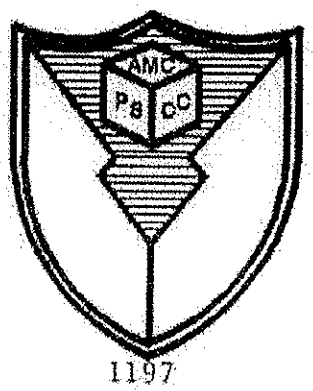
ASSIGNMENT REPORT

TE-LS-50-91 JULY 1991

TESTING OF CLIP-LOK TM SYSTEMS' DEMOUNTABLE PLYWOOD CONTAINERS

PREPARED BY:



PACKAGING, STORAGE, AND CONTAINERIZATION CENTER
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ABSTRACT

At the request of Clip-Lok™ Simpak[1], London, Ontario, Canada, five demountable plywood containers were sent to the U.S. Army Materiel Command Packaging, Storage, and Containerization Center (AMCPSCC) for testing. The top, bottom, sides, and ends of each container were held together with the Clip-Lok™ fastening system. Of the five containers, three were tested for shipment of general supplies (spare parts) and two were tested for the shipment of liquids. The two containers tested for the shipment of liquids each contained a special disposable plastic bag to contain the liquid. The tests were designed to determine if the containers (held together with the Clip-Lok™ system[1]) can be used as shipping containers in the Army supply system. Except for the plastic disposable bags, the test results demonstrated that the containers (i.e., the boxes themselves) will survive the handling hazards expected in military distribution as simulated in the laboratory by a sequence of rough handling tests.

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[1] Citation of a trade name of a commercially available product does not constitute an official endorsement of one product over another manufacturer's product, but only advise of what is available. There are other suppliers of this type or a similar type of product.

U.S. ARMY MATERIEL COMMAND
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AMCPSCC Assignment Report TE-LS-50-91

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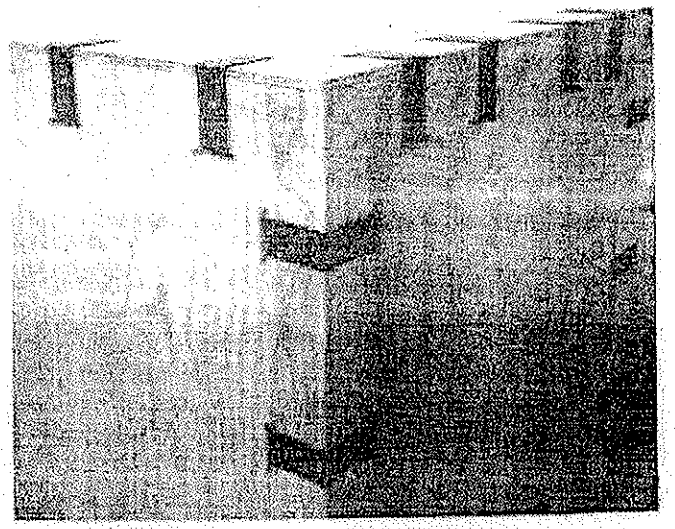
1. Introduction. The Clip-Lok™ System[1] is a patented collapsible container system which enables plywood boxes to be clipped together or taken apart in minutes (see photograph 1). It can be used in a variety of different shipping/storage applications for both wet and dry goods. The Clip-Lok™ System[1] uses slots on the container panels much the same as the spring-clip system tested under Assignment Number TE-LS-24-89, Testing of Hardy Built™ System[1] Demountable PPP-B-601 Containers. The manufacturer of the Clip-Lok™ System[1] claims the Army can benefit by using this system over any other multi-trip container system, because this system is simpler to use and more economical to maintain. Five of these systems were sent to the Engineering and Testing Branch for testing and evaluation.



Photograph 1. View showing clip attachments of top panel to side and end panels of container 2.

2. Discussion. a. Dummy loads used in testing. The dummy loads used in the test consisted of layers of 16- by 12- by 10-inch fiberboard boxes (weighing approximately 55 lb ea) and a mixture of wooden blocks. The dummy loads were packaged so as to form a type 2 load (see photograph 2). Water was used for the two "bag-in-box assemblies" (containers 4 and 5).

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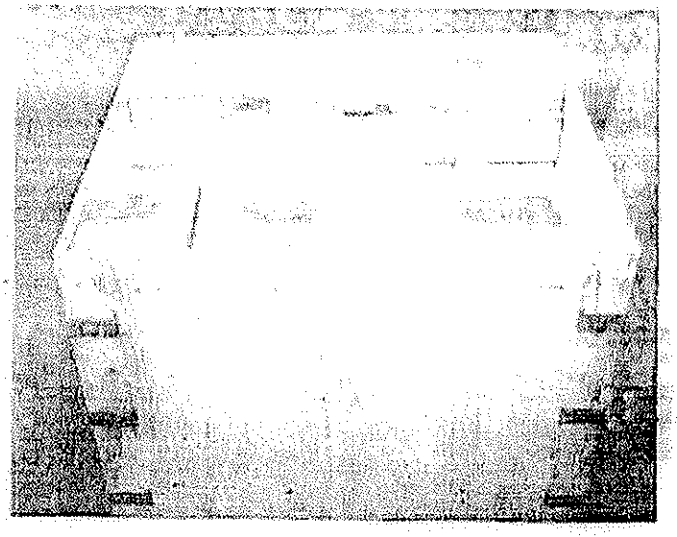


Photograph 2. The type 2 load placed in containers 1 through 3 for testing.

b. Physical characteristics of the containers. The exterior and interior dimensions of the five containers and the load weight placed in each are shown in table 1.

c. Tests conducted. Each container was subjected to the following rough handling tests, in the sequence shown:

(1) Mechanical handling test (lifting and transporting by forklift truck -- road test) per Method 5011.1 of Federal Test Method Standard (FTMS) 101c.

(2) Vibration test (repetitive shock--tested to 1G). The procedure followed was similar to Method 5019.1 of FTMS 101c.

(3) Edgewise-drop (rotational) test per Method 5008.1 of FTMS 101c.

(4) Incline-impact test per American Society of Testing and Materials Standard D 880, Procedure C.

(5) Mechanical handling test (lifting and transporting by forklift truck -- road test) per Method 5011.1 of FTMS 101c.

(6) Superimposed/compressive load test. This test was conducted to determine the stackability of the containers.

Table 1. Physical Characteristics of Test Containers

	Containers 1 through 3	Container 4*	Container 5*
Exterior dimensions (in)	40 x 48 x 43	40 x 48 x 41	40 x 48 x 34 1/2
Interior dimensions (in)	38 1/2 x 46 1/2 x 37 1/4	38 1/2 x 46 1/2 x 35 1/4	38 1/2 x 46 1/2 x 28
Exterior cube (cubic ft)	47.78	45.56	38.33
Interior cube (cubic ft)	38.59	36.52	29.79
Tare weight (lb)	221	221	204
Load weight (lb)	2000	2000	1812
Gross weight (lb)	2221	2221	2016

*Containers 4 and 5 included a special plastic disposable bag for the transport of liquids.

Table 1. Physical Characteristics of Test Containers

d. Test results. (1) The results of the rough handling tests are shown in table 2. Passing was determined by the ability of the fasteners to hold the container and its contents in position during testing. After testing, the container must be reusable without repair. The container must pass all testing to be considered acceptable. Testing was stopped at the first test failure. However, the superimposed load test was conducted on all 5 containers.

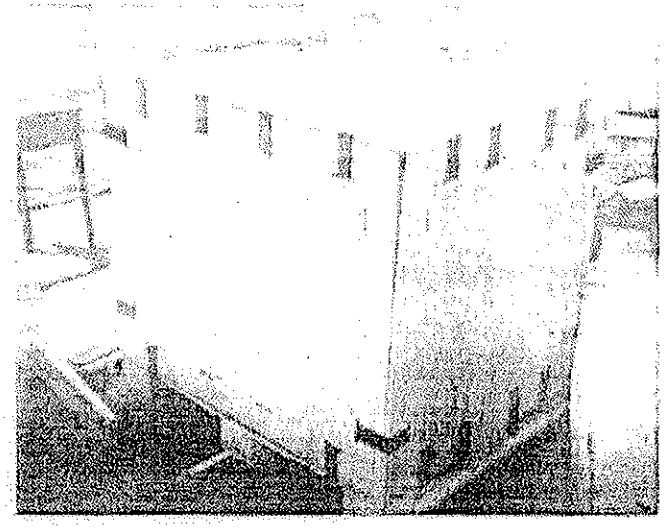
Table 2. Rough Handling Test Results

Container Number	#1	#2	#3	#4	#5
Road test	Passed	Passed	Passed	Passed	Passed
Vibration test	Passed	Passed	Passed	Failed	Failed
Drop test	Passed	Passed	Passed	-	-
Incline-impact test	Passed	Passed	Passed	-	-
Road test	Passed	Passed	Passed	-	-
Superimposed load*	Passed	Passed	Passed	Passed	Passed

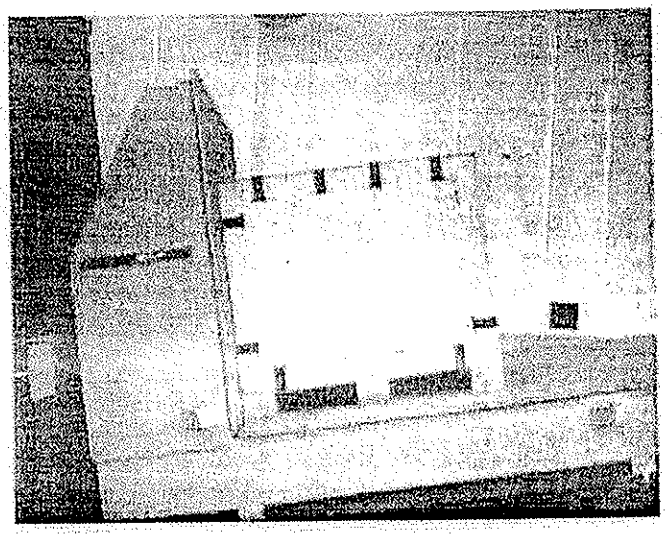
*This test was conducted with no load inside the containers. Each container was subjected to a 10,000 pound compressive load.

(2) It can be noted from table 2 that the three containers tested for shipment of general supplies passed all testing, while the two containers (bag-in-box) tested for the shipment of liquid (water) did not pass all testing. With respect to each of the five containers, the following was noted:

(a) Container 1. This container lost three clips during drop testing but still passed the remainder of the rough handling tests without the use of these clips (see photographs 3 and 4). It should be noted that container 1 had 4 less clips than the other 4 containers (i.e., container 1 was fastened with 40 clips, while containers 2, 3, 4, and 5 were each fastened with 44 clips). Note from photographs 3 and 4 that there are only two clips holding the sides to the ends of container 1, while the other containers had three clips. The lost clips were replaced for the compressive load test.

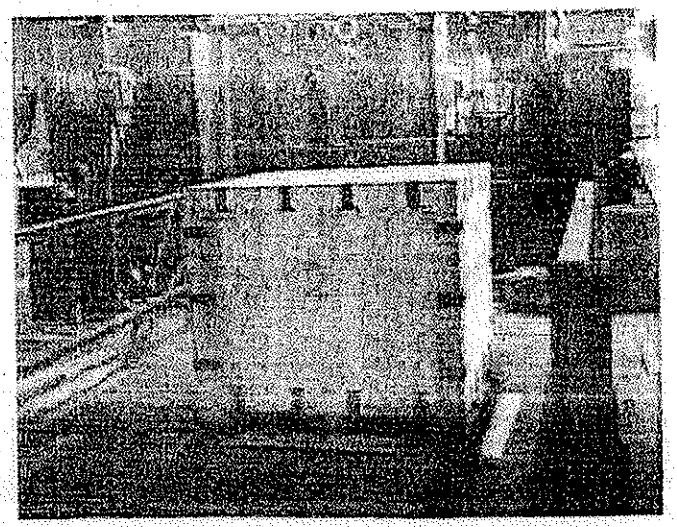


Photograph 3. Condition of container 1 after drop testing. Note the 1/2-inch deflection in the center of the base caused by the loss of the two side/base clips. The clip to the right came off after the first drop, while the left clip fell off after the second drop. Also note the gap between the end and side panels at the upper corner. The loss of this clip also occurred on the second of 4 drops.

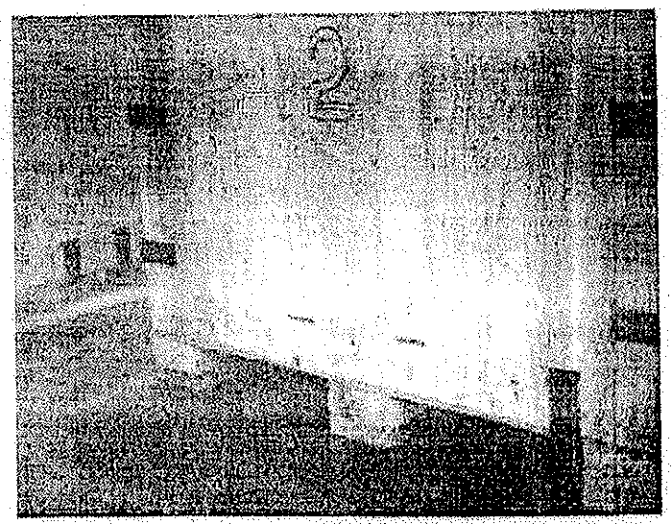


Photograph 4. Container 1 being incline-impact tested without the three clips lost during drop testing.

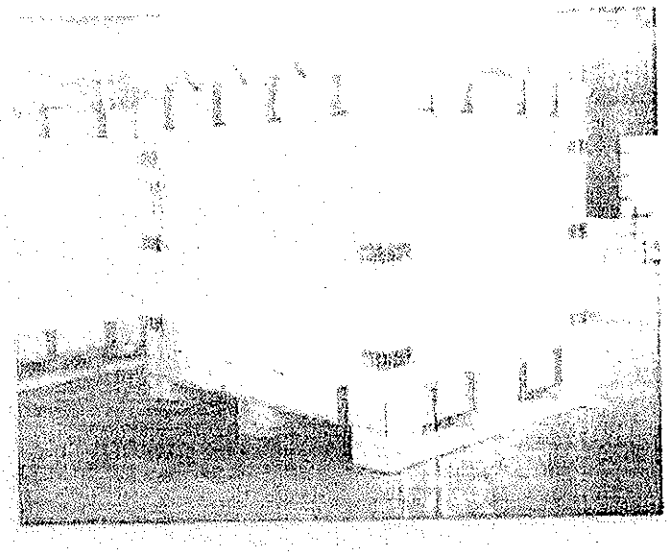
(b) Container 2. This container lost four clips as a result of drop testing but still passed the remaining tests without the use of these clips. See photographs 5, 6, and 7. Even with the loss of four clips, there was no noted physical damage to any part of the container. The lost clips were replaced for the compressive load test.



Photograph 5. View of container 2 being vibration tested with type 2 load weighing 2,000 pounds. Note that container 2 had three clips fastening the sides to the ends.

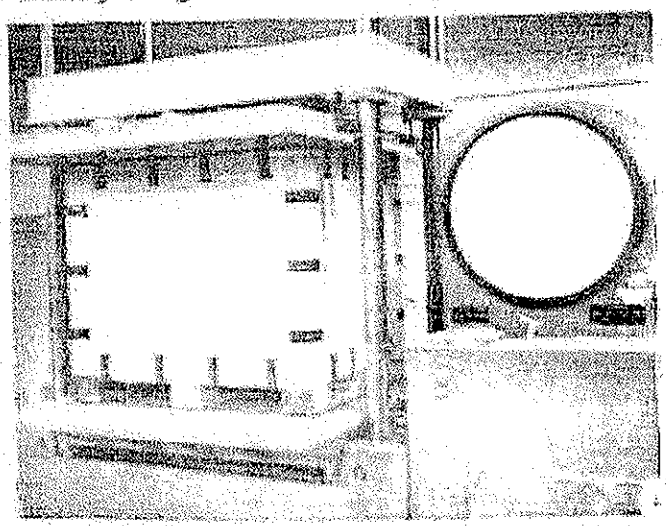


Photograph 6. Close-up of the base of container 2 showing empty clip slots. Container 2 finished the remaining incline-impact and road tests without any further clip loss. Despite the loss of clips, there was no physical damage to the panels of the container.



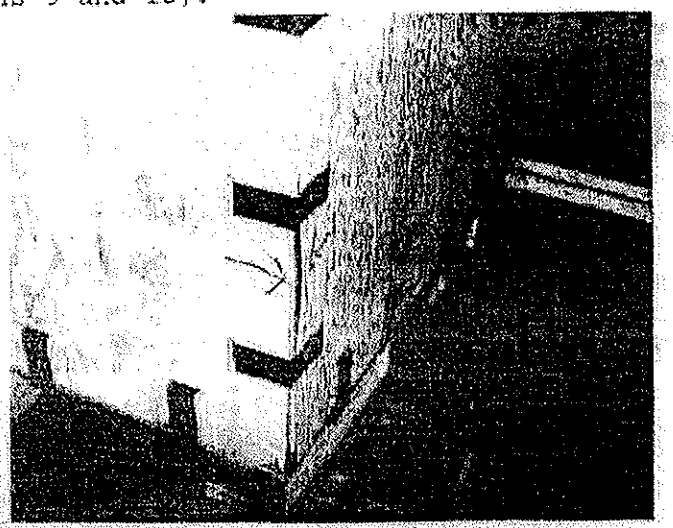
Photograph 7. View of container 2 after all testing was completed. Note the loss of four clips which occurred during drop testing.

(c) Container 3. This container lost no clips as a result of being rough handled. See photograph 8 for the condition of this container while being subjected to a compressive load of 10,000 pounds.

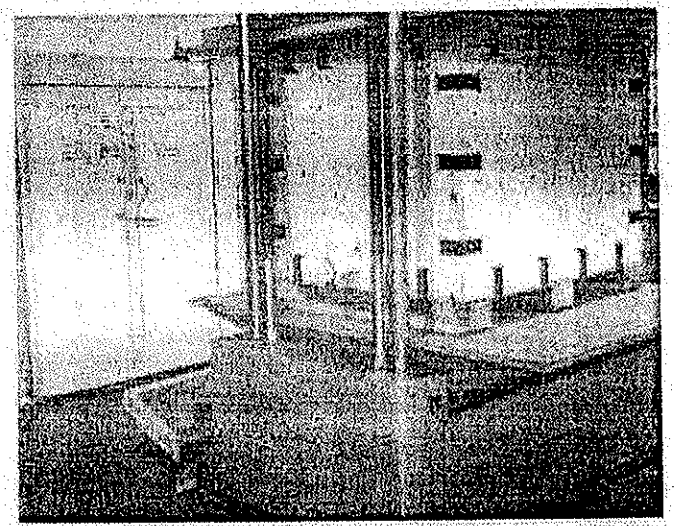


Photograph 8. Container 3 (empty) being subjected to a gradual load of 10,000 pounds applied by the compression testing machine. No container bulging occurred and no strain on the clips was noted. The results of this test were typical of all containers.

(d) Container 4. The bag in this container failed by tearing, due to excessive wear against the sides and ends of the container after 55 minutes of vibration testing. A second bag was placed inside container 4 with a fiberboard liner. This bag failed after 1 hour and 10 minutes of vibration testing. Location of the tear in both instances was in the top left-hand corner in reference to the drain spout. Although the bags used inside the container failed, the box itself was not damaged and did not lose any clips (see photographs 9 and 10).

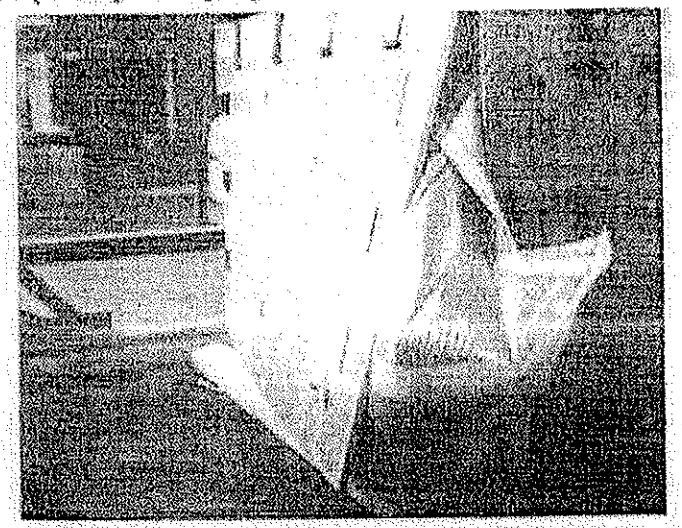


Photograph 9. View showing the plastic bag slipping out of the crack at corner 2-6-3 as a result of vibration testing. Water was detected at corner 1-6-2 after 55 minutes of testing.

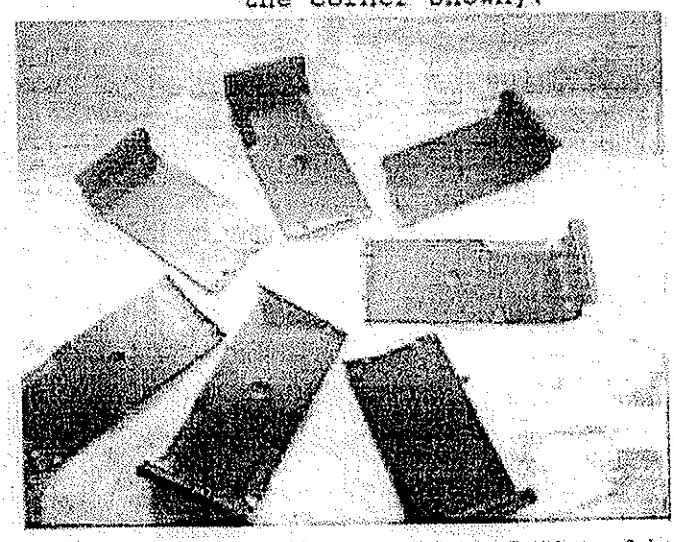


Photograph 10. Container 4 positioned in the compression machine before testing. The spout was removed before the compressive load of 10,000 pounds was applied.

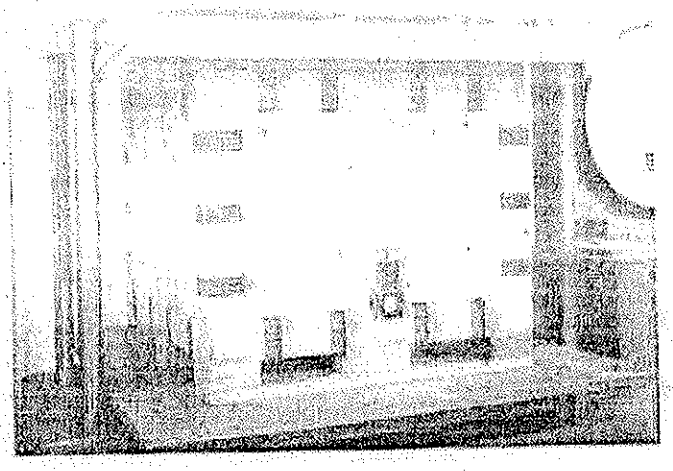
(e) Container 5. After 18 minutes of vibration testing, this container began to lose clips (i.e., the clips would pop off). The test was stopped after 26 minutes of vibration testing when a total of seven clips popped off the container. At this point, the bag began to come out of the unfastened side of the container. Of the seven clips lost, four snapped into two pieces. There were no leaks in the plastic bag at the time the test was stopped. For the stacking test, the lost clips were replaced with spare clips (see photographs 11 thru 13).



Photograph 11. View showing the plastic bag coming through the unfastened corner of container 5 during vibration testing. Note the loss of seven clips (i.e. the four that attached the side to the base and the three that held the end to the side of the corner shown).



Photograph 12. View showing parts of the clips that snapped into two pieces under the stress of vibration testing.



Photograph 13. Container 5 being subjected to a 10,000 pound compressive load. There was no container bulging or clips lost.

(3) After all testing was completed, each of the five containers was knocked down and then reassembled to see if the panels lined up with each other for reuse without any type of repair (other than replacing clips). There was no noted misalignment in the refastening of the panels or damage to any part of the container, also the clips were reusable (i.e., they still had an adequate degree of resiliency).

3. Conclusions. a. The Clip-Lok™ System[1] container fastening system can be used on shipping containers carrying type 1 and 2 loads of supplies weighing up to 2,000 pounds without the use of strapping.

b. The Clip-Lok™ System[1] container fastening system can be used to construct demountable wood and/or plywood containers of 3/4-inch thickness and above.

4. Recommendation. It is recommended that before being used by an Army activity, the Clip-Lok™ System[1] demountable container be compared with presently used containers in regard to cost, inventory control, and number of trips to be economically feasible for use.

[1] Citation of a trade name of a commercially available product does not constitute an official endorsement of one product over another manufacturer's product, but only advise of what is available. There are other suppliers of this type or a similar type of product.

5. Keyword Identifiers. Knock down, demountable, clips, containers, reusable, box fasteners, plywood boxes, and multi-trip.

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