FINAL REPORT
MAY 2000

REPORT NO. 99-12

TRAILER CARGO, 2.5-TON MTV M1082, AND
TRAILER CARGO, 5-TON MTV, M1095,
TP-94-01, TRANSPORTABILITY TESTING PROCEDURES

Prepared for:
U.S. Army Tank-automotive
and Armaments Command
ATTN: SFAE-GCSS-W-MTV
Warren, MI 48397-5000

Distribution Unlimited

VALIDATION ENGINEERING DIVISION
MCALESTER, OKLAHOMA 74501-9053

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REPORT NO. 99-12
TRAILER CARGO, 2.5-TON MTV M1082,
AND TRAILER CARGO, 5-TON MTV, M1095,
TP-94-01, TRANSPORTABILITY TESTING PROCEDURES

MAY 2000

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-Dev), was tasked by the U.S. Army Tank-automotive and Armaments Command (TACOM) to conduct TP-94-01, “Transportability Testing Procedures,” on the Trailer Cargo, 2.5 Ton MTV M1082, and Trailer Cargo, 5-Ton MTV, M1095, hereinafter referred to in this report as 2.5-ton and 5-ton tactical trailers, manufactured by Stewart and Stevenson Services, Inc., Tactical Vehicle Systems Division, Sealy, Texas.

The trailers were loaded with 155MM Separate Loading Projectiles (SLPs) and 120MM Tank Ammunition on metal pallets simulating the maximum trailer payload. The trailers were tested and evaluated in accordance with the testing procedures of TP-94-01, “Transportability Testing Procedures.” Testing included rail impact tests at 4, 6, and 8.1 mph forward, and 8.1 mph in the reverse direction, hazard course, and road course. The satisfactory performance of the 2.5-ton and 5-ton tactical trailers during testing has demonstrated that they are adequate to transport ammunition.

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U.S. ARMY DEFENSE AMMUNITION CENTER

VALIDATION ENGINEERING DIVISION
MCALESTER, OK 74501-9053

REPORT NO. 99-12

TRAILER CARGO, 2.5-TON MTV M1082, AND TRAILER CARGO, 5-TON MTV, M1095, TP-94-01, TRANSPORTABILITY TESTING PROCEDURES

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</tbody>
</table>
PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked by the U.S. Army Tank-automotive and Armaments Command (TACOM) to conduct transportability testing procedures on the Trailer Cargo, 2.5-Ton MTV, M1082 and Trailer Cargo, 5-Ton MTV, M1095 manufactured by Stewart and Stevenson Services, Inc., Tactical Vehicle Systems Division, Sealy, Texas.

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


C. OBJECTIVE. The objective of the tests was to determine if the 2.5-ton and 5-ton tactical trailers produced by Stewart and Stevenson satisfied the transportability requirements of TP-94-01.

D. CONCLUSION. The 2.5- and 5-ton tactical trailers were tested in accordance with the Transportability Testing Procedures TP-94-01. Minor deficiencies were found during testing, but they had no impact on the ability of the trailers to safely transport ammunition. The satisfactory performance of the 2.5-ton and 5-ton tactical trailers during testing has demonstrated that they are adequate to transport ammunition.
## PART 2 - ATTENDEES

DATES PERFORMED: MARCH 29-31, 2000

<table>
<thead>
<tr>
<th>ATTENDEE</th>
<th>MAILING ADDRESS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Philip Barickman</td>
<td>Director U.S. Army Defense Ammunition Center</td>
</tr>
<tr>
<td>General Engineer</td>
<td>ATTN: SMAAC-DEV</td>
</tr>
<tr>
<td>DSN 956-8992</td>
<td>1 C Tree Road, Bldg. 35</td>
</tr>
<tr>
<td>(918) 420-8992</td>
<td>McAlester, OK 74501-9053</td>
</tr>
<tr>
<td>Gregory Willis</td>
<td>Director U.S. Army Defense Ammunition Center</td>
</tr>
<tr>
<td>Industrial Engineer</td>
<td>ATTN: SMAAC-DET</td>
</tr>
<tr>
<td>DSN 956-8075</td>
<td>1 C Tree Road, Bldg. 35</td>
</tr>
<tr>
<td>(918) 420-8075</td>
<td>McAlester, OK 74501-9053</td>
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<tr>
<td>Jeffrey Dugan</td>
<td>Director U.S. Army Defense Ammunition Center</td>
</tr>
<tr>
<td>General Engineer</td>
<td>ATTN: SMAAC-DET</td>
</tr>
<tr>
<td>DSN 956-8225</td>
<td>1 C Tree Road, Bldg. 35</td>
</tr>
<tr>
<td>(918) 420-8225</td>
<td>McAlester, OK 74501-9053</td>
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</tbody>
</table>
PART 3 – TEST EQUIPMENT

1. Trailer Cargo, 2.5-Ton MTV, M1082
NSN: 2320-Z3-606-8001
Contract #: DAAE07-98-C-M1018
Stewart and Stevenson Services, Inc.
Tactical Vehicle Systems
Sealy, TX 77474
VSN/USA PB029X
MFG Serial #: TL-011120BEKG
MFG Date: 11-98
Del Date: 12-98

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</tr>
<tr>
<td>Gross</td>
<td>1,400</td>
<td>5,055</td>
<td>11,510</td>
</tr>
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</table>
2. Trailer Cargo, 5-Ton MTV, M1095
NSN: 2320-Z9-017-2001
Contract #: DAAE07-98-C-M1018
Stewart and Stevenson Services, Inc.
Tactical Vehicle Systems
Sealy, TX 77474
VSN/USA PB029X
MFG Serial # TL-011295BEKG
MFG Date: 11-98
Del Date: 12-98

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<th>TOTAL</th>
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<tr>
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<td>800</td>
<td>4,200</td>
<td>9,200</td>
</tr>
<tr>
<td>Gross</td>
<td>1,924</td>
<td>8,638</td>
<td>19,200</td>
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</table>
PART 4 - TEST PROCEDURES

The test procedures outlined in this section were extracted from TP-94-01, “Transportability Testing Procedures,” dated July 1994. This document identifies the testing requirements for validating tactical vehicles and unloading procedures used for shipping munitions by intermodal freight containers, commercial or tactical truck, or trailer or railcar. The transportability tests that were conducted on the 2.5-ton and 5-ton tactical trailers are summarized below.

A. TEST PREPARATION. The test load was prepared using the blocking and bracing procedures proposed for use with munitions (see part 6 for procedures). The first rail impact test was conducted with the loaded 2.5-ton and 5-ton tactical trailers loaded to capacity and secured to the railcar. Inert (non-explosive) items were used to build the load. The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were identical to live (explosive) ammunition.

B. RAIL IMPACT TEST METHOD. The trailers were loaded and secured to a conventional friction draft gear flatcar. MTMC-TEA Pamphlet 55-19, “Tiedown Handbook for Rail Movements” procedures were used to secure the trailers to the flatcar. Equipment needed to perform the test included the specimen (hammer) car, four (4) empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars were positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit pushed the specimen car toward the anvil at a predetermined speed, then disconnected from the specimen car approximately fifty (50) yards away from the anvil cars allowing the specimen car to roll freely along the track until it struck the anvil. This constituted an impact. Impacting was 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 4 and 6 mph impact speeds were
approximate; the 8.1 mph is a minimum. Impact speeds were determined by using an electronic counter to measure the time for the specimen car to traverse an eleven-foot distance immediately prior to contact with the anvil cars (see Figure 1).

---

Figure 1
C. **HAZARD COURSE.** The loaded 2.5-ton and 5-ton tactical trailers were transported over the 200-foot-long segment of concrete-paved road that consists of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course was traversed two times (see figure 2).

![Diagram of hazard course](image)

**Figure 2.**

1. The first series of ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
2. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.
3. The second series of ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
4. The test load is driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

D. **ROAD TRIP.** The loaded 2.5-ton and 5-ton tactical trailers were transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete, and asphalt. The test route included curves, corners, railroad crossings, and stops and starts. The trailers traveled at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

E. **PANIC STOPS.** Upon completion of the road trip, the loaded trailers were subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction. The first three stops were at 5, 10, and 15 mph, while the stop in the reverse direction was at approximately 5 mph.

F. **WASHBOARD COURSE.** The loaded 2.5-ton and 5-ton tactical trailers were driven over the washboard course at a speed that produced the most violent response in the trailers.
Figure 3.
PART 5 - TEST RESULTS

TEST SEQUENCE 1

The 2.5-ton and 5-ton tactical trailers were each loaded with inert 120MM tank ammunition to the specified trailer design payload. The 120MM test load was prepared using the blocking and bracing procedures proposed for use with munitions (see Part 6-Drawings, pages 2 and 4). Tie down of the trailers to the flat car was conducted in accordance with MTMC-TEA Pamphlet 55-19, "Tiedown Handbook for Rail Movements."

Rail Impact Testing of 2.5-Ton and 5-Ton Trailers
A. **Rail Impact Data**

Test Date: 13 January 2000

**Specimen Load:** 2.5-Ton Tactical Trailer loaded with 120MM tank ammunition
5-Ton Tactical Trailer loaded with 120MM tank ammunition

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>WEIGHT</th>
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</thead>
<tbody>
<tr>
<td>Flat Car Number: HTTX 95014</td>
<td>67,800 pounds</td>
</tr>
<tr>
<td>2.5-Ton Tactical Trailer</td>
<td>6,510 pounds</td>
</tr>
<tr>
<td>5-Ton Tactical Trailer</td>
<td>9,200 pounds</td>
</tr>
</tbody>
</table>

**Load Type:** 120MM Tank Ammunition with metal pallets

- 2.5 - Ton Trailer load: 5,150 pounds
- 5 - Ton Trailer load: 10,300 pounds

**Total Specimen Weight:** 98,960 pounds

**Buffer Car (four cars) Weight:** 250,000 pounds

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<th>IMPACT NO.</th>
<th>VELOCITY (MPH)</th>
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<tr>
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</tr>
<tr>
<td>2</td>
<td>6.36</td>
</tr>
<tr>
<td>3</td>
<td>8.67</td>
</tr>
<tr>
<td>4</td>
<td>8.82</td>
</tr>
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</table>

**Remarks:** No deficiencies were found upon inspection of the trailers and tiedowns following completion of the rail impact testing.
2.5-Ton Tactical Trailer Rail Impact Testing

5-Ton Tactical Trailer Rail Impact Testing
B. **Hazard Course**

**Test Date:** 7 January 2000

**Specimen Load:** 2.5-Ton Tactical Trailer with 120MM Tank Ammunition

<table>
<thead>
<tr>
<th>PASS NO.</th>
<th>ELAPSED TIME</th>
<th>VELOCITY (MPH)</th>
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<tbody>
<tr>
<td>1</td>
<td>29 Seconds</td>
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<td>2</td>
<td>25 Seconds</td>
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<td>3</td>
<td>22 Seconds</td>
<td>5.4</td>
</tr>
<tr>
<td>4</td>
<td>22 Seconds</td>
<td>5.4</td>
</tr>
</tbody>
</table>

**Remarks:**

1. Lateral movement of load during testing. Three straps were frayed upon completion of testing.
2. No damage or failures occurred with the tie-down rings or trailer.

---

*Hazard Course Testing of 2.5-Ton Tactical Trailer*
Test Date: 7 January 2000
Specimen Load: 5-Ton Tactical Trailer with 120MM Tank Ammunition

<table>
<thead>
<tr>
<th>PASS NO.</th>
<th>ELAPSED TIME</th>
<th>VELOCITY (MPH)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>18 Seconds</td>
<td>6.6</td>
</tr>
<tr>
<td>2</td>
<td>23 Seconds</td>
<td>5.2</td>
</tr>
<tr>
<td>3</td>
<td>20 Seconds</td>
<td>6.0</td>
</tr>
<tr>
<td>4</td>
<td>20 Seconds</td>
<td>6.0</td>
</tr>
</tbody>
</table>

Remarks:
1. Lateral movement of load during testing. One strap came loose during testing. Strap was relocated and tightened and testing continued.
2. No damage or failures occurred with the tie-down rings or trailer.

Hazard Course Testing of 5-Ton Tactical Trailer
C. **Road Trip**

Test Date: 7 January 2000

**Specimen Load:** 2.5-Ton and 5-Ton Tactical Trailers with 120MM Tank Ammunition

**Remarks:** No damage or load movement observed after completion of the road test.

D. **Panic Stop Test**

Test Date: 7 January 2000

**Specimen Load:** 2.5-Ton and 5-Ton Tactical Trailers with 120MM Tank Ammunition

**Remarks:** No damage or load movement observed after completion of test.

---

Panic Stop Testing of 2.5-Ton Tactical Trailer
E. **Washboard Course**

*Test Date:* 7 January 2000  
*Specimen Load:* 2.5-Ton Tactical Trailer with 120MM Tank Ammunition:

*Remarks:*

1. Three straps broke during testing.
2. Fore and aft movement of the load.
3. No damage or failures occurred with the tie-down rings or trailer.
4. Straps were replaced and strapping board added prior to 13 January 2000 rail impact testing.
Broken straps during washboard testing of 2.5-Ton Tactical Trailer

**Specimen Load:** 5-Ton Tactical Trailer with 120MM Tank Ammunition:

**Remarks:**

1. No load movement.
2. No damage or failures occurred with the tie-down rings or trailer.
TEST SEQUENCE 2

The 2.5-ton and 5-ton tactical trailers were each loaded with inert 155MM Separate Loading Projectiles (SLPs) to the specified trailer design payload. The 155MM SLP test load was prepared using the blocking and bracing procedures proposed for use with munitions (see Part 6-Drawings, pages 3, 5, and 6). Tie down of the trailers to the flatcar was conducted in accordance with MTMC-TEA Pamphlet 55-19, "Tiedown Handbook for Rail Movements."

A. Rail Impact Data

Test Date: 20 January 2000

Specimen Load: 2.5-Ton Tactical Trailer loaded with 155MM SLPs

5-Ton Tactical Trailer loaded with 155MM SLPs

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>WEIGHT</th>
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<tbody>
<tr>
<td>Flat Car Number: HTTX 95014</td>
<td>67,800 pounds</td>
</tr>
<tr>
<td>2.5-Ton Tactical Trailer</td>
<td>6,510 pounds</td>
</tr>
<tr>
<td>5-Ton Tactical Trailer</td>
<td>9,200 pounds</td>
</tr>
<tr>
<td>Load Type: 155MM SLPs</td>
<td></td>
</tr>
<tr>
<td>2.5 - Ton Tactical Trailer load</td>
<td>5,130 pounds</td>
</tr>
<tr>
<td>5 - Ton Tactical Trailer load</td>
<td>10,490 pounds</td>
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<tr>
<td>Total Specimen Weight</td>
<td>99,130 pounds</td>
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<tr>
<td>Buffer Car (four cars) Weight:</td>
<td>250,000 pounds</td>
</tr>
<tr>
<td>IMPACT NO.</td>
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<tr>
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<td>8.72</td>
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<td>4</td>
<td>8.57</td>
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**Remarks:** No deficiencies were found upon inspection of the trailers and tiedowns following completion of the rail impact testing.
2.5-Ton Tactical Trailer with 155MM SLPs

5-Ton Tactical Trailer with 155MM SLPs
B. **Hazard Course**

Test Date: 24 January 2000

**Specimen Load:** Rail Ties – 2.5-Ton Tactical Trailer with 155MM SLPs

<table>
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<td>2</td>
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<td>3</td>
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</tr>
<tr>
<td>4</td>
<td>25 Seconds</td>
<td>4.8</td>
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</table>

**Remarks:** No damage or failures occurred with the tie-down rings or trailer.

Hazard Course Testing of 2.5-Ton Tactical Trailer with 155MM SLPs
Specimen Load: 5-Ton Tactical Trailer with 155MM SLPs

<table>
<thead>
<tr>
<th>PASS NO.</th>
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<tr>
<td>4</td>
<td>25 Seconds</td>
<td>4.8</td>
</tr>
</tbody>
</table>

Remarks: No damage or failures occurred with the tie-down rings or trailer.

Hazard Course Testing of 5-Ton Tactical Trailer with 155MM SLPs
C.  **Road Trip**

Test Date: 24 January 2000  
**Specimen Load:** 2.5-Ton and 5-Ton Tactical Trailers with 155MM SLPs

**Remarks:** No damage or failures occurred with the tie-down rings or trailer.

D.  **Panic Stop Test**

Test Date: 24 January 2000  
**Specimen Load:** 2.5-Ton and 5-Ton Tactical Trailers with 155MM SLPs

**Remarks:** No damage or failures occurred with the tiedown rings or trailer.

E.  **Washboard Course**

Test Date: 24 January 2000  
**Specimen Load:** 2.5-Ton Tactical Trailer with 155MM SLPs

**Remarks:**

1. No damage or failures occurred with the tie-down rings or trailer.
2. Following completion of test series (hazard, panic stops and washboard) the total load movement was 0.75 inches to the side and 0.25 inch forward.

**Specimen Load:** 5-Ton Tactical Trailer with 155MM SLPs

**Remarks:**

1. No damage or failures occurred with the tie-down rings or trailer
2. No load movement.
Washboard Course of 2.5-Ton Tactical Trailer with 155MM SLPs
TEST SKETCH

LOADING AND TIEDOWN •
PROCEDURES FOR
AMMUNITION ITEMS
LOADED ON THE M1082
AND M1095 FMTV TRAILERS

• NOTE: THE AMMUNITION TIEDOWN PROCEDURES CONTAINED WITHIN THIS DOCUMENT ARE TYPICAL. THE DEPICTED ITEMS ARE REPRESENTATIVE OF THE VARIOUS TYPES OF AMMUNITION THAT MAY BE RESTRAINED AND TRANSPORTED ON THE M1082 AND M1095 FMTV TRAILERS. THESE PROCEDURES WERE USED IN SUPPORT OF THE FMTV TRAILER AMMUNITION CERTIFICATION TRANSPORTABILITY TEST PROGRAM.

Prepared during January 2000 by:
U.S. Army Defense Ammunition Center
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McAlester, OK 74501
POC: Mr. Jeff Dugan
DSN 956-8073
Comm (918) 420-8073
Fax 956-8811
E-mail: dugan@dac-emh2.army.mil
KEY NUMBERS
1. WEB STRAP TIE-DOWN ASSEMBLY (2 REQUIRED).
2. WEB STRAP TIE-DOWN ASSEMBLY (4 REQUIRED).
3. WEB STRAP TIE-DOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

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<tr>
<td>PALLETTIZED UNIT</td>
<td>2</td>
<td>5,000 LBS</td>
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TANK AMMO LOAD ON 2-1/2 TON FMTV TRAILER
KEY NUMBERS

1. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).
2. WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
3. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

<table>
<thead>
<tr>
<th>ITEM</th>
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<tbody>
<tr>
<td>PALLETTIZED UNIT</td>
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155MM PROJECTILE LOAD ON 2-1/2 TON FMTV TRAILER
KEY NUMBERS

1. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).
2. WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
3. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).
4. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

<table>
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<th>ITEM</th>
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<tbody>
<tr>
<td>PALLETED UNIT</td>
<td>4</td>
<td>10,000 LBS</td>
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TANK AMMO LOAD ON 5 TON FMTV TRAILER
NOTE: THIS DRAWING SHOWS STRAP ASSEMBLIES AS TESTED. FOR IMPROVED STAP ASSEMBLY LOCATIONS SEE PAGE 6.

KEY NUMBERS
1. WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
2. WEB STRAP TIEDOWN ASSEMBLY (6 REQUIRED).
3. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

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<td>PALLETTIZED UNIT</td>
<td>12</td>
<td>12,000 LBS</td>
</tr>
</tbody>
</table>

155MM PROJECTILE LOAD ON 5 TON FMTV TRAILER
NOTE: THIS DRAWING SHOWS STRAP ASSEMBLIES AT IMPROVED LOCATIONS DETERMINED BY TESTING.

KEY NUMBERS
1. WEB STRAP TIEDOWN ASSEMBLY (4 REQUIRED).
2. WEB STRAP TIEDOWN ASSEMBLY (6 REQUIRED).
3. WEB STRAP TIEDOWN ASSEMBLY (2 REQUIRED).

TEST LOAD AS SHOWN

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUANTITY</th>
<th>WEIGHT (APPROX)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PALLETTIZED UNIT</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

12 — — — — 12,000 LBS