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AFPEA PROJECT NO. 77-P7-23

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TESTING AND ANALYSIS OF HOUSEHOLD GOODS CONTAINERS

AFALD/PTPD
Air Force Packaging Evaluation Agency
Wright-Patterson AFB OH 45433

July 1977

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ABSTRACT

As part of the Air Force Packaging Evaluation Agency (AFPEA) mission, test and evaluation services are available to all agencies in the DOD. These services are used to evaluate a single container design or to compare and contrast various designs and products from a variety of sources. Through this engineering effort, AFPEA is able to help make sure the best and most economical containers are used in the transportation system.

Recently, the Design Division of AFALD/PTP conducted testing and evaluation of six household goods containers. While none of the containers passed the testing criteria established, there was ample opportunity to observe the effect of variations in construction. It is very probable that with more emphasis on the container seal design, one or more of the tested containers can successfully pass all tests required.

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28 July 1977

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INTRODUCTION

The Air Force Packaging Evaluation Agency (AFPEA) has completed testing of five household goods containers, one each from five separate manufacturers. Initial testing was conducted at the request of GSA as part of a container evaluation program. An additional container was submitted to the AFPEA testing facilities as part of the 'compare and contrast' function of the evaluation.

Following is a list of container manufacturers in the order of container testing:

1. ARBI CONTAINER COMPANY, INC.
2. PAK-WELL INC.
3. HUGHES BOX AND CONTAINER COMPANY
4. ROWLEY & ASSOCIATES
5. WR-ALC (SPECIAL DESIGN EFFORT)
6. BLAKELY (NOT TESTED)

AFPEA acted as the independent and unbiased agency for all testing. MIL-STD-1489A, "Performance Testing of Commercially Owned Household Goods Containers," was strictly followed in both preparation and testing of all containers. The following sections contain each test report as required by MIL-STD-1489A, along with representative photographs.

PHASE I

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PROCEDURE

The following test report requirements are provided to comply with Appendix A of MIL-STD-1489A, "Performance Testing of Commercially Owned Household Goods Containers."

SECTION 1 - IDENTIFICATION INFORMATION

1. Test Report Date of Issuance -- 27 April 1977

2. Container Manufacturer -- ARBI Container Company, Inc.
   P.O. Box 3588
   Jackson MS 39207

3. Testing Sponsor -- J. Burton, Federal Supply Service

4. Carrier Representative -- N/A

5. Test Laboratory -- Air Force Packaging Evaluation Agency
   HQ AFALD/PTP
   Wright-Patterson AFB OH 45433

6. Government Representatives -- R. T. Gibbons, F. R. Yeager
   P. Quijas, J. H. Schenck

7. Container Built in Accordance With -- PPP-B-00580 (Navy) Amendment 1. Deviations only as authorized in Government contract.

SECTION 2 - CONTAINER CONFIGURATION CHARACTERISTICS

1. Exterior Dimensions -- 96 1/2 x 42.5 x 84

2. Exterior Volume -- 199.4

3. Interior Dimensions -- 93.5 x 39.75 x 78.5

4. Interior Volume -- 168.8 cu ft

5. Ratio Interior to Exterior Volume -- 0.85:1

6. Tare Weight -- 415

7. Tare Density -- 2.08 pcf

8. Cube Utilization -- (8 x 8 x 20 VAN) - Actual - 4 containers with 582 cu ft unused volume

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SECTION 3

TEST RESULTS (A)

1. Test Method 500, Drop Test

2. Conducted on: 20 April 1977

3. Method 500, Drop Test, was conducted in strict compliance with MIL-STD-1489A, with no deviations.

4. No test measurements required.

5. Post inspection revealed the following:

   a. At conclusion of edge drops -

      (1) A small separation developed between the header and the skid.

      (2) Splits developed in the side horizontal cleats where the clip hardware screws entered.

      (3) Separation between the side and end seams became evident.

   b. At conclusion of corner drops -

      (1) All cleats showed some evidence of splitting at the clip hardware screw entrance points similar to that described in 5.a.(2) above.

      (2) Small crack developed in one side plywood panel.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, Method 500 of MIL-STD-1489A.

TEST RESULTS (B)

1. Test Method 501, Stacking Test

2. Conducted on: 20 April 1977

3. Method 501, Stacking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations. The test apparatus used to provide a constant test load was a Testing Machines Inc. (TMI), high capacity compression tester, model no. 17-24-2 with graphic and digital readout of load and deflection.

4. Test measurements. The magnitude of the superimposed load was kept constant for over one hour at 7120 lbs. The testing machine was programmed to prevent load drop-off due to the relaxation of the material. Maximum bulging on the container occurred on side #3. This displacement was 1.32" from the no-load conditions.

5. Post-test inspection findings showed no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 501.

TEST RESULTS (C)

1. Test Method 502, Racking Test

2. Conducted on: 20 April 1977

3. Method 502, Racking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. Test measurements were as follows:

   a. A 360 lb compressive force was necessary to lift the container's unrestricted sides just clear of the supporting surface.

   b. The maximum change in length of a diagonal was 0.25" on side #2 in the direction away from the restricted side.

5. Post-test inspection findings show no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 502.

TEST RESULTS (D)

1. Test Method 503, Pendulum Impact Test

2. Conducted on: 20 April 1977

3. Method 503, Pendulum Impact Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed the following:

   a. All clip hardware screw entry points showed cracks developing or spreading.

   b. All seams continued to open slightly. This was mostly visible on the end/side seams.

   c. On end 3-2 a large split developed. This was a continuation of a crack developed in the drop test sequence.

   d. Several staple heads had popped up on the inside of the container. Maximum displacement of the staple head was approximately 0.125".

6. The container's performance was marginal when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 503. It is extremely doubtful that this container would withstand the multi-trip environment for which it was designed.

TEST RESULTS (E)

1. Test Method 504, Watertightness Test

2. Conducted on 20 April 1977

3. Method 504, Watertightness Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings revealed a small amount of water on the interior sides and ends. The side/end seams showed a slight trace of water. The major area of water entrance was at the container interior base. There was a considerable amount of standing water covering approximately 55 percent of the floor.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 504.

TEST RESULTS (F)

1. Test Method 505, Pendulum Puncture Test

2. Conducted on 20 April 1977

3. Method 505, Pendulum Puncture Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed the impact surfaces pulled away from the lower horizontal cleats during each of the four impacts. This was due in all probability to the non-clinching of the cement-coated staples used to join the plywood panels to the cleats. The staple was in accordance with PPP-B-00580 (Navy) "Box, Wood, Household Goods," Amendment 1, paragraph 3.3.3.2.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 505.

SECTION 4 - VERIFICATION

The Air Force Packaging Evaluation Agency has no direct financial interest in either the design or manufacture of the container. The test equipment, test procedures, test conditions, and sequences of testing employed conformed to all applicable provisions of the document. The test report accurately depicts the test findings.

JACK E. THOMPSON
Director
Air Force Packaging
Evaluation Agency

FIGURE 1. THE ARBI CONTAINER COMPANY CONTAINER PRIOR TO END PENDULUM PUNCTURE TEST

FIGURE 2. CLEATED CORNER SEALED WITH CAULKING

FIGURE 3. END DAMAGED DURING DROP TEST SEQUENCE

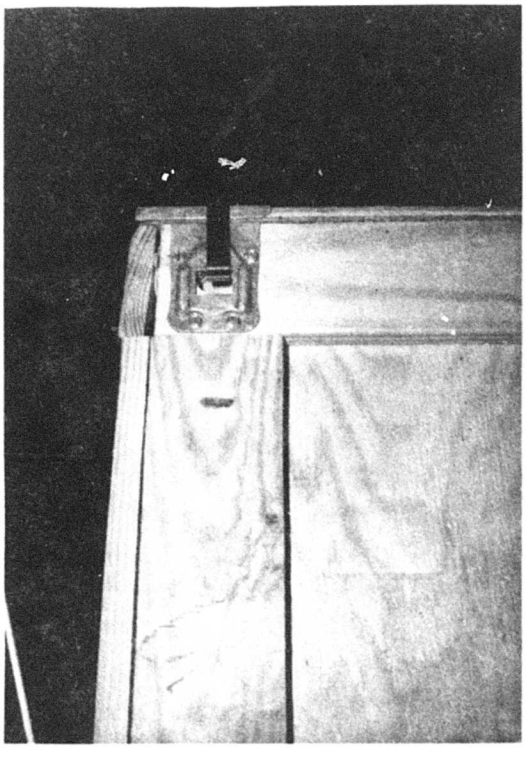

FIGURE 4. ADDITIONAL CORNER DAMAGE FROM IMPACT

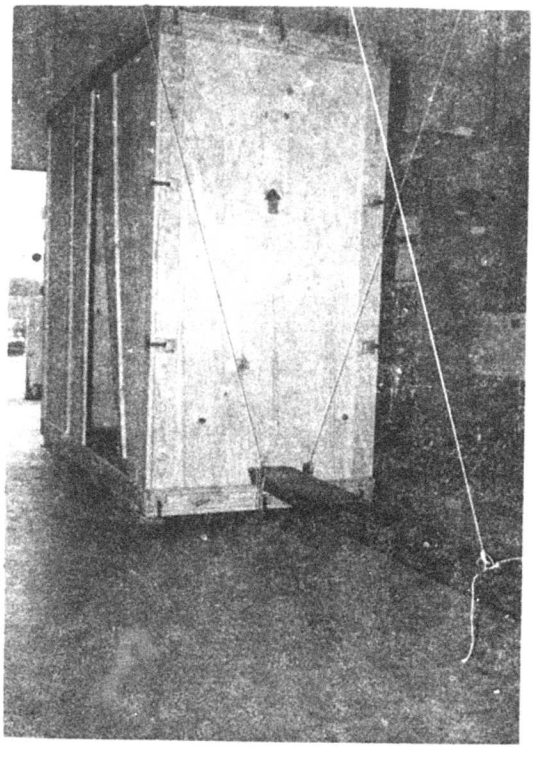

FIGURE 5. EQUIPMENT SET-UP PRIOR TO END PENDULUM PUNCTURE TEST

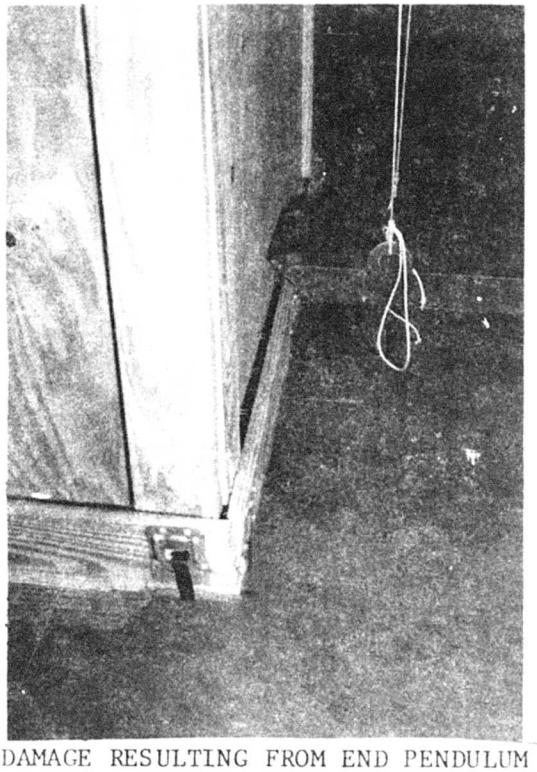

FIGURE 6. DAMAGE RESULTING FROM END PENDULUM PUNCTURE TEST

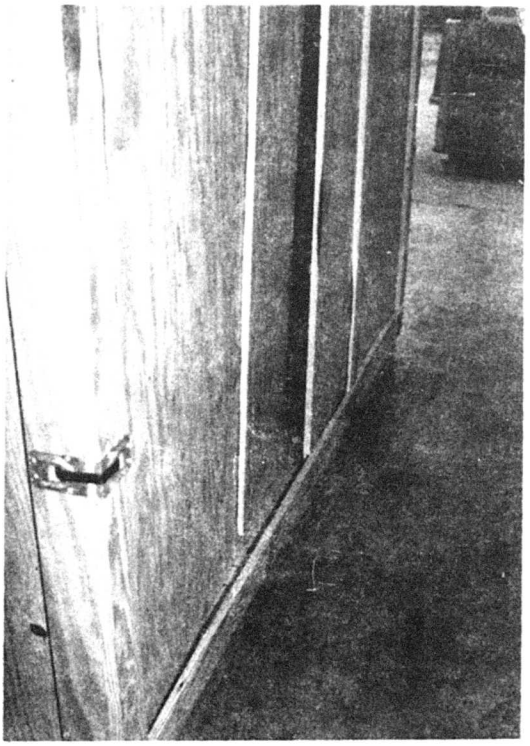

FIGURE 7. DAMAGE RESULTING FROM SIDE PENDULUM PUNCTURE TEST

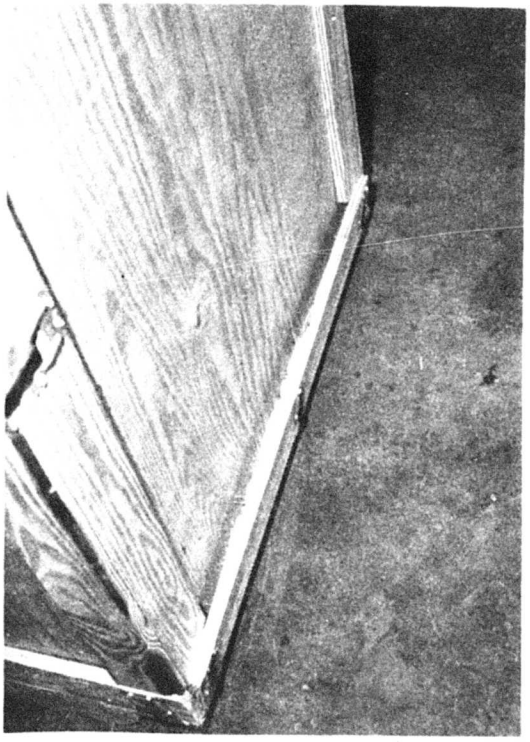

FIGURE 8. TOP VIEW OF PLYWOOD/CLEAT SEPARATION

PHASE II

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PROCEDURE

The following test report requirements are provided to comply with Appendix A of MIL-STD-1489A, "Performance Testing of Commercially Owned Household Goods Containers."

SECTION 1 - IDENTIFICATION INFORMATION

1. Test Report Date of Issuance - 19 May 1977

2. Container Manufacturer - PAK WELL INC.
673 Morgan Avenue
Brooklyn NY 11222

3. Testing Sponsor - J. Burton, Federal Supply Service

4. Carrier Representative - N/A

5. Test Laboratory - Air Force Packaging Evaluation Agency
HQ AFALD/PTP
Wright-Patterson AFB OH 45433

6. Government Representatives - Richard T. Gibbons
Frank R. Yeager

7. Container Built in Accordance With - PPP-B-00580 (Navy) Amendment 1. Deviations only as authorized in Government contract.

SECTION 2 - CONTAINER CONFIGURATION CHARACTERISTICS

1. Exterior Dimensions - 96 1/2 x 42.5 x 84

2. Exterior Volume - 199.4

3. Interior Dimensions - 93.5 x 39.75 x 78.5

4. Interior Volume - 168.8 cu ft

5. Ratio Interior to Exterior Volume - 0.85:1

6. Tare Weight - 415 lbs

7. Tare Density - 2.08 pcf

8. Cube Utilization (8 x 8 x 20 VAN) - Actual - 4 containers with 582 cu ft unused volume

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SECTION 3 - TEST RESULTS (A)

1. Test Method 500, Drop Test

2. Conducted on 12 May 1977

3. Method 500, Drop Test, was conducted in strict compliance with MIL-STD-1489A, with no deviations.

4. No test measurements required.

5. Post inspection revealed the following:

   a. At conclusion of edge drops there was no damage apparent.

   b. At the conclusion of the corner drops there was a minimal amount of damage in the impact areas.

6. The container's performance was satisfactory when evaluated against the criteria established in MIL-STD-1489A, Method 500, paragraph 7.

TEST RESULTS (B)

1. Test Method 501, Stacking Test

2. Conducted on: 12 May 1977

3. Method 501, Stacking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations. The test apparatus used to supply a constant test load was a Testing Machines Inc. (TMI), high capacity compression tester, model no. 17-24-2 with graphic and digital readout of load and deflection.

4. Test measurements. The magnitude of the superimposed load was kept constant for over one hour at 7000 lbs. The testing machine was programmed to prevent load drop-off due to the relaxation of the material. Maximum bulging on the container occurred on side 1. This displacement was 3/8" from the no-load conditions.

5. Post-test inspection findings showed no damage to the container, with 1/16" distortion maximum, from the pre-stressed condition.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 501.

TEST RESULTS (C)

1. Test Method 502, Racking Test

2. Conducted on: 12 May 1977

3. Method 502, Racking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. Test measurements were as follows:

   a. A 360 lb compressive force was necessary to lift the contractor's unrestricted sides just clear of the supporting surface.

   b. The maximum change in length of a diagonal was 0.25" on side 1 in the direction away from the restricted side.

5. Post-test inspection findings show no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 502.

TEST RESULTS (D)

1. Test Method 503, Pendulum Impact Test

2. Conducted on: 12 May 1977

3. Method 503, Pendulum Impact Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed the following:

   a. Three clip screw entry points showed slight cracks developing.

   b. All seams opened slightly. This was mostly visible on the end/side seams.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 503.

TEST RESULTS (E)

1. Test Method 504, Watertightness Test

2. Conducted on: 12 May 1977

3. Method 504, Watertightness Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings revealed water on the interior sides and ends. The side/end seams showed a slight trace of water. The major area of water entrance was at the container interior top/side seals. There was a considerable amount of standing water covering approximately 60 percent of the floor.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 504.

TEST RESULTS (F)

1. Test Method 505, Pendulum Puncture Test

2. Conducted on: 12 May 1977

3. Method 505, Pendulum Puncture Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings found the impact surfaces pulled away from the lower horizontal cleats on each of the four impacts.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 505.

SECTION 4 - VERIFICATION

The Air Force Packaging Evaluation Agency has no direct financial interest in either the design or manufacture of the container. The test equipment, test procedures, test conditions, and sequences of testing employed conformed to all applicable provisions of the document. The test report accurately depicts the test findings.

JACK E. THOMPSON
Director
Air Force Packaging
Evaluation Agency

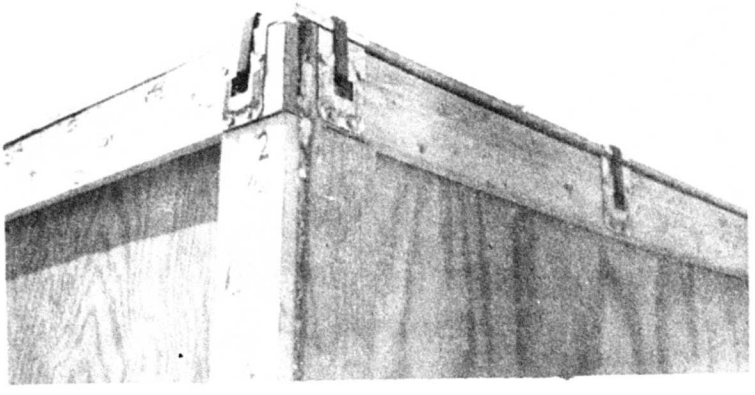

FIGURE 9. SIDE VIEW - PAK-WELL CONTAINER TOP CORNER AFTER DROP TEST SERIES

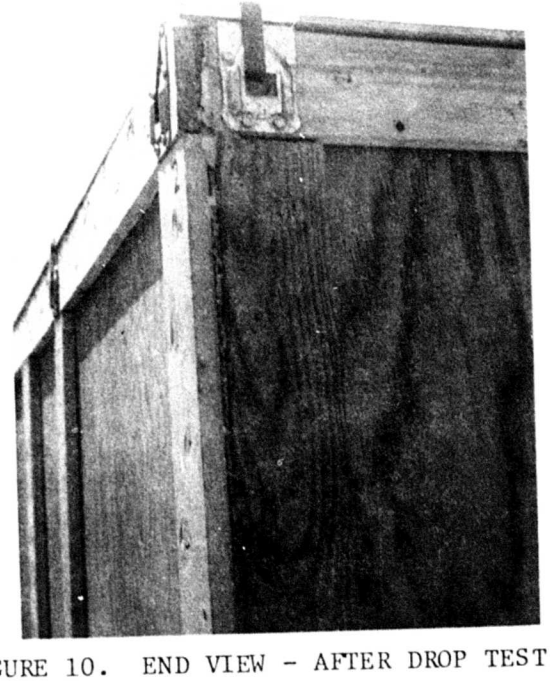

FIGURE 10. END VIEW - AFTER DROP TEST SERIES

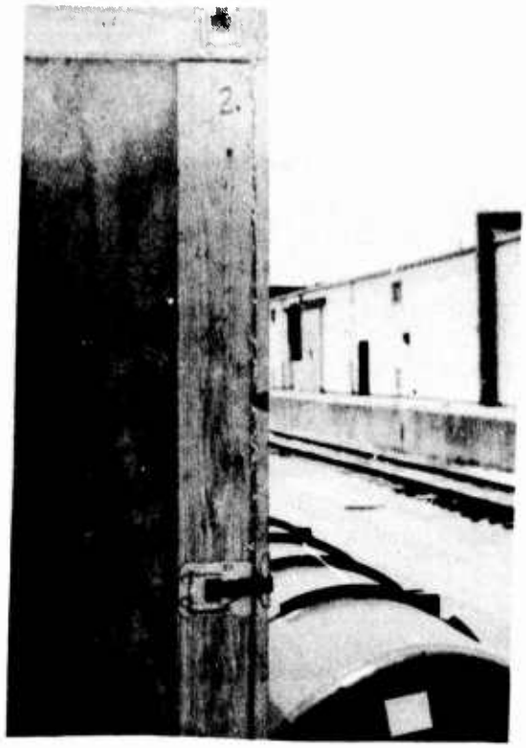

FIGURE 11. END, RIGHT SIDE AFTER ROUGH HANDLING

FIGURE 12. END, LEFT SIDE AFTER ROUGH HANDLING

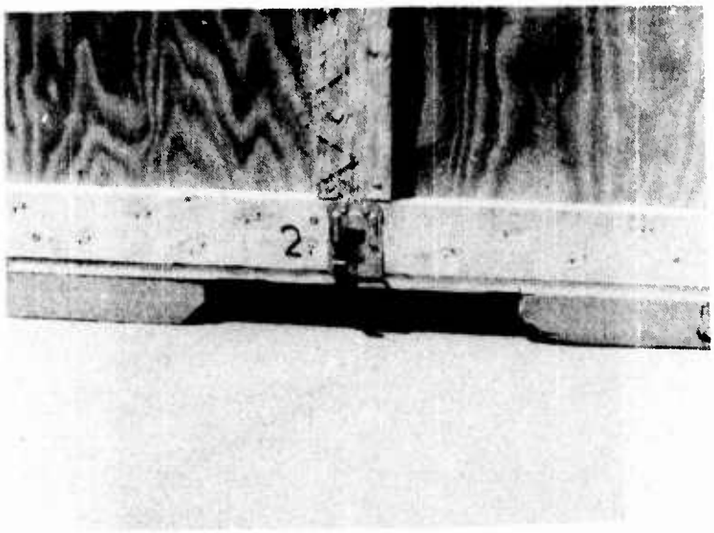

FIGURE 13. CLIMP SEPARATION AFTER ROUGH HANDLING

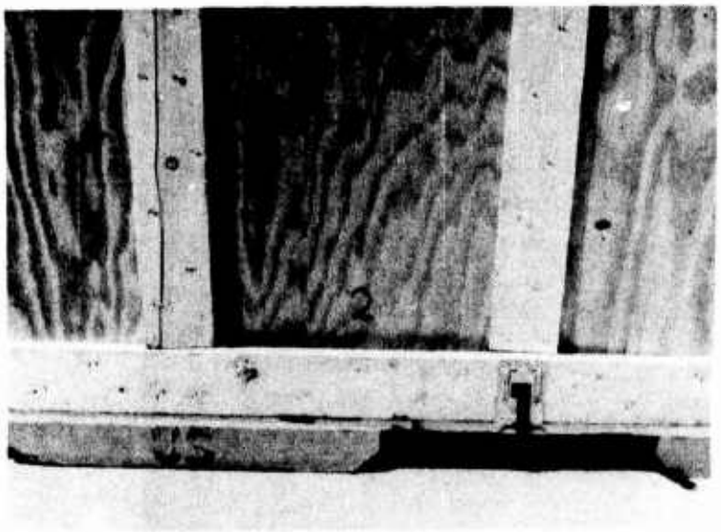

FIGURE 14. SIDE SEPARATION FROM PENDULUM PUNCTURE TEST

FIGURE 15. END SEPARATION AFTER PENDULUM IMPACT TEST

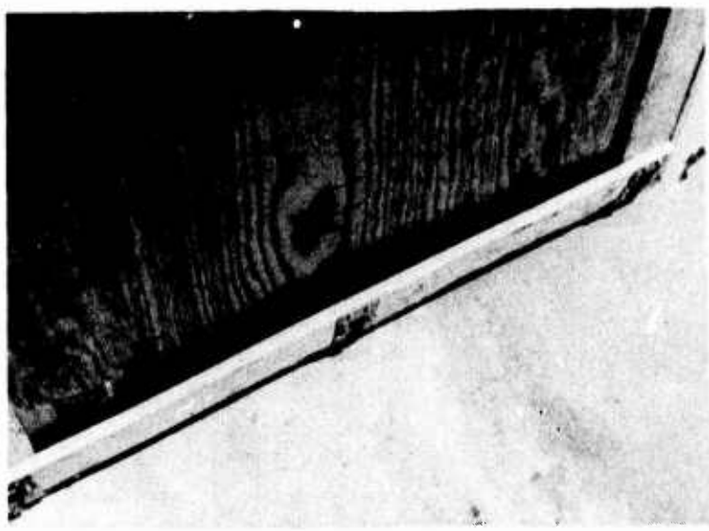

FIGURE 16. SIDE VIEW OF END SEPARATION

PHASE III

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PROCEDURE

The following test report requirements are provided to comply with Appendix A of MIL-STD-1489A, "Performance Testing of Commercially Owned Household Goods Containers."

SECTION 1 - IDENTIFICATION INFORMATION

1. Test Report Date of Issuance -- 25 May 1977

2. Container Manufacturer -- Hughes Box & Container Co.
   Baltimore MD

3. Testing Sponsor -- J. Burton, Federal Supply Service

4. Carrier Representative -- N/A

5. Test Laboratory -- Air Force Packaging Evaluation Agency
   HQ AFALD/PTP
   Wright-Patterson AFB OH 45433

6. Government Representatives -- Richard T. Gibbons
   Frank R. Yeager

7. Container Built in Accordance With -- PPP-B-0058C (Navy) Amendment 1. Deviations only as authorized in Government contract.

SECTION 2 - CONTAINER CONFIGURATION CHARACTERISTICS

1. Exterior Dimensions -- 96.5 x 42.5 x 84

2. Exterior Volume -- 199.4

3. Interior Dimensions -- 93.5 x 39.75 x 78.5

4. Interior Volume -- 168.8 cu ft

5. Ratio Interior to Exterior Volume -- 0.85:1

6. Tare Weight -- 415 lbs

7. Tare Density -- 2.08 pcf

8. Cube Utilization -- (8 x 8 x 20 VAN) - Actual - 4 containers with 582 cu ft unused volume.

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SECTION 3

TEST RESULTS (A)

1. Test Method 500, Drop Test

2. Conducted on: 18 May 1977

3. Method 500, Drop Test, was conducted in strict compliance with MIL-STD-1489A, with no deviations.

4. No test measurements required.

5. Post inspection revealed the following:

   a. At conclusion of edge drops there was only superficial damage evident.

   b. At the conclusion of the corner drops only slight surface damage was noted.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, Method 500 of MIL-STD-1489A.

TEST RESULTS (B)

1. Test Method 501, Stacking Test

2. Conducted on: 18 May 1977

3. Method 501, Stacking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations. The test apparatus used to supply a constant test load was a Testing Machines Inc. (TMI), high capacity compression tester, model no. 17-24-2 with graphic and digital readout of load and deflection.

4. Test measurements. The magnitude of the superimposed load was kept constant for over one hour at 7100 lbs. The testing machine was programmed to prevent load drop-off due to the relaxation of the material. Maximum bulging on the container occurred on side #3. This displacement was 5/8" from the no-load conditions.

5. Post-test inspection findings showed no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 501.

TEST RESULTS (C)

1. Test Method 502, Racking Test

2. Conducted on: 18 May 1977

3. Method 502, Racking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. Test measurements were as follows:

   a. A 360 lb compressive force was necessary to lift the container's unrestricted sides just clear of the supporting surface.

   b. The maximum change in length of a diagonal was 0.50" on side #4 in the direction away from the restricted side.

5. Post-test inspection findings show no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 502.

TEST RESULTS (D)

1. Test Method 503, Pendulum Impact Test

2. Conducted on: 18 May 1977

3. Method 503, Pendulum Impact Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed the following:

   a. Ten screw entry points showed cracks developing or spreading.

   b. All seams opened slightly.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 503.

TEST RESULTS (E)

1. Test Method 504, Watertightness Test

2. Conducted on: 18 May 1977

3. Method 504, Watertightness Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings revealed a small amount of water on the interior sides and ends. The side/end seams showed a slight trace of water. The major area of water entrance was at the container interior base. There was a considerable amount of standing water covering approximately 45 percent of the floor.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 504.

TEST RESULTS (F)

1. Test Method 505, Pendulum Puncture Test

2. Conducted on: 18 May 1977

3. Method 505, Pendulum Puncture Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings found the impact surfaces pulled away from the lower horizontal cleats on one end and one side impact.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 505.

SECTION 4 - VERIFICATION

The Air Force Packaging Evaluation Agency has no direct financial interest in either the design or manufacture of the container. The test equipment, test procedures, test conditions, and sequences of testing employed conformed to all applicable provisions of the document. The test report accurately depicts the test findings.

JACK E. THOMPSON
Director
Air Force Packaging
Evaluation Agency

FIGURE 17. TOP SIDE CORNER OF HUGHES CONTAINER

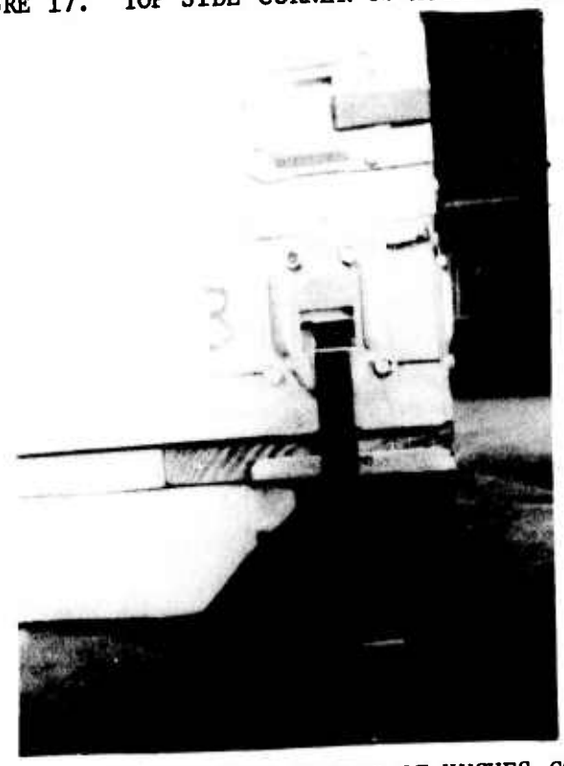

FIGURE 18. BOTTOM SIDE CORNER OF HUGHES CONTAINER

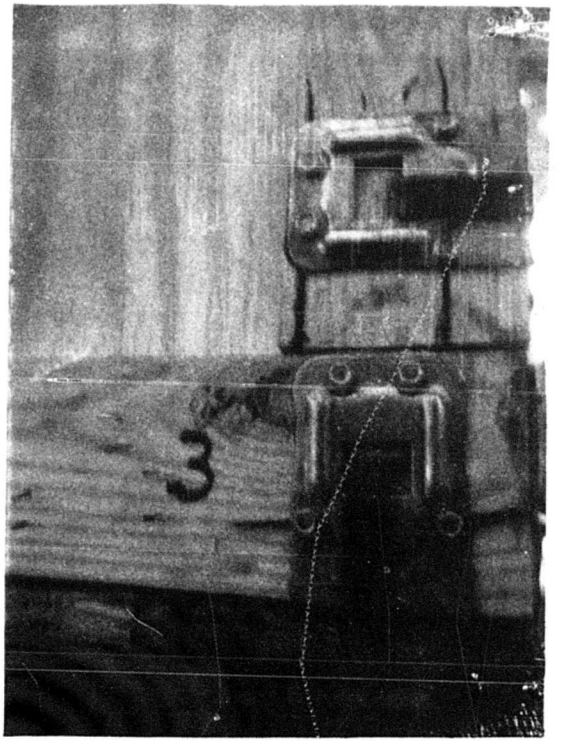

FIGURE 19. CRACKS DEVELOPING FROM BRACK SCREWS, LOWER CORNER

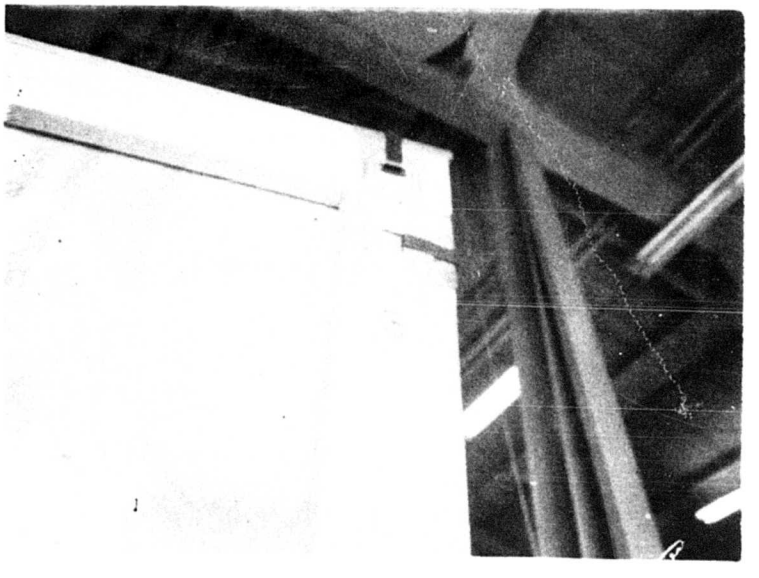

FIGURE 20. CRACKS DEVELOPING, UPPER CORNER

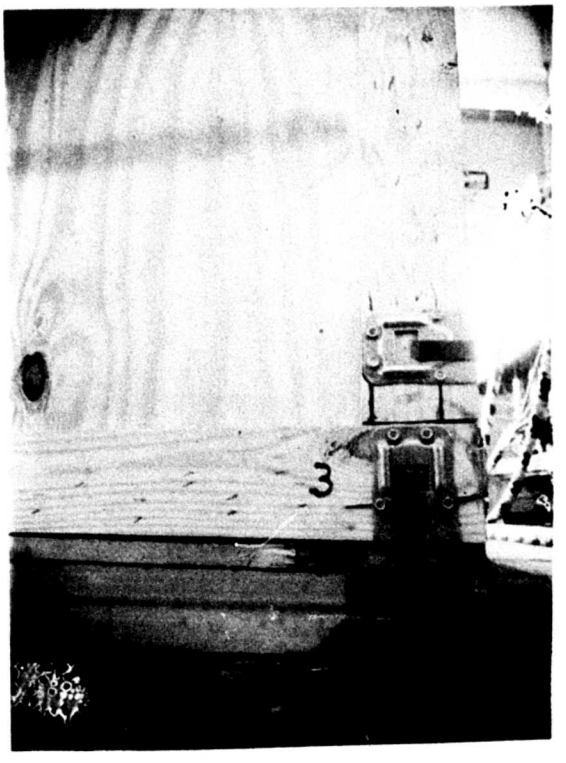

FIGURE 21. SEPARATION AND CRACKS FROM DROP TEST SERIES

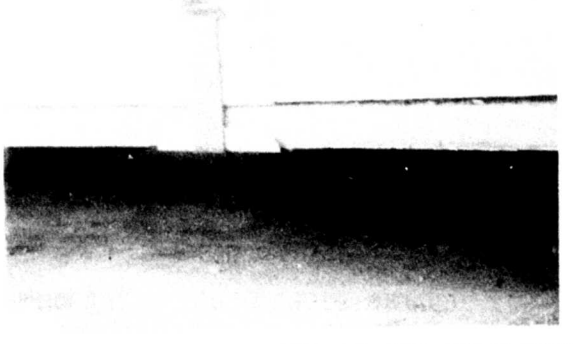

FIGURE 22. SEPARATION AT MID-SIDE POINT

FIGURE 23. SEPARATION RESULTING FROM PENDULUM PUNCTURE

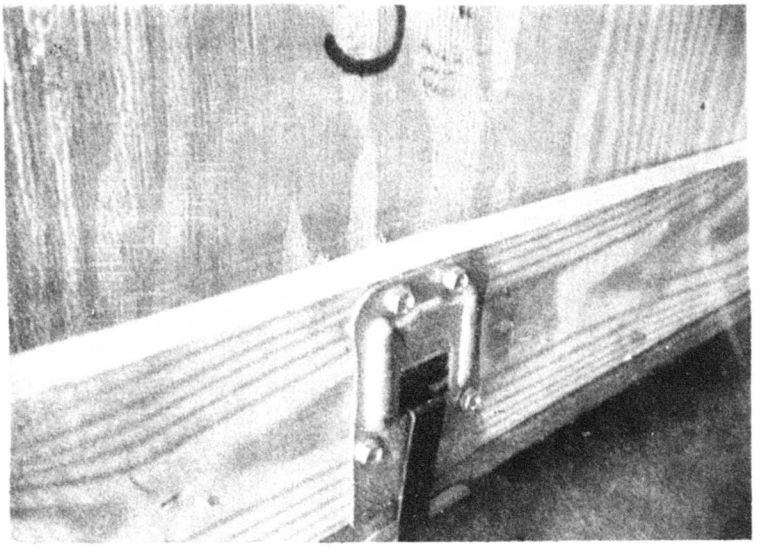

FIGURE 24. SIDE VIEW OF PUNCTURE TEST SEPARATION

PHASE IV

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PROCEDURE

The following test report requirements are provided to comply with Appendix A of MIL-STD-1489A, "Performance Testing of Commercially Owned Household Goods Containers."

SECTION 1 - IDENTIFICATION INFORMATION

1. Test Report Date of Issuance -- 3 Jun 77

2. Container Manufacturer -- Rowley & Associates
   1725 Hallam Drive
   Lakeland, FL 33803

3. Testing Sponsor -- J. Burton, Federal Supply Service

4. Carrier Representative -- N/A

5. Test Laboratory -- Air Force Packaging Evaluation Agency
   HQ AFALD/PTP
   Wright-Patterson AFB OH 45433

6. Government Representatives -- Richard T. Gibbons
   Frank R. Yeager
   Daryl Edwards

7. Container Built in Accordance With -- PPP-B-00580 (Navy) Amendment 1. Deviations only as authorized.

SECTION 2 - CONTAINER CONFIGURATION CHARACTERISTICS

1. Exterior Dimensions -- 87-1/8 X 47-1/8 X 87 inches

2. Exterior Volume -- 206.7 ft^3

3. Interior Dimensions -- 84-1/8 X 44-3/8 X 81-1/2 inches

4. Interior Volume -- 176.1 ft^3

5. Ratio Interior to Exterior Volume -- 0.85:1

6. Tare Weight -- 470

7. Tare Density -- 2.27 pcf

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8. Cube Utilization -- (8 X 8 X 20 VAN) - Actual - 5 containers with 247 cu ft unused volume.

SECTION 3

TEST RESULTS (A)

1. Test Method 500, Drop Test

2. Conducted on: 20 May 1977

3. Method 500, Drop Test, was conducted in strict compliance with MIL-STD-1489A, with no deviations.

4. No test measurements required.

5. Post inspection revealed the following:

   a. At conclusion of edge drops there was no visable detrimental damage.

   b. At conclusion of corner drops there was no visable detrimental damage.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, Method 500 of MIL-STD-1489A.

TEST RESULTS (B)

1. Test Method 501, Stacking Test

2. Conducted on: 24 May 1977

3. Method 501, Stacking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations. The test apparatus used to provide a constant test load was a Testing Machines Inc. (TMI), high capacity compression tester, model no. 17-24-2 with graphic and digital readout of load and deflection.

4. Test measurements. The magnitude of the superimposed load was kept constant for over one hour at 7130 lbs. The testing machine was programmed to prevent load drop-off due to the relaxation of the material. Maxi-

mum bulging on the container occurred on side #3. This displacement was 0.52" from the no-load conditions.

5. Post-test inspection findings showed no damage to the container. Permanent distortion was less than 0.1".

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 501.

TEST RESULTS (C)

1. Test Method 502, Racking Test

2. Conducted on: 25 May 1977

3. Method 502, Racking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. Test measurements were as follows:

   a. A 375 lb compressive force was necessary to lift the container's unrestricted sides just clear of the supporting surface.

   b. The maximum change in length of a diagonal was 0.125" on side #2 in the direction away from the restricted side.

5. Post-test inspection findings show no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 502.

TEST RESULTS (D)

1. Test Method 503, Pendulum Impact Test

2. Conducted on: 20 May 1977

3. Method 503, Pendulum Impact Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed that there was no structural damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 503.

TEST RESULTS (E)

1. Test Method 504, Watertightness Test

2. Conducted on: 25 May 1977

3. Method 504, Watertightness Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings revealed a small amount of water on the interior sides and ends. The side/end seams showed a slight trace of water. There was a considerable amount of standing water covering approximately 50 percent of the floor.

6. The container's performance was unsatisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 504.

TEST RESULTS (F)

1. Test Method 505, Pendulum Puncture Test

2. Conducted on: 27 May 1977

3. Method 505, Pendulum Puncture Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed no critical damage.

6. The container's performance was satisfactory when evaluated against the criteria established in para-

graph 7, MIL-STD-1489A, Method 505.

SECTION 4 - VERIFICATION

The Air Force Packaging Evaluation Agency has no direct financial interest in either the design or manufacture of the container. The test equipment, test procedures, test conditions, and sequences of testing employed conformed to all applicable provisions of the document. The test report accurately depicts the test findings.

JACK E. THOMPSON
Director
Air Force Packaging
Evaluation Agency

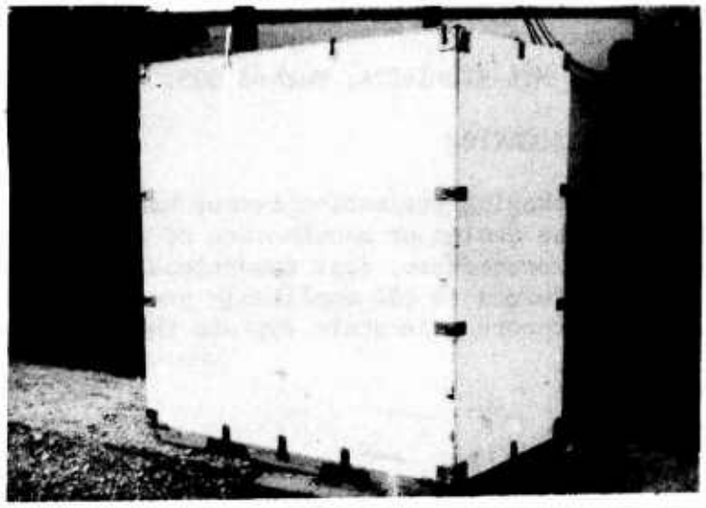

FIGURE 25. OVERALL VIEW OF ROWLEY & ASSOCIATES CONTAINER

FIGURE 26. WATER INFILTRATION AREA, FRONT

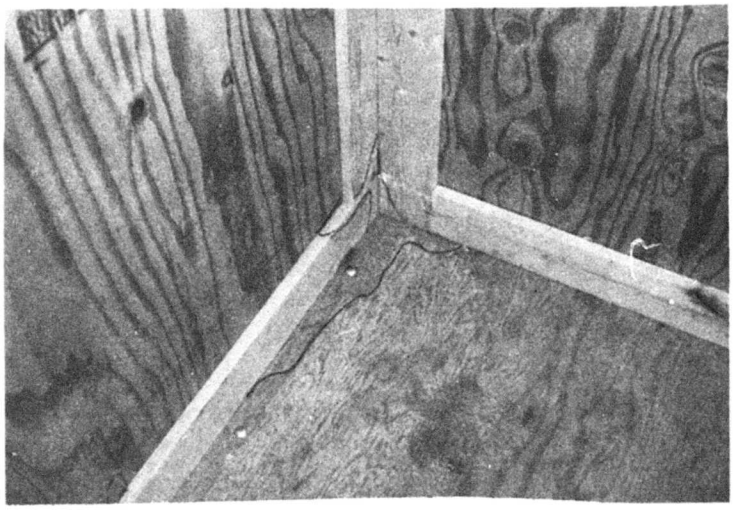

FIGURE 27. WATER INFILTRATION, LEFT REAR

FIGURE 28. WATER INFILTRATION, RIGHT REAR

PHASE V

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PROCEDURE

The following test report requirements are provided to comply with Appendix A of MIL-STD-1489A, "Performance Testing of Commercially Owned Household Goods Containers."

SECTION 1 - IDENTIFICATION INFORMATION

1. Test Report Date of Issuance -- 10 Jun 1977

2. Container Manufacturer -- WR-ALC/DSPC

3. Testing Sponsor -- J. Burton, Federal Supply Service

4. Carrier Representative -- N/A

5. Test Laboratory -- Air Force Packaging Evaluation Agency
   HQ AFALD/PTP
   Wright-Patterson AFB OH 45433

6. Government Representatives -- Richard T. Gibbons
   Frank R. Yeager
   Daryl Edwards
   J. H. Schenck

7. Container Built in Accordance With -- PPP-B-00580 (Navy) Amendment 1. Deviations only as authorized.

SECTION 2 - CONTAINER CONFIGURATION CHARACTERISTICS

1. Exterior Dimensions -- 87 X 47 X 87

2. Exterior Volume -- 205.9 cu ft

3. Interior Dimensions -- 84.75 X 44.75 X 81.5

4. Interior Volume -- 178.9 cu ft

5. Ratio Interior to Exterior Volume -- 0.87:1

6. Tare Weight -- 465

7. Tare Density -- 2.26 pcf

8. Cube Utilization -- (8 X 8 X 20 VAN) - Actual - 5 containers

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with 250.7 cu ft unused volume

SECTION 3

TEST RESULTS (A)

1. Test Method 500, Drop Test

2. Conducted on: 7 Jun 1977

3. Method 500, Drop Test, was conducted in strict compliance with MIL-STD-1489A, with no deviations.

4. No test measurements required.

5. Post inspection revealed the following:

   a. At conclusion of edge drops there was no apparent damage

   b. At conclusion of corner drops - the bottom center clip hardware was pulled completely out on the side that had the column joiner in place of the hinge.

6. The container's performance was marginally satisfactory when evaluated against the criteria established in paragraph 7, Method 500 of MIL-STD-1489A.

TEST RESULTS (B)

1. Test Method 501, Stacking Test

2. Conducted on: 7 Jun 1977

3. Method 501, Stacking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations. The test apparatus used to provide a constant test load was a Testing Machines Inc. (TMI), high capacity compression tester, model no. 17-24-2 with graphic and digital readout of load and deflection.

4. Test measurements. The magnitude of the superimposed load was kept constant for over one hour at 7130 lbs. The testing machine was programmed to prevent load drop-off due to the relaxation of the material. Maxi-

mum bulging on the container occurred on side #3. This displacement was 0.50" from the no-load conditions.

5. Post-test inspection findings showed no damage to the container. Permanent deformation was less than 1/16" maximum.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 501.

TEST RESULTS (C)

1. Test Method 502, Racking Test

2. Conducted on: 7 Jun 1977

3. Method 502, Racking Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. Test measurements were as follows:

   a. A 200 lb compressive force was necessary to lift the container's unrestricted sides just clear of the supporting surface.

   b. The maximum change in length of a diagonal was 1/32" on side #4 in the direction away from the restricted side.

5. Post-test inspection findings show no damage to the container.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 502.

TEST RESULTS (D)

1. Test Method 503, Pendulum Impact Test

2. Conducted on: 7 Jun 1977

3. Method 503, Pendulum Impact Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed that there was no structural damage.

6. The container's performance was satisfactory when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 503.

TEST RESULTS (E)

1. Test Method 504, Watertightness Test

2. Conducted on: 8 Jun 77

3. Method 504, Watertightness Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings revealed a large amount of water on the interior sides and ends. The side/end seams showed a slight trace of water. The major area of water entrance was at the container side seams. There was a considerable amount of standing water covering approximately 85 percent of the floor.

6. The container's performance was <u>unsatisfactory</u> when evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 504.

TEST RESULTS (F)

1. Test Method 505, Pendulum Puncture Test

2. Conducted on: 8 Jun 77

3. Method 505, Pendulum Puncture Test, was conducted in strict compliance with MIL-STD-1489A with no deviations.

4. No test measurements required.

5. Post-test inspection findings showed no critical damage.

6. The container's performance was satisfactory when

evaluated against the criteria established in paragraph 7, MIL-STD-1489A, Method 505.

SECTION 4 - VERIFICATION

The Air Force Packaging Evaluation Agency has no direct financial interest in either the design or manufacture of the container. The test equipment, test procedures, test conditions, and sequences of testing employed conformed to all applicable provisions of the document. The test report accurately depicts the test findings.

JACK E. THOMPSON
Director
Air Force Packaging
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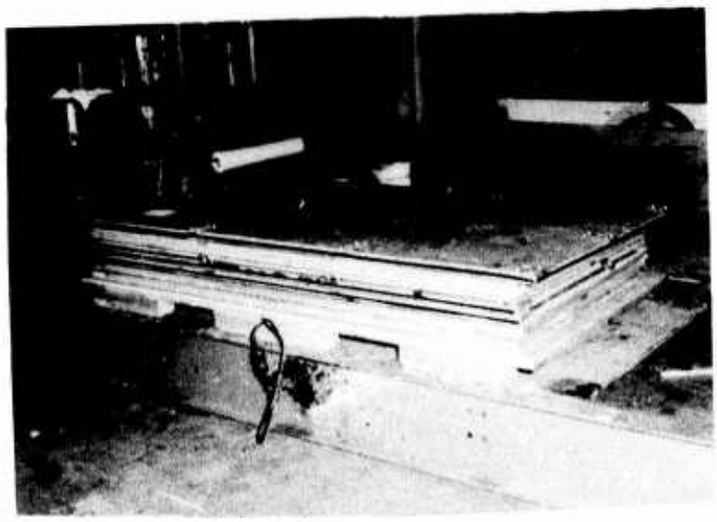

FIGURE 29. WR-ALC CONTAINER, DISASSEMBLED

DISCUSSION

All five containers tested had one common design flaw; one that was instrumental in the failure of each. The problem identified was that which showed all containers were unable to pass the watertightness test. The seal which provides the watertightness was ineffective, regardless of the type of sealing material used.

The first three containers tested, failed the pendulum puncture test. These containers, manufactured by Arbi Container Company, Inc., PAK-WELL, and the Hughes Box and Container Company all had the 1 x 4 cleating on the exterior of the container. The two containers that passed this phase of testing had the 1 x 4 cleating on the box interior. The positioning of the cleats was then, seen to be the determining factor as to whether or not the container passed the test. Whether or not the staples used in construction of the end and side panels were clinched appeared to have no effect on the container performance during the puncture test.

A sixth container, manufactured by Blakely, arrived at the AFPEA in such poor condition that testing was not conducted. The maximum amount of caulking allowed would not have prevented water infiltration when subjected to the watertightness test outlined in MIL-STD-1489A.

The container manufactured by Rowley & Associates seemed to have the best overall performance, and with improved seal design, the container should have no problems passing all tests in MIL-STD-1489A.

The container manufactured by WR-ALC personnel was designed with a hinged side section for better knocked-down stacking and transportation. By using this hinge, all container panels become approximately the same size. With a proper seal design between the hinged sections, as well as at the standard joints, this container could prove to be the most effective design.

Testing on all containers was terminated after the pendulum puncture test to provide uniform evaluation. At this point, all containers had failed.

RECOMMENDATIONS

The Air Force Packaging Evaluation Agency makes the following recommendations based on recently completed testing and evaluation of six household goods containers, one each from six different manufacturers:

1. MIL-STD-1489A should be evaluated and improved so as to provide

a more representative, accurate, and fully reproducible test plan for container evaluation. AFPEA will, of course, have some initial input for this effort.

2. Cleats (1 x 4's) should be used on the inside rather than outside of the container to prevent staple pull-out from the plywood/cleat construction.

3. A redesign of the seal area is imperative. The water infiltration problem, common to all containers tested, supports this recommendation. If the present type of seal design is retained, then an effort should be made to alter or amend the MIL-STD-1489A water test since the present containers fabricated in accordance with the specification will not pass this test.

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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)

Container
Household Goods
Testing
Crates
Rough Handling
Transportation

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

As part of the Air Force Packaging Evaluation Agency (AFPEA) mission, test and evaluation services are available to all agencies in the DOD. These services are used to evaluate a single container design or to compare and contrast various designs and products from a variety of sources. Through this engineering effort, AFPEA is able to help make sure the best and most economical containers are used in the transportation system.

Recently, the Design Division of AFALD/PTP conducted testing ~~(Cont'd)~~ over

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and evaluation of six household goods containers. While none of the containers passed the testing criteria established, there was ample opportunity to observe the effect of variations in construction. It is very probable that with more emphasis on the container seal design, one or more of the tested containers can successfully pass all tests required.