FINAL REPORT
MARCH 2013

REPORT NO. 12-26

TRANSPORTABILITY TESTING OF THE MOBILE SHELTER SYSTEMS (MSS) ISO 20 LARGE SHARKCAGE TP-94-01, REV. 2, JUNE 2004, "TRANSPORTABILITY TESTING PROCEDURES"

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Distribution Unlimited

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REPORT NO. 12-26 **MAR 2013**

**TRANSPORTABILITY TESTING OF
THE MOBILE SHELTER SYSTEMS
ISO 20 LARGE SHARKCAGE,
TP-94-01, REV. 2, JUNE 2004,
"TRANSPORTABILITY TESTING PROCEDURES"**

ABSTRACT

The U.S. Army Defense Ammunition Center (DAC), Explosives Safety Engineering Division (DAC-ESE), was tasked by Mobile Shelter Systems (MSS) to conduct transportability testing on and validate for ammunition use the ISO 20 Large SharkCage, a specialized storage and transportation system. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004 "Transportability Testing Procedures."

The following observations resulted from the testing of ISO 20 Large SharkCage:

1. Unblocked (loose) and relatively heavy ammunition items/packages can damage the SharkCage during transportation.
2. Minor damage occurred to the SharkCages during testing. Shelf damage (minor bending of shelf beams) due to package movement during transit of the Washboard Course, was the main damage noted.
3. Excessive relative movement of packages within the SharkCage can damage packages. Minor damage to some wirebound boxes occurred during the testing – the wire on the boxes can "catch" on the wire grid of the SharkCage.

The Mobile Shelter Systems ISO 20 Large SharkCage, as currently designed, is adequate for the transport of ammunition. The ISO 20 Large SharkCage successfully completed transportability testing and is approved for transport of ammunition.

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REPORT NO. 12-26

TRANSPORTABILITY TESTING OF THE
MOBILE SHELTER SYSTEMS
ISO 20 LARGE SHARKCAGE
TP-94-01, REVISION 2, JUNE 2004
"TRANSPORTABILITY TESTING PROCEDURES"

TABLE OF CONTENTS

PART 1 – INTRODUCTION

A. BACKGROUND.

The U.S. Army Defense Ammunition Center (DAC), Explosives Safety Engineering Division (DAC-ESE), was tasked by Mobile Shelter Systems (MSS) to conduct transportability testing on and validate for ammunition use the ISO 20 Large SharkCage, a specialized storage and transportation system. The purpose of the testing was to certify that the ISO 20 Large SharkCage can safely be used to transport ammunition. The testing was conducted in accordance with TP-94-01, Revision 2, June 2004 "Transportability Testing Procedures."

B. AUTHORITY.

This test was conducted IAW mission responsibilities delegated by the U.S. Army Joint Munitions Command (JMC), Rock Island, IL. Reference is made to the following:

1. AR 385-10, 27 November 2013, Army Safety Program.
2. AR 740-1, 26 August 2008, Storage and Supply Activity Operation.
3. JMC-R, 10-23, 19 September 2011, Mission and Major Functions of U.S. Army Defense Ammunition Center (DAC).

C. OBJECTIVE.

The objective of the testing was to validate the Mobile Shelter Systems ISO 20 Large SharkCage when transportability tested in accordance with TP-94-01, Revision 2, June 2004.

D. <u>OBSERVATIONS</u>.

The following observations resulted from the testing of ISO 20 Large SharkCage:

1. Unblocked (loose) and relatively heavy ammunition items/packages can damage the SharkCage during transportation.
2. Minor damage occurred to the SharkCages during testing. Shelf damage (minor bending of shelf beams) due to package movement during transit of the Washboard Course, was the main damage noted.
3. Excessive relative movement of packages within the SharkCage can damage packages. Minor damage to some wirebound boxes occurred during the testing – the wire on the boxes can “catch” on the wire grid of the SharkCage.

E. <u>CONCLUSION</u>.

The Mobile Shelter Systems ISO 20 Large SharkCage, as currently designed, is adequate for the transport of ammunition. The ISO 20 Large SharkCage successfully completed transportability testing and is approved for transport of ammunition.

PART 2 – ATTENDEES

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Ralph Kluna	Mobile Shelter Systems Athens, GA 30606
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PART 3 - TEST EQUIPMENT

1. Semitrailer, flatbed, breakbulk/container transporter, 34 ton
   Model #: M872
   Manufactured by Southwest Truck Body Company, Saint Louis, MO.
   NSN: 2330 01 039 8095
   Weight: 19,290 pounds

2. Truck, Tractor, MTV, M1088 A1
   ID #: J0229
   NSN: 2320 01 447 3893
   VSN: NL1FSC
   MFG Serial #: T-018488EFJM
   Weight: 19,340 pounds

3. Intermodal Container
   USAU 0766386
   Date of Manufacture: March 2007
   Weight: 4,755 pounds

4. Flatcar DODX 42353
   Manufactured by Thrall Car
   Length: 89 feet – 4 inches
   Empty Weight: 85,000 pounds

PART 4 – TEST PROCEDURES

The test procedures outlined in this section were extracted from TP-94-01, “Transportability Testing Procedures,” Revision 2, June 2004, for validating tactical vehicles and outloading procedures used for shipping munitions by tactical truck, railcar, and ocean-going vessels.

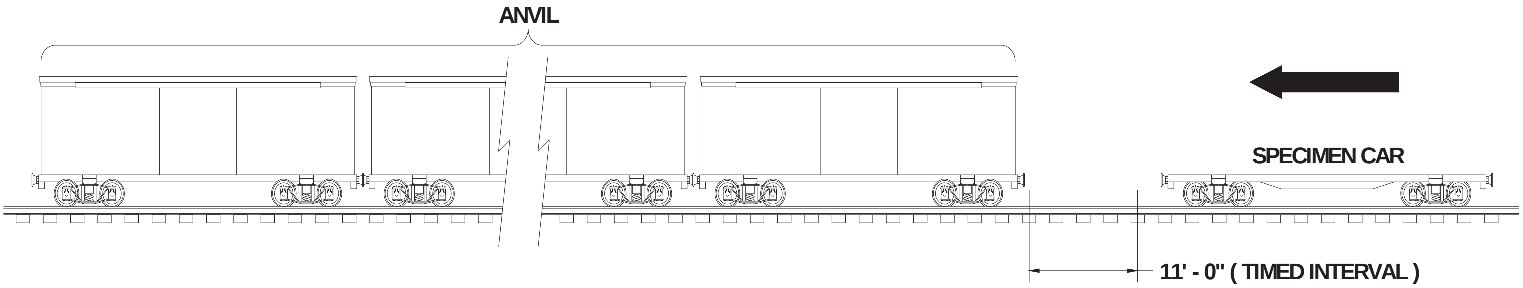
Inert (non-explosive) items were used to build the test loads. The test loads were prepared, where necessary, using the outloading procedures proposed for use with the MSS ISO 20 Large SharkCage (see Part 6 – Drawings). The weight and physical characteristics (weights, physical dimensions, center of gravity, etc.) of the test loads were similar to 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 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 the forward direction and at a speed of 8.1 mph in the reverse direction. The tolerance for the speeds is plus 0.5 mph, minus 0.5 mph for the 4 mph and 6 mph impacts, and plus 0.5 mph, minus 0 mph for the 8.1 mph impacts. 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



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

ANVIL CAR TOTAL WEIGHT: 250,000 (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 PMH

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)

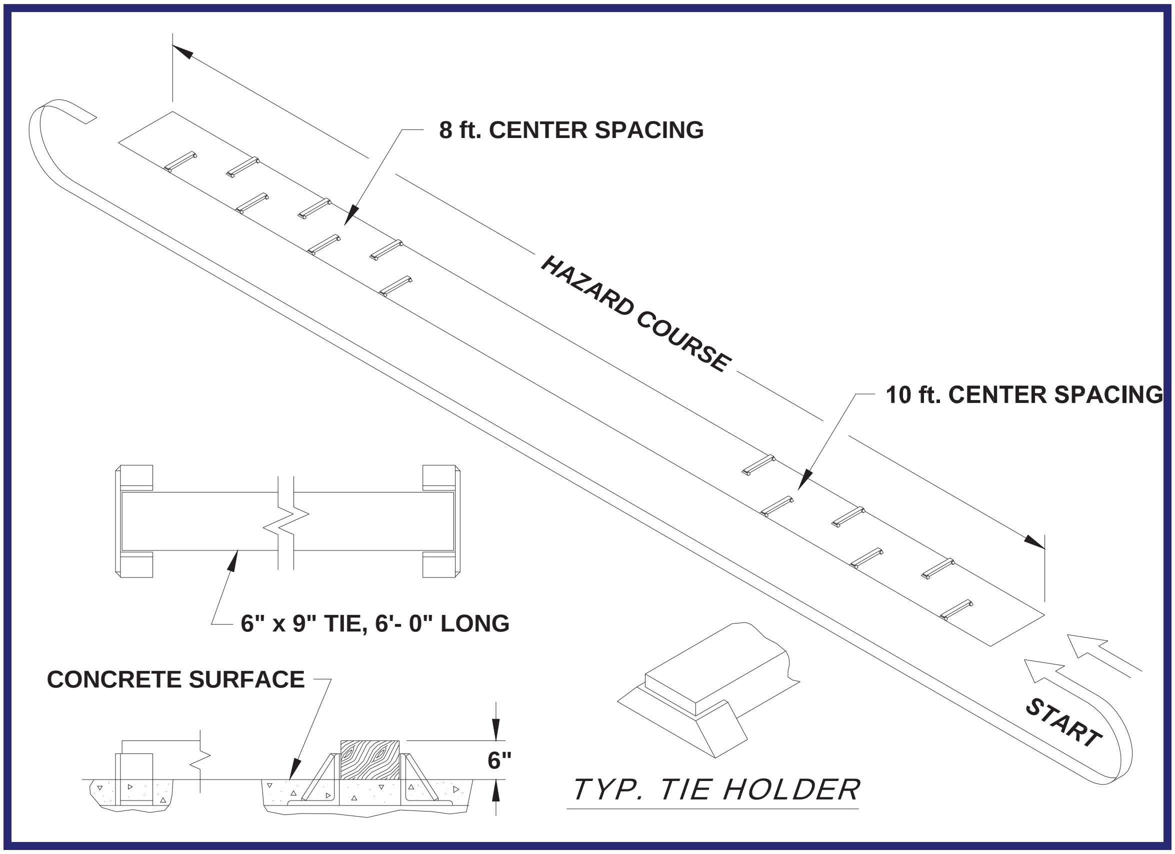


Figure 2. Hazard Course Sketch

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

b. Following the first series of ties, a paved roadway of 75 feet separates the first and the 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's centerline for a distance of 48 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 (1) in the reverse direction while traveling down a 7 percent grade. The first three forward stops are at 5, 10, and 15 mph while the stop in the reverse direction is at 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. (see figure 3)

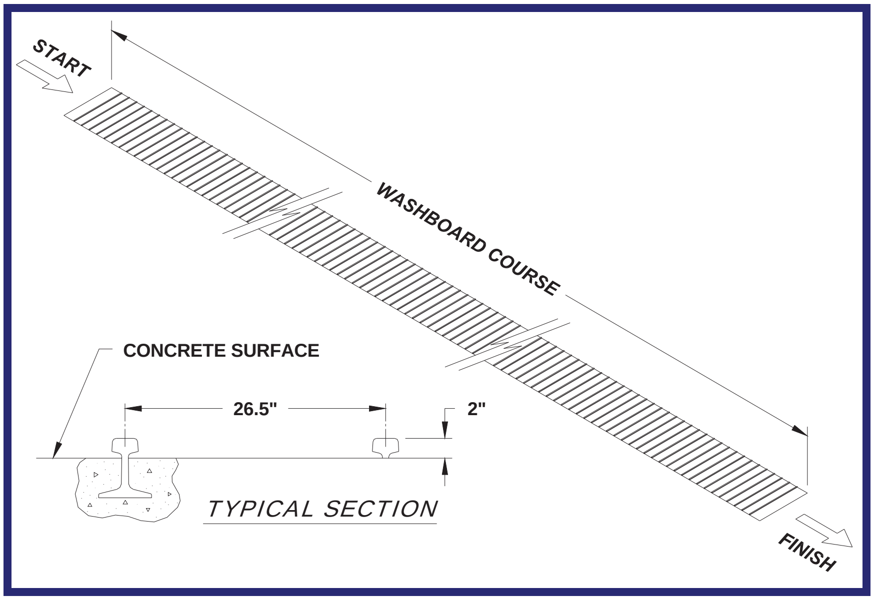


Figure 3. Washboard Course Sketch

C. OCEAN-GOING VESSEL TEST.

Shipboard Motion Simulator (Test Method 5). The shipboard motion simulator (SMS) is used for testing loads in 8-feet wide by 20-feet long intermodal freight containers. The specimen shall be positioned onto the SMS and securely locked in place using the cam lock at each corner. Using the procedure detailed in the operating instructions, the SMS shall begin oscillating at an angle of 30 degrees, plus or minus 2 degrees, either side of vertical center with a frequency of 2 cycles per minute (30 seconds, plus or minus 2 seconds) for duration of two (2) hours. This frequency shall 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 or minus one second per cycle) and the apparatus operated for two (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, plus or minus one second per cycle), and the apparatus operated for four (4) hours. The operation does not have to be continuous; however, no changes 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 5 - TEST RESULTS

5.1 TESTING DATES: 14 – 17 JANUARY 2013

Test Specimen:	Mobile Shelter Systems ISO 20 Large SharkCage
Payload:	Five MSS ISO 20 Large SharkCages; each loaded with various ammunition packages
Gross Weight:	25,385 pounds (approx.) (Five loaded SharkCages w/dunnage plus end opening ISO Container)
Payload Weight:	20,685 pounds (approx.) (Five loaded SharkCages)

Photo 1. End Opening ISO Container Loaded with SharkCages

A. RAIL IMPACT TESTS.

Remarks:

Inspection following completion of the test did not reveal any notable damage to the ISO 20 Large SharkCage.

B. ON/OFF ROAD TESTS.

1. HAZARD COURSE.

Photo 2. Hazard Course Testing of the ISO 20 Large SharkCage.

Pass No.	Elapsed Time	Avg. Velocity (mph)
1	22.4 Seconds	6.1
2	24.2 Seconds	5.6

Figure 4.

<u>Remarks</u>:

1. Figure 4 lists the average speeds of the test load through the hazard course.

2. Inspection (as possible) following each pass did not reveal any significant damage to the ISO 20 Large SharkCage.

3. No notable movement of the payload was detected during the test.

2. <u>ROAD TRIP</u>.

<u>Remarks</u>:

1. The road trip was conducted between the road hazard course passes #2 and #3.
2. Inspection following each pass did not reveal any significant damage to the ISO 20 Large SharkCage.
3. No notable movement of the payload was detected during the test.

3. <u>PANIC STOPS</u>.

N/A.

4. <u>HAZARD COURSE</u>.

Pass No.	Elapsed Time	Avg. Velocity (mph)
3	23.8 Seconds	5.7
4	24.3 Seconds	5.6

Figure 5.

<u>Remarks</u>:

1. Figure 5 lists the average speeds of the test load through the hazard course.

2. Inspection following each pass did not reveal any significant damage to the ISO 20 Large SharkCage.

3. No notable movement of the payload was detected during the test.

5. **WASHBOARD COURSE**.

Remarks:

1. Inspection following completion of the course did not reveal any notable damage to the ISO 20 Large SharkCage.

Photo 3. Washboard Course Testing of the ISO 20 Large SharkCage.

C. OCEAN-GOING VESSEL TEST.

Remarks:

1. Inspection following completion of the test did not reveal any notable damage to the ISO 20 Large SharkCage.

D. OBSERVATION.

The inspection of MSS ISO 20 Large SharkCage after testing did not reveal any significant damage. After the payload was removed from the end opening ISO container, only minor damage to the SharkCage shelves was noted.

E. CONCLUSION.

The Mobile Shelter Systems ISO 20 Large SharkCage, as currently designed, is adequate for the transport of ammunition. The ISO 20 Large SharkCage successfully completed transportability testing and is approved for transport of ammunition.

PART 6 – DRAWINGS FOR PROCEDURES

The following drawings represent the load configuration that was subjected to the test criteria.

TEST SKETCH

LOADING AND BRACING PROCEDURES FOR THE STORAGE AND TRANSPORT FRAME (STF) (ISO 20 LARGE SHARKCAGE) IN AN END OPENING ISO CONTAINER

THIS TEN PAGE DOCUMENT DEPICTS MOBILE SHELTER SYSTEM (MSS) STF ISO 20 LARGE SHARKCAGE PROTOTYPE (5,000 LBS GROSS WEIGHT MAXIMUM) FOR TRANSPORTABILITY TESTING

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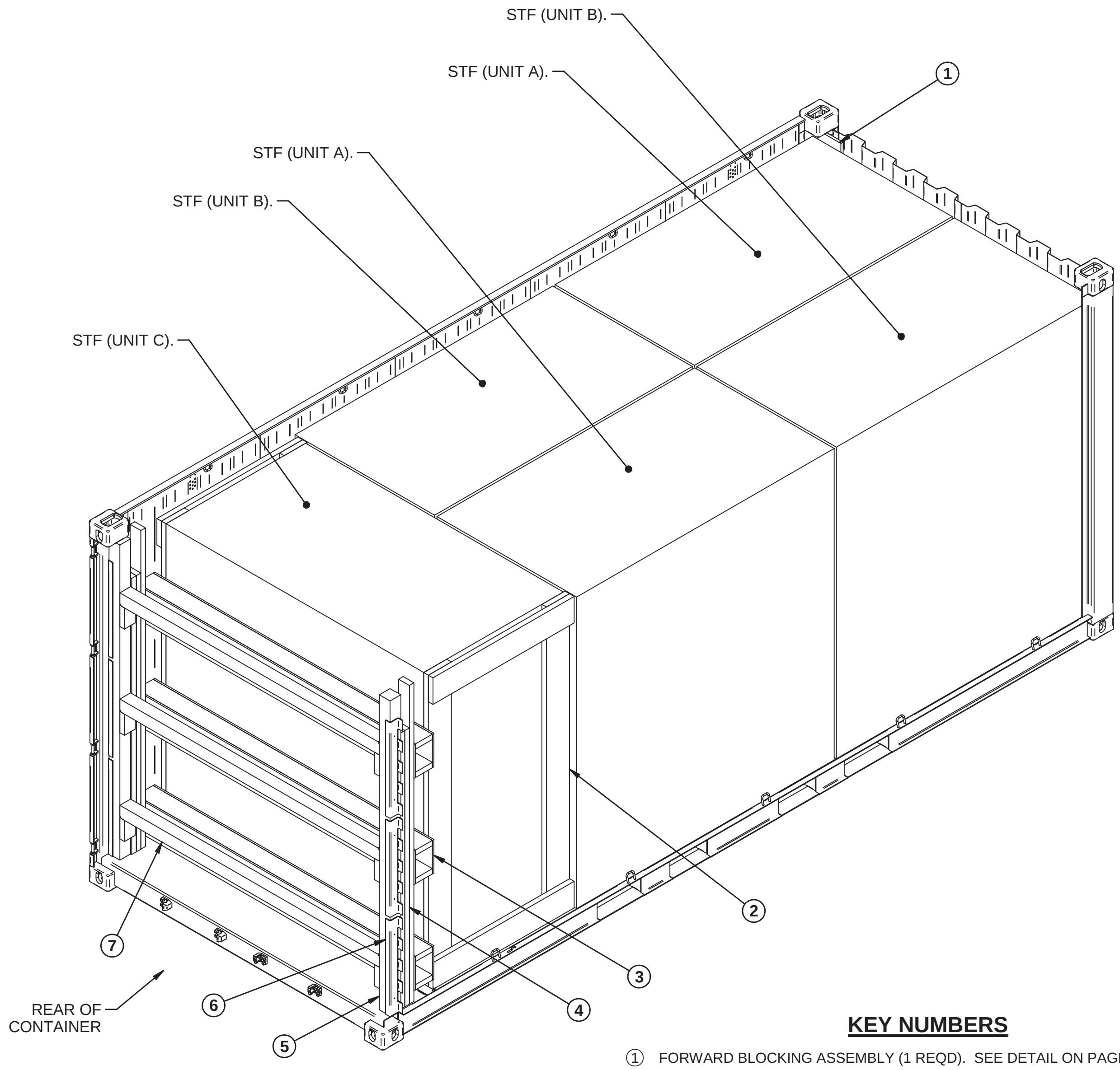
CHIEF, ENGINEERING DIVISION



ISOMETRIC VIEW

KEY NUMBERS

① FORWARD BLOCKING ASSEMBLY (1 REQD). SEE DETAIL ON PAGE 3.

② SIDE BLOCKING ASSEMBLY (2 REQD). SEE DETAIL ON PAGE 3.

③ REAR BLOCKING ASSEMBLY (1 REQD). SEE DETAIL ON PAGE 4.

④ FILLER, 2" X 4" X 6'-6" (AS REQD). NAIL THE FIRST PIECE TO THE REAR BLOCKING ASSEMBLY W/6 NAILS OF A SUITABLE SIZE (10d FOR 2" THICK MATERIAL). NAIL EACH ADDITIONAL PIECE TO THE PREVIOUS PIECE IN A SIMILAR MANNER.

⑤ DOOR POST VERTICAL ASSEMBLY (2 REQD). SEE DETAIL ON PAGE 4.

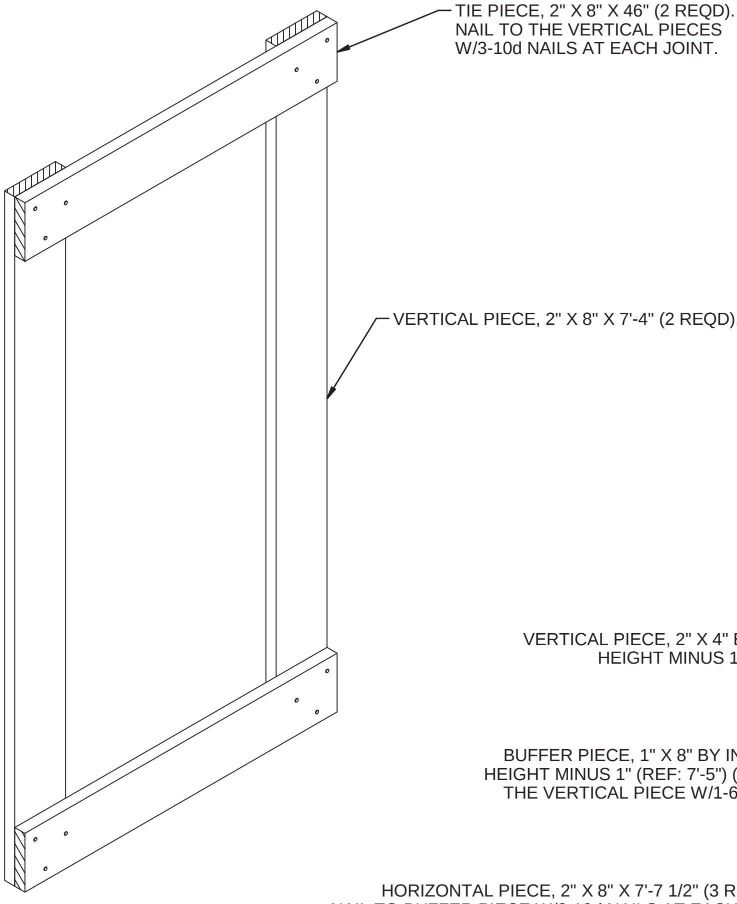
⑥ UNIVERSAL LOAD RETAINER (6 REQD). NAIL THROUGH THE HOLES INTO THE DOOR POST VERTICAL ASSEMBLY W/2-10d NAILS. SEE DEPARTMENT OF ARMY DRAWING DA-116.

⑦ DOOR SPANNER, 4" X 4" MATERIAL CUT TO A LENGTH THAT WILL PROVIDE A DRIVE FIT (REF: 7'-1 1/4") (3 REQD). TOENAIL TO THE DOOR POST VERTICAL ASSEMBLY W/2-12d NAILS AT EACH END.

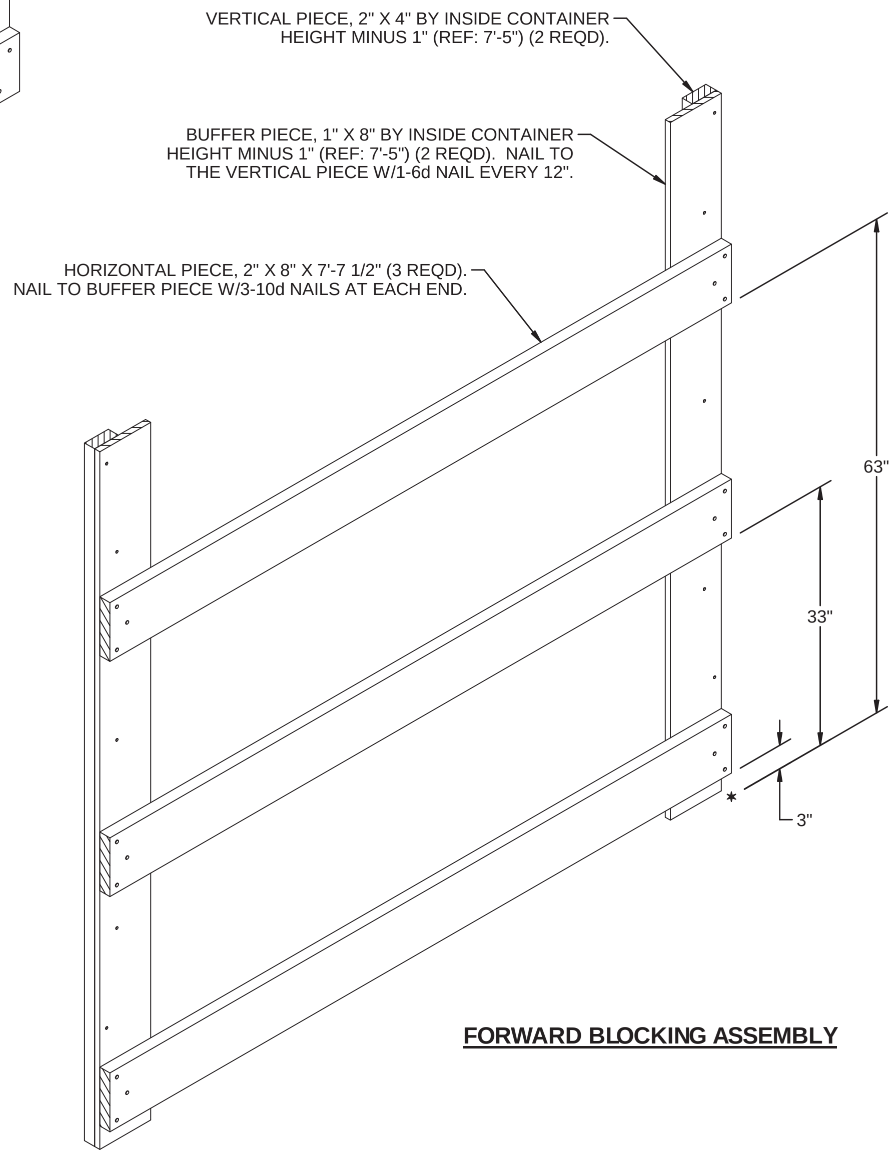
LOAD AS SHOWN

ITEM	QUANTITY	WEIGHT (APPROX)
STF	5	20,414 LBS
DUNNAGE		616 LBS
ISO CONTAINER		4,700 LBS
TOTAL WEIGHT		25,730 LBS

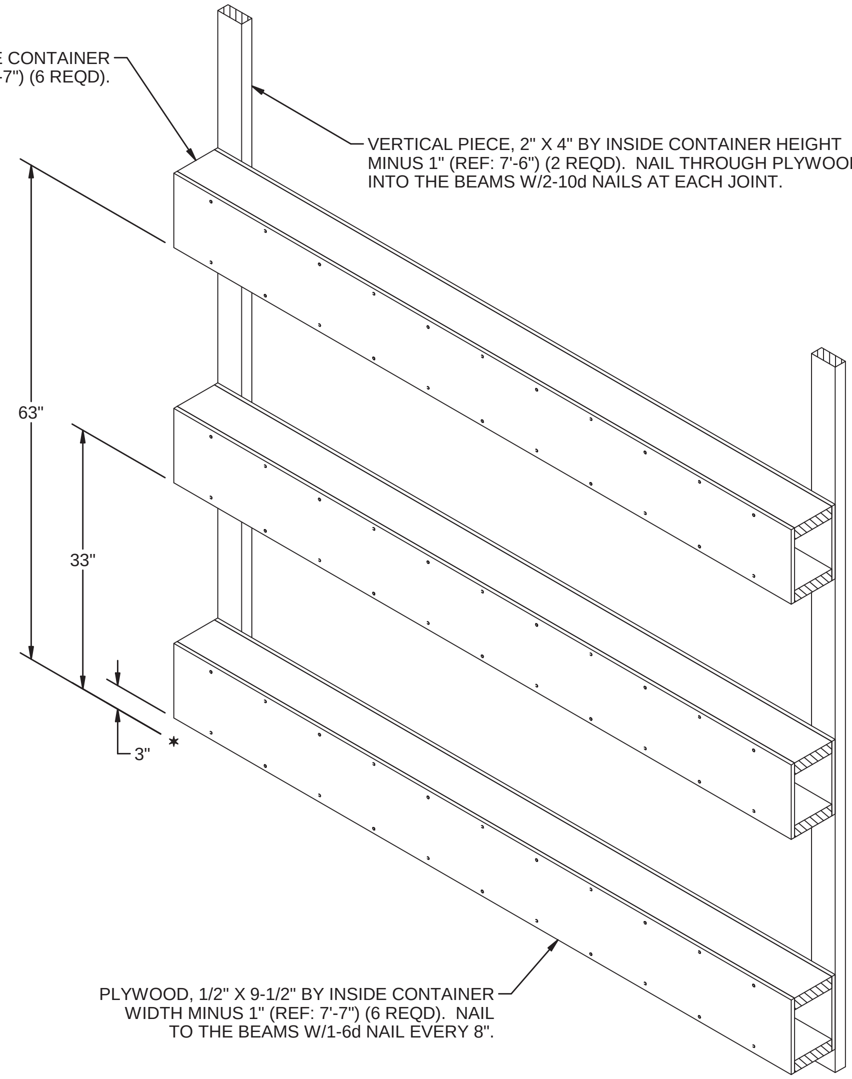
FIVE STF IN END OPENING ISO CONTAINER



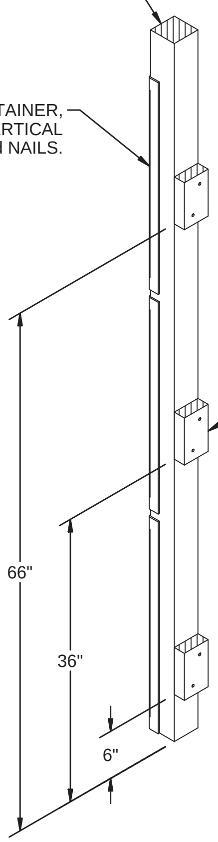
SIDE BLOCKING ASSEMBLY



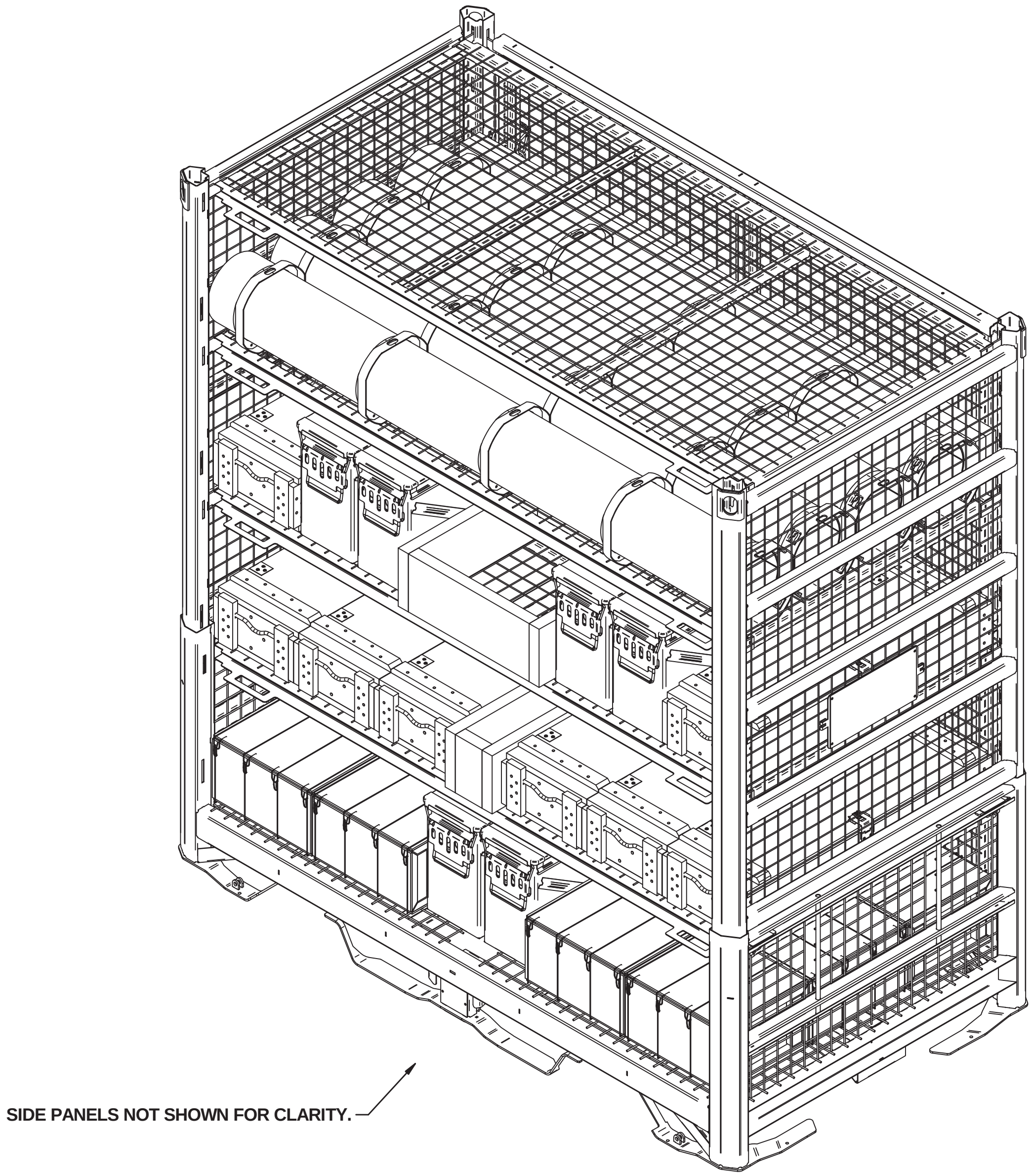
FORWARD BLOCKING ASSEMBLY



REAR BLOCKING ASSEMBLY

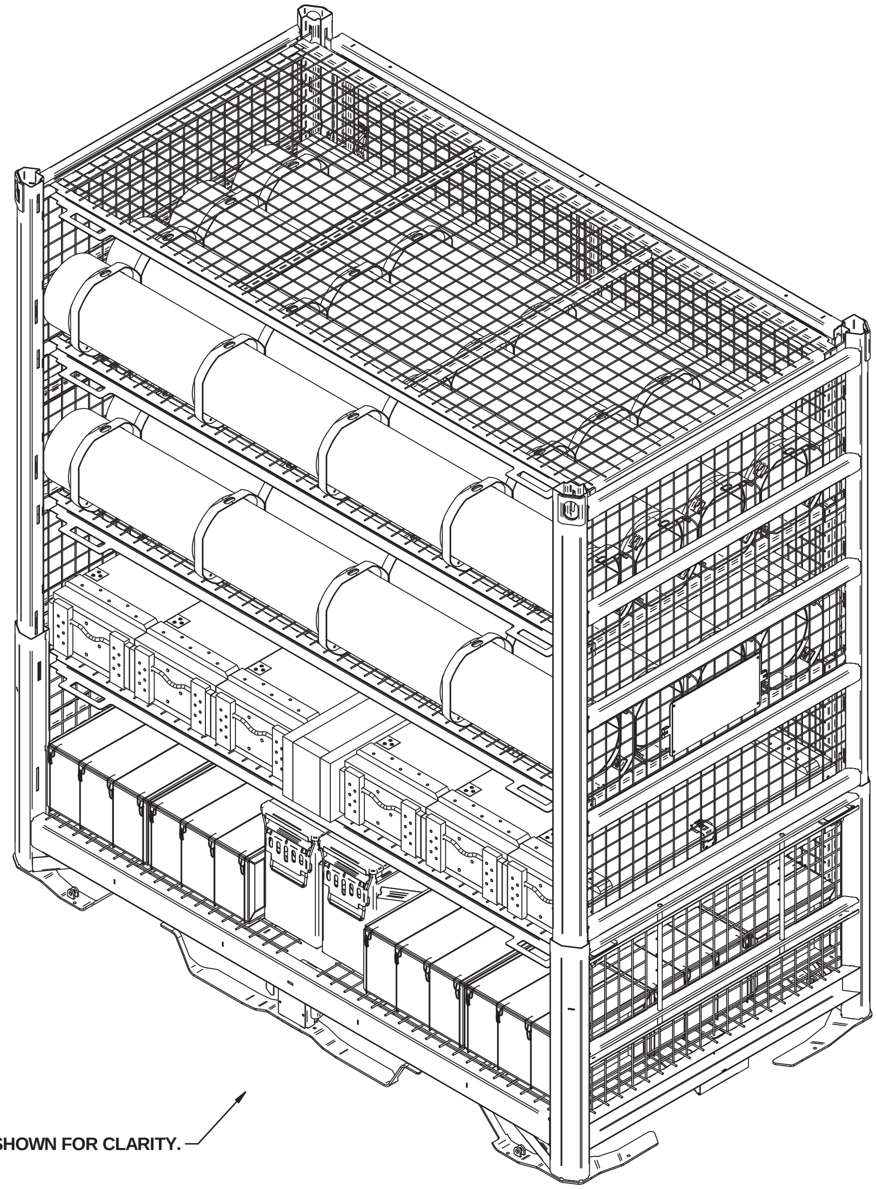


DOOR POST VERTICAL ASSEMBLY



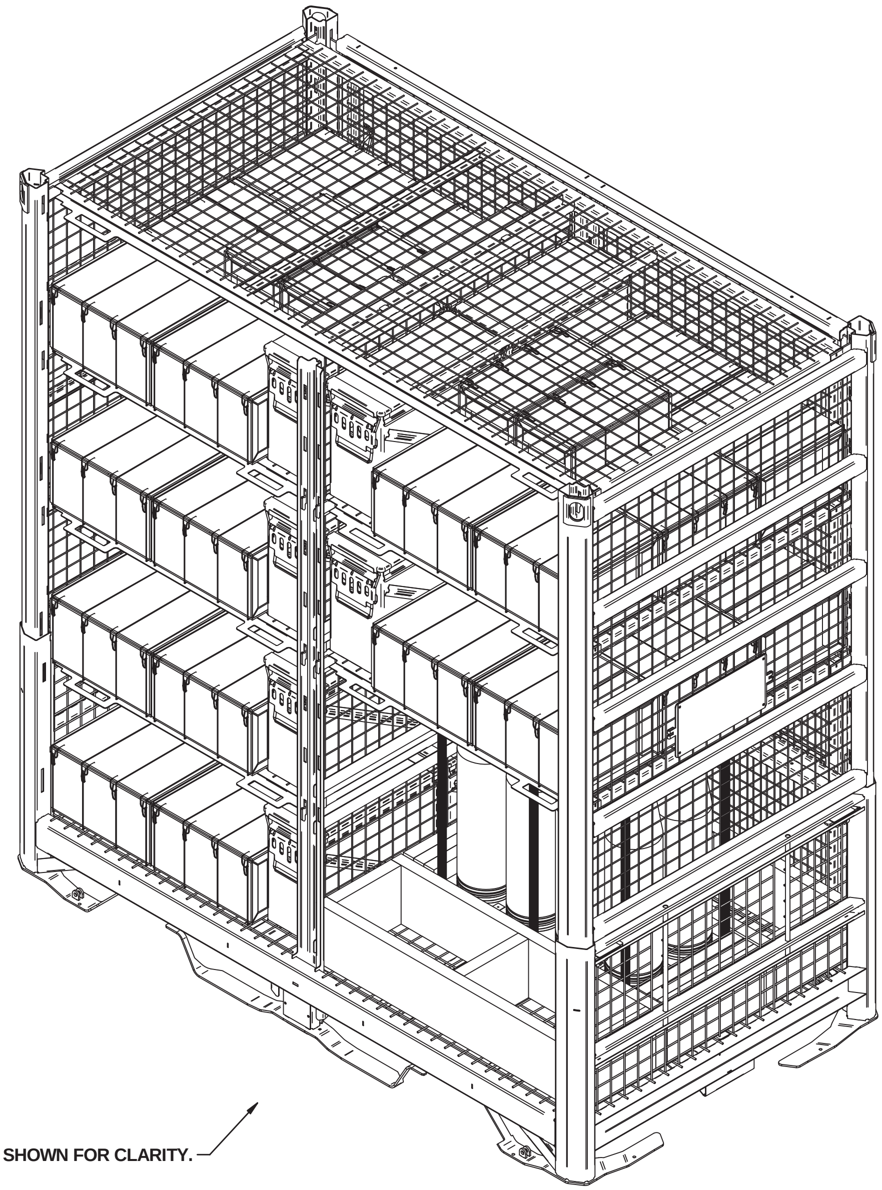
STF COMPOSITION CHART – FULL LENGTH SHELVES – UNIT A						
LEVEL	SHELF SET	NOMENCLATURE	PKG TYPE	NO. REQD	UNIT WT (LBS)	TOTAL WT (LBS)
TOP SHELF	A	2.75 ROCKET	PA150 CANS	4	160	640
SECOND SHELF	B	105MM 7.62MM, 20MM, 40MM	C445 WOODEN BOX M548 CAN	2 8	120 80	240 640
THIRD SHELF	C	105MM	C445 WOODEN BOX	6	120	720
BOTTOM SHELF	D	.50 CAL 7.62MM, 20MM, 40MM	2M2A1/WIREBOUND M548 CAN	14 4	38 80	532 320

BLOCKING 85 LBS
TOTAL WEIGHT 3177 LBS



STF COMPOSITION CHART – FULL LENGTH SHELVES – UNIT B						
LEVEL	SHELF SET	NOMENCLATURE	PKG TYPE	NO. REQD	UNIT WT (LBS)	TOTAL WT (LBS)
TOP SHELF	A	2.75 ROCKET	PA150 CANS	4	160	640
SECOND SHELF	A	2.75 ROCKET	PA150 CANS	4	160	640
THIRD SHELF	C	105MM	C445 WOODEN BOX	6	120	720
BOTTOM SHELF	D	.50 CAL 7.62MM, 20MM, 40MM	2M2A1/WIREBOUND M548 CAN	14 4	38 80	532 320

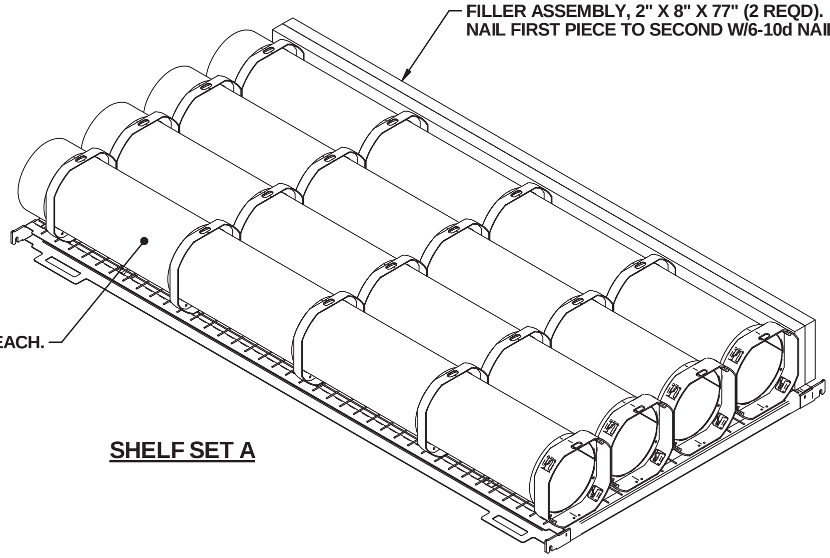
BLOCKING 90LBS
TOTAL WEIGHT 2942 LBS



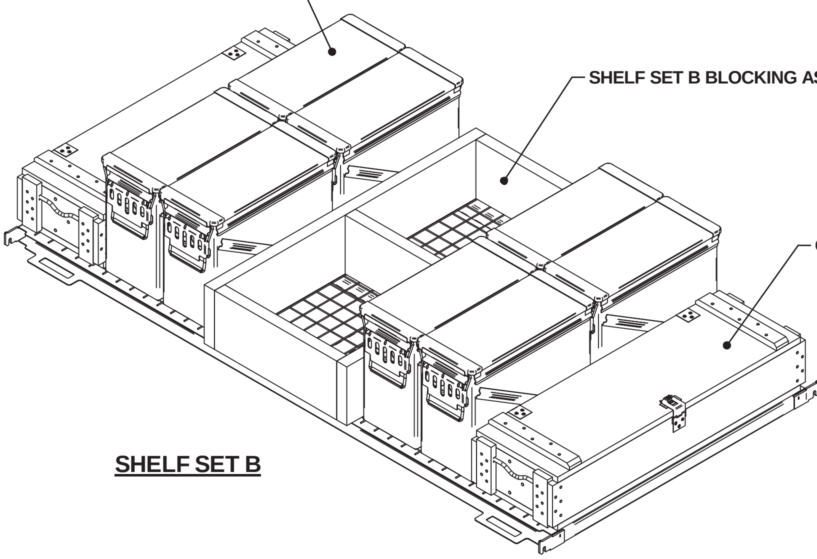
STF COMPOSITION CHART – HALF LENGTH SHELVES – UNIT C						
LEVEL	SHELF SET	NOMENCLATURE	PKG TYPE	NO. REQD	UNIT WT (LBS)	TOTAL WT (LBS)
6 SHELVES	½ OF D	.50 CAL 7.62MM, 20MM, 40MM	2M2A1/WIREBOUND M548 CAN	7 2	65 80	455 160
BOTTOM SHELF	E	155MM PROJECTILES	8/PALLET UNIT	1	874	874

BLOCKING 68LBS

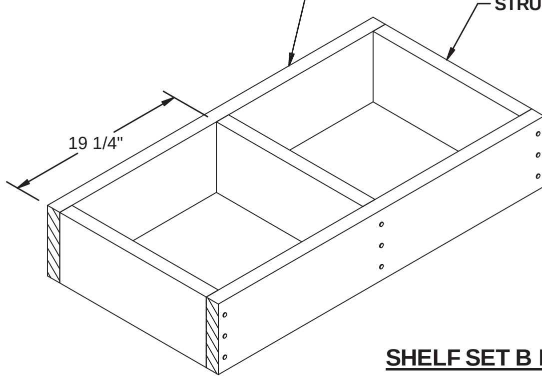
TOTAL WEIGHT 4632 LBS



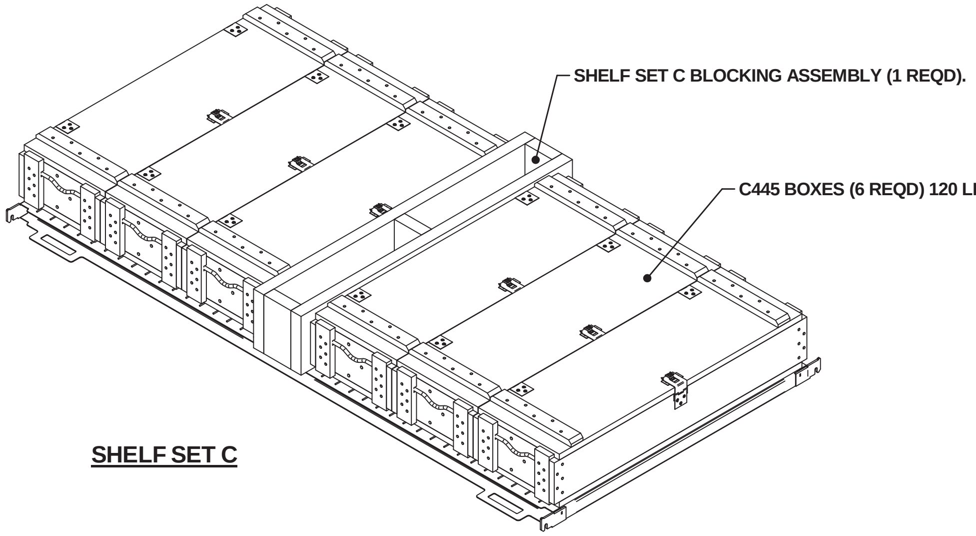
SHELF SET A



SHELF SET B



SHELF SET B BLOCKING ASSEMBLY



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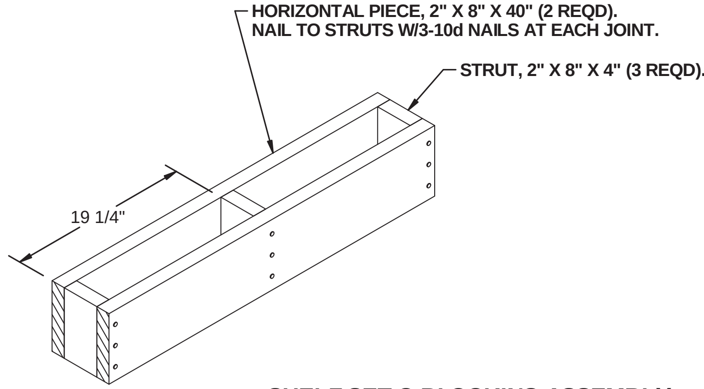

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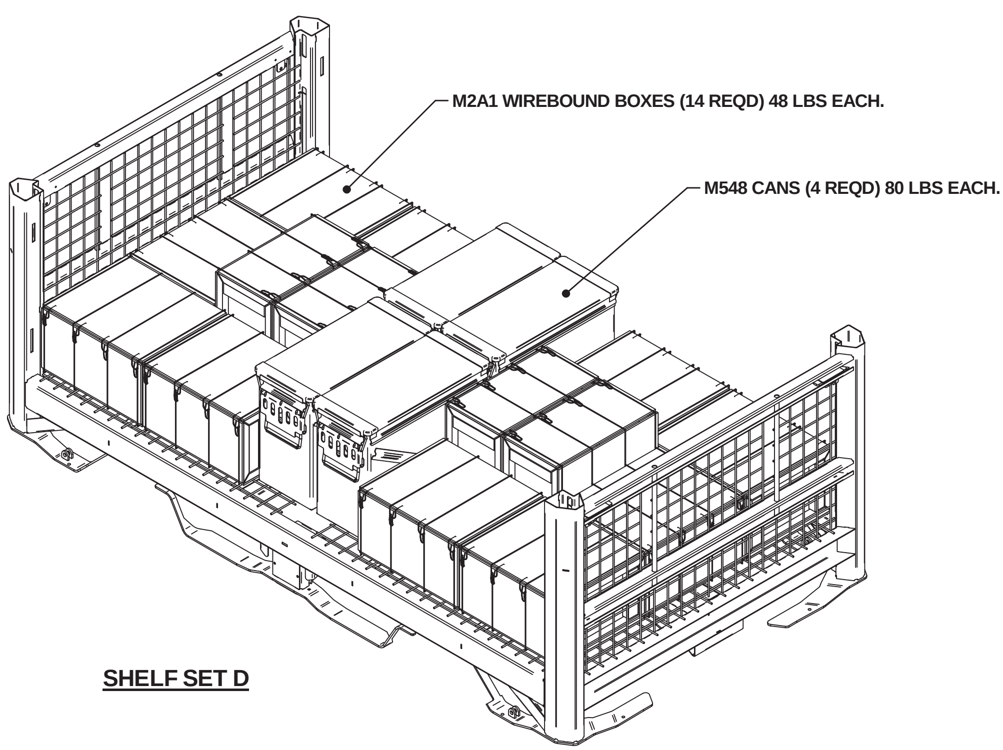

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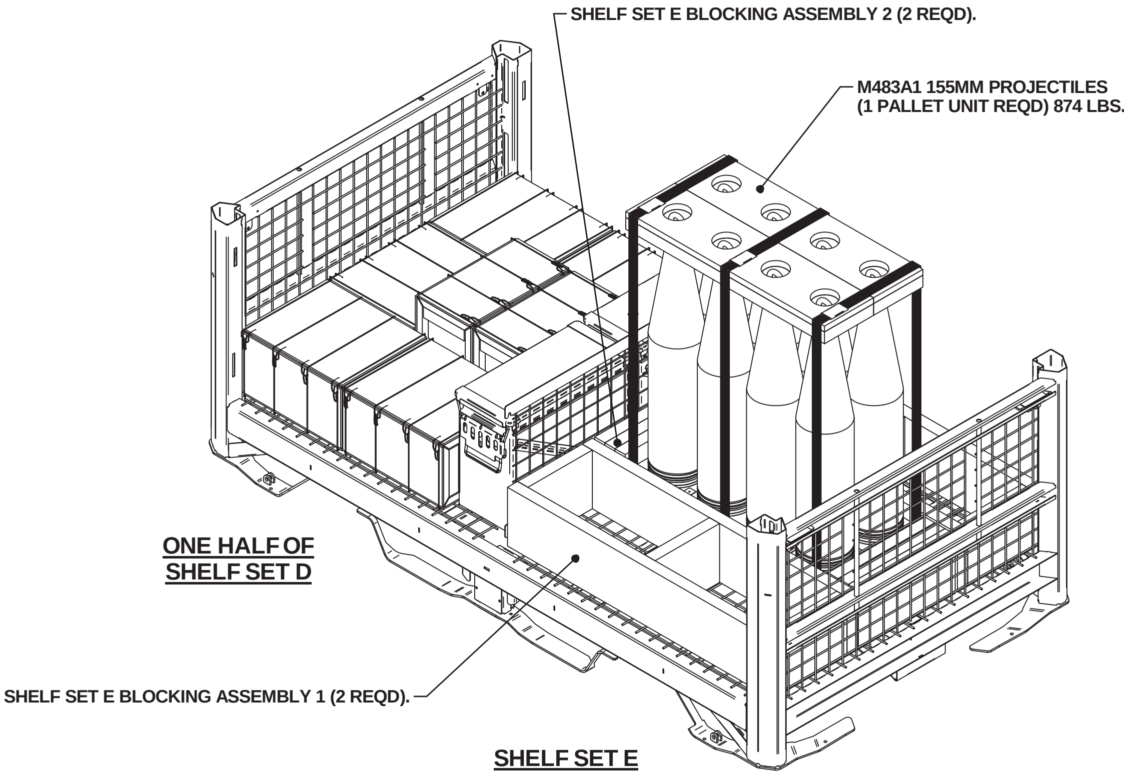
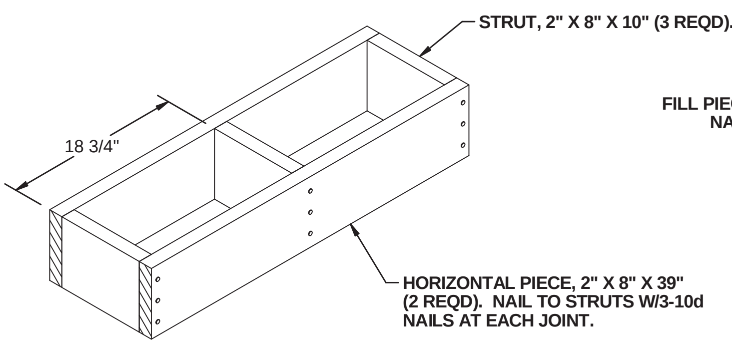
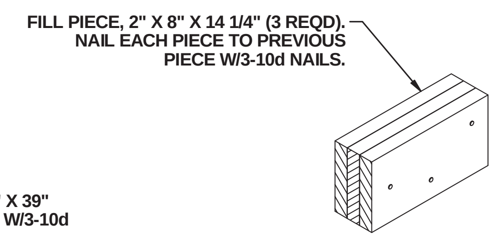


SHELF SET E



SHELF SET E BLOCKING ASSEMBLY 1



SHELF SET E BLOCKING ASSEMBLY 2