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FINAL REPORT

JANUARY 1988

EVT 38-87-3
MIL-STD-1660 ENGINEERING TEST OF 48" X 40" STANDARD METAL PALLET USING REVERSE LIGHTENING HOLES AND METAL TOP LIFT

Prepared for:
Project Manager for Ammunition Logistics
ATTN: AMCPM-AL
Picatinny Arsenal, NJ 07806-5000

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EVALUATION DIVISION
SAVANNA, ILLINOIS 61074-9639

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The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), has been tasked by the Project Manager for Ammunition Logistics (PM-AMMOLOG), Picatinny Arsenal, NJ, to design, fabricate and test a Standard Metal Pallet. This report contains the procedures, results and recommendations from the MIL-STD-1660 engineering test that was conducted on one prototype design of the 48" x 40" pallet. As a result of the pallet's performance during the test, recommendations for redesign of the pallet evolved.

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

Evaluation Division

Savanna, IL 61074-9639

REPORT NO. EVT 38-87-3

MIL-STD-1660 ENGINEERING TEST OF 48" x 40" STANDARD METAL PALLET USING REVERSE LIGHTENING HOLES AND METAL TOP LIFT

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School, Evaluation Division, was tasked by the Project Manager for Ammunition Logistics (PM-AMMOLOG), AMCPM-AL, to design, test, and evaluate a 48" x 40" standard metal pallet. For this test, a metal pallet equipped with reverse lightening hole posts and metal top lift was loaded with M548 containers. (See Drawings for details on reverse lightening hole posts). The test procedure for evaluating the metal pallet is MIL-STD-1660, Design Criteria 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 Commmand, Rock Island, IL.

C. OBJECTIVE. The objective of these tests is to assess the metal pallet's capability to meet Army functional/operational requirements for MIL-STD-1660, Design Criteria for Ammunition Unit Loads.

PART 2

ATTENDEES

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Test Engineer

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PART 3

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads dated 8 April 1977. This standard identifies nine steps that a unitized load must undergo if it is considered to be acceptable. The 2 tests that were conducted on the sample pallet 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. Unless 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.

PART 4

TEST EQUIPMENT

1. TEST SPECIMEN.

a.	Drawing Number:	
b.	Width:	37-1/2 inches
c.	Length:	50-1/2 inches
d.	Height:	48-3/4 inches
e.	Weight:	4,250 pounds

2. COMPRESSION TESTER.

a.	Manufacturer:	Ormond Manufacturing
b.	Platform:	60 inches by 60 inches
c.	Compression Limit:	50,000 pounds
d.	Tension Limit:	50,000 pounds

3. TRANSPORTATION SIMULATOR.

a.	Manufacturer:	Gaines Laboratory
b.	Capacity:	6,000-pound pallet
c.	Displacement:	1/2-inch Amplitude
d.	Speed:	50 to 400 rpm
e.	Platform:	5 foot by 8 foot

4. INCLINED RAMP.

a.	Manufacturer:	Conbur Incline
b.	Type:	Impact Tester
c.	Grade:	10% Incline
d.	Length:	12-foot Incline

PART 5

TEST RESULTS

1. STACKING TEST.

Pallet Weight - 4,250 pounds
Pallet Height - 48-3/4 inches
Test Load - 16,800 pounds

The test pallet was loaded to 16,800 pounds compression for a period of one hour. At the end of the 1 hour period, the compression load had decreased to 15,000 pounds and the load had compressed 1/2 inch. After the test pallet was removed from the compression table, a deformation of 1/4 inch was noted. No damage was evident in the load or the pallet.

2. REPETITIVE SHOCK TEST.

The test pallet successfully passed the lateral transportation simulation but was considered to have failed the longitudinal simulation when the center skid broke loose from the pallet. The remaining outer skids were severely damaged and fell off the pallet base when the load was removed from the transportation simulator. Failure of the pallet appeared to have occurred in the struts at the bend next to the skids. The bend first developed cracks and then broke from the constant pounding that the pallet is subject to during the transportation simulation. Duration of the test was 90 minutes for each orientation of the pallet. In order to achieve the required 1/16-inch clearance between the pallet and the transportation simulator bed, the equipment was operated at 220 rpm.

PART 6

CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS. The pallet successfully passed both the stacking test and the lateral portion of the transportation simulation. During the second half of the transportation simulation, the test was stopped when the center skid broke loose from the pallet base. The weak point of the pallet that appears to have failed first was at the bend in the posts next to the skids.

2. RECOMMENDATIONS. It is recommended that this pallet not be used to transport military loads until design changes are made to the pallet that will enable it to pass the MIL-STD-1660 test criteria. The critical area on the pallet that needs to be modified is the posts that connect the skid to the pallet base. Recommendations for changes to the pallet design would be to use a heavier gauge metal for the posts or add a piece of metal to the inside of the strut to reinforce the bends next to the skids.

PART 7

PHOTOGRAPHS

DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo 1. This photo shows the metal pallet loaded with M548 cans in the Compression Tester.

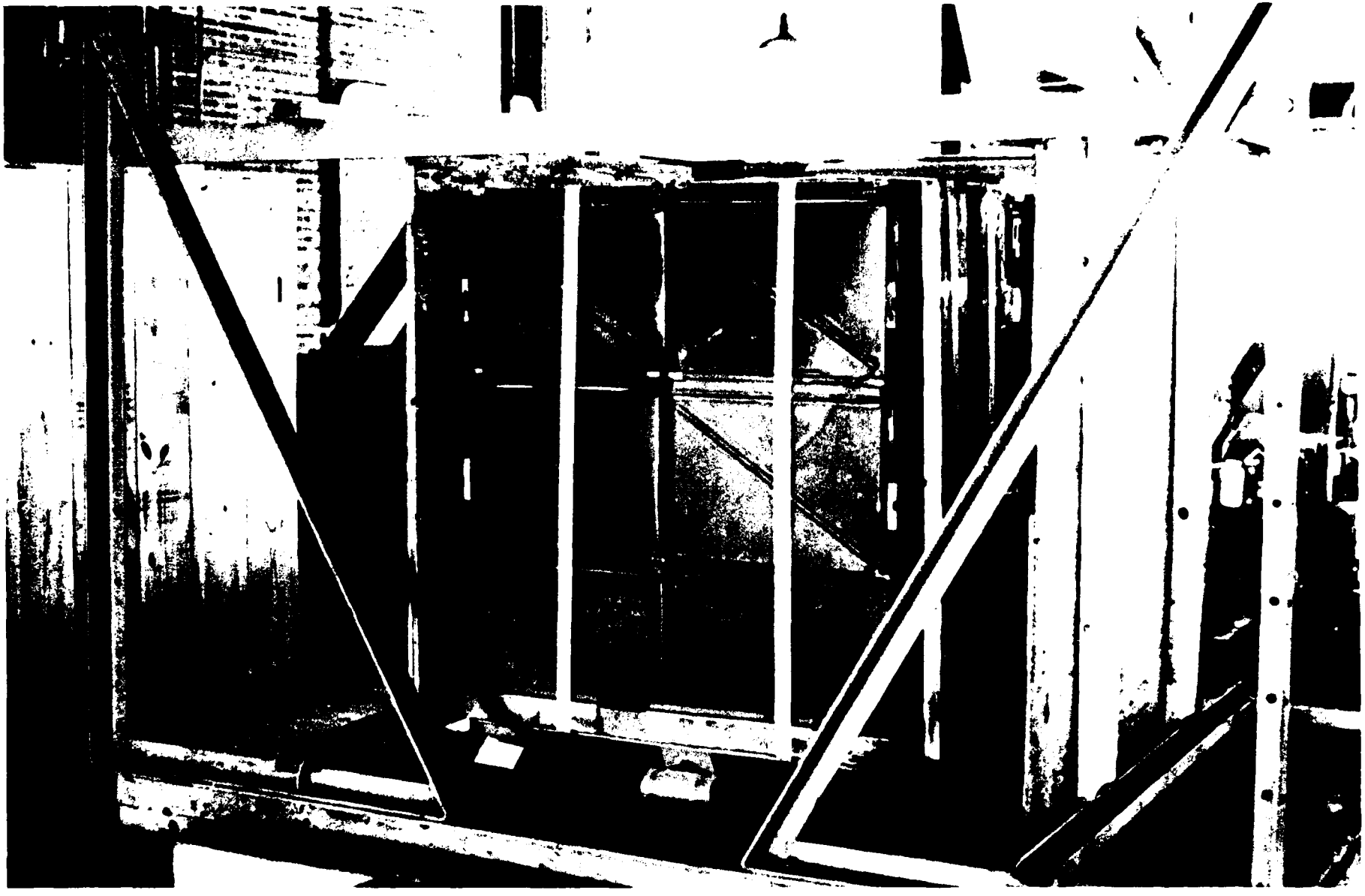

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Photo 2. This photo shows the M548 cans and pallet in the Transportation Simulator in the Lateral Orientation.

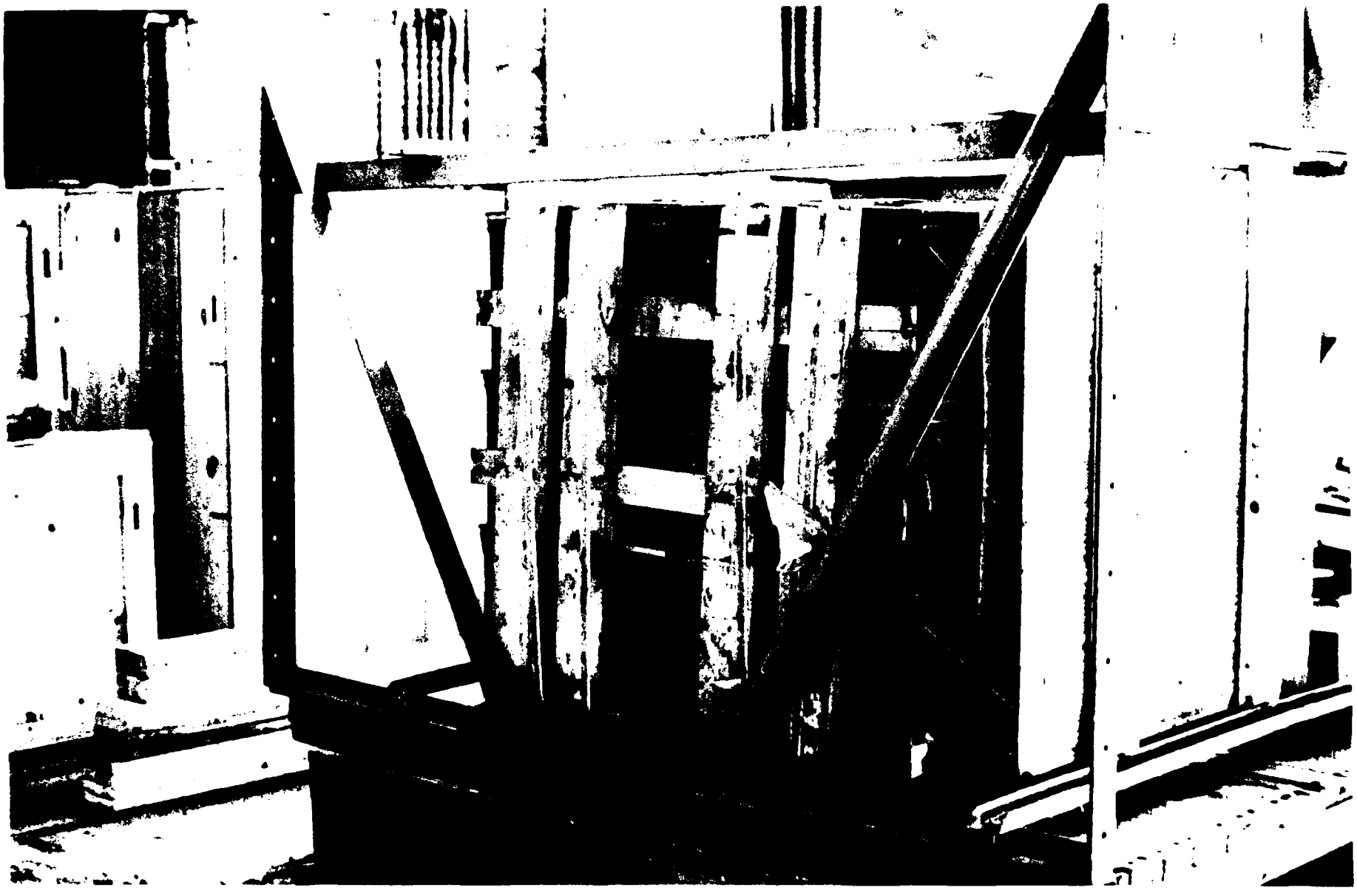

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Photo 3. This photo shows the M548 cans and pallet in the Transportation simulator in the Longitudinal Orientation at the end of the test.

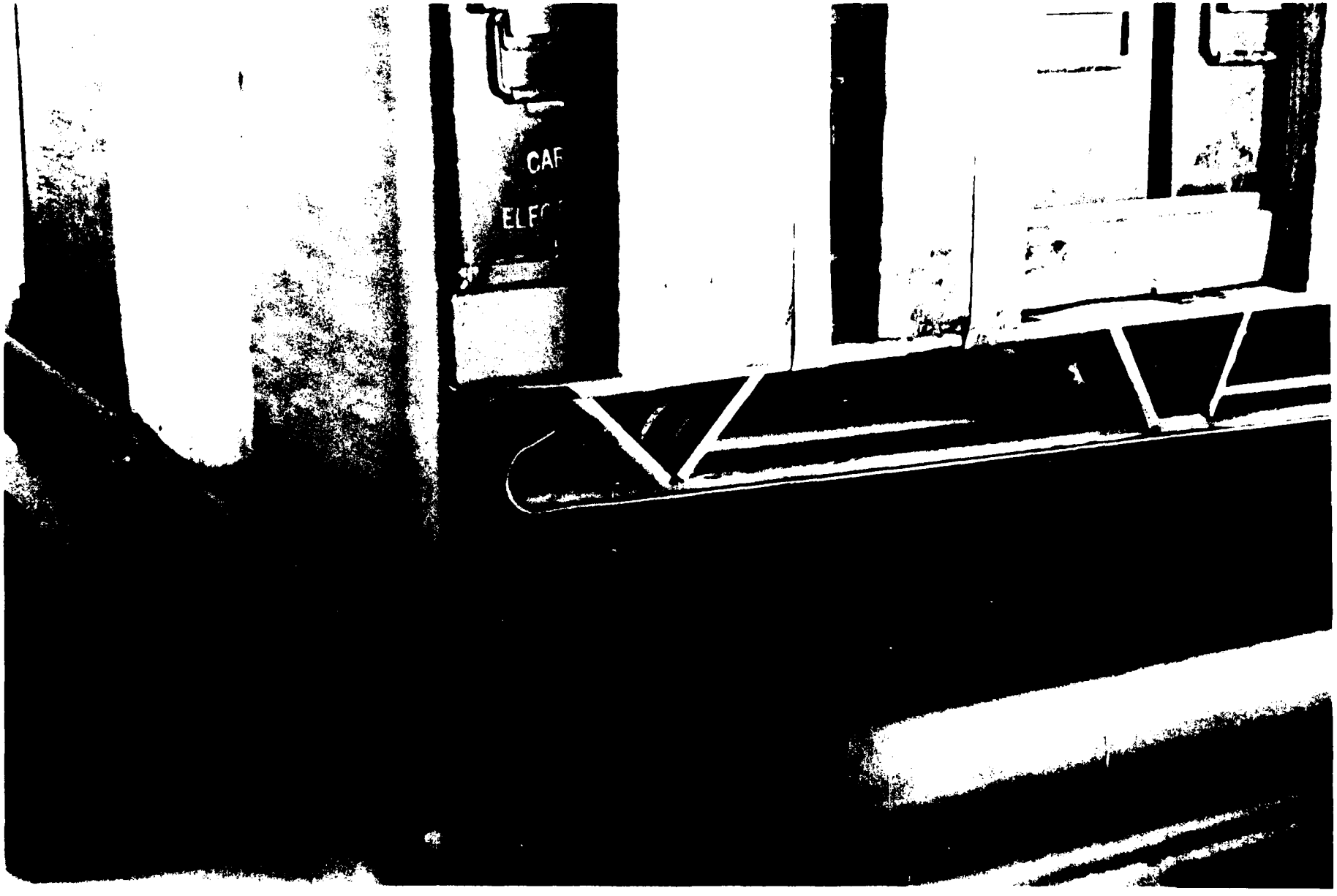

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Photo 4. This photo shows the location of the break in the posts.

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Photo 5. This photo shows the position of the middle skid at the end of the longitudinal portion of the Transportation Simulation.

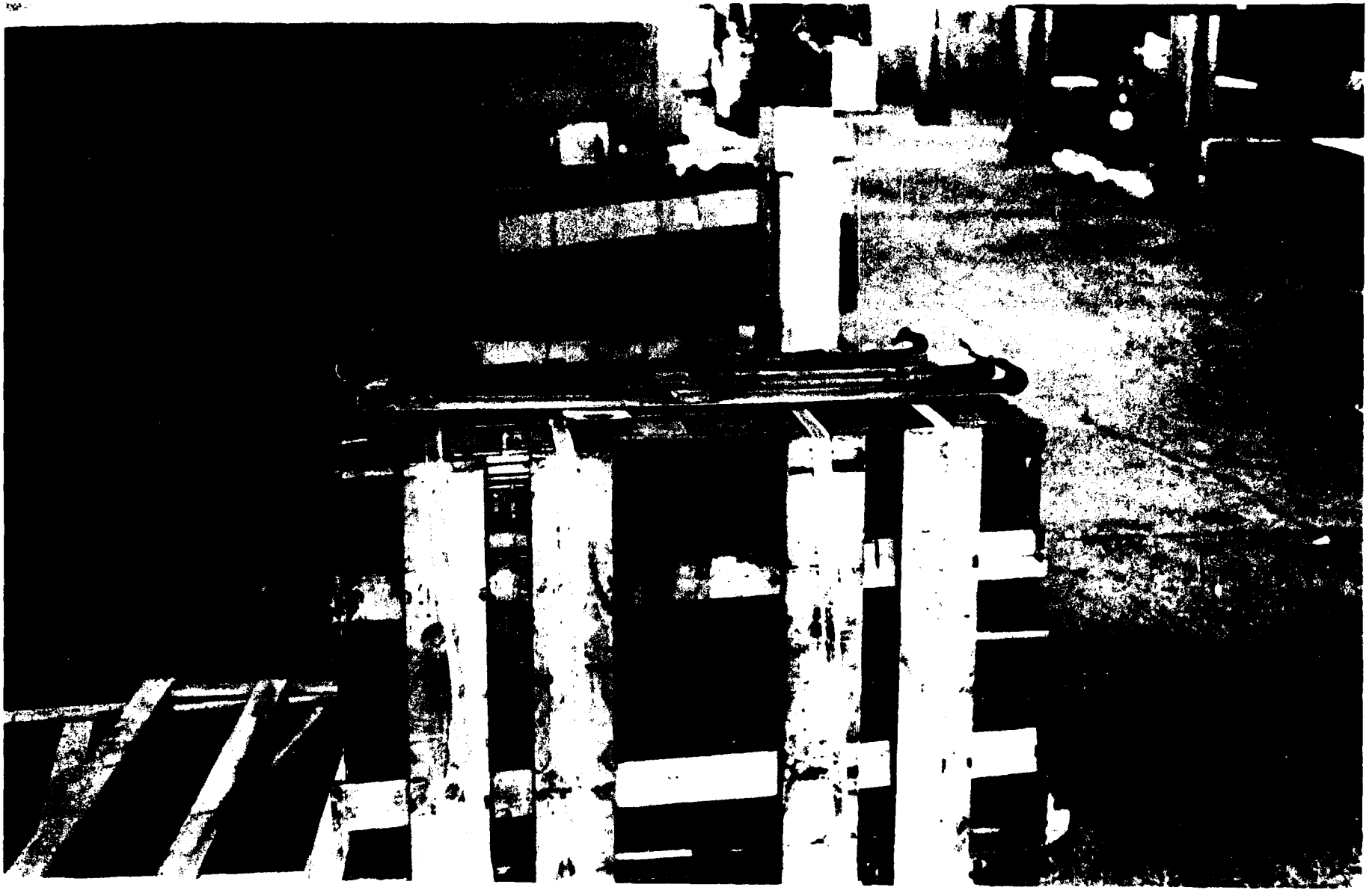

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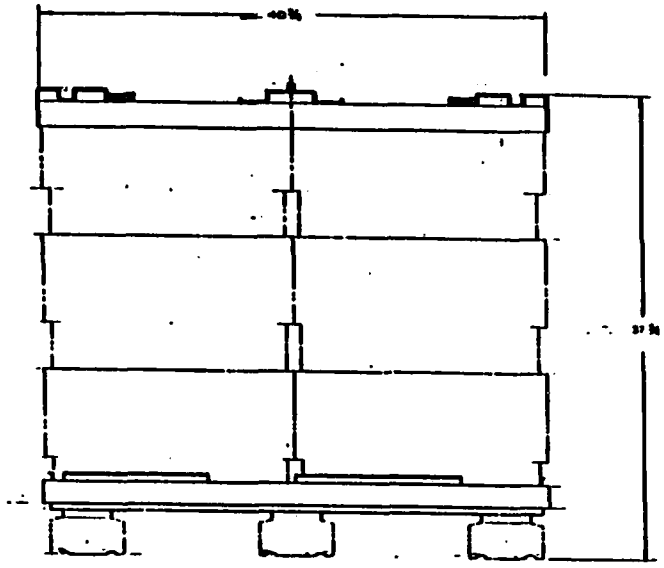
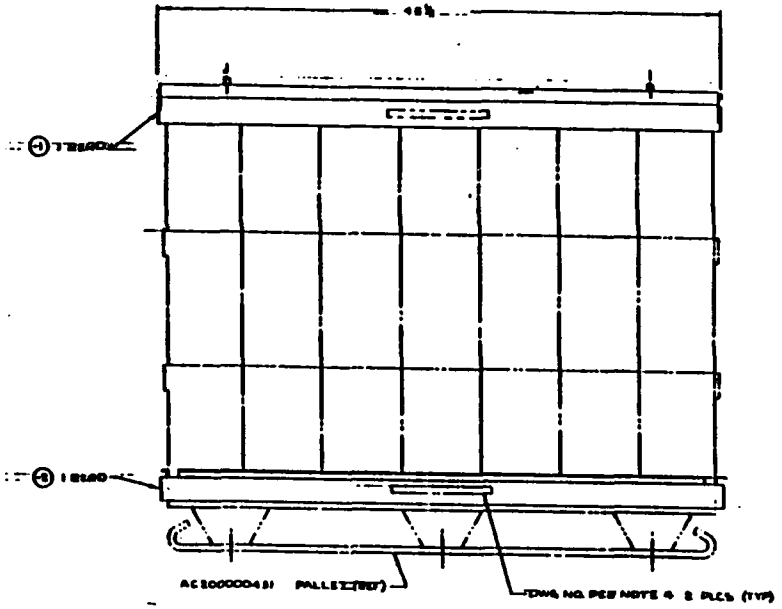
Photo 6. This photo shows the condition of the pallet after it was removed from the Transportation Simulator.

PART 8

DRAWINGS





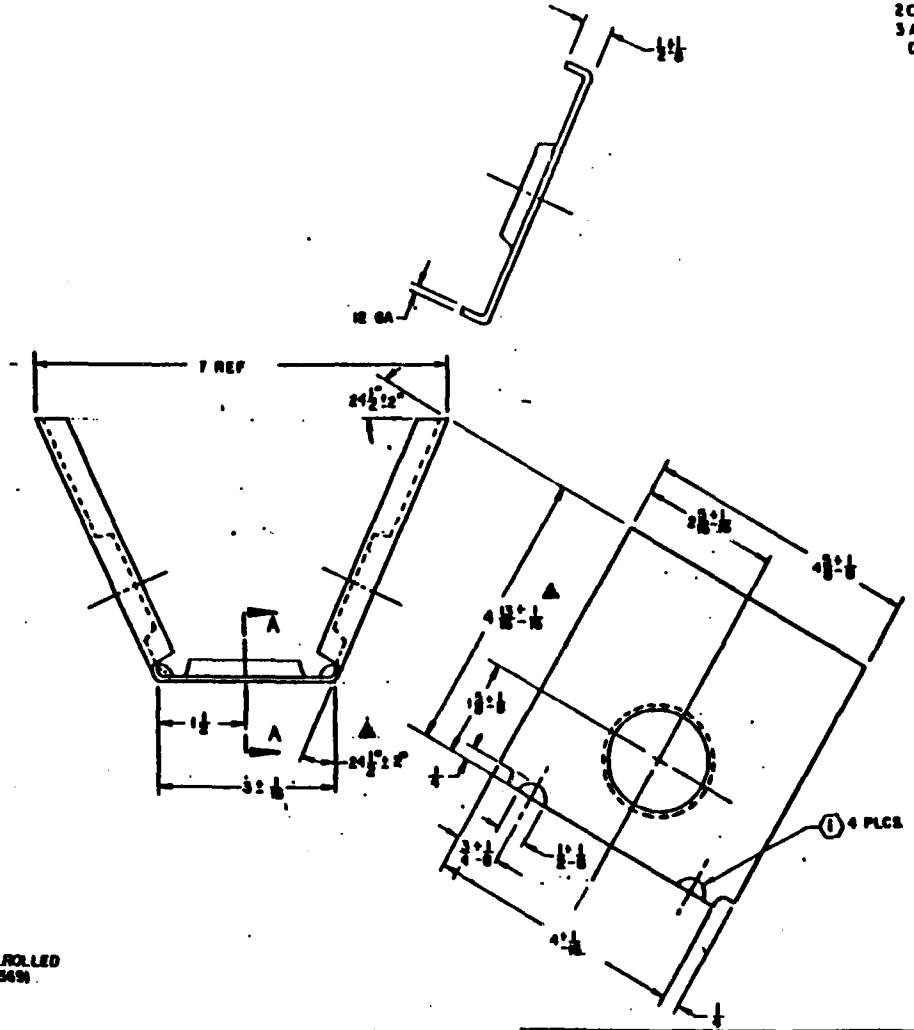
NOTES:

1. SEND RADII $\frac{1}{8}$ IN UNLESS OTHERWISE NOTED.
2. SPEC MIL-S-2000, AMERICAN WELDING SOCIETY STD A5.4-79 AND ANSI Y14.5-82 APPLY
3. PROTECTIVE FINISH SHALL BE IN ACCORDANCE WITH DWG AC80000431 COLOR SHALL BE GREEN No 383 PER MIL-E-46810
4. MARKING SHALL BE IN ACCORDANCE WITH DWG AC80000431 COLOR SHALL BE WHITE No 37875 $\frac{1}{2}$ - IN HIGH LETTERS
5. MATERIAL - STL, CARBON, COLD ROLL OR HOT ROLL PER ASTM A569.
6. ALL DIMENSIONS ARE IN INCHES
7. WELDMENT DISTORTION SPEC MIL-STD-1185 APPLIES

		9-19-86	ARMAMENT, MUNITIONS & CHEMICAL COMMAND
			ADAPTER - PALLET, 40MM CONTAINER

REVISION			
A	1 CHANGED DIMENSION 2 CHANGED ANGLE 3 ADDED REINFORCEMENT DIMPLE DETAIL AND NOTE		

SECTION A-A



NOTES:

1. BEND RADII 1/8 MAX WHERE NOT NOTED
2. MATERIAL: SHT SAE OR ANSI 1010 STEEL, CARBON, COLD ROLLED OR HOT ROLLED, PER ASTM A568 (ASTM A366 OR A569)
3. ALL DIMENSIONS ARE IN INCHES
4. (1) REINFORCEMENT DIMPLE

APPLICATION		21 NOV 86	ARMAMENT, MUNITIONS & CHEMICAL COMMAND
			POST · PALLET, SHEET METAL
			D 28638 AC200000429