

FINAL REPORT  
JULY 1997

REPORT NO. 96-21

REUSABLE "CLIP-LOK" PALLET  
MIL-STD-1660 TESTS

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Prepared for:  
U.S. Army Armament Research, Development  
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VALIDATION ENGINEERING DIVISION  
SAVANNA, ILLINOIS 61074-9639

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| 19. ABSTRACT (Continue on reverse if necessary and identify by block number)<br><br>The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660, Design Criteria for Ammunition Unit Loads, testing on the reusable Clip-Lok pallet produced by Clip-Lok SimPak USA, Inc. After three failed pallets, a Clip-Lok configuration was developed for pallet weights up to 4,000 pounds that met the test requirements of the MIL-STD-1660 criteria for shipment of ammunition loads. |       |  |   |  |                            |
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| 22a. NAME OF RESPONSIBLE INDIVIDUAL<br><br>JEROME H. KROHN   |       | 22b. TELEPHONE (Include Area Code)<br><br>815-273-8929           |   | 22c. OFFICE SYMBOL<br><br>SIOAC-DEV                    |                            |

U.S. ARMY DEFENSE AMMUNITION CENTER  
VALIDATION ENGINEERING DIVISION  
SAVANNA, IL 61074-9639

REPORT NO. 96-21

REUSABLE "CLIP-LOK" PALLET MIL-STD-1660 TESTS

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## PART 1

### INTRODUCTION

A. **BACKGROUND**. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SIOAC-DEV), was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC) to conduct MIL-STD-1660, Design Criteria for Ammunition Unit Loads, tests on the reusable Clip-Lok pallet produced by Clip-Lok SimPak USA, Inc. Initial testing allowed for redesigns to improve the strength of the pallet in order to meet the test requirements of the MIL-STD-1660 criteria for shipment of ammunition loads.

B. **AUTHORITY**. This test was conducted IAW mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL. Reference is made to the following:

1. Change 4, 4 October 1974, to AR740-1, 23 April 1973, Storage and Supply Activity Operation.

2. AMCCOM-R, 10-17, Mission and Major Functions of USADACS, 13 January 1986.

C. **OBJECTIVE**. The objective of these tests was to determine if the Clip-Lok company could produce a pallet that would meet MIL-STD-1660 test requirements for shipment of ammunition.

D. **CONCLUSION**. The third design of the Clip-Lok pallet with the addition of a 3/4-inch layer of plywood on top of the pallet deck and seven 3/4-inch metal bands over top of the pallet clips was able to meet MIL-STD-1660 test requirements for shipment of ammunition and is recommended for U.S. Army (USA)-wide use on loads up to 4,000 pounds.

PART 2

MARCH - AUGUST 1996

ATTENDEES

Quinn D. Hartman  
General Engineer  
DSN 585-8992  
815-273-8992

Director  
U.S. Army Defense Ammunition Center  
ATTN: SIOAC-DEV  
3700 Army Depot Road  
Savanna, IL 61074-9639

Jerry H. Krohn  
Supervisory General Engineer  
DSN 585-8908  
815-273-8908

Director  
U.S. Army Defense Ammunition Center  
ATTN: SIOAC-DEV  
3700 Army Depot Road  
Savanna, IL 61074-9639

Thomas J. Michels  
Supervisory General Engineer  
DSN 585-8080  
815-273-8080

Director  
U.S. Army Defense Ammunition Center  
ATTN: SIOAC-DES  
3700 Army Depot Road  
Savanna, IL 61074-9639

Walter B. Holcombe  
DSN 493-8204  
309-782-8204

Commander  
U.S. Army Armament Research, Development  
and Engineering Center  
ATTN: AMSTA-AR-ESK  
Rock Island, IL 61299-7300

Steve Carlton  
Regional Sales Manager  
770-399-0437

Clip-Lok SimPak USA  
1 Dunwoody Park  
Suite 103  
Atlanta, GA 30338

## 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 nine steps that a unitized load must undergo if it is to be considered acceptable. The four tests that were conducted on the test pallets are summarized below.

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

B. REPETITIVE SHOCK TEST. The repetitive shock test was conducted IAW Method 5019, Federal Standard 101. The test procedure is as follows: The test specimen was placed on, but not fastened to, the platform. With the specimen in one position, the platform was vibrated at 1/2-inch amplitude (1-inch double amplitude) starting at a frequency of approximately 3 cycles per second. The frequency was steadily increased until the package left the platform. The resonant frequency was achieved when a 1/16-inch-thick feeler gage momentarily slid freely between every point on the specimen in contact with the platform at some instance during the cycle or a platform acceleration achieved 1 +/- 0.1 Gs. Midway into the testing period, the specimen was rotated 90 degrees and the test continued for the duration. Unless failure occurred, the total time of vibration was two hours if the specimen was tested in one position and three hours for more than one position.

C. EDGEWISE ROTATIONAL DROP TEST. This test was conducted using the procedures of Method 5008, Federal Standard 101. The procedure for the edgewise rotational drop test is as follows: The specimen was placed on its skids with one end of the pallet supported on a beam 4-1/2 inches high. The height of the beam was increased if necessary to ensure that there was no support for the skids between the ends of the pallet when dropping took place, but was not high enough to cause the pallet to slide on the supports when the dropped end was raised for the drops. The unsupported end of the pallet was then 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 conforms to the following tabulation:

| GROSS WEIGHT<br>(WITHIN RANGE<br>LIMITS)<br>(Pounds) | DIMENSIONS OF<br>ANY EDGE, HEIGHT<br>OR WIDTH (WITHIN<br>RANGE LIMITS)<br>(Inches) | HEIGHT OF DROPS<br>ON EDGES |          |
|--|--|-----------------------------|----------|
|  |  | Level A                     | Level B  |
|  |  | (Inches)                    | (Inches) |
| 150 - 250  | 60 - 66  | 36                          | 27       |
| 250 - 400  | 66 - 72  | 32                          | 24       |
| 400 - 600  | 72 - 80  | 28                          | 21       |
| 600 - 1,000  | 80 - 95  | 24                          | 18       |
| 1,000 - 1,500  | 95 - 114   | 20                          | 16       |
| 1,500 - 2,000  | 114 - 144  | 17                          | 14       |
| 2,000 - 3,000  | Above 145 - No limit   | 15                          | 12       |
| Above - 3,000  |  | 12                          | 9        |

D. INCLINE-IMPACT TEST. This test was 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 was placed on the carriage with the surface or edge to be impacted

projecting at least 2 inches beyond the front end of the carriage. The carriage was brought to a predetermined position on the incline and released. If it was desired to concentrate the impact on any particular position on the container, a 4- by 4-inch timber was attached to the bumper in the desired position before the test. No part of the timber was struck by the carriage. The position of the container on the carriage and the sequence in which surfaces and edges were subjected to impacts was at the option of the testing activity and depends upon the objective of the tests. This test was to determine satisfactory requirements for a container or pack, and, unless otherwise specified, the specimen was 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 was 7 feet per second.

## PART 4

### TEST EQUIPMENT

#### A. Compression Tester.

- |                       |                      |
|-----------------------|----------------------|
| 1. Manufacturer:      | Ormond Manufacturing |
| 2. Platform:          | 60- by 60-inches     |
| 3. Compression Limit: | 50,000 pounds        |
| 4. Tension Limit:     | 50,000 pounds        |

#### B. Transportation Simulator.

- |                  |                    |
|------------------|--------------------|
| 1. Manufacturer: | Gaynes Laboratory  |
| 2. Capacity:     | 6,000-pound pallet |
| 3. Displacement: | 1/2-inch amplitude |
| 4. Speed:        | 50 to 400 rpm      |
| 5. Platform:     | 5- by 8-foot       |

#### C. Inclined Plane.

- |                  |                    |
|------------------|--------------------|
| 1. Manufacturer: | Conbur Incline     |
| 2. Type:         | Impact Tester      |
| 3. Grade:        | 10 percent incline |
| 4. Length:       | 12-foot            |

## PART 5

### TEST RESULTS

During the approval process, four Clip-Lok pallets were tested with the MIL-STD-1660 criteria for shipment of ammunition loads. After each of the three pallet failures, Clip-Lok SimPak USA, Inc. made alterations to the pallet designs based on the performance and mode of failure during the testing. Two additional partial tests were also performed in order to assess the viability of potential modifications using previously tested pallets.

A. Test 1. Clip-Lok pallet design submission No. 1.

|                |  |
|----------------|--|
| Date:          | 14 March 1996  |
| Weight:        | 3,110 pounds   |
| Length:        | 48-1/4 inches  |
| Width:         | 40-1/4 inches  |
| Height:        | 50-1/2 inches  |
| Configuration: | 24 clips on pallet box, no metal banding, loaded with 105mm<br>C445 ammunition boxes |

1. Compression Test. The test pallet was compressed with a load force of 11,825 pounds for 60 minutes. No damage was noted as a result of this test.

2. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 200 RPM in the longitudinal orientation and 90 minutes at 190 RPM in the lateral orientation. No damage was noted as a result of this test.

3. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 24-inches on the longitudinal and lateral drops. During the longitudinal drops, three clips fell off of the pallet box during the first drop and four clips fell off during the fourth drop. No clips fell off during the lateral drops. Results from this testing indicated that two clips along the long side of the pallet base was going to be insufficient to prevent the pallet base from bowing.

4. Incline-Impact Test. The test pallet was incline-impacted on all four sides from an incline distance of 8-feet. No damage or loss of clips was noted during this test.

5. Post Test Inspection. After the completion of MIL-STD-1660 testing, the pallet was disassembled and inspected for additional damage. Additional damage noted included significant wear to the bottom of the pallet skids, all six skid tips were broken off at the edge of the pallet skid post, and the pallet deck was cracked at the edge of the pallet around one of the middle skid posts. The pallet was rejected primarily on the fact that the clips fell off during the edgewise rotational drop testing.

B. Test 2. Clip-Lok pallet design submission No. 2.

|                |   |
|----------------|---|
| Date:          | 22-23 April 1996  |
| Weight:        | 3,010 pounds  |
| Length:        | 48-1/4 inches   |
| Width:         | 40-1/4 inches   |
| Height:        | 50-1/2 inches   |
| Configuration: | 28 clips on pallet box, no metal banding, loaded with 105mm C445 ammunition boxes |

1. Compression Test. The test pallet was compressed with a load force of 11,445 pounds for 60 minutes. No damage was noted as a result of this test.

2. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 250 rpm in the longitudinal orientation and 90 minutes at 220 rpm in the lateral orientation. During the initial shaker table speed adjustments, two clips fell off of the pallet. The clips were replaced and testing continued.

3. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 24-inches on the longitudinal and lateral drops. During the second drop (lateral), one of the upper corner clips (at impact end) and top edge clip (at impact end) fell off of the pallet. After inspection, one of the clips was noted to have been permanently deformed and was

replaced before testing continued. During the fourth drop (lateral), one of the short side bottom edge clips (at impact end) fell off during the drop. No damage or loss of clips was noted during the longitudinal drops.

4. Incline-Impact Test. The test pallet was incline-impacted on all four sides from an incline distance of 8-feet. No damage or loss of clips was noted during this test.

5. Post Test Inspection. After the completion of MIL-STD-1660 testing, the pallet was disassembled and inspected for additional damage. No additional damage was noted; however, the pallet was rejected due to the loss of the clips during the repetitive shock and edgewise rotational drop testing.

C. Test 3. Clip-Lok pallet design submission No. 2, engineering modification test.

Date: 23 April 1996  
Weight: 3,010 pounds  
Length: 48-1/4 inches  
Width: 40-1/4 inches  
Height: 50-1/2 inches  
Configuration: 28 clips on pallet box, four 3/4-inch metal bands added to pallet  
(see photos in Part 6), loaded with 105mm C445 ammunition boxes

1. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 24-inches on the longitudinal and lateral drops. No damage or loss of clips was experienced during the drop tests after the metal banding was added to the pallet.

D. Test 4. Clip-Lok pallet design submission No. 3.

Date: 26 July 1996  
Weight: 4,335 pounds  
Length: 48-1/4 inches  
Width: 40-1/4 inches  
Height: 50-1/2 inches  
Configuration: 28 clips on pallet box, four 3/4-inch metal bands added to pallet,  
loaded with 30 M548 containers

1. Compression Test. The test pallet was compressed with a load force of 16,565 pounds for 60 minutes. No damage was noted as a result of this test.

2. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 135 rpm in the longitudinal orientation and 90 minutes at 140 rpm in the lateral orientation. Approximately 60 minutes into the longitudinal orientation, one of the top clips broke. The clip was replaced and an additional 3/4-inch band was placed horizontally around the pallet midway between the side clips. The longitudinal orientation was restarted for an additional 90 minutes. No additional problems were experienced during the repetitive shock test.

3. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 12-inches on the longitudinal and lateral drops. During the first drop (longitudinal), both middle side clips disengaged from the pallet. During the second drop (lateral), the middle containers on either side of the skid post broke through the deck plywood (see photos in Part 6). The pallet was rejected at this point and no additional testing was conducted.

E. Test 5. Clip-Lok pallet design submission No. 3.

|                |  |
|----------------|--|
| Date:          | 29 July 1996   |
| Weight:        | 4,305 pounds   |
| Length:        | 48-1/4 inches  |
| Width:         | 40-1/4 inches  |
| Height:        | 50-1/2 inches  |
| Configuration: | 28 clips on pallet box, seven 3/4-inch metal bands added to pallet (see photos in Part 6), 3/4-inch layer of plywood placed on top of pallet base prior to loading, loaded with 24 M548 containers |

1. Compression Test. The test pallet was compressed with a load force of 16,530 pounds for 60 minutes. No damage was noted as a result of this test.

2. Repetitive Shock Test. The test pallet was vibrated 90 minutes at 165 RPM in the longitudinal orientation and 90 minutes at 186 RPM in the lateral orientation. No damage or loss of clips was noted.

3. Edgewise Rotational Drop Test. The test pallet was edgewise rotationally dropped from a height of 12-inches on the longitudinal and lateral drops. The skids were noted to have bent during the drops; however, no permanent damage or loss of clips was noted.

4. Incline-Impact Test. The test pallet was incline-impacted on all four sides from an incline distance of 8-feet. No damage or loss of clips was noted during this test.

5. Post Test Inspection. After the completion of MIL-STD-1660 testing, the pallet was disassembled and inspected for additional damage. No damage was noted. The Clip-Lok pallet, design No. 3, with the additional layer of plywood and the 3/4-inch metal banding was considered to have successfully passed MIL-STD-1660 testing.

F. Test 6. Clip-Lok pallet design submission No. 3.

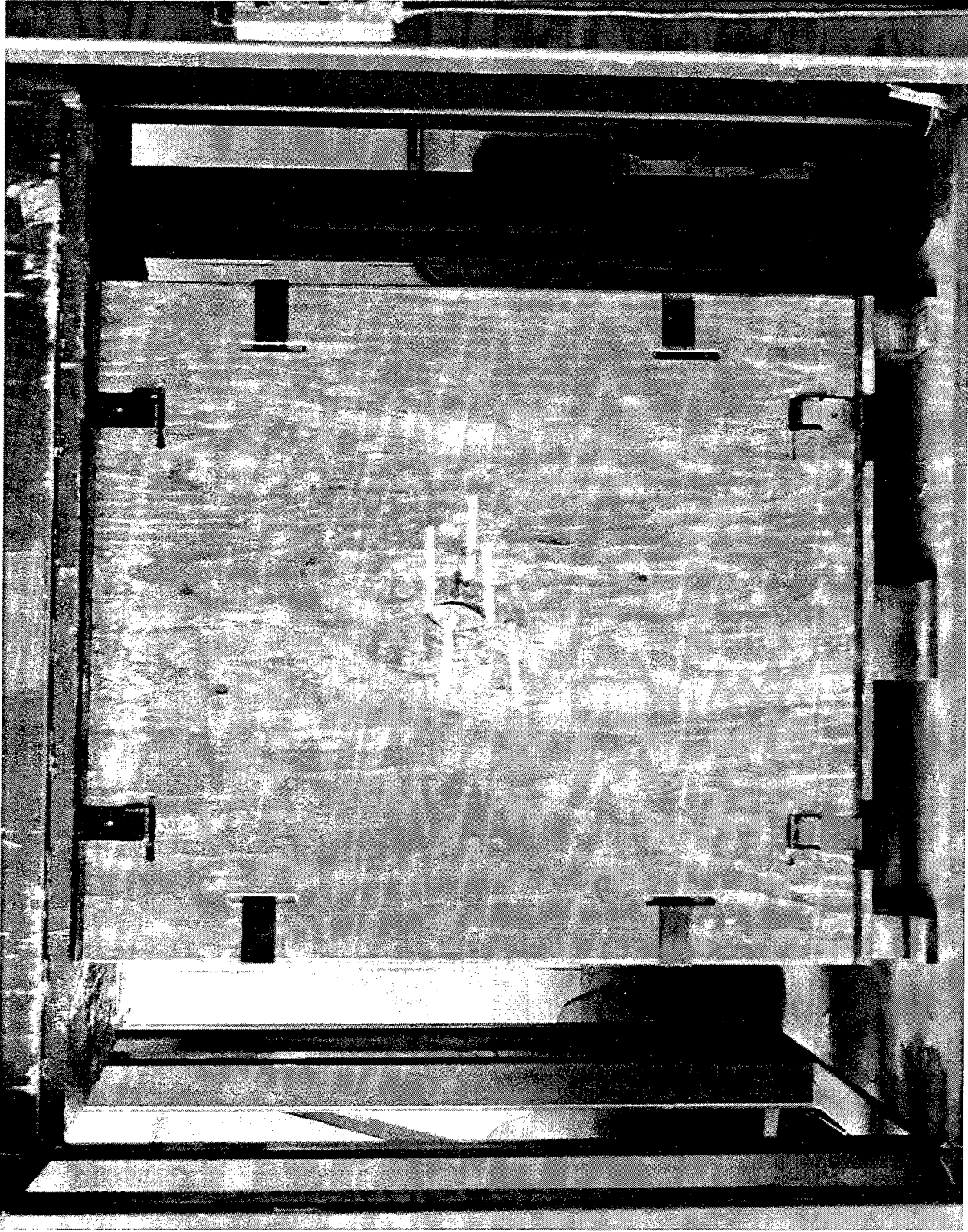
|                |  |
|----------------|--|
| Date:          | 23 August 1996   |
| Weight:        | 2,985 pounds   |
| Length:        | 48-1/4 inches  |
| Width:         | 40-1/4 inches  |
| Height:        | 50-1/2 inches  |
| Configuration: | 28 clips on pallet box, seven 3/4-inch metal bands added to pallet (see photos in Part 6), original pallet base configuration (no additional layer of 3/4-inch plywood), loaded with 105mm C445 ammunition boxes |

1. Edgewise Rotational Drop Test. An additional edgewise rotational drop test was conducted at 3,000 pounds without the additional layer of 3/4-inch plywood to determine if the plywood would only be needed for pallet weights in excess of 3,000 pounds. The test pallet was edgewise rotationally dropped from a height of 15-inches on the longitudinal and lateral drops. After completion of the test, the pallet deck was noted to have deformed along one of the

grooves in the pallet deck that was added for storage of the clips in the collapsed shipping mode. Deformation of the base allowed one of the sides to shift approximately 1/2-inch relative to the top of the pallet box. Had the load consisted of a commodity that provided more point loading than the 105mm boxes; i.e., M548 containers, the pallet deck would have probably cracked. Due to the marginal results of this test, the 3/4-inch layer of plywood was determined to be mandatory on all load weights for this pallet as well as the seven 3/4-inch metal bands.

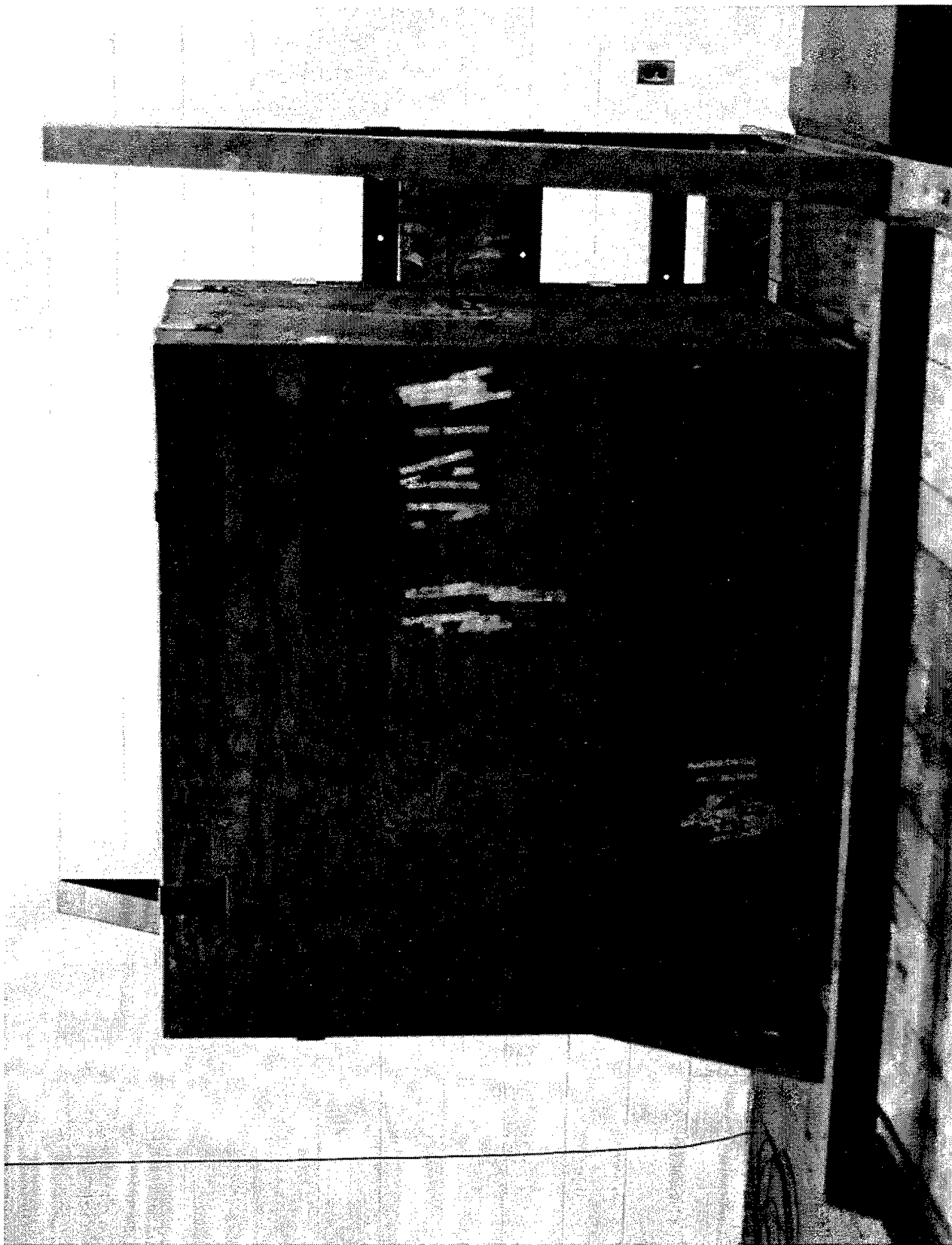
PART 6

PHOTOGRAPHS



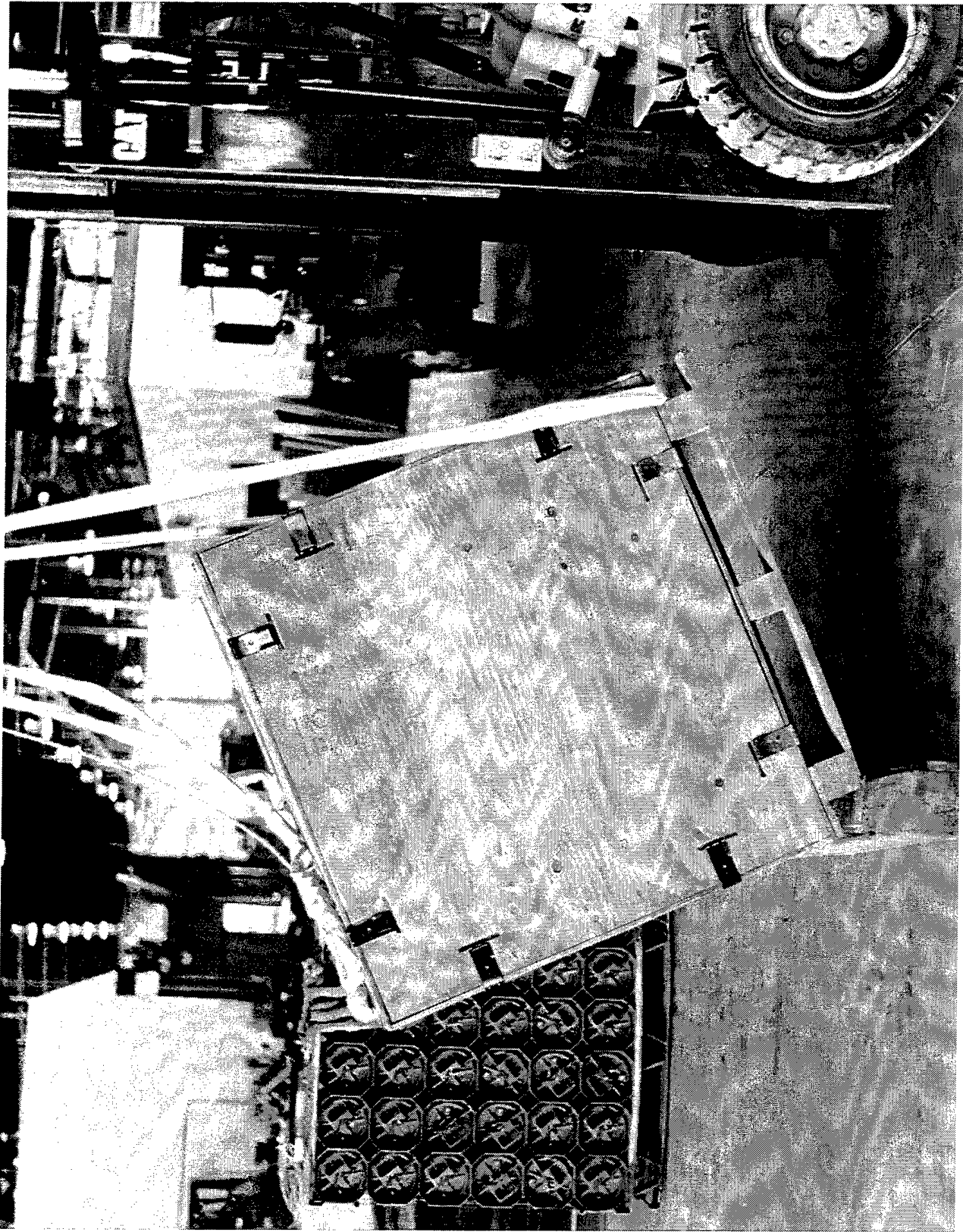
U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-136-2150. This photograph shows the first Clip-Lok pallet in the compression tester.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-136-2144. This photograph shows the first Clip-Lok pallet on the vibration table in the lateral orientation.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-136-2153. This photograph shows the first Clip-Lok pallet raised for one of the edgewise rotational drops.



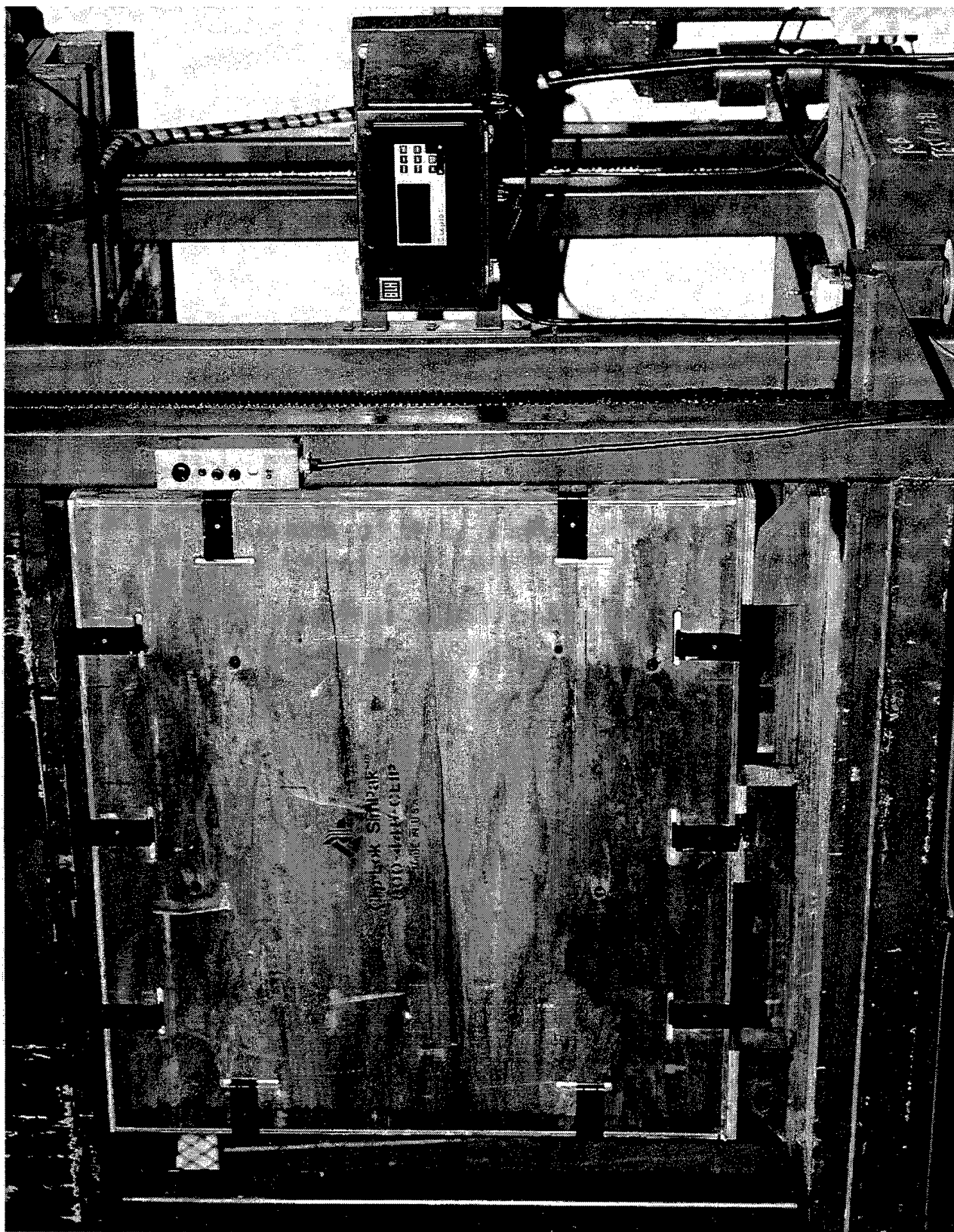
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PHOTO NO. A0317-SCN-96-136-2159. This photograph shows the first Clip-Lok pallet after one of the longitudinal edgewise rotational drops. Note the damage to the skids and the missing clips.



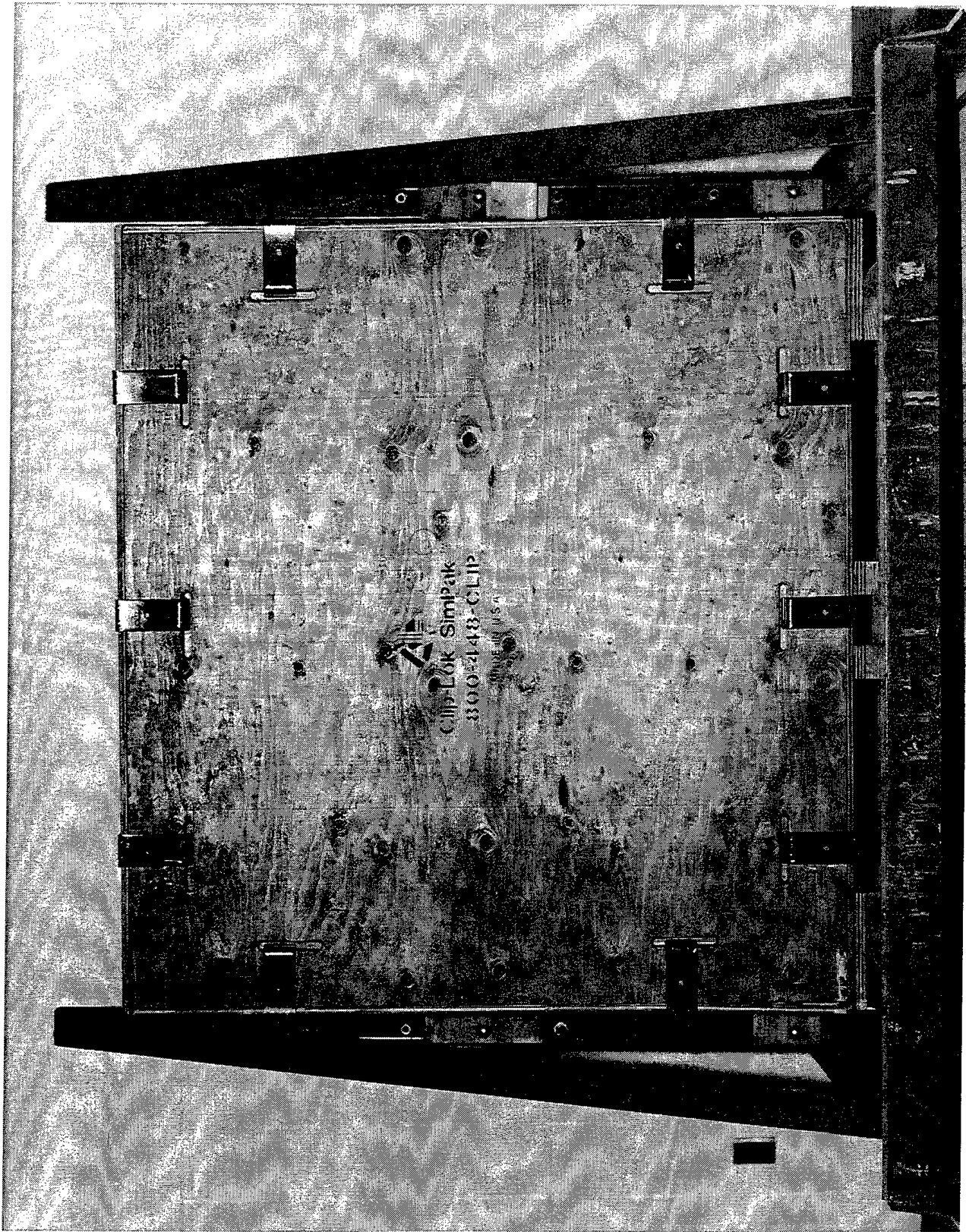
U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-136-2163. This photograph shows the first Clip-Lok pallet on the incline-impact tester.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-134-2632. This photograph shows the second Clip-Lok pallet in the compression tester.



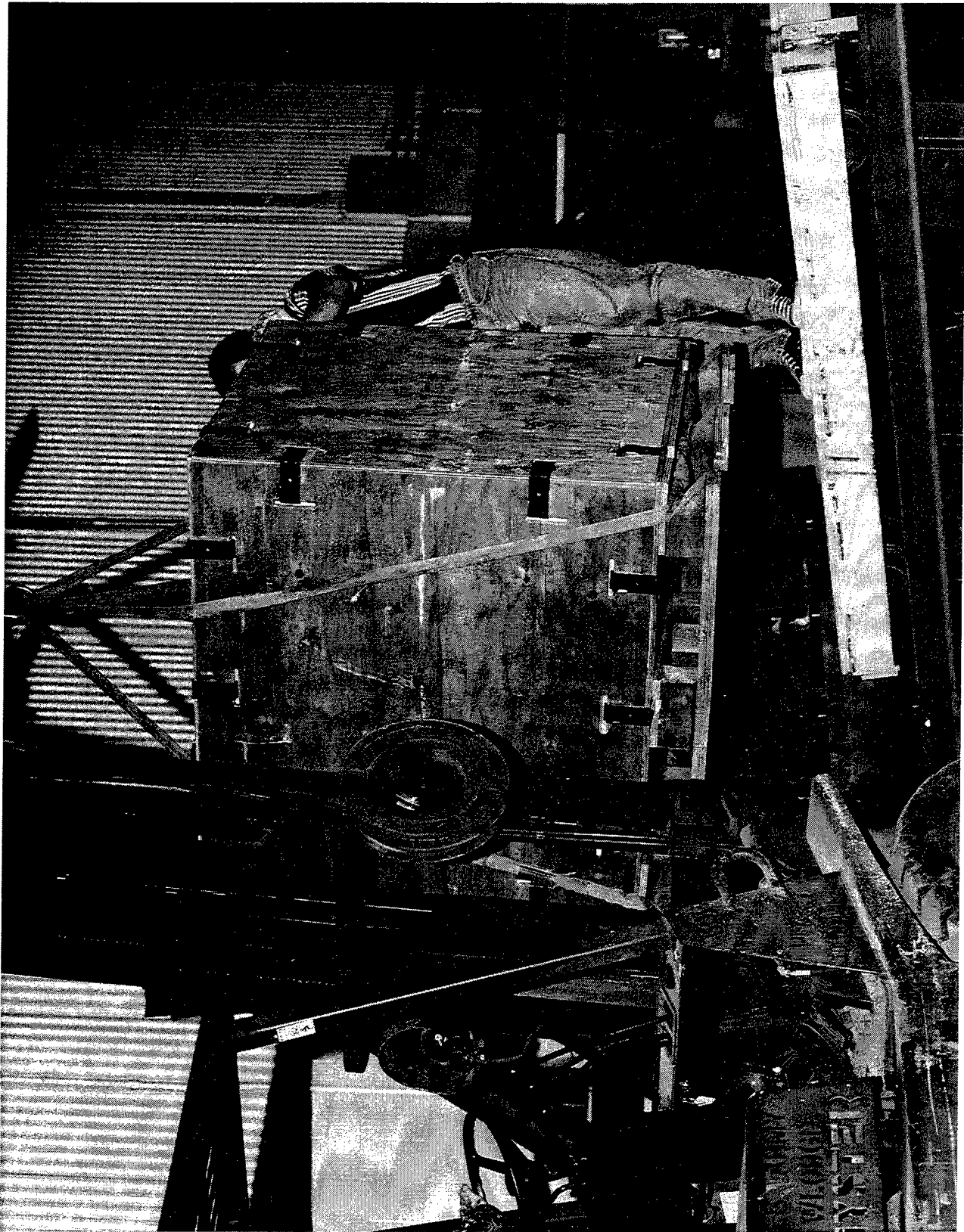
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PHOTO NO. A0317-SCN-96-134-2604. This photograph shows the second Clip-Lok pallet on the vibration table in the lateral orientation.



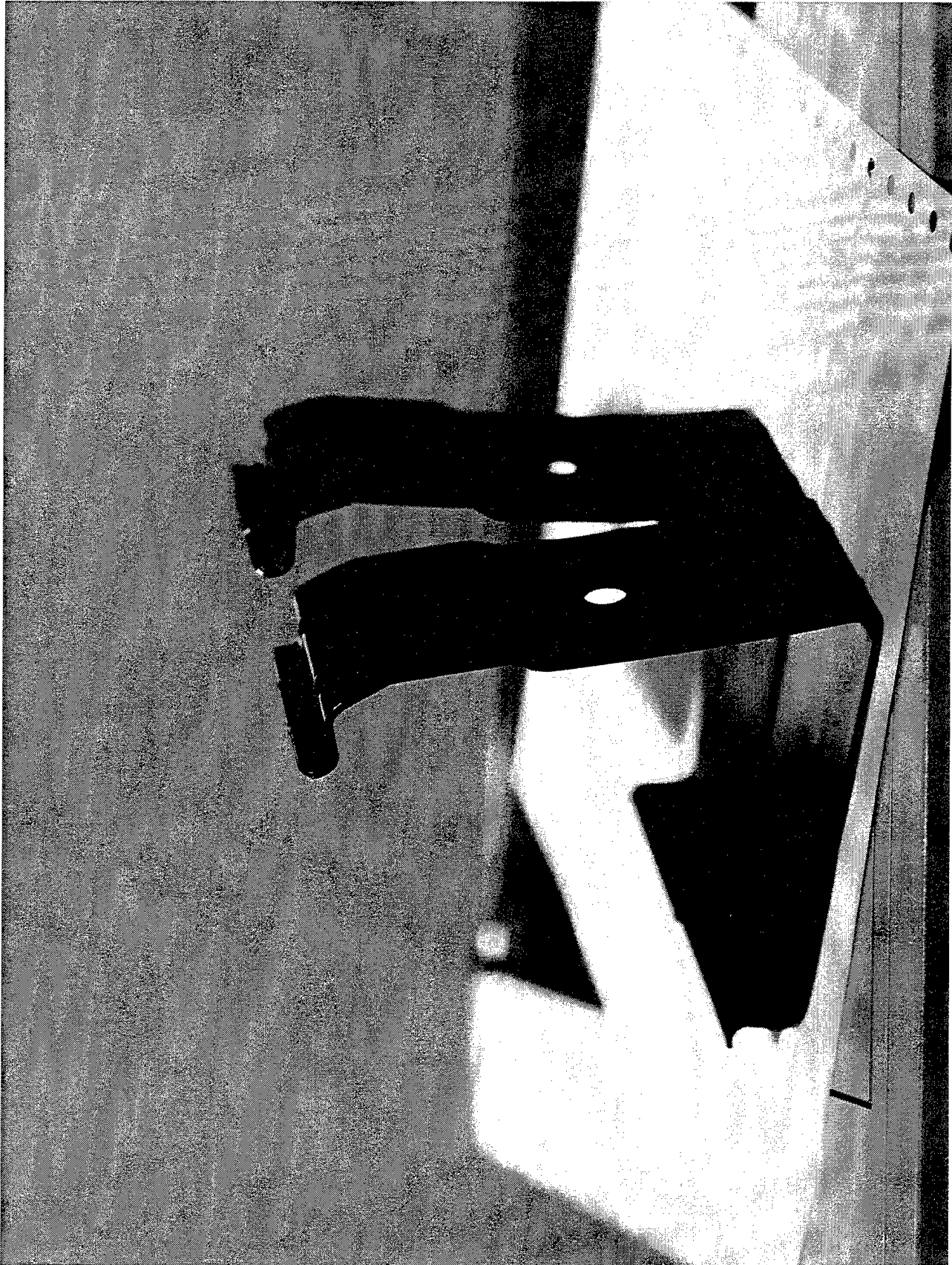
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PHOTO NO. A0317-SCN-96-134-2611. This photograph shows the second Clip-Lok pallet raised for one of the edgewise rotational drops.



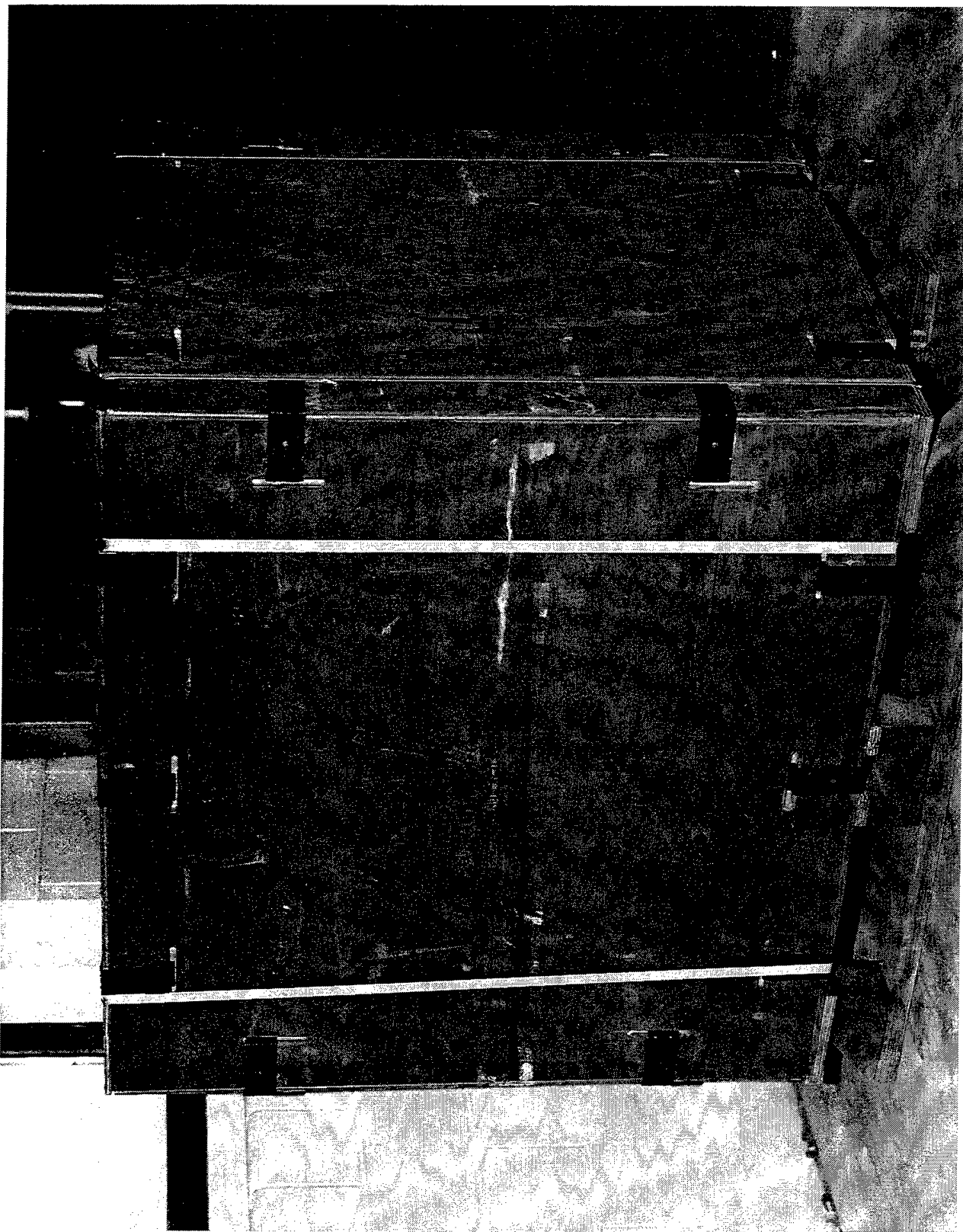
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PHOTO NO. A0317-SCN-96-134-2630. This photograph shows the second Clip-Lok pallet being placed on the incline-impact tester.



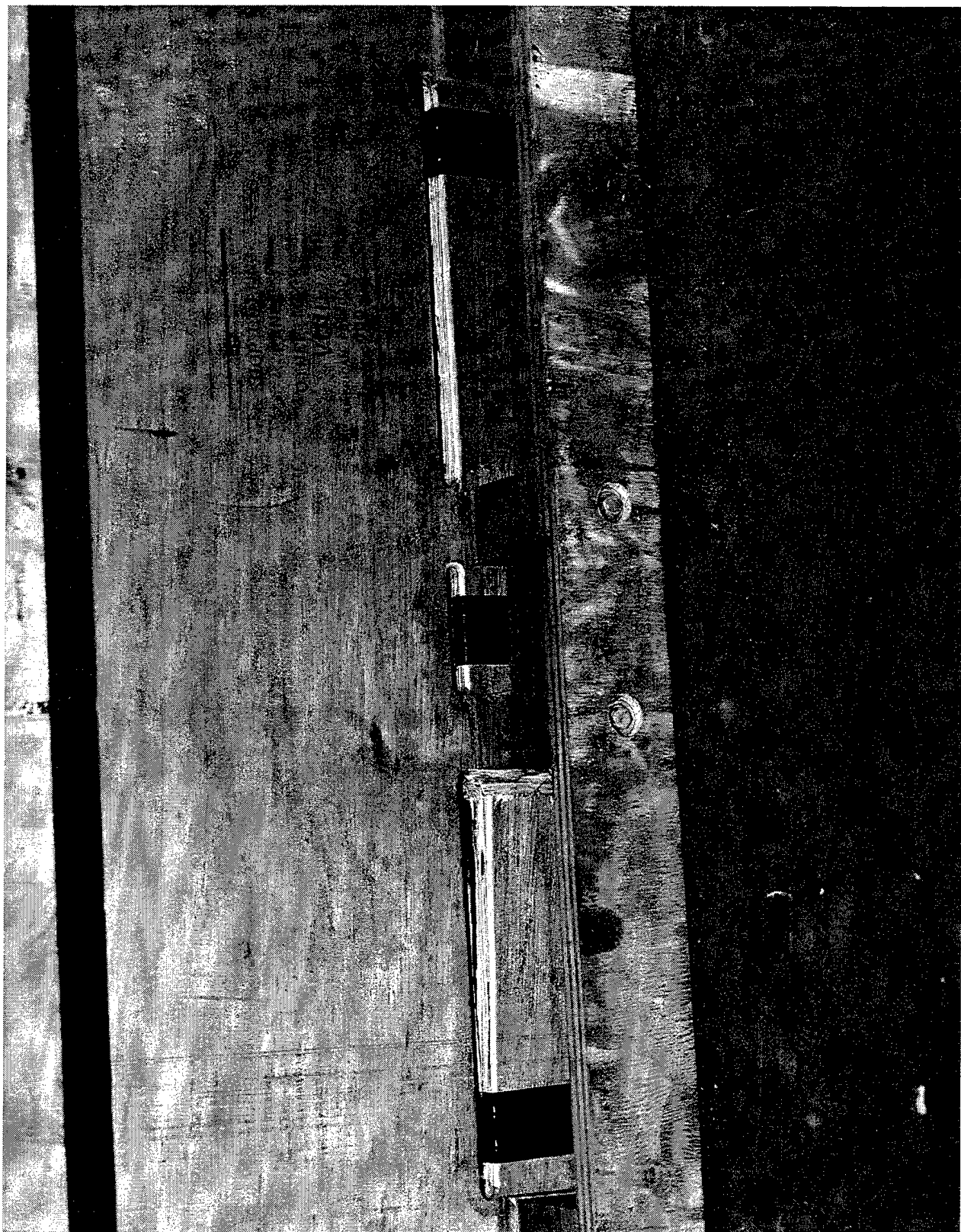
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PHOTO NO. A0317-SCN-96-134-2623. This photograph shows an undamaged clip in the foreground and the deformed clip in the background.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-134-2027. This photograph shows the steel strapping that was added to the second Clip-Lok pallet in an attempt to prevent the clips from falling off during the edgewise rotational drops.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-134-4654. This photograph shows the damage that the third Clip-Lok pallet sustained during the edgewise rotational drop test with a 4,000-pound test load.



U.S. ARMY DEFENSE AMMUNITION CENTER - SAVANNA, IL

PHOTO NO. A0317-SCN-96-134-4653. This photograph shows the third Clip-Lok pallet with steel strapping that met MIL-STD-1660 criteria for shipment of ammunition loads.

PART 7

DRAWINGS

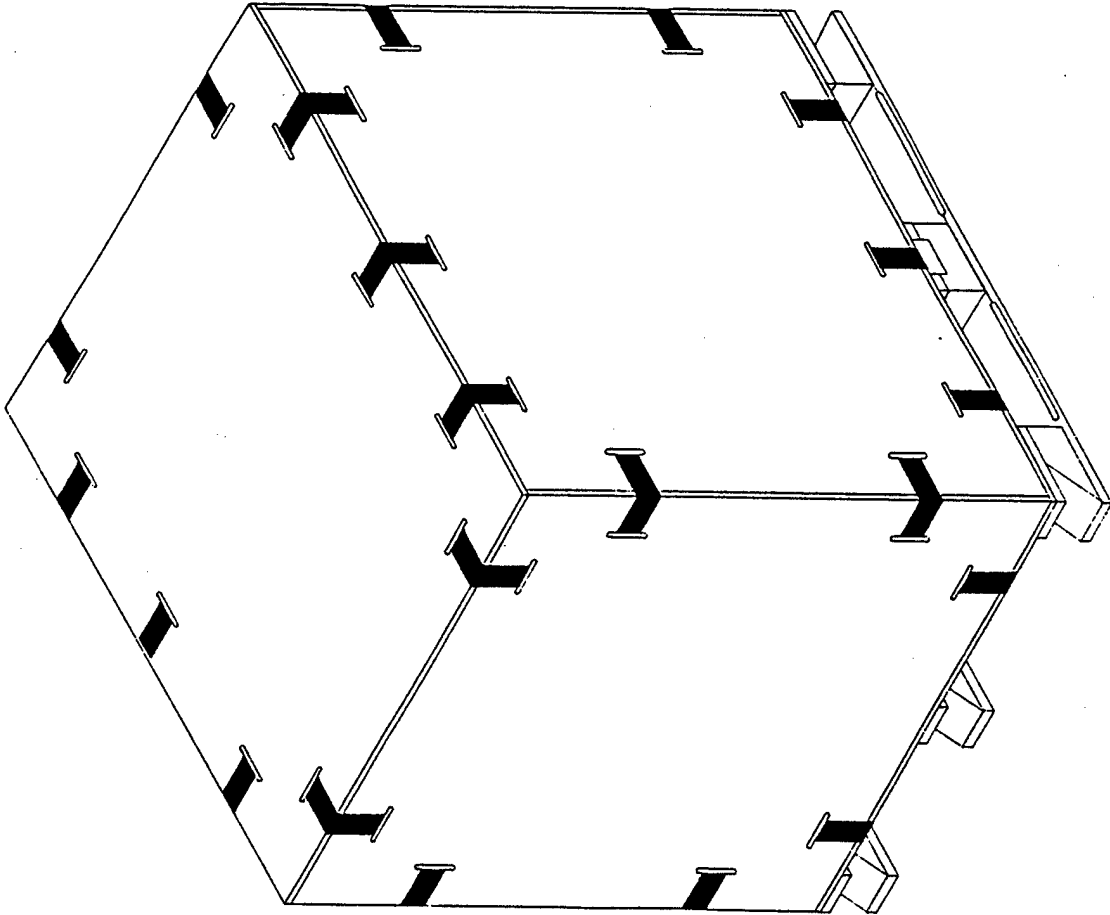
# **MANUFACTURER'S DRAWINGS**



ISOMETRIC VIEW

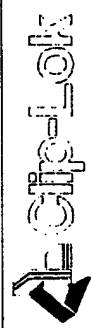
Mon Feb 12 16:59:02 1996

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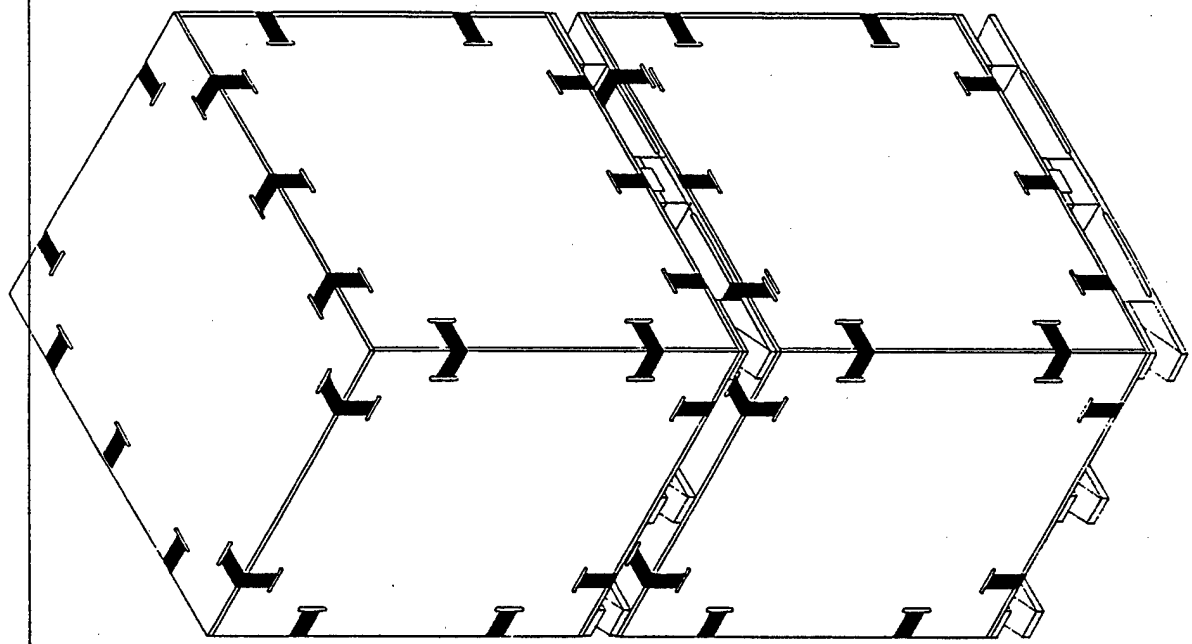
Customer : Rock Island Arsenal  
Project number : 1  
Clip-Lok Ref : RI49661  
Dimension Length Width Height  
External : 48 x 40 x 50 ins.  
Internal : 46.5 x 38.5 x 43.4 ins.  
Int. Capacity : 45 ft3  
Type of clips : Big  
Total clips : 28  
Type of pallet : 4-way entry

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STAGING CASES

Mon Feb 12 15:59:02 1996



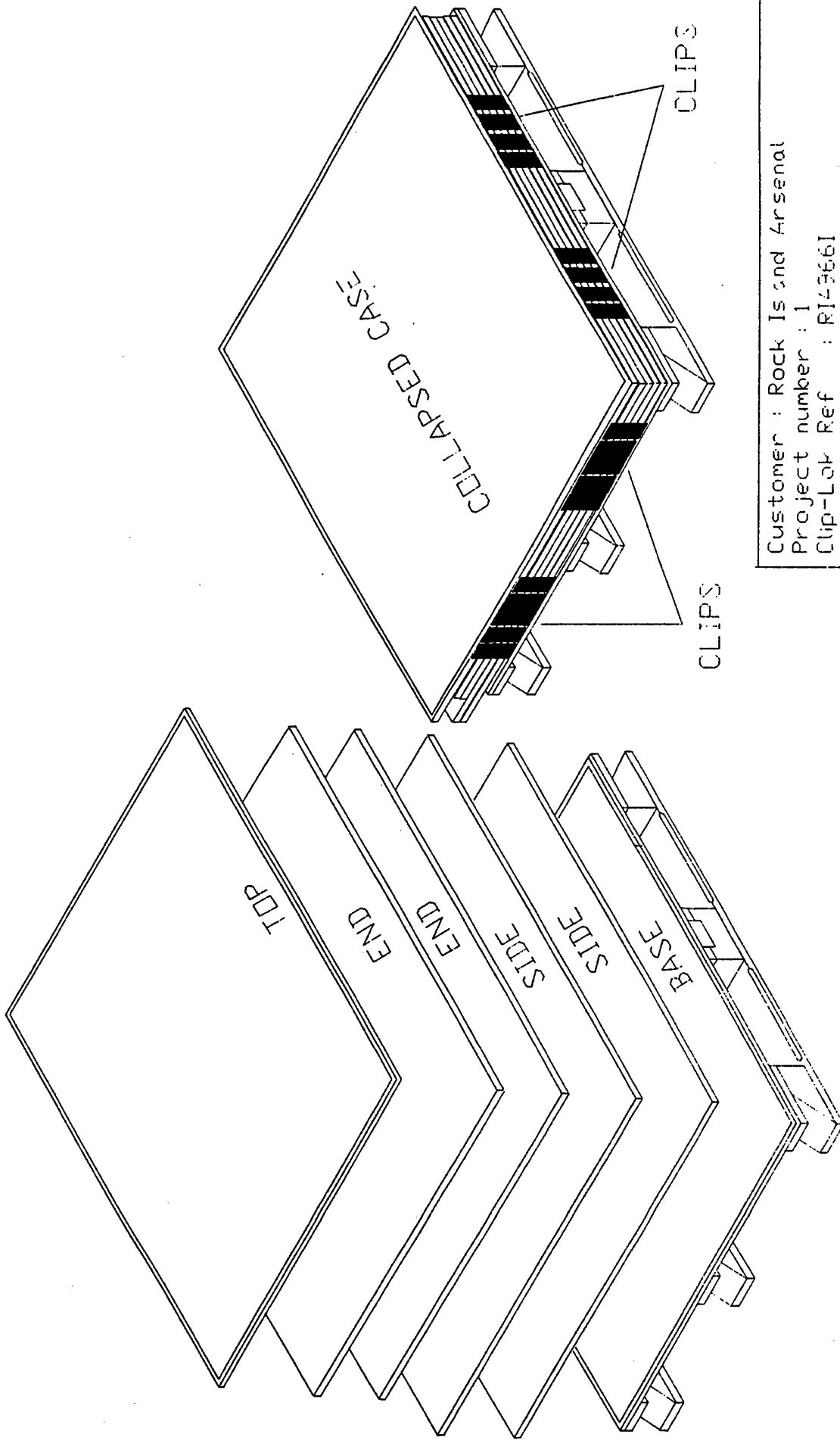


ISOMETRIC VIEW

Mon Feb 12 16:59:02 1996

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# COLLAPSING OF CASE



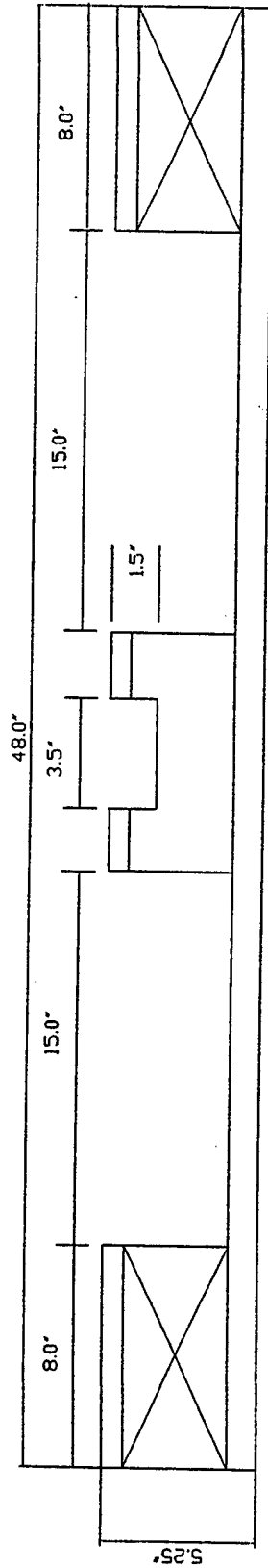
Customer : Rock Is and Arsenal  
 Project number : 1  
 Clip-Lok Ref : RI-9661



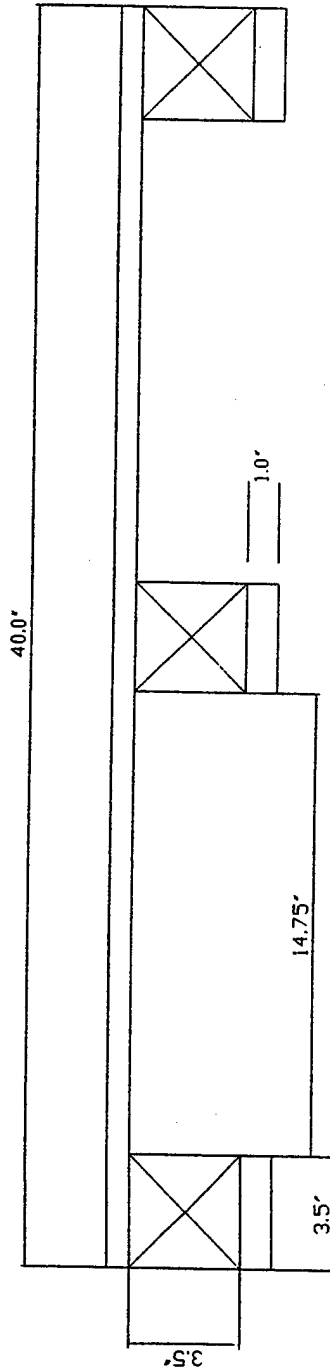
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### 4-WAY PALLET SIDE & END VIEWS

Mon Jun 24 21:42:47 1996



Side View

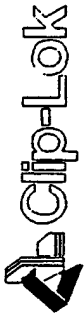


End View

Customer : Rock Island Arsenal  
 Project number : 1  
 Clip-Lok Ref : RIA966A

Number of bearers : 3  
 Runner material : PLYWOOD  
 Block material : HARDWOOD  
 Crossmember material : PLYWOOD

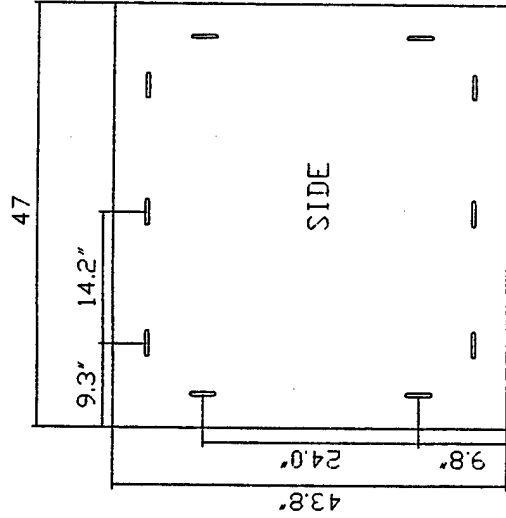
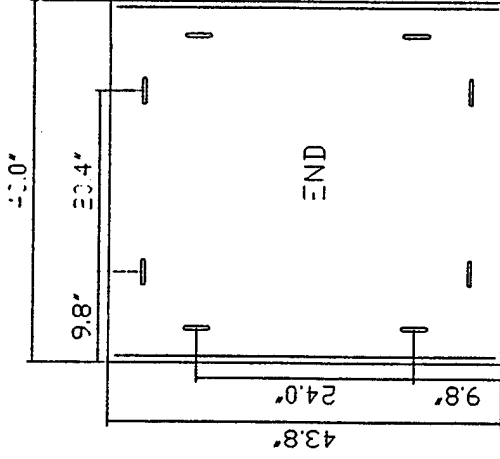
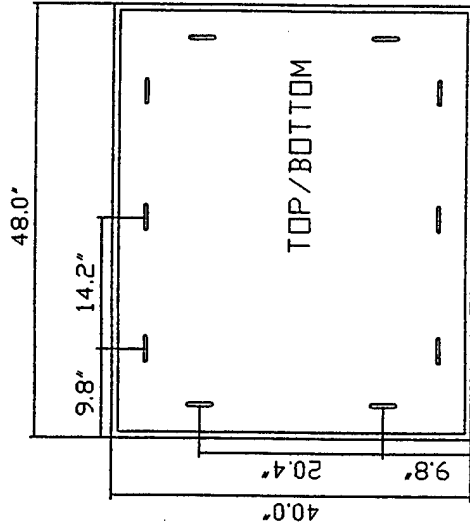
Main handling along length  
 Pallet base height : 5.25'



ALL PANELS

Mon Jun 24 21:42:36 1996

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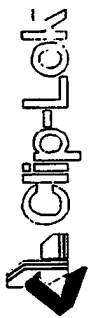


Customer name : Rock Island Arsenal  
Project number : 1  
Clip-Lok Ref : RIA966A

Top material : PLYWOOD  
Top thickness : 0.75 ins.

Side/End material : PLYWOOD  
Side/End thickness : 0.75 ins.

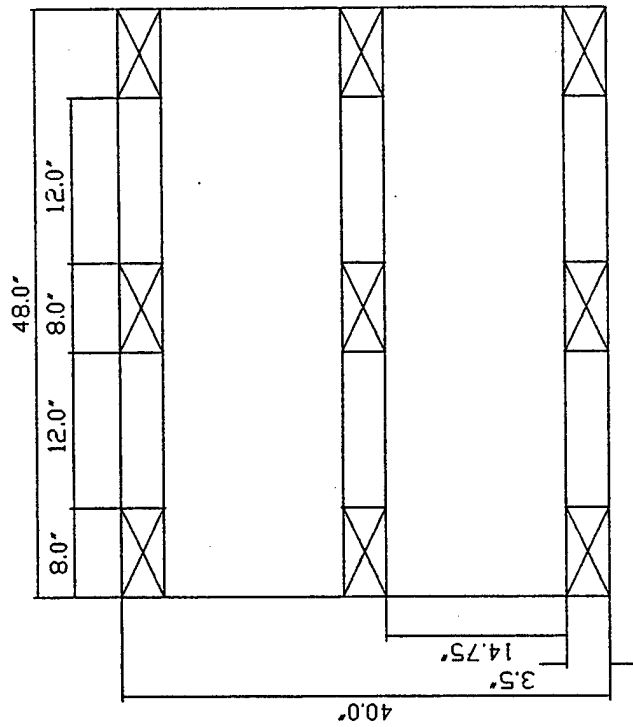
Bottom material : PLYWOOD  
Bottom thickness : 0.75 ins.



# 4-WAY PALLET - TOP VIEW

Mon Jun 24 21:42:59 1996

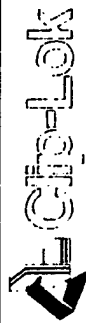
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Customer: Rock Island Arsenal  
 Project number : 1  
 Clip-Lok Ref : PIA966A

Nails per block : 0  
 Total number of nails : 0  
 Bolts per block : 2  
 Total number of bolts : 12

Main handling along length  
 Pallet base height : 5.25"  
 Crossmembers on the blocks



BASE PANEL GROOVES

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48.0"

12.0"

12.0"

40.0"

BASE

GROOVES TO BE CUT  
BETWEEN  
BLOCKS

Customer name : Rock Island Arsenal  
Project number : 1  
Clip-Lok Ref : RIA966A

# **UNITIZATION PROCEDURES**

# UNITIZATION PROCEDURES FOR PALLET BOX PACKING OF RETROGRADE AMMUNITION

## WARNING

THIS DRAWING IS ONLY AUTHORIZED FOR RETROGRADE OPERATIONS, WHEN SPECIFIC PACKING PROCEDURES HAVE BEEN REQUESTED IN WRITING AND PROVIDED BY COMMANDER, U.S. ARMY INDUSTRIAL OPERATIONS COMMAND, ATTN: AMSTA-AR-ESK, ROCK ISLAND, IL 61299-7300, FOR SPECIFIC APPENDIX APPROVAL AND COMPETENT AUTHORITY APPROVAL (CAA).

## INDEX

| <u>ITEM</u>                              | <u>PAGES</u> |
|--|--------------|
| PALLET UNIT A - - - - -                  | 2            |
| DUNNAGE DETAILS - - - - -                | 3,4          |
| PALLET UNIT B CLIP-LOK RIA966I - - - - - | 5,6,7        |

## REVISION

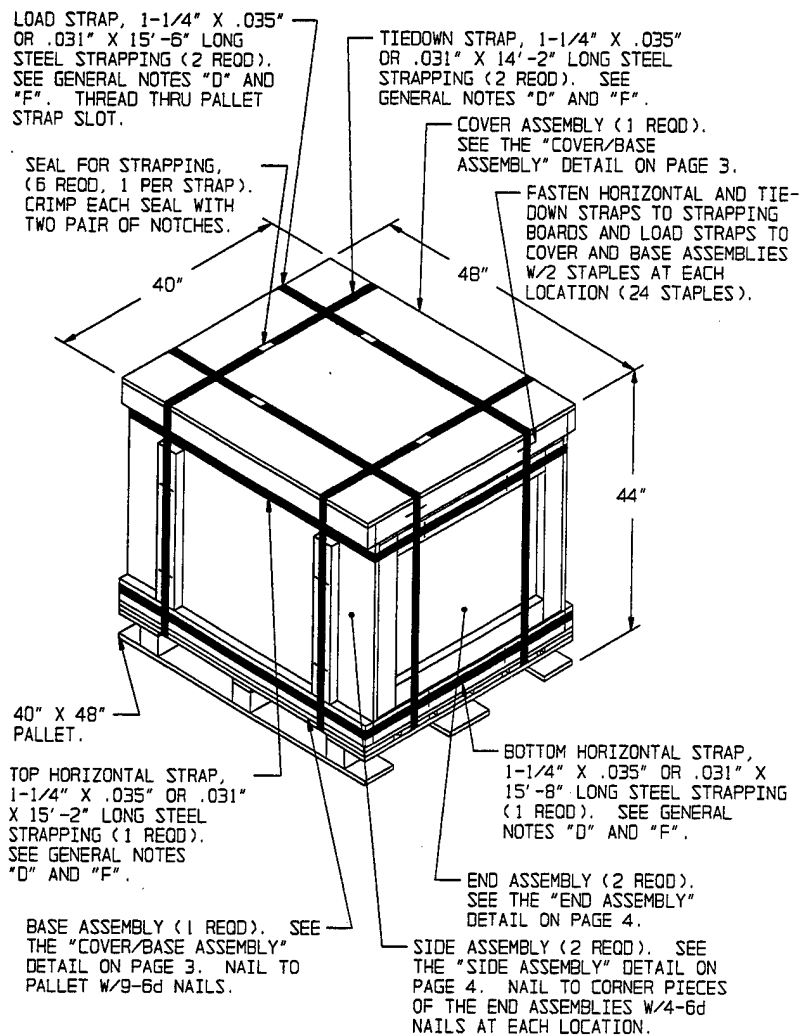
REVISION NO. 3, DATED JUNE 1996, CONSISTS OF:

1. DELETING PALLET UNIT A.
2. RENAMING PALLET UNIT B TO PALLET UNIT A.
3. ADDING GENERAL NOTE PERMITTING CONTINUED USE OF EXISTING PALLET UNIT A STOCKS.
4. CHANGING 2" X 8" PIECES IN BASE ASSEMBLY TO 2" X 4".
5. ADDING CLIP-LOK PALLET BOX.
6. CHANGING ADDRESS IN WARNING.

| U.S. ARMY MATERIEL COMMAND DRAWING                                  |           |                               |   |
|---|-----------|-------------------------------|---|
| APPROVED, U.S. ARMY INDUSTRIAL OPERATIONS COMMAND                   |           | DRAFTSMAN                     | BETTY J. KUNDERT                          |
| <i>David A. Pichard</i> <i>James B. Hahn</i>                        |           | ENGINEER                      | SANDRA M. SCHULTZ                         |
| AMSTA-AR-ESK  | AMSIO-TMJ | SUPPLY ENGINEERING DIVISION   | TRANSPORTATION ENGINEERING DIVISION       |
|   |           | <i>T.J. Michel</i>            | <i>Laura A. Fisher</i> <i>J.M. Keenan</i> |
| APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND |           | *LOGISTICS ENGINEERING OFFICE |   |
| <i>Larry V. Dullaba</i>   |           | <i>William J. Ernst</i>       |   |
| DEFENSE AMMUNITION CENTER   |           | MAY 1991                      |   |
| REVISION NO. 3  | JUNE 1996 | CLASS                         | DIVISION                                  |
| SEE REVISION LISTING ABOVE  |           | 19                            | 48  |
|   |           | DRAWING                       | FILE                                      |
|   |           | 4233                          | 20PE<br>1000                              |

DO NOT SCALE

**GENERAL NOTES**



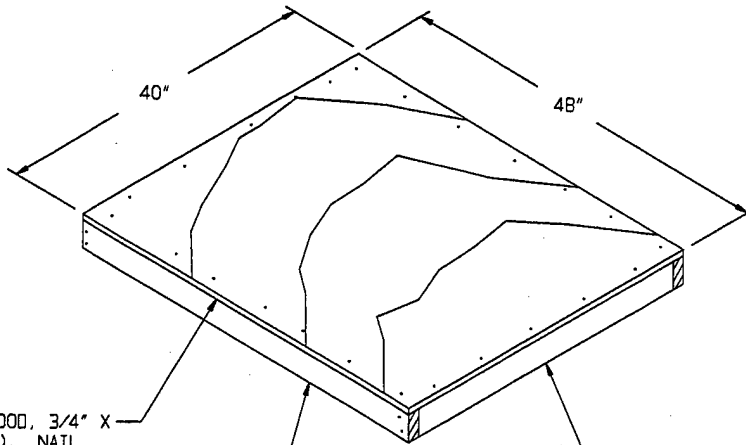
- A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH AR 740-1, AND AUGMENTS TM 743-200-1 (CHAPTER 5) AND CONFORMS TO MIL-STD-1660.
- B. DIMENSIONAL LUMBER SPECIFIED THROUGHOUT THE DRAWING IS OF NOMINAL SIZE. FOR EXAMPLE, 2" X 4" MATERIAL IS ACTUALLY 1-1/2" THICK BY 3-1/2" WIDE.
- C. UNLESS OTHERWISE SPECIFIED, A MANUFACTURING TOLERANCE OF + OR - 1/4" IS ALLOWED ON ALL DIMENSIONS. ALTHOUGH A + OR - 1/4" TOLERANCE IS ALLOWED, ALL DIMENSIONAL LUMBER MEMBERS IN A SET, SUCH AS VERTICAL PIECES IN AN END ASSEMBLY, MUST BE WITHIN 1/8" OF THE SAME LENGTH.
- D. WHEN APPLYING ANY STRAP, CARE MUST BE EXERCISED TO ASSURE THAT THE END OF THE STRAP ON THE UNDERSIDE OF THE JOINT EXTENDS AT LEAST 6" BEYOND THE SEAL. THE EXTRA MINIMUM LENGTH OF STRAP IS REQUIRED TO PERMIT SUBSEQUENT TIGHTENING OF LOOSENED STRAPPING. RETENSIONING CAN BE ACCOMPLISHED WITHOUT REPLACING STRAPPING OR SPLICING STRAPPING THROUGH THE USE OF A MANUAL OR PNEUMATIC FEEDWHEEL TYPE TENSIONING TOOL, AS MANUFACTURED BY SEVERAL COMPANIES, AND THE APPLICATION OF ONE ADDITIONAL SEAL.
- E. IN ORDER TO OBTAIN COMPACT AND SOUND UNITS, ALL STRAPS SHALL BE LOCATED IN PROPER ALIGNMENT AND TENSIONED UNTIL THEY CUT INTO THE EDGE OF THE COVER ASSEMBLY AND THE PALLET DECK. AFTER TENSIONING, ALL STRAPS WILL BE SECURED USING ONE SEAL AND TWO PAIR OF NOTCHES PER SEAL.
- F. INSTALL EACH HORIZONTAL, LOAD, AND TIEDOWN STRAP TO BE LOCATED AS SHOWN. HORIZONTAL STRAPS MUST BE TENSIONED AND SEALED PRIOR TO THE APPLICATION OF TIEDOWN AND LOAD STRAPS. LOAD STRAPS MUST BE TENSIONED AND SEALED AFTER THE HORIZONTAL STRAPS AND PRIOR TO THE TIEDOWN STRAPS.
- G. PALLET UNIT DETAILS ARE BASED ON THE MAXIMUM ALLOWABLE DIMENSIONS OF THE PALLET UNIT. THE HEIGHT OF THE SIDE AND END ASSEMBLIES MAY BE SHORTENED ACCORDING TO THE SIZE AND WEIGHT OF THE RETROGRADE AMMUNITION ITEMS INSIDE.
- H. PACKAGED RETROGRADE AMMUNITION MUST CONTACT THE SIDE AND END ASSEMBLIES. FIBERBOARD LINERS SHALL BE USED FOR UNPACKAGED RETROGRADE AMMUNITION TO PREVENT CONTACT WITH THE SIDE AND END ASSEMBLIES. FILLERS SUCH AS PLYWOOD, FIBERBOARD, HONEYCOMB FILLER, FOAM CUSHIONING MATERIAL, OR HARDBOARD SHALL BE ADDED AS REQUIRED TO OBTAIN A TIGHT PACK. FOR PROCEDURES FOR A SPECIFIC ITEM REFER TO THE APPLICABLE APPENDICES.
- J. THE STYLE 1 PALLET DELINEATED IN THE DETAIL AT LEFT NEED NOT HAVE CHAMFERS AS SPECIFIED WITHIN MILITARY SPECIFICATION MIL-P-15011 WHEN USED FOR THE UNITIZATION OF ITEMS COVERED BY THIS APPENDIX.
- K. REGARDLESS OF THE QUANTITY OF RETROGRADE AMMUNITION TO BE PALLETIZED, THE TOTAL WEIGHT OF A FULLY LOADED PALLET UNIT WILL NOT EXCEED 3,000 POUNDS FOR PALLET UNIT A AND 4,000 POUNDS FOR PALLET UNIT B. WHEN THE TOTAL WEIGHT OF A FULLY LOADED PALLET UNIT EXCEEDS THESE WEIGHTS, AMMUNITION MUST BE REMOVED, AND FILLER SUCH AS EMPTY BOXES, FIBERBOARD, HARDBOARD, HONEYCOMB FILLER, FOAM CUSHIONING MATERIAL, PLYWOOD, OR WOOD MUST BE SUBSTITUTED.
- L. PALLET BOXES CONSTRUCTED IN ACCORDANCE WITH THE 19-48-4233 SERIES APPENDICES AND THE BASIC PROCEDURE MAY CONTINUE TO BE USED, BUT NO NEW PALLET BOXES WILL BE FABRICATED IN ACCORDANCE WITH THE SUPERSEDED PROCEDURE.

**PALLET UNIT A  
UNIT DATA**

|                                  |              |                             |
|----------------------------------|--------------|-----------------------------|
| RETROGRADE AMMUNITION INSIDE BOX | -----        | 2,684 LBS (MAXIMUM)         |
| DUNNAGE                          | -----        | 236 LBS                     |
| PALLET                           | -----        | 80 LBS                      |
| <b>TOTAL WEIGHT</b>              | <b>-----</b> | <b>3,000 LBS (MAXIMUM)</b>  |
| <b>CUBE</b>                      | <b>-----</b> | <b>48.9 CU FT (MAXIMUM)</b> |

**BILL OF MATERIAL (UNIT A)**

| LUMBER                    | LINEAR FEET      | BOARD FEET |
|---------------------------|------------------|------------|
| 2" X 4"                   | 57.16            | 38.11      |
| NAILS                     | NO. REOD         | POUNDS     |
| 6d (2")                   | 117              | 0.69       |
| 10d (3")                  | 64               | 0.98       |
| PALLET, 40" X 48"         | 1 REOD           | 80 LBS     |
| STEEL STRAPPING, 1-1/4"   | 90.17' REOD      | 13.66 LBS  |
| SEAL FOR 1-1/4" STRAPPING | 6 REOD           | NIL        |
| PLYWOOD, 3/4"             | 69.58 SQ FT REOD | 143.51 LBS |
| STAPLE, 1-17/32" X 3/4"   | 24 REOD          | NIL        |



COVER PIECE, PLYWOOD, 3/4" X 40" X 48" (1 REQD). NAIL TO LATERAL PIECES W/5-10d NAILS AT EACH LOCATION. NAIL TO LONGITUDINAL PIECES W/7-10d NAILS AT EACH LOCATION.

LONGITUDINAL PIECE, 2" X 4" X 48" (2 REQD). NAIL TO LATERAL PIECES W/2-10d NAILS AT EACH END.

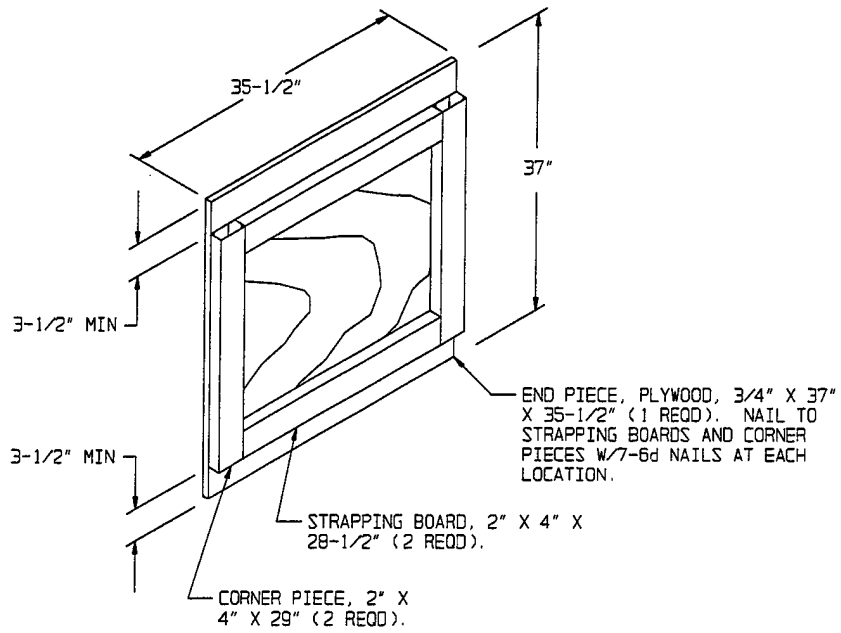
LATERAL PIECE, 2" X 4" X 37" (2 REQD).

COVER/BASE ASSEMBLY

(2 REQD)

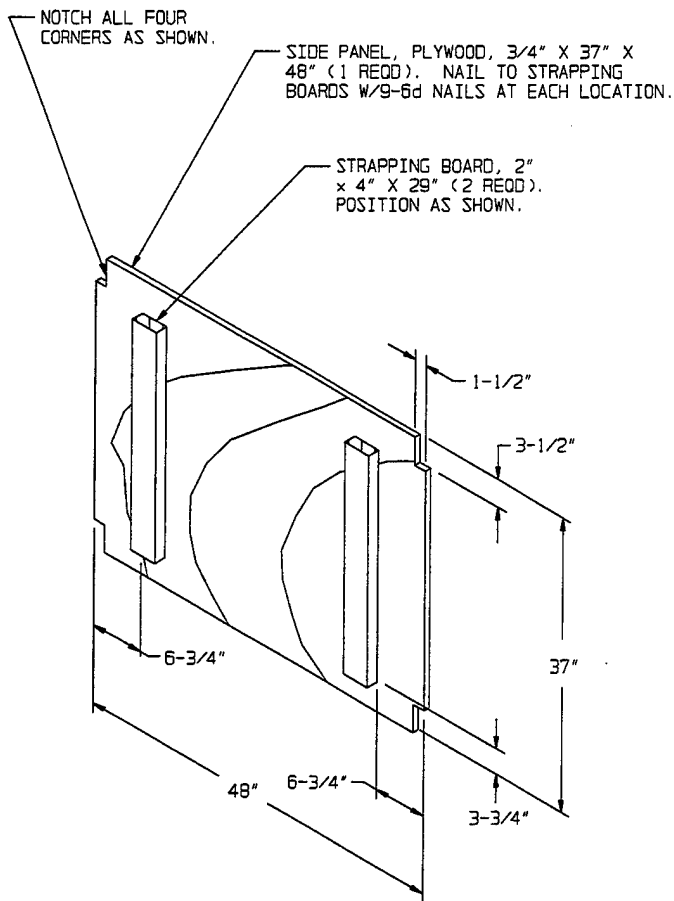
MATERIAL SPECIFICATIONS

- PALLET - - - - -: MIL SPEC MIL-P-15011; 4-WAY ENTRY, STYLE 1, TYPE I, CLASS 1.
- LUMBER - - - - -: SEE TM 743-200-1 (DUNNAGE LUMBER) AND FED SPEC MM-L-751.
- NAILS - - - - -: FED SPEC FF-N-105; COMMON.
- PLYWOOD - - - - -: COMMERCIAL ITEM DESCRIPTION A-A-55057, TYPE A, CONSTRUCTION AND INDUSTRIAL PLYWOOD, INTERIOR WITH EXTERIOR GLUE, GRADE C-D. IF SPECIFIED GRADE IS NOT AVAILABLE, A BETTER INTERIOR OR AN EXTERIOR GRADE MAY BE SUBSTITUTED.
- HARDBOARD - - - - -: ANSI/AHA A135.4, CLASS 1.
- HONEYCOMB FILLER - - - - -: FIBERBOARD, FACING PAPER WEIGHT 69 POUNDS/1,000 SQUARE FEET, CORE PAPER WEIGHT 33 POUNDS/1,000 SQUARE FEET, 1/2" CORE CELL CENTERS, INTERNATIONAL HONEYCOMB CORP (OR EQUAL).
- STRAPPING, STEEL - - - - -: ASTM D3953; FLAT STRAPPING, TYPE 1, HEAVY DUTY, FINISH B (GRADE 2), SIZE 3/4" OR 1-1/4" X .035" OR .031".
- SEAL, STRAP - - - - -: ASTM D3953; CLASS H, FINISH B (GRADE 2) DOUBLE NOTCH TYPE, STYLE I, II, OR IV).
- FIBERBOARD - - - - -: ASTM D4727.
- STAPLE - - - - -: FED SPEC FF-N-105; 1-17/32" CROWN WIDTH X 3/4" LEG LENGTH FOR 1-1/4" STRAPPING, TYPE III, STYLE 3.
- FOAM CUSHIONING MATERIAL - - - - -: FED SPEC PPP-C-1752, TYPE I, CLASS 2, GRADE A OR B, OR COMMERCIAL EQUIVALENT.



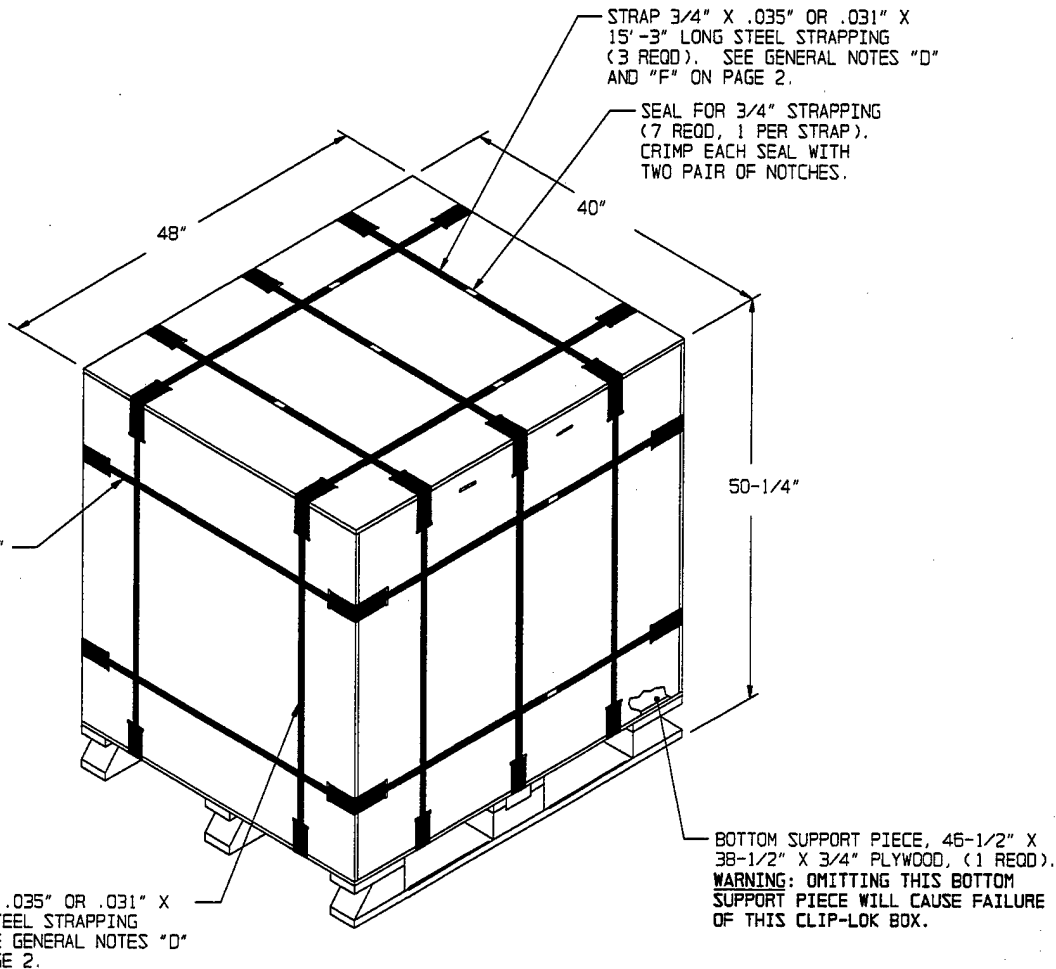
**END ASSEMBLY**

(2 REOD)



**SIDE ASSEMBLY**

(2 REOD)



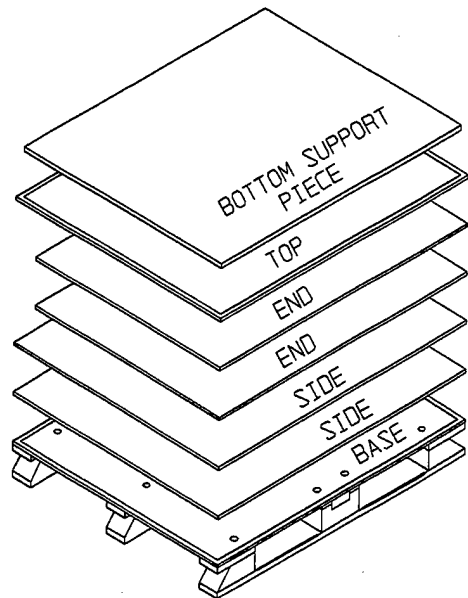
**PALLET UNIT B**  
**CLIP-LOK RIA966I**  
**UNIT DATA**

|                                  |       |                      |
|----------------------------------|-------|----------------------|
| RETROGRADE AMMUNITION INSIDE BOX | ----- | 3,754 LBS (MAXIMUM)  |
| DUNNAGE                          | ----- | 10 LBS               |
| PALLET BOX                       | ----- | 236 LBS              |
| <hr/>                            |       |                      |
| TOTAL WEIGHT                     | ----- | 4,000 LBS (MAXIMUM)  |
| CUBE                             | ----- | 55.8 CU FT (MAXIMUM) |

**NOTES:**

- SOURCE OF SUPPLY: THE CLIP-LOK REFERENCE NUMBER RIA966I HAS BEEN TESTED UNDER MIL-STD-1660 AND APPROVED FOR USE. THIS PALLET BOX CAN BE OBTAINED FROM CLIP-LOK SIMPACK USA, INC., TELEPHONE 800-448-CLIP.
- OTHER VENDORS' PALLET BOXES MAY BE QUALIFIED FOR USE BY SUBMITTING SAMPLE BOXES TO THE DEFENSE AMMUNITION CENTER, 3700 ARMY DEPOT ROAD, SAVANNA, IL 61074-9639. CONTACT THE PACKAGING OFFICE, AMSTA-AR-ESK, ROCK ISLAND, IL - TELEPHONE 309-782-8204 OR THE VALIDATION ENGINEERING DIVISION, SIOAC-DEV, SAVANNA, IL - TELEPHONE 815-273-8929.

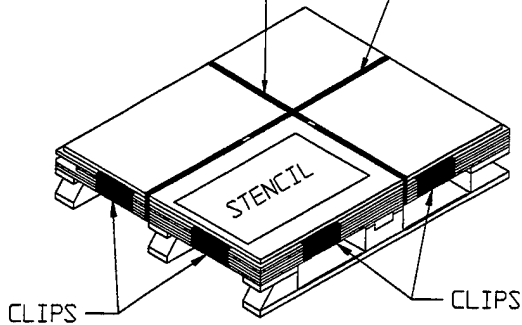
| BILL OF MATERIAL (UNIT B) |                    |          |
|---------------------------|--------------------|----------|
| PALLET BOX, CLIP-LOK      | ----- 1 REOD       | 236 LBS  |
| STEEL STRAPPING, 3/4"     | ----- 110.25' REOD | 9.84 LBS |
| SEAL FOR 3/4" STRAPPING   | ----- 7 REOD       | NIL      |



STACKING FOR COLLAPSED CLIP-LOK BOX

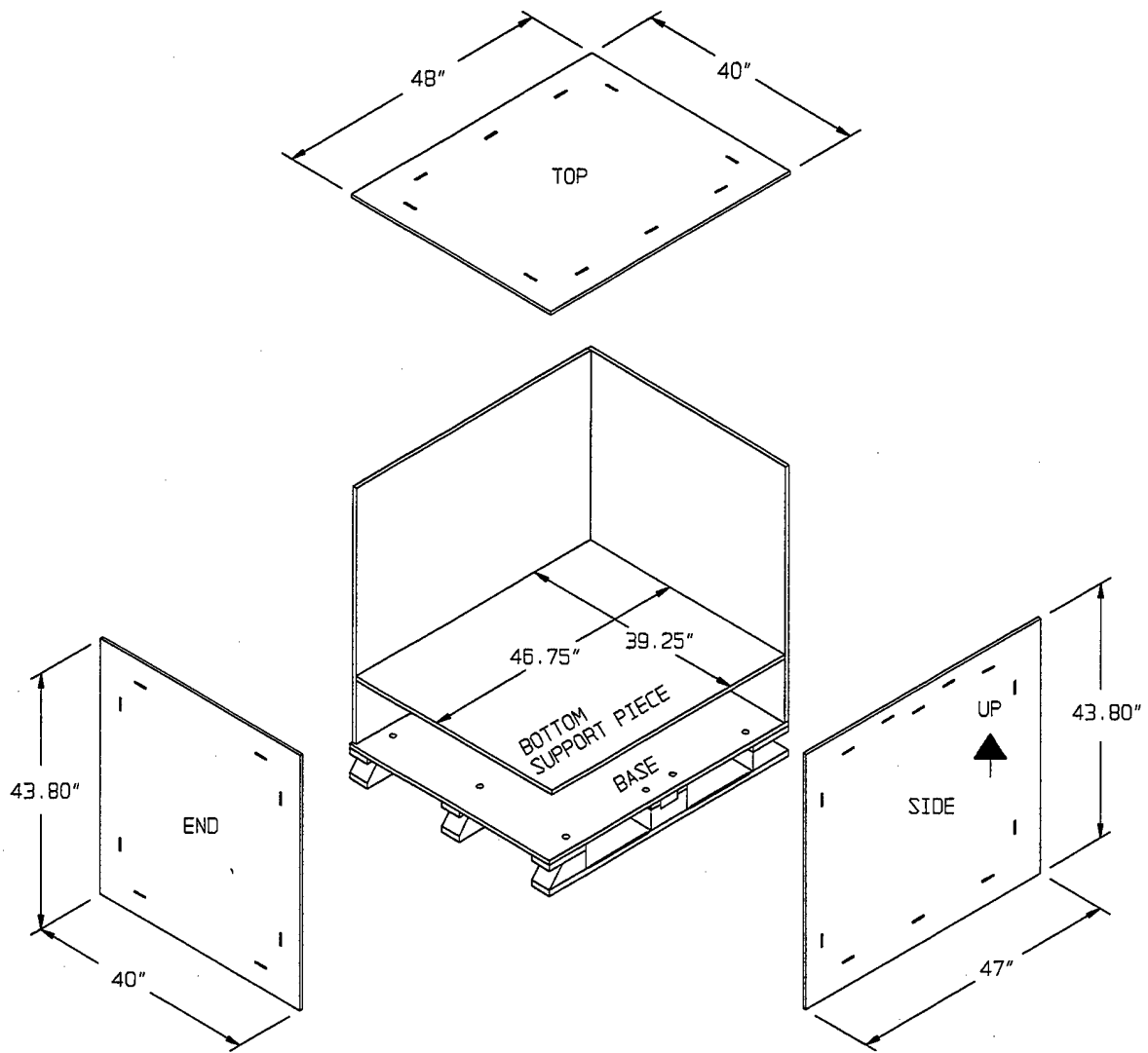
BUNDLING LOAD STRAP, 3/4" X .035" OR .031" X 8'-3" LONG STEEL STRAPPING (1 REED).

BUNDLING TIEDOWN STRAP, 3/4" X .035" OR .031" X 9'-9" LONG STEEL STRAPPING (1 REED).



COLLAPSED BOX

DETAILS OF CLIP-LOK BOX



SPECIAL NOTES:

1. THE ABOVE DRAWING WILL BE STENCILED ON THE BOTTOM SUPPORT PIECE.
2. AN ARROW WITH UP WILL BE STENCILED ON THE SIDE PIECES AS SHOWN TO ENSURE THE STACKING SLOTS ARE ON TOP.

STENCIL FOR BOTTOM SUPPORT PIECE

PAGE 7