FINAL REPORT

MARCH 1988

EVT 46-87

MIL-STD-1660 TEST OF GENERAL ELECTRIC PLASTIC PALLET

Prepared for:
U.S. Army Armament Research,
Development and Engineering Center
ATTN: SMCAR-AEP
Picatinny Arsenal, NJ 07801-5001

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The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), has been tasked by the U.S. Army Armament Research, Development and Engineering Center (SMCAR-AEP), Picatinny Arsenal, NJ, to test a plastic pallet made from a General Electric AZDEL material. This plastic material is currently being used in plastic automotive applications and in special designed rackable pallets. The sample pallet was designed for a 2,500 pound load weight. It was loaded to 2,340 pounds of inert ammunition containers and subjected to MIL-STD-1660 testing procedures. The result of this engineering test showed that the AZDEL pallet, after modification, couls be considered for transportation of ammunition.

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REPORT NO. EVT 8-87

MIL-STD-1660 TEST OF GENERAL ELECTRIC PLASTIC PALLET

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School, Evaluation Division, was asked by the U.S. Army Armament Research, Development and Engineering Center (SMCAR-AEP) to test a pallet fabricated from General Electric AZDEL. The test procedure for evaluating this pallet is MIL-STD-1660, Design for Ammunition Unit Loads.

B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command, Rock Island, IL.

C. OBJECTIVE. The objective of this engineering test is to determine if the plastic pallet fabricated from General Electric AZDEL could be considered suitable for ammunition unit loads.

PART 2

ATTENDEES

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PART 3

TEST PROCEDURES

The test procedures outlined in this section are extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is considered to be acceptable. These tests are synopsized below:

1. STACKING TESTS. The unit load shall be loaded to simulate a stack of identical unit loads stacked 16 feet high, for a period of one hour. This stacking load is simulated by subjecting the unit load to a compression of weight equal to an equivalent 16-foot stacking height. The compression load is calculated in the following manner. The unit load weight is divided by the unit load height in inches and multiplied by 192. The resulting number is the equivalent compressive force of a 16-foot-high load.

2. REPETITIVE SHOCK TEST. The repetitive shock test shall be conducted in accordance with Method 5019, Federal Standard 101. The test procedure is as follows. The test specimen shall be placed on, but not fastened to, the platform. With the specimen in one position, vibrate the platform at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of about 3 cycles per second. Steadily increase the frequency until the package leaves the platform. The resonant frequency is achieved when a 1/16-inch-thick feeler may be momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieves one plus or minus zero point one G. Midway into the testing period the specimen shall be rotated 90 degrees and the test continued for the duration. If failure occurs, the total time of vibration shall be two hours if the specimen is tested in one position; and if tested in more than one position, the total time shall be three hours.

3. EDGEWISE DROP TEST. This test shall be conducted by using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Drop (Rotational) Test is as follows: The specimen shall be placed on its bottom with one end of the base of the container supported on a sill nominally 6 inches high. The height of the sill shall be increased if necessary to ensure that there will be no support for the base between the ends of the container when dropping takes place, but should not be high enough to cause the container to slide on the supports when the dropped end is raised for the drops. The unsupported end of the container shall then be raised and allowed to fall freely to the concrete, pavement, or similar underlying surface from a prescribed height. Unless otherwise specified, the height of drop for level A protection shall conform to the following tabulation.

GROSS WEIGHT NOT EXCEEDING	DIMENSIONS ON ANY EDGE NOT EXCEEDING	HEIGHT OF DROP LEVEL A PROTECTION
Pounds	Inches	Inches
600	72	36
3,000	no limit	24
no limit	no limit	12

4. IMPACT TEST. This test shall be conducted by using the procedure of Method 5023, Incline-Impact Test of Federal Standard 101. The procedure for the Incline-Impact Test is as follows: The specimen shall be placed on the carriage with the surface or edge which is to be impacted projecting at least 2 inches beyond the front end of the carriage. The carriage shall be brought to a predetermined position on the incline and released. If it is desired to concentrate the impact on any particular position on the container, a 4x4-inch timber

may be attached to the bumper in the desired position before the test. No part of the timber shall be struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges are subjected to impacts may be at the option of the testing activity and will depend upon the objective of the tests. When the test is to determine satisfactory requirements for a container or pack and unless otherwise specified the specimen shall be subjected to one impact on each surface that has each dimension less than 9.5-feet. Unless otherwise specified, the velocity at time of impact shall be 7-feet per second.

PART 4

TEST EQUIPMENT

1. TEST SPECIMEN

   a. Width: 40 inches

   b. Length: 48 inches

   c. Height: 37.5 inches

   d. Weight: 2340 pounds

2. COMPRESSION TESTER

   a. Manufacturer: Ormond Scientific

   b. Platform: 60 inches by 60 inches

   c. Compression Limit: 50,000 pounds

   d. Tension Limit: 50,000 pounds

3. TRANSPORTATION SIMULATOR

   a. Manufacturer: Gaynes Laboratory

   b. Capacity: 6,000-pound pallet

   c. 1/2-inch Amplitude

   d. Speed: 50 to 3000 cpm

   e. Platform: 5 foot by 8 foot

4. INCLINED RAMP

   a. Manufacturer: Conbur Incline

   b. Impact Tester

   c. 10 Percent Incline

   d. 12-foot Incline

PART 5

TEST RESULTS

1. STACKING TEST

Pallet Weight - 2,340 lbs.

Pallet Height - 37.5 in.

Test Load Weight - 11,980 lbs.

The subject pallet was loaded to 11,980 lbs. compression for a period of one hour. At the end of this period of time, the compressive load had decreased to 11,100 lbs. When the compression load was removed from the test specimen no measurable deformation in the load was evident.

2. REPETITIVE SHOCK TEST

Subject pallet successfully passed a longitudinal transportation simulation test for a 90-minute test period. Rotating the pallet 90 degrees and subjecting it to a second 90-minute period in the Transportation Simulator caused no damage to the pallet. In order to achieve a 1/16-inch displacement between the pallet and the Transportation Simulator bed, the equipment was operated at 225 rpm. Operating the simulator at this speed produced an acceleration of 0.72g.

3. EDGEWISE DROP TEST

Each side of the pallet base was placed on a beam displacing it six inches above the floor. The opposite side was raised to a height of 24 inches above the floor and then dropped. This process was repeated in a clockwise direction on all four sides of the pallet. During this test the pallet was damaged by the sling used to lift the pallet. It cut into the pallet deck protruding from under the test load.

4. IMPACT TEST

The inclined impact test consisted of placing the test pallet on an inclined sled with 2 inches of pallet projecting over the edge of the sled. The sled was then raised approximately 8 feet up the ramp and allowed to accelerate and impact into a solid wall. This test was repeated once on each side of the pallet. The inclined impact test of this pallet with an optional 9 inch bumper caused vertical braces to crack.

PART 6

CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS

The General Electric plastic pallet remained intact throughout the MIL-STD-1660 testing sequence; however, the loaded pallet did not exhibit the rigidity experienced with wood or metal. This flexibility allows excessive movement in the unit load. Some fatigue areas on the pallet were noted as cracking and breaking of the base. The thin deck plate will be subject to breaking when impacted into objects or lifted with slings.

2. RECOMMENDATIONS

The General Electric plastic pallet is capable of meeting the test requirements of MIL-STD-1660. There are a few modifications required to make it a candidate for ammunition transportation. First, the pallet must be able to meet the design requirements of MIL-P-15011, and, secondly, the unit must offer a stiffer base to maintain a compact, sound, tight unit load. It should be pointed out that this engineering test was to evaluate the possibility of using AZEDL as a material for the fabrication of pallets. This document does not certify compliance with either MIL-P-15011 or MIL-STD-1660 as applied to the immediate certification of ammunition shipment.

PART 7

PHOTOGRAPHS

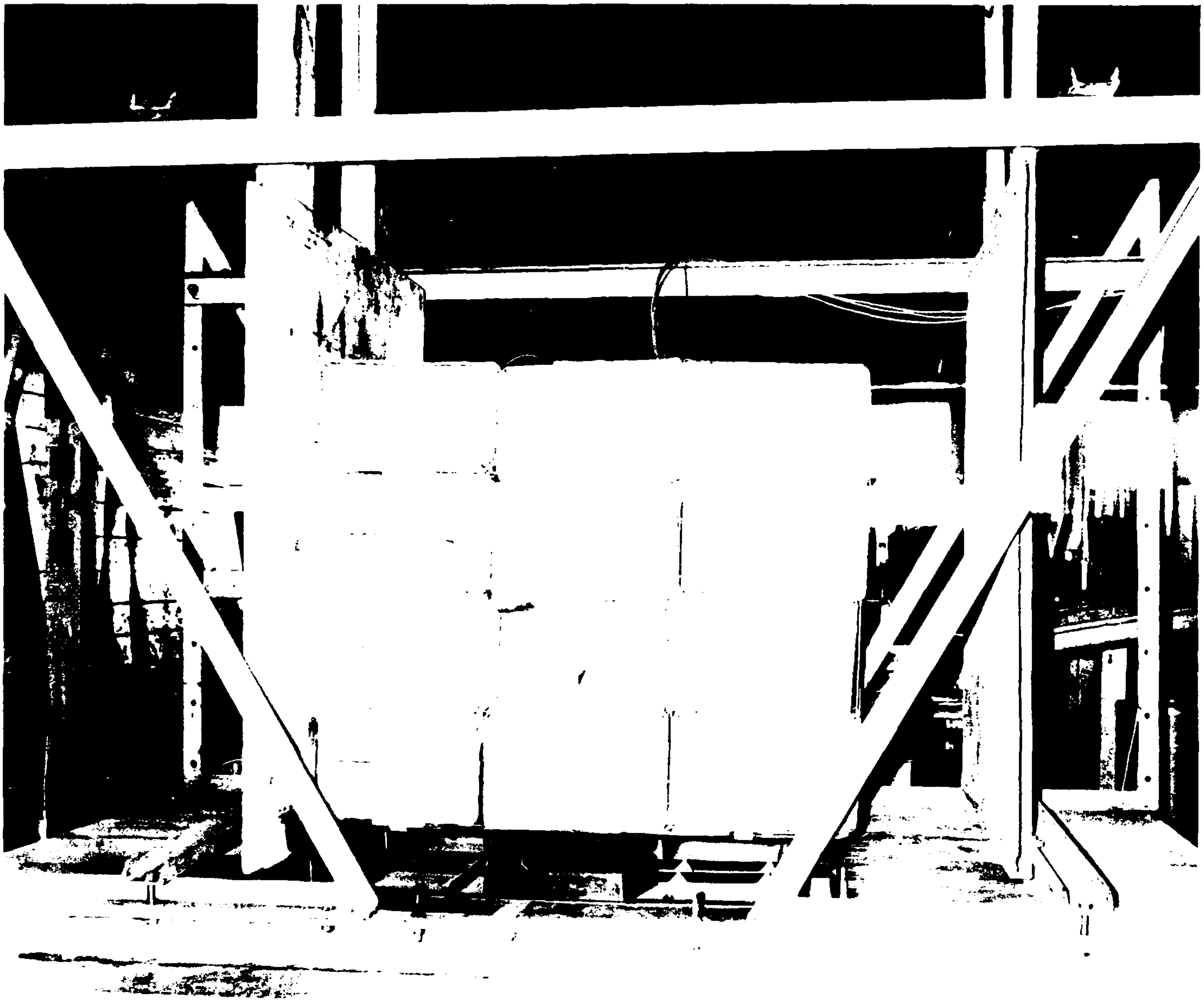

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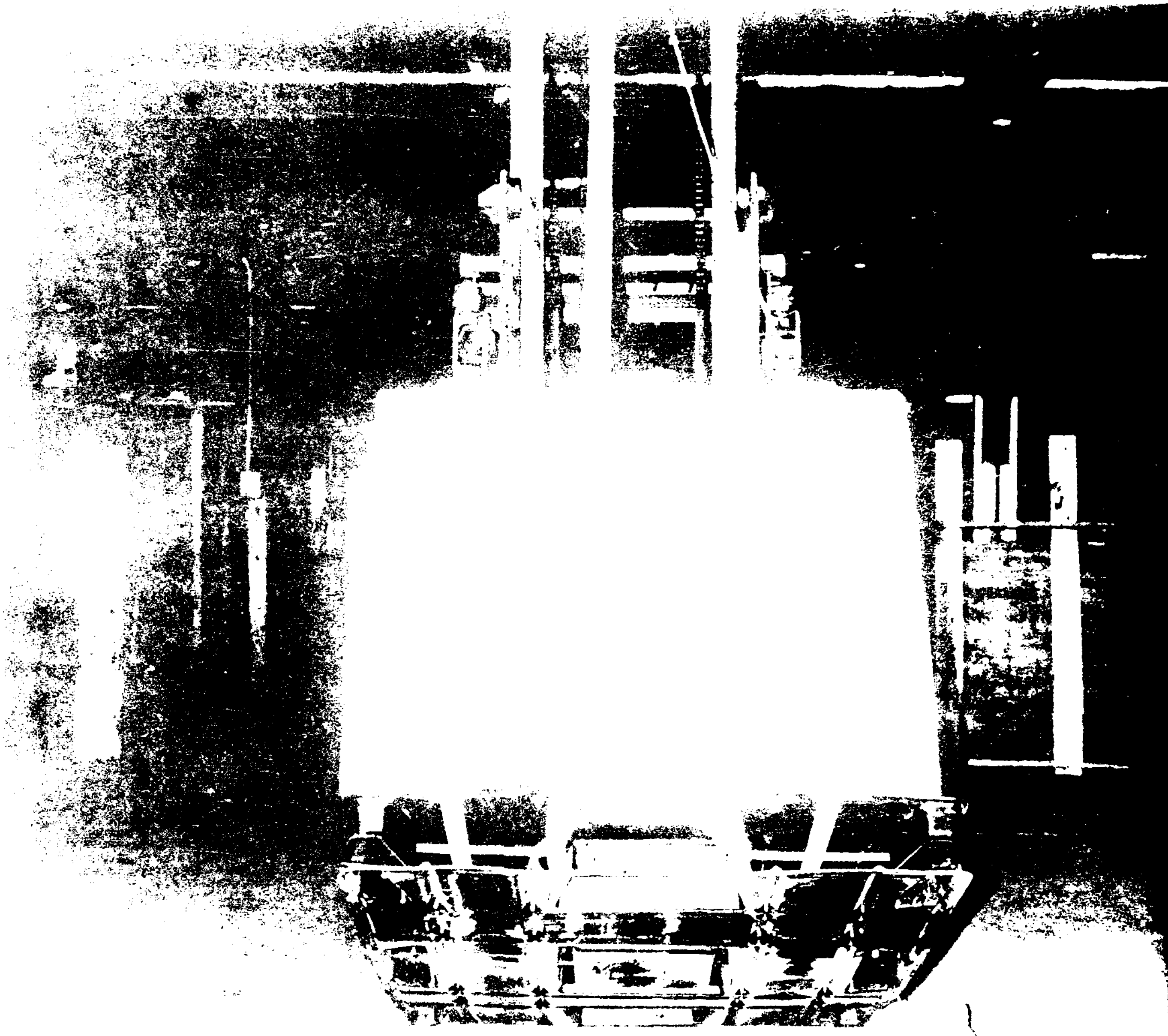
Photo 2. This photo shows the General Electric plastic pallet on the transportation simulator. It was operated at 225rpm producing an acceleration of 0.72g.



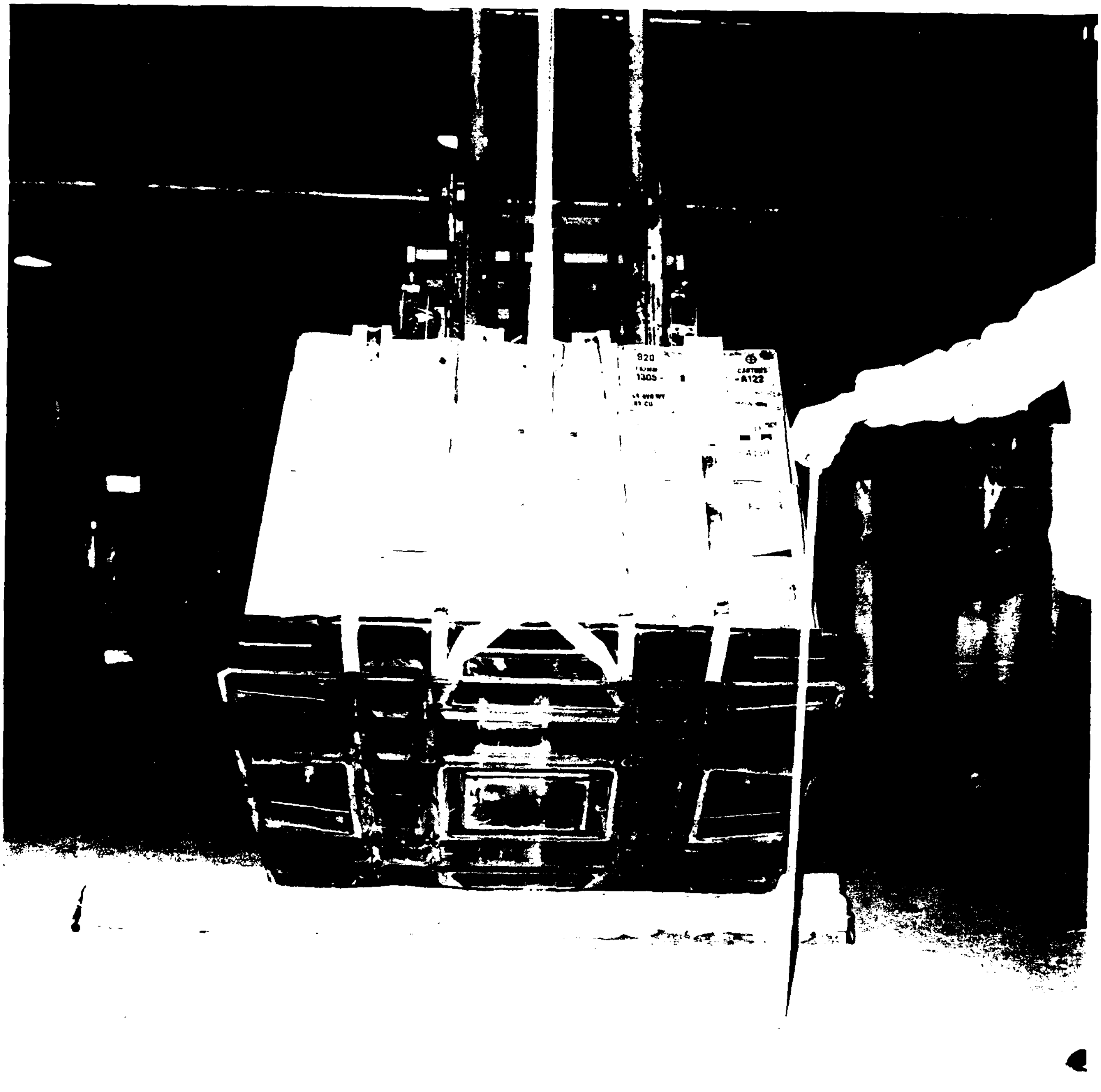


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Photo 4. This photo shows the General Electric plastic pallet ready for the second edgewise rotational drop.

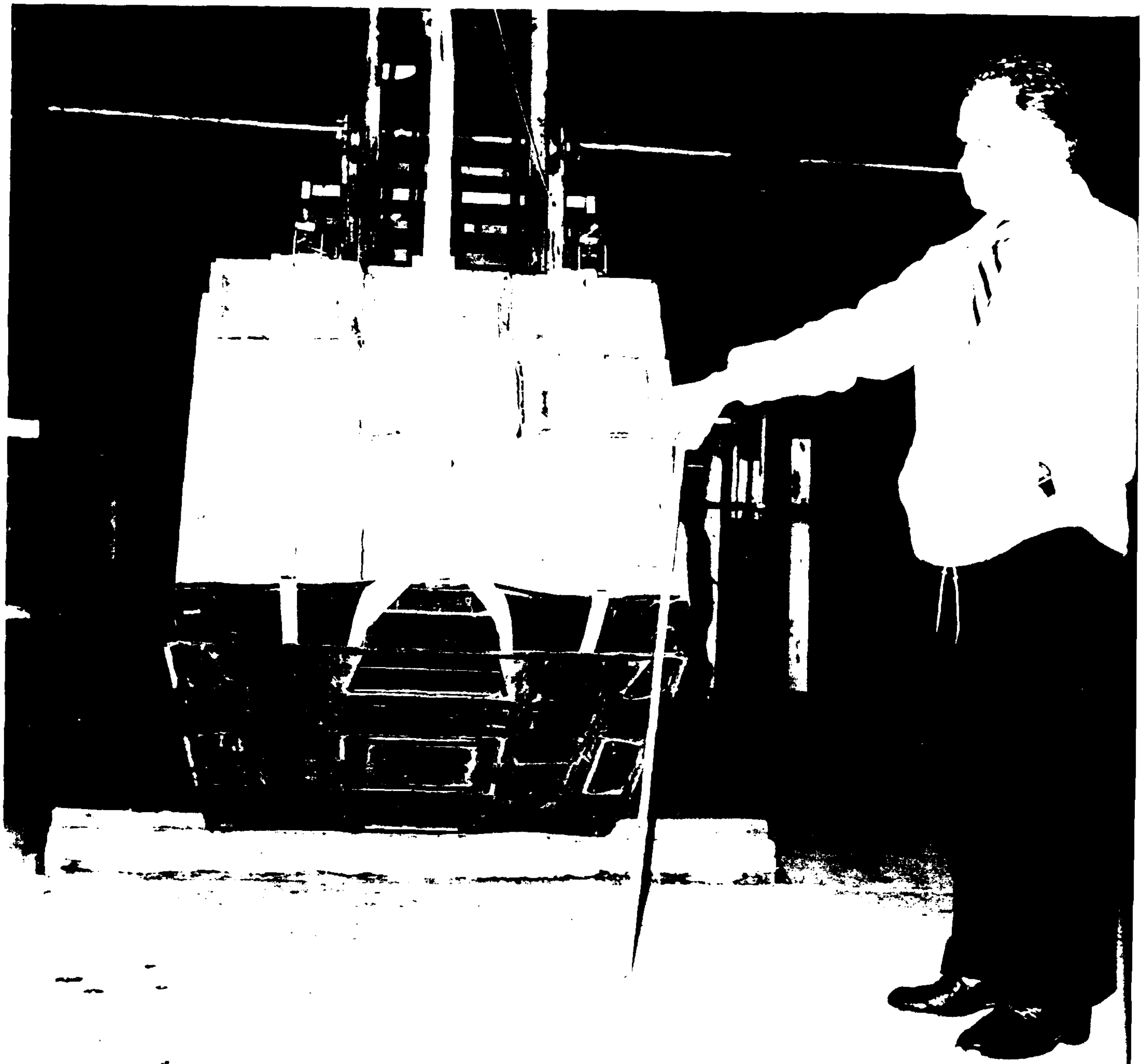

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Photo 5. This photo shows the General Electric [illegible] ready for the third edgewise rotational drop. The drop height is 24 inches.

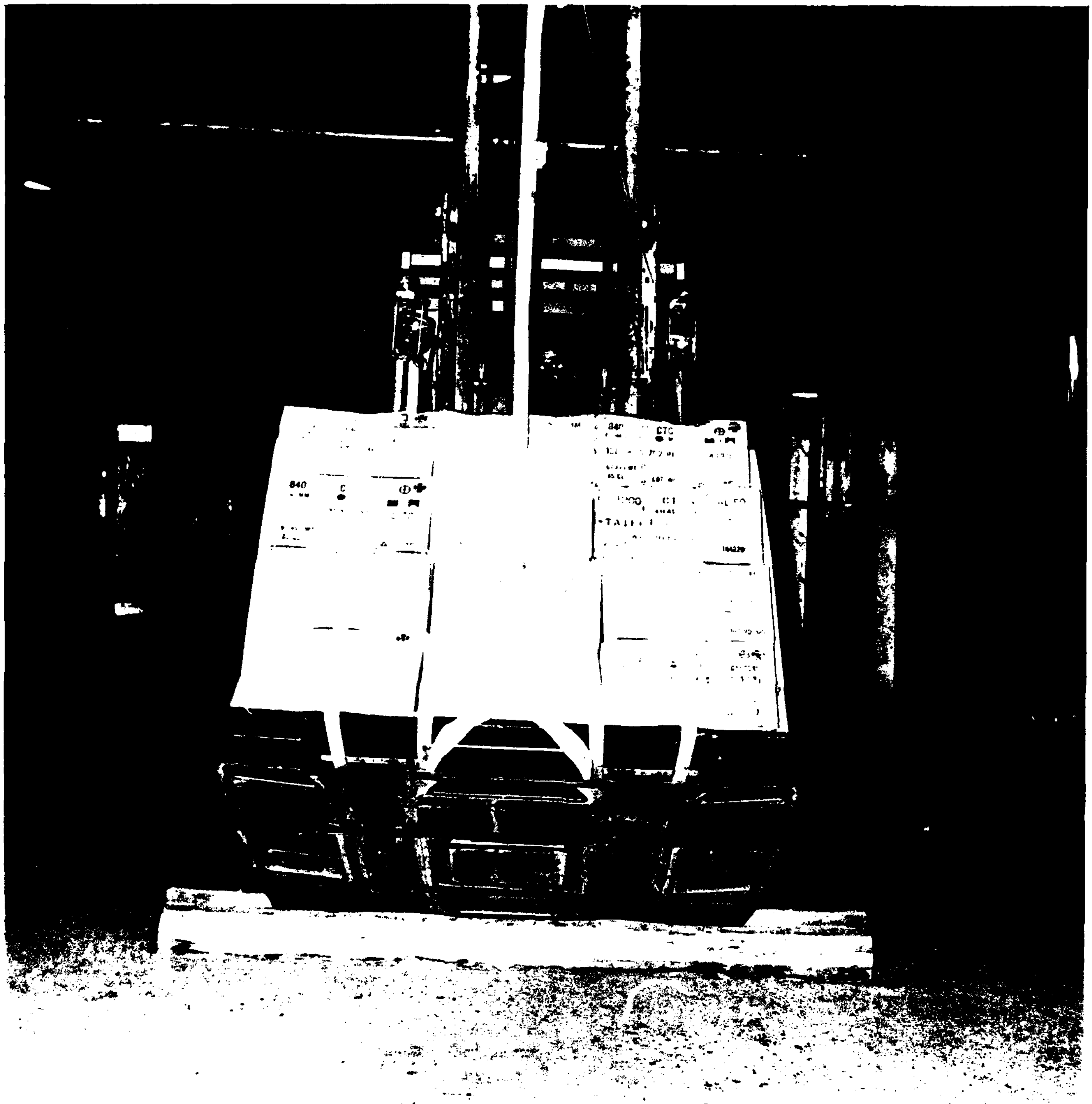

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Photo 6. This photo shows the General Electric plastic pallet ready for the fourth edgewise rotational drop.

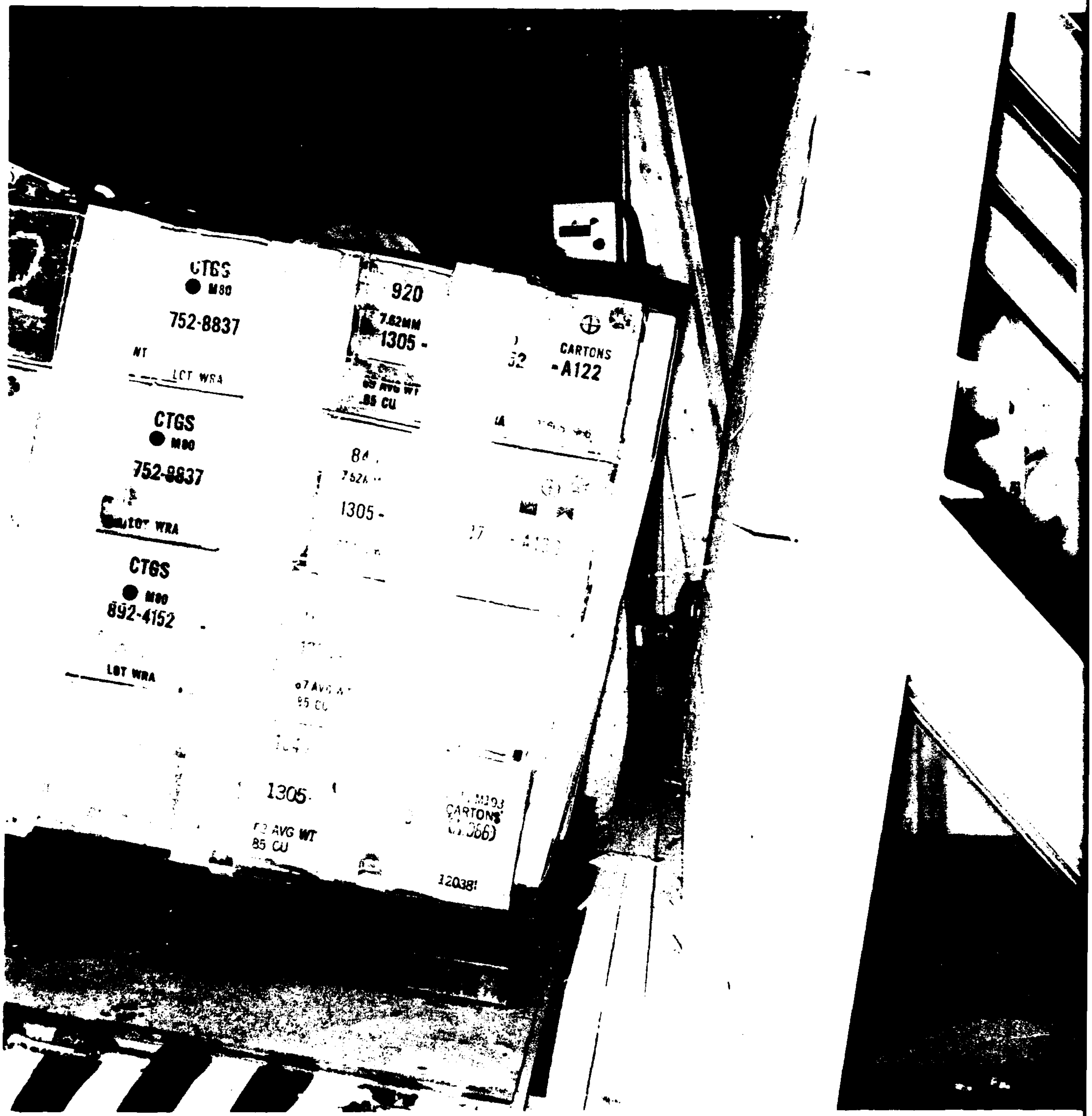

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Photo 7. This photo shows the General Electric plastic pallet after inclined impact on the first side. Note the broken unitization filler.

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Photo 8. This photo shows the General Electric plastic pallet after inclined impact on the third side. Note the broken unitization filler.

PART 8

ACCELEROMETER DATA

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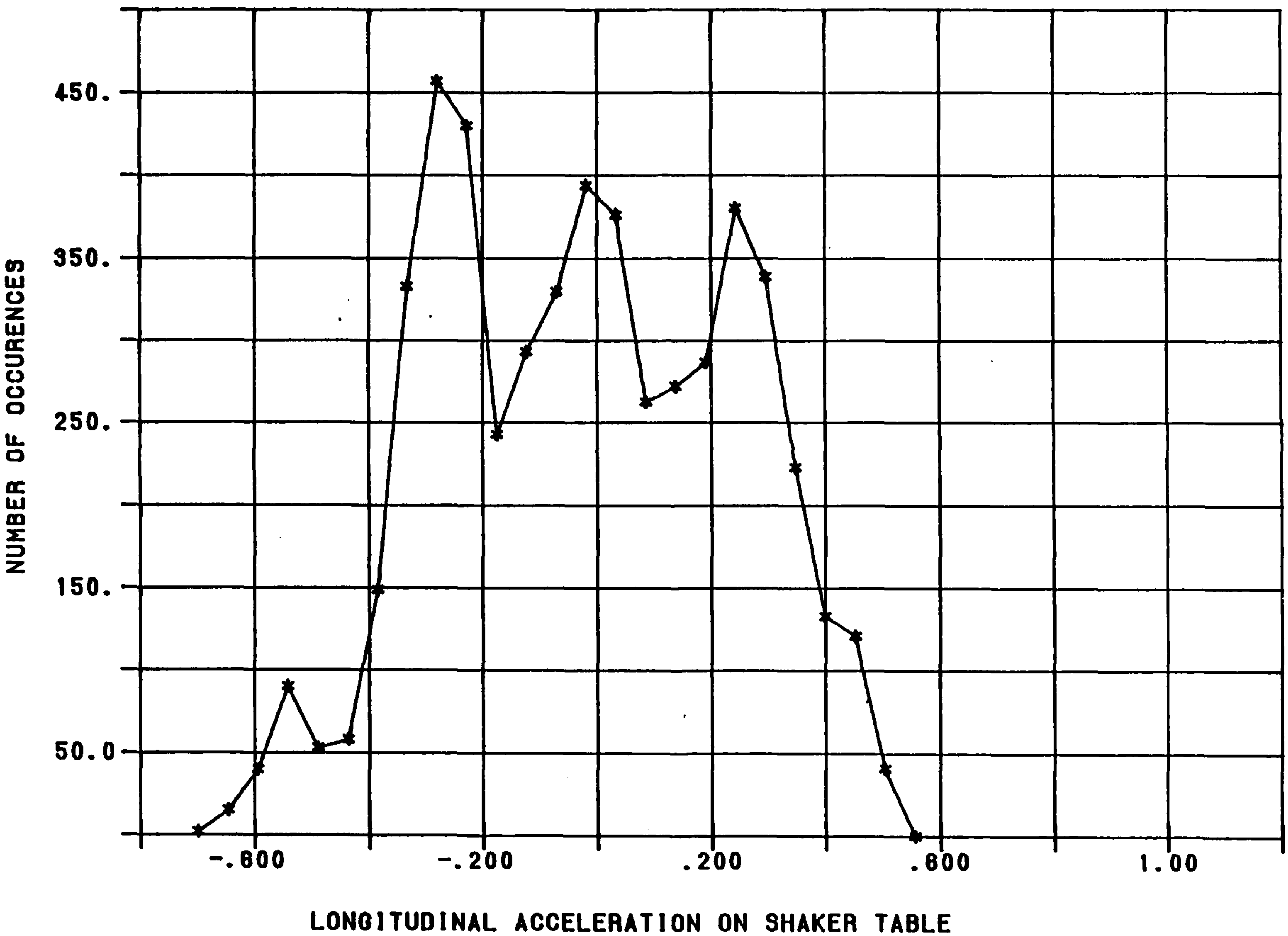
LATERAL PALLET POSITION

	MEAN	VARIANCE
LONG. ACCEL. ON TABLE	.202	.013
VERT. ACCEL. ON TABLE	.217	.017
LONG. ACCEL. ON LOAD	.792	.352
LAT. ACCEL. ON LOAD	.555	.273
VERT. ACCEL. ON LOAD	.331	.051

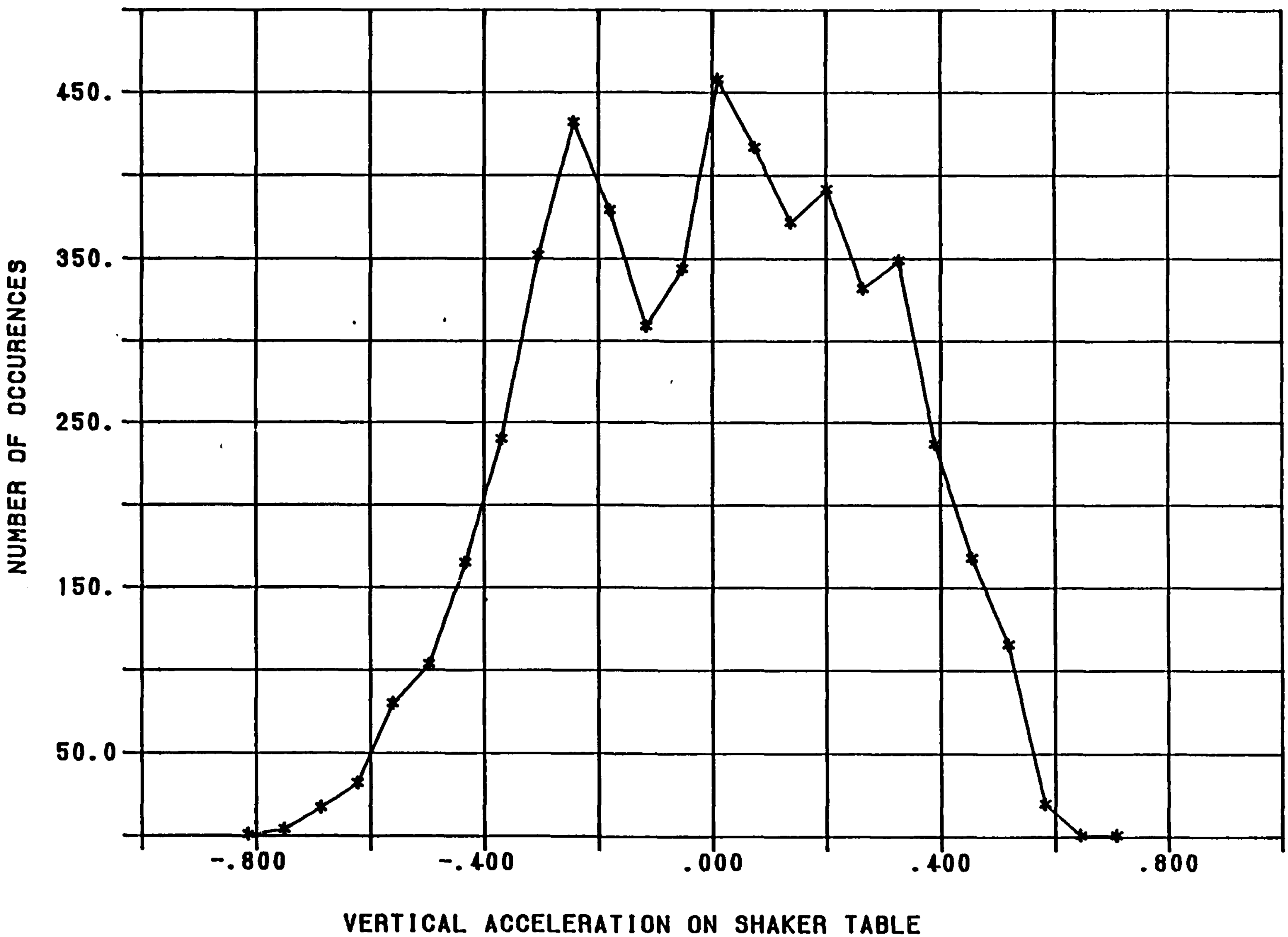
LONGITUDINAL PALLET POSITION

	MEAN	VARIANCE
LONG. ACCEL. ON TABLE	.228	.021
VERT. ACCEL. ON TABLE	.242	.025
LONG. ACCEL. ON LOAD	.627	.165
LAT. ACCEL. ON LOAD	.588	.186
VERT. ACCEL. ON LOAD	.366	.067

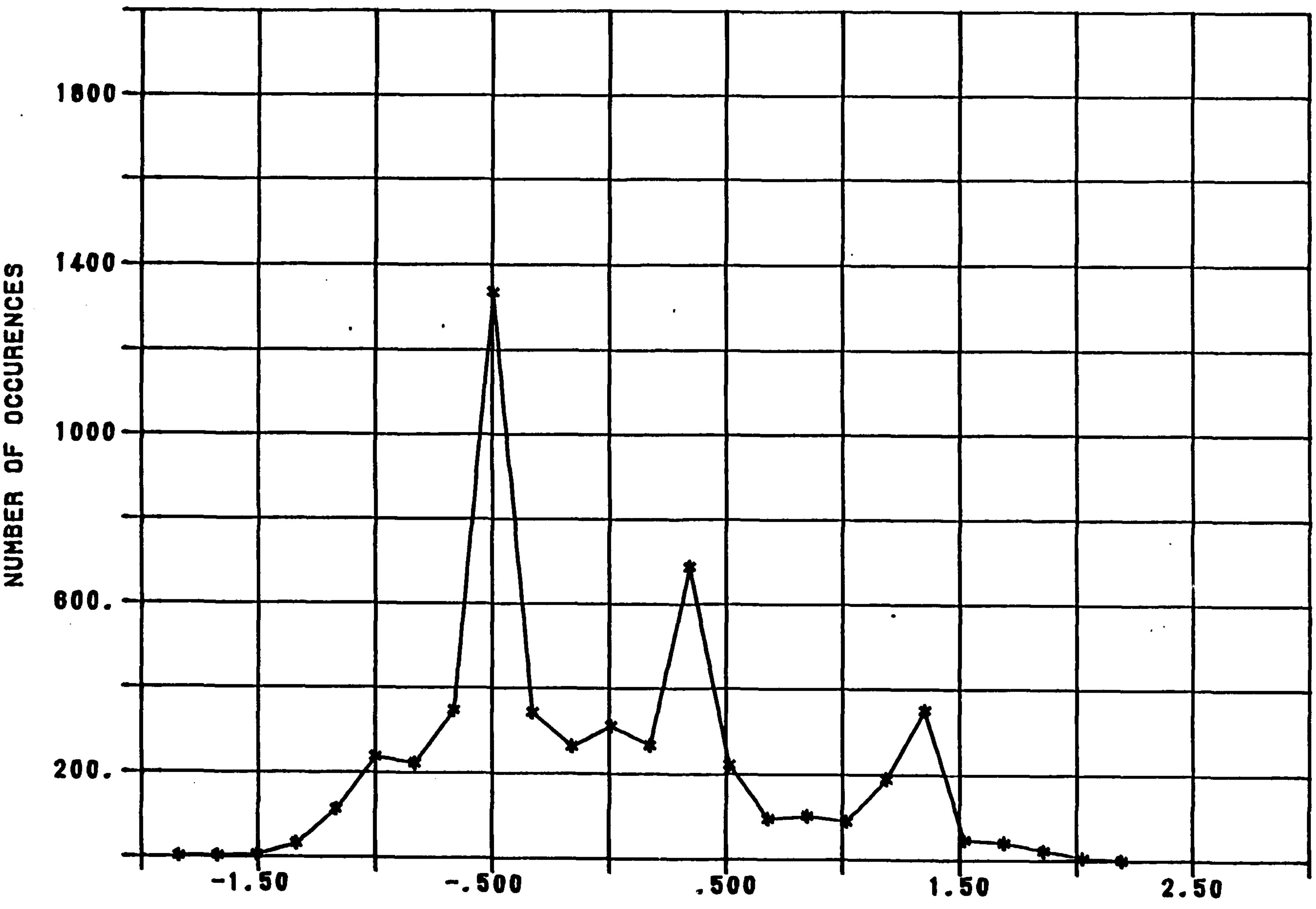
EVT 46-87 LONGITUDINAL PALLET POSITION



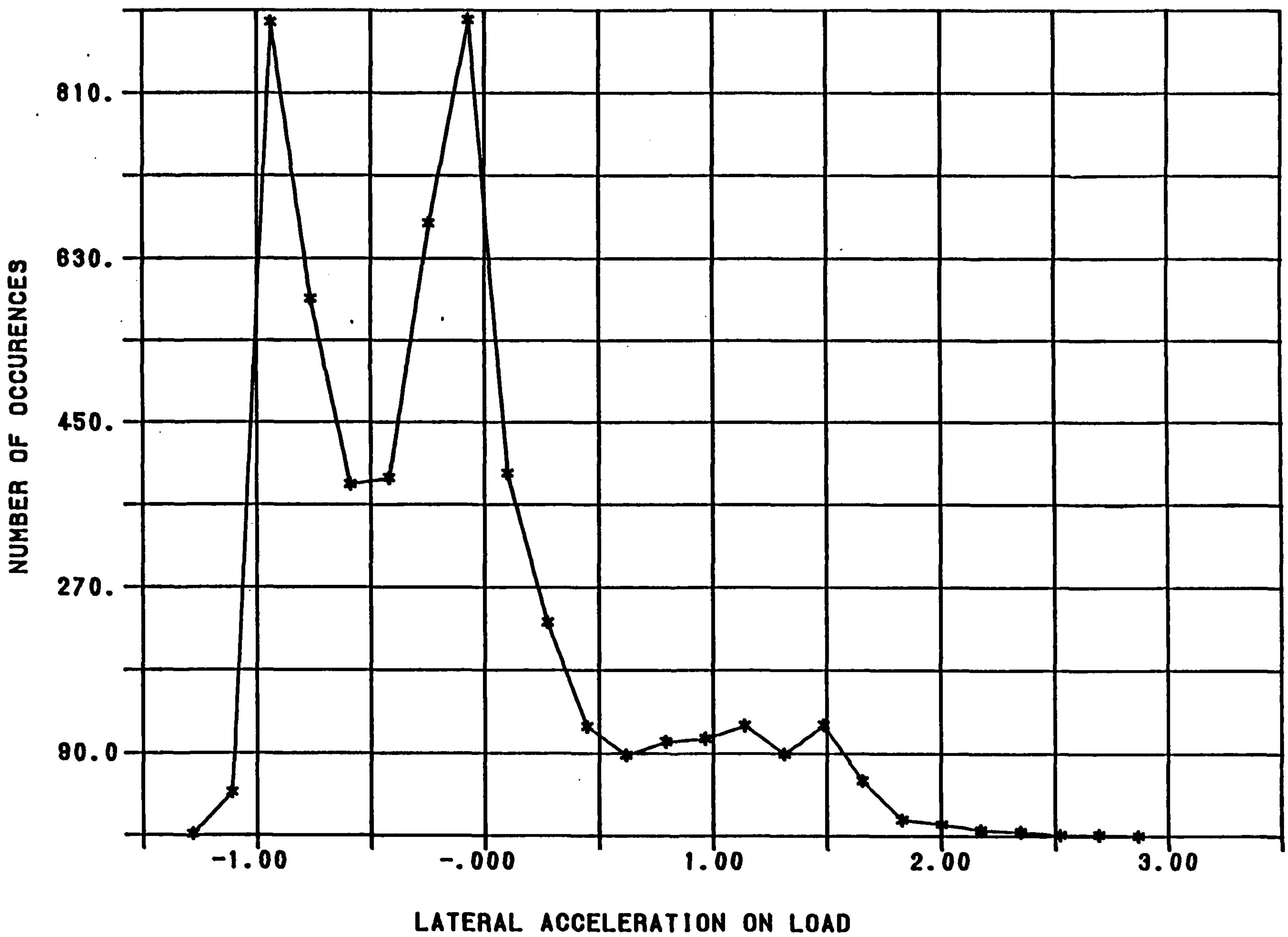
EVT 48-87 LONGITUDINAL PALLET POSITION



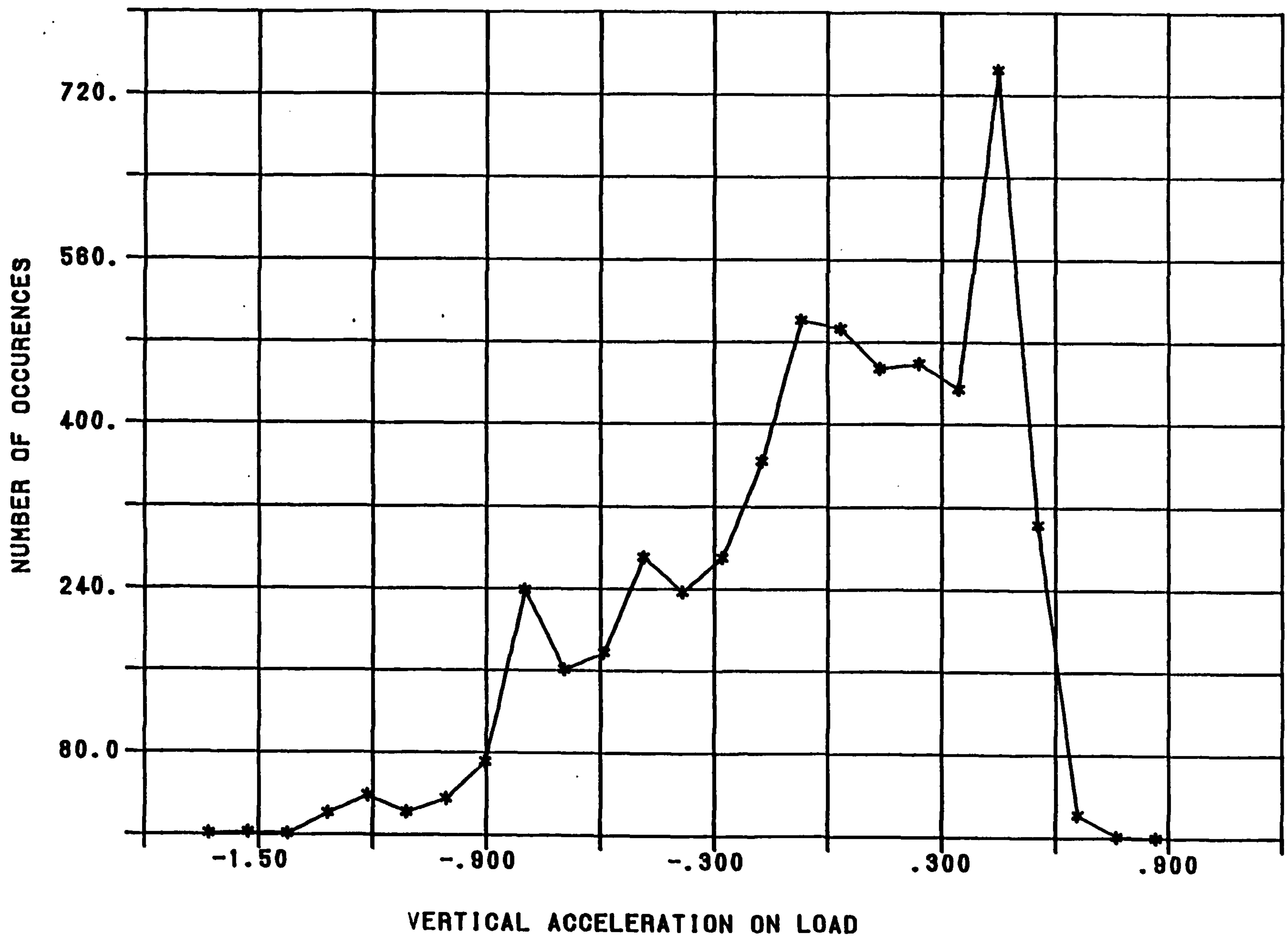
EVT 46-87 LONGITUDINAL PALLET POSITION



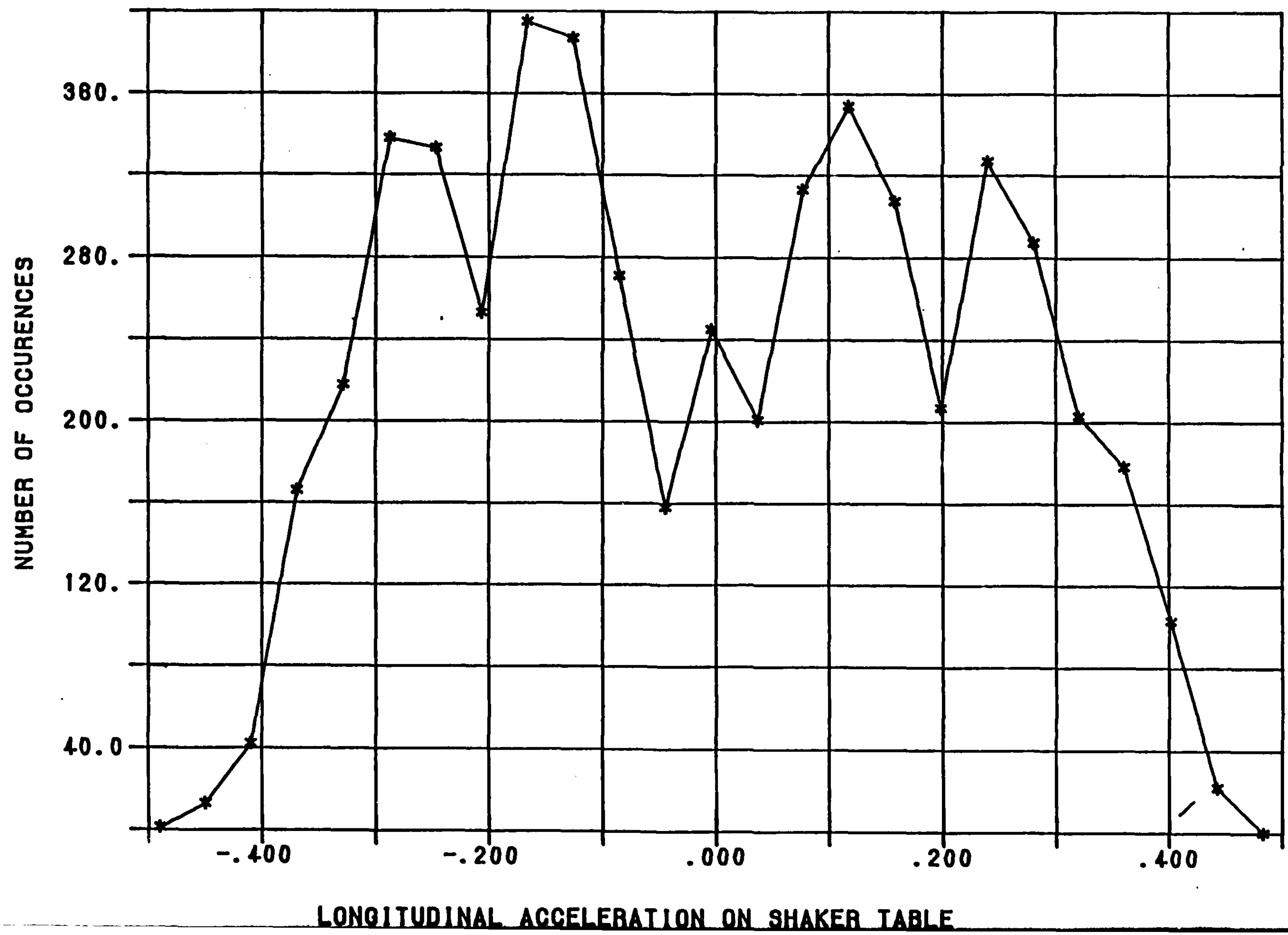
EVT 46-87 LONGITUDINAL PALLET POSITION



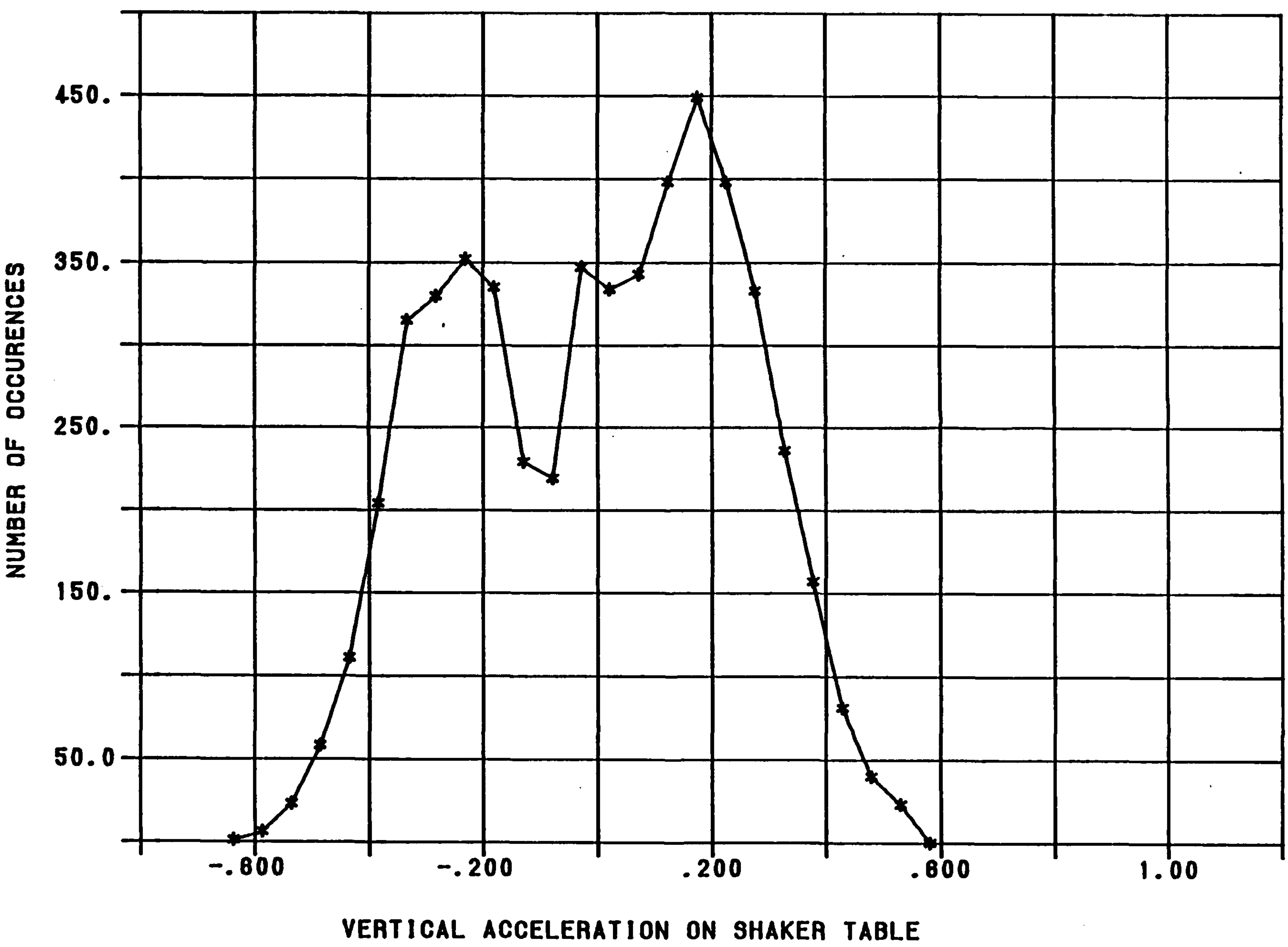
EVT 48-87 LONGITUDINAL PALLET POSITION



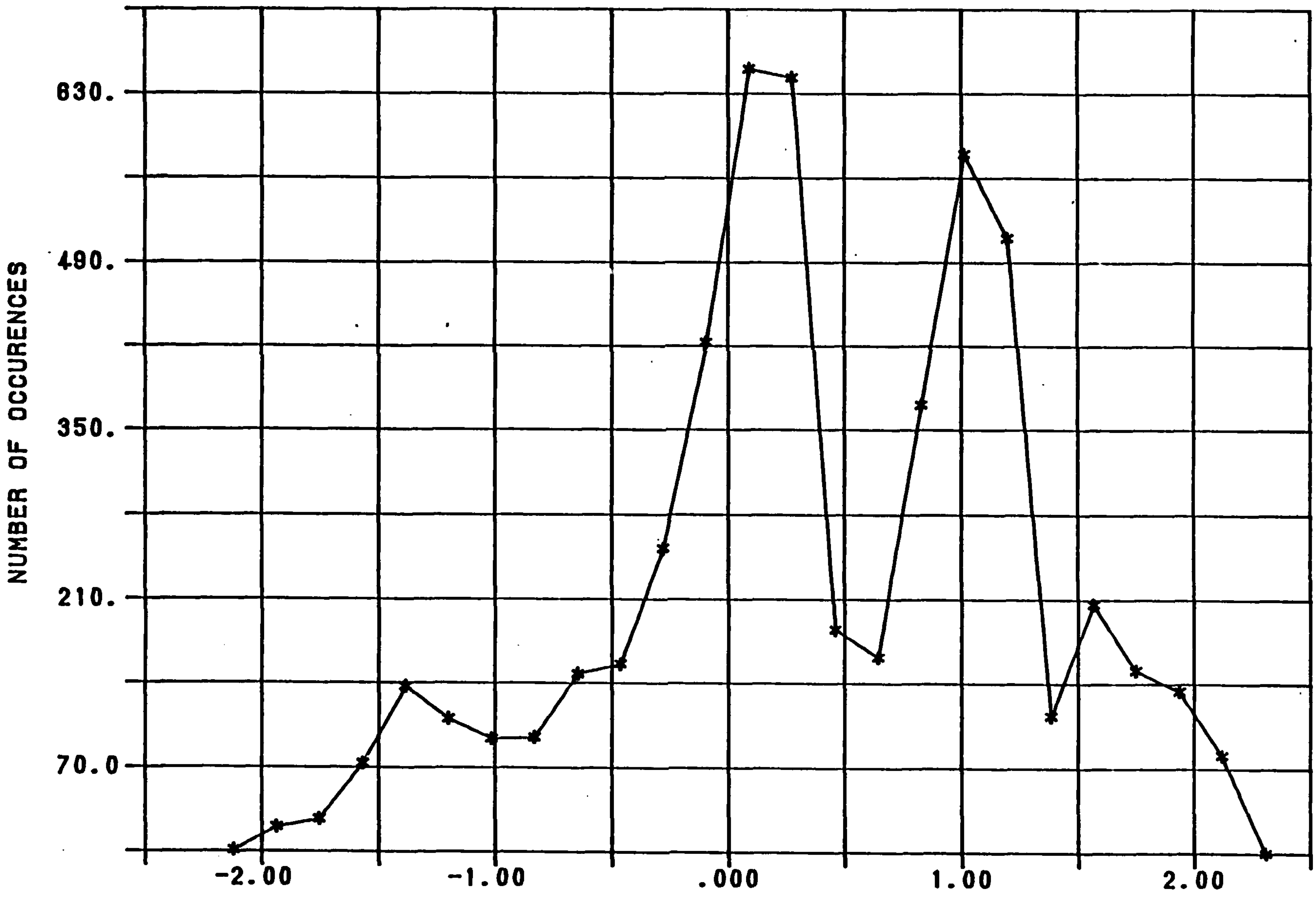
EVT 46-87 LATERAL PALLET POSITION

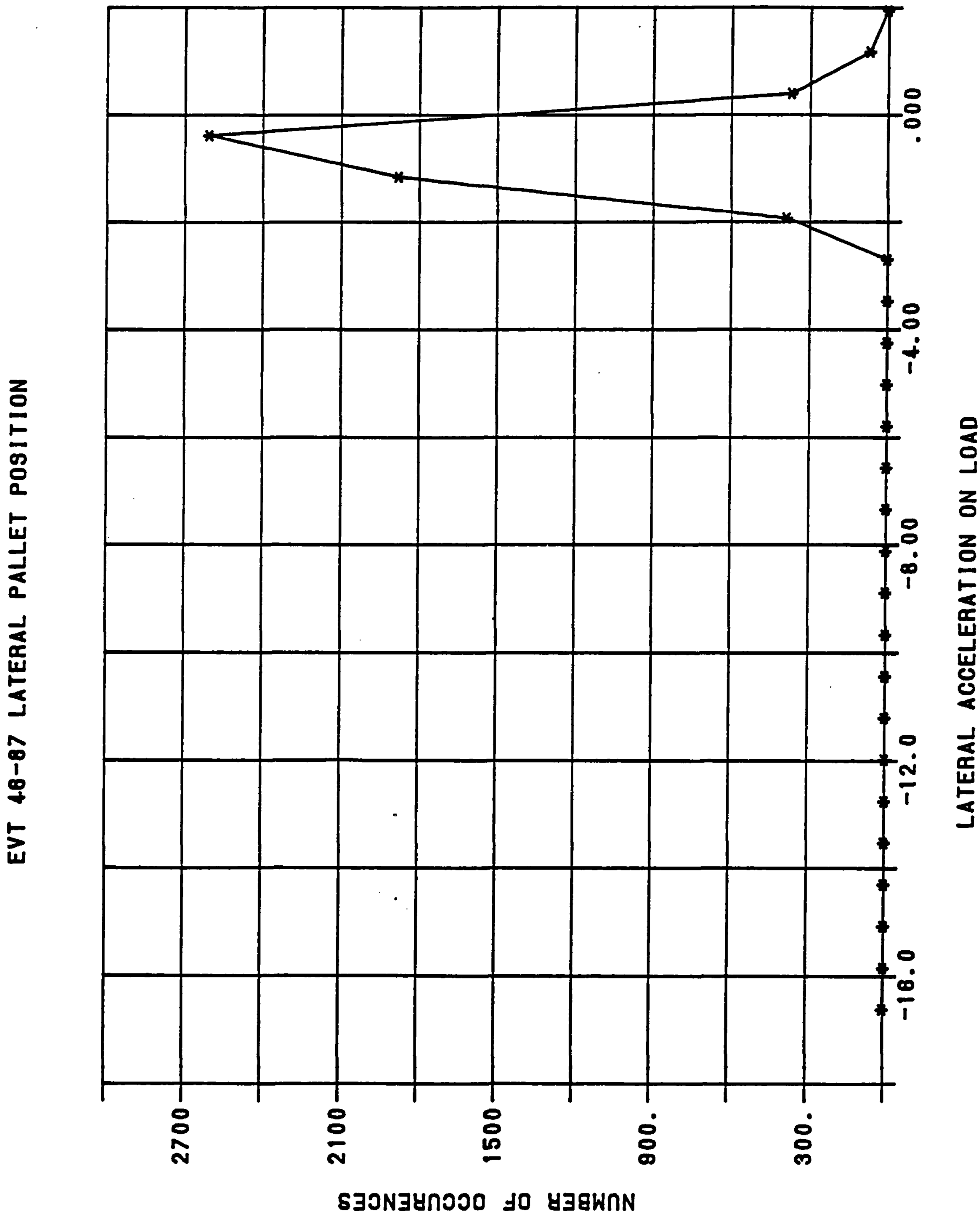


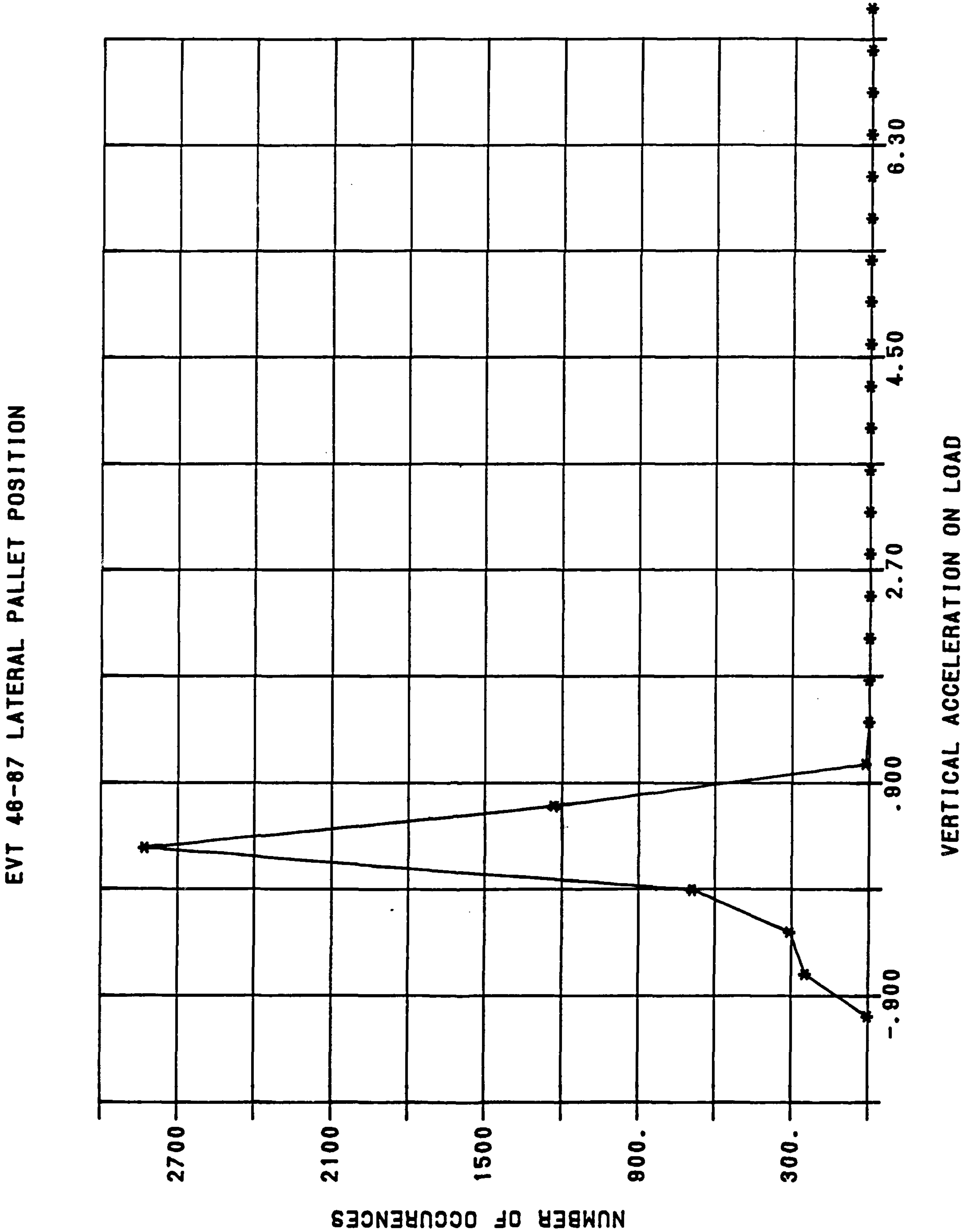
EVT 48-87 LATERAL PALLET POSITION



EVT 46-87 LATERAL PALLET POSITION




EVT 46-87 LATERAL PALLET POSITION
LATERAL ACCELERATION ON LOAD
-16.0
-12.0
-8.00
-4.00
.000
NUMBER OF OCCURENCES
2700
2100
1500
900.
300.


EVT 46-87 LATERAL PALLET POSITION
2700
2100
1500
900.
300.
NUMBER OF OCCURENCES
-.900
.900
2.70
4.50
6.30
VERTICAL ACCELERATION ON LOAD