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PACKAGING PERFORMANCE TESTING
OF A TRIPLE-WALL CORRUGATED FIBERBOARD
BOX (47.5 IN. BY 39.5 IN. BY 28.0 IN.), CONTAINING 100 LB OF SOLID
HAZARDOUS MATERIALS - PACKING GROUP III

ALL TRANSPORTATION MODES

Date: June 29, 2004

AFPTEF PROJECT NUMBER: 04-P-101
POP TEST ID NUMBER: DODPOPHM/USA/DOD/AF69/DLA-F060

Part 1.

A. Title: PACKAGING PERFORMANCE TESTING OF A TRIPLE-WALL CORRUGATED FIBERBOARD BOX (47.5 IN. BY 39.5 IN. BY 28.0 IN.), CONTAINING 100 LB OF SOLID HAZARDOUS MATERIALS - PACKING GROUP III

Report Number: DLA-F060
AFPTEF Project Number: 04-P-101
Manhours: 40

Report Type: FINAL

B.
TEST REPORT APPLICABILITY STATEMENTS see section 2E.

Report Prepared by:

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Testing Completion Date: 28 June 04

Approved for Publication and Dated: 29 June 04

Responsible Individual: Robbin L. Miller

Performing Activity: AF Packaging Technology and Engineering Facility
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Specific Authority: Distribution Statement F. Further dissemination only as directed by AFMC LSO/LOP or higher DoD authority.

Requesting Organization: Defense Distribution Center
DDC-J-3/J-4-0
ATTN: POP Team
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New Cumberland PA 17070

Part 2. Data Sheet**A. Exterior Shipping Container****UN Type:** Fiberboard box**UN Code:** 4G**NSN:** 8115-00-901-6435**Specification Number(s):** ASTM D5118, Style HSCC; ASTM D4727, Type CF, Class WR, Var TW, Gr 1100, V3c**Container Manufacturer:** (GSA) Arvco Container Corporation, Kalamazoo, Michigan 49001**Date of Manufacture:** April 2004 (GSA advice code "2G" – newest stock)**Material:** Triple-wall Corrugated Fiberboard**Container Dimensions:** 47.5 in. x 39.5 in. x 28.0 in. ID

Pallet Specification: ASME MH1.8M (Standard 48 in. x 40 in. stringer style wooden pallet. **NOTE:** All wooden pallets produced entirely or in part of solid wood packaging material (SWPM) shall be constructed from material which has been heat treated to 56°C or 133°F for 30 minutes. Certification is required by an accredited agency recognized by the American Lumber Standards Committee (ALSC). Construction and certification shall be in accordance with the International Plant Protection Convention (IPPC) guidelines of March 2002, and ISPM 15, Guidelines for Regulating Wood Packaging Materials in International Trade. These documents can be found at www.aphis.usda.gov. On pallets, the marking shall be applied to the stringer of block on opposite sides and ends of the pallet and be contrasting and clearly visible.

B. Inner Packaging of Container**Closure (Type/Method):** ASTM D5168, Appendix, para. X1.3.11, Style G Container, using 16 mm (3/4-inch) flat steel strapping.**Tape Specification:** A-A-1687 Fiber Reinforced Tape, 1-inch; NSN 7510-00-582-4772.**Closure Specification Number(s):** ASTM D3953, Type I, Class A or B, minimum 16 mm (3/4-inch) width and minimum thickness of 0.46 mm (0.018 in.).**Reinforcement Specification Number(s):** Not applicable.**Absorbent Material Description:** Not applicable.

Additional Description: Container is attached to a standard wood pallet using the 16 mm (3/4-inch) width steel strapping (above). The same strapping used to attached the container to the pallet also is the strapping that closes the container (see Figure 3). Edge pads, either purchased or constructed of single/double-wall fiberboard strips (wider than the steel strapping) should be used to protect the upper edges of the triple-wall lid from tearing or collapsing as the steel-strapping is tightened.

Loading of container (see photos, Figures 1 – 3, and drawing).

1. Line the container with a 3-mil or 4-mil (preferable) gusseted polyethylene bag, with minimum dimensions in any one direction of 54 in. x 44 in. x 90 in. (Associated Bag Company part numbers 22-5-17 (3-mil bag) or 22-6-23 (4-mil bag)), and drape excess liner material over the top edge of box to hold it in place while filling.

2. Load target batting into lined box. Pull upper edges of liner material together, and either fold down the plastic liner and tape closed using 1-inch fiber-reinforced nylon tape; or twist the gathered liner to close and secure with a 12-inch minimum length of 1-inch fiber-reinforced nylon tape. Excess air should be pressed out of the liner as it is gathered together to prevent it from "puffing up" and interfering with closing the box. See Figure 2.

3. Place lid on box and close IAW 2A. See Figure 3.

C. Actual Product: Not Used**NSN:** N/A**Specification:** Unknown**UN/DOT/IMO/IATA Proper Shipping Name:** Hazardous Waste, N.O.S. (Target Batting) [or other lightweight bulky solids]**United Nations Code Number:** NA 3077**United Nations Packing Group:** III**UN Hazard Class:** 9 **DOT Hazard Class:** 9

IMO Hazard Class: 9 **IATA Hazard Class:** 9
Physical State: SOLID
Items per container: Various
Gross Mass/Weight: 80.7 kg (178 lb)
Item Mass/Weight: Not to exceed 100 lb
Density/Specific Gravity: N/A
Drop Height: 0.8 m (31.5 in.)
Minimum Stacking Weight/Force Required: 195.6 kg (431 lb)
Additional Description: NA.

D. Test Product: Used

Name: Bagged Absorbent GP, Ametek Microfoam roll.
United Nations Packaging Group: N/A
Physical State: Solid
Items per outer container: Various
Gross Weight (loaded container strapped to pallet): 80.7 kg (178 lb)
Test Item Weight: 45.3 kg (100 lbs)
Test Item Dimensions: N/A
Density/Specific Gravity: NA
Drop Height: 0.8 meters (31.5 in.)
Stacking Weight/Force used: 220.0 kg (485 lb)
Additional Description: N/A

E. Test Applicability- See test results in parts 7

(1) Tests documented herein are design qualification. It is the responsibility of the government shipper/certifier to fully verify design compliance and packaging material quality.

(2) Drop testing performed herein was tested in accordance with DLAD 4145.41, AR 700-143, AFJI 24-210, NAVSUPINST 4030.55A, and MCO 4030.40A. This joint DoD policy document allows packaging to be drop tested more than once provided the packaging continues to pass the 49CFR 178.603 requirements. Questions about or clarification of this policy can be sought from the respective preparing activities of the regulation.

(3) DoD contractor use of this test report or its resultant certifying mark only with the permission of the testing activity AND as specified in DLAD 4145.41, AR 700-143, AFJI 24-210, NAVSUPINST 4030.55A, and MCO 4030.40A.

(4) Pass/fail conclusions were based on the particular specimens, both inner and outer containers, and quantities of each submitted for test. Extrapolation to other manufacturers, applications, commodities, inner containers, container sizes, or lesser internal quantities is the responsibility of the packaging design agency or applicable higher headquarters and the limitations documented in 49CFR. Extrapolation of test results based on lesser than minimum UN/DOT required test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

(5) Reference to specification materials has been made based on one of the following methods: supplied by AFPTEF, provided by the requester, markings printed on, attached to or embossed on the packaging.

(6) Testing performed in accordance with 49CFR 170-180, except as documented in this report.

(7) Performance testing was undertaken and completed at the request of an agency responsible for management of the dangerous good(s). The completion of successful UN/DOT testing does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).

(8) The DOT performance tests are intended to evaluate the performance of the entire packaging configuration's ability to prevent the release of contents during conditions normally incident to transportation. The criteria used to evaluate container system performance is whether the contents of the packaging are retained intact. The successful completion of the recommended tests does not ensure undamaged delivery.

(9) Tests performed and documented, herein, in no way verify Government supplier's operations (included but not limited to: internal procedures, suppliers, or manufacturing processes) comply with the DOT's or international's regulations. The testing facility has no knowledge and assumes no knowledge, that specific material testing requirements (i.e. plastics - only allowed to use regrind from the same operation; specific vendor plastic formulations including quantity of carbon black, ultra-violet inhibitors or pigments, or production run's individual leakproofness tests) are or were performed by the manufacturer(s) listed herein, unless otherwise noted in the report.

Part 3. Introduction.

Brief description of why specific tests were performed and rationale for the test product selected (if applicable).

Packing Group III testing was requested on the above stated configuration. For lesser quantities, variations to testing requirements can be found in 49 CFR, part 178.601(g).

Bags of Absorbent GP and one roll of Ametek Microfoam were used as a substitute for the actual item as permitted by 49 CFR part 178.602(c).

Each packaging was subjected to appropriate drop and vibration testing as prescribed by ASTM D4919. These tests are designed to simulate the shock and vibration a package configuration may encounter during conditions normally incident to transportation. The order of testing was the vibration test followed by the drop test; the stacking test was performed on an empty outer container. The Cobb test was performed on samples taken from boxes not otherwise used in testing.

The use of one sample packaging configuration for multiple tests and drops is DoD policy as stated in DLAD 4145.41, AR 700-143, AFJI 24-210, NAVSUPINST 4030.55A, and MCO 4030.40A. This option was exercised in this test as noted in Part 6.

Part 4. Tests Required/Performed (as applicable).

NOTE: Packagings fabricated from fiberboard, paperboard, or paper, including composite containers with outer fiberboard containers, should be conditioned for a minimum 24 hours prior to any testing. Standard conditions $23 \pm 3^{\circ}\text{C}$ ($73 \pm 4^{\circ}\text{F}$) and $50 \pm 2\%$ relative humidity apply.

A. Leakproofness test. 3 outer containers each individually tested for 5 minutes (30 minutes for plastic containers). **Not applicable.**

B. Hydrostatic Pressure Test. 3 outer containers each individually tested for 5 minutes at 15 psig. **Not applicable.**

C. Stacking Test. One test per outer container, 3 containers required. Compression by a top load is calculated to simulate a stack height of **3 meters**, maintained for 24 hours. **NOTE:** If only one configuration sample is tested, test duration shall be 72 hours.

Static weight. Apply the calculated weights using a constant load evenly over the entire container.

$$M = \frac{m(3000-h)}{h}$$

where: m = container's gross mass (as shipped) in kilograms = **80.7 kg**
 h = container's height in millimeters = **876.3 mm** (effective height for container in stack)
 M = constant load mass in kilograms = **195.6 kg**

or:
$$W = \frac{w(118-h)}{h}$$

where: w = container's gross weight (as shipped) in pounds = **178 lb**
 h = container's height in inches = **34.5 in.** (effective height for container in stack)
 W = constant load weight in pounds = **431 lb**

NOTE: Where the contents of the test sample are non-dangerous liquids with relative density different from that of the liquid to be transported, the force shall be calculated in relation to the latter.

Information - This test assumes similar weight containers stacked on top of the test sample. This may or may not be a valid assumption. This calculation also only provides a minimum weight. Consideration should be given to what will actually be experienced in the transportation cycle.

D. Drop Test. 5 drops in order: flat on the top, bottom, long side, short side and top corner. The drop height shall be appropriate for the packaging group of the commodity. The container shall strike a target which shall be a rigid, non-resilient, flat, and horizontal surface. For other than flat drops, the center of gravity shall be vertically over the point of impact. **NOTE:** All drops may be made on one sample. If the sample fails after drops 2 through 5, it may be replaced by another sample identically loaded. This option was used as noted in Part 3.

1. Solids and liquids, if the test is performed with the actual contents to be carried, or with another substance having essentially the same characteristics, or for liquids if the test is performed with water and the intended contents has density less than 1.2 g/cm³ (specific gravity less than 1.2) the drop height shall be:

<u>Packing Group</u>	<u>Drop Height</u>
I	1.8m (70.9 in.)
II	1.2m (47.2 in.)
III	0.8m (31.5 in.)

2. Where the test sample doesn't contain the intended contents and its specific gravity is greater than 1.2, then obtain the required drop height in meters by calculating the following with product density (d):

<u>Packing Group</u>	<u>Drop Height</u>
I	(d) x 1.5m ((d) x 59.1 in.)
II	(d) x 1.0m ((d) x 39.4 in.)
III	(d) x 0.67m ((d) x 26.4 in.)

Round the drop height up to the first decimal.

E. Vibration Test (domestic requirement). One test per container, total of three test specimens. The test shall be performed for 1 hour at a frequency that causes the package to be raised from the vibrating platform to such a degree that a piece of material approximately **0.2 cm** (1/16 in.) thickness can be passed between the bottom of the package and the platform. The vibrating platform shall have a vertical double-amplitude (peak-to-peak) displacement of **2.54 cm** (1 in.). Perform tests in accordance to 49CFR 173 Subpart B, Appendix C and 49 CFR 178. **NOTE:** If only one configuration sample is tested, test duration shall be 3 hours.

F. Fiberboard Water Resistance (Cobb) Test. One test per fiberboard specimen, total of ten. Strong, solid or double faced corrugated fiberboard (single or multi-walled) must be used, appropriate for the capacity and the intended use of the box. The water resistant outer surface must not increase in mass greater than **155 grams per meter² (0.0316 pounds per foot²)** after 30 minutes in accordance with International Standards Organization (ISO) 535 or Technical Association of the Pulp and Paper Industry (TAPPI) T441 or ASTM D 3285. Five individual fiberboard specimens shall be exposed on the wire side and five on the felt side.

Part 5. Criteria for Passing Tests.

A. Leakproofness Test. Any leakage is cause for rejection. **Not applicable.**

B. Hydrostatic Pressure Test. Any leakage is cause for rejection. **Not applicable.**

C. Stacking Test.

No test sample shall leak. Composite and combination containers shall not exhibit leakage of the filling substance from the inner receptacle or container. No test sample shall show deterioration which adversely affects transportation safety or show any distortion liable to reduce its strength, cause stacking instability, or cause damage to internal container components likely to reduce transportation safety.

D. Drop Test.

Each packaging containing liquids shall be leakproof when internal and external pressures are equalized. Composite and combination containers shall not exhibit damage to the outer packaging likely to adversely affect transportation. In addition, the inner packaging shall not leak into the filling substance or lading.

E. Vibration Test.

No rupture or leakage from any of the packages. No test specimen shall show any deterioration which could adversely affect transportation safety, result in possible discharge of contents or reduce packaging strength.

F. Fiberboard Water Resistance Test.

The calculated water absorption of all samples shall be less than **155 g/m²**.

Part 6. Discussion and Test results.

Narrative description of test results, including any rationale for variations. For each packaging to pass, all applicable tests must be performed and pass criteria listed herein.

A. Leakproofness Test. Not applicable.

B. Hydrostatic Pressure Test. Not applicable.

C. Drop Test. Pass

Tested at standard conditions: 23 Degrees C., 50% RH.

The packaging was dropped 0.8 meters onto the required four flat sides and a top corner . Although there was minor crushing of the impact corner, there was no damage to the container that would be likely to cause leakage from, or weakening of, the package during transportation. See Figures 4 and 5.

D. Stacking Test. Pass

Duration: 72 hours at standard conditions: 23 Degrees C., 50% RH.

The same container used in the drop testing was stacked with 485 lb for 72 hours (although the container was loaded, the load provided no support to the container walls or lid). There was no damage to the container which could result in damage to the inner item, no crushing, nor stack instability. No other adverse results were noted. See Figure 6.

E. Vibration Test. Pass

Duration: 3 hours at standard conditions: 23 Degrees C., 50% RH.

The same packaging used in the drop and stacking tests was vibrated on an electro-hydraulic vibration table which was set at 1-inch vertical double amplitude (peak-to-peak) displacement, at a frequency such that the packaging was raised from the platform. The distance was measured using a 1/16-inch feeler gage. At the proper frequency (3.91 Hz) the feeler gage could be passed between the bottom of the package and the table surface. There was no damage to the outer container that would be likely to cause leakage from, or weakening of, the package during transportation. See Figure 7.

F. Water Resistance (Cobb) Test. Pass

Test at standard conditions: 23 Degrees C., 50% RH.

As required by 49 CFR part 178.516, ASTM D 3285 Water Absorptiveness of Nonfibuluous Paper and Paperboard (Cobb Test) was performed on specimens cut from the lot of containers used in the drop stack and vibration tests. The test period (exposure of the samples to water) was 30 minutes.

5 Specimens were tested on the interior side. Average **119.14 g/m²**.

5 Specimens were tested on the exterior side. Average **111.52 g/m²**.

0 Specimens exceeded the 155 grams per square meter maximum limit.

Part 7. Performance Marking on Container:

The container specified herein passes the DoT and international regulatory requirements to the extent tested. Equivalent DoD built or grandfathered containers MAY also qualify for the following marking as directed by DoD policy documents.



Part 8. References

- A. 49CFR 170-180
- B. DLAD 4145.41/AR 700-143/AFJI 24-210/NAVSUPINST 4030.55A/MCO 4030.40A - Packaging of Hazardous Materials
- C. ISO 535/TAPPI T 441/ASTM 3285 - Determination of Water Absorption of Paper and Board (Cobb Method)
- D. ISO 3574 - Cold-reduced carbon steel sheet of commercial and drawing quantities.
- E. ASTM D999 - Methods for Vibration Testing of Shipping Containers.

Part 9. Distribution List

Commander
Defense Logistics Agency
DDC-J-3/J-4-0
ATTN: Linda McCarthy
2001 Mission Drive
New Cumberland PA 17070

AFMC LSO/LOP
Project Folder



Figure 1. Test load in box. Excess depth of inner liner is draped over sides of box to hold it in place.



Figure 2. Closure of inner liner. Top is twisted shut and twist is bound with strip of fiber-reinforced packaging tape.



Figure 3. Closed triple-wall box containing the test load. Note strips of single-wall fiberboard used as edge-protectors under the strapping along the upper edges of the box. Strips of tape were used only to temporarily hold the corners of the lid in place while steel strapping was applied.



Figure 4. Drop test.



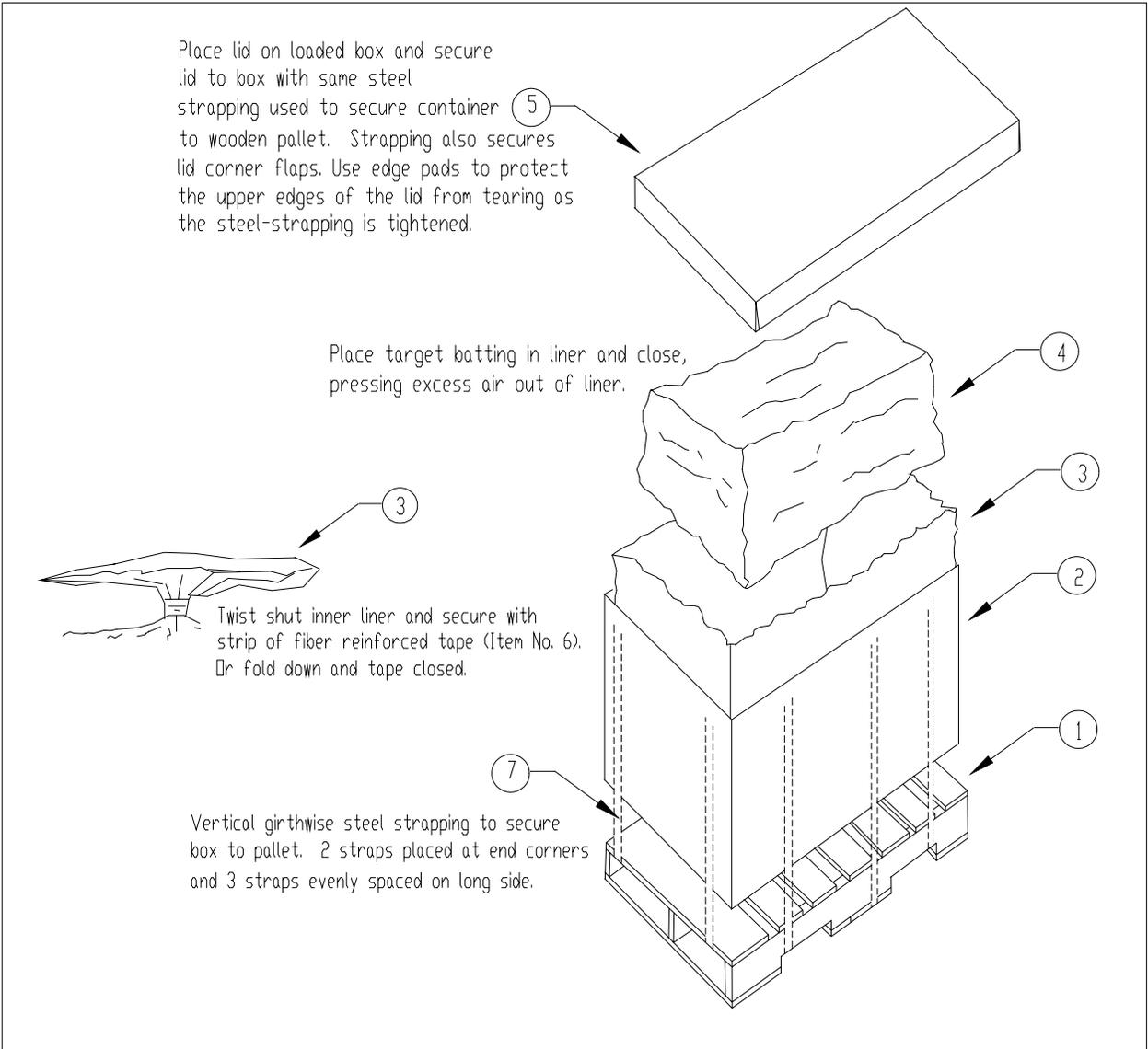
Figure 5. Minor crushing of packaging corner caused by drop test.



Figure 6. Stack test.



Figure 7. Vibration test.



7	A/R	3/4-in. Flat Steel Strapping	ASTM D3953, Type I, Class A or B
6	A/R	Fiber Reinforced Tape, 1-inch width	NSN 7510-00-582-4772
5	1	TW Corr. Fiberboard Lid	
4	A/R	Target Batting	UN 3077
3	1	3-mil Poly Bag, 54 in. x 44 in. x 90 in. min. dimensions.	4-mil Poly Bag, may also be used, same min. dimensions.
2	1	TW Corr. Fiberboard Box, 47.5 in. x 39.5 in. x 28.0 in.	NSN 8115-00-901-6435
1	1	48 in. x 40 in. Stringer-style Wood Pallet	ASME MH1.8M (see Test Report, Part 2A)
Item	Qty	Description	Notes

		AFPTEF Air Force Packaging Technology and Engineering Facility	Note: Follow All Instructions in TR
File: DLAF060-04.DWG			Dimensions in Inches
Dwg No: DLAF06004		DATE: 18 June 04	Scale: NONE
Engineer: Evans			PAGE 1 OF 1

