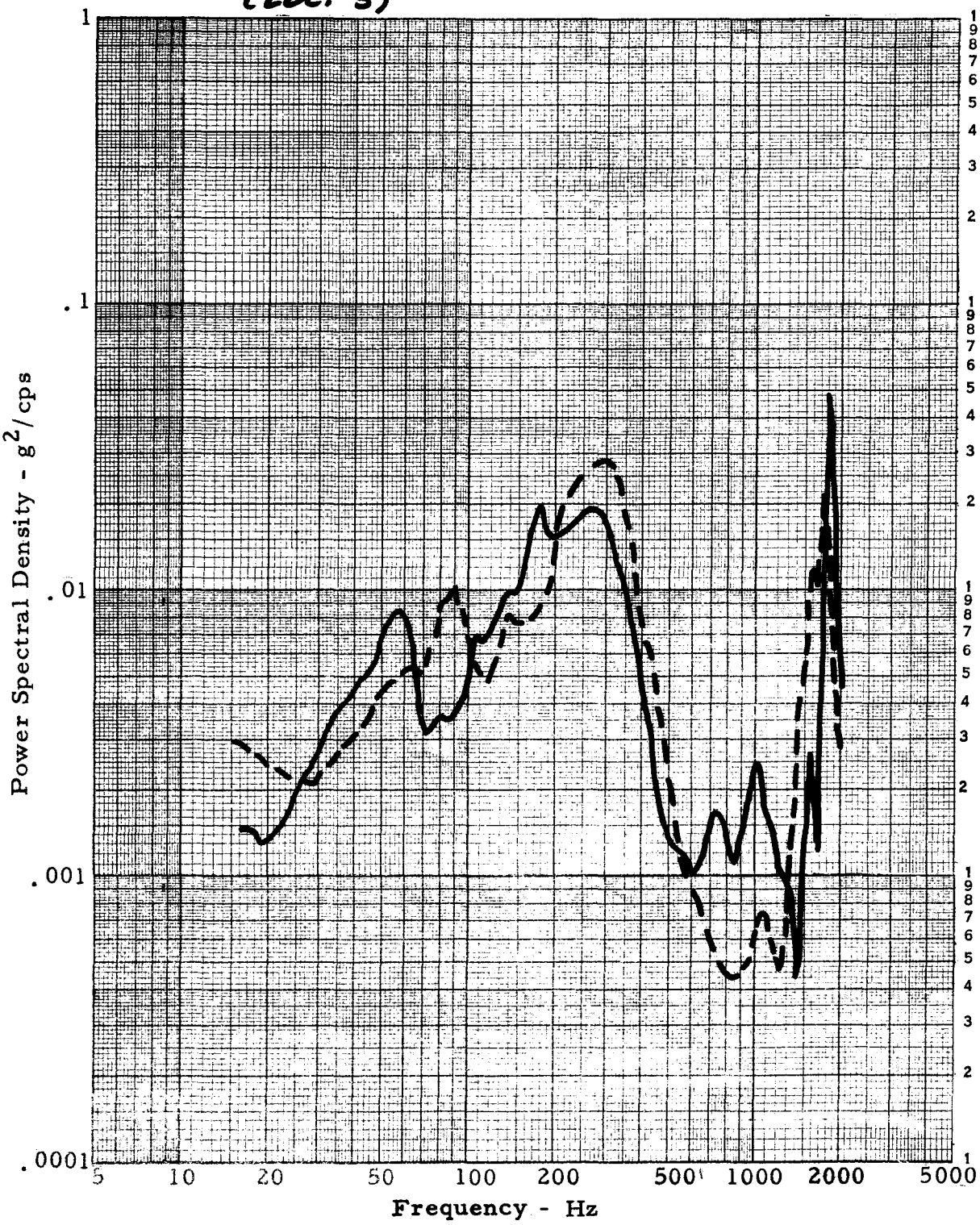


Note: X-input only

RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C — — —
(LOC. 3)

SN: CPLEE
Axis: Y



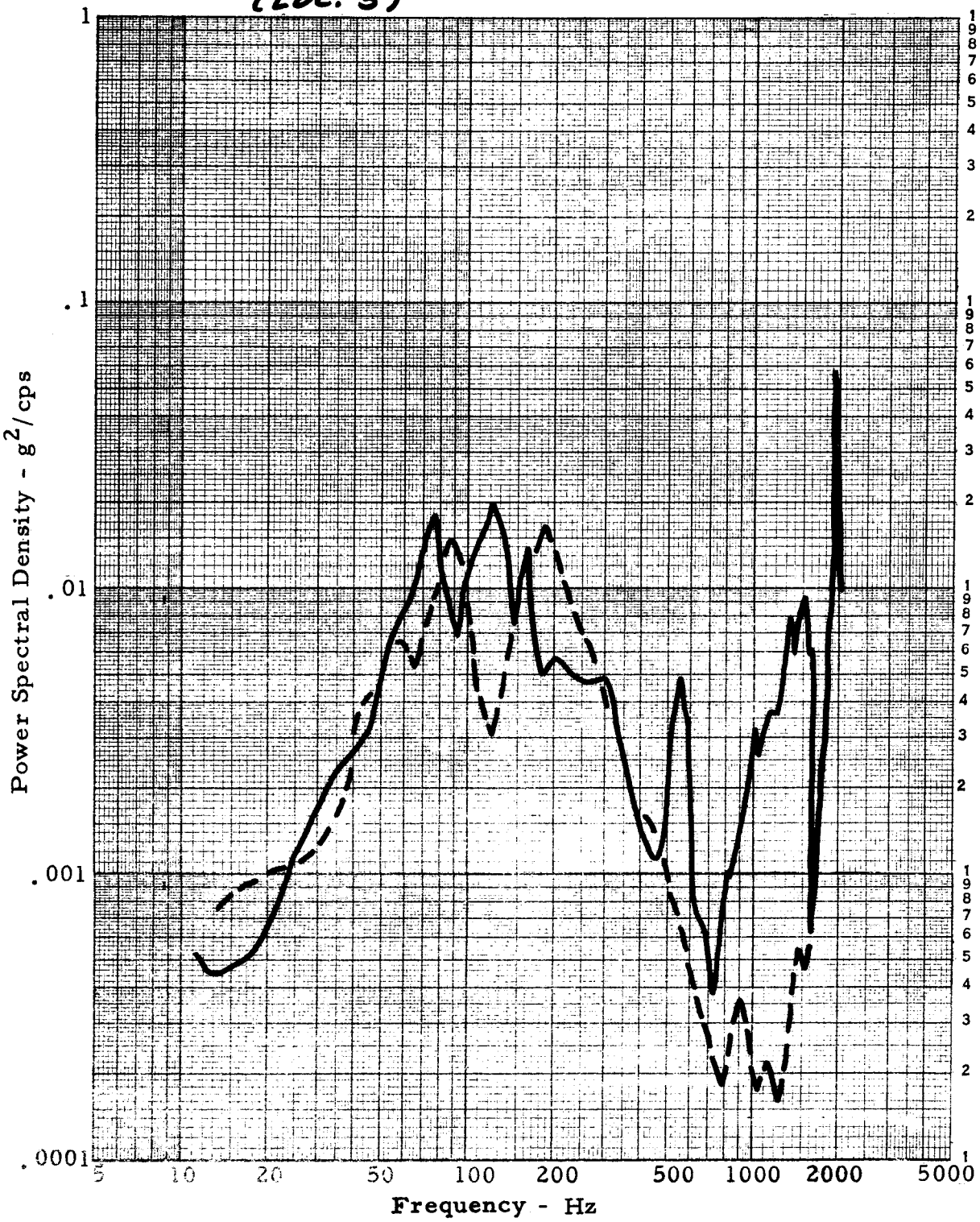
440-13A

Note: Y-input only

RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C — — —
(LOC. 3)

SN: CPLEE
Axis: Z



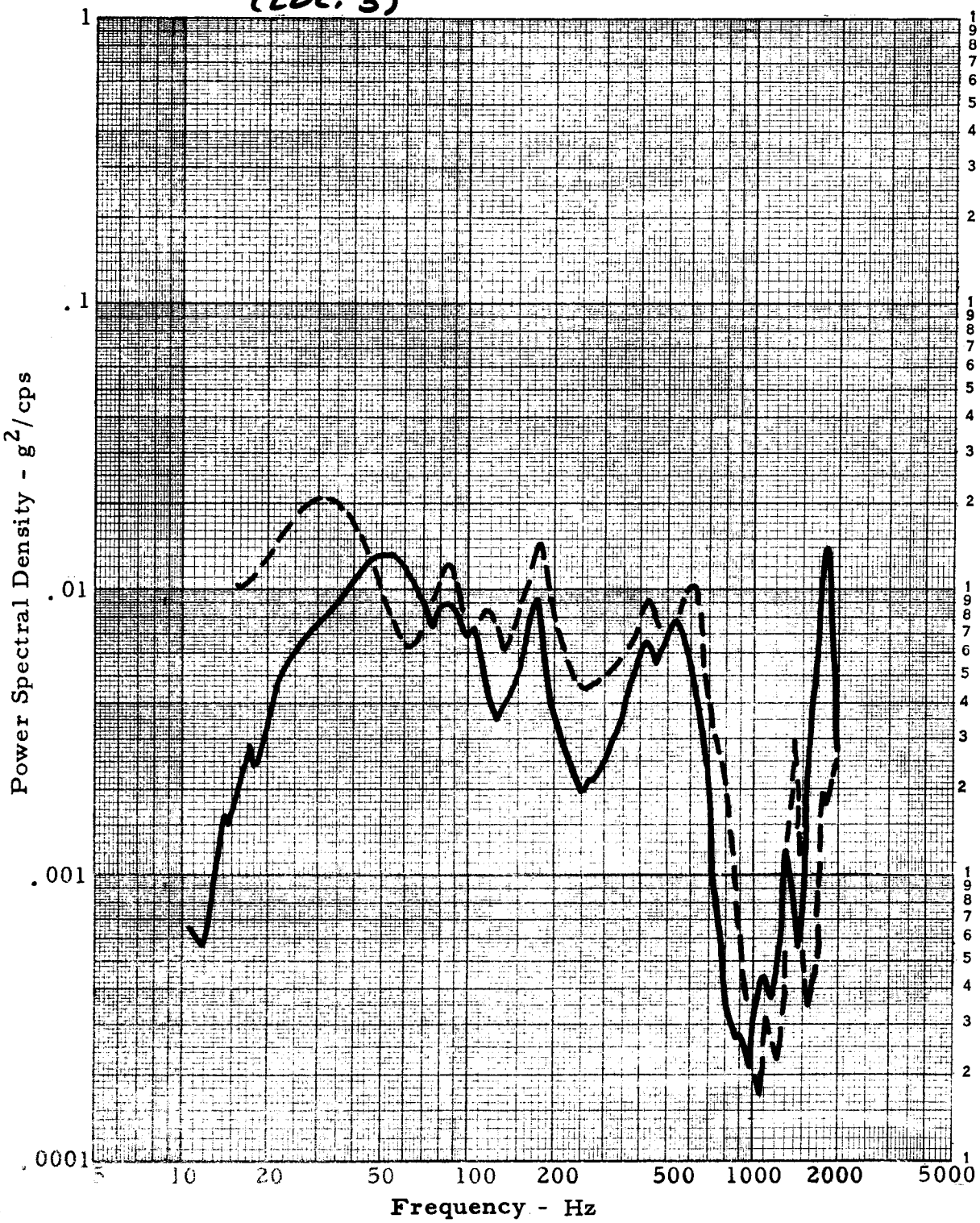
440-13A

Note: Z-input only

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C - - -
(LOC. 3)

SN: CPLEE
Axis: X



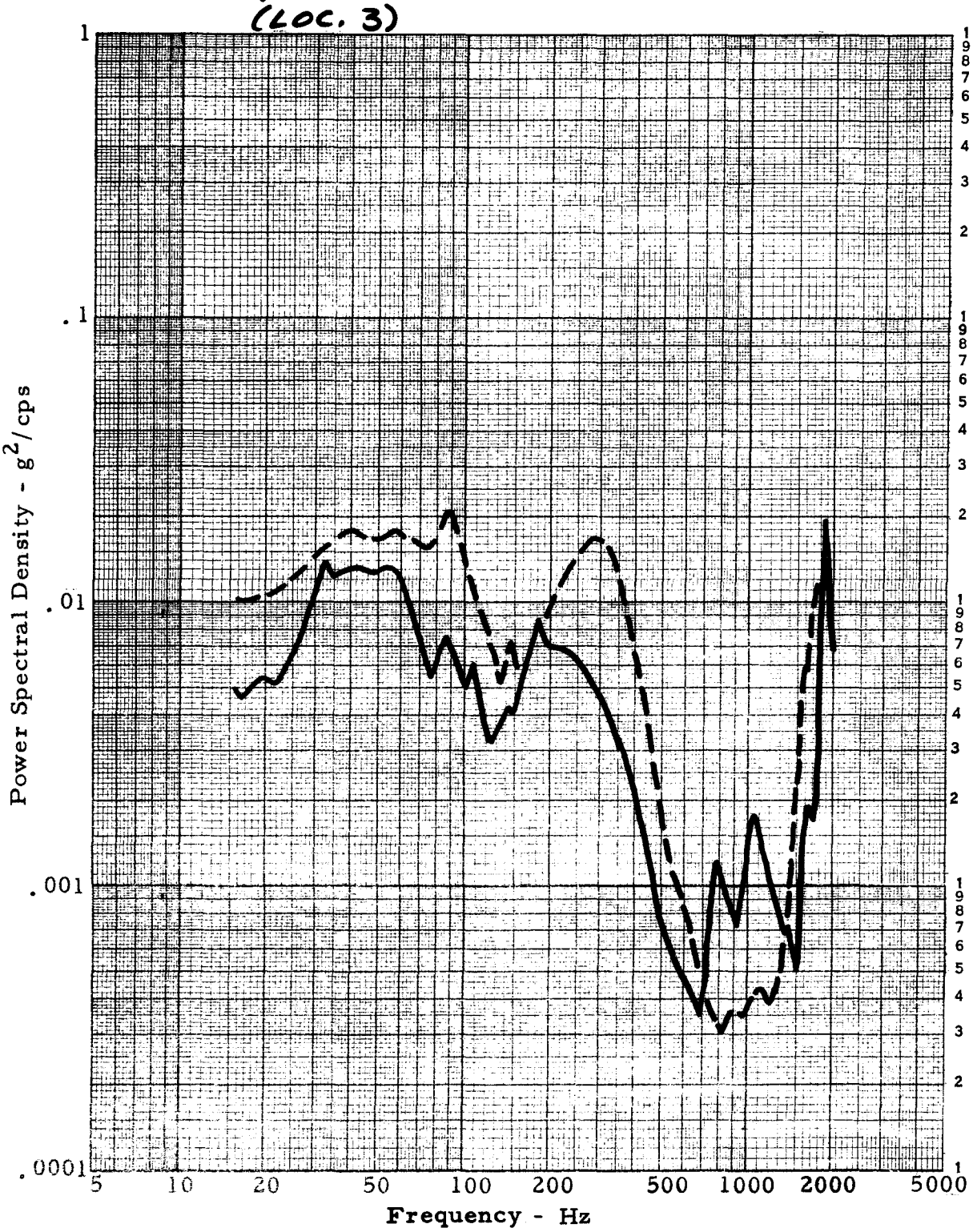
440-13A

Note: X-input only

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B ———
~~Test Data:~~ QUAL. C — — —
(LOC. 3)

SN: CPLEE
Axis: Y

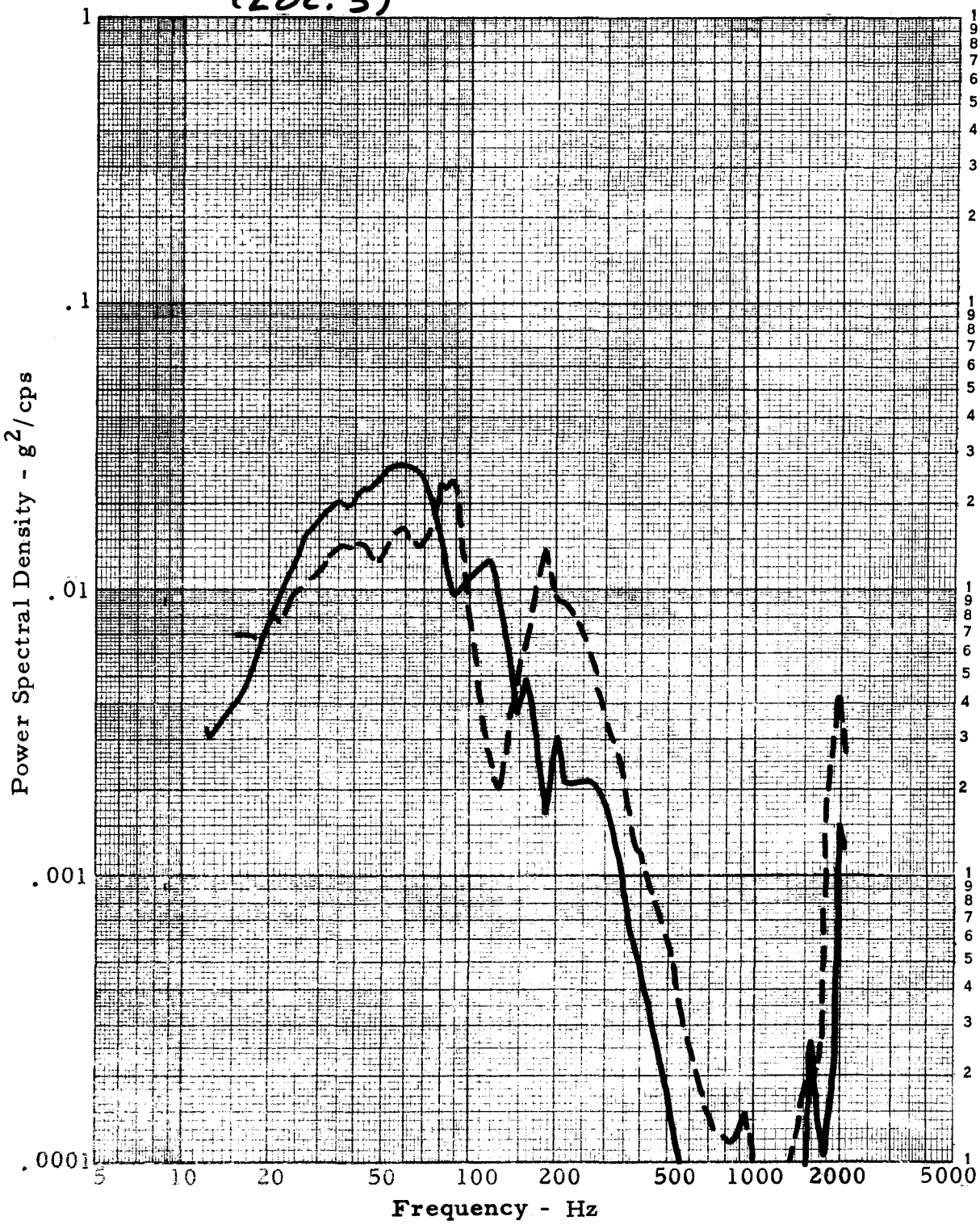


Note: Y-input only

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B ———
~~Test Date~~: QUAL. C - - -
(LOC. 3)

SN: CPLEE
Axis: Z

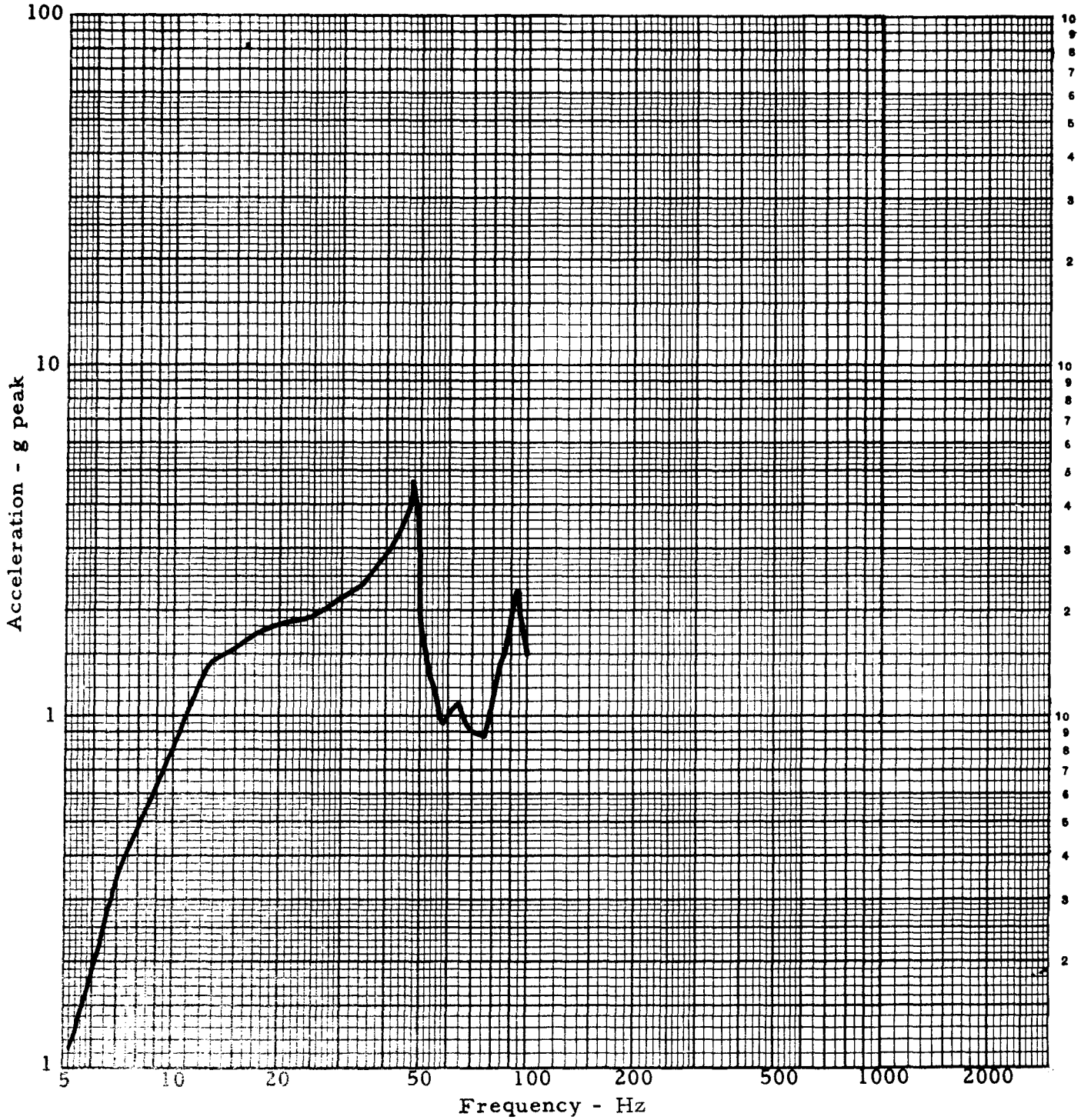


NOTE: Z-input only

VIBRATION LEVELS

Test Item: QUAL. C
Test Date:

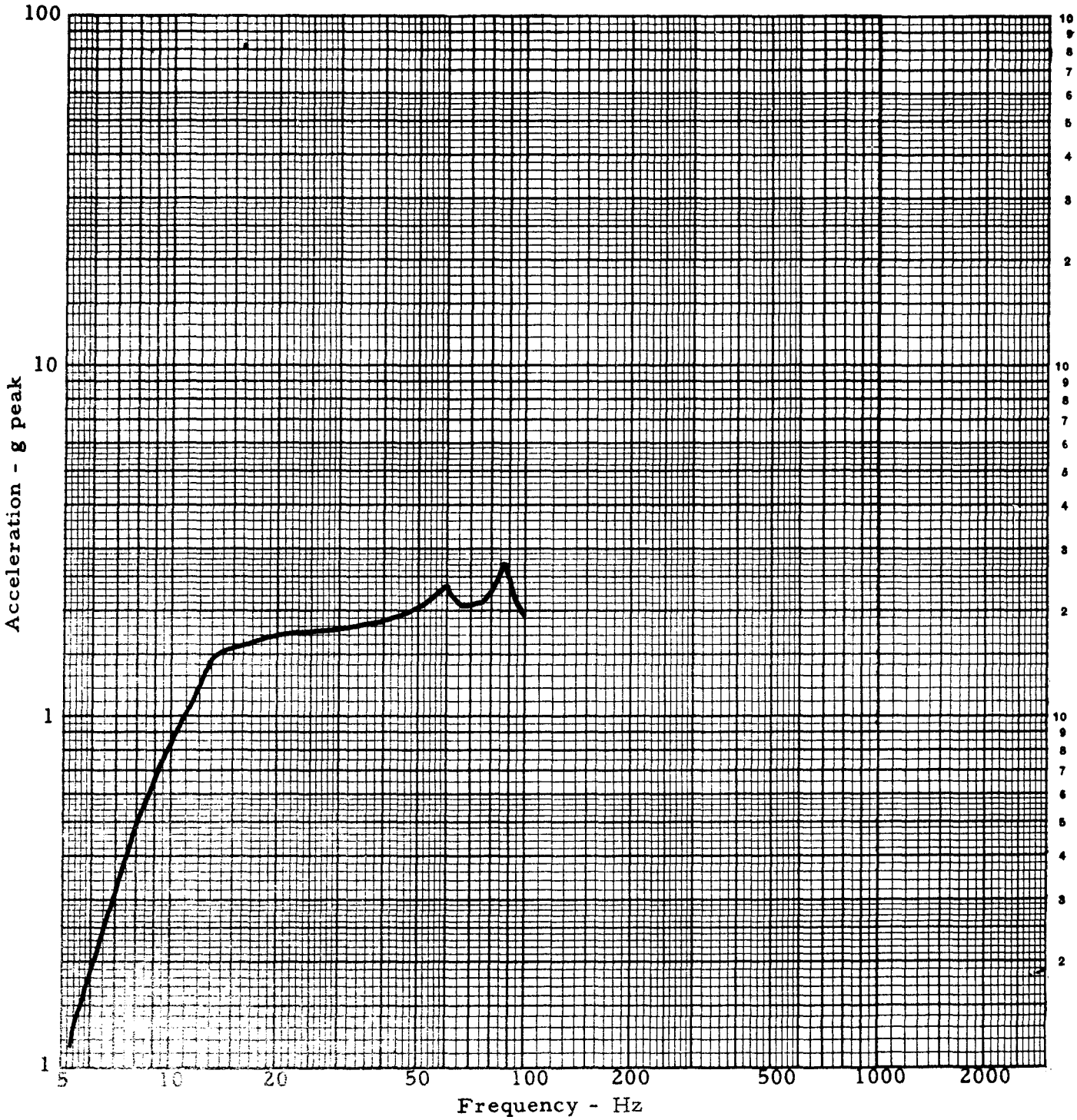
Serial Number: CPLEE (LOC. 2)
Input Axis: X, Y, Z
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. C
Test Date:

Serial Number: CPLEE (LOC. 2)
Input Axis: X, Y, Z
Response Axis: Y

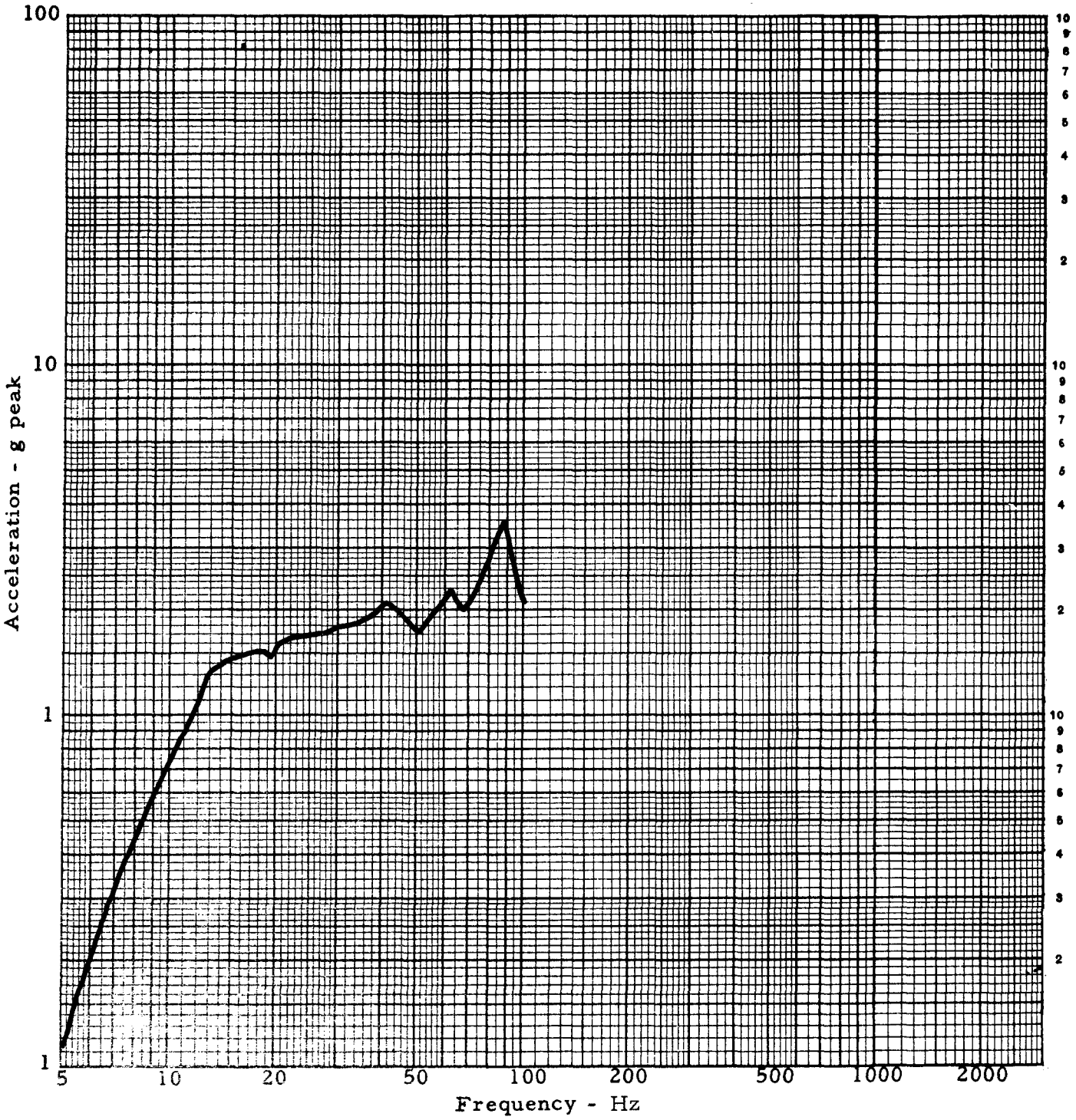


440-8 A

VIBRATION LEVELS

Test Item: QUAL. C
Test Date:

Serial Number: CPLEE (LOC. 2)
Input Axis: X, Y, Z
Response Axis: Z

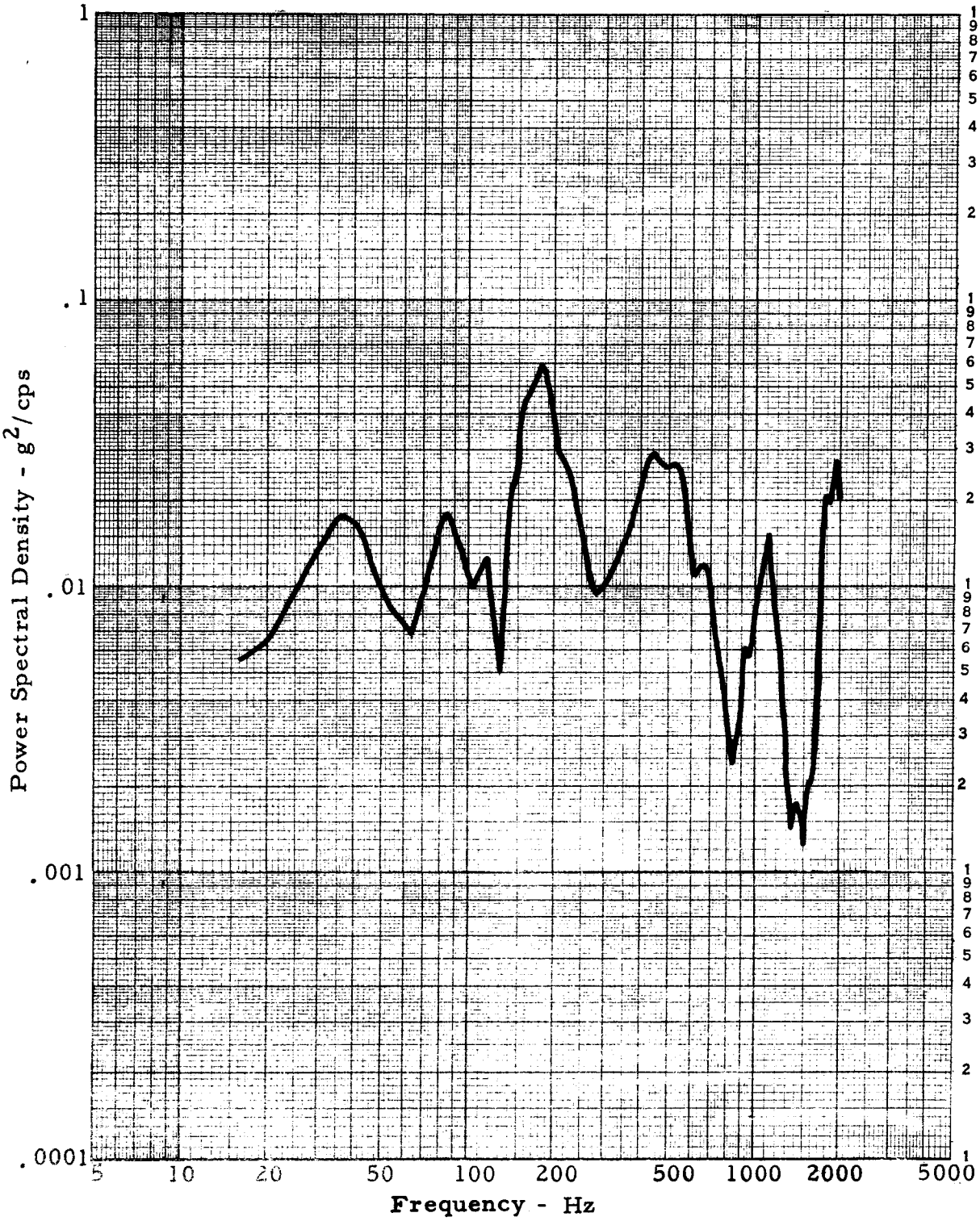


440-8 A

RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. C
Test Date:

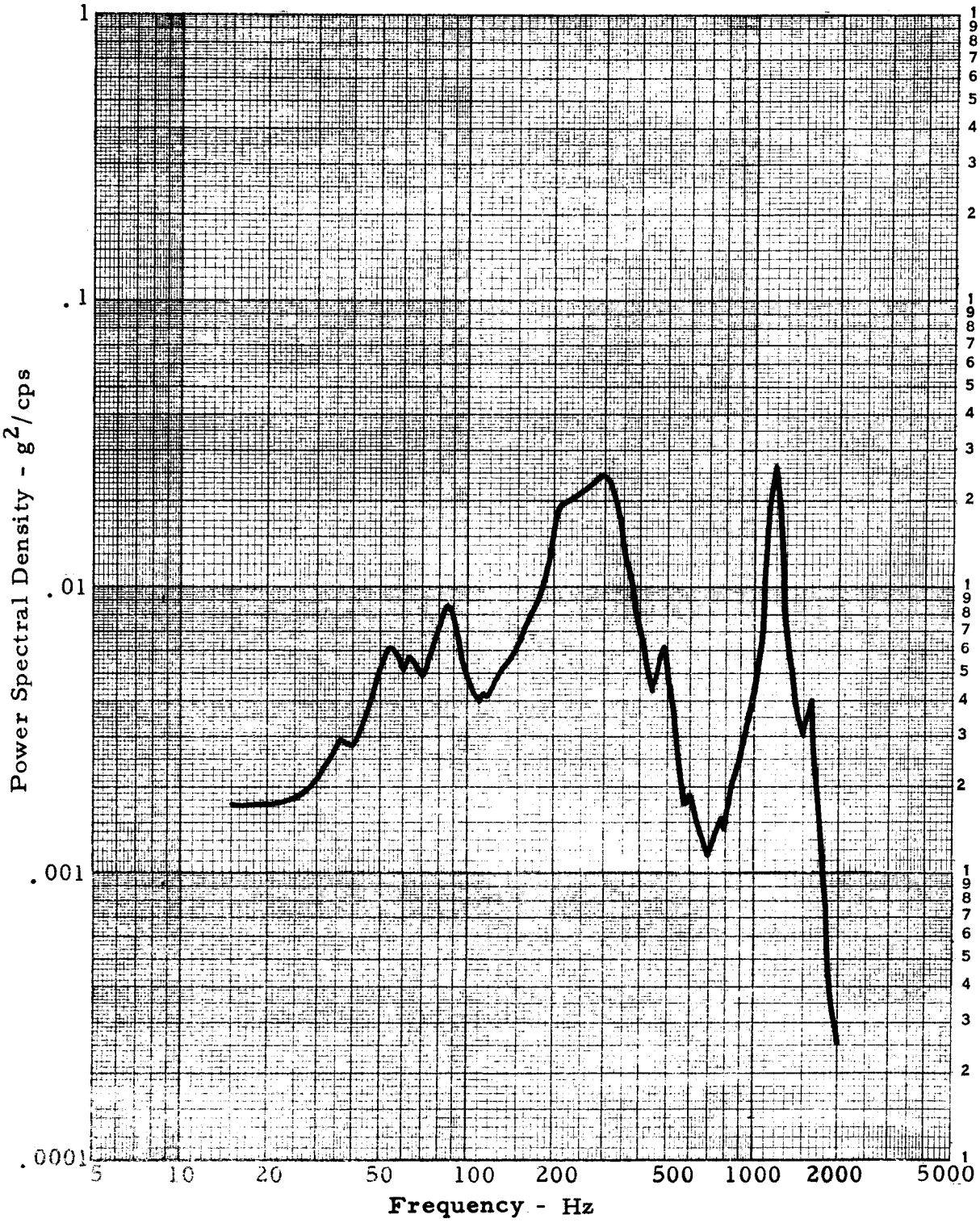
SN: CPLEE (LOC. 2)
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. C
Test Date:

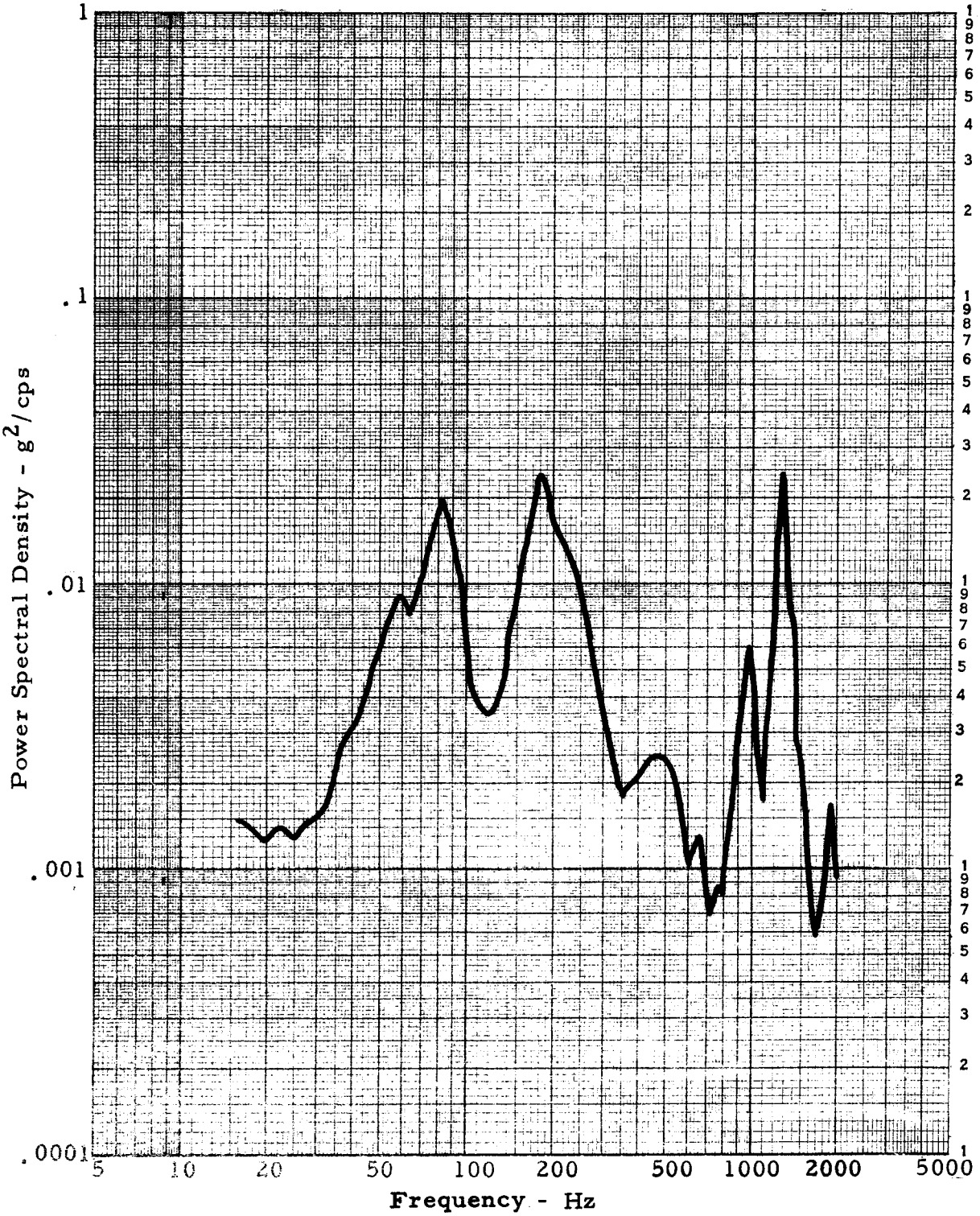
SN: CPLEE (LOC. 2)
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. C
Test Date:

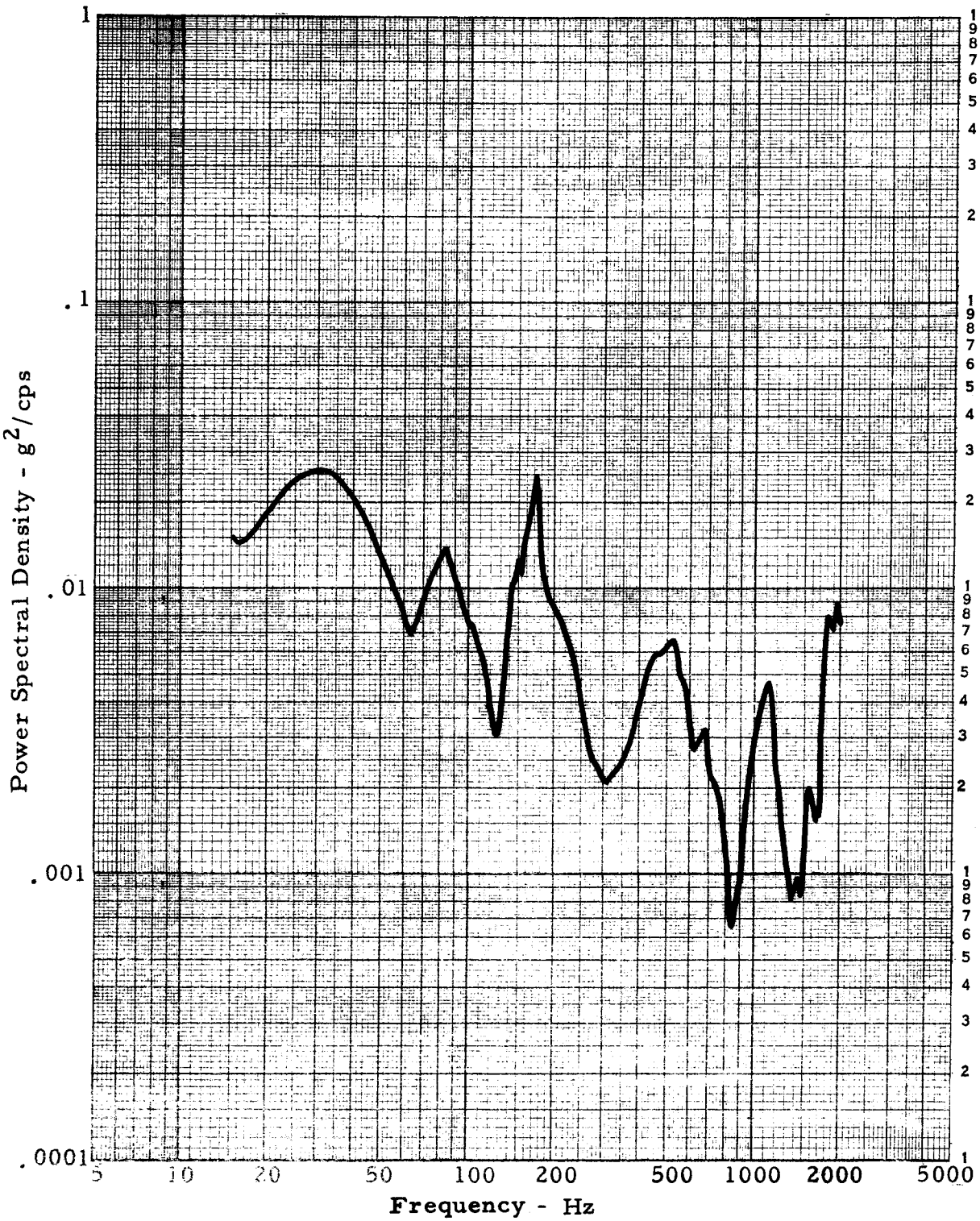
SN: CPLEE (LOC. 2)
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. C
Test Date:

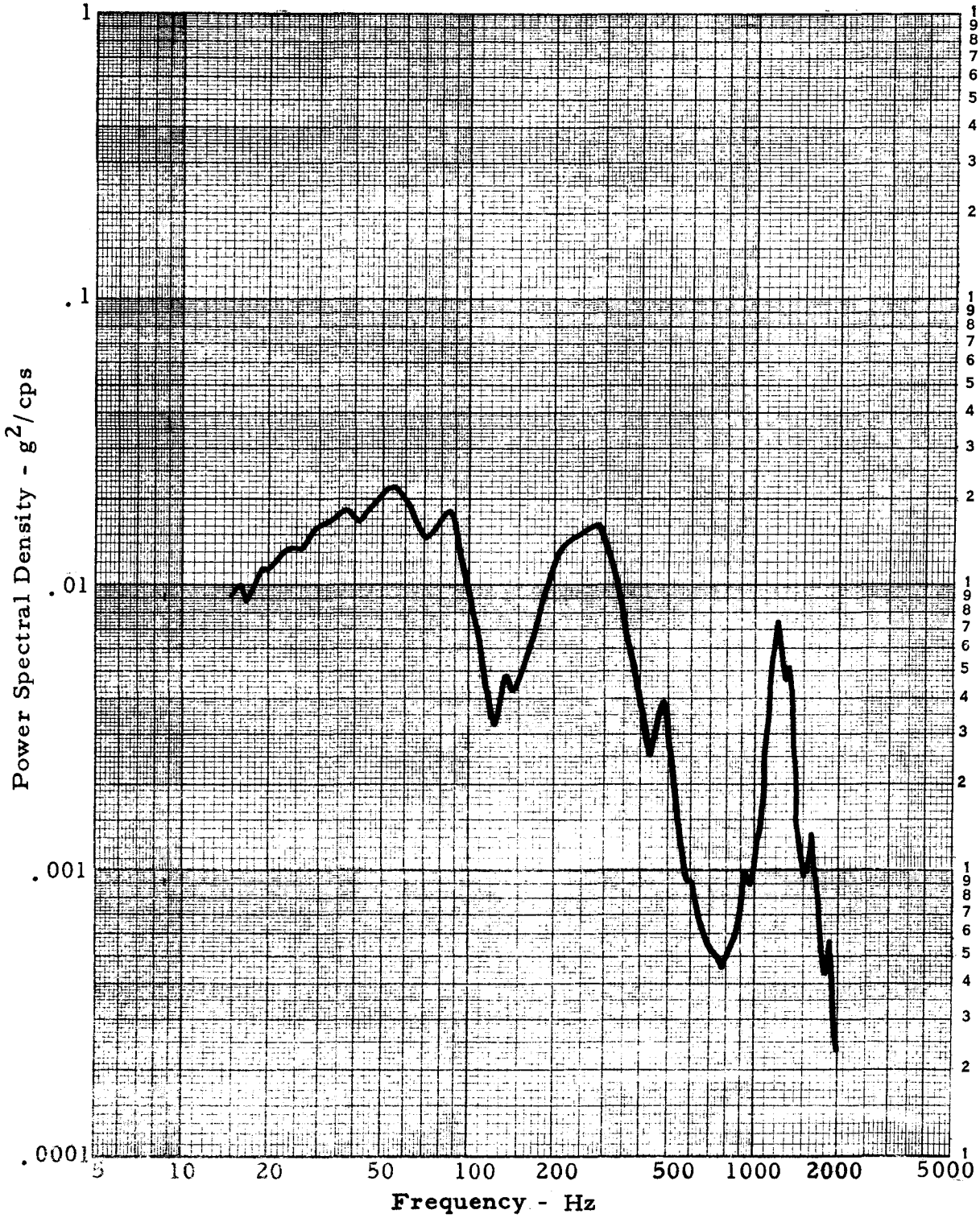
SN: CPLEE (LOC. 2)
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. C
Test Date:

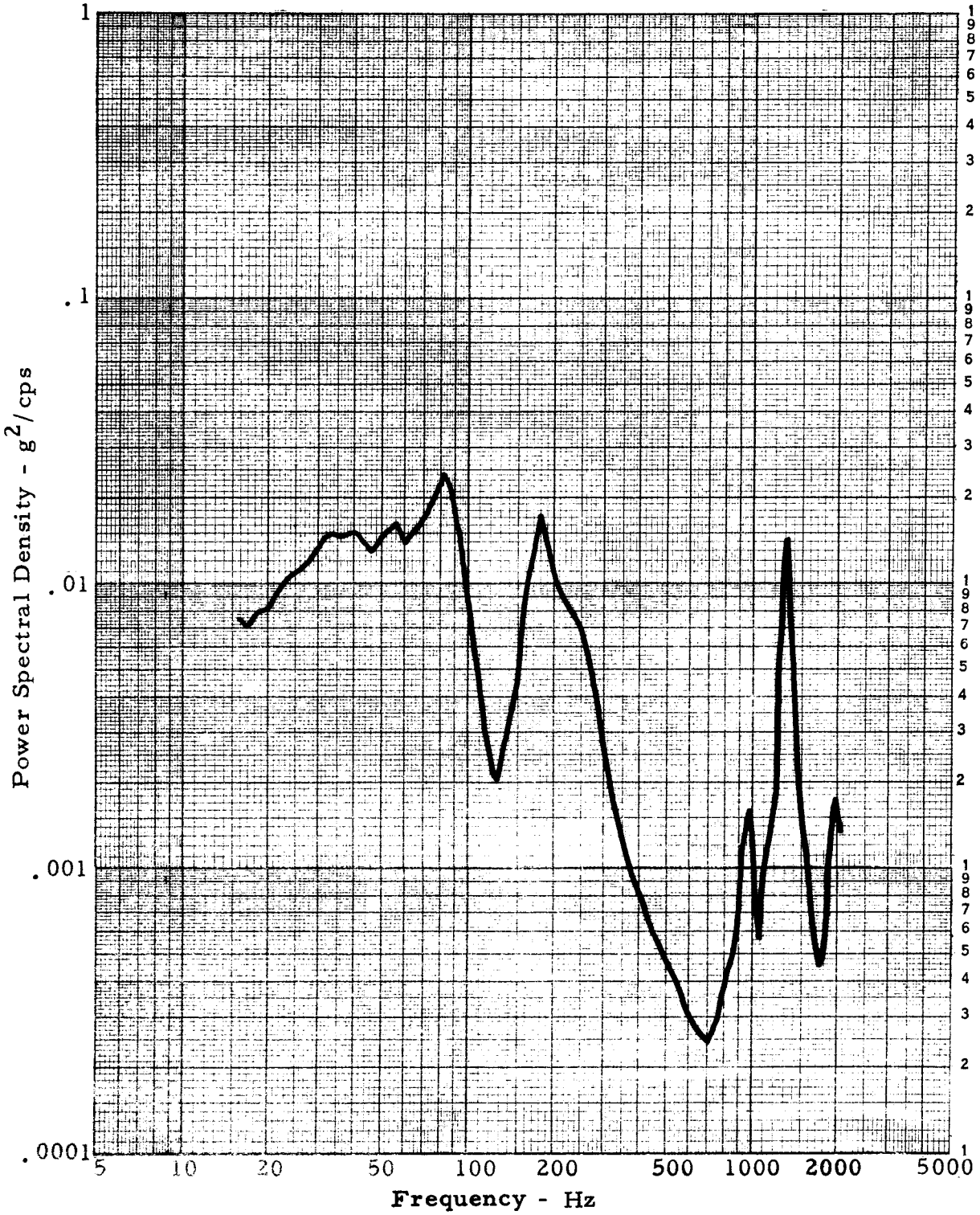
SN: CPLEE (LOC. 2)
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. C
Test Date:

SN: CPLEE (LOC. 2)
Axis: Z



VIBRATION LEVELS

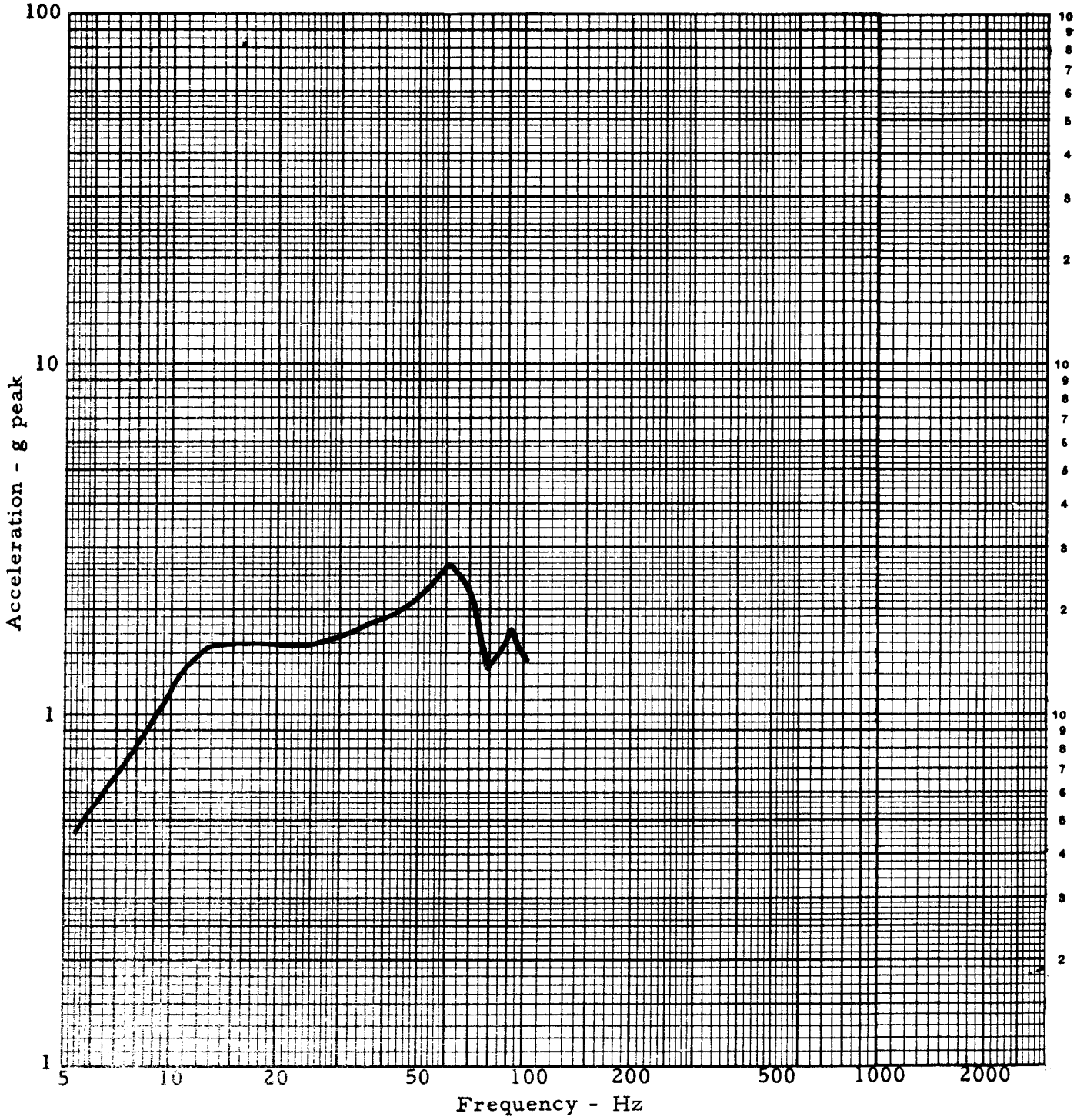
Test Item: QUAL. B
Test Date:

Serial Number: CSE
Input Axis:
Response Axis: X

VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

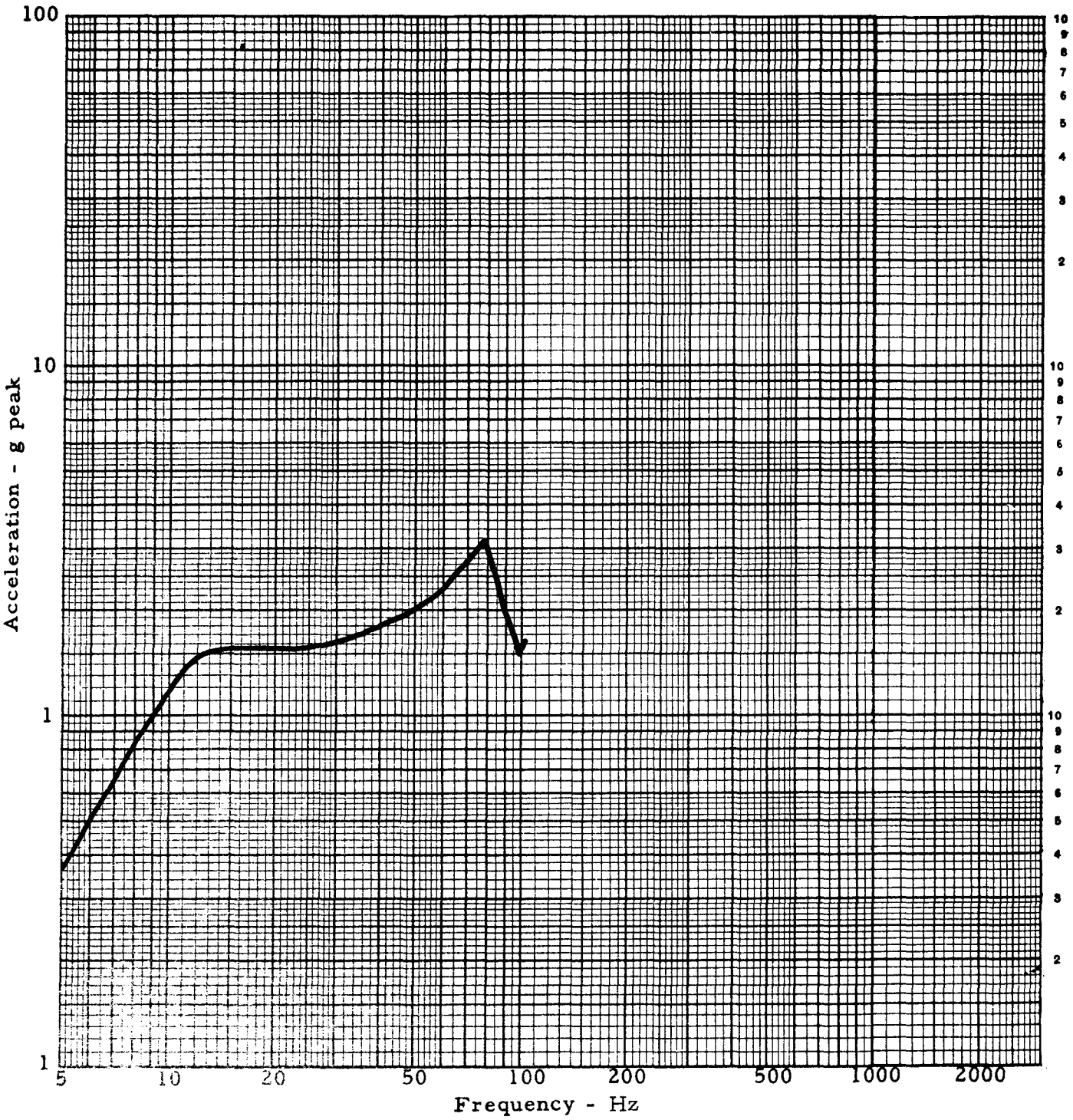
Serial Number: CSE
Input Axis:
Response Axis: Y



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

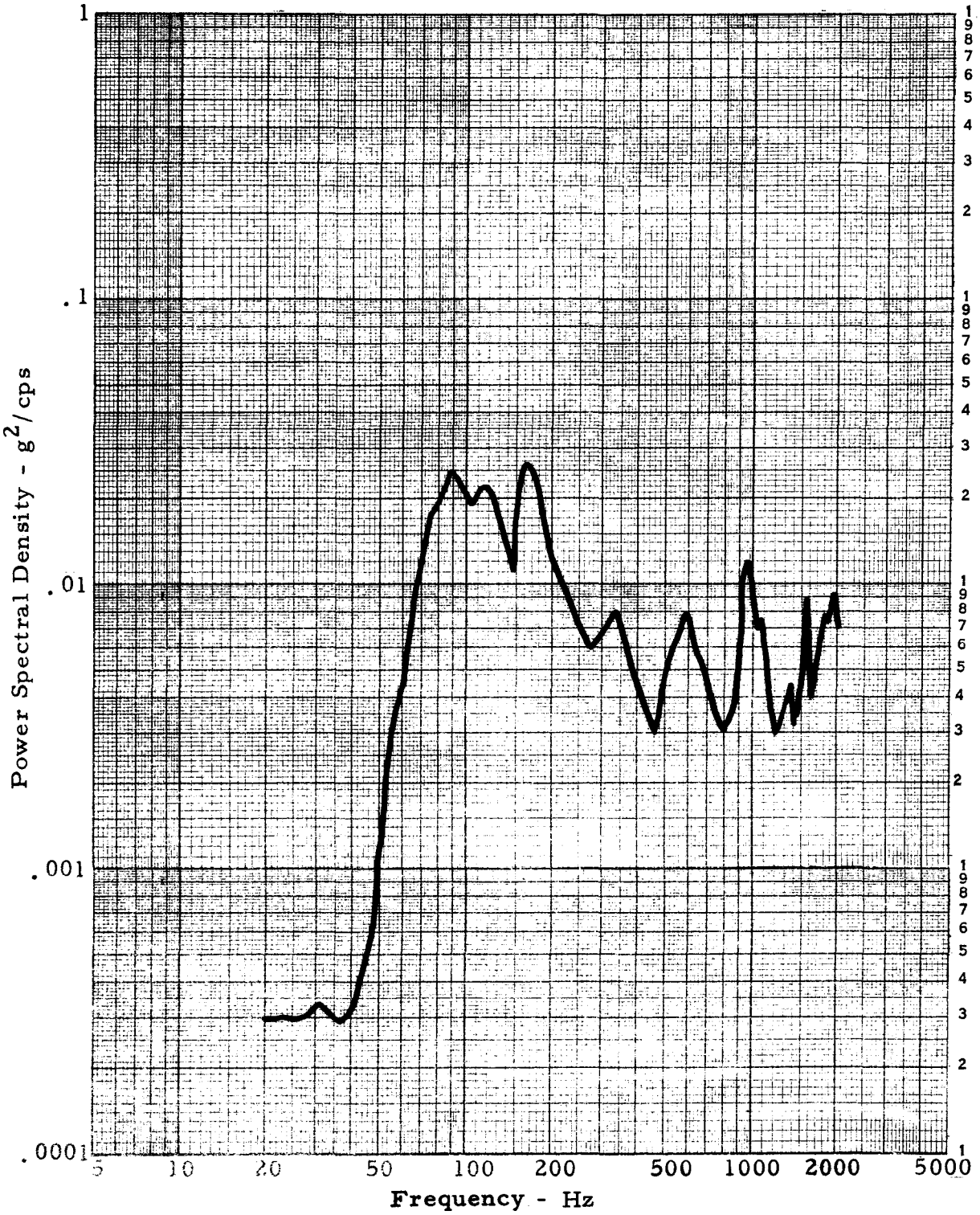
Serial Number: CSE
Input Axis:
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

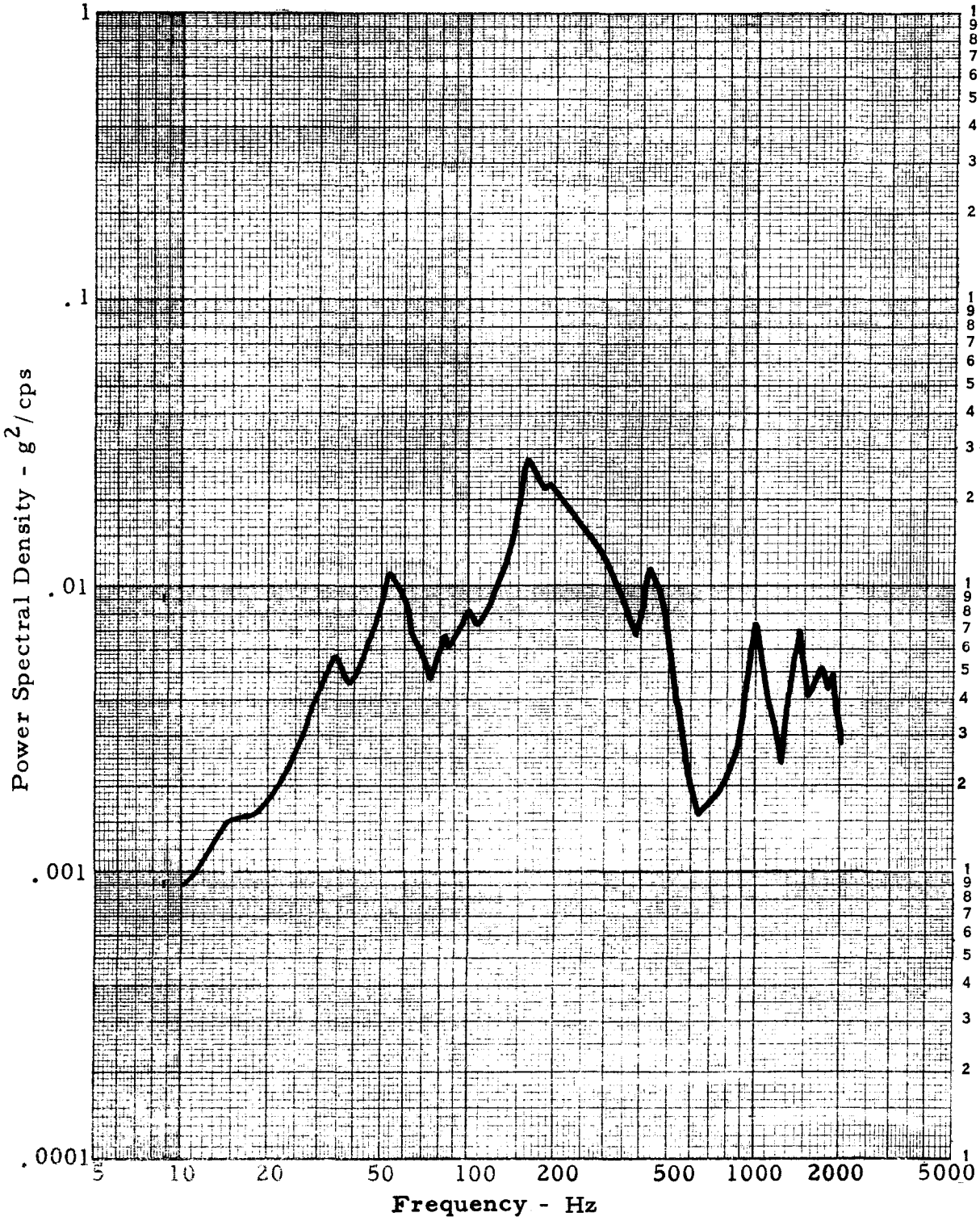
SN: CSE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

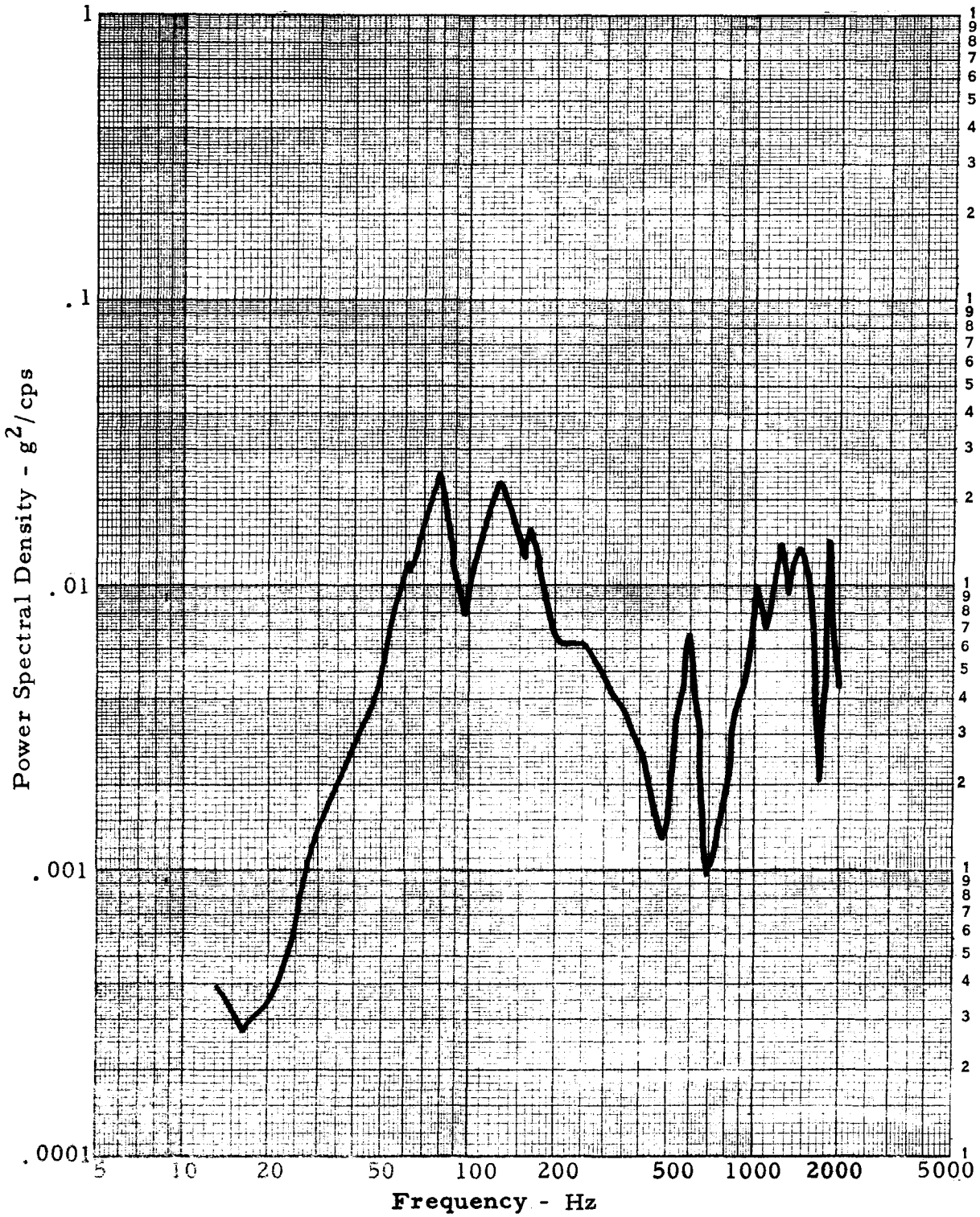
SN: CSE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL.B
Test Date:

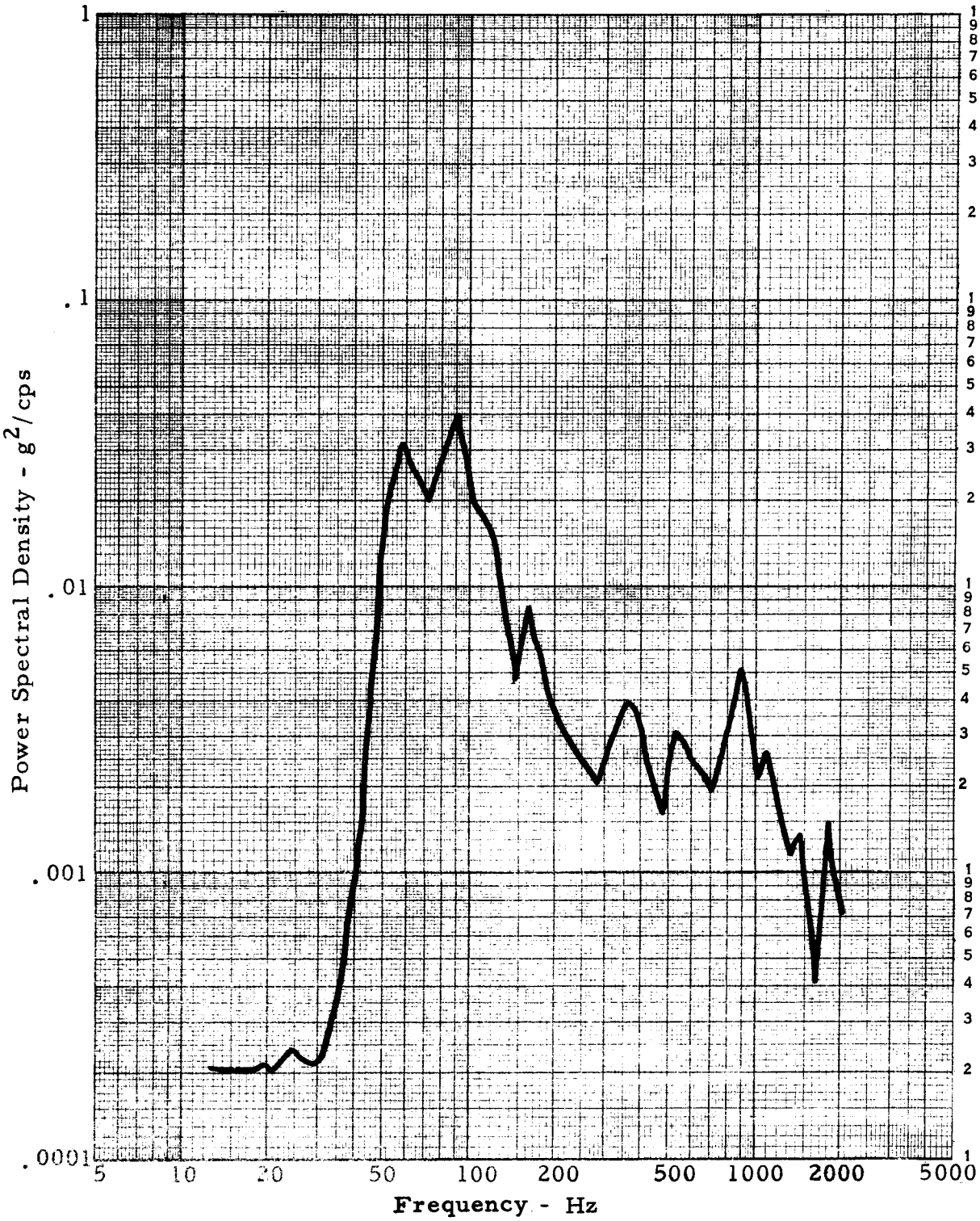
SN: CSE
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

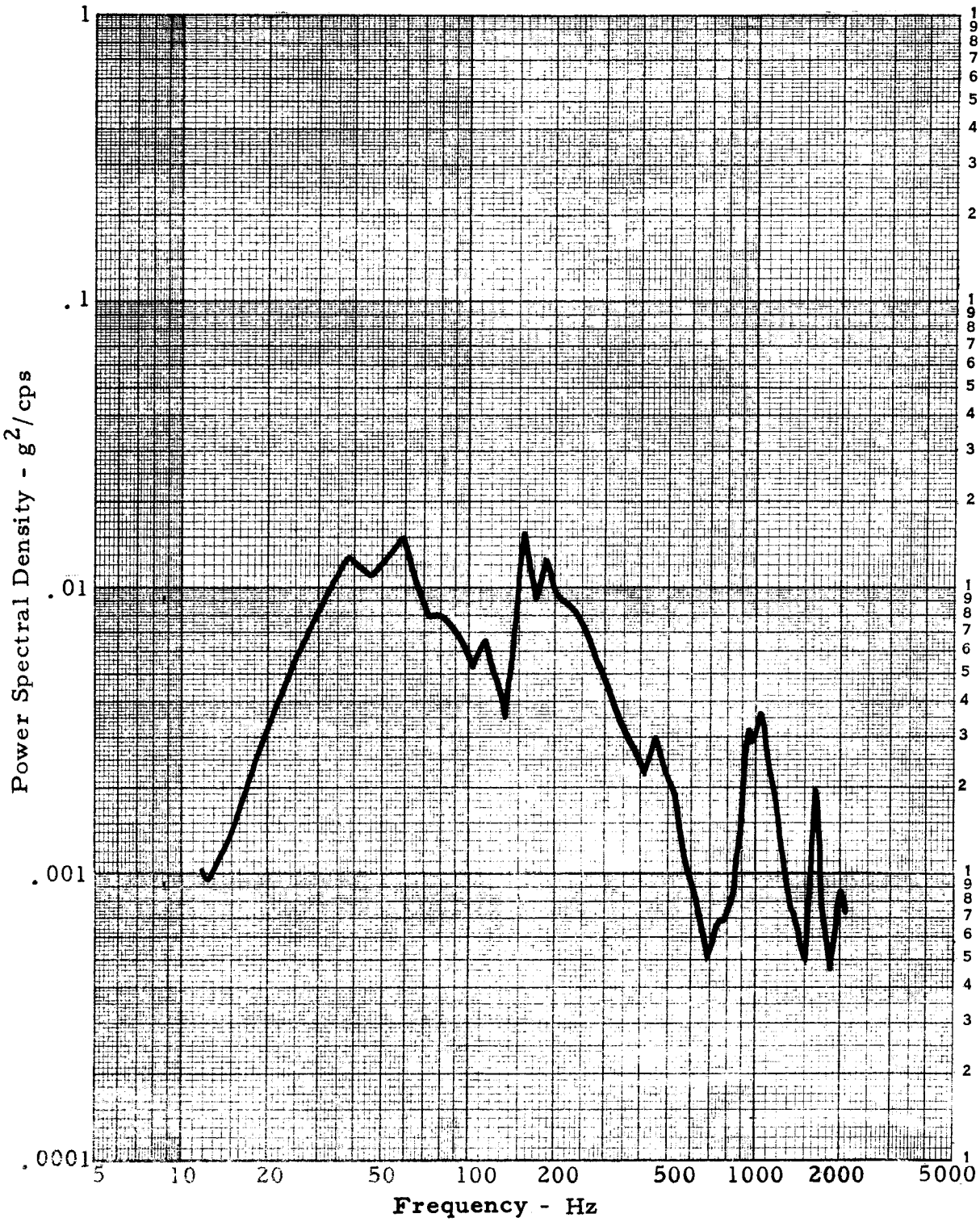
SN: CSE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

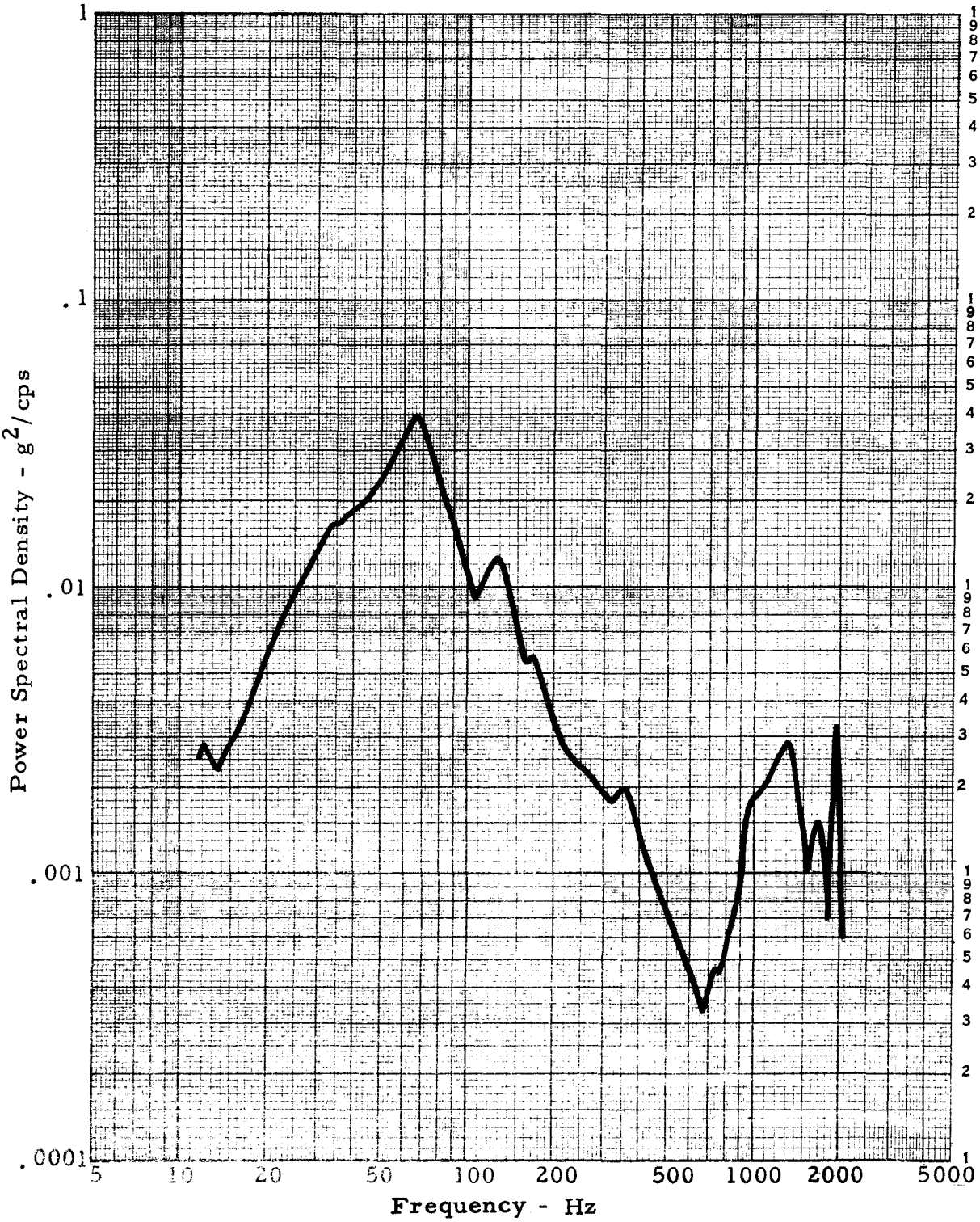
SN: CSE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

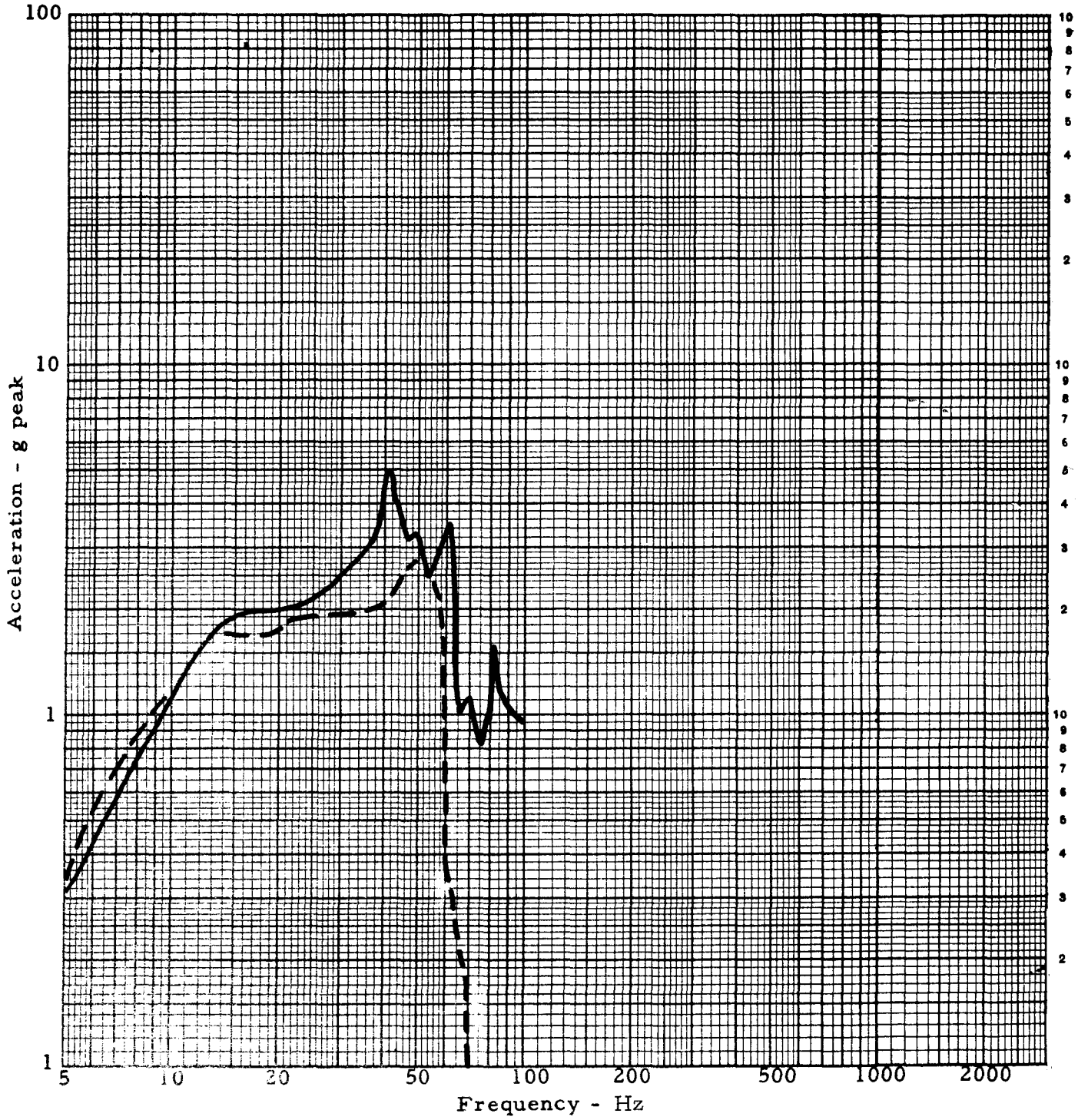
SN: CSE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. SA ———
~~Test Date:~~ QUAL. B — — —

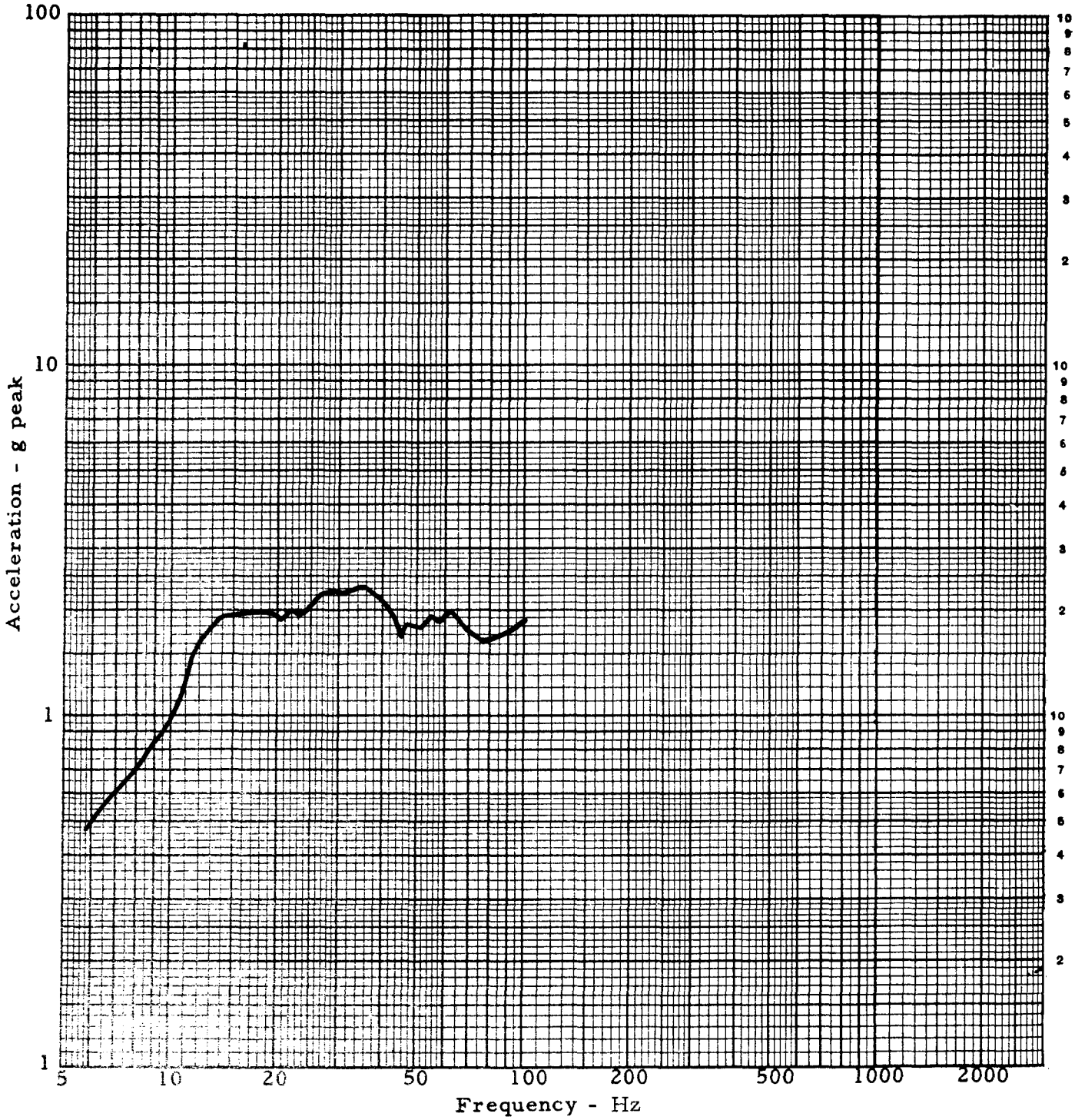
Serial Number: GIM
Input Axis: X (only)
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. SA
~~Test Date:~~ QUAL. B NOT RECORDED

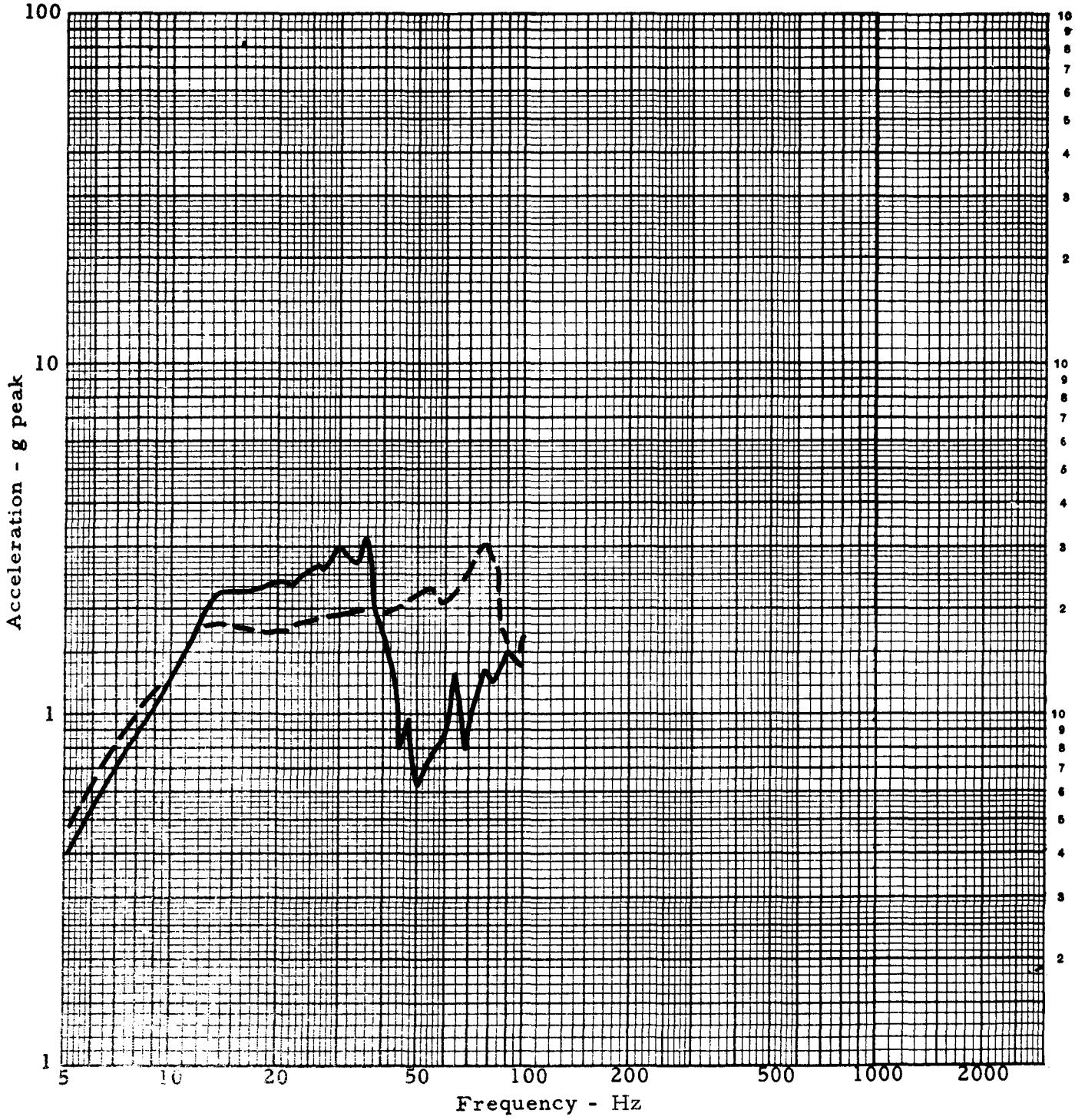
Serial Number: GIM
Input Axis: Y (only)
Response Axis: Y



VIBRATION LEVELS

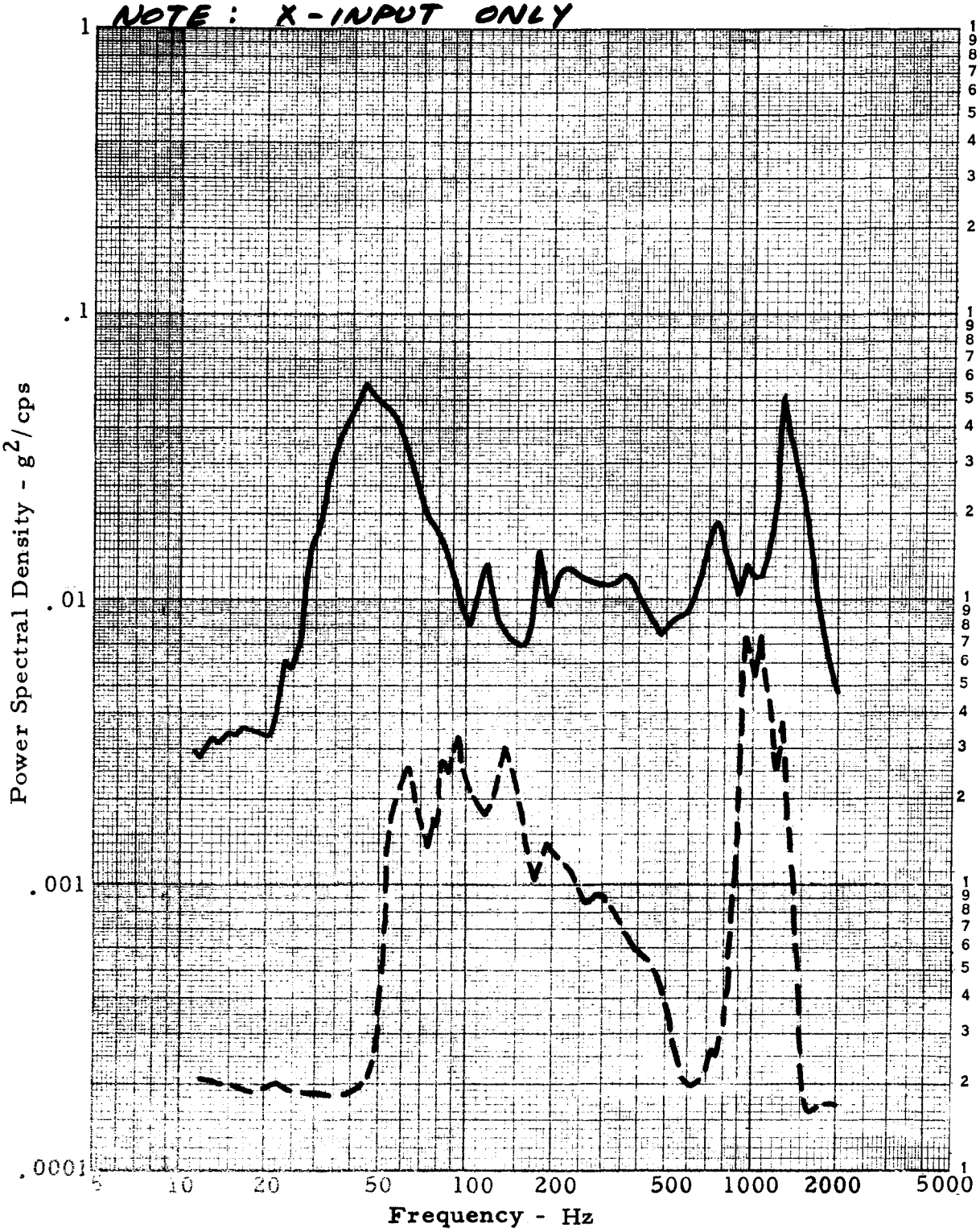
Test Item: QUAL. SA ———
~~Test Date:~~ QUAL. B – – –

Serial Number: GIM
Input Axis: Z (only)
Response Axis: Z



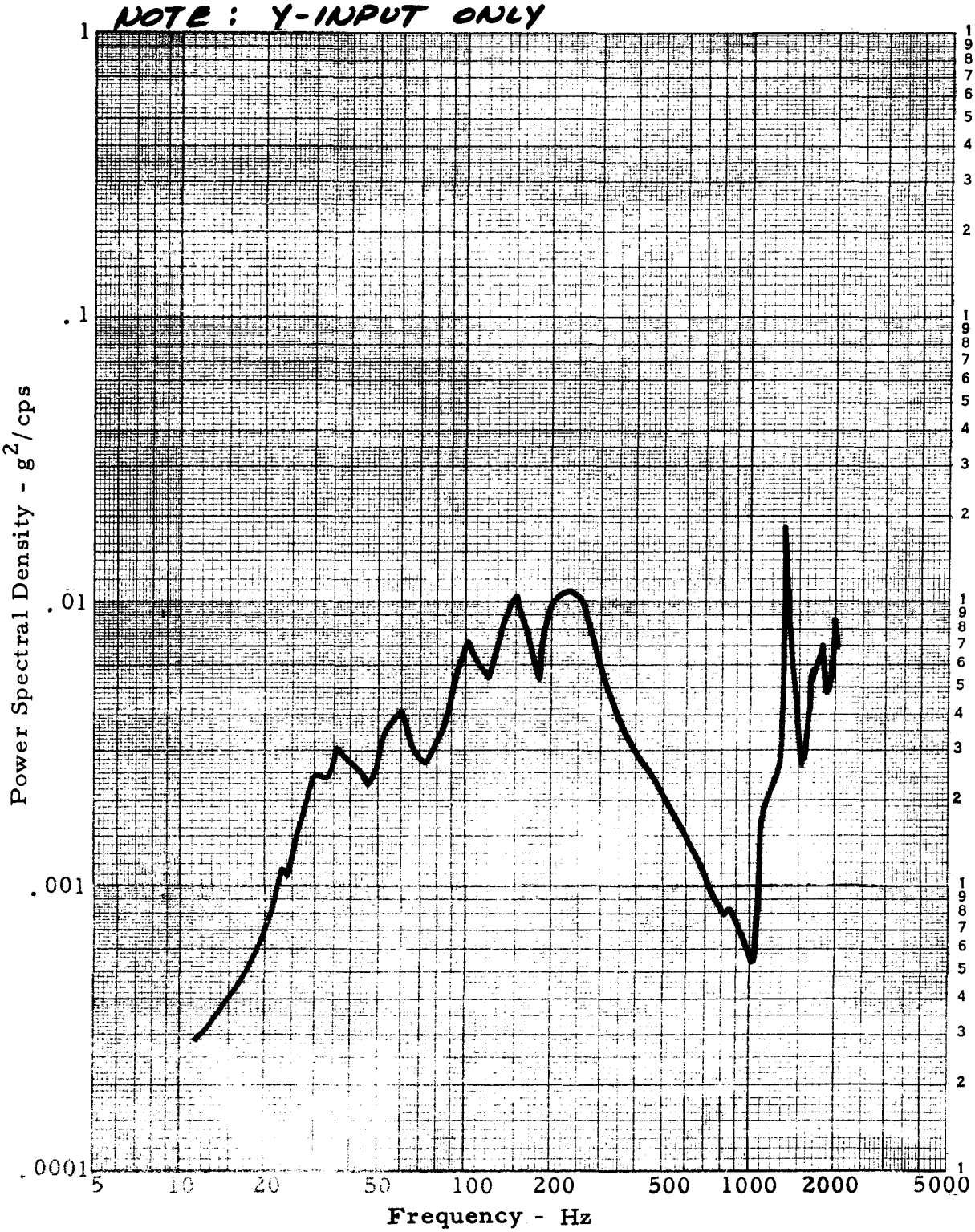
RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA ———
~~Test Date:~~ QUAL. B — — —
SN: GIM
Axis: X
NOTE: X-INPUT ONLY



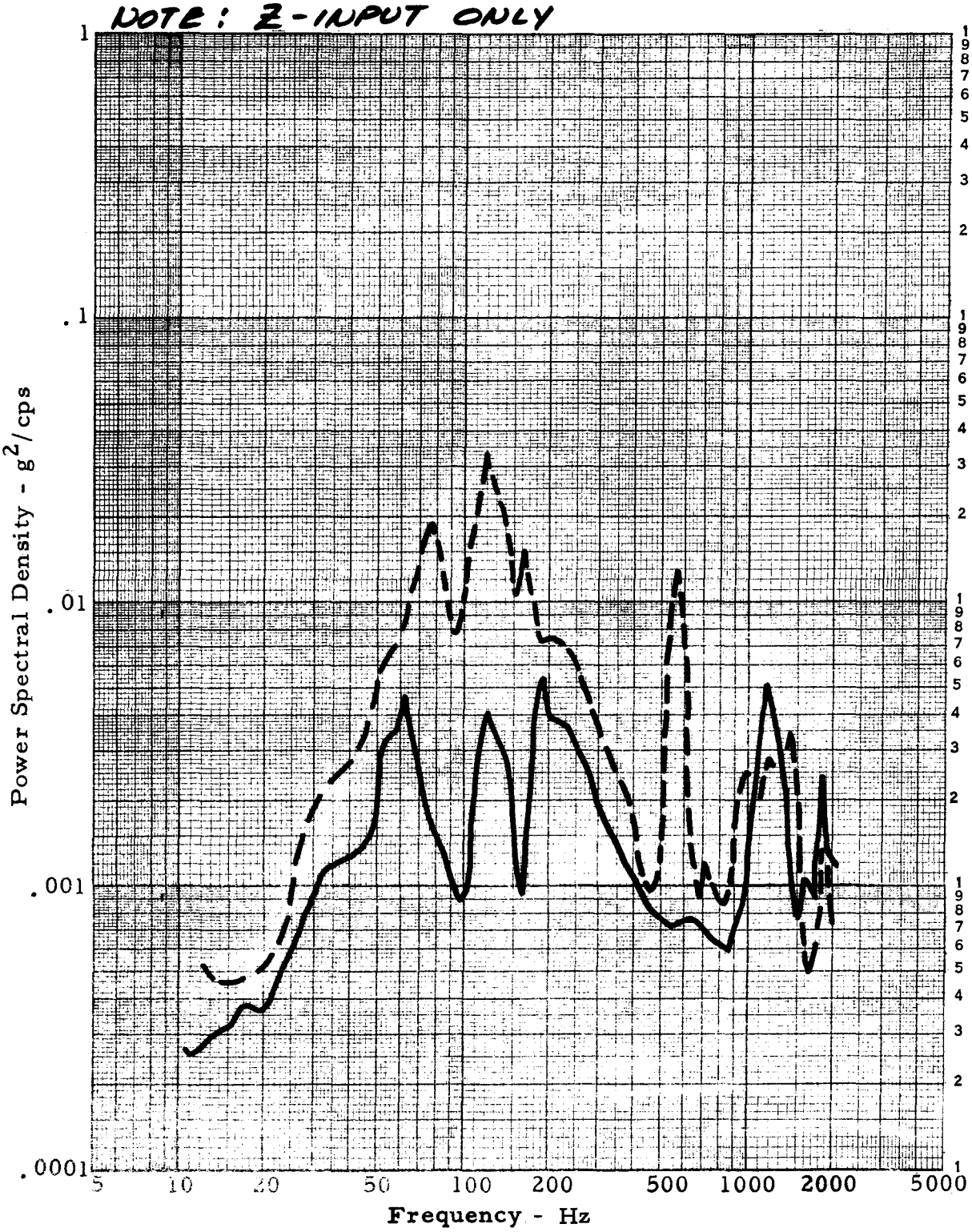
RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. SA
~~Test Date:~~ QUAL. B NOT RECORDED
SN: GIM
Axis: Y
NOTE: Y-INPUT ONLY



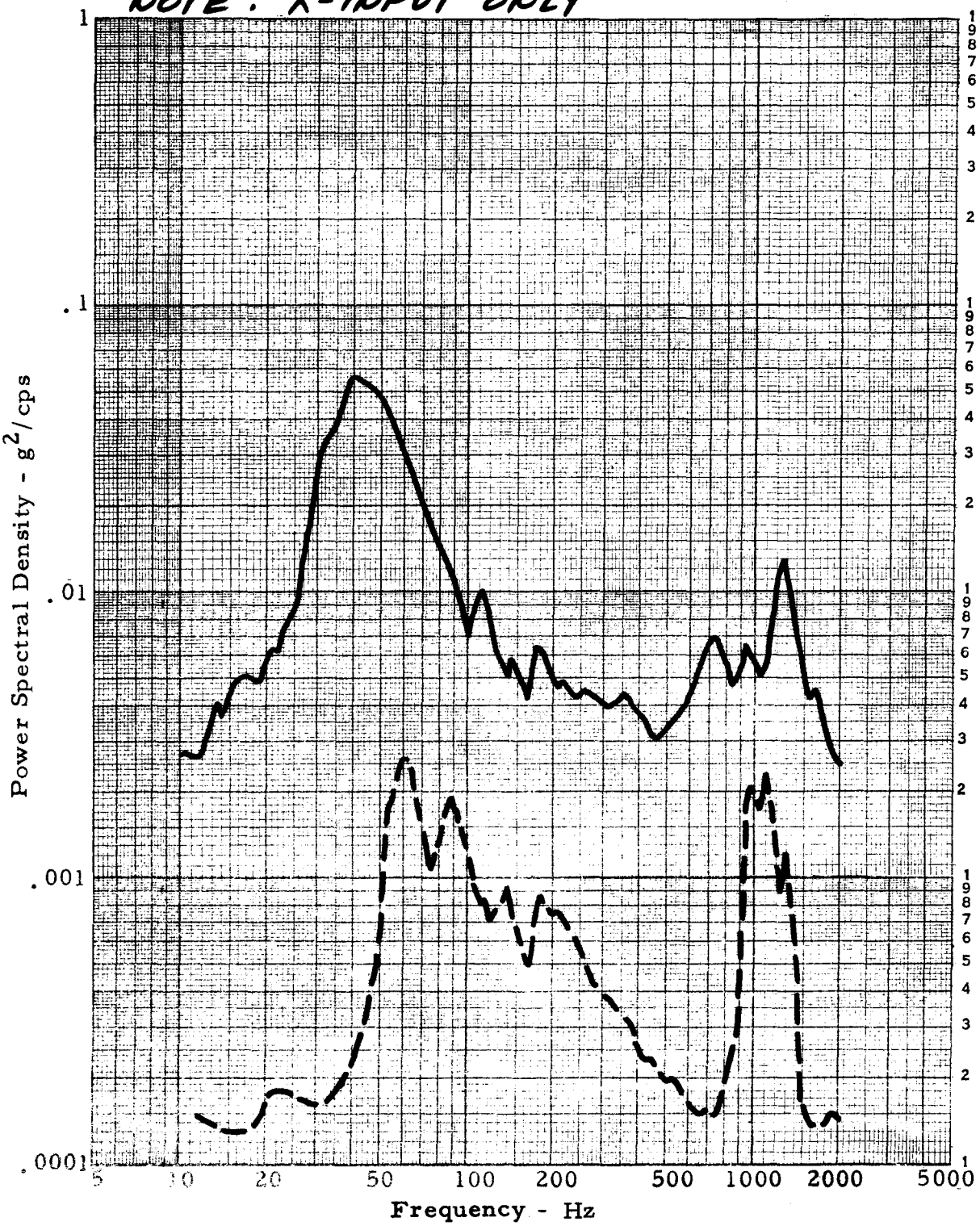
RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. SA ———
~~Test Date~~: QUAL. B — — —
SN: GIM
Axis: Z
NOTE: Z-INPUT ONLY



RANDOM VIBRATION SPECTRUM

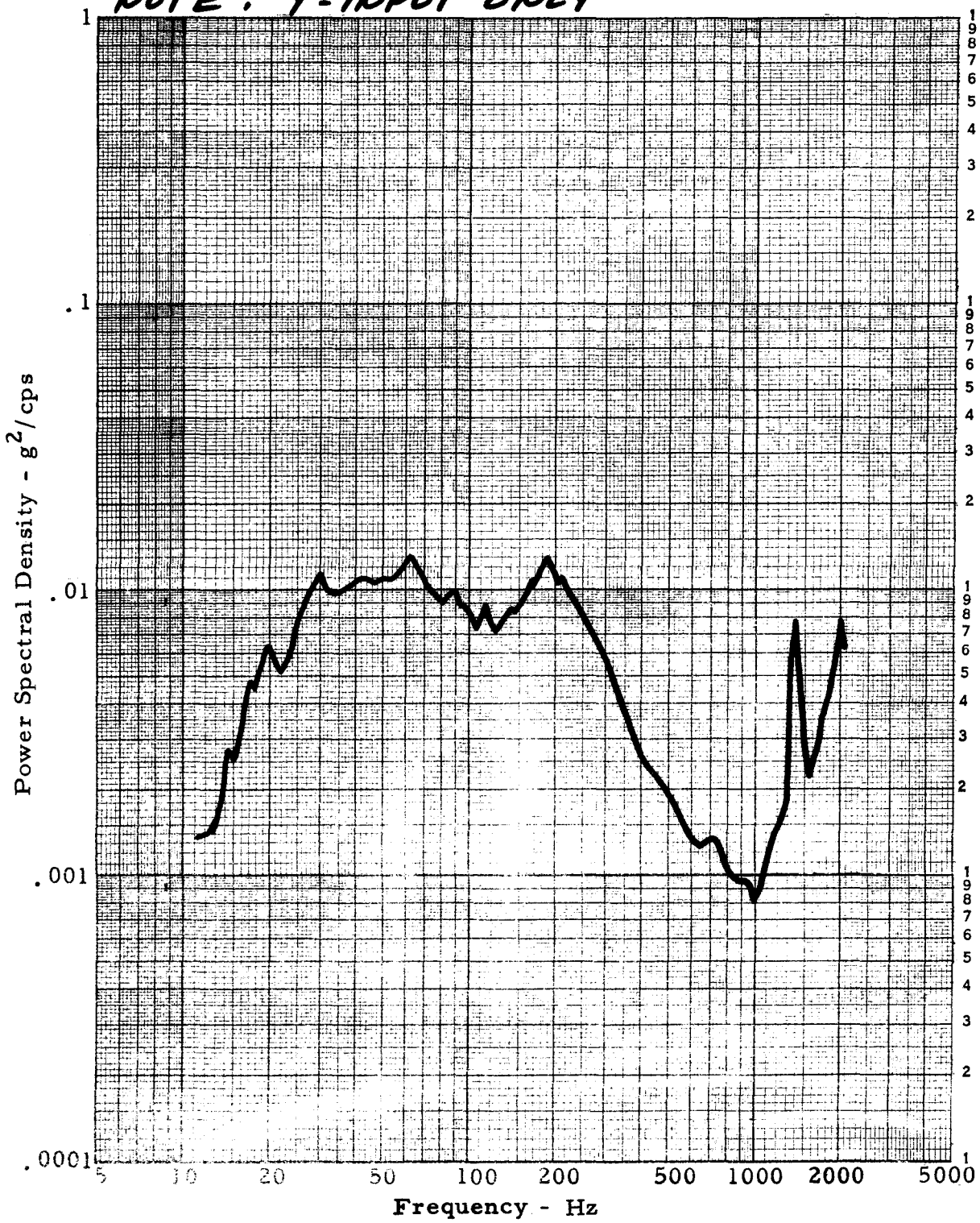
Test: Lun. Des.
Test Item: QUAL. SA ———
~~Test Date~~: QUAL. B — — —
SN: GIM
Axis: X
NOTE: X-INPUT ONLY



RANDOM VIBRATION SPECTRUM

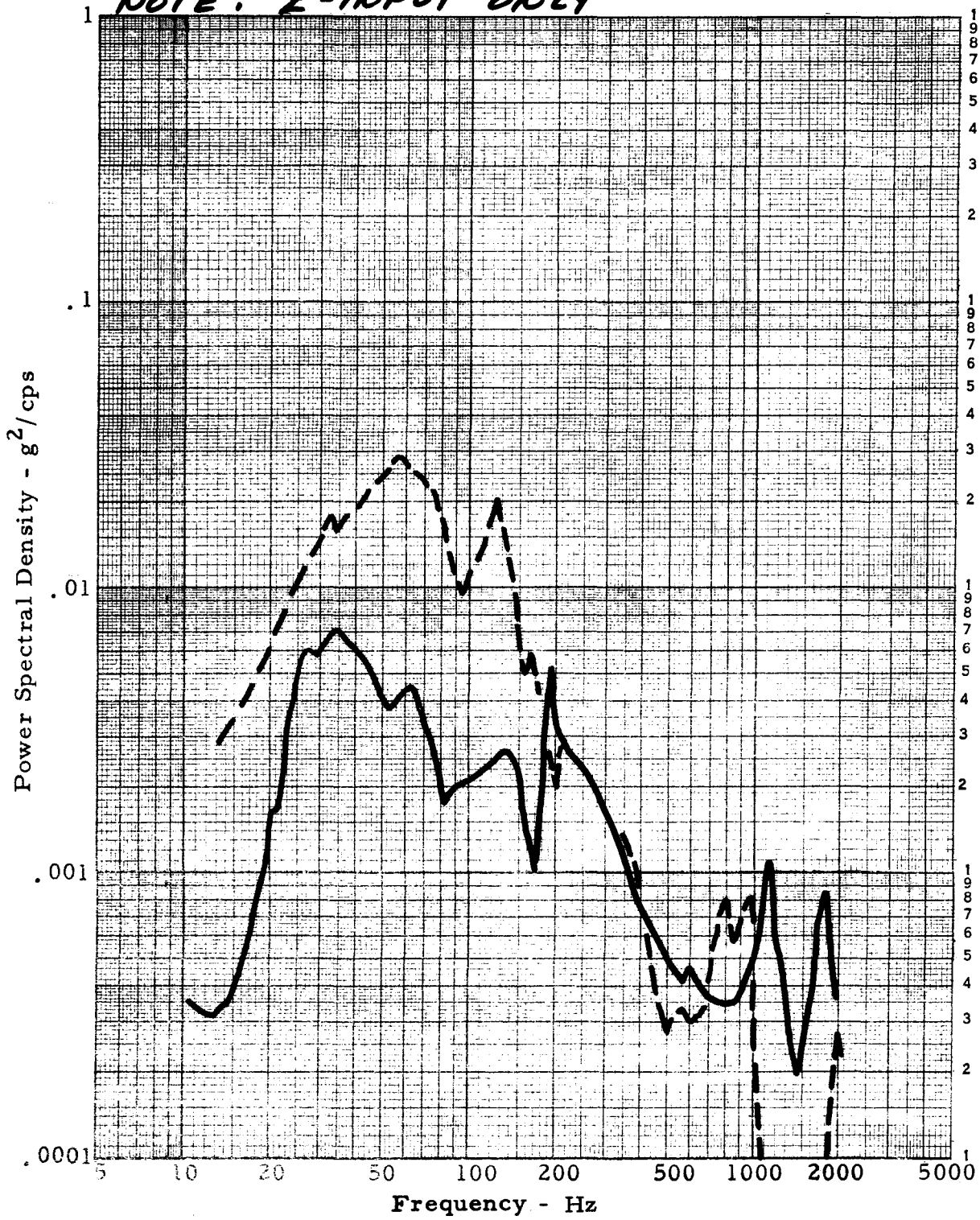
Test: Lun. Des.
Test Item: QUAL. SA
~~Test Date:~~ QUAL. B NOT RECORDED
NOTE: Y-INPUT ONLY

SN: GIM
Axis: Y



RANDOM VIBRATION SPECTRUM

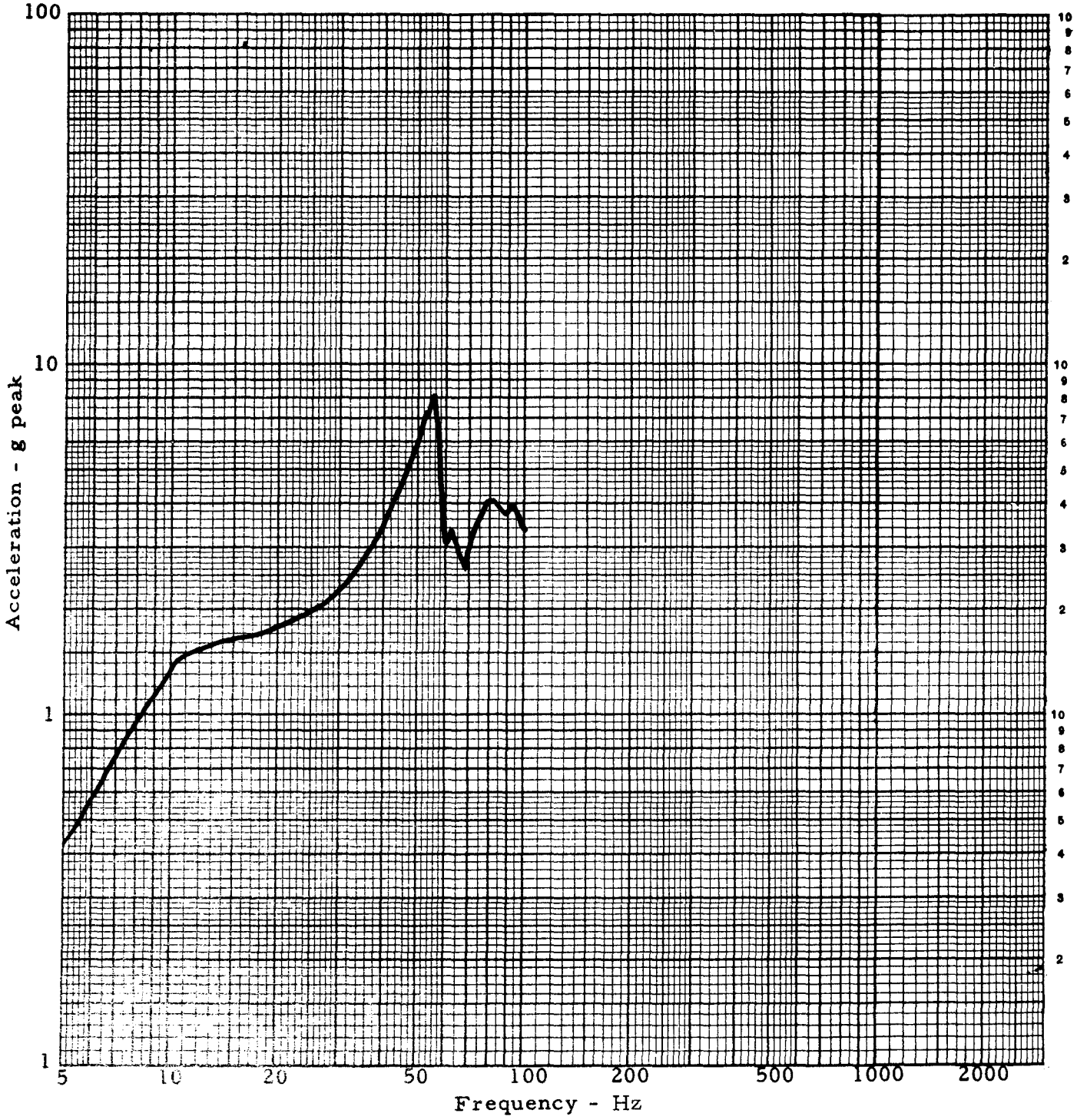
Test: Lun. Des.
Test Item: QUAL. SA ———— SN: GIM
~~Test Date:~~ QUAL. B — — — Axis: Z
NOTE: Z-INPUT ONLY



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

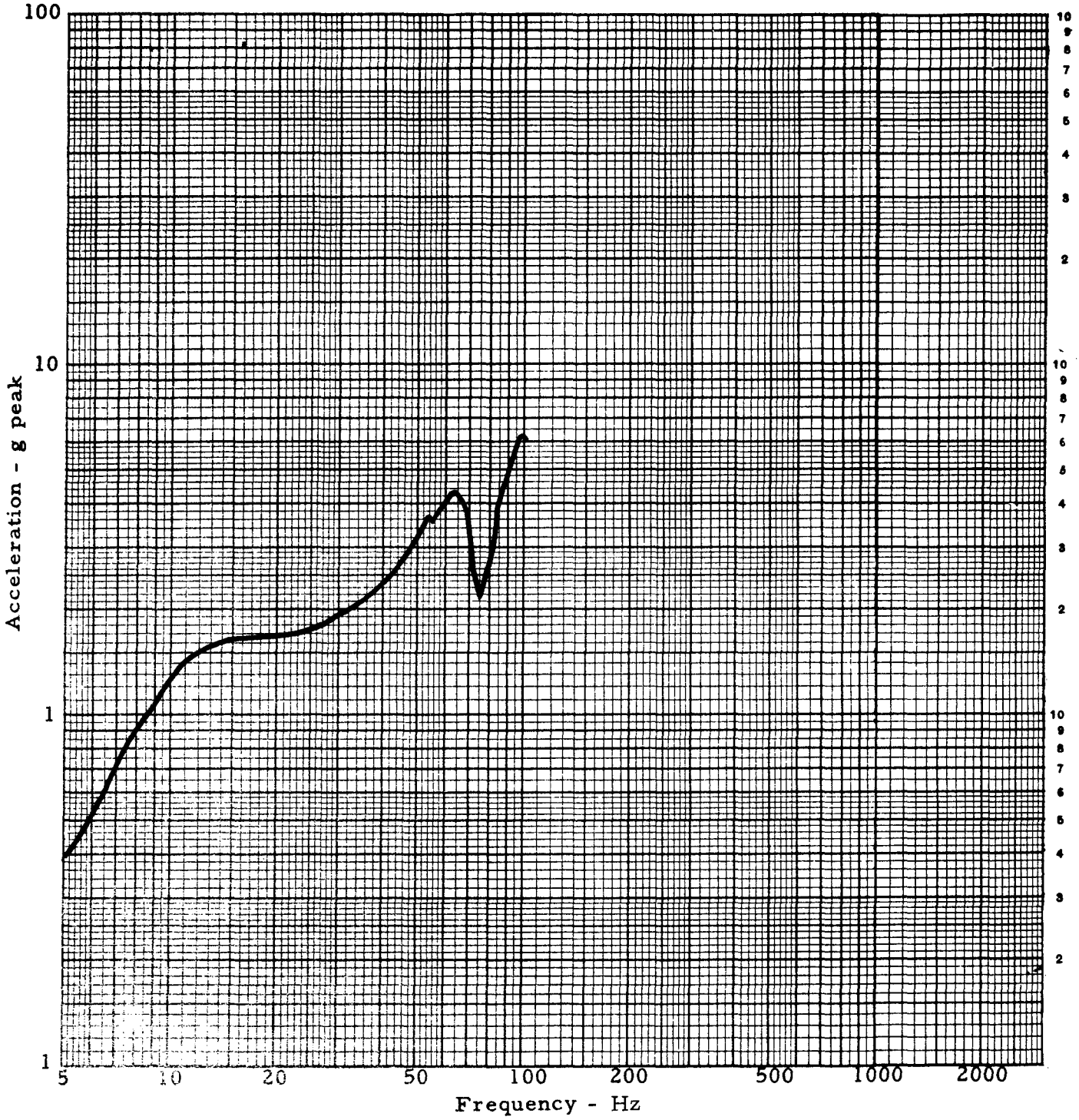
Serial Number: HFE
Input Axis:
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

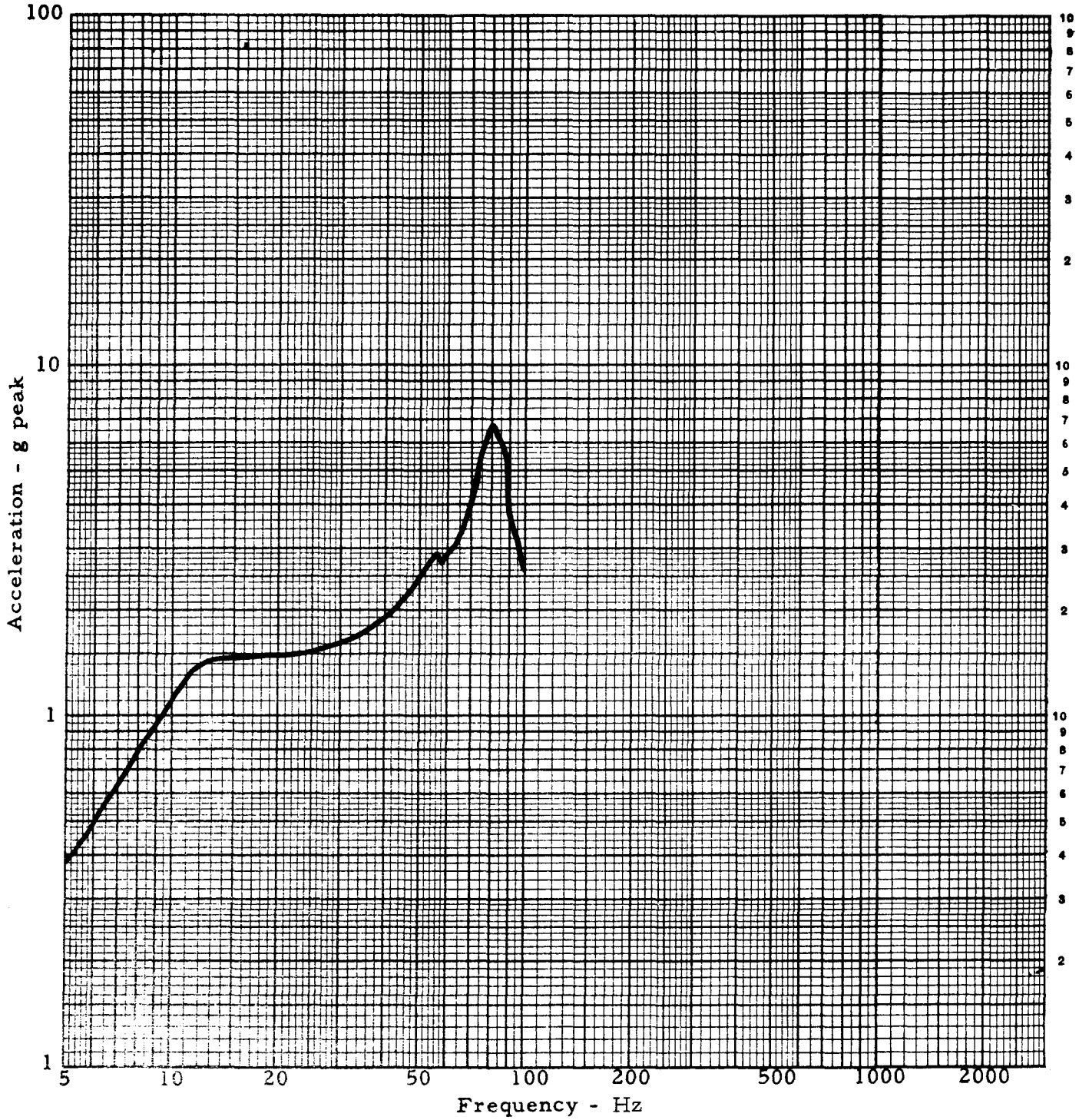
Serial Number: HFE
Input Axis:
Response Axis: Y



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

Serial Number: HFE
Input Axis:
Response Axis: Z



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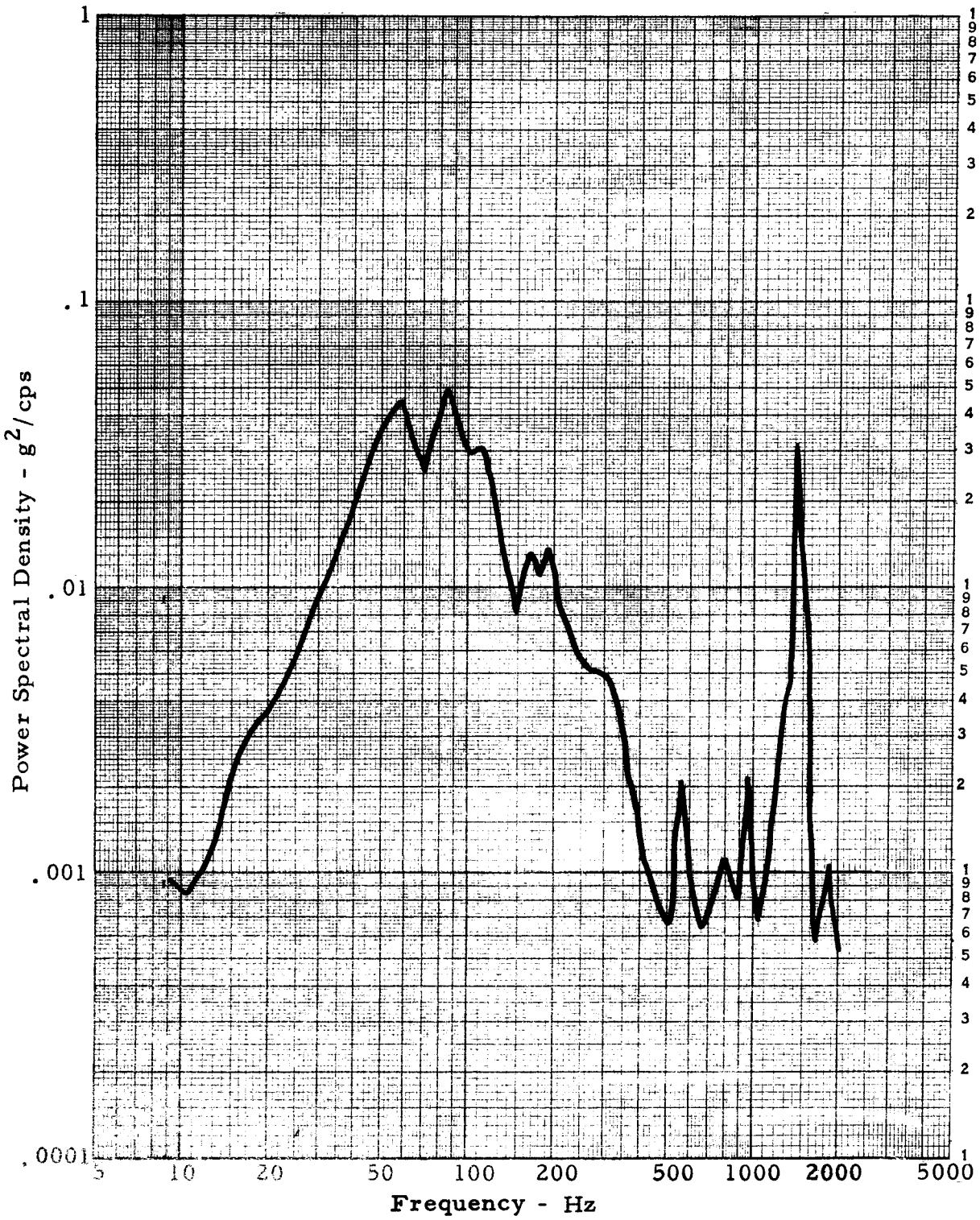
RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B
Test Date:

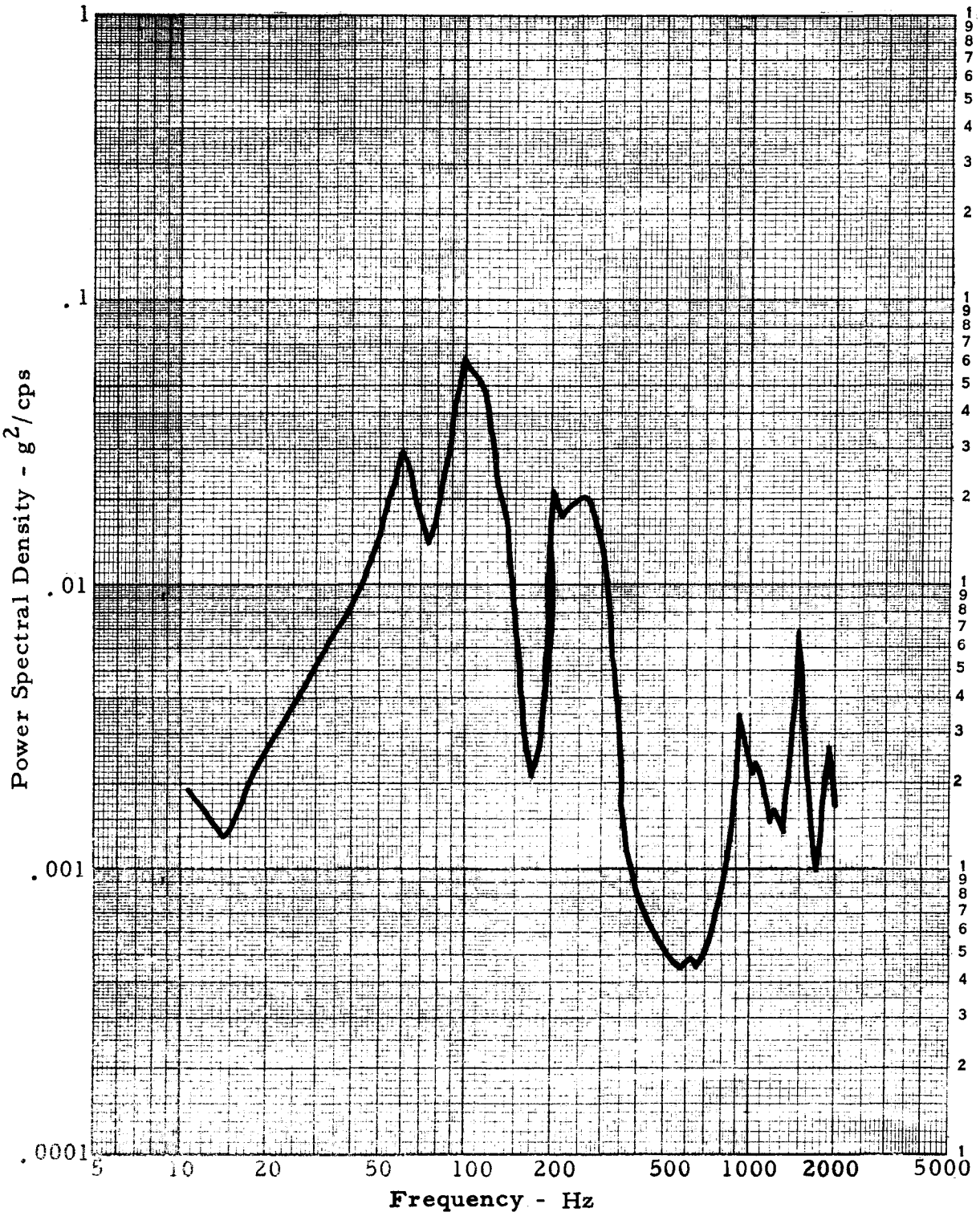
SN: HFE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B
Test Date:

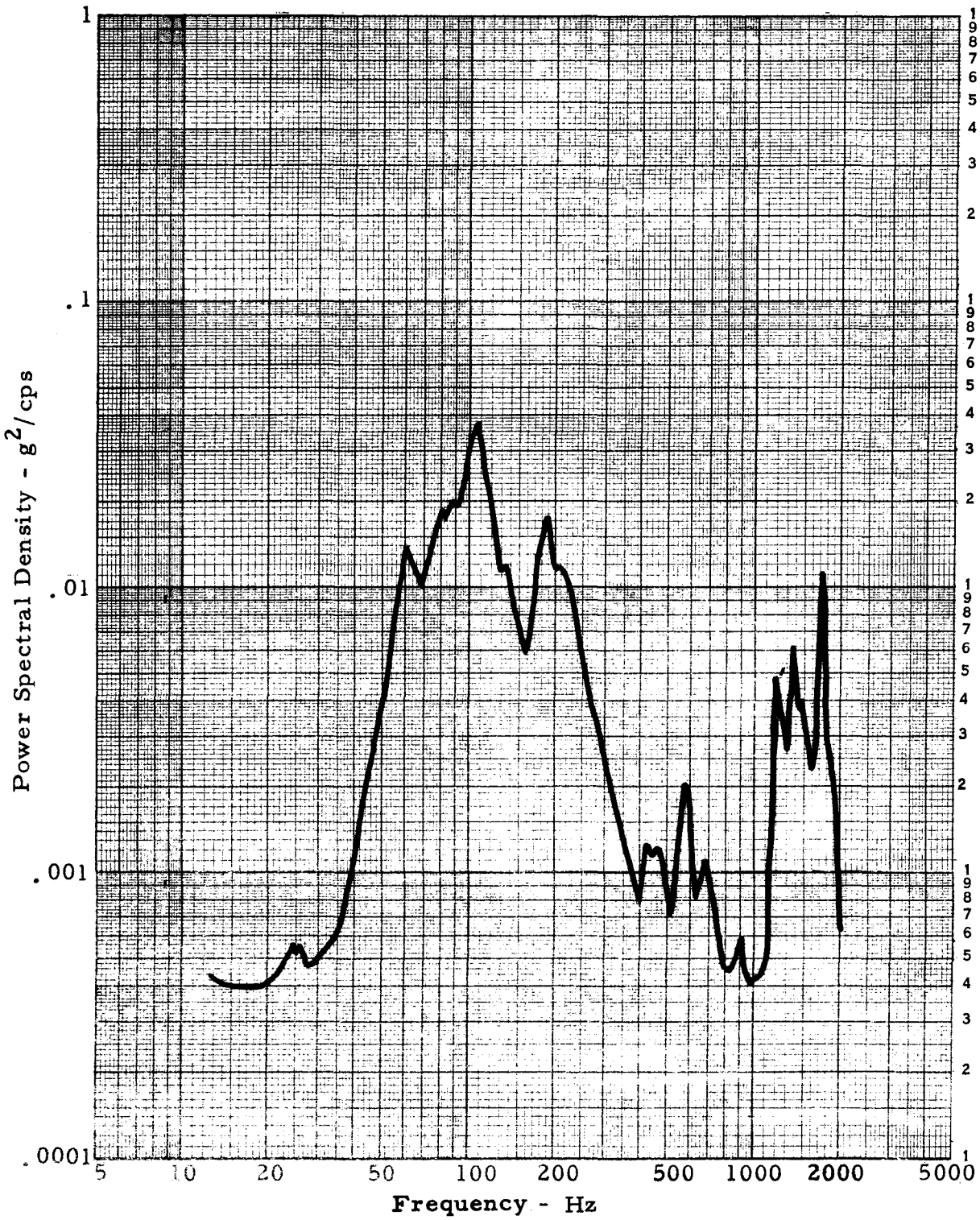
SN: HFE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

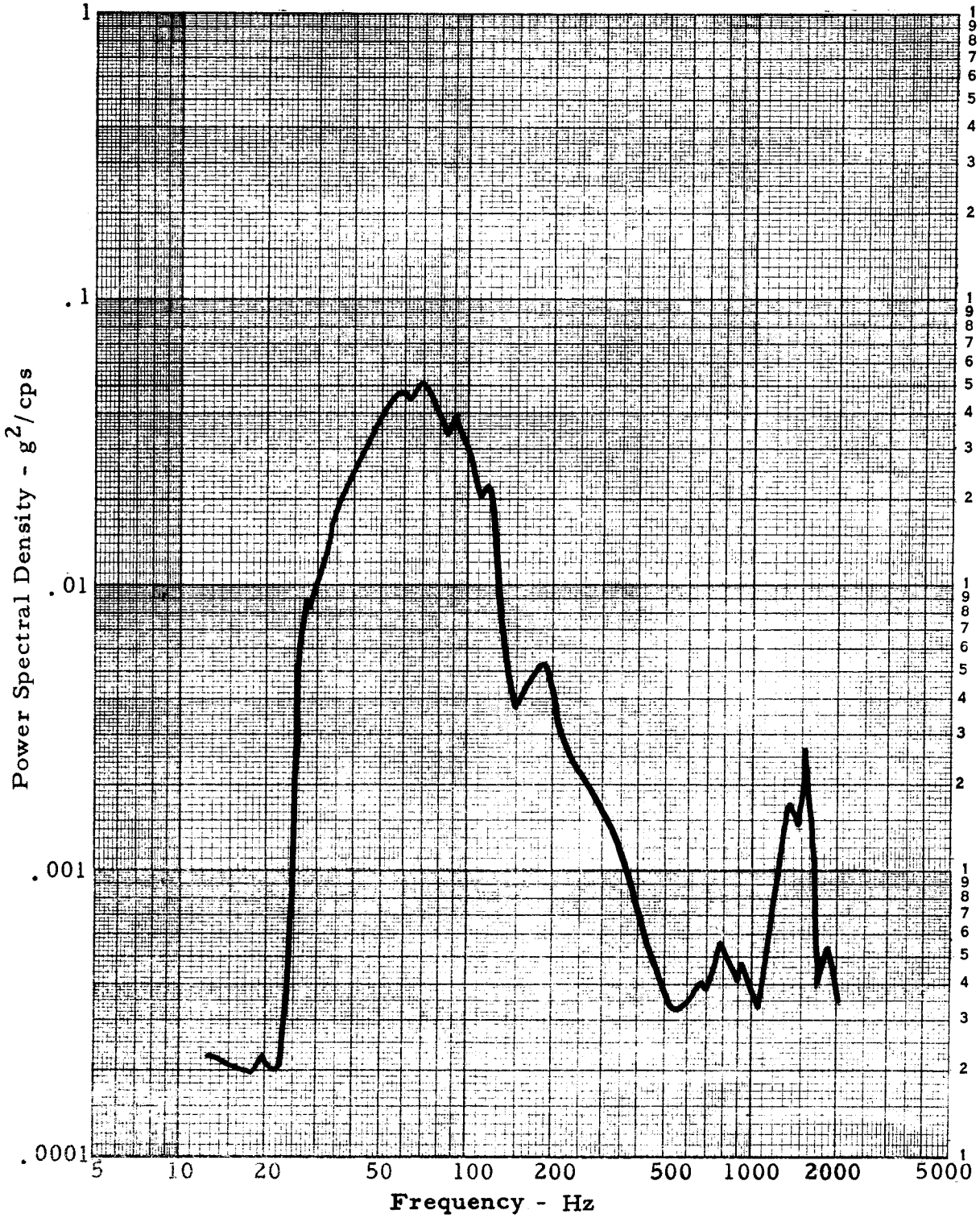
SN: HFE
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

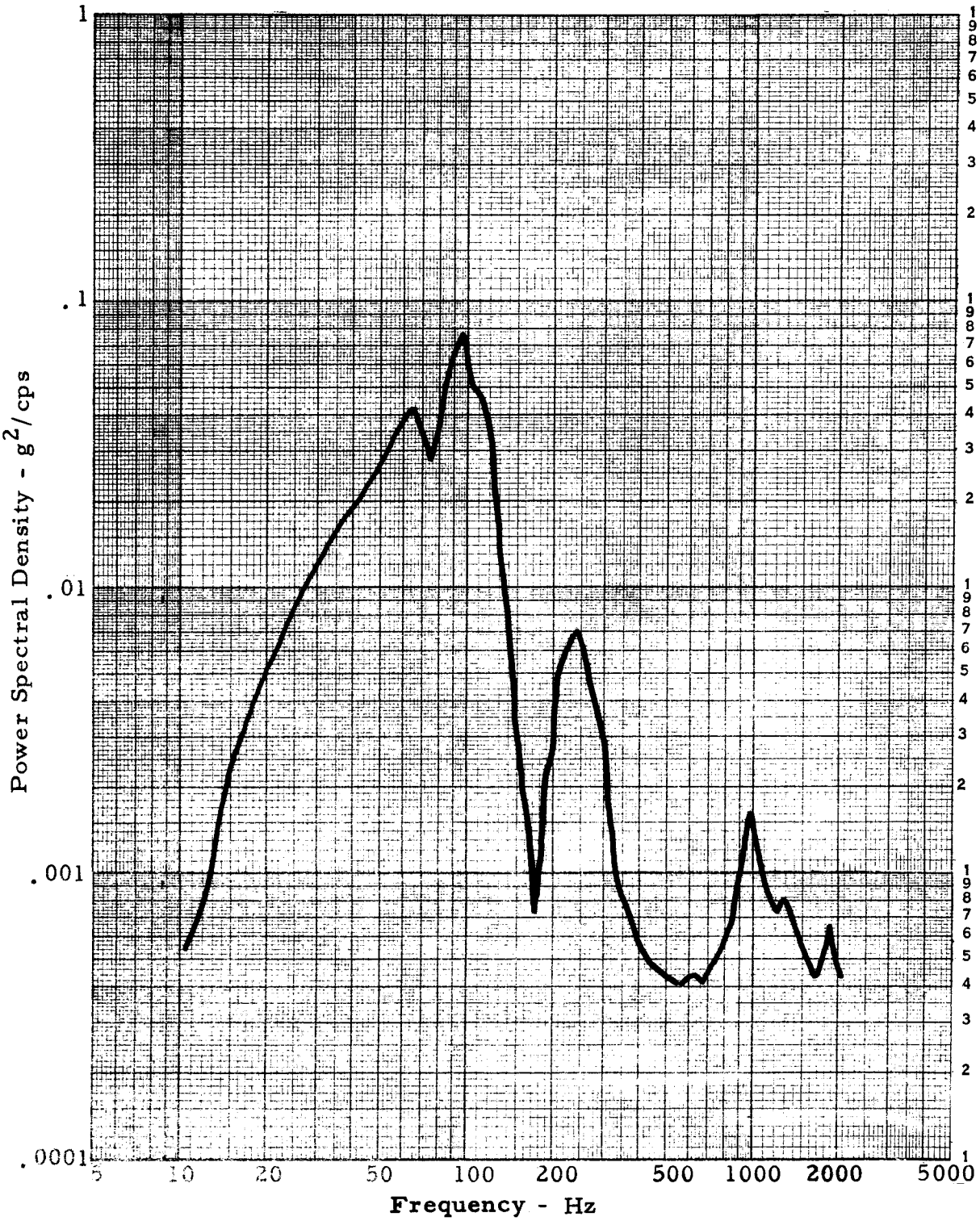
SN: HFE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL.B
Test Date:

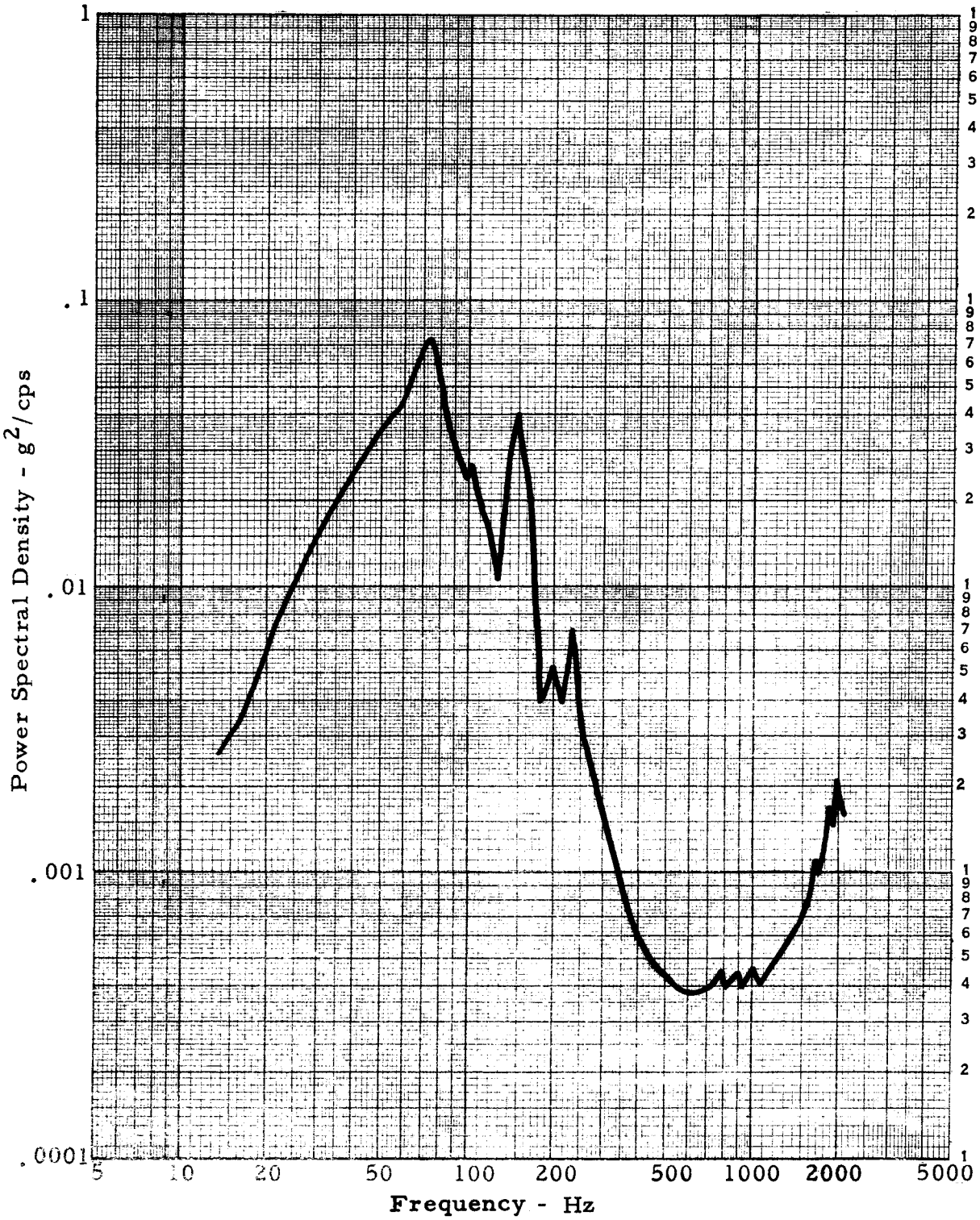
SN: HFE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

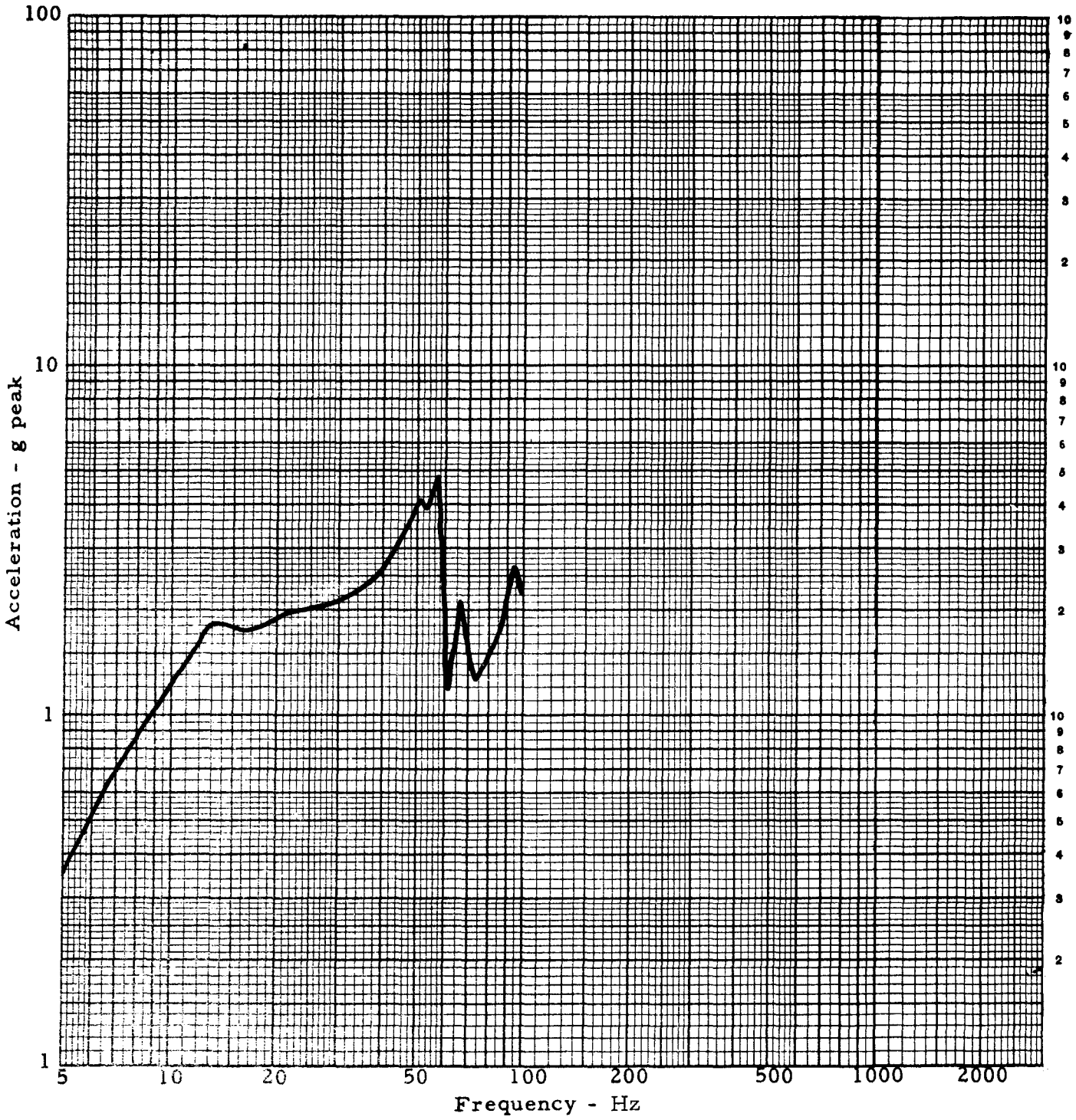
SN: HFE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

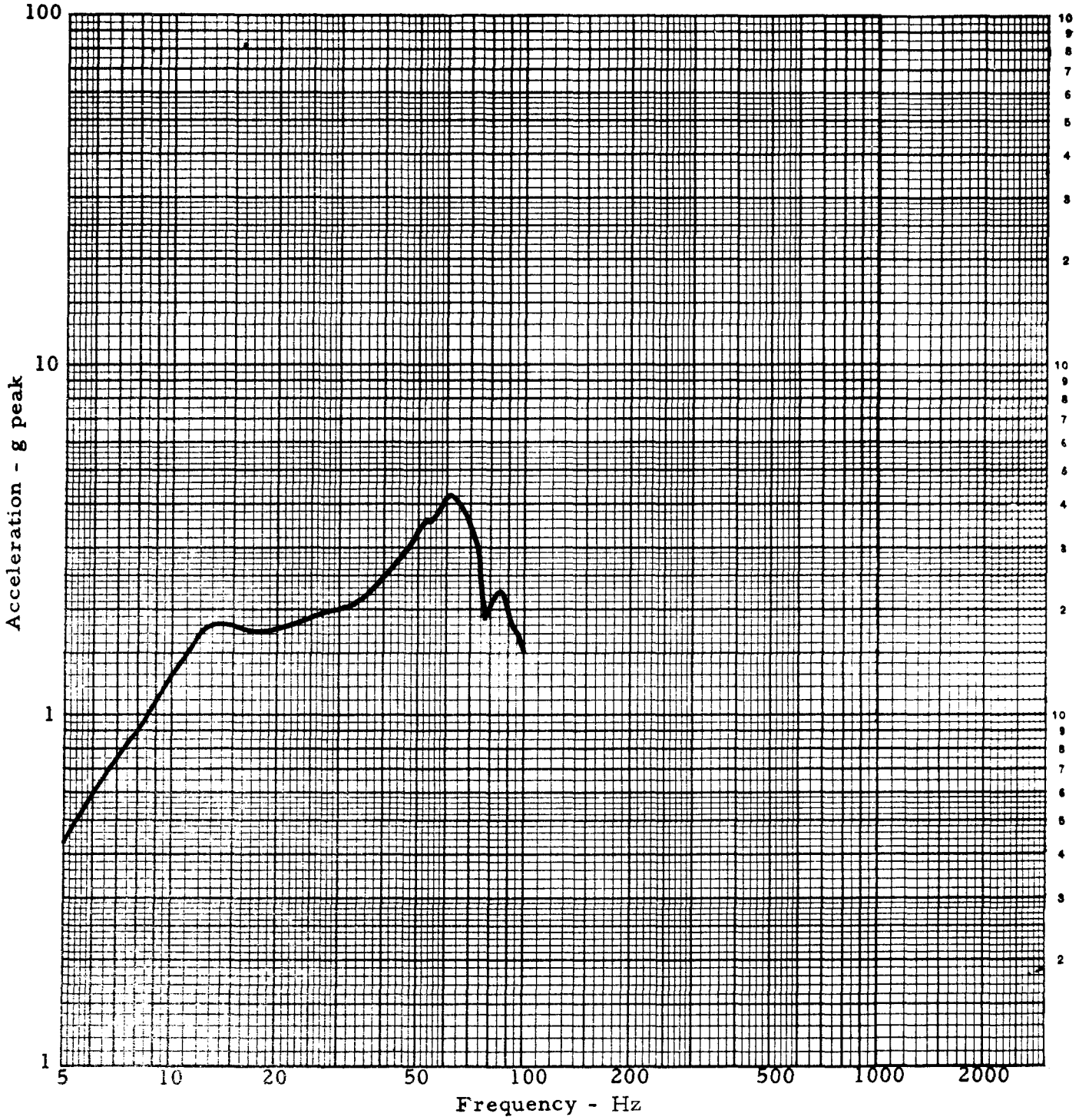
Serial Number: HFE-PROBE
Input Axis:
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

Serial Number: HFE-PROBE
Input Axis:
Response Axis: Y



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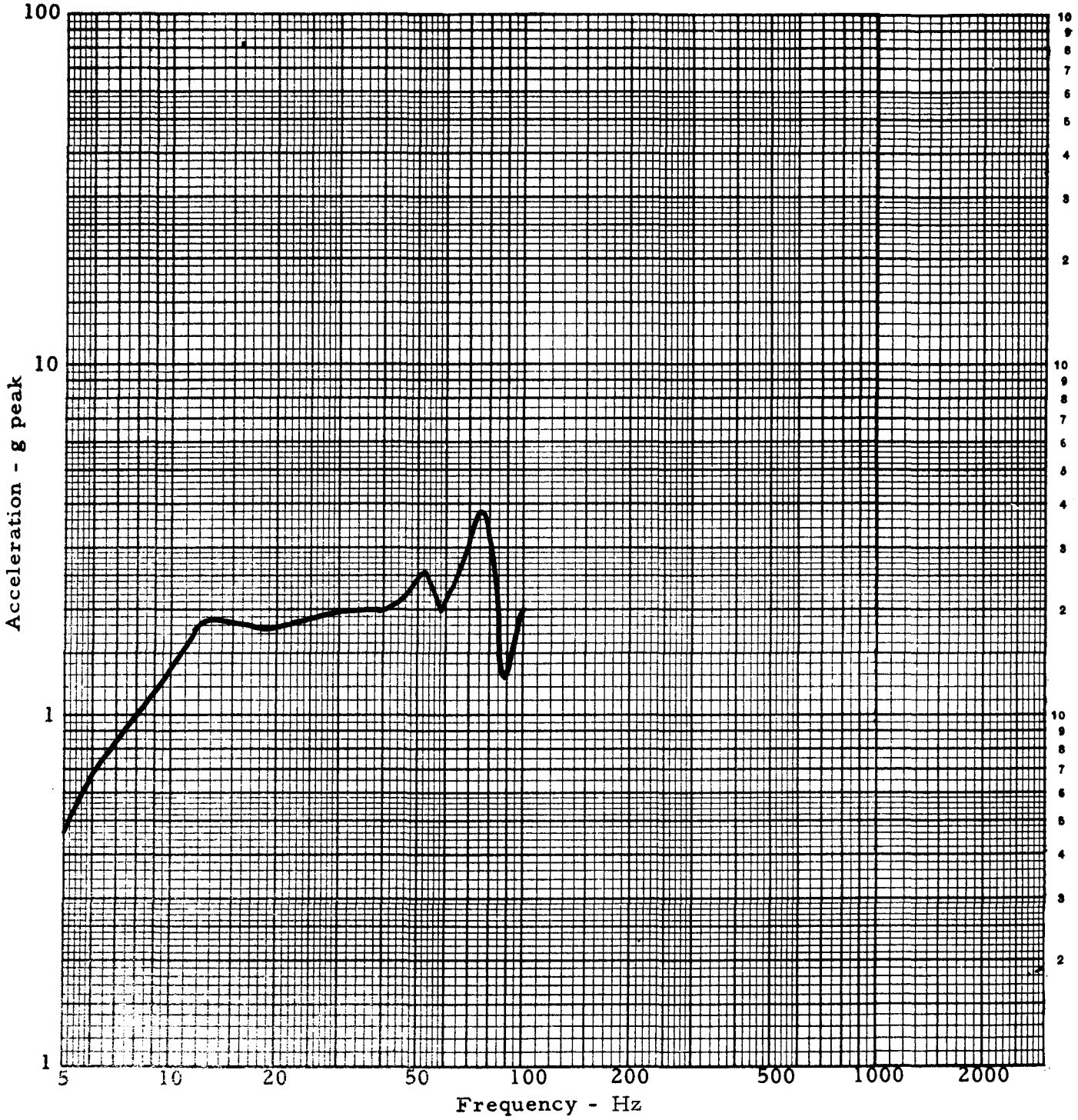
VIBRATION LEVELS

Test Item: QUAL. B
Test Date:

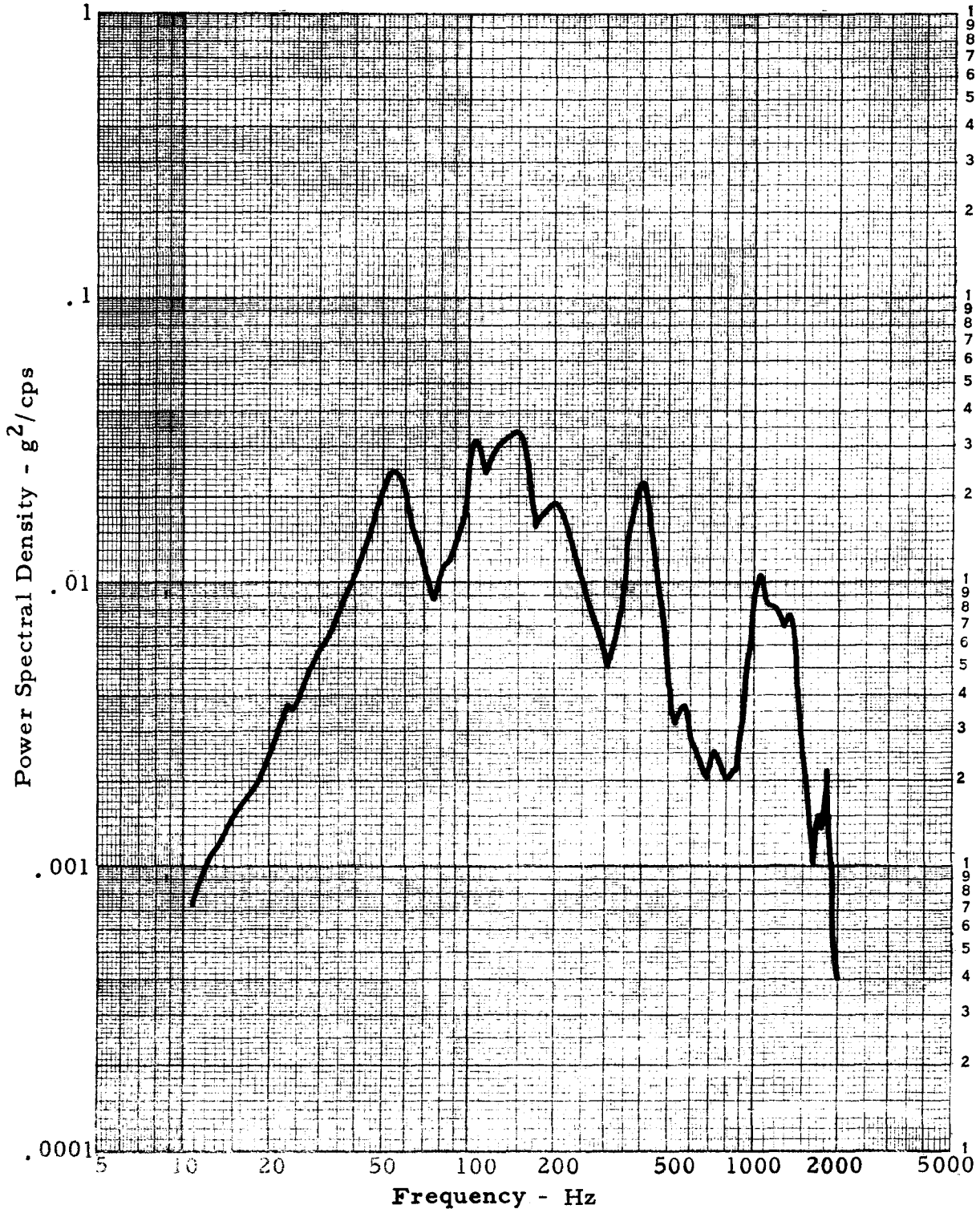
Serial Number: HFE-PROBE
Input Axis:
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL.B
Test Date:

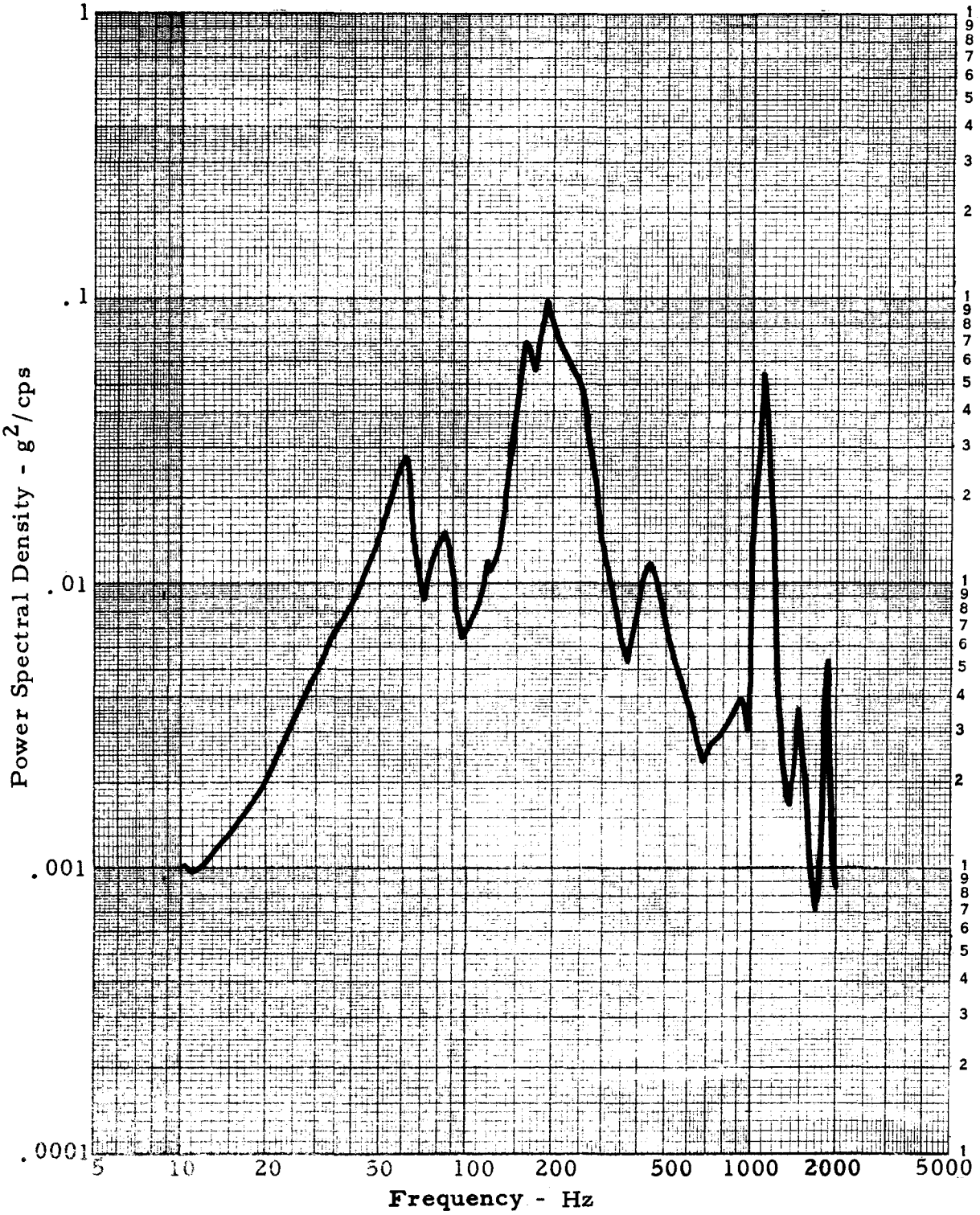
SN: HFE-PROBE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

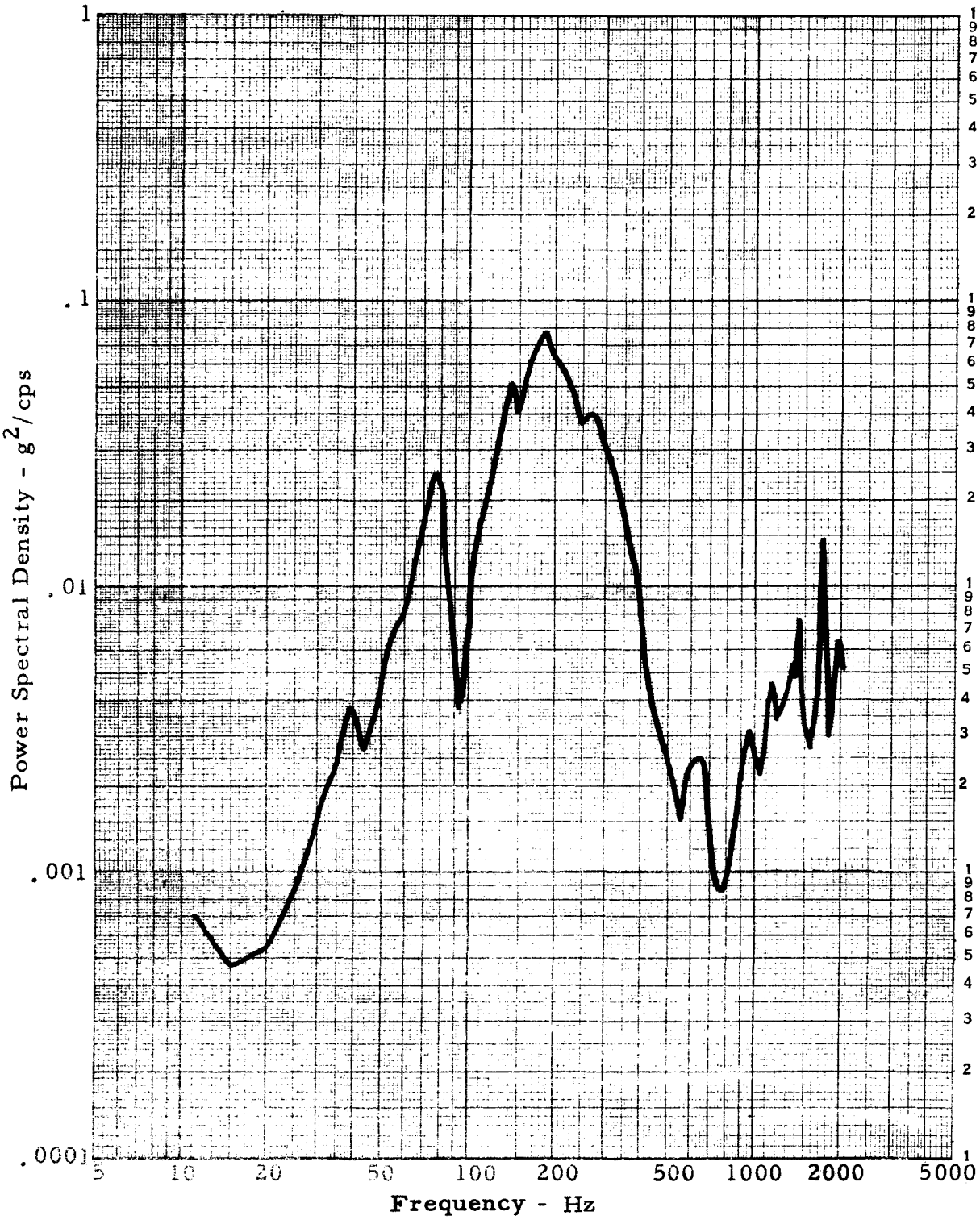
SN: HFE-PROBE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. B
Test Date:

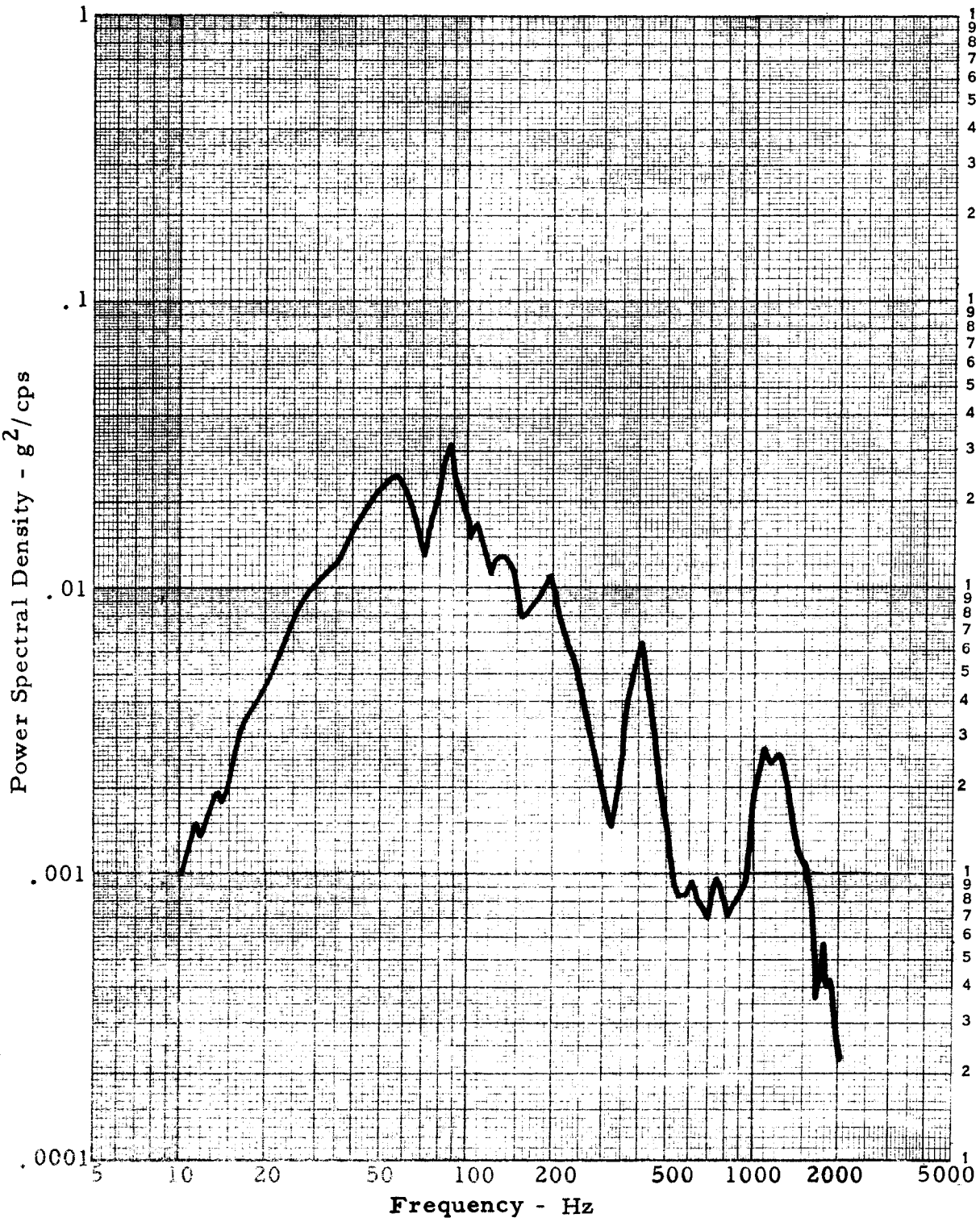
SN: HFE-PROBE
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

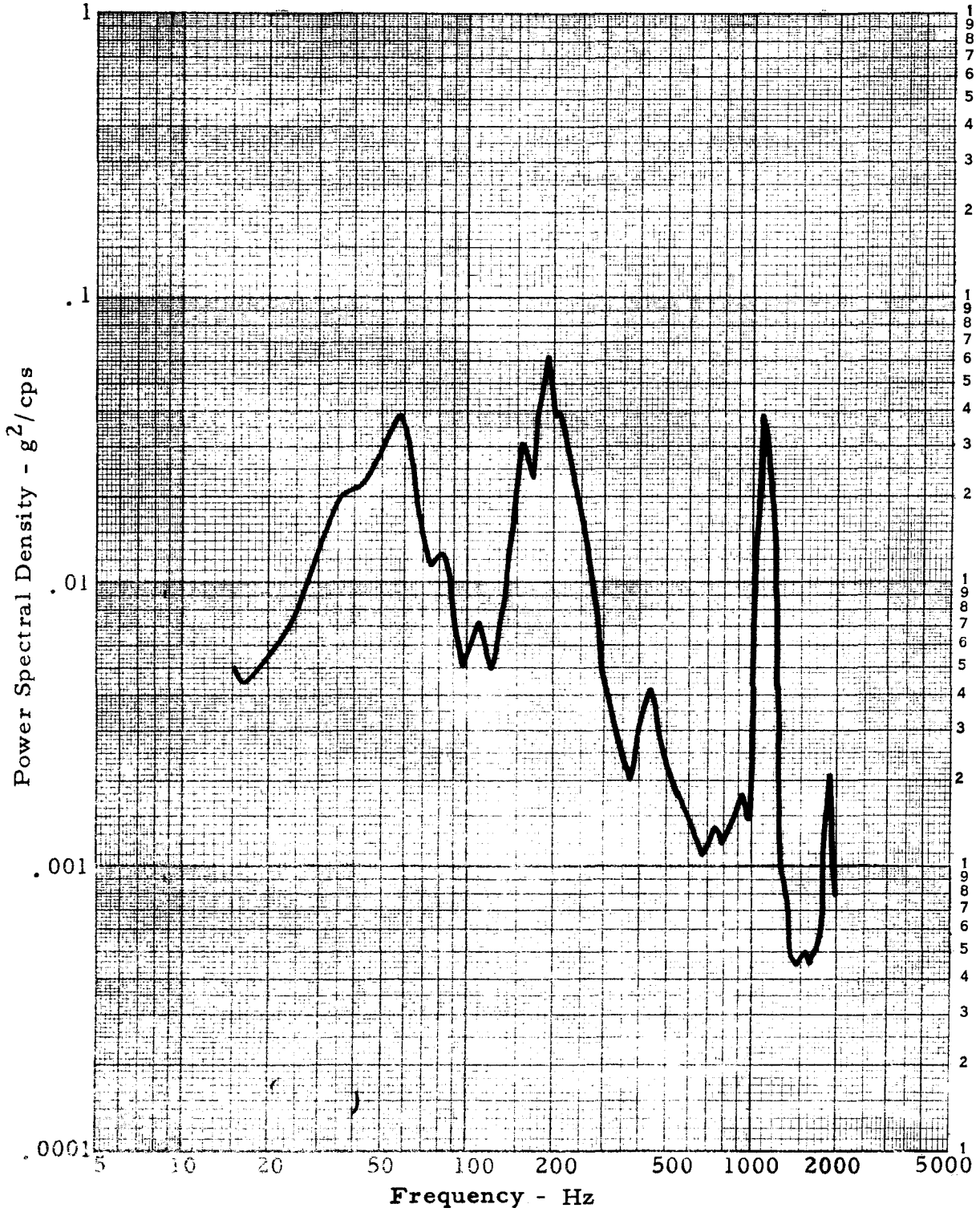
SN: HFE-PROBE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

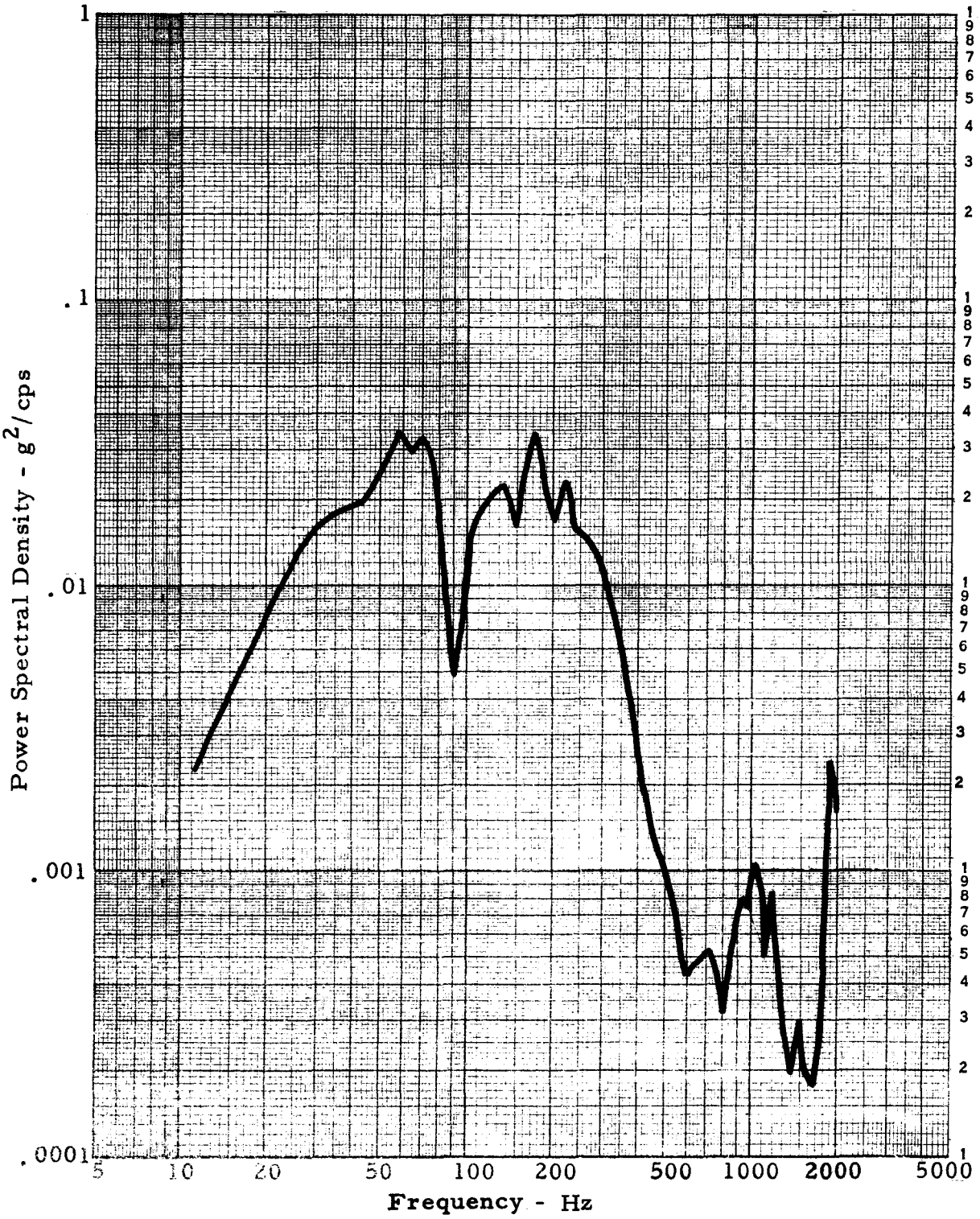
SN: HFE-PROBE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. B
Test Date:

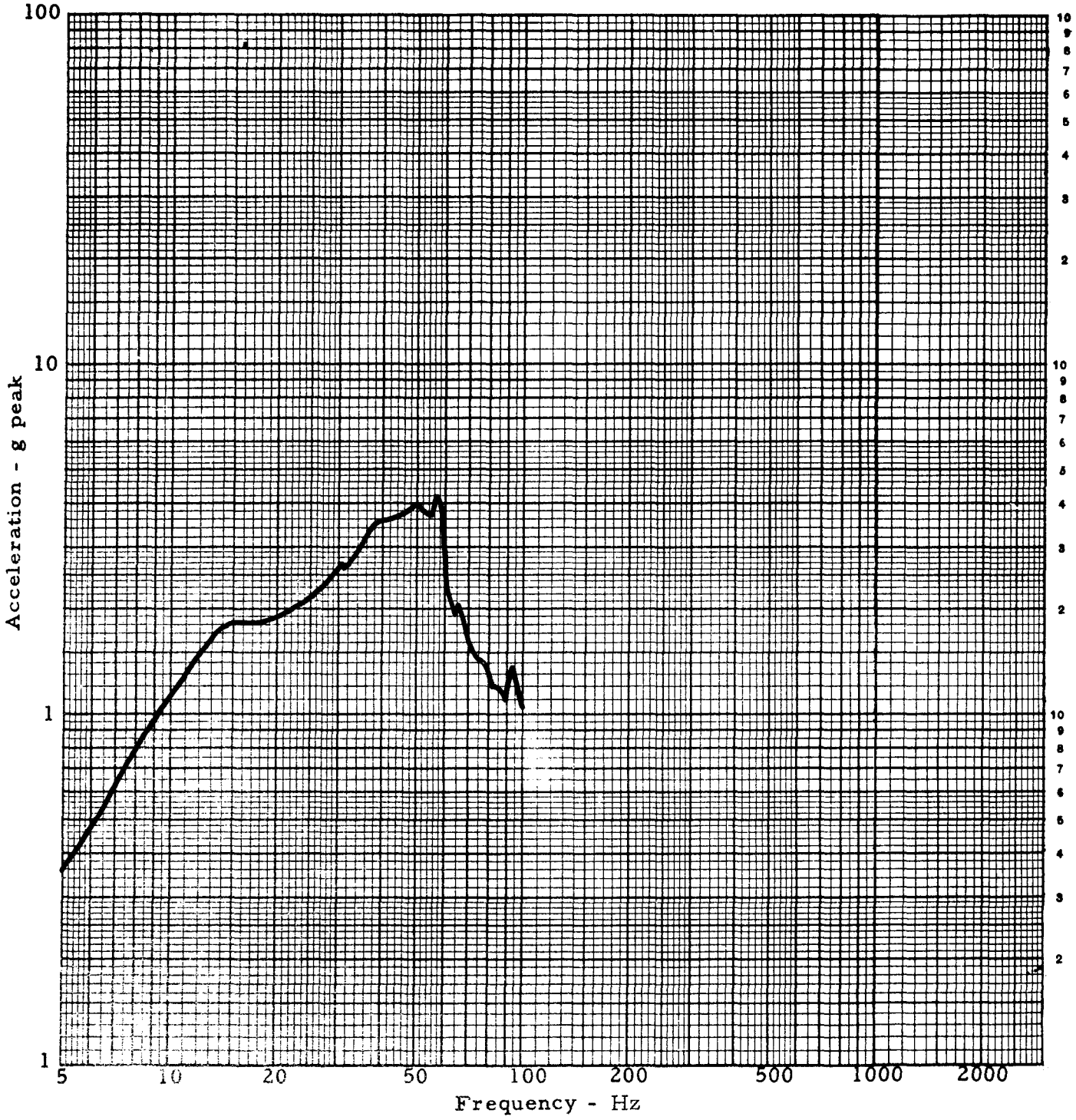
SN: HFE-PROBE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

Serial Number: LSM
Input Axis:
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

Serial Number: LSM
Input Axis:
Response Axis: Y

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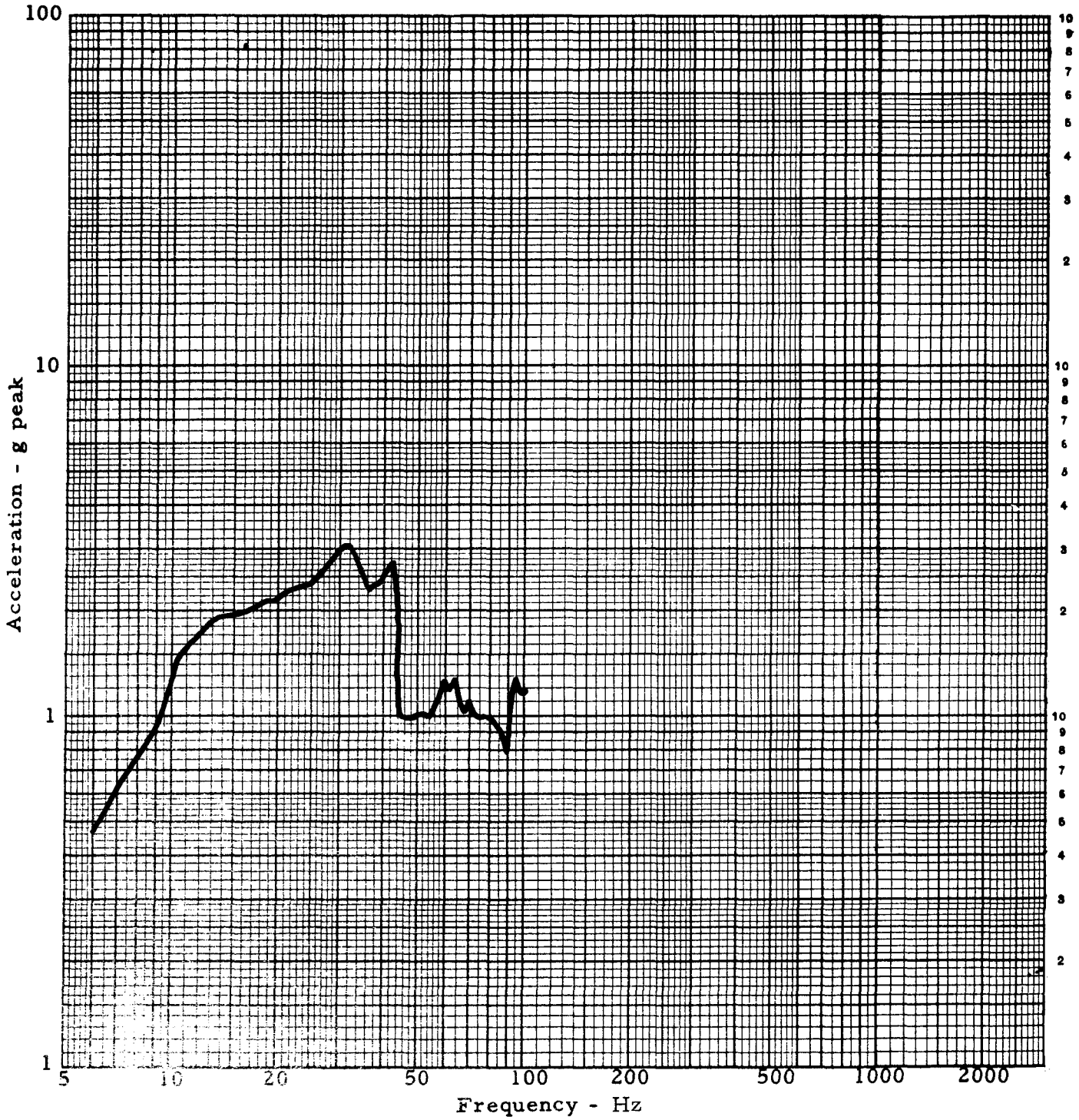
VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

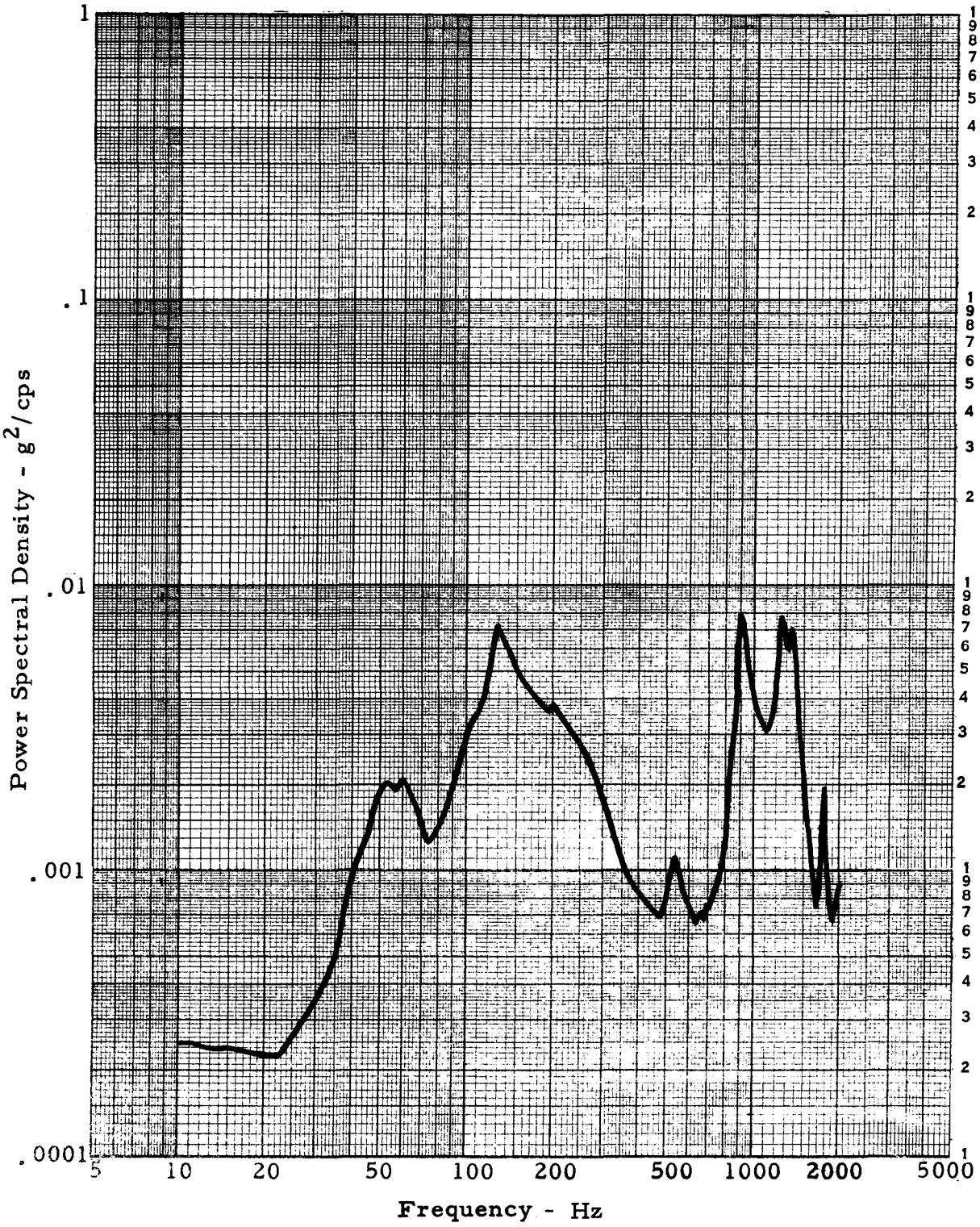
Serial Number: LSM
Input Axis:
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. SA
Test Date:

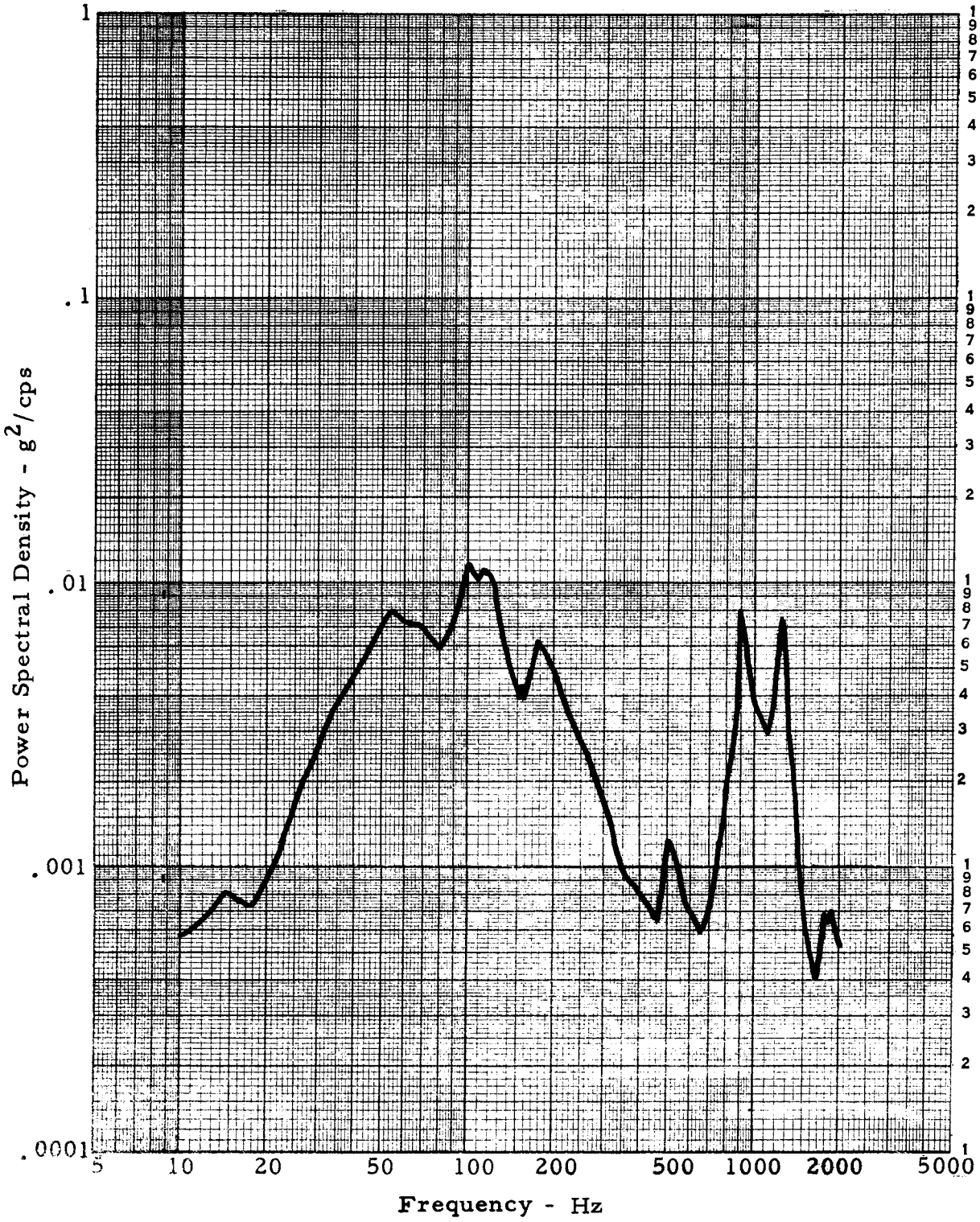
SN: LSM
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. SA
Test Date:

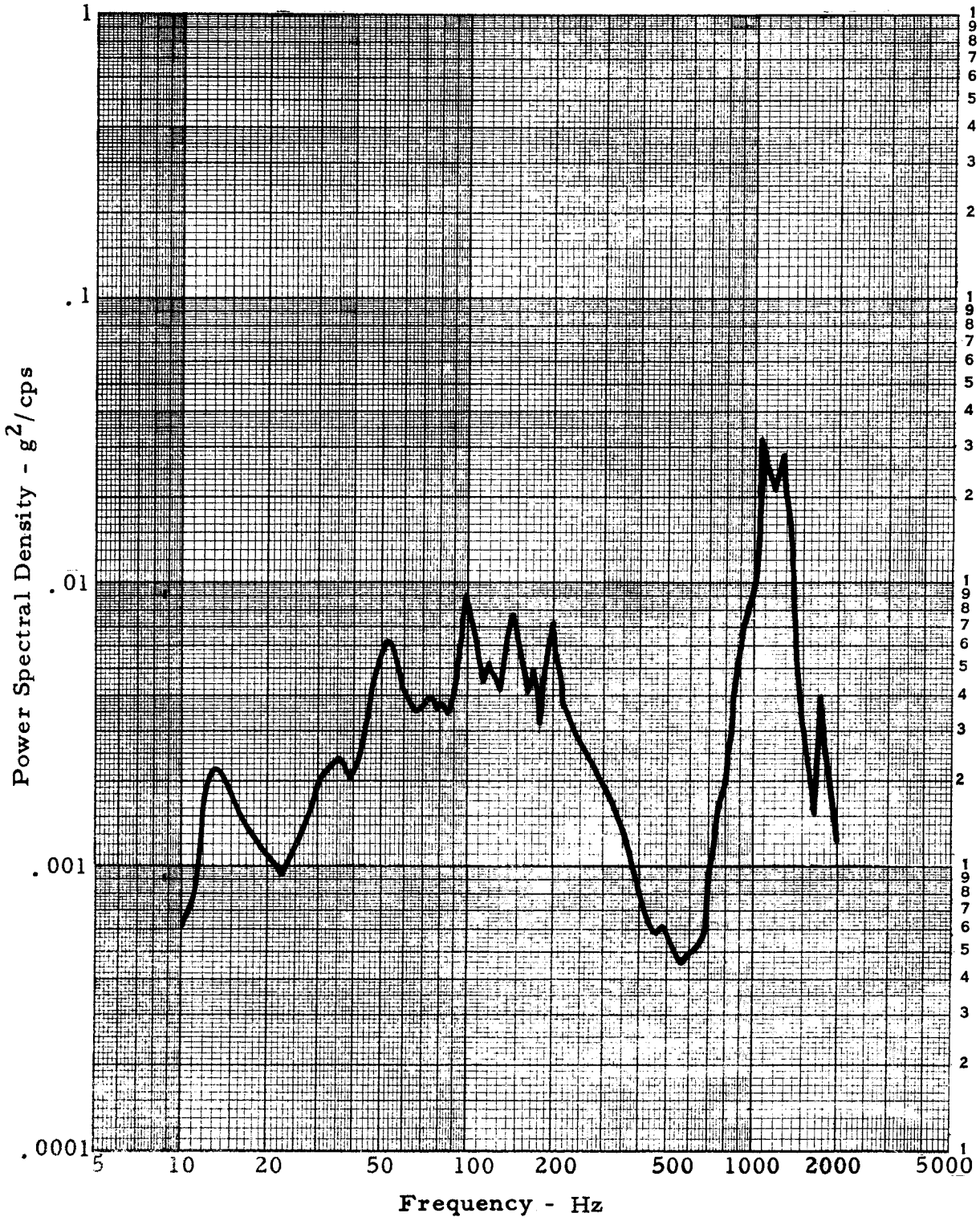
SN: LSM
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

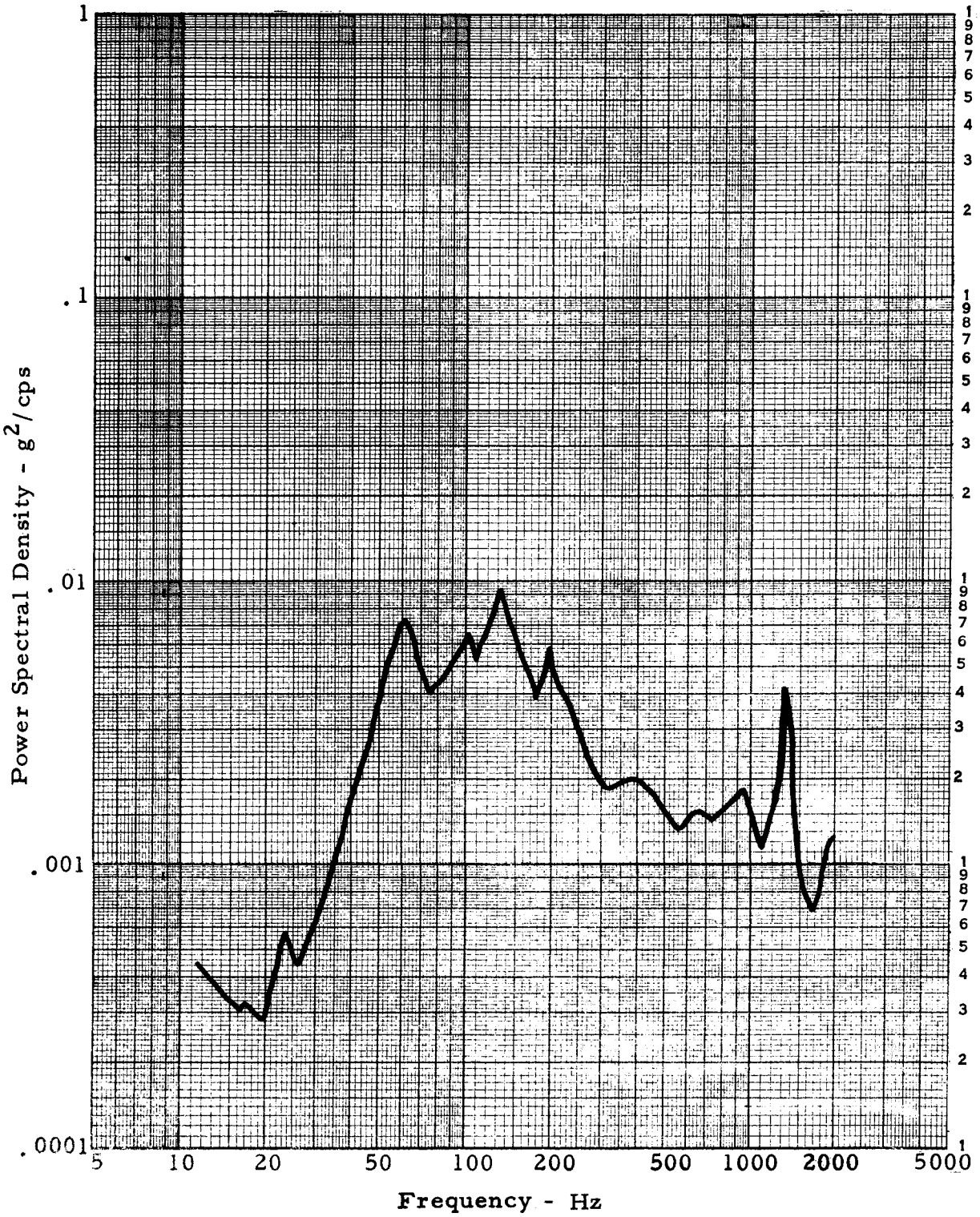
SN: LSM
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

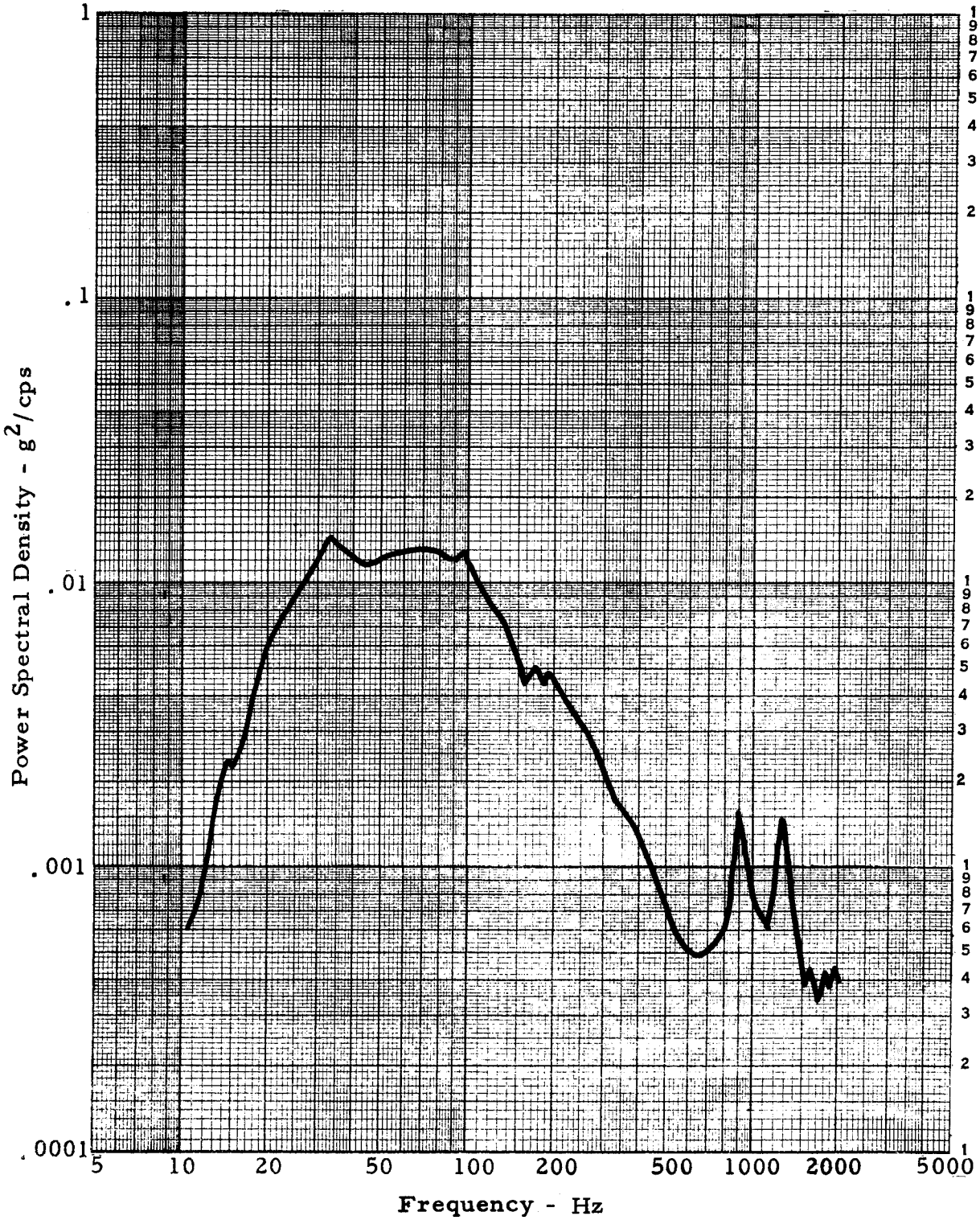
SN: LSM
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

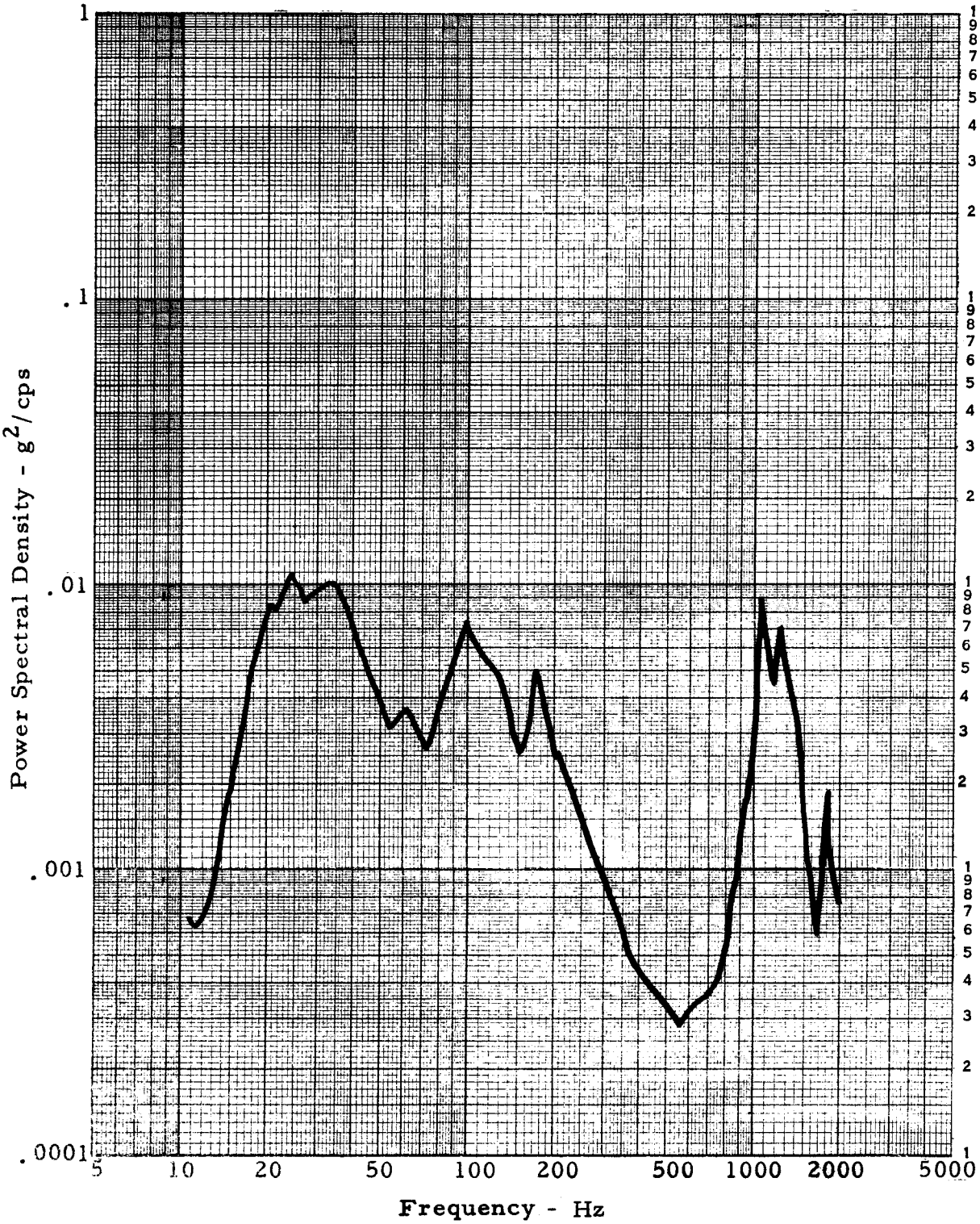
SN: LSM
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

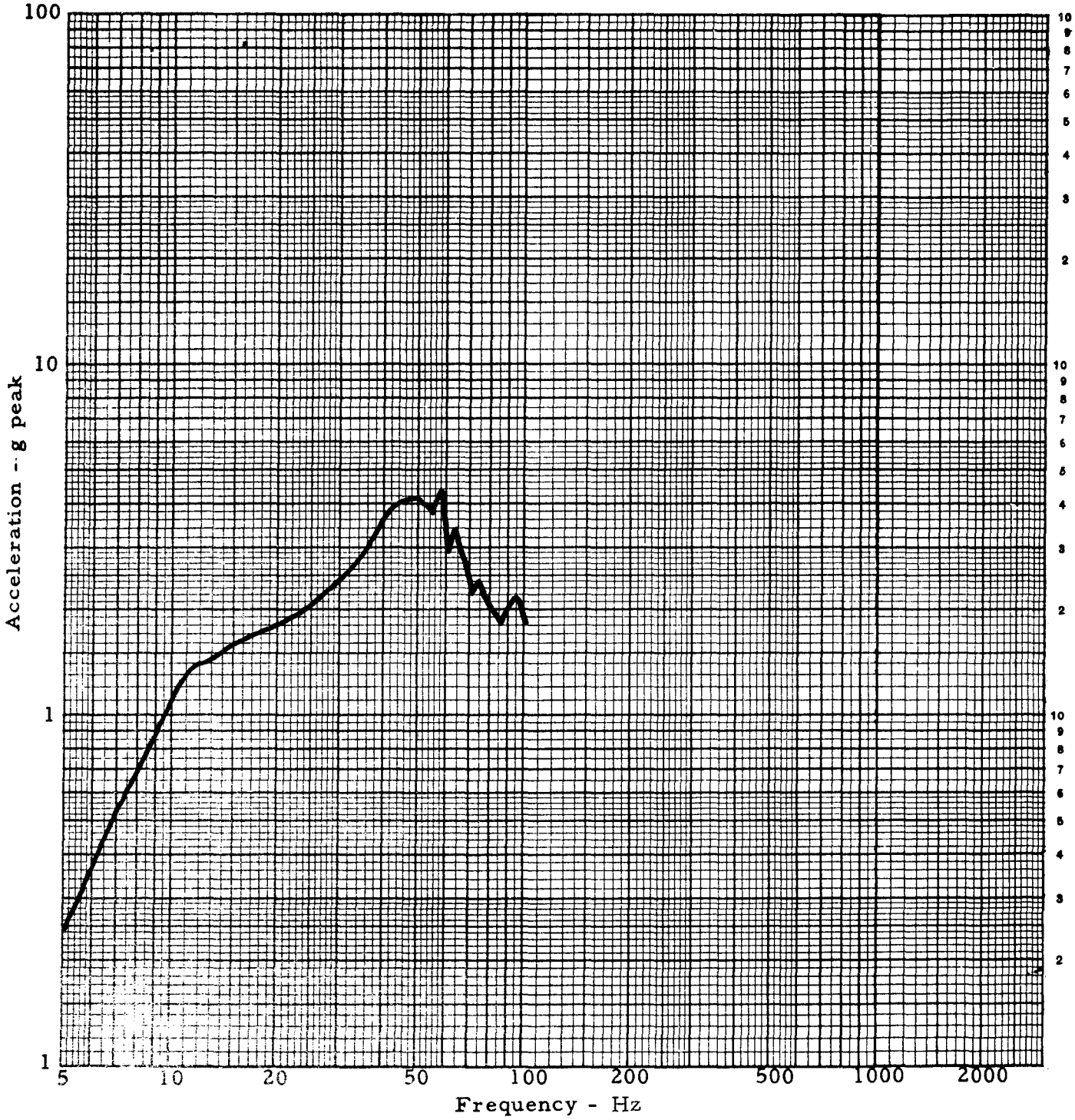
SN: LSM
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

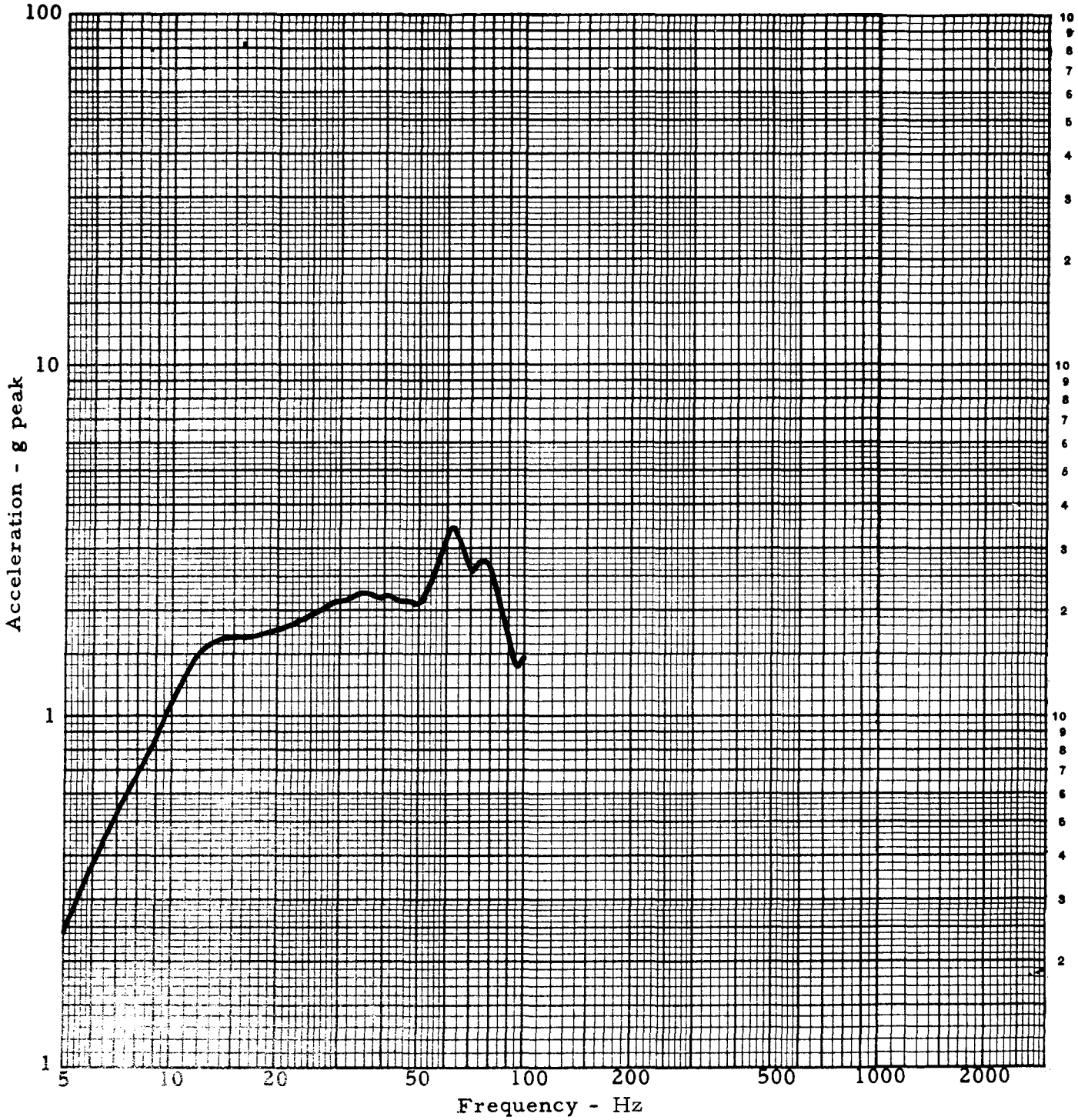
Serial Number: PSE
Input Axis:
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL, SA
Test Date:

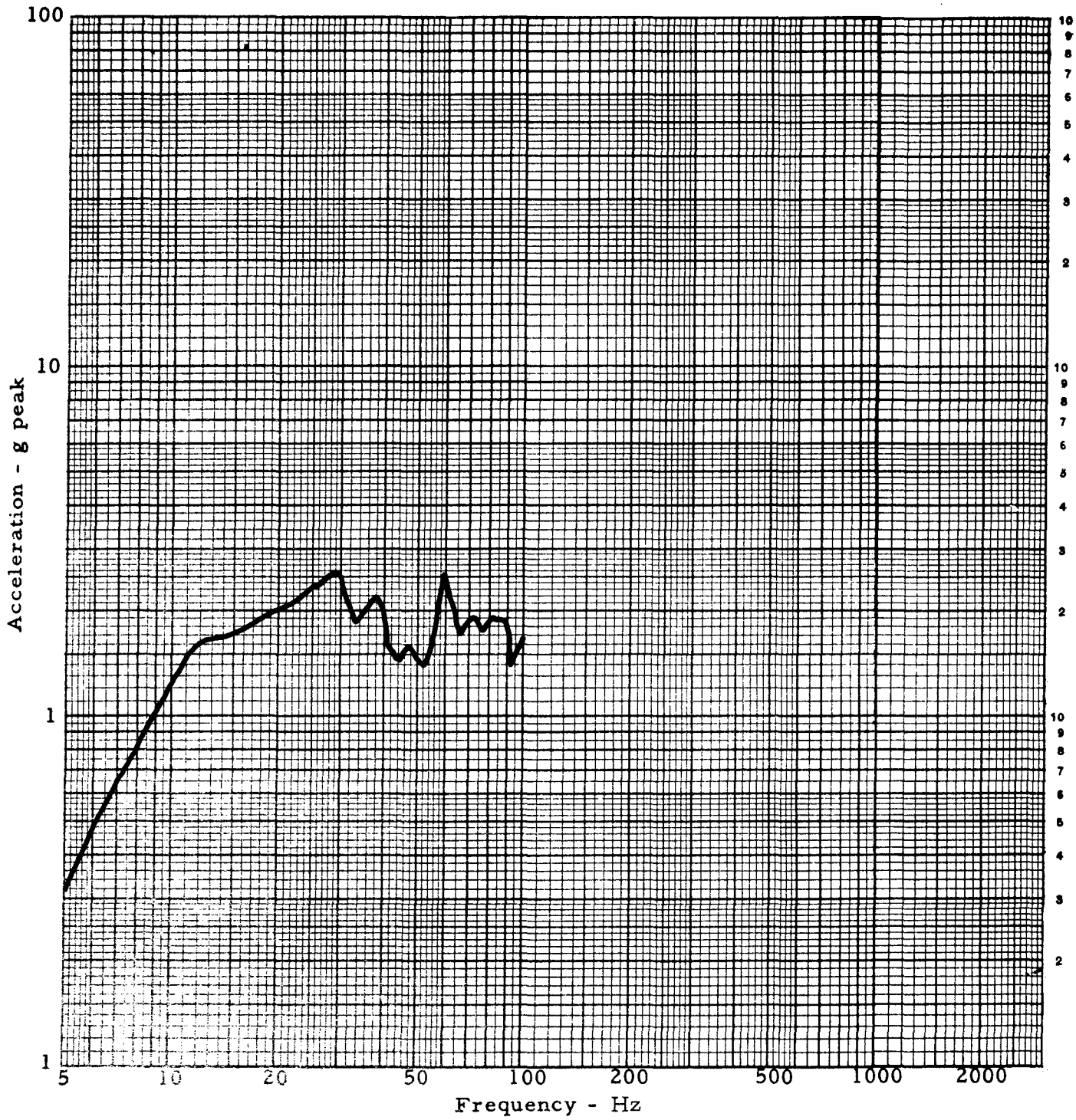
Serial Number: PSE
Input Axis:
Response Axis: Y



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

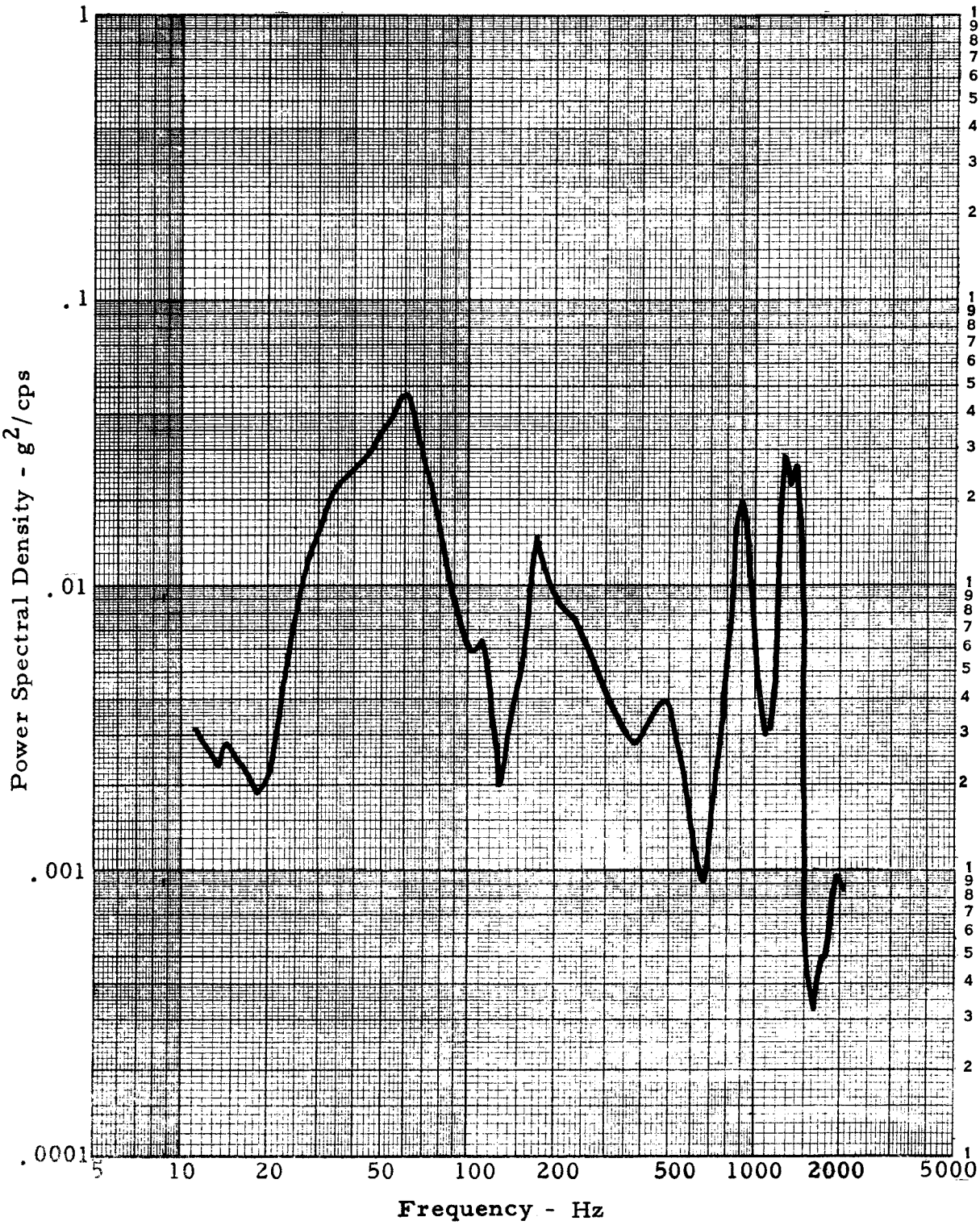
Serial Number: PSE
Input Axis:
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL, SA
Test Date:

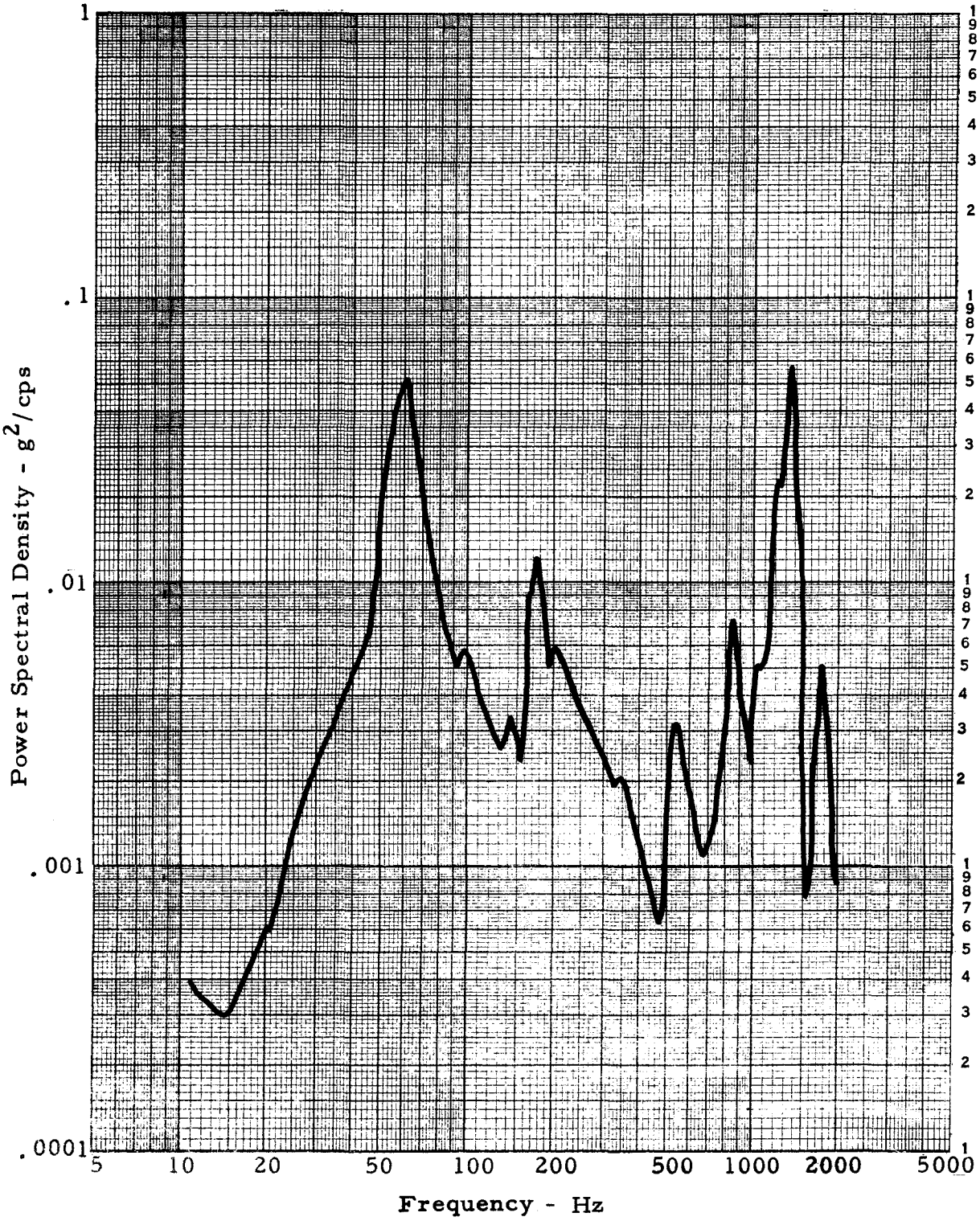
SN: PSE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

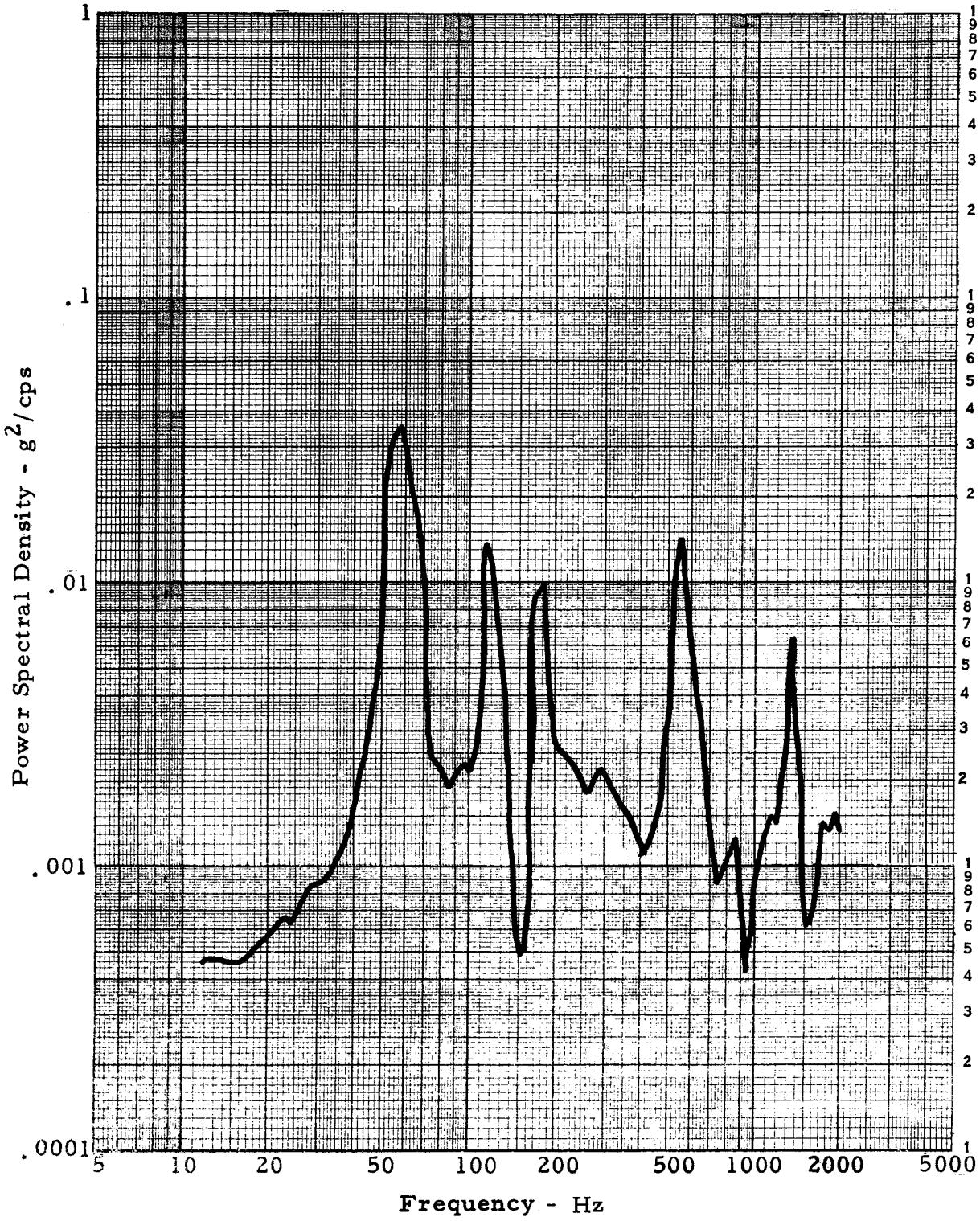
SN: PSE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL, SA
Test Date:

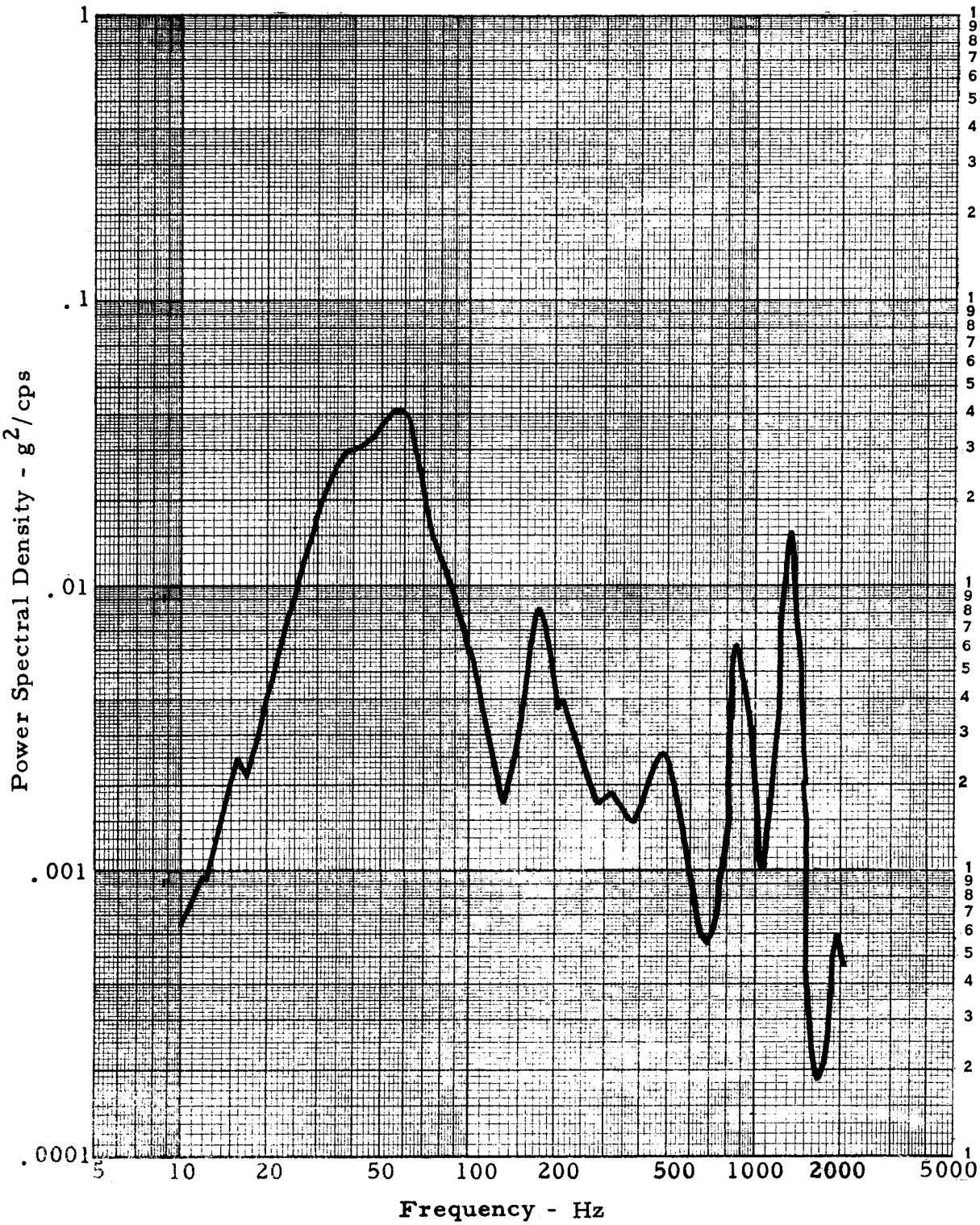
SN: PSE
Axis: Z



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL, SA
Test Date:

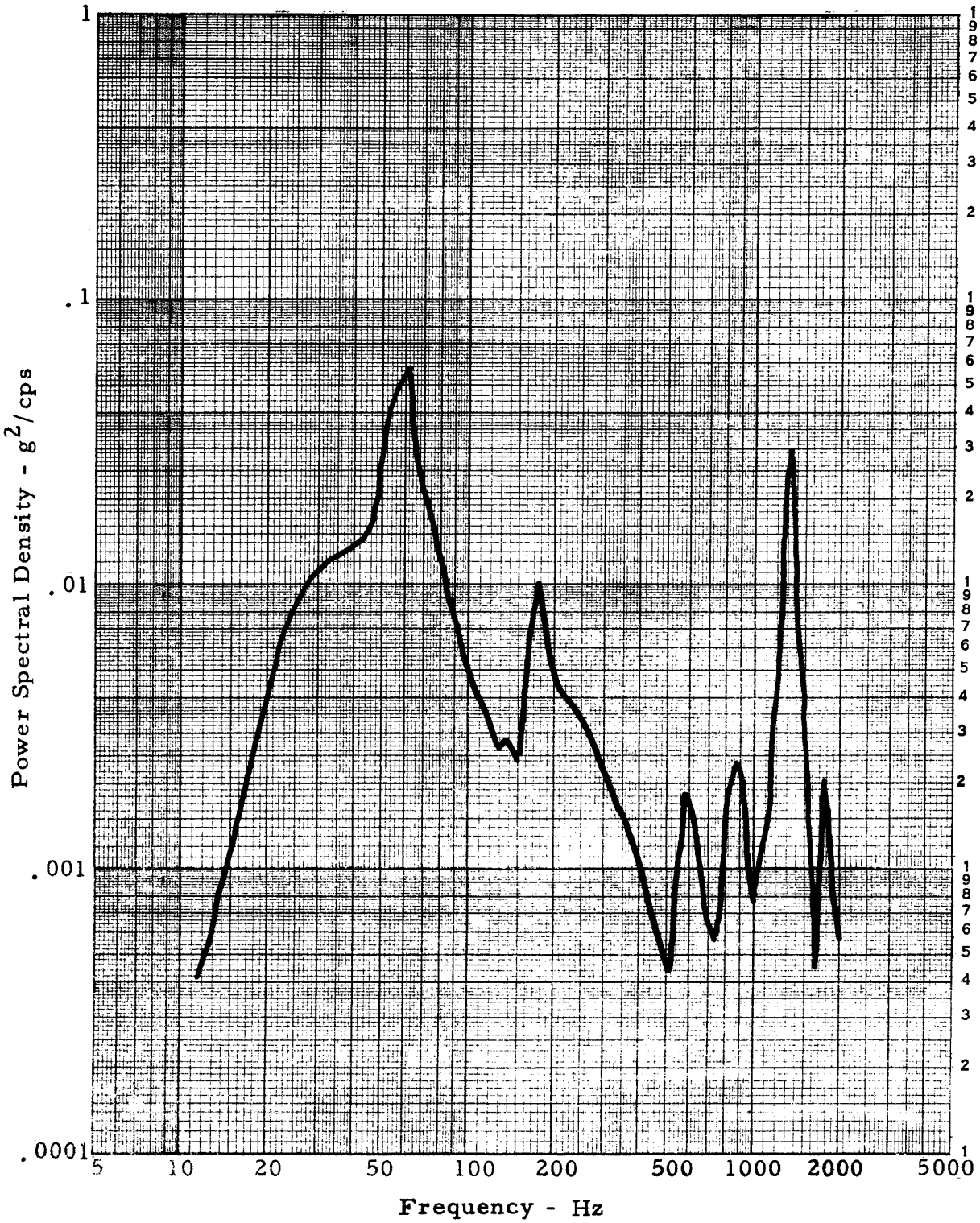
SN: PSE
Axis: X



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

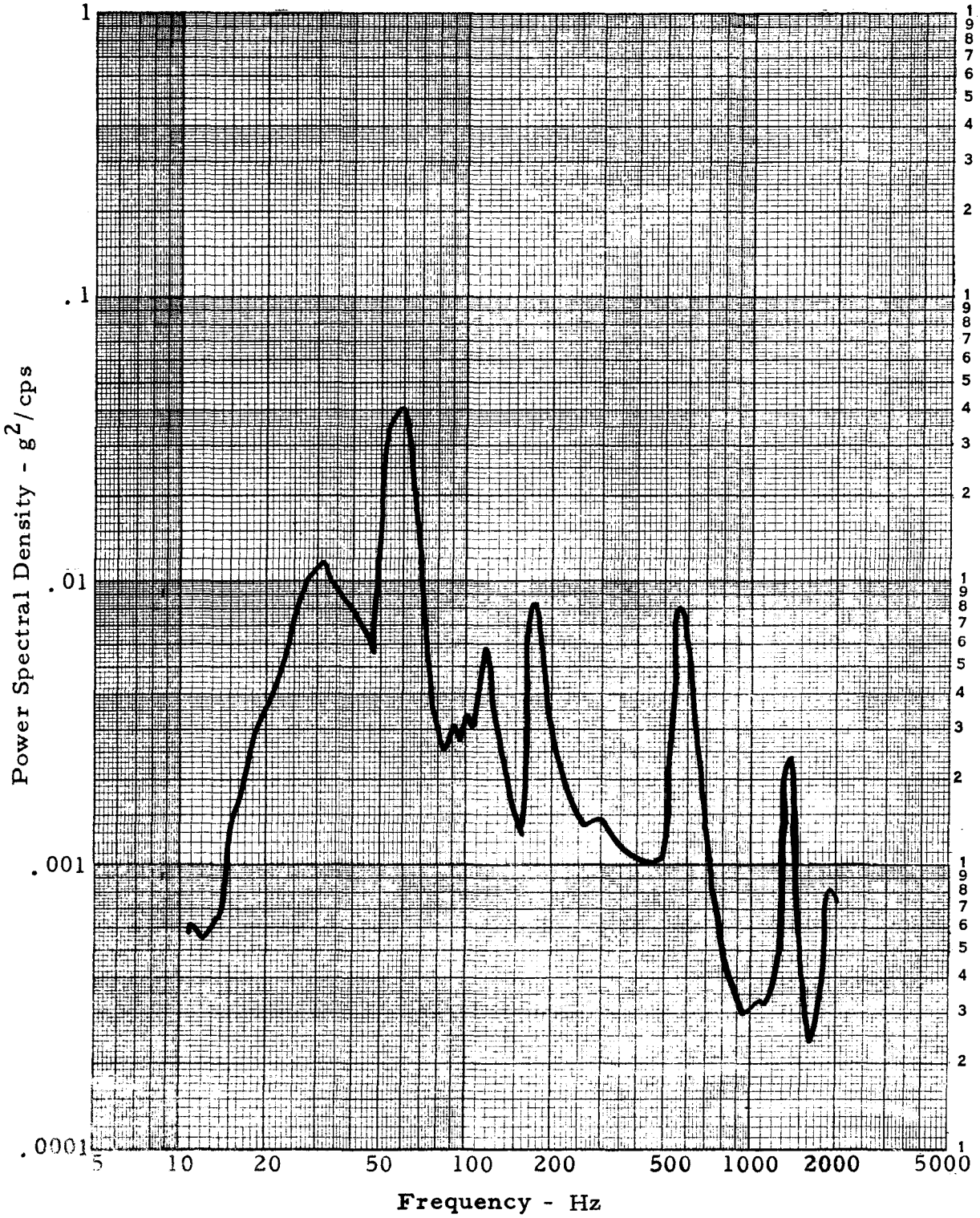
SN: PSE
Axis: Y



RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

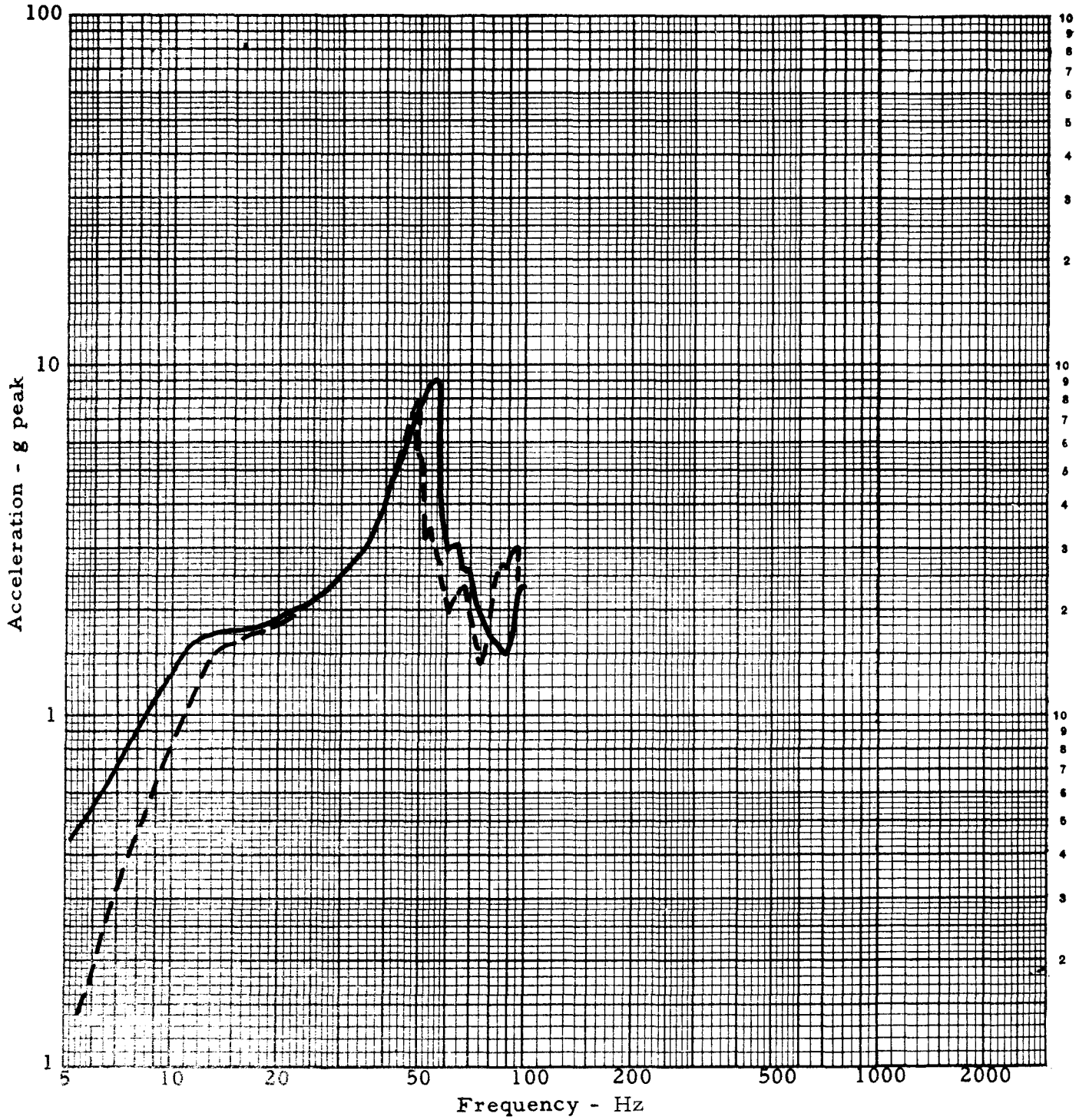
SN: PSE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. B ———
~~Test Date~~: QUAL. C — — —

Serial Number: PSE
Input Axis:
Response Axis: X

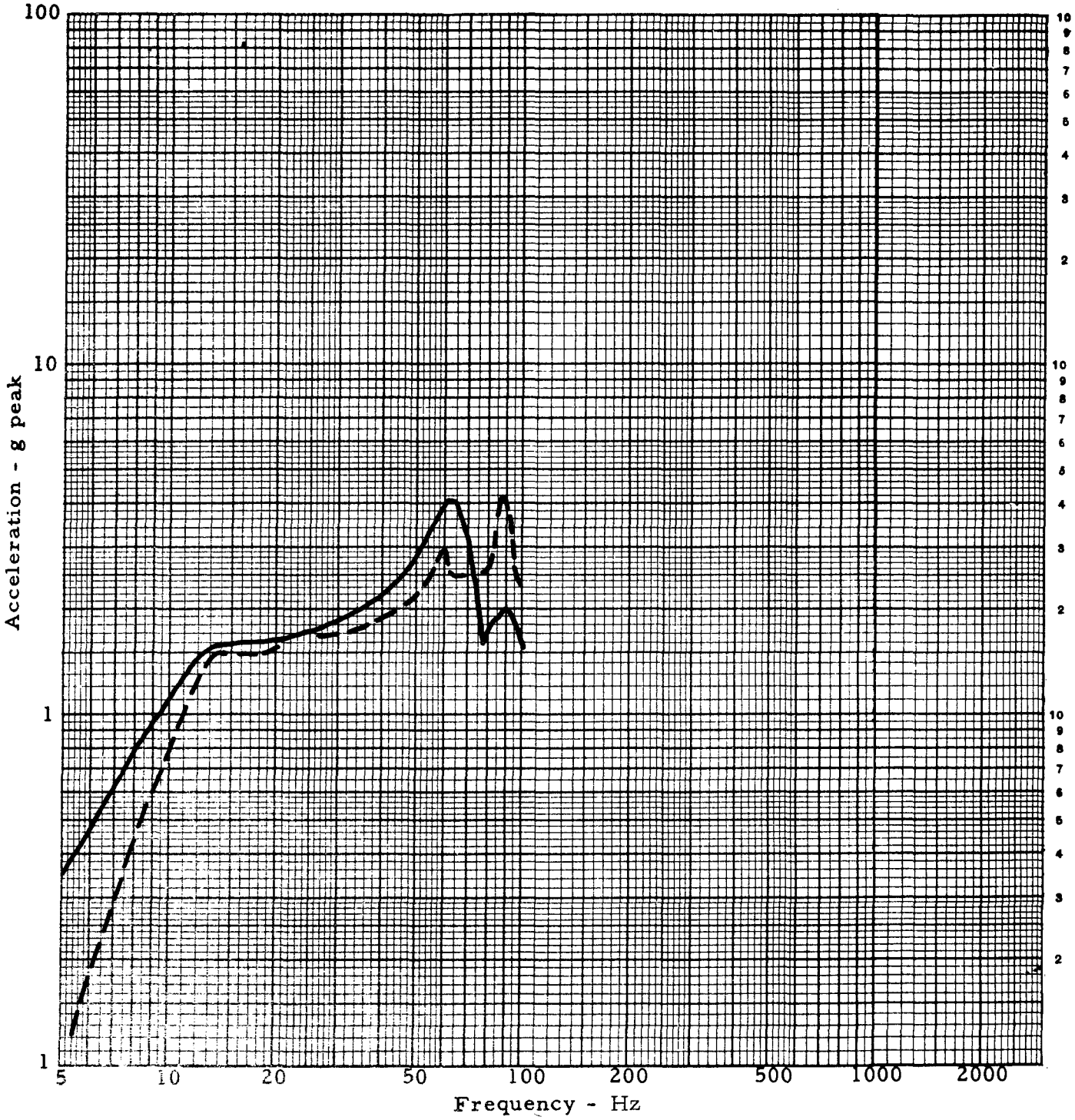


440-8 A

VIBRATION LEVELS

Test Item: QUAL. B ———
~~Test Date~~: QUAL. C — — —

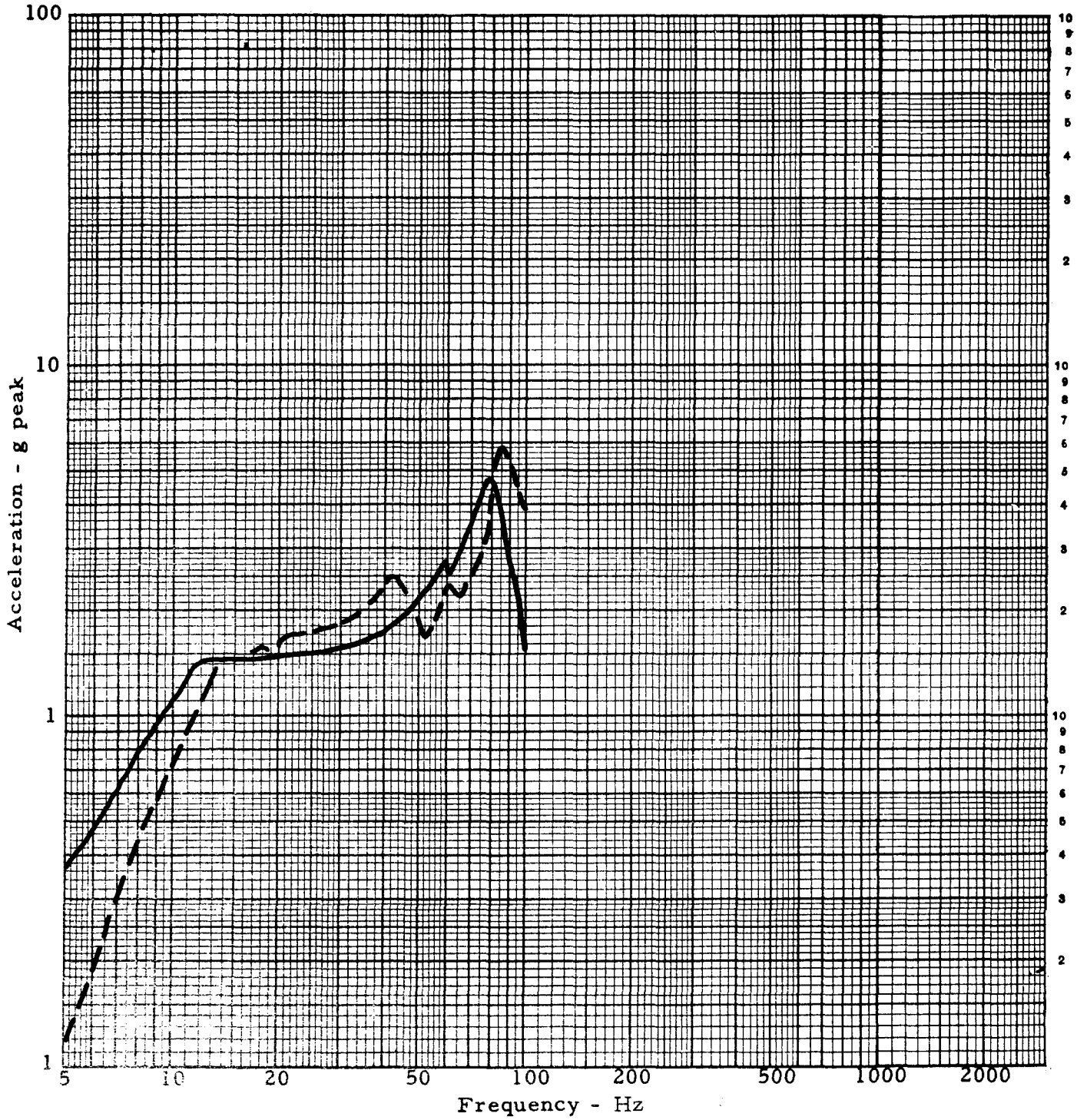
Serial Number: PSE
Input Axis:
Response Axis: Y



VIBRATION LEVELS

Test Item: QUAL. B
~~Test Date:~~ QUAL. C

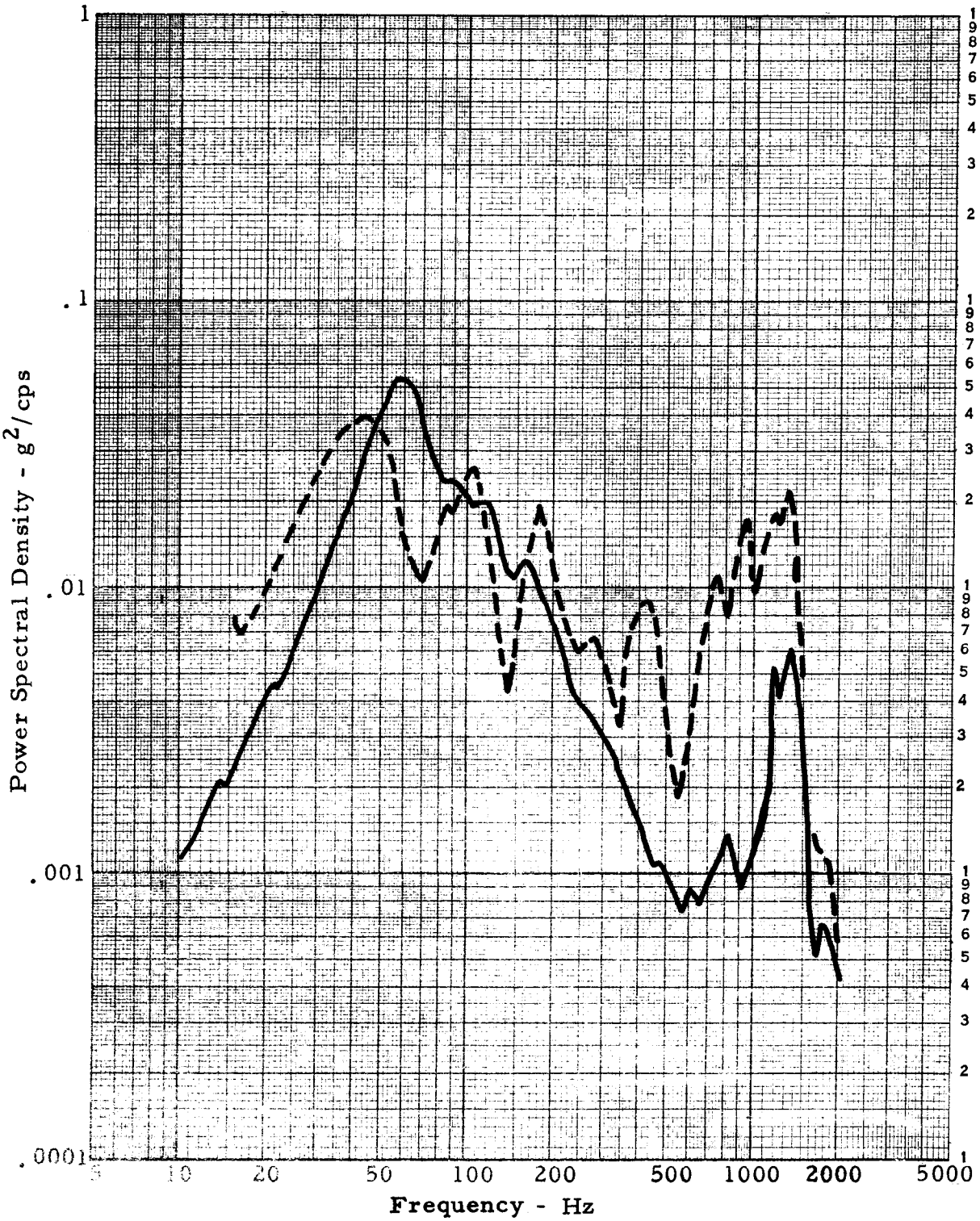
Serial Number: PSE
Input Axis:
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C - - -

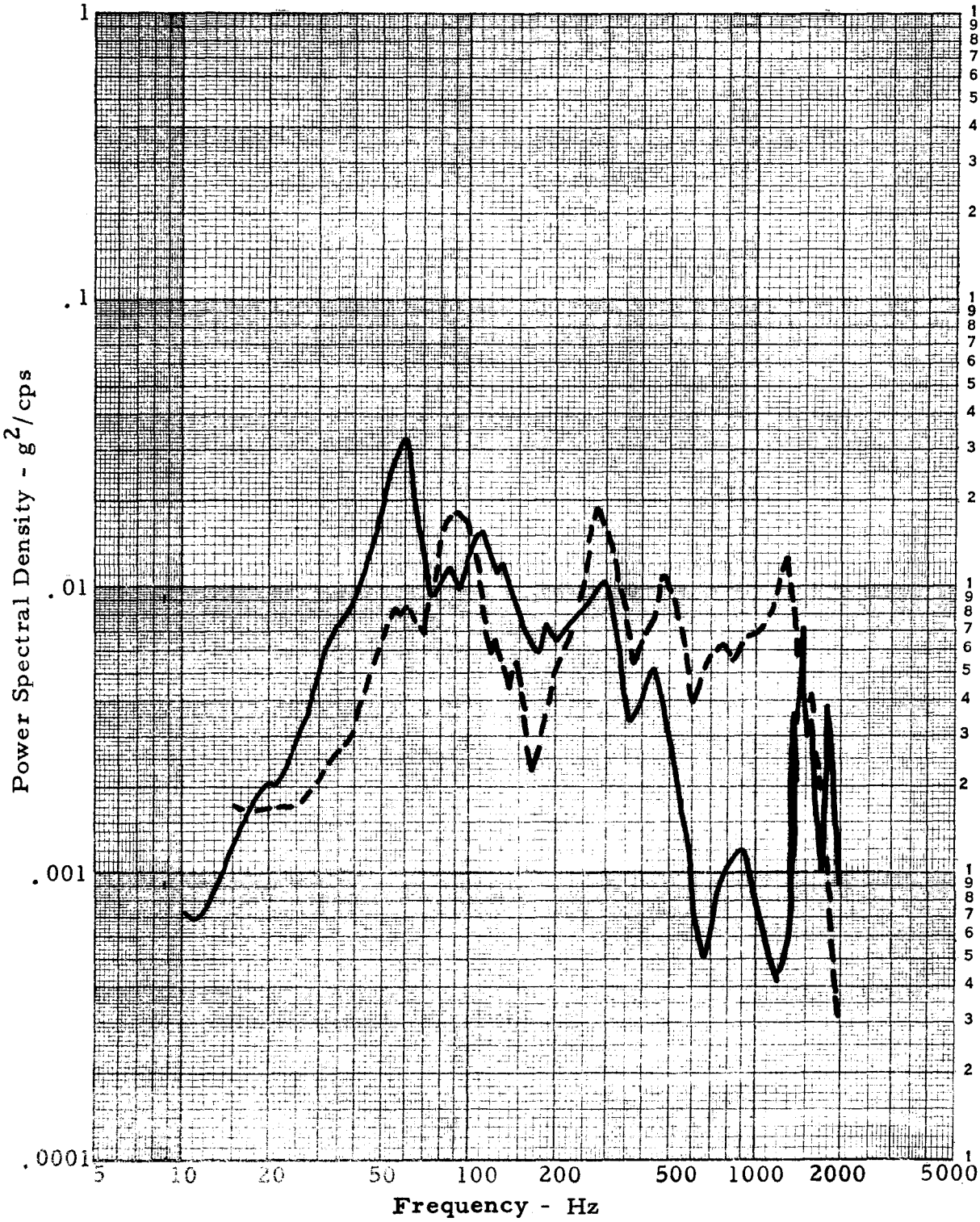
SN: PSE
Axis: X



RANDOM VIBRATION SPECTRUM

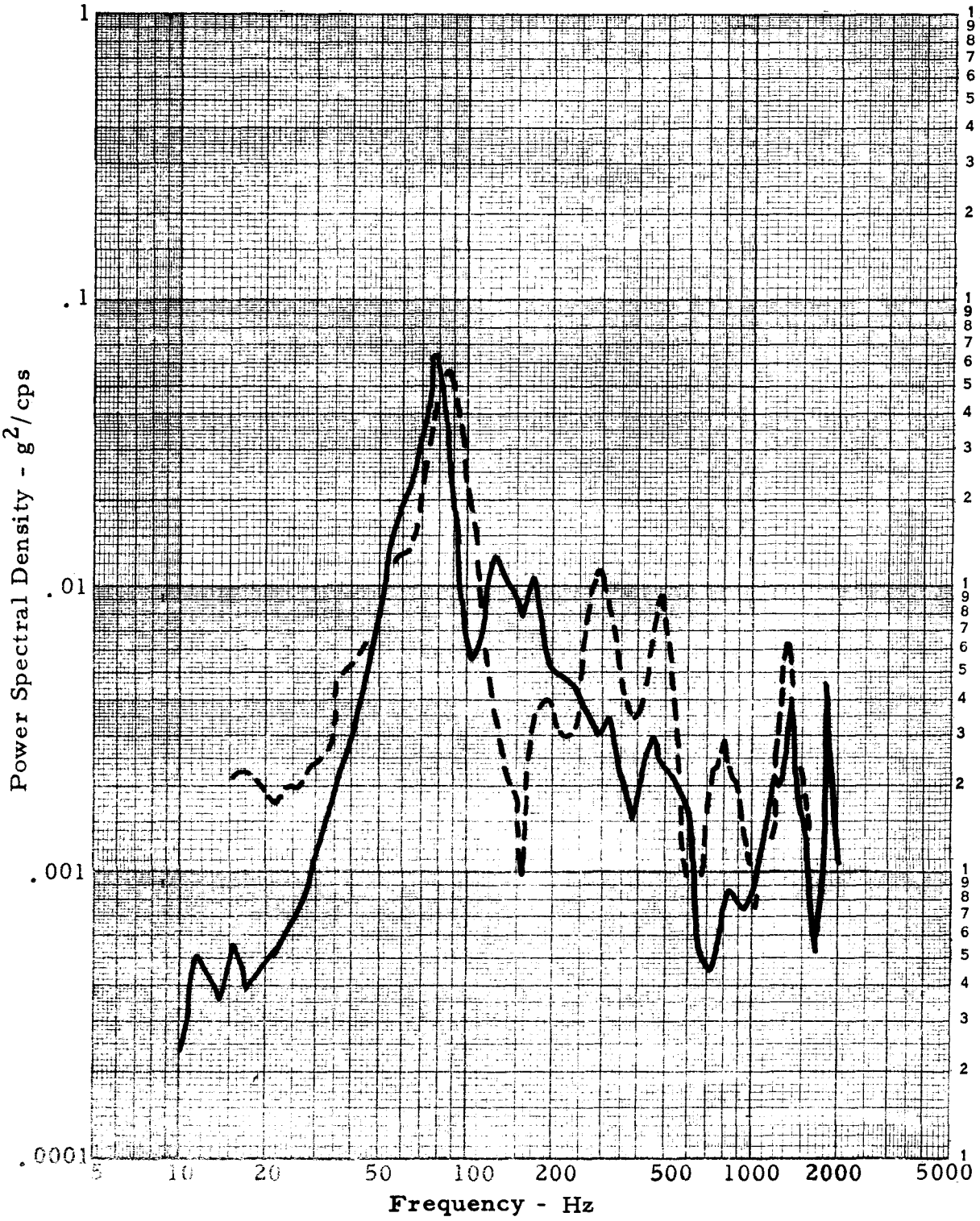
Test: L & B
Test Item: QUAL. B ——— QUAL. C - - -
~~Test Date~~:

SN: PSE
Axis: Y



RANDOM VIBRATION SPECTRUM

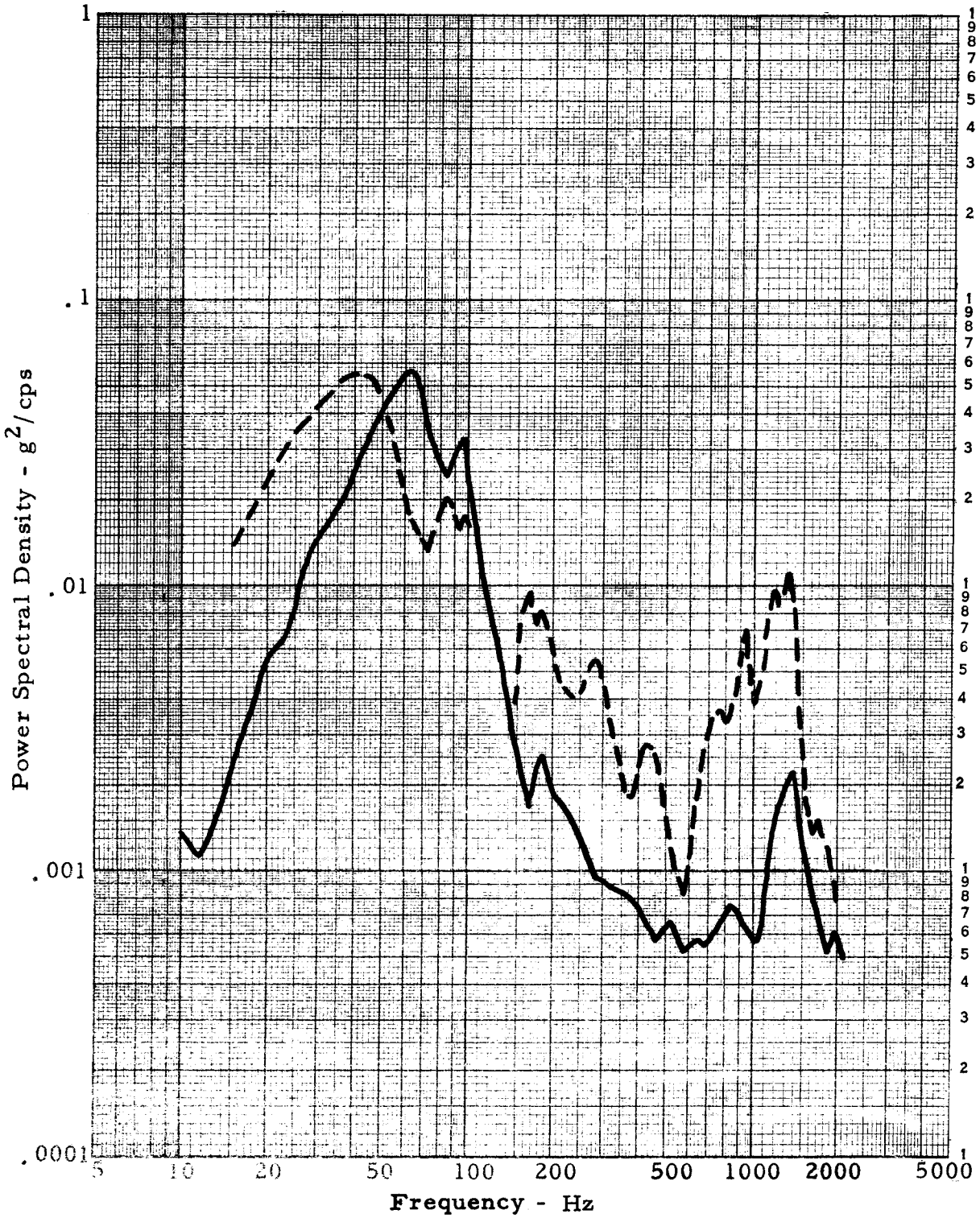
Test: L&B
Test Item: QUAL. B ——— QUAL. C – – –
~~Test Date:~~
SN: PSE
Axis: Z



RANDOM VIBRATION SPECTRUM

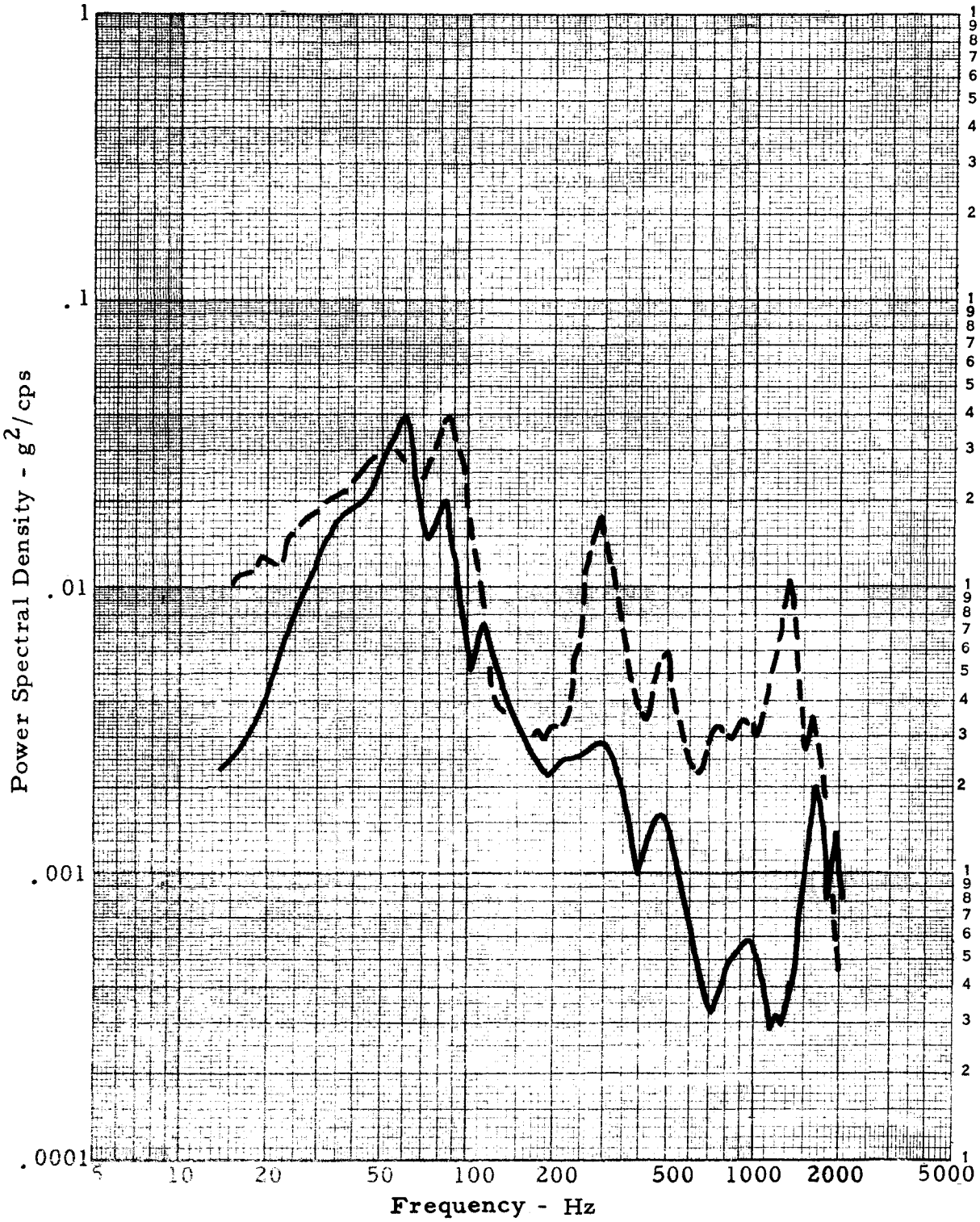
Test: Lun. Des.
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C - - - -

SN: PSE
Axis: X



RANDOM VIBRATION SPECTRUM

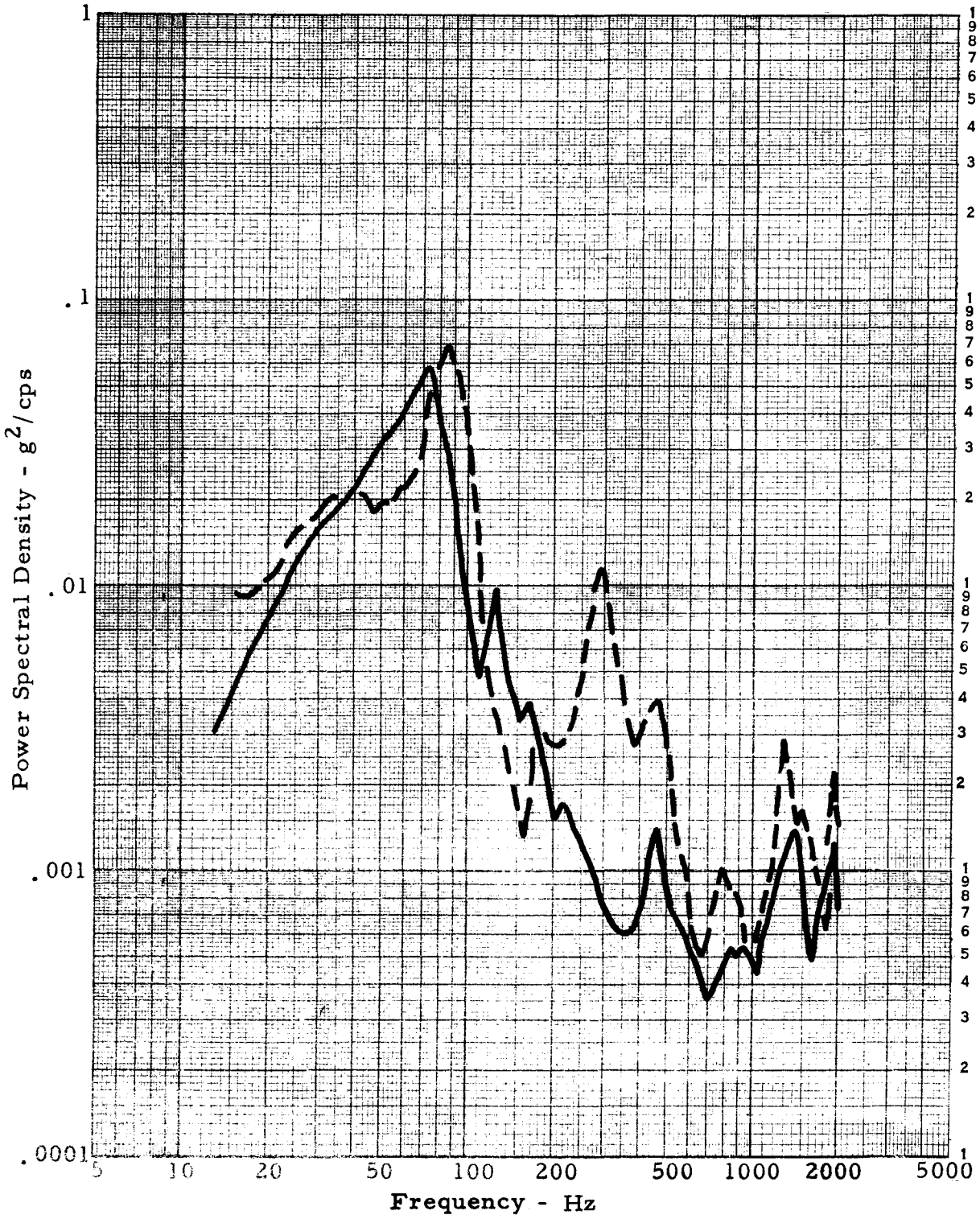
Test: Lun. Des.
Test Item: QUAL. B ——— SN: PSE
~~Test Date~~: QUAL. C – – – Axis: Y



RANDOM VIBRATION SPECTRUM

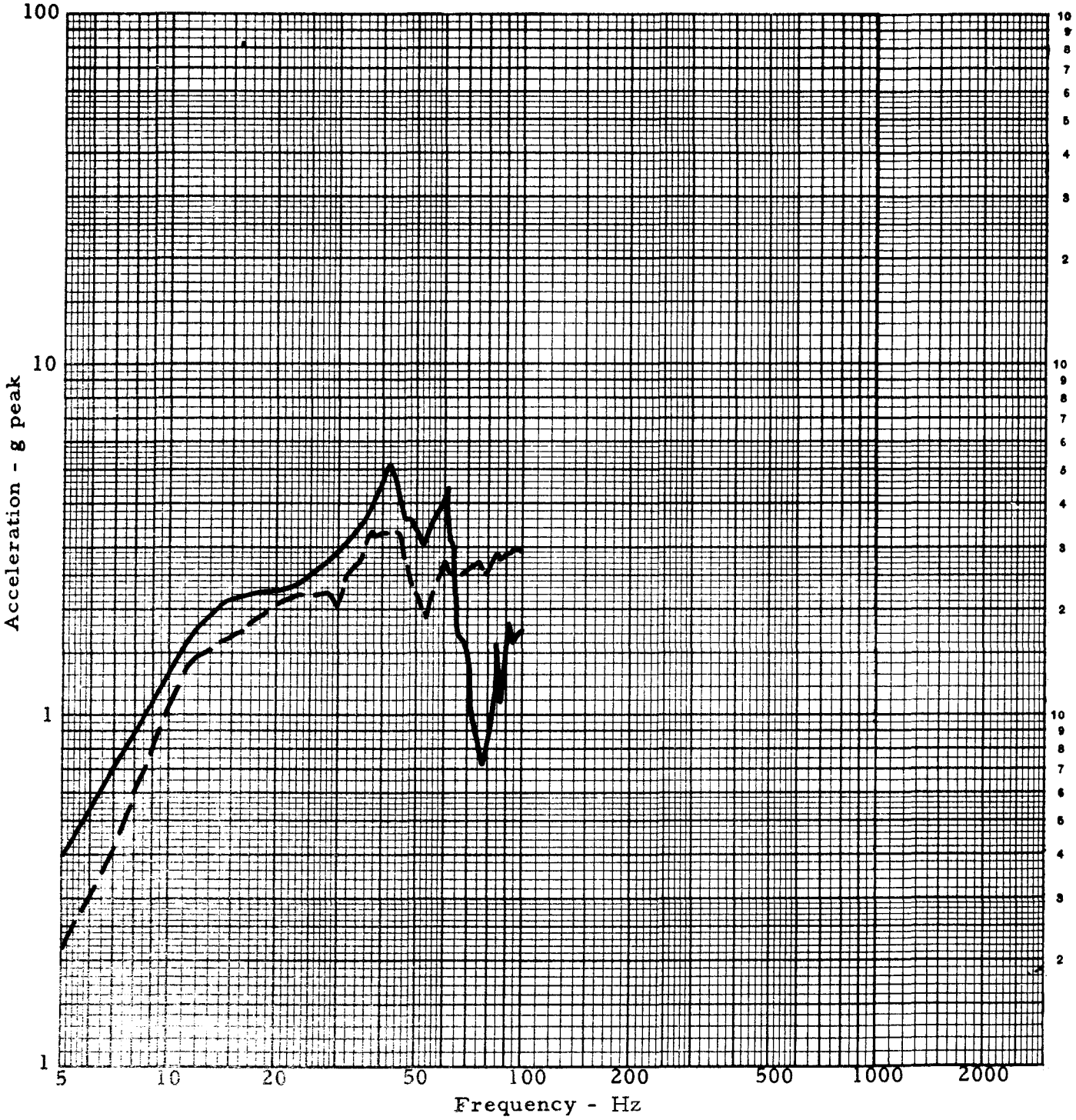
Test: LUN. DES.
Test Item: QUAL. B ———
~~Test Date:~~ QUAL. C — — —

SN: PSE
Axis: Z



VIBRATION LEVELS

Test Item: QUAL. SA, IN-AXIS ———— Serial Number: RTG
~~Test Date:~~ QUAL. B, IN-AXIS — — — — Input Axis:
QUAL. B, CROSS-AXIS* ..... Response Axis: X



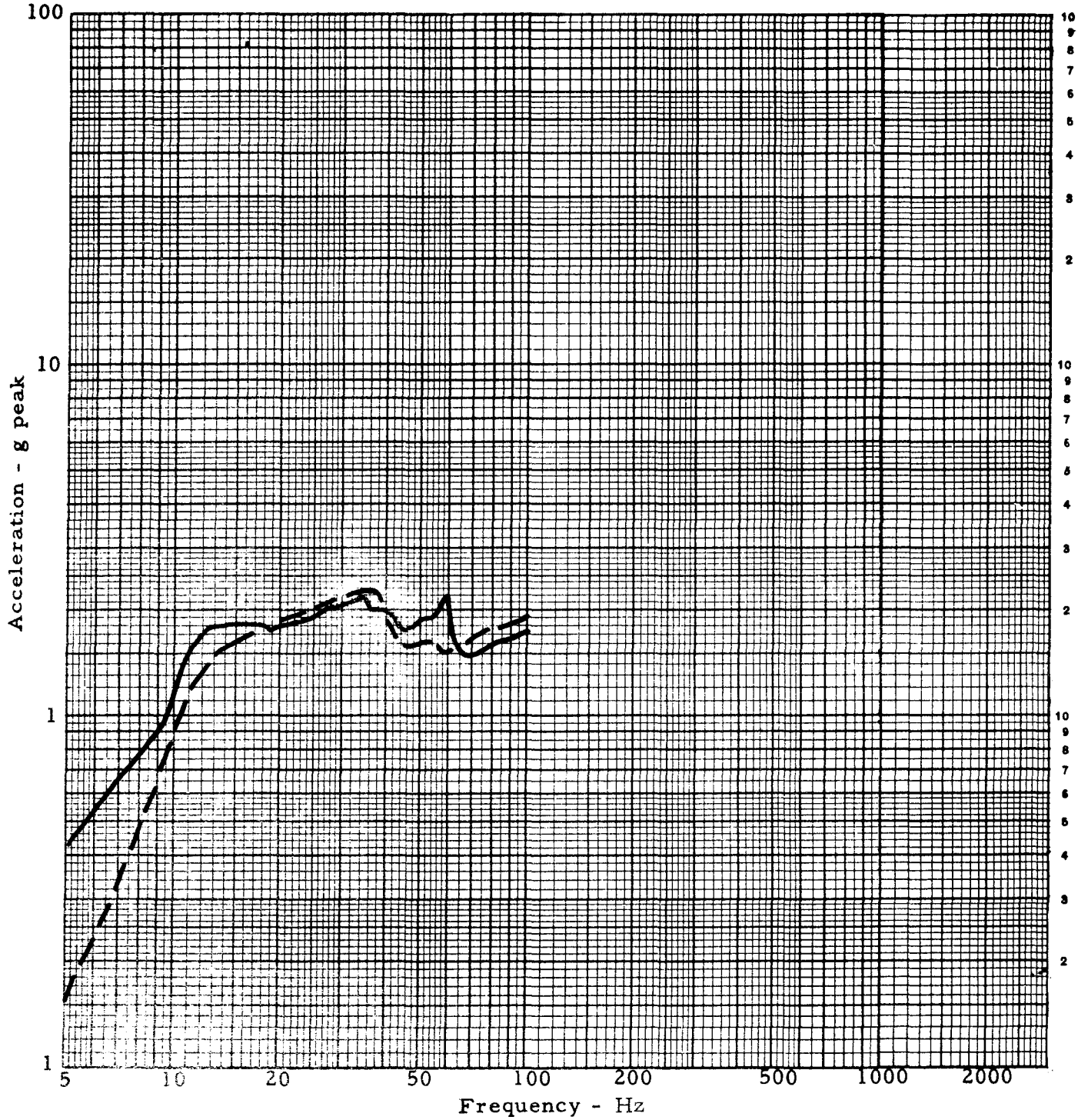
440-8 A

* shown only if greater than IN-AXIS data

VIBRATION LEVELS

Test Item: QUAL. 5A, in-axis ———
~~Test Date~~: QUAL. B, in-axis — — —
QUAL. B, cross-axis* . . . . .

Serial Number: RTG
Input Axis:
Response Axis: Y



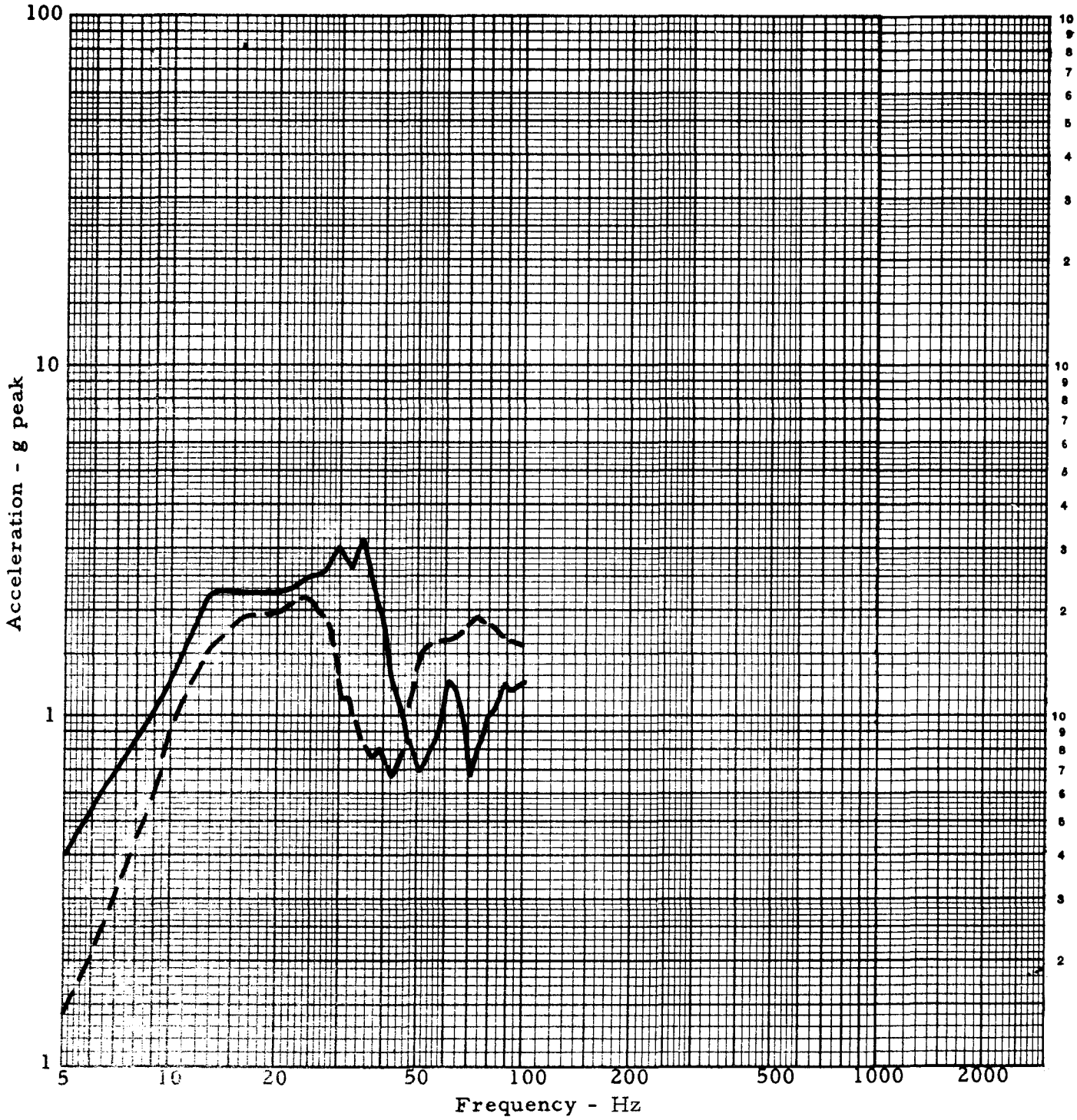
440-8 A

* shown only if greater than in-axis data

VIBRATION LEVELS

Test Item: QUAL. SA, IN-AXIS ———
~~Test Date:~~ QUAL. B, IN-AXIS — — —
QUAL. B, CROSS-AXIS* · · · · ·

Serial Number: RTG
Input Axis:
Response Axis: Z

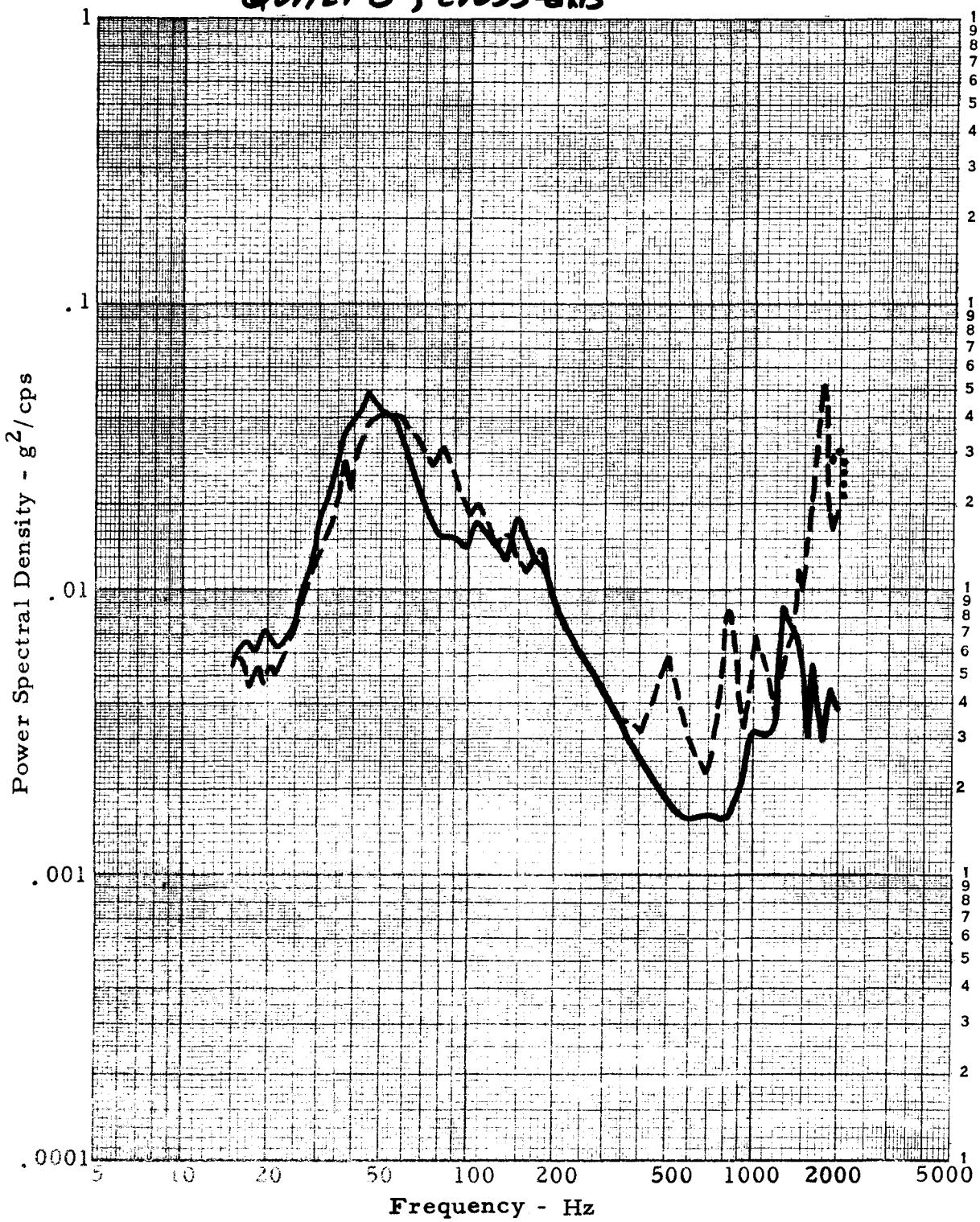


440-8 A

* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

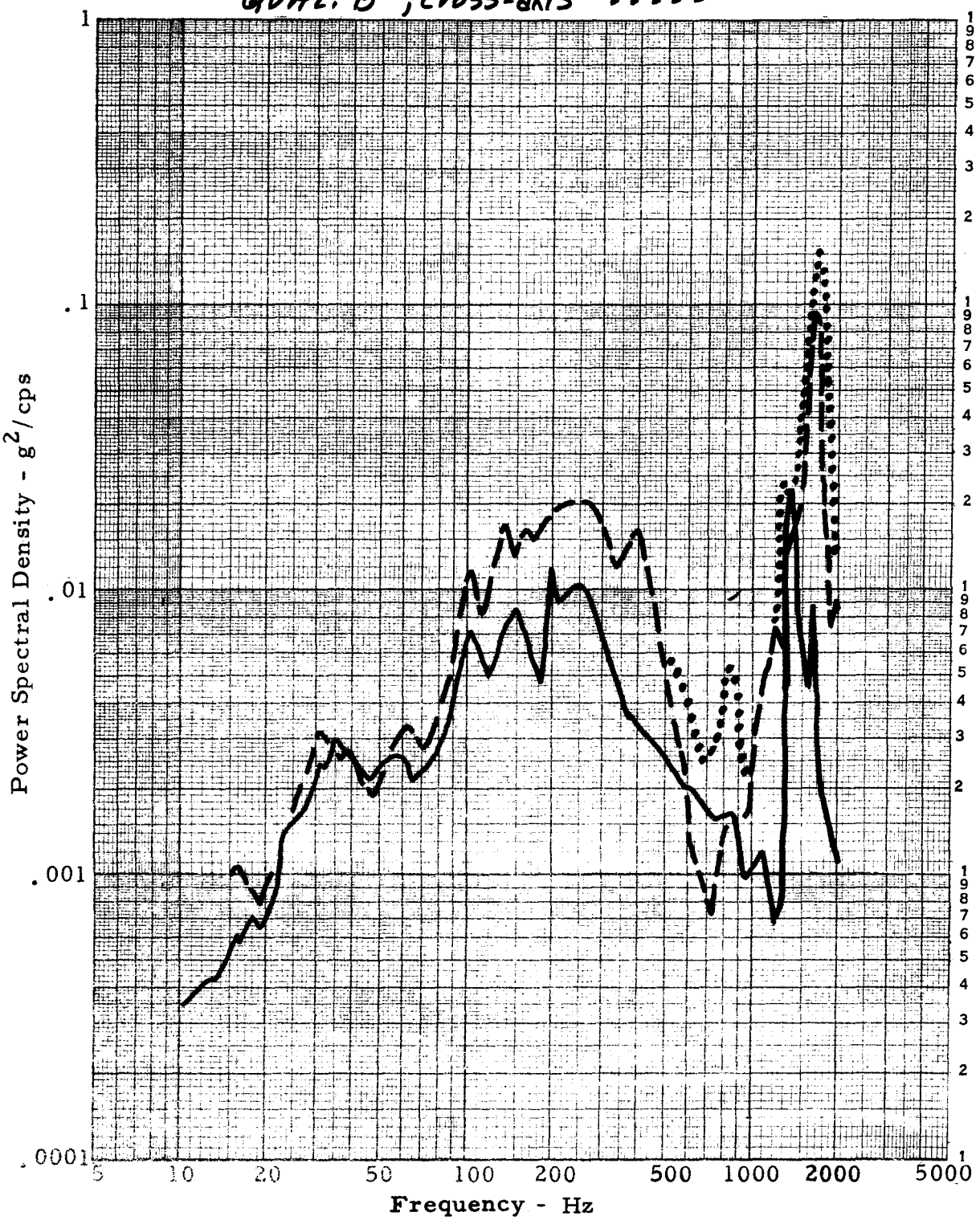
Test: L&B
Test Item: QUAL. SA, IN-AXIS ——— SN: RTG
~~Test Date:~~ QUAL. B, IN-AXIS — — — Axis: X
QUAL. B, CROSS-AXIS* · · · · ·



* shown only if greater than IN-AXIS data

RANDOM VIBRATION SPECTRUM

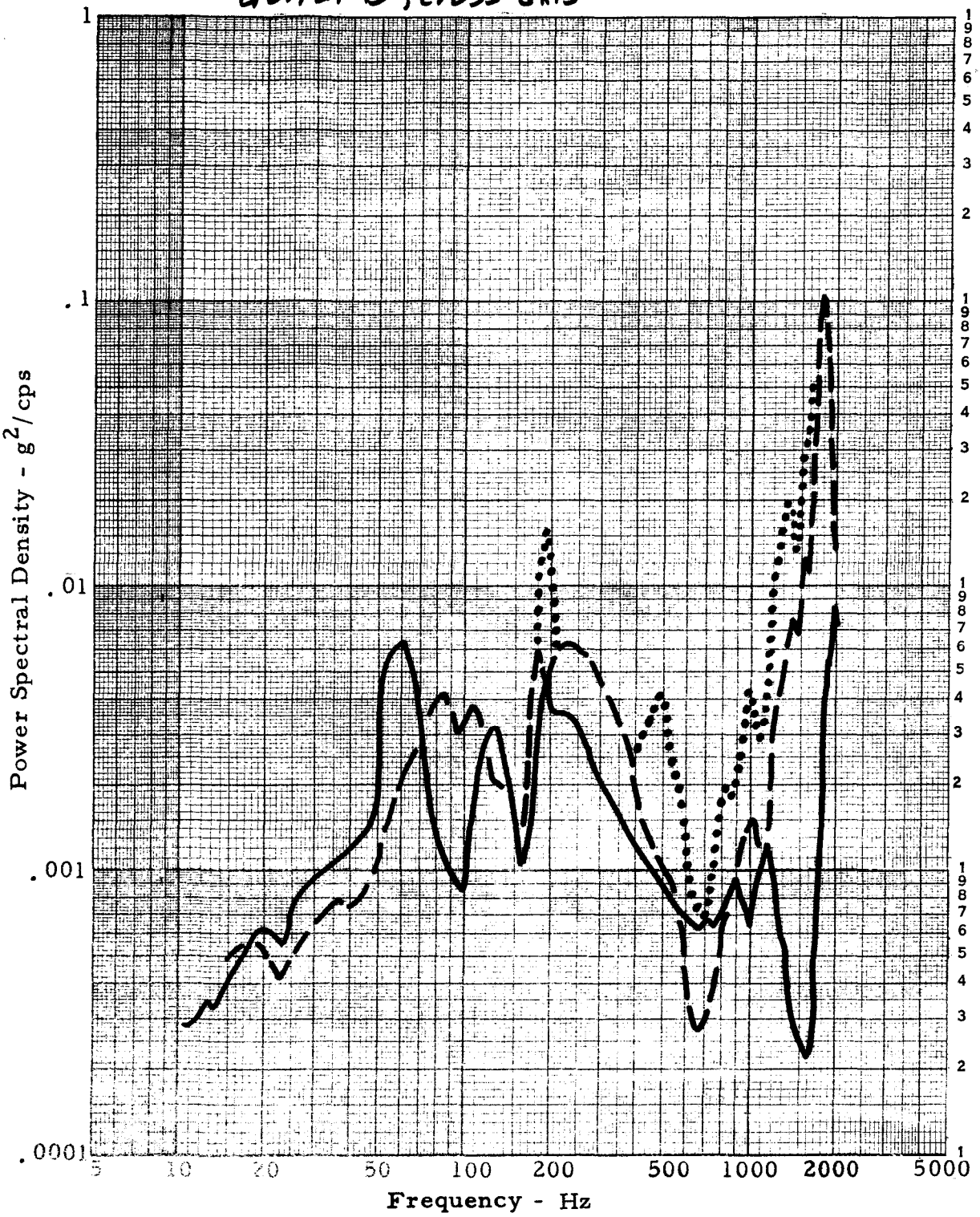
Test: L & B
Test Item: QUAL. SA, IN-AXIS ———— SN: RTG
~~Test Date:~~ QUAL. B, IN-AXIS — — — Axis: Y
QUAL. B, CROSS-AXIS* · · · · ·



* shown only if greater than IN-AXIS data

RANDOM VIBRATION SPECTRUM

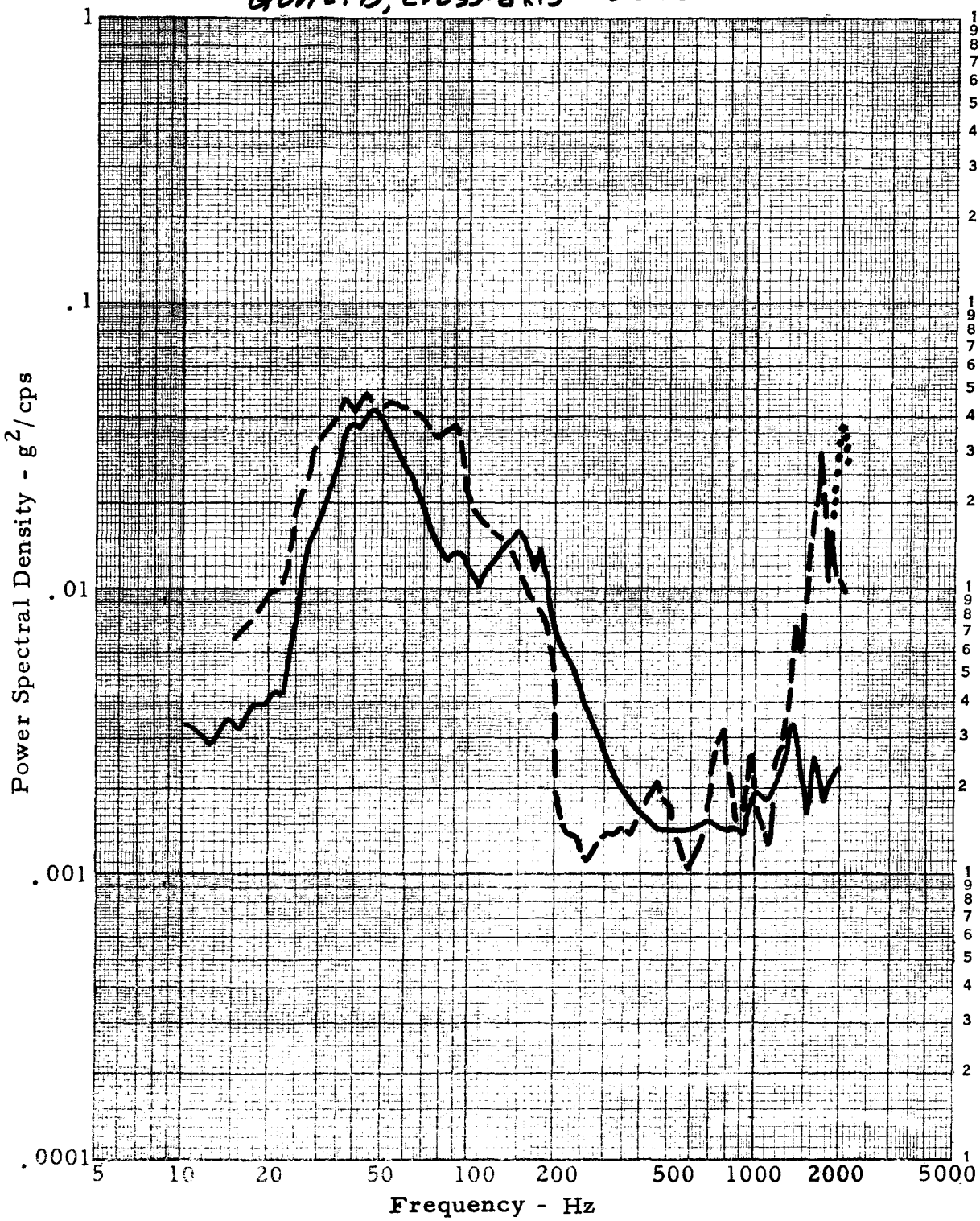
Test: L & B
Test Item: QUAL. SA, in-axis ———— SN: RTG
~~Test Date:~~ QUAL. B, in-axis — — — Axis: Z
QUAL. B, cross-axis* · · · · ·



* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

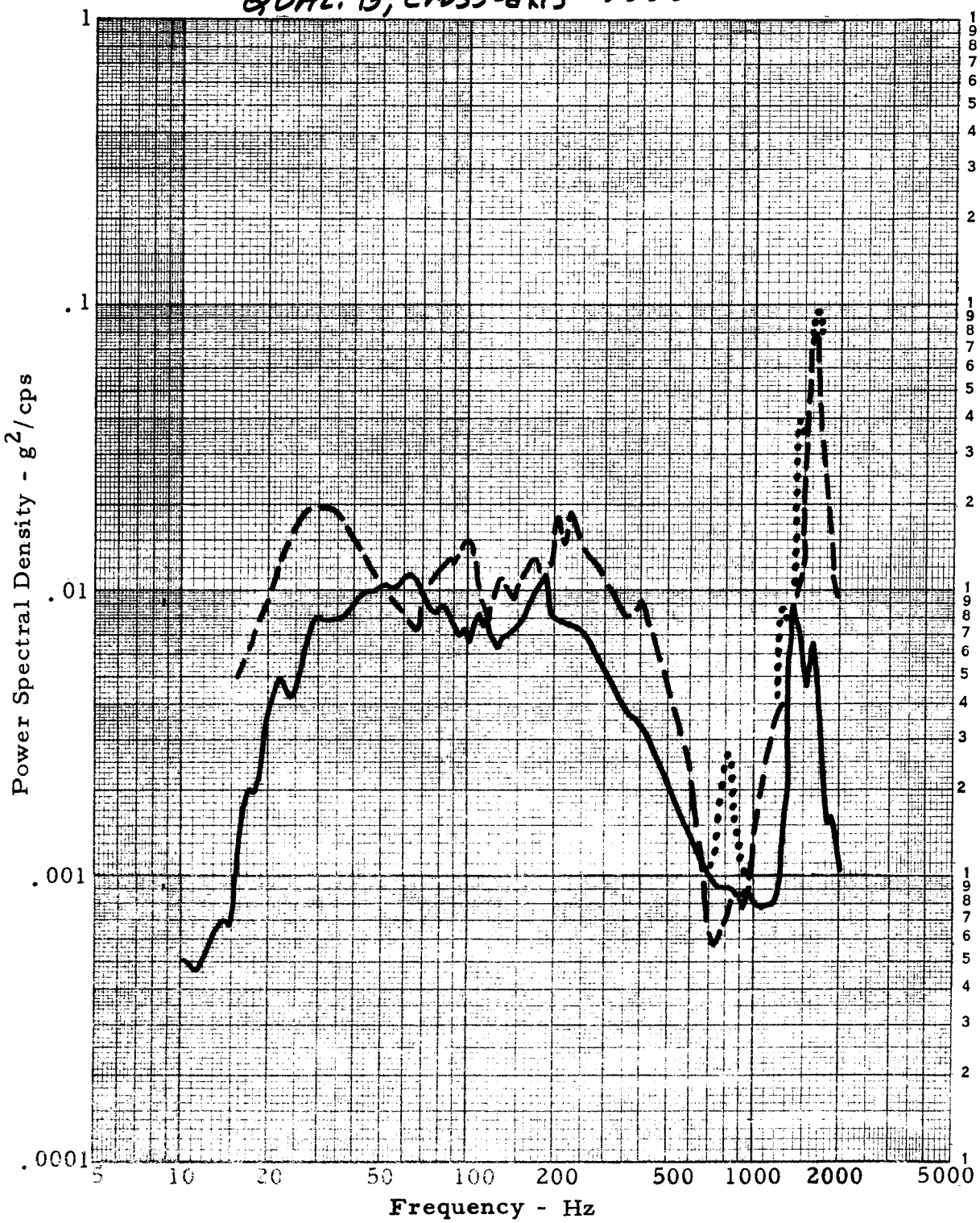
Test: Lun. Des.
Test Item: QUAL. 5A, in-axis ———— SN: RTG
~~Test Date:~~ QUAL. B, in-axis — — — Axis: X
QUAL. B, cross-axis* - - - - -



*shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

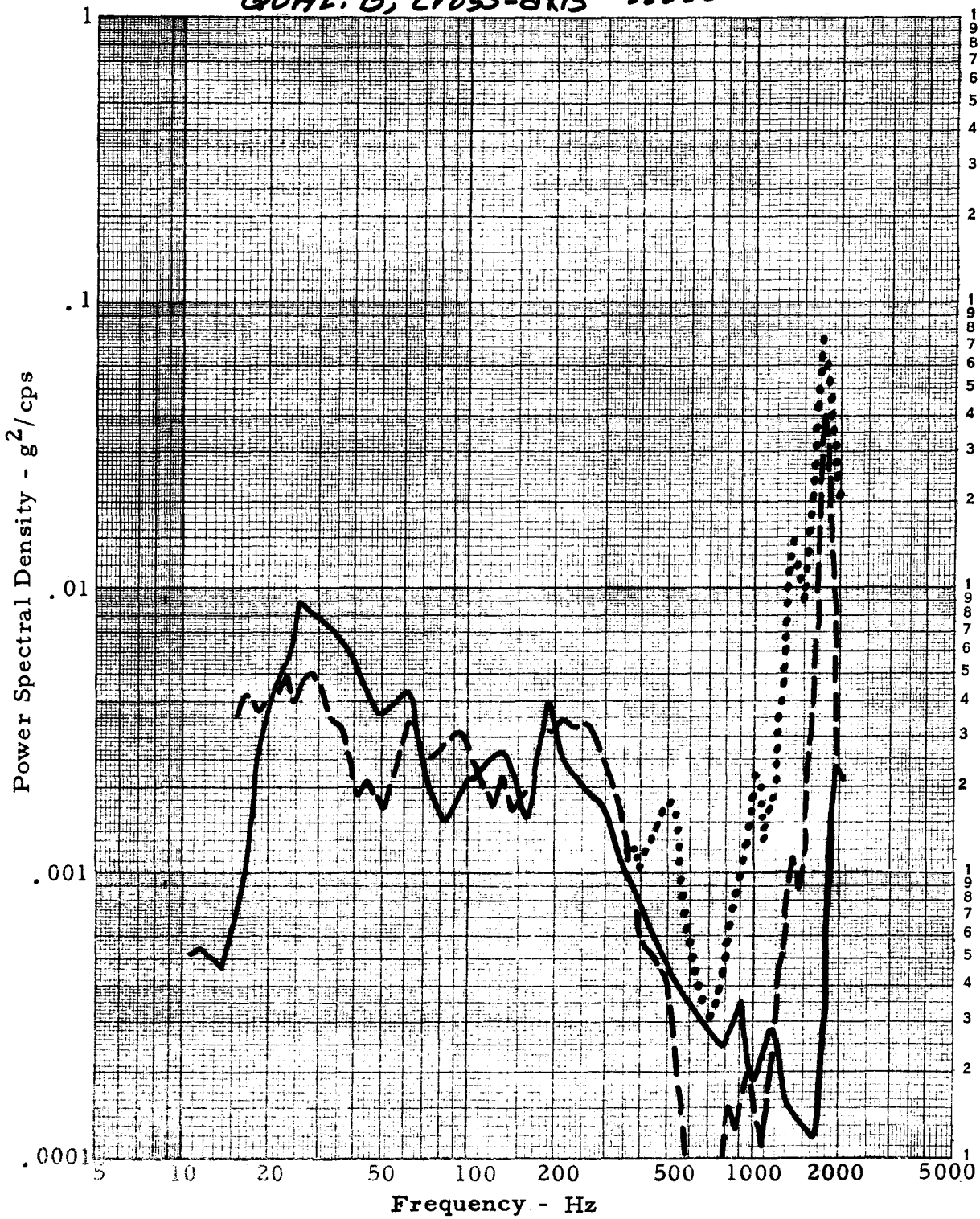
Test: Lun. Des.
Test Item: QUAL. 5A, IN-AXIS ———— SN: RTG
~~Test Date:~~ QUAL. B, IN-AXIS — — — Axis: Y
QUAL. B, CROSS-AXIS* . . . . . .



* shown only if greater than in-axis data

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. 5A, in-axis ———— SN: RTG
~~Test Date:~~ QUAL. B, in-axis — — — Axis: Z
QUAL. B, cross-axis* .....

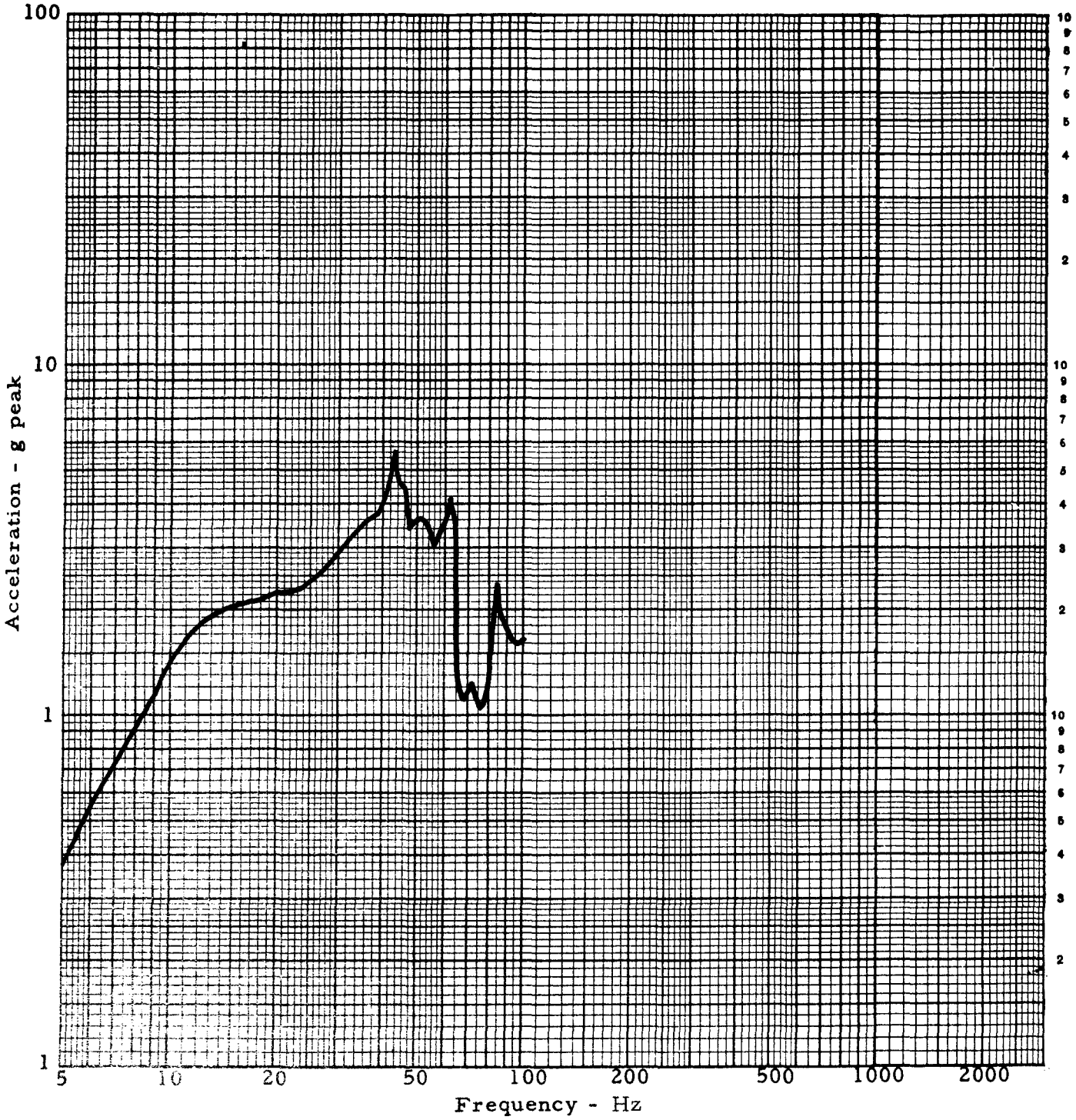


* shown only if greater than in-axis data

VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

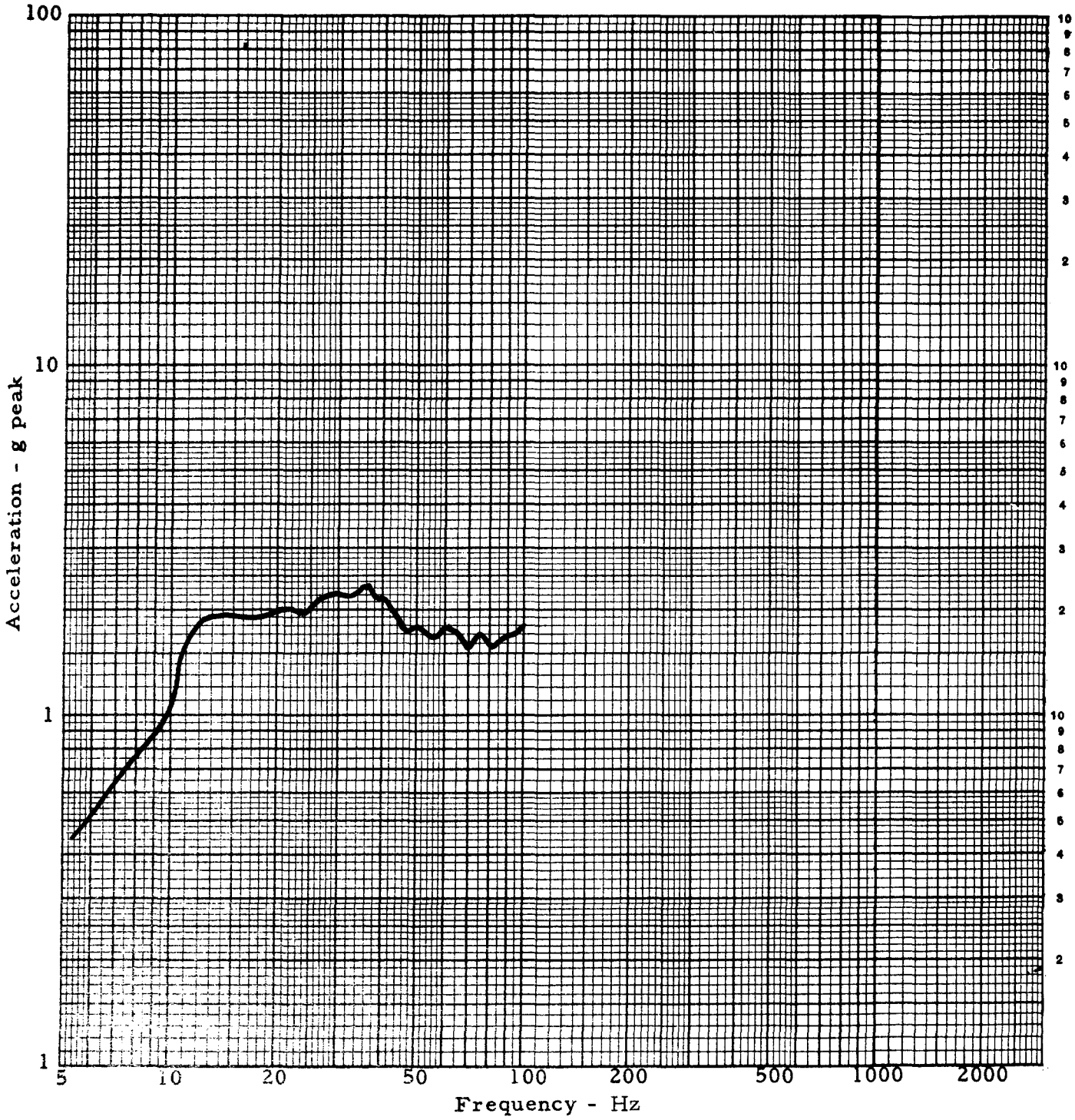
Serial Number: SIDE
Input Axis: X (only)
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

Serial Number: SIDE
Input Axis: Y (only)
Response Axis: Y



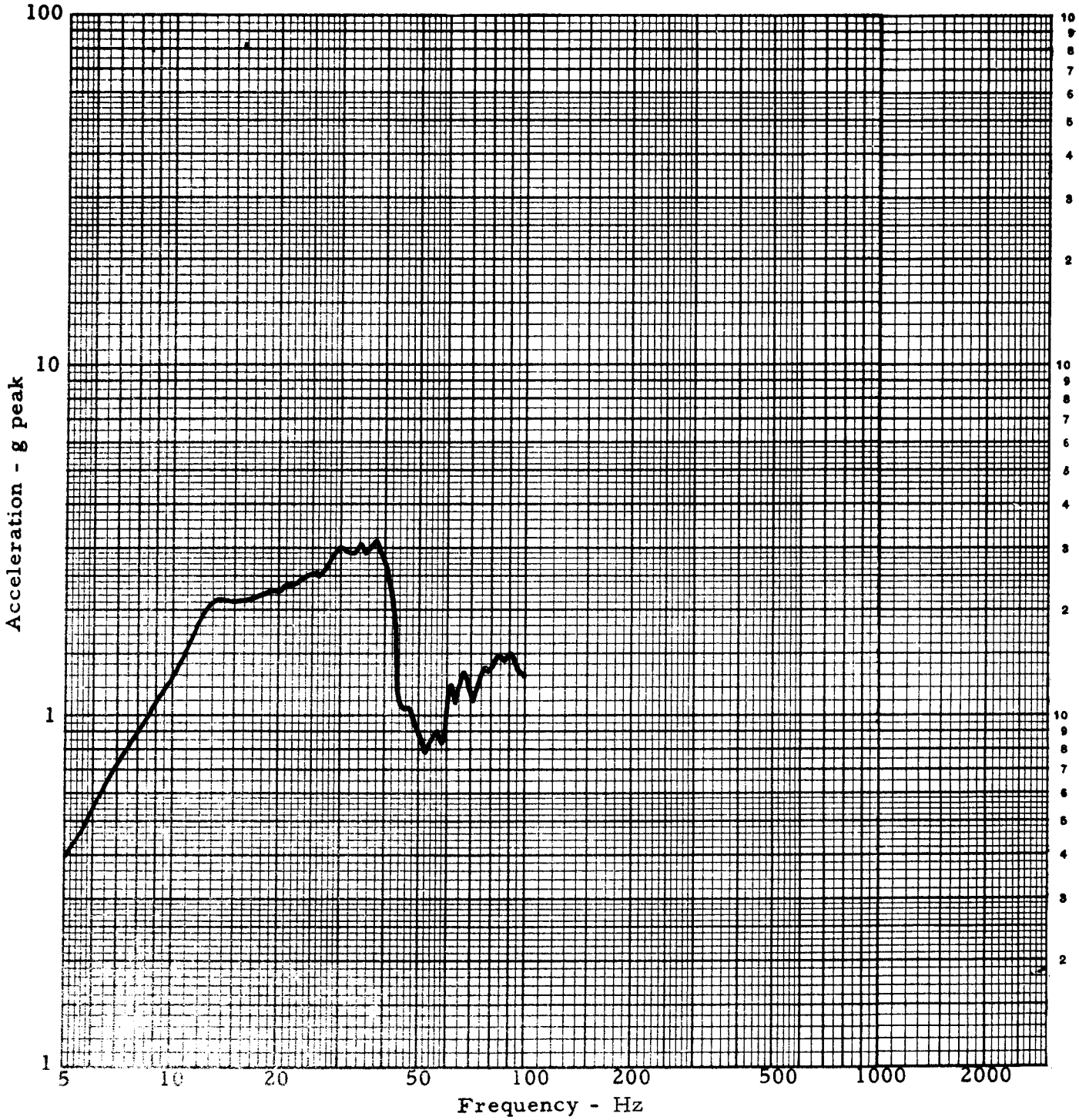
440-8 A

Note: no data available at loc. #2 — the data shown above is from loc. #3 — data from accept. tests show insignificant difference between loc. 2 & 3 for Y-axis

VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

Serial Number: SIDE
Input Axis: Z (only)
Response Axis: Z

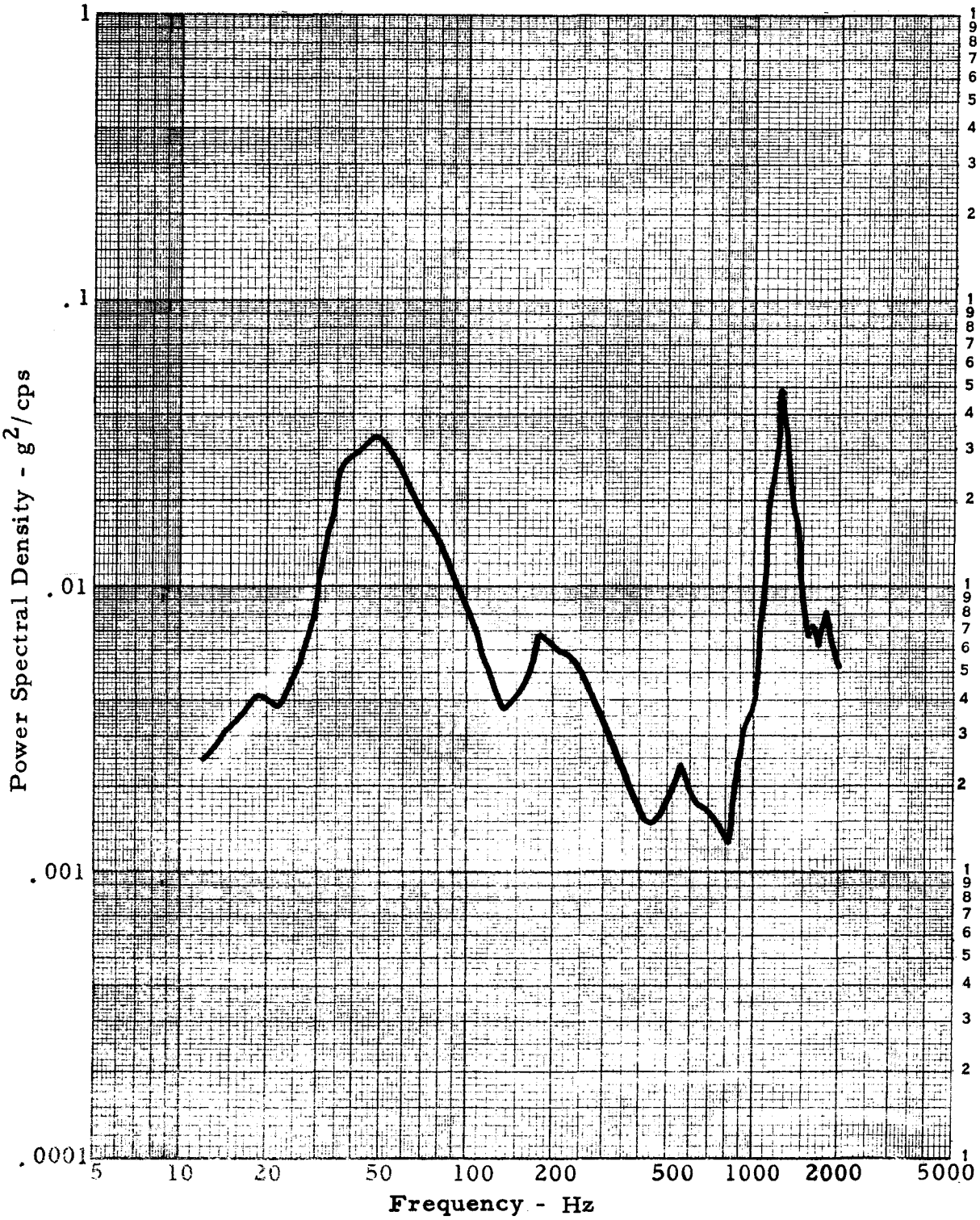


440-8 A

RANDOM VIBRATION SPECTRUM

Test: L & B
Test Item: QUAL. SA
Test Date:

SN: SIDE
Axis: X



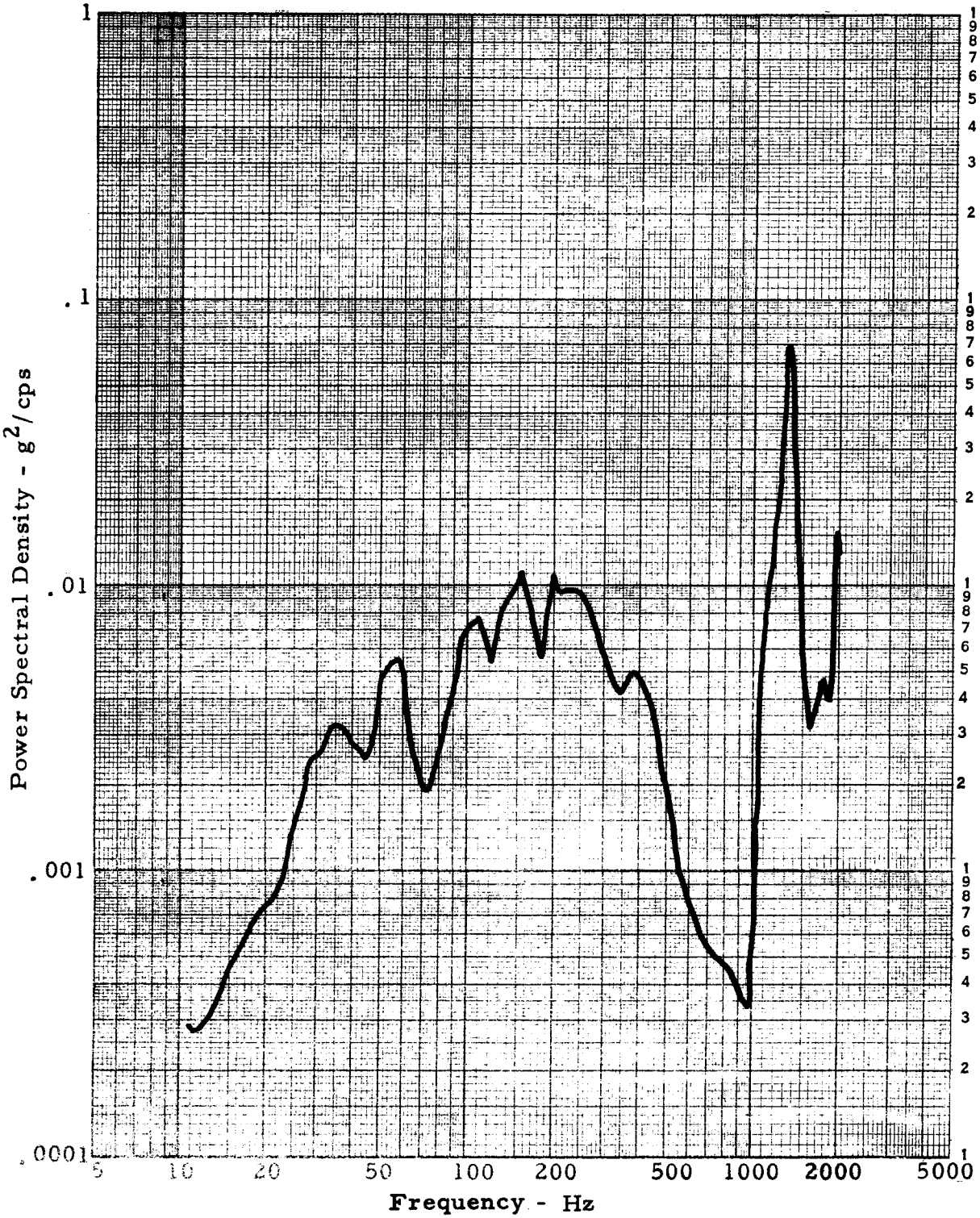
440-13A

Note: X-input only

RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

SN: SIDE
Axis: Y

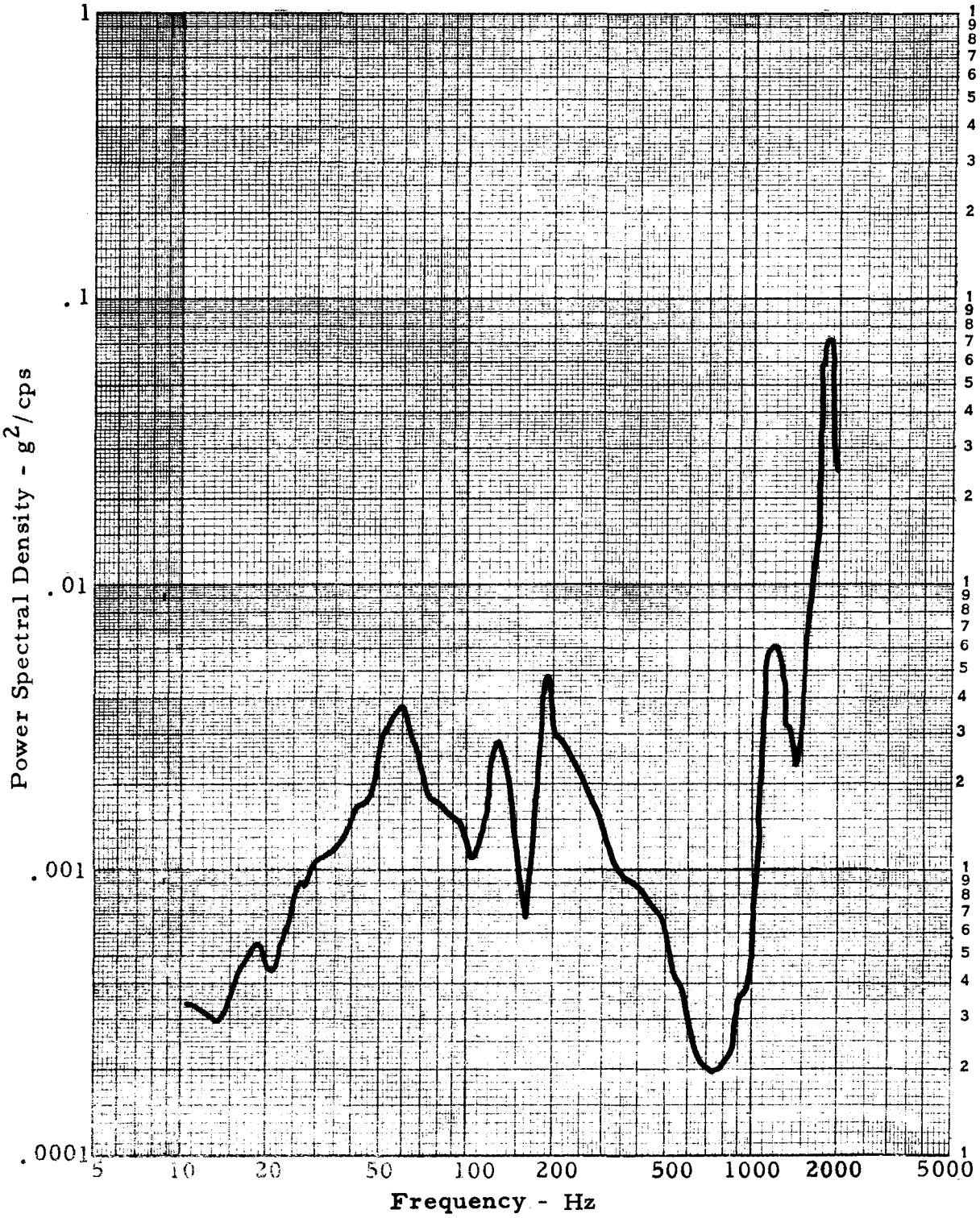


Note: Y-input only

RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

SN: SIDE
Axis: Z

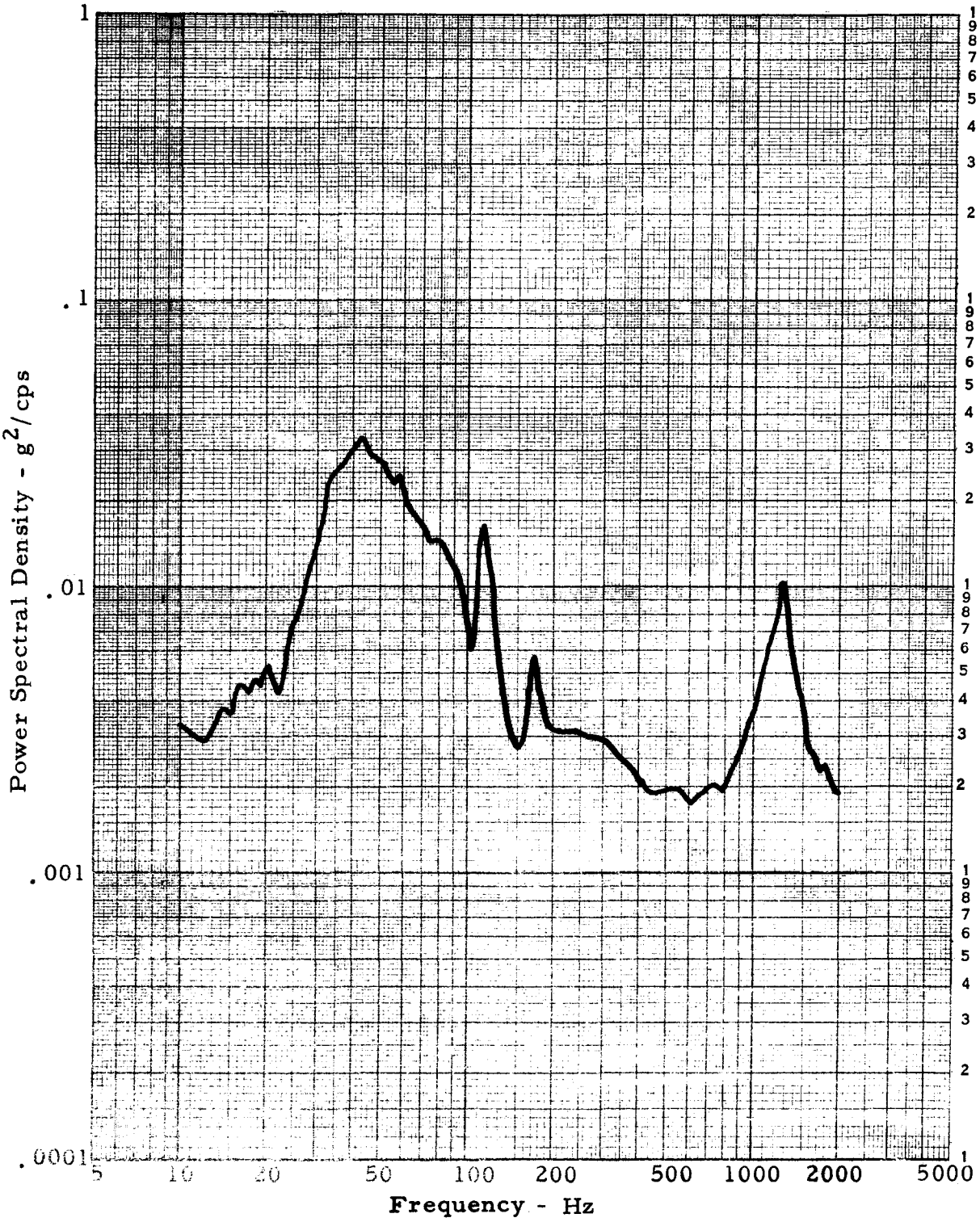


Note: Z-input only

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

SN: SIDE
Axis: X

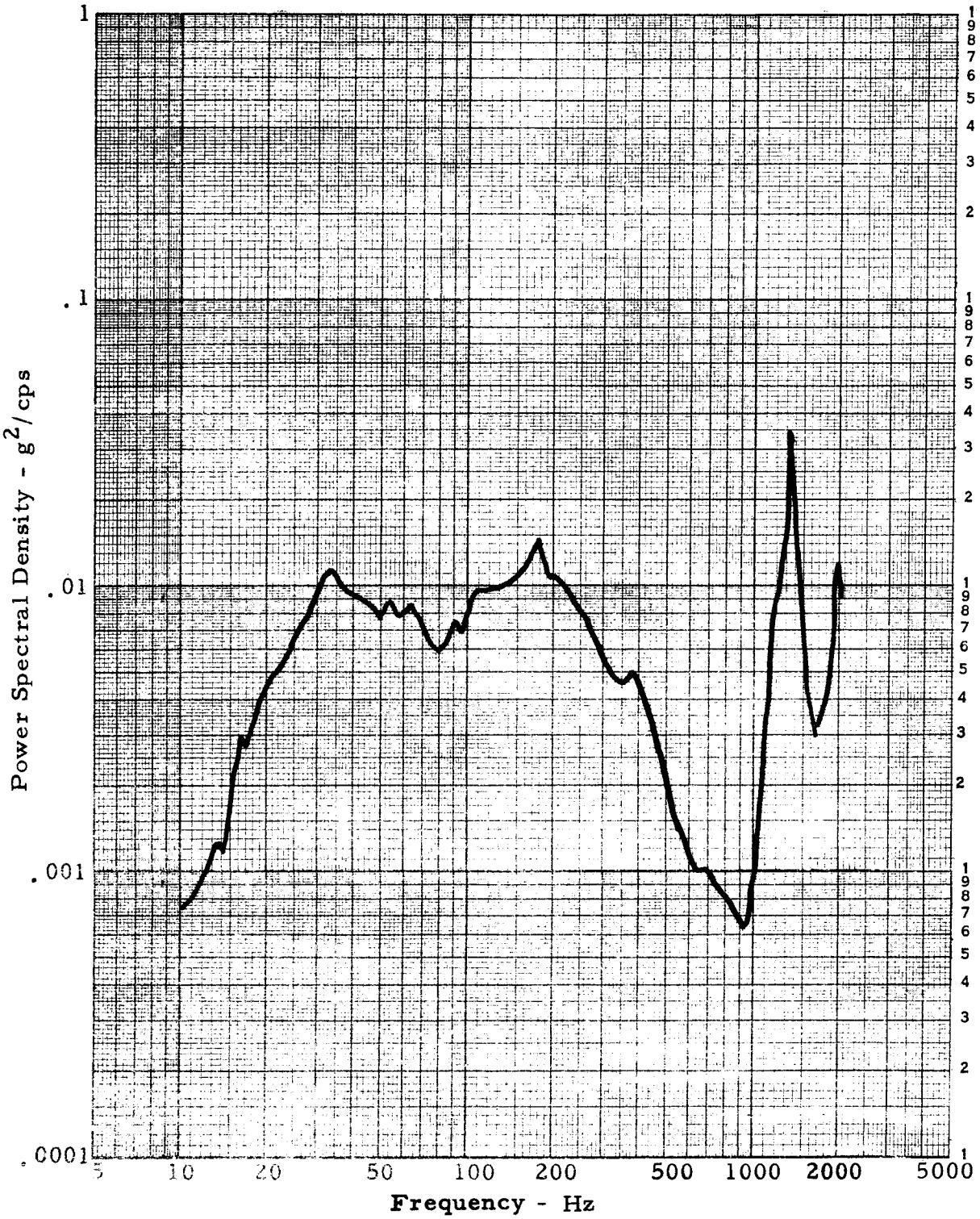


Note: X-input only

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

SN: SIDE
Axis: Y

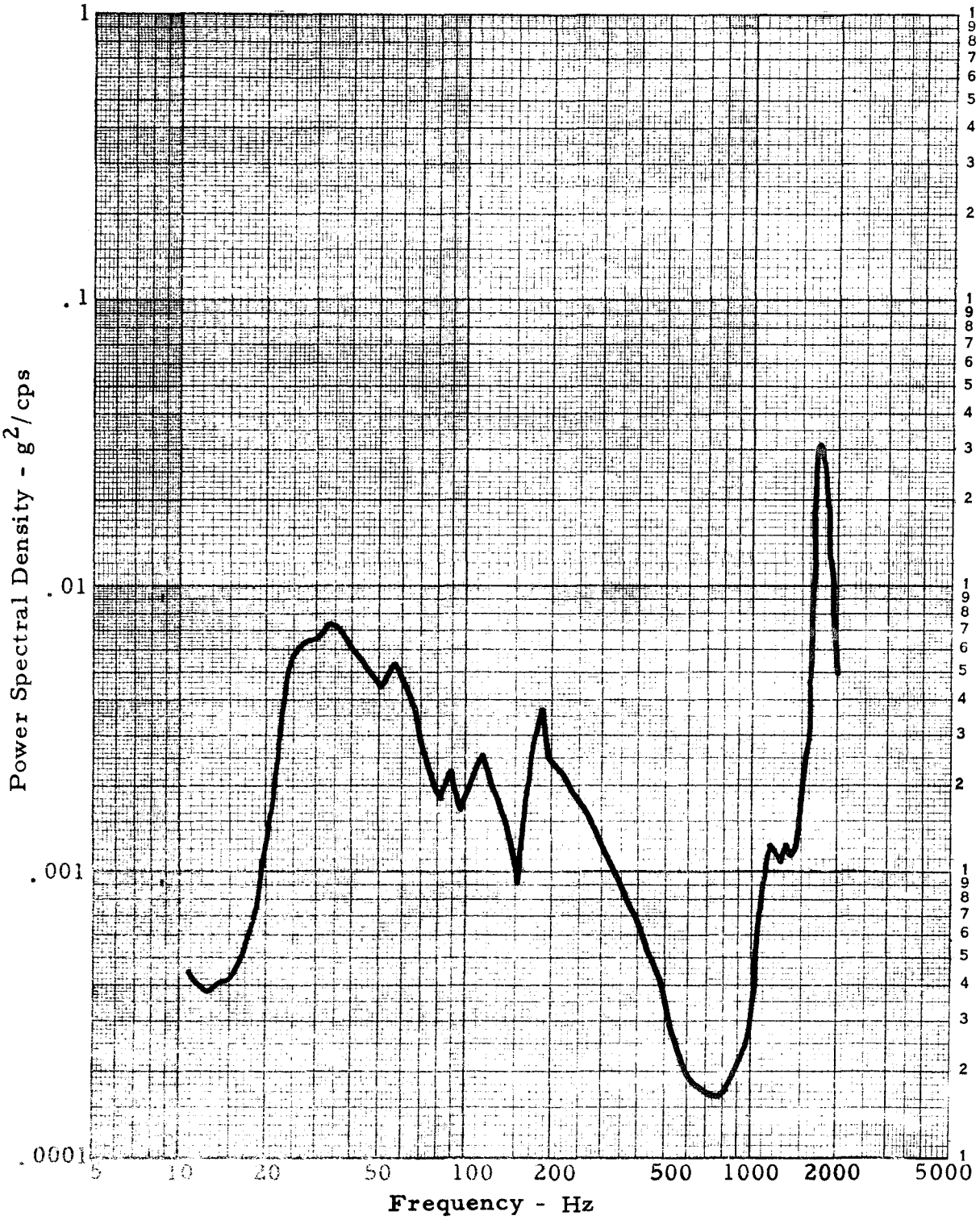


Note: Y-input only

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

SN: SIDE
Axis: Z

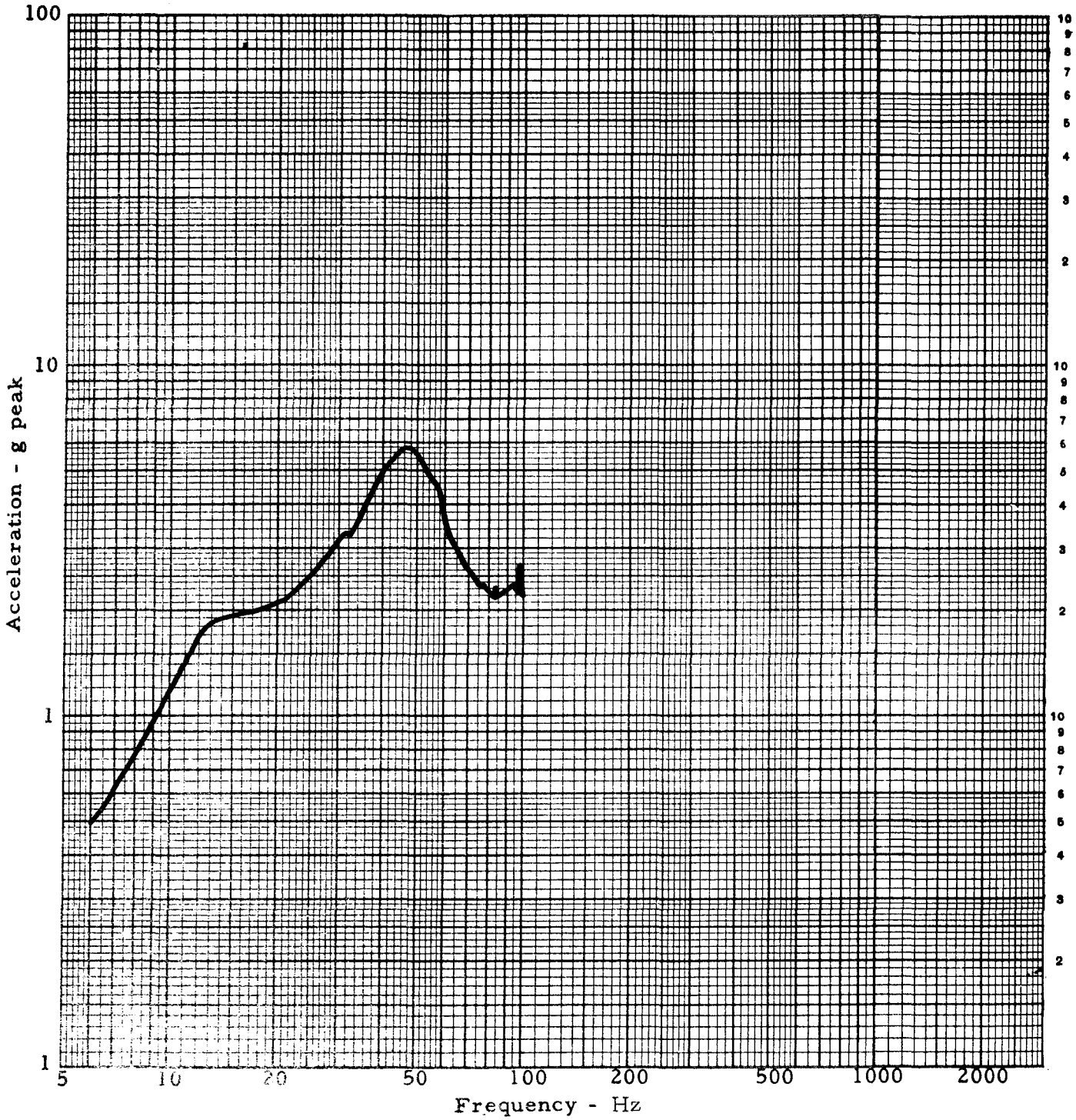


Note: Z-input only

VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

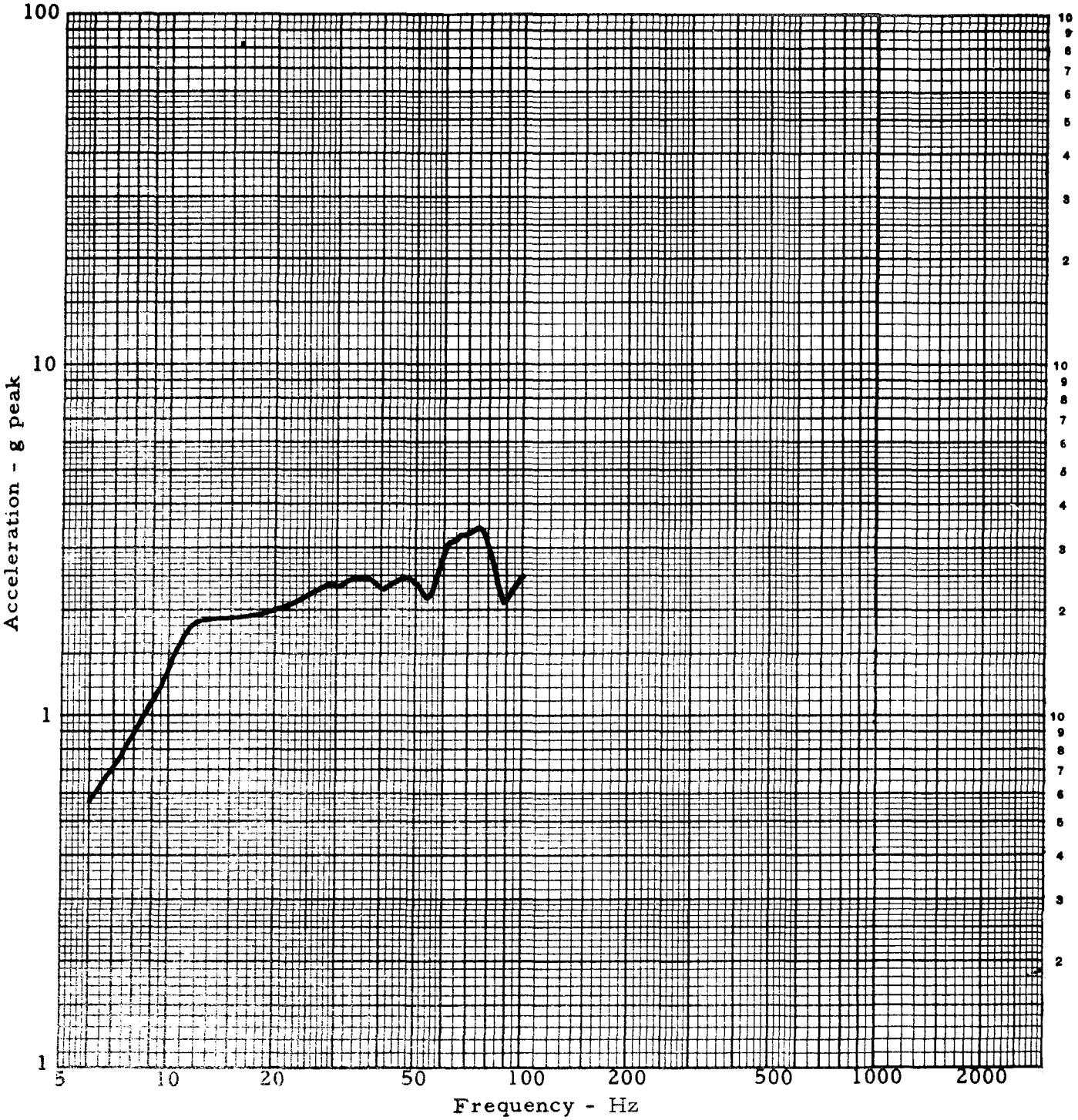
Serial Number: 3WS
Input Axis: X, Y, & Z
Response Axis: X



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

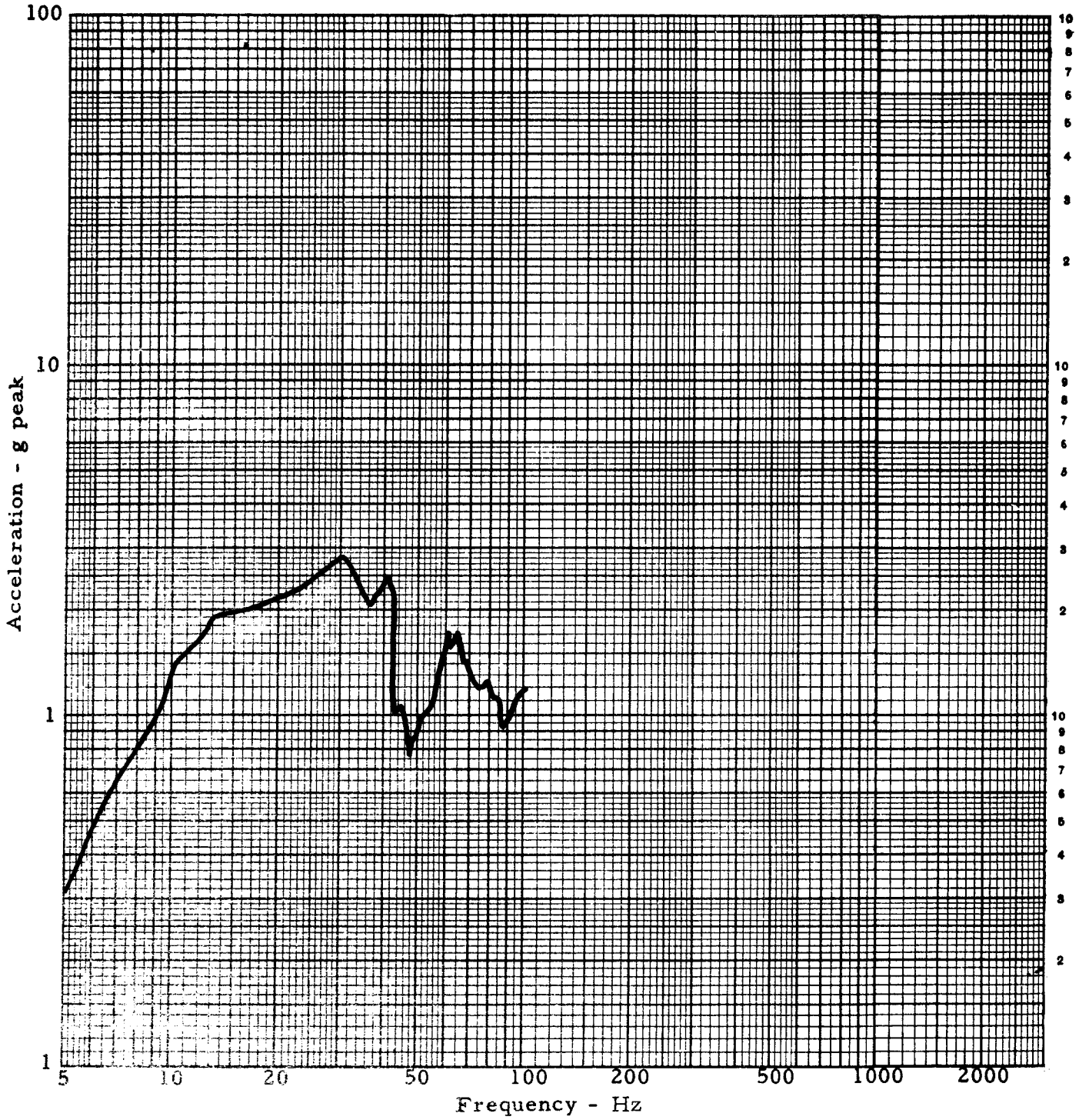
Serial Number: SWS
Input Axis: X & Y
Response Axis: Y



VIBRATION LEVELS

Test Item: QUAL. SA
Test Date:

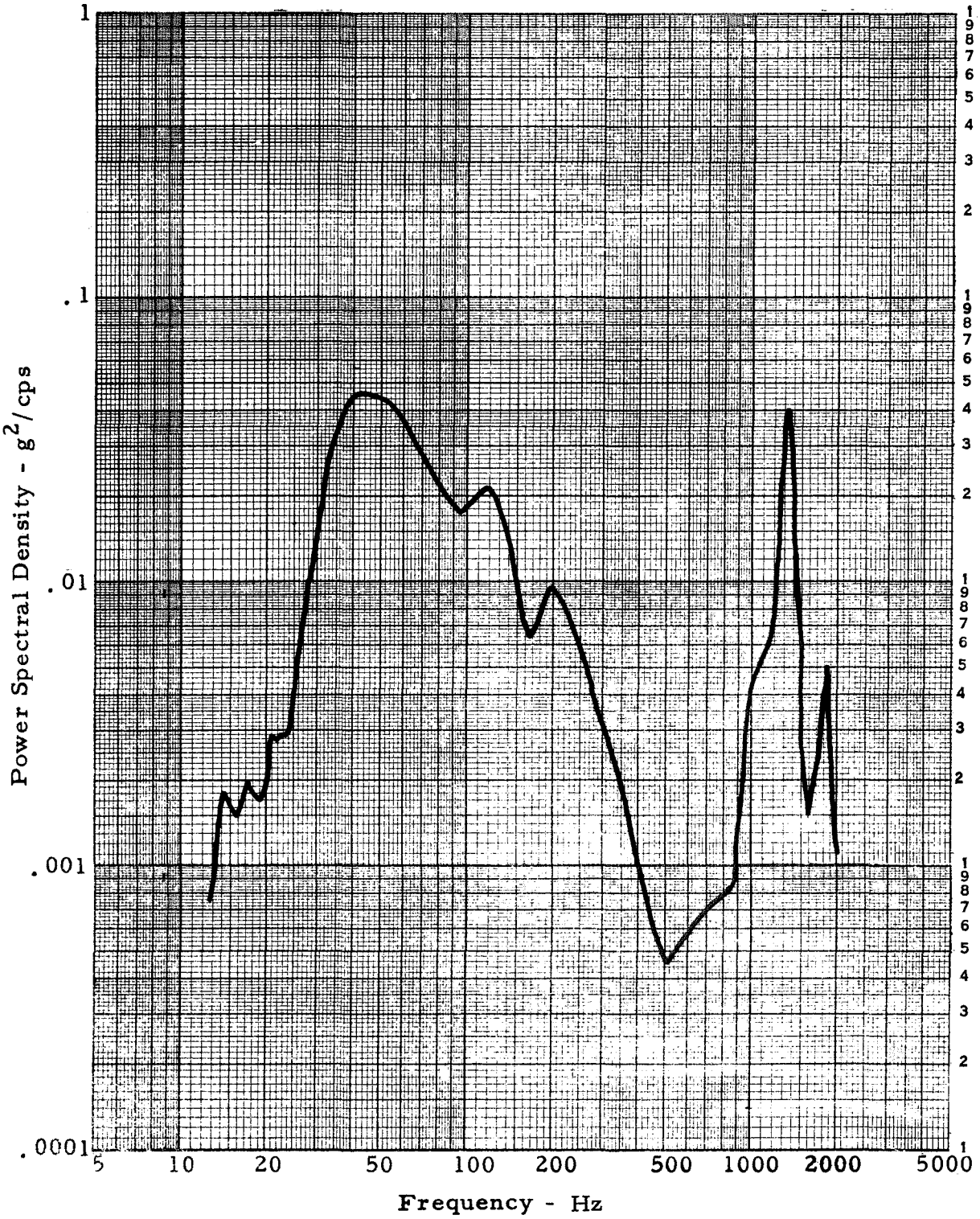
Serial Number: SWS
Input Axis: Z
Response Axis: Z



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

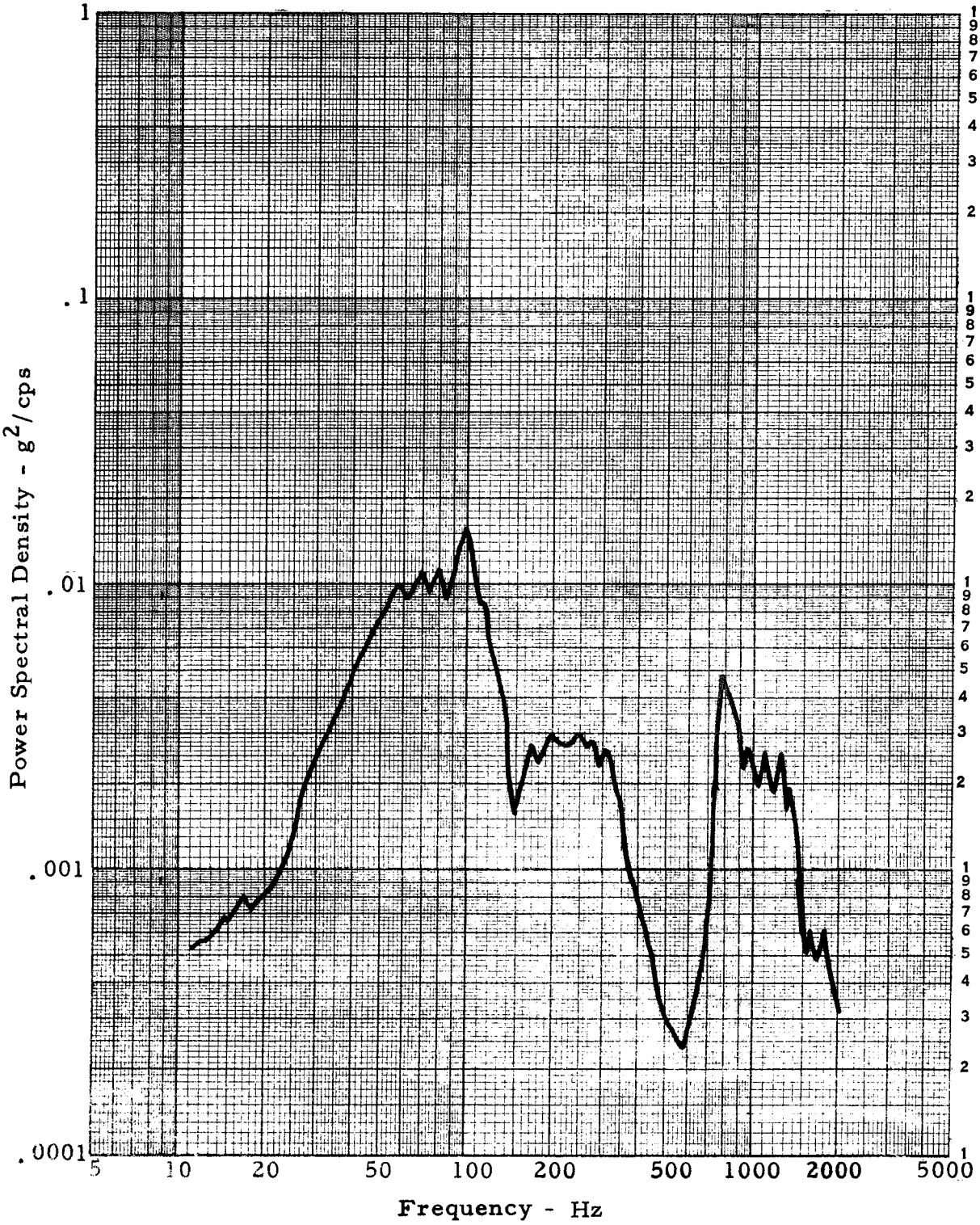
SN: SWS
Axis: X



RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

SN: SWS
Axis: Y

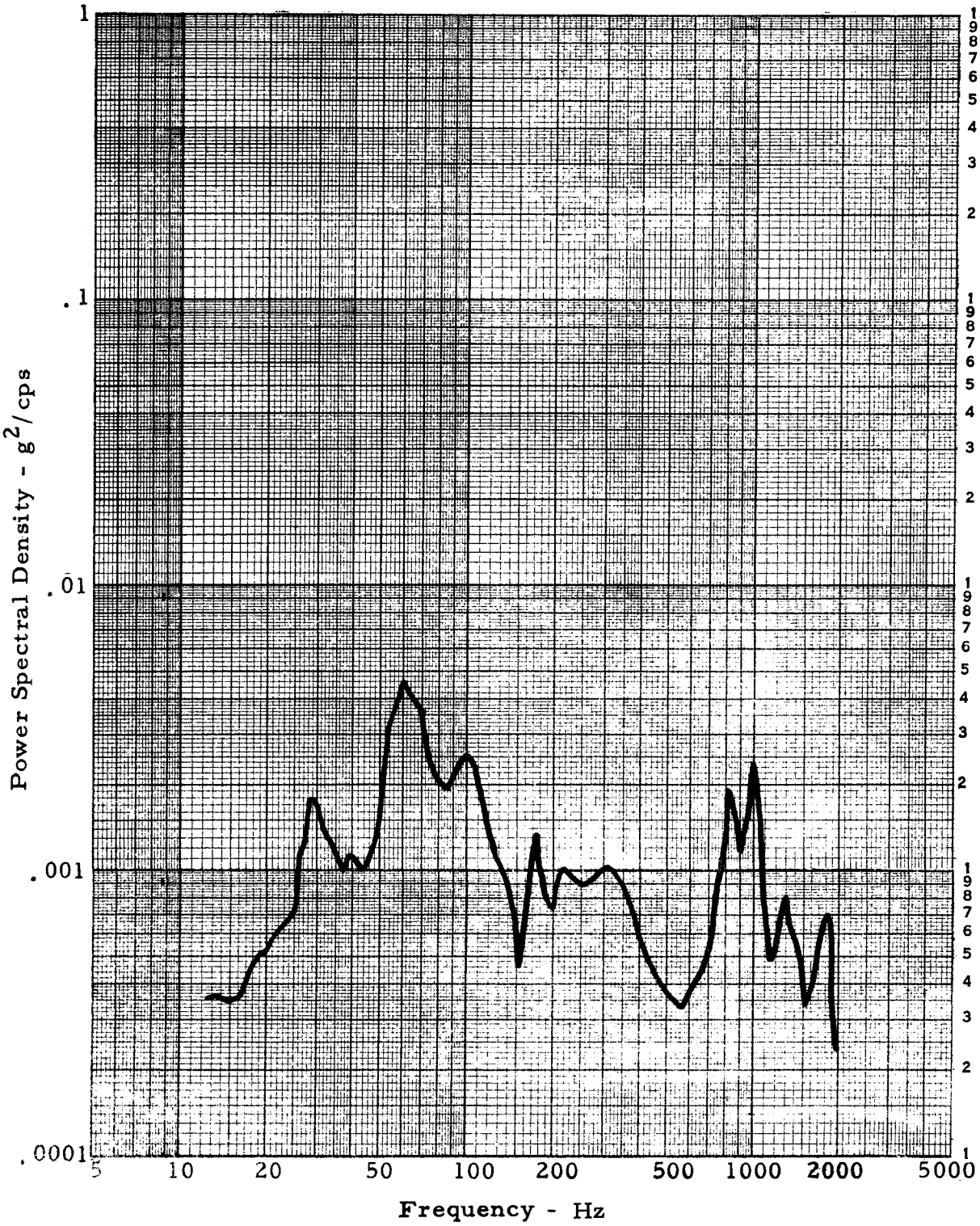


440-13A NOTE: X & Y INPUT ONLY

RANDOM VIBRATION SPECTRUM

Test: L&B
Test Item: QUAL. SA
Test Date:

SN: JWS
Axis: Z



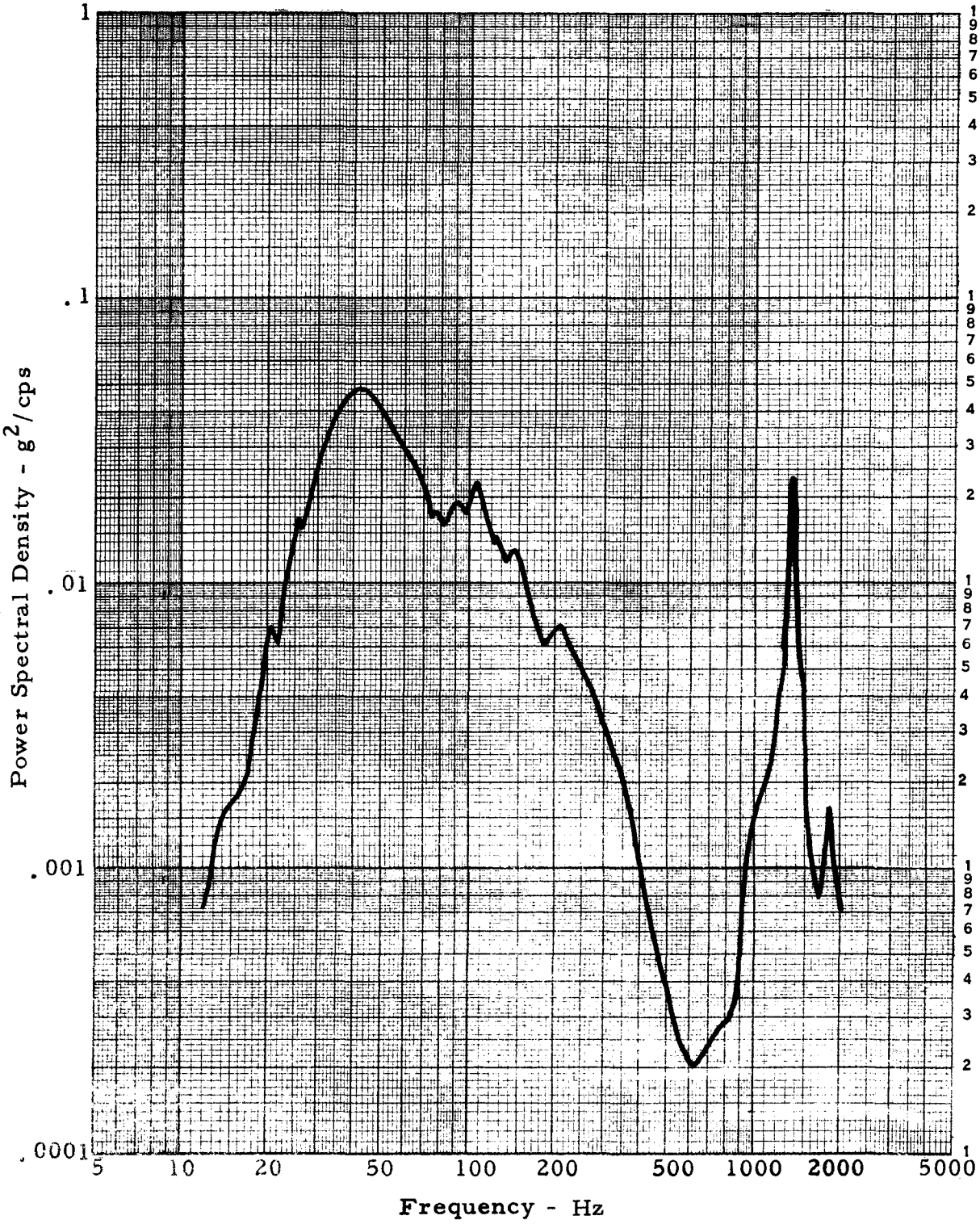
440-13A

Note: Z-input only

RANDOM VIBRATION SPECTRUM

Test: LUN. DES.
Test Item: QUAL. SA
Test Date:

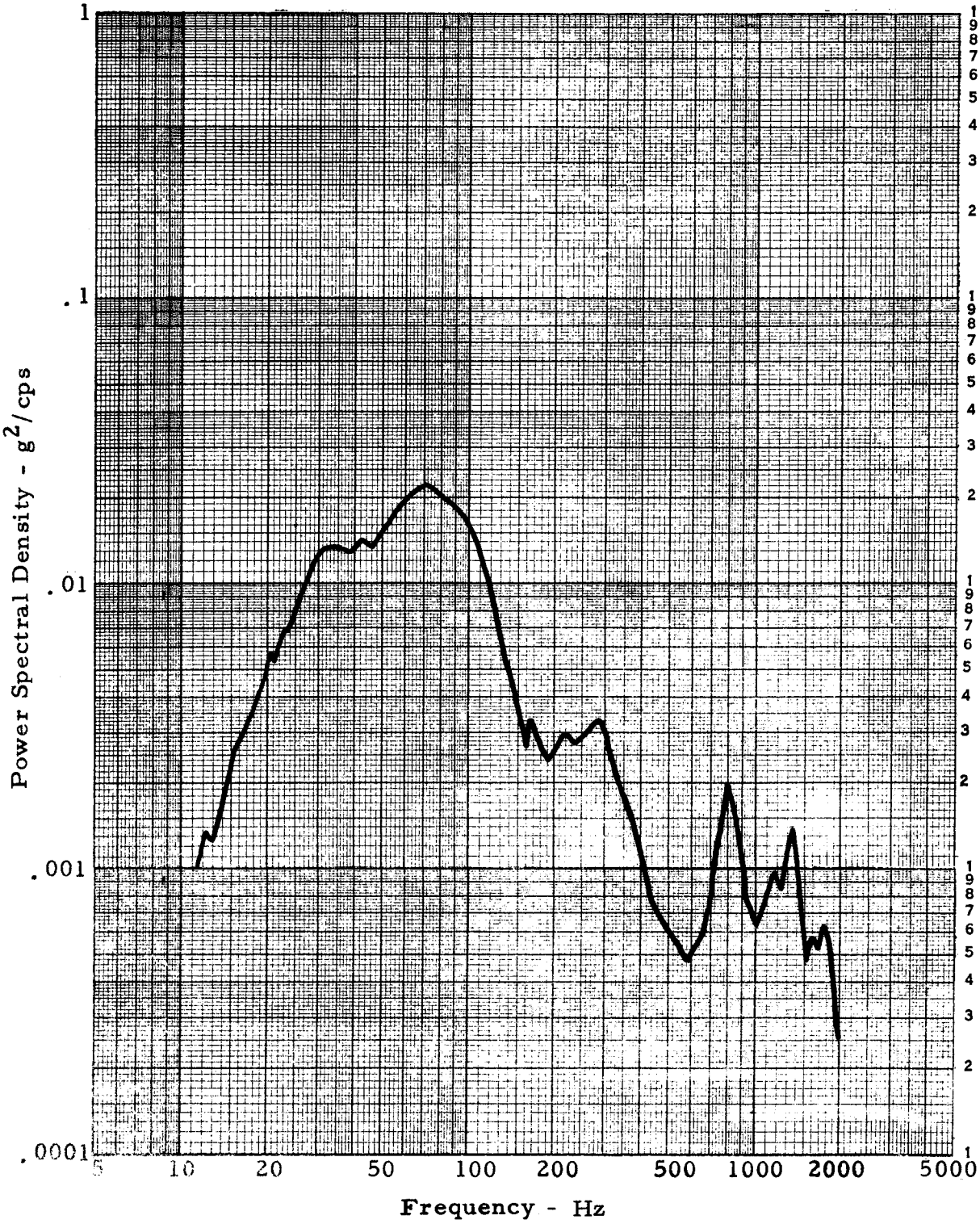
SN: SWS
Axis: X



RANDOM VIBRATION SPECTRUM

Test: LUN. DES.
Test Item: QUAL. SA
Test Date:

SN: SWS
Axis: Y

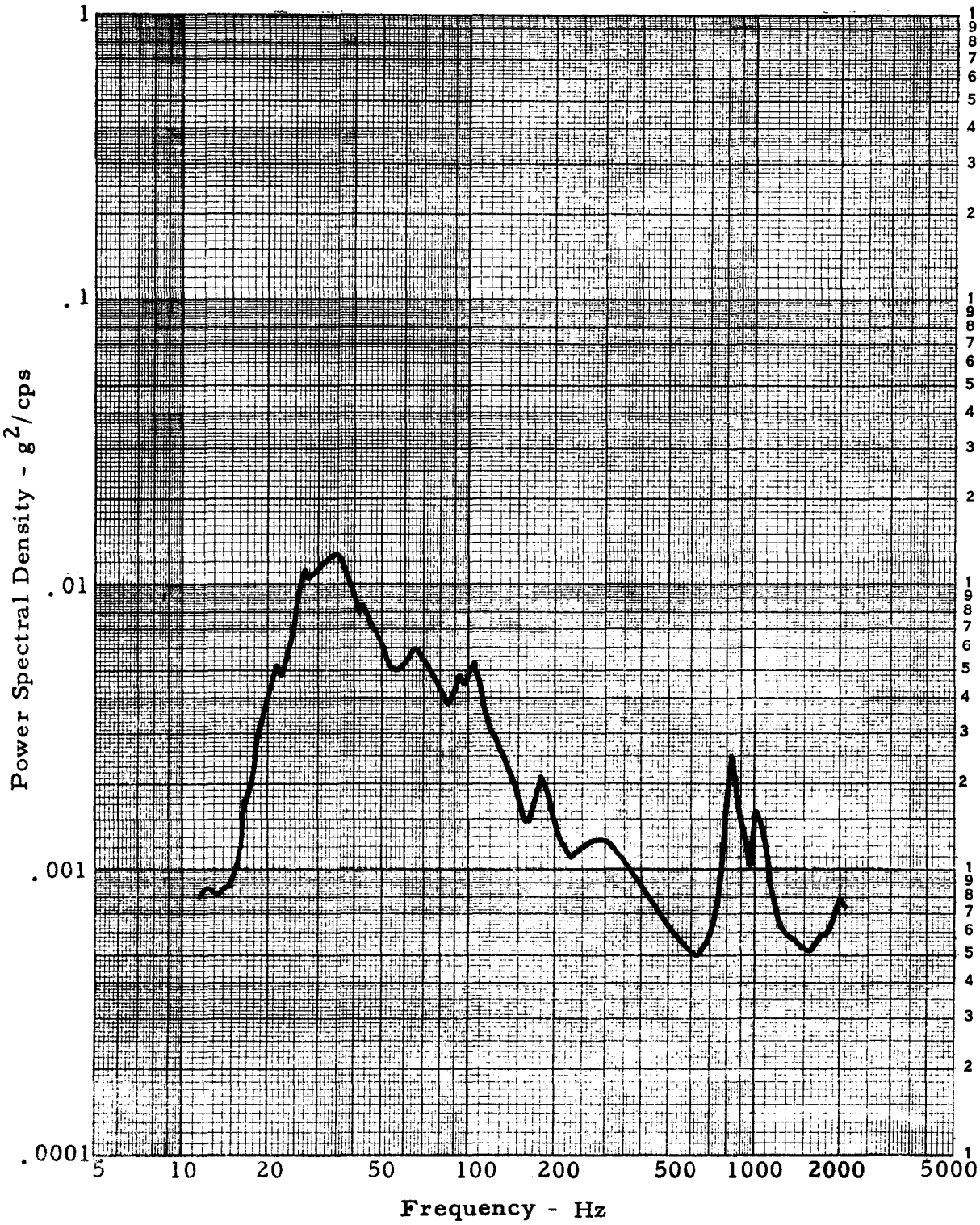


NOTE: X & Y INPUT ONLY

RANDOM VIBRATION SPECTRUM

Test: Lun. Des.
Test Item: QUAL. SA
Test Date:

SN: SWS
Axis: Z



NOTE: Z INPUT ONLY