

TECHNICAL REPORT

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EVALUATION OF WAX-IMPREGNATED
CORRUGATED FIBERBOARD CONTAINERIZERS
AND SHEATHING

by
Anderson Miller

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**TECHNICAL REPORT
68-19-GP**

**EVALUATION OF WAX-IMPREGNATED CORRUGATED
FIBERBOARD CONTAINERIZERS AND
SHEATHING**

by

**Anderson Miller
Engineering Sciences Division**

**Project reference:
Applications Engineering**

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**General Equipment & Packaging Laboratory
U. S. ARMY NATICK LABORATORIES
Natick, Massachusetts**

FOREWORD

One of the problems facing military shipments and storage of supplies today are the extremes in environmental conditions of Southeast Asia. Conventional type fiberboard packages are encountering conditions that are extremely hazardous to containers. High temperatures combined with high humidity are causing deterioration, failures and delamination of the containers, sheathing material and containerizers.

To meet and combat some of these problems this study was conducted to determine the performance of wax-impregnated double-wall corrugated fiberboard containerizers and single-wall sheathing for unitized loads.

The evaluation was accomplished under Applications Engineering funds.

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TABLE OF CONTENTS

	<u>Page</u>
Abstract	iv
1. Introduction	1
2. Material and Equipment	4
3. Environmental Conditions	6
4. Test Plan for Evaluation	6
5. Procedure	8
6. Results	11
7. Discussion	14
8. Conclusions	16

ABSTRACT

This study was conducted to evaluate the performance of wax/resin-impregnated double-wall corrugated fiberboard containerizers and single-wall corrugated fiberboard wax-impregnated sheathing for palletized loads. The containerizers were evaluated to determine their compressive strength and resistance to rough handling under various environmental conditions. They were subjected to compression tests and rough handling tests after conditioning at 100°F., 90% R. H., water spray, and at 73°F. ±5°F. and 50% ±5% R. H. The single-wall sheathed loads were subjected to rough handling tests under similar conditions. Components were tested for wet and dry puncture, wet and dry mullen, water pick-up, and for bleeding.

It was found that wax impregnation of the double-wall board described in this study contributes significantly to increased compression strength of containerizers under environmental extremes. The rough handling tests did not have any adverse effect on the containerizers tested with loads of 2400 pounds. During the tests the entire load merely shifted slightly in the direction of the impact. The sheathing sustained some damage during the rough handling tests. Damage was confined mostly to the manufacturer's joint.

Wax-impregnated fiberboard sheathing should be of a better quality than that tested in this study to assure increased performance. Good quality wax-impregnated fiberboard may be the answer to some of the container problems encountered in Southeast Asia.

EVALUATION OF WAX-IMPREGNATED CORRUGATED FIBERBOARD CONTAINERIZERS AND SHEATHING

1. Introduction

Previous studies conducted in this laboratory indicated that good quality wax-impregnated containers are highly resistant to high temperature and high humidity. These physical properties are important to the military in meeting the packaging requirements of areas such as Southeast Asia.

A concurrent packaging development has been the consolidation of smaller units into unit size loads. Unitization has proved to be the most efficient and most economical way of moving supplies.

To further investigate the possible uses of wax-impregnated fiberboard, the previous studies were extended to cover unitized packaging.

In considering unitization, the most important factor, of course, is compressive strength. The reason for this is that unit loads and unitizers must lend themselves to stacking to utilize all available storage space. Normally, non-supporting items are placed in containerizers and self-supporting items are sheathed with a protective cover. The containerizer (Figure 1) is required to provide stacking strength as well as environmental protection, and the sheathing (Figure 2) is required to offer resistance to adverse environmental conditions.

Based on these requirements this study was conducted to determine the performance of double-wall wax-impregnated corrugated fiberboard containerizers and single-wall wax-impregnated corrugated fiberboard sheathed loads under supply line conditions. The containerizers and unit loads were exposed to simulated adverse weather conditions and subjected to both compression and rough handling tests similar to those encountered in shipment and storage along military supply lines.

Additional tests were conducted to determine the effect of long-term storage on the compressive strength of wax-impregnated double-wall fiberboard under high temperature and high humidity conditions. The containers with dimensions of 22" x 22" x 14" were tested after conditioned storage periods of up to six months. The tests indicated that the wax-impregnated corrugated double-wall fiberboard is superior to conventional type weather-resistant boards under similar conditions.

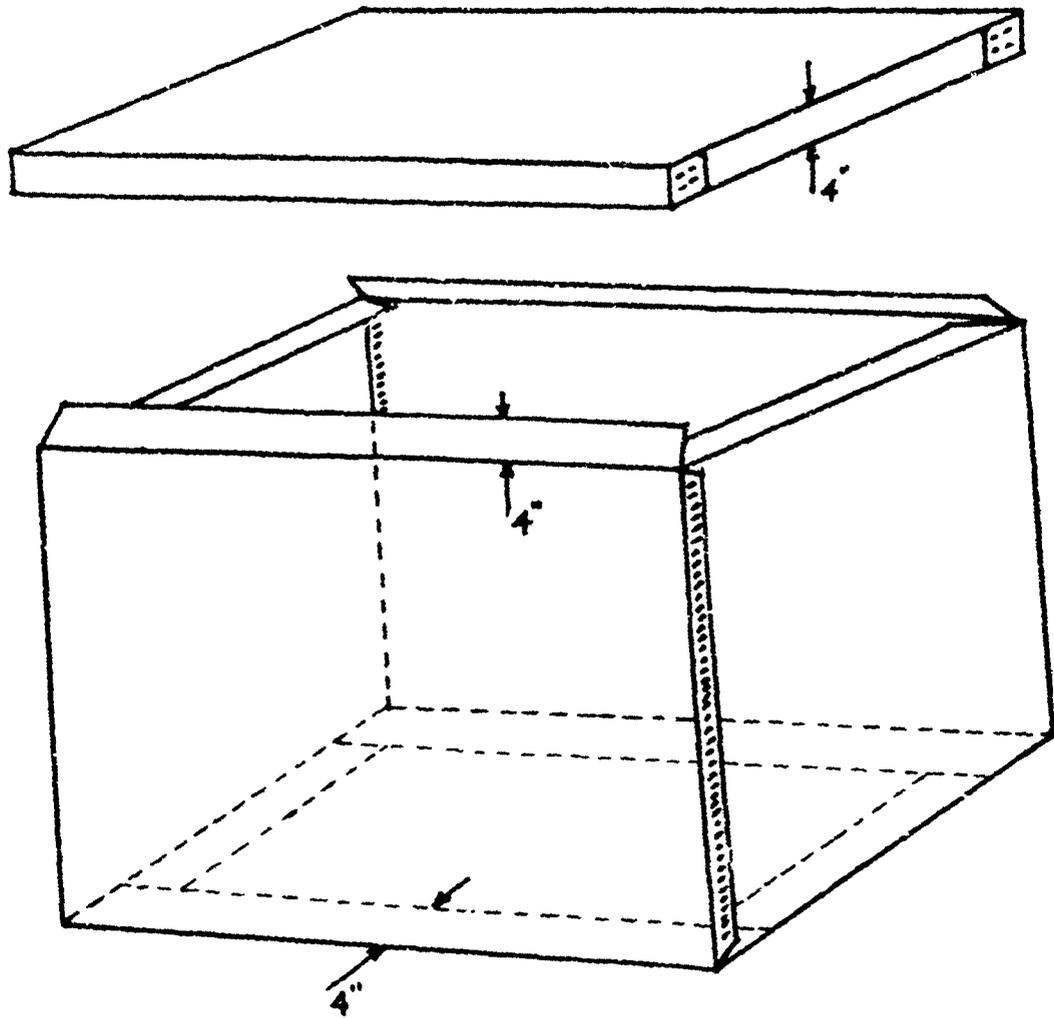


Figure 1. Design Configuration of the Wax-Impregnated Double-Wall Corrugated Containerizers and V2s Solid Fiberboard Containerizers

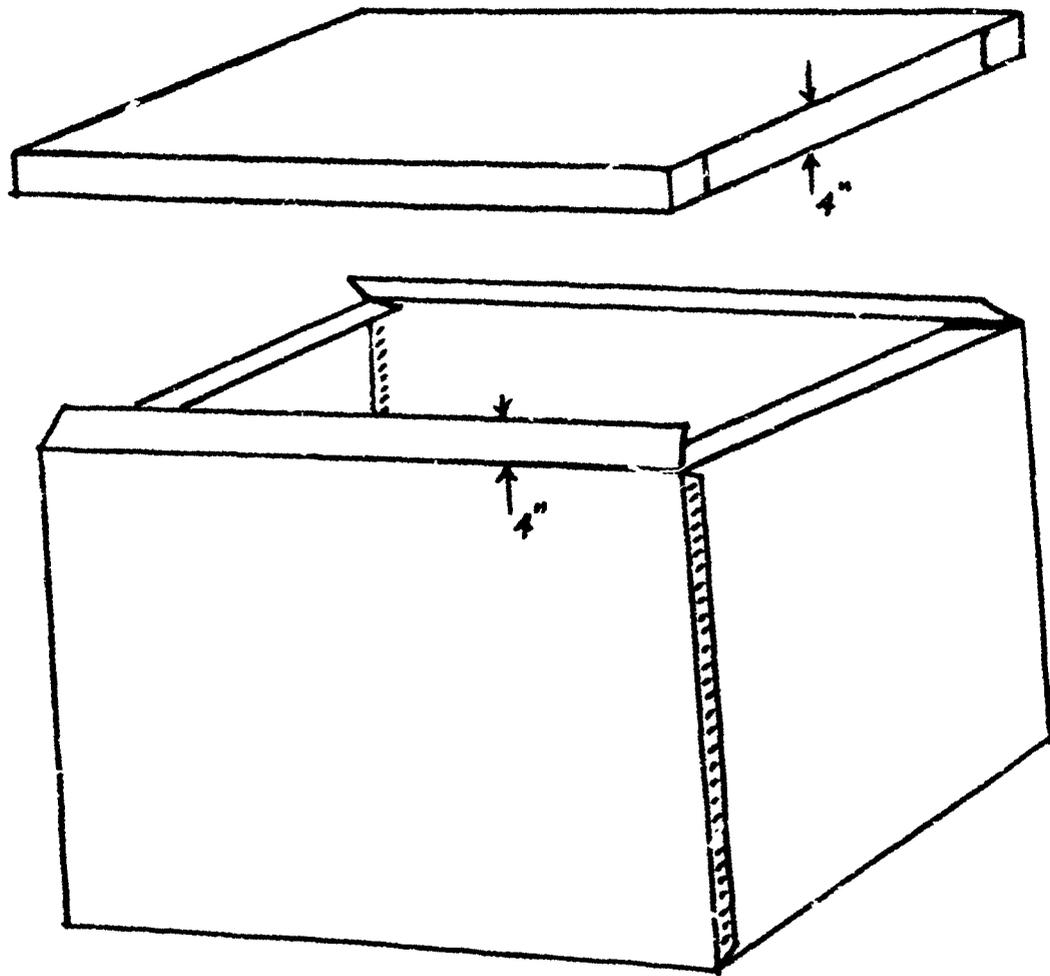


Figure 2. Design Configuration of the V2s Sheathing and Wax-Impregnated Corrugated Single-Wall Sheathing

2. Material and Equipment

The material and equipment used in this study were as follows:

a. Containerizers

The wax-impregnated containerizers were fabricated from 400 pound test A-B flute double-wall corrugated fiberboard in accordance with MIL-L-35078 for type II loads, class A (see Figure 1). The overall dimensions of the containerizers were 40" x 48" x 48" and the weight of the component parts of the fiberboard were as follows:

- (1) Outer liner - 69 pounds per 1000 square feet.
- (2) First corrugated medium - 33 pounds per 1000 square feet.
- (3) Intermediate liner - 42 pounds per 1000 square feet.
- (4) Second corrugated medium - 33 pounds per 1000 square feet.
- (5) Outer liner - 69 pounds per 1000 square feet.
- (6) Impregnation - the containerizers were impregnated with a wax formulation made by St. Regis Paper Company.

For control tests, V2s containerizers were used with triple-wall liners fabricated in accordance with MIL-L-35078, type II for class B loads and weather-resistant triple-wall half-slotted consolidation containers with caps fabricated in accordance with PPP-B-640, class 2, grade A and style G. The overall size of these containerizers were 40" x 48" x 48". These containerizers are currently being used for level B shipments of supplies and are among the better available fiberboard unitizers being used by the military.

b. Sheathing

The sheathing was fabricated from 250 pound test, C flute single-wall corrugated wax-impregnated fiberboard in accordance with MIL-L-35078 for type I loads, corner-cut cap and one-piece sleeve (see Figure 2). The overall dimensions were 40" x 48" x 48" and the weight of the component plies were as follows:

- (1) Outer liner - 69 pounds per 1000 square feet.
- (2) Corrugated medium - 33 pounds per 1000 square feet.

(3) Outer liner - 42 pounds per 1000 square feet.

(4) Impregnation - the sheathing was impregnated with a wax formulation made by St. Regis Paper Company.

A type 1 load with V2s sheathing was used for the control tests.

Both the wax-impregnated double-wall corrugated containerizers and 250 pound test wax-impregnated sheathing were manufactured by St. Regis Paper Company of Salinas, California. The V2s containerizer with weather-resistant triple-wall liner was fabricated in-house. The half-slotted weather-resistant triple-wall containerizer with cap was manufactured by Tri-Wall Container, Inc., Feeding Hills, Massachusetts.

c. Storage Test Containers

The Regular Slotted Containers (RSC), 400 pound test C-B flute double-wall wax-impregnated containers used for compression tests after various storage periods were fabricated by the Hollinger Corporation of Arlington, Virginia. Overall dimensions were 22" x 22" x 14". These containers were tested to determine the effect of long-term storage at high temperature and high humidity on wax-impregnated containers. The bottom flaps were stapled and the top flaps fastened with weather-resistant adhesive. The weight of the component plies was as follows:

(1) Outer liner - 69 pounds per 1000 square feet.

(2) First corrugated medium - 33 pounds per 1000 square feet.

(3) Intermediate liner - 42 pounds per 1000 square feet.

(4) Second corrugated medium - 33 pounds per 1000 square feet.

(5) Outer liner - 69 pounds per 1000 square feet.

(6) Impregnation - the containers were impregnated with a wax-polyethylene formula ion called "Sealite 48" made by the Humble Oil Company.

d. Equipment

The heavy duty Incline Impact Tester manufactured by Wisconsin Foundry and Machine Company, Madison, Wisconsin, was used to conduct the incline impact tests. Drop tests were conducted with a

4000 pound capacity fork lift truck equipped with a chain and quick-release device for raising and dropping the load. The 10,000 capacity Tinius Olsen Compression Tester was used to conduct the compression tests.

3. Environmental Conditions

Environmental conditions were selected to simulate the adverse weather conditions encountered along military supply lines with particular emphasis on conditions expected in Southeast Asia.

The containerizers sheathed loads and containers were exposed to the following conditions during the course of the test cycles:

- a. Ambient Room Temperature: 75°F. $\pm 5^{\circ}$.
- b. Desert Conditions: 140°F., 10% R. H. for 48 hours.
- c. High-Temperature, High-Moisture Conditions: 100°F., 90% R. H. for periods ranging from 7 days to 6 months.
- d. Water Spray: 100 inches simulated rainfall.

4. Test Plan for Evaluation

The test plan for evaluating the sheathed loads and containerizers is designed to determine the performance of the loads under conditions that are usually encountered in supply line shipment. The shipping performance cycle is used to determine the effect of drop tests on the loads. Such conditions usually occur during sling handling in loading and unloading at shipping ports. The impact performance cycle is used to simulate the rough handling encountered by the packs in holds of ships or in rail car shipments. Compression tests are conducted to determine the stacking strength of the containerizers under various environmental conditions. The test plan used for evaluating the containerizers and sheathed loads was as follows:

a. Type I - Sheathed Loads

(1) Shipping Performance Test Cycle

- (a) Conditioned at 140°F., 48 hours.
- (b) Edgewise drop test on the four bottom edges, Federal Test Method Standard 101A, Method 213.

- (c) Water spray, 100 inches.
- (d) Edgewise drop test on the 4 bottom edges.
- (e) Conditioned at 100°F., 90% R.H. for 48 hours.
- (f) Edgewise drop test on the 4 bottom edges.

In the above Performance Cycle the end edge drops were made from a height of 24", while the drop height for the side edges was reduced to 18" to avoid "tipping over" of the load.

(2) Impact Performance Cycle

- (a) Conditioned at ambient room temperature. 75°F., ±5°.
- (b) Incline Impact Test, Federal Standard 101A, Method 211.

b. Type II Containerizers

(1) Compression Tests

- (a) Conditioned at ambient room temperature, 75°F., ±5°.
- (b) Water spray, 100 inches.
- (c) Conditioned at 100°F., 90% R.H., 30 days.
- (d) Compression tests at a platen speed of 0.4 inches per minute.

Each containerizer tested in the above cycle was subjected in the sequences as listed.

(2) Shipping Performance Test Cycle

- (a) Conditioned at 140°F., 48 hours.
- (b) Edgewise drop test on four bottom edges, Federal Test Method Standard 101A, Method 213.
- (c) Water spray, 100 inches.
- (d) Edgewise drop test on four bottom edges.
- (e) Conditioned at 100°F., 90% R.H. for 48 hours.

(f) Edgewise drop test on four bottom edges.

The end edge drops were made from a height of 24", while the drop height for the side edges was reduced to 18" to avoid "tipping over" of the load.

(3) Impact Performance Test Cycle

(a) Conditioned at ambient room temperature for 48 hours.

(b) Water spray, 100 inches.

(c) Conditioned at 100°F., 90% R.H. for 30 days.

(d) Incline impact test on the four vertical edges at 7 feet per second.

c. Container Tests

Compression tests after conditioning at 100°F., 90% R.H. for periods ranging from 7 days to six months.

d. Component Tests

(1) Bleeding Resistance Test, ASTM Standard 917*.

(2) Puncture Test, ASTM Standard 781.

(3) Bursting Strength Test, ASTM Standard 774.

(4) Water Pick-Up Test, PPP-F-310c.

5. Procedure

a. Type I Sheath Loads

(1) Preparation of Test Loads

Six pallet loads of cased canned items weighing 2400 pounds were sheathed with 250 pound test wax-impregnated corrugated fiberboard. The sheathing consisted of a one piece tube with 4" flanges at the top and a cap with 4" flanges and cut-corners. The sheathed loads were

*The first set of samples was tested at 110°F. This process was repeated using new samples at each 10°F. elevation in temperature until bleeding occurred.

then strapped two lengthwise and two girthwise with 3/4" x .023" flat steel strapping. For the control, two similar loads were sheathed with V2s solid fiberboard and strapped in the same manner.

(2) Shipping Performance Cycle

Three of the loads sheathed with wax-impregnated corrugated fiberboard and one of the V2s sheathed loads were subjected to the Shipping Performance Cycle. During the course of the cycle the sheathing materials were examined for bleeding under high temperature, damage in rough handling, and ply separation after water spray and high humidity.

(3) Impact Performance Cycle

The remaining three loads sheathed with wax-impregnated corrugated fiberboard and the remaining load sheathed with V2s solid fiberboard were subjected to the impact performance cycle. For this cycle the loads were subjected to four incline impact tests on diagonally opposite vertical edges at a velocity of 7 feet per second. After each impact the sheathing materials were examined for damage.

b. Type II Containerizers

(1) Preparation of Containerizers

Nine double-wall 400 pound test wax-impregnated corrugated containerizers measuring 40" x 48" x 48" were each fastened to a 40" x 48" pallet base with a 43" x 51" x 3/4" plywood load spreader. The purpose of the load spreaders was to eliminate the overhang of the unitizer and permit an accurate comparison of the various type boards.

Nine 40" x 48" x 48" weather-resistant triple-wall containerizers and three 40" x 48" x 48" V2s containerizers with a triple-wall liner were each fastened to a 40" x 48" pallet with a 43" x 51" x 3/4" load spreader. Each containerizer was then strapped two lengthwise and two girthwise with 3/4" x .023" flat steel strapping.

Four 40" x 48" x 48" double-wall wax-impregnated containerizers, two plain weather-resistant triple-wall containerizers, and two V2s containerizers with triple-wall liners were each fastened to a 40" x 48" pallet base. Each of the containerizers was then loaded with 2400 pounds of cased canned items and strapped 2 lengthwise and 2 girthwise with 3/4" x .023" steel strapping.

(2) Compression Test

Three each of the wax-impregnated corrugated double-wall containerizers, three each of the weather-resistant triple-wall containerizers, and one each of the V2s containerizer with triple-wall liner was subjected to compression test after each of the following conditions:

- (a) Ambient Room Temperature - 75°F. $\pm 5^{\circ}$.
- (b) Water Spray - 100 inches.
- (c) Tropical Conditions 100°F., 90% R.H. for 30 days.

The loads were compressed on the 10,000 pound capacity Minius Olsen Compression Tester, at a platen speed of 0.4 inch per minute until failure occurred. Failure of the containerizers was denoted by a sudden decline in the compression strength after the peak load was passed.

(3) Shipping Performance Cycle

Two double-wall wax-impregnated containerizers, one triple-wall weather-resistant containerizer, and one of the V2s containerizers with triple-wall liners were subjected to the shipping performance test cycle. Each containerizer contained a load of 2400 pounds of cased canned items. After each phase of the test cycle the containerizers were examined for damage.

(4) Impact Performance Cycle

Two double-wall wax-impregnated containerizers, one plain triple-wall weather-resistant containerizer, and one V2s containerizer with triple-wall liner were subjected to the impact performance cycle. Each containerizer contained a load of 2400 pounds of cased canned items. After each impact the containerizers were examined for damage.

c. Container Storage Tests

Eighteen 22" x 22" x 14" double-wall wax-impregnated containers were placed in the 100°F., 90% R.H. room. Three of these containers were taken out after periods of 1 week, 1 month, 2 months, 3 months, 4 months and 6 months and subjected to a top to bottom compression test. The containers were tested at a platen speed of 0.4 inch per minute and the peak force in pounds recorded. The purpose of these tests were to determine the effect of high temperature and high humidity on the compressive strength of double-wall wax-impregnated corrugated fiberboard containers.

d. Component Tests

Samples of the wax-impregnated board used in fabricating the containerizers and the storage test containers were subjected to the following tests:

- (1) Bleeding test.
- (2) Dry puncture test.
- (3) Wet puncture test (24 hours total immersion).
- (4) Dry Mullen test.
- (5) Wet Mullen test (24 hours total immersion).
- (6) Water pick-up test (24 hours total immersion).

The purpose of these tests was to determine if the two types of double-wall board were similar in puncture, mullen burst, water pick-up and bleeding resistance properties.

6. Results

a. Type I Sheath Loads

(1) Shipping Performance Cycle

Both the V2s solid fiberboard and the 250 pound test wax-impregnated single-wall fiberboard performed satisfactorily through the shipping performance cycle. The V2s sheathing sustained 1" to 3" tears along the bottom edges in the areas around the steel straps. This was caused by the straps when the load shifted in the direction of the impact. The wax-impregnated board sustained similar damage as well as some staple pullage in the manufacturer's joint. Staple pullage occurred over a distance of about 18" from the bottom of one of the loads in one joint after impact following conditioning at 140°F. No further damage occurred during the remaining phases of the test. In the remaining two loads tested, staple pullage only occurred in an area from 1 to 6 inch from the bottom and in only one of the joints of each load. The edges of the containers adjacent to the joints where staple pullage occurred became wet during the water spray phase of the cycle. There was no wetting of contents in the loads sheathed with V2s solid fiberboard.

(2) Impact Performance Cycle

There was no severe damage to either the V2s solid fiberboard or 250 pound wax-impregnated corrugated fiberboard sheathing during the impact performance test. During the impact tests the loads merely shifted in the direction of the impact. The shifting of the loads caused two to four inch tears in the bottom of the sheathing in the areas adjacent to the straps.

The 4" flanges of the caps on the wax-impregnated corrugated fiberboard sheathed loads were torn in the areas adjacent to the straps. The loads with both types of sheathing remained intact and were still protected by the sheathing.

b. Type II Containerizers

(1) Compression Tests

The results of the compression tests of the containerizers exposed to various conditions were as follows:

	<u>73° ±5°F. 50% ±5% R. H.</u>	<u>100" water spray</u>	<u>100°F., 90% R. H., 30 days</u>
Double-Wall Wax Impregnated	5700 4900 5100 <hr/> 5233	3520 3500 3670 <hr/> 3563	2320 2240 2250 <hr/> 2270
Standard Weather- Resistant Triple- Wall	7830 7195 7480 <hr/> 7501	970 930 1020 <hr/> 973	3620 3540 3580 <hr/> 3580
V2s with Triple- Wall Liner (For Comparison)	8150	7140*	5530*

(2) Shipping Performance Test & Impact Performance Test

There was no damage in any of the containerizers subjected to the shipping performance test and the impact performance test. The loads shifted in the direction of the impact but were restrained by the straps.

*The liners in the V2s containerizers did not become wet in the time periods tested.

(3) Container Storage Test

The results of the compression tests of the wax-impregnated double-wall 22" x 22" x 14" containers exposed to 100°F., 90% R.H. for up to 6 months and the control containers were as follows:

Container Storage Test	Ambient room temperature (48 hours) 73°F. ±5°F.		100°F., 90% R.H.
		5490	
	6110		3060
	5520		3150
	<u>5706</u>	1 week	<u>3013</u>
		1 month	2950
			2965
			<u>2840</u>
			2885
		2 months	2620
			2450
			<u>2570</u>
			2546
		3 months	2900
			2600
			<u>2660</u>
			2720
		4 months	2690
			2740
			<u>2610</u>
			2680
		6 months	3020
			2790
			<u>2830</u>
			2880

(4) Component Tests

(a) Bleeding Tests

The samples taken from the board used in fabricating the containerizers and sheathing began to bleed at 120°F. The samples taken from the 22" x 22" x 14" containers began to bleed at 130°F.

(b) Puncture Test

The average of the results* of the puncture tests of the containerizer board and the 22" x 22" x 14" container board were as follows:

	<u>Wax-impregnated containerizer board</u>	<u>Wax-impregnated 22" x 22" x 14" container</u>
Dry	695	698
Wet	478	552

(c) Bursting Strength Tests

The average of the dry and wet bursting strength tests of the containerizer board and 22" x 22" x 14" container board were as follows:

	<u>Wax-impregnated containerizer board</u>	<u>Wax-impregnated 22" x 22" x 14" container board</u>
Dry	422 psi	469 psi
Wet	356 psi	346 psi

(d) Water Pick-Up Tests

The containerizer board had a water pick-up of 41% and the 22" x 22" x 14" container board had a water pick-up of 42%.

A review of the results of the container storage tests show that the greatest reduction in compression strength of double-wall corrugated containers occur in the first week of exposure to high-temperature and high-humidity conditions. The puncture test, Mullen test and water pick-up were almost equal for both board types.

7. Discussion

This study shows that wax-impregnated fiberboard has a place in the packaging systems of the military services. Weather-resistance

*The units are given in inch-ounces per inch of tear.

and high compression strength are advantages which cannot be overlooked when considering shipments to areas such as Southeast Asia. The tests conducted in this study showed that the wax-impregnated sheathing and containerizers were not too adversely affected by the different conditions. The 250 pound test sheathing sustained some damage in rough handling but still offered sufficient protection to the items. Damage to the sheathing was mostly confined to the manufacturer's joint. This could be prevented by using a better quality board such as 275 or 350 pound test board and by redesign of the sheathing. Instead of using a one piece sheath with two joints, a two piece sheath could be applied over the load using 8 inch overlaps in accordance with MIL-L-35078.

The compressive strength of the double-wall wax-impregnated containerizers shown under the most severe conditions (water spray) is superior to that of weather-resistant triple-wall. It is about 50% of V2s with a triple-wall liner providing the triple-wall liner remains dry. If the liner became wet, the compressive strength would be affected the same as that of the triple-wall containerizer, or only about 25% of that remaining in the wax board containerizer.

The compressive strength of the wax impregnated containerizers was reduced by 57.7% under high temperature and high humidity for 30 days, while that of triple containerizers was reduced by 52.6%. The compressive strength of the V2s containerizer with triple-wall liner was reduced by 33.2% under similar conditions.

The container storage tests show that the compressive strength of wax-impregnated containers reduces to a constant level after 7 days storage at high temperature and high humidity, and remains almost constant for at least 6 months. Previous tests have shown that the compressive strength of untreated fiberboard does not reach a constant level but continue to reduce with time under high temperature and high humidity conditions.

The reason for the constant level reached by the wax-impregnated board is that it will only pickup 45 percent moisture. The untreated board will eventually reach equilibrium with the 90 or 95 percent environment and lose most of its compressive strength.

Because of the high puncture resistance of the double-wall wax-impregnated board, the containerizers can be expected to resist the damage that is normally experienced in handling. To obtain these strength properties, the initial board before wax-impregnation must be of a superior quality which can be procured by establishing minimum requirements. These requirements must be based on the performance

of the untreated and treated board under water immersion and must control the water pick-up characteristics of the finished product. The wax-impregnated board tested in this study had a water pick-up of less than 45% based on the dry weight at 73°F., 50% R.H. The double-wall wax-impregnated fiberboards had an average wet bursting strength of not less than 300 psi. Based on the performance of these two types of double-wall fiberboard, these values could be a good starting point in setting minimum requirements. The requirements for single-wall wax-impregnated fiberboard for sheathing could be handled in the same manner.

The compression tests of the 22" x 22" x 14" wax-impregnated containers exposed to 100°F., 90% R.H. for up to 6 months indicate the major loss in compressive strength occurs in the first 7 days. After that the compression strength remains relatively unchanged.

8. Conclusions

Double-wall corrugated wax-impregnated fiberboard similar to the board tested in this study is suitable for fabricating containerizers for level A shipments. Wax-impregnated fiberboard is superior to standard fiberboards in maintaining its compressive strength under adverse weather conditions. Double-wall wax-impregnated fiberboard is superior to unsheathed triple-wall containerizers under water spray, but not under high-temperature high-humidity conditions. However, the combination of VZs containerizer with triple-wall liner is superior to either the unsheathed triple-wall containerizer or the double-wall wax-impregnated containerizer. Minimum requirements should be established for the fiberboard to assure good quality wax-impregnated containers, containerizers and sheathing.

Wax-impregnated fiberboard for sheathing should be of a better quality than that tested in this study to assure increased performance. Good quality wax-impregnated fiberboard may be the answer to some of the container problems encountered in Southeast Asia.

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13. ABSTRACT This study was conducted to evaluate the performance of wax/resin-impregnated double-wall corrugated fiberboard containerizers and single-wall corrugated fiberboard wax-impregnated sheathing for palletized loads. The containerizers were evaluated to determine their compressive strength and resistance to rough handling under various environmental conditions. They were subjected to compression tests and rough handling tests after conditioning at 100°F., 90% R.H., water spray, and at 73°F. ±5°F. and 50% ±5% R.H. The single-wall sheathed loads were subjected to rough handling tests under similar conditions. Components were tested for wet and dry puncture, wet and dry mullen, water pick-up, and for bleeding.			
It was found that wax-impregnation of the double-wall board described in this study contributes significantly to increased compression strength of containerizers under environmental extremes. The rough handling tests did not have any adverse effect on the containerizers tested with loads of 2400 pounds. During the tests the entire load merely shifted slightly in the direction of the impact. The sheathing sustained some damage during the rough handling tests. Damage was confined mostly to the manufacturer's joint.			
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DD FORM 1473

REPLACES DD FORM 1473, 1 JAN 64, WHICH IS OBSOLETE FOR ARMY USE.

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Impregnation	8				6	
Fiberboard	1		7		6	
Containers	1		7		7	
Waxes	1		7		6	
Shipping Containers	1		7		7	
Double-Wall			7		6	
Transportation	4		4		4	
Armed Forces Supplies	4		4		4	
Temperature			6			
Impact			6			
Compression			6			
Humidity			6			

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