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DAMPING AND VIBRATION CHARACTERISTICS OF A 185-INCH SAND-DAMPED--ETC(U)
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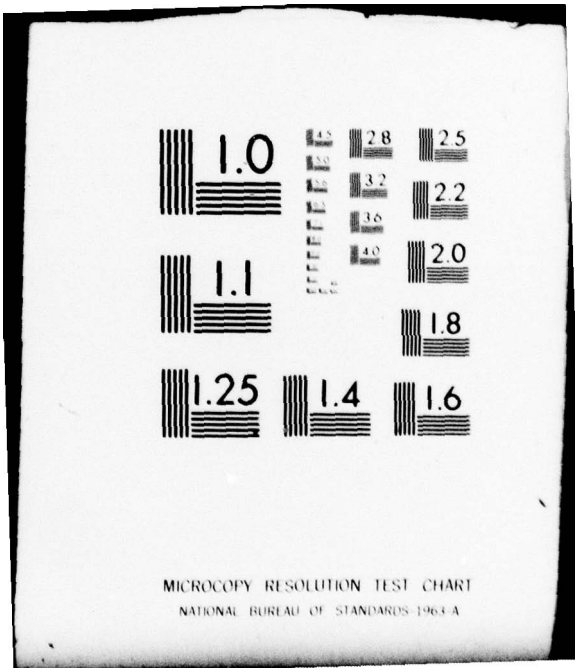
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U. S. NAVY UNDERWATER SOUND LABORATORY
FORT TRUMBULL, NEW LONDON, CONNECTICUT

DAMPING AND VIBRATION CHARACTERISTICS OF A 185-INCH SAND-DAMPED CW 554/SQS-4 STEEL SONAR DOME

Technical memo.

by

Howard N. Phelps, Jr.

USL Technical Memorandum No. 933-182-64

26 June 1964

12 p.

INTRODUCTION

This technical memorandum presents the damping and vibration characteristics of a 185-inch CW 554/SQS-4 steel sonar dome with sand damping, Serial B-38, as tested in air. The damping and vibration characteristics will be used as a reference for the future testing of other sonar domes of this size.

EXPERIMENTAL PROCEDURE

The dome was suspended from two hoists by nylon ropes to provide vibration isolation of the dome.

Damping Tests

The method used for the damping studies is discussed in detail in references (a), (b), and (c). Accelerometers were placed and measurements were taken at twelve different locations on the dome; figure 1 shows the locations of the accelerometers. Results from all of the measurements were similar; therefore, only those taken at locations 1 and 2 are reported.

Vibration Tests

Vibration tests on the dome were made in two parts. Figure 2 shows the block diagram of the instrumentation for the frequency range from 100 cps to 10 Kcps. Figure 3 shows the block diagram of the

instrumentation for the frequency range from 10 Kcps to 20 Kcps. The accelerometers and the driver were placed as shown on Figure 1. The dome was driven at constant force and at various frequencies while accelerations were measured at the locations on the dome. A constant force was maintained by keeping the voltage output of the force gage constant. This was done by controlling the signal input to the power amplifier.

For the frequency range from 100 cps to 10 Kcps, an Endevco Model 2217 accelerometer was used. Force was measured in rms volts and converted to rms pounds. Accelerations were read in peak-to-peak in./sec^2. This was converted to acceleration decibels. From reference (d)

$$adb = 20 \text{ Log}_{10} \left(\frac{a}{a_o}\right)$$

Where: abd = acceleration decibels (∴ not a product of a, d & b- - from reference (d))

a = acceleration in cm/sec^2

$a_o = 10^{-3}$ cm/sec^2

In the frequency range from 10 kcps to 20 kcps, the force is measured in rms volts and converted to rms pounds. The acceleration is measured in rms volts and converted to acceleration decibels. References (e) and (f) show results of vibration tests made on other domes.

RESULTS

Figure 4 presents the decay rate vs. 1/3-octave band center frequency for positions 1 and 2 on the dome. Figure 5 presents the percentage of critical damping vs. 1/3-octave band center frequency for positions 1 and 2 on the dome. It should be noted that the damping characteristics at position 2 are slightly better than the damping characteristics at position 1. This is due to the fact that position 2 is located above the damping material of the dome. In general, the trend of the two curves on each plot are the same.

Figures 6 and 7 present the vibration data vs. frequency for positions 1 and 2, respectively. It should be noted that the accelerations near the damping material (position 2) are less than at position 1. Resonance points of this dome occur between 1100 cps and 1400 cps.

However, it should be remembered that these resonances will probably change when the dome is in water. They will probably also change when the dome is mounted on a ship.

SUMMARY

A 185" CW554/SQS-4 steel sonar dome was tested for reference purposes so as to be able to compare damping and vibration characteristics with other domes of approximately the same size. Figures 4 through 7 are to serve as the curves with which similar data are to be compared.

HOWARD N. PHELPS, JR.
Mechanical Engineer

List of References

(a) LTJG J. E. Barger, USN, "An Experimental Determination of the Degree of Damping in Structures," USL Technical Memorandum No. 1210-94-59, dated 17 June 1959.

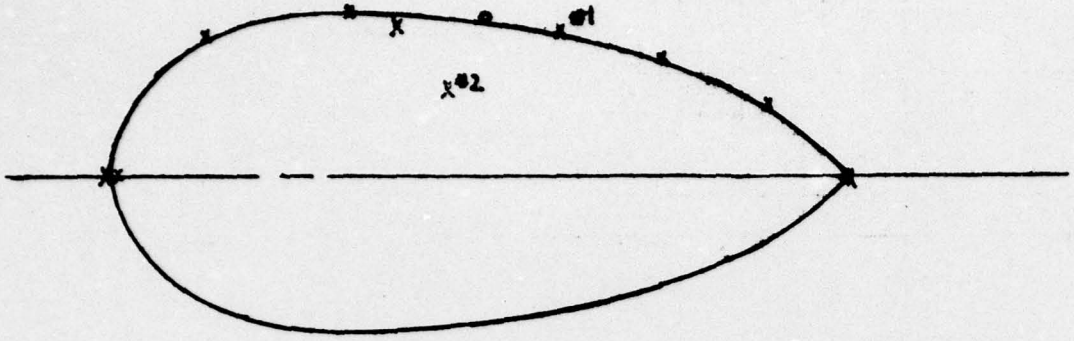
(b) J. H. Rogers, "Decay Rate Data for Two Thicknesses of Load Compound EX-B322," USL Technical Memorandum No. 1210-106-60, dated 18 August 1960

(c) H. N. Phelps, Jr., "Damping Characteristics of Three Untreated Steel Plates," USL Technical Memorandum No. 933-54-64, dated 17 February 1964.

(d) "Units for Vibration in the Field of Acoustics," Bureau of Ships, ALL/NOISE (371), EN8/A2-6, Ser 371-526, 80ct. 1951 (Acc. #10135-13-A)

(e) A. Cizek and J. Bradley, "Vibration Damping of a Sonar Dome," Material Laboratory, New York Naval Shipyard, Proceedings of the Structural Vibration Damping Conference, Mare Island Naval Shipyard, dated 25 and 26 October 1962 (CONFIDENTIAL) (Acc. #39177)

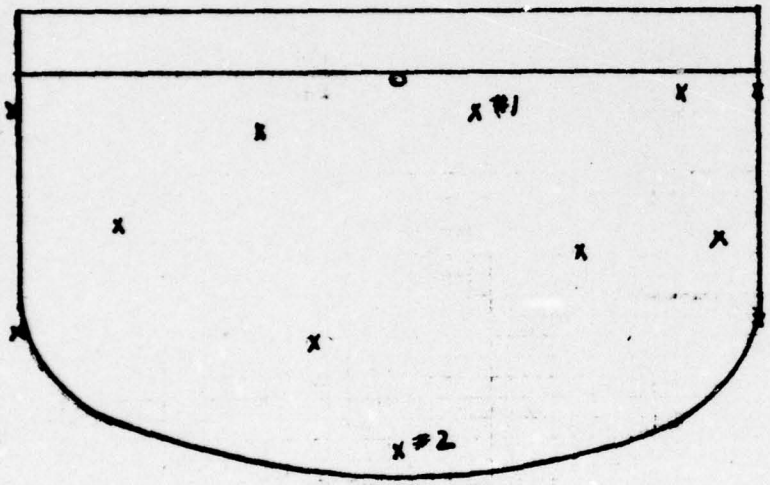
(f) W. H. Keene, "Transmissibility and Damping Tests on 100-inch Steel Sonar Dome," General Dynamics Corporation, Electric Boat Division, Groton, Connecticut, TSD59-063, P59-061, April 1959 (Acc. #32386).



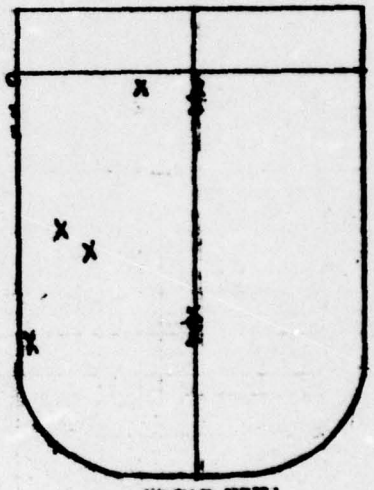
X Accelerometer Locations.

O Driver Location.

TOP VIEW



SIDE VIEW



REAR VIEW

POSITION OF ACCELEROMETERS AND DRIVER
ON SONAR DOME

Figure 1. to USL Ser 933-182-64 of 26 June 1964

BLOCK DIAGRAM OF INSTRUMENTATION USED FOR

VIBRATION TESTS FROM 100 cps to 10000 cps

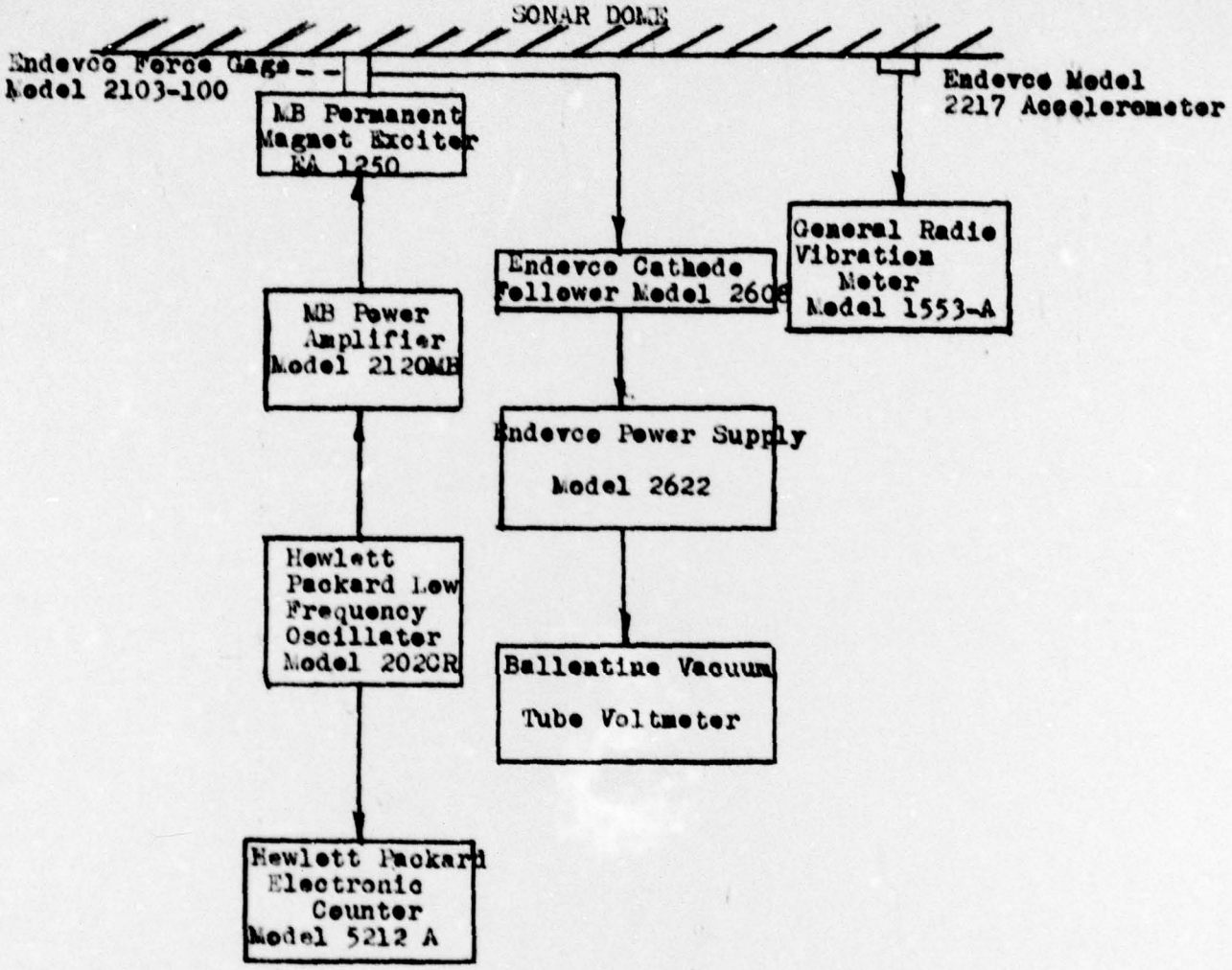


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FIGURE #2

LOCK DIAGRAM OF INSTRUMENTAT FOR

VIBRATION TESTS FROM 10000 cps to 20000 cps

SONAR DOME

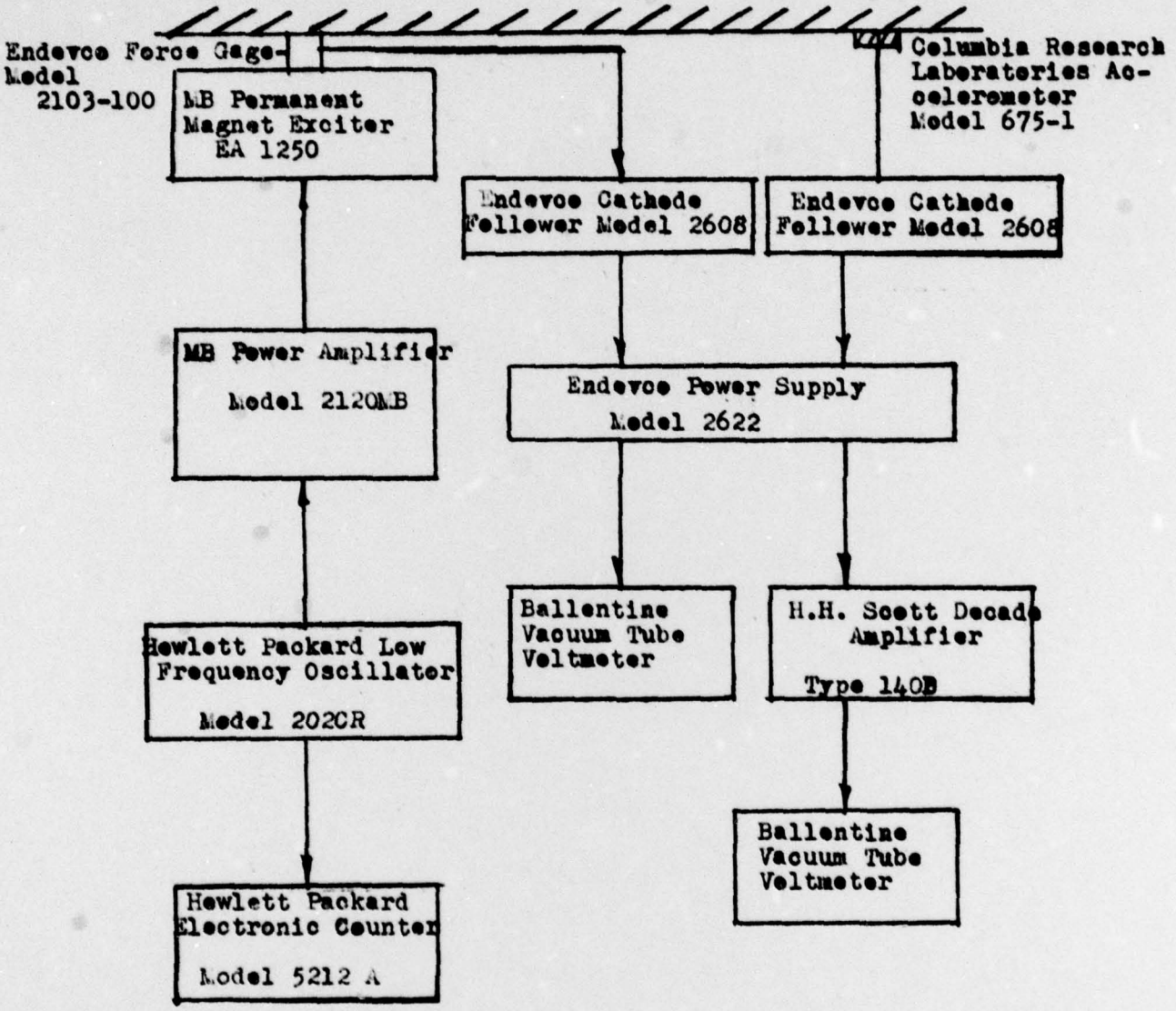

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FIGURE #3

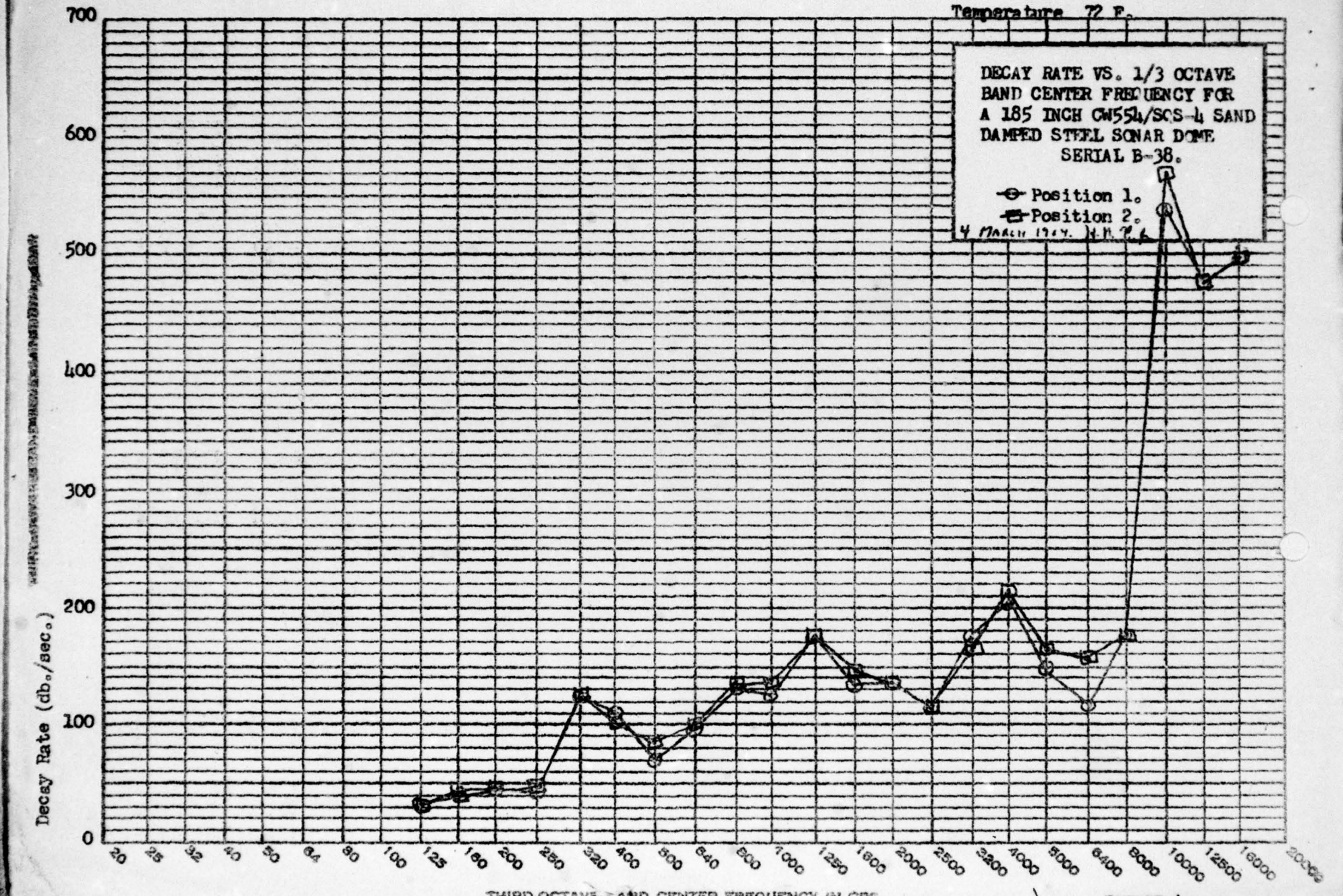

FIGURE 4.

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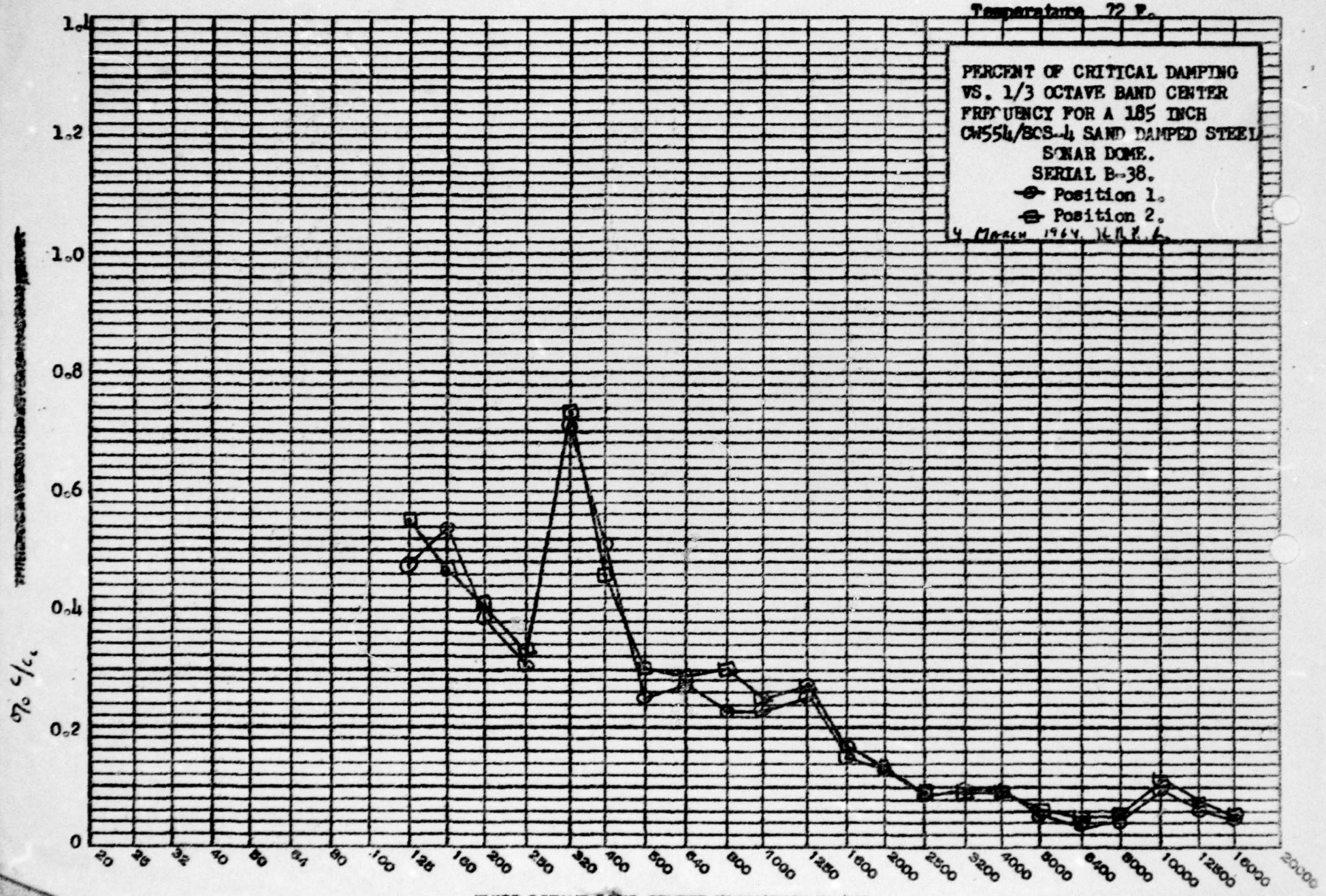
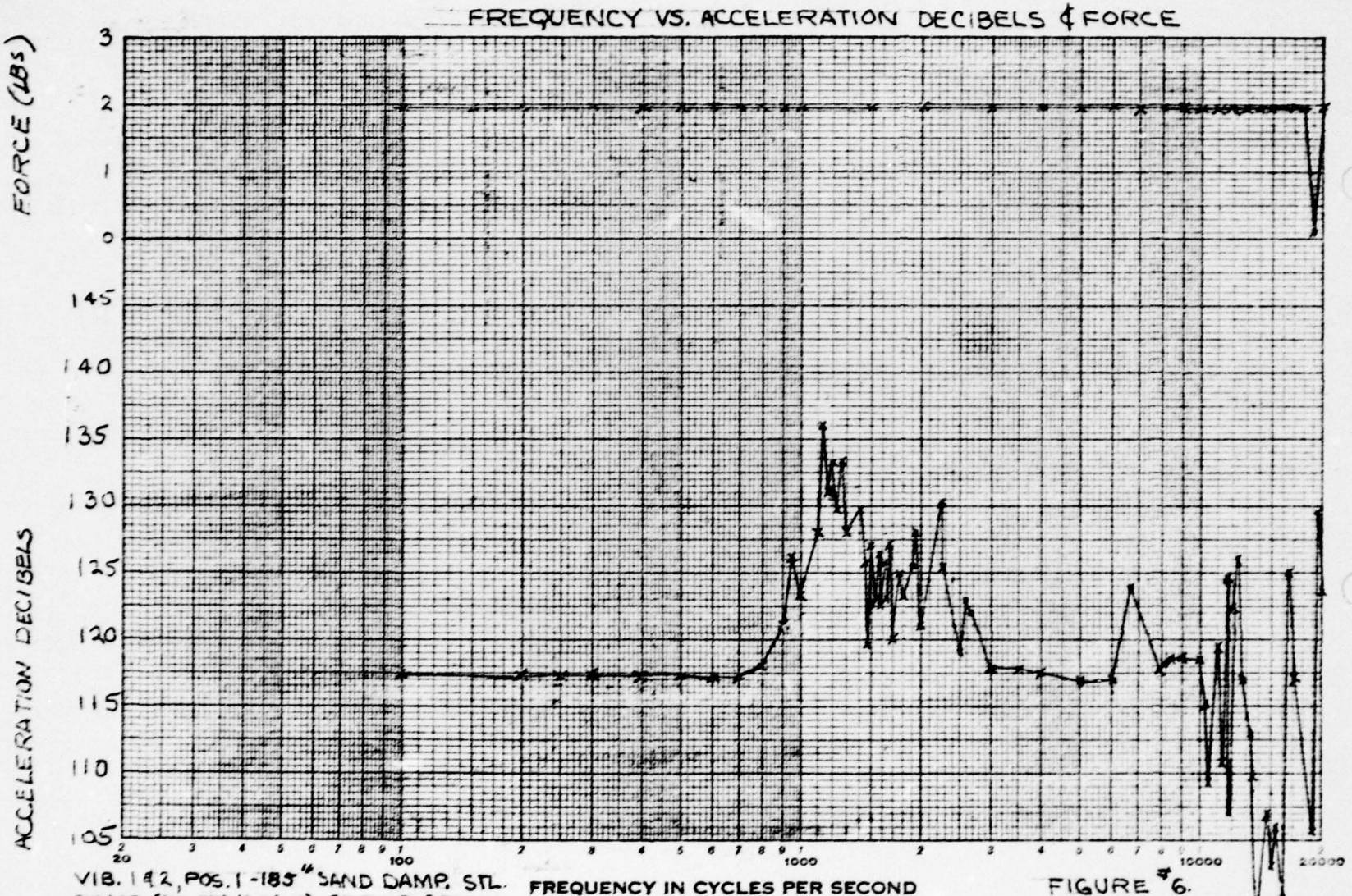


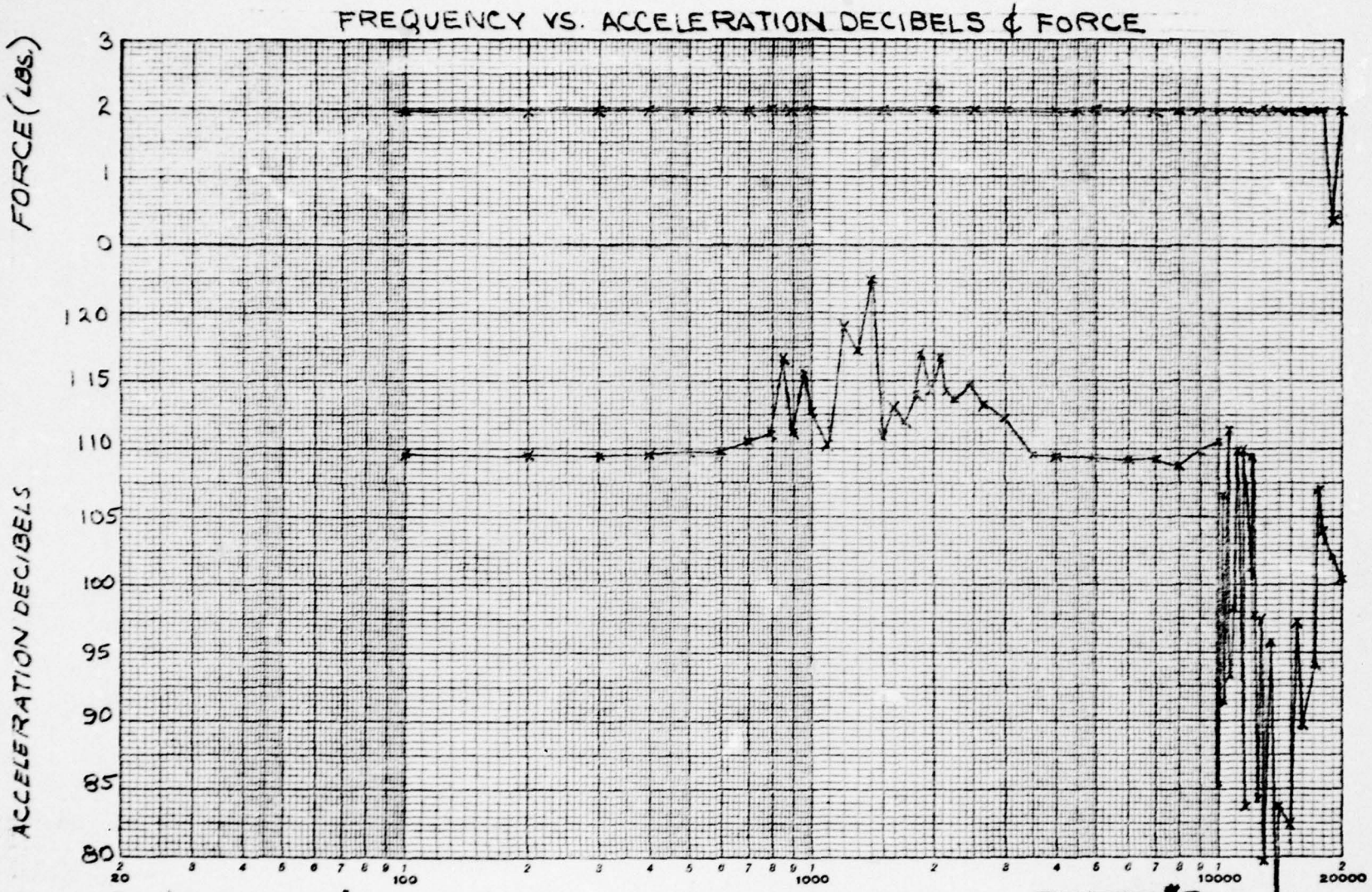
FIGURE 5.



VIB. 142, POS. 1 -185" SAND DAMP. STL. DOME (CW-554/595-4) SER. B-38
TEMP. IN AIR - 74F - 4/28/64

FIGURE #6.

USL Ser 933-182-64 of 26 June 1964



VIB. 1&2, POS. 2-185° SAND DAMP.
STL. DOME (CW-554/60S-4) SER. B-38
TEMP. IN AIR -70°F - 4/28/64

FIGURE #7

USL Ser 933-182-64 of 26 June 1964