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MARCH 1990

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MIL-STD-1660 TESTS ON REVISED PALLET ADAPTER AND TOP LIFT ASSEMBLY FOR 40mm CONTAINERS

Prepared for:

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Office of the Project Manager, Ammunition Logistics
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VALIDATION ENGINEERING DIVISION
SAVANNA, ILLINOIS 61074-9639

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The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by the Project Manager, Ammunition Logistics (PM-AMMOLOG) to conduct MIL-STD-1660 tests on the pallet adapter and top lift assembly for 40mm containers on metal pallets. This report contains the procedures, results, and recommendations from the MIL-STD-1660 tests conducted. As a result of testing, the pallet adapter and top lift assembly passed MIL-STD-1660 tests.

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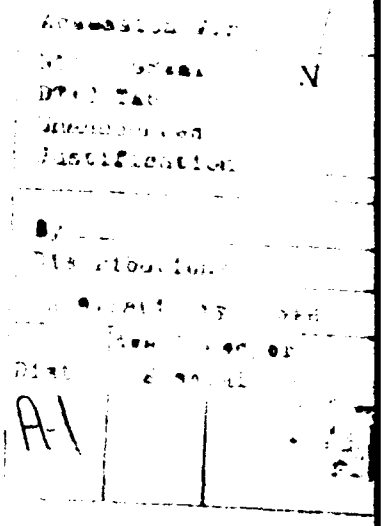
FOR
40mm CONTAINERS



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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Validation Engineering Division (SMCAC-DEV), was tasked by the Project Manager, Ammunition Logistics (PM-AMMOLOG), AMCPM-AL, to test the pallet adapter and top lift assembly for 40mm containers.

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

C. OBJECTIVE. The objective of this series of tests was to assess the ability of the pallet adapter and top lift assembly to sustain transportation conditions.

PART 2

MIL-STD-1660 TESTS ON REVISED PALLET ADAPTER AND TOP LIFT ASSEMBLY FOR 40mm CONTAINERS

MARCH 1990

TEST ATTENDEES

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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, 8 April 1977. This standard identifies five steps that a unitized load must undergo if it is considered to be acceptable. The five tests that were conducted on the test 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 gage 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 1 ± 0.1G. 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.

3. EDGEWISE ROTATIONAL DROP TEST. This test shall be conducted by using the procedures of Method 5008, Federal Standard 101. The procedure for the Edgewise Rotational Drop Test is as follows: The specimen shall be placed on its skids with one end of the pallet supported on a beam 4 1/2-inches high. The height of the beam shall be increased, if necessary, to ensure that there will be no support for the skids between the ends of the pallet when dropping takes place, but should not be high enough to cause the pallet to slide on the supports when the dropped end is raised for the drops. The unsupported end of the pallet 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:

DIMENSIONS ON GROSS WEIGHT NOT EXCEEDING	HEIGHT OF DROP 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 two 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 4- by 4-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 the time of impact shall be 7 feet-per-second.

5. SLING COMPATIBILITY TEST. Unit loads utilizing special design for nonstandard pallets shall be lifted, slung, lowered, and otherwise handled, as necessary, using slings of the types normally used for handling the unit loads under consideration. Slings shall be easily attached and removed. Danger of slippage or disengagement when load is suspended shall be cause for rejection of the unit load.

PART 4

TEST EQUIPMENT

1. TEST PALLET.

a. Drawing Number:	ACV00021
b. Unitization:	3-foot-high by 2-foot-wide by 7-foot-deep
c. Width:	41 inches (104.14cm)
d. Length:	44.75 inches (113.67cm)
e. Height:	36.37 inches (92.39cm)
f. Weight:	2,350 pounds (1,068kg)

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

4. INCLINED RAMP.

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

PART 5

TEST RESULTS

MIL-STD-1660 TESTS. The testing was repeated for each succeeding design. During the first cycle weld cracks became a problem due to workmanship, thus necessitating a design change for the second iteration. A change in design was also implemented after the second cycle of testing since a portion of the previous design change was reversed.

FIRST ITERATION

1. STACKING TEST. The first test pallet was loaded to 12,400-pounds compression for a period of one hour. Both during and after the test, no damage was noted.

2. REPETITIVE SHOCK TEST. During the first 90 minutes of vibration, the pallet skids were longitudinal to the induced dynamic load. The test equipment during this cycle was operated at 190 rpm which achieved the required 1/16-inch minimum clearance. The second 90 minutes of vibration was at 210 rpm with the pallet skids oriented lateral to the induced dynamic load. Weld cracks appeared on the top lift assembly opposite the impacting wall.

3. EDGEWISE ROTATIONAL DROP TEST. The first drop was perpendicular to the skids with this process repeated in a clockwise direction until all four sides of the pallet had been tested. Weld cracks increased from the lifting during the test. No other damage was noted.

4. IMPACT TEST. The inclined plane was set to allow the pallet to travel eight feet prior to impacting a stationary wall. The pallet was rotated clockwise after each impact, until all four sides had been tested. No damage was noted to the pallet adapter or top lift assembly during this test.

5. SLING TEST. The sling test consisted of five different lifting configurations using the top adapter assembly and a four-legged sling. The sling configurations included the following: a three corner, two alternate corners, two adjacent corners, another pair of adjacent corners, and a single corner lift. The top lift assembly showed some bending during the three- legged test due to the weld cracks. As a result, welds were added to the previous design for the next test.

6. DISASSEMBLY TEST. Two of four stacking lugs failed on the pallet adapter during the MIL-STD-1660 testing. It is not determined when the failure occurred since the lugs are not visible while the pallet is assembled.

SECOND ITERATION

1. STACKING TEST. The second test pallet was loaded to 12,530-pounds compression for a period of one hour. During this test, no damage to the pallet was noted.

2. REPETITIVE SHOCK TEST. During the first 90 minutes of vibration, the pallet skids were positioned lateral to the induced dynamic load. The test equipment was operated at 190 rpm during the first cycle and 175 rpm during the second 90 minutes. No problems were encountered during this test.

3. EDGEWISE ROTATIONAL DROP TEST. The first drop was made parallel to the skids and proceeded counterclockwise. No problems were noted during the four drops.

4. IMPACT TEST. The first impact was parallel to the skids and proceeded counterclockwise. One container shifted toward the interior of the pallet. No damage was noted during this test.

5. SLING TEST. The top lift assembly showed slight bending during the three-legged test. The bending worsened, during the two point sling tests, on opposite corners. The bending was due to a design change which removed some material on the corners for streamlining purposes.

6. DISASSEMBLY TEST. All four stacking lugs remained on the pallet adapter during the MIL-STD-1660 testing. No damage was noted.

THIRD ITERATION

1. STACKING TEST. The third test pallet was loaded to 12,530-pounds compression for a period of one hour. No problems were noted during this test.

2. REPETITIVE SHOCK TEST. During the first 90 minutes of vibration, the pallet skids were positioned longitudinal to the induced dynamic load with the vibration table set at 185 rpm. During the second 90 minutes of vibration, the test equipment was set at 205 rpm with no pallet damage noted during this cycle.

3. EDGEWISE ROTATIONAL DROP TEST. The first drop was parallel to the skids and proceeded clockwise. No problems were noted during the four drops.

4. IMPACT TEST. The first impact was parallel to the skids and proceeded clockwise. No damage was noted during this test.

5. SLING TEST. The pallet design showed sufficient strength in all of the sling tests; although, during lifting, the sling hooks tended to slip which could lead to disengagement if not monitored closely during lifting.

6. DISASSEMBLY TEST. All four stacking lugs remained on the pallet adapter during the MIL-STD-1660 testing. No damage was noted.

PART 6

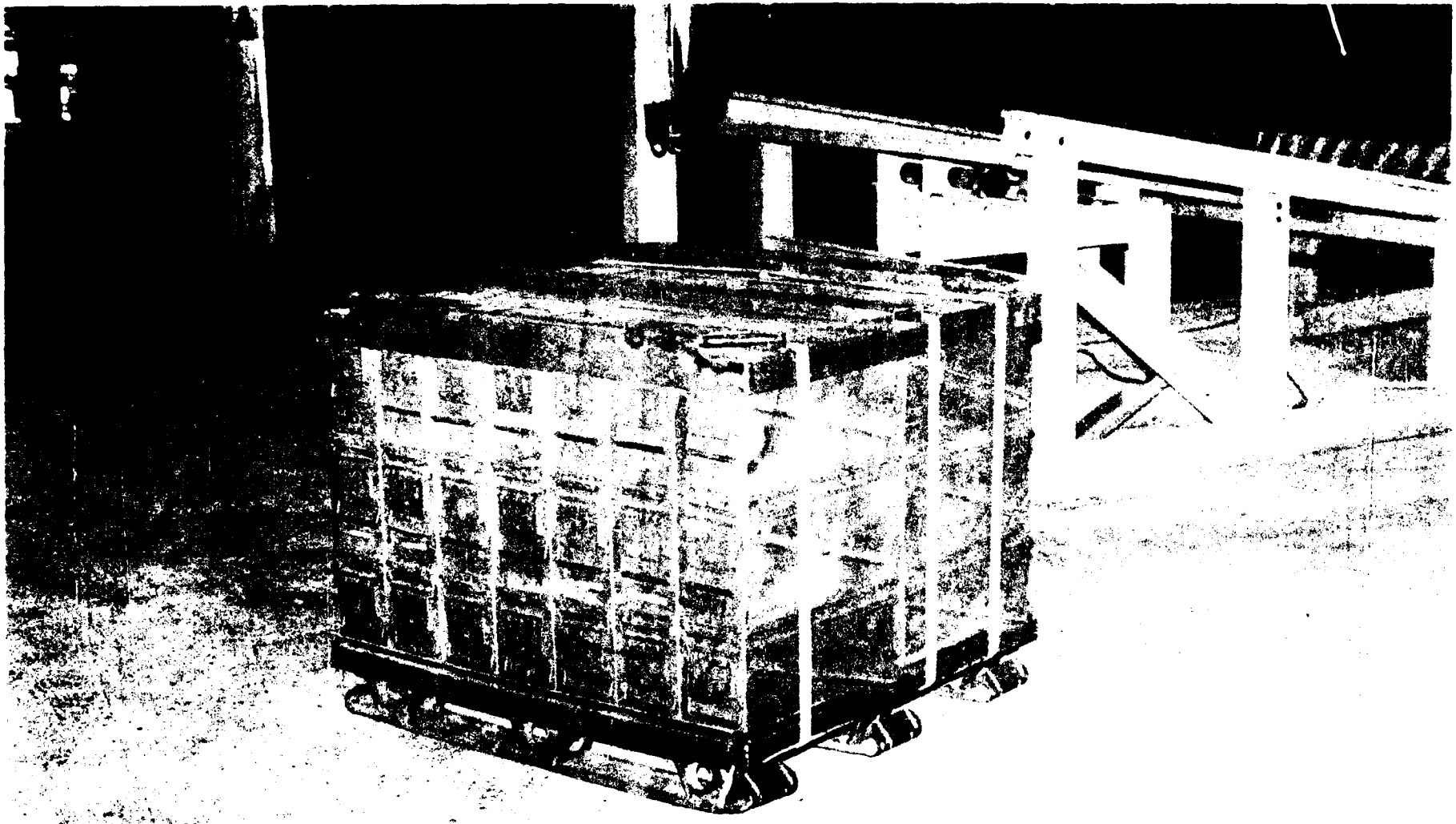
CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS. The final design for the pallet adapter and top lift assembly passed MIL-STD-1660, Design Criteria for Ammunition Unit Loads. All problems encountered during testing were resolved before completion of testing; also, all aspects of design passed two out of three tests. Since workmanship was acceptable following the second and third tests, the strength of the corner lift was acceptable following the first and third tests, and the stacking lugs remained on the pallet adapter following the second and third tests.

2. RECOMMENDATIONS. Close the channel in the top lift assembly to prevent the lifting hooks from slipping into the channel of the top lift assembly.

PART 7

PHOTOGRAPHS



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
Photo No. AO317-SPN-90-320-3448. This photo shows the final pallet following testing.		

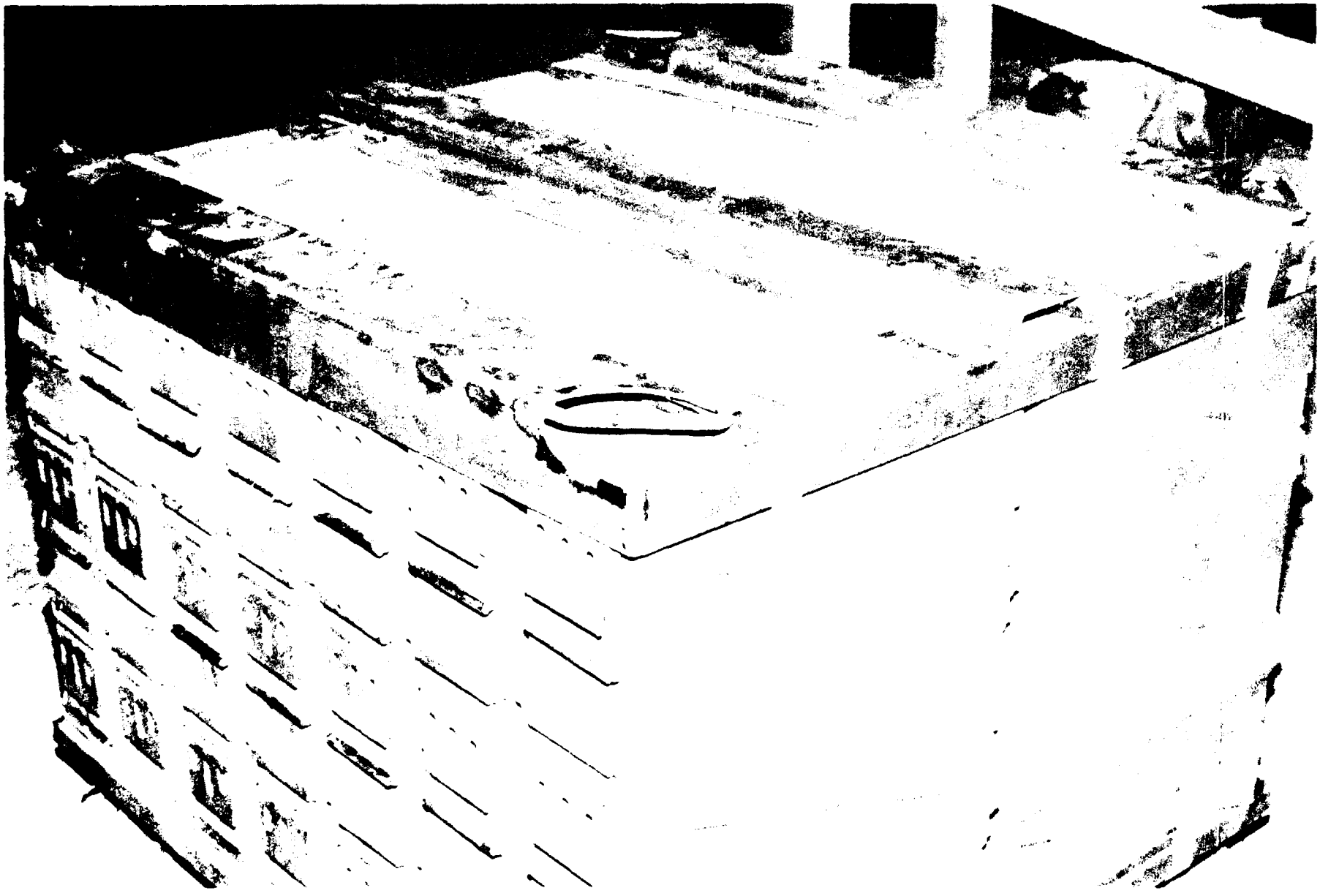


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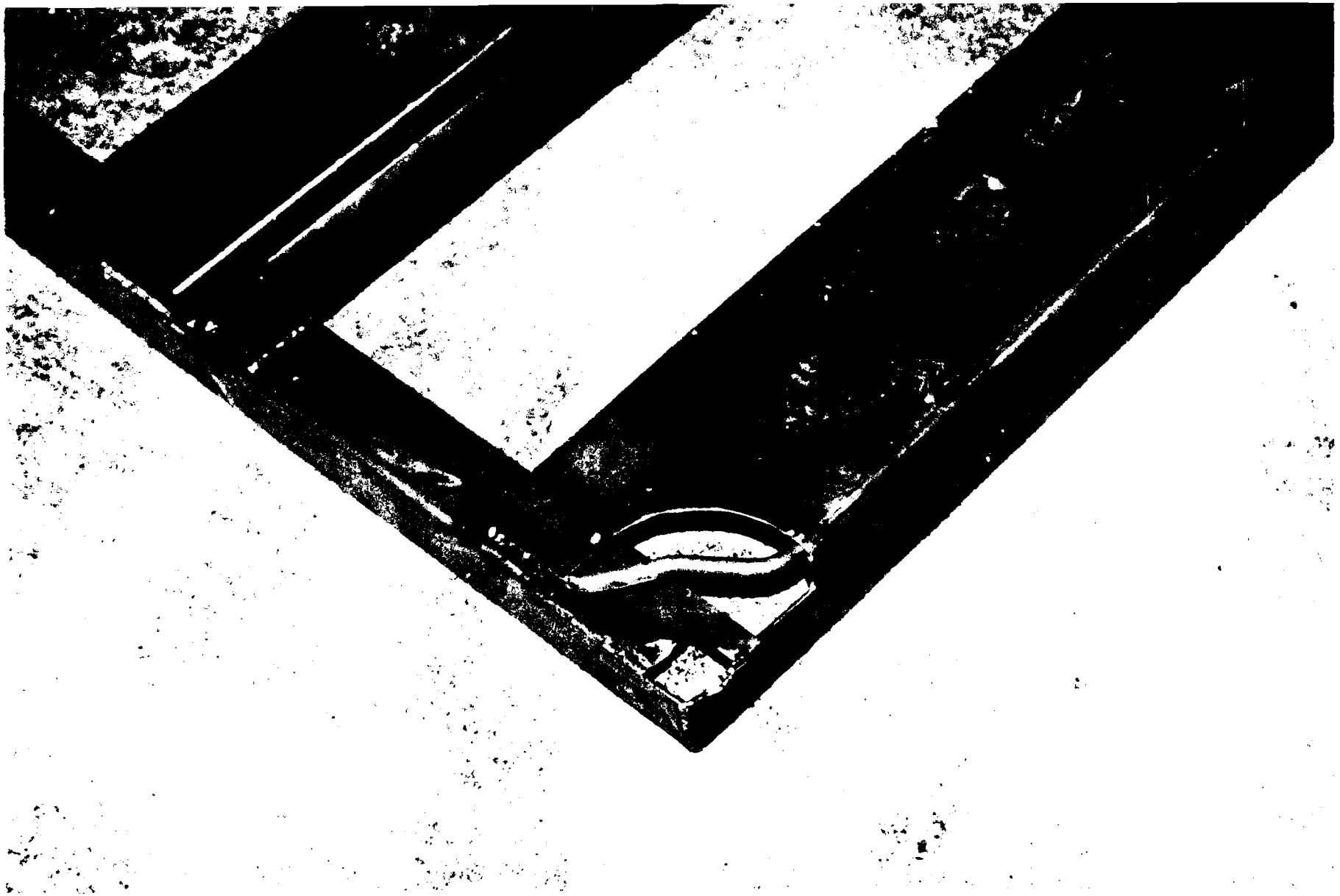
Photo No. AO317-SPN-90-320-3447. This photo shows the final pallet following testing.



	U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL	
Photo No. AO317-SCN-91-15-6743. This photo shows the first top lift design.		

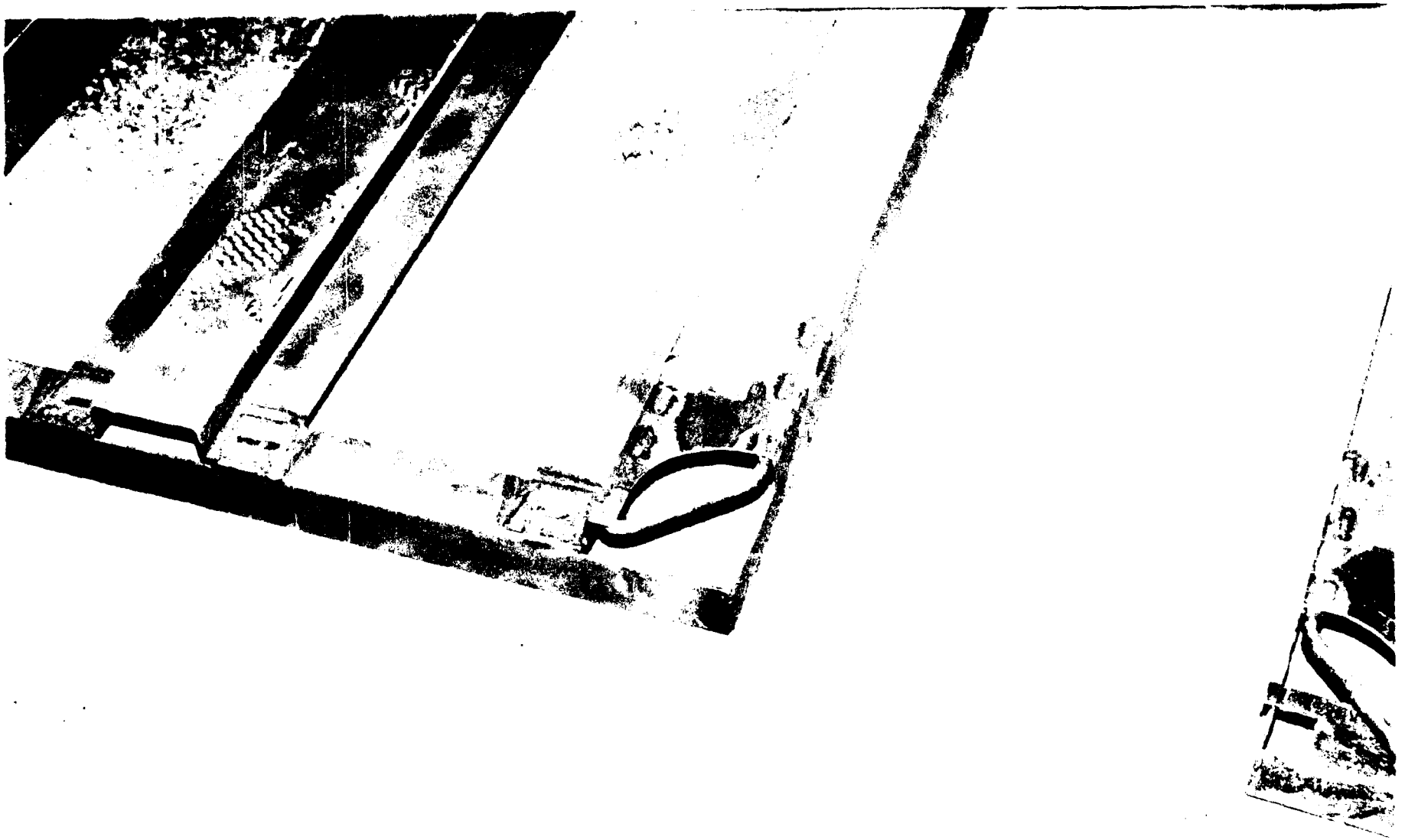


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Photo No. AO317-SCN-91-15-6744-90. This photo shows the second top lift design. Note the removal of material.		

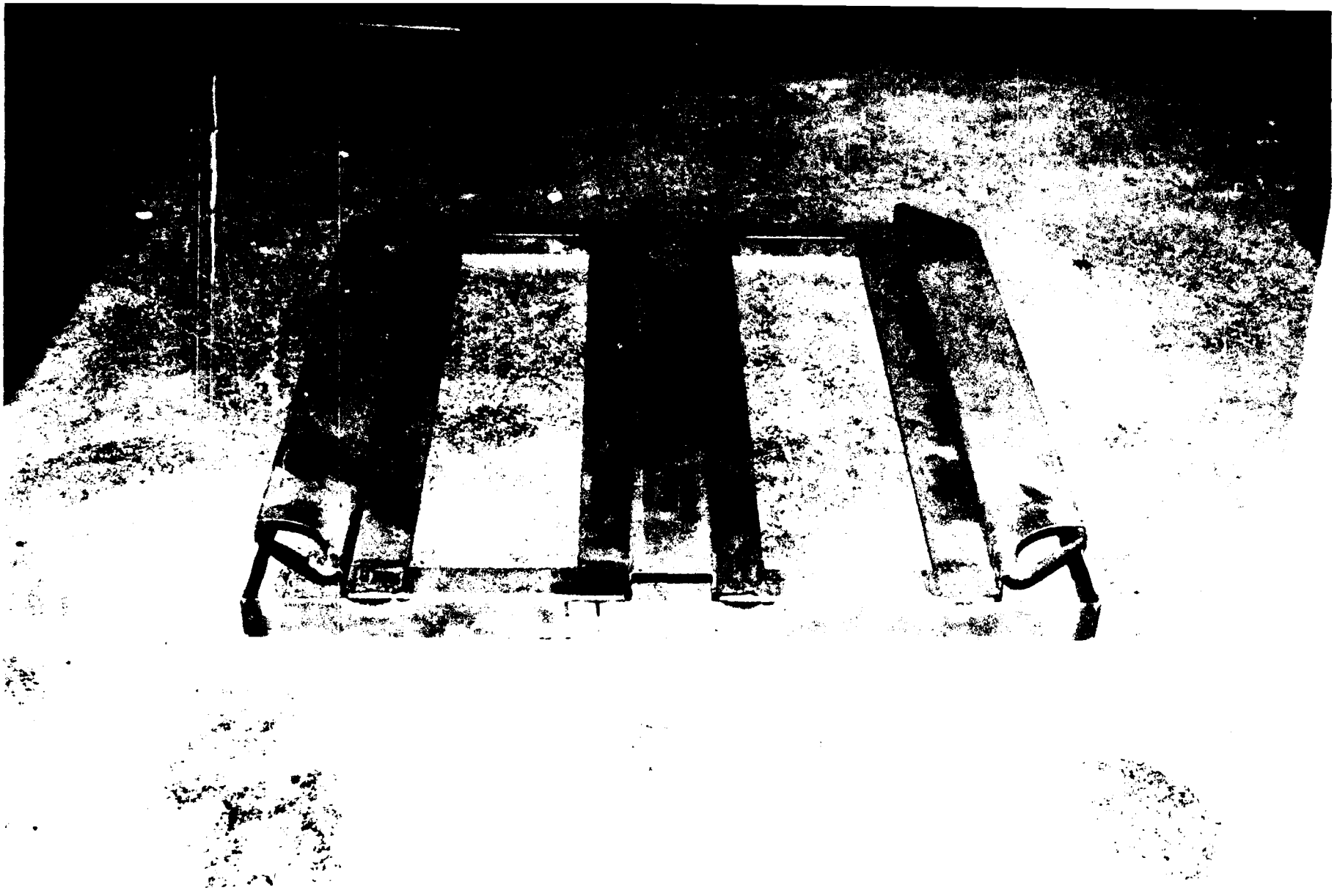

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Photo No. AO317-SCN-91-15-6745-90. This photo shows the second top lift design.		

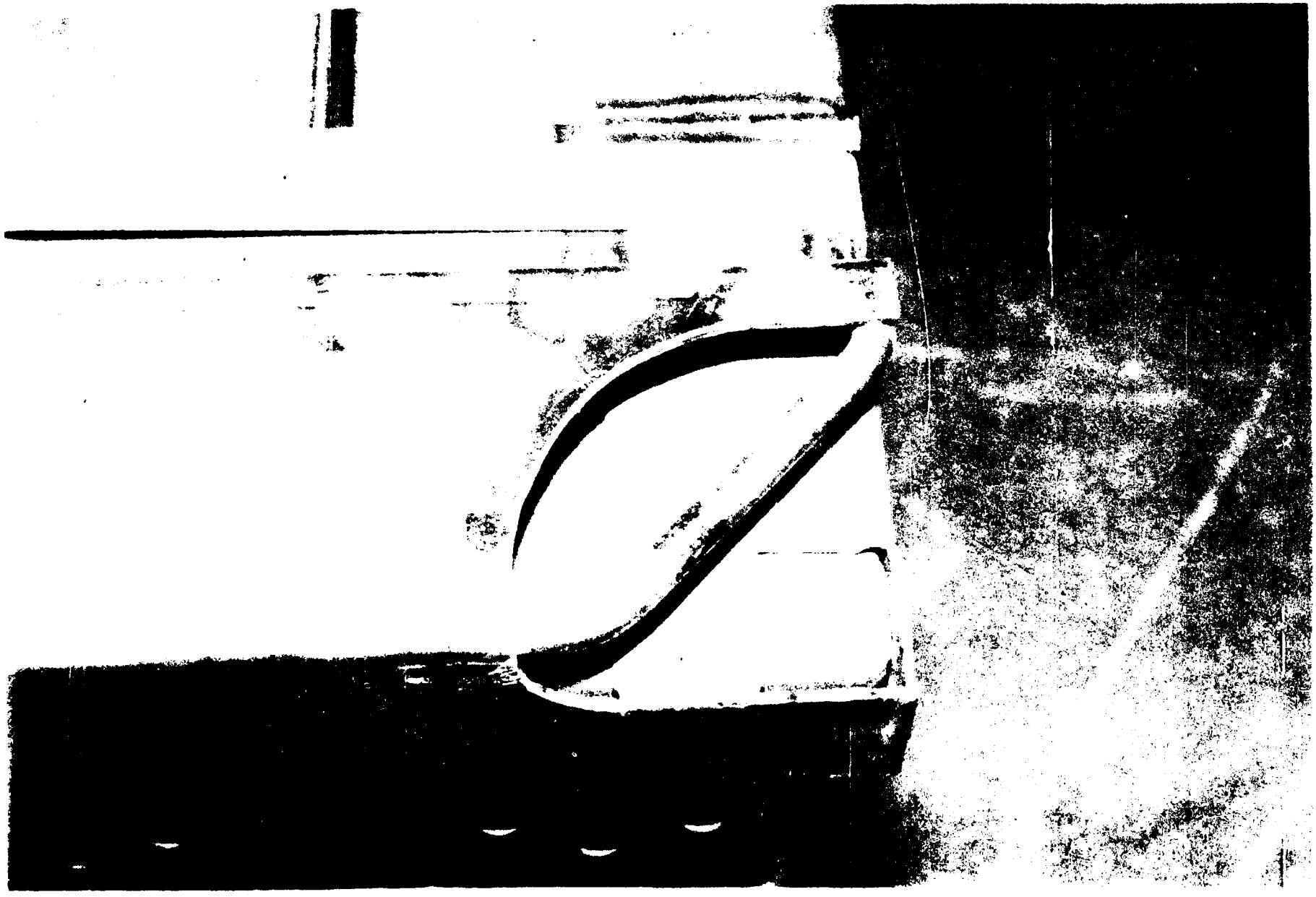

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Photo No. AO317-SPN-90-320-3450. This photo shows the third and final top lift design.

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Photo No. AO317-SPN-90-320-3449. This photo shows the final pallet following testing.		