

REPORT NO. EVT 15-84

MIL-STD-1660 TEST

OF

MODIFIED MIL-STD-1322-806

(M2A1 METAL CAN W/O WIREBOUND BOX)

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SAVANNA, ILLINOIS 61074-9639

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER EVT 15-84	2. GOVT ACCESSION NO.	RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) MIL-STD-1660 Test of Modified MIL-STD-1322-806 (M2A1 Metal Can W/O Wirebound Box)		5. TYPE OF REPORT & PERIOD COVERED FINAL
7. AUTHOR(s) Mr. Quinn Hartman		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Defense Ammunition Center and School ATTN: SMCAC-DEV Savanna, IL 61074-9639		8. CONTRACT OR GRANT NUMBER(s)
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Armament, Munitions and Chemical Command ATTN: SMCAR-ESK Rock Island, IL 61299-7300		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		12. REPORT DATE December 1987
		13. NUMBER OF PAGES 33
		15. SECURITY CLASS (of this report) UNCLAS
		15a. DECLASSIFICATION DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) UNLIMITED		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) MIL-STD-1322-806 MIL-STD-1660 M2A1 Cans Ammunition Transportation		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), has been tasked by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), SMCAR-ESK, Rock Island, IL, to test the possibility of stacking demolition charges in M2A1 cans in configurations of two or more high on a pallet. Under project no. FSA-146-75, the Storage and Outloading Division (SMCAC-DEO) modified MIL-STD-1322-806 for M2A1 cans in configurations of two-and three-high on a pallet. The methods and results of MIL-STD-1660 (cont)		

testing and APE 1958 leak testing of the unitization procedure described in modified MIL-STD-1322-806 are contained within this report. As a result of these tests, it was found that the referenced procedure did not satisfactorily protect the M2A1 containers in the unitized load.

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OF

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(M2A1 Metal Can W/O Wirebound Box)

DECEMBER 1987



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Evaluation Division

U.S. Army Defense Ammunition Center and School

Savanna, IL 61074-9639

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ABSTRACT

The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), has been tasked by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), SMCAR-ESK, Rock Island, IL, to test the possibility of stacking demolition charges in M2A1 cans in configurations of two or more high on a pallet. Under project no. FSA-146-75, the Storage and Outloading Division (SMCAC-DEO) modified MIL-STD-1322-806 for M2A1 cans in configurations of two-and three-high on a pallet. The methods and results of MIL-STD-1660 testing and APE 1958 leak testing of the unitization procedure described in modified MIL-STD-1322-806 are contained within this report. As a result of these tests, it was found that the referenced procedure did not satisfactorily protect the M2A1 containers in the unitized load.

U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

Evaluation Division

Savanna, IL 61074-9639

REPORT NO. EVT 15-84

MIL-STD-1660 TEST OF

MODIFIED MIL-STD-1322-806

(M2A1 Metal Can W/O Wirebound Box)

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PART I.

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School, Evaluation Division, was tasked by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), SMCAR-ESK, to test the possibilities of stacking demolition charges in M2A1 cans in configurations of two or more high on a pallet. Unitization procedures to test two and three high configurations of M2A1 containers were developed by the Storage and Outloading Division, SMCAC-DEO, under project no. FSA-146-75. Testing procedures that were used for evaluating modified MIL-STD-1322-806 consisted of MIL-STD-1660, Design Criteria for Ammunition Unit Loads and Can Leak Tester, APE 1958.

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 these tests was to determine if a pallet load of M2A1 containers in a three-high configuration could pass the APE 1958 leak test after being subjected to the stresses of the MIL-STD-1660 test.

PART II.

ATTENDEES

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PART III.

TEST PROCEDURES

The test procedures outlined in this section were extracted from MIL-STD-1660, Design Criteria for Ammunition Unit Loads, 8 April 1977, and Operation Manual for Can Leak Test Device APE 1958 (June 1978). MIL-STD-1660 identifies nine steps that a unitized load must undergo if it is considered to be acceptable. The operation Manual for APE 1958 identified a series of steps that must be performed to determine if the M2A1 cans meet the leak criteria. These tests are synopsized below:

1. LEAK TESTING. Prior to unitization of the M2A1 cans and after MIL-STD-1660 testing of the load, each M2A1 can shall be leak tested using APE 1958 so that an accurate record of can failure can be established. The criteria for failure of an M2A1 can is a leakage rate exceeding 0.4 CC per second when a 3 psi gage minimum external vacuum is applied.
2. 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.
3. 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 one-tenth 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.

4. 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
<u>Pounds</u>	<u>Inches</u>	<u>Inches</u>
600	72	36
3,000	no limit	24
no limit	no limit	12

5. 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 IV.

TEST EQUIPMENT

1. TEST SPECIMEN.

- a. Drawing Number:
- b. Width: 42-1/2 in.
- c. Length: 48 in.
- d. Height: 27 in.
- e. Weight: 2,240 lbs.

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

5. APE 1958 CAN LEAK TESTER.

- a. Manufacturer: Toole Army Depot
- b. Type: Vacuum Leak Tester.

PART V.

TEST RESULTS

1. STACKING TEST.

Pallet Weight - 2,240 lbs.
Pallet Height - 27 in.
Test Load - 16,000 lbs.

The test pallet was loaded to 16,000 pounds compression for a period of one hour. At the end of the one-hour period, the compression load had decreased to 15,300 pounds. After the test pallet was removed from the compression table, no measurable deformation in the load was evident.

2. REPETITIVE SHOCK TEST.

The test pallet successfully passed both the longitudinal and lateral 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 200 rpm.

3. EDGEWISE DROP TEST.

Each side of the pallet base was placed on a beam displacing it 6 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 either a clockwise or counterclockwise direction on all four sides of the pallet.

The impact from the edgewise drop test caused the M2A1 cans to rack up out of position so that the hinge end of the cans was resting on the adjacent cans. This racking of the cans caused the load straps to loosen to

the point where the straps could be pulled several inches away from the pallet unit side.

4. IMPACT TEST.

The incline impact tester was set to allow the pallet to travel 8 feet before impacting the bumper of the impact tester. In between impacts, the pallet was rotated in either a clockwise or counterclockwise direction until all four sides of the pallet had been impacted. No additional loosening of the load straps or racking of the M2A1 cans was noted during the impact test.

5. LEAK TEST.

The M2A1 cans were tested before being placed on the pallet to ensure that all the cans had good seals prior to testing. At completion of the pallet testing, the straps were cut on the pallet and the cans were again leak tested. Figure 1 shows the results of the second leak test performed after the MIL-STD-1660 testing was completed.

FIGURE 1: SUMMARY OF LEAK TEST FOR MODIFIED MIL-STD-1322-806

```

-----
| Gn | Go | Go * Gn | Go | Gn | Gn |
-----
| Gn | ? | Go * Ln | Go | Gn | Gn |
-----
| Go | Go | Gn * Go | Go | Gn | Gn |
-----
| Gn | Gn | Gn * Gn | Gn | Gn | Gn |
-----

```

Top Layer

```

-----
| Gn | Go | Lo * Lo | Gn | Gn | Gn |
-----
| Gn | Lo | Go * Go | Gn | Gn | Gn |
-----
| Gn | Go | Go * Go | Go | Gn | Gn |
-----
| Go | Go | Lo * Lo | Go | Gn | Gn |
-----

```

Middle Layer

```

-----
| Gn | Gn | Go * Go | Gn | ? | ? |
-----
| ? | Go | Go * Go | Lo | ? | ? |
-----
| ? | Go | Go * Lo | ? | ? | ? |
-----
| ? | Go | Go * Go | Go | Gn | ? |
-----

```

Bottom Layer

Notes:

- * - Position of divider board.
- ? - Unable to leak test due to dents from test.
- Go - Older can used in previous test, passed leak test.
- Gn - New can never previously tested, passed leak test.
- Lo - Older can used in previous test, failed leak test.
- Ln - New can never previously tested, failed leak test.

PART VI.

CONCLUSIONS AND RECOMMENDATIONS

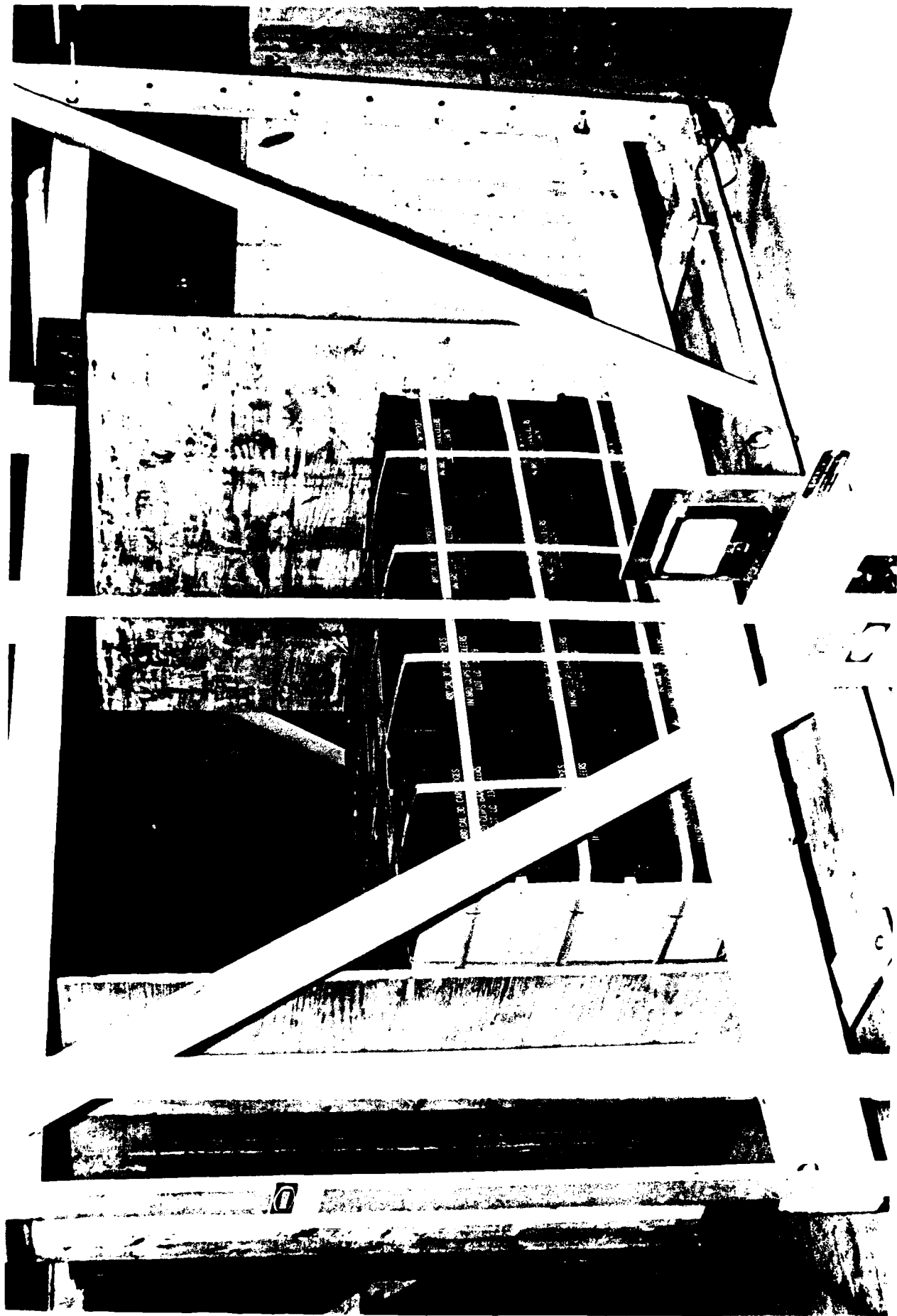
1. CONCLUSIONS. Based on MIL-STD-1660 testing criteria, the test pallet passed both the compression and transportation tests. However, it failed the edgewise drop test due to the racking of the M2A1 cans and the loosening of the load straps. The incline impact test was run after failure had occurred so that the full extent of damage to the M2A1 can's seals could be recorded.

From the standpoint of individual can performance, the test pallet had a failure rate of 24 percent from either leaking or dented cans. (See Figure 1). Since there had been damage to eight of the M2A1 can's seals, it was decided by the Storage and Outloading Division (SMCAC-DEO) that the two-high configuration would not be tested.

2. RECOMMENDATIONS. Since the modified MIL-STD-1322-860 did not satisfactorily protect the M2A1 cans from damage, it is recommended that this unitization procedure, as designed, should not be used to transport M2A1 cans. To improve the pallet, divider boards running crosswise to the skids in between each row of cans need to be added to prevent the cans from jumping out of position. Also, a layer of cushioning material between the bottom row of cans and the pallet could help to reduce the amount of cans that are dented. Finally, a layer of plywood on top of the pallet could be added to distribute the force from the compression tester to possible reduce the number of leaking M2A1 cans.

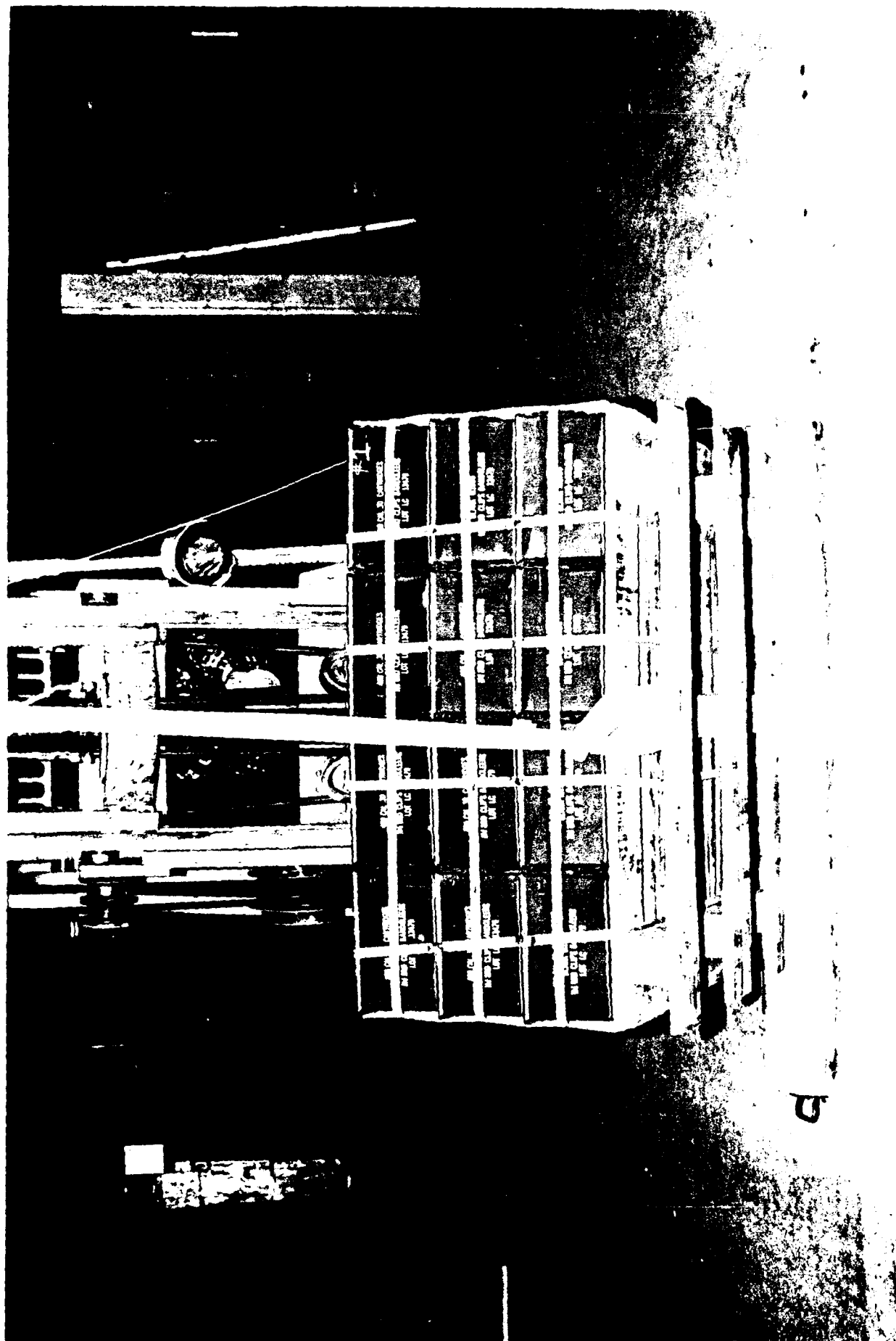
PART VII.

PHOTOGRAPHS



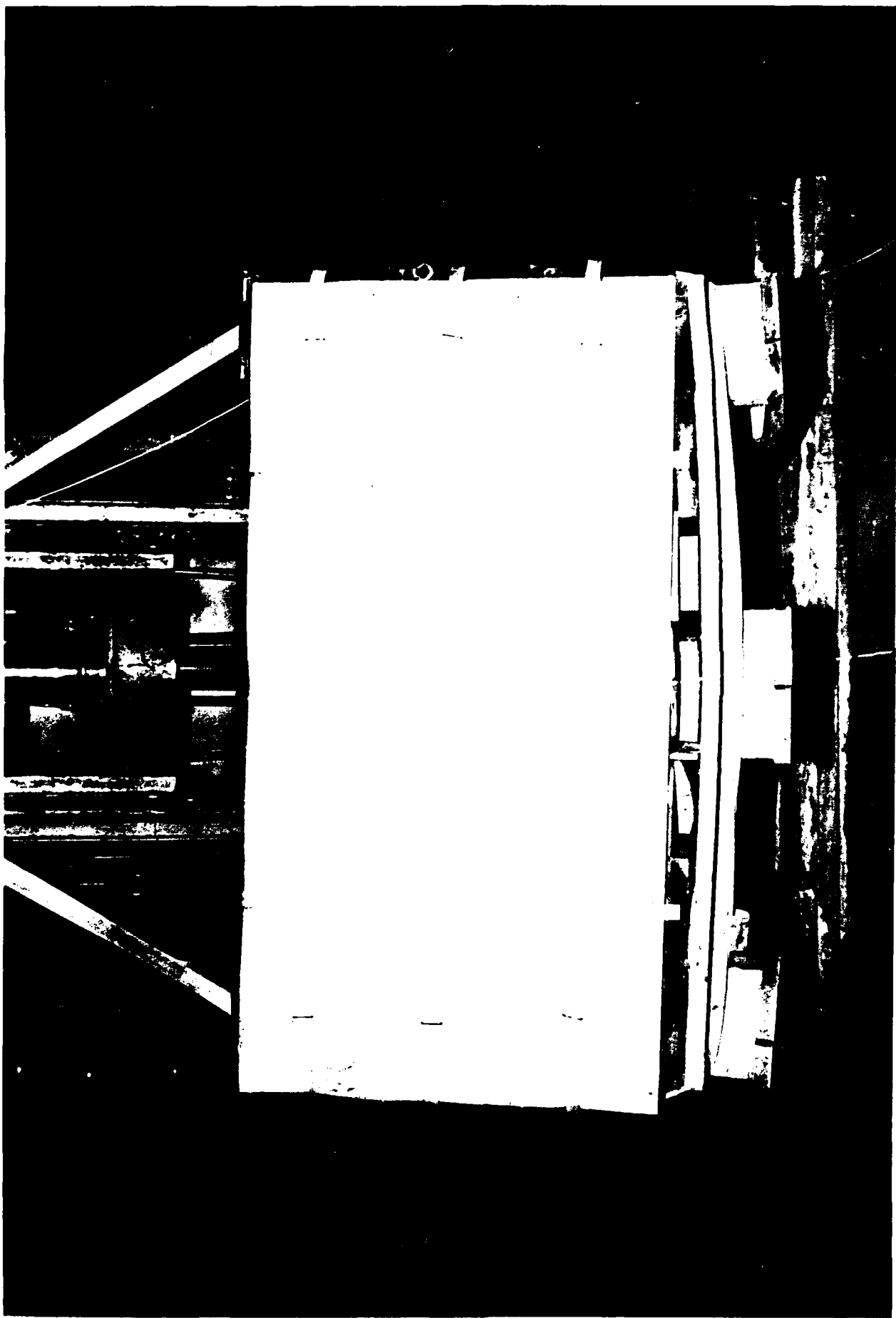
DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo 1. This photo shows the M2A1 cans in the Transportation Simulator in the Longitudinal Orientation.



DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo 2. This photo shows the M2A1 cans raised 24" prior to the first edgewise rotational drop.



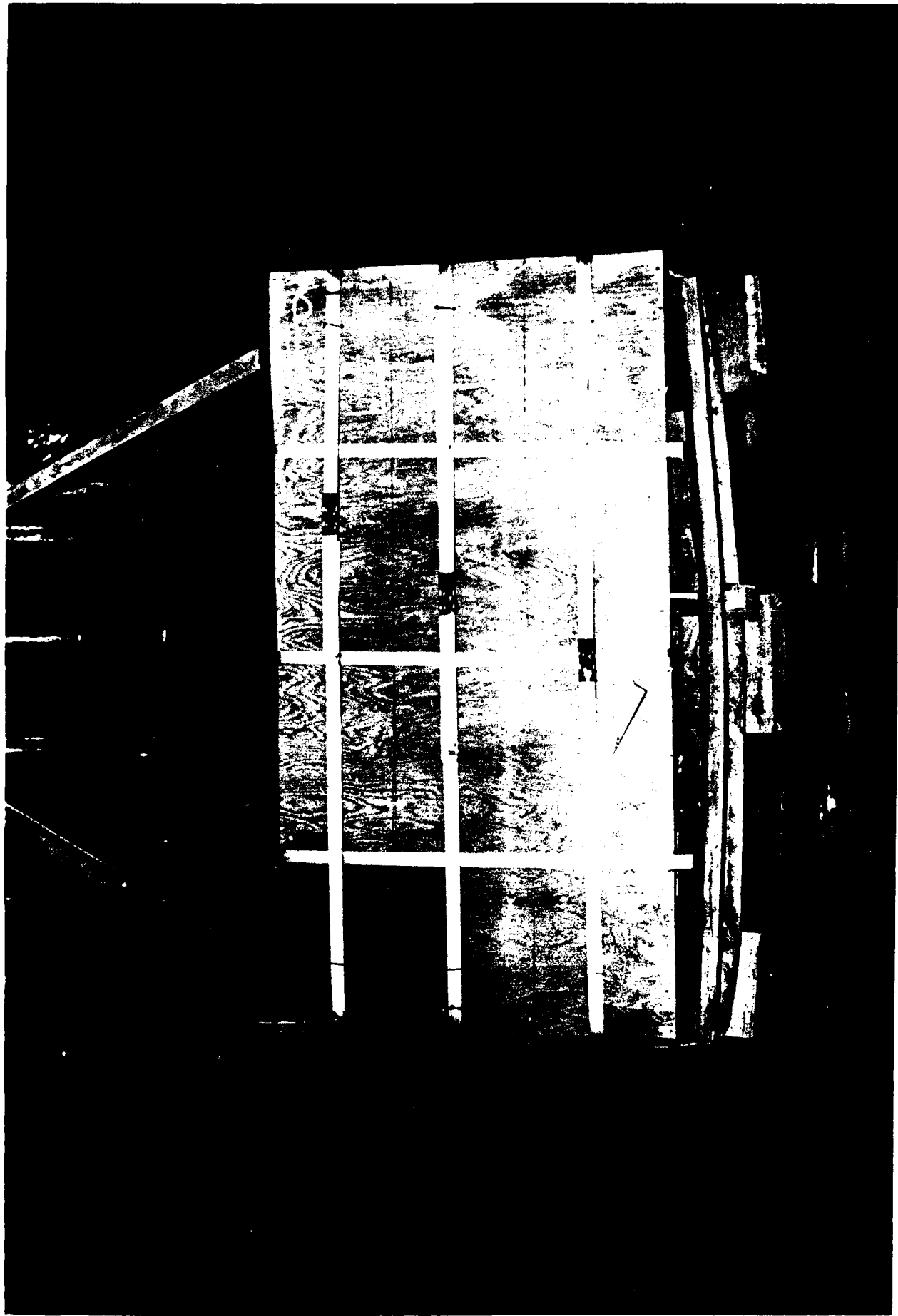
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Photo 3. This photo shows the M2A1 cans raised 24" prior to the second edgewise rotational drop.



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Photo 4. This photo shows the M2A1 cans raised 24" prior to the third edgewise rotational drop.



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Photo 5. This photo shows the M2A1 cans raised 24" prior to the fourth edgewise rotational drop.

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Photo 6. This photo shows the 82A cans raised S' prior to the first inclined impact.



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Figure 7. This photo shows the WAI ramp raised 8' prior to the second inclined impact



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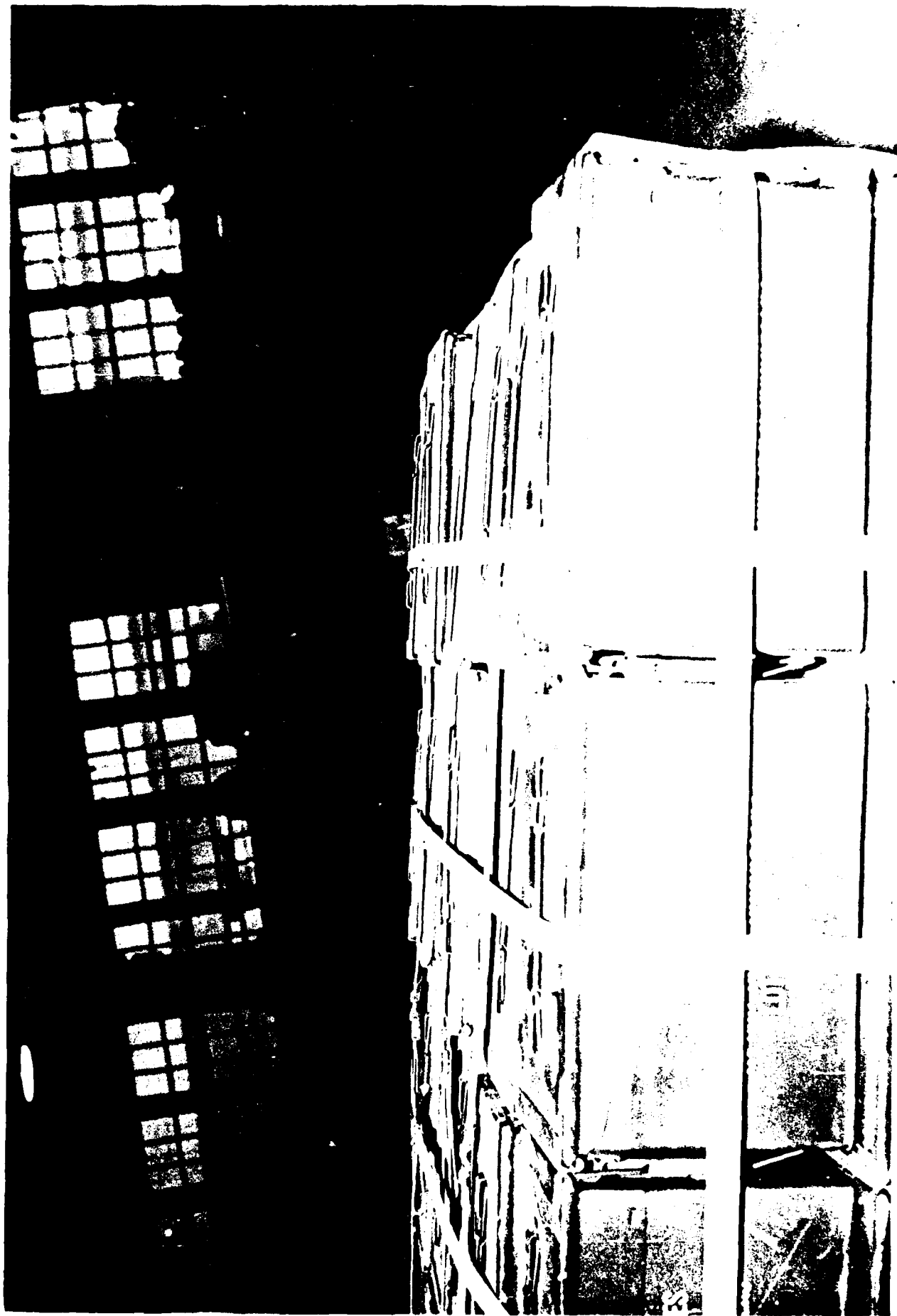
Photo 8. This photo shows the M2A1 cans raised 8' prior to the third inclined impact.



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Photo 14. (14) Photo shows the MIA cans raised 8' prior to the fourth inclined impact.



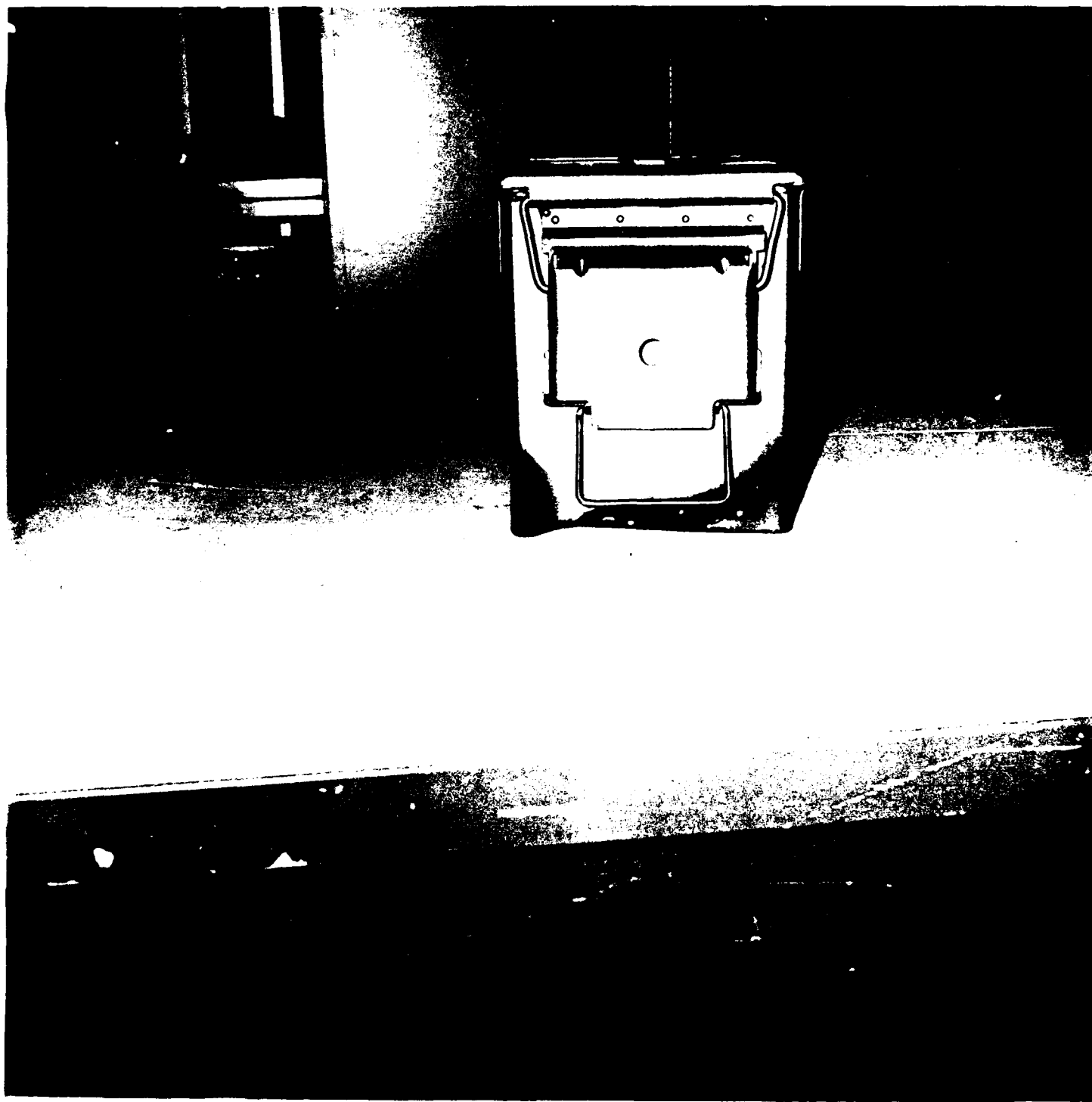


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Photo 10. This photo shows the racking of the M2A1 cans that took place during the edgewise rotational drop.

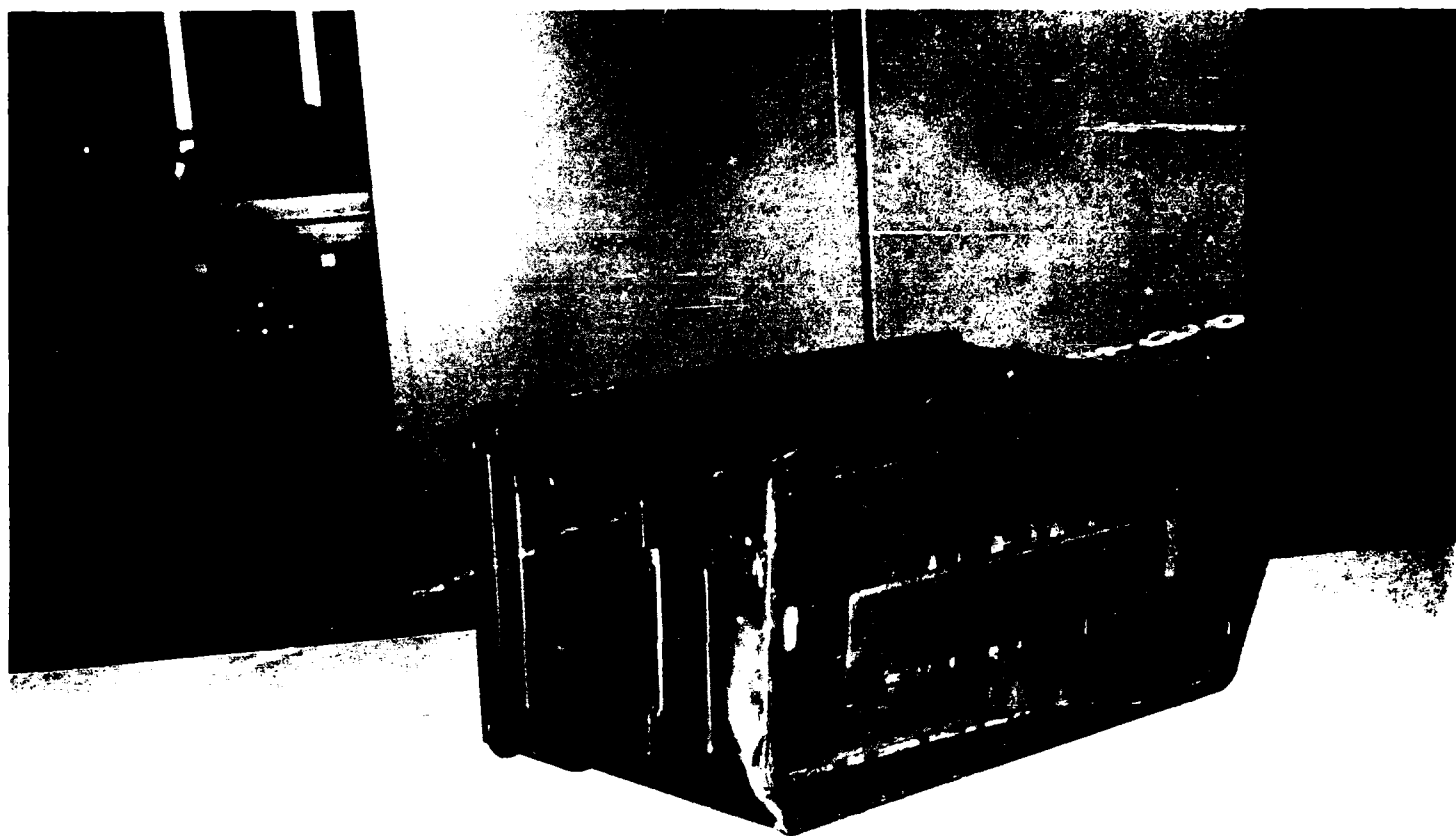
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Photo 11. This photo shows the denting of that 12 of the M2A1 cans sustained during the test.



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Photo 12. This photo shows additional denting that 12 of the M2A1 cans sustained during the test.



PART VIII.

UNITIZATION PROCEDURE

MILITARY STANDARD

MIL-STD-1322-806

14 MAY 1981

UNIT LOAD

FOR DOMESTIC AND OVERSEAS SHIPMENT

~~CHARGE 1 DEMOLITION~~
CARTRIDGE, SIGNAL, PRACTICE BOMB MK 4 MOD 3
~~OR CXU-3 A/B IN BOX, AMMUNITION M2A1~~

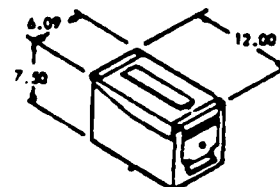
SUPERSEDES

WB-53/106

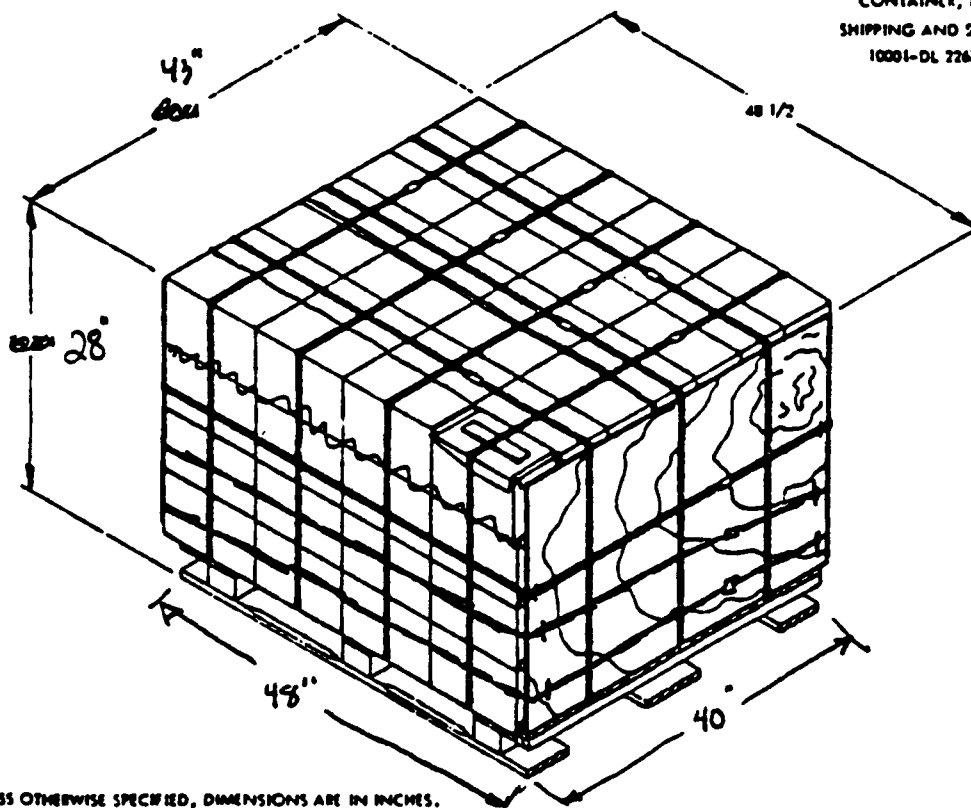
26 FEBRUARY 1971

UNIT LOAD DATA

	DDIC/MALC	MK 4	CXU-3 A/B
NUMBER OF CONTAINERS PER CONTAINER		12	50
NUMBER OF CONTAINERS PER UNIT LOAD		84	112
NUMBER OF CARTRIDGES PER UNIT LOAD		1008	1400
GROSS WEIGHT OF ONE CONTAINER (ESTIMATED)		25.78 LBS	16.78 LBS
WEIGHT OF PALLET		40.00 LBS	40.00 LBS
GROSS WEIGHT OF UNIT LOAD (ESTIMATED)		1066 LBS	1711 LBS
CUBE		33.6 CU FT	47.7 CU FT
HAZARD CLASSIFICATION		CLASS C	CLASS II - C
DOT		CLASS C	CLASS II - C
CG		CLASS I	CLASS II - C



CONTAINER, M2A1
SHIPPING AND STORAGE
10001-DL 7267153



NOTES:

1. UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES.
2. FOR CROSS REFERENCE TO ASSOCIATED TRUCKLOADING, CONTAINERLOADING AND CARLOADING MILITARY STANDARDS, REFER TO INDEX TO STANDARDS, MIL-M78K-236

FSC 8140

THIS UNIT LOAD IS AUTHORIZED
AND RELEASED FOR THE PREPARATION OF
UNIT LOADS FOR DOMESTIC AND OVERSEAS SHIPPING,
HANDLING AND STORAGE.

REQUIREMENTS FOR CONSTRUCTION
OF THIS UNIT LOAD SHALL CONSIST
OF THIS DOCUMENT AND THE LATEST
ISSUE OF MIL-STD-1323

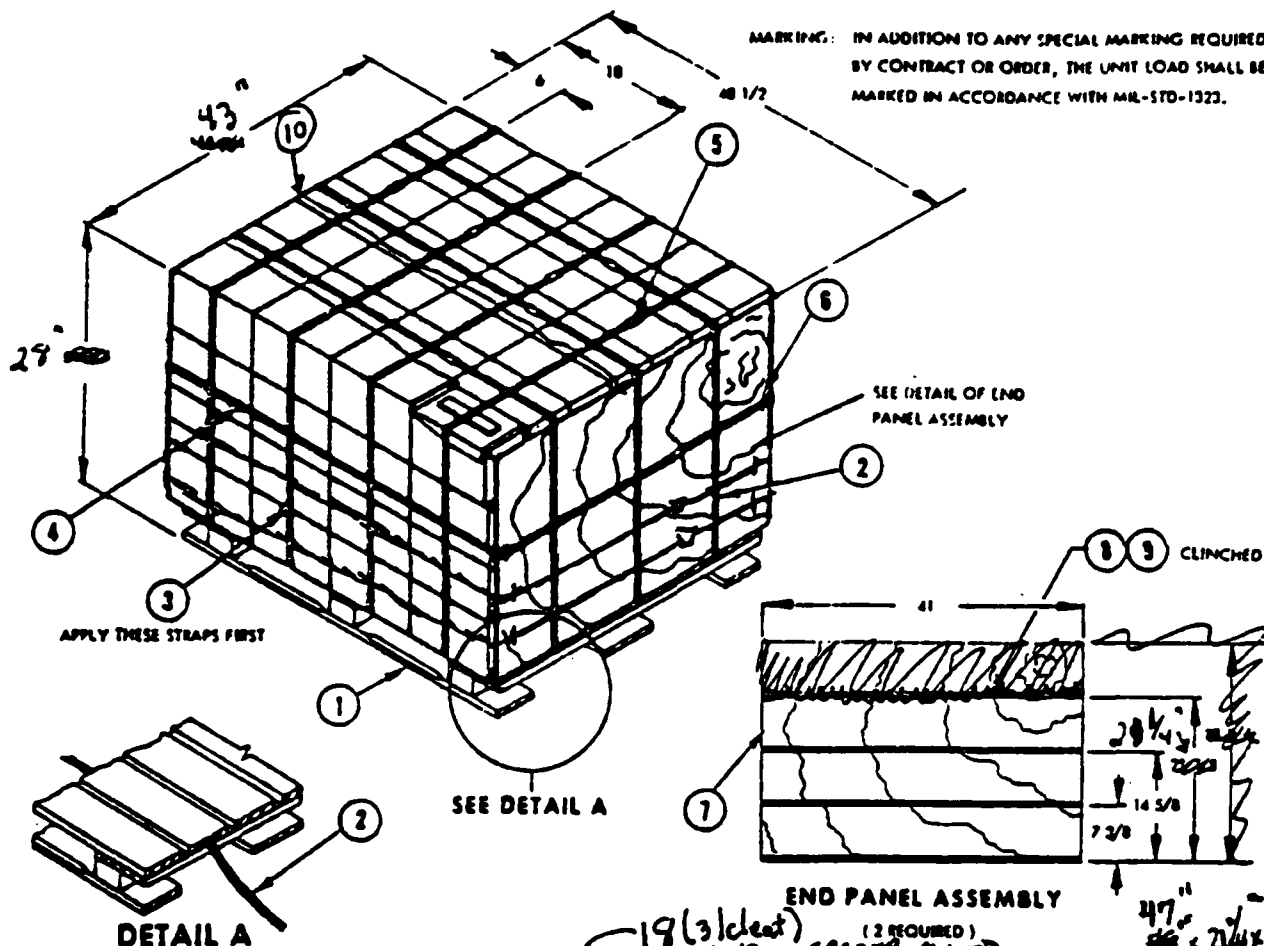
M. J. Gray NWHC 5/12/81
SIGNATURE TECHNICAL DIRECTION AGENT (TDA) DATE
E. E. Keller 5/12/81
SIGNATURE AMPS/COM BY DIRECTION DATE

ORIGINATOR *Charles McKiside* 5/12/81
NAVAL WEAPONS HANDLING CENTER
WPNSTA EARLE, NEW JERSEY DATE

PAGE 1 OF 2

PALLETIZING PROCEDURE

- THREAD STRAPPING, ITEM 2, THROUGH SLOTS IN PALLET DECK, ITEM 1 AS SHOWN IN DETAIL A, AND PLACE THE CENTER STRAP ON THE PALLET DECK.
- POSITION THE CONTAINERS ON THE PALLET DECK WITH CLOSURES IN ONE DIRECTION.
- POSITION STRAPPING, ITEM 3, UNDER THE PALLET DECK AND AROUND THE UNIT LOAD, TENSION AND DOUBLE NOTCH SEAL, ITEM 5.
- POSITION STRAPPING, ITEM 2, AROUND THE END PANEL ASSEMBLY. THE CLEAT ON THE END PANEL MUST BE POSITIONED AGAINST THE LOWER SECTION OF THE CONTAINERS, AS SHOWN, TENSION THE STRAPPING AND DOUBLE NOTCH SEAL.
- POSITION THE GIRTHWISE STRAPPING, ITEM 4, OVER THE THIRD CLEAT OF THE END PANEL ASSEMBLY, AS SHOWN, TENSION AND DOUBLE NOTCH SEAL.
- SECURE THE GIRTHWISE STRAPPING, WITH STAPLES, ITEM 6.



NOTES:

1. WHEN PALLET MIL-P-13011 IS NOT AVAILABLE, WOOD PALLET NIN-P-71, TYPE X, SIZE 2, GROUP IX, MAY BE USED AS AN ALTERNATE.
2. .001 COLD ROLLED, HEAT TREATED, MAY BE SUBSTITUTED.
3. UNLESS OTHERWISE SPECIFIED ALL MATERIAL SHALL BE AS SPECIFIED IN THE GENERAL DOCUMENT, MIL-STD-1323.

DEPALLETIZING PROCEDURE

- REMOVE STAPLES.
- CUT AND REMOVE STRAPPING.
- REMOVE END PANELS.
- REMOVE CONTAINERS.

END PANEL ASSEMBLY				
9	MAIL, STD BOX	SEE NOTE 3	24 1/2	
8	CLEAT, END	SEE NOTE 3	41 X 48 X 1/2	
7	PANEL, END	SEE NOTE 3	41 X 48 X 1/4	
6	STAPLES 15/16 X 3/4	COM'L	3/4	
5	SEAL 3/4"	SEE NOTES 2 & 3	3/4	
4	STRAPPING, GIRTHWISE	SEE NOTES 2 & 3	3/4 X .035 X 48	
3	STRAPPING, LONG	SEE NOTES 2 & 3	3/4 X .035 X 48	
2	STRAPPING, SHORT	SEE NOTE 1	48 X 48 X 1/2	
REQ.	ITEM	DESCRIPTION	MAT'L/DWG	DIMENSIONS

LIST OF MATERIALS

REVIEW ACTIVITY:
NAVY-OS, AS

PREPARING ACTIVITY:
NAVY-OS
(PMS) JCT N.Y. 8140-11001