FINAL REPORT
SEPTEMBER 1989

EVT 35-89

TRANSPORTABILITY TEST
OF THE
CNU-180B/E CONTAINERS
IN AN
ISO SIDE-OPENING CONTAINER

DISTRIBUTION STATEMENT A
Approved for public release
Distribution Unlimited

Prepared for:
U.S. Army Defense Ammunition
Center and School
ATTN: SMCAC-DEO
Savanna, IL 61074-9639

US ARMY ARMAMENT
MUNITIONS
CHEMICAL COMMAND
US ARMY DEFENSE AMMUNITION
CENTER AND SCHOOL
Transportability Test of the CNU-180B/E Containers in an ISO Side-Opening Container

The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), was tasked by the Storage and Outloading Division (SMCAC-DEO) to test a blocking and bracing procedure for the CNU-180B/E containers in an Air Force International Standards Organization (ISO) side-opening container. The tests conducted on this shipping configuration were: Rail Impact Test, Hazard Course, Road Trip, Washboard Course, and Shipboard Transportation Simulator (STS). These tests resulted in an acceptable outloading procedure for this shipping configuration. Test results are contained in this report.
TRANSPORTABILITY TEST OF THE
CNU-180B/E CONTAINERS IN AN ISO SIDE-OPENING CONTAINER

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. Conclusions</td>
<td>1-1</td>
</tr>
<tr>
<td>E. Recommendation</td>
<td>1-1</td>
</tr>
<tr>
<td>2. ATTENDEES</td>
<td>2-1</td>
</tr>
<tr>
<td>3. TEST PROCEDURES</td>
<td>3-1</td>
</tr>
<tr>
<td>4. TEST RESULTS</td>
<td>4-1</td>
</tr>
<tr>
<td>5. BLOCKING AND BRACING PROCEDURE</td>
<td>5-1</td>
</tr>
<tr>
<td>6. PHOTOGRAPHS</td>
<td>6-1</td>
</tr>
</tbody>
</table>
PART 1
INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center and School (USADACS), Evaluation Division (SMCAC-DEV), was tasked by the Storage and Outloading Division (SMCAC-DEO) to test a blocking and bracing procedure for the CNU-180B/E containers in an Air Force ISO side-opening container. The tests conducted on this shipping configuration were Rail Impact Test, Hazard Course, Road Trip, Washboard Course, and STS.

B. AUTHORITY. This test was conducted in accordance with mission responsibilities delegated by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, IL 61299-6000. Reference is made to Change 4, 4 October 1974, to AR 740-1, 23 April 1971, Storage and Supply Operations; AMCCOMR 10-17, 13 January 1986, Mission and Major Functions of U.S. Army Defense Ammunition Center and School.

C. OBJECTIVE. The objective of these tests was to determine if the outloading procedures developed for the CNU-180B/E containers provided suitable protection in a road, rail, and ship transportation environment. The tests performed on the CNU-180B/E shipping configuration were: Rail Impact Test, Hazard Course, Road Trip, Washboard Course, and STS.

D. CONCLUSIONS. The tested configuration passed the rail, road (hazard, trip, and washboard), and STS tests.

E. RECOMMENDATION. It is recommended that the outloading procedures be adopted for shipping the CNU-180B/E containers in an ISO side-opening container by rail, road, and ship.
## ATTENDEES

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>U.S. Army Defense Ammunition Center and School</th>
<th>Address and Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C. McIntosh</td>
<td>Director</td>
<td>U.S. Army Defense Ammunition Center and School</td>
<td>ATTN: SMCAC-DEV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Savanna, IL 61074-9639</td>
</tr>
<tr>
<td>Test Engineer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AV 585-8989</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comm 815-273-8989</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dave Valant</td>
<td>Director</td>
<td>U.S. Army Defense Ammunition Center and School</td>
<td>ATTN: SMCAC-DEV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Savanna, IL 61074-9639</td>
</tr>
<tr>
<td>Electronic Technician</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AV 585-8988</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comm 815-273-8988</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jerry Krohn</td>
<td>Director</td>
<td>U.S. Army Defense Ammunition Center and School</td>
<td>ATTN: SMCAC-DEV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Savanna, IL 61074-9639</td>
</tr>
<tr>
<td>Test Engineer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AV 585-8908</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comm 815-273-8908</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Greg Willis</td>
<td>Director</td>
<td>U.S. Army Defense Ammunition Center and School</td>
<td>ATTN: SMCAC-DEO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Savanna, IL 61074-9639</td>
</tr>
<tr>
<td>Industrial Engineer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AV 585-8084</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comm 815-273-8084</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PART 3
TEST PROCEDURES

A. RAIL IMPACT TEST. The test load or vehicle should be positioned in/on a railcar. For containers, the loaded container shall be positioned on a container chassis and securely locked in place using the twist locks at each corner. The container chassis shall be secured to a railcar. Equipment needed to perform the test includes the specimen (hammer) car, five empty railroad cars connected together to serve as the 250,000-pound anvil, and a railroad locomotive. These anvil cars are positioned on a level section of track with air and hand brakes set and with the draft gear compressed. The locomotive unit pulls the specimen car several hundred yards away from the anvil cars and, then, pushes the specimen car toward the anvil at a predetermined speed, disconnects from the specimen car about 50 yards away from the anvil cars, and allows the specimen car to roll freely along the track until it strikes the anvil. This constitutes an impact. Impacting is accomplished at speeds of 4, 6, and 8 miles per hour (mph) in one direction and at a speed of 8 mph in the opposite direction. The 4 and 6 mph impact speeds are approximate; the 8 mph speed is a minimum. Impact speeds are to be determined by using an electronic counter to measure the time required for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars.

B. HAZARD COURSE. The specimen being tested will be subjected to the road hazard course. Using a suitable truck/tractor or tactical vehicle, the vehicle/specimen of test method no. 1 shall be towed/driven over a hazard course two times at a speed of approximately 5 mph. The speed may be increased or decreased, as appropriate, to produce the most violent load response.
C. **ROAD TRIP.** Using a suitable truck/tractor or tactical vehicle, the vehicle with the specimen load shall be driven/towed for a total distance of at least 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. Test route shall include curves, corners, railroad crossings, cattle guards, stops, and starts. The test vehicle shall travel at the maximum speed suitable for the particular road being traversed, except as limited by legal restrictions.

D. **WASHBOARD COURSE.** Using a suitable truck/tractor, and/or tactical vehicle, the specimen shall be towed/driven over the washboard course at a speed which produces the most violent response in the particular test load (as indicated by the resonant frequency of the suspension system beneath the load).

E. **SHIPBOARD TRANSPORTATION SIMULATOR (STS).** The test load (specimen) shall be positioned onto the STS and securely locked in place using the cam lock at each corner. Using the procedure detailed in the operating instruction, the STS shall be started oscillating at an amplitude of $30^\circ \pm 2^\circ$ either side of center and a frequency of 2 cycles per minute (30 seconds plus 2 seconds total roll period). This frequency shall be maintained for at least 15 minutes during which time the load will be observed for apparent defects that could cause a safety hazard. The frequency of oscillation shall then be increased to 4 cycles per minute (15 seconds plus 1-second roll period) and the apparatus operated for 2 hours. If an inspection of the load does not indicate an impending failure, the frequency of oscillation shall be further increased to 5 cycles per minute (12 seconds $\pm$ 1-second cycle time), and the apparatus operated for 4 hours. The operation does not necessarily have to be continuous; however, no change or adjustments to the load or load restraints shall be permitted at any time during the test. After once being set in place, the test load (specimen) shall not be removed from the apparatus until the test has been completed or is terminated.
PART 4

TEST RESULTS
ROAD TEST AND SHIPBOARD TRANSPORTATION SIMULATOR (STS) DATA

TEST NO. 1  DATE: 26 September 1989

TEST SPECIMEN: CNU-180B/E Containers in a Side-Opening ISO Container

PASS 1-A OVER FIRST SERIES OF TIES: 0.11 MIN 5.16 MPH
PASS 1-B OVER SECOND SERIES OF TIES: 0.11 MIN 5.16 MPH

REMARKS: No Damage.

PASS 2-A OVER FIRST SERIES OF TIES: 0.11 MIN 5.16 MPH
PASS 2-B OVER SECOND SERIES OF TIES: 0.11 MIN 5.16 MPH

REMARKS: No internal or external damage. No load shift.

30-MILE ROAD TEST: No damage.

PASS 3-A OVER FIRST SERIES OF TIES: 0.10 SEC 5.68 MPH
PASS 3-B OVER SECOND SERIES OF TIES: 0.10 SEC 5.68 MPH

REMARKS: No external damage.

PASS 4-A OVER FIRST SERIES OF TIES: 0.10 SEC 5.68 MPH
PASS 4-B OVER SECOND SERIES OF TIES: 0.10 SEC 5.68 MPH

REMARKS: No external or internal damage. No load shift. Paint abrasion on side doors from blocking movement.

Washboard Course: No damage.

Shipboard Transportation Simulator (STS): No damage or load shifting.
RAIL IMPACT TEST DATA

TEST NO. 2 DATE: 3 October 1989

TEST SPECIMEN: CNU-180B/E Containers in a Side-Opening Container

TEST CAR NO. TTX 250254 LT. WT. 55,400 POUNDS

CONTAINER: USAF 0010582 LT. WT. 6,050 POUNDS

MILVAN CHASSIS: 5394 LT. WT. 6,100 POUNDS

LADING AND DUNNAGE WT. 25,480 POUNDS

TOTAL SPECIMEN WT. 93,030 POUNDS

BUFFER CAR (5 CARS) WT. 250,000 POUNDS

<table>
<thead>
<tr>
<th>IMPACT NO.</th>
<th>END STRUCK</th>
<th>VELOCITY (MPH)</th>
<th>REMARKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rear</td>
<td>4.41</td>
<td>No damage</td>
</tr>
<tr>
<td>2</td>
<td>Rear</td>
<td>6.15</td>
<td>No damage</td>
</tr>
<tr>
<td>3</td>
<td>Rear</td>
<td>8.03</td>
<td>No damage</td>
</tr>
<tr>
<td>4</td>
<td>Forward</td>
<td>8.15</td>
<td>No damage</td>
</tr>
</tbody>
</table>
PART 5

BLOCKING AND BRACING PROCEDURE
ISOMETRIC VIEW

KEY NUMBERS


3. STRUT, 4” X 4” BY CUT-TO-FIT (REF: 48”) (6 REQD.). TOE NAIL TO PIECES MARKED 2 AND 3 W/2-10d NAILS AT EACH END. SEE GENERAL NOTES “F”, “H”, “J” AND “K” ON PAGE 3.


5. CORNER FILL PIECE, 2” X 4” X 7”-0” (2 REQD.). NAIL TO CORNER ASSEMBLY W/7-10d NAILS. SEE GENERAL NOTES “F”, “H”, “J” AND “K” ON PAGE 3.

LOADING AND BRACING WITH WOODEN DUNNAGE IN SIDE OPENING COMMERCIAL CONTAINER OF CBU 52, CBU 58, OR CBU 71 IN CNU-126/E, CNU-180/E OR CNU-180B/E SHIPPING AND STORAGE CONTAINER

INDEX

<table>
<thead>
<tr>
<th>ITEM</th>
<th>PAGE(S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TYPICAL LOADING PROCEDURES</td>
<td>2</td>
</tr>
<tr>
<td>GENERAL NOTES, AND MATERIAL SPECIFICATIONS</td>
<td>3</td>
</tr>
<tr>
<td>TYPICAL CONTAINER DETAILS</td>
<td>4</td>
</tr>
<tr>
<td>GENERAL DETAILS</td>
<td>5.6</td>
</tr>
</tbody>
</table>

LOADING AND BRACING SPECIFICATIONS SET FORTH WITHIN THIS DRAWING ARE APPLICABLE TO LOADS THAT ARE TO BE SHIPPED BY TRAILER/CONTAINER-ON-FLAT CAR (T/COFC) RAIL CARRIER SERVICE. THESE SPECIFICATIONS MAY ALSO BE USED FOR LOADS THAT ARE TO BE MOVED BY MOTOR OR WATER CARRIERS. SEE GENERAL NOTE "M" ON PAGE 3.

U.S. ARMY MATERIEL COMMAND DRAWING

APPROVED, U.S. ARMY ARMAMENT, MUNITIONS AND CHEMICAL COMMAND

DRAFTSMAN: S. WILSON

TECHNICIAN: G. WILLIS

LOGISTICS ENGINEERING OFFICE

U.S. ARMY DEFENSE AMMUNITION CENTER AND SCHOOL

CLASS: 19  DIVISION: 48  DRAWING: 7110  FILE: SP 15J11

DO NOT SCALE

5-2  PROJECT SP 158-88
**GENERAL NOTES CONTINUED**

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

L. PORTIONS OF THE CONTAINER DEPICTED WITHIN THIS DRAWING, SUCH AS THE SIDE DOORS, HAVE NOT BEEN SHOWN IN THE LOAD VIEW FOR CLARITY PURPOSES.

M. REQUIREMENTS CITED WITHIN THE BUREAU OF EXPLOSIVES PAMPHLET OC APPLY WHEN THE SHIPMENT MOVES BY TRAILER/CONTAINER-ON-FLAT-CAR (T/COFC). SPECIAL T/COFC NOTES FOLLOW:

1. A LOADED CONTAINER MUST BE ON A CHASSIS EQUIPPED WITH TWO BOGGIE ASSEMBLIES WHEN BEING MOVED IN TOP SERVICE.

2. THE LOAD LIMIT OF A T/COFC 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 INTERSTATE AND/OR INTERSTATE MOVES BY MOTOR CARRIER, A PROPER CHASSIS OR MODIFIED FLAT BED TRAILER MUST BE USED TO PRECLUDE VIOLATION OF ONE OR MORE "WEIGHT LIMIT" 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 EQUIVALENT TO 25.4MM AND ONE POUND EQUALS 0.4536.

P. RECOMMENDED SEQUENTIAL LOADING PROCEDURES:

1. PREFABRICATE FOUR CORNER ASSEMBLIES, TWO SIDEWALL CENTER ASSEMBLIES (ONE RIGHT HAND AND ONE LEFT HAND), TWO CENTER FILL ASSEMBLIES, AND TWO DOORWALL CENTER ASSEMBLIES (ONE RIGHT HAND AND ONE LEFT HAND).

2. INSTALL TWO CORNER ASSEMBLIES.

3. LOAD EITHER SIX CBU-100/E, CBU-180/E OR CBU-125/E CONTAINERS. THEY ARE TO BE POSITIONED TIGHTLY AGAINST THE CORNER ASSEMBLY AND THE CENTER FILL ASSEMBLY.

4. INSTALL BOTH SIDEWALL CENTER ASSEMBLIES.

5. INSTALL BOTH CENTER FILL ASSEMBLIES.

6. REPEAT STEP 2. 

7. REPEAT STEP 3.

8. INSTALL BOTH DOORWALL CENTER ASSEMBLIES.

9. INSTALL STRAIGHT CUT-TO-FIT.

---

**BILL OF MATERIAL**

<table>
<thead>
<tr>
<th>MATERIAL DESCRIPTION</th>
<th>LINEAR FEET</th>
<th>BOARD FEET</th>
</tr>
</thead>
<tbody>
<tr>
<td>2&quot; x 3&quot;</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2&quot; x 4&quot;</td>
<td>180</td>
<td>125</td>
</tr>
<tr>
<td>2&quot; x 6&quot;</td>
<td>56</td>
<td>50</td>
</tr>
<tr>
<td>4&quot; x 6&quot;</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>4&quot; x 4&quot;</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>NAILS</td>
<td>NO. REQD.</td>
<td>POUNDS</td>
</tr>
<tr>
<td>10d (3&quot;)</td>
<td>264</td>
<td>4</td>
</tr>
</tbody>
</table>

---

**MATERIAL SPECIFICATIONS**

- NAILS: FED SPEC FF-H-105: COMMON.

---

**GENERAL NOTES**

A. THIS DOCUMENT HAS BEEN PREPARED AND ISSUED IN ACCORDANCE WITH 49 CFR 401-1 AND AUGMENTS TM 743-200-1 (CHAPTER 5).


C. THE SPECIFIED OUTLOADING PROCEDURES ARE APPLICABLE TO THE CBU 52, CBU 56, OR CBU 71 BODIES PACKED IN A CBU-125/E, CBU-180/E, OR CBU-125/E CONTAINER WITH EXPLOSIVES INSIDE ASSEMBLIES.

D. THE OUTLOADING PROCEDURES SPECIFIED HEREIN CAN ALSO BE UTILIZED FOR THE SHIPMENT OF THE SPECIFIED CBU-125/E, CBU-180/E, OR CBU-180/E CONTAINERS WHEN THEY ARE LOADED WITH AN ITEM WHICH IS IDENTIFIED DIFFERENTLY BY NOMENCLATURE THAN THE ITEM DESIGNATED WITHIN THE DRAWING TITLE.

---

**CONVERSION LAWS' MUST CARRIER. DURING CONTAINER-ON-FLAT-CAR (T/COFC).**

---

**PROJECT SP 158-68**

---

**PAGE 3**
TIE PIECE, 2" X 4" X 8'-0" (4 REGD). NAIL TO THE SPACER PIECES W/2-10d NAILS PER JOINT.

BEARING PIECE, 2" X 4" X 8'-0" (4 REGD). NAIL TO THE TIE PIECES AND THE STRUTS W/2-10d NAILS AT EACH JOINT.

RETAINER CLEAT, 2" X 3" (ACTUAL) X 12" (2 REGD). NAIL TO THE BEARING PIECE W/1-10d NAIL AND TO FILL PIECE W/2-10d NAILS.

CENTER FILL ASSEMBLY
CORNER ASSEMBLY

SIDE PIECE. 2' X 4' X 7'-0" (1 REQD). NAIL TO THE END PIECE W/7-10D NAILS.

END PIECE. 2' X 4' X 7'-0" (1 REQD). NAIL TO THE SIDE PIECE W/7-10D NAILS.

SIDE PIECE. 2' X 6' X 7'-0" (1 REQD). NAIL TO THE SIDE PIECE W/7-10D NAILS.

END PIECE. 2' X 6' X 7'-0" (1 REQD). NAIL TO THE END PIECE W/7-10D NAILS.

SIDEPIECE 2' X 8' X 7'-0" (1 REQD). NAIL TO THE END PIECE W/7-10D NAILS.

DOORWAY FILL PIECE 2' X 6' X 7'-0" (1 REQD). NAIL TO THE SIDE PIECE W/7-10D NAILS.

SIDE PIECE W/2-L0D NAILS.

STRAIGHT LEDGER. 2' X 4' X 5' (3 REQD). NAIL TO THE END PIECE W/2-10D NAILS.

STRAIGHT LEDGER. 2' X 4' X 5' (3 REQD). NAIL TO THE END PIECE W/2-10D NAILS.

SIDEWALL CENTER ASSEMBLY *

DOOR WALL CENTER ASSEMBLY *

* NOTE: ONE "RIGHT HAND" AND ONE "LEFT HAND" ASSEMBLY ARE REQUIRED.
PART 6

PHOTOGRAPHS
| Photo No. 1 | This photo shows the CNU-180B/E containers loaded in a side-opening container. Note: Dunnage lateral support strength depends on the container sidewalls at the rear and doors on the front. |
AVAILABILITY NOTICE

A complimentary copy of this report is furnished each attendee on automatic distribution. Additional copies or authority for reprinting may be obtained by written request from Director, U.S. Army Defense Ammunition Center and School, ATTN: SMCAC-DEV, Savanna, IL 61074-9639.

DISTRIBUTION INSTRUCTIONS

Destroy this report when no longer needed. Do not return.

* * *

Citation of trade names in this report does not constitute an official endorsement.

* * *

The information contained herein will not be used for advertising purposes.