



**Test Results:** \_\_\_ single X combination \_\_\_ composite

**Section I. Pre-test Conditions**

For initial testing, a bundle of boxes were received in new condition. Boxes from the lot from which this box was taken have also been performance tested with a variety of bottles and cans. All fiberboard containers are conditioned to standard conditions (23°C, 50% RH) prior to testing.

The following identification schema designates the packaging specimen used for the test(s) indicated. Assignments were made at random, in no particular order of sequence. This configuration was tested, using both cellulose fiber absorbent (A) and vermiculite (A1).

<u>Specimen No.</u>	<u>Test</u>
B	Stack Test
A,	Repetitive-Shock Vibration Test
A, A1	Drop Test: flat onto bottom, drop test (3) flat onto top, drop test (1) flat onto long side, drop test (4) flat onto short side, drop test (6) diagonal bottom corner, drop test (2-3-5)
C	Water Resistance Test

**Section II. Summary**

<b>A. Drop test - A = 47.25"; A1 = 71.00"</b>	<b>PASS/FAIL</b>
<b>B. Leakproofness test</b>	N/A
<b>C. Internal pressure test/Hydrostatic pressure test</b>	N/A
<b>D. Stacking test - Static load, 600 lbs., 24 hrs.</b>	<b>PASS</b>
<b>E. Vibration standard - Repetitive-shock, rotary motion A = 3.33 Hz., 1 hr.</b>	<b>PASS</b>
<b>F. Water resistance test - V3c, Felt side</b>	<b>PASS</b>
<b>G. Compatibility test</b>	N/A

**Test Results** (continued)**Section III. Discussion****A. Drop test:** 49 CFR §178.603

Test date(s): A = 06/03/04

Standard conditions (23° C &amp; 50% RH)

A1 = 06/04/04

No	Ht.	Orientation	Results
A	47.25"	Flat onto box bottom (3)	Pass/No leaks/rupture; entire contents retained
A	47.25"	Flat onto box top (1)	Pass/No leaks/rupture; entire contents retained
A	47.25"	Flat onto box long side(4)	Pass/No leaks/rupture; entire contents retained
A	47.25"	Flat onto box short side(6)	Pass/No leaks/rupture; entire contents retained
A	47.25"	Diagonally onto bottom corner (2-3-5)	Pass/No leaks/rupture; minor crushing of the 2-3-5 corner; contents retained completely within the box
A1	71.00"	Flat onto box bottom (3)	Fail, Battery case cracked
A1	71.00"	Flat onto box top (1)	Fail, Battery case cracked, terminals bent
A1	71.00"	Flat onto box long side(4)	Fail, Battery case cracked
A1	71.00"	Flat onto box short side(6)	Fail, Battery case cracked
A1	71.00"	Diagonally onto bottom corner (2-3-5)	Fail, Battery case cracked

The specimen was a combination packaging consisting of a grade V3c fiberboard box (outer packaging) containing packaged article (one, lead-acid battery).

In conducting the drop test, all five drops (flat bottom, flat top, flat long side, flat short side, and diagonal bottom corner) were performed on the same configuration. Five drops per configuration exceeds 49 CFR §178.603 requirements, as well as both UN and ASTM recommendations (i.e., one drop on a side or corner per box). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

**B. Leakproofness test:** 49 CFR §178.604

N/A. The leakproofness test was not conducted on the box, because the packaging is not intended for the containment of liquids.

**C. Internal Pressure/Hydrostatic Pressure test:** 49 CFR §178.605

N/A. Testing for the maintenance of internal pressure is not required for this configuration.

**Test Results: Section III** (continued).

**D. Stacking test:** 49 CFR §178.606

**Test date(s):** 06/03/04

Ambient conditions (~70°F & 48% RH)

No.	Length	Type	Load/Force Required	Peak Force	Results	Stability Maintained?
B	24 hrs	Static	554 lb	616 lbf	Pass	Yes

A compression table was used to establish a static top load of 600 lbs for the stack test, because it could hold the load constant for the required 24-hours timeframe. The total top load applied on the empty box was greater than the minimum required for one box based on the outside box height and the gross packaged weight. The top load was to simulate a stack of identical packagings that might be stacked on the packaging during transport.

**E. Vibration test:** See 49 CFR §178.608. **Test date(s):** A = 06/03/04

Ambient conditions (~70° F & 48% RH)

No.	Frequency	Duration	Results
A	3.33 Hz	1 hr	Pass. No leakage, rupture, or damage

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (49 CFR §173.24a(a)(5)), the vibration test was performed, as a means to determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The packaging was tested using a 1,250-lbs vibration table (rotary motion) that had a 1-inch vertical double amplitude (peak-to-peak displacement) such that the packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

**F. Water resistance (Cobb Method) test** (fiberboard): 49 CFR §178.516. As required by the standards for fiberboard boxes, the Cobb Method Test for water absorptiveness was performed on specimen "B" cut from one box. **Test date(s):** 4/12/04

No. specimens felt side (exterior) 10. Average 117 g/m<sup>2</sup>. Highest exterior value was 122 g/m<sup>2</sup>. Lowest exterior value was 115 g/m<sup>2</sup>. All of the samples tested were free of printing.

No. specimens exceeding 155 g/m<sup>2</sup> 0.

The shipper must take appropriate steps to ensure that the box is correctly constructed with the felt side on the outside.

**Test Results: Section III** (continued)

**G. Compatibility test** (plastics packagings only): N/A.

**Test Personnel**

The following personnel performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein-- Richard D. LaFave, Stuart N. Crouse, Timothy L. Reimann, and Lynn Hill.

**References**

**A. Title 49 Code of Federal Regulations, Parts 106-180,**  
current as of 1 Oct 2003

**B. International Air Transport Association Dangerous Goods Regulations,** 45th edition, 2004

**C. ASTM D 4919,** Specification for Testing of Hazardous Materials Packagings.

**D. ASTM D 999,** Standard Method for Vibration Testing of Shipping Containers.

**E. ASTM D 951,** Standard Test Method Water Resistance of Shipping Containers by Spray Method.

**F. TAPPI Standard: T 441** Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test).

**G. Recommendations on the Transport of Dangerous Goods,** Thirteenth revised edition, United Nations, New York, 2003.

**H. DLAD 4145.41/AR 700-143/AFJI 24-201/NAVSUPINST 4030.55A/MCO 4030.40A,** Packaging of Hazardous Material, 23 Jul 96.

**I. AFMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19G/DLAI4145.3,** Preparing Hazardous Materials for Military Air Shipments, 11 Dec 01.

**Test Results: Section III (continued)**

**Equipment**

<b>Item</b>	<b>Manufacturer</b>	<b>Serial No.</b>	<b>Calibration Expiration Date</b>
1,250-lb vibration table	L.A.B Skaneateles, NY	241121	see note
11,000-lb compression tester	Chant Engr. Co. New Britain, PA	001	4/05
500-lb scale	Ohaus Corporation USA	5097971	4/05
9,000-gram balance	Ohaus Corporation USA	20078	4/05
Release hook	Lansmont Monterey, CA	N/A	N/R
Cobb Sizing Tester	Teledyne Curley Troy, NY	4180-A	N/R

*Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements, ANSI/ISO 17025 (General Requirements for the Competence of Testing and Calibration Laboratories) and TB 43180 (Calibration and Repair Requirements for the Maintenance of Army Materiel).*

## **Test Applicability**

Pass/fail conclusions were based on the particular fiberboard box specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Testing was performed per *Title 49* Code of Federal Regulations.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests 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).

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous materials and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration that simply uses the performance tested outer fiberboard box. Packaging paragraphs apply.

**Test Data Sheet**

**Section I. Test Product**

**Physical State:**  X  solid   liquid   gas   aerosol

Name: Lead-acid battery, One (1), 10 1/8" x 7" x 11 1/2"

Amount Per Container (Configuration):

Item Weight: 54.0 lbs  
 Tare Weight: 13.0 lbs  
 Gross Weight: 67.0 lbs

**Section II. Test Parameters**

**Drop Height:** Ref: 49 CFR §178.603

1.8 m; 71 in. (PG I, II, & III, SG ≤1.2 or solids)  
 X  1.2 m; 47 in. (PG II & III, SG ≤1.2 or solids)  
  0.8 m; 32 in. (PG III, SG ≤1.2 or solids)  
  from--  106.3 in.  PG I: 1.8 (SG) x 1.5 m x 39.37 in./m  
  PG II: SG x 1.0 m x 39.37 in./m  
  PG III: SG x 0.67 m x 39.37 in./m

**Stacking Weight Formula- DLA COMBINATION PACKAGINGS**

Variables	Inputs	Calculations
h height, drum/box	12.75	
n # stacked containers	XXXXXXXXXX	9.30
w1 weight, drum/box	2.65	2.65
w2 weight, bottle/can	0	0
w3 weight, ring/pad	0	0.00
q1 # inner containers	1	1.00
v1 max. volume, 1 inner container	0	0
v total volume	XXXXXXXXXX	0
w4 weight, item (unpacked)	54	54.00
W5 weight, absorbent	10	10.00
W gross weight	XXXXXXXXXX	66.65
C constant	1	XXXXXXXXXX
Sg specific gravity	1	1.00
PG packing group	1	XXXXXXXXXX

**NOTE:** A1 = (n-1)\*(w+(1.8\*v\*8.3\*0.98))\*(c), Packing Group I  
 A2 = (n-1)\*(w+(2.7\*v\*8.3\*0.98))\*(c), Packing Group II  
 A3 = (n-1)\*(w+(4.0\*v\*8.3\*0.98))\*(c), Packing Group III

A1 = stacking weight in pounds, PG I  
 A2 = stacking weight in pounds, PG II  
 A3 = stacking weight in pounds, PG III  
 n = (118/h), minimum number of containers that when stacked, reach a height of 3 m  
 w = w1+(w2\*q1)+(w3\*q1)+w5, total weight in pounds  
 v = v1\*q1, total volume  
 C = either 1.5 (the compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing), or 1.0 (static top load)

A1 Stacking weight-PG I	XXXXXXXXXX	553.20	554
A2 Stacking weight-PG II	XXXXXXXXXX	553.20	554
A3 Stacking weight-PG III	XXXXXXXXXX	553.20	554

B-1

RN: DLA04-F059

**Appendix C**

## Packaging Data Sheet

### Section I. Exterior Shipping Container

Packaging Category: \_\_\_ single X combination \_\_\_ composite

UN Type: Fiberboard boxes (49 CFR §178.516) UN Code: 4G

Specification No.: ASTM-D4727; CF; V3c; WR; SW; Style RSC; 2.6 lbs.; 14" x 14" x 12"(ID); 14.5" x 14.5" x 12.75"(OD) Bursting Strength-400

Manufacturer: Lynchburg Sheltered Industries, Lynchburg, VA 24501

Date(s) of Manufacture: February 2004

Closure Method: The fiberboard box was sealed (7 strip method) using 2" A-A-1830 clear tape. The box was reinforced with 1 inch filament-reinforced tape in both the lengthwise and girthwise direction. (See drawing)

#### Additional Description:

a. A 30 x 36 inch, 4-Mil-polyethylene liner was first placed in the fiberboard box for the purpose of encapsulating the absorbent and the test product. Approximately ½ inches of loose-fill absorbent cushioning was firmly packed in the bottom of the fiberboard box. The bagged battery was placed on the absorbent material, and additional loose-fill absorbent material was then packed around and over the battery. The loose fill absorbent material must be firmly compressed in approximately every 4 inches until box top is reached. Void space is not acceptable. Twist and tape plastic bag with 2" plastic tape. Close box with 2" tape.

**NOTE:** It is critical that the full amount of absorbent is used.

b. For this configuration, only fine grade vermiculite can be used. Inner packagings have a tendency to migrate if the loose fill material is not firmly packed, especially along the bottom of the container.

c. The quantities of absorbent material do meet the 1-Gallon guidelines for absorbent materials as outlined in AFMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19F/DLAM 4145.3, Preparing Hazardous Materials for Military Air Shipments.

**Appendix C** (Continued)

**Section II. Inner/Intermediate Packaging/Article**

Quantity of Inner Containers: One (1), flat polyethylene bag,  
30 x 36 x .004 inches (containing a wet cell battery)

Closure Type: 2 in. wide, clear plastic tape, IAW ASTM D 5486,  
Type II, NSN: 7510-00-266-6715

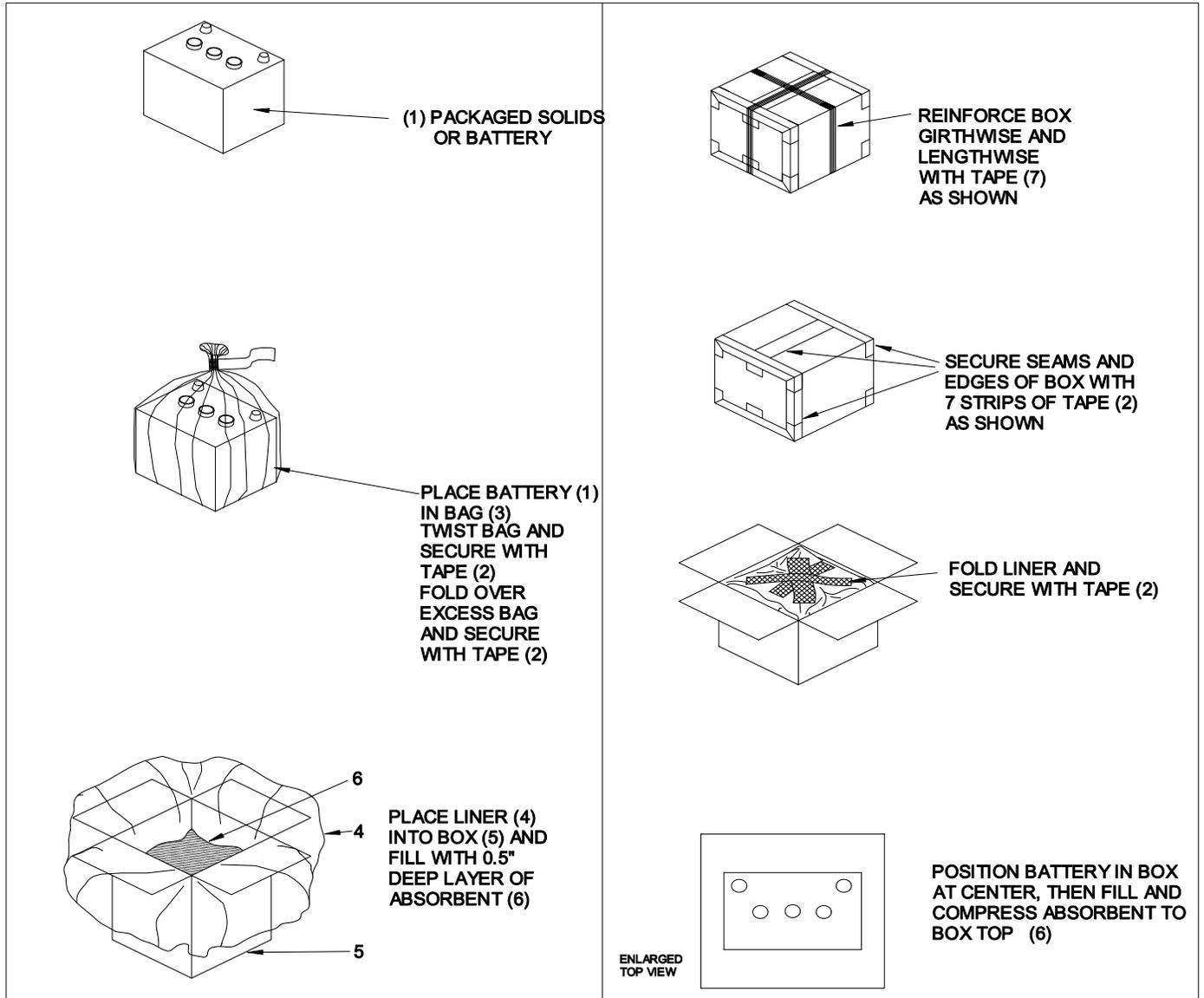
Intermediate Packaging: 30 x 36 x .004 in., flat polyethylene bag

Cushioning: Vermiculite; weight - 10 lbs.

Manufacturer/Distributor: vermiculite, fine grain, Palmetto Vermiculite  
Company, Inc.

Closure Type: 2 inch, ASTM D-5486, Type II, NSN: 7510-00-266-6715

Appendix D



ITEM	DESCRIPTION	04F059
1	PACKAGED SOLIDS OR BATTERY	
2	2-INCH WIDE, PRESSURE-SENSITIVE TAPE, IAW ASTM D 5486, TY II, NSN: 7510-00-266-6715	
3	PLASTIC BAG, 4-MIL POLYETHYLENE	
4	PLASTIC BAG, 4-MIL POLYETHYLENE, 30 X 36 BOX LINER	
5	FIBERBOARD BOX, ASTM D5118, STYLE RSC, GRADE V3c, NSN: 8115-00-183-9489, 14x14x12 IN.	
6	CELLULOSE FIBER ABSORBENT, OR VERMICULITE, A-A-52450	
7	1-INCH WIDE, PRESSURE-SENSITIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D5330, TY II	



Article (Lead acid battery) with plastic bag (inner package).

D-2

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**Appendix D** (Continued)



Inner packaging twisted and taped.

D-3

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**Appendix D** (Continued)



Inner Packaging closed.

D-4

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**Appendix D** (Continued)



Inner Packaging with box liner in outer container.

D-5

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**Appendix D** (Continued)



Inner Packaging, absorbent and box liner in outer container.

D-6

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**Appendix D** (Continued)



Intermediate Packaging (box liner) closed in outer container.

D-7

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**Appendix D** (Continued)



Closed outer container (fiberboard box).

D-8

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**Appendix D** (Continued)



Closed outer container (fiberboard box) and reinforced with tape.