FINAL REPORT
JULY 2002

REPORT NO. 01-22

CORDSTRAP™ W/MK-82 BOMBS,
TP-94-01,
“TRANSPORTABILITY TESTING PROCEDURES”

Prepared for:
U.S. Air Force
Air Expeditionary Battelab
360 Gunfighter Ave
Mt Home AFB, ID 83648

Distribution Unlimited

VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053

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ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division, (SOSAC-DEV), was tasked by the USAF Air Expeditionary Battle lab to conduct transportability testing and to validate Cordstrap™ material as an alternative to using wood for blocking and bracing the MK-82 500-pound bombs in an end-opening 20-foot-long intermodal container. Based on our review and testing, the Cordstrap™ material was not effective as an alternative to wood for restraint of the MK-82 bombs in an end-opening intermodal container.

During testing, the Cordstrap™ either stretched excessively or broke which allowed the payload to move. Also, the airbags that were used during initial testing lost pressure due to temperature changes and would not hold the load tightly. The Cordstrap™ system is dependent on the intermodal container having lashing rings located along the floor and roof. Not all intermodal containers have lashing rings; and, therefore, the system could not be used in containers without rings. Additionally, the Cordstrap™ material was not effective as an alternative to wood since considerable wood dunnage was still required to block and brace the payload. Cordstrap™ material could not be used as a forward bulkhead and required excessive time and labor to install.

Prepared by:  

Reviewed by:

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JERRY W. BEAVER  
Chief, Validation Engineering Division
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>PART</th>
<th>PAGE NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. INTRODUCTION ..........................................................</td>
<td>1-1</td>
</tr>
<tr>
<td>A. BACKGROUND ..........................................................</td>
<td>1-1</td>
</tr>
<tr>
<td>B. AUTHORITY ..........................................................</td>
<td>1-1</td>
</tr>
<tr>
<td>C. OBJECTIVE ..........................................................</td>
<td>1-1</td>
</tr>
<tr>
<td>D. CONCLUSION ..........................................................</td>
<td>1-1</td>
</tr>
<tr>
<td>2. ATTENDEES ..........................................................</td>
<td>2-1</td>
</tr>
<tr>
<td>3. TEST EQUIPMENT ......................................................</td>
<td>3-1</td>
</tr>
<tr>
<td>4. TEST PROCEDURES ....................................................</td>
<td>4-1</td>
</tr>
<tr>
<td>A. RAIL TEST ..........................................................</td>
<td>4-1</td>
</tr>
<tr>
<td>B. ON/OFF ROAD TEST ..................................................</td>
<td>4-3</td>
</tr>
<tr>
<td>1. HAZARD COURSE .....................................................</td>
<td>4-3</td>
</tr>
<tr>
<td>2. ROAD TRIP ..........................................................</td>
<td>4-4</td>
</tr>
<tr>
<td>3. PANIC STOPS .......................................................</td>
<td>4-4</td>
</tr>
<tr>
<td>4. WASHBOARD COURSE ................................................</td>
<td>4-4</td>
</tr>
<tr>
<td>C. OCEAN GOING VESSEL TEST (STS) ..................................</td>
<td>4-5</td>
</tr>
<tr>
<td>5. TEST RESULTS .........................................................</td>
<td>5-1</td>
</tr>
<tr>
<td>5.1 TESTING DATE- (17-19 Oct 2001) ................................</td>
<td>5-1</td>
</tr>
<tr>
<td>A. RAIL TEST ..........................................................</td>
<td>5-1</td>
</tr>
<tr>
<td>B. ON/OFF ROAD TEST ..................................................</td>
<td>5-6</td>
</tr>
<tr>
<td>1. HAZARD COURSE .....................................................</td>
<td>5-6</td>
</tr>
<tr>
<td>2. ROAD TRIP ..........................................................</td>
<td>5-7</td>
</tr>
<tr>
<td>3. PANIC STOPS .......................................................</td>
<td>5-7</td>
</tr>
<tr>
<td>4. WASHBOARD COURSE ................................................</td>
<td>5-8</td>
</tr>
<tr>
<td>C. SHIPBOARD TRANSPORTATION SIMULATOR ............................</td>
<td>5-9</td>
</tr>
<tr>
<td>D. AIR BAG HISTORY ....................................................</td>
<td>5-10</td>
</tr>
<tr>
<td>5.2 TESTING DATE- (28 Jan 2002) ...................................</td>
<td>5-13</td>
</tr>
<tr>
<td>A. RAIL TEST ..........................................................</td>
<td>5-13</td>
</tr>
<tr>
<td>6. ACCELEROMETER DATA ................................................</td>
<td>6-1</td>
</tr>
<tr>
<td>7. DRAWINGS ..........................................................</td>
<td>7-1</td>
</tr>
</tbody>
</table>
PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SOSAC-DEV), was tasked by the Air Force Air Expeditionary Battlelab to conduct transportability testing using the Cordstrap™ material to secure the MK-82 500-pound bombs in an end-opening 20-foot-long intermodal container. Loading procedures specified in AMC Drawing 19-48-8643 were used as a guideline. The container load was tested in accordance with TP-94-01, “Transportability Testing Procedures.”

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations Support Command (OSC), Rock Island, IL. Reference is made to the following:


C. OBJECTIVE. The objective of the testing was to validate the use of Cordstrap™ material as an alternative to wood for restraint of the MK-82 500-pound bombs in an end-opening 20-foot-long intermodal container.

D. CONCLUSION. Based on our review and testing the Cordstrap™ material was not effective as an alternative to wood for restraint of the MK-82 500-pound bombs in an end-opening 20-foot-long intermodal container. During testing the Cordstrap™ either stretched excessively or broke which allowed the payload to move. Also, the airbags that were used during initial testing lost pressure due to temperature changes and would not hold the load tightly. The Cordstrap™ system is dependent upon the intermodal container having lashing rings located along the floor and roof. Not all intermodal containers have lashing rings; and, therefore, the system could not be used in containers without rings. Additionally,
the Cordstrap™ material was not effective as an alternative to wood since considerable wood dunnage was still required to block and brace the payload. The Cordstrap™ material could not be used as a forward bulkhead and required excessive time and labor to install.
### ATTENDEE

<table>
<thead>
<tr>
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<th>Title</th>
<th>Mailing Address</th>
</tr>
</thead>
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<td>P.O. Box 315</td>
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<td></td>
<td>5750 AH Deurne – The Netherlands</td>
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<td>MSgt Tim Lewis</td>
<td>Munitions Director</td>
<td>U.S. Air Force</td>
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<td>DSN 728-3524</td>
<td>Air Expeditionary Battlelab</td>
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<td>360 Gunfighter Ave</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mt Home, ID 83648</td>
</tr>
</tbody>
</table>
PART 3 - TEST EQUIPMENT

1. MK-82 500-pound bombs using Cordstrap™ for restraint.

Photo No. 1: Loaded container with MK-82 bombs and Cordstrap™.

2. Intermodal End-Opening Container, 20-foot long
   Manufactured by: Evergreen Heavy Industries Corp.
   Date of Manufacture: 11/90
   ID #: USSC 0018162
   Maximum Gross Weight: 52,910 Pounds
   Tare Weight: 4,850 Pounds
   (Used during October 2001 Testing)

3. Intermodal End-Opening Container, 20-foot long
   Manufactured by: Siam Cargo Container Ltd.
   Date of Manufacture: 12/96
   ID #: MLCU 3211090
   Maximum Gross Weight: 67,200 Pounds
   Tare Weight: 4,850 Pounds
(Used during January 2002 Testing)

4. Truck, Tractor
   5-Ton, 6 X 6
   Model #: M931 A2 wo/winch
   Manufactured by: BMY – Division of HARSCO
   ID #: 31 021 89
   NSN: 2320 01 230 0302
   Weight: 20,100 pounds

5. Semitrailer, Flatbed, Breakbulk/Container Transporter, 22.5 Ton
   Model #: M871
   Manufactured by Southwest Truck Body, St. Louis, MO
   ID #: NX03PJ – 0063
   NSN: 2330 00 122 6799
   Weight: 15,630 pounds
PART 4 - TEST PROCEDURES

The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," July 1994, for validating tactical vehicles and outloading procedures used for shipping munitions by truck and railcar.

Inert (non-explosive) items were used to build the load. The test loads were prepared using the blocking and bracing procedures proposed for use with munitions (see Part 7 for procedures). The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads simulate live (explosive) ammunition.

A. RAIL TEST. RAIL IMPACT TEST METHOD. The test load or vehicle will be secured to a flatcar. The equipment needed to perform the test will include the specimen (hammer) car, four empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars will be positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit will push the specimen car toward the anvil at a predetermined speed, then disconnect from the specimen car approximately 50 yards away from the anvil cars allowing the specimen car to roll freely along the track until it strikes the anvil. This will constitute an impact. Impacting will be accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. The speeds will have a tolerance of plus .5 mph and minus zero mph. The impact speeds will be determined by using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).
ASSOCIATION OF AMERICAN RAILROADS (AAR)

STANDARD TEST PLAN

5 BUFFER CARS (ANVIL) WITH DRAFT GEAR COMPRESSED AND AIR BRAKES IN A SET POSITION

ANVIL CAR TOTAL WT. 250,000 LBS (APPROX)

SPECIMEN CAR IS RELEASED BY SWITCH ENGINE TO ATTAIN:

IMPACT NO. 1 @ 4 MPH
IMPACT NO. 2 @ 6 MPH
IMPACT NO. 3 @ 8.1 MPH

THEN THE CAR IS REVERSED AND RELEASED BY SWITCH ENGINE TO ATTAIN:

IMPACT NO. 4 @ 8.1 MPH

FIGURE 1. RAIL IMPACT SKETCH
B. **ON/OFF ROAD TEST.**

1. **HAZARD COURSE.** The test load or vehicle will be transported over the 200-foot-long segment of concrete-paved road consisting of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course will be traversed two times (see Figure 2).

![Figure 2. Hazard Course Sketch](image)

   
   a. The first series of 6 ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

   b. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.
c. The second series of 7 ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.

d. The test load is driven across the hazard course at speeds that will produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

2. **ROAD TRIP.** The test load or vehicle will be transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route will include curves, corners, railroad crossings and stops and starts. The test load or vehicle will travel at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

3. **PANIC STOPS.** During the road trip, the test load or vehicle will be subjected to three (3) full airbrake stops while traveling in the forward direction and one in the reverse direction while traveling down a 7 percent grade. The first three stops are at 5, 10, and 15 mph while the stop in the reverse direction is approximately 5 mph. This testing will not be required if the Rail Impact Test is performed.

4. **WASHBOARD COURSE.** The test load or vehicle will be driven over the washboard course at a speed that produces the most violent response in the vertical direction.
Figure 3. Washboard Course Sketch

C. OCEAN-GOING VESSEL TEST. SHIPBOARD TRANSPORTATION SIMULATOR (STS) TEST METHOD. The test load will be secured inside an ISO container and will be positioned onto the STS and securely locked in place using the cam locks at each corner. Oscillation of the STS will be started and rotate to an angle of 30 degrees plus or minus 2 degrees, either side of center and at a frequency of 2 cycles-per-minute (30 seconds plus or minus 2 seconds total roll period). This frequency will be observed for apparent defects that could cause a safety hazard. The frequency of oscillation will then be increased to 4 cycles-per-minute (15 seconds plus or minus 1 second per roll period) and the apparatus operated a period of two (2) hours. An inspection of the load will then be conducted. If the inspection does not indicate an impending failure, the frequency of oscillation will be further increased to 5 cycles-per-minute (12 seconds plus or minus 1 second-cycle time), and the apparatus operated for four (4) hours. The operation does not necessarily have to be continuous, however, no change or adjustments to the load or load restraints will be permitted at any
time during the test. After once being set in place, the test load (specimen) will
not be removed from the apparatus until the test has been completed or is
terminated
PART 5 - TEST RESULTS

5.1 Testing Date: 17-19 October 2001
Payload: Cordstrap™ Material with MK-82 Payload
Gross Weight: 40,850 pounds

Photo 2: Tightening of Cordstrap™ prior to testing.
Photo 3: Fully loaded container with Cordstrap™, airbags and MK-82 bombs prior to testing.

A. RAIL TEST. RAIL IMPACT TEST METHOD.

Photo 4: Rail Impact testing of Cordstrap™.
### Table

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flatcar Number: DODX 48797</td>
<td>62,700 lbs.</td>
</tr>
<tr>
<td>Intermodal Container with 2,000 # GBU-31(V) 1/B</td>
<td>36,225 lbs.</td>
</tr>
<tr>
<td>M1 Flatrack with MLRS Pods</td>
<td>28,265 lbs.</td>
</tr>
<tr>
<td>Intermodal container with Cordstrap™ Restraint</td>
<td>40,850 lbs.</td>
</tr>
<tr>
<td>Total Specimen Wt.</td>
<td>168,040 lbs.</td>
</tr>
<tr>
<td>Buffer Car (four cars)</td>
<td>250,000 lbs.</td>
</tr>
</tbody>
</table>

**Figure 4**

**Remarks:** Figure 4 lists the test components and weights of the items used during the Rail Impact Tests. The intermodal container with the Cordstrap™ and MK-82 bombs was secured on the Container-on-Flatcar (COFC). The M1 Flatrack with MLRS pods and the intermodal container with the 2000-pound bombs were used as ballast for the test.

### Table

<table>
<thead>
<tr>
<th>Impact Number</th>
<th>Velocity (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.1</td>
</tr>
<tr>
<td>2</td>
<td>6.2</td>
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<tr>
<td>3</td>
<td>8.4</td>
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<tr>
<td>4</td>
<td>Not Conducted</td>
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</tbody>
</table>

**Figure 5**

**Remarks:**
1. Figure 5 lists the average speeds of the specimen car immediately prior to impact with the anvil. Impact # 4 would have been the reverse impact.
2. Following Impact # 2 the load moved 0.5 inches toward the container door. The payload at the closed end of the container was no longer in contact with the end gate.
3. Following Impact # 3 the load moved 6-8 inches toward the container door. The vertical strap broke at the top-lashing ring, curbside of the container. This allowed the entire end wall and strapping to loosen and the load to move.

4. Due to the catastrophic failure of the strapping, testing was stopped following Impact # 3 and the container was offloaded from the railcar.

Photo 5: Final dunnage position following 8 mph rail impact and straps breaking.

Photo 6: Broken straps following 8 mph rail impact.
In order to gain additional information the Cordstrap™ representatives were permitted to reload the container using different strapping and the Hazard Course, Road Trip, Washboard Course, and Shipboard Transportation Simulator (STS) tests were conducted. The follow-on testing was for informational purposes only.
B. ON/OFF ROAD TESTS.

1. HAZARD COURSE.

![Photo 8: Hazard Course testing of Cordstrap™ and MK-82 bombs.](image)

<table>
<thead>
<tr>
<th>Pass No.</th>
<th>Elapsed Time</th>
<th>Velocity (mph)</th>
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<tr>
<td>1</td>
<td>24 Seconds</td>
<td>6.1</td>
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<tr>
<td>2</td>
<td>26 Seconds</td>
<td>5.6</td>
</tr>
<tr>
<td>3</td>
<td>27 Seconds</td>
<td>5.4</td>
</tr>
<tr>
<td>4</td>
<td>24 Seconds</td>
<td>6.1</td>
</tr>
</tbody>
</table>

**Figure 6**

**Remarks:**
1. Figure 6 lists the average speeds of the test load through the Hazard Course.
2. Following Passes #2 and #4 the load was examined and no significant movement or damage to the system was found.
3. Passes #3 and #4 were conducted following the completion of the Road Trip.
2. **ROAD TRIP.** Examination of the load and strapping system upon completion of the road trip revealed that the straps across the nose end of the bombs, at the closed end of the container, had loosened. The loosening was caused by the straps sliding toward the nose end of the bombs.

![Photo 9: Loose Cordstrap™ following Road Course.](image)

3. **PANIC STOPS.** Testing was not performed since earlier load had already demonstrated poor longitudinal restraint of Cordstrap™ material during rail impact test.
4. **WASHBOARD COURSE.**

![Photo 10: Washboard Course testing of Cordstrap™ with MK-82 bombs.](image)

**Remarks:**

1. The straps across the nose ends of the bombs at the closed end of the container slipped completely off of the bombs.
2. The load moved 0.5 inches toward the driver's side of the container and 0.125 inches toward the closed end of the container.
C. **OCEAN-GOING VESSEL.** SHIPBOARD TRANSPORTATION SIMULATOR (STS) TEST METHOD.

Photo 11: Shipboard Transportation Simulator testing of Cordstrap™ with MK-82 bombs.

**Remarks:**

1. The intermodal container with the Cordstrap™ and MK-82 bombs were removed from the trailer and positioned onto the STS.
2. During testing the load moved 1 inch in each direction (left and right). The total movement was 2 inches.
3. The center pallet, on the driver’s side, shifted during testing. The pallet shifted away from the container wall 0.25 inches at the base of the bomb to 1 inch at the nose end of the bomb.
4. The anti-slip pads between the pallets and the container floor, at the door end of the container, wore through.
D. **AIR BAG HISTORY.** Air bags were used in blocking and bracing the MK-82 bomb pallets in the intermodal container. One air bag was located in the front (closed end) of the container and one was located in the center.

![Photo 12: View of front air bag.](image)

![Photo 13: View of center air bag.](image)
During the complete testing sequence, the pressure in each air bag was monitored. The pressures were as follows:

1 bar = 14.5 pounds/inch$^2$

**16 October 2001, 1300 HRS**
Front – 0.225 bar  
Center – 0.225 bar

**17 October 2001, 0845 HRS**
Front – 0.200 bar  
Center – 0.215 bar

**17 October 2001, 1100 HRS**
Front – 0.210 bar  
Center – 0.220 bar

Following the 1100 hrs reading the bags were removed from the container and deflated and destroyed. The container was then reloaded using different straps and new air bags.

**17 October 2001, 1400 HRS**
Front – 0.250 bar  
Center – 0.25 bar

**18 October 2001 – 0730 HRS**
Front – 0.190 bar  
Center – 0.210 bar
18 October 2001 – 1330 HRS
Front – 0.200 bar
Center – 0.250 bar

21 November 2001 – 0900 HRS
Front – 0.125 bar
Center – 0.100 bar

Remarks: Air bags are not an acceptable alternative for wood blocking and bracing. The air bags deflated over time due to changes in temperature and pressure and would not hold the load tight. Also, air bags are susceptible to puncture and damage.

5.2 Testing Date: 28 January 2002
Payload: Cordstrap™ Material with MK-82 Payload
Gross Weight: 40,850 pounds

Photo 14: Pre-Staging of Cordstrap™ prior to loading container with MK-82 bombs.
Note: The customer, USAF Air Force Air Expeditionary Battlelab, only required that Rail Testing be conducted; therefore, Hazard Course, Road Trip, Washboard Course, and Shipboard Transportation Simulator tests were not conducted.

Photo 15: Cordstrap™ restraining payload.

Photo 16: Fully loaded container with Cordstrap™ and MK-82 bombs.
A. RAIL TEST. RAIL IMPACT TEST METHOD.

<table>
<thead>
<tr>
<th>Description</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Flatcar Number: DODX 48797</td>
<td>62,700 lbs.</td>
</tr>
<tr>
<td>M1 Flatrack with MLRS Pods</td>
<td>28,265 lbs.</td>
</tr>
<tr>
<td>Intermodal container with Cordstrap™ Restraint</td>
<td>40,850 lbs.</td>
</tr>
<tr>
<td>Total Specimen Wt.</td>
<td>131,815 lbs.</td>
</tr>
<tr>
<td>Buffer Car (four cars)</td>
<td>250,000 lbs.</td>
</tr>
</tbody>
</table>

Figure 7

Remarks: Figure 7 lists the test components and weights of the items used during the Rail Tests. The intermodal container with the Cordstrap™ and MK-82 Bombs was secured on the Container-on-Flatcar (COFC). The M1 Flatrack with MLRS pods was used as ballast for the test.

<table>
<thead>
<tr>
<th>Impact Number</th>
<th>Velocity (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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<td>3</td>
<td>8.1</td>
</tr>
<tr>
<td>4</td>
<td>8.2</td>
</tr>
</tbody>
</table>

Figure 8
Remarks:
1. Figure 8 lists the average speeds of the specimen car immediately prior to impact with the anvil. Impact #4 is the reverse impact.
2. Following Impact #2 the payload moved 0.75 inches.
3. Following Impact #3 the payload moved an additional 1-1.5 inches.
4. Following Impact #4 the payload moved 8.5–9 inches.
5. The movement of the payload was excessive and could result in damage to the intermodal container and/or the payload. The testing was discontinued due to the unsafe condition.

Photo 17: Movement of payload from 8 mph reverse rail impact.
Photo 18: Loose straps following reverse 8 mph impact.
PART 6 – ACCELEROMETER DATA

The first accelerometers were located in various areas on the test specimen. These areas are described on each of the following graphic depictions of each of the railcar impacts, hazard course, road course, and washboard course. The axial orientation of the accelerometers is as follows:

- $r$ – resultant vector
- $x$ – longitudinal axis
- $y$ – lateral axis
- $z$ – vertical axis

A table depicting the identification and location of the graphic illustrations is below:

<table>
<thead>
<tr>
<th>TEST</th>
<th>PAGE</th>
<th>SENSOR LOCATION</th>
</tr>
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<tbody>
<tr>
<td>Rail Impact</td>
<td>6-2</td>
<td>Railcar Coupler</td>
</tr>
<tr>
<td>Rail Impact</td>
<td>6-3</td>
<td>Container Rear</td>
</tr>
<tr>
<td>Rail Impact</td>
<td>6-4</td>
<td>Container Front</td>
</tr>
</tbody>
</table>

Photo 19: Sensor located at container front on MK-82 pallets.

Photo 19: Sensor located at container rear on MK-82 pallets.
PART 7 – DRAWINGS

The following drawing represents the load configuration that was subjected to the test criteria. The drawing can be accessed at:

LOADING AND BRACING IN END OPENING ISO CONTAINERS OF MK82 (500 POUND) BOMBS ON MHU-149/E METAL PALLETS

INDEX

ITEM

TYPICAL LOADING PROCEDURES .................................................. 2
GENERAL NOTES AND MATERIAL SPECIFICATIONS .................................. 3
PALLET UNIT DETAIL ............................................................... 4
DETAILS ........................................... 4-8
LESS-THAN-FULL-LOAD DETAILS ............................................... 9-10

* LOADING AND BRACING SPECIFICATIONS SET FORTH WITHIN THIS DRAWING ARE APPLICABLE TO LOADS THAT ARE TO BE SHIPPED BY TRAILER/CONTAINER-ON-FLATCAR (T/COFC) RAIL CARRIER SERVICE. THESE SPECIFICATIONS MAY ALSO BE USED FOR LOADS THAT ARE TO BE MOVED BY MOTOR OR WATER CARRIERS.

U.S. ARMY MATERIEL COMMAND DRAWING

APPROVED: U.S. ARMY INDUSTRIAL OPERATIONS COMMAND

ENGINEER

LAURA FIEFFER

DO NOT SCALE

WEB SITE: HTTP://WWW.DAC.ARMY.MIL

APRIL 1997

APPROVED BY ORDER OF COMMANDING GENERAL
U.S. ARMY MATERIEL COMMAND

TRANSPORTATION ENGINEERING DIVISION

DEFENSE AMMUNITION CENTER

LOGISTICS ENGINEERING OFFICE

PROJECT SP 342-97
ISOMETRIC VIEW

BILL OF MATERIAL

<table>
<thead>
<tr>
<th>LUMBER</th>
<th>LINEAR FEET</th>
<th>BOARD FEET</th>
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</thead>
<tbody>
<tr>
<td>2&quot; X 4&quot;</td>
<td>338</td>
<td>226</td>
</tr>
<tr>
<td>2&quot; X 6&quot;</td>
<td>729</td>
<td>729</td>
</tr>
<tr>
<td>4&quot; X 4&quot;</td>
<td>49</td>
<td>69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NAILS</th>
<th>NO. REQD</th>
<th>POUNDS</th>
</tr>
</thead>
<tbody>
<tr>
<td>10d (3&quot;)</td>
<td>1254</td>
<td>20</td>
</tr>
<tr>
<td>12d (3-1/4&quot;)</td>
<td>44</td>
<td>3/4</td>
</tr>
</tbody>
</table>

| WIRE, NO. 14 GAGE | 12' REQD | NIL |

KEY NUMBERS

1. FORWARD/REAR BLOCKING ASSEMBLY (2 REQD). SEE THE DETAIL ON PAGE 5. NOTE: STRUT LEDGERS ARE ONLY REQUIRED ON THE REAR BLOCKING ASSEMBLY. DO NOT INSTALL STRUT LEDGERS ON THE FORWARD BLOCKING ASSEMBLY.


5. SEPARATOR GATE (2 REQD). SEE THE DETAIL ON PAGE 5.


7. DOOR SPANNER, 4" X 4" MATERIAL, CUT TO A LENGTH THAT WILL PROVIDE FOR A DRIVE FIT (REF: 7"-1-3/8") (2 REQD). TOE NAIL TO THE DOOR POST VERTICAL W/12d NAILS AT EACH END. SEE THE "BEVEL-CUT" DETAIL ON PAGE 4.


LOAD AS SHOWN

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>WEIGHT (APPROX)</th>
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</thead>
<tbody>
<tr>
<td>PALLET UNIT</td>
<td>12</td>
<td>36,420 lbs</td>
</tr>
<tr>
<td>DUNNAGE</td>
<td></td>
<td>2,063 lbs</td>
</tr>
<tr>
<td>CONTAINER</td>
<td></td>
<td>4,700 lbs</td>
</tr>
</tbody>
</table>

TOTAL WEIGHT = 45,183 lbs (APPROX)
H. WHETHER A CONTAINER IS FULL OR IS LOADED WITH A REDUCE QUANTITY OF LADING UNITS, THE LENGTHWIDE CENTER OF GRAVITY OF THE LOAD MUST BE WITHIN 1\(\frac{1}{2}\)" IN EITHER DIRECTION, OF THE MID-POINT OF THE CONTAINER.

J. CAUTION: DO NOT NAIL DUNNGAGE MATERIAL TO THE CONTAINER WALLS OR FLOOR. ALL NAILING WILL BE WITHIN THE DUNNGAGE.

K. PORTIONS OF THE CONTAINER DEPICTED WITHIN THIS DRAWING, SUCH AS THE SIDEWALL, HAVE NOT BEEN SHOWN IN THE LOAD VIEWS FOR CLARITY PURPOSES.

L. MAXIMUM LOAD WEIGHT CRITERIA:

THE MAXIMUM LOAD WEIGHTS ARE CONTROLLED BY EQUIPMENT CAPABILITY FACTORS. ALTHOUGH THE HEAVIEST MAXIMUM LOADS ARE DELINCEATED IN THE LOAD VIEWS, PROVISIONS ARE INCLUDED WITHIN THIS DRAWING SO THAT THE BASIC LOADS WILL BE ADJUSTED TO SATISFY A LESSER QUANTITY OF LADING UNITS. DEPENDING ON TRANSPORTATION ROUTING, IT MAY BE NECESSARY TO REDUCE THE LOAD WEIGHT TO SATISFY "WEIGHT LAWS" OF CERTAIN STATES. ALSO, IT MAY BE NECESSARY TO REDUCE THE LOAD WEIGHT TO SATISFY OTHER WEIGHT RESTRICTIONS IMPOSED BY THE INTERMODAL CONTAINER SYSTEM.

M. REQUIREMENTS CITIED WITHIN THE BUREAU OF EXPLOSIVES PAMPHLET 66 APPLY WHEN THE SHIPMENT MOVES BY TRAILER/CONTAINER-ON-FLATCAR (T/FC0). SPECIAL T/FC0 NOTES FOLLOW:

1. A LOADED CONTAINER MUST BE ON A CHASSIS EQUIPPED WITH TWO BOOIE ASSEMBLIES WHEN BEING MOVED IN T/FC0 SERVICE.

2. THE LOAD LIMIT OF A T/FC0 RAILCAR MUST NOT BE EXCEEDED, NOR WILL A CAR BE LOADED SO THAT THE TRUCK UNDER ONE END OF THE CAR CARRIES MORE THAN ONE-HALF OF THE LOAD LIMIT FOR THAT CAR.

N. DURING INSTRAIBATE AND/OR INTERSTATE MOVES BY MOTOR CARRIER, A PROPER CHASSIS OR MODIFIED FLATBED TRAILER MUST BE USED TO PRECLUDE VIOLATION OF ONE OR MORE "WEIGHT LAWS" APPLICABLE TO THE STATE OR STATES INVOLVED.

O. CONVERSION TO METRIC EQUIVALENTS: DIMENSIONS WITHIN THIS DOCUMENT ARE EXPRESSED IN INCHES AND WEIGHTS ARE EXPRESSED IN POUNDS. WHEN NECESSARY, THE METRIC EQUIVALENTS MAY BE COMPUTED ON THE BASIS OF ONE INCH EQUALS 25.4MM AND ONE POUND EQUALS 0.454 KG.

P. THE QUANTITY OF PALLET UNITS SHOWN IN THE LOAD ON PAGE 2 MAY BE REDUCED FOR SHIPMENT, IF DESIRED. SEE THE "LESS-THAN-FULL-LOAD" DETAILS ON PAGE 9.

Q. RECOMMENDED SEQUENTIAL LOADING PROCEDURES:

1. PREFABRICATE TWO FORWARD/REAR BLOCKING ASSEMBLIES, SIX SIDE-FILL ASSEMBLIES (THREE LEFT HAND AND THREE RIGHT HAND), THREE CENTER FILL ASSEMBLIES, TWO SEPARATOR GATES AND TWO DOOR POST VERTICALS (ONE LEFT HAND AND ONE RIGHT HAND).

2. INSTALL THE FORWARD BLOCKING ASSEMBLY.

3. INSTALL TWO SIDE FILL ASSEMBLIES (ONE LEFT HAND AND ONE RIGHT HAND).

4. LOAD FOUR PALLET UNITS.

5. INSTALL ONE CENTER FILL ASSEMBLY WITH TIE WIRE.

6. INSTALL ONE SEPARATOR GATE.

7. REPEAT STEPS 3 THRU 6 TWICE.

8. INSTALL THE REAR BLOCKING ASSEMBLY.

9. INSTALL THE DOOR POST VERTICALS AND THE THREE DOOR SPANNERS.

10. INSTALL THE EIGHT STRUTS.

MATERIAL SPECIFICATIONS

LUMBER: SEE TM 743-200-1 (DUNNGAGE LUMBER) AND FED SPEC MM-L-751.

NAILS: FED SPEC FF-N-105; COMMON.

WIRE, CARBON STEEL: ASTM A853; ANNEALED AT FINISH, BLACK OXIDE FINISH, 0.005" DIA, GRADE 1006 OR BETTER.

PALLET UNIT DETAIL

GROSS WEIGHT: 5,035 LBS (APPROX)
CUBE: 42.5 CUBIC FEET (APPROX)

VERTICAL PIECE, 4" X 4" BY INSIDE CONTAINER
HEIGHT MINUS 1" (REF: 7'-6") (1 REQD).

STRUT LEDGER, 2" X 4" X 8' (7 REQD), NAIL
TO THE VERTICAL PIECE W/2-10d NAILS.

INDICATES A DOOR SPANNER OR A STRUT.

BEVEL-CUT
IF DESIRED, EACH END OF A DOOR SPANNER
PIECE OR A STRUT MAY BE BEVEL-CUT AS
SHOWN ABOVE TO FACILITATE THE ACHIEVEMENT
OF A TIGHT DOOR-POST-TO-DOOR-POST OR REAR-
BLOCKING-ASSEMBLY-TO-DOOR-POST FIT.

DOOR POST VERTICAL
A LEFT HAND ASSEMBLY IS DEPICTED, A RIGHT HAND ASSEMBLY IS
ALSO REQUIRED. FOR A ONE HIGH LOAD, ELIMINATE THE UPPER TWO
STRUT LEDGERS AND THE UPPER DOOR SPANNER LEDGER. RELOCATE
THE MIDDLE DOOR SPANNER LEDGER AT 24'-3/4".
VERTICAL PIECE, 2" X 6" X 72" (DOUBLED) (6 REQD). NAIL THE FIRST PIECE TO THE BEAM ASSEMBLIES W/3-10d NAILS AT EACH JOINT. LAMINATE THE SECOND PIECE TO THE FIRST W/6-10d NAILS.

BUFFER PIECE, 2" X 4" BY INSIDE CONTAINER HEIGHT MINUS 1" (REF: 7'-6" AT FORWARD END OF CONTAINER, 7'-4" AT REAR OF CONTAINER) (2 REQD). NAIL TO THE BEAM ASSEMBLIES W/5-10d NAILS AT EACH JOINT.

BEAM ASSEMBLY, 2" X 8" BY INSIDE CONTAINER WIDTH MINUS 1" (REF: 7'-7") (QUINTUPLED) (4 REQD). LAMINATE THE FIRST PIECE TO THE SECOND W/1-10d NAILS. LAMINATE EACH ADDITIONAL PIECE IN A LIKE MANNER.

STRUT LEDGER, 2" X 4" X 8' (8 REQD). NAIL TO THE BUFFER PIECES W/2-10d NAILS EACH. NOTE: STRUT LEDGERS ARE ONLY REQUIRED ON THE REAR BLOCKING ASSEMBLY. DO NOT INSTALL ON THE FORWARD BLOCKING ASSEMBLY.

FORWARD/REAR BLOCKING ASSEMBLY

NOTE: FOR A ONE HIGH LOAD, ELIMINATE THE TOP TWO BEAM ASSEMBLIES AND THE TOP FOUR STRUT LEDGERS (WHERE APPROPRIATE). SHORTEN THE VERTICAL PIECES APPROPRIATELY.

VERTICAL PIECE, 2" X 6" X 72" (6 REQD). NAIL TO THE TIE PIECES W/3-10d NAILS AT EACH END.

TIE PIECE, 2" X 4" BY INSIDE CONTAINER WIDTH MINUS 1" (REF: 7'-7") (2 REQD).

STOP PIECE, 2" X 4" X 7-1/2" (DOUBLED) (2 REQD). ALIGN THE FIRST PIECE WITH THE CORNER OF THE BEAM ASSEMBLY AND NAIL TO THE BEAM ASSEMBLY W/5-10d NAILS. LAMINATE THE SECOND PIECE TO THE FIRST W/3-10d NAILS.

SEPARATOR GATE

NOTE: FOR A ONE HIGH LOAD, SHORTEN THE VERTICAL PIECES TO 96".
VERTICAL PIECE, 2" X 8" BY INSIDE CONTAINER HEIGHT MINUS 1" (REF: 7'-8") (2 REQD).

ORIENT WITH THIS END TOWARDS BOMB NOSE.

VERTICAL PIECE, 2" X 4" X 72" (2 REQD).

HORIZONTAL PIECE, 2" X 6" X 81" (4 REQD). NAIL TO THE VERTICAL PIECES W/5-10d NAILS AT EACH JOINT. SEE "NOTE" BELOW.

NOTE: THE LENGTH OF THE HORIZONTAL PIECES MUST BE REDUCED TO 60" FOR THE TWO ASSEMBLIES THAT ARE ADJACENT TO THE FORWARD BLOCKING ASSEMBLY.

SIDE FILL ASSEMBLY
NOTE: FOR A ONE HIGH LOAD, ELIMINATE THE TOP TWO HORIZONTAL PIECES AND SHORTEN THE 2" X 4" VERTICAL PIECES TO 36". A LEFT HAND ASSEMBLY IS DEPICTED ABOVE, RIGHT HAND ASSEMBLIES ARE ALSO REQUIRED.

LONGITUDINAL PIECE, 2" X 4" X 44" (8 REQD). NAIL TO THE VERTICAL PIECES AND TO THE CENTER LATERAL PIECE W/5-10d NAILS AT EACH JOINT.

LATERAL PIECE, 2" X 4" X 11" (12 REQD). NAIL TO THE VERTICAL PIECES W/5-10d NAILS AT EACH END.

VERTICAL PIECE, 2" X 4" X 67-1/2" (4 REQD).

CENTER FILL ASSEMBLY
NOTE: FOR A ONE HIGH LOAD, ELIMINATE THE TOP FOUR LONGITUDINAL PIECES AND THE TOP SIX LATERAL PIECES AND SHORTEN THE VERTICAL PIECES TO 34".
DETAIL A

A PARTIAL PLAN VIEW OF THE LEFT REAR PORTION OF THE CONTAINER IS SHOWN DEPICTING THE PROPER POSITION OF THE FILL MATERIAL AND ADJACENT DUNNAGE PIECES.

SPECIAL NOTE:

WHEN ISO CONTAINERS ARE NOT EQUIPPED WITH PRE-WELDED LOAD RETAINERS, AS DEPICTED IN "DETAIL A" ABOVE, DOOR POST VERTICAL RETAINERS WILL BE REQUIRED FOR THE LOAD DEPICTED ON PAGE 2. SEE VARIOUS LOADS WITHIN AMQ DRAWING 19-45-4153-10PA1002 FOR EXAMPLES. SEE PAGE 8 FOR DETAILS OF THE METAL DOOR POST VERTICAL RETAINER.

DETAIL B

A PARTIAL PLAN VIEW OF THE LEFT REAR PORTION OF THE CONTAINER IS SHOWN DEPICTING THE PROPER POSITION OF THE DOOR POST VERTICAL RETAINER AND ADJACENT DUNNAGE PIECES.
STEEL STRIP, 1/8" THICK BY 4" WIDE BY 83" LONG (1.70 LBS/FT).

SQUARE STRUCTURAL TUBING, 3/4" SQUARE BY .120" WALL THICKNESS BY 83" LONG (1.03 LBS/FT).

RECTANGULAR STRUCTURAL TUBING, 1-1/2" BY 1" BY .120" WALL THICKNESS BY 83" LONG (1.84 LBS/FT).

SQUARE STRUCTURAL TUBING, 3/4" SQUARE BY .120" WALL THICKNESS BY 83" LONG (1.03 LBS/FT).

RECTANGULAR STRUCTURAL TUBING, 1-1/2" BY 1" BY .120" WALL THICKNESS BY 83" LONG (1.84 LBS/FT).

DOOR POST VERTICAL RETAINER

NOTE: THE ABOVE ASSEMBLY HAS BEEN SHOWN ROTATED 90° FROM THE ORIENTATION IN WHICH IT IS INSTALLED IN THE LEFT REAR CORNER OF THE CONTAINER. THE ASSEMBLY HAS BEEN ROTATED FOR HOLE LOCATION CLARITY.
TIE WIRE, NO. 14 GAGE WIRE 24" LONG (2 REQD PER OMITTED UNIT ASSEMBLY), INSTALL TO FORM A COMPLETE LOOP AROUND THE OMITTED UNIT ASSEMBLY AND THE ADJACENT DUNNAGE ASSEMBLY. BRING ENDS TOGETHER AND TWIST TAU. SECURE TO THE OMITTED UNIT ASSEMBLY WITH A PARTIALLY DRIVEN 10D NAIL BENT OVER THE WIRE OR WITH A STRAP STAPLE.

LESS-TAN-FULL-LOAD PROCEDURE

THE DETAIL ABOVE DEPICTS A BLOCKING METHOD TO BE USED IN A LESS-TAN-FULL CONTAINER LOAD (LESS THAN 12 UNITS). KEY NUMBERS REFER TO KEY NUMBERS ON PAGE 2. SEE GENERAL NOTE "H" ON PAGE 3.
OMITTED UNIT ASSEMBLY

SIDE VIEW