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TEST AND EVALUATION OF CONTAINER MK 619 MOD 0 FOR HARPOON GUIDA--ETC(U)
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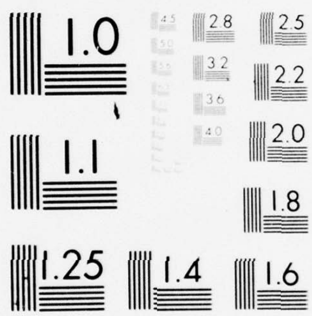

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NWHC REPORT 7684
30 JUNE 1977

A NAVAL WEAPONS HANDLING CENTER

TECHNICAL REPORT

TEST AND EVALUATION OF CONTAINER MK 619 MOD O FOR HARPOON GUIDANCE SECTION AN/DSQ-28

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NAVAL WEAPONS STATION EARLE
Colts Neck, New Jersey 07722

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This report details the test and evaluation of a prototype container Mk 619 Mod 0 designed to protect a HARPOON Guidance Section AN/DSQ-28 from the hazards and environments associated with transportation and handling. Test results indicated that with the adoption of two minor design changes pertaining to handling and closure, the container can adequately perform its intended function.

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TEST AND EVALUATION

OF

CONTAINER MK 619 MOD 0

FOR

HARPOON GUIDANCE SECTION AN/DSQ-28

Abstract

This report details the test and evaluation of a prototype container Mk 619 Mod 0 designed to protect a HARPOON Guidance Section AN/DSQ-28 from the hazards and environments associated with transportation and handling. Test results indicated that with the adoption of two minor design changes pertaining to handling and closure, the container can adequately perform its intended function.

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INTRODUCTION

The Naval Weapons Handling Center, WPNSTA Earle was tasked to design, develop and document a shipping and storage container for the HARPOON Guidance Section AN/DSQ-28. As a result of this task, a prototype container designed by the NWHC, WPNSTA Earle and fabricated by Container Research Corp. was tested in accordance with applicable requirements of MIL-STD-648 and XAS-4313.

The primary objectives of the tests were to evaluate the adequacy of the container in providing shipping, storage, and handling protection for a packaged HARPOON Guidance Section. The following sections of this report present the details of the test program.

ITEM DESCRIPTION

The test container, Mk 619 Mod 0, is designed and fabricated in accordance with DL 2645306 to meet the requirements of specification XAS-4313. It is a steel chest-type container mounted to a rectangular tubular base. See Figure 1. The container handling provisions consist of side lift fork pockets, four hoisting fittings and a flange on each end to enable the top of the container to be manually lifted. Shock mitigation is accomplished by cushion assemblies as shown in Figure 2. The cushioning consists of 2 lbs. per cubic foot nominal density polyethylene foam assemblies bonded to the top and base sections of the container and providing the Guidance Section shock mitigation in the vertical and traverse direction. The two end cushions (2 lbs. per cubic foot nominal density polyethylene foam) bonded to plywood platens provide shock mitigation in the longitudinal direction. Forward and aft covers for the Guidance Section are supplied with the container and are respectively fabricated from 6 lb. per cubic foot density polyethylene foam and linear polyethylene. Figure 3 shows the covers inserted on the weapon section prior to loading into the container. The Guidance Section in the container is shown in Figure 4. The external overall dimensions of the container are 52" long X 23 7/8" wide X 25 7/8" high. The empty weight of the container (with cushion assemblies and end covers) is 268 lbs. and the loaded weight (with the Guidance Section is 414 lbs.

TEST EQUIPMENT AND INSTRUMENTATION

Two triaxial accelerometers were used to monitor shock response. One accelerometer was mounted at the aft edge of the Guidance Section and the other at the CG. Accelerometer outputs were recorded on magnetic tape at a speed of 30 inches per second. Visual records were produced by a playback of the recorded shock signals at a speed of 3.75 inches per second into a hot pen recorder. Unidirectional accelerometers were used for monitoring vibration response of the Guidance Section. Instrumentation used in obtaining shock and vibration data is shown in Table 1.

Major test equipment used to provide dynamic inputs and environmental conditioning are listed below:

1. LAB 8000 SLVMO-10 Transportation vibration simulator used for Low Order Repetitive Shock.

2. LING Vibration Exciter System XPXO/16 with an A300 EM Shaker - Used for vibration sweeps in the frequency range 5 - 500 Hz.

3. CONRAD WD 1024 Walk In Temperature and Humidity Chamber - Used to thermally condition the test item for shock tests.

A digital computer program (SPECT) was used to generate shock response spectrum comparisons between the test data and allowable shock.

TEST PROCEDURES AND RESULTS

Tests were conducted in accordance with specification XAS-4313 and acceptance tests outlined in MIL-STD-648 and FED-STD-101B. Unless otherwise noted, test procedures and results are presented in the sequence conducted.

1. Inspection and Fit Test. The container was visually and dimensionally inspected for conformance to the drawing package DL 2645306. The container was loaded several times to determine adequacy of fit and function.

   Results - The container was within the dimensional tolerances specified. Fit and compatibility of the Guidance Section and placement of the container top section were performed without difficulty. However, some difficulty was experienced with the two T-bolt fasteners located at each end of the container. Although locking of the fasteners was accomplished using an open end wrench, their location (in line with the vertical rectangular tubular members) does not allow sufficient clearance to use a socket wrench which would expedite closure.

2. Leakage Test (Initial). This test was conducted at room temperature (70 F) using the pneumatic pressure technique outlined in Method 5009 of FED-STD-101 and the pressure requirements outlined in MIL-STD-648, paragraph 5.6, Table 11.

In preparation for the leak test, a fitting was installed through the container humidity indicator hole. The fitting is designed to allow an external source of compressed air to be paid into the container, which can be monitored by means of an air pressure gage. When the air pressure gage recorded the nominal specified container pressure, the external air supply was shut off. Air pressure corrections were made to compensate for the effect of temperature change of the throttled air before monitoring the leak rate. The container air pressure test requirements are 2.5 + .5 PSIG, with a pressure drop not exceeding 0.05 PSIG during an elapsed time of one hour after pressurizing the container.

Results - No leakage could be detected during the one hour test period.

> NOTE: This test was repeated after completion of all tests as described in this report. The result was the same.

3. Repetitive Shock Test. This test was conducted at an ambient temperature of approximately 70°F in accordance with paragraph 5.2.2 of MIL-STD-648 and Method 5019 of FED-STD-101B.

The loaded container was placed base down on a vibration table (LAB-8000 SLVMO-10) having a vertical linear motion of 1" double amplitude. The frequency of the table motion was increased until the container left the table by 1/16" at some instant during each cycle. The container was vibrated for two hours under these conditions with an input frequency of 3.8 Hz.

Results - Post test examination disclosed no visible damage to either the Guidance Section or the container.

4. Vibration Fatigue Test. This test was conducted at 70°F in each of the three mutual perpendicular axes. A sinusoidal sweep was conducted to determine the isolation system natural frequency and peak transmissibility through the specified frequency range of 5 to 500 Hz. The test item was then vibrated for 30 minutes (uninterrupted) along each of the three axes at the resonant frequency determined from the sweep.

Results - Figures 5 - 10 show the transmissibility characteristics both before and after the 30 minute dwell test superimposed upon the allowable transmissibility. Initial equipment problems preclude obtaining container input levels in accordance with MIL-STD-648, which requires 0.125 inch D.A. from 5-12.5 Hz and 1.0 g from 12.5 to 50 Hz. Figures 5-10 represent transmissibility results (before and after the 30 minute dwell test) obtained with a constant input level of 0.3 g's. Figures 5 and 6 indicate marginal to slightly out of specification conditions at 8 Hz and 300 and 430 Hz before dwell and 430 and 485 Hz after dwell. The measured transmissibility at the 8 Hz resonance peak which is the basic resonance of the cushion system in the transverse direction would decrease in response to greater input levels due to more effective damping and is, therefore, of no concern. This is clearly demonstrated by comparison of Figures 10 and 11. Figure 11 is a repeat test of the container in the vertical direction after equipment repair enabled an increase excitation level (0.125 inch D.A., 5-12.5 Hz). Marked decrease in the basic resonance peak as a result of increased input amplitude is typical of the excitation level sensitivity of expanded polyethylene foam (and to similar degrees with other isolation materials). It should be noted that the allowable transmissibility indicated in the figures is based upon input levels of XAS 2381 and XAS 4313 and that lower level inputs would naturally permit greater transmissibilities. The higher frequency resonance peaks of Figures 5 and 6 are believed to be test fixture induced. Figures 9 and 10 indicates a fixture resonance problem at approximately 65 Hz, which was eliminated from the results by relocating the control accelerometer. Comparison of Figures 9 and 10 with Figure 11 clearly shows the elimination of this fixture resonance. A summary of the sweep results are tabulated below:

Axis	Excitation at Res. (inch D.A.)	Before Dwell Fn.	Before Dwell Tran.	After Dwell Fn	After Dwell Tran.
Vert.	.03/.125*	14	7.2	11	2.5
Trans.	.09	8	4.5	8.2	6.0
Long.	.119	7.6	5.5	6.6	4.0

* 0.030 inch DA before dwell
  0.125 inch DA after dwell

A post test examination of the container and contents indicated that there were no detrimental effects of the dwell tests.

5. Shock Tests

a. Rotational Corner-Drop Tests. This test was conducted in accordance with paragraph 5.2.4 of MIL-STD-648 and Method 5005 by supporting the loaded container at one end by a 6 inch block at one corner and a 12 inch block at the adjacent corner. The corner diagonally opposite the 12 inch block was raised to a height of 36 inches and allowed to free fall and impact on a concrete surface. This test was conducted with the container conditioned at 140°F and -20°F. A total of four (4) drops were conducted (two at each temperature).

b. Incline Impact Test. This test was conducted in accordance with paragraph 5.2.7 of MIL-STD-648 and Method 5023 of FED-STD-101B with optional timber. The loaded container was placed on the carriage of the tester and released from a predetermined point on the ten-degree track that had been calibrated to obtain an impact velocity of 10 and 7 ft/sec. This test was performed on both ends at 10 ft/sec. and on both sides at 7 ft/sec. This sequence of incline impact tests were conducted with the container conditioned at 140°F and -20°F for a total of eight (8) impacts.

c. Drop Test (Free Fall). This test was conducted in accordance with paragraph 4.2.2.10.2 of specification XAS 4341A and paragraph 5.2.1.1 of MIL-STD-648 at room temperature. The loaded container was raised to a height of 18 inches and allowed to free-fall flat on its base on an unyeilding surface (concrete).

Results - A summary of the shock results is presented in Table 11 and the major deceleration-time curves are shown in Figure 12. The shock response spectrum of the largest shock was generated and compared to the allowable spectrum. This comparison presented as Figure 13 shows that the spectrum of the most severe of the thirteen response pulses exceeds the allowable spectrum in the frequency range 40-55 Hz. The interpretation of this condition is that the response pulse has greater damage potential to Guidance Section components which have resonanes between 40 and 55 Hz than the specification pulse. This is only significant, therefore, if such components exist and cannot survive shock approximately 15% in excess of the design level. In addition, the containerized Guidance Section must experience a 36 inch impact of its corner on a non-yeilding surface at -20°F. Since these circumstances are highly unlikely to occur, this out of specification condition is not considered to be important. Shock spectra for other shocks were not computed because of their significantly lower amplitudes.

6. Forktruck Handling Test. The "lifting and transporting by forktruck" test outlined in paragraph 6.2 in Method 5011 of FED-STD-101B was performed using a standard 4000 lb. capacity electric powered forktruck. The loaded container was hoisted by the forktruck and driven 100 ft. over 1-inch high boards spaced 54 inches apart at right angles, 60°, and 75° from the path of travel.

Results - The container was handled by the forktruck with no noticeable difficulty or structural degradation.

7. Skid Strength Test. The pushing and towing test of Method

5011, paragraphs 6.5 and 6.6 of FED-STD-101B was performed using a standard 4000 lb. capacity electric powered forklift truck. The pushing test was performed with the forks of the vehicle extended through the container forklift pockets, but not supporting the container, the vehicle mast was positioned vertically. The container was pushed along a concrete surface a distance of 35 ft. in approximately 85 seconds. The towing test was performed by placing an appropriate tow line to the forklift truck. The container was towed along a concrete surface a distance of 100 ft. in approximately 23 seconds. This test was performed twice. Once with the container's longitudinal axis parallel to and once at a right angle to the vehicle path of travel.

Results - Except for scrape marks, there was no damage inflicted to the container body or skid surface.

8. Concentrated Load Test. The concentrated load test was performed as specified by paragraph 4.2.2.6 of XAS 4313. The container was subjected to a load equivalent to that imposed by stacking four loaded containers upon the bottom container. The load was based on the gross weight of one container (414 lbs.) and consisted of 1656 lbs. The overload was maintained for a 12 hour period.

Results - A visual inspection of the container showed no edvidence of damage.

9. Hoisting Strength (Four Point Overload). Conducted in accordance with paragraph 4.2.2.9 on XAS 4313. The container's four hoisting fittings were overloaded 5:1 based on the gross weight on one loaded container, 414 lbs. The loaded container was positioned

under a hydraulic tension machine and hoisted with an appropriate sling attached to the four hoisting fittings. The container was secured to the deck and a tension load of 2070 lbs. was applied to the hoisting fittings. The test was maintained for a 5 minute period.

Results - On completion of the test, there was no visible indication of structural degredation of the lifting fittings. However, it was noted that insufficient clearance exists between the lifting fittings and the container body resulting in binding of the sling hooks.

10. Hoisting Strength (Single Point Overload). This test was performed by hoisting the loaded container by a single hoisting fitting. This test was performed on all four fittings and in each case was held for a 5 minute period.

Results - On completion of this test, visual inspection showed no evidence of structural failure of the lifting fittings.

CONCLUSIONS

The results of this evaluation indicate that the container, Mk 619 Mod 0, is suitable for its intended purpose as a shipping and storage container for the HARPOON Guidance Section AN/DSQ-28. Tests results indicate the cushion system employed in the container provides adequate isolation from the shock and vibration inputs specified. The condition of the container after completion of all tests was good and was considered structurally capable of being reusable. Two problem areas exist and are listed below.

1. The T-bolt fasteners located at the forward and aft ends are

partially inaccessable resulting in some difficulty in locking/unlocking operations.

2. The location of the four lifting fittings do not allow sufficient clearance to permit the hoisting sling hooks to assume a normal, in line configuration with the sling legs during hoisting.

RECOMMENDATIONS

Based upon the conclusions, it is recommended that the T-bolts located at the container ends and the hoisting fittings be relocated to permit appropriate clearances. (It should be noted that these recommendations have been implemented by modifying the drawing package to reflect relocation of the T-bolt fasteners inboard of their present location and the lifting fittings downward. Both of these modifications should be effective.)

TABLE 1

SHOCK AND VIBRATION INSTRUMENTATION

ITEM	MANUFACTURER	MODEL	SERIAL NO.
Accelerometer (2)	Endevco	2223C	LA80/LA440
Accelerometer (2)	Endevco	2219	FB16/FB17
Vibration Pickup (1)	MB	126	16419R
Signal Conditioner (6)	Endevco	4470	
Charge Amplifier (6)	Endevco	4477	
Charge Amplifier (2)	Endevco	2720P	
Vibration Meter (1)	MB	M-6	
X-Y Plotter	Moseley	135A	
Impedance Analyzer (1)	Spectral Dynamics	SD-1002A	
Magnetic Tape Recorder (1)	Sangamo	4700	
Pen Reloader (1)	Beckman	RS	

TABLE 11

PEAK DECELERATION AND DURATION AT ACCELEROMETER NEAREST TO IMPACT

Test Event	Longitudinal Axis				Transverse Axis				Vertical Axis			
	-20°F		140°F		-20°F		140°F		-20°F		140°F	
Cornerwise-Drop (Rotational) 36" Height	g's	ms	g's	ms	g's	ms	g's	ms	g's	ms	g's	ms
AFT PORT	*	*			6.5	20			25.2	31		
FWD STBD **	13.5	33			13.8	18			10.1	21		
AFT STBD **			9.1	55			6.2	57			15.3	60
FWD PORT **			9.1	35			6.1	65			7.9	60
10 ft/sec Impact												
AFT END	15.7	33	15.3	47								
FWD END	18.4	40	12.2	60								
7 ft/sec Impact												
PORT SIDE					10.5	45	8.6	62				
STBD SIDE					14.6	30	10.7	55				
18" Vertical Shock									70°G			
BOTTOM FACE									16.5 g's		45 ms	

*Instrumentation Failure
**Accelerometer at c.g.

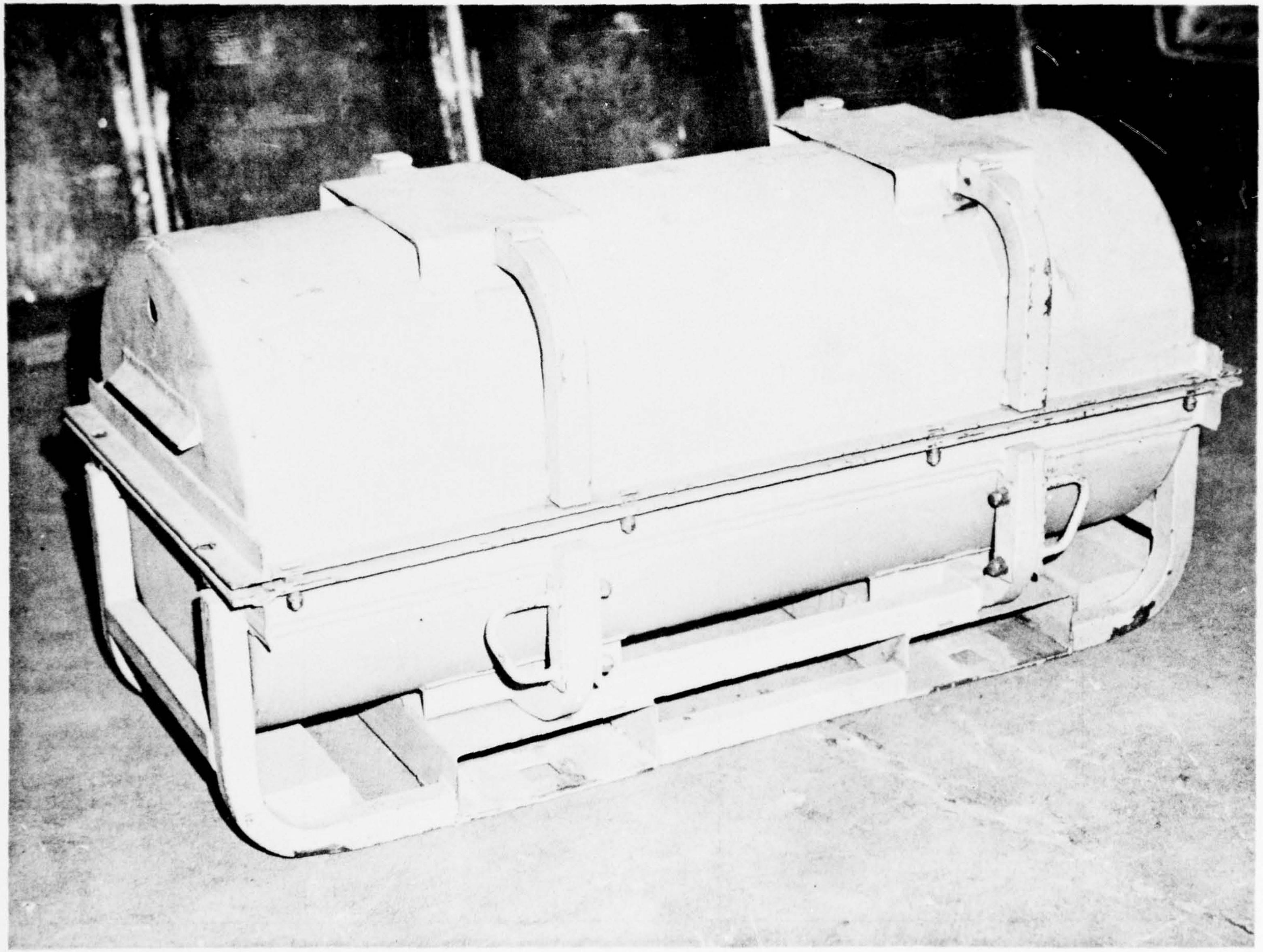


FIG. 1 CONTAINER MK 619 MOD 0

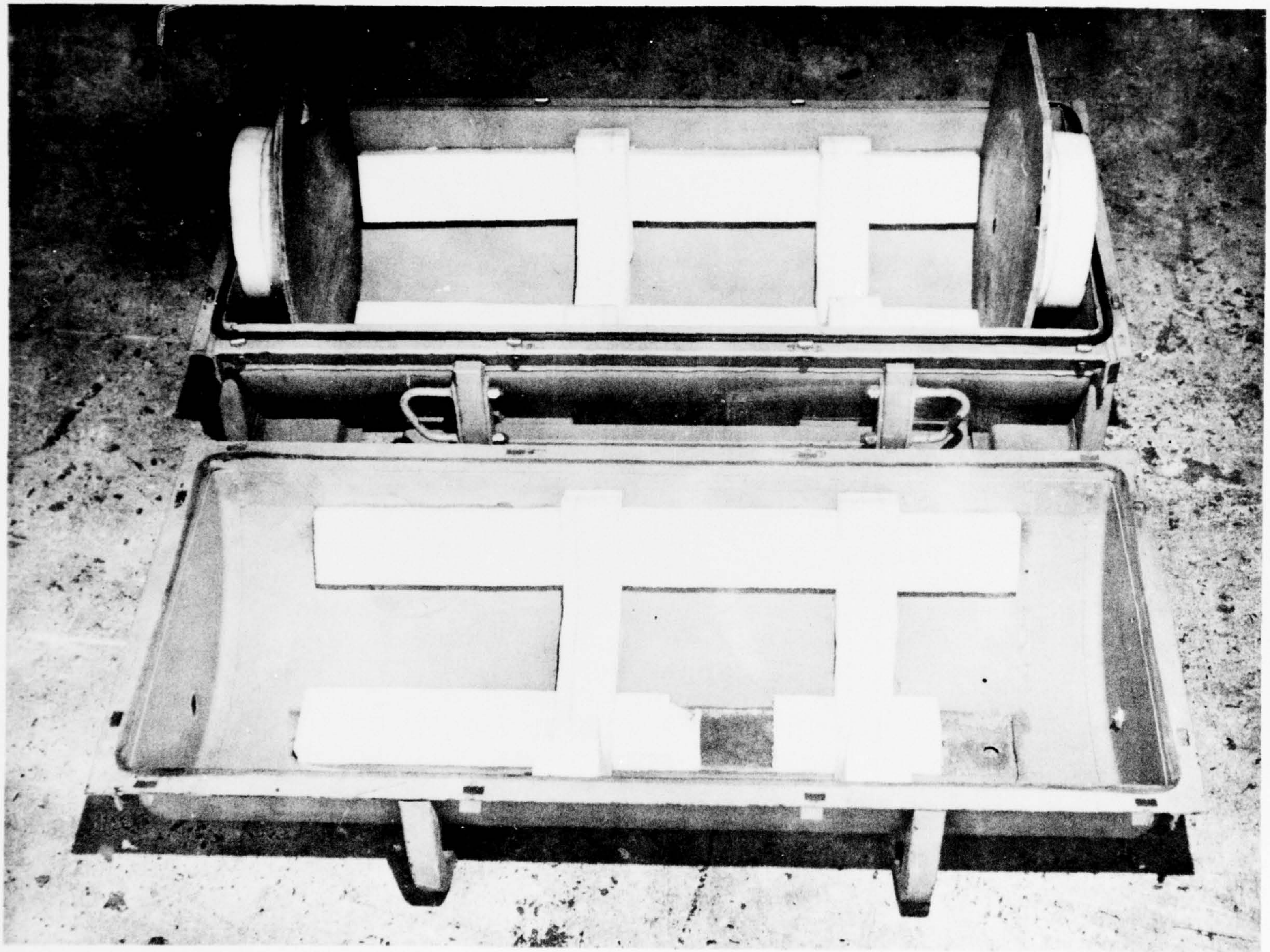


FIG. 2 CUSHIONING SYSTEM

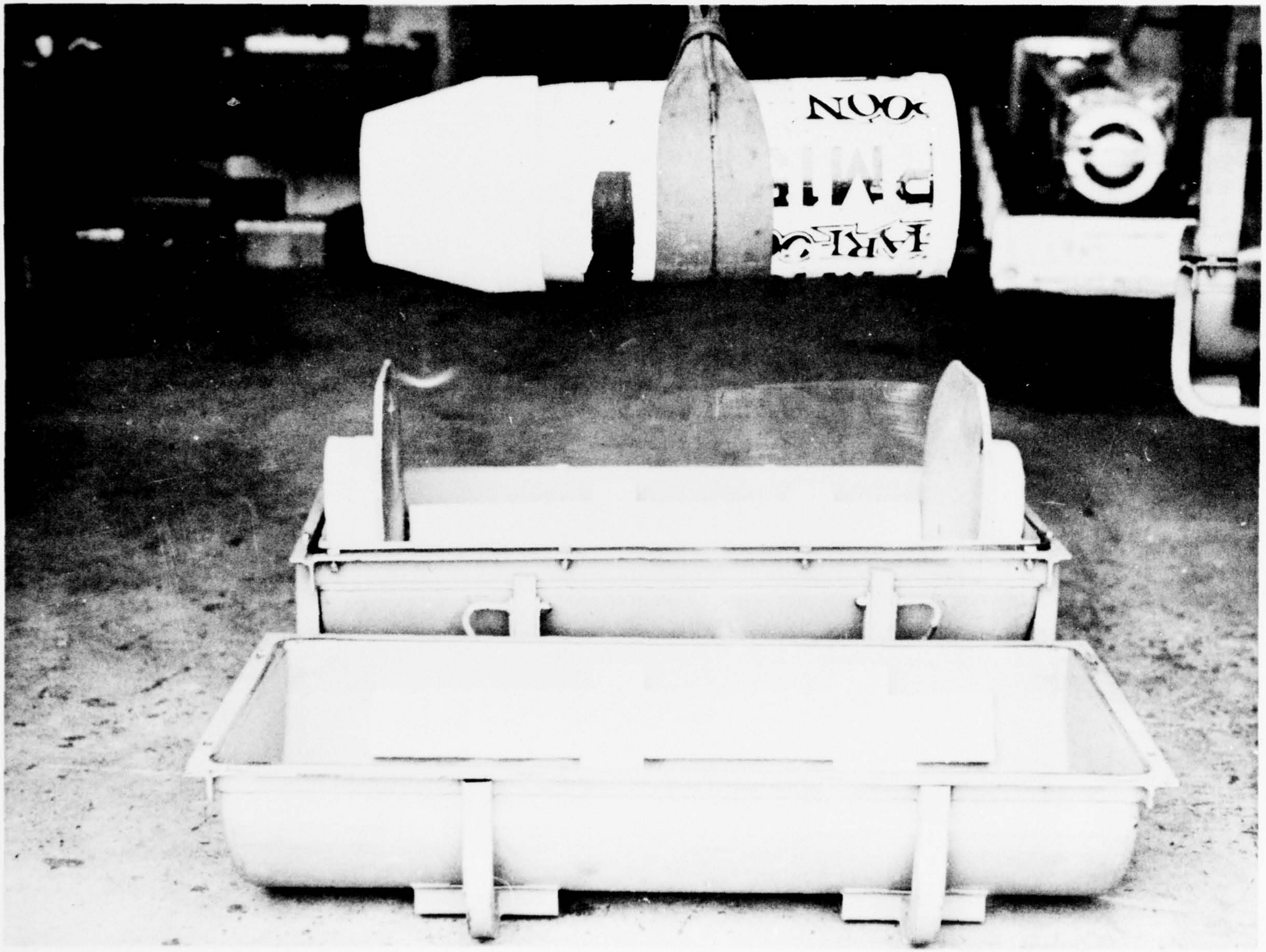


FIG. 3 NOSE COVER-CCB POLYETHYLENE AFT COVER LINEAR POLYETHYLENE

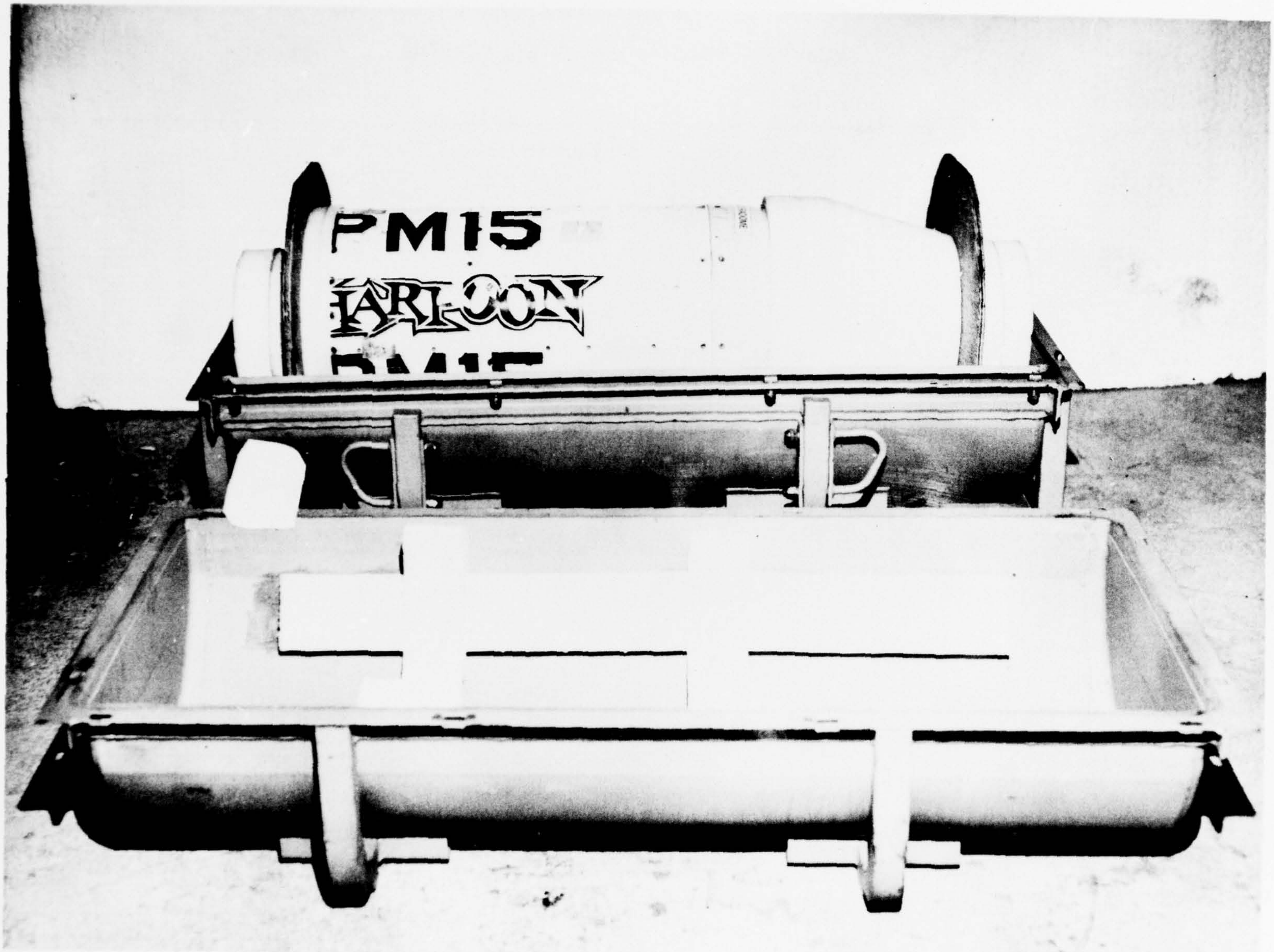


FIG. 4 GUIDANCE SECTION IN CONTAINER

FIGURE 5. TRANSVERSE RESONANCE SEARCH

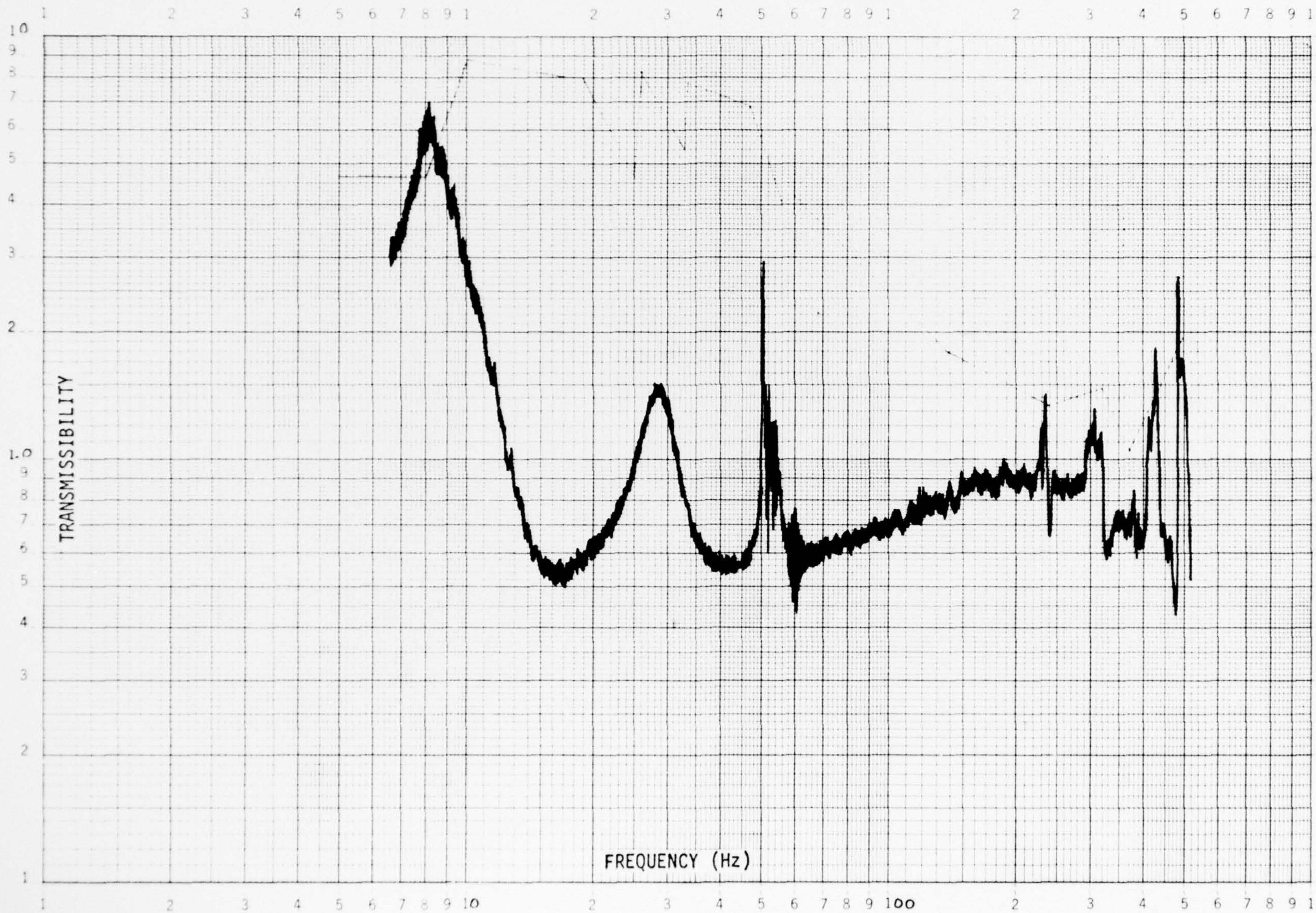
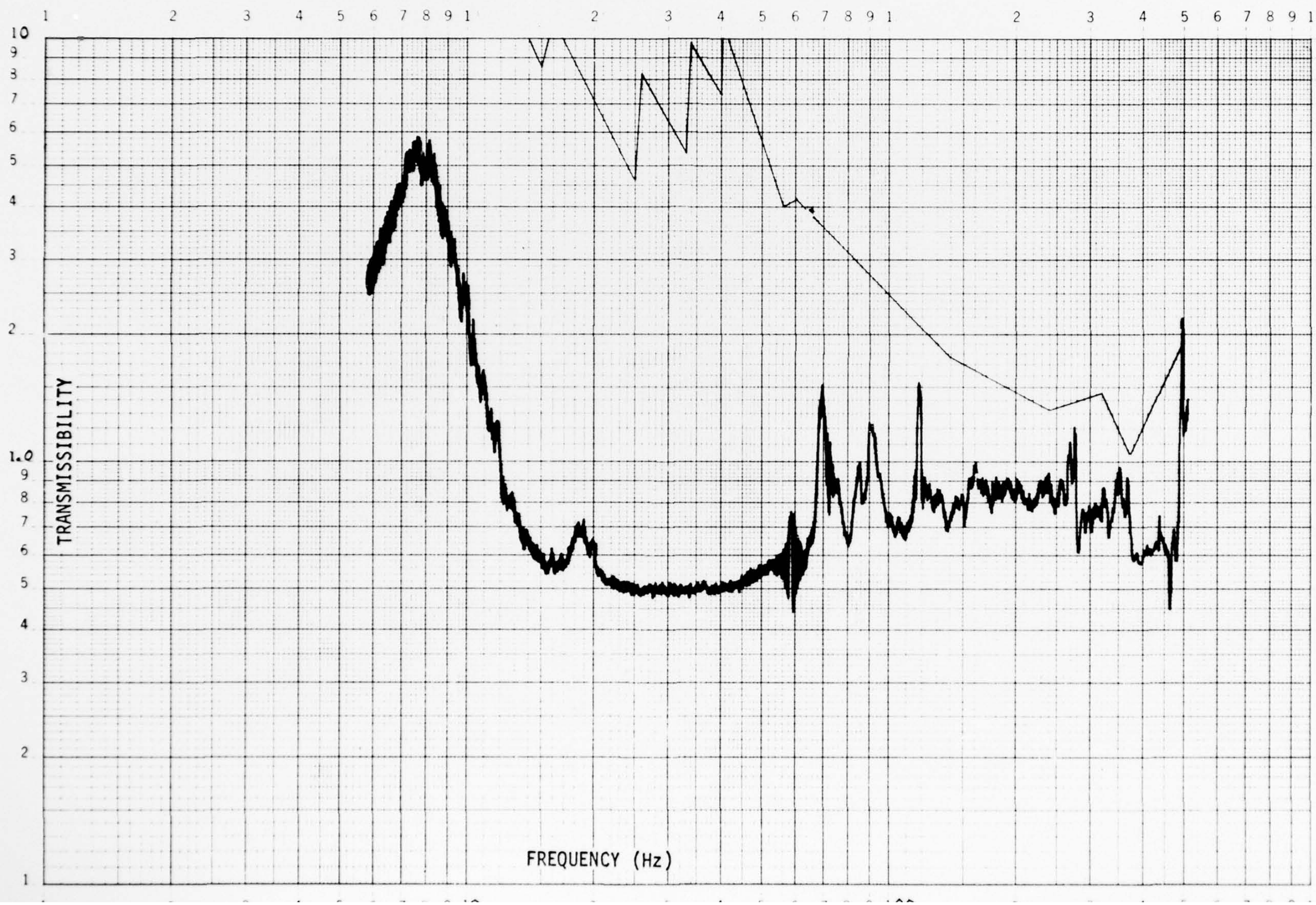
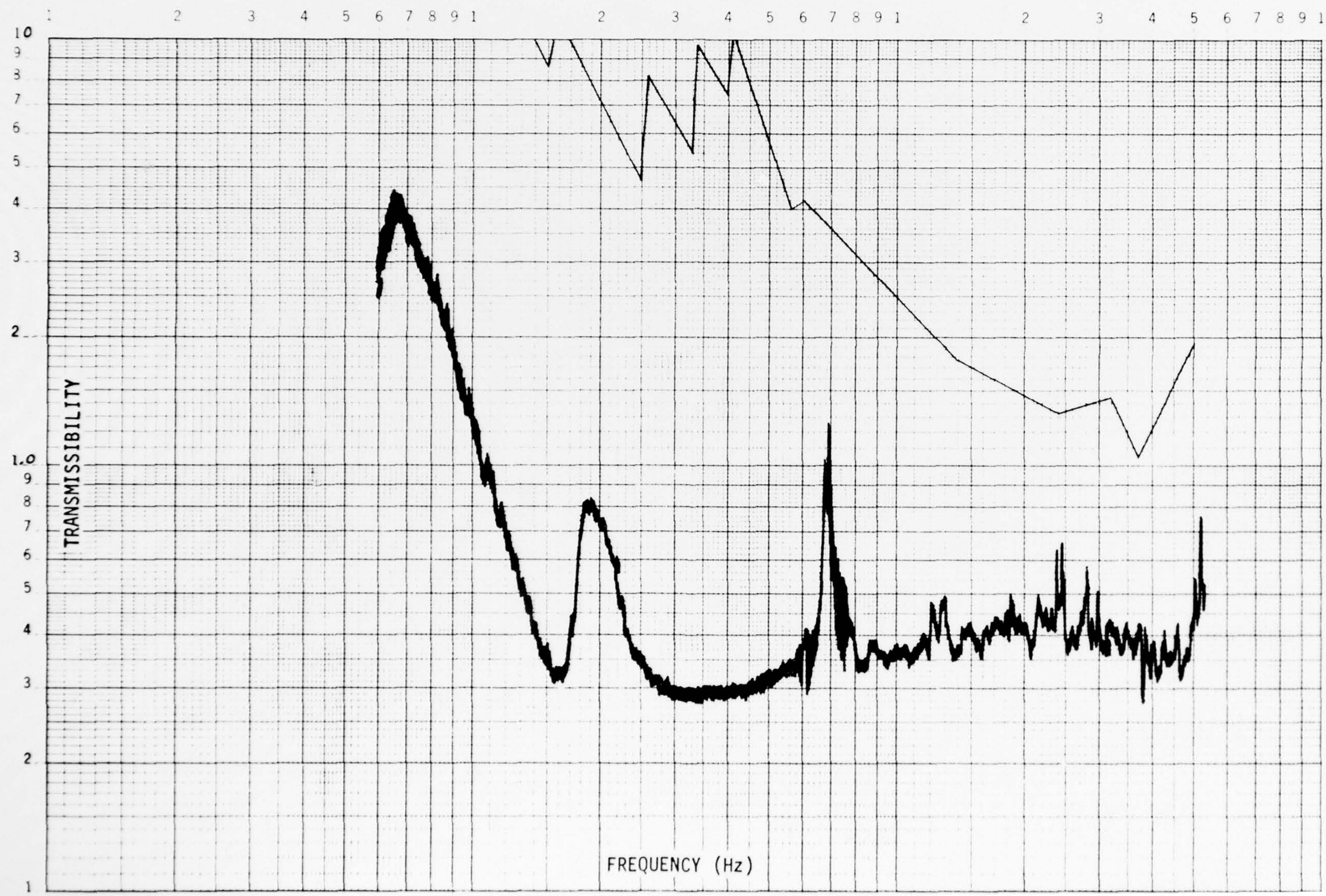


FIGURE 6 TRANSVERSE-AFTER 30 MINUTE DWELL


TRANSMISSIBILITY
FREQUENCY (Hz)


TRANSMISSIBILITY
FREQUENCY (Hz)

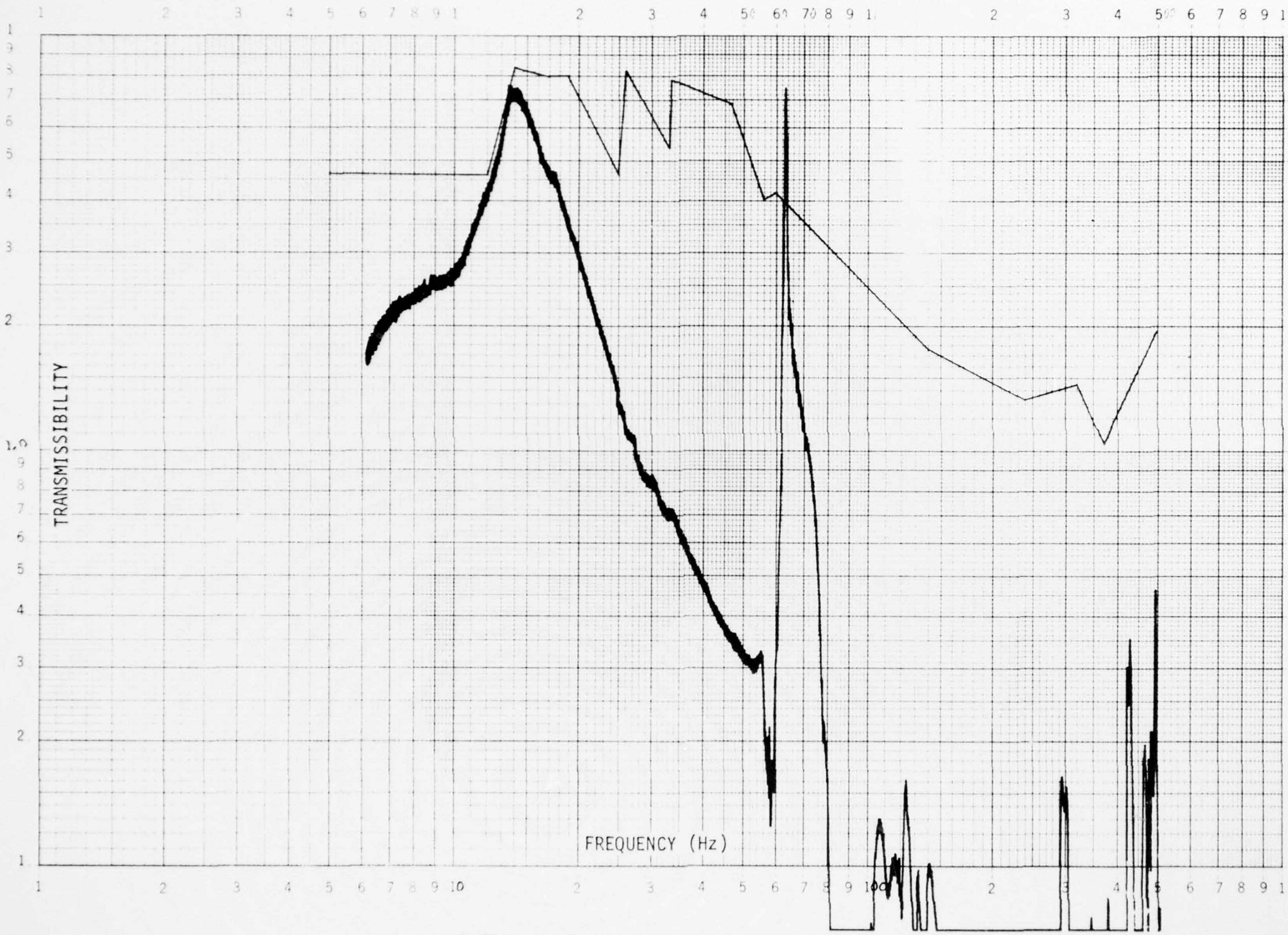


FIGURE 9 VERTICAL-RESONANCE SEARCH

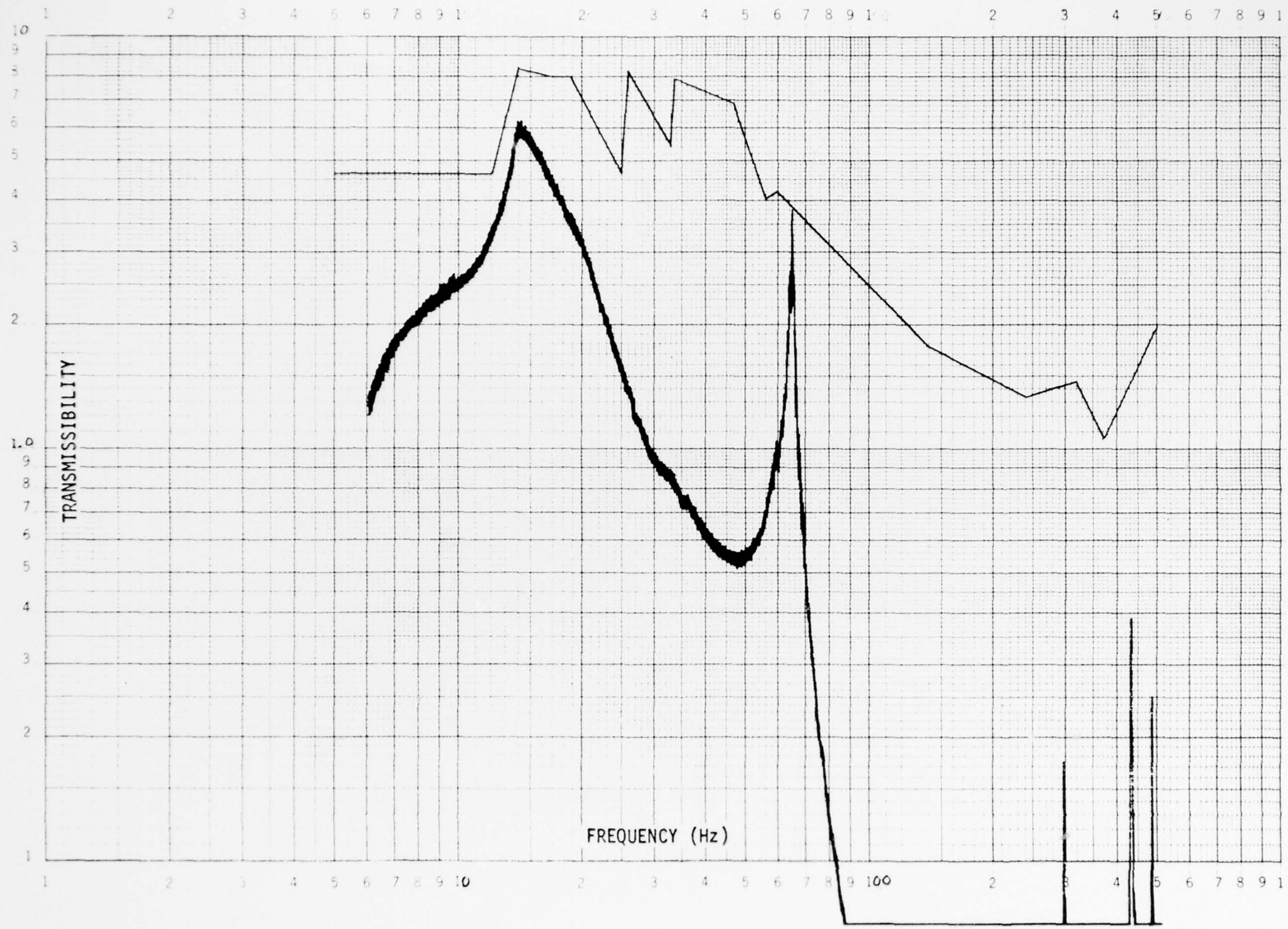


FIGURE 10 VERTICAL-AFTER 30 MINUTE DWELL

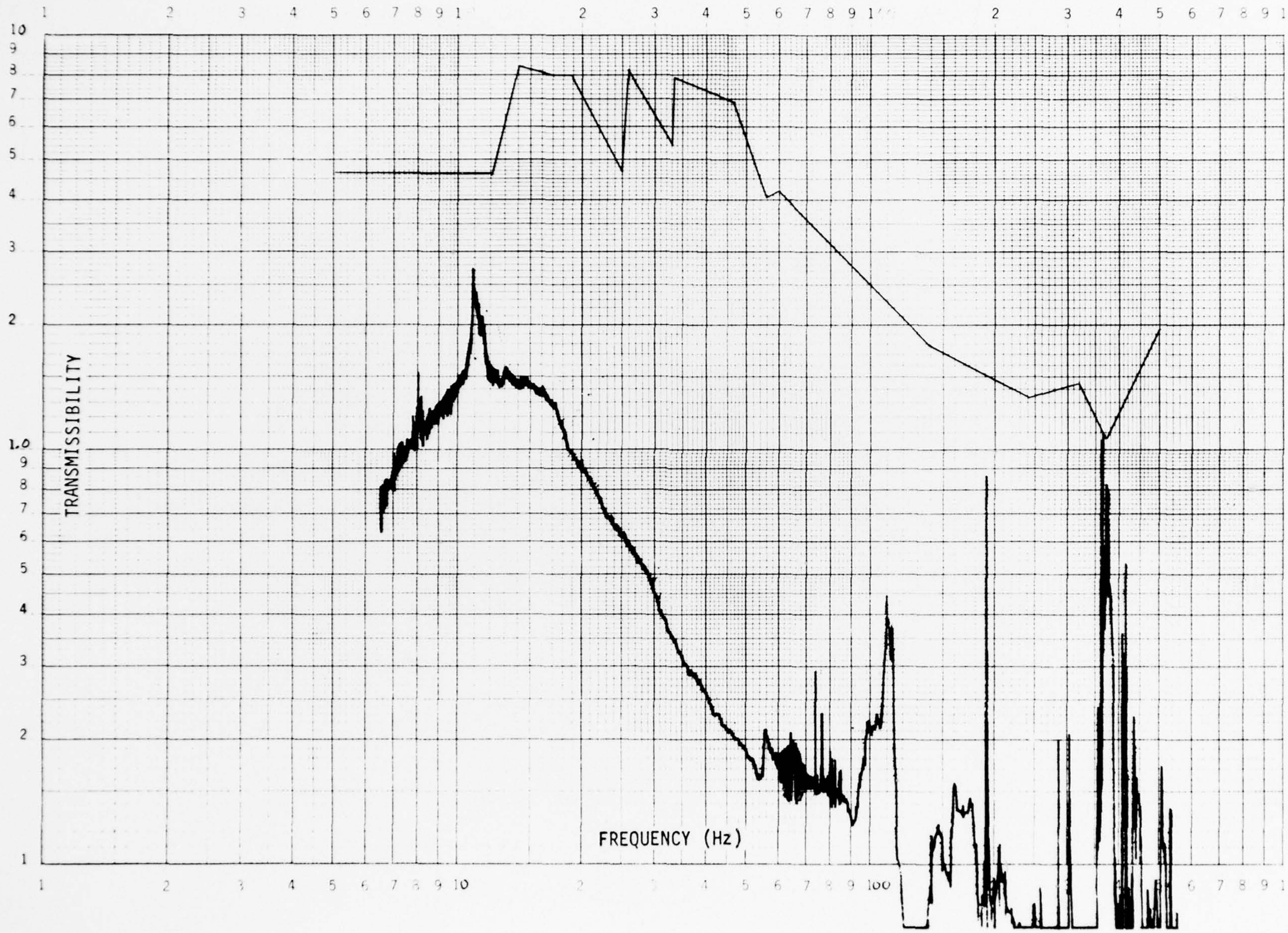
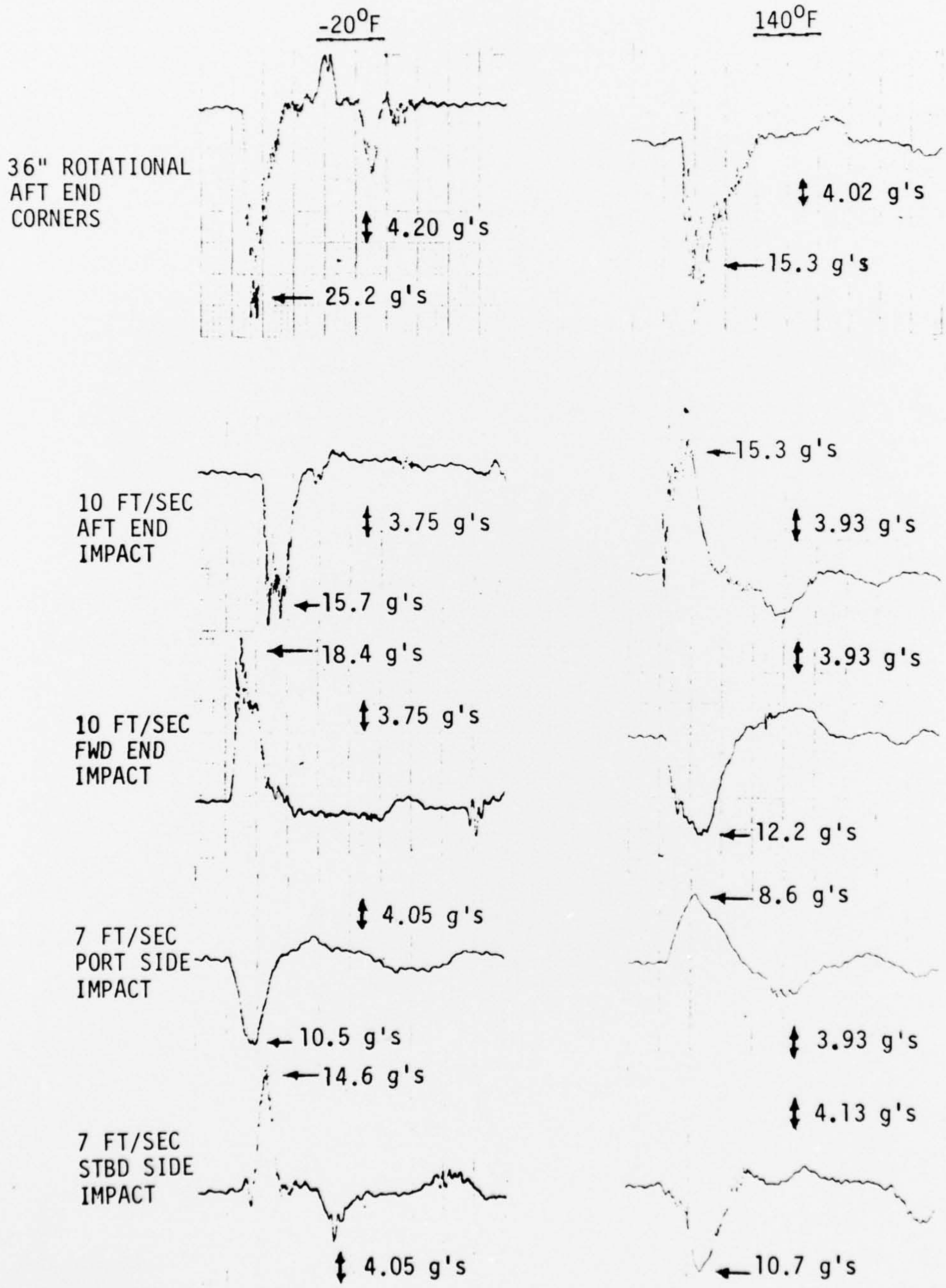


FIGURE 11 VERTICAL-CONTROL ACCELEROMETER RELOCATED

FIGURE 12
MAJOR SHOCK PULSES



NOTE: HORIZONTAL SCALE = 5 ms/mm

DATE 076203 REMARKS

FIGURE 13
CONTAINER MK619 MOD0
36 INCH ROTATIONAL CORNER DROP AT -20F

SHOCK SPECTRUM
SPECIFICATION = ◆
RESPONSE = +

FREQ HZ	SPEC G	RESP G
4.	13.0	10.6
8.	25.2	20.1
12.	35.7	27.6
16.	44.0	33.2
20.	49.7	37.2
28.	52.5	42.5
36.	46.4	45.0
44.	38.5	45.2
52.	38.1	43.5
60.	43.4	40.8
68.	46.4	38.2
76.	44.1	35.2
84.	40.1	32.8
92.	39.2	30.9
100.	42.0	29.8
120.	42.0	35.2
140.	42.0	39.6
160.	42.0	41.5
180.	42.0	41.4
200.	42.0	40.5
220.	42.0	37.4
240.	42.0	35.4
260.	42.0	32.4
280.	42.0	29.9
300.	42.0	27.8