TECHNICAL MANUAL

TRANSPORTABILITY GUIDANCE

GUN, AIR DEFENSE ARTILLERY, SELF-PROPELLED, 20-MM, M163A1 NSN 2350-01-017-2113

GUN, AIR DEFENSE ARTILLERY, TOWED, 20-MM, M167A1 NSN 1005-01-014-0837

HEADQUARTERS, DEPARTMENT OF THE ARMY

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TRANSPORTABILITY GUIDANCE
GUN, AIR DEFENSE ARTILLERY, SELF-PROPELLED, 20-MM, M163A1 NSN 2350-1-017-2113
GUN, AIR DEFENSE ARTILLERY, TOWED, 20-MM, M167A1 NSN 10051-014-0837

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CHAPTER 1
INTRODUCTION

1-1. Purpose and Scope

a. This manual provides transportability guidance for logistical handling and movement of the Gun, Air Defense Artillery, Self-Propelled, 20-mm, M163A1 and the Gun, Air Defense Artillery, Towed, 20-mm, M167A1, also referred to herein as guns.

b. The intent of this manual is to provide transportation officers and other personnel responsible for movement or for providing transportation services with information considered appropriate for safe transport. Significant technical and physical characteristics, as well as safety considerations, required for worldwide movement by the various modes of transportation are included. Where considered appropriate, metric equivalents are given in parentheses following dimensions or other measurements. References are contained in the appendix.

1-2. Reporting of Publication Improvements

Users of this publication are encouraged to recommend changes and submit comments for its improvement. Comments should be prepared on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded to Director, Military Traffic Management Command Transportation Engineering Agency, ATTN: MTT-TRP, PO Box 6276, Newport News, VA 23606 (electrically transmitted messages should be addressed to: DIRMTMCTEA FT EUSTIS VA/ /MTT-TRP//).

1-3. Safety

Appropriate precautionary measures required during movement of the guns are contained in chapter 3.

1-4. Definitions of Warnings, Cautions, and Notes

Throughout this manual, warnings, cautions, and notes emphasize important or critical guidance. They are used for the following conditions:

a. Warning. An operating procedure or practice that, if not correctly followed, could result in injury or loss of life.

b. Caution. An operating procedure or practice that, if not strictly observed, could result in damage to or destruction of equipment.

c. Note. An operating procedure or condition that must be emphasized.

CHAPTER 2
TRANSPORTABILITY DATA

Section I. General

2-1. Scope
This chapter provides a general description of the Gun, Air Defense Artillery, Self-Propelled, 20-mm, M163A1, and of the Gun, Air Defense Artillery, Towed, 20-rmm, M167A1, including photographs, characteristics and data that are necessary for movement by various transportation modes.

2-2. Description
a. Gun, Air Defense Artillery, Self-Propelled, 20-mm, M163A1. The M163A1 self-propelled gun is a lightweight, full-tracked vehicle, capable of amphibious operation on streams and lakes. The gun and its components shown in figure 2-1, are mounted on the M741 tracked chassis.

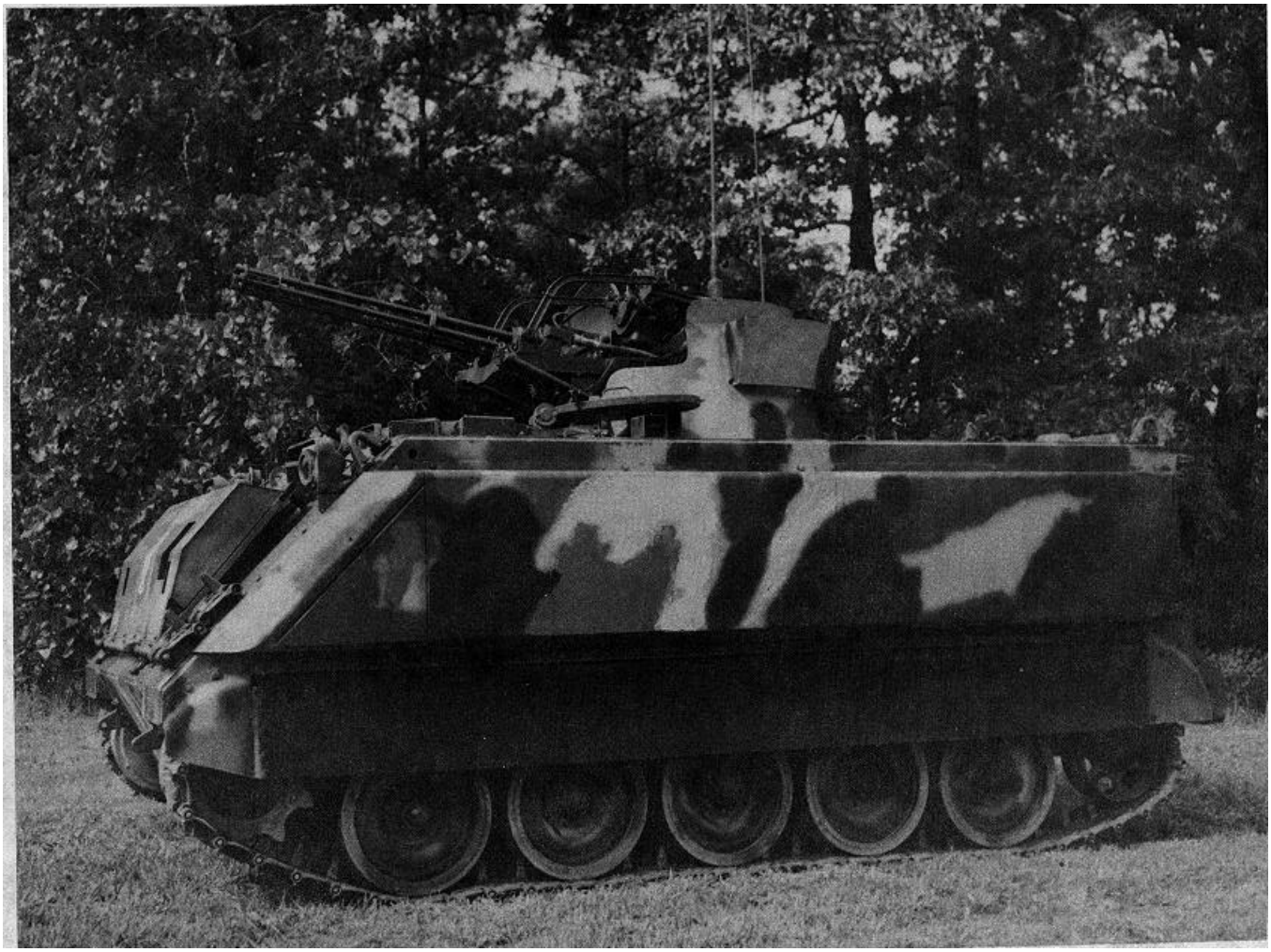


Figure 2-1. Gun, Air Defense Artillery, Self-Propelled, 20-mm, M163A1.

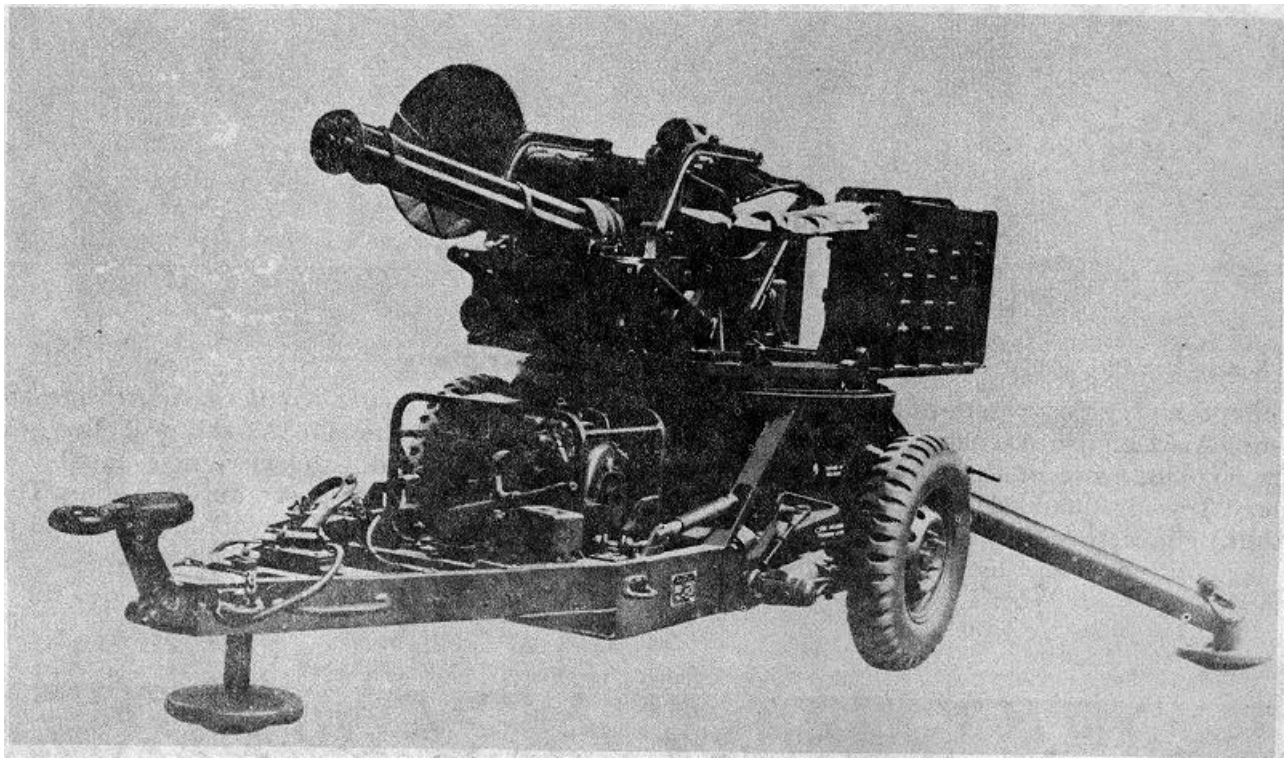


Figure 2-2. Gun, Air Defense Artillery, Towed, 20-mm, M167A1, left side.

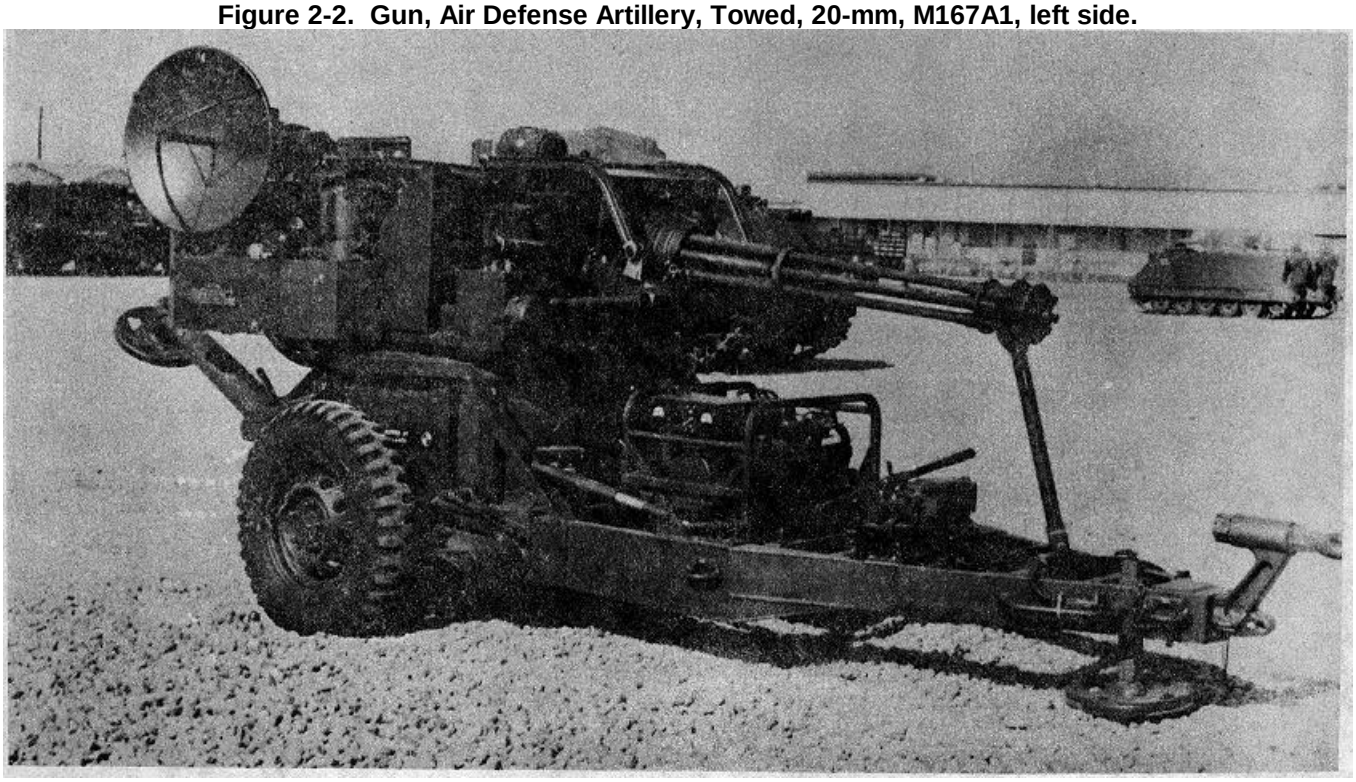


Figure 2-3. Gun, Air Defense Artillery, Towed, 20-mm, M167A1, right side.

b. Gun, Air Defense Artillery, Towed, 20-mm, M167A1. The M67A1 gun is mounted on a 2-wheel carriage. It is towed by the M561 Gamma Goat or 1 1/2-ton and larger vehicles, and is fitted with either a standard or with a goose neck towing pintle. Left-and right-side views are shown in figures 2-2 and 2-3.

Section II. CHARACTERISTICS AND RELATED DATE

2-3. General Transportability Characteristics

Data contained herein are applicable to items having the model number and National Stock Number (NSN) shown. Items having a different model number or NSN may have characteristics that will affect the loadability to such an extent that the guidance shown in this manual will not apply. Essential item data follows:

	M16SA1 self-propelled	*M167A1 towed*
NSN	2350-1-017-2113	1005-01-014-0837
Line item number	J 96694	J 96845
Total weight	24,700 lb (11,203.7 kg)	3260 lb (1478.7 kg)
Axle weight		3155 lb (1431.1 kg)
Weight on pintle		105 lb (47.6 kg)
Tire size		7.00 x 16
Tire inflation pressure		45 psi
Length	191.5 in (4.86 m)	196.0 in (4.98 m)
Length reduced *	190.0 in (4.83 m)	158.1 in (4.01 m)
Width	112.5 in (2.85 m)	93.38 in (2.37 m)
Width reduced *	100.0 in (2.54 m)	78.0 in (1.98 m)
Height	112.0 in (2.84 m)	80.3 in (2.04 m)
Height reduced *	105.6 in (2.68 m)	74.0 in (1.88 m)
Volume	1396.4 cu ft (39.53 m3)	712.3 cu ft (20.17 m^3)
Volume reduced *	1161.1 cu ft (32.87 m3)	467.4 cu ft (13.23 m^3)

* See table 2-1.

2-4. Elevation Drawings

This section provides drawings (fig 2-4 - 2-7) that are necessary for determining the loadability of the items for movement by various transportation modes.

2-5. Reduced Configuration

Transportation economies can be obtained by reducing each gun to its minimum dimensions for terminal handling and ocean transport. Table 2-1 provides guidance for maximum reduction without major disassembly. Except for ocean transport, the guns should be reduced only to the extent necessary for the most restrictive mode to be used.

2-6. Unusual Characteristics

The guns do not have any unusual characteristics that would require special precaution or attention to be given to temperature, atmospheric pressure, or humidity variations during their exposure to normal transportation environments.

2-7. Hazardous and Dangerous Characteristics

Unless the guns are shipped with ammunition under the provisions of Department of Transportation Special Permit No. 3498 (applicable to shipments in periods of actual national emergency), they will not present any hazardous or dangerous characteristics during exposure to normal transportation environments.

2-8. Sensitivity

The guns are so designed that when restrained in accordance with the guidance contained in this manual, they can withstand the shocks and vibrations associated with current transportation methods.

2-9. CONUS Freight Classification

Rail and motor freight classification descriptions and item numbers will be determined in accordance with chapter 211 of AR 55355 and the Freight Classification Guide System. Proper classification and/or description of articles must be determined and provided on the bill of lading before the shipment is released to the carrier.

Table 2-1. Dimensional Reductions

Item	M163A1	M167A1
Goose neck towing pintle		X
Radar antenna, stowed position	X	X
Outriggers		X
Front towing eye hooks	X	
Flotation pods	X	
Traction shrouds	X	

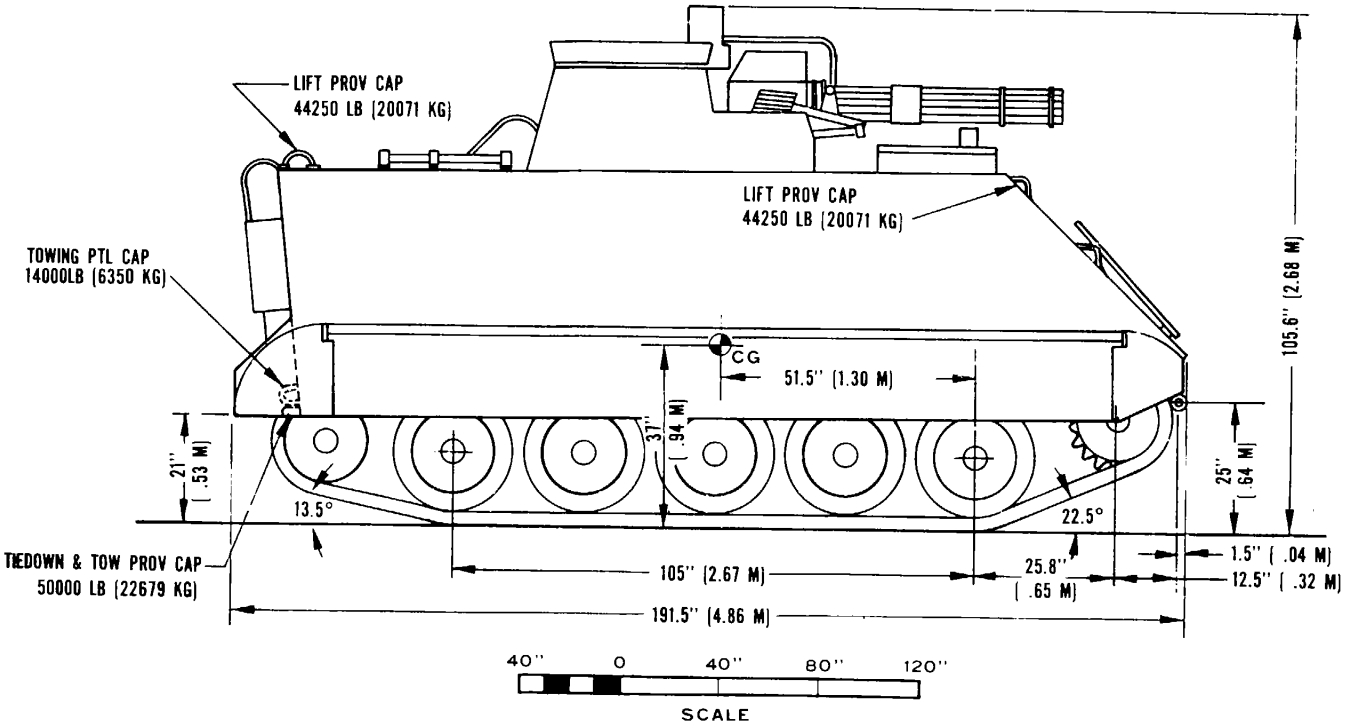


Figure 2-4. Side elevation, Gun, Air Defense Artillery, Self-Propelled, 20 mm, M16SA1.

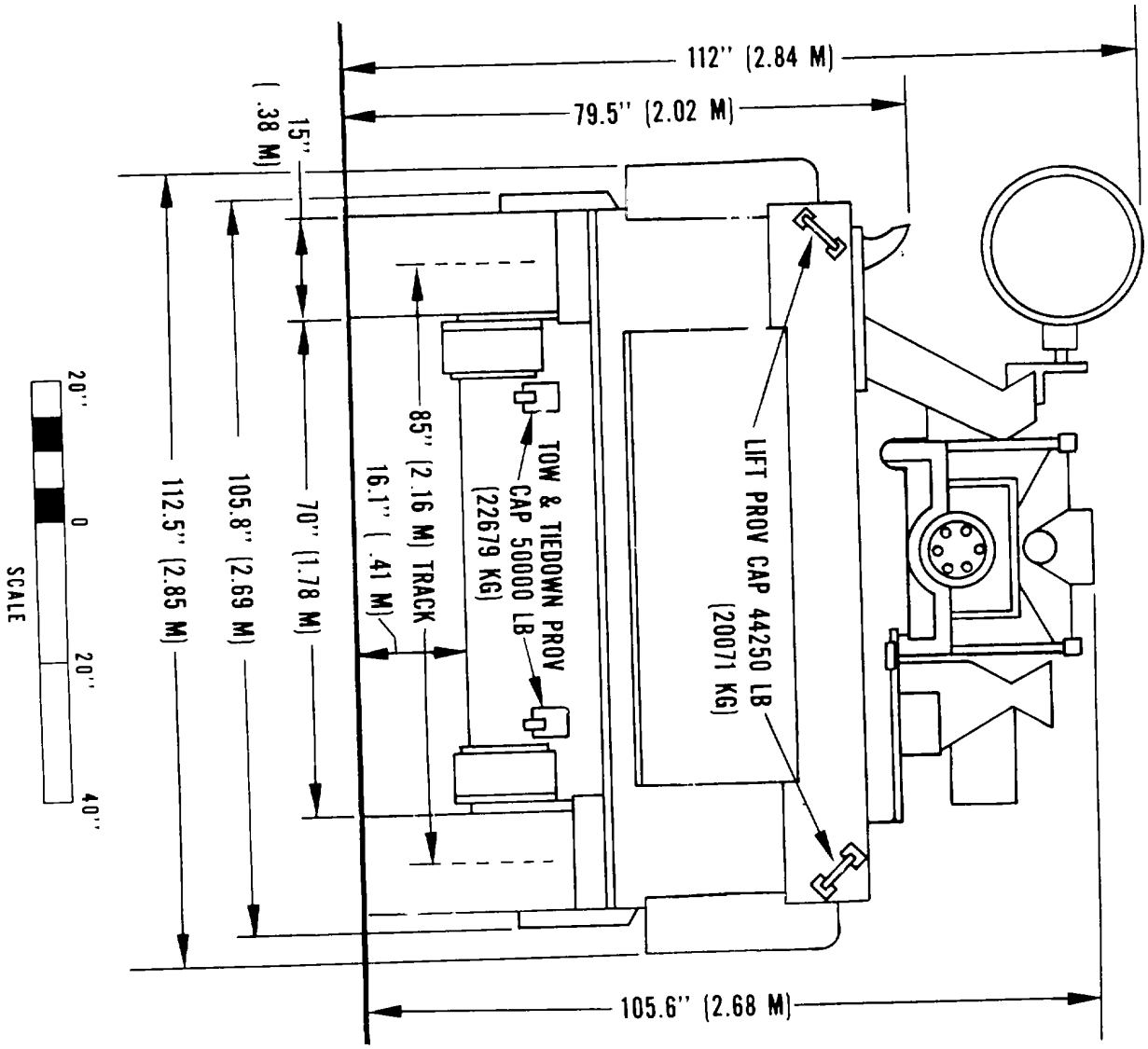


Figure 2-5. Front elevation, Gun, Air Defense Artillery, Self-Propelled, 20-mm, M163A1

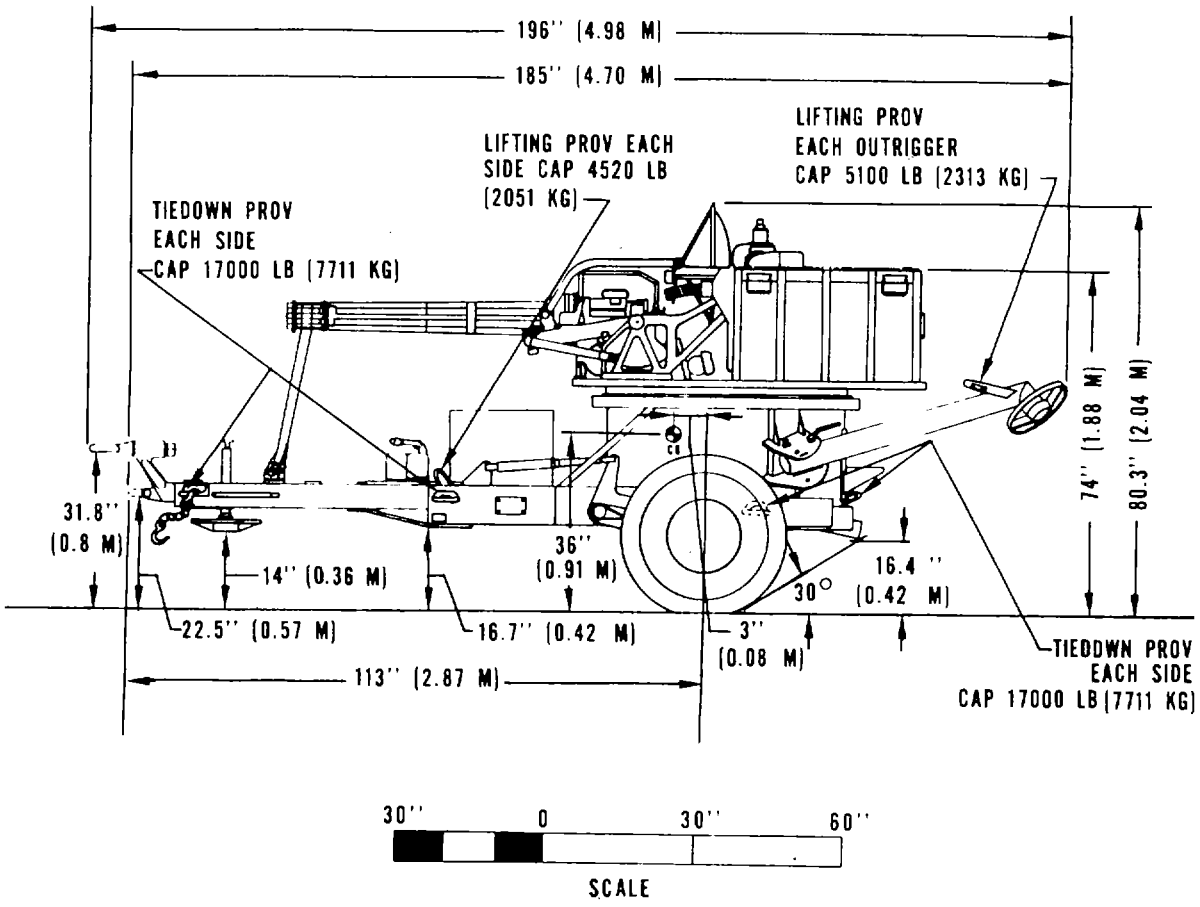


Figure 2-6. Side elevation, Gun, Air Defense Artillery, Towed, 20-mm, M167A1.

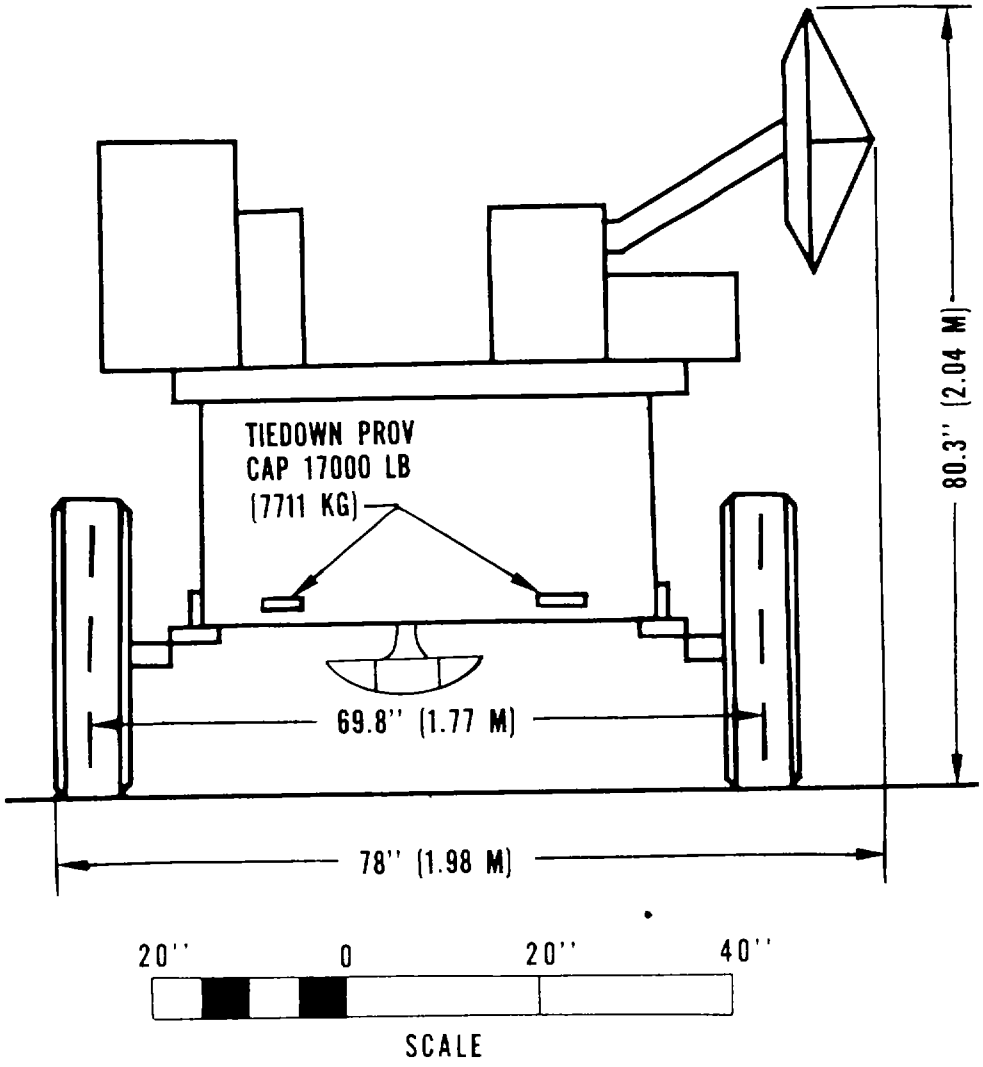


Figure 2-7. Rear elevation, Gun, Air Defense Artillery, Towed, 20-mm, M167A1.

CHAPTER 3
SAFETY

3-1. General

General safety considerations and precautions during loading operations are as follows:

a. Check each gun to insure that all loose equipment is properly secured.

b. Make sure no personnel or obstacles are in the way before moving the gun.

c. When backing or moving the guns in confined areas make sure appropriate guides to assist are visibly posted.

d. Comply with other operational safety precautions as outlined in TM 9-1005-286-10 and TM 9-2350-300-10, Operator's Manuals.

WARNING

Fire extinguishers must be readily available during all loading and unloading operations.

WARNING

When loading and unloading the M163A1, proper ventilation must be provided if carrier engine is used. Prolonged inhalation of exhaust fumes will produce adverse effects that may be fatal.

3-2. Specific Safety Requirements

Pertinent safety requirements by individual mode can be found, where applicable, in subsequent chapters.

CHAPTER 4
AIR TRANSPORTABILITY GUIDANCE

4-1. Scope
This chapter provides transportability guidance for air movement of the M163A1 and M167A1 guns. It covers significant technical and physical characteristics and safety considerations and prescribes the materials required to prepare, load, and unload the guns as internal loads aboard US Army and US Air Force aircraft.

4-2. Maximum Use of Aircraft Capacity
The loads described in this chapter are not maximum aircraft loads. Total cargo loads and operating ranges are subject to variables such as weather, airfield conditions, individual aircraft characteristics, and distance. General guidance on total cargo loads and operating ranges is provided in TM 38-236/(AFP 71-8). For specific guidance contact the nearest Military Airlift Command (MAC) activity.

4-3. Safety
In addition to the safety precautions contained in chapter 3, the following should be noted:

a. If ammunition or explosives are to be transported with the guns, the activity offering the guns for air transport shall notify the aircraft commander or his designated representative.

b. The M163A1 carrier's fuel tanks must not be more than three-fourths full.

WARNING

Fire extinguishers must be readily available during all loading and unloading operations.

WARNING

When loading and unloading the M163A1, if carrier engine is used, proper ventilation must be provided. Prolonged inhalation of exhaust fumes will produce adverse effects that may be fatal.

CAUTION

Do not allow guns to exceed 3 miles per hour (walking speed) on loading ramps or inside aircraft.

NOTE

Air Force aircraft loads depicted in this manual are restrained to the minimum of 3g forward restraint. This must be increased to a minimum of 8g forward restraint when passengers or nuclear weapons cargo are carried forward of other cargo.

4-4. Preparation of Guns
a. *M163A1 Self-Propelled Gun*.

(1) Remove radio antennas and secure inside carrier.

(2) Install travel lock on cannon.

(3) Place radar antenna in stow position.

(4) Secure all loose items inside carrier.

b. *M167A1 Towed Gun*.

(1) Secure all loose items.

(2) Make sure that the generator set (APU) fuel tank is not more than three-fourths full.

(3) Retract outriggers.

(4) Install travel lock on cannon.

(5) Place radar antenna in stow position.

4-5. Transport by US Air Force Aircraft
a. The M163A1 self-propelled gun and the M167A1 towed gun are transportable in C-130, C-141, or C-5A aircraft.

b. The aircraft commander or his representatives must insure that the guns are placed aboard an aircraft, properly secured, and offloaded in accordance with the appropriate Air Force technical order.

c. Metal parts of the M163A1 carrier tracks must not make contact with the aircraft loading ramp or cargo compartment floor. Inconsistencies in rubber track pad thickness and available contact area after prolonged operation prohibit loading or unloading the M163A1 without shoring. Use 1x 12-inch lumber to make two rows of shoring 24 inches wide and spread to match the M163A1 carrier tracks. Lay shoring from the ground end of the aircraft ramp extension into the cargo compartment so that, in the tiedown position, the M163A1 tracks are on shoring. Shoring is provided by the transported unit or shipping activity.

d. When the M163A1 has been positioned

aboard the aircraft, the transmission should be placed in neutral, the parking brake set, and the suspension lockout control placed in the lockout position.

e. Shoring is required underneath the front drop pad of the M167A1 to prevent contact with the aircraft floor. Place a piece of 5/8 x 10 x 12-inch plywood, or similar lumber, under the front drop pad when the gun is in the tiedown position.

f. If the M561 Gamma Goat is to be transported with the M167A1 gun, TM 55-2320-242-15-1 should be consulted.

g. Tiedown diagrams (fig 4-1 - 4-6) and data tables (tables 4-1 - 4-6) are based on acceptable methods and can be used as a guide in loading and securing the guns aboard the aircraft. Tables list the type and capacity of tiedown devices required, location points on the guns, and aircraft fittings to which the devices are secured.

Table 4-1. Tiedown Data for M167A1 in C-5 Aircraft

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb	type	capacity in 1,000 lb	Attach to item
B1	25	MB-1	10	Left front tiedown provision
F1	25	MB-1	10	Right front tiedown provision
B2	25	MB-1	10	Left side tiedown provision
F2	25	MB-1	10	Right side tiedown provision
C2	25	MB-1	10	Left rear tiedown provision
E2	25	MB-1	10	Right rear tiedown provision

Table 4-2. Tiedown Data for M167A1 in C-141 Aircraft

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb	type	capacity in 1,000 lb	Attach to item
B1	10	MB-1	10	Right rear tiedown provision
F1	10	MB-1	10	Left rear tiedown provision
B2	10	MB-1	10	Right side tiedown provision
F2	10	MB-1	10	Left side tiedown provision
B3	10	MB-1	10	Right front tiedown provision
F3	10	MB-1	10	Left front tiedown provision

Table 4-3. Tiedown Data for M167A1 in C-130 Aircraft

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb	type	capacity in 1,000 lb	Attach to item
B1	10	MB-1	10	Right rear tiedown provision
F1	10	MB-1	10	Left rear tiedown provision
B2	10	MB-1	10	Right side tiedown provision
F2	10	MB-1	10	Left side tiedown provision
B3	10	MB-1	10	Right front tiedown provision
F3	10	MB-1	10	Left front tiedown provision

Table 4-4. Tiedown Data for M16SA1 in C-5 Aircraft

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb	type	capacity in 1,000 lb	Attach to item
C1	25	MB-2	25	Left front towing/tiedown provision
E1	25	MB-2	25	Right front towing/tiedown provision
B2	25	MB-2	25	Left front lifting provision
C2	25	MB-2	25	No. 1 left road wheel arm
E2	25	MB-2	25	No. 1 right road wheel arm
F2	25	MB-2	25	Right front lifting provision
B3	25	MB-2	25	Left rear lifting provision
C3	25	MB-2	25	No. 5 left road wheel arm
E3	25	MB-2	25	No. 5 right road wheel arm
F3	25	MB-2	25	Left rear lifting provision
C4	25	MB-2	25	Left rear towing/tiedown provision
E4	25	MB-2	25	Right rear towing/tiedown provision

* D-1 may be substituted for MB-2.

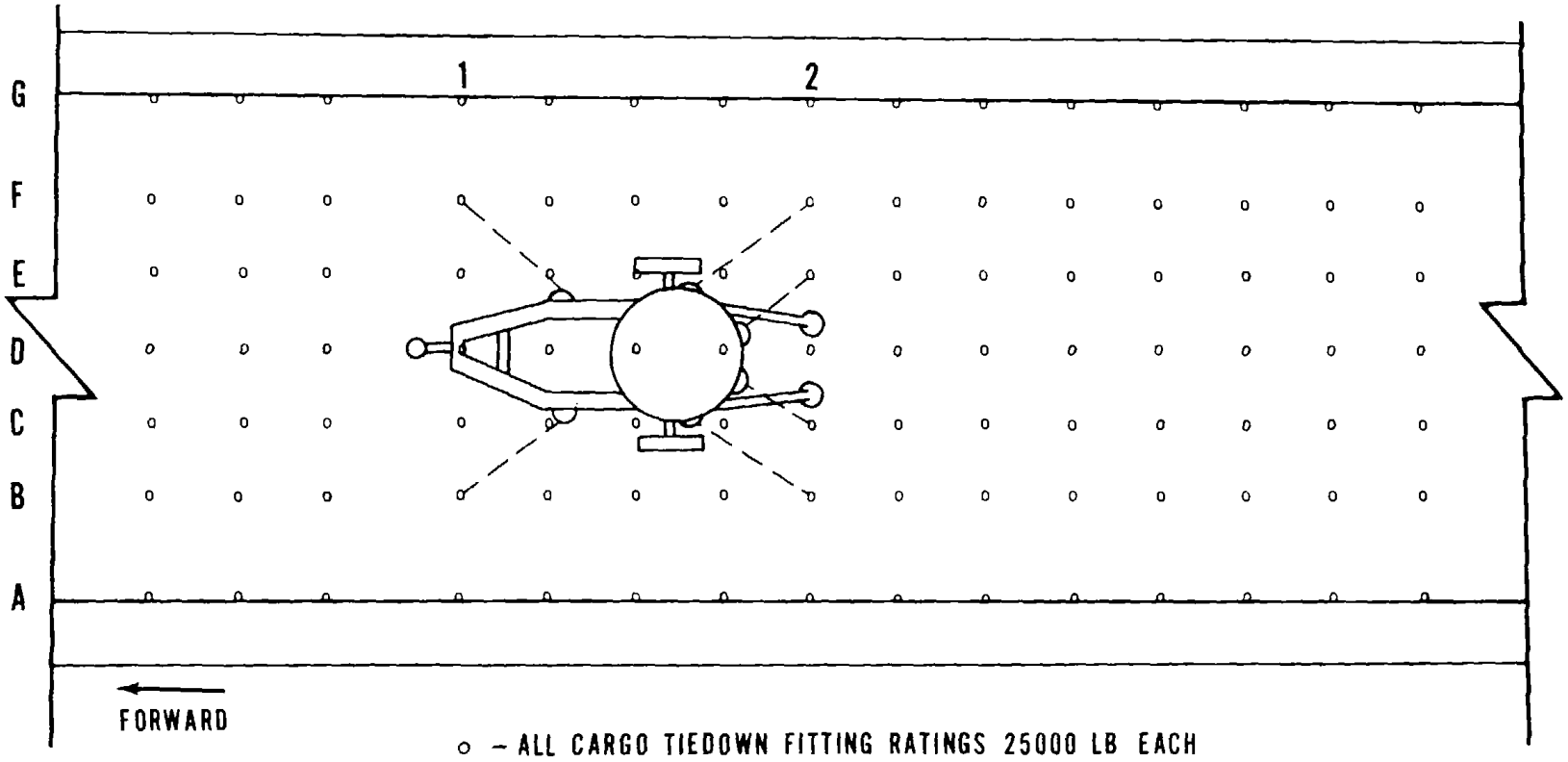
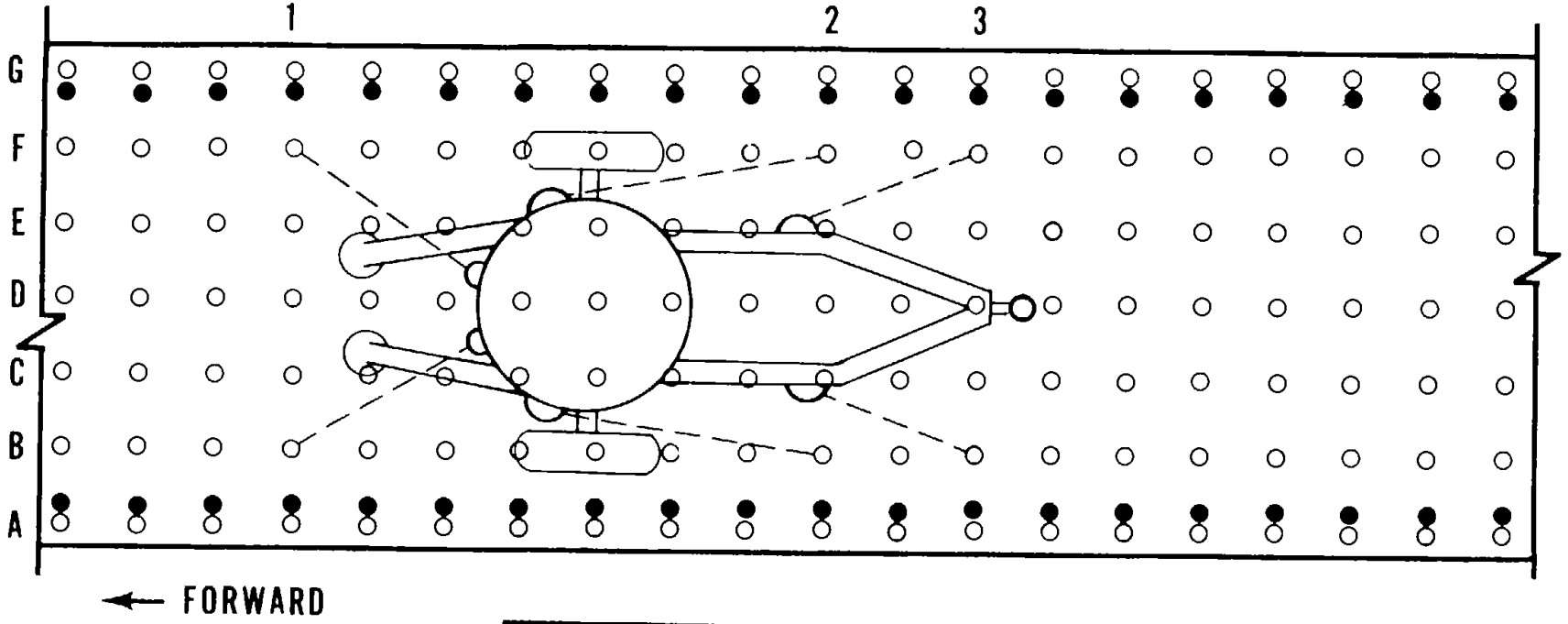
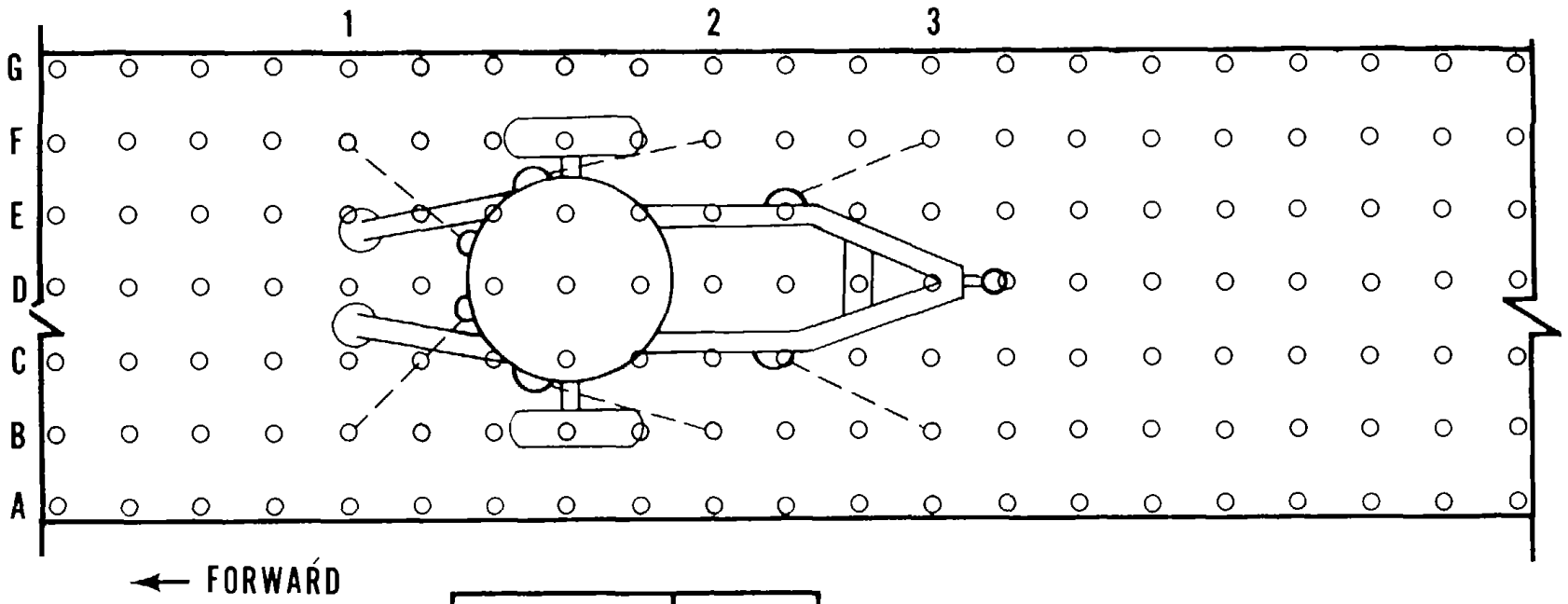


Figure 4-1. Tiedown diagram for M167A1 in C-5A aircraft.



SYMBOL	○	●
STRENGTH OF FITTING AND BASIC LOAD DIRECTION	10000 LB ANY	25000 LB ANY

Figure 4-2. Tiedown diagram for M167A1 in C-141 aircraft.



SYMBOL	○
STRENGTH OF FITTING AND BASIC LOAD DIRECTION	10000 LB ANY

Figure 4-3. Tiedown diagram for M167A1 in C-130 aircraft.

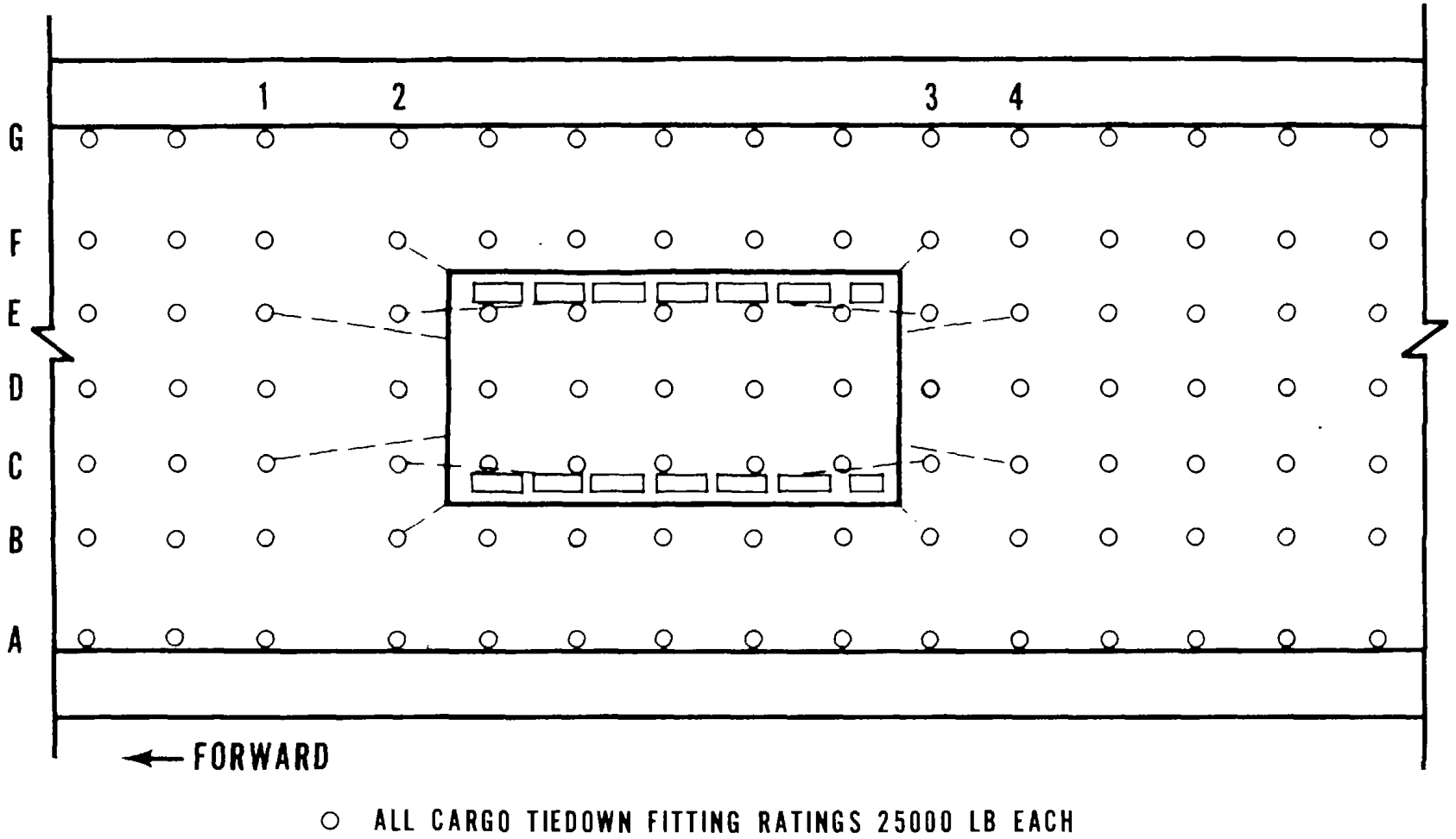
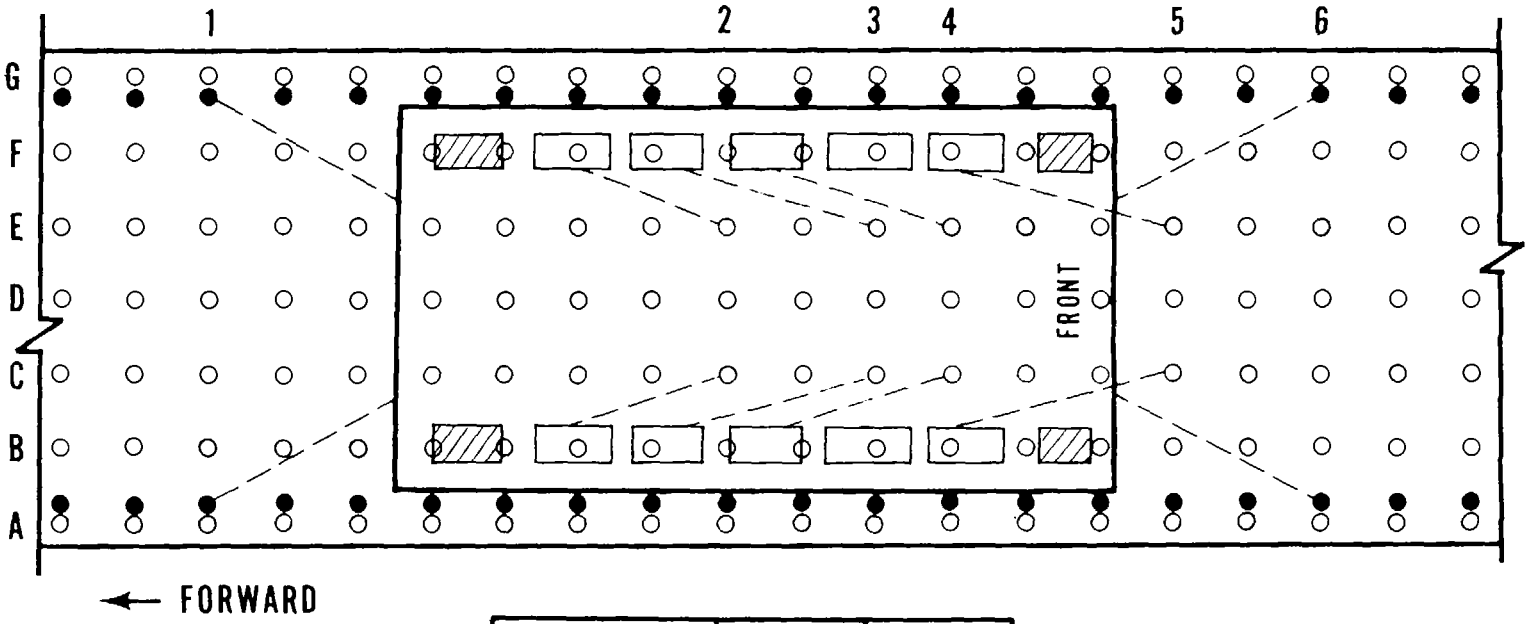
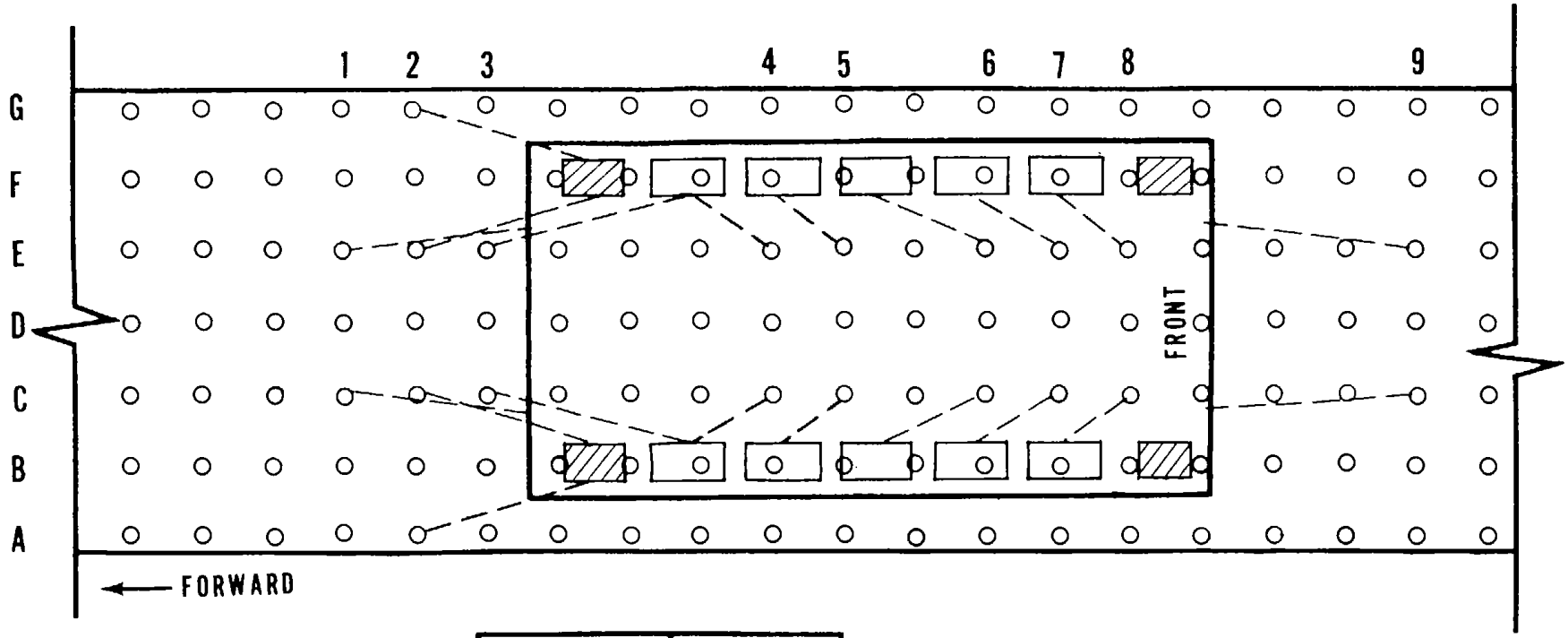


Figure 4-4. Tiedown diagram for M163A1 in C-5A aircraft.



SYMBOL	○	●
STRENGTH OF FITTING AND BASIC LOAD DIRECTION	10000 LB ANY	25000 LB ANY

Figure 4-5. Tiedown diagram for M163A1 in C-141 aircraft.



SYMBOL	○
STRENGTH OF FITTING AND BASIC LOAD DIRECTION	10000-LB ANY

Figure 4-6. Tiedown diagram for M163A1 in C-130 aircraft.

Table 4-5. Tiedown Data for M16SA1 in C-141 Aircraft

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb	type	capacity in 1,000 lb	Attach to item
A1	25	MB-2	25	Right rear towing and tie-down provision
G1	25	MB-2	25	Left rear towing and tie-down provision
C2	10	MB-1	10	No. 5 right road wheel arm
E2	10	MB-1	10	No. 5 left road wheel arm
C3	10	MB-1	10	No. 4 right road wheel arm
E3	10	MB-1	10	No. 4 left road wheel arm
C4	10	MB-1	10	No. 3 right road wheel arm
E4	10	MB-1	10	No. 3 left road wheel arm
C5	10	MB-1	10	No. 1 right road wheel arm
E5	10	MB-1	10	No. 1 left road wheel arm
A6	25	MB-2	25	Right front towing and tie-down provision
G6	25	MB-2	25	Left front towing and tie-down provision

Table 4-6. Tiedown Data for M163A1 in C-130 Aircraft

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb.	Type	capacity in 1,000 lb	Attach to item
C1	10	MB-1	10	Right rear towing and tie-down provision
E1	10	MB-1	10	Left rear towing and tie-down provision
A2	10	MB-1	10	Right rear lifting provision
C2	10	MB-1	10	Right idler wheel arm
E2	10	MB-1	10	Left idler wheel arm
G2	10	MB-1	10	Left rear lifting provision
C3	10	MB-1	10	No. 5 right road wheel arm
E3	10	MB-1	10	No. 5 left road wheel arm
C4	10	MB-1	10	No. 5 right road wheel arm
E4	10	MB-1	10	No. 5 left road wheel arm
C5	10	MB-1	10	No. 4 right road wheel arm
E5	10	MB-1	10	No. 4 left road wheel arm
C6	10	MB-1	10	No. 3 right road wheel arm
E6	10	MB-1	10	No. 3 left road wheel arm
C7	10	MB-1	10	No. 2 right road wheel arm
E7	10	MB-1	10	No. 2 left road wheel arm
C8	10	MB-1	10	No. 1 right road wheel arm
E8	10	MB-1	10	No. 1 left road wheel arm
C9	10	MB-1	10	Right front towing and tie-down provision
E9	10	MB-1	10	Left front towing and tie-down provision

4-6. Transport by US Army Aircraft

a. The guns exceed size and weight limitations for transport by US Army fixed-wing aircraft. The M163A1 also exceeds size and weight limitations for internal and external transport by US Army rotary-wing aircraft. The M167A1 can be transported internally and externally by US Army rotary-wing aircraft. Rigging instructions for external loads are contained in TM 55-450-11 and TM 55-450-12. The tiedown diagram (fig 4-7) and data table (table 4-7) are based on acceptable methods and can be used for securing the M167A1 in the CH-47 aircraft.

b. Prepare the M167A1 for loading aboard a CH-47 helicopter as follows:

(1) Secure all loose items.

(2) The generator set (APU) fuel tank must not be more than three-fourths full.

(3) Retract outriggers.

(4) Install travel lock on cannon.

(5) Place radar antenna in stow position.

(6) To insure clearance, lower the gun carriage assembly to the CH-47 loading and unloading height indicated on the gun carriage data plate.

c. When the M167A1 is in the tiedown position inside the helicopter, place a piece of 3/4x 10x 12-inch plywood, or similar lumber shoring, underneath the front drop pad as shown in figure 4-8.

d. Lower the gun carriage assembly to the CH-47 stow position indicated on the gun carriage data plate, allowing the rear, bottom edge of the gun tub to rest on a piece of 3/4x 12x 36-inch plywood, or similar lumber shoring, as shown in figure 4-9.

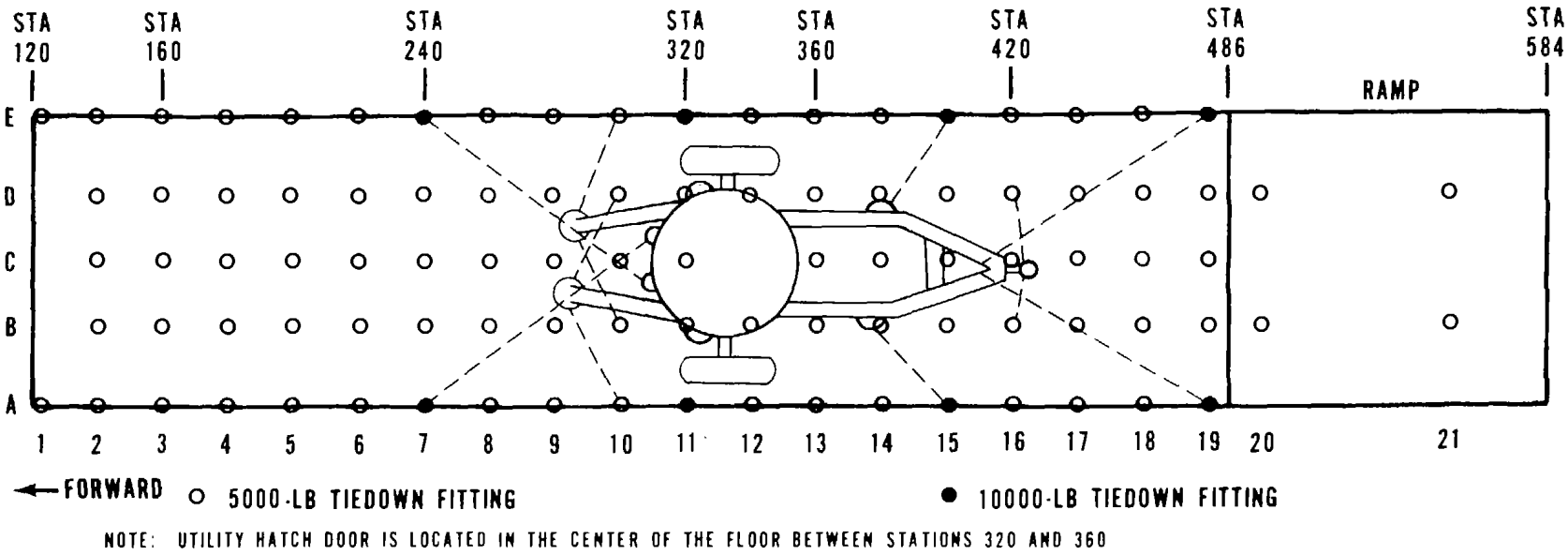


Figure 4-7. Tiedown diagram for M167A1 in CH-47 helicopter.

Table 4-7. Tiedown Data for M167A1 in CH-47 Helicopter

Tiedown fitting		Tiedown device		
designation	capacity in 1,000 lb	type	capacity in 1,000 lb	Attach to item
A7	10	MB-1	10	Left rear tiedown provision
E7	10	MB-1	10	Right rear tiedown provision
A10/D10	5	CGU-1/B	5	Over right outrigger through lifting eye
B10/E10	5	CGU-i/B	5	Over left outrigger through lifting eye
A15	10	MB-1	10	Right side tiedown provision
E15	10	MB-1	10	Left side tiedown provision
B16/D16	5	CGU-1/B	5	Through lunette
A19	10	MB-1	10	Right front tiedown provision
E19	10	MB-1	10	Left front tiedown provision

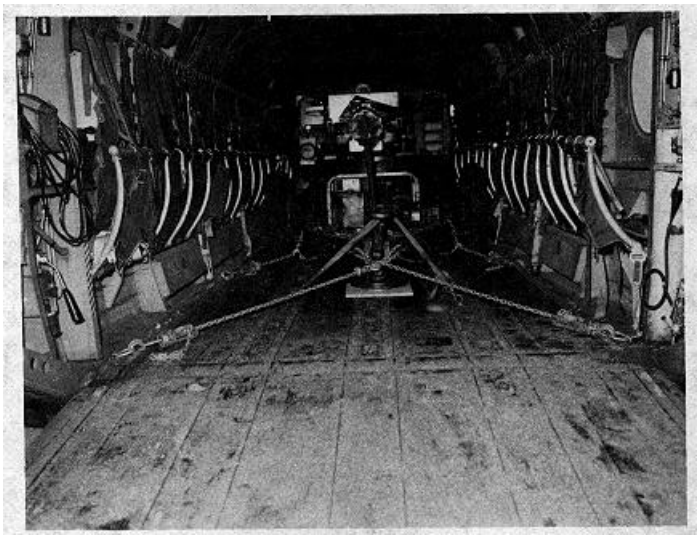


Figure 4-8. M167A1l shoring and tie downs in CH-47 (front view).

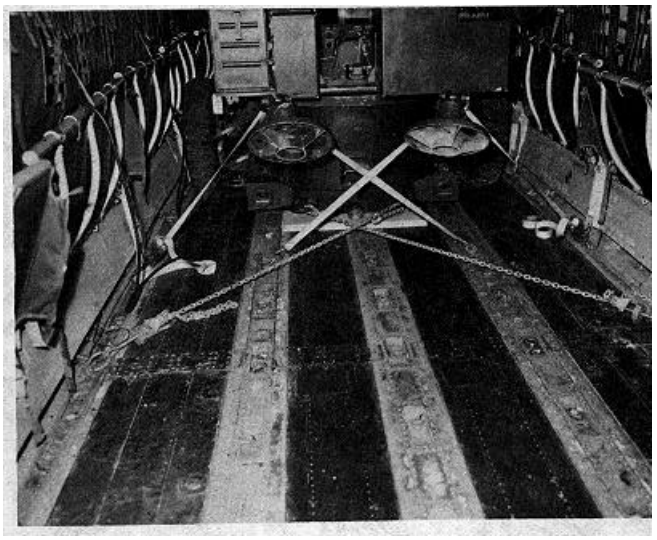


Figure 4-9. M167A1 shoring and tie downs in CH-47 (rear view).

CHAPTER 5
HIGHWAY TRANSPORTABILITY GUIDANCE

Section I. GENERAL

5-1. Scope
This chapter provides transportability guidance for highway movement of the M163A1 and M167A1 guns. It covers significant technical and physical characteristics and safety considerations and also prescribes the materials required to load the guns on semitrailers.

5-2. Safety
In addition to safety precautions in chapter 3, CONUS movement is subject to all safety laws, rules, and regulations applicable to commercial carriers. In overseas areas, movements are governed by theater and local regulations.

CAUTION

Do not allow guns to exceed 3 miles per hour (walking speed) when being driven or towed onto or off a semitrailer or truck.

5-3. General
The M163A1 self-propelled gun is considered self-deliverable only under appropriate tactical situations. Although the carrier tracks are equipped with rubber pads, movement over paved public highways will not be made without specific approval as outlined in AR 55-162. Additionally, the M163A1 exceeds the CONUS legal width limitation of 96 inches. This restriction also applies to highway movement overseas. Legal limitations of overseas areas are identified in "Limits of Motor Vehicle Sizes and Weights," International Road Federation, 1023 Washington Building, Washington, D. C. 20005.

Section II. TRANSPORT BY SEMITRAILER

5-4. Preparation
a. Place the radar antenna in the stow position on both the M163A1 and M167A1.

b. M163A1. Remove radio antennas and secure inside carrier. Secure all loose items inside carrier.

c. For detailed instructions, refer to TM 9-1005-286-10 (M167A1) or TM 9-2350-300-10 (M163A1).

5-5. Transport on Semitrailer
a. General. The M167A1 and M163A1, loaded on semitrailers, may be transported over highways. Movement of the M163A1 self-propelled gun over public highways in CONUS and overseas should be made only when other modes of transport are not available or practical. Highway shipments may be made using either military or commercial semitrailers (15-ton minimum capacity for the M163A1 selfpropelled gun). Tractors and semitrailers large enough to transport the M163A1 normally exceed dimensional and/or weight limitations in CONUS and overseas. Special permits are required in CONUS (AR 55-162), and special routing may be required overseas. The M163A1 and M167A1 are shown as typical loads on semitrailers in figures 5-1 and 5-2.

b. Material. Adequate blocking and tiedown material is provided by the shipping activity. Tables 5-1 and 5-3 provide a bill of materials for blocking and tiedown of the guns, and tables 5-2 and 5-4 provide data concerning the application of materials required for securing the guns on semitrailers.

c. Loading. The guns may be placed in the tiedown position on a semitrailer by a crane (15-ton minimum capacity for the M163A1), or they may be driven or towed onto the semitrailer provided a suitable ramp is available. When gun is in the tiedown position, set and wire-tie parking brakes. When loading the M163A1, set and wire-tie transmission in neutral.

WARNING

At no time during loading operations should personnel, other than the driver required to drive the M163A1 carrier or the tow vehicle, be on the trailer bed.

WARNING

Loading should not be conducted on side or lateral slopes exceeding 10 percent or with a tractor-to-trailer offset angle greater than 5 degrees. Avoid loading on a severe downgrade to prevent the payload from rolling forward on the trailer.

d. Tiedowns. Figures 5-1 and 5-2 provide tiedown diagrams that are compatible with standard loading practices and will adequately restrain the loads against forces encountered at normal speeds and operating conditions. Figure 5-3 provides a turning diagram for the M127A1 semitrailer towed by the M818 truck-tractor.

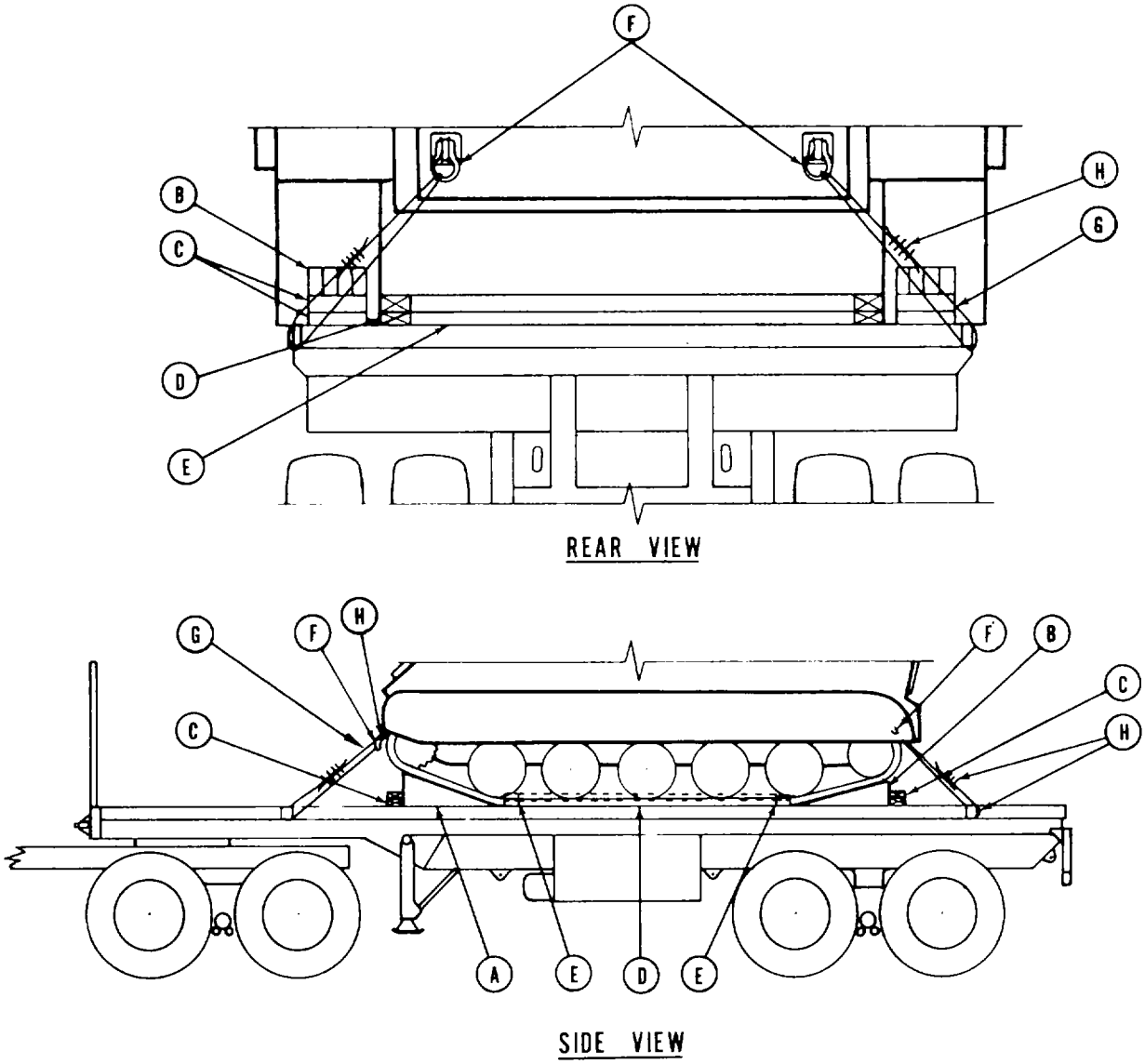


Figure 5-1. Typical blocking and tiedown diagram for Gun, Air Defense Artillery, Self-Propelled, 20-mm, M16SA1 on semitrailer, M127A1.

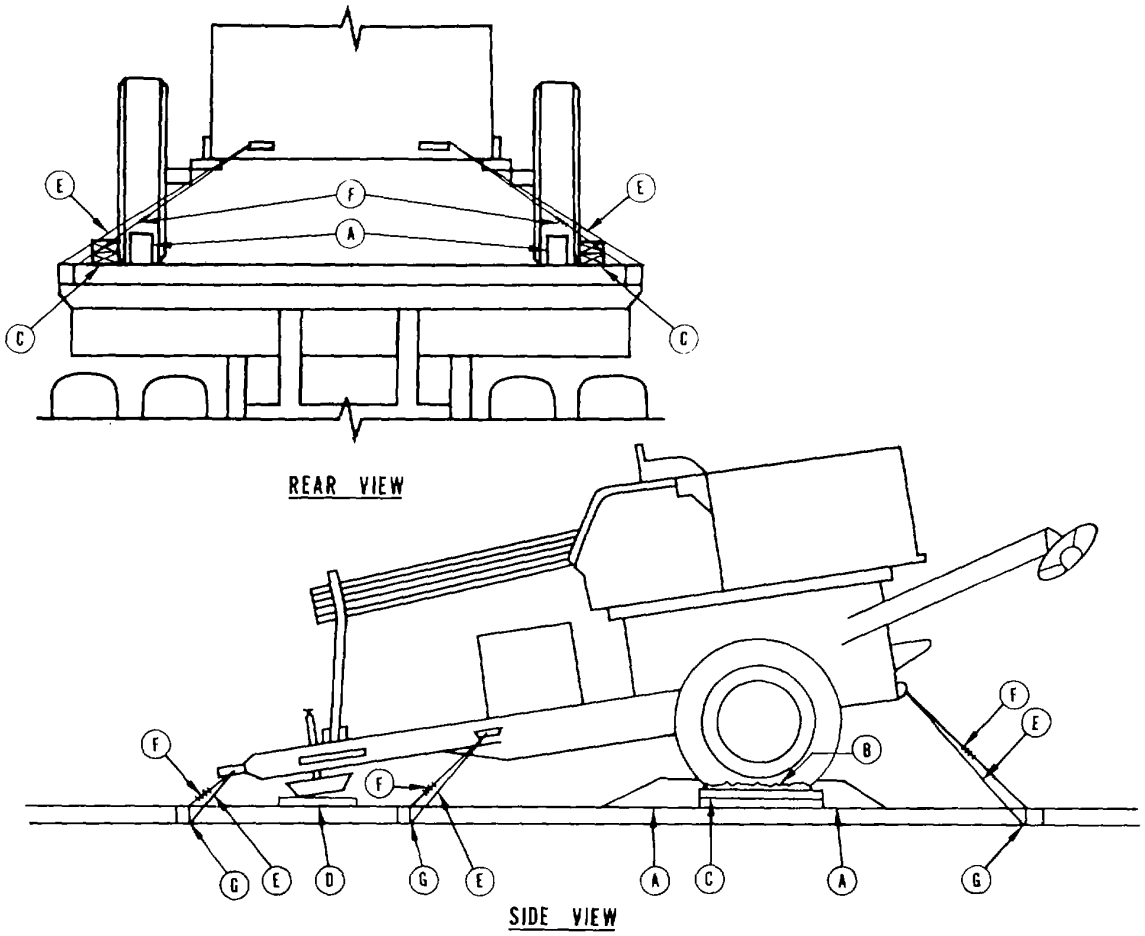


Figure 5-2. Typical blocking and tiedown diagram for Gun, Air Defense Artillery, towed, 20-mm, M167A1 on semitrailer, M127A1.

Table 5-1. Bill of Materials for Blocking and Tiedown of Gun, Air Defense Artillery, Self-Propelled, 20-mm, M163A1 on Semitrailer M127A1 (Fig 5-1)

Item	Description	Approximate quantity
Lumber	Douglas-fir, or comparable, straight-grain, free from material defects;	
	Fed Spec MM-L-751H: 2- x 4-inch	62 linear ft
	2- x 6-inch	8 linear ft
	2- x 8-inch	12 linear ft
	2- x 12-inch	10 linear ft
Nails	Common, steel, flathead, bright or cement-coated; table X1-b, Fed spec FF-N-105B:	
	12d	60
	30d	140
	40d	20
Shackles	Clevis-assembly, suspension, bolt-and-nut-type, large, NSN 1670-00-090-5354.	4
Thimbles	Standard, open-type: 1/2-inch	8
Clamps	Wire rope, U-bolt clips, saddled, single grip, steel, Crosby heavy duty, or equal; Fed Spec FF-C-450D: 1/2-inch.	24
Wire rope*	6 x 19, IWRC; improved plow steel, preformed, regular-lay; table X, Fed Spec RR-W-410C: 1/2-inch.	60 ft

*3/8-inch chain, 18,000 lb proof-test, may be substituted for wire rope. It must be furnished by the shipper.

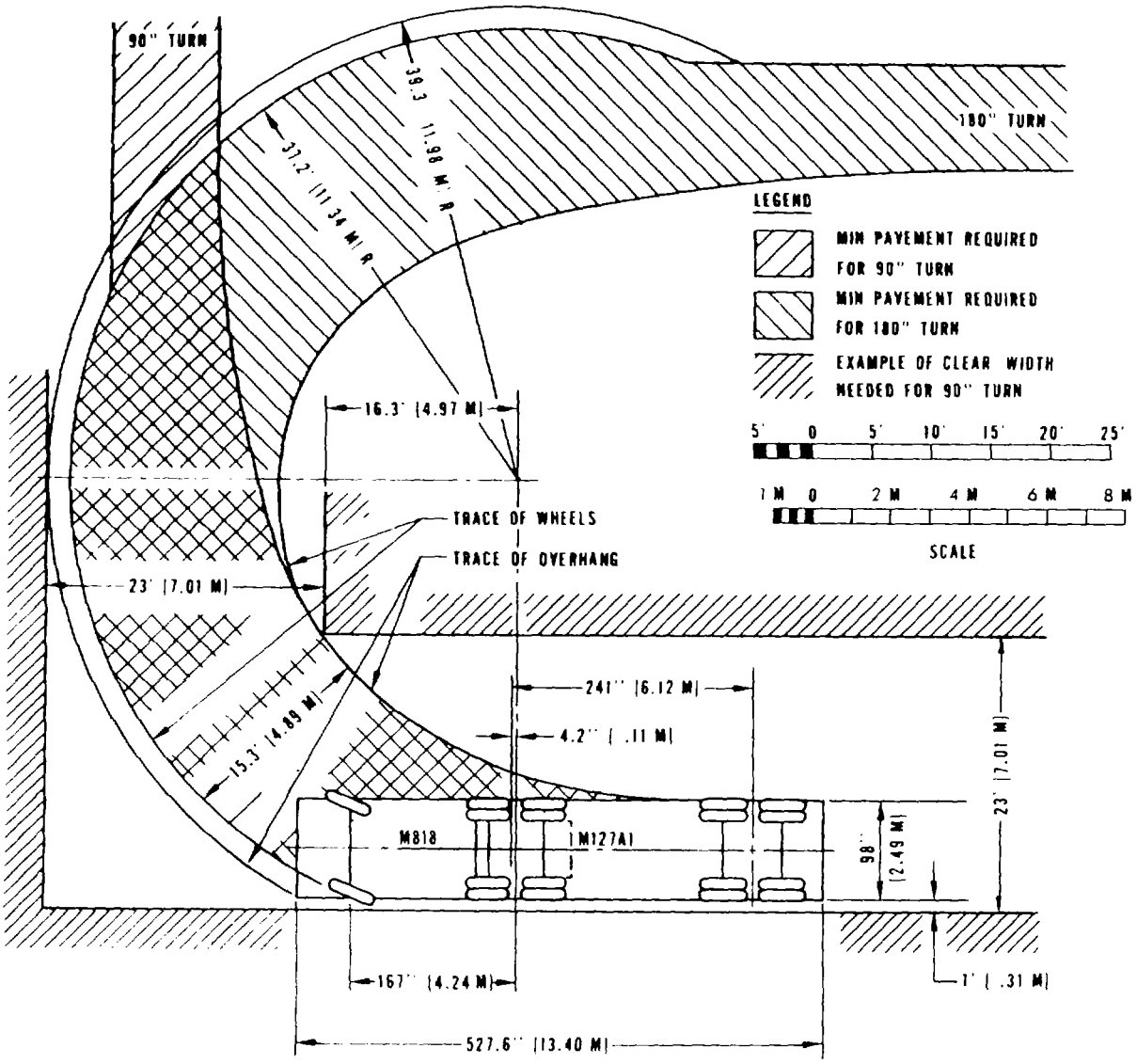


Figure 5-3. Turning diagram for semitrailer, M127A1, towed by truck-tractor, M818.

Table 5-2. Application of Materials for Blocking and Tiedown of Gun, Air Defense Artillery, Self-Propelled, 20-mmn, M163A1 on Semitrailer M127A1 (Fig 5-1)

Item	No. required	Application
A	2	*Blocks (detail 1,fig 7-2).* Each to consist of four pieces of 2- x 12- x 29-inch lumber cut as shown in detail 1. Nail the two inside pieces together with three 12d nails through each side. Nail the two outside pieces to the inside pieces with four 12d nails on each side. Locate one block against the front of each track as shown in fig 5-1. Toenail heel of each block through the two inside pieces to trailer floor with two 30d nails. Toenail each side of block to trailer floor with two 40d nails.
B	2	*Blocks (detail 2, fig 7-2).* Each to consist of four pieces of 2- x 8- x 31-inch lumber cut as shown in detail 2. Construct and apply to rear of tracks in same manner as item A above.
C	4	*End cleat.* Each to consist of two pieces of 2- x 6- x 12-inch lumber. Center bottom pieces crosswise against heel of blocks A and B, and nail to trailer floor with four 30d nails. Nail top pieces to bottom pieces with four 30d nails in each.
D	2	*Side blocks.* Each to consist of two pieces of 2- x 4- x 105-inch lumber. Locate the bottom pieces longitudinally against the inside edge of each track, and nail to trailer floor with 30d nails spaced approximately 8 inches apart. Nail top pieces to bottom pieces in like manner.
E	2	*Brace*. Each to consist of 2- x 4- x length-to-suit (approximately 71-inch) lumber. Locate bottom pieces between and at each end of item D, and nail to trailer floor with 30d nails spaced approximately 8 inches apart. Nail top pieces to bottom pieces in like manner.
F	4	*Shackle*. Attach one to each front and rear towing provision.
G	4	*Wire rope.* Each to consist of one piece of 1/2-inch wire rope, length as required (approximately 15 feet). Form a complete loop between shackles and trailer stake pocket. Wire rope ends should overlap at least 24 inches. The angle of tiedown should be as close to 45 degrees as possible.
H	24	*Clamps.* Place four on each wire rope at the overlap areas and space 3 1/2 inches apart with a minimum of 6 inches from each end of wire rope (detail 3, fig 7-2). Tension wire rope and tighten clamps. Use one clamp to secure each thimble to wire rope at stake pocket (detail 4, fig 7-2) and shackle.
J	8	*Thimbles*. Place one on wire rope at each stake pocket and shackle. Secure with one item H (detail 4, fig 7-2).

Table 5-3. Bill of Materials for Blocking and Tiedown of Gun, Air Defense Artillery, Towed, 20-mm, M167A1 on Semitrailer M127A1 (Fig 5-2)

Item	Description	Approximate quantity
Lumber	Douglas-fir, or comparable, straight-grain free from material defects;	
	Fed spec MM-L-751H: 2- x 4-inch	12 linear ft
	2- x 6-inch	6 linear ft
	6- x 8-inch	6 linear ft
	2- x 10-inch	1 linear ft
Nails	Common, steel, flathead, bright or cement-coated; table XI-b, Fed Spec	
	FF-N-105B: 12d	20
	20d	14
	40d	28
Wire rope*	6 x 19, IWRC, improved plow steel, preformed, regular-lay; table X,	
	Fed Spec RR-W-410C: 3/8-inch	90 ft
Clamps	Wire rope, U-bolt clips, saddled, single grip, steel, Crosby	
	heavy-duty, or equal; MIL-STD 16842: 3/8-inch	30
Thimbles	Standard, open-type: 3/8-inch	6
Cushioning material	Waterproof paper, burlap, or other suitable material	as required

* 3/8-inch chain, 8,500 lb proof-test, may be substituted for wire rope. It must be furnished by the shipper.

Table 5-4. Application of Materials for Blocking and Tiedown of Gun, Air Defense Artillery, Towed, 20-mm, M167A1 on Semitrailer M127A1 (Fig 5-2)

Item	No. required	Application
A	4	*Chock blocks (detail 1,fig 7-4).* Locate 45° portion of block against the front and rear of each tire. Nail heel of block to trailer floor with three 40d nails, and toenail that portion of block under tire to floor with two 40d nails on each side before items B and C are applied.
B	1 ea per item C	*Suitable material such as waterproof paper or burlap.* Locate bottom portion under item C. The top portion should extend 2 inches above item C (detail 2, fig 7-4).
C	2	*Side block.* Each to consist of one piece of 2- x 6- x 36-inch lumber and two pieces of 2- x 4- x 36-inch lumber (detail 2, fig 7-4). Nail one 2- x 6- x 36-inch piece to the edge of one of the 2- x 4- x 36-inch pieces with five 12d nails. Place against tires with item C in place, and nail to trailer floor through the 2- x 4- x 36-inch piece with five 20d nails. Nail the other 2- x 4- x 36-inch piece to the one below in a like manner.
D	1	*Shoring*. Locate piece of 2- x 10- x 12-inch lumber underneath front drop pad. Nail to trailer floor with four 20d nails.
E	6	*Wire rope, 3/8 inch.* Attach through the M167A1 rear and side tiedown provisions and in a complete loop through the trailer stake pocket at a maximum angle of 45 degrees. Attach through the M167A1 lunette and in a complete loop through stake pockets on each side of trailer. Wire rope ends should overlap a minimum of 24 inches (detail 3, fig 7-4).
F	30	*Clamps, 3/8 inch.* Secure the ends of the wire rope at the overlap area with four clamps each, and space 3 1/2 inches apart with a minimum of 6 inches from ends of rope. Place one additional clamp to secure thimble and wire rope together at each stake pocket (detail 3, fig 7-4).
G	6	*Thimble, open-type, 3/8 inch.* Place one at bottom of each stake pocket where wire rope passes through (detail 3, fig 7-4).

CHAPTER 6
MARINE AND TERMINAL TRANSPORTABILITY GUIDANCE

Section I. GENERAL

6-1. Scope
This chapter provides transportability guidance for marine and terminal movement of the M163A1 and M167A1 guns. It covers significant technical and physical characteristics and safety considerations and prescribes the materials and guidance required to prepare, lift, tie down, and off-load the guns.

6-2. Safety
In addition to the safety precautions contained in chapter 3, the following should be noted as applicable:

a. The activity offering the guns for transport shall notify carrier if ammunition or explosives are to be transported with the guns. Compliance with AR 55-228, paragraph 2-7, and the provisions of US CG 108 are mandatory.

b. Ammunition and vehicles shall be handled and stowed in accordance with Water Carrier Tariff No. 31 or reissues thereof.

c. Fire extinguishers must be available during all loading and off-loading operations.

d. Stevedore slings and other items used in loading and off-loading operations should be inspected for condition and capacity (15-ton minimum for the M163A1 and 3-ton minimum for the M167A1).

e. Personnel should be cautioned not to walk under items being lifted.

f. Lifting eyes and shackles should be inspected to insure that they are complete and not damaged.

g. All lifts should have at least two tag lines attached to control the swing of the lift while suspended.

6-3. Water Shipment
The guns can be transported by a variety of inland-waterway cargo carriers, lighters, and most seagoing cargo vessels.

NOTE

The methods described in this chapter for lifting and securing are suggested procedures. Other methods of handling and stowage may be used provided they will insure safe delivery without damage.

Section II. LOADING AND SECURING

6-4. General Rules

a. Stowage. Whenever possible, below-deck stowage should be provided. In general, good stowage means placing the guns as close together as possible with minimum space between outer item and sweat boards (approximately 4 to 6 inches). Breakable parts should be protected, spare parts stowed in or near parent item, brakes set with brake level wire-tied, transmission placed in neutral with control level wire tied, battery terminals disconnected and taped, and fuel tanks drained. Secure guns by blocking tracks or wheels front, rear, and on both sides; lash wire rope or chains to bulkhead, stanchions, or padeyes.

NOTES

1. When guns are loaded on vessels that are adequately ventilated by power blowers, such as roll-on/roll-off vessels, fuel need not be drained or batteries disconnected.

2. Tracked vehicles may arrive at the terminal with access hatches spotwelded shut to prevent pilferage. Since these vehicles are not maneuverable under their own power, brakes are not set and transmissions are placed in neutral position to permit towing in the loading area.

b. Lifting. Correct lifting points on the M163A1 are the lifting eyes located at each upper front and rear corner of the hull. A typical lifting diagram is shown in figure 6-1. Correct lifting points on the M167A1 are the lifting eyes on top of the carriage frame forward of the

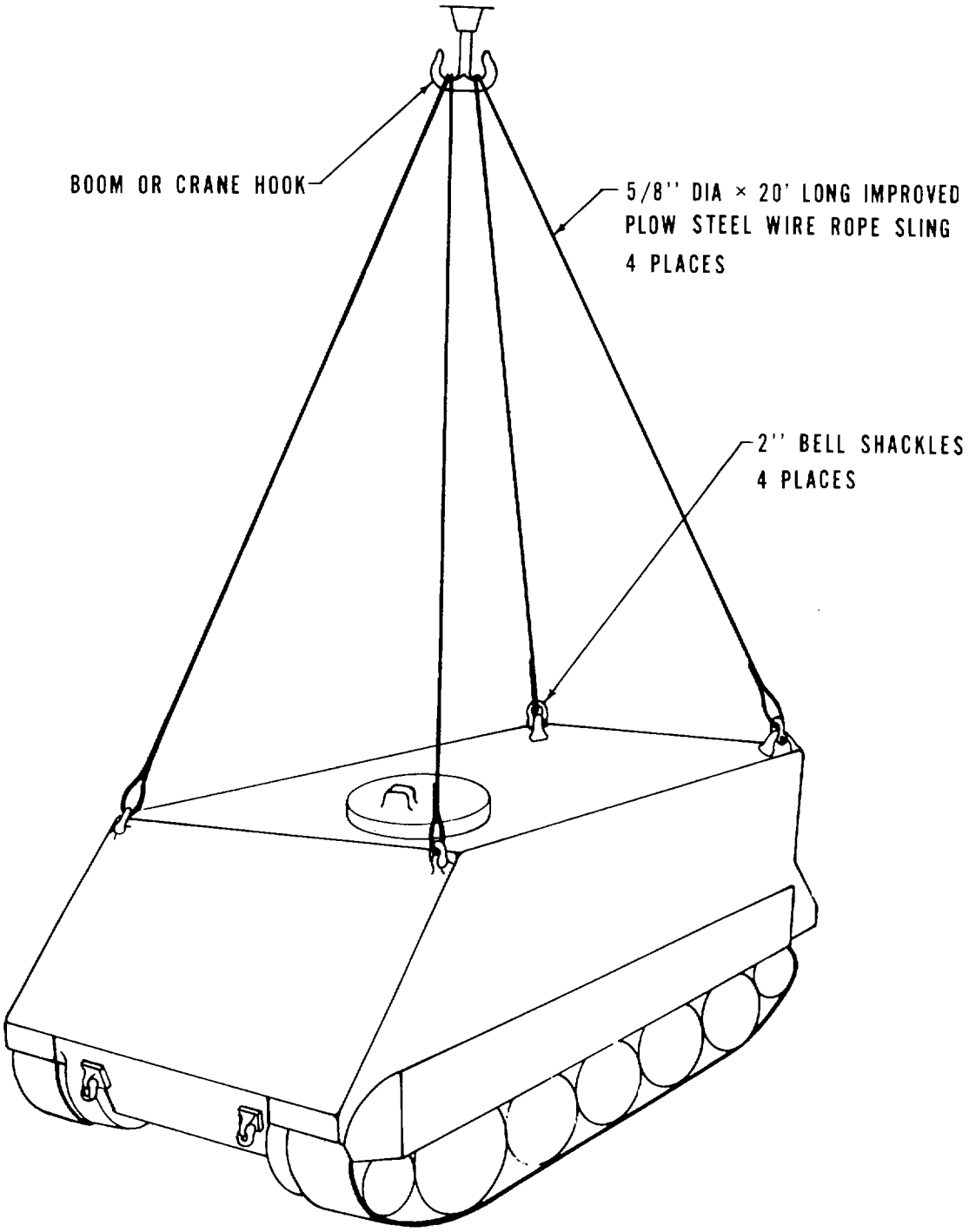


Figure 6-1. Lifting diagram for M163A1 using four-legged bridle sling.

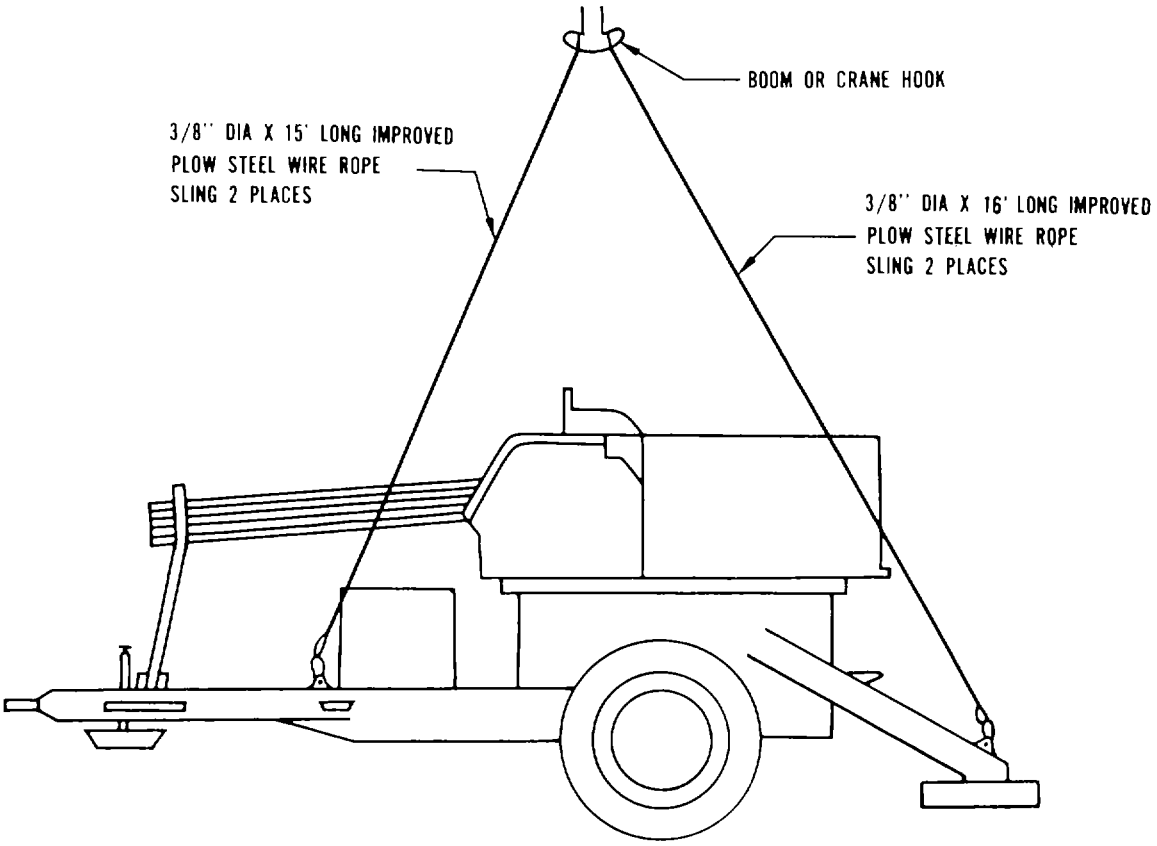


Figure 6-2. Lifting diagram for M167A1.

generator and at the ends of the outriggers. The gun is lifted with the outriggers extended. A typical lifting diagram is shown in figure 6-2.

c. Loading. The guns should be stowed on seagoing cargo vessels in their minimum configuration as described in paragraph 2-3. They may be loaded aboard landing craft, beach discharge lighters, heavy and medium amphibious lighters, and landing ships by crane. The M163A1 may be loaded under its own power, and the M167A1 may be loaded by towing. Both guns can also be loaded onto the decks of barges from a pier when tidal conditions are suitable and ramps are available. The guns can be loaded onto seagoing vessels by shoreside or floating cranes or by heavy-lift ship's gear. They can be driven or towed aboard roll-on/roll-off vessels. Figures 6-3 and 6-4 show typical blocking and tiedown details. Tables 6-1 and 6-3 provide a bill of materials for blocking and tiedown of the guns, and tables 6-2 and 6-4 provide data concerning the application of materials required for securing the guns in general-cargo vessels.

d. Special Design. Seatrain, roll-on/roll-off, landing, and attack cargo ships are equipped with patented lashing gear and pre-positioned fittings in the decks. The use of such equipment is adequate, and additional blocking and bracing is not required.

6-5. Barges and Lighters

When transporting the guns short distances by barge or similar lighterage on sheltered waters, blocking and chocking will be required. When moving guns on extended distances or through rough waters, tiedowns must also be used.

6-6. Landing Ships, Landing Craft, and Amphibians

When transporting the guns extended distances or through rough waters, blocking and tiedowns must be used. In most cases, the vessels have turnbuckle tiedowns with a fitting on one end that fits into a deck cloverleaf. Where these are not provided, a suitable substitute may be used.

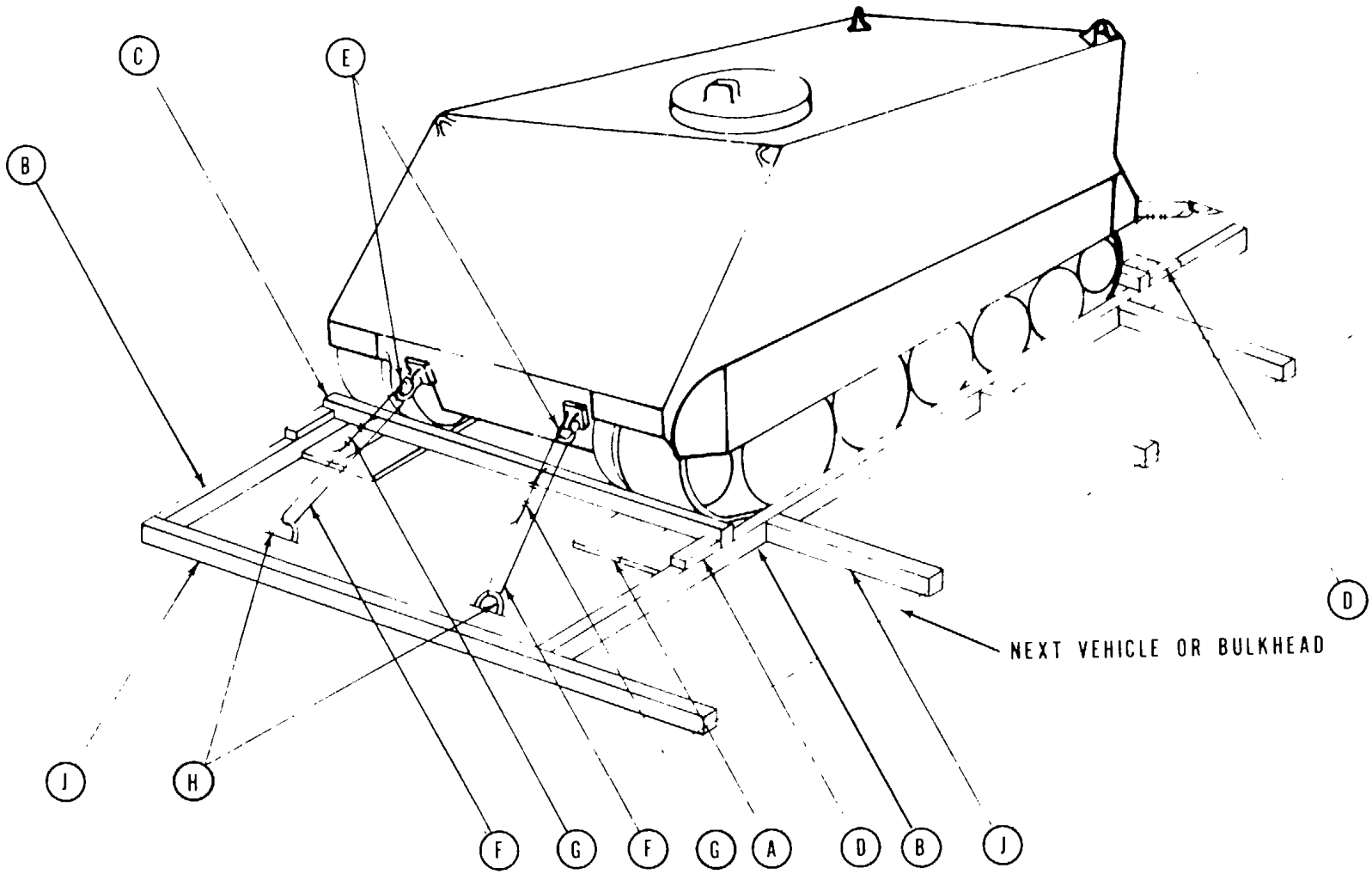


Figure 6-3. Blocking and tiedown for M163A1 in general-cargo vessel.

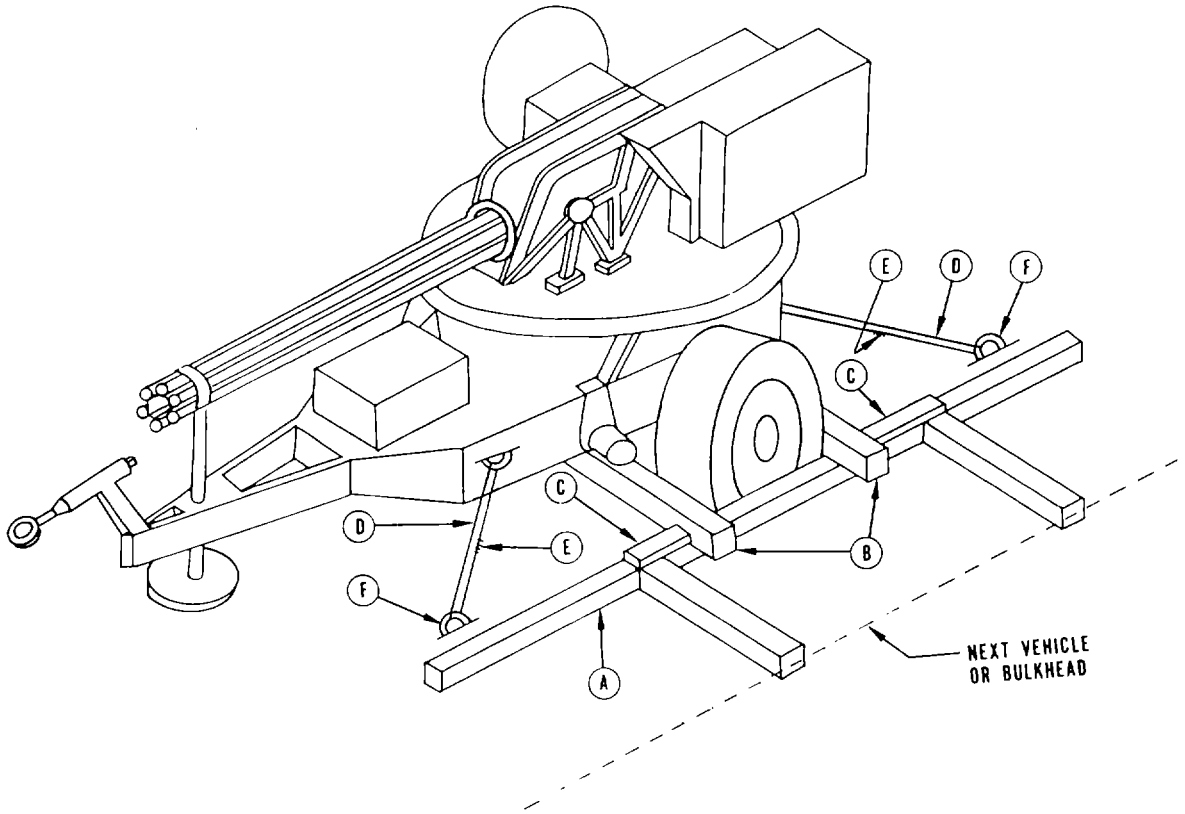


Figure 6-4. Blocking and tiedown for M167A1 in general-cargo vessel.

Table 6-1. Bill of Materials for Blocking and Tiedown of M168A1 in General-Cargo Vessel (Fig 6-3)

Item	Description	Approximate quantity
Lumber	Douglas-fir, or comparable, straight-grain, free from material defects;	
	Fed spec MM-L-751H: 4- x 6-inch	5 linear ft
	2- x 12-inch	40 linear ft
	6- x 8-inch	60 linear ft
Nails	Common, steel, flathead, bright or cement-coated; table II-b,	
	Fed Spec FF-N-105B: 40d	60
Wire rope*	6 x 19, IWRC, improved plow steel, preformed, regular-lay; table X	
	Fed Spec RR-W-410C: 5/8-inch	60 ft
Clamps	Wire rope, U-bolt clips, saddled, single grip, steel, Crosby	
	heavy-duty, or equal; Fed Spec FF-C-450D: 5/8-inch	16
Shackles	Clevis-assembly, suspension, bolt-and-nut type, large, NSN	
	1670-00-090-5354, or equal (for front and rear towing and tie-down provisions)	4

* 3/8-inch chain, 18,000 lb proof-test, may be substituted for wire rope. It must be furnished by the shipper.

Table 6-2. Application of Materials for Blocking and Tiedown of M163A1 in General-Cargo Vessel (Fig 6-3)

Item	No. required	Application
A	4	*Lumber, 2- x 12- x 120-inch.* Pre-position on deck so that two pieces will be under each track.
B	2	*Side blocking.* Each consists of 6- x 8- x 240-inch lumber. Locate one piece on each side of carrier against outside edge of tracks.
C	2	*End blocking.* Each consists of 6- x 8- x 118-inch lumber. Locate on top of item B and against tracks at front and rear. Toenail to item B with four 40d nails at each end.
D	4	*Backup cleats*. Each consists of 4- x 6- x 12-inch lumber. Locate on top of item B against item C. Nail to item B with four 40d nails.
E	4	*Shackles*. Secure one shackle to each towing provision (two at front and two at rear of carrier).
F	4	*Wire rope, 5/8-inch*. Make a complete loop through shackle and padeye (item H), secure with clamps (item G).
G	16	*Clamps, 5/8-inch.* Use four to secure each item F.
H	4	*Padeyes*. Built into vessel deck.
J	as required	*Bracing*. Consists of 6- x 8-inch x length cut-to-suit. Brace as required against adjacent vehicle, cargo, or vessel bulkhead. Secure each end of each piece to adjacent blocking or bracing by toenailing with four 40d nails. Lumber for this requirement not included in table 6-1.

Table 6-3. Bill of Materials for Blocking and Tiedown of M167A1 in General-Cargo Vessel (Fig 6-4)

Item	Description	Approximate quantity
Lumber	Douglas-fir, or comparable, straight-grain, free from material defects;	
	Fed Spec MM-L-751H: 2- x 4-inch	18 linear ft
	4- x 4-inch	32 linear ft
Nails	Common, steel, flathead, bright or cement coated; table X1-b,	
	Fed Spec FF-N-105B: 30d	24
Wire rope*	6 x 19, IWRC, improved plow steel, preformed, regular-lay;	
	table X, Fed Spec RR-W-410C: 3/8-inch	40 ft
Clamps	Wire rope, U-bolt clips, saddled, single grip, steel, Crosby	
	heavy-duty, or equal; MIL-STD 16842: 3/8-inch	16

* 3/8-inch chain, 8,500 lb proof-test, may be substituted for wire rope. It must be furnished by the shipper.

Table 6-4. Application of Materials for Blocking and Tiedown of M167A1 in General-Cargo Vessel (Fig 6-4)

Item	No. required	Application
A	2	*Side blocking.* Each consists of 4- x 4- x 190-inch lumber. Locate one piece on each side of gun carriage against outside of each wheel.
B	2	*End blocking*. Each consists of 2- x 4- x 82-inch lumber. Locate on top of item A and against front and rear of tires. Nail to item A with three 30d nails at each end.
C	4	*Backup cleats.* Each consists of 2- x 4- x 12-inch lumber. Locate on top of item A against item B. Nail to item B with three 30d nails.
D	4	*Wire rope.* Make a complete loop through gun tiedown provisions and padeye (item F), secure with clamps (item E).
E	16	*Clamps, 3/8-inch.* Use four to secure each item D.
F	4	Padeyes, built into vessel deck.
G	as required	*Bracing*. Each consists of 4- x 4-inch length cut-to-suit. Brace as required against adjacent gun, vehicle, cargo or side of vessel bulkhead. Secure each end of each piece to adjacent blocking or bracing by nailing. Material for this item not included in table 6-3.

CHAPTER 7
RAIL TRANSPORTABILITY GUIDANCE

Section I. GENERAL

7-1. Scope
This chapter provides transportability guidance for rail movement of the M163A1 and M167A1 guns. It covers significant technical and physical characteristics of the guns, as well as safety considerations. It also prescribes the materials and guidance to prepare, load, and tie down the guns on open-top flatcars.

7-2. Maximum Utilization of Railcars
Additional cargo, as approved by the activity offering the guns for transport, may be transported with the guns.

Section II. TRANSPORT ON CONUS RAILROADS

7-3. General
The M163A1 and M167A1 guns, when loaded on suitable railcars, can be transported on CONUS railways without sectionalization or major disassembly. They can be transported within the Association of American Railroad's Outline Diagram of Single Loads, Without End Overhang, on Open-Top Cars, as shown in both the Railway Line Clearance Publication and the Official Railway Equipment Register.

7-4. Preparation

a. M167A1 Self-Propelled Gun.

(1) Remove radio antennas and secure inside carrier.

(2) Install travel lock on cannon.

(3) Place radar antenna in stow position.

(4) Remove all basic issue items from outside and secure inside carrier.

b. M167A1 Towed Gun.

(1) Secure all loose items.

(2) Retract outriggers.

(3) Install travel lock on cannon.

(4) Place radar antenna in stow position.

7-5. Loading on General-Purpose Flatcars
a. Either gun may be placed in the tiedown position on the railcar by a crane, or they may be towed onto the railcar if a suitable ramp or bridge plate is available. The M163A1 may be driven into position on the railcar.

CAUTION

Do not allow the guns to exceed 3 miles per hour (walking speed) during loading or unloading operations.

b. The loads shown in figures 7-1 and 7-3 are based on a flatcar minimum width of 10 feet 6 inches for the M163A1 and 9 feet 6 inches for the M167A1, which will provide sufficient space for blocking materials. Figures 7-2 and 7-4 are blocking and tiedown detail diagrams for figures 7-1 and 7-3 respectively. Tables 7-1 and 7-3 are bills of material for blocking and tiedown of the guns, and tables 7-2 and 7-4 provide data concerning the application of materials required for securing the guns on general-purpose flatcars.

NOTE

A staggered nailing pattern should be used when lumber is nailed to the floor of the railcar. Additionally, the nailing pattern for an upper piece of lumber will be adjusted as required so that a nail for that piece will not be driven through, onto, or right beside a nail in the lower piece of lumber.

7-6. Loading on Special-Purpose Flatcars
The load shown in figure 7-5 is based on the use of CONUS cushioned rub rail or similar type flatcar for loading the M163A1. This flatcar is equipped with special heavy-duty tiedown devices and two cushioned rub rails running the length of the car on either side of the center sill. Table 7-5 presents materials and their application for securing the M163A1 on cushioned rub rail flatcars. The load shown in figure 7-6 is based on the use of CONUS OTTX, or similar type of flatcar, for

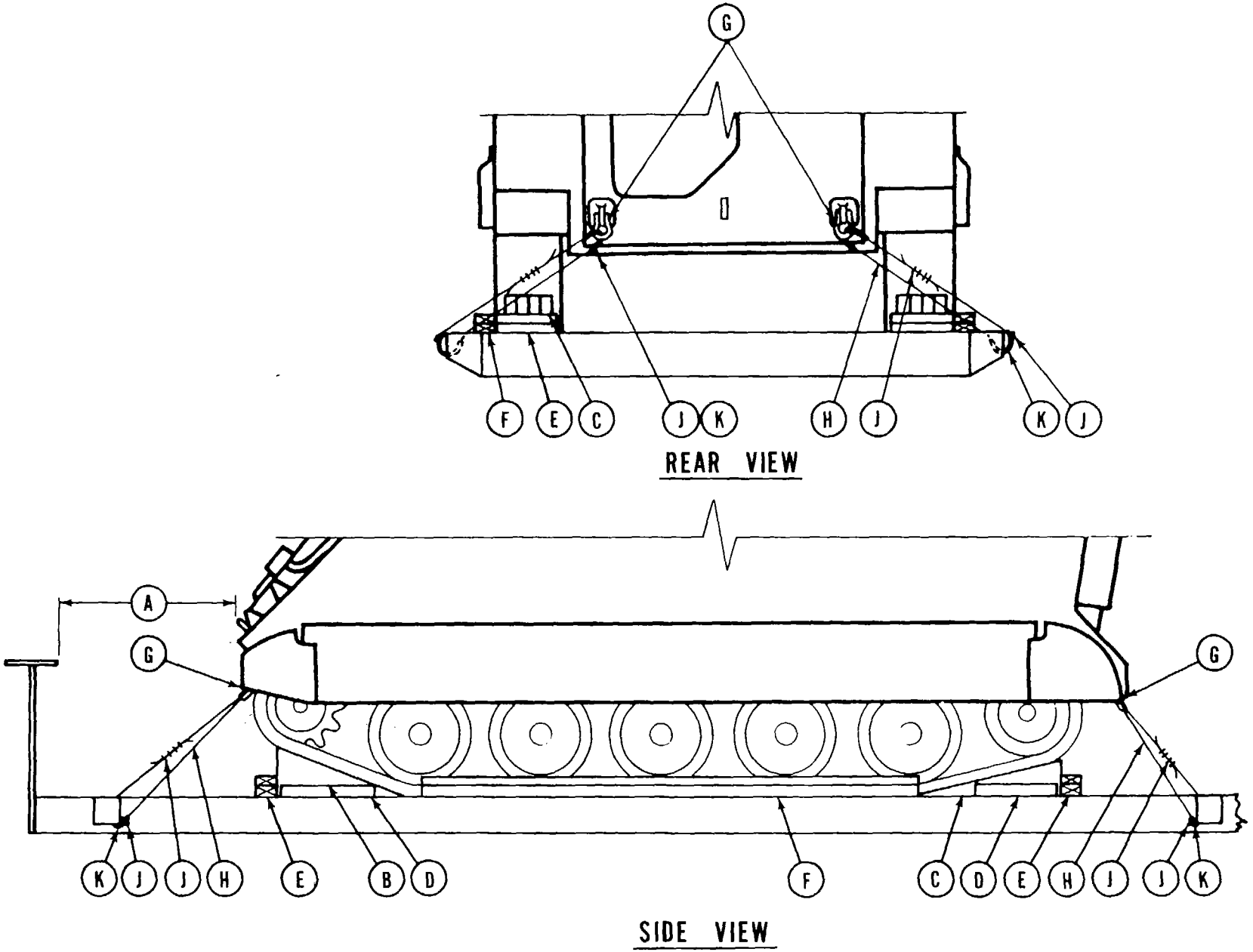


Figure 7-1. Blocking and tiedown diagram for Gun, Air Defense Artillery, Self-Propelled 20-mm, M163A1, on CONUS general-purpose flatcar.

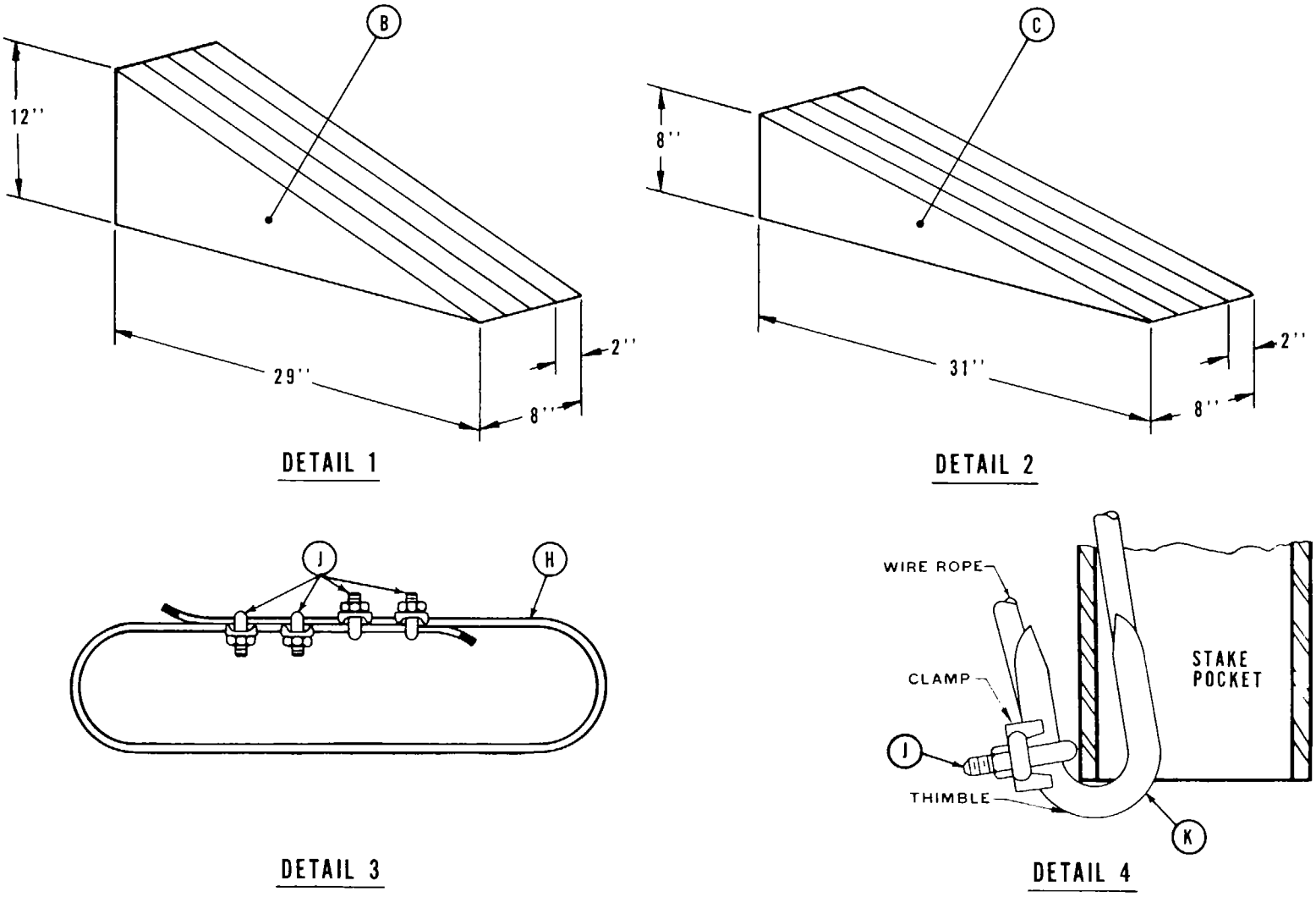


Figure 7-2. Blocking and tiedown details, M163A1.

loading the M167A1. This car is equipped with special tiedown channels along the sides of the car and adjacent to the center sill on each side. Each tiedown channel contains movable and retractable ratchet winches and chain tiedown assemblies. Table 7-6 presents materials and their application for securing the M167A1 on OTTX or on a similar type of flatcar.

Table 7-1. Bill of Materials for Blocking and Tiedown of M163Al on CONUS General-Purpose Flatcar (Fig 7-1)

Item	Description	Approximate quantity
Lumber	Douglas-fir, or comparable, straight-grain, free from material defects;	
	Fed Spec MM-L-751H: 2- x 4-inch	50 linear ft
	2- x 6-inch	10 linear ft
	2- x 8-inch	11 linear ft
	2- x 12-inch	10 linear ft
Nails	Common, steel, flathead, bright or cement-coated; table X1-b, Fed Spec	
	FF-N-105B: 12d	56
	20d	32
	30d	90
	40d	16
Thimbles	Standard, open-type: 1/2-inch	8
Clamps	Wire rope, U-bolt clips, saddled, single-grip, steel, Crosby heavy-duty or equal; Fed Spec FF-C-450D: 1/2-inch	24
Shackles	Clevis-assembly, suspension, bolt-and-nut-type, large, NSN 1670-00-090-5354, or equal	4
Wire rope*	6 x 19, IWRC, improved plow steel, preformed, regular-lay; table X, Fed Spec RR-W-410C: 1/2-inch	60 ft

* 3/8-inch chain, 18,000 lb proof-test, may be substituted for wire rope. It must be furnished by the shipper. Steel banding and annealed wire are not authorized substitutes.

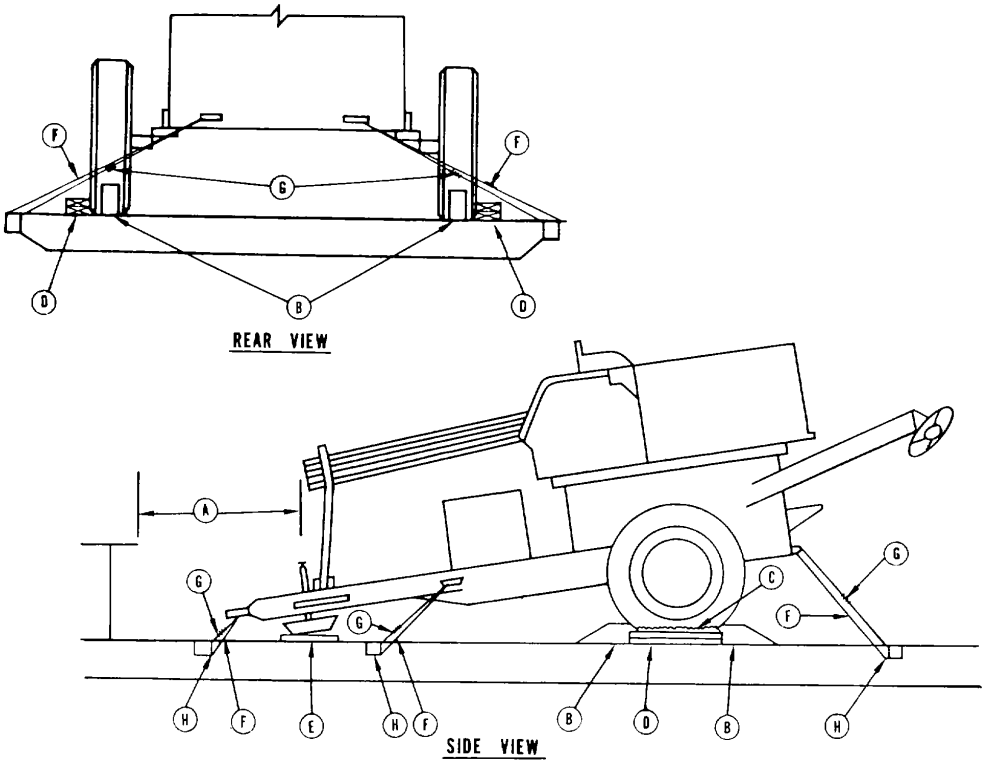


Figure 7-3. Blocking and tiedown diagram for Gun, Air Defense Artillery, Towed 20-mm, M167A1, on CONUS general-purpose flatcar.

Table 7-2. Application of Materials for Blocking and Tiedown of M163A1 on CONUS General-Purpose Flatcar (Fig 7-1)

Item	No, required	Application
A		*Brake wheel clearance.* Minimum clearance required is 6 inches above, in back of, and on both sides of, and 4 inches underneath wheel (fig 7-1).
B	2	*Blocks (detail 1,fig 7-2).* Each to consist of four pieces of 2- x 12- x 29-inch lumber, cut as shown in detail 1. Nail the two inside pieces together with three 12d nails through each side. Nail the two outside pieces to the inside pieces with four 12d nails on each side. Locate one block against the front of each track, as shown in fig 7-1. Toe-nail heel of each block through the two inside pieces to car floor with two 30d nails. Toe-nail each side of block to car floor with two 40d nails.
C	2	*Blocks (detail 2,fig 7-2).* Each to consist of four pieces of 2- x 8- x 31-inch lumber cut as shown in detail 2. Construct and apply to rear tracks in same manner as in item B above.
D	8	*Side cleat.* Each to consist of one piece of 2- x 4- x 24-inch lumber. Locate one on each side of blocks B and C (flush with heel of block), and nail to car floor with four 20d nails.
E	4	*End cleat.* Each to consist of two pieces of 2- x 6- x 14-inch lumber. Center bottom pieces cross-wise against heel of blocks B and C, and nail to car floor with four 30d nails. Nail top pieces to bottom pieces with four 30d nails.
F	2	*Side block.* Each to consist of two pieces of 2- x 4- x 102-inch lumber. Locate the bottom pieces longitudinally against the outside of each track, and nail to car floor with 30d nails spaced approximately 8 inches apart. Nail top pieces to bottom pieces in like manner.
G	4	*Shackles*. Attach one to each front and rear towing provision.
H	4	*Wire rope.* Each to consist of one piece of 1/2-inch wire rope, length as required (approximately 15 feet). Form a complete loop between each shackle and appropriate flatcar stake pocket. Wire rope ends should overlap at least 24 inches. The angle of tiedown should be approximately 45 degrees.
J	24	*Clamps*. Place four on each wire rope at the overlap area and space 3 1/2 inches apart with a minimum of 6 inches from each end of wire and tighten clamps. Use one clamp to secure each thimble to wire rope at stake pocket (detail 4, fig 7-2) and shackle.
K	8	*Thimbles*. Place one on wire rope at each stake pocket and shackle. Secure with one item J (detail 4, fig 7-2).

GENERAL INSTRUCTIONS

1. Hand brakes must not be set. Transmission lever must be placed and wire-tied in neutral position.
2. Tensioning of wire rope can be accomplished with an appropriate-size come-along mechanical hoist or equal tensioning device.
3. See General Rules 1, 2, 3, 4, 5, 9, 11, 14, 15, 19, and 19A, Section I of the Rules Governing the Loading of Commodities on Open-Top Cars and Trailers, published by the Association of American Railroads, for further details.

Table 7-3. Bill of Materials for Blocking and Tiedown of M167A1 on CONUS General-Purpose Flatcar (Fig 7-3)

Item	Description	Approximate quantity
Lumber	Douglas-fir, or comparable, straight-grain, free from material defects;	
	Fed Spec MM-L-751H: 2- x 4-inch	12 linear ft
	2- x 6-inch	6 linear ft
	6- x 8-inch	6 linear ft
	2- x 10-inch	1 linear ft
Nails	Common, steel, flathead, bright or cement-coated; table XI-b,	
	Fed Spec FF-N-105B: 12d	20
	20d	14
	40d	28
Wire rope*	6 x 19, IWRC, improved plow steel, preformed, regular-lay;	
	table X, Fed Spec RR-W-410C: 3/8-inch	90 ft
Clamps	Wire rope, U-bolt clips, saddled, single-grip, steel, Crosby	
	heavy-duty or equal; MIL-STD 16842: 3/8-inch	30
Thimbles	Standard, open-type: 3/8-inch	6
Cushioning material	Waterproof paper, burlap, or other suitable material	as required

* 3/8-inch chain, 8,500 lb proof-test, may be substituted for wire rope. It must be furnished by the shipper. Steel banding and annealed wire are not authorized substitutes.

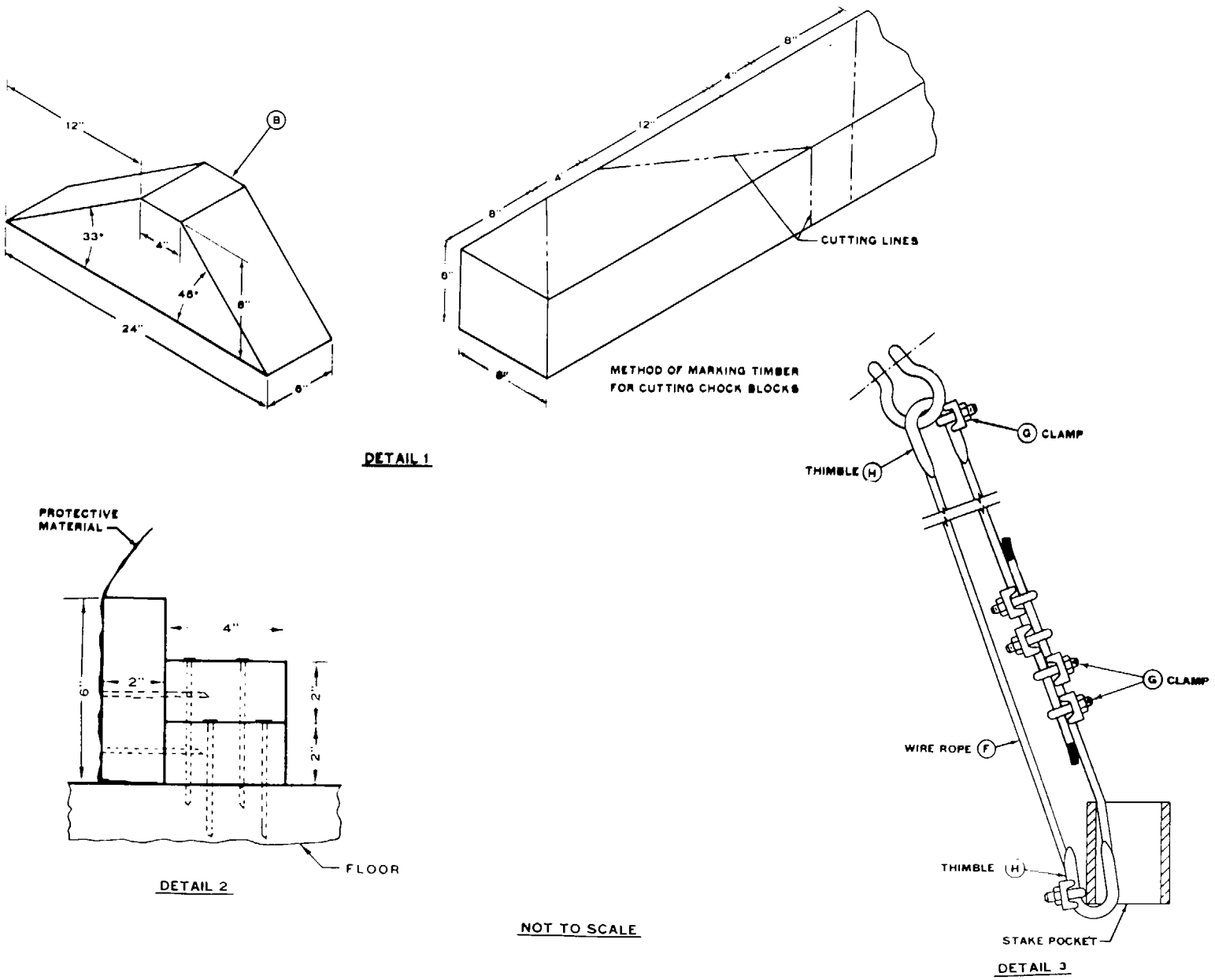


Figure 7-4. Blocking and tiedown details, M167A1.

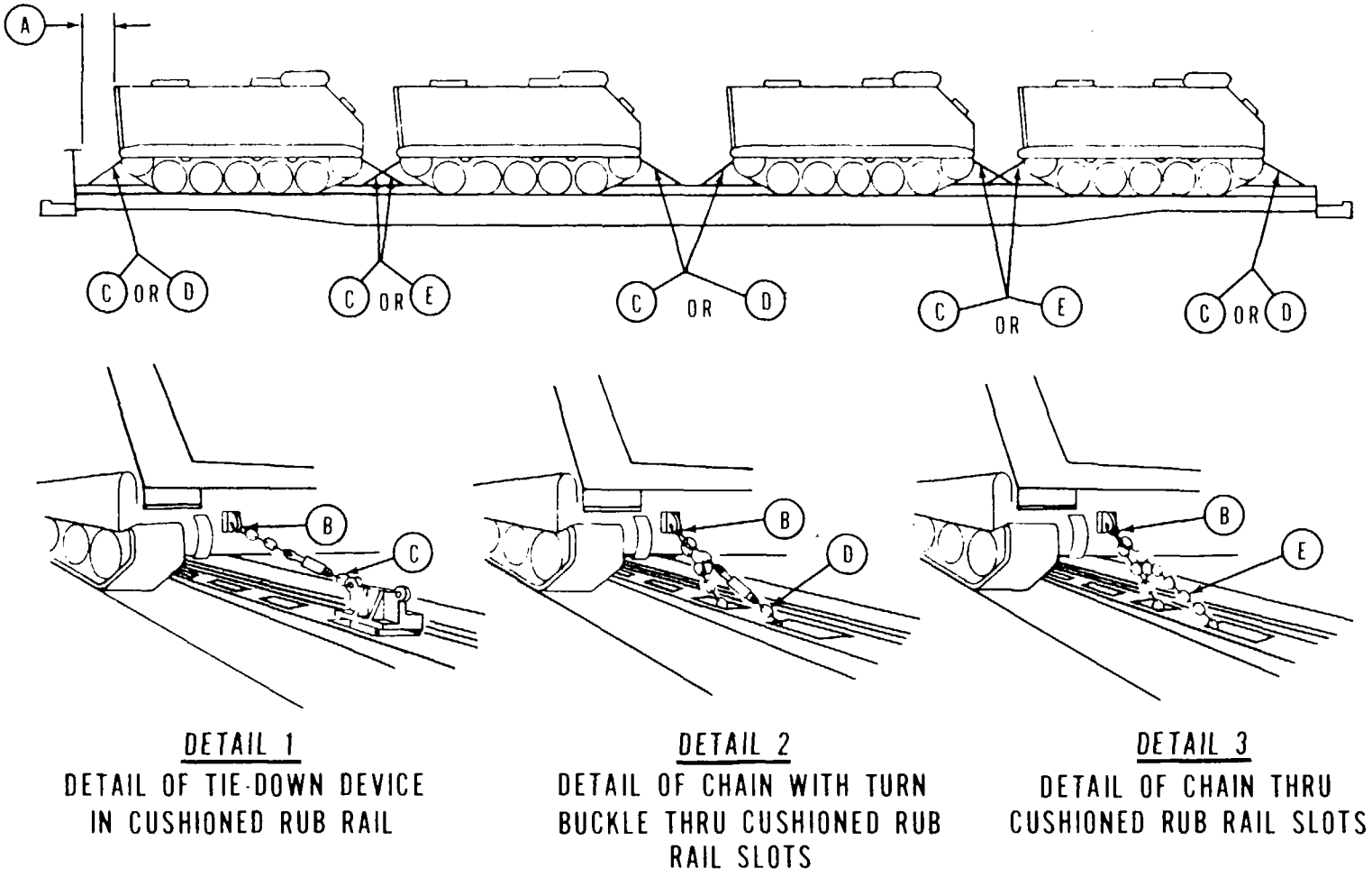


Figure 7-5. Tiedown diagram for M163A1 on cushioned rub-rail or similar type of flatcar.

Table 7-4. Application of Materials for' Blocking and Tiedown of M167A1 on CONUS General-Purpose Flatcar (Fig 7-3)

Item	No. required	Application
A		*Brake wheel clearance.* Minimum clearance required is 6 inches above, in back of, and on both sides of, and 4 inches underneath wheel (fig 7-3).
B	4	*Chock blocks (detail 1,fig 7-4).* Locate 45° portion of block against the front and rear of each tire. Nail heel of block to car floor with three 40d nails, and toenail that portion of block under tire to car floor with two 40d nails on each side before items C and D are applied.
C	1 ea per item D	*Suitable material such as waterproof paper or burlap.* Locate bottom portion under item D. The top portion should extend 2 inches above item D (detail 2, fig 7-4).
D	2	*Side block.* Each to consist of one piece of 2- x 6- x 36-inch lumber and two pieces of 2- x 4- x 36-inch lumber (detail 2, fig 7-4). Nail one 2- x 6- x 36-inch piece to the edge of one of the 2- x 4- x 36-inch pieces with five 12d nails. Place against tires with item C in place, and nail to car floor through the 2- x 4- x 36-inch piece with five 20d nails. Nail the other 2- x 4- x 36-inch piece to the one below in a like manner.
E	1	*Shoring.* Locate piece of 2- x 10- x 12-inch piece of lumber underneath front drop pad. Nail to car floor with four 20d nails.
F	6	*Wire rope, 3/8-inch.* Attach through the M167 tiedown provisions and in a complete loop through the car stake pocket at a maximum angle of 45 degrees. Attach through the M167 lunette and in a complete loop to stake pockets on each side of flatcar. Wire rope ends should overlap a minimum of 24 inches (detail 3, fig 7-4).
G	30	*Clamps, 3/8-inch.* Secure the ends of the wire rope at the overlap area with four clamps each, and space 2 1/2 inches apart with a minimum of 6 inches from ends of rope. Place one additional clamp to secure thimble and wire rope together at each stake pocket (detail 3, fig 7-4).
H	6	*Thimble, open-type, 3/8-inch.* Place one at bottom of each stake pocket through which wire rope passes (detail 3, fig 7-4).

GENERAL INSTRUCTIONS

1. Handbrake for each wheel must be firmly set, with hand levers wire-tied.
2. Tensioning of wire rope can be accomplished with an appropriate-size come-along, mechanical hoist, or equal tensioning device.
3. See General Rules 1, 2, 3, 4, 5, 9, 11, 14, 15, 19, and 19B, Section I of the Rules Governing the Loading of Commodities on Open-Top Cars and Trailers, published by the Association of American Railroads, for further details.

Table 7-5. Application of Chain Tiedowns for Securing the M163A1 on Flatcars Equipped With Cushioned Rub Rails (Fig 7-5)

Item	No. required	Application
A		*Brake-wheel clearance*. Minimum clearance required is 6 inches above, in back of, and on both sides of, and 4 inches underneath wheel (fig 7-5).
B	4 ea unit	*Shackles*. Attach an appropriate-size shackle and pin to the front and rear towing provisions, and secure the pin with a cotter key.
C	4 ea unit	*Device*. Brandon single-chain tiedown device with 1/2-inch diameter excelloy chain, or similar, proof-tested to 27,500 lb. Attach to the shackle and the car rub rail (detail 1, fig 7-5). Items D and E may be substituted for item C when required as indicated below.
D	2 ea unit	*Chain with turnbuckle.* Attach to the shackle and car rub rail (detail 2, fig 7-5). Details listed in "General Instructions," below.
E	2 ea unit	*Chain*. Attach to the shackle and car rub rail (detail 3, fig 7-5). Details listed in "General Instructions," below.

GENERAL INSTRUCTIONS

1. Shippers should specify cars equipped with tiedown devices in the quantity shown in item C when ordering specialized railroad freight equipment. If conventional chain tiedowns are provided in lieu of the tiedown devices specified in item C, they must conform to the requirements of items D and E and must be applied as follows:

a. Attach the two chain tiedowns (detail 3, fig 7-5), item E, to one end of the M163A1 and to the car tiedown facility. Make as tight as possible by hand, and attach chain hook to an appropriate link.

b. Attach the two chain tiedowns with the adjustable turnbuckles (detail 2, fig 7-5), item D, to the opposite end of the M163A1 and to the car tiedown facility. All four chain tiedowns should be made taut by tightening the turnbuckles.

NOTE

Load binders are not to be used in lieu of turnbuckles to tension tiedown chains.

2. Vehicles must face in the same direction and be uniformly spaced along the length of the car to allow sufficient space at each end of the car and between the vehicles for securement. Apply tiedowns parallel to each other at the same end of the vehicle and down from the vehicle point of attachment to the car tiedown facility. The angle of the tiedown must not be greater than 45°.

3. Handbrakes on vehicles must not be set.
4. Gearshift levers must be placed in the neutral position.
5. Open hooks must be secured with wire over the opening to prevent the hook from becoming disengaged from the chain link to which it is secured.
6. Turnbuckles not equipped with self-locking devices must be wired or locked to prevent them from turning during transit.
7. Four M163A1s can be loaded on 85-foot or larger cushioned rub-rail-equipped cars or similar railroad flatcars with center tiedown positions running the entire length of the car.
8. See General Rules 4, 5, 7, 11, and 19A, Section I of the *Rules Governing the Loading of Commodities on Open Top Cars and Trailers,* published by the Association of American Railroads, for further details.

Table 7-6. Application of Chain Tiedowns for Securing the M167A1 on Flatcars Equipped with Chain Tiedown Assemblies (Fig 7-6)

Item	No. required	Application
A		*Brake wheel clearance.* Minimum clearance required is 6 inches above, in back of, and on both sides of, and 4 inches underneath wheel.
B	4	*Chain tiedown device with 3/8-inch alloy chain.* Attach from M167A1 tiedown provisions to inside tiedown channels.
C	2	*Chain tiedown device with 3/8-inch alloy chain.* Attach from M167A1 towing lunette to inside tiedown channels.
D	1	*Shoring.* Locate piece of 2- x 10- x 12-inch lumber underneath front drop pad. Nail to car floor with four 20d nails.

GENERAL INSTRUCTIONS

1. When ordering specialized railway equipment, shippers should specify cars equipped with tiedown devices in the required

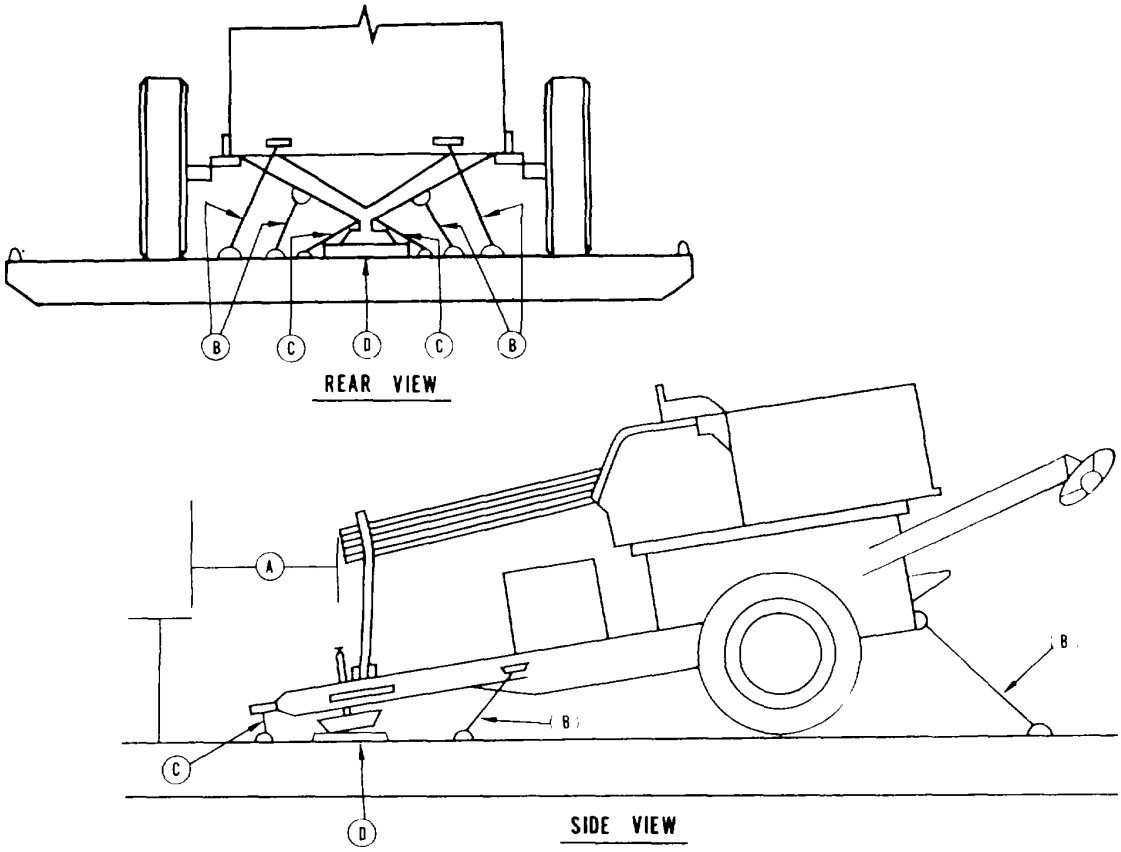


Figure 7-6. Tiedown diagram for M167A1 on OTTX or similar type of flatcar.

quantity. Chains and turnbuckles of appropriate size and strength will be used when carriers furnish cars without built-in chains and tensioning devices. Load binders will not be used in lieu of turnbuckles to tension tiedown chains.
2. Handbrakes must be set and levers must be wire-tied.
3. Open hooks must be secured with wire over the opening to prevent the hook from becoming disengaged from the chain link to which it is attached.
4. Turnbuckles used to tighten chains must be wired or locked to prevent them from turning unless turnbuckles are equipped with self-locking devices.
5. See General Rules 4, 5, 11, 15, 19, and 19B, Section I of the *Rules Governing the Loading of Commodities on Open Top Cars and Trailers* published by the Association of American Railroads for further details.

Section III. TRANSPORT ON FOREIGN RAILWAYS

7-7. General

The transportability guidance contained in this section is applicable when the M163A1 and M167A1 guns are transported on foreign railways. Considered are single and multiple movements on the types of railcars normally used to transport this type of equipment. The M163A1 self-propelled gun can be transported in its reduced height configuration, with restrictions, within European countries complying with the International Loading Gauge (formerly Berne International); in most Middle East and South American countries; and in Australia, India, and Pakistan. Clearances vary from one country to the next and within a country; consequently, evaluation of transportability capability must be made on each shipment. The M167A1 towed gun can be transported in its reduced configuration, without restriction, within European countries complying with the International Loading Gauge, in most Middle East and South American countries; and in Australia, India, and Pakistan.

7-8. Transport on US Army-Owned Foreign Service Flatcars

a. The guns can be transported on a number of US Army-owned foreign service flatcars. These flatcars are exclusively for the transport of US military material. Table 7-7 presents a few of the flatcars available in Europe that are suitable for transporting the guns.

b. The materials required for blocking and tiedown of the guns on US Army-owned foreign-service flatcars are essentially the same as those used within CONUS.

Table 7-7. Characteristics of US Army-Owned European Flatcars Available for Transporting Vehicles

Flatcar designation	Capacity	Length	Width	Platform height*
SSY**	52 ton (47.17 m ton)	31-ft 2-in (9.50 m)	10-ft 4-in (3.15 m)	4-ft 2 3/4-in (1.29 m)
SSYS	66 ton (59.88 m ton)	31-ft 2-in (9.50 m)	10-ft 4-in (3.15 m)	4-ft 2 3/4-in (1.29 m)
FFLM	90 ton (81.65 m ton)	46-ft 8-in (14.42 m)	10-ft 3-in (3.12 m)	4-ft 2 3/4-in (1.29 m)

* Above top of rail.
** German-owned SSY cars are designated RLMMP.

APPENDIX
REFERENCES

1. Army Regulations (AR)

55-15	Land Transportation Within Areas Outside the Continental United States.
55-29	Military Convoy Operations in CONUS.
55-162	Permits for Oversize, Overweight, or Other Special Military Movements on Public Highways in the United States.
55-228	Transportation by Water of Explosives and Hazardous Cargo.
55-355	Military Traffic Management Regulation.
385-40	Accident Reporting and Records.
746-1	Color, Marking, and Preparation of Equipment for Shipment.

2. Army Field Manuals (FM)

1-100	Army Aviation Utilization.
5-36	Route Reconnaissance and Classification.
55-13 (AFM 76-12)	Air Transport of Supplies and Equipment: Standard Loads in Air Force C-5 Aircraft.
55-15	Transportation Reference Data.
55-17	Terminal Operations Specialist's Handbook.
55-60	Army Terminal Operations.

3. Army Supply Bulletin (SB)

700-20	Army Adopted/Other Items Selected for Authorization/List of Reportable Items.

4. Army Technical Bulletin (TB)

55-46-1	Standard Characteristics (Dimensions, Weight, and Cube) for Transportability of Military Vehicles and Other Outsize/ Overweight Equipment (in TOE Line Item Number Sequence).

5. Army Technical Manuals (TM)

5-725	Rigging
9-1005-286-10	Operator's Manual (Crew) for Gun, Air Defense Artillery, Towed, 20-MM, M167.
9-2350-300-10	Operator's Manual (Crew) for Gun, Air Defense Artillery, Self-Propelled, 20-MM, M163.
38-236 (AFP 71-8)	Preparation of Freight for Air Shipment.
38-250 (AFM 71-4)	Packaging and Handling of Dangerous Materials for Transport by Military Aircraft.
55-450-10/1	Air Transport of Supplies and Equipment: Standard Loads in US Air Force C-130E Aircraft.
55-450-10/2	Air Transport of Supplies and Equipment: Standard Loads in US Air Force C-141 Aircraft.
55-450-11	Air Transport of Supplies and Equipment: Helicopter External Loads Rigged with Air Delivery Equipment.
55450-12	Air Transport of Supplies and Equipment: Helicopter External Loads for Sling, Nylon and Chain, Multiple Leg (15,000-pound-capacity) FSN 1670-9023080.

55-450-15	Air Movement of Troops and Equipment (Nontactical).
55-500	Marine Equipment Characteristics and Data.
55-600	Transportation Services at Continental United States (CONUS) Installations.
55-601	Railcar Loading Procedures.
55-603 (AFM 75-5)	Movement of Military Impedimenta by Commercial Carriers.
55-650	Highway Transportability Criteria for the United States.
55-2200-001-12	Transportability Guidance: Application of Blocking, Bracing and Tiedown Materials for Rail Transportation Open-Top and Closed Railcar Loading Rules.
55-2320-242-15-1	Transportability Guidance, Truck, Cargo, 1 1/4-Ton, 6 x 6, M561 (FSN 2320-873-5407).

6. Air Force Manuals (AFM)

TO 1-1B-40	Handbook of Weight and Balance Data.
TO 1C-5A-9	Loading Instructions USAF Series C-5A Aircraft.
TO 1C-130A-9	Loading Instructions USAF Series C-130 Aircraft.
TO 1C-141A-9	Loading Instructions USAF Series C-141 Aircraft.

NOTE

Air Force Technical Orders that have not been integrated into the Department of the Army publications system may be requisitioned through the Adjutant General Office in accordance with AR 310-71.

7. Department of Transportation
   a. US CG 108 Rules and Regulations for Military Explosives and Hazardous Munitions.
   b. Special Permit No. 3498.
   Commander
   Military Traffic Management Command
   ATTN: MTMC-SS
   Washington, DC 20315

8. Other Publications and Sources of Procurement
   a. Rail and Highway Shipment:
   (1) *Code of Federal Regulations Title 49*-Transportation, Parts 170-179.
   Available from: Superintendent of Documents
   US Government Printing Office
   Washington, DC 20402
   (2) Association of American Railroads *Rules Governing the Loading of Commodities on Open-Top Cars and Trailers*
   Section No. 1-General Rules.
   Section No. 6-Rules Governing the Loading of Department of Defense Material in Open-Top Cars.
   Available from: Association of American Railroads
   59 E. Van Buren Street
   Chicago, IL 60605
   (3) R. M. Graziano's Tariff No. 31 (or reissues thereof)-*Hazardous Materials Regulations of the Department of Transportation, Including Specifications for Shipping Containers*
   Available from: R. M. Graziano, Agent
   1920 L Street NW
   Washington, DC 20036

(4) American Trucking Association, Inc., Agent, Publication ICC ATA
III-C/FMC F-1-17 (or reissues thereof)-*Department of Transportation Regulations Governing Transportation of Hazardous Materials by Motor, Rail, and Water, Including Specifications for Shipping Containers*
Available from: James C. Harkins, Issuing Officer
1616 P Street NW
Washington, DC 20036

(5) International Road Federation
Limits of Motor Vehicle Sizes and Weights
Available from: International Road Federation
1023 Washington Building
Washington, DC 20005

b. Water Shipment:
Code of Federal Regulations
Title 46-Shipping, Part 146
Available from: Superintendent of Documents
US Government Printing Office
Washington, DC 20402

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
1 decimeter = 10 centimeters = 3.94 inches
1 meter = 10 decimeters = 39.37 inches
1 dekameter = 10 meters = 32.8 feet
1 hectometer = 10 dekameters = 328.08 feet
1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
1 decigram = 10 centigrams = 1.54 grains
1 gram = 10 decigram = .035 ounce
1 decagram = 10 grams = .35 ounce
1 hectogram = 10 decagrams = 3.52 ounces
1 kilogram = 10 hectograms = 2.2 pounds
1 quintal = 100 kilograms = 220.46 pounds
1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliters = .34 fl. ounce
1 deciliter = 10 centiliters = 3.38 fl. ounces
1 liter = 10 deciliters = 33.81 fl. ounces
1 dekaliter = 10 liters = 2.64 gallons
1 hectoliter = 10 dekaliters = 26.42 gallons
1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

To change	*To*	*Multiply by*	*To change*	*To*	*Multiply by*
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29,573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

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