TEA PAMPHLET 55-19 SIXTH EDITION

Tiedown Handbook For Rail Movements

TRANSPORTATION AND TRAVEL

TIEDOWN HANDBOOK

FOR

RAIL MOVEMENTS

SIXTH EDITION

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Preface

This is the sixth edition of the pamphlet. It has been reorganized to improve utility, includes new information and figures, and eliminates wooden blocking methods of securement. However, do not destroy the earlier editions because they are still usable. This pamphlet will aid the soldier in meeting the Association of American Railroads (AAR) rules thereby ensuring safe rail transport of equipment. It contains general information, procedures, and figures for the correct tiedown of military equipment on railcars.

This pamphlet covers minimum standards; your local railroad may require additional securement based on the condition of the railcar or other factors that cannot be standardized. The pamphlet is not designed to cover every vehicle in the US Army inventory. The vehicles covered in this pamphlet are those most commonly transported by rail. When in doubt, check the AAR Loading Rules or check with the mechanical department of the railroad transporting your equipment.

In this edition, we have kept the chain-tiedown information from the earlier editions while eliminating the blocking sections. Blocking and wire rope (as a primary tiedown) methods of vehicle securement are rarely used for military vehicles anymore, since chain-equipped flatcars have become widely available. Wire rope continues as a secondary tiedown material for items such as gun turrets and secondary loads. We will maintain the fifth edition on our web site for wire rope and blocking reference. On each tiedown figure, we have updated the pertinent figure and section numbers from the AAR loading rules for cross referencing.

The earlier editions lack the above changes, but they may satisfy your other needs, since many of the chain tiedown methods are unchanged. You may want to compare the sixth edition with the earlier editions to annotate changes in your earlier pamphlets, but please note, the page numbers are radically different. Because of printing costs, we are printing only a limited supply of the sixth edition. Please feel free to make copies of the pamphlet at your own discretion.

We invite users of this pamphlet to recommend changes and submit comments. Please prepare comments on DA Form 2028 (Recommended Changes to Publications and Blank

Forms) or in a similar format and forward to the address given on the back of the title page (p. ii).

We now have this and other publications available on the Internet at http://www.tea.army.mil/ in Adobe Acrobat Reader (.pdf) format. The pamphlets are specifically at http://www.tea.army.mil/dpe/FIELD.HTM.

Contents

List of Illustrations

Page

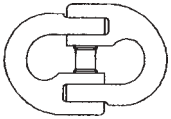
What is *That* Called?

Slip hook

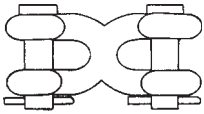
Grab hook

Claw hook

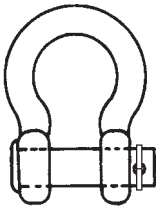
Adjustable double grab hook



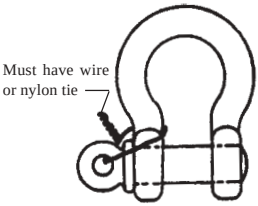
Coupling link



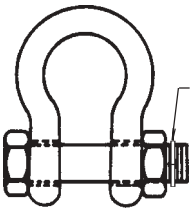
Double clevis chain link



Round pin anchor shackle
(not recommended for rail tiedown)



Screw pin anchor shackle



Safety anchor shackle

Notes

Section I. Requirements for All Equipment

A. This pamphlet provides users with the proper methods for securing wheeled and tracked vehicles on the chain-equipped flatcars that are now widely available to the military. It contains basic information from the Association of American Railroads (AAR)[1] and from experience gained through monitoring many military rail loadouts during deployments.

B. Remember, all equipment loaded onto flatcars must be firmly and properly secured to counteract longitudinal, lateral, and vertical forces. AAR General Rules require both the rail carrier (See footnote 1, Rule 1.2.2, Section No. 1) and the shipper (See footnote 1, Rule 1.2.3, Section No. 1) to comply with all applicable loading rules and observe the drawings and specifications of applicable figures. The AAR rules are divided into two categories: "General Rules" (Section No. 1) covering the approved materials and methods of load securement and "figures" (Section No. 2 through 7) covering specific commodities including items such as military vehicles and equipment. The AAR rules are mandatory for Government shippers. Flatcars loaded with your equipment will not move until the railroad inspects and accepts them as safe loads. The railroad inspector has the final word if a specific figure is not involved. This pamphlet was published in accordance with the AAR loading rules; however, follow the AAR loading rules if any conflict arises with this pamphlet.[2] If, in such a conflict, you feel you have followed all the rules and want a second opinion or some help resolving the issue, call the DOD-AAR Representative, Mr. Robert Kerr at (757) 599-1645 or DSN 826-4643.

C. The following general procedures apply to all types of flatcars.

1. Gearshift Levers and Brakes

Place gearshift levers of automatic or manual transmissions in neutral and secure with

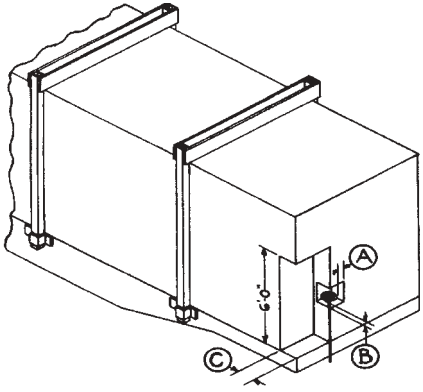
[1]*AAR Open Top Loading Rules Manual* (OTLRM), Section No. 1, General Rules for Loading All Commodities; Section No. 3, Rules for Loading Construction and Farm Machinery; Section No. 6, Rules for Loading Military Equipment and Materiel; and Section No. 7, Rules for Loading All Commodities on Open Top Trailers and Containers for Rail Transport. Toll free 877-999-8824 (Washington, DC: AAR, Revised Annually.) Reference is made throughout this pamphlet to the underlying provisions in the AAR OTLRM.

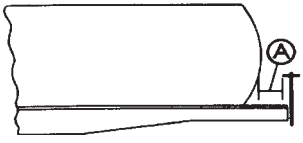
[2]See footnote 1.

wire. Set all parking brakes and then wire tie or block the hand levers. Setting the brakes is a precaution against the vehicle rolling inadvertently and not part of the securement. Generally, set the brakes after the chains are tightened, however, some vehicles require engine power to set the brakes, which may be set once the vehicle is spotted. [Never set the test item brakes when performing the MIL-STD-810 rail impact test. This verifies that brakes are not part of the securement.]

2. Brake Wheel

Allow a 12-inch minimum clearance from the end of the car, 6 inches around and above the brake wheel, and 4 inches below the brake wheel (fig 1). Note that side-mounted brake lever clearance need not be taken into account. (See footnote 1, Rule 2.1, Section No. 1)





Item	Description
A	6 in. clearance in back, on both sides of, and above brake wheel, except as shown for tanks and similar shapes in one piece.
B	4 in. clearance underneath brake wheel.
C	12 in. minimum clearance from end of car to load, extending from center of brake wheel to side of car and 6 ft. above car floor. On gondola cars this space may be utilized from floor of car to 4 in. below bottom of brake wheel, Item "B."

Figure 1. Brake wheel clearance.

3. Vehicle Spacing

The AAR rules state: "1.2.22 Separate piles or units loaded on one car may be secured to different specific figures or General Rules and located not closer than 2 feet to the adjacent pile or unit. Vehicles with spring suspensions secured to different figures or General Rules may be loaded closer than 2 feet but not less than 10 in. apart. 1.2.23 Cargo such as trailers and fork trucks may be loaded with the tongue or forks beneath the next vehicle, provided that points where the vehicles may touch are separated by a minimum horizontal distance of 10 in. and the tongue or forks are secured against vertical displacement."

4. Securing Movable Structure

Equipment with rotating parts, such as tank turrets, and movable parts, such as crane outriggers and booms, must have those parts positively secured, usually with wire rope. (rules 6.1 to 6.3) This prevents the parts from moving out or up during shipment. Serious accidents can result from parts striking bridges, structures, or passing trains.

5. Forty-Five Degree Tiedown Angle

Place the vehicles on the flatcar so the tiedown wire rope or chain makes approximately a 45 degree angle with the flatcar's deck when viewed from the side. Measuring by eye is usually good enough. If you want to layout the correct angle with a tape measure, make the longitudinal distance from the point the tiedown attaches to the deck to the tiedown provision on the vehicle equal to the vertical distance from the deck to the provision (fig 2). Do not cross the tiedowns.

6. Inverted Tiedowns

Inverted tiedowns are tiedown chains or wire ropes that are secured under the vehicle rather than out, away from the vehicle (fig 3). Inverted tiedowns are only appropriate in cases in which the tiedown does not contact any part of the vehicle except the tiedown provision. Do not use inverted tiedowns if the tiedown bears on the bottom of the bumper or frame of the vehicle. For example, some trailers do have tiedown provisions that are mounted below the frame such that inverted tiedowns can be used. Another consideration is the vehicle ground clearance. To use inverted tiedowns, there must be enough space under the vehicle for a soldier to adequately secure the tiedowns.

7. Tiedown Provisions

The procedures in this pamphlet generally cover equipment that was manufactured to meet MIL-STD-209, *Interface Standard for Lifting and Tiedown Provisions*. MIL-STD-209 provides for adequate strength tiedown provisions for all modes of transport including rail. Some equipment requires specialized procedures, which will be described on a MIL-STD-209 data plate attached to the equipment. MIL-STD-209 is available at http://assist2.daps.dla.mil/quicksearch/ or at http://www.tea.army.mil/pubs/nr/deploy/transinstruction/MIL-STD-209J.pdf

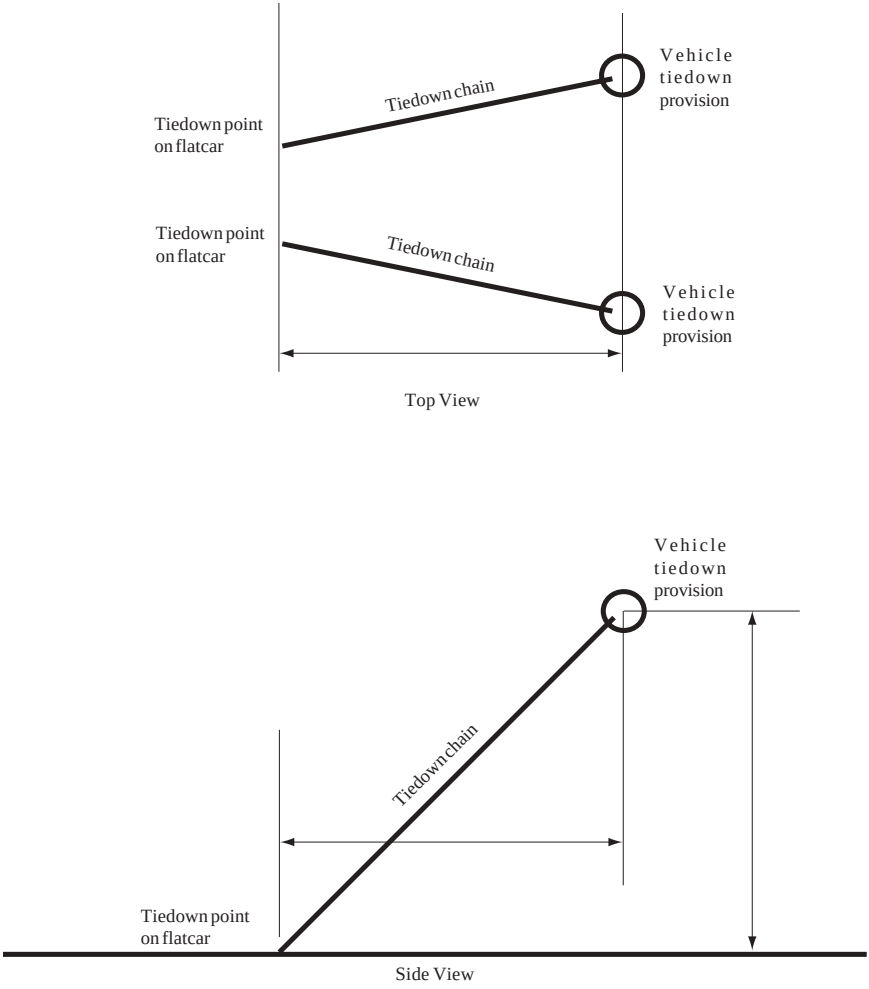


Figure 2. Angle of 45 degrees in the side view; the dimensions shown are all equal.

Figure 3. Inverted tiedown on the trailer.

D. WIRE ROPE

Wire rope is used to secure movable parts on equipment, such as the barrel and turret on the M1 tank and the rear door (ramp) on the M577 tracked vehicle. Secure the wire rope using clamps. Apply the clamps, also called clips, fist distance apart, with the saddle against the tension-bearing side of the wire rope and the U-bolt against the dead end. The clamp must be the same size as the wire rope being used (fig 4). Tension the wire rope by pulling tight by hand for movable parts mentioned above. For secondary loads, tension the wire rope using a hoist (chain or wire rope) with two cable grippers, as shown in figure 5. A properly tensioned tiedown will deflect no more than about an inch with the weight of a person standing on it. Be sure that at least 24 inches of wire rope overlap to allow proper application of cable clamps. Alternately tighten the nuts and torque cable clamps to the following guideline values:

45 foot-pounds for 3/8-inch wire rope
65 foot-pounds for 1/2-inch wire rope
130 foot-pounds for 5/8-inch wire rope

If the clamps break before reaching the above torques, use six instead of four clamps for a complete loop and torque to a value just below the breaking point.

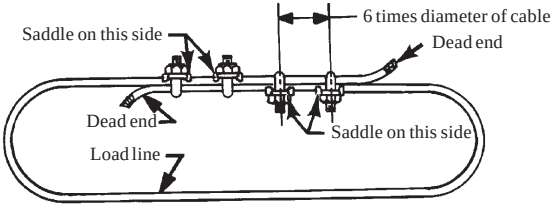


Figure 4. Complete loop wire rope assembly.

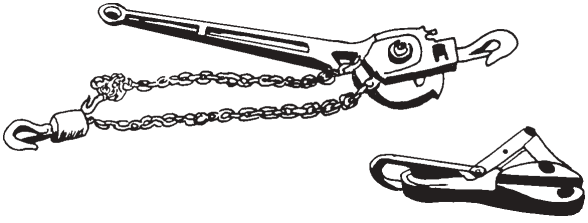


Figure 5. Chain hoist and cable gripper.

E. CHAIN TIEDOWN

Most CONUS chain-equipped flatcars have either 3/8- or 1/2-inch steel alloy chains. Apply chain hooks over the vehicle tiedown shackles, rather than under. Wire (or secure by other suitable means such as nylon tie straps) the grabhook to the chain link, as shown in figure 6, to prevent disengagement. If turnbuckles (used to tighten chains) are not equipped with jamnuts (fig 7) or a locking device, they must be wired to prevent them from loosening.

Apply tiedown chains symmetrically around the vehicle with an angle from deck to chain of about 45 degrees. Do not cross the chains. Completely seat the chain anchors in the channels, as shown in figure 8. When attaching chains to the vehicle, secure the shortest chains first and the longest chains last. A properly tensioned tiedown will deflect no more than about an inch with the weight of a person standing on it.

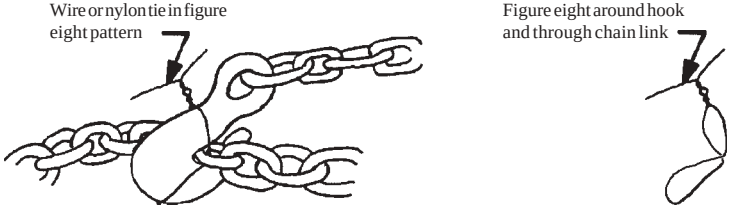


Figure 6. Proper securement of grabhook and chain link.

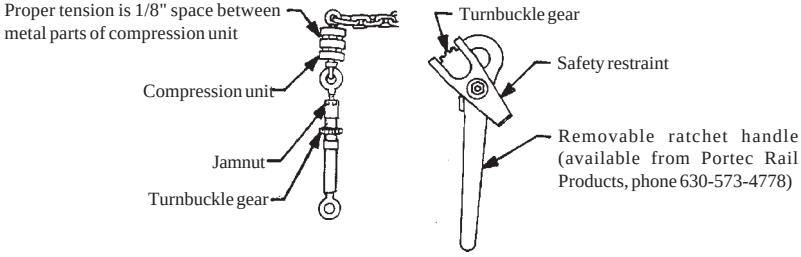


Figure 7. Turnbuckle.

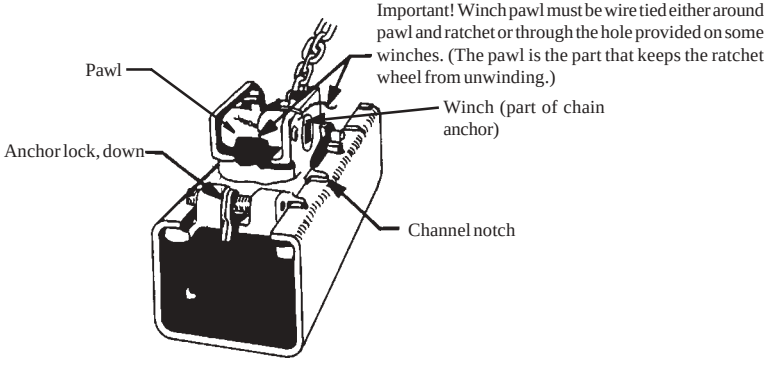


Figure 8. Chain anchor and chain anchor channel.

The general guidelines for securing wheeled vehicles on chain-equipped cars by diameter of chains are given in the following table (See footnote 1, page 1, Figure 88-B, Section No. 6):

Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-8,500	3/8	6,600	4
8,500-16,000	3/8	9,000	4
16,000-25,000	3/8	9,000	8
16,000-25,000	1/2	11,250	4
25,000-40,000	1/2	13,750	4
40,000-55,000	1/2	13,750	8
55,000-80,000	1/2	13,750	12

For vehicles not covered above, use the following formula to determine the number of chains required (See footnote 1, page 1, Rule 5.3, Section No. 1). The weight of Army equipment is printed on bar-code labels applied to both the front and side of each item. The minimum breaking [force] strength of most alloy chain is about four times the working load limit (WLL), and the proof load is typically two times the WLL. Chain-equipped flatcars used to be stenciled with the proof [test] load of the chains and the AAR figures were often in terms of proof loads. If you have a known proof load for a chain, divide the proof load by two to get the WLL for that chain. The National Association of Chain Manufacturers (NACM) states that "The Proof Test and Minimum Breaking Force shall not be used as criteria for service or design purposes."

$$\text{Number of chains required} = \frac{\text{vehicle weight}}{\text{chain working load limit}} \times 2$$

The tables provided with the figures in appendix A, B, or C are based on this formula or on specific figures. However, when using this formula in the field, the user must realize that it yields the least number of chains required. Most vehicles have four tiedown provisions, and each provision must have the same number of chains attached to it. Also, the number of chains restraining movement in one direction (either longitudinal or lateral) must equal the number

in the opposite direction (this is called symmetry). This usually results in the number of chains required being a multiple of four, that is 4, 8, 12, 16, and so forth. If the resulting number of chains derived from the formula does not provide for a symmetrical configuration, add chains such that each tiedown has the same number and equal numbers oppose each other. For example, if the formula yields 9 chains required, use 12 chains to establish symmetry about the 4 tiedown provisions.

The DODX 41000- and DODX 42000-series flatcars and repaired chains on some of the DODX 40000-series flatcars are equipped with turnbuckle locking sleeves as shown in figure 9. The lock nut (if present) need not be used if the locking sleeve is properly applied.

As you remove chains preparing to unload flatcars, place the chains into the anchor channels, so the chains cannot fall off the side of the car. Chains hanging off the side of the cars can cause injuries, cause derailments, and destroy railroad infrastructure.

Figure 9. Turnbuckle locking sleeves.

F. STEEL BANDING/STRAPPING

Steel banding can be used to secure secondary loads and to prevent some items from extending out over the flatcar sides. For instance, expansible vans are often banded to prevent the sides from expanding during rail transport. Rule 17 in Section No. 1 (see footnote 1, page 1) explains the requirements for banding. A new part of the rule requires periodic testing of the sealing tools to make sure they continue to produce joints of adequate strength. The following excerpt gives some of the detailed requirements:

"**17.2.9.4 Tool and Joint Condition Testing**

17.2.9.4.1 The compatibility and condition of the materials and joint-making tools for load securement bands must be verified. This is to be done by subjecting sample band joints to laboratory testing at periodic intervals to ensure that minimum joint strength is being consistently obtained.

17.2.9.4.2 Testing is to be done on at least an annual basis, or after a maximum cycle time of 3,000 applications, whichever occurs first. Testing is to be conducted in accordance with Rule 17.4, except as noted here regarding the number of test samples and test-record handling. Testing is to be performed by either the banding or tool manufacturer, or other certified testing facility. The latter may include a user's own test equipment, provided all required test functions can be achieved, and evidence of industry-recognized certification of the test equipment can be readily produced upon request by the AAR or its designated representative.

17.2.9.4.3 Users must maintain documentation of all test results for the most recent 2-year period. Current test records of the results of each individually identified tool are to be maintained and made available for inspection upon request.

17.2.9.4.4 Each joint-making tool is to be stamped or otherwise permanently marked with a distinctive and legible identification mark or serial number. A minimum of three band-joint samples, made with each tool used in the application of steel bands on loads for rail transport, must be subjected to testing. If a tool is used to make more than one type or size of joint, each type and size must be tested accordingly.

17.2.9.4.5 All sample band joints must be made using AAR-approved banding. Each sample is to be at least 18 in. long with the joint centered between the ends of the sample. Each sample must be legibly marked with the identification of the equipment with which the joint was actually made. This information is to be verified and documented in the record of testing by the tester, and attested to by the tester signing the test report."

Section II. Wheeled Vehicles

All wheeled vehicles must have their tires fully inflated to highway pressure for rail transport. The tires must be capable of holding that pressure for at least the length of the trip. Tires are a part of the securement of the vehicle in that, if a tire goes flat, it will leave the tiedowns loose. Also, flat tires have started fires on moving trains by rubbing on the flatcar deck.

A. TRAILERS AND SEMITRAILERS

Most units prefer to transport trailers attached to their prime mover as shown in appendix A (pp. A-8 and A-9). This minimizes the loading and unloading time and generally simplifies the tiedown procedure by eliminating any blocking required to support the lunette or kingpin. Semitrailer landing legs cannot bear the shock of rail movement and must be raised at least 4 inches above the deck of the flatcar.

Semitrailers that do not have dedicated prime movers can be shipped on specialized flatcars with retractable hitches or stanchions (p. A-10). The entire restraint is provided by the hitch being locked on the semitrailer kingpin. This method of loading is called trailer-on-flatcar (TOFC). The hitches can only accommodate 2-inch kingpins and semitrailer gross weights up to 65,000 pounds. Trailers shipped by TOFC must meet AAR specification M-931, "Highway Trailers, All Types, for TOFC Service." Trailers meeting the latest version of M-931, 1 May 1999, will have a "certification plate" adjacent to the DOT certification label. Some semitrailers can exceed the weight limit and may have 3-1/2-inch kingpins, and thus, cannot be shipped by TOFC.

The M969A2, M969A3, and the M967A2 are the only semitrailer tankers that are capable of rail transport loaded with fuel. Shipment of tankers by TOFC with fuel requires special permission from the Federal Railroad Administration (FRA) through MTMC Operations.

B. VEHICLES ON BI-LEVEL FLATCARS

Bi-level flatcars may be used for smaller vehicles. The tiedown procedure is the same as for single-deck chain-tiedown flatcars. The types of chain assemblies on bi-level flatcars vary widely. Your local railroad can provide details about the chain assemblies on and the dimensions of bi-level flatcars. Before using bi-level flatcars, check their dimensions to be sure

sufficient clearance exists for the driver to get into or out of the vehicle after the vehicle is loaded on the flatcar. Also, make certain your destination has ramps to unload the cars you use. When you order bi-level flatcars make certain that the railroad knows they will be used for military vehicles. Many bi-level cars are equipped with restraint devices such as frame tiedown T-hooks that are not suitable for most military vehicles. Make certain that the total load on each deck of the bi-level car does not exceed 40,000 pounds.

C. GRATE/LOCK CHOCKING SYSTEM (GLCS) ON BI-LEVEL CARS

The GLCS (fig 10) has been tested and approved by the AAR for HMMWVs without trailers. Use four chocks per HMMWV, carefully following the instructions posted inside the bi-level car. In addition to those instructions, the HMMWV brakes must be set hard, the engine must be in neutral, and the transfer case must be in four wheel drive, low range.

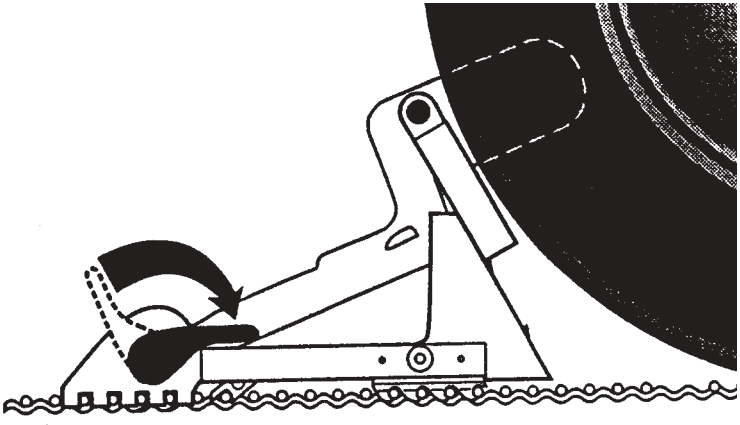


Figure 10. Grate/Lock Chock.

Section III. Tracked Vehicles

A. SHACKLES

Most existing tracked vehicles do not have tiedown shackles as basic issue items (BII). The towing hooks are not suitable for rail securement. Pack the towing hooks and use the towing lugs for tiedown by equipping them with shackles. Select the largest and strongest shackles that will fit the towing lugs.

TACOM has developed a special shackle suitable for light tracked vehicles. The national stock number (NSN) is 4030-01-369-7612, which will get you a 1-inch shackle, labeled WLL 12.5 T (25,000 pounds, working load limit (WLL)), on which the pin has been replaced with a 1-inch grade 8 bolt. The end of the bolt must be wired or secured by other suitable means to prevent the nut from vibrating off during rail transport.

For medium-sized vehicles, use the shackles developed for the Bradley, NSN 4030-01-187-0964. These shackles have a 1-3/8-inch-diameter pin and are labeled WLL 21 T. The 21 T shackle (210,000 lbs min breaking strength) is a 1-1/4 inch size safety anchor shackle with a 1-1/4-inch body, a 3-1/4-inch-diameter opening at the bow, and a 1-3/8-inch bolt pin. No wire tying is necessary on this shackle if the cotter pin is in place.

Heavy vehicles require either the special unmarked military shackles developed for the DODX 40000-series flatcar or the 21 T shackles. Some vehicles may still need the link (ring) in the pintle as a tiedown provision. The unmarked military shackles have a 1-1/2-inch body, a 4-inch-diameter opening at the bow, and a 1-3/8-inch-diameter screw-pin and were bought by part number which follows (by unmarked we mean no WLL, manufacturer, nor size marking; many are indeed marked "Japan"). Any tiedown point that requires three chains requires the 4-inch-diameter or larger opening shackle. For tiedown points that require no more than two chains, the 21 T shackle may be used. The above numbers of chains allowed per shackle are based on DODX flatcars that have a slip hook at the free end of each chain assembly. On flatcars such as HTTX on which the chain assemblies have no slip hook, the chain is passed through the tiedown shackle and secured to itself with an adjustable double grabhook. Up to four 1/2-inch chains can be passed through the 21 T shackle. The unmarked military shackles are in the supply system, but they are not stocked and cost $93.38 each

(as of 1 May 2003) using NSN 4030-01-391-2790. These shackles have the following manufacturers' part numbers:

Shackle: MacLean-Fogg 61284 or Midland Forge MK0267

Link or Ring: MacLean-Fogg 61283 (optional for M1)
(While no longer essential for rail transport, the Air Force very much wants the link (ring) for air transport)

The manufacturer of the MK0267 shackle is Columbus McKinnon Corp., Midland Forge (319) 362-1111.

The following suppliers can provide the MacLean-Fogg shackle and link:
(MacLean-Fogg is no longer in this business, but the part numbers are recognized by the other suppliers.)

Holland Company (708) 672-2300 extension 779

John Sakash Company (630) 833-3940

You may use lifting provisions for tiedown if they are located so the wire rope or chain does not bear on the body of the vehicle. Lifting provisions are often large enough for tiedown without using shackles. A good example of usable lift provisions is the rear lift provisions on the M1 tank.

B. TRACKED VEHICLE TURRET RESTRAINT AND SIDE OVERHANG

Once the tracked vehicle is in place on the flatcar, tie the gearshift lever in the neutral position. Set the brakes if available. Wire the turret lock and elevating mechanisms in place, and engage any hull-mounted barrel lock. Ensure that two complete wire rope loops have been put around the barrel and secured one to each side of the hull (details given below). This procedure provides positive visible protection against the barrel elevating or the turret turning.

Many tracked vehicles are wider than the flatcar. Therefore, when loading tracked vehicles onto flatcars, be sure to center the vehicle on the flatcar. The overhang of the vehicle on each side of the flatcar must be equal to avoid rail clearance difficulties. Measure the overhang on both sides from the car side to the edge of the vehicle's track. The allowable

variation is when the two measurements, one subtracted from the other, have a difference of 1 inch or less. This results in the load's longitudinal centerline being no more than 1/2-inch away from the flatcar's longitudinal centerline.

If applicable, wrap cushioning material (waterproof paper, burlap, or plastic—to protect the paint) around the gun tube, and secure the gun tube with one complete loop of 3/8-inch wire rope, with two clamps, to a lifting eye on each side of the gun tube (a total of 2 complete loops). On the M1 tank, use the engine hatch cover lifting eyes as the hull attachment points for the wire rope loops. Hand tension the wire rope, but fully torque the clamps. This must be checked at the flatcar loading site, but will be easier to apply at the motor pool before loading begins.

The bridge sections of tracked vehicles used as bridge launchers normally must be removed and shipped separately.

For further guidance, check the vehicle data plate, operator's manual, and on older vehicles, the transportability guidance technical manual applicable to the vehicle being secured.

C. TRACKED VEHICLES ON CHAIN-EQUIPPED FLATCARS

The size and number of chains required will depend on the size and weight of the vehicle. Slip hooks as used on the DODX 40000-, 41000-, and 42000-series flatcars should be applied to tiedown provisions with the point down (fig 11). If the hooks are placed horizontally, they can point either direction.

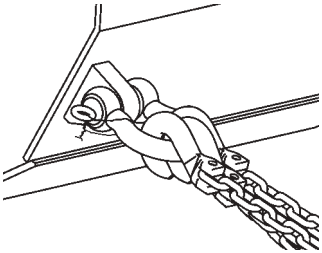


Figure 11. Slip hooks with the point down.

NOTE

Armored personnel carriers are shipped on a variety of commercial chain-equipped cars; however, the M2/M3 Bradley can be easily shipped only on HTTX, DODX 41000- series, and similar cars. The DODX 41000-series can carry one and only one M1 tank. The recommended flatcar on which to ship the M1-series tanks is the DODX 40000-series flatcar. It has the ability to transport two M1 tanks, and it is equipped with thirty-six 1/2-inch special alloy, 13,750-lb working load limit (WLL) chains. The DODX 40000-series flatcars are no longer equipped with shackles or links (rings), so any shackles or links used should be unloaded with the vehicles and, ideally, should be assigned to and kept with the vehicles. See also “Section IX. Flatcar Types” on page 30.

Section IV. Tools for Rail Loading

Table 1 outlines the suggested rail loading toolkit needed by personnel conducting a rail outload in CONUS. Specific information on some items follows the table.

Table 1. Suggested CONUS Rail Loading Toolkit

Quantity	*Item*	*Remarks*	*National Stock Number*
1pr	Pliers	Side cutting or slip-joint (8-inch)	5120-00-239- 8251 or 5120-00-059-6711
2	Puller, hoist	Cable puller (used with cable grips), 4000-pound capacity	5120-01-337-6485
2	Ratchet	1/2-inch square drive, reversible	5120-00-230-6385
1	Removable turnbuckle handle	To rapidly tighten turnbuckles with turnbuckle gear	Available from Portec Rail Products, Inc. Phone 630-573-4778
1	Screwdriver	Common, 8-inch	5120-00-596-9364
2	Socket	1/2-inch square drive, 3/4-inch (12-point)	5120-00-189-7985
2	Socket	1/2-inch square drive, 7/8-inch (12-point)	5120-00-189-7934
2	Socket	1/2-inch square drive, 15/16-inch (12-point)	5120-00-189-7935
2	Tape measure	Steel, 12-foot, recoil type	5210-00-182-4797
1	Torque wrench	1/2-inch square drive, for wire rope clips	5120-00-640-6364
1	Wire cutter	steel wire cutter	5110-01-473-9293
1	Wire rope cutter	Hydraulic, 1-1/8-inch cable capacity	5110-00-224-7058

Table 1- Continued

Quantity	*Item*	*Remarks*	*National Stock Number*
1	Brace and bit or electric drill	To predrill lumber for spikes, if needed	5110-00-293-1958 or 5130-00-935-7354
1	Drill set, twist	Sizes 1/16 to 1/2-inch by 16ths	5133-00-293-0982
4	Cable grip	.162 to .552-inch capacity .5 to .75-inch capacity	5120-00-238-4436 5120-00-224-2661
1	Chain saw	Gasoline-engine-driven, 10-inch bar (requires chain lubricating oil and gas/oil fuel mixture for two-cycle engines)	NA
2	Claw & pinch bar	30-inch length	NA
1	Drift or pin punch	1/8-inch point, .313 stock diameter,8-inch length	5120-00-240-8898
1	Flex handle (breaker bar)	3/4-inch square drive, 20 inches long	5120-00-221-7959
10pr	Gloves, work	Leather or leather-palm	NA
3	Hammers	1-pound 2-pound 3-pound	5120-00-061-8543 5120-00-061-8546 5120-00-900-6111
2	Marker crayon	One black, one yellow (no stock info)	7510-00-285-1730
2	Monkey wrench	Lightweight, 10.25 to 13.75 inches long, 2.125-inch capacity	5120-00-293-3009
1	Nailpuller	If not on pliers	5120-00-542-4828

A. SOCKET

Users must check socket sizes against actual hardware that will be used. The nut size used on wire rope clamps varies by manufacturer and by clamp size.

B. FLEX HANDLE (COMMONLY CALLED "BREAKER BAR")

For tightening the chain and the anchor block of a chain-tiedown assembly, this tool is more effective than a 3/4-inch drive ratchet. It costs much less than a ratchet and is less likely to be pilfered. An even more cost-effective substitute would be a locally fabricated tool made of 3/4-inch square bar stock, cut into 20-inch lengths, and bent 90 degrees on the end (2 or 1-1/2 inches) of each bar. This would form, in effect, a huge Allen wrench, and would be as effective as a more expensive tool since the chain winch usually requires only one-half to three-quarters of a turn to tension the chain. Do not use a cheater bar or pipe extension handle on the wrenches, or you could over tension and break the chain assembly or break the wrench.

C. MONKEY WRENCH

Some chain tiedowns are tensioned by a turnbuckle (see fig 6) with a tubular body in the chain assembly, rather than by a winch in the anchor block. Although the slack can be taken out of the chain by manually twisting the turnbuckle (which gives the tiedown the appearance of being tight), additional tension is necessary and can be applied with a wrench, since one end of the turnbuckle body has a 1-1/2-inch hexagonal section. A 15-inch adjustable wrench is the smallest that will open to 1-1/2 inches. But, a much smaller (11-inch), and less expensive, monkey wrench will open to 2-1/2 inches, for turning the turnbuckle and for other uses requiring a general-purpose wrench. Two wrenches are needed, one to hold the turnbuckle and one to set the jamnut.

D. GLOVES

Leather or leather-palm work gloves must be worn by persons loading flatcars. The gloves may be included in the toolkit or issued by the unit supply section. Regardless, gloves must be worn for safety reasons. Leather gloves must be locally purchased.

E. CHAIN SAW

A small gasoline-engine-driven chain saw with a 10-inch cutter bar is useful for cutting

lumber at the loading area. One saw with a qualified operator is sufficient at each loading site (not one saw per toolkit). With the use of blocking diminishing, the chain saw may not be needed at the loading site.

Any lumber items needed should be delivered to the loading site in precut, usable lengths. This allows the chain saw to be used only for cutting special blocking and bracing pieces for unusual equipment or for special cases. Handsaws are far too slow and are usually kinked by inexperienced "carpenters."

Section V. Tips and Common Mistakes

A. PREPARING VEHICLES PRIOR TO LOADING

1. Be sure that all lifting and tiedown shackles are attached to the vehicle. Do not use bumperettes, axles, towing pintles, or towing hooks as points of attachment, except where specifically shown in a figure.

2. Make sure fuel tanks are no more than three-quarters full. Jerry cans are either DOT 5 metal or POP (performance oriented packaging) certified plastic 5 gallon containers. The safest transport is empty and purged of fuel. The POP certified containers are less likely to leak than the metal ones and are, therefore, the preferred type if you must transport fuel.

3. Remove or band canvas and bows to prevent wind damage.

4. Protect windshields from thrown rocks (if needed; this is a local decision). Notched plywood banded in place works well. Remember, what you use will have to withstand sustained high wind in either direction on the moving train.

5. Reduce vehicles to their lowest configuration (for shipping or if appropriate).

6. Secure any materials or equipment loaded in the beds of trucks by banding or other means. Such loads are called nested or secondary loads. Bands (also called steel strapping) should be at least 3/4 by 0.020 inches and must be AAR approved. Bands must be applied with the AAR approval marking facing out. Make certain the band sealing tool inspection and testing records are up to date (see page 10). You may also use wire rope properly secured with clamps, see pages 5 and 6. Nylon straps are not AAR approved. Hemp, sisal, manila, and other natural and man-made fiber rope is not an approved tiedown for secondary loads. Polyester webbing is approved for vertical tiedown only; lateral and longitudinal restraint must be by other approved materials. Do not load secondary loads on noncargo areas of equipment such as van tops and vehicle sides.

7. Make certain that hood latches are functional and secure (wind can tear hoods off). Vehicles may travel facing forward or backward or both on a particular rail journey.

8. Inflate tires to highway pressure. Repair or replace leaking tires. As a last resort, block up the axle with solid blocking so no load rests on the flat tire. A flat tire on a truck loaded on a moving train can cause a fire due to the rubbing of the wheel on the pinched double layer of tire rubber against the deck.

9. When unloading flatcars, stow the chains in the chain anchor channels. For safety reasons, the chains must be stowed to prevent them from hanging through the deck or off the sides of the flatcars.

10. Install the rail transport locking pins on all PLS and LHS flatracks loaded on the trucks and trailers on both sides (see pages A-3 and A-4).

B. PREPARING FLATCARS FOR LOADING

1. Inspect flatcars to verify deck suitability. Holes in decking, bad order safety appliances, and so forth, must be repaired by the railroad prior to loading, or the car must be rejected by the installation transportation officer (ITO) or his representative at a port or activity. On chain-equipped cars, anchor channels should not be bent, and all chains and tightening devices should be operative. Loading teams should have a rust retardant oil available to free frozen locking devices.

2. Chock flatcar wheels to prevent movement while loading.

3. Store unused chains in the channels to prevent damage when loading vehicles.

4. Clean debris from anchor channels on chain-equipped cars to allow locking devices to be moved the length of the channel. Remove any protruding nails from the deck of the car (they are a tripping hazard).

C. LOADING VEHICLES

1. Use flatcar and ground guides when loading vehicles. Guides should keep one flatcar distance between them and the vehicle being loaded. A guide should never walk backwards on a flatcar onto which a second vehicle is being loaded. Before directing the loading of a second vehicle, the flatcar guide should mount the previously loaded vehicle to avoid being crushed between the vehicles.

2. When loading wheeled vehicles, use spanners strong enough to support the heaviest load anticipated and properly position them (see p 27). When loading vehicles between flatcars of unequal deck heights, be sure to place dunnage under the spanner to prevent it from slipping. When driving on spanners, try to maintain a constant speed; avoid four-wheel drive, jamming on brakes, and reversing. For added safety, use nylon straps to secure spanners between flatcars.

3. Be sure to leave at least 10 inches between vehicles to avoid damage in transit and to obtain a proper angle of tiedown.

4. When loading wheeled vehicles on multilevel flatcars, exercise care when going from one flatcar to another. Loading decks may be set at different heights, thereby causing the top of the vehicle to strike the upper deck. Load bottom decks first since the upper deck ramps may block the lower deck.

5. Do not overload cars. Check the weight on each car against the load limit stenciled on the side of the car. Try to keep the loaded center of gravity on each carload below 98 inches. This is not an issue with most military equipment, but can arise with heavy secondary loads. Speed restrictions apply if the combined center of gravity is above 98 inches.

D. SECURING VEHICLES

1. Turn turntable-type winches in the proper direction so that the chain is taken up on the underside of the ratchet wheel (fig 12).

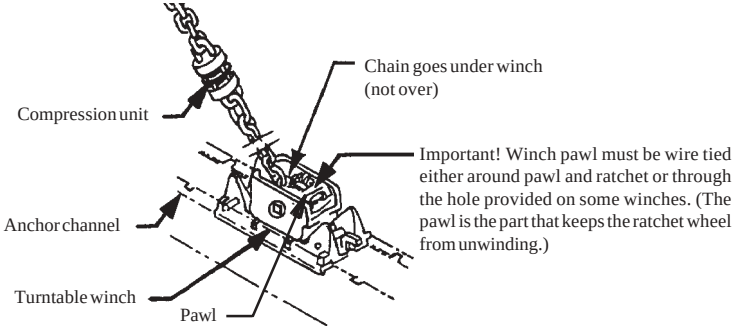


Figure 12. Correct position of chain anchor winch.

2. Be sure proper tension of wire rope or chains exists. Tension wire rope to allow no more than 1-inch deflection when supporting the weight of a full grown man. Tension chains to achieve a moderate deflection of the vehicle's suspension. After initially tensioning each chain, strike it sharply with a hammer or bar and retighten. Repeat this step if necessary. This helps the links seat in their longest length and helps prevent loose chains in transit.

3. Stow excess chain in the anchor channel.

4. On chain devices, secure open hooks (grab hooks) to the chain link with wire or nylon tie strap. (This does not apply to claw hooks or to slip hooks applied directly to a tiedown provision.)

5. Lock chain-tightening devices with wire. Turnbuckles must have jamnuts tightened wrench-tight with two wrenches or must have locking sleeves, which must be lowered to eyebolt.

Section VI. Comparison of the Rail Shock Environment

In North America, Europe, and Korea

Railcars in North America use automatic couplers, while in Europe, railcars are linked together manually. Automatic couplers tend to encourage impacts to ensure engagement of the coupler mechanism. The railroad companies admonish their employees not to impact cars faster than 4 mph, but higher impacts sometimes occur. The Association of American Railroads (AAR) impact test, used to verify the safe loading procedures for most commodities, calls for impacts of 4, 6, and 8 mph and then 8 mph in the opposite direction. Military vehicles must pass the MIL-STD-810 version of the AAR test to receive transportability approval.

The automatic couplers are attached to the car frame through a draft gear that may be standard or cushioned. The division between standard and cushioned is travel of less than 5 inches for standard and greater than 5 inches for cushioned. Standard draft gear travel is usually about 2 to 3.5 inches. Cushioned draft gear travel is usually about 9 to 15 inches. The draft gear provides shock mitigation in buff (compression), and if not extended, in draft (tension) but also adds slack to a train. Slack is the difference in length of a train between being bunched together and being stretched out.

The European cars do not have automatic couplers. Instead, they are coupled by hand using a turnbuckle-like device that draws the cars together. European cars have buffers, one at each corner on the ends, which are pulled together and compressed by the coupling device. This arrangement limits the slack in European trains. The Korean railroad uses automatic couplers similar to those in North America, but the flatcars are typically loaded and unloaded as a unit train, so the cars are not as likely to be uncoupled and coupled as in North America.

Railroads in North America operate significantly longer trains than in Europe. The longer trains, combined with the major difference in coupling systems, lead to higher shocks in moving North American trains. As a train goes up and down hills, accelerates, and applies the brakes, the slack runs in and out, propagating shocks as the cars rapidly change velocity. In some areas of North America, trains are limited to 60 cushioned cars because of the severity of the shocks produced by the terrain and the slack. Cushioned cars are typically used for military moves. For other operational reasons, the railroads would run trains of over 100 cars. European trains usually consist of 20 to 40 cars. Korean trains are typically limited to 22 cars

due to the length of passing sidings, so in-train shocks due to slack would be significantly less than in North America.

Heavier loads are transported on trains in North America. Allowable railcar axle loads in North America are roughly 50 percent higher than those in Europe and Korea. That means that the mass (weight) of each car in North America may be significantly higher than in Europe or Korea, thereby contributing to higher shock levels. This is true of military trains, since a North American 89-foot car will hold more vehicles than a typically used European 61-foot (18 500-mm) flatcar with the same number of axles. Korean cars are shorter than North American cars, also having the effect of lowering the total mass of a train.

Hump operations can also cause severe shocks. A hump is a hill down which cars are allowed to roll into one of multiple tracks and is used to sort cars based on destination. Several humps do exist in Europe. The biggest difference between the humps in North America and Europe is that in North America the cars are expected to couple, while in Europe excess impact could cause the cars to bounce apart.

The distances traveled by rail in North America are vastly greater than those in Europe and Korea, therefore, the cumulative effect of shocks is greater.

Most of the flatcars that the military uses in North America are equipped with integral tiedown chains (and cushioned draft gear). Wire rope tiedown for vehicles in North America has virtually disappeared, leaving only the threat of use in the case of a general deployment, which may bring plain, non-chain-equipped flatcars back into military use. In Europe and Korea the shipper provides tiedown materials.

Former Soviet Union (FSU) railroads use a similar coupling system to the one used in North America, so the shock environment will fall somewhere between that in North America and in Korea depending on the length and speed of the trains (see pg 37).

Rail tiedown in North America requires the highest level of restraint of all modes of transport. The procedures in this pamphlet are suitable for North American and possibly FSU rail transportation but will be excessive for rail transportation in other countries.

Section VII. Spanners

Spanners are bridge plates that allow wheeled vehicles to roll from one flatcar to the next. The military has never standardized nor officially recognized the need for spanners, so they continue to be a locally produced or purchased item. Spanners can be wooden, steel, or aluminum, and there are many opinions about the relative advantages of one type over another. We have looked in some detail at an aluminum spanner design and it is presented here as one option (figs 13 and 14). The choice of design remains with the local unit. Most spanners will

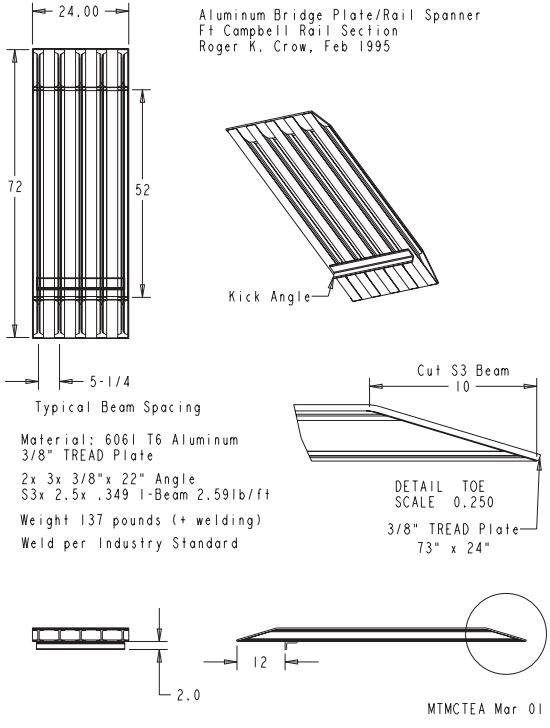


Figure 13. Six-foot aluminum spanner.

be the 6-foot size, but most installations will also need some 10-foot size spanners. The 10-foot spanners are needed to accommodate flatcars with sliding cushioned center sills. The spanners shown here are good for vehicle loads up to and including the palletized load system (PLS), that is, axle weights up to 20,000 pounds.

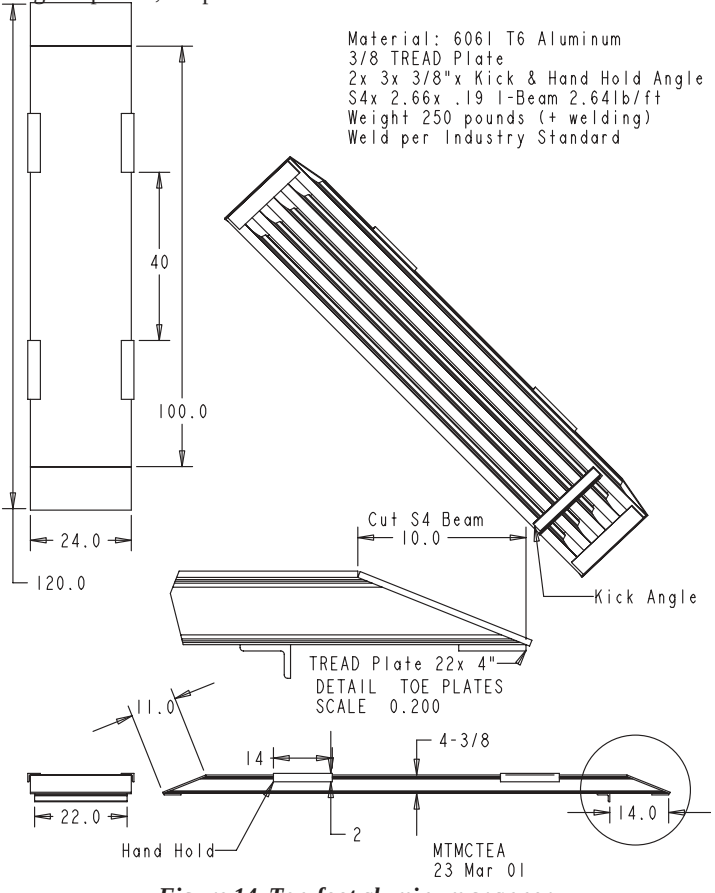


Figure 14. Ten-foot aluminum spanner.

Section VIII. Loading Ramp

The military often uses an end ramp for circus-loading flatcars. Below (fig 15) is a steel ramp that can be locally fabricated to provide some flexibility in the choice of loading sites. A Pro-E drawing can be found on our web site: www.tea.army.mil specifically at [https://www.tea.army.mil/res/3d/3dmodels.asp?type=1].

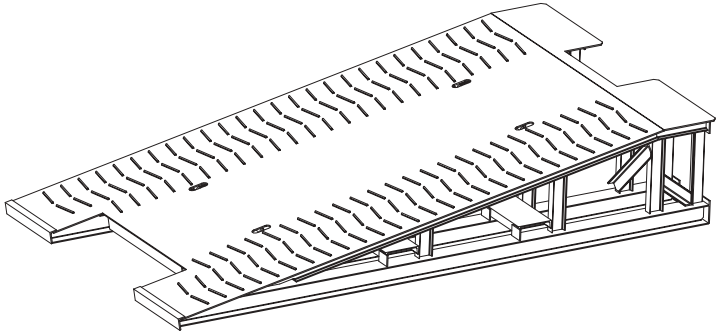


Figure 15. Steel end ramp for wheeled and heavy tracked vehicles.

Section IX. Flatcar Types

A relatively few types of chain-equipped flatcars serve the bulk of the military's needs. Flatcar lengths fall into two main categories: 60 to 68 feet and 89 feet. The shorter cars are typically about 10 to 10-1/2 feet wide and the 89-foot cars are 9 to 9-1/2 feet wide. Most of the commercial flatcars are nominally 70-ton capacity cars, while the DOD-owned cars (DODX) are 100-ton cars for the DODX 41000- and 42000-series (figs 16 and 17) and 140-ton cars for the DODX 40000-series (fig 18). The weight each flatcar can actually carry, and which you must not exceed, is stenciled on the side as the load limit (LD LMT). Additional information is published in MIL-STD-1366 available at http://assist2.daps.dla.mil/quicksearch/ or at https://www.tea.army.mil/pubs/res/deploy/transinstruction/MIL-STD-1366D.pdf starting on page 17.

Figure 16. DODX 41000-series 68-foot flatcar.

Figure 17. DODX 42000-series 89-foot flatcar.

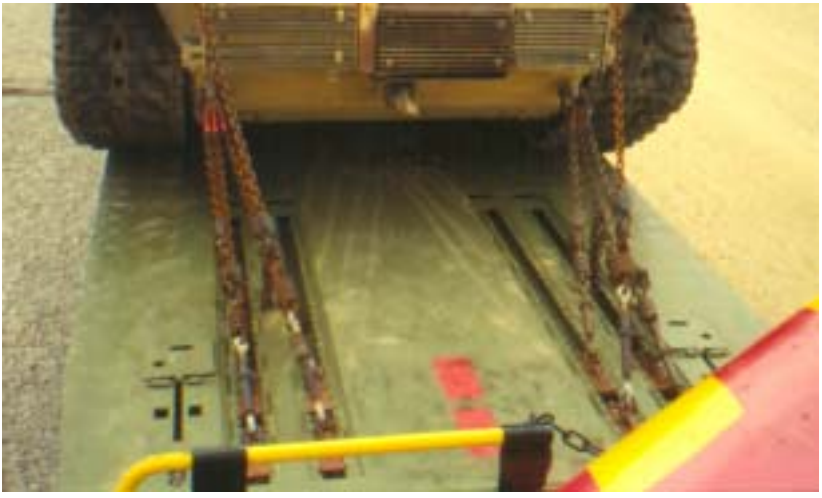


Figure 18. DODX 40000-series 68-foot flatcar.

Among the commercial flatcars, the majority are owned by TTX Company with the others being owned by the various railroads. The OTTX (fig 19), most ITTX (fig 20), and similar flatcars are equipped with 3/8-inch chains, which are suitable for the generally lighter military vehicles. The HTTX (fig 21), TTDX (fig 22), and some ITTX cars are equipped with 1/2-inch chains suitable for all military vehicles that will fit on each car type. These TTX cars will reach the end of their 50-year life and will be scrapped around 2015.

Figure 19. OTTX 60-foot flatcar.

Figure 20. ITTX 89-foot flatcar.

Figure 21. HTTX 60-foot flatcar.

Figure 22. TTDX 89-foot flatcar; the deck layout is similar to the ITTX flatcar.

Section X. Loading and Tiedown Checklist

For Vehicles on Chain Tiedown Flatcars

NOTE: Copies of this page should be distributed to loading teams.

- ☐ Make certain all hood latches are secured (to avoid wind damage).
- ☐ Leave at least 10 inches between vehicles.
- ☐ Check for proper brake wheel clearance (see fig 1, p. 2).
- ☐ Do not cross the chains.
- ☐ Use symmetrical tiedown patterns (multiples of 4).
- ☐ Secure tiedowns at approximately 45 degree angles.
- ☐ Seat and lock chain anchor or winch.
- ☐ Secure shackle in tiedown provision with wire tie or cotter pin.
- ☐ Pull chain tight and attach hook above the compression unit.
- ☐ Tighten chain.
- ☐ Use appropriate tools.
- ☐ Make sure chain is not kinked or binding.
- ☐ Secure hooks with wire or nylon tie straps.
- ☐ Make sure turnbuckles are wired or locked.
- ☐ Tighten jamnuts with two wrenches. Lower locking sleeves.
- ☐ Do not secure chains to axles or springs unless figure shows to.
- ☐ Make certain turrets and guns, radiator doors, side skirts, outriggers, crane booms, expansible van bodies, movable parts, and secondary loads are secured from extending up or out over the side of the flatcar during transport.

Section XI. Practical Tips

For Units Deploying by Rail

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MTMC Operations Center
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A. INSTALLATION TRANSPORTATION OFFICE (ITO)

1. Keep your ITO up to date on changes in quantities/types of equipment being shipped.

2. Military Transportation Management Command (MTMC) and your ITO are accustomed to dealing with each other; ask your ITO to pass on to you any information they receive from MTMC about your movement.

B. FLATCAR SUPPLY

1. You will likely encounter both DODX and non-DODX flatcars.

2. DODX 40000-series flatcars (6-axle, 68') can carry two heavy tracked vehicles and DODX 41000-series flatcars (4-axle, 68') can carry one; these are the only flatcars authorized to carry heavy tracked vehicles. Their 68-foot length also makes them useful to carry tractor-trailer combinations such as the HET and the Patriot.

3. DODX 40000-, 41000-, and 42000-series (4-axle, 89') flatcars all have 1/2-inch chain tiedown assemblies for vehicles and container attachment points for 20-foot ISO containers. DODX 48000-series flatcars (4-axle, 89') have only container attachment points.

4. Most non-DODX chain tiedown flatcars have the following reporting marks: OTTX (60', 3/8" chains), HTTX (60', ½" chains), ITTX (89', 3/8" chains), and TTDX (89', ½" chains).

C. EMPTY FLATCAR DELIVERY

1. The railroads have the right to make substitutions if the flatcars ordered are not available; for example, if you order ten 89-foot flatcars you may get fifteen 60-foot flatcars instead. If this would cause problems based on what you are loading, make sure the ITO knows this before he orders flatcars.

2. Keep in touch with the ITO, so as not to be surprised by delivery of flatcars earlier or later than expected.

D. RAMP SPOTTING GUIDELINES FOR LOADING

1. Flatcars for heavy tracked vehicle loading should be next to the ramp, so that the vehicles are not run over cars that can't take their weight.

2. Shorter flatcars are wider than longer flatcars; loading will go faster if the shorter flatcars are next to the ramp.

3. Some commercial flatcars have side sills, handholds, and so forth, that project above the deck. These hinder loading and may prevent loading these flatcars with central tire inflation system (CTIS) vehicles. Flatcars without projections above the deck should be placed next to the ramp, so that CTIS vehicles can be loaded on them without being damaged.

4. The above guidelines can be ignored and loading simplified significantly if you have enough ramps available to place different flatcar types at different ramps.

E. TIEDOWN

1. Get copies of this pamphlet for all of your tiedown supervisors. See http://www.tea.army.mil/pubs/pubs_order.htm to order additional copies.

2. Make sure you have sufficient spanners (see pg 27) on hand and that they are sturdy enough for what you have to load.

3. Tiedown provisions on military vehicles are strong enough to be used for loading all vehicles, except most heavy tracked vehicles have no tiedown provisions and require shackles attached to the towing lugs. The ITO should have a supply of shackles for such vehicles.

4. If desired, most railroads will arrange for a subcontractor experienced with military loadings to help you to tiedown loads correctly. Let your ITO know before he requests a rate if you want this service. The additional cost will be built into the transportation charge.

5. Railroad inspectors must approve your tiedown work before the railroad will move the flatcars. If the inspector requires additional work beyond the book, do it so you can proceed with the deployment. If the inspector says that you do not have to do work required by the pamphlet, complete the work anyway; otherwise you will have mistrained your tiedown crews and your trains may be delayed en route, especially if the trains are interchanged to another railroad that does follow the rules.

F. TRACKING

1. In transit visibility is based on a flatcar's reporting marks, that is, DODX, ITTX, and so forth, and number.

2. Record at least the reporting marks and number of all flatcars carrying critical equipment (equipment you need unloaded first, and so forth). If you do not track all flatcars en route, at least track these.

G. UNLOADING

1. The first train to leave may not be the first train to arrive. The flatcars on the front of the train when it leaves may be on the rear when it arrives. If you need to give the railroad special instructions for unloading, specify the reporting marks and numbers of the flatcars involved.

2. If you are traveling to the National Training Center (NTC) or Joint Reserve Training Center (JRTC), you may have to integrate your arrival with another unit's departure, or vice versa. If a train must be held short of the destination because it would otherwise congest the railhead, it will lose its crew and possibly its power to other assignments. Try to schedule (along with your ITO) departures to prevent this from happening; if it does, take into account that the railroad will have to get power and crew back out to the train when calculating how much lead time you need to give when ordering the train into the railhead.

3. The flatcars that brought your equipment out may not be the same flatcars that take it back. Do not take tiedown assemblies, and so forth, off the flatcars during unloading. On the other hand, do not leave shackles, and so forth, on the flatcars expecting that they will be there when you get back.

H. DOWN THE (RAIL)ROAD

1. Future deployments may involve using railroads of the former Soviet Union (FSU).

2. FSU railroads use a similar coupling system to the one used in North America, so in the absence of detailed instructions from the local railroads, use the tiedown instructions in this pamphlet.

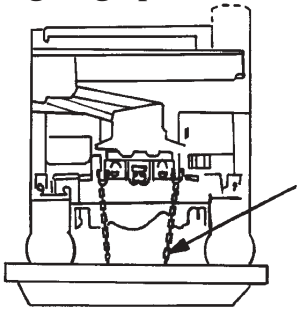
3. Dimensional information for FSU flatcars can be found at www.1520mm.com/r/w/platforms.html.

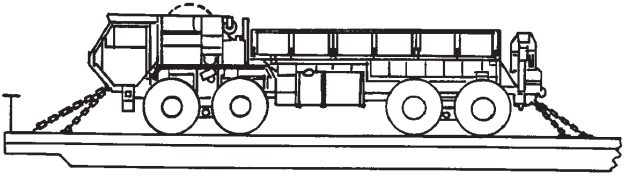
I. CONSIDER THE FOLLOWING IN SEQUENCE

1. Internal and secondary (nested) Loads
2. Hazardous Materials Markings and Documents.
3. Vehicle Preparation
4. Tools
5. Safety Brief
6. Flatcar Preparation
7. Loading the Flatcars and Securing the Vehicles
8. Final Inspection

Appendix A. Trucks and Trailers

Trucks Weighing up to 80,000 Pounds



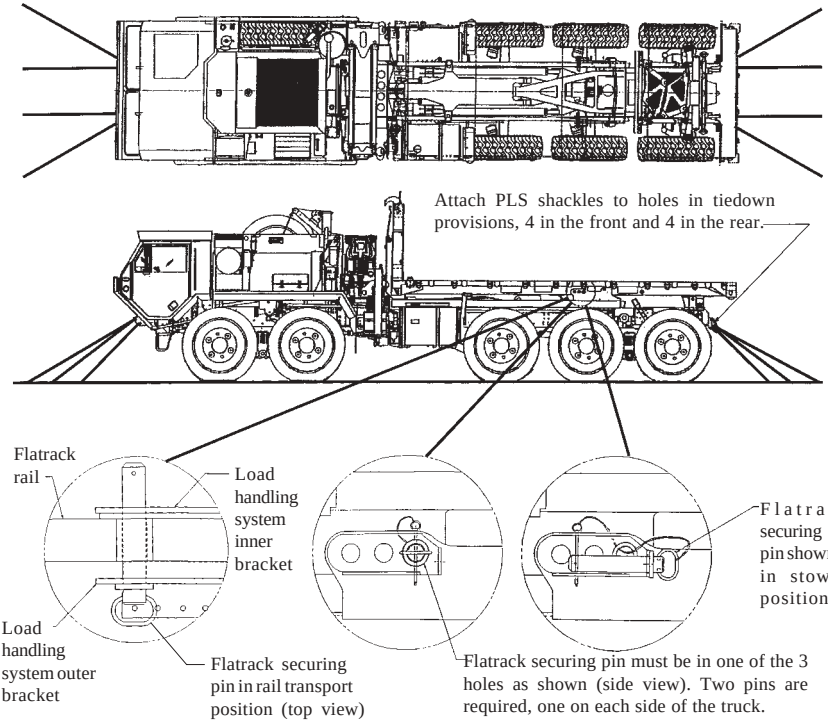


Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-8,500	3/8	6,600	4
8,500-16,000	3/8	9,000	4
16,000-25,000	3/8	9,000	8
16,000-25,000	1/2	11,250	4
25,000-40,000	1/2	13,750	4
40,000-55,000	1/2	13,750	8
55,000-80,000	1/2	13,750	12

Notes:
1. From figure 88-B, Section No. 6.
2. The HEMTT wrecker must have the locking pins secured in the outriggers to prevent them from settling down and out. Outriggers extending past the side of the car can cause serious accidents.
3. The secondary load must be secured to 3 gs longitudinally (fore and aft) and 2 gs laterally and vertically.

M1074/M1075 PLS and M1120 HEMTT LHS Truck

PLS = Palletized Load System, LHS = Load Handling System



Notes:

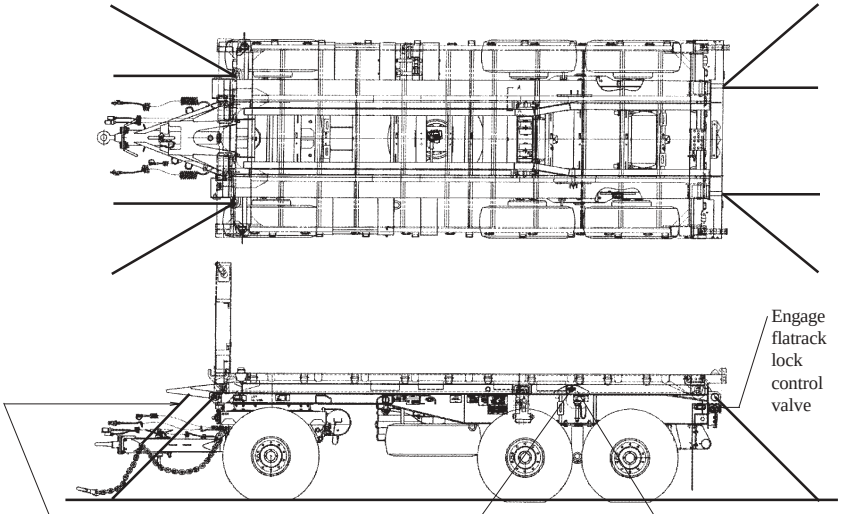
1. The majority of chains should go to the center tiedown channels.

2. From Figure 88-C, Section No. 6.

Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
49,500-82,000	1/2	13,750	12
82,000-88,000	1/2	13,750	16

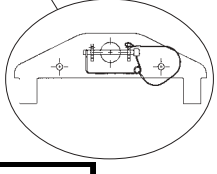
3. The secondary load must be secured to 3 gs longitudinally (fore and aft) and 2 gs laterally and vertically.

M1076 Palletized Load System (PLS) Trailer



Secure drawbar in shortest position. With drawbar raised horizontal, secure drawbar safety chain attachment point to bumper with one complete loop of 3/8" wire rope pulled snug, fastened with 4 clamps. If desired, drawbar may be lowered onto a piece of 2" lumber nailed to the deck. Secure drawbar down with two chains.

Install 2 removable plates (one on each side of trailer) and then install the 2 flatrack securing pins.

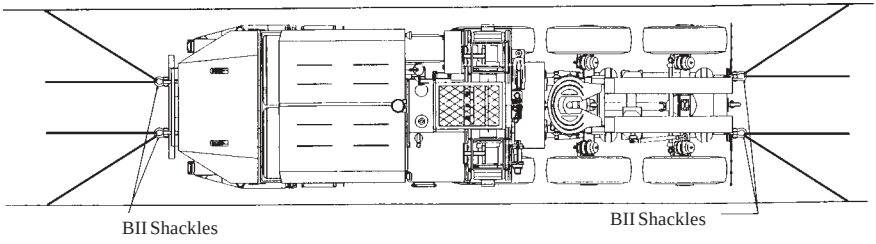


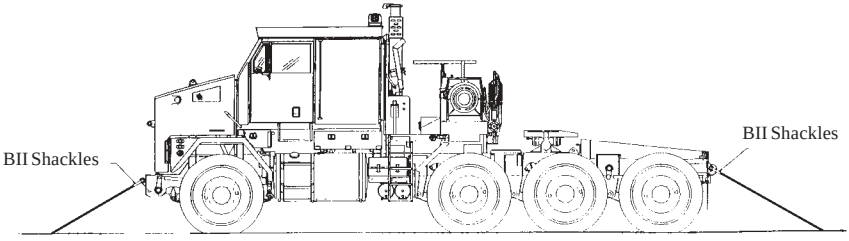
Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
16,500-27,500	1/2	13,750	4
27,500-55,000	1/2	13,750	8

Notes:
1. The secondary load must be secured to 3 gs longitudinally (fore and aft) and 2 gs laterally and vertically.
2. From Figure 88-C, Section No. 6.

M1070 Tractor

(41,000 lb)



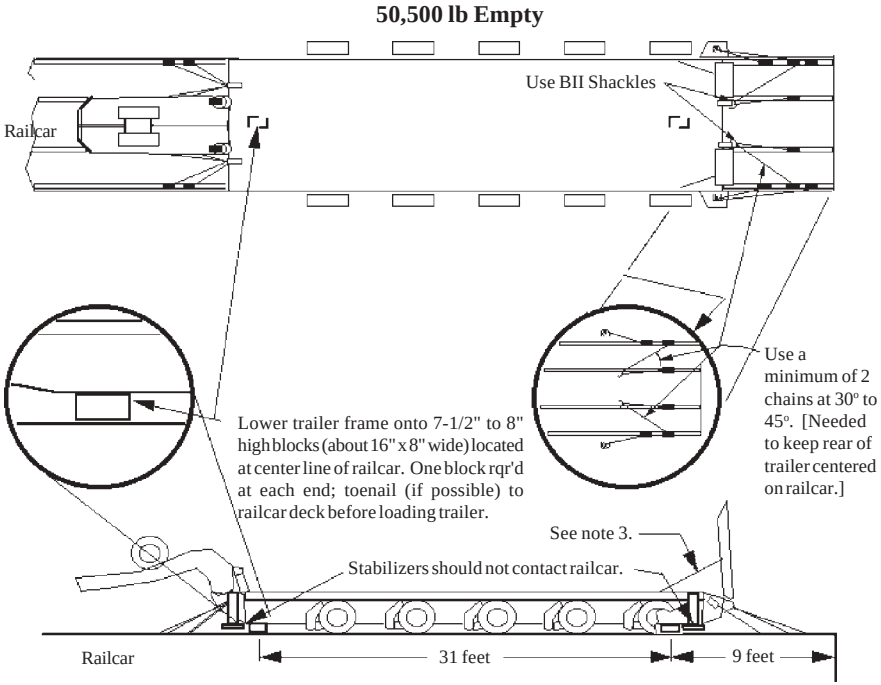


Notes:
1. 1/2" steel chain (27,500 lb minimum proof test value (WLL 13,750)), 8 required.

2. BII shackles, NSN: 4030-01-408-2774, WLL 17T, 1-3/8" screw pin anchor shackle with cotter pin.

3. From figure 88-B, Section No. 6.

M1000 Trailer



Notes:

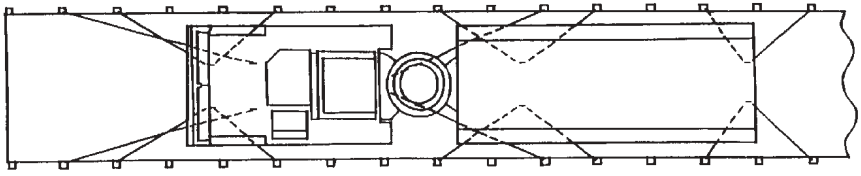
1. Use OTTX (or equal) Chain Tiedown Railcar: 16 chains (8 at each end) 3/8" chain for empty (unloaded) M1000.

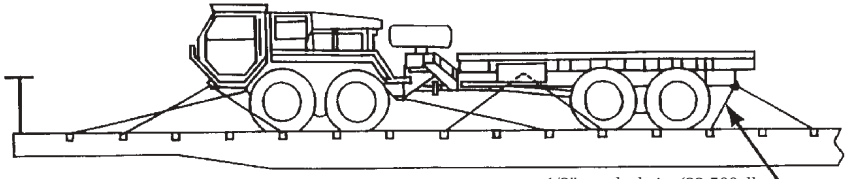
2. HTTX (and other) railcars equipped with 1/2" chain: 8 chains (4 at each end) may be used for empty M1000; 16 chains (8 at each end) must be used for the loaded M1000 (50,500 lb. max payload).

3. Onboard chains.

4. From General Rules, Section No. 1.

Logistics Vehicle System





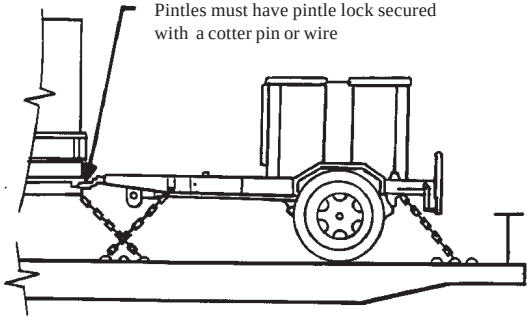
1/2" steel chain (22,500 lb minimum proof test value (WLL 11,250)), 16 required

Notes:
1. Install and secure the lockout strut to prevent articulation.

2. From General Rules, Section No. 1.

3. This figure (requiring more than 4 tiedown provisions for the vehicle) is a procedural fix for a vehicle with inadequate transportability. Do not use this figure as a basis of design for new or rebuy vehicles.

Trailer Attached to Prime Mover



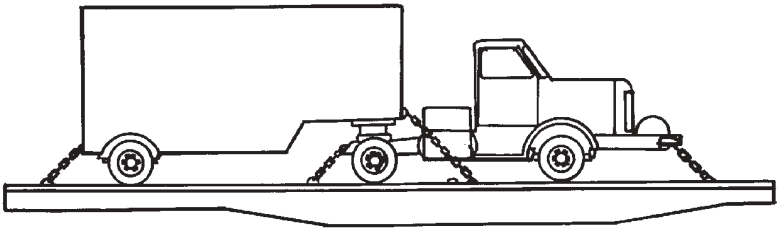
Notes:

1. Tie down trailer as shown. Refer to table below for chain requirements.
2. The prime mover will be chained as if it were being loaded alone. Check the specific diagram in the wheeled vehicles part of the appendix.
3. Treat each vehicle as if it was being tied down separately, except omit the front support and towing ring tiedowns on the trailer. Each vehicle must have at least 4 tiedowns with equal numbers pulling fore and aft.
4. From General Rules, Section No. 1, using the chain formula.

THIS TABLE IS FOR THE TRAILER ONLY

Trailer Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required per vehicle
0 – 13,200	3/8	6,600	4
0 – 18,000	3/8	9,000	4
18,000 – 36,000	3/8	9,000	8
0 – 27,500	1/2	13,750	4
27,500 – 55,000	1/2	13,750	8
55,000 – 82,500	1/2	13,750	12
82,500 – 110,000	1/2	13,750	16

Semitrailer Attached to Prime Mover



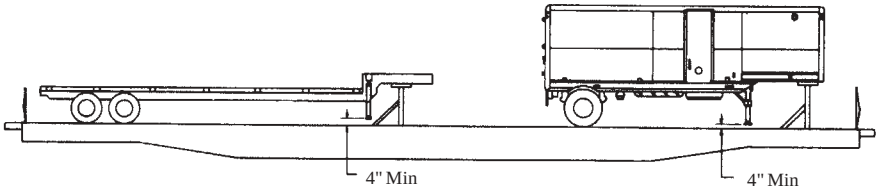
Notes:
1. Secure the semitrailer as shown using the table below to determine the chain requirements.
2. Chain the prime mover as if it were alone, using the appropriate figure from this appendix.
3. From General Rules, Section No. 1, using the chain formula.

THIS TABLE IS FOR THE TRAILER ONLY

Trailer Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required per vehicle
0 – 13,200	3/8	6,600	4
0 – 18,000	3/8	9,000	4
18,000 – 36,000	3/8	9,000	8
0 – 27,500	1/2	13,750	4
27,500 – 55,000	1/2	13,750	8
55,000 – 82,500	1/2	13,750	12
82,500 – 110,000	1/2	13,750	16

Trailer on Flat Car (TOFC)

Semitrailers on Flatcars with Stanchions



Notes:

1. Be sure hitch is securely locked in "UP" position.

2. Be sure trailer kingpin is locked in place on the hitch.

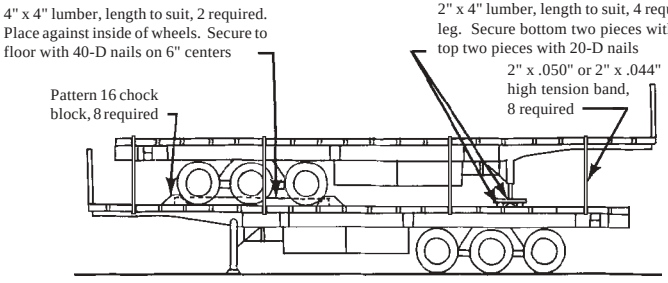
3. Applies to vehicles up to 65,000 lb as long as kingpin height is between 47 inches minimum and 52 inches maximum.

4. The hitches will only fit 2-inch kingpins.

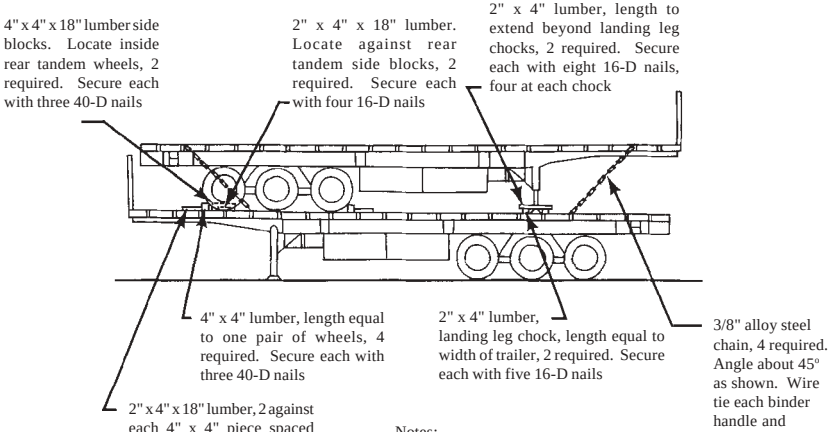
5. From figure 202, Section No. 6.

Trailers, M872, Double Stacked

Two Separate Methods



Note: From figure 434, Section No. 7.



Notes:

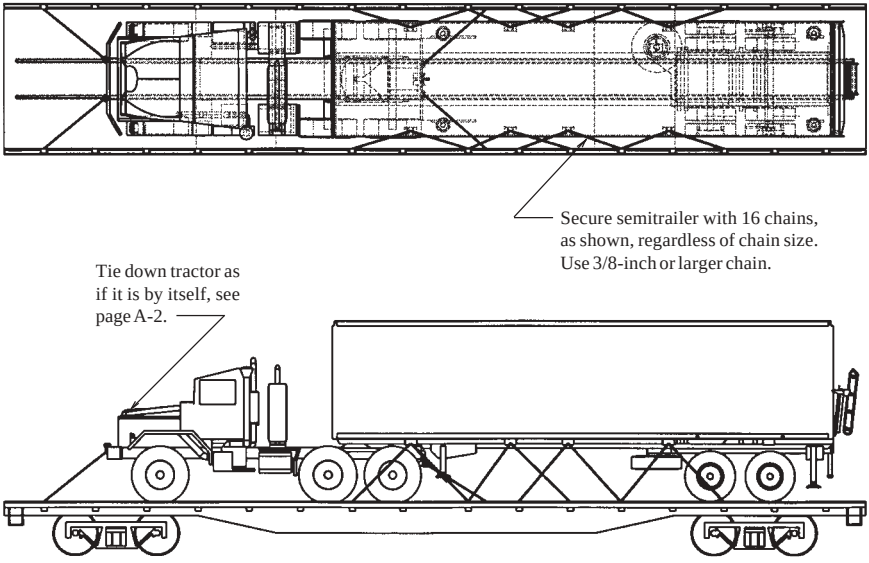
1. From figure 432, Section No. 7.

2. Tie bottom trailer same as single trailer, trailer attached to prime mover, or as trailer on flatcar with retractable stanchion.

3. Some trailers have partial steel decking preventing the direct nailing of blocking. On these trailers the blocking must be secured to side stakes or fastened by other means.

M129A4 and M1063 Semitrailers
(If trailer on flat car service (TOFC) Is Not Available)

Semitrailer 16,000 lb Empty to 41,000 lb Fully loaded



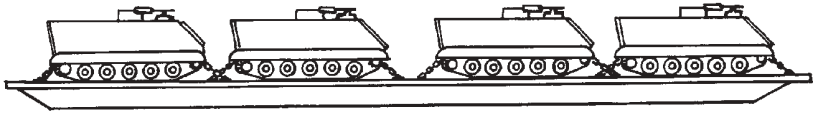
Notes:
1. From General Rules, Section No. 1.

2. This may also be used for all semitrailers with bar tiedown provisions built into the semitrailer underframe.

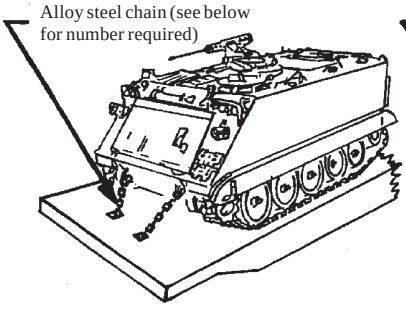
3. This semitrailer figure (requiring more than 4 tiedown chains for the semitrailer) is a procedural fix for a vehicle with inadequate transportability. Do not use this figure as a basis of design for new or rebuy vehicles.

Appendix B. Tracked and Wheeled Armored Vehicles

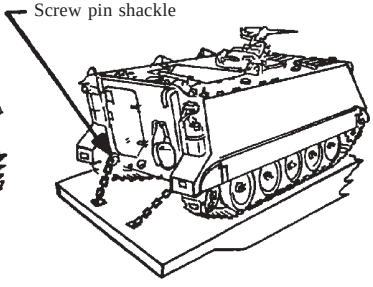
Tracked Vehicles up to 30,000 lb



SIDE VIEW



FRONT VIEW



REAR VIEW

Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-16,000	3/8	9,000	4
16,000-25,000	3/8	9,000	8
16,000-25,000	1/2	11,250	4
25,000-30,000	1/2	13,750	4

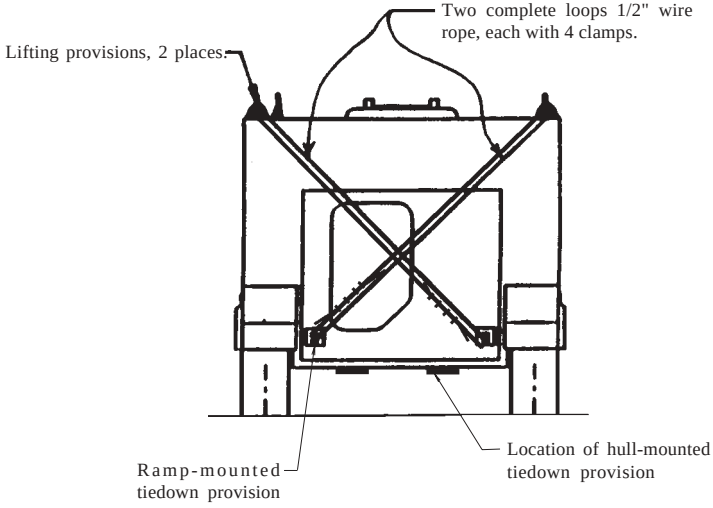
Notes:

1. Use the WLL 12.5 ton special shackle NSN 4030-01-369-7612 for tiedown. Wire-tie the nut on the bolt or drill the bolt and install a cotter pin. The railroad does not provide shackles.

2. The M577 and the M1068 (all series) must have an X pattern of 1/2" wire rope to secure the ramp (see p. B-3).

3. From figure 87-B, Section No. 6.

M577 and M1068 Ramp Securement



M577/M1068 REAR VIEW

Notes:

1. This applies to all series of M577 and M1068 vehicles on which the tiedown provisions used to secure the vehicle are mounted on the ramp. The wire rope is not required on vehicles that have the rear tiedown provisions mounted on the hull used for securement rather than those on the ramp.

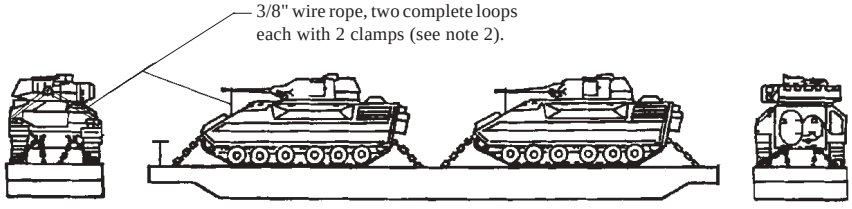
2. Fully engage ramp latches.

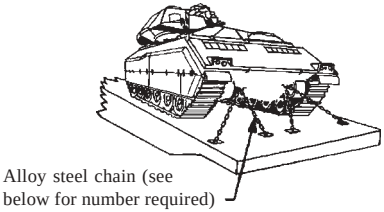
3. The wire rope must be crossed as shown. The wire ropes are routed from the lifting provision to the tiedown shackle. The point where the two wire rope loops touch must be protected from chafing. Scrap rubber hose or sheet metal fastened in place will meet this requirement.

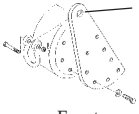
4. This (laced wire rope) is a procedural fix for vehicles with inadequate transportability. Do not use this figure as a basis of design for new or rebuy vehicles.

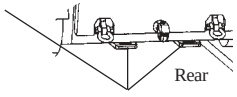
5. From AAR circular letter c-7824 (M577), 20 April 92, and figures 87, 87-A, and 87-B, Section No. 6.

Tanks and Similar Units 30,000 to 60,000 lb









Notes:

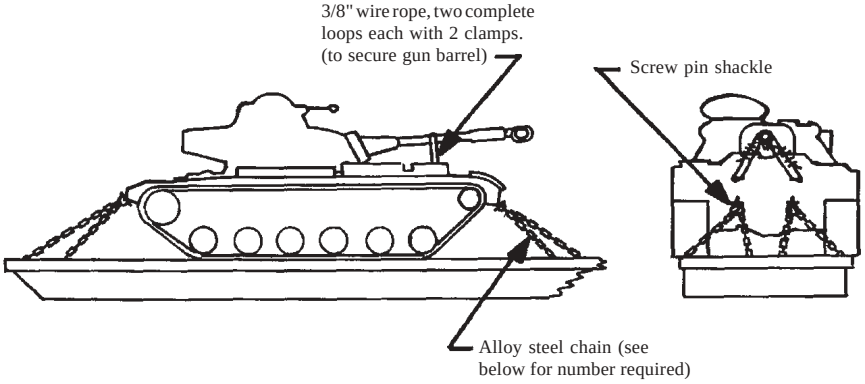
1. Shackle - use the 21-ton, 1-1/4-inch (1-3/8-inch pin), bolt-pin safety anchor shackle, NSN 4030-01-187-0964. The railroad does not provide shackles.

2. If the gun barrel is installed or if the rotating turret can extend beyond the side of the vehicle, the turret must be secured from rotation with two complete loops of 3/8" wire rope each with 2 clamps, one to each side from the gun or turret to the hull.

3. From figure 78-B, Section No. 6.

Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
30,000 – 40,000	1/2	13,750	8
40,000 – 55,000	1/2	13,750	12
55,000 – 60,000	1/2	13,750	16

Tanks and Similar Units 60,000 to 100,000 lb



Notes:

1. Shackle - for most vehicles, use the 21-ton, 1-1/4-inch (1-3/8-inch pin), bolt-pin safety anchor shackle, NSN 4030-01-187-0964. If a towing lug requires more than two chains, put two chains in the first shackle and add another shackle for up to two more chains. Add a third shackle if a fifth chain is required. Another approach, if the tiedown provisions are not too high, is to feed the slip hook and chain through the shackle in the towing lug and hook the chain into the claw hook on the same chain assembly. One slip hook and four chains will fit in the 21-ton shackle. Put the hook in last, but tension it first to make certain it is seated properly on the shackle. The railroad does not provide shackles. The AAAV has four of its own shackles, each of which will accept 4 chains.

2. From figure 78-B, Section No. 6.

Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required per vehicle
60,000 – 82,000	1/2	13,750	16
82,000 – 100,000	1/2	13,750	20

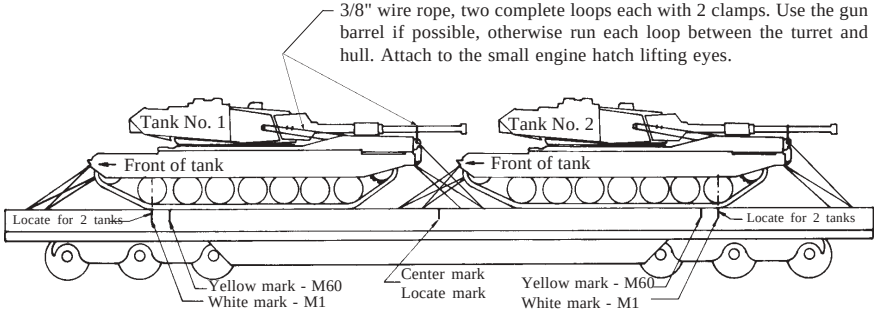
DODX 40000-Series Flatcar Checklist

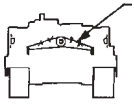
Note: Copies of this page should be distributed to loading teams.

- ☐ Locate chain anchors as indicated.
- ☐ Extend turnbuckles.
- ☐ Position tanks on flatcar.
- ☐ Install shackles (and links (rings), if required, on tanks).
- ☐ Pull chain tight and attach claw hook.
- ☐ Tighten until 1/8 inch of rubber shows at compression unit.
- ☐ Ensure anchor locking tabs are down in recess.
- ☐ Wire tie shackle screw pins (or secure by other suitable means).
- ☐ Secure pintle lock with cotter pin, if the pintle is used.
- ☐ Two-wrench tighten jamnuts or properly apply locking device.
- ☐ Make certain turret and gun, radiator door, side skirts, and so forth, are secured from extending over the side of the flatcar.
- ☐ Lock turret and secure the handle.

Tracked Vehicles Over 100,000 lb

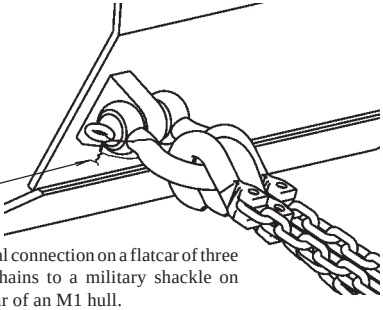
DODX 40000-Series Flatcars





Barrel securement to keep turret from turning as shown above. Attach to the small engine hatch lifting eyes.

REAR VIEW



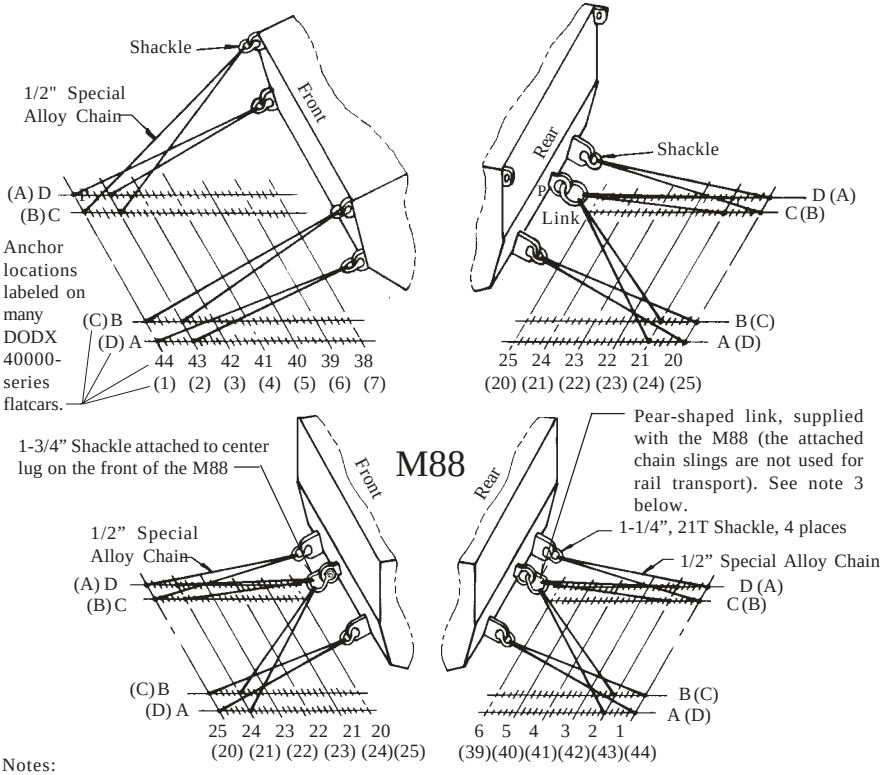
Screw pin shackle pins must be wire tied to the shackle body or secured by other suitable means.

Typical connection on a flatcar of three 1/2" chains to a military shackle on the rear of an M1 hull.

Note: From figure 83, Section No. 6.

M1 Tanks with Optional Link (Ring) and M88

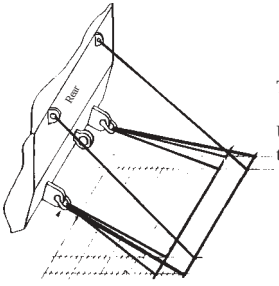
(See the next page (B-9) for procedure without link (ring))



Notes:

1. Sixteen (16) Chains required per tank; use 1/2" dia extra strength special alloy chain, working load limit (WLL) 13,750 lb. Use 200,000-lb minimum breaking strength links (rings). See page 13 and 14 for approved shackles and shackle and link sources.
2. For the center front of the M88 use an alloy, 1-3/4-inch, 40-ton safety anchor shackle, NSN 4030-00-369-2955.
3. If the pear-shaped link (NSN 4010-00-133-6517) is not available on the M88, you may use the MacLean-Fogg part number 61283 ring (link) or any other master link having a minimum breaking strength of 200,000 pounds, a maximum nominal bar size of 1-3/4 inches, and a clear opening of about 5 inches to accommodate four chain assembly slip hooks.
4. From figure 83, Section No. 6.

Tracked Vehicles Over 100,000 lb without the Link

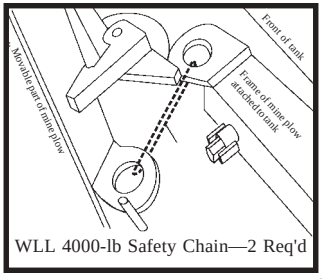


This procedure is approved as an option in Section No. 6, figure number 83.

Use the same anchor locations on the flatcar as shown on page B-8 and reroute the chains as shown to the left.

Unmarked military shackle, see page 13 and B-7.

M1 with Mine Clearing Blade System
(Mine Plow)



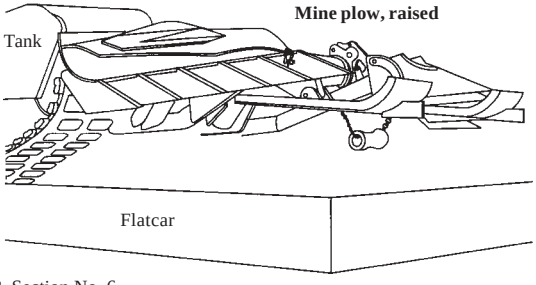
Anchor locations labeled on many DODX 40000-series flatcars.

Warning!

Do not allow anyone under the mine plow until both safety chains are secure.

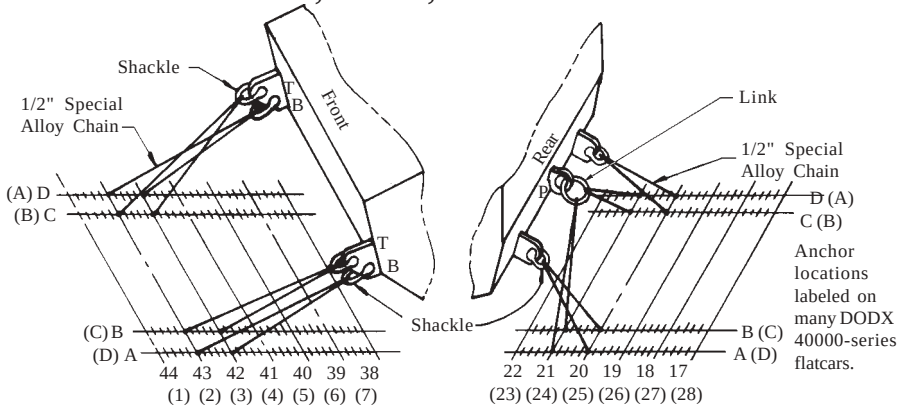
1. Apply the safety chain with the plow in the raised position forming a complete loop through the two eyes. Fasten the chain to itself with a grabhook (secured with wire or other suitable means) or a double clevis chain link.
2. The chains that attach to the pipe structure at the bottom of the mine plow are routed under the pipe, over and down in front of the pipe, and the hooks attached to the chains as chokers which must be pulled tight and wire tied.
3. If the skids and/or roller are removed, they must be securely chained down or loaded securely as secondary loads in a cargo vehicle.

Mine plow, raised

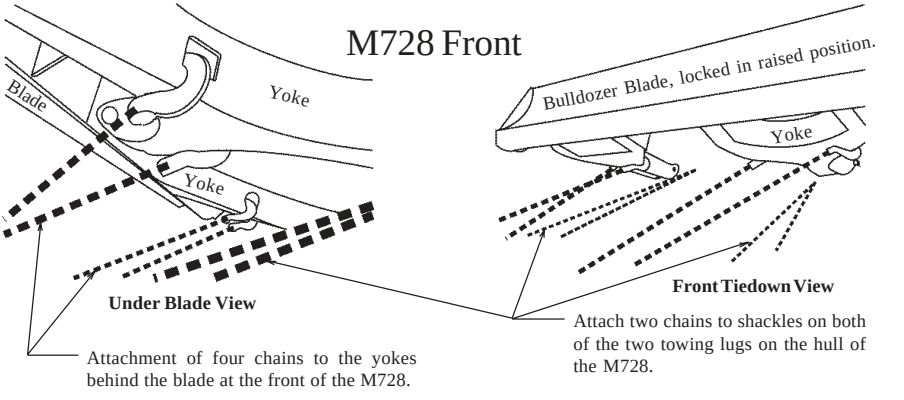


Note: From figure 83, Section No. 6.

M60 Tanks, AVLB, and Rear of M728



M728 Front

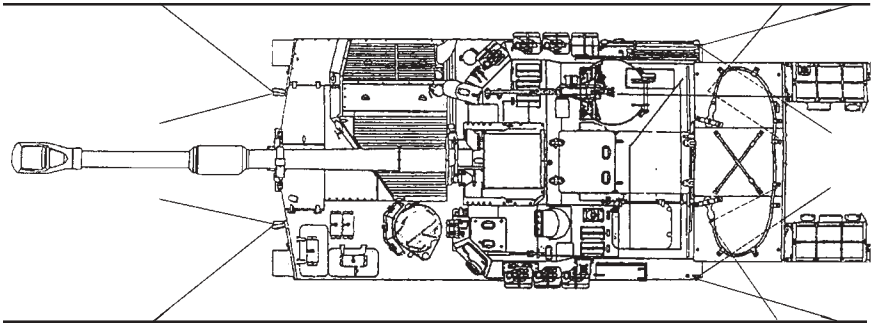


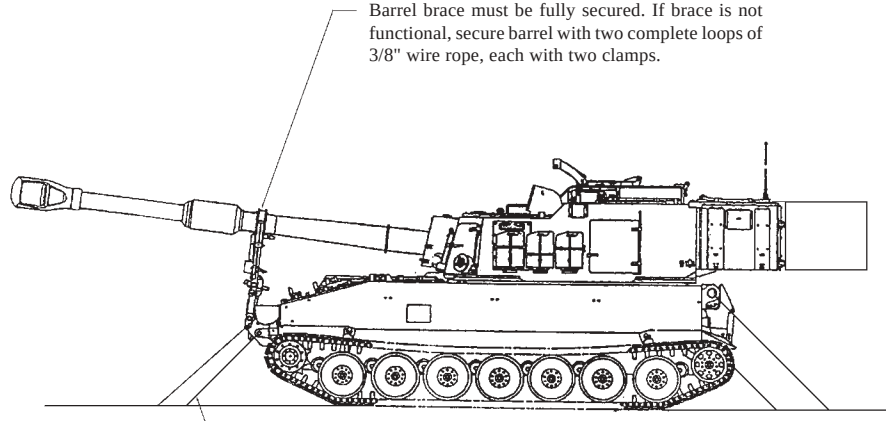
Notes:

1. The rear of the M728 is the same as the M60, but the M728 has its own master link that may be used in the pintle.
2. On the M728, wire tie the blade latches to ensure the blade is secured in the raised position, and don't forget to lock the turret lock and wire rope tie the boom and turret to prevent rotation.
3. Sixteen (16) Chains required per tank; use 1/2" dia extra strength special alloy chain, working load limit (WLL) 13,750 lb. Use 200,000-lb minimum breaking strength links (rings). See page 13 and 14 for approved shackles and shackle and link sources.
4. From figure 83, Section No. 6.

M109A6 Paladin Howitzer

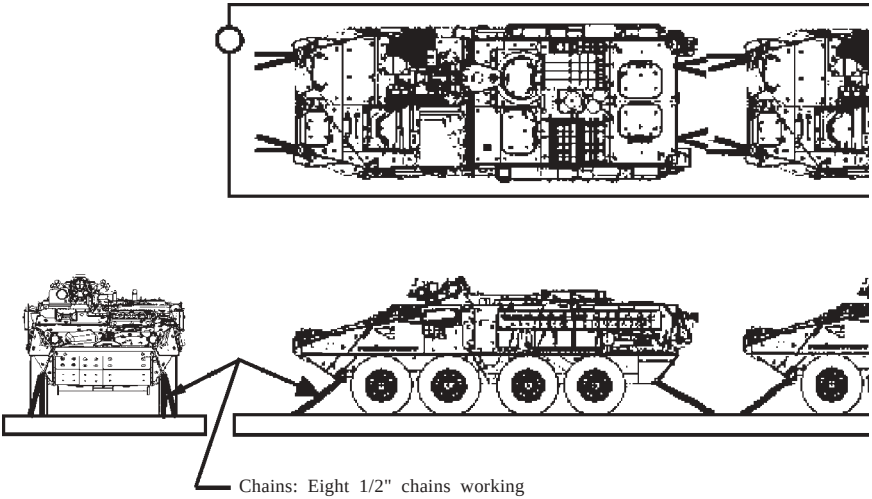
56,800 TO 82,000 LB





Note: From figure 78-B, Section No. 6.

Stryker



Chains: Eight 1/2" chains working load limit (WLL) 13,750 pounds or Twelve 3/8" chains WLL 9,000 pounds required per vehicle. Do not attach to shackles.

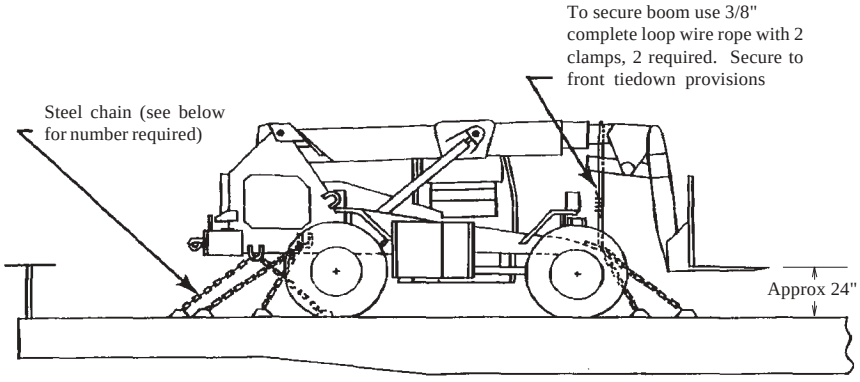
Notes:
1. From General Rules, Section No. 1. Figure pending. Section No. 6, Figure No. (when Published)_____
2. Use the fixed, solid tiedown provisions for tiedown rather than the shackles, which may be present.
3. If equipped, the remote weapon station and TOW missile launcher should be reduced for rail transport.
4. After driving the vehicle onto the flatcar, the vehicle suspension must be reduced to the transport position (i.e. on the suspension bump-stops) using the vehicle's integral height management system. This reduces vehicle transport height and lateral/vertical movement. When the vehicle is on the bump stops, there is about one inch distance between the top of each tire and the bottom of the overhanging hull.
5. Following rail shipment and chain removal, restore the vehicle suspension to the highway setting using the vehicle's integral height management system.
6. Stryker vehicles can be loaded or unloaded without spanners provided the space between the flatcars or between flatcar and ramp is limited to a maximum of 39 inches (34 inches is better). Use all-wheel drive, and the height management system can be in transport (lowered) or nominal (highway) position. Other wheeled and band-tracked vehicles require spanners.

Notes

Appendix C. Materials Handling and Construction Equipment and Non-Vehicles

Variable Reach Forklift Truck

30,000 lb and Under



Notes:

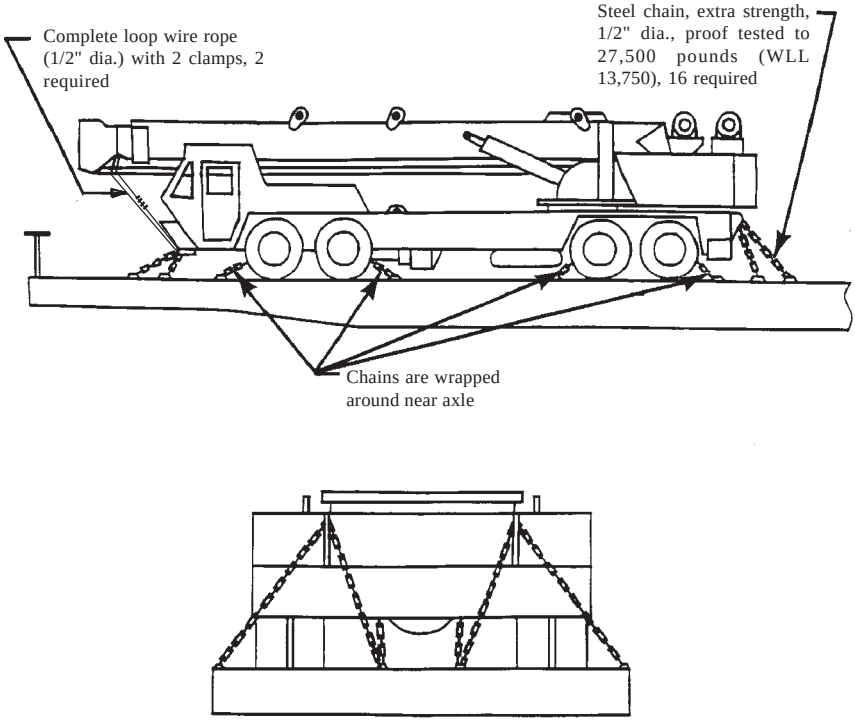
1. Use flatcars with raised side sills, if possible. Locate suitable protective material such as waterproof paper or burlap, and so forth, between each tire and side sill to extend 2 in. above sill.

2. From figure 54-A, Section No. 6.

Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-30,000	3/8	9,000	12
0-15,000	1/2	13,750	4
15,000-30,000	1/2	13,750	8

Wheel-Mounted Crane (25- and 35-ton)

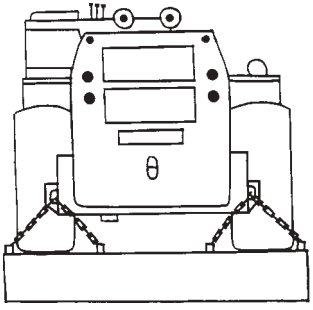
Under 72,000 lb



Note: From General Rules, Section No. 1.

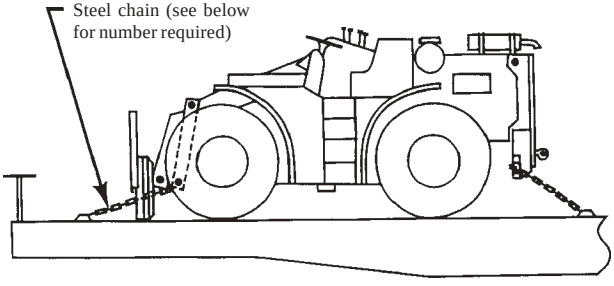
Tractors, Forklifts, Loaders, and so forth

(Rough Terrain Forklift Truck, and so forth)



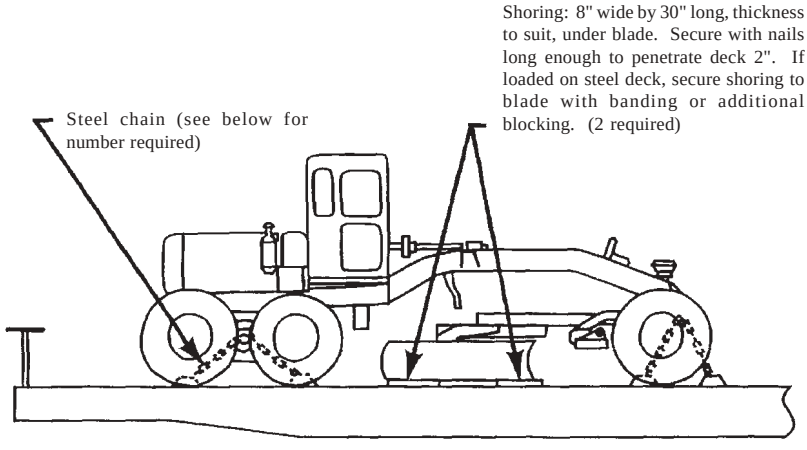
Notes:
1. Articulated units must be made rigid by use of the lock-out bar. Lock-out bar pins must be secured to prevent displacement. Add four chains if the lock-out bar is missing.

2. From figure 48-C, Section No. 6.



Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-15,000	1/2	13,750	4
15,000-30,000	1/2	13,750	8
30,000-45,000	1/2	13,750	12
45,000-60,000	1/2	13,750	16
60,000-75,000	1/2	13,750	20

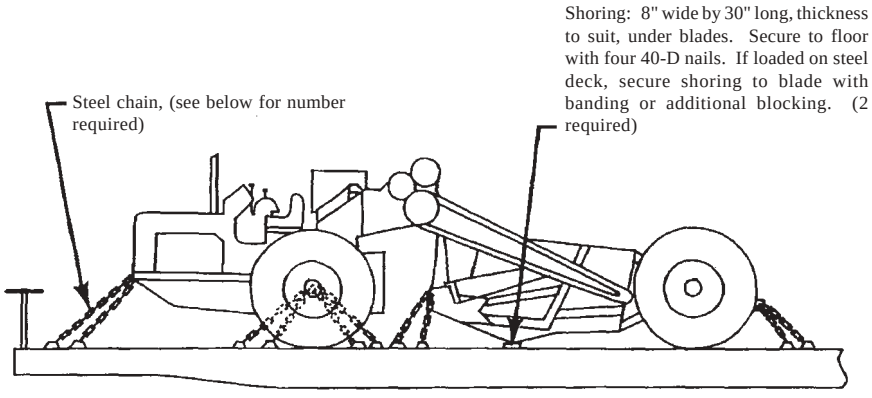
Motor Grader



Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-15,000	1/2	13,750	4
15,000-30,000	1/2	13,750	8

Note: From figure 110, Section No. 3.

Scraper (Earthmover)



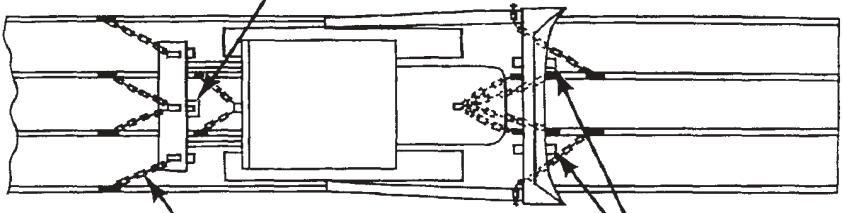
Vehicle Weight Ranges (lb)	Alloy Steel Chain		
	Dia (in.)	Minimum Working Load Limit (lb)	Number of Chains Required Per Vehicle
0-15,000	1/2	13,750	4
15,000-30,000	1/2	13,750	8
30,000-45,000	1/2	13,750	12
45,000-60,000	1/2	13,750	16
60,000-75,000	1/2	13,750	20

Note: From figure 48-D, Section No. 6.

D-7 Caterpillar Dozer

up to 82,000 lb

4" x 8" x 30" lumber (2 required) stacked under center ripper. Drill and toenail first block to car floor with four 30-D nails. Then nail second block to first in same manner. Lower ripper onto blocks. If loaded on steel deck, secure shoring with banding or additional blocking.



1/2" steel chain, (27,500 lb minimum proof test value (WLL 13,750)), 12 required

4" x 8" x 30" lumber, place under blade lengthwise. Drill and toenail each block to car floor. Lower blade and lock cylinders in position. If loaded on a steel deck, secure shoring to blade with banding or additional blocking. (2 required)

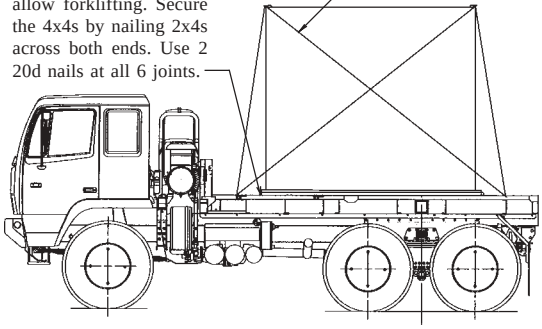
Note: From General Rules, Section No. 1.

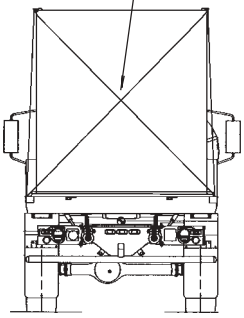
CONEX or ISU Container on 5-Ton Trucks

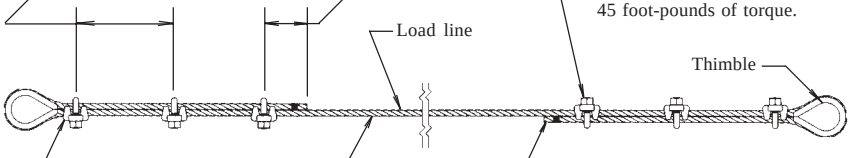
Single strand of 3/8-inch wire rope with a loop and thimble at both ends, each secured with 3 wire rope clamps (8 places, see details below).

Protect the wire ropes from chafing where they cross with rubber hose, soft sheet metal, or other means secured to stay in place (4 places).

Place 3 4x4s along the truck bed to protect the bottom of the ISU and to allow forklifting. Secure the 4x4s by nailing 2x4s across both ends. Use 2 20d nails at all 6 joints.



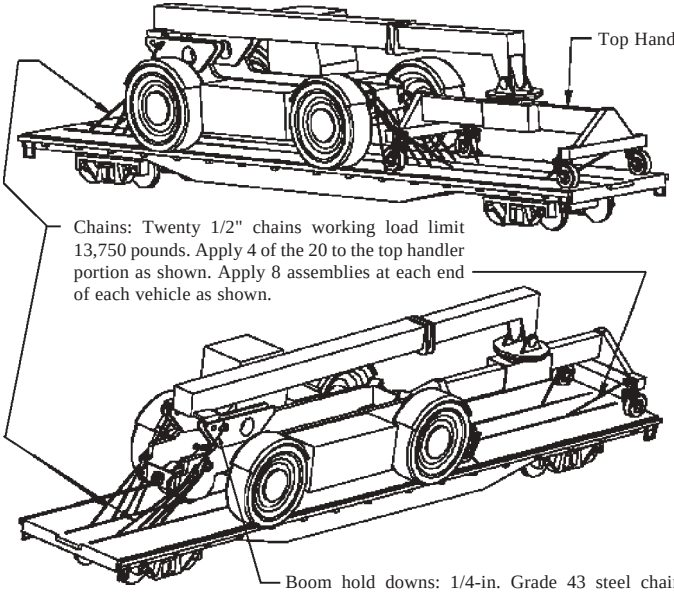




Notes:

1. From General Rules, Section No. 1. See page A-2 for tiedown of the truck to the flatcar.
2. If you use shackles to attach the wire rope to the tiedown rings, use at least 1/2-inch, 2-ton working load limit (WLL) safety anchor shackles and make certain the nut is secured with the cotter pin.
3. Use the same procedure for each container loaded on a flatbed semitrailer.

Kalmar Rough Terrain Container Handler (RTCH)



Notes:

1. From Section No. 6, Figure 54-b (to be published in 2004).
2. When ordering flatcars, shippers should specify HTTX-type cars, DODX 40,000- or 41,000-series cars, or similar equipped with tie-down devices in the quantity and strength shown above.
3. To correctly distribute the weight on the flatcar, the top handler must be retracted to within approximately 20 in. of the front tires (96.5 in. on the vehicle's ECS display screen), and the far end located within 1 ft of the car end sill. The RTCH weighs about 120,000 pounds.
4. On DODX flatcars, the pair of tie downs in the outboard channels are to be relocated to the inboard channels.
5. Shackles are not needed, nor should they be used on the vehicle tie downs.
6. See TM 10-3930-675-10 ROUGH TERRAIN CONTAINER HANDLER (RTCH); RT 240; 53,000 LB CAPACITY; 4X4 (NSN 3930-01-473-3998) starting on page 0007 00-1 for preparation for shipment.

Improved Ribbon Bridge

Common Bridge Transporter (CBT) M15 Bridge Adapter Pallet (BAP) and Standard and Improved Ribbon Bridge (IRB) Bays

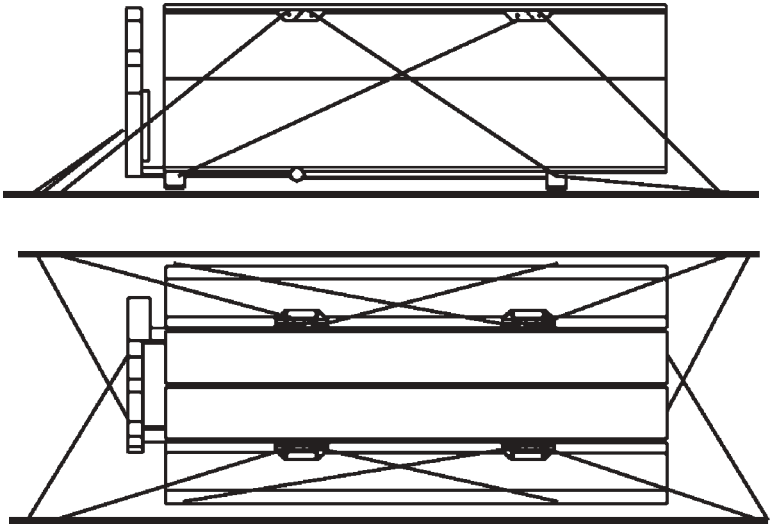


Figure 1. BAP and Bridge Bay (Side and Top View)

Tiedown Instructions: The procedure for securing and transporting the standard ribbon bridge bays and the improved ribbon bridge bays is identical. The BAP should be secured to the bridge bay (ramp or interior) by 5/8" wire rope. The wire rope should run from the lifting provisions on the "legs" of the BAP to the interior lifting eyes on the top of the bridge bay for a total of four tiedowns (fig 1). The bridge bay is then secured to the railcar with four 5/8" wire rope loops connected to chains from the railcar deck (figs 1 and 2). They should be run from the outside lifting eyes on the top of the bridge bay (fig 3). Chains from the outside stake pockets of the railcar are then secured to the wire rope loops (fig 4). For extra lateral restraint, four more chains should run from the tiedown provisions on the BAP to the outside stake pockets of the railcar. These chains should cross each other (fig 5).

Improved Ribbon Bridge (cont)

CBT BAP and Standard and IRB Bays (cont)

Figure 2. BAP and Bridge Bay from Actual RIT.

Figure 3. Close Up of the Top Lifting Eyes of the Bridge Bay Used for Tiedowns.

Improved Ribbon Bridge (cont)

CBT BAP and Standard and IRB Bays (cont)

Figure 4. Side View of Tiedowns from Actual RIT.

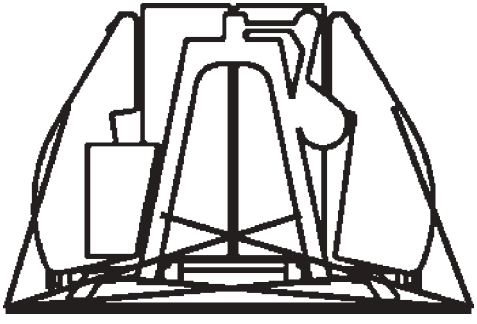


Figure 5. Side View of Cross Lateral Restraint Tiedowns.

Improved Ribbon Bridge (cont)

Common Bridge Transporter (CBT) M14 Improved Boat Cradle (IBC) and Bridge Erection Boat

Figure 6. IBC and Boat from Actual RIT.

Tiedown Instructions: The IBC is secured to the railcar (fig 6) by attaching chains from the outside stake pockets to the four tiedown provisions on the IBC, two in the front and two in the back (figs 7 – 9). Additionally, the Bridge Erection Boat is secured to the railcar with chains attached to 5/8" wire rope loops (similar to those used in the BAP bridge bay). The wire rope loops are attached to the Bridge Erection Boat on the front lifting provisions (figs 9 and 10). The keel pin located at the bottom of the IBC is not to be used to secure the Bridge Erection Boat to the IBC for rail transport. Damage could result to the boat if the keel pin is used.

Figure 7. Chain Tiedowns on the Front of the IBC.

Improved Ribbon Bridge (cont)

CBT IBC and Bridge Erection Boat (cont)

Figure 8. Chain Tiedowns on the Rear of the IBC and the Front of the Boat.

Figure 9. Chain Tiedowns on the Rear of the IBC and the Front of the Boat.

Improved Ribbon Bridge (cont)

CBT IBC and Bridge Erection Boat (cont)

Figure 10. Chain Tiedowns on the Front of the IBC.

Notes

Index

A

B

C

D

E

F

G

H

I

K

L

M

O

P

R

S

T

V

W