FINAL REPORT

DECEMBER 1987

EVT 50-87

MIL-STD-1660 TEST OF UNITIZATION PROCEDURES FOR COMPLETE ROUNDS PACKED IN CYLINDRICAL METAL CONTAINERS ON 4-WAY-ENTRY PALLET PA116 SERIES CONTAINER

Prepared for:
U.S. Army Armament, Munitions and
Chemical Command
ATTN: SMCAR-ESE
Rock Island, IL 61299-7300

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) EVT 50-87	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION U.S. Army Defense Ammunition Center and School 6b. OFFICE SYMBOL (If applicable) SMCAC-DEV	7a. NAME OF MONITORING ORGANIZATION U.S. Army Armament, Munitions and Chemical Command
6c. ADDRESS (City, State, and ZIP Code) Savanna, IL 61074-9639	7b. ADDRESS (City, State, and ZIP Code) ATTN: SMCAR-ESK Rock Island, IL 61299-7300
8a. NAME OF FUNDING/SPONSORING ORGANIZATION U.S. Army Armament, Munitions and Chemical Command 8b. OFFICE SYMBOL (If applicable) SMCAR-ESK	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code) Rock Island, IL 61299-7300	10. SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO. / PROJECT NO. / TASK NO. / WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)

MIL-STD-1660 Test of Unitization Procedures for Complete Rounds Packed in Cylindrical Metal Containers on 4-way-entry Pallet PA116 Series Container

12. PERSONAL AUTHOR(S)

A. C. McIntosh, Jr.

13a. TYPE OF REPORT	13b. TIME COVERED	14. DATE OF REPORT (Year, Month, Day)	15. PAGE COUNT
FINAL	FROM Feb TO Mar	1988 March	34

16. SUPPLEMENTARY NOTATION

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	MIL-STD-1660 ammunition 4-way-entry pallet ammunition transportation PA116 series container

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), was asked by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), SMCAR-ESK, to test a unitization procedure for shipping PA116 series metal containers on the standard MIL-P-15011 4-way-entry pallet with a top-lift attachment. This unitization configuration was tested in accordance with requirements set forth in MIL-STD-1660 Design Criteria for Ammunition Unit Loads. The subject unitization is delineated in 19-48-4079/7E. The unitization, as shown in the attached procedure, satisfactorily complied with the test requirement and criteria established in MIL-STD-1660. This report has the results of those tests.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT	21. ABSTRACT SECURITY CLASSIFICATION
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS	
22a. NAME OF RESPONSIBLE INDIVIDUAL THOMAS J. MICHELS, Chief, Evaluation Division	22b. TELEPHONE (Include Area Code) AV 585-8928 / 22c. OFFICE SYMBOL SMCAC-DEV

DD Form 1473, JUN 86 Previous editions are obsolete. SECURITY CLASSIFICATION OF THIS PAGE

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U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL
Evaluation Division
Savanna, IL 61074-9639

REPORT NO. EVT 50-87

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PART 1

PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS) was asked by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), SMCAR-ESK, to test a 4-way entry pallet fabricated to MIL-P-15011 requirements for PA116 series containers with a top-lifting attachment. The pallet used is the standard double-wing design fabricated from native hardwood.

B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by AMCCOM.

C. OBJECTIVE. The objective of this test is to evaluate the unitization procedure for complete rounds packed in cylindrical metal containers on 4-way entry pallets, PA116 series containers to MIL-STD-1660, Design Criteria for Ammunition Unit Loads.

PART 2

LIST OF ATTENDEES

A.C. McIntosh Test Engineer AV 585-8989	U.S. Army Defense Ammunition Center and School ATTN: SMCAC-DEV Savanna, IL 61074-9639
David V. Valant Electronics Technician AV 585-8988	U.S. Army Defense Ammunition Center and School ATTN: SMCAC-DEV Savanna, IL 61074-9639
Laura Fieffer Industrial Engineer AV 585-8075	U.S. Army Defense Ammunition Center and School ATTN: SMCAC-DEO Savanna, IL 61074-9639

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. FORKLIFTING TEST. This test shall be conducted by using the procedures of Method 5011 of Federal Standard 101, Procedure 6.3, Hoisting With Slings, subsection 6.3.2, Sling Handling with Attachments. Attach slings to two hoisting attachment provisions, one on each side or each end so that the specimen will remain upright when hoisted. The length of the slings shall be such that when lifting they form an angle between 20 and 25 degrees with horizontal plane. Lift the specimen clear of the floor and hold it suspended for not less than two minutes. Observe carefully for any

indications of inadequacies in the specimen. Record observations and let the specimen down. Repeat with other hoisting attachment provisions until each has been tested. This procedure is repeated for combinations in the number of pick up points on the unit; four, three, two, alternate two, and finally, one pick up provision is used for lifting.

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 4.

TEST EQUIPMENT

1. TEST SPECIMEN.

   a. Drawing Number: 19-48-4079/7B

   b. Width: 40 inches

   c. Length: 44 inches

   d. Height: 53 inches

   e. Weight: 2,400 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 - 2,400 lbs.
Pallet Height - 53 in.
Test Load Weight - 8,900 lbs.

The subject pallet was loaded to 9,000 lbs. compression for a period of one hour. At the end of one hour the compression decreased to approximately 8,000 lbs. When the test specimen was removed from the compression tester, no measurable deformation to the unit load was realized.

2. REPETITIVE SHOCK TEST. The subject pallet successfully passed the longitudinal transportation test in a 90-minute 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 or strapping. Operational speed of the transportation simulator for both tests was 200 rpm. The approximate driving force into the load from the transportation simulator is 0.5 G acceleration.

3. EDGEWISE DROP TEST. Each side of the pallet was placed on a beam in turn displacing it 6 in. above the floor. The opposite side was raised to a height of 24 in. above the floor and then dropped. No damage occurred to the unit load on any of the four drops.

4. HOISTING WITH ATTACHMENTS. The subject unit load was lifted from four, three, two, alternate two, and one lifting point of a hoisting attachment with slings of a length to produce a 20 to 25 degree incline with the horizontal position of the pallet. The load was lifted clear of the floor and held for a period of two minutes with each lifting configuration. As a result of these lifting configurations no damage was caused to the unit load or to the lifting attachment assembly.

5. IMPACT TEST. The incline impact test consisted of placing the PA116 series container 4-way entry pallet unit on an inclined sled with 2 in. of the pallet base projecting over the sled. The sled was then raised approximately 8 ft. up the inclined ramp and released allowing it to accelerate and impact into a solid wall. This test was repeated once on each side of the pallet. After completing this test the pallet unit was observed to have no additional damage.

PART 6

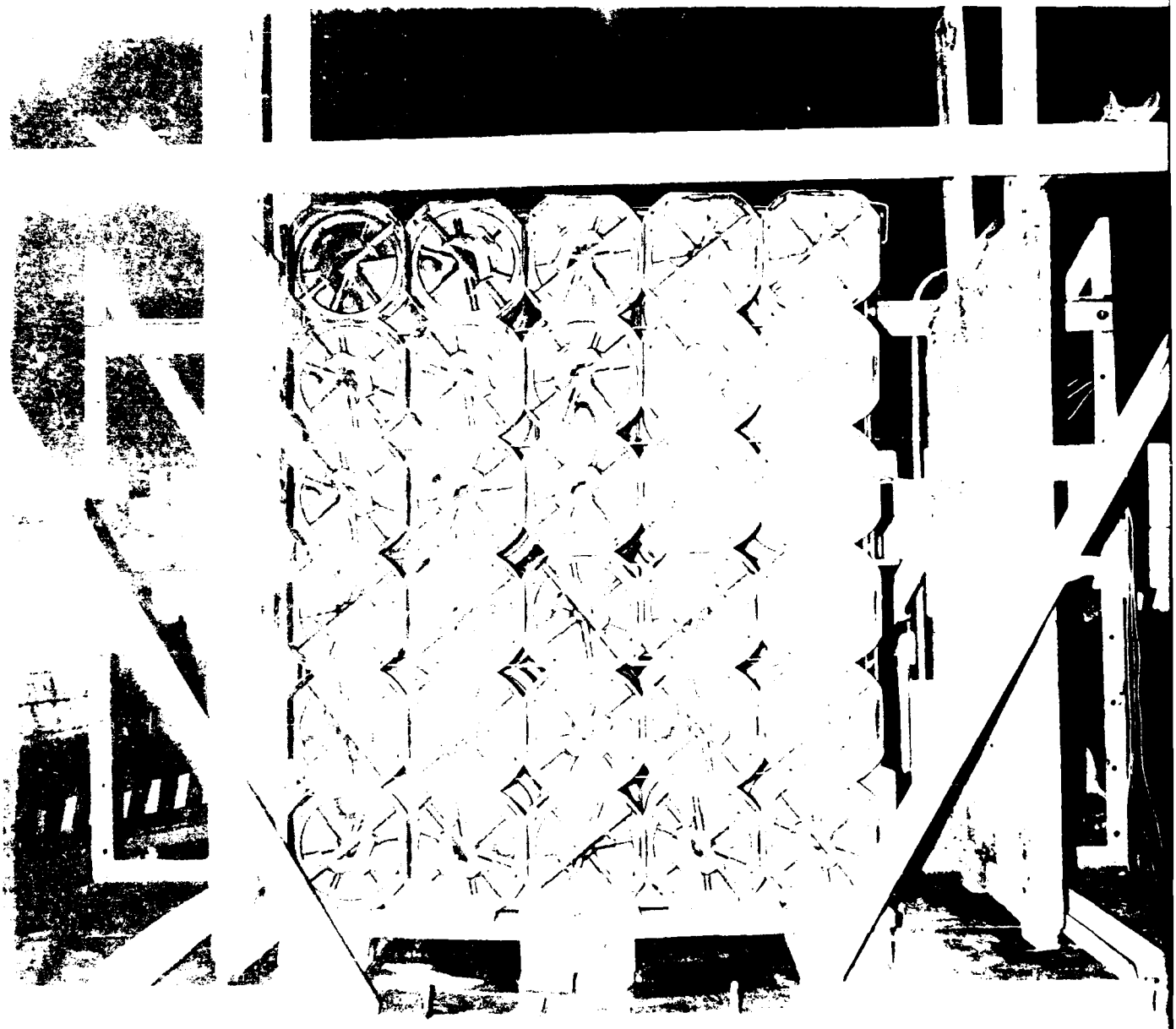
CONCLUSIONS AND RECOMMENDATIONS

1. CONCLUSIONS. Unitization Procedure 19-48-4079/7B for complete rounds packed in cylindrical metal containers on 4-way entry pallets, PA116 series container, successfully completed MIL-STD-1660 pallet testing criteria.

2. RECOMMENDATIONS. It is recommended that subject unitization procedure be approved for field use in unitizing PA116 series containers on a wood pallet with top-lift devices.

PART 7

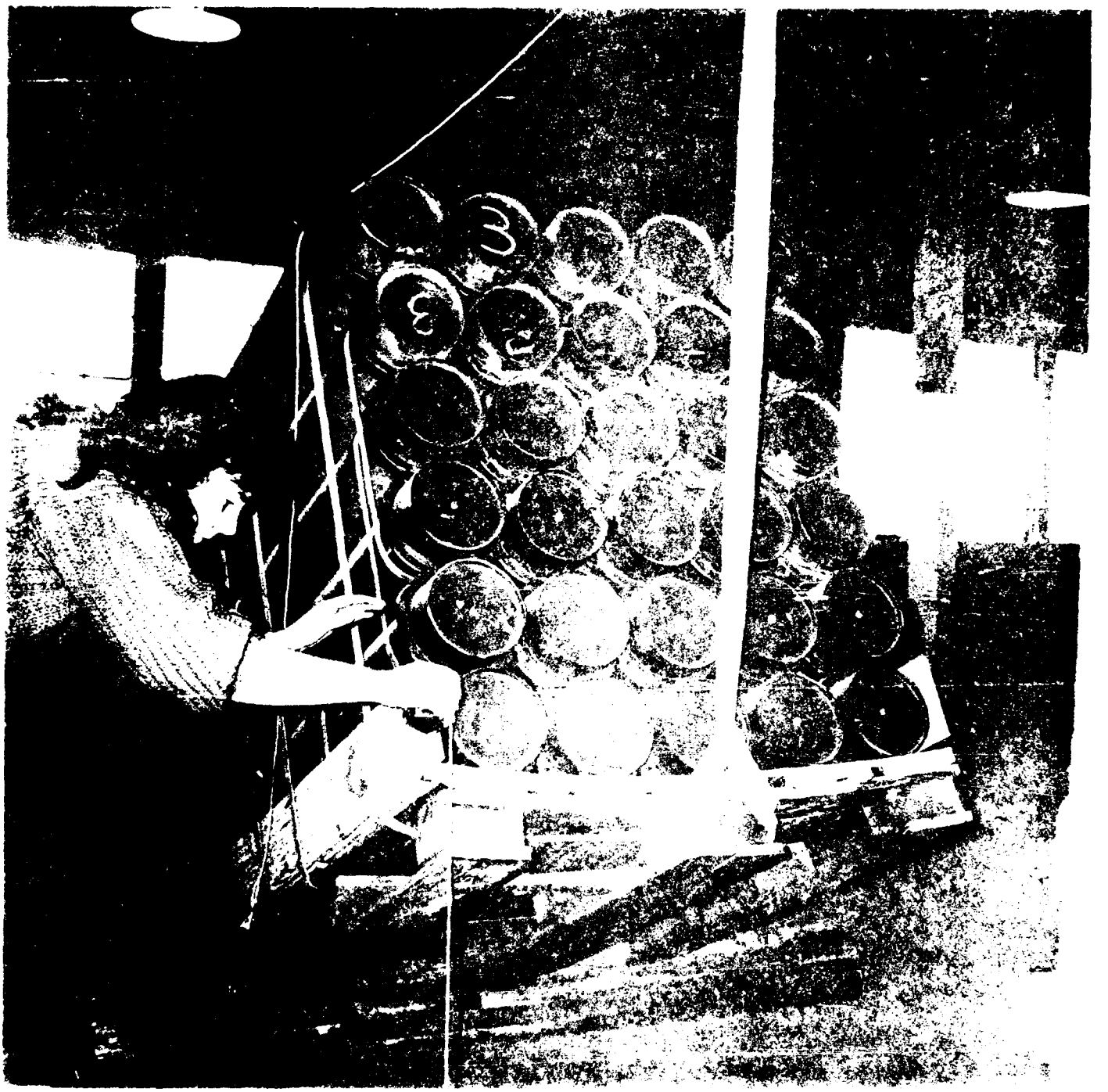
PHOTOGRAPHS



AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

[illegible] containers in
[illegible] the direction of table motion

CENTER AND SCHOOL - SAVANNA



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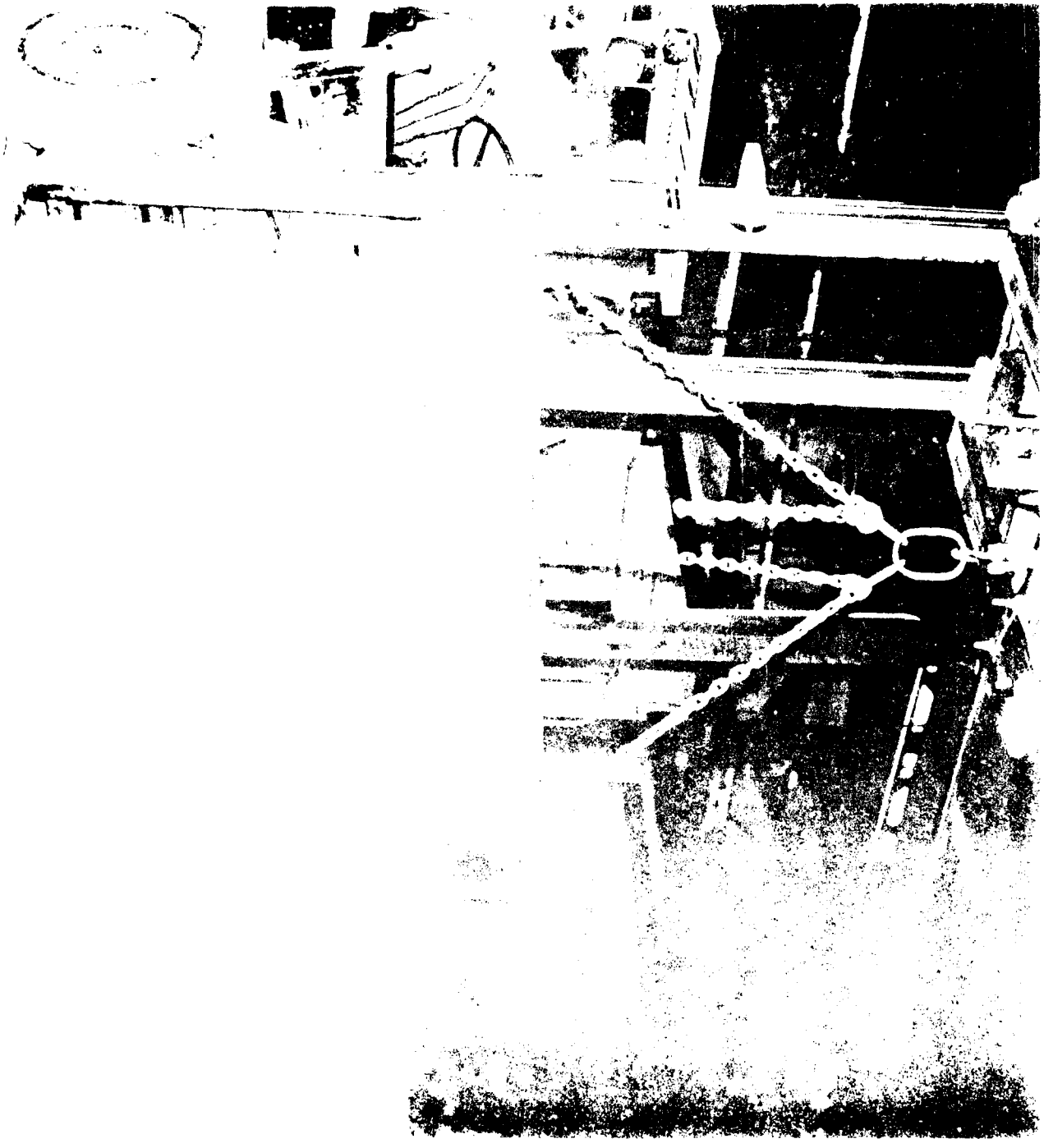

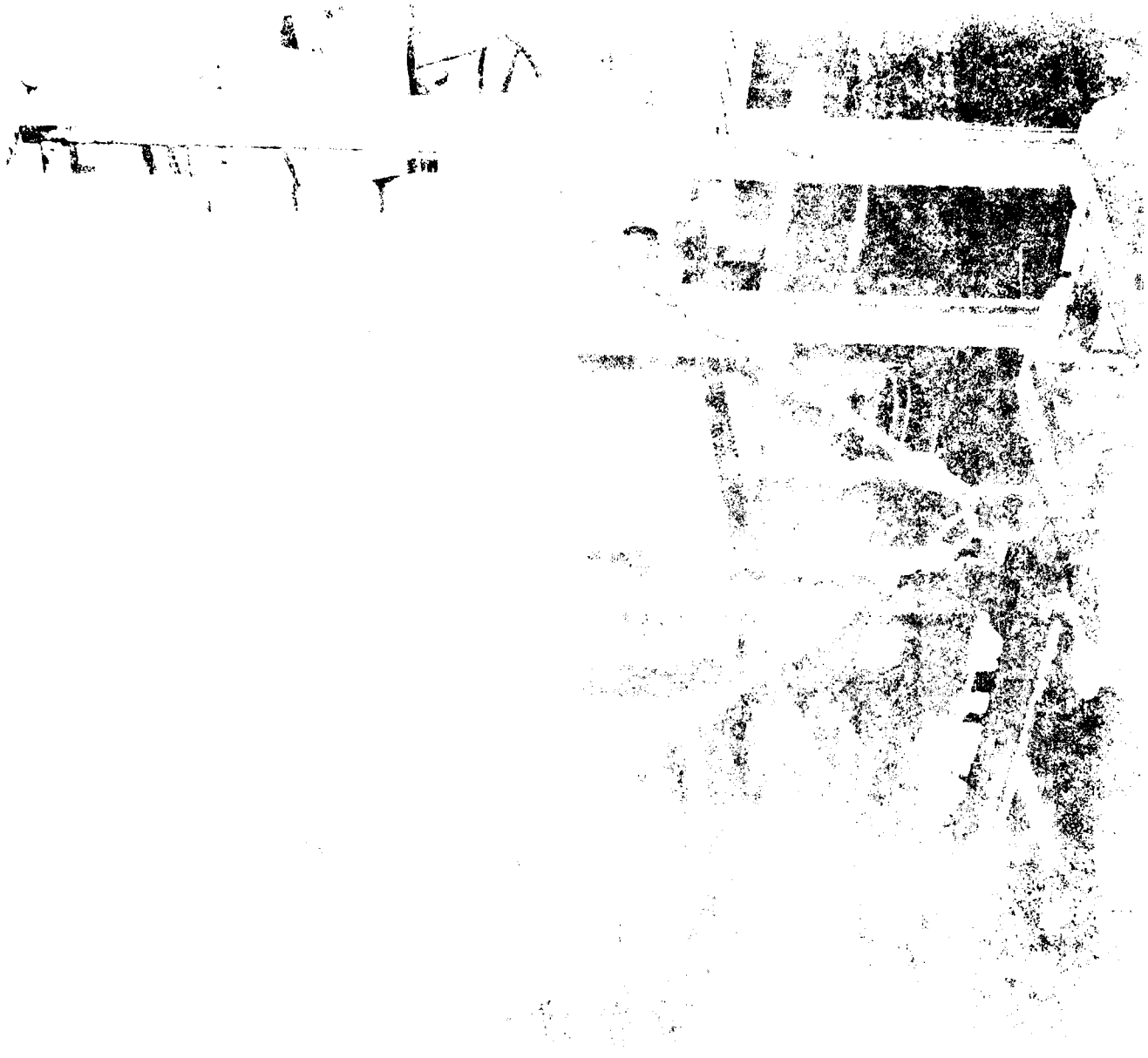

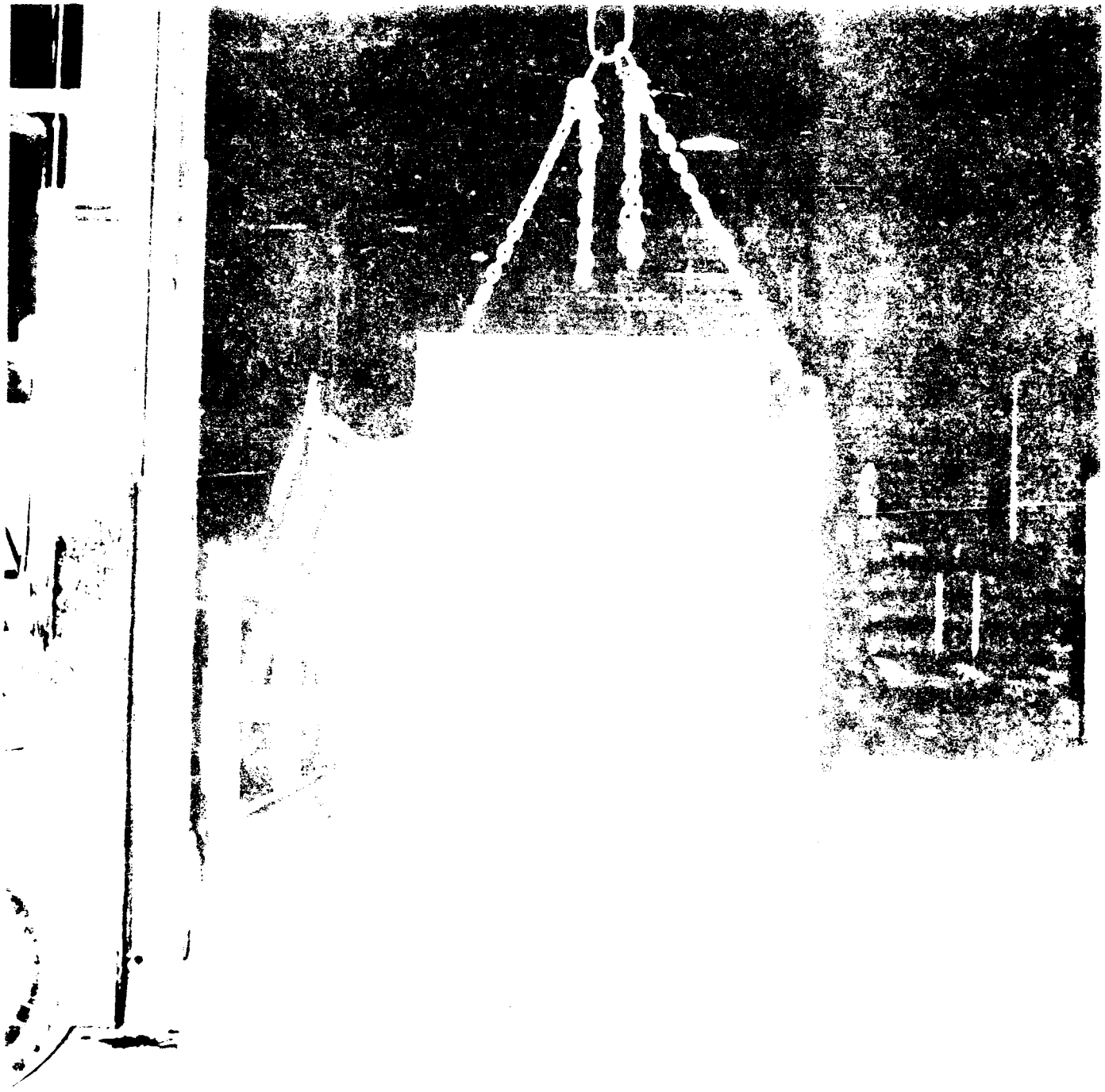

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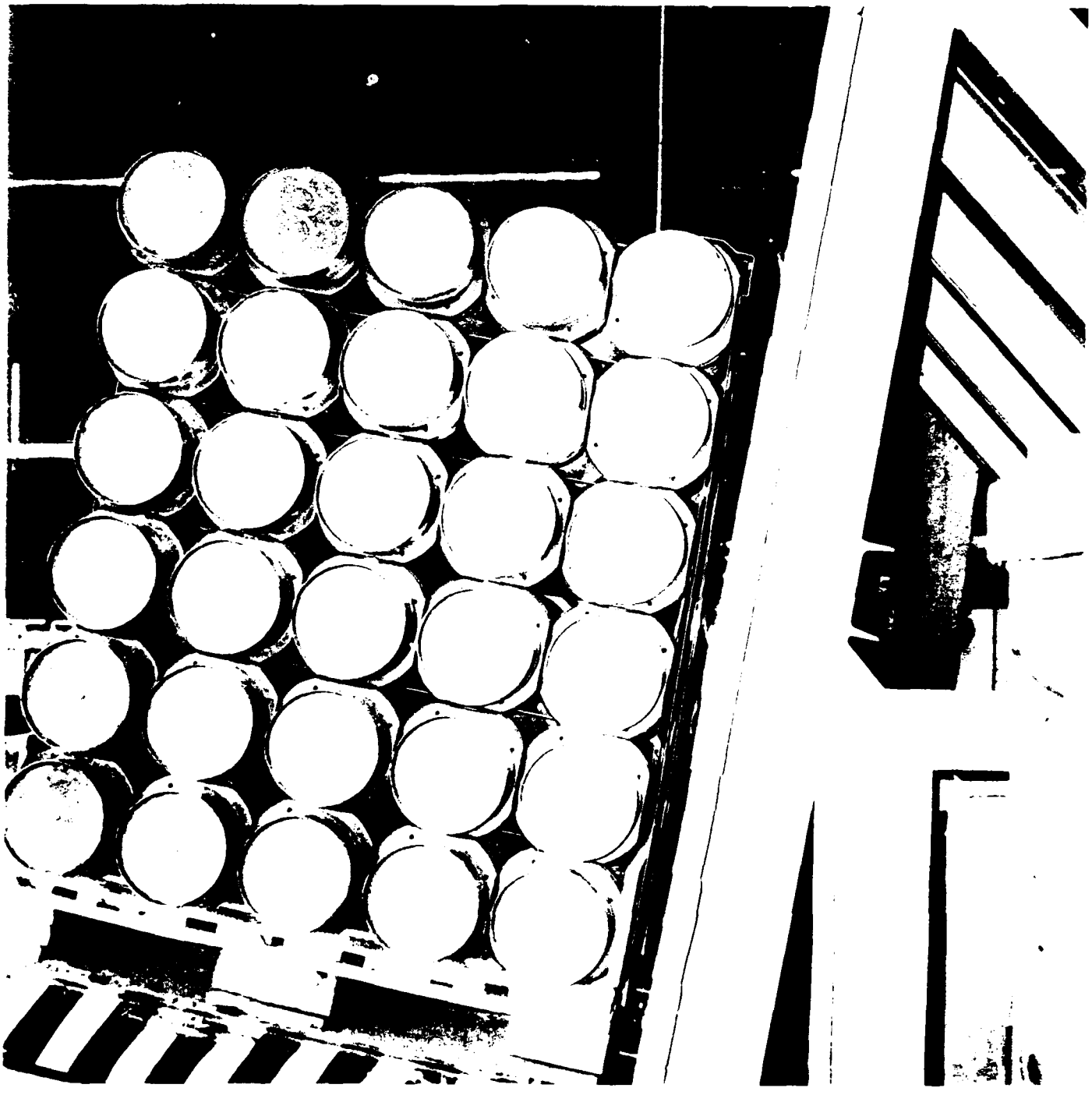
Photo No. 10. This photo shows the unitization procedure for PA116 series containers after the first inclined impact.



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[illegible] as the [illegible] for SA116 series containers [illegible]

DEFENSE AMMUNITION CENTER AND SCHOOL- SAVANNA, IL

Photo No. 12. This photo shows the unitization procedure for PA116 series containers after the third inclined impact.

DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL

Photo No. 13. This photo shows the unitization procedure for PA116 series containers at the fourth and last inclined impact.

PART 8

UNITIZATION PROCEDURES

APPENDIX 7B

UNITIZATION PROCEDURES FOR COMPLETE ROUNDS PACKED IN CYLINDRICAL METAL CONTAINERS ON 4-WAY ENTRY PALLETS*

PA116 SERIES CONTAINER

INDEX

PALLET UNIT DATA						
ITEMS INCLUDED		HAZARD CLASSIFICATION ◐				WEIGHT
NSN	DODIC	DOT CLASS	CG CLASS	QD CLASS	COMP GROUP	(LBS)
1315-01-250-8636	C784	B	II-B	1.3	C	2,391
1315-01-242-4796	C785	B	II-B	1.3	C	2,061

◐ HAZARD CLASSIFICATION DATA CONTAINED IN THE ABOVE CHART IS FOR GUIDANCE AND INFORMATIONAL PURPOSES ONLY. VERIFICATION OF THE SPECIFIED DATA SHOULD BE MADE BY CONSULTING THE MOST RECENT JOINT HAZARD CLASSIFICATION SYSTEM LISTING OR OTHER APPROVED LISTING (S).

NOTICE: THIS APPENDIX CANNOT STAND ALONG BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZATION PROCEDURES DRAWING 19-48-4079-20PM1002.

* SEE GENERAL NOTE "L" ON PAGE 2

DO NOT SCALE

REVISIONS				DRAFTSMAN: Dw / tm	PROJ ENG: LAF / WRF	
				CHECKER: GPS	LOG ENGRD OFFICE: Watervliet	
				APPROVED, U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND: D.H. Martin	D.J. Headen
				APPROVED BY ORDER OF COMMANDING GENERAL, U.S. ARMY MATERIEL COMMAND (AMC): John L. Byrnes, U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL	
				U.S. ARMY AMC DRAWING		
				NOVEMBER 1987		
				CLASS	DIVISION	DRAWING	FILE
				19	48	4079/78	20PM 1002

PROJECT FSA 63/78-66

GENERAL NOTES

A. THIS APPENDIX CANNOT STAND ALONE BUT MUST BE USED IN CONJUNCTION WITH THE BASIC UNITIZING PROCEDURES DRAWING 19-48-4079-20PM1002. TO PRODUCE AN APPROVED UNIT LOAD, ALL PERTINENT PROCEDURES, SPECIFICATIONS AND CRITERIA SET FORTH WITHIN THE BASIC DRAWING WILL APPLY TO THE PROCEDURES DELINEATED IN THIS APPENDIX. ANY EXCEPTIONS TO THE BASIC PROCEDURES ARE SPECIFIED IN THIS APPENDIX.

B. DIMENSIONS, CUBE AND WEIGHT OF A PALLET UNIT WILL VARY SLIGHTLY DEPENDING UPON THE ACTUAL DIMENSIONS OF THE CONTAINER, WEIGHT OF THE SPECIFIED ITEM AND METHOD OF UNITIZATION.

C. FOR OUTLOADING AND STORAGE OF THE ITEMS COVERED BY THIS APPENDIX, CONTACT THE U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL, ATTN: SMCAC-DEC, SAVANNA, IL 61074-9639, FOR SPECIFIC PROCEDURAL GUIDANCE.

D. FOR METHOD OF SECURING A STRAP CUTTER TO THE PALLET UNIT, SEE DARCOM DRAWING 19-48-4127-20P1000.

E. IF ITEMS COVERED HEREIN ARE UNITIZED PRIOR TO ISSUANCE OF THIS APPENDIX, THE CONTAINERS NEED NOT BE REUNITIZED SOLELY TO CONFORM TO THIS APPENDIX.

F. FOR DETAILS OF THE PA116 SERIES CONTAINER, SEE U.S. ARMY ARMAMENT RESEARCH AND DEVELOPMENT CENTER DRAWING NO. 9386831.

CONTAINER DIMENSIONS ——— 44-1/2" LONG X 7-3/4" WIDE X 7-3/4" HIGH
CONTAINER CUBE ——— 1.5 CUBIC FEET (APPROX)
CONTAINER WEIGHT ———
(WITH ROUND) ——— 64 OR 75 POUNDS (APPROX)

G. THE UNITIZATION PROCEDURES SPECIFIED HEREIN MAY ALSO BE USED FOR UNITIZING COMPLETE ROUNDS WHEN IDENTIFIED BY DIFFERENT NATIONAL STOCK NUMBERS (NSN) THAN THOSE SHOWN ON THE COVER PAGE, PROVIDED THE ITEM IS PACKED IN THE SAME CONTAINER. THE EXPLOSIVE CLASSIFICATION OF OTHER ITEMS MAY BE DIFFERENT THAN THOSE SHOWN.

H. FOR DETAILS OF THE METAL LIFTING FRAME SEE MILITARY SPECIFICATION MIL-A-70753.

J. FULL IDENTIFICATION MARKINGS IN ACCORDANCE WITH MIL-STD-129, TO INCLUDE NSN AND DODIC, QUANTITY AND NOMENCLATURE, LOT NUMBER, AND GROSS WEIGHT OF THE LOAD SHALL BE MARKED ON TAGS LOCATED ON OPPOSITE UPPER CORNERS OF THE LOAD.

K. BAR CODE LABELS ARE REQUIRED ON THE STRAPS OF OPPOSITE CORNERS. SEE MIL-STD-129.

L. THE SPECIAL PALLET WILL BE CONSTRUCTED AND ASSEMBLED IN ACCORDANCE WITH A MILITARY SPECIFICATION MIL-P-15011, STYLE 1, TYPE I, CLASS 1 PALLET WITH THE EXCEPTION THAT THE TOP AND BOTTOM DECK BOARDS WILL BE 44" LONG INSTEAD OF 48". ALL OTHER REQUIREMENTS SPECIFIED WITHIN MIL-P-15011 FOR A STYLE 1, TYPE I, CLASS 1 PALLET WILL APPLY TO THE PALLET SPECIFIED WITHIN THIS DRAWING.

M. THE MODIFIED STYLE 1 PALLET DELINEATED IN THE DETAIL ON PAGE 4 NEED NOT HAVE CHAMFERS OR STRAP SLOTS AS SPECIFIED WITHIN MILITARY SPECIFICATION MIL-P-15011 WHEN USED FOR THE UNITIZATION OF THE ITEMS COVERED BY THIS APPENDIX.

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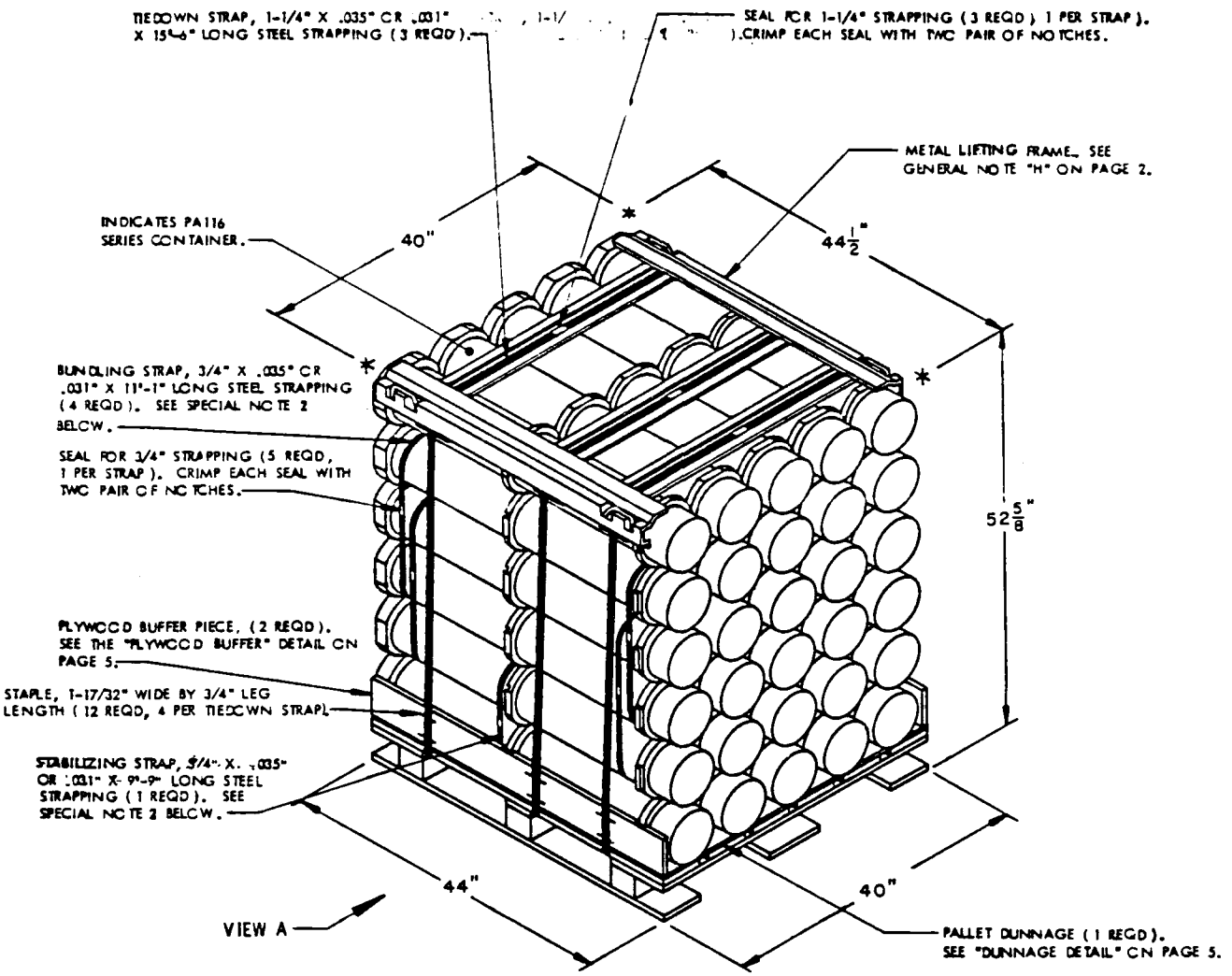
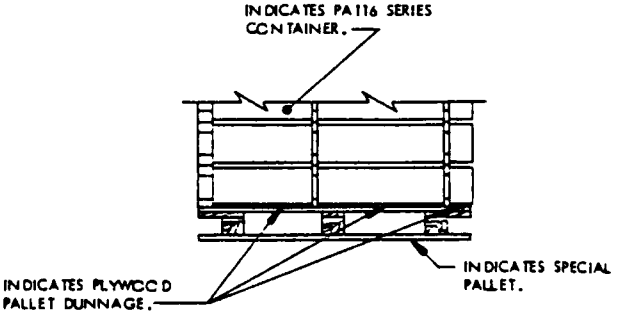


ISOMETRIC VIEW

SPECIAL NOTES:

1. ALTHOUGH THE CONTAINERS DEPICTED IN THE UNIT LOAD ABOVE ARE CONSTRUCTED WITH INTERLOCKING DEVICES, THE INTERLOCKS WILL NOT FUNCTION PROPERLY UNLESS THE CONTAINERS ARE POSITIONED SO THAT THE "PINS" OF THE INTERLOCKS ARE IN AN UPRIGHT ORIENTATION. THIS ORIENTATION WILL PRECLUDE INTERFERENCE OF THE "PINS" AND THE PLYWOOD PALLET DUNNAGE AND WILL AID IN THE PREVENTION OF CONTAINER MOVEMENT, BOTH LATERALLY AND LONGITUDINALLY, DURING SHIPMENT OF THE UNIT LOAD.

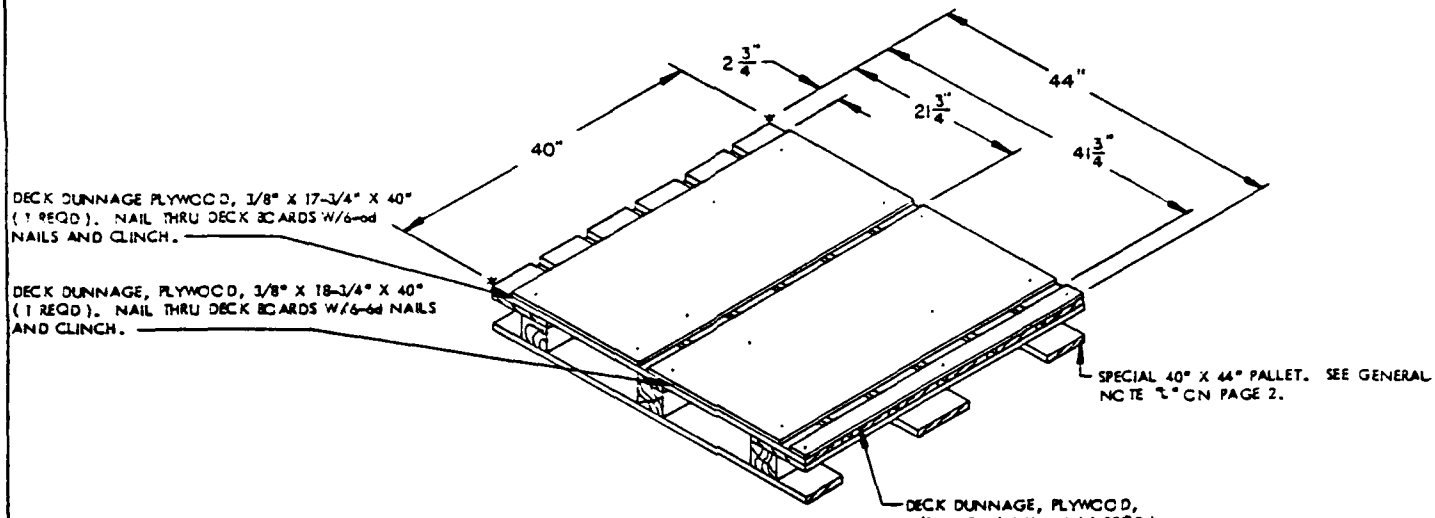
2. BUNDLING STRAPS AND STABILIZING STRAP MUST BE TENSIONED AND SEALED PRIOR TO THE APPLICATION OF THE TIEDOWN STRAPS. ALL STRAPS MUST BE INSTALLED AS CLOSE AS POSSIBLE TO THE CONTAINER RINGS. CAUTION: STRAPS MUST NOT BE ALLOWED TO OVERLAP.



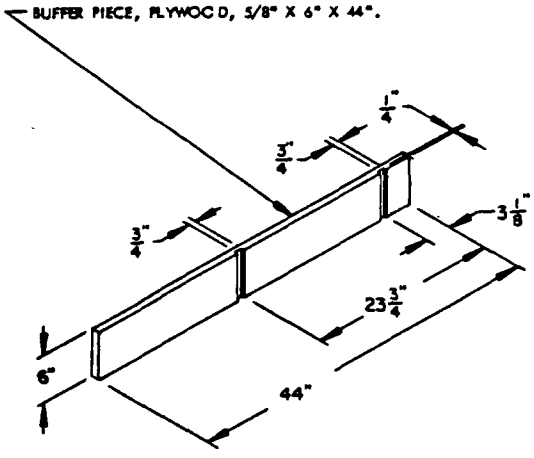
PARTIAL VIEW A

(PLYWOOD BUFFER HAS BEEN OMITTED FOR CLARITY).

UNIT DETAIL



PALLET DUNNAGE LOCATION



PLYWOOD BUFFER

BILL OF MATERIAL		
NAILS	NO. REQD	POUNDS
6d (2")	15	0.09

SPECIAL PALLET, 40" X 44"	1 REQD	77 LBS
STEEL STRAPPING, 3/4"	54.08' REQD	3.86 LBS
STEEL STRAPPING, 1-1/4"	46.50' REQD	6.64 LBS
SEAL FOR 3/4" STRAPPING	5 REQD	NIL
SEAL FOR 1-1/4" STRAPPING	3 REQD	NIL
PLYWOOD, 3/8"	10.76 SQ FT REQD	11.10 LBS
PLYWOOD, 5/8"	3.67 SQ FT REQD	6.30 LBS
STAPLES FOR 1-1/4" STRAPPING	12 REQD	NIL
METAL LIFTING FRAME	1 REQD	.36 LBS

UNIT DATA

CUBE	54.2 CUBIC FEET (APPROX)
CONTAINER — 30 EACH @ 75 LBS	2,250 LBS (APPROX)
DUNNAGE	64 LBS
PALLET	77 LBS
TOTAL WEIGHT	2,391 LBS (APPROX)

DUNNAGE DETAILS