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Technical Report ARAED-TR-92029

PERFORMANCE ORIENTED PACKAGING TESTING FOR LIQUID PROPELLANT, XM1846

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December 1992



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REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE December 1992		3. REPORT TYPE AND DATES COVERED
4. TITLE AND SUBTITLE PERFORMANCE ORIENTED PACKAGING TESTING FOR LIQUID PROPELLANT, XM1846			5. FUNDING NUMBERS	
6. AUTHOR(S) Amin Yousef and Frank Chan				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESSES(S) ARDEC, AED Packaging Div (SMCAR-AEP) Picatinny Arsenal, NJ 07806-5000			8. PERFORMING ORGANIZATION REPORT NUMBER Technical Report ARAED-TR-92029	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(S) ARDEC, IMD STINFO Br (SMCAR-IMI-I) Picatinny Arsenal, N J 07806-5000			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) The results of the tests conducted on a triple pack configuration for liquid propellant (LP) XM1846 are detailed in this report. The requirements stated in the Codes of Federal Regulation (CFR), Title 49, for the shipment of hazardous materials are the basis for these tests. These tests were to ensure that the package tested would provide sufficient protection for the contents throughout the logistic cycle. The tests simulated the rough handling that the package would encounter during transport. The test results indicated that the package was safe for the shipment of LP.				
14. SUBJECT TERMS LP XM1846, Composite container, Performance oriented packaging, POP marking, DOT container			15. NUMBER OF PAGES 12	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT SAR	

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INTRODUCTION

A 30-gallon Department of Transportation (DOT) composite contained in a 55-gallon metal overpack (fig. 1) to be used for packaging liquid propellant (LP), XM1846, to performance oriented packaging (POP) requirements was tested in accordance with the Codes of Federal Regulation (CFR), Title 49.

In order to be certified, the container with the contents must pass the following tests:

1. Hydrostatic pressure (fig. 2)
2. Stacking (fig. 3)
3. Vibration (fig. 4)
4. 4-ft drop tests (figs. 5 and 6)

These tests must be conducted as stated in CFR, Title 49, Group II (medium danger hazardous materials), paragraphs 178.605, 178.606, 178.608, and 178.603, respectively.

DISCUSSION

A DOT 30-gallon composite container used in the testing consisted of a metal container fabricated with mild steel and an inner polyethylene container. The DOT specifications for the metal container and the plastic inner container are 6D (19-gauge body thickness) and 2SL (0.040-inch body thickness), respectively. A plastic barrier bag was used to seal the container.

The outer pack used for the above composite container was a 55-gallon metal container with a full open head, DOT specification 17H (18-gauge body thickness). The void spaces between the outer and inner container were filled with a cushioning material called vermiculite.

Water was used in the testing to simulate LP. To compensate for the difference of the specific gravities between water (1.0) and LP (1.4), the drop height was increased to 4 feet 7 inches for the 4-ft drop test and lead weights were added to the contents for the vibration test.

MATERIAL DESCRIPTION

1. Vermiculite - A cushioning material used to fill the void spaces between the inner 30-gallon composite container and the outer 55-gallon steel container. The specification is as follows:

Vermiculite, Grade #1, Extra course #1
Bulk density, 4-6 lbs/cubic feet (PCF)
Color, beige
Manufacturer, Therm-O-Rock

2. Plastic barrier bag - A polyethylene bag used to seal the inner 3-gallon composite container.

3. 30-gallon composite container

Steel container - DOT specification 6D
Inner polyethylene container
Tare weight - 33 lbs
Manufacturer - General Container Corporation

4. 55-gallon overpack container

DOT specification 17H, open head, fully removable cover
Tare weight - 52 lbs
Manufacturer - General Container Corporation

TEST PROCEDURES

Hydrostatic Pressure Test

Three 30-gallon composite containers were filled with city water and pressurized to 100 kpa (15 psi) for a period of 30 minutes. The passing criteria was that no packaged content should leak and all three containers passed the test.

Stacking Test

Three outer containers (55-gallon) with the contents were subjected to a static load of 1335 pounds for a period of 24 hours at ambient temperature. The above static load was derived based on the total of the three containers each weighing 445 pounds. In order to pass this test, no packaged contents should leak and the damage resulted should not cause any reduction in strength or instability in stacking. At the conclusion of this test no deflection was found.

Vibration Test

Three outer containers with the contents were subjected to the test at a frequency of 4.5 hertz and 1 inch displacement for one hour. Lead weights (125 lbs for each container) were added to the contents to simulate the weight of LP. In order to

pass this test, the damage sustained should not cause any leakage of the packaged contents. All three containers passed the test.

Drop Test

Six outer containers with the contents were conditioned to 0°F followed by the 4-ft drop tests. Ethylene glycol was used to prevent water from freezing. The drop height, as mentioned before was adjusted to 4 feet 7 inches to simulate LP. The drop orientations selected were flat on side (seam) and diagonal top chime. The acceptance criteria is the same as the one stated in the vibration test. All containers tested sustained minor damage and no leakage was found.

The POP marking for the package tested was as follows:

POP MARKING FOR THE PACKAGE TESTED	
	1A2/Y205/S/92 USA/DOD/AYD

CONCLUSION

The 30-gallon composite container for LP in a 55-gallon metal overpack passed the POP requirements successfully based on the above tests conducted at ARDEC, Picatinny Arsenal. This package is recommended to be used for shipping LP, XM1846, both CONUS and OCONUS. If the package is considered to be recycled, the outer 55-gallon container should be a DOT specification 5B type.

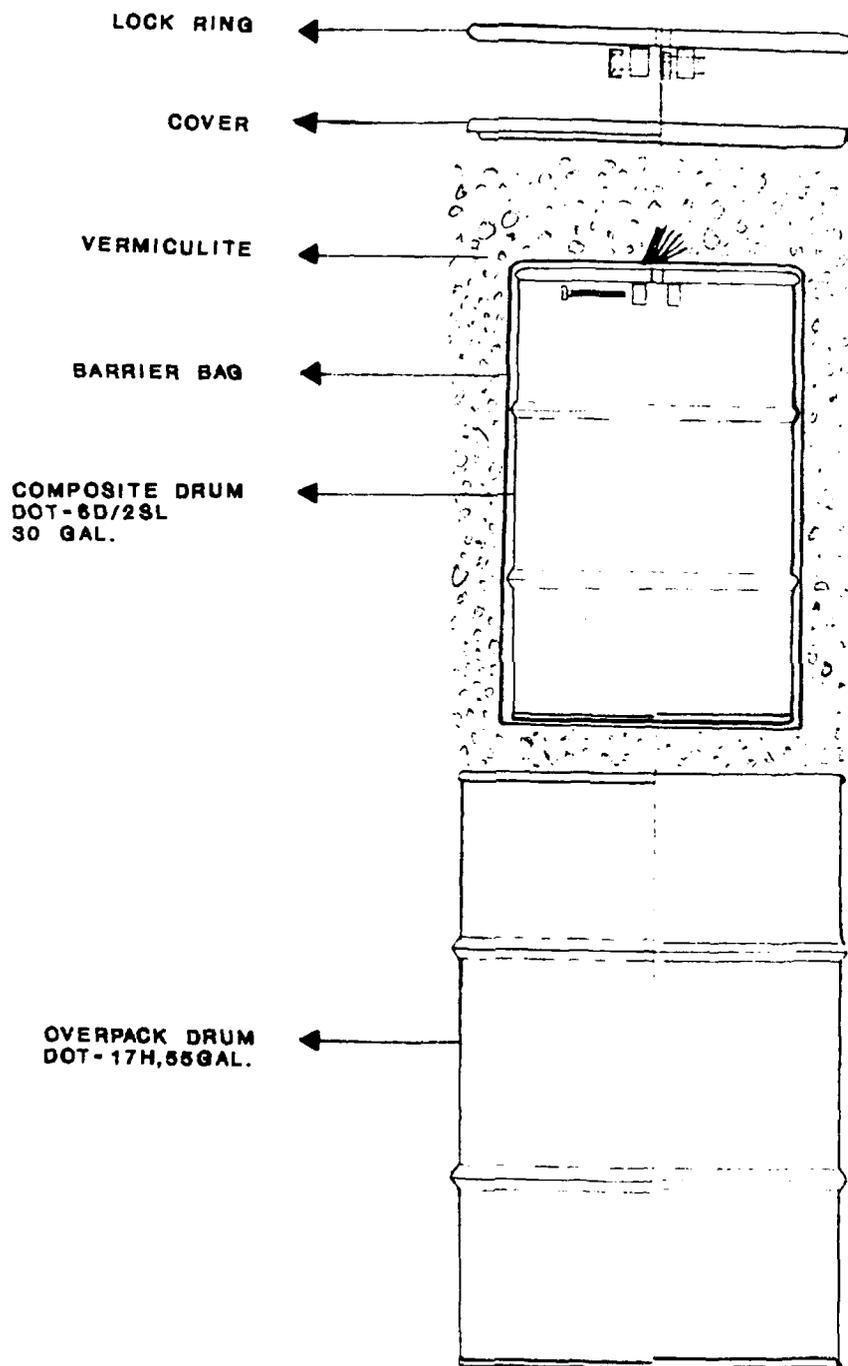


Figure 1. 55-gallon liquid propellant container

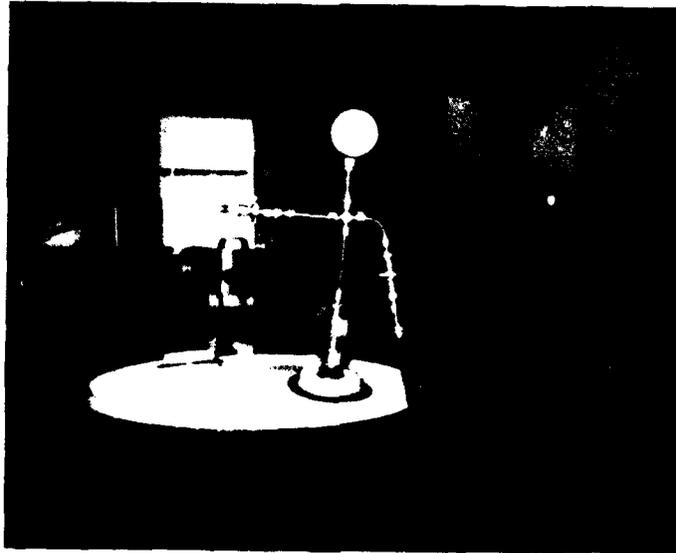


Figure 2. Hydrostatic pressure test set-up

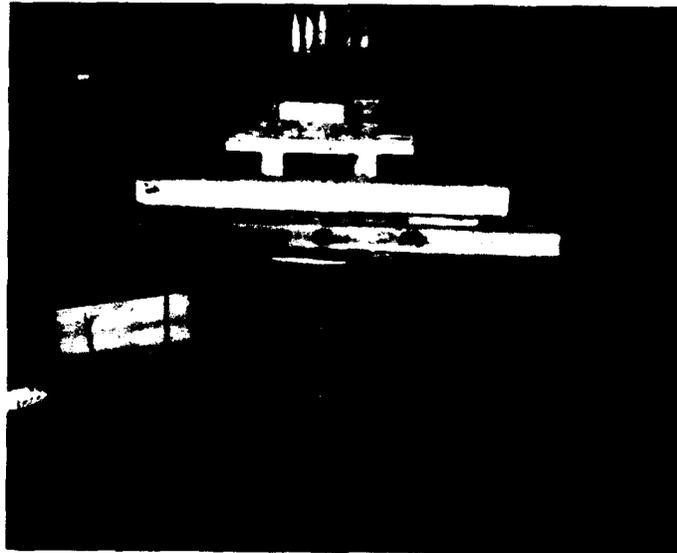


Figure 3. 24-hour stacking test set-up



Figure 4. Vibration standard test set-up

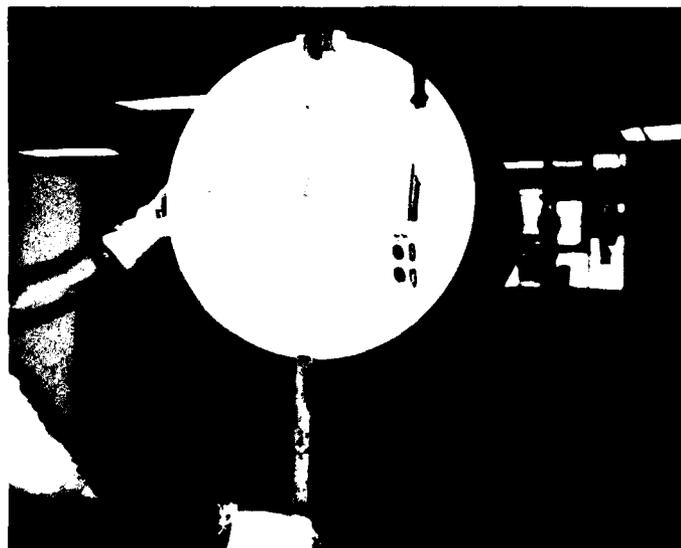


Figure 5. 4 ft 7 in. flat on side drop test set-up

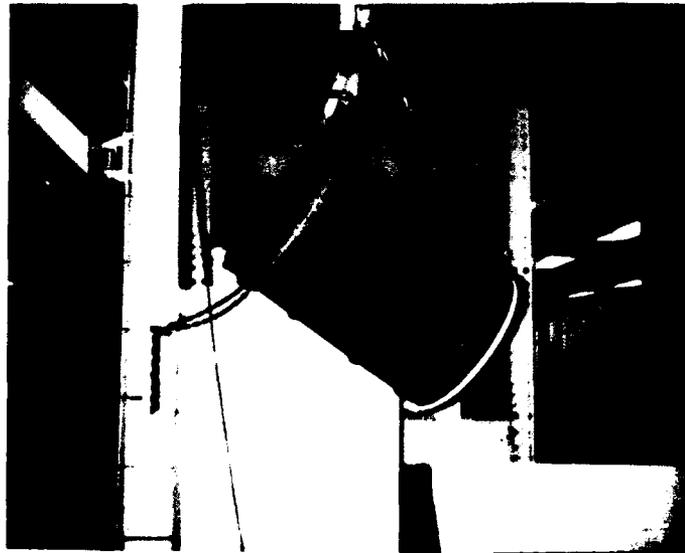


Figure 6. 4 ft 7 in. diagonal top chime drop test set-up

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