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Final Report  
JANUARY 1989

EVT 45-87

MIL-STD-1660 TEST OF  
55-GALLON DRUM PLASTIC PALLET

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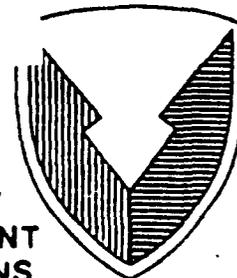
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<p>The U.S. Army Defense Ammunition Center and School (USADACS) was tasked by the U.S. Army Armament, Research, Development, and Engineering Center (ARDEC), SMCAR-ESK, to evaluate a plastic pallet for transportation of 55-gallon metal drums. The plastic pallet, manufactured by Menasha Corporation, 426 Montgomery Street, Watertown, WI 53094, was tested to MIL-STD-1660, Design Criteria for Ammunition Unit Loads. The unitization consisted of the plastic pallet with four 55-gallon drums filled with water. Wood separators were placed between the drums. The drums were held in place with girth bands and crossed banding over the top of each drum and under the pallet deck. The unitization was subjected to stacking, transportation simulation, edgewise rotational drop, and inclined impact tests.</p>					
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19. Abstract (CONT)

Damage to the pallet was incurred as a result of these tests. One pallet post cracked, a steel band cut into the pallet deck, the steel drums gauged the pallet deck, and several cracks appeared in the deck. The pallet deck has 20 drum positioning lugs; 5 for each drum. Of the 20 lugs, 11 were sheared off during testing, thus allowing metal drums to slide on the deck. Due to the extensive damage (cracked deck and sheared-positioning retaining lugs), this pallet is unsatisfactory for transportation of ammunition items. However, it is suitable for moving drums in a warehouse environment. Care should be exercised when stacking these items, since the flexible pallet has a tendency to deform the stacking surface. This could lead to an unstable stack. Detailed test results are contained in the remainder of this report.

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

REPORT NO. EVT 45-87

MIL-STD-1660 TEST OF

55-GALLON DRUM PLASTIC PALLET

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PART 1

INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS) was tasked by the U.S. Army Armament Research, Development and Engineering Center (ARDEC), SMCAR-ESK, to test a plastic 55-gallon drum pallet. The test specimen was manufactured by Menesha Corporation, Watertown, WI. To date, no plastic pallets have been tested for 55-gallon drums. These pallets, tested to MIL-STD-1660 criteria, are not expected to be used in the transportation of ammunition.

B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by ARDEC and AR740-1.

C. OBJECTIVE. The objective of this test is to evaluate a plastic 55-gallon drum pallet in accordance with the test criteria of MIL-STD-1660, Design Criteria for Ammunition Unit Loads.

Part 2

ATTENDEES

A.C. McIntosh, Jr.  
Test Engineer  
AV 585-8989  
Comm. 815-273-8989

Director  
U.S. Army Defense Ammunition Center  
and School  
ATTN: SMCAC-DEV  
Savanna, IL 61074-9639

## 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), and Operation manual for Container Leak Test Device APE 1958 (June 1978). MIL-STD-1660 identifies four steps the unitized load must undergo if it is considered to be acceptable. The operation Manual for APE 1958 identifies a series of steps that must be performed to determine if the M2A1 cans meet the leak criteria. 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 load of a 16-foot-high unit stack.
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 a magnitude of 1 G. Midway into the testing period the specimen shall be rotated 90 degrees and the test continued for the duration.

Unless failure occurs, the total time of vibration shall be two hours if the specimen is tested in one position; and, if tested in more than one position, the total time shall be three hours.

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. 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:

Table 1: Drop Levels

<u>GROSS WEIGHT NOT EXCEEDING</u>	<u>DIMENSIONS ON ANY EDGE NOT EXCEEDING</u>	<u>HEIGHT OF DROP LEVEL A PROTECTION</u>
600 lbs.	72 inches	36 inches
3,000 lbs.	no limit	24 inches
no limit	no limit	12 inches

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 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 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 time of impact shall be 7-feet-per-second.

PART 4

TEST EQUIPMENT

1. TEST SPECIMEN.

- a. Width: 49 inches
- b. Length: 49 inches
- c. Height: 42 inches
- d. Weight: 2,250 pounds

2. COMPRESSION TESTER.

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

3. TRANSPORTATION SIMULATOR.

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

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

1. STACKING TEST

Pallet Weight: 2,250 pounds  
Pallet Height: 42 inches  
Test Load: 10,285 pounds

The test pallet was loaded to 10,285 pounds compression. The compression load was maintained for a period of 60 minutes. To simulate stacking, a second pallet was placed on top of the 55-gallon drum. Under the compression force of 10,285 pounds, the stacking pallet deformed around the dunnage on the test specimen. When the compression load was removed and the test pallet taken out of the compression tester, no measurable deformation was observed.

2. REPETITIVE SHOCK TEST. The plastic 55-gallon drum pallet was subjected to two 90 minute periods of transportation simulation. At the end of the first 90 minute period, the pallet was rotated 90 degrees and subjected to the second 90 minute period of vibration. The transportation simulator was operated at 180 rpm for the duration of the test. No damage was induced to the unitization during this test. The pallet exhibited extensive flexing during the test.

3. EDGEWISE ROTATIONAL DROP TEST. One edge of the pallet is placed on a beam raising it six inches above the floor. The opposite side is raised 24 inches above the floor and then dropped. This process was repeated for each side of the pallet. No damage occurred after the first edgewise drop. On the three following drops, cracks were observed in the upper deck. Also, the pallet exhibited a spring action on impact causing the raised edge of the pallet to snap off the beam.

4. IMPACT TEST. The Inclined-Impact Test consisted of placing the plastic 55-gallon drum pallet on an inclined-impact tester sled. The pallet was positioned on the sled so that two inches of the pallet overhung the sled on the impact side. The sled was raised approximately eight feet up at 10 degrees and released to roll freely into the impact wall. This test was performed once on each side of the pallet for a total of four impacts. No damage to the pallet or 55-gallon drum was caused by this test.

PART 6

CONCLUSIONS ND RECOMMENDATIONS

1. CONCLUSIONS. As a result of these tests, the plastic 55-gallon drum pallet sustained damage. Two cracks developed in the deck about six inches long, and one base post had a crack about two inches long. The pallet has 20 positioning lugs used to keep the drums on the pallet. After testing, 11 had been sheared off, 2 others were 90 percent sheared off, and the rest were damaged by the cutting action of the drum ends when rebounding onto the pallet.

2. RECOMMENDATIONS. Based on these tests, the plastic 55-gallon drum pallet is not recommended for transporting ammunition. This recommendation is based primarily on cracks which developed in the pallet during testing. When dunnage is used to provide strapping guides over the drums, to a point where it protrudes above the drum surface, stacking is not recommended due to the flexible nature of the pallet and its ability to conform to the surface on which it is placed.

PART 7

PHOTOGRAPHS



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Photo No. 1 This photograph shows the 55-gallon drum plastic pallet after MIL-STD-1660 testing. Note cracks in the deck and lower skid. Excessive strap loosening was observed.



**DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL**

Photo No. 2 This photograph shows the 55-gallon drum plastic pallet after MIL-STD-1660 testing. Note the crack on the pallet deck. Also note the lack of drum retaining lugs on the deck. Most of the retaining lugs molded into the pallet deck were sheared off in the process of testing.

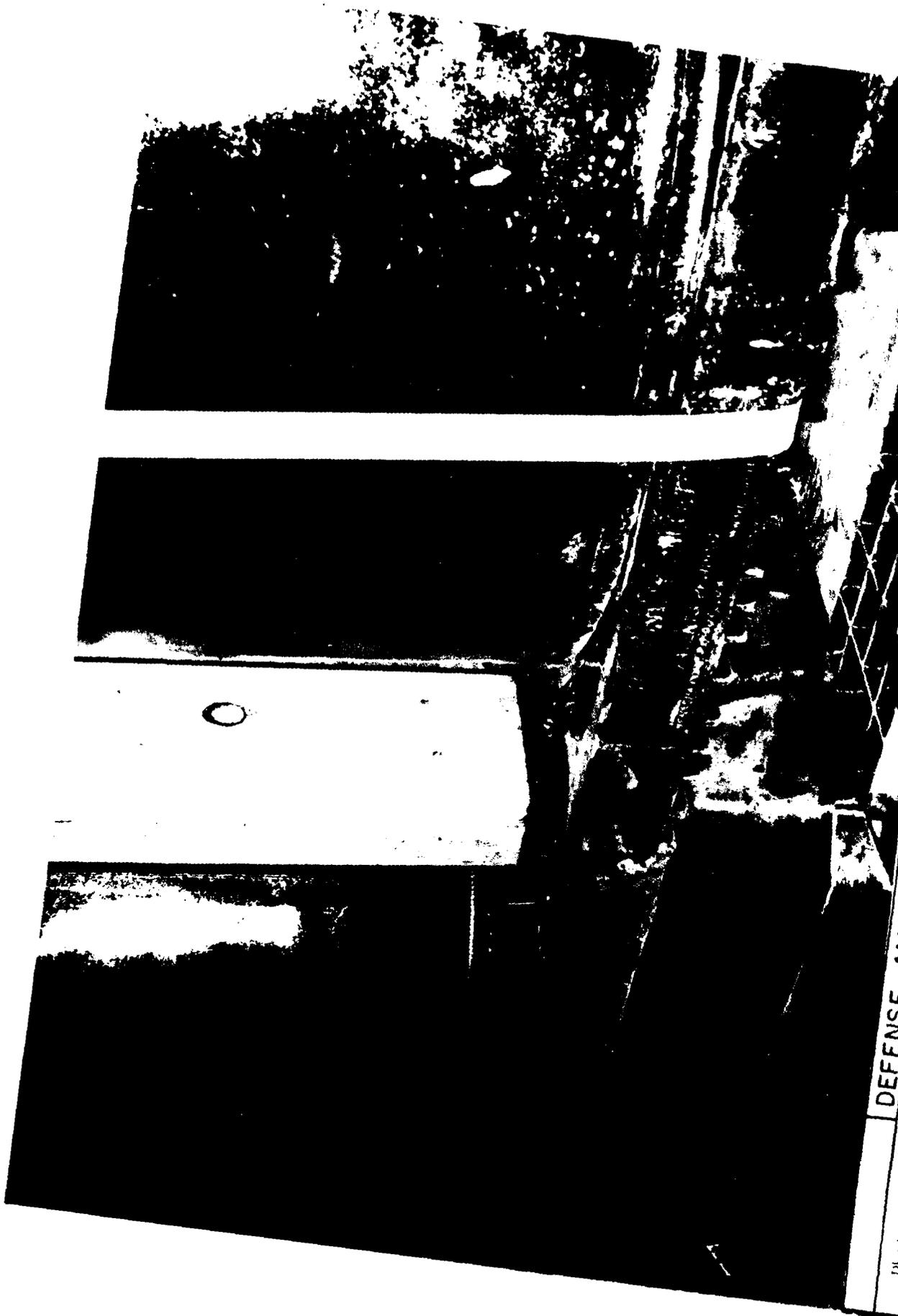


Photo No. 3

**DEFENSE AMMUNITION CENTER AND SCHOOL - SAVANNA, IL**

This photograph shows the 55 gallon drum plastic pallet after MIL-STD-1660 testing. Note, at the center of the photograph, the plastic drum retaining lug partially sheared from drum movement on the pallet deck.