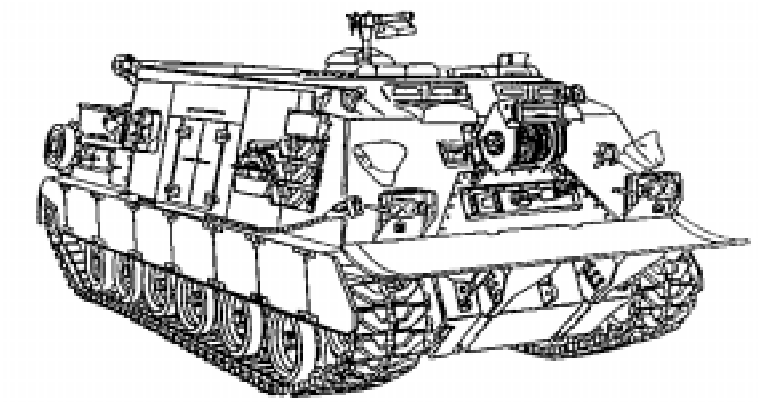
DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

COMMANDER'S GUIDE TO SAFETY

TANK AND AUTOMOTIVE EQUIPMENT

M88A2 Heavy Recovery Vehicle



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HEADQUARTERS, DEPARTMENT OF THE ARMY

June 2000

WARNING SUMMARY

WARNING

HAZARDS

FALLING HAZARDS

- ✔ Never crawl under equipment when performing maintenance unless equipment is securely blocked. Equipment may fall and cause serious injury or death to personnel.
- ✔ Keep clear of equipment when equipment is being raised or lowered. Equipment may fall and cause serious injury or death to personnel.
- ✔ Do not work on equipment supported only by lift jacks or hoist. Always use blocks or proper stands to support item prior to any work. Equipment may fall and cause severe injury or death to personnel.
- ✔ Fuel and oil are slippery and can cause falls. To avoid injury, wipe up spilled fuel or oil immediately with rags. Dispose of fuel-soaked rags in accordance with unit policy.
- ✔ Clean shoes and wipe hands before climbing onto vehicle and use grab handles. Failure to comply may result in injury to personnel.
- ✔ Do not remove all four hinge pins from the same skirt. Skirt may fall causing serious injury.
- ✔ Do not stand on top of vehicle while boom is being raised or lowered. Failure to comply may result in boom impacting personnel causing injury or death to personnel.
- ✔ Unless otherwise specified, perform all maintenance procedures with all equipment lowered to the ground, transmission in neutral, parking/emergency brake applied, and the engine stopped to prevent possible injury to personnel due to falling equipment or rolling vehicle.

HEARING HAZARDS

- ✔ Personnel hearing can be permanently damaged if exposed to constant high noise levels of 85 dB. (A) or greater. Wear approved hearing protection devices when working in high noise level areas. Personnel exposed to high noise levels shall participate in a hearing conservation program in accordance with DA PAM 40-501. Hearing loss occurs gradually but becomes permanent over time.

SINGLE HEARING PROTECTION REQUIRED

- ✔ Wear hearing protection during engine and/or APU operations; also when operating the vehicle up to a speed of 20 mph. Single hearing protection includes earplugs, earmuffs, attenuating Combat Vehicle Crewman (CVC) helmet, or headset. Failure to wear hearing protection can result in hearing damage.
- ✔ Wear hearing protection when firing the M2 machine gun.

DOUBLE HEARING PROTECTION REQUIRED

- ✔ Wear double hearing protection when operating the vehicle over a speed of 20 mph. Double hearing protection consists of wearing earplugs or earmuffs with either an attenuating CVC helmet or headset. Failure to wear hearing protection can result in hearing damage.

FIRE HAZARDS

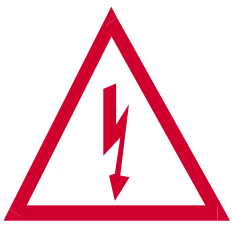
- ✓ Fuel is very flammable and can explode easily. To avoid serious injury or death, keep fuel away from open flame or extreme heat. Always keep fire extinguisher within easy reach when working with fuel. Do not work on fuel system when engine is hot. Fuel can be ignited by hot engine. When working with fuel, post signs that read “no smoking within 50 feet of vehicle.”
- ✓ Do not operate vehicle with any class of fuel leak. Fuel may ignite causing serious bodily injury.
- ✓ During refuel/defueling operations, all personnel must dismount from the vehicle and the portable fire extinguishers must be readily accessible and manned at all times. Failure to comply may result in injury or death to personnel.
- ✓ Shut off personnel heater if; fuel leakage is observed, heater will not start in specified time following proper procedures (heater lamp does not come on), blower does not operate or heater goes out (heater lamp goes out). Failure to comply may result in personnel injury or death and/or equipment damage due to potential for a crew compartment fire.

FIRE EXTINGUISHER/CO2 HAZARDS

- ✓ CO2 fire extinguisher can cause suffocation and severe burns. Exit vehicle immediately after discharging fire extinguisher. Handle fire extinguisher carefully. Do not bang or drop the cylinder. Failure to comply may result in injury or death.

ELECTRICAL HAZARDS

High voltage is used in the operation of some equipment. Death on contact may result if personnel fail to observe safety precautions.



- ✓ Never work on electronic equipment unless at least one other person familiar with the operation and hazards of the equipment is nearby. That person should also be competent in giving first aid. When an operator helps a technician, that operator must be warned about dangerous areas.
- ✓ Shut off power supply to equipment before beginning work. When working inside equipment with power off, take special care to ground every capacitor likely to hold a dangerous potential.
- ✓ Be careful not to contact high-voltage connections when installing or operating this equipment.
- ✓ Remove rings, bracelets, wristwatches, and neck chains before working on any vehicle. Jewelry can catch on equipment and cause injury, or may cause a short across an electrical circuit causing severe burns or electrical shock.
- ✓ Keep one hand away from the equipment to reduce the hazard of current flowing through life-sustaining organs of the body.

ELECTRICAL HAZARDS (CON'T.)

- ✔ Overhead power lines can cause electrical shock and damage to equipment. Tie down antennas before driving under overhead power lines. Failure to comply may result in injury or death to personnel.
- ✔ Radio antennas can radiate harmful levels of radio frequency energy. Remain at least two feet from radiating antennas of vehicle-mounted radios. Failure to comply may result in personnel injury.
- ✔ Be certain vehicle master switch is off when working on vehicle electrical system to prevent injury due to electrical shock.

BURN HAZARDS

- ✔ Adhesives, solvents, and sealing compounds can burn easily, give off harmful vapors and are harmful to skin/clothing. To avoid injury or death, keep away from open flame and use only in well-ventilated area. If adhesive, solvent, or sealing compound get on skin or clothing, wash immediately with soap and water.
- ✔ Do not touch hot exhaust system with bare hands. Failure to comply will result in injury to personnel.
- ✔ Allow engine to cool before performing maintenance on the muffler, exhaust pipe, exhaust manifolds or turbocharger. If necessary, use insulated pads or gloves.
- ✔ Do not touch cone when using fire extinguisher. Hands may be severely burned. Failure to comply may result in injury to personnel.

CLEANING HAZARDS

- ✔ Dry-cleaning solvent P-D-680 is toxic and flammable. Wear protective goggles and gloves and use only in a well-ventilated area. Avoid contact with skin, eyes and clothes. Do not breathe the vapors. Do not use near open flame or excessive heat. The flash point is 100-138 degrees F (38-50 C). **If you become dizzy while using dry-cleaning solvent, get fresh air immediately and get medical aid. If contact with eyes is made, wash your eyes with water and get medical aid immediately.**
- ✔ **Do not use mineral spirits or paint thinner to clean the M88 HRV.** Mineral spirits and paint thinners are highly toxic and combustible. **Prolonged breathing can cause dizziness, nausea and even death.**
- ✔ Use care when removing snap and retaining rings. Snap and retaining rings are under spring tension and can act as projectiles when released and could cause severe eye injury.

HIGH PRESSURE HAZARDS

- ✔ Never disconnect any hydraulic line or fitting without first dropping pressure to zero. High-pressure hydraulics operate this equipment. Refer to vehicle operator and maintenance manuals for hydraulic oil pressures. A high-pressure oil stream can pierce body and cause severe injury to personnel.

HIGH PRESSURE HAZARDS (CON'T.)

- ✔ When adjusting track tension, grease will be under pressure. **Personnel must wear goggles.** Failure to comply may result in eye injury to personnel.
- ✔ Use goggles and proper grounding procedures during refueling to prevent serious injury or death to personnel.
- ✔ Diesel fuel or hydraulic fluid leaks under pressure may not be visible. Use a piece of wood or cardboard to find leaks; do not use a bare hand. Wear safety goggles for protection. Failure to comply may result in injury to personnel.

BATTERY HAZARDS

- ✔ Lead-acid gasses can explode. Do not smoke, have open flames or make sparks around a battery, especially if caps are off. If a battery is gassing, it can explode and cause injury to personnel.
- ✔ Ventilate when charging or using in an enclosed space.
- ✔ Wear safety goggles and acid-proof gloves when battery cover must be removed or when adding electrolyte.
- ✔ Avoid electrolyte contact with skin, eyes, or clothing. If battery electrolyte spills, take immediate action to stop burning effects:

  External: Immediately flush with cold running water to remove all acid.

  Eyes: Flush with cold water for at least 15 minutes. Seek immediate medical attention.

BATTERY HAZARDS (CON'T.)

Internal:	Drink large amounts of water or milk. Follow with milk of magnesia, beaten egg, or vegetable oil. Seek immediate medical attention.
Clothing or Vehicle:	Wash at once with cold water. Neutralize with baking soda or household ammonia solution.

NBC OPERATIONS

- ✔ **After nuclear, biological, or chemical (NBC) exposure** of the vehicle, *all* air filters shall be handled with **extreme caution.** Unprotected personnel may experience injury or death if residual toxic agents or radioactive materials are present. If vehicle is exposed to chemical or biological agents, servicing personnel shall wear protective mask, hood, protective over garments, and chemical protective gloves and boots.
- ✔ **All contaminated air filters** shall be placed into double-lined plastic bags and swiftly moved to segregation area away from the work site. The same procedure applies for radioactive dust contamination, however, the NBC Team should measure the radiation prior to filter removal to determine the extent of safety procedures required per the NBC annex to the Standard Operating Procedures (SOP). The segregation area in which the contaminated air filter is temporarily stored shall be marked with appropriate NBC placards. Final disposal of contaminated air filters shall be in accordance with local SOP.

NBC OPERATIONS (CON'T.)

- ✓ **Do not operate blower** in an area where the air is contaminated. Failure to comply may result in personnel breathing contaminated air, causing injury or death to personnel.
- ✓ Do not use decontamination spray on personnel. It could cause personal injury.
- ✓ Do not use decontaminates on eyes, mouth or open wounds. This may cause personal injury. Flush these areas with water.

PAINTING HAZARDS

- ✓ **Chemical Agent Resistant Coating (CARC)** paint contains isocyamate (HDI) which is highly irritating to skin and respiratory system. High concentrations of HDI can produce symptoms of itching and reddening of skin, a burning sensation in the throat, nose and watering of the eyes.
- ✓ Extreme concentrations of HDI can cause cough, shortness of breath, pain during respiration, increased sputum production and chest tightness. The following precautions must be taken whenever using CARC paint:
  - ■ Always use air line respirators when using CARC paint unless air sampling shows exposure to be below hazardous level threshold standards.
  - ■ Do not allow skin or eyes to come in contact with CARC paint. Always wear protective equipment (gloves, ventilation mask, safety goggles, etc.).

PAINTING HAZARDS (CON'T.)

- Do not use CARC paint without adequate ventilation.
- Never weld or cut CARC coated materials.
- Do not grind or sand painted equipment with out high-efficiency air purifying respirators in use.
- Be aware of CARC paint exposure symptoms. Symptoms can occur a few days after initial exposure. **Seek medical attention immediately if symptoms are detected.**

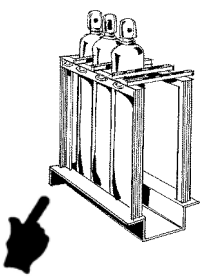
COMPRESSED AIR HAZARDS

✓ Compressed air used for cleaning purposes will not exceed 30 psi (207 kpa). Use only with effective chip guarding and personal protective equipment (goggles, shield, gloves, etc.).

AMMUNITION HAZARDS

✓ Check that machine gun is clear of ammo and barrel is free of obstructions to prevent injury to personnel.

COMPRESSED CYLINDERS (GAS) HAZARDS



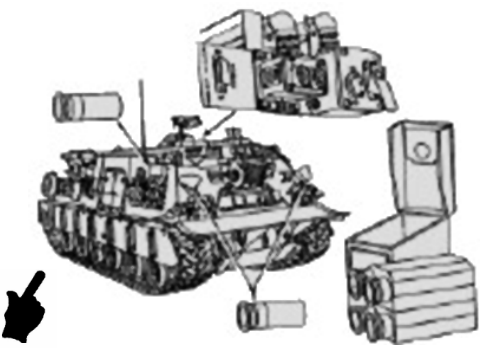
✓ Oxygen gas is stored under extremely high pressure. Ensure protective cap is in place when cylinder is not in use. If head of cylinder is broken off, personnel may be injured or killed.

✓ Ensure oxygen bottle valve is turned off and regulator gauges read zero (0) psi before removing regulator valve. Oxygen is under high pressure and could cause serious injury or death to personnel.

COMPRESSED CYLINDERS (GAS) HAZARDS (CON'T.)

- ✓ Acetylene gas is stored under extremely high pressure. Ensure protective cap is in place when cylinder is not in use. If head of cylinder is broken off, personnel may be injured or killed.
- ✓ Ensure acetylene bottle valve is turned off before removing regulator valve. Acetylene is under high pressure and could cause serious injury or death to personnel.

GRENADE LAUNCHER HAZARDS



- ✓ Do not fire grenades when personnel are outside the vehicle. Grenades contain red phosphorous which is a fire hazard and dangerous to all personnel outside the vehicle. Fire grenades only when all hatches are closed. Failure to comply may result in injury to personnel.
- ✓ Ensure that arming switch is off (lamp not lit) before loading grenades into a discharger. Failure to comply may result in firing grenades accidentally causing injury or death to personnel.
- ✓ Never place body in front of discharger when loading grenades or when dischargers are unloaded/loaded. Failure to comply may result in injury or death to personnel due to accidental discharge.
- ✓ Follow standard weapon loading procedures when handling and loading grenades. Failure to comply may result in injury or death to personnel due to accidental discharge.

FASTENERS AND ATTACHING HARDWARE HAZARDS

✓ **Always use the same fastener part number** (or equivalent) when replacing fasteners. Do not risk using a fastener of less quality; do not mix metric and inch (customary) fasteners. Mismatched or incorrect fasteners can result in damage, malfunction or injury.

FIRE RETARDANT HYDRAULIC OIL (FRH) HAZARDS

✓ FRH hydraulic fluid may contain tricresyl phosphate which if taken internally, can cause paralysis. Hydraulic fluid may be absorbed through the skin. Follow these precautions:

- Wear long sleeves, gloves, goggles, and face shield when using FRH.
- If FRH contacts eyes, immediately flush eyes with water and get immediate medical attention.
- If FRH contacts skin, thoroughly wash with soap and water.
- After using FRH, wash hands thoroughly before eating or smoking.

CARBON MONOXIDE POISONING HAZARDS

✓ Carbon monoxide is a colorless, odorless, deadly poisonous gas which, when inhaled, deprives the body of oxygen and causes suffocation. Exposure to air contaminated with carbon monoxide produces symptoms of headache, dizziness, loss of muscular control, apparent drowsiness and coma. Permanent brain damage or death can result from severe exposure.

CARBON MONOXIDE POISONING HAZARDS (CON'T.)

- ✔ Carbon monoxide occurs in the exhaust fumes of fuel-burning heaters and internal combustion engines. It becomes dangerously concentrated under conditions of inadequate ventilation.
- ✔ The following procedures must be observed to ensure the safety of personnel whenever the personnel heater, main or auxiliary engine of any vehicle is operated for maintenance purposes or tactical use.

  - ■ Do not operate heater or engine of vehicle in an enclosed area unless it is adequately ventilated.
  - ■ Do not idle engine for long periods without maintaining adequate ventilation in personnel compartments.
  - ■ Do not drive any vehicle with inspection plates or engine compartment doors removed unless necessary for maintenance.
  - ■ Be alert at all times during vehicle operation for exhaust odors and exposure symptoms. If either are present, immediately ventilate personnel compartments.

"The best defense against carbon monoxide poisoning is adequate ventilation"

EXHAUST GASES CAN KILL

✔ Brain damage or death can result from heavy exposure. Precautions must be followed to ensure crew safety when personnel heater, main or auxiliary engine of any vehicle is operated for any purpose.

- Do not operate vehicle engine in enclosed areas.
- Do not idle vehicle engine with vehicle windows closed.
- Be alert at all times for exhaust odors.
- Be alert for exhaust poisoning symptoms:

  - Headache
  - Dizziness
  - Sleepiness
  - Loss of Muscular Control

If you see another person with exhaust poisoning symptoms, proceed with the following:

- **Remove person from area**
- **Expose to open air**
- **Keep person warm**
- **Do not permit physical exercise**
- **Administer artificial respiration, if necessary**
- **Seek immediate medical attention**

✔ Be aware; the field protective mask for NBC protection will not protect you from carbon monoxide poisoning.

✔ Do not operate personnel heater with vehicle breather vent closed. Carbon monoxide poisoning can occur. Failure to comply may result in injury or death to personnel.

CHANGE
NO. 1

TB 9-2350-292-10
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HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, DC., 1 July 2001

COMMANDER'S GUIDE TO SAFETY
TANK AND AUTOMOTIVE EQUIPMENT
M88A2 HEAVY RECOVERY VEHICLE

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TB 9-2350-292-10, June 2000, is changed as follows:

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2. The purpose of this change is to update the text and enhance the art in TB 9-2350-292-10.

3. New or changed material is indicated by a vertical bar in the outside margin of the text changes and by a hand symbol beside illustration changes.

4. Remove the old pages and insert the new pages as indicated below:

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c thru d	c thru d
i thru l	i thru l
i thru ii	i thru ii
1 thru 6	1 thru 6
9 thru 10	9 thru 10
13 thru 14	13 thru 14
19 thru 22	19 thru 22
25 thru 34	25 thru 34

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Date of issue for original and changed pages are:

Original…...0……..June 2000
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TOTAL NUMBER OF PAGES IN THIS PUBLICATION IS 60, CONSISTING OF THE FOLLOWING:

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Authentication Page	1	21	0
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TECHNICAL BULLETIN
CHANGE NO. 1

TB 9-235-292-10

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, D.C., 1 June 2000

COMMANDER'S GUIDE TO SAFETY
TANK AND AUTOMOTIVE EQUIPMENT
M88A2 Heavy Recovery Vehicle

REPORTING OF ERRORS AND RECOMMENDING IMPROVEMENTS

You can help improve this publication. If you find mistakes or if you know of a way to improve the procedures, please let us know. Submit your DA Form 2028-2 (Recommended Changes to Equipment Technical Publications), through the Internet, on the Army Electronic Product Support (AEPS) website. The Internet address is http://aeps.ria.army.mil. If you need a password, scroll down and click on "ACCESS REQUEST FORM." The DA Form 2028 is located in the ON-LINE FORMS PROCESSING section of the AEPS. Fill out the form and click on SUBMIT. Using this form on the AEPS will enable us to respond quicker to your comments and better manage the DA Form 2028 program. You may also mail, fax or email your letter, DA Form 2028, or DA Form 2028-2 direct to: Commander, U.S. Army Tank-automotive and Armaments Command, ATTN: AMSTA-LC-CIP-WT, Rock Island, IL 61299-7630. The email address is TACOM-TECH-PUBS@ria.army.mil. The fax number is DSN 793-0726 or commercial (309) 782-0726.

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Introduction . . .

This guide provides M88A2 HERCULES crews, supervisors and unit commanders a quick and handy reference on the safe operation and maintenance of the M88A2 Heavy Recovery Vehicle. Crews and supervisors should give particular attention to the proper driving and towing techniques and procedures outlined in this guide.

NOTE: *This guide is not meant to be used in-lieu of the Operator's Manual, but in conjunction with the associated Technical and Field Manuals.*

The contents of this guide provide you extracts from the warnings and cautions, as well as operations and procedures listed in the Operator's Manual (TM 9-2350-292-10) the Maintenance Manuals (TM 9-2350-292-20-1 & -2) and FM's 21-306 and 9-43-2.

Any comments or suggestions should be mailed to:

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SAFE DRIVING OPERATIONS

- ✓ Always use two personnel to guide driver when backing the vehicle for emplacement or any other reason. Both guides must stand to the left a safe distance from vehicle. Left front guide must be visible to driver.
- ✓ Do not stand between vehicles while one or more of them are running. Vehicle could jump and pin you against the other vehicle.
- ✓ Hatches could close and injure or kill personnel. Visually check inside and outside locks of hatches for latching before operating in open hatch mode.
- ✓ Always use “three point contact” with vehicle; face vehicle when entering or leaving crew compartment. Three point contact means that three out of four arms and legs are in contact with the vehicle at all times during mounting or dismounting.
- ✓ Never use control levers as a hand-hold when entering or exiting the vehicle. Never step on foot controls when mounting or climbing off vehicle.
- ✓ Never enter a moving vehicle. Failure to comply may result in injury or death to personnel.
- ✓ Do not use on-board equipment for purposes other than its intended use, unless authorized by the Tank-automotive and Armaments Command (TACOM).
- ✓ Fasten seat belt before operating vehicle. Avoid sudden stops and operate at a safe speed.
- ✓ Make sure steering wheel is centered and locked. Vehicle may move during engine starting causing injury to personnel.

SAFE DRIVING OPERATIONS (CON'T.)

- ✓ If low brake pressure indicator comes on and stays on, do not operate vehicle. Notify unit maintenance.
- ✓ Vehicle steers in opposite direction when transmission is in reverse. Turn wheel right, vehicle moves left. Turn wheel left, vehicle moves right. Be sure that the steering wheel is positioned correctly before moving vehicle.
- ✓ Do not shift into reverse when vehicle is moving +forward. Personnel could be thrown from seat.
- ✓ Do not jerk vehicle around into a hard turn. Failure to comply may result in personnel being thrown from seat causing injury to or damage to equipment.
- ✓ Vehicle must be at a complete stop prior to shifting transmission to neutral.
- ✓ Do not use hand throttle control in place of accelerator for speed control except in an emergency.
- ✓ Always secure boom, spade, hatches, doors, and all other equipment before moving out.
- ✓ Approach an obstruction or obstacle head-on when possible. Warn crew members to brace themselves. Secure hatches and doors. Failure to comply may result in injury or death to personnel.
- ✓ Secure APU compartment door with door latch.
- ✓ **Do not leave the operator's seat while the engine is running.**
- ✓ Maximum depth of water should be known, do not exceed a depth of 56 in. The highest wave should not reach the opening of main engine air inlets.

SAFE DRIVING OPERATIONS (CON'T.)

- ✓ Excessive speed is a common driver error and a frequent cause of accidents. Adjust your speed to existing conditions (road surface, visibility, weather, etc.) no matter what the posted speed limit may be. Drive at a speed that gives you safe control of your vehicle at all times.
- ✓ Do not permit riders on the outside of a tracked vehicle unless ordered to do so by the vehicle commander.
- ✓ Warn the crew when you are about to cross a ditch, climb an obstacle, or take any action that might cause the crew members to be caught off balance.
- ✓ When a tracked vehicle gets out of control and over-turns, it is safer to *stay* in the vehicle than to try to get out while the vehicle is still moving. You may receive slight injuries from being thrown against metal parts; but if you try to leave the vehicle, it may roll over and crush you.
- ✓ Once the vehicle stops moving, get out as fast as possible because spilled fuel and oils may catch on fire. The first thing the driver should do in such an emergency is shut-off the engine and turn off the master power switch to minimize the fire hazard.

X **WARNING!**

Failure to comply with the above procedures may result in serious injury or death of personnel.

AUXILIARY EQUIPMENT

Most vehicles have auxiliary equipment. The auxiliary generator and engine, night vision devices, and communication equipment are examples of auxiliary equipment the driver uses separately from driving the vehicle. The vehicle TM may refer you to another manual for the information on the auxiliary equipment. It is as important for you to know how to operate and maintain the auxiliary equipment of your vehicle as it is to be able to operate and maintain the vehicle.

RECOVERY SAFETY AND PRINCIPLES

RECOVERY

Recovery is retrieving, or freeing immobile, inoperative, or abandoned materiel from its current position and returning it to operation or to a maintenance site for repair. These actions typically involve towing, lifting, and winching.

Towing is typically limited to moving vehicles to the nearest Unit Maintenance Collection Point.

Recovery consists of: self-recovery, like-recovery, and dedicated-recovery. Self-recovery actions use only the equipment's assets; like-recovery actions involve the assistance of a second, similar vehicle; and dedicated-recovery requires the assistance of a vehicle which is specifically designed and dedicated to recovery operations.

VEHICLE RECOVERY

Recovery of tracked vehicles that are mired or otherwise, unable to move under their own power is difficult even under the best conditions. In a combat situation, the difficulties increase considerably and in many cases, the conditions under which the vehicle is mired are far worse than in peacetime situations. FM 9-43-2 tells you how to recover a vehicle under a variety of situations.

Regardless of conditions, as a minimum, the following precautions must be taken during recovery operations:

- ✓ Shut-off engines and apply brakes while cables or tow bars are connected and disconnected.
- ✓ Position the main gun to prevent impact on the hull or turret of another vehicle in case of a collision.

VEHICLE RECOVERY (CON'T.)

- ✓ Close hatch doors and observe through periscopes during vehicle recovery.
- ✓ Make sure personnel on the ground stand at a distance from the rigging greater than the distance between the two rigging points. They should never stand within an angle formed by the rigging.
- ✓ Inspect riggings for proper attachments. Make sure pin safety keys are in place.
- ✓ Have one person control the operation. He should be positioned clear of all cables and where all drivers can see his signals throughout the periscopes.
- ✓ Apply power gradually to remove slack from rigging.
- ✓ Do not smoke or allow open flames near nosed or overturned vehicles due to possible fuel leaks.
- ✓ Point exhausts of towing tracked vehicle away from nosed or overturned vehicles. The exhausts may ignite spilled fuel.
- ✓ Remove fuel and oil from recovered nosed or overturned vehicles. Run a complete maintenance check before starting the engine.

RECOVERY VEHICLES

Recovery vehicles are used in situations where self/like-vehicle recovery is not possible due to the severity of the situation, safety considerations, or the inability to use like-vehicle assets employed in their primary function.

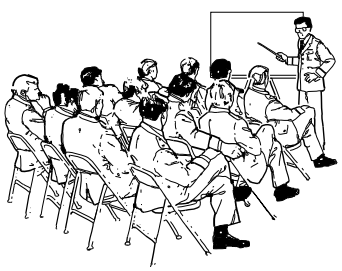
Recovery managers must ensure recovery vehicles are used only when required and returned quickly to a central location to support the unit. In addition to it's recovery mission, this equipment is often used for heavy lifting required in maintenance operations.

Recovery manager/supervisors must use all available resources carefully to provide sustained support.

PRINCIPLES OF RECOVERY

Recovery is performed to:

- ✔ Retrieve damaged equipment for repair and return to use.
- ✔ Retrieve abandoned equipment for further use.
- ✔ Prevent enemy capture of equipment.
- ✔ Obtain enemy material and records for intelligence purposes or for use by us or allied forces.



METHODS OF RECOVERY

The four methods of recovery are:

✔	**Winching**	Using winches on special purpose or cargo vehicles.
✔	**Lifting**	Using lifting capabilities of special purpose vehicles.
✔	**Towing**	Using the towing capabilities of similar or special purpose vehicles.
✔	**Expedients**	Used when other methods are not adaptable to the situation, or when appropriate like-vehicles or dedicated recovery vehicles are not available.

RECOVERY SAFETY

Recovery can be inherently dangerous unless safety is continually observed and practiced. Each of the recovery functions (winching, lifting, and towing) must only be performed with safety as the primary concern.

Always follow safety warnings in the operators manual for both the recovery vehicle and the recovered vehicle or equipment. As well as FM's 9-43-1 and 9-43-2.

Recovery managers and supervisors should know recovery equipment capabilities and limitations. Keep all but the minimum required personnel away from the recovery area. Each recovery crew member must know where other crew members are located at all times.

Remember!

During Recovery Operations,

SAFETY FIRST !

RECOVERY SAFETY (CON'T.)

What Recovery Managers, Supervisors, Operators should take into consideration:

- ✓ Equipment Identification (what is it that needs to be towed or recovered and it's situation?)
- ✓ Verification of Location and Status of disabled vehicle (8-digit coordinate)
- ✓ Update on the current tactical situation
- ✓ Defensive/Offensive Operations/NBC Operations (additional decontamination equipment needed?)
- ✓ Availability of Communications (Pri/Alt Freq/applicable call signs)
- ✓ Day or Night Operation (additional night vision devices needed?)
- ✓ Forecast (weather conditions)
- ✓ Locations of the UMCP/MSR/Evacuation points

The following are some of the applicable common skills required to perform Recovery Operations:

SKILL LEVEL 1

Identify topographic symbols	071-329-1000
Identify terrain features	071-329-1001
Determine grid coordinates	071-329-1002
Measure distance	071-329-1008
Orient a map to the ground by terrain association	071-329-1012

RECOVERY SAFETY (CON'T)

SKILL LEVEL 2

Select a movement route	071-326-0515
Determine the elevation of a point on the ground using a map	071-329-1004
Use a map overlay	071-329-1019

SKILL LEVEL 3

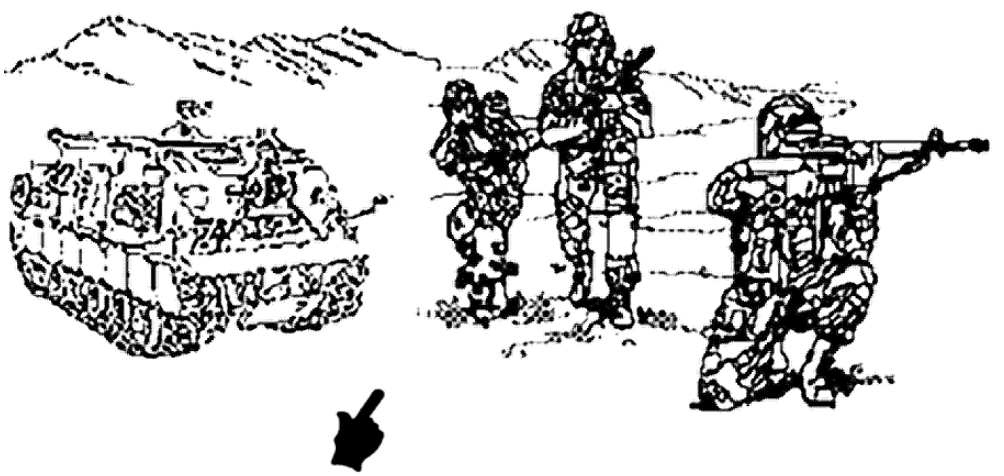
Analyze terrain	071-331-0820
Direct vehicle and equipment recovery operations	091-309-0711
Control mission safety hazards	850-001-3001

SKILL LEVEL 4

Prepare a route reconnaissance overlay	051-196-3065

LIEUTENANTS AND CAPTAINS

Direct vehicle and equipment recovery operation	03-4995.90-0010



RECOVERY PROCEDURES

In any and all recovery operations, use the following eight-step method:

STEP 1. RECONNOITER AREA

- ✔ Check the terrain for an approach to the load, then determine the method of rigging and the availability of natural anchors. As with a tactical mission, a recovery crew must know the problem before making decisions.

- ✔ Make a complete ground survey of the area, then select the best route of approach to the disabled vehicle to prevent possible disablement of the recovery vehicle.

- ✔ When selecting the evacuation route, ensure the military route classification number will support the combination vehicle classification (recovery plus towed vehicle). Refer to FM 5-36 for further information.

STEP 2. ESTIMATE THE SITUATION

- ✔ Estimate the resistance created by the load and determine the capacity of the available effort. For most recovery operations involving winching, the available effort would be the maximum capacity of the winch.

STEP 3. CALCULATE RATIO

- ✔ Compute an estimated mechanical advantage for the rigging by dividing the resistance of the load (STEP 2) by the available effort (the capacity of the winch).

RECOVERY PROCEDURES (CON'T.)

STEP 4. OBTAIN RESISTANCE

- ✔ Compute the tackle resistance and total resistance. Determine the resistance of the tackle. The percent of the load resistance, as determined in STEP 2, is multiplied by the number of sheaves in the rigging. The determined resistance of the tackle added to the load resistance equals the total resistance.
- ✔ Total effort available is winch capacity multiplied by the mechanical advantage, as computed in STEP 3. If effort available is more than total resistance, proceed to STEP 5.
- ✔ If it is less, go to STEP 3 and add mechanical advantage.

STEP 5. VERIFY SOLUTION

- ✔ Compute line forces to compare with the winch and dead line capacities. Divide the total resistance (STEP 4) by the mechanical advantage (STEP 3). The result is the force of the fall line. The fall line force must be less than the capacity of effort. Therefore, this step of the recovery procedure is the key step to solving the problem.
- ✔ When verifying the solution, if the computed fall line force is greater than the effort, the mechanical advantage must be increased. Note that no physical work has occurred up to this point. As a result, no time is lost moving equipment or having to re-erect rigging equipment. Compute the dead line force, determine the required strength of equipment capacity and choose the correct equipment to use as dead lines.

RECOVERY PROCEDURES (CON'T.)

STEP 6. ERECT RIGGING

Orient the crew, instruct them to assemble the tackle and then move to a safe location. Advise the crew members of the plan, direct them to erect the tackle, and assign specific tasks. Crew members who have finished their tasks should assist those who are having difficulty. The crew members can save time by having a thorough knowledge of the tackle to be erected and by helping each other. Observe all safety precautions!

STEP 7. RECHECK RIGGING

Make sure that tackle is rigged for proper and safe operation. Direct the operator to remove most of the slack from the lines and to inspect for correct assembly. If any corrections must be made, direct the crew members to make them. Explain the details of the operations to the operators of the recovery vehicle and the other vehicles involved. Direct operators to be prepared to watch for and act on signals. Then move to a safe location where signals can be observed by all vehicle operators.

RECOVERY PROCEDURES (CON'T.)

STEP 8. YOU ARE READY

Signal the operators to apply winch power and recover the load. Be alert and make sure that nothing obstructs the operations of the equipment, and that all personnel on the ground remain at a safe location.

NOTE: *This eight-step procedure should be followed during all recovery operations. To assist in memorizing these steps and their sequence, they are arranged so that the first letter of each step will spell out the word "Recovery." This plan is of value to recovery crews, for application and supervision, and also to commanders for determining the efficiency of their recovery crews* and their need for training.

R ECONNOITER AREA
E STIMATE SITUATION
C ALCULATE RATIO
O BTAIN RESISTANCE
V ERIFY SOLUTION
E RECT RIGGING
R ECHECK RIGGING
Y OU ARE READY

CAUTION!

TRACK TOWING

Although towing can be done with similar vehicles, it is often necessary for the recovery vehicle to tow a disabled vehicle to some point where repairs can be made or evacuation effected.

The method of tow depends primarily on the type of terrain.

- ✔ Take care to prevent further damage to the vehicle when towing. Do not engage the towed vehicle's transmission during towing operations. Check the disabled vehicle's -10 manual for vehicle preparation, any further precautions, and the towing speed.
- ✔ Exercise extreme caution when towing.
- ✔ Towed tracked vehicles will not have any braking effect. The recovery vehicle must provide braking for the towed vehicle as well as itself. Remember, the M1A2 and other Abrams FOV's as well as other tracked vehicles that are of equal weight as the recovery vehicle require a holdback vehicle during towing operations.
- ✔ A holdback vehicle or braking method is mandatory when using tow cables. Check the operators manual.
- ✔ Take care when towing vehicles so that you maintain control of both the towing and towed vehicles. Consider terrain, weather, and road conditions. Never exceed tow speeds listed in operator's manuals.
- ✔ **Use third vehicle to hold back disabled vehicle. Refer to FM 9-43-2 and Towing Operations Instructions for procedures. Failure to comply may result in a jackknife or collision which may result in injury or death to personnel or damage to equipment.**

CAUTION!

- ✔ Replace tow pintle if a pry bar is needed to open jaw after towing mission.
- ✔ Do not exceed maximum speeds for towing with tow bar or tow cables. Failure to comply may result in injury or death to personnel or damage to equipment.
- ✔ Towing a disabled vehicle requires use of towing pintle and tow bar. When towing a vehicle, maintain the following speeds: 5 to 17 mph (8 - 27 kmph) over hard, level, smooth road or 3 mph (5 kmph) over hilly, cross-country ground. These figures are maximum speeds. Go slower if towing on steep slopes (10-25%) or if disabled vehicle's technical manual specifies slower speeds. You must obtain your unit commanders approval to tow on slopes above 25% (per FM 9-43-2).
- ✔ Make sure disabled vehicle will not move after it is disconnected from M88A2. If final drives of disabled vehicle were disconnected for towing, chock vehicle before disconnecting tow bar. Disabled vehicle may not have any brakes. Failure to comply may result in movement of the disabled vehicle causing injury or death to personnel or damage to equipment.
- ✔ Shut off engine(s) and lock brakes on both vehicles before going between them. Vehicle may jump and crush personnel against other vehicle. Failure to comply may result in injury or death to personnel.
- ✔ When towing in unusual conditions (mud, snow, ice), recommend the crew perform a risk analysis.
- ✔ **Operational Risk Assessment (ORA) must be completed for every 70 ton class vehicle towing mission. Ref: -10 manual.**

1. Perform Operational Risk Assessment as follows:

   (a) Operational Risk Assessment (ORA) must be completed prior to every 70-ton class vehicle recovery mission

   (b) Reproduce the matrix (page 16.2) locally as needed.

   (c) Fill out the ORA matrix form, taking into consideration the following conditions:
      1. Driver/TC Experience
      2. Visibility (weather conditions)
      3. Terrain (including surface conditions and slope)
      4. Use of hold back vehicle and its associated hazards

   (d) Total “risk factor(s)” given to each category and enter on “TOTAL RISK” line.

   (e) Have the ORA reviewed by the appropriate decision authority (depending upon the risk level) to either ACCEPT or REJECT the risk assessments required for the mission.

   (f) To reduce the risk level, it may be necessary to consider one or more of the following:
      1. Request a more experienced driver.
      2. Wait for better weather.
      3. Identify a better route through the terrain

TOWING OPERATIONAL RISK ASSESSMENT

UNIT_____ **OPERATOR**_____ **TC**_____
RECOVERY VEHICLE BUMPER #_____ **TOWED LOAD**_____
DATE_____

M88 A2 EXPERIENCE	0-6 Months	7-12 Months	13-24 Months	25+ Months	RISK
DRIVER	4	3	2	1	
TC	4	3	2	1	

VISIBILITY	Reduced Visibility	Clear	
DAY Reduced Visibility (RAIN, FOG & DUST)	1	0	
NIGHT (Includes the use of NVG's)	2		

SURFACE CONDITION	Wet	Dry		
ASPHALT, CONCRETE		2	1	
	Wet	Dry		
SECONDARY ROADS (Hard Packed Gravel)	4	3		
LOOSE CONDITIONS (Sand, Dirt, Loose Gravel)	4			
MUD & CLAY	5			
SNOW & ICE **RECOMMEND A HOLD BACK VEHICLE**				

SLOPE				
0-5%			1	
6-10%		2		
11-14%	3			
15-19%	5			
20-22%	6			
23% +	**RECOMMEND A HOLD BACK VEHICLE**			
			TOTAL RISK	

(5-10) Medium PLT LDR/SGT

(11-16) High CO CDR/XO

(17+) Recommend HOLD-BACK VEHICLE

TC Signature_____ Verifying Authority_____

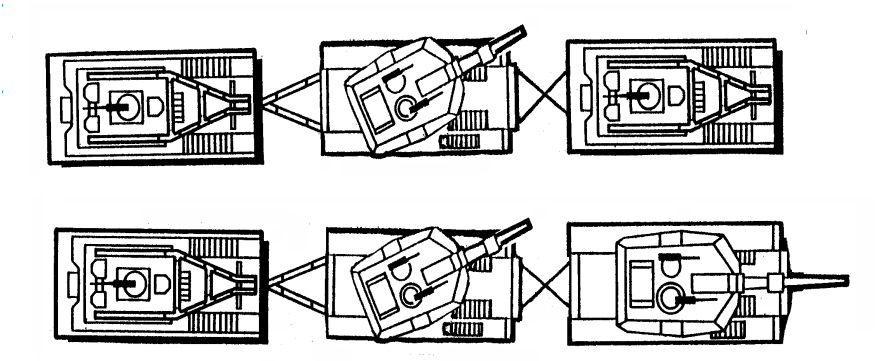
*Risk Assessment must be completed prior to 70 ton class vehicle Towing Operation.
*In conditions assessed a high risk, commanders may require the use of a hold-back vehicle.
*OC&S has experienced difficulties at 15% + slopes and under degraded soil conditions.
A hold-back vehicle may be recommended.
*All slopes 15% and above must be signed off by the Company Commander.
*Cross-Country Tow w/cables requires a hold-back vehicle. (FM 9-43-2)
- Cross-Country Tow requires Como between towing vehicle and hold-back vehicle.
*Combat Tow does not require hold-back vehicle.

REPRODUCE

CAUTION!

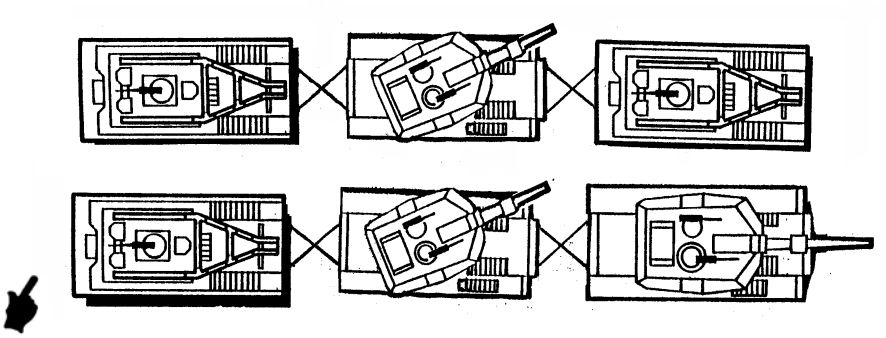
- ✓ When towing tracked vehicles with only one track, there will be a difference in resistance and steering capability between a complete track on one side and road wheels on the other side. As a result, the towed vehicle will pull in the direction of the side lacking the track.
- ✓ Check the technical manual pertaining to the towed vehicle to determine the necessary preparations and precautions to be used to prevent further damage.
- ✓ Never exceed the towing speed outlined in the technical manual.

HIGHWAY TOW/SECONDARY TOW AND MOST CROSS-COUNTRY TOWING

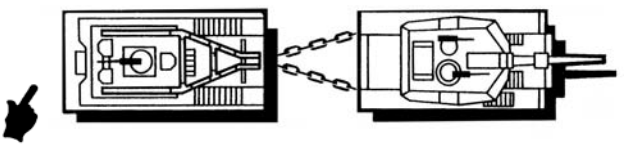


Attach the recovery vehicle's tow bar to the tow lugs of the disabled vehicle (upper tow lugs on the M1 FOV). Place the lunette of the tow bar in the recovery vehicle's tow pintle. This can be done using the chain hoist attaching one part to the tow bar and the other to a place on the recovery vehicle higher than the tow pintle. This allows a single soldier to raise the tow bar to the pintle without getting between the two vehicles. Secure the pintle in the closed position. Ensure cotter pin is engaged in the tow pintle and one end bent over. A driver is not required in the towed vehicle.

CROSS-COUNTRY TOW



Only in extreme cases, or as a backup, will crossed tow cables be used as a method of cross-country towing. Use



crossed tow cables between the recovery vehicle and the disabled vehicle as when towing similar vehicles. A holdback vehicle is required so that the towed vehicle will not overrun the recovery vehicle.

COMBAT TOW

Use combat tow to make a towing connection under small-arms fire to provide the least possible exposure of personnel. Attach the lifting v-chain to the recovery vehicle's tow pintle before moving to the disabled vehicle. Move the recovery vehicle into the danger area. Back it up until contact is made with the front of the disabled vehicle. If possible, a crew member in the disabled vehicle can connect the v-chain legs to the front tow hooks of the disabled vehicle. The recovery vehicle then moves out, towing the disabled vehicle. Do not use combat tow for distances greater than one-quarter mile. Conditions permitting, change the towing procedure after that distance.

TOWING OPERATIONS ON GRADES

Towing a disabled vehicle is never easy, but towing up or down a grade can be even more difficult and dangerous. While towing a disabled vehicle, do not attempt to negotiate a grade (either up or down) greater than 25 percent unless you have the express permission of your commander.

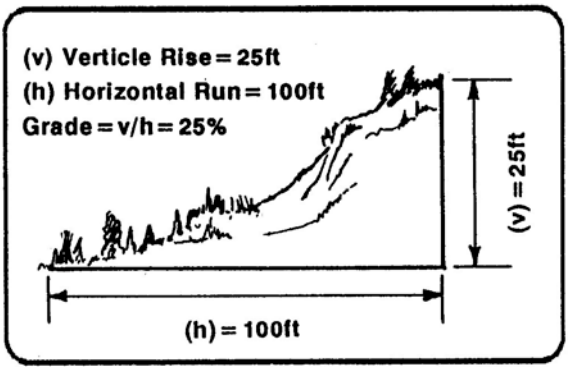
NOTE: Under no conditions will you ever negotiate a slope greater than 30 percent while towing a vehicle.

In order to know which grades to avoid, you have to know how to classify them. Grades are defined in terms of percent, or the amount of a grade's vertical height (rise) over its horizontal length (run). If a road gains 25 feet of height over 100 feet of length, it is classified as a 25 percent grade.

The best way to classify a grade is with a surveyor's level, which will be BII on the Improved Recovery Vehicle, M88A2. The operator stands at the top (or bottom) of the hill, and chooses a point as close to the bottom (or top) of the hill, as possible where he will be traveling. The operator then looks through the sight of the level at the point he has chosen and turns the level knob until he sees the level bubble centered between the witness marks. He then just reads the percent grade off the indicator.

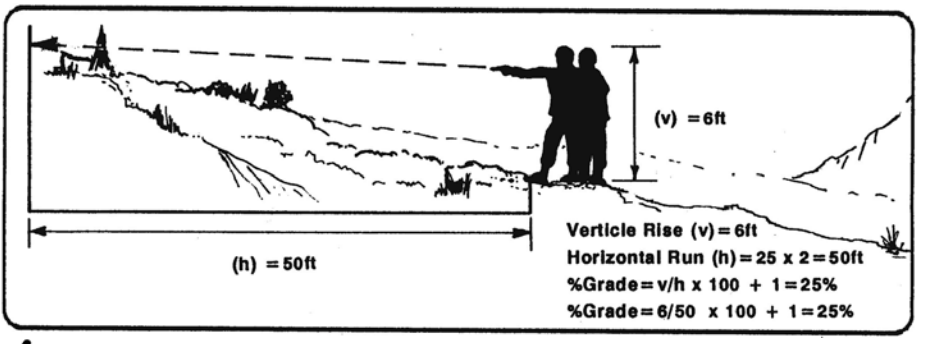
An expedient method uses a small level, a 10 inch piece of flat wood and a ruler. Lay the piece of wood on the steepest part of the grade, with the length of the wood running up and down hill. Put the level on the piece of wood and start to raise the downhill side of the wood up, until the bubble in the level is between the witness marks.

TOWING OPERATIONS ON GRADES (CON'T.)



Expedient Method

Measure the distance between the road and the bottom of the wood. If it is 3 inches, you are on a 30 percent slope; 2.5 inches, and you are on a 25 percent slope, and so on.



Eye Sight and Pace Method

One other way of determining grade is the eye sight and pace method. You need to know your height and the length of your stride. If a soldier is 6 feet tall and his step is 2 feet long, he stands at the bottom of the hill and picks a spot on the hill that is the same height as his head. He then walks to that spot counting his steps. Once he reaches the spot, he multiplies his steps by his stride (2 feet) and then divides his height (6 feet) by that number, multiply by 100 and add 1.

TOWING OPERATIONS ON GRADES (CON'T.)

Take the following items into consideration while doing your terrain analysis.

- ✔ Trails/grades with sharp curves mean additional control is needed during ascending and descending. There is no safety zone in case of a runaway load.
- ✔ Inclement weather (rain, snow, ice) will naturally affect the road conditions, making them more likely to cause loss of traction.
- ✔ Dry, dusty soil can cause a loss of traction as well as wet muddy soil. Do not let the soil conditions fool you.

If you have to shift into first gear to climb a grade, there is a good chance it is too steep to descend that way with a towed load. Check it before descending.

If you can find a way around the steep grades, good. If not, what are your options? First notify your commander. Tell him the percent grade of the road, weather visibility, and what the road conditions are (wet, dry, muddy, paved). The recovery vehicle driver's experience, and the type load he is towing, will play an important role in the commander's decision. If you, the driver, do not feel confident in negotiating the grade, make that known to the commander. The best course of action may be to get the most experienced wrecker/recovery vehicle operator on the site to take the mission.

In summary, ensure you conduct a good route reconnaissance on your way to the disabled vehicle's site. Avoid all hills or roads with a grade of 25 percent or greater when at all possible while towing a load. If not, notify your commander and take proper precautions.

RIGGING BETWEEN VEHICLES

- ✔ While rigging is being erected between vehicles, turn off the engines and apply the brakes. This prevents possible injury to the recovery personnel and disabled vehicle crew or damage to the vehicles.
- ✔ Safety devices/keys/shackle pins should be securely in place on all tow hooks, shackles, or other items of equipment before beginning any operation.

POSITIONING GUN TUBES

During tank recovery (towing), position the main gun tube so that it will not be damaged. If the gun tube of a disabled tank is involved in a collision (this could occur on a nosed or overturned tank), support maintenance personnel should always check the gun before firing.

TOW BAR HANDLING

- ✔ Before attempting to tow a disabled vehicle, make sure you are familiar with the location, features, and operation of all components of the tow bar. Some tow bars have operator's instruction decals mounted on them. Ensure the proper tow bar is used based on the equipment being towed. Tow bars can be used to tow any vehicle up to the gross weight of the tow bar's towing capacity.
- ✔ Before attaching the tow bar to a disabled vehicle, set parking brake and place chock blocks in the front and rear of the tracks of disabled vehicle. After attaching the tow bar, set parking brake on recovery vehicle and shut down the engine. Release parking brakes on disabled vehicle (if applicable, disconnect final drives) and remove chock blocks.

TOW BAR HANDLING (CON'T.)

✓ Refer to disabled vehicle's technical manual for proper towing procedure. Ensure the proper pin assemblies are in the clevis holes and always be sure the quick release pins are properly secured.

TOW CABLES AND TOW BARS INSPECTION

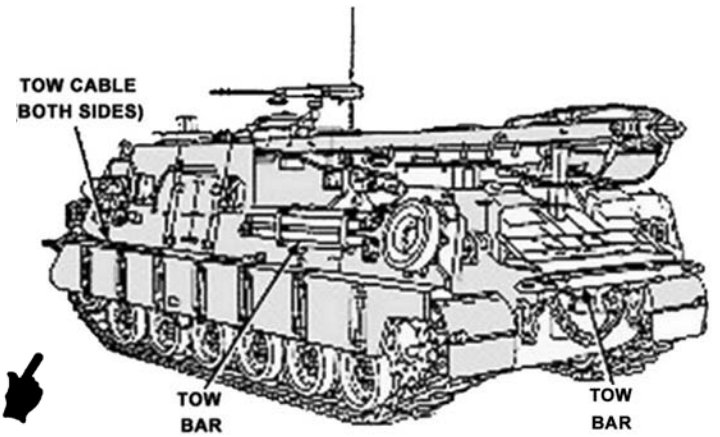
Visually inspect tow bar legs for bends and cracks. Inspect lunette for cracks and bends. Inspect for tow bar pins, clevises, and locking pins. Inspect tow cables for kinks or broken/frayed wires. Inspect eyelets for cracks.

The vehicle is not fully mission capable if any of the following conditions exist:

A. Both tow bars missing or unserviceable.

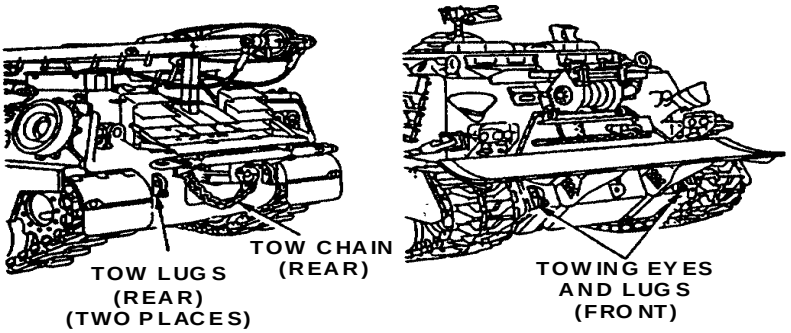
B. Any bends, cracks, missing pins/locking pins. Lunette bent or cracked.

C. Cable missing, kinks, bends, or broken/frayed wires. Eyelet cracked.



TOW PINTLE AND TOW LUG INSPECTION

Visually inspect (front and rear) tow lugs for presence and condition. Visually inspect tow pintle for presence, condition and cracks. Move tow pintle lock and pintle hook by hand.



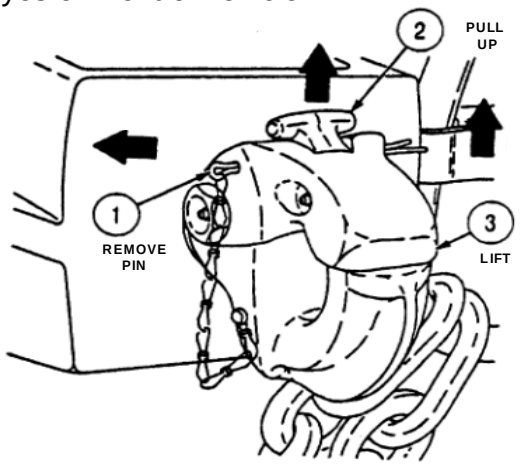
The vehicle is not fully mission capable if any of the following conditions exist:

A. Tow lugs missing or broken.

B. Tow pintle missing, broken or cracked. The pintle lock and hook will not operate by hand.

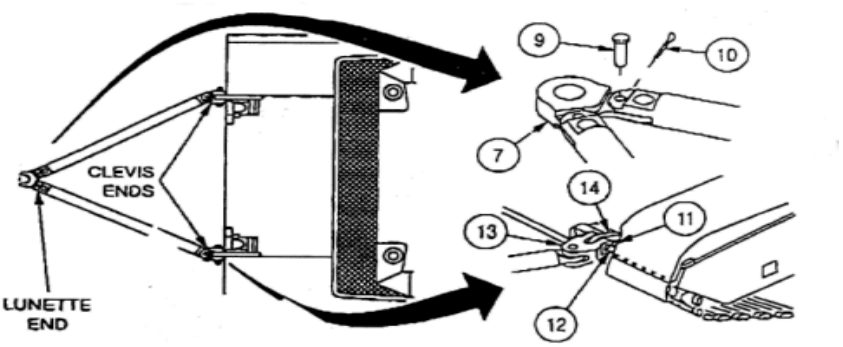
TOWING WITH TOW BAR

✓ When attempting to tow Abrams combat tank, always connect tow bar to smaller of two holes in tank's upper lifting eyes on front of vehicle.



TOWING WITH TOW BAR (CON'T.)

- ✓ Make sure clevis markings "TOW↑BAR" is facing upward with arrow pointing towards tow bar when securing clevis to tow lugs of disabled vehicle or upper lifting eyes on front of Abrams' FOV. Failure to comply wil result in equipmet damage.
- ✓ Position M88A2's towing pintle in front of tow bar, apply brakes, shift transmission selector lever to park to lock the brakes, and shut off the engine.
- ✓ Open the towing pintle.
- ✓ Connect the chain hoist and sling to the tow bar.
- ✓ Lift the tow bar with the chain hoist until it is at the same height as the tow pintle.
- ✓ **Stay out from between vehicles while M88A2 is being positioned.**
- ✓ Use two ground guides to direct operator while backing up.
- ✓ Start main engine and back M88A2 until lunette end of tow bar is connected to towing pintle.
- ✓ Apply brakes, shift transmission to park, and shut down engine.
- ✓ Close and secure pintle hook.
- ✓ Remove chain hoist and sling.



✓ Check disabled vehicle's technical manual for any special towing procedures before towing (such as disconnecting final drives).

✓ Ensure the head end of all pins are facing up or into the center of the vehicle.

TOWING WITH TOW CABLES

✓ A holdback/third vehicle or braking method is mandatory when using tow cables, ref: FM 9-43-2. Shackles will not fit rear towing eyes of all vehicles. Use highest strength shackle available for each application.

✓ Position the M88A2 in front or rear of disabled vehicle, depress brakes, shift transmission selector lever to park (P) to lock brakes. Shut down engine.

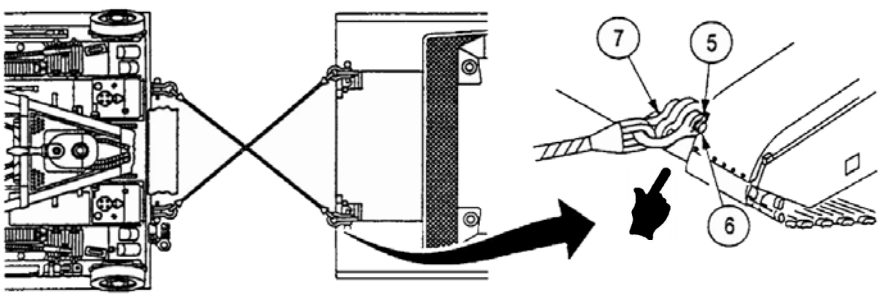
✓ Stay out from between vehicles while the M88A2 is being positioned. Failure to comply may result in personnel being crushed between vehicles.

✓ Do not bend or loop cables when rigging vehicle for towing. This will weaken the cables and cause them to break. Failure to comply may result in injury or DEATH to personnel or damage to equipment.

✓ Ensure locking pins are securely fastened in clevis pins to avoid separation of tow cable from vehicle. Failure to comply may result in injury or DEATH to personnel or damage to equipment.

✓ For towing, connect 50-ton shackles to front lifting eyes of disabled vehicle, and rear towing lugs, upper eyes only, on M88A2. Tow cables should cross when installed properly.

✓ Use crossed tow cables as the method for attaching the braking or holdback vehicle. Connect tow cables using two 21-ton shackles to lower towing eyes on the Abrams FOV. Do not connect tow cables to Abrams lifting eyes.



LIFTING/WINCHING OPERATIONS

LIFTING OPERATIONS

HOISTING CAPACITY (FOUR PART LINE)	
Spade up	12,000 lbs. or 6 tons
Spade up with lockout blocks	50,000 lbs. or 25 tons
Spade down	70,000 lbs. or 35 tons

- ✓ Extreme caution is necessary when working near a wire rope under tension. A snapped wire rope, shifting or swinging load may result in injury or death to personnel.
- ✓ **At no time will any personnel get under a suspended load.**
- ✓ **An operator will be in the driver's seat anytime the vehicle is running.**
- ✓ **If one or more roadwheels lose ground contact, lower load immediately.** Load is in excess of 75,000 lbs. (34,050kg) and exceeds the lifting limits of the vehicle. Failure to comply may result in injury to personnel or damage to equipment.
- ✓ To avoid personal injury, use an assistant when lifting parts or components that weigh more than 40 lbs. (23kg). Failure to comply may cause injury to personnel.
- ✓ Ensure all safety pins and bolts are in place and secure prior to any lifting, towing or winching operations.
- ✓ Auxiliary boom maximum weight limit is 1,000 lbs. (453.6 kg). Do not exceed limit or boom may fail, causing injury or death to personnel.

LIFTING OPERATIONS (CON'T.)

- ✓ The 35-ton hook block weighs approximately 350 lbs. (159 kg). Use a suitable lifting device to lift or move. Failure to comply may result in injury to personnel.
- ✓ Stabilize 6 to 25-ton (5,443 to 22, 680 kg) loads against spade when moving. Failure to comply may result in load swinging and impacting personnel, causing injury or death to personnel or damage to equipment.
- ✓ **Do not keep boom in full raised position for an extended period of time. Failure to the hydraulic system could occur, allowing the boom to free-fall when lowered, causing injury or death to personnel.**
- ✓ Do not lift loads at an angle of more than three degrees from center. Failure to comply may result in injury to personnel or damage to equipment.
- ✓ Do not exceed 70,000 lbs. (31, 780 kg) lift capacity of hoist winch. Failure to comply may result in failure to the hoist winch causing the load to free-fall resulting in injury or death to personnel or damage to equipment.
- ✓ **Never use hoist winch with less than five wraps on the drum.** Failure to complay may result in the hoist winch cable coming loose from the drum causing injury to personnel or damage to equipment.
- ✓ Do not stand on top of the vehicle while boom is being raised or lowered. Failure to comply may result in boom impacting personnel causing injury or death to personnel.
- ✓ Prior to raising the boom, remove any loose objects from the boom basket and ensure all hatches are closed. Failure to comply may result in loose objects falling on personnel standing below, causing injury or death to personnel.
- ✓ When raising the boom, check that the hoist winch and stayline cables and other equipment do not catch on the deck door, hinges and handles. Failure to comply may result in injury to personnel or damge to equipment.

LIFTING OPERATIONS (CONT.)

WINCHING OPERATIONS

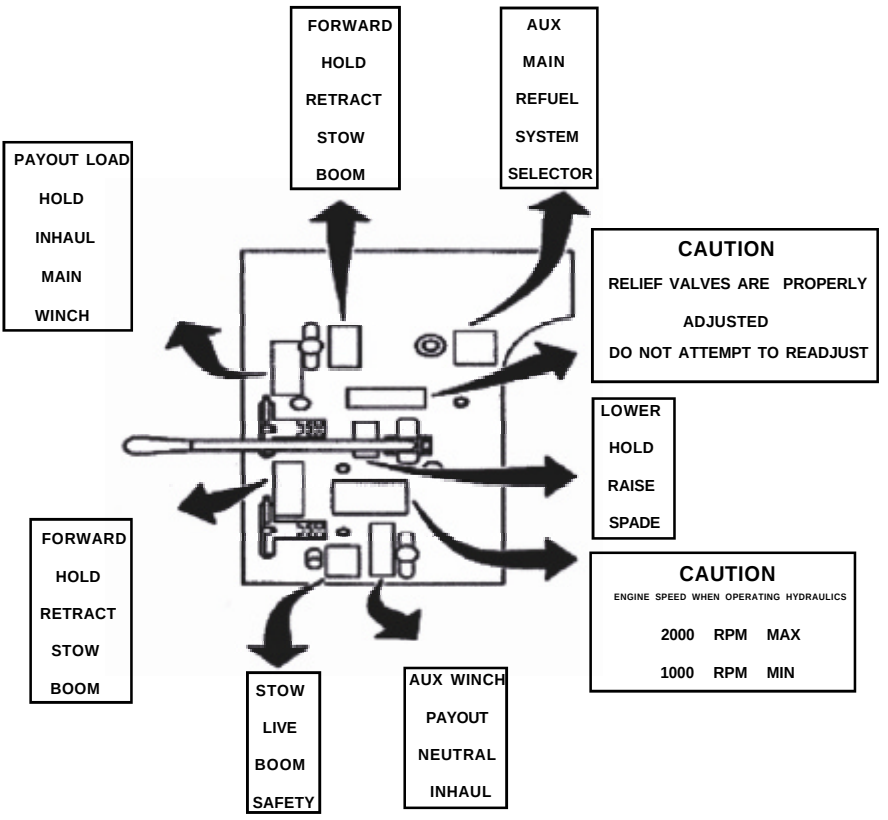
MAIN WINCH:

Usable Cable Lenght 280 ft.
Straight Line Pull 140,000 lbs.

- ✓ The 140-ton (127, 120 kg) snatch block weighs 209 lbs. (94.8 kg.). Use auxilliary boom to stow and unstow. Use three people when lifting or moving. Do not lift above waist. Failure to comply may result in injury to personnel.
- ✓ **All personnel must stand clear of vehicle; at least double the distance of the cable used in case the cable snaps. Failure to comply may result in injury or death to personnel.**
- ✓ Extreme caution is necessary when working near a wire rope under tension. A snapped wire rope may result in injury or death to personnel.
- ✓ Wire cable can become frayed or contain broken wires. Wear heavy leather-palmed work gloves when handling cable. Frays or broken wires may result in injury or death to personnel.
- ✓ Never let moving cables slide through your hands, even when wearing gloves. A broken wire could cut through the glove and may result in injury to personnel.
- ✓ **A minimum of four wraps should remain on the main winch drum at all times.** Failure to comply may result in the main winch cable coming loose from the drum resulting in injury or death to personnel or damage to equipment.

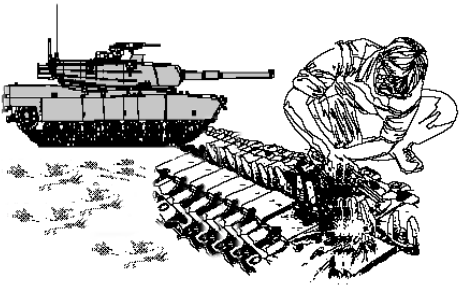
AUXILIARY WINCH:

✓ Never use the auxiliary winch with less than five wraps on the drum. Failure to comply may result in the auxiliary winch cable coming loose from the drum causing injury to personnel or damage to equipment.



✓ Do not move the auxiliary winch and the main winch operating levers to inhaul at the same time. This may result in the auxiliary winch cable snapping which may result in injury or death to personnel.

MAINTENANCE PROCEDURES



- ✓ When adjustment or service requires a running engine, two personnel will be used; one at the vehicle controls and the other at the service point. This helps prevent accidental movement of controls. Failure to comply may result in injury or death to personnel.
- ✓ During a slave start do not allow personnel to get between the two vehicles. Lock brakes on vehicles and reduce slaving vehicle engine speed to low idle (825 to 875 rpm). Failure to comply may result in injury or death to personnel if vehicle moves.
- ✓ If the boom is in the full raised position, the powerpack is removed, and the APU is non-operational, leave boom in full raised position. Do not attempt to lower boom. This may cause damage to boom, boom cylinders and the hydraulic system.
- ✓ To avoid damage to the boom and hydraulic system, always keep boom in stowed position when not in use.
- ✓ Some adhesives cause immediate bonding on contact with eyes, skin, clothing and also gives off harmful vapors. Wear protective goggles and use adhesives in a well-ventilated area. **If adhesive gets in eyes, try to keep eyes open; flush eyes with water for 15 minutes and get immediate medical attention.**
- ✓ Adhesive sealant MIL-S-46163 can damage your eyes. Wear safety goggles/glasses when using sealant and avoid contact with eyes. **If sealant contacts eyes, flush eyes with water and get immediate medical attention.**

MAINTENANCE PROCEDURES *(Con't.)*

- ✓ When working on a running engine, provide shielding for exposed rotating parts. Tools, clothing or hands can get caught and cause serious injury to personnel.
- ✓ When breaking track stand clear; end connector may fly and strike nearby personnel. Failure to comply may result in injury to personnel.
- ✓ When adjusting track tension, grease will be under pressure. Personnel must wear goggles. Failure to comply may result in eye injury to personnel.
- ✓ Use goggles and proper grounding procedures during refueling to prevent serious injury or death to personnel.

By Order of the Secretary of the Army:

ERIC K. SHINSEKI
General, United States Army
Chief of Staff

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