HANDBOOK

No. 08-30 Sep 08

MRAP Vehicles

Tactics, Techniques, and Procedures

Center for Army Lessons Learned (CALL)
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Foreword

This book describes the general capabilities and limitations of the mine-resistant ambush-protected (MRAP) vehicle and associated tactics, techniques, and procedures (TTP) employed by MRAP-equipped units. The essential information presented in this book is a guide to assist commanders, leaders, and Warfighters in preparing for and conducting operations with MRAP vehicles against an asymmetric, dedicated, and innovative threat in current and future areas of operations.

MRAP vehicles are providing a significant increase in force protection and enhancing the confidence of Warfighters engaging the enemy. In many cases, Warfighters have survived attacks that would have completely destroyed other armored vehicles. This level of protection did not come without trade-offs in performance. The MRAP vehicle's size, weight, and height above ground contribute to its armor to make it a very survivable vehicle; however, they also affect its overall maneuverability and mobility. Developers intend to address the mobility issue with a restricted terrain MRAP variant that can provide the protection similar to the current MRAP vehicle and the mobility similar to the high-mobility multipurpose wheeled vehicle. This capability will increase the Warfighters' effectiveness by giving them the ability to operate in areas previously denied to the MRAP vehicle due to its size and weight.

TTP for employing MRAP vehicles are similar to those used with existing vehicles; therefore, the aim of this book is to acquaint users with the capabilities and limitations of the MRAP vehicle and identify how it may influence planning and executing tactical missions. While this book serves as a starting point, units must continually analyze how the MRAP vehicle affects operations in their current mission and share that information with their unit and across the services.

Warfighters and leaders must understand and not exceed the operating limitations of their specific MRAP vehicle. The safety guidelines outlined in this book will ensure you operate the vehicle to its fullest capability, safely allowing you to fight and win in combat.

We continue to examine and anticipate the war-fighting needs of our deployed forces. Based on lessons learned and with help from industry, future MRAP vehicles will have improved capability. Units who successfully employ these vehicles against the enemy do so by integrating protection with training, planning, smart tactics, and well-rehearsed drills. This knowledge and preparation will help accomplish your missions and possibly save your life.

WALTER WOJDAKOWSKI
Major General, USA
Commanding

MRAP Vehicles Handbook

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Introduction

"The companies that have been awarded the MRAP [mine-resistant ambush-protected] contracts are ramping up their production capabilities … I am pressing them very hard to see where they can cut the time scale as well as increase their production …. You have to look outside the normal bureaucratic way of doing things and so does industry—because lives are at stake."

–Secretary of Defense Robert M. Gates, March 27, 2007

This book will familiarize Warfighters and leaders with the MRAP vehicle, its capabilities and limitations, and planning considerations for its employment. The information found in this book does not replace or override any safety precautions, warnings, notes in existing technical and/or operator manuals, or unit standing orders or operating procedures.

The acronym "MRAP" does not mean any one specific vehicle. It is a generic term intended to apply to vehicles from different manufacturers that meet a common set of capabilities. There are several manufacturers, each providing a unique variant of the MRAP vehicle. The photos and drawings used in this book are not intended to imply a preference for any specific design or manufacturer. They are simply representative of the family of MRAP vehicles. The joint services are fielding these vehicles to improve the force protection of units operating in the high-threat areas of Iraq and Afghanistan. The fielding plan is based on threat levels; units with the highest threat level have the priority for MRAP vehicles.

There are three categories of MRAP vehicles. Category (CAT) I and CAT II vehicles carry six and ten Warfighters respectively and supplement missions performed with the up-armored high mobility multipurpose wheeled vehicle and other combat vehicles. CAT III vehicles are used to support route clearance missions.

Since the tactics, techniques, and procedures involved in employing MRAP vehicles are similar to those employed with existing vehicles, the aim of this document is to identify the basic capabilities and limitations of MRAP vehicles and how equipping a unit with these vehicles may influence the planning and execution of tactical tasks. While this document serves as a starting point, units equipped with MRAP vehicles must continually analyze how the vehicle affects operations in their current situation and share that information across their unit(s) and the Army. Units are encouraged to send recommended changes to scott.blaney@us.army.mil and/or the USAIC POC Thomas.j.stafford@us.army.mil.

Seen on the side of an MRAP vehicle:

"This truck saved my life as well as 5 others 02 Apr 08 at 2300 L in Basral, IZ."

–CW2, SF

Chapter 1

Program Overview

The mine-resistant ambush-protected (MRAP) vehicle is not a new light tactical wheeled vehicle; an interim replacement for the high-mobility multipurpose wheeled vehicle (HMMWV) fleet; or a bridge to the joint light tactical vehicle, which is intended to eventually replace the HMMWV. Its mission role is similar to the Stryker in many respects. It will provide small units conducting typical counterinsurgency missions with protected mobility and mounted firepower. Squads and platoons use MRAP vehicles to conduct both mounted and dismounted missions. Typical mission sets supported by MRAP vehicles include the following:

- Cordon and search
- Raids
- Mounted combat patrol
- Traffic control points
- Convoy security
- Escort
- Medical evacuation (MEDEVAC)
- Protected personnel transport

MRAP vehicles replace many up-armored HMMWVs (UAHs) currently used to conduct these missions. However, units will want to retain some UAHs for operations in terrain where MRAP vehicles are unsuitable.

MRAP vehicles are divided into three categories based on the number of occupants the vehicle must hold and mission-specific mine/improvised explosive device clearance operations.

- Category (CAT) I MRAP vehicles are fire team-size vehicles designed to hold six occupants, including the driver, vehicle commander, and gunner. CAT I MRAP vehicles provide units with a protected maneuver capability in urban areas and other restricted terrain. They primarily serve as armored personnel carriers for fire teams and weapons carriers for medium and heavy machine guns. Reconnaissance units use CAT I MRAP vehicles to conduct mounted reconnaissance while employing the Long Range Scout Surveillance System from the vehicle.

CAT I MRAP

- CAT II MRAP vehicles are a squad-size vehicle designed to hold ten occupants, including the driver, vehicle commander, and gunner. The CAT II MRAP vehicle is considered a multi-mission vehicle and provides units with protected transport between secure areas. Sapper and rifle squads use the CAT II MRAP vehicle for protected maneuver and movement when it is necessary to mass Soldiers rapidly for a mission such as a quick reaction force. The purpose-built armored ambulance used by MEDEVAC squads conducting ground MEDEVAC is a CAT II vehicle.

CAT II MRAP

- CAT III vehicles are equipped for mine/improvised explosive device clearance operations and explosive ordnance disposal. The vehicles transport no less than six personnel, five with additional equipment installed.

This book addresses CAT I and CAT II MRAP vehicles.

Chapter 2

Vehicle Descriptions

Several manufacturers are producing the mine-resistant ambush-protected (MRAP) vehicle. Each variant is distinctly different from another, but they all provide the following similar capabilities and general levels of protection:

- Designed from the ground up to reduce casualties and increase crew and passenger survivability as a result of mine explosions, improvised explosive device (IED) detonations, and small-arms fire.
- Armored vehicles with blast-resistant body design (characterized by a V-shaped hull, integrated armor, raised chassis, and blow-off wheels). Blast forces are deflected away from the crew by the vehicle's V-shaped hull.
- Can operate on all terrain and in all weather.
- Troop capacity includes a driver and up to nine combat-equipped Soldiers.
- Armament may include an M2 50-caliber heavy machine gun, MK-19 automatic grenade launcher, or M240 medium machine gun.
- Accessories may include objective gunner protection kit, driver vision enhancer, jammer and AN/VRC 92 dual long-range radio system, Blue Force Tracker, and a warrior aid and litter kit.
- Can operate in extreme temperatures (-25 to 120 degrees Fahrenheit).
- Can operate in excess of 300 miles without refueling.
- Air transportable by C-17.
- Can cross water obstacles up to 36 inches deep.
- Can negotiate up to a 60 percent grade and 30 percent side slope.
- Equipped with run-flat tires, anti-lock brakes, and a fire-suppression system.

Individual characteristics of the common variants are displayed below.

MaxxPro Category (CAT) I/CAT II, Navistar Defense, LCC

System Description: The MaxxPro vehicle is capable of supporting multiple combat missions in urban or confined areas including mounted patrols, convoy security, casualty evacuation, reconnaissance, communications, command and control, troop and cargo transport, and direct interaction. The CAT II is a 4X4 with a gross vehicle weight (GVW) of 31,300 to 52,000 lb. Missions include convoy lead/escort, ambulance, explosive ordnance disposal (EOD), and combat engineer operations. Operator manual is Technical Manual (TM) 9-2355-106-10.

System Characteristics:

Configuration type: 4X4
Operational length: 250 in.
Operational width: 120 in.
Operational height: 159 in.
Minimum ground clearance: 10.9 in.
Maximum speed: 69.2 mph
Time to 50 meters (m): 8.3 sec.
GVW: 43,500 lb.
Minimum turning distance (curb to curb): 62 ft. (R), 62 ft. (L)
Payload (gross vehicle weight rating [GVWR] – GVW): 4,368 lb.
Maximum slope: Up to 60%
Center of gravity (GVW vertical): 57.8 in.
Consumption rate (miles/gallon): 5.8

Figure 2-1

MaxxPro MRAP Expedient Armor Program (MEAP), Navistar Defense, LCC

System Description: The MaxxPro accommodates the MRAP MEAP add-on-armor kit. The kit makes the vehicle 5 in. wider, adds 4,500 lb. of weight, and raises the center of gravity by 2.2 in. This kit changes handling, stopping distance (longer), and acceleration (slower) rates; increases fuel consumption rates; and raises the center of gravity. The operator manual is TM 9-2355-106-10.

System Characteristics:

Configuration type: 4X4
Operational length: 250 in.
Operational width: 125 in.
Operational height: 159 in.
Minimum ground clearance: 10.9 in.
Maximum speed: NA
Time to 50 m: NA
GVWR: 43,500 lb.
Minimum turning distance (curb to curb): 68.3 ft.
Payload (GVWR – GVW): 132 lb.
Kit weight: 4,500 lb.
Maximum slope: 30% side/50% long grade
Center of gravity (GVW vertical): 59.9 in.
Consumption rate (miles/gallon): NA

Operating limitations (from the Certificate of Materiel Release, U.S. Army Tank-Automotive Research, Development, and Engineering Center [TARDEC]):

- Maximum speeds:
    - Paved road: 55 mph (handling issues)
    - Smooth secondary road surfaces: 35 mph (suspension damage)
    - Rough secondary road surfaces/cross-country: 10 mph (suspension damage)
- Do not park vehicle on grade greater than 20 percent—the parking brake will not hold. Always chalk the wheels when the vehicle is stopped.
- Do not ascend a grade greater than 50 percent.
- Do not climb over a vertical obstacle greater than 14 inches.
- Personnel should be trained on the proper installation and removal of the spall liners to minimize the hazards associated with accessing and using components and equipment within the vehicle.
- The base vehicle pneumatic door opening device was upgraded with the MEAP kit to a linear electric actuator. The upgraded system allows the operator to open and close the door with the additional weight of the installed MEAP kit. The electric actuator is a 24-volt ball screw type

rated at 2,200 lb. Test results for longitudinal and side slopes are as follows:

  - **Side slope:** Driver and passenger doors self open and close up to and including 30 percent grade.

  - **Longitudinal slope:** Driver and passenger doors self open and close up to and including 30 percent longitudinal grade.

- The electrical actuator will not operate when the system power is lost. To open the door when the system power is lost, external DC power would need to be supplied to the actuator, or one would need to mechanically remove the internal quick release pin.

Figure 2-2

MaxxPro Plus, Navistar Defense, LCC

System Description: The MaxxPro Plus is purpose-built to accommodate armor to defeat the explosively formed projectile (EFP) IED. The operator manual is TM 9-2355-106-10.

System	MRAP CAT I MaxxPro	MRAP CAT I MaxxPro Plus
GVW	43,500 lb.	53,000 lb.
Engine horsepower (HP)	300 HP	355 HP
Engine torque	950 ft-lb.	1,190 ft-lb.
Transmission	Allison 3000SP	Allison 3200SP
Alternator	400 amp	570 amp
Front axle gross axle weight rating (GAWR)	18,000 lb.	23,000 lb.
Steering system	Single steering gear box	Dual steering gear box
Brakes	Drum	Disc
Rear axle GAWR	25,500 lb.	30,000 lb.
Wheel configuration	Single wheel	Rear dual wheels
GVWR	43,500 lb.	53,000 lb.
Curb weight (CAT I)	36,800 lb.	38,900 lb.
Combat weight (CAT I)	39,100 lb.	43,178 lb.
Payload available (CAT I)	4,368 lb.	11,922 lb.
Max sustained speed (65 mph)	71.4 mph (rated)	65.8 mph (est)
0 to 50 m	8.9 sec.	9 sec. (est)

Figure 2-3

Figure 2-4

RG-33L, BAE Systems-Ground Systems (BAE-GS), CAT II

System Description: CAT II vehicles provide a larger, reconfigurable vehicle that is capable of supporting multi-mission operations such as convoy lead, troop transport, EOD, ambulance, and combat engineering. The operator manual is TM 9-2355-108-10.

System Characteristics:

Configuration type: 6X6
Operational length: 337 in.
Operational width: 108 in.
Operational height: 134 in.
Minimum ground clearance: 14.4 in.
Maximum speed: 67.9 mph
Time to 50 m: 8.7 sec.
GVWR: 52,000 lb.
Minimum turning distance (curb to curb): 81.6 ft. (R), 76.4 ft. (L)
Payload (GVWR – GVW): 778 lb.
Maximum slope: 60%
Center of gravity (GVW vertical): 57.6 in.
Consumption rate (miles/gallon): 6.9

Figure 2-5

RG-33L, BAE Systems-Ground Systems (BAE-GS), CAT II

System Description: Same RG-33L vehicle as above except with Tank-Automotive and Armaments Command (TACOM)-approved add-on armor to defeat the EFP threat. The add-on-armor kit adds 12,736 lb. and makes the RG-33L 4 ft. 9 in. wider. Expect slower acceleration rates, longer stopping distances, higher roll rates (higher center of gravity), increased fuel consumption rates, and decreased side-slope limitations. All of these characteristics have not been formally quantified yet and are to be determined (TBD). The operator manual is TM 9-2355-108-10.

System Characteristics:

Configuration type: 6X6
Operational length: 337 in.
Operational width: 167 in.
Operational height: 134 in.
Minimum ground clearance: TBD
Maximum speed: TBD
Time to 50 m: TBD
GVWR: 73,500 lb.
Minimum turning distance (curb to curb): TBD
Payload (GVWR – GVW): TBD
Kit weight: 12,736 lb.
Maximum slope: TBD
Center of gravity (GVW vertical): TBD
Consumption rate (miles/gallon): TBD

Figure 2-6

Heavy Armored Ground Ambulance (HAGA), BAE Systems-GS, CAT II

System Description: HAGA is built from the base RG33L vehicle. Modifications to the vehicle allow for en route care for six ambulatory to three litter-bound patients, while still providing increased survivability and reducing additional injury to patients or crew members from mine explosions, IEDs, and small-arms fire. The operator manual is TM 9-2355-108-10.

System Characteristics:

Configuration type: 6X6
Operational length: 337 in.
Operational width: 108 in.
Operational height: 134 in.
Minimum ground clearance: 14 in.
Maximum speed: 67.9 mph
Time to 50 m: 8.7 sec.
GVWR: 52,000 lb.
Minimum turning distance (curb to curb): 81.6 ft. (R), 76.4 ft. (L)
Payload (GVWR – GVW): 1,000 lb.
Maximum slope: 60%
Center of gravity (GVW vertical): 57.6 in.
Consumption rate (miles/gallon): 6.9

Figure 2-7

Caiman, BAE Systems-Mobility and Protection Systems (M&PS), CAT I

System Description: The Caiman is based on the family of medium tactical vehicles platform. CAT I and CAT II support the same mission profiles described for the MaxxPro and RG-33L. The operator manual is TM 9-2355-107-10.

System Characteristics:

Configuration type: 6X6
Occupants: 6
Operational length: 309 in.
Operational width: 121 in.
Operational height: 143 in.
Minimum ground clearance: 14 in.
Maximum speed: 64.4 mph
Time to 50 m: 9 sec.
GVWR: 50,620 lb.
Minimum turning distance (curb to curb): 61.8 ft.
Payload (GVWR – GVW): 8,368 lb.
Maximum slope: 60%
Center of gravity (GVW vertical): 55.8 in.
Consumption rate (miles/gallon): 5.5

Figure 2-8

Caiman, BAE Systems-M&PS, CAT I

System Description: Same Caiman vehicle as described previously with TACOM-approved add-on armor to defeat the EFP threat. The add-on-armor kit adds 13,456 lb. and makes the Caiman 1ft. 1 in. wider. Expect slower acceleration, longer stopping distances, higher roll rates (higher center of gravity), increased fuel consumption, and decreased side-slope limitations. All of these characteristics have not been formally quantified yet and are TBD. The operator manual is TM 9-2355-107-10.

System Characteristics:

Configuration type: 6X6
Operational length: 309 in.
Operational width: 134 in.
Operational height: 143 in.
Minimum ground clearance: 14 in.
Maximum speed: TBD
Time to 50 m: TBD
GVWR: 62,000 lb.
Minimum turning distance (curb to curb): TBD
Payload (GVWR – GVW): TBD
Kit weight: 13,456 lb.
Maximum slope: TBD
Center of gravity (GVW vertical): TBD
Consumption rate (miles/gallon): TBD

Figure 2-9: AKA "Mama Bear"

RG31 A2, General Dynamics Land Systems-Canada, CAT II

System Description: The RG31A2 is fielded to Soldiers in Afghanistan only. The operator manual is TM 9-2355-315-10.

System Characteristics:

Configuration type: 4X4
Occupants: 8
Operational length: 277 in.
Operational width: 96 in.
Operational height: 137 in.
Minimum ground clearance: 13.6 in.
Maximum speed: 55 mph
Time to 50 m: 8 sec.
GVWR: 37,485 lb.
Minimum turning distance (curb to curb): 51.9 ft. (R), 50.9 ft. (L)
Payload (GVWR – GVW): 8,368 lb.
Maximum slope: 60%
Center of gravity (GVW vertical): 54.1 in.
Consumption rate (miles/gallon): 8.6

Figure 2-10

Cougar, Force Protection, Inc. (FPI), CAT II

System Description: The Cougar can be configured for a wide range of tasks including carrying up to 12 troops, EOD, command and control, artillery prime mover, recovery, and ambulance duty. The operator manual is currently under development. Use the manufacturer's operator manual: FPI 100001624 REV B.

System Characteristics:

Configuration type: 6X6
Occupants: 8
Operational length: 277 in.
Operational width: 96 in.
Operational height: 137 in.
Minimum ground clearance: 13.6 in.
Maximum speed: 55 mph
Time to 50 m: 8 sec.
GVWR: 37,485 lb.
Minimum turning distance (curb to curb): 51.9 ft. (R), 50.9 ft. (L)
Payload (GVWR – GVW): 3,655 lb.
Maximum slope: 60%
Center of gravity (GVW vertical): 54.1 in.
Consumption rate (miles/gallon): 8.6

Figure 2-11

Additional Information

The Program Manager for MRAP vehicles has an AKO-shared folder that contains the operator manuals listed in the above figures. To download the manuals, go to <https://www.us.army.mil/suite/collaboration/kc_V.do?kcid=8895283&load=true>.

The Center for Army Lessons Learned has an MRAP vehicles focus area within the FORSCOM Training Guidance for SWA, Change 1. To access the site, go to <https://call2.army.mil/toc.asp?document=2398#mrap>.

Chapter 3

Mission Equipment Packages

The following depicts the planned mission equipment packages employed on mine-resistant ambush-protected (MRAP) vehicles. Except for special purpose variants, there is no difference between the mission equipment for Category (CAT) I and CAT II MRAP vehicles.

MRAP vehicles are delivered for fielding with the following installed:

- Objective gunner protection kit (OGPK)
- Driver's vision enhancer
- Duke, Chameleon, or counter radio-controlled improvised explosive device (RCIED) electronic warfare (CREW) vehicle receiver/jammer (CVRJ) counter IED jammer
- Radio system
    - º AN/VRC-92 Single-Channel Ground and Airborne Radio System Dual very high frequency (VHF)
    - º AN/VRC-103 VHF/ultrahigh frequency (select vehicles)
    - º AN/VRC-104 high frequency/VHF (select vehicles)
    - º AN/VRC-110 (United States Marine Corps [USMC] and Army Afghanistan)
- Force XXI battle command—brigade and below, Blue Force Tracker
- Intercom system (Army: VIC [Vehicle Intercom System]-3; USMC: Tactical Operations Center Intercommunications System [TOCNET])
- Warrior aid and litter kit
- Spotlights
- Rhino II
- Medical mission package (ambulance)

MRAP vehicles are delivered for fielding with installation kits for:

- Long-Range Advanced Scout Surveillance System (LRAS3) (CAT I Recon)
- Remote Weapon Station (selected vehicles)
- Fire support mission packages (selected vehicles)

- Roller installation kit (selected vehicles)
- Improved Target Acquisition System (selected vehicles)

Note: The MRAP OGPK will mount the M2 .50-cal machine gun, M240 7.62-mm machine gun, Mk-19 40-mm grenade machine gun, and M249 5.56-mm squad automatic weapon. Units provide weapons, weapons mounts, LRAS3, and other equipment.

Chapter 4

Configuration/Mission Crosswalk

This table depicts the relationship between typical unit missions and standard mine-resistant ambush-protected vehicle configurations.

Category (CAT)	Configuration Description with Mission Equipment Package	Combat Patrol	Convoy Protection/ Escort	Support By Fire	Traffic Control Point	Cordon and Search/Raid	Protected Tactical Movement	Quick Reaction Force	C3	CASEVAC	Recon Zone/Area/Route	Screen/Presence/Security Operations	MEDEVAC/En Route Care
CAT I Maneuver	Fire team-size vehicle (6 Soldiers) GPK w/M2 50-cal or M240 7.62-mm or Mk19 40mm Dual SINCGARS w/BFT, VIC-3, DVE, Spotlight, CREW	X	X	X	X	X	X	X	X	X	X	X	
CAT I Recon	Squad/Section-size vehicle (6 Soldiers) GPK w/ M2 50-cal or M240 7.62-mm LRAS3 Dual SINCGARS w/BFT, VIC-3, DVE, Spotlight, CREW	X	X	X	X	X	X		X	X	X	X	
CAT II Maneuver/ Protected Movement	Squad size-vehicle (10 Soldiers) GPK w/ M2 50-cal or M240 7.62-mm or Mk19 40mm Dual SINCGARS w/BFT, VIC-3, DVE, Spotlight, CREW	X	X	X	X	X	X	X		X			
CAT I/II Ambulance	2 to 4-litter capacity GPK w/M249 SAW self-defense weapon Dual SINCGARS w/BFT, VIC-3, DVE, Spotlight, CREW Medical Mission Package						X			X			X

Figure 4-1

Chapter 5

Operating Speeds

Mine-resistant ambush-protected (MRAP) vehicles have relatively quick acceleration and a high top speed for vehicles of their weight and size. Most operations will not require use of all the speed the MRAP vehicle can deliver. Its dash speed will permit rapid movement between covered and concealed positions or breaking contact. Review your unit's tactical standing operating procedures for further guidance.

Ultimately, the commander will determine and set the rate of movement based on a thorough understanding of mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC). Operating MRAP vehicles at high speed in a tactical environment will get you into a dangerous situation faster than you can counter or react to it. Here are some things to keep in mind when operating MRAP vehicles:

- Driving at high speed does not increase safety or security during combat logistic patrols or other mounted combat operations. Higher speeds reduce driver reaction time, extend stopping distances, and increase roll rates that can lead to tip over/rollover.

- Traveling at high speeds (anything greater than 25 miles per hour [mph]) significantly decreases the ability to accurately visually scan the road surface.

- Slow speeds and careful observation greatly increase the chance of spotting improvised explosive device (IED) indicators or the IED itself.

- Slow speeds allow the MRAP vehicle crew and local national drivers to react to one another on the road before escalation of force procedures or evasive maneuvers are required.

- MRAP vehicles are generally very tall with a high center of gravity which greatly increases the chance of a roll or tip over. Slow speeds will reduce the possibility of an accident, tip over, or rollover.

Vehicle	Max Speed	50 m Dash (sec)	0 to 30 mph (sec)
MaxxPro	69	8	12
RG 33 CAT I	69	8	10
RG 33 CAT II	68	9	13
HAGA	65	9	N/A
Caiman	64	9	14
RG 31 MK5E	72	9	13
Cougar CAT I	69	9	12
Cougar CAT II	64	10	16

Table 5-1: Demonstrated Speed and Acceleration

System	Speed (mph)
CAT I	10-15 mph
CAT II	10-15 mph

Table 5-2: Recommended Maximum Cross-Country and Trail Speeds

All variants of the MRAP are required to travel 300 miles on a full tank of fuel. The exact mileage beyond 300 will vary depending on category, manufacturer, load, and driver actions.

Chapter 6

Capabilities and Limitations

The mine-resistant ambush-protected (MRAP) vehicle provides a shift in combat power. Crew and passenger protection is increased; however, units are faced with new challenges conducting movement and maneuver. The following are general capabilities and limitations for leaders to consider when employing MRAP vehicles.

Protection:

The MRAP is designed for the distinct purpose of increasing the protection of Soldiers against small-arms fire and the detonation of mines or improvised explosive devices (IEDs) employed singularly or in combination. While the exact level of protection each vehicle offers is classified, the vehicles do allow Soldiers and leaders to take measured risks. With increased protection, an MRAP vehicle can reduce its standoff to potential threats or move through potential danger areas when mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT-TC) conditions dictate the increased risk is required.

Given the evolving nature of the threat, the enemy will seek ways to defeat MRAP vehicles' anti-mine shape and armor. For this reason, commanders and leaders must not rely on the sheer survivability of the MRAP vehicles, but must leverage all the tools and technology available to defeat threats on the battlefield. Accordingly, leaders and Soldiers alike must make sure that this boost in confidence does not become overconfidence and lead to needless risk-taking. Units that successfully employ MRAP vehicles against the enemy will do so by integrating MRAP protection with training, planning, smart tactics, well-rehearsed drills, and lethal execution.

Movement and Maneuver:

In order to effectively protect the MRAP vehicles, the weight and size have increased significantly when compared to the up-armored high mobility multipurpose wheeled vehicle (HMMWV) (UAH). This has the following second-order effects on a unit's movement and maneuver:

- **Acceleration and deceleration:** MRAP vehicles will not accelerate or stop at the rate Soldiers may be accustomed to with the UAH.

- **Bridges and soft soil:** MRAP vehicles will require a higher bridge classification—20 tons or greater depending on the category of vehicle and final load of troops and equipment. MRAP vehicles operators must ensure bridge classifications are for wheeled vehicles. Soft soil poses a risk to MRAP vehicles. It is likely that the four-wheeled MRAP vehicle poses a greater risk of sinking or bogging down in soft soil. Avoid moving too close to the edges of roads that may collapse and cause the vehicle to tip over.

WARNING

Operating on single-lane and/or steeply crowned rural roads, roads with no shoulders, roads with soft shoulders and/or washouts around culverts and especially any road bordering water (canal/irrigation ditch/pond) requires extreme caution. The majority of MRAP vehicles rollovers are due to the road/shoulder/bridge approach giving way under the MRAP vehicle's weight and high center of gravity.

Operation on slopes:

The MRAP will ascend longitudinal slopes of up to 60 percent; however, extreme caution must be exercised on slopes greater than 50 percent. The MRAP vehicle is capable of operating on side slopes of up to 30 percent (use extreme caution on side slopes greater than 25 percent).

Restricted terrain:

The overall size of MRAP will limit its mobility in urban terrain:

- Narrow streets and gates may make turns and turning around difficult.
- There is the potential for increased difficulty in navigating through traffic.
- Cross-country speeds are significantly reduced due to the high center of gravity. Tall vehicles pose a greater risk of tip or rollover when negotiating slopes, trenches, ditches, and other obstacles.
- Special consideration should be taken for low-hanging wires (crews need to have a wire-strike plan). Leaders must account for antenna heights for both counter radio-controlled IED electronic warfare (CREW) and radio antennas when operating in urban terrain.

Vehicle height:

The height of the MRAP vehicle provides operational capabilities and limitations:

- During movement, the height allows the gunner to see over other vehicles and perform overwatch for the convoy. It also can help Soldiers gain access to second floors of buildings and observe over or gain access into walled compounds.
- The height of the MRAP vehicles limits access to confined areas and poses a safety risk where there are low-hanging power lines that pose an electrical hazard to the gunner.

Area of operations (AO):

Vehicle commanders and drivers must know their specific MRAP vehicle's physical dimensions (length, width, height, and weight) and mobility limitations.

Brigade combat teams and separate battalions must complete a MRAP-specific trafficability study of the AO to identify the following:

- Dimensions and weight limitations of bridges and overpasses
- Narrow roads with no or narrow shoulders
- Roads that border bodies of water
- Culvert locations (also hiding places for IEDs)
- Power lines (height and voltages)
- No-go terrain (urban and rural)

Trafficability studies/products must be available to the leaders and Soldiers operating MRAP vehicles so they can factor these AO-specific trafficability and terrain limitations into their composite risk management and combat planning processes.

Recovery:

The MRAP vehicle is all-wheel-drive capable. MRAP vehicles may be equipped with a winch for self recovery. Most MRAP vehicles can tow a like-sized vehicle. When a tow bar is connected to the bumper of an RG-33 (CAT I and CAT II), it cannot be lifted high enough to connect it to the tow pintle of the towing RG-33. The weight of the MRAP vehicle will require a wrecker that can pull approximately 20 tons. The vast majority of MRAP vehicle recovery scenarios can be adequately accomplished with currently fielded recovery systems—MK-36 medium tactical vehicle replacement (MTVR), logistic vehicle system (LVS) wrecker, M984 heavy expanded mobility tactical truck (HEMTT) wrecker, and M88.

WARNING

The current self-recovery winch is inadequate and unsafe for recovery operations and should not be used. Ensure personnel are clear of cables and chains during recovery in case the cables and chains break.

Note: See Appendix A for recovery techniques and instructions for specific MRAP vehicle variants.

Fields of fire:

While the MRAP vehicle provides a more stable firing platform than the UAH, it also significantly limits the gunner's field of fire (limited turret traversing due to antennas and limited capability to fully depress). Additionally, the firing ports for passengers in the vehicle are of very little use. There is significant dead space to the front, rear, and sides. (See dead space diagram in Chapter 7, Employment Considerations.)

Load capacity:

While the MRAP appears large, the armor protection and V-shaped hull significantly reduces the interior space. When fully loaded with Soldiers, there is little space for additional mission equipment not directly designed into the vehicle. Leaders and Soldiers are required to prioritize loads and use exterior points of attachment or compartments to secure additional equipment. When the CAT II vehicle gunner's platform is raised, there is only space for 8 passengers (instead of 10) in some variants such as the Cougar.

Situational awareness:

Inherent with enclosed armored vehicles is the loss of some degree of crew visibility immediately around the vehicle. While the MRAP vehicle is equipped with windows, the passengers' ability to view and hear outside the vehicle is severely limited. Gunners are critical in compensating for these limitations; however, the gunner protection kit reduces his ability to see in all directions. Assigning occupants sectors of observation will be important. Commanders and leaders must be aware of the psychological effect large armored vehicles have on interacting with the population. Force protection must be balanced with the need to interact with the population during stability operations.

Exiting and entering the vehicle:

Exiting the vehicle in response to an ambush and loading or unloading equipment and casualties are difficult due to the steps and back hatch on some MRAP variants; units must train and rehearse individuals and teams to streamline the process for mounting and dismounting operations under various conditions.

The International Military and Government (IMG) MaxxPro is currently the only MRAP vehicle with a rear ramp instead of a door. Make sure you know how long it will take to lower and raise the ramp. Consider how this and the chance of enemy encounter will affect where you dismount or remount the MRAP vehicle. Raising the ramp can take between 13 and 16 seconds. Lowering the ramp can take between 17 and 19 seconds. For planning, use 14 seconds to raise the ramp and 19 seconds to lower the ramp.

Recommendations

Vehicle commander:

- Enforce the use of crew restraints and protective headgear, and ensure all loads are secure.
- Incorporate the potential for rollover due to terrain/roads/trails along routes and in the area of operations to include bridge ratings, culverts, and bridge approaches.
- Incorporate the potential for wire (power line) strike and have a workable action plan.
- Ensure anticipated hazards to include alternate/bypass routes are briefed.

- Ensure drivers avoid abrupt steering maneuvers (slow down prior to turning) and know proper maneuvering techniques if the MRAP vehicle leaves the roadway.
- Never allow radio antennas to contact high-tension power lines.

Crew/passengers:

- Practice rollover and water egress drills to standard.
- Maintain situational awareness and use crew/passenger coordination measures.
- Know beforehand how your combat locks work.

Chapter 7

Employment Considerations

There are three major considerations for employing the mine-resistant ambush-protected (MRAP) vehicle during tactical operations:

- Survivability and increased firepower that can be maneuvered around the battlefield.
- Effects of restricted terrain on maneuver.
- Challenges of combining mounted and dismounted operations.

The MRAP vehicle presents leaders with new tactical and accidental risks to mitigate. In balancing these risks and benefits, the commander thoroughly evaluates the factors of mission, enemy, terrain and weather, troops and support available, time available, and civil considerations (METT TC). Company leadership must know the latest developments in threat tactics against mounted patrols and convoys.

Unit tactical standing operating procedures and the Center for Army Lessons Learned unclassified and classified Web sites and publications are other sources to consider for tactics, techniques, and procedures (TTP). Below are some general considerations based on historical and current observations from both Operation Enduring Freedom (OEF) and Operation Iraqi Freedom (OIF):

- All-round security and observation coupled with an aggressive crew and passenger security and weapons posture are normally the biggest enemy deterrent.
- Trends indicate that vehicles without all-round security are individually targeted for attack. The enemy can even target individual vehicles with poor security from within larger convoys.
- The vehicle suspension should be monitored to detect deterioration and failure. Vehicle passenger or materiel loads should be closely monitored.
- Commanders should carefully consider the mix of vehicles on missions to maximize the strengths of each type of vehicle and the associated order of march during movement. The MRAP vehicle provides good protection but significantly limits visibility. Generally, the MRAP vehicle should lead any movement.
- An emerging technique from theater is using a casualty evacuation-prepared MRAP vehicle toward the end of a convoy to care for any injured Soldiers. The space inside the vehicle makes it very suitable for litter casualties.
- Some commanders in theater are finding the MRAP vehicle makes an excellent mobile and protected tactical command post vehicle.

Force Protection

Force protection is irrevocably linked to mission success. Consequently, it must always be an important consideration in the planning and execution of missions that employ motorized forces. The balance between the protection of vehicles and occupants, observation, and the employment of weapons is critical.

Heavily armored vehicles, especially wheeled vehicles with extra armor such as the MRAP vehicle, severely limit crew and passenger observation in restrictive and urban terrain. They can also limit weapons employment at close ranges.

Both shoulder-fired antitank rocket launchers and improvised explosive devices (IEDs) can defeat many armored vehicles and can defeat the MRAP vehicle when carefully employed.

Insurgent and terrorist enemy forces target vehicles with poor security because they seem easier to destroy and less likely to respond effectively.

Commanders must stress that increased survivability only comes in part from armor, security posture, and the rapid response to threats:

- Leaders must strive to compensate for reduced observation; gunners play a larger role in creating 360-degree awareness for the crew.
- Bounding overwatch when practical and traveling overwatch at all other times are keys to the 360-degree awareness and rapid response to threats.
- Communication among the MRAP vehicles in the formation is essential.

The MRAP vehicle is designed with a series of protection mechanisms to enhance the survival and increase the mission effectiveness of its crew and passengers:

- The initial layer is designed to prevent explosive and projectile penetration and consists of the geometric shape of the body to deflect the blast combined with opaque and transparent ballistic armor to prevent hull penetration. The elevated body combines with the shape to provide the occupants with stand-off from the blast.
- The second layer mitigates when the first layer is overmatched and consists of fire suppression mechanisms to quickly extinguish fires and prevent secondary explosions.
- The third layer minimizes the effects of shock and blast on the occupants and consists of shock-absorbing seats that limit the transfer of energy to the body and seat restraints that keep the occupant secured in the vehicle.
- A final layer of protection is provided by the individual Soldier and consists of personal protective equipment such as helmet, body armor, eye protection, hearing protection, etc.

All these mechanisms must work in unison to achieve full MRAP protective capabilities. Although MRAP vehicles provide a significant increase in force protection, Soldiers and leaders must not become complacent and remove their

personal protective equipment while riding in the vehicle. To do so only increases the risk of injury when the MRAP vehicle is attacked.

MRAP Vehicle Communication Considerations

MRAP vehicle crew communication is paramount to smooth vehicle operation:

- Commanders must consider how dismounted Soldiers will communicate with the mounted crew and other dismounted Soldiers.
- All MRAP systems are equipped with vehicle intercom systems for the driver, vehicle commander, gunner, and at least one occupant.
- It is essential that commanders consider the challenges of communications and ensure procedures are established to maintain effective communications between the crew, passengers, and dismounted forces.
- Squads and platoons should develop and rehearse communications plans between mounted and dismounted elements as a part of mission preparation.

MRAP Vehicle Equipment Load Plans

Externally stowed items:

- Leaders must ensure that any externally stowed items are secured from theft and do not constitute a fire hazard if the MRAP is attacked by IEDs, anti-armor ordnance, or other flammable weapons.
- External stowage should be minimized or modified to lessen the threat of vehicle fire and to not restrict the view or movement of gunners or passengers providing security.

Internally stowed items:

- All items stored inside the vehicle must be secured to prevent them from becoming secondary missiles in the event of an IED strike or a rollover. Loose equipment can seriously injure Soldiers.
- Commanders should minimize or eliminate the number of flammable items stowed inside the vehicle.

MRAP Vehicle Urban Patrolling

The basic planning considerations for both mounted and dismounted patrolling are almost identical. Although MRAP vehicles will typically have the advantage of mobility and firepower over dismounted elements, communications and observation pose difficulties, as previously noted. The more heavily armored MRAP vehicle might be at greater risk in the urban environment unless closely supported by dismounted forces. Therefore, this environment calls for integrating dismounted with mounted patrol elements:

- The enhanced mobility allows greater and faster area of operations (AO) saturation and expansion of control.
- Integrating vehicles with foot patrols allows for increased sustainment loads.
- Lighter, faster infantry forces have a greater chance of capturing or killing lightly armed insurgents; mounted firepower provides support or moves to block escaping or flanking enemy.
- Mounted elements increase patrol flexibility and versatility.
- Units employing the MRAP vehicle as part of a patrol in stability operations should always operate in sections of at least two vehicles.

Other considerations for urban operations include the following:

- Avoid contact with overhead power lines.
- Avoid streets and alleys that are too narrow for particular vehicles. Enemy forces can quickly identify this fact and plan their own routes accordingly.
- Consider civilian vehicle and pedestrian traffic flow when planning patrol routes. For each operation, consider the effects of military vehicles on civilian traffic flow and patterns.
- Heavy vehicles can damage or even destroy civilian roads in the AO. They can also damage or destroy underground and above ground utilities.
- Avoid using night-vision devices (NVDs) or blackout driving around civilian traffic using white lights. Doing so endangers you and the civilians, and they can see you anyway.

Reduced dismounted capability

Units that are not vehicular by tables of organization and equipment do not receive additional Soldiers when issued an MRAP vehicle. This means they must supply vehicle crews at the expense of troops available for dismounted operations. This requires leaders to carefully plan based on their mission requirements.

When portions of the crew dismount (vehicle commander/gunner), the MRAP vehicle is not fully capable. There is risk in operating an MRAP vehicle with a one- or two-man crew. Leaders have devised creative solutions to keep tactical integrity dismounted while maintaining mounted capability:

- Use operational rally points to secure vehicles to maximize a dismounted presence.
- Designate one unit/squad mounted (filling the crew positions) while another unit/squad is dismounted (filling the passenger positions) during movement.

Units in theater have also had success by training and rehearsing designated driver and gunner teams to better synchronize vehicle movement and firing activities.

MRAP Vehicle Maintenance

Vehicle maintenance is critical to mission accomplishment. Poorly maintained vehicles will fail. As they do, the OPTEMPO for functional vehicles increases dramatically. Potential adverse effects can result:

- Reduced cargo or personnel carrying capacity, which reduces the combat power ratio in the field.
- Increased service requirements and maintenance problems for overused vehicles that have been maintained properly by their crews.

Initially, the MRAP vehicle will rely heavily on contract maintenance or field service representatives (FSRs). This arrangement provides its own unique challenges for units, particularly if they are not collocated on a FOB with their parent unit or are competing with other units for priority of maintenance support. Commanders should institute on-the-job training programs with their unit mechanics and assigned FSRs.

Rough Terrain Driving

Drivers must become familiar with the various terrain conditions in the AO and considerations for crossing the conditions encountered. Using good off-road driving techniques is the best way to limit broken vehicle parts and getting stuck.

- The MRAP vehicle is not capable of high-speed travel on rough terrain.
- Depending on the MRAP variant, drivers should not operate the vehicle at speeds greater than 5 to 10 mph on rough terrain unless a tactical emergency exists.
- All drivers must be well trained in judging terrain and negotiating various terrain conditions.
- Drivers must be extremely careful and mindful of the MRAP vehicle's speed when negotiating obstacles and aware of the vehicle's high center of gravity.
- Many operations and movements are at night, so driver training should focus on using NVDs.

In addition, drivers should develop the following skills:

- Use momentum and understand the effects of vehicle speed.
- Know the vehicle's capabilities and the impact of the on-board payload.
- Estimate and use proper speeds for the appropriate terrain conditions.
- Avoid sudden forward and braking thrusts.

WARNING

The MRAP vehicle may become unstable and tip over when negotiating vertical obstacles and deep ruts or potholes in the path of movement. Use extreme caution and reduce vehicle speed.

Long-Range Operations

If the commander must conduct long-range operations, then he must be reasonably sure of the range and expected time of the operation. This assurance allows him to estimate logistic support accurately. The logistic resources required to support long-range mounted operations will drive many aspects of the mission planning (Classes III and IX, specifically). Additional considerations for long-range operations include the following:

- Mission range (mileage), duration, and expected vehicle fuel consumption
- Availability of resupply or support during operations
- Planned vehicle loads (personnel and equipment)
- Expected enemy situation
- Terrain considerations such as:
    - Road conditions
    - Off-road travel conditions
    - River crossings
    - Bridges, tunnels, and choke points
- Weather forecast:
    - How it will affect movement
    - Expected rainfall or snowfall
- Presence of civilian vehicles in the area—vehicles normally encountered in the AO
- Communications ranges
- Navigational considerations
- Movement times:
    - Day or night?

- White light or NVD?
- Road or cross country?

- Recovery:
  - Can the unit self recover?
  - How will the unit deal with non-recoverable or disabled vehicles?

- Load plan for casualties or additional personnel in case vehicles are destroyed or disabled

MRAP Vehicle Roof Hatch

Some MRAP vehicles are equipped with roof hatches. Roof hatches on MRAP vehicles were designed for evacuation and not intended to be manned during movement. Standing in an open roof hatch is not safe during movement due to the small size of the hatches and the rough ride of the vehicle. (See the Tank-Automotive and Armaments Command [TACOM] Safety-of-Use [SOU] message below.)

TACOM SOU 08-020, MRAP, Escape Hatch –

WARNING

DEATH OR SERIOUS INJURY TO SOLDIERS OR DAMAGE TO ARMY EQUIPMENT WILL OCCUR IF THE INSTRUCTIONS IN THIS MESSAGE ARE NOT FOLLOWED.

Subject: Safety Of Use (SOU) Message, TACOM Control No. SOU 08-020, Operational, Affecting the following Mine Resistant Ambush Protected (MRAP) vehicles; BAE RG-33L Cat II NSN 2355-01-552-4677, IMG/Navistar MaxxPro Cat I NSN 2355-01-553-4364, GDLS-C RG31A2 Mk5E Cat I NSN 235501-553-5581, and FPI Cougar/JERRV Cat II NSN 2320-01-552-5565.

Problem: Users are utilizing the emergency hatches located on the roof of the vehicles as additional manned weapon stations. The escape hatches were not designed to be modified for this purpose. **Operating the vehicle with a person standing out of the emergency escape hatch puts that person at a greater risk of injury or death in the event of an accident or rollover. The escape hatches on MRAPs are generally located inside the danger zone of radio and countermeasure antennae. Utilizing the escape hatches as a manned weapon station places the individual in danger due to the high levels of radiation generated by the radio and countermeasure antennae.**

User Actions: Cease the practice of using escape hatches as manned weapons stations. Refrain from all attempts to modify the escape hatches in any way to mount weapon systems. Remove any add-on equipment, and return the escape hatches to their original configuration.

Weapons Dead Space

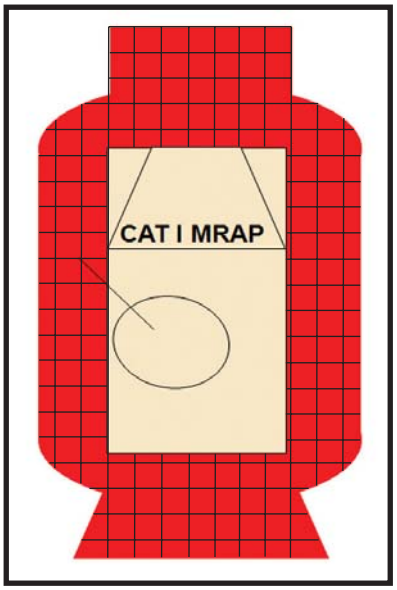

Figure 7-1: This figure shows the shape of weapons deadspace on a typical CAT I MRAP vehicle as measured from the weapon mounted on the turret.

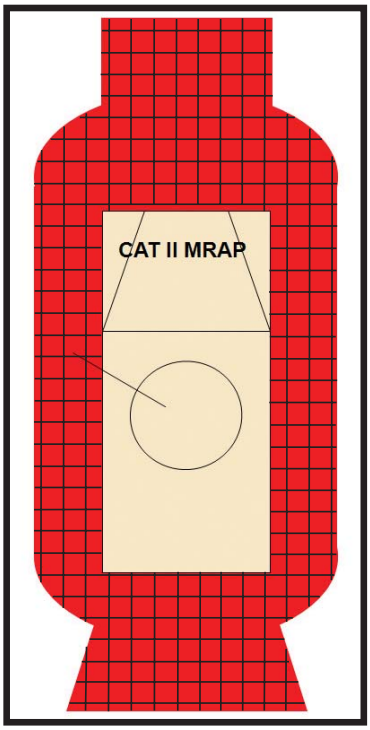

Figure 7-2: This figure shows the shape of weapons deadspace on a typical CAT II MRAP vehicle as measured from the weapon mounted on the turret.

MRAP Vehicle Safety

Vehicular operations pose a new set of tactical and accident risks. Commanders must consider this when planning operations and use the risk management process to mitigate those risks.

Vehicle tip or rollover

MRAP vehicles have much larger profiles and weights than the vehicles they replaced in theater. Take into account the mission criticality, MRAP vehicle mission profiles, MRAP vehicle mission weights, ground pressures, weather, and terrain.

Perform a rollover drill rehearsal with the gunner and crew prior to every movement during rainy season. Heavy rains in theater may cause unpaved roads to loosen and give way under the weight of the MRAP vehicle, especially if there is a steep embankment or canal running alongside the road. MRAP vehicle crews should practice rollover drills to standard. Be proficient and learn to work as a team.

Ensure all personnel wear seatbelts, protective ensemble, and headgear. The risk of fatality is three times greater for Marines, Sailors, and Soldiers who do not wear a seatbelt during tactical vehicle operations (OIF/OEF CY 03-04, United States Army Center for Health Promotion and Preventive Medicine study). Seatbelts allow the driver to remain in a position from which to stabilize an out-of-control vehicle. Gunner restraints prevent the gunner from becoming a potential fatality as a direct result of being ejected from the interior, causing death on impact or crushing from the MRAP vehicle.

Ensure all required equipment inside the vehicle is properly stowed and secured. Interior occupants can sustain injuries from flying equipment, which makes securing loads particularly important since objects inside the cab will become deadly flying missiles should a rollover occur.

Use a ground guide through tight areas, when tactical conditions permit.

Unlock combat doors when around bodies of water if the tactical situation permits. This will allow rescuers to enter the vehicle.

Fire hazards

While fire suppression systems are under consideration, all vehicles will have fire extinguishers. The first priority for fire extinguishers should be to extinguish fires on personnel or to extinguish fire in parts of the vehicle that allow the evacuation of passengers. Crews must know how to react to a fire. Fire extinguishers should be readily available on all vehicles. Consider mounting fire extinguishers near an egress point. Be aware of the placement of flammable materials.

Dismounted troops near or under the vehicle

The crew must be continuously aware of dismounted troops around their vehicle. Dismounted troops must make their presence known to the crew. Soldiers should never lie under the vehicle or around the wheel wells. They must always be able to

quickly move or roll away if a vehicle moves suddenly. Despite the crews' understanding, an MRAP vehicle crew that is in contact with the enemy may react before realizing a Soldier is under its vehicle.

Crew-served weapon proficiency

Vehicles often are issued with crew-served weapons. Anyone who will potentially operate the weapons system must be trained at a minimum to load, clear, reduce stoppage, and engage targets. This procedure will:

- Ensure crew-served weapons will always be manned in the event of a wounded gunner.
- Ensure Soldiers do not have negligent discharges due to a lack of training.

Composite risk assessment

Incorporate the potential for rollovers during risk assessments by evaluating bridges and terrain along the route:

- Be alert and always use caution on roads close to bodies of water.
- Always consider allowing greater clearance when traveling along the edge of the road.
- Assess the potential for low hanging power lines.
- Ensure hazards are briefed prior to the mission and brief options for alternate or bypass routes.

Steering

Many rollovers occur when drivers panic and overcorrect their steering when reacting to an emergency or to a wheel going off the pavement's edge. At highway speeds, overcorrecting or excessive steering can cause the driver to lose control, which can force the vehicle to slide sideways and roll over. Sudden vehicle maneuvers are particularly risky since the speed and a load shift can make the vehicle unstable.

Proper maneuvering

At some point, your vehicle may drift off the roadway onto the shoulder or you may steer onto the shoulder to avoid a collision. There may be a drop-off of several inches from the edge of the road to the shoulder. Most shoulders provide less traction than the roadway surface. They may be quite narrow and consist of loose gravel, grass, or mud. Despite these variables, pulling off onto the shoulder and returning to the roadway can be done safely. Practice the following proper procedures:

- If you run the two right or left wheels off the paved roadway, keep a firm grip on the steering wheel.

- Keep the vehicle traveling straight ahead.
- Straddle the edge of the pavement. You must fight the tendency of the wheels to pull toward soft shoulders. You also must resist the urge to immediately whip the vehicle back onto the pavement.
- Ease off the accelerator pedal so the vehicle slows down.
- Avoid braking, if possible; if braking is necessary, use a gentle squeeze braking application so you can control steering.
- Before returning to the pavement, visually check ahead, to the sides, and to the rear. Unless some object beside the road poses a serious threat of a collision, avoid trying to return to the roadway immediately.
- Move the off-road tires out about 1 l/2 to 2 feet away from the pavement edge.
- When it is safe and your speed is under control, turn the wheel quickly about a quarter turn to the right or left as necessary. This lets the tire climb the pavement edge and get back on the roadway.
- As soon as the front tires are back on the roadway, counter steer quickly to maintain your proper lane.
- Reduce speeds when negotiating turns.
- Avoid sudden vehicle maneuvers, overcorrecting, or excessive steering that can result in loss of control that may cause a maneuver initiated rollover.
- Use caution on rural roads. When a vehicle goes off a rural road, the vehicle can overturn when it strikes a ditch or embankment or is tripped by soft soil.
- Road shoulders in the Middle East do not meet U.S. standards and may collapse under the weight of the MRAP vehicle, especially when the road is above grade and can fall to lower ground (ditches and canals).
- MRAP vehicle crews must maintain situational awareness and use vehicle crew coordination. The vehicle commander and the gunner may often be able to better determine the closeness of the vehicle to the edge of the road than the driver. They should not hesitate to alert the driver if he is getting too close to the edge of the road.
- Use caution when crossing bridges that are unrated (get prior guidance from combat engineers).

Tire pressure

Improperly inflated or worn tires can be especially dangerous because they inhibit your ability to maintain vehicle control, the most important factor in reducing the chance of rollover. Worn tires may cause the vehicle to slide sideways off the road

on wet or slippery pavement and increase its risk of rolling over. Improper tire inflation can accelerate tire wear and can even lead to tire failure. It is important to maintain your tire pressure in accordance with the operator's manual and replace tires when necessary.

Vehicle crashes

Vehicle crashes includes crashing into terrain, obstacles, and other vehicles. This is especially true for backing up in a vehicle with significantly reduced visibility. Ensure drivers are properly trained and briefed on the anticipated terrain for the operation. Operate vehicles as a crew. Do not let drivers move vehicles alone unless it is mission essential. Use ground guides where tactically sound.

Falls

Soldiers should use three points of contact when on top of the vehicle due to its height. Soldiers should not jump from the top of an MRAP vehicle.

Vehicle antennas

Antennas on the MRAP vehicle must be lowered or protected from contact with power lines; serious injury or death as well as vehicle damage can occur.

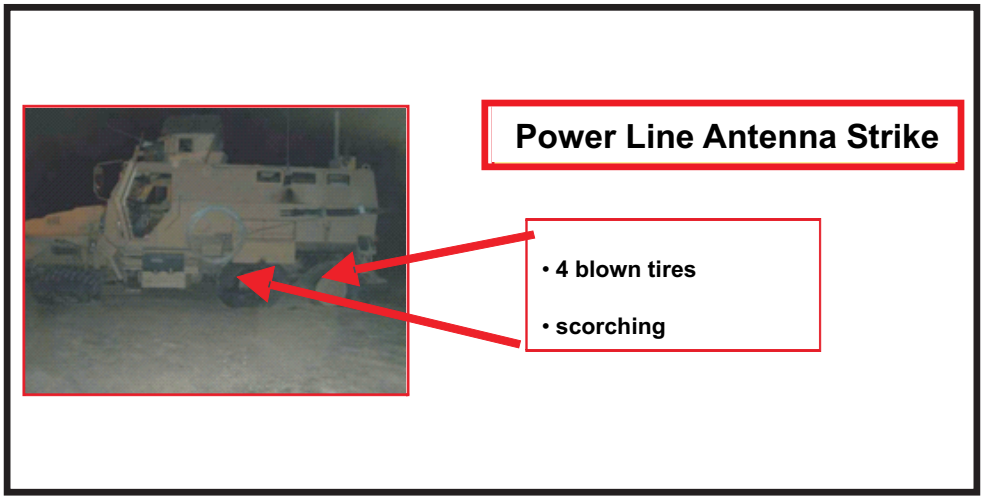

Figure 7-3

Smashed and pinched extremities

Some MRAP doors are not hydraulic or do not have positive stops and can swing free, breaking or cutting off fingers. Soldiers must be aware of personnel to the rear of the vehicle when opening the rear door or dropping the ramp.

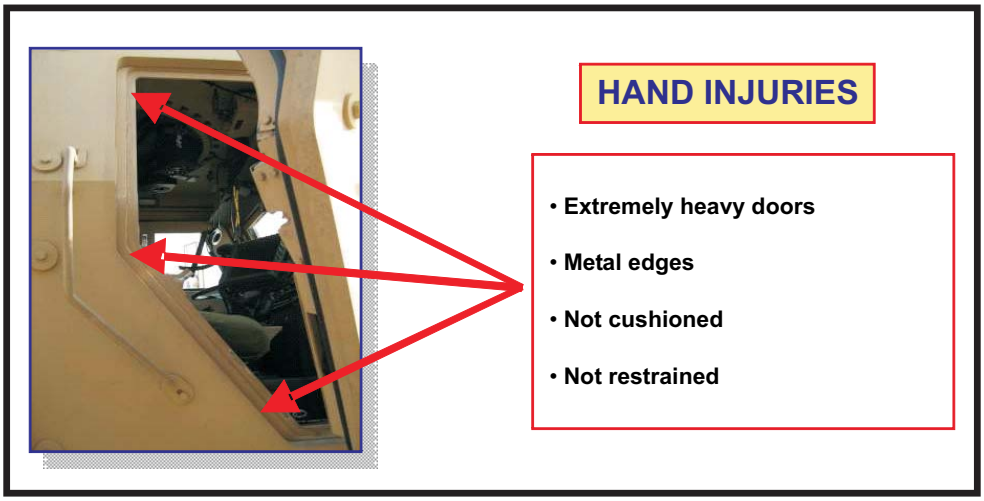

Figure 7-4

Additional Information

Safety of use messages (SOUM)–U.S. Army Materiel Command's Logistic Web portal for SOUM is: <https://aeps2.ria.army.mil/Commodity/safety/SafetyComm.cfm?FunType=SOUM>. (Use Ctrl F and search for MRAP.)

Logistics Assistance Representative (LAR) Web links:

- Iraq: <https://aeps2.ria.army.mil/Services/Lars/Tacom/larmap/LARlocate/larmap.cfm#swa>
- Afghanistan: <https://aeps2.ria.army.mil/Services/Lars/Tacom/larmap/larlocate/larmap.cfm#uzbafghn>

Chapter 8

Tactical Manning

The seating capacity of the mine-resistant ambush-protected (MRAP) category (CAT) I vehicle is 6 passengers, and the seating capacity for the CAT II vehicle protected movement variant is 8 to10 passengers. Units may opt to make seat configuration adjustments based on mission, model, and manufacturer of the MRAP vehicle they are operating. The following diagrams show the most common passenger seating configuration for an interim brigade combat team (IBCT); passengers may be forward or inward facing.

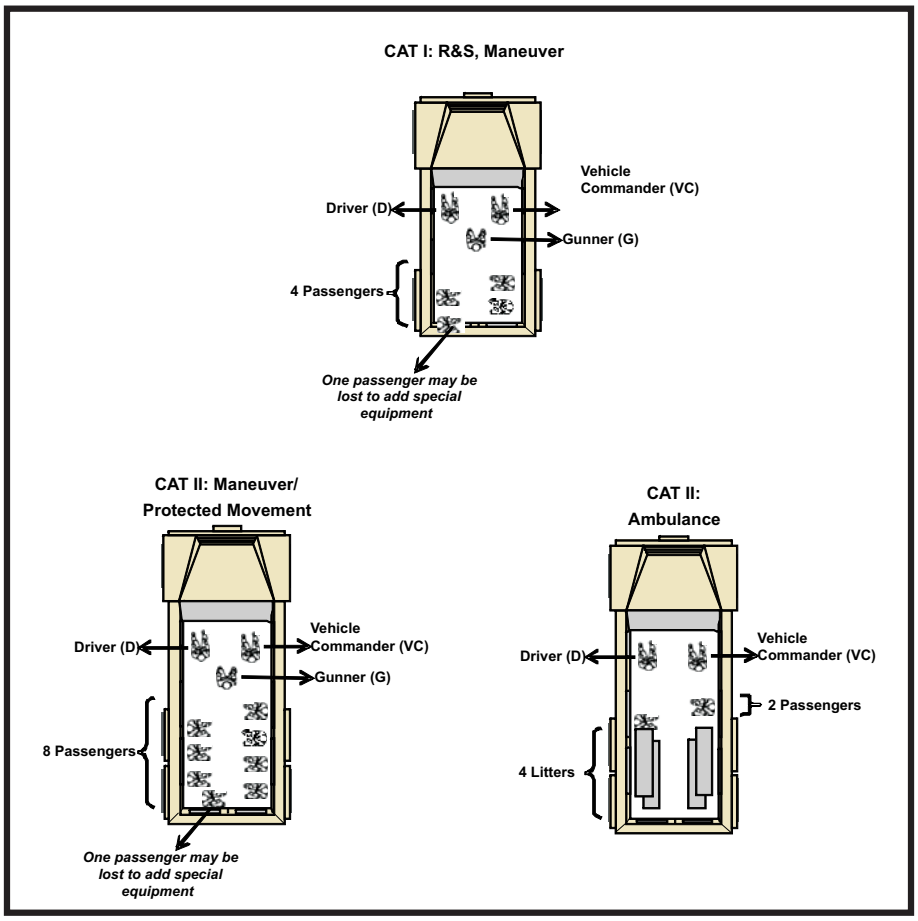

Figure 8-1

Following is an example of one way to cross-load an IBCT rifle platoon into eight MRAP CAT I vehicles. Some platoon-size units may not receive this many MRAP vehicles; this example serves as a baseline for unit consideration. Modifications must be made to fit each unit's specific task organization, fielding, and mission. A table of organization and equipment (TO&E) 39-man platoon with 1 medic leaves 8 open seats.

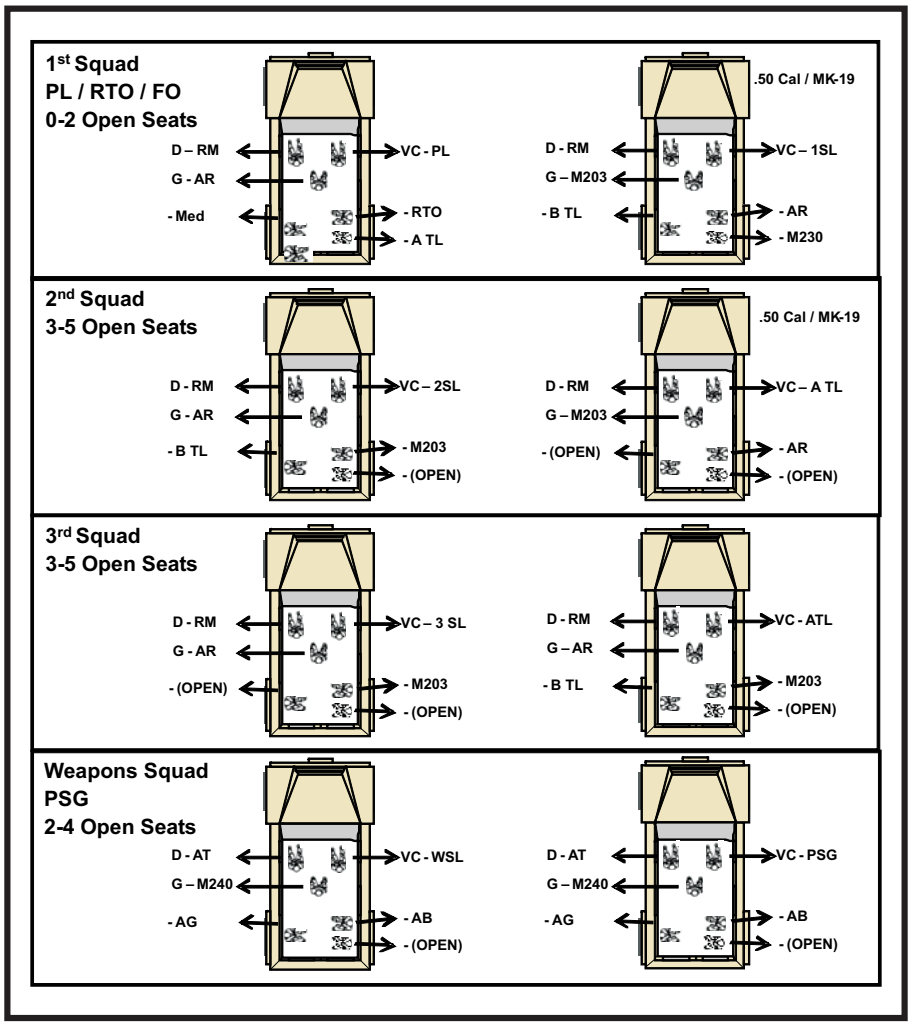

Figure 8-2

The above seating is an example that may best support unit integrity for mounted operations to include mounted combat patrol and outer cordon and traffic control point operations. The above seating assumes the platoon has two crew-served weapons (.50 cal and MK-19). A TO&E 39-man platoon with 1 forward observer leaves 8 to 16 open seats.

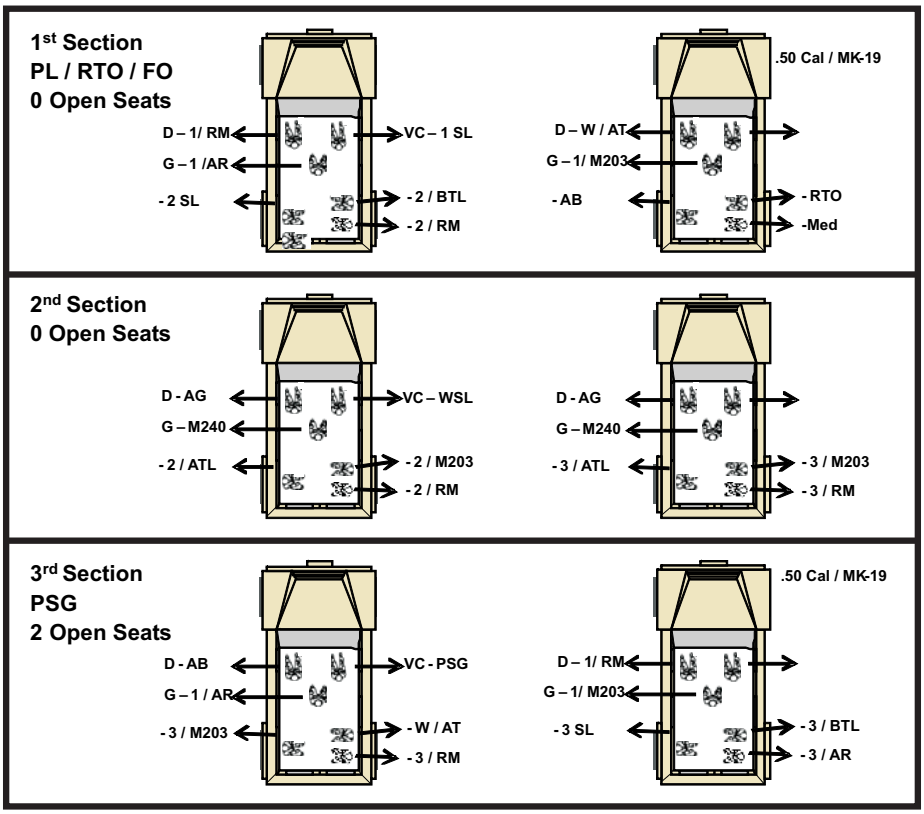

Figure 8-3

The above seating is an example that may best support dismounted operations such as raid, search, or leader engagements. Units should consider requesting CAT II support to maximize dismounted Soldiers, using two to four CAT I vehicles as escort and overwatch. The above seating assumes the platoon has two crew-served weapons (.50 cal and MK-19) and the seventh seat is available in the vehicle. A TO&E 39-man platoon with 1 medic leaves 2 open seats.

Chapter 9

Load Plans

This section is divided into two parts. Part one provides basic diagrams and equipment lists for units' use in developing their specific mine-resistant ambush-protected (MRAP) vehicle load plans using unit standing operating procedures and directives. Part two provides a detailed example of an MRAP vehicle-specific load plan for a category (CAT) I and CAT II MRAP variant.

While the MRAP vehicle is larger than the up-armored high-mobility multipurpose wheeled vehicle (HMMWV) (UAH), there are still many space claims for radios, improvised explosive device-defeat systems, and mission equipment packages. The final load configuration is dependent upon vendor, category, and modifications made after testing. The diagram below is furnished to record load plans used by a unit in its current situation.

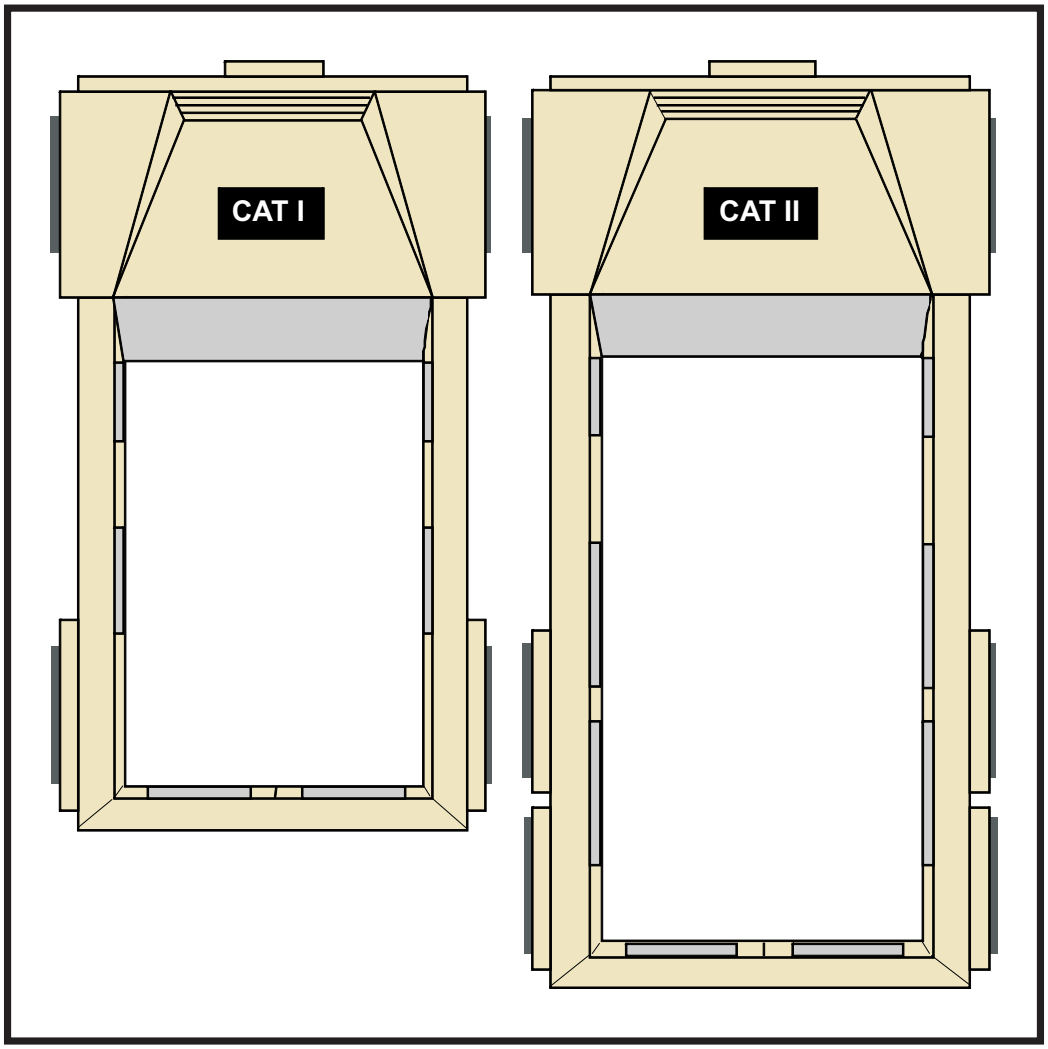

Figure 9-1

Equipment Lists

Vehicle items:

- Cotton bag, for jack and tools
- Bag, tool, cotton duct
- Extension, jack handle
- Handle, mechanical jack
- Jack, scissors, hand
- Pliers, slip joint
- Screwdriver, cross-tip
- Screwdriver, flat-tip
- Wrench, adjustable
- Wrench, ratchet
- Wrench, wheel lug
- Fire extinguisher
- Bag assembly, pamphlet
- Technical Manual 9-2320-387-10
- Folder, equipment record
- Max tool kit, combination tool
- Hydraulic winch controller cable
- Slave cable
- Warning triangles, set
- Tow chains or towing straps
- Tow bar (if equipped)
- Sledge hammer
- Ax

- ☐ Shovel
- ☐ Bolt cutters
- ☐ Gloves, wire handlers
- ☐ Air horn
- ☐ Spotlight
- ☐ Laser pointer
- ☐ Combat lifesaver bag
- ☐ Infrared strobe light
- ☐ Can, fuel, 5 gallon
- ☐ Litter
- ☐ 9-line medical evacuation “cheat” card
- ☐ Other

Detainee kit (1 per MRAP vehicle):

- ☐ 15 flex cuffs
- ☐ 15 blindfolds (cravat bandage)
- ☐ Detainee paperwork with document protectors
    - ☐ DA 2823, Sworn Statement
    - ☐ Coalition Apprehension Form
- ☐ Platoon detainee startup sheet
- ☐ 25 feet 550 cord
- ☐ 15 Ziploc bags, 1-gallon size
- ☐ 15 shoe tags
- ☐ Black Sharpie marker
- ☐ Heavy medical scissors
- ☐ Digital camera

- ☐ 4 plastic trash bags
- ☐ Latex gloves (CAT I - 6 pair; CAT II - 10 pair)
- ☐ Other

Pickup zone marking kit (one per MRAP vehicle):

- ☐ Carrying bag or case
- ☐ VS-17 panel
- ☐ 2 smoke grenades
- ☐ 6 chem-lite spinners
- ☐ Strobe light
- ☐ Other

Traffic control point (TCP) kit (one per MRAP vehicle):

- ☐ 2 rolls concertina wire
- ☐ Handheld metal detector (2 per patrol)
- ☐ 2 large vehicle search mirror
- ☐ 1 small vehicle search mirror
- ☐ Spike strip (1 per patrol)
- ☐ Extra flex cuffs
- ☐ Megaphone (1 per patrol)
- ☐ TCP signs
    - #1 Vehicle “Coalition Checkpoint Ahead”
    - #2 Vehicle “STOP…Search Area”
    - #3 Vehicle “STOP”
- ☐ 5 traffic cones
- ☐ Ex-Spray kit
- ☐ Platoon detainee startup sheet
- ☐ Other

Weapons and ammunition:

- Crew-served weapon, mounted
- 800 rounds for crew-served weapon (minimum)
- Rifle, 5.56-mm (in gunner's turret)
- M-136 (AT-4) anti-tank missile
- 2 red star cluster
- 2 green star cluster
- Fragmentation grenades
- Smoke grenades
- Other

Crew sustainment load:

- 1 case bottled water x 1 day
- 1 case meals, ready-to-eat x 1 day
- Rucksack or assault pack x # crewmembers
- Other

Example Combat Load Plans for CAT I and CAT II MRAP Vehicles

International Military and Government (IMG) MaxxPro CAT I

IMG CAT I Combat Load Plan
Exterior Stowage – Top

ITEM NO	NOMENCLATURE	QTY
1	Machine gun, 7.62mm, M240B (not shown)	1
2	Ammo, 7.62mm, 100 rd belt loaded in weapon (not shown)	100 rds
3	Concertina wire (roll)	1

USER COMMENTS: Traffic cones (carried by all vehicles in Iraq per SOP) should be added to the Load List and stowed on the outside of the vehicle. There are no tie-down points for the concertina wire on the hood. A more accessible stowage location for the wire is desired.

Figure 9-2

IMG CAT I Combat Load Plan
Exterior Stowage – Rear

ITEM NO.	NOMENCLATURE	QTY
1	*Can, water, 5 gal.	4
*Vehicle unique BII provided by vendor (not on PM Load List)		

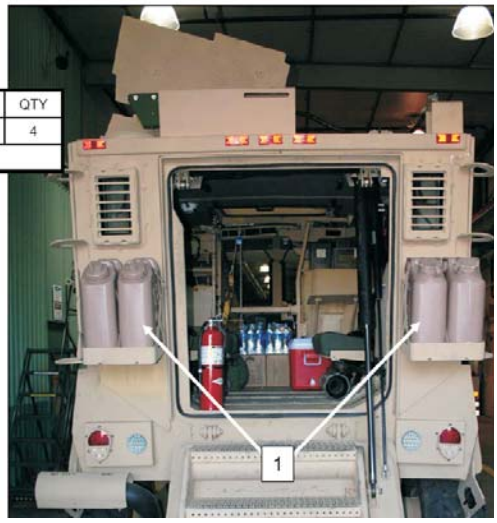

Figure 9-3

IMG CAT I Combat Load Plan
Exterior Stowage – Left Side

USER COMMENTS: No tie-down points are provided inside or outside the stowage boxes to secure items. Suggest adding "tie-down brackets" (NSN 2590-20-000-0168) to the side of the vehicle to secure exterior items like the litter. These brackets (used on Stryker) provide tie-down points for cargo straps and can be installed using the same mounting bolts that hold the armor.

ITEM NO.	NOMENCLATURE	QTY
1	*Chock blocks	2
2	*Kit, highway safety (a.k.a. triangle set)	1
3	Tow cable or tow strap	1
4	*Pad, jack (not shown)	1
5	*Jack, bottle, 20 ton	1
6	Litter, folding	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

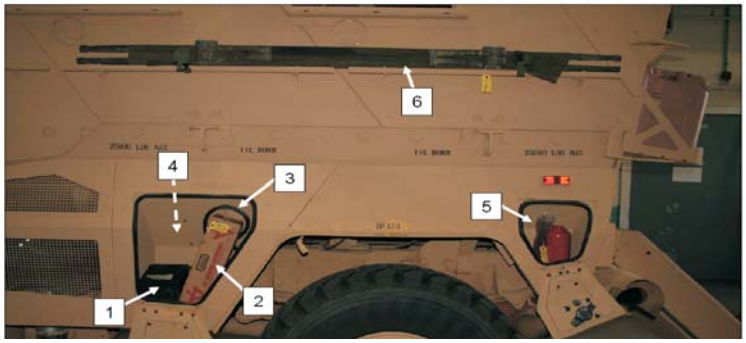

Figure 9-4

IMG CAT I Combat Load Plan
Exterior Stowage – Right Side

USER COMMENTS: No tie-down points are provided inside or outside the stowage boxes to secure items. Suggest adding "tie-down brackets" (NSN 2590-20-000-0168) to the side of the vehicle to secure exterior items like the tanker's bar and lug wrench (ref page 4 for additional information).

ITEM NO.	NOMENCLATURE	QTY
1	Max tool kit (replaces Pioneer tool kit)	1
2	*Slave cable (vehicle specific)	1
3	Slave cable (common NATO)	1
4	*Work light with extension	1
5	*Winch control	1
6	*Block and tackle (6 inch, 6 ton)	1
7	*Tankers bar, 60 inch	1
8	*Assy, lug wrench	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

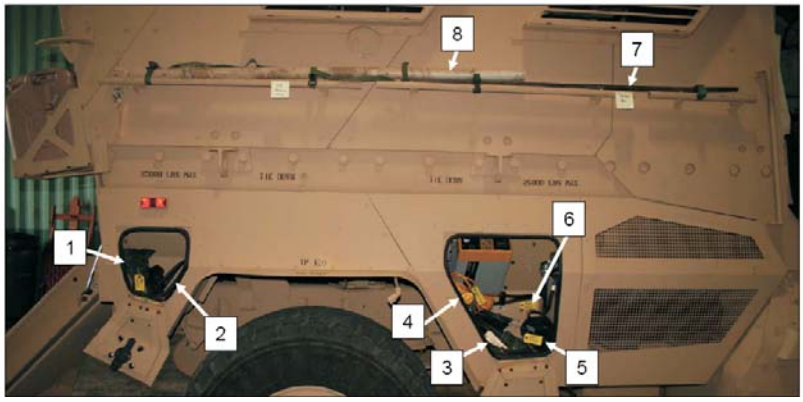

Figure 9-5

IMG CAT I Combat Load Plan
Interior Stowage – TC Station

ITEM NO.	NOMENCLATURE	QTY
1	Binoculars, stabilized, M25 (w/ 2 ea AA batteries)	1

Figure 9-6

IMG CAT I Combat Load Plan
Interior Stowage – Turret Gunner Area

ITEM NO.	NOMENCLATURE	QTY
1	Ammo, 5.56mm f/ M249 SAW, 800 rds (1 can = 4 drums = 800 rds)	1 can
2	Ammo, 7.62mm f/ M240B MG, 1100 rds (1 can = 200 rds). Note: 100 rds in weapon.	6 cans
3	Bottled water (12-pack) (1 case in cooler)	3
4	Meal ready-to-eat (MRE) (case)	2
5	Cooler w/ ice and 1 case bottled water	1
6	Breach kit	1
7	Body bag	1
8	Axe (part of Max tool kit)	1
9	Sledge hammer	1
10	Bolt cutter	1
11	Batteries, spare f/ NVGs (in .50 cal ammo can) (hidden from view)	6 sets
12	Enemy Prisoner of War (EPW) kit (in .50 cal ammo can) (hidden from view)	1

USER COMMENTS: No stowage racks or tie-down points are provided inside the vehicle; all items need to be secured. Piling items loosely on floor as shown is unacceptable. Current stowed location of ammo cans on top of Life Support System is inappropriate. An ammo stowage bin is preferred means to stow ammo cans, and it should be located close to gunner's station for quick access. Reference "stowage box" (NSN 2540-01-463-0567) used on the Abrams tank for a concept.

Figure 9-7

IMG CAT I Combat Load Plan
Interior Stowage –
Troop Compartment (Left front)

ITEM NO.	NOMENCLATURE	QTY
1	Chem lights (box)	1
2	Pen flares (box)	1
3	Combat medic bag	1
4	Combat Lifesaver Bag (CLS)	2
5	Panel marker, aerial (VS-17)	2
6	Human remains kit	1
7	*First aid kit	
8	Spare barrel w/ bag, f/ M240B MG	1
9	Spare barrel w/ bag, f/ M249 SAW	1
10	*Bag, tool (contents shown on page 9)	1
11	*Bag, pamphlet w/ vehicle log book and Operator's TM (hidden from view)	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

USER COMMENTS: No stowage racks or tie-down points are provided inside the vehicle; all items need to be secured. Piling items loosely on floor as shown is unacceptable.

Figure 9-8

IMG CAT I Combat Load Plan
Tool Bag (contents)

ITEM NO.	NOMENCLATURE	QTY
1	Brake chamber caging tool	1
2	Air chuck gage and hose	1
3	Padlock for tool box and stowage areas	3
4	Hammer, ball peen, 1.5 lbs	1
5	Pliers, side cutter	1
6	Wrench, adjustable, 15 in.	1
7	Wrench, adjustable, 10 in.	1
8	Screwdriver, flat tip, 3/8 x 12	1
9	Screwdriver, flat tip, 3/16 x 6	1
10	Screwdriver, cross tip #4	1
11	Screwdriver, cross tip #2	1
12	Pry bar, 16 in.	1
13	Flashlight	1
14	Batteries for flashlight	2
15	Ratchet, 1/2 in. drive	1
16	Socket set, METRIC	1
17	Socket set, STD	1
18	Cargo tie-down strap	2
19	Grease gun	1
20	Pliers, slip	1
Note: All items listed are a part of vehicle unique BII provided by vendor and are not on PM Load List		

Figure 9-9

IMG CAT I Combat Load Plan
Interior Stowage –
Troop Compartment (Rear)

ITEM NO.	NOMENCLATURE	QTY
1	M136 (AT-4)	2
2	*Extinguisher, fire	2
*Vehicle unique BII provided by vendor (not on PM Load List)		

USER COMMENTS: No stowage brackets are provided for the AT-4s. "AT-4 brackets" (NSN 5340-20-000-0241, 2 ea) like are used on Stryker are a possible fix. AT-4 brackets should be installed high in vehicle away from likely overmatching shotlines. Stowage brackets for the fire extinguishers are required. Mount each bottle in a separate area of the vehicle (location shown is not intended to be final).

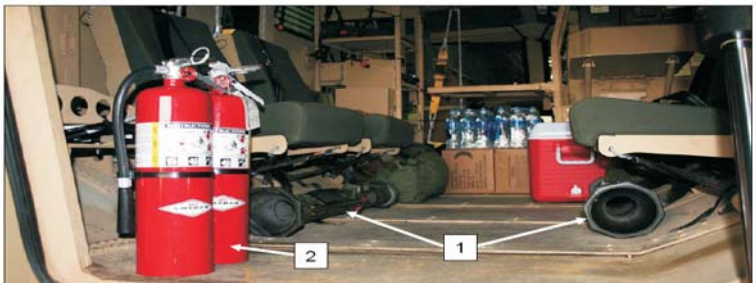

Figure 9-10

Caiman

Caiman 6X6 Combat Load Plan
Exterior Stowage - Top

ITEM NO.	NOMENCLATURE	QTY
1	Machine gun, 7.62mm, M240B (not shown)	1
2	Ammo, 7.62mm, 100 rd belt loaded in weapon (not shown)	100 rds
3	Concertina wire (roll secured on hood using cargo straps)	1

USER COMMENTS: Traffic cones (carried by all vehicles in Iraq per SOP) should be added to the Load List and stowed on the outside of the vehicle.

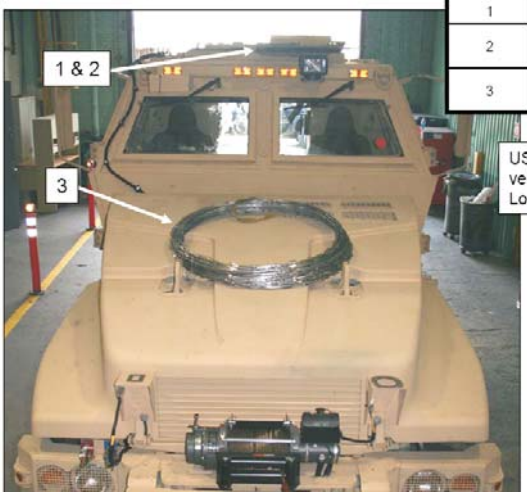

Figure 9-11

Caiman 6X6 Combat Load Plan
Exterior Stowage - Left Side

USER COMMENTS: No tie-down points are provided inside or outside the stowage boxes to secure items. Suggest adding "tie-down brackets" (NSN 2590-20-000-0168) to the side of the vehicle to secure items like the litter. These brackets (used on Stryker) provide tie-down points for cargo straps and can be installed using the same mounting bolts that hold the armor.

ITEM NO.	NOMENCLATURE	QTY
1	*Floodlight, electrical	1
2	*Winch control	1
3	*Gage, tire pressure with hose	1
4	*Mirror, spare	2
5	*Block, snatch	1
6	*Kit, highway safety (a.k.a. triangle set)	1
7	Litter, folding	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

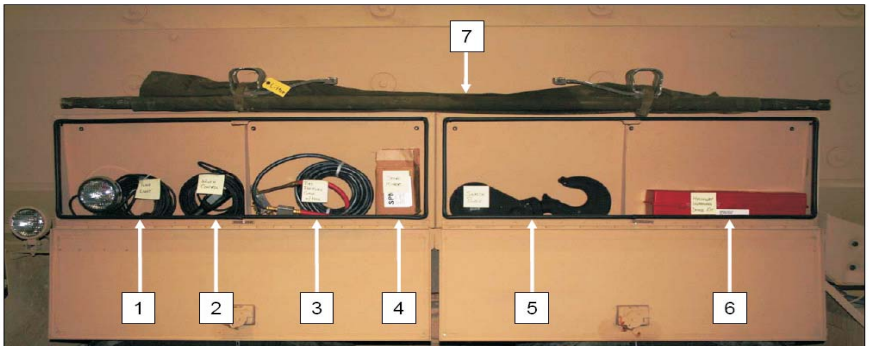

Figure 9-12

Caiman 6X6 Combat Load Plan
Exterior Stowage - Right Side

USER COMMENTS: No tie-down points are provided inside or outside the stowage boxes to secure items. Suggest adding "tie-down brackets" (NSN 2590-20-000-0168) to the side of the vehicle to secure items like the tow cable.

ITEM NO.	NOMENCLATURE	QTY
1	*Bag assembly, pamphlet w/ binder, LL, 3-ring log	1
2	*Chock blocks	2
3	*Bag, tool (contents shown below)	1
	*Pliers, slip, joint	1
	*Screwdriver, cross tip	2
	*Screwdriver, flat tip	1
	*Wrench, Adj, 8 inch	1
	*Wrench, Adj, 12 inch	1
4	Axe (part of Max tool kit)	1
5	Max tool kit (replaces Pioneer tool kit)	1
6	Bolt cutter	1
7	Sledge hammer	1
8	Tow cable or tow strap	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

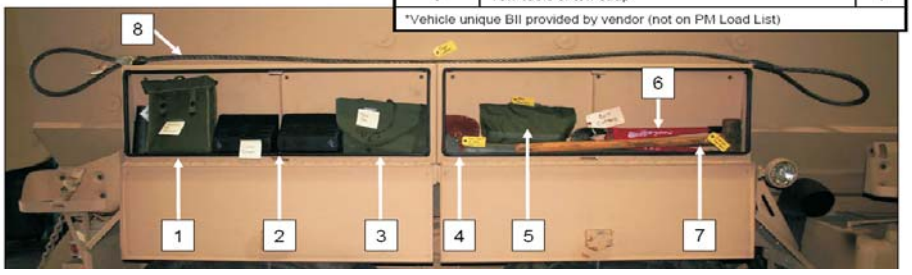

Figure 9-13

Caiman 6X6 Combat Load Plan
Interior Stowage - Driver Station

ITEM NO.	NOMENCLATURE	QTY
1	*Chain w/ padlock (to lock steering wheel)	1
2	*Extinguisher, fire	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

Figure 9-14

Caiman 6X6 Combat Load Plan
Interior Stowage - TC Station

ITEM NO.	NOMENCLATURE	QTY
1	Binoculars, stabilized, M25 (w/ 2 ea AA batteries)	1
2	*Extinguisher, fire	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

Figure 9-15

Caiman 6X6 Combat Load Plan
Interior Stowage - Troop Compartment (Left)

USER COMMENTS: No stowage racks or useable tie-down points are provided inside the vehicle. There are tie-down points along the center of the floor, but none along the walls to connect to. Possible solutions include: 1) Install a rail system on the floor and walls that would allow adjustable tie-down points to be attached to it (similar concept in Stryker, which uses "metal molding" of various lengths, example NSN 2590-21-920-2044). Cargo netting or straps could then be thrown over stowage and fastened to the rails. 2) Build stowage racks that can be attached to the walls using the mounting points previously used by the four seats that were removed. Ideally, there should be a mix of options 1 and 2 to better accommodate both large and small items. Notes: 1) AT-4s should be stowed high in vehicle away from likely overmatching shotlines. 2) The folding tray installed in front left corner of compartment where seat was previously located is of no value to majority of soldiers and should be removed.

ITEM NO.	NOMENCLATURE	QTY
1	Bottled water (12-pack) (1 case can go in cooler)	4
2	M136 (AT-4)	2
3	Batteries, spare f/ NVGs (in .50 cal ammo can)	6 sets
4	Enemy Prisoner of War (EPW) kit (in .50 cal ammo can)	1
5	Ammo, 7.62mm f/ M240B MG, 1100 rds (1 can = 200 rds). Note: 100 rds in weapon.	6 cans
6	Ammo, 5.56mm f/ M249 SAW, 800 rds (1 can = 4 drums = 800 rds)	1 can
7	*Extinguisher, fire	1

*Vehicle unique BII provided by vendor (not on PM Load List)

Figure 9-16

Caiman 6X6 Combat Load Plan
Interior Stowage -
Troop Compartment (Right)

USER COMMENTS: Same as before (see page 7)

ITEM NO.	NOMENCLATURE	QTY
1	Cooler w/ ice and 1 case bottled water	1
2	Combat medic bag	1
3	Body bag	1
4	Breach kit	1
5	Human remains kit	1
6	Combat Lifesaver Bag (CLS)	3
7	Panel marker, aerial (VS-17)	2
8	Chem lights (box)	1
9	Pen flares (box)	1
10	Spare barrel w/ bag, f/ M240B MG	1
11	Spare barrel w/ bag, f/ M249 SAW	1
12	Meal ready-to-eat (MRE) (case)	3
13	Slave cable	1
14	*Extinguisher, fire	1

*Vehicle unique BII provided by vendor (not on PM Load List)

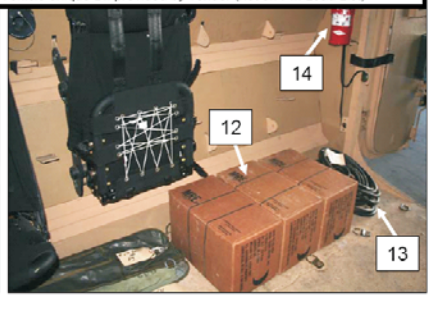

Figure 9-17

RG33 CAT II

BAE CAT II Combat Load Plan
Exterior Stowage – Top

ITEM NO.	NOMENCLATURE	QTY
1	Machine gun, 7.62mm, M240B	1
2	Ammo, 7.62mm, 100 rd belt loaded in weapon	100 rds
3	Concertina wire (roll secured on hood using cargo straps)	1

USER COMMENTS: Traffic cones (carried by all vehicles in Iraq per SOP) should be added to the Load List and stowed on the outside of the vehicle. There are not adequate tie-down points for the concertina wire on the hood (handles are far apart making them a poor choice). A more accessible stowage location for the wire is desired.

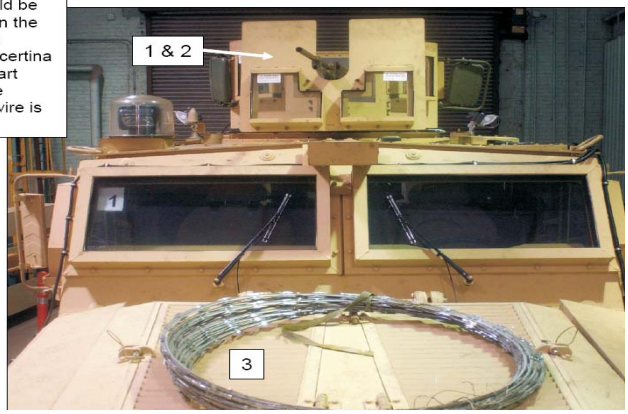

Figure 9-18

BAE CAT II Combat Load Plan
Exterior Stowage – Left Side

ITEM NO.	NOMENCLATURE	QTY
1	Tow cable or tow strap	1
2	Sledge hammer	1
3	Bolt cutter	1
4	Axe (part of Max tool kit)	
5	Max tool kit (replaces Pioneer tool kit)	1
6	*Winch control	1
7	*Block and tackle (6 inch, 6 ton)	1
8	*Chock blocks	2
9	Slave cable	1
10	Litter, folding	1
*Vehicle unique BII provided by vendor (not on PM Load List)		

USER COMMENTS: No tie-down points are provided inside or outside the stowage boxes to secure items. Litter was secured to body of vehicle with cargo straps routed through gaps in the window frame. Footman loops should be added (same as on right side of vehicle).

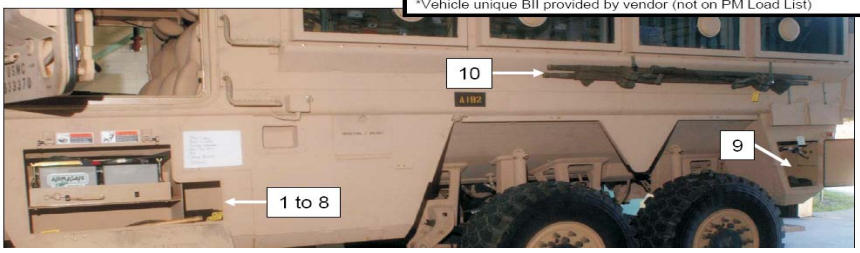

Figure 9-19

BAE CAT II Combat Load Plan
Interior Stowage –
Troop Compartment (Right Front)

USER COMMENTS: Breach kit needs tie-down point(s).

ITEM NO.	NOMENCLATURE	QTY
1	Ammo, 7.62mm f/ M240B MG, 1100 rds (1 can = 200 rds). Note: 100 rds in weapon.	6 cans
2	Breach kit	1
3	Chem lights (box)	1
4	Pen flares (box)	1
5	Human remains kit	1

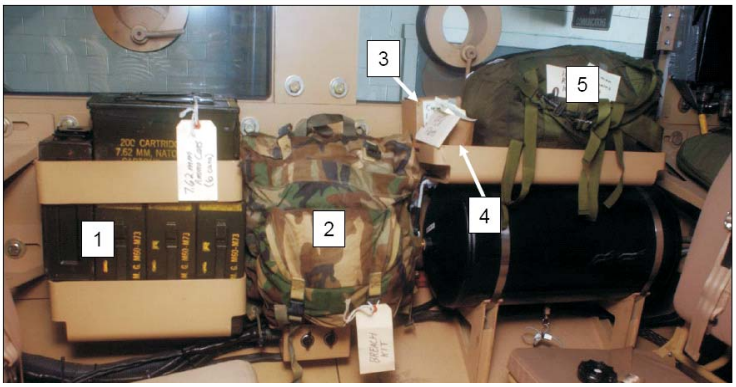

Figure 9-20

BAE CAT II Combat Load Plan
Interior Stowage –
Troop Compartment (Right Rear)

USER COMMENTS: No stowage brackets are provided inside the vehicle for the AT-4s and there is insufficient room to stow them (current location shown on top of Chameleon is inappropriate). "AT-4 brackets" (NSN 5340-20-000-0241, 2 ea) like are used on Stryker is a possible fix. AT-4 brackets should be installed high in vehicle away from likely overmatching shotlines. Existing stowage brackets located throughout vehicle under seats were meant to hold .50 cal or 40mm ammo cans; they work for items like the panel markers and body bag, but are not ideal and tie-down is awkward. Brackets designed to fit specific items being stowed should be provided. There is insufficient space inside the vehicle to stow the combat medic bag. Current location (behind right rear crew seat) is tight and impacts soldier ingress/egress to some degree.

ITEM NO.	NOMENCLATURE	QTY
1	Spare barrel w/ bag, f/ M249 SAW (hidden)	1
2	Spare barrel w/ bag, f/ M240B MG (hidden)	1
3	Ammo, 5.56mm f/ M249 SAW, 800 rds (1 can = 4 drums = 800 rds, stowed on floor between middle seats)	1 can
4	Panel marker, aerial (VS-17)	2
5	Body bag	1
6	M136 (AT-4)	2
7	Combat medic bag	1

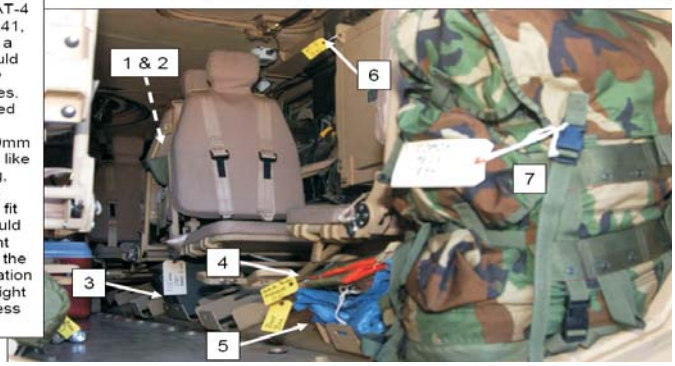

Figure 9-21

BAE CAT II Combat Load Plan
Interior Stowage –
Troop Compartment (Left Rear)

USER COMMENTS: Cooler location blocks ingress/egress routes.

ITEM NO.	NOMENCLATURE	QTY
1	Combat Lifesaver Bag (CLS)	3
2	Batteries, spare f/ NVGs (in .50 cal ammo can, stowed on floor between middle seats)	10 sets
3	Enemy Prisoner of War (EPW) kit (in .50 cal ammo can, stowed on floor between middle seats)	1
4	Cooler w/ ice and 1 case bottled water	1
5	*Extinguisher, fire (not shown, located on left wall, 2 locations, rear seat and front seat)	2

*Vehicle unique BII provided by vendor (not on PM Load List)

Figure 9-22

Chapter 10

Individual Protective Measures

(Information in this chapter is taken from a briefing by Lt. Col. Wayne A. Sinclair, United States Marine Corps, titled "The Last Defense – Vehicle Survivability Against Mines and IEDs.")

Individual protective measures enhance one's chance of surviving an encounter with an improvised explosive device (IED) regardless of the type of vehicle. These universal survivability measures can make the difference between being carried away and walking away from an IED encounter.

Seatbelts

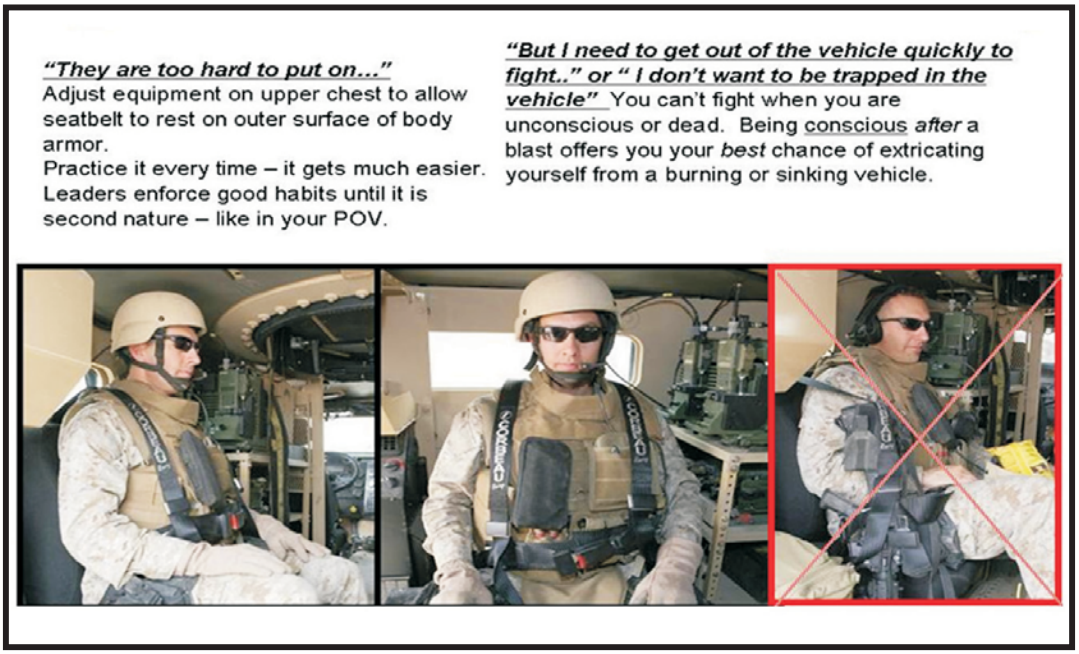

Figure 10-1

Given the violent forces exerted on the human body during vertical acceleration, a crash, or a vehicle rollover, the ability to remain restrained to a stable surface is an essential component of safety and survival.

Either the traditional or retractable diagonal seatbelts or the more effective four-point seat harness restraints offered by the mine-resistant ambush-protected (MRAP) vehicle can prove cumbersome given the bulk of flak jackets and chest-worn equipment. Nevertheless, purposeful modifications to modular lightweight load-carrying equipment (MOLLE)-weave equipment configurations can allow for easier wear. With consistent practice, this essential element of tactical discipline will become second nature.

Concerns about one's ability to rapidly exit a vehicle must be tempered by the knowledge that seatbelts prevent occupants from being slammed into vehicle roofs,

doors, and windshields. Post-IED analysis reveals that simply remaining conscious offers occupants the best chance to escape from a burning or submerged vehicle.

Personal Protective Equipment

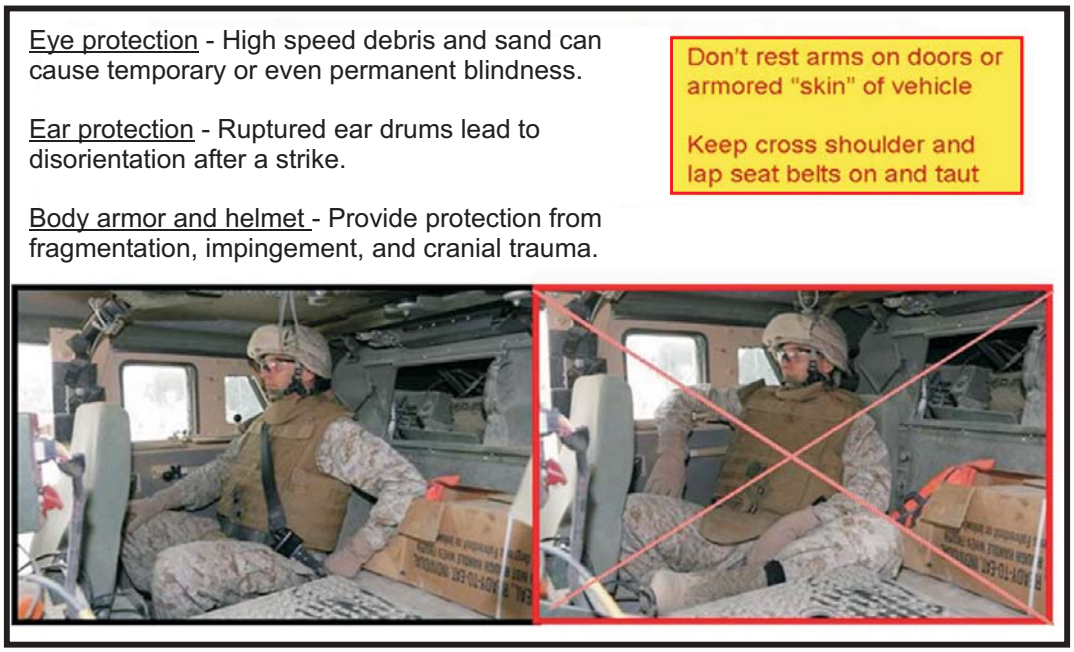

Figure 10-2

Eyes and ears are particularly vulnerable to fragmentation and overpressure injuries during a blast. Inner-ear ruptures further contribute to a victim's disorientation in the critical minutes following a strike. Helmets and body armor provide essential protection against primary fragmentation, the blunt trauma associated with secondary missiles, and impacts during a vehicle rollover.

Keep a safe separation between body parts and external armor. Body armor may not be able to prevent serious injury or death if arms, shoulders, and head rest against the outer skin of an armored vehicle at the time of a nearby explosion.

Driving Posture

Drivers are particularly susceptible to injury during a mine or IED strike. The steering wheel, control levers, pedals, and confined knee space all constitute serious blunt trauma hazards during vertical acceleration. An erect posture mitigates spinal injuries and keeps the steering wheel clear from causing traumatic strikes to one's chest and torso. Calculated security halts serve as stretch breaks and can offset the fatigue that comes from prolonged PPE wear and proper spinal posture.

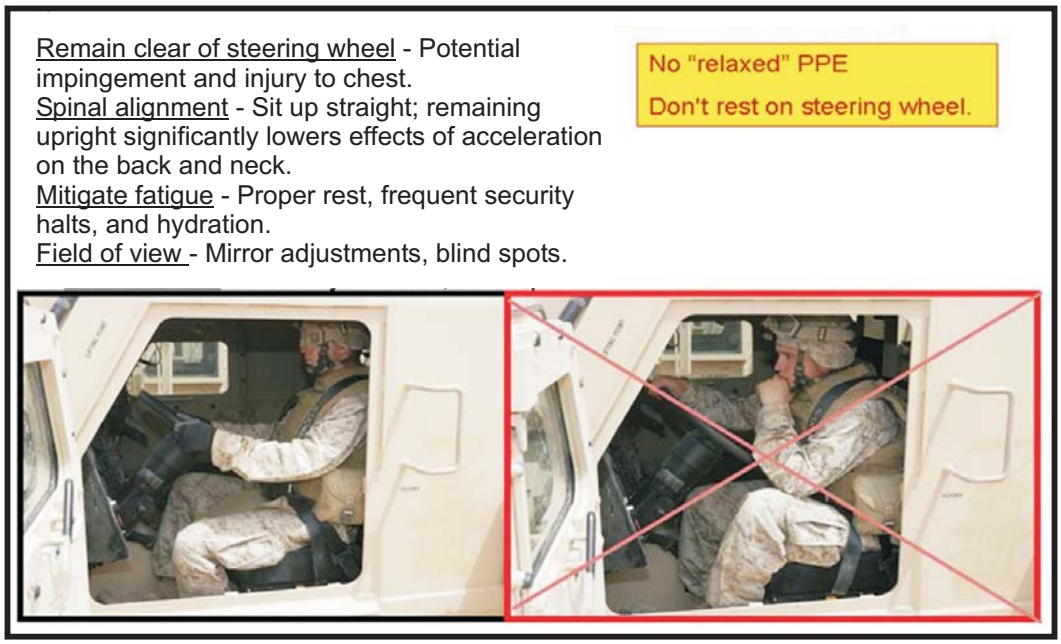

Figure 10-3

Passenger Area

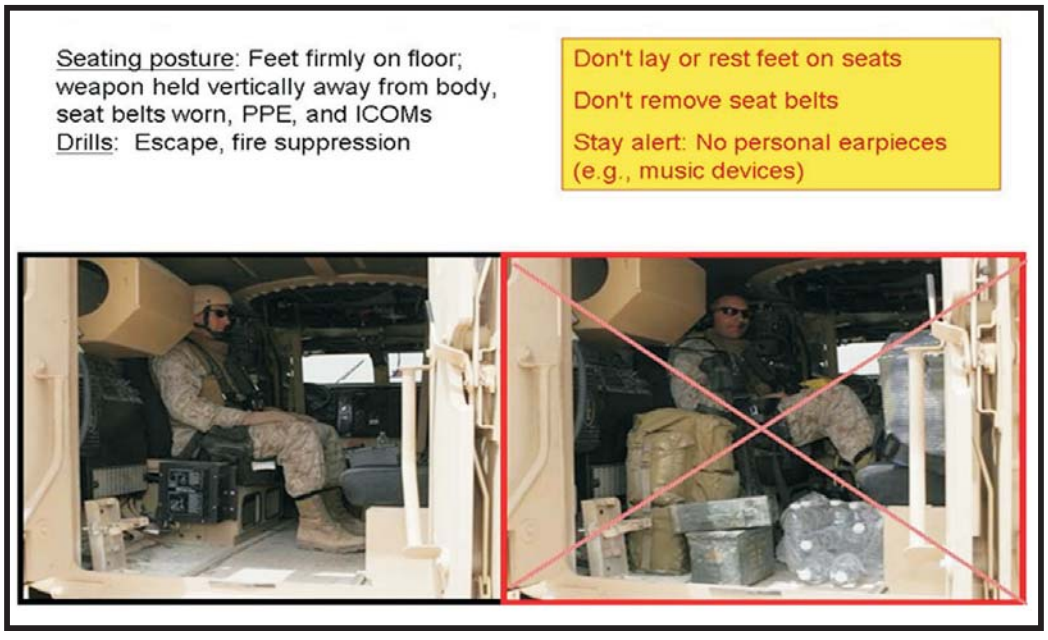

Figure 10-4

Seating posture and seatbelts are also important for MRAP vehicle passengers.

Vertical acceleration plays havoc on an unrestrained and cluttered crew compartment (see Figure 10-4).

Passengers distracted or lacking situational awareness due to personal music devices and an unfamiliarity with the location of fire extinguishers, first aid kits—and in this case, the five available escape hatches of a 4x4 Cougar—are a threat to themselves and the mission.

Future MRAP variants may have foot straps or stirrups attached to the seats. Occupants should use these if equipped, since having the feet off the floor offers more protection in a blast.

Vehicle Preparation

Figure 10-5

Enhanced survivability involves teamwork. Collective, disciplined vehicle preparations mitigate injuries and increase survival rates considerably.

Deadly overpressure buildups associated with a hull breach or floor rupture should be vented though an open gunner's ring or, lacking that, another top hatch left slightly open or set at "combat lock."

Sandbags provide additional protection from high-speed fragmentation on vehicle floors and prevent shattered heels from buckled floor armor.

Loose equipment and supplies pose secondary missile threats, causing additional and totally preventable injuries. (The clutter found in the HMMWV shown in Figure 10-5 was not staged and included a tow bar, which is not only a potential source of injuries but also can trap an individual inside the vehicle.)

At three to four inches thick, transparent armor—otherwise known as ballistic glass—can distort visibility under the best circumstances. Ensuring glass is spotless, along with a dedicated road watcher who doubles as the assistant driver,

will significantly improve the chances that IEDs and other threats will be identified in sufficient time to avoid or react effectively.

Fire presents another danger. JP 8—universal fuel—has a flash point 30 degrees lower than diesel. In essence, when warmed to 100 degrees Fahrenheit, JP 8 will produce vapors subject to a flash ignition. Consider the following

- Externally carried fuel cans on troop vehicles present considerable risk.
- Never carry fuel inside compartments or the trunk of a HMMWV.
- Jerry cans are plastic and very susceptible to rupture during an IED strike, creating an instant inferno that has no chance of being extinguished by the on-board automatic fire suppression systems. The puncturing of a five-gallon Jerry can by a hot fragment can turn a survivable IED strike into a catastrophe.
- Fire extinguishers must be functional and secured.
- Auto fire-suppression systems should be part of regular pre-operational checks and serviced with scheduled maintenance.

Figure 10-6

Other Habits

Immediate action training often focuses on external threats in the wake of an IED attack—5/25s, outward focused security, seeking a covered position. While these steps can be essential due to the threat of ambushes that accompany a strike, immediate attention must also be given to the internal concerns below. All these are

based on observations and analysis of lethal IED events in Multi-National Forces-West. The following concerns should become common practice:

- Know where every potential escape hatch is in the dark and how to manipulate the handle to open it—or which ones must be used when upside down or rolled onto one particular side.
- Given the frequency of concussions, temporary blindness, disorientation, and unconsciousness following large IED strikes, never assume that all occupants have safely exited a damaged vehicle—especially if it is burning.
- If your vehicle is struck and on fire, the sequence of essential tasks is escape, then accountability, then suppression of the fire, then first aid. Leaders must assure Soldiers know and understand these steps.
- Stay in the tracks of the vehicle in front of you (whenever possible and appropriate).
- Keep speeds below 35 mph.

Good Habits to Remember:

Rehearse post strike immediate "internal actions for vehicle crews and passengers:

- **Escape**
- **Accountability**
- **Fire suppression**
- **First aid**

As a rule of thumb, follow the path of the vehicle in front.

Keep speeds down—the risk versus gain analysis is clearly in favor of slower vehicle speeds.

Chapter 11

Casualty Evacuation Procedures

Casualty evacuation (CASEVAC) is the evacuation of sick and wounded on a nonstandard platform normally not manned by medical personnel or equipped with medical sets kits and outfits designed for en route care.

The CASEVAC conversion kit (CCK) consists of two brackets for the litter-support arms. These two brackets are permanently installed to the wall of the vehicle. The two litter-support arms are stored on the vehicle until the CASEVAC kit is ready to be used. There are two arm mounts inside the litter arms. The arms are attached to the bracket, which is permanently installed to the wall of the vehicle. Secure the casualty to the litter by using the casualty litter straps.

Loading and Unloading a Litter Casualty

Place the MRAP vehicle CCK into operation

Step 1. Attach the litter support arm to the front bracket that is already permanently mounted on the wall. The litter support arm will slide easily onto the arm mount.

Step 2. Install the litter arm mounting pin through both the litter support arm and the mount to secure the litter support arm to the front bracket.

Step 3. Pull out the end by pulling on the litter arm release pin to enable the end to slide out. Pull it out enough so that it will accommodate the width of a litter.

Step 4. Load the casualty head first into the vehicle. Place the litter handles (the handles located at the head of the casualty) onto the litter support arm. Slide the litter support arm inward toward the wall to secure the litter so that the litter stop cuffs over the litter handle.

Step 5. A second Soldier installs the other (rear) litter support arm while the first Soldier, who is at the foot of the casualty, supports the litter in the air.

Step 6. The second Soldier installs the litter arm mounting pin to secure the litter support arm to the bracket.

Step 7. The first Soldier, while supporting the weight of the litter, lowers the litter onto the rear litter support arm. The second Soldier slides the litter support arm inward toward the wall to secure the litter and the casualty so that the litter stop cuffs over the litter handles, thus securing the litter casualty to the CCK.

Step 8. Unload the casualty in reverse sequence.

Loading and unloading a litter casualty using a spine board

Step 1. (For this portion, the CCK is already installed and configured to receive a casualty with a litter already secured to the CCK. For this instruction, ensure the casualty is secured using litter straps to the spine board and is prepared for evacuation). From the start position with four personnel at each corner of the board, the team approaches the rear entrance of the vehicle.

Step 2. At the rear entrance, the team executes to a three-man semi-overhead carry while one individual mounts the vehicle. The three-man team shuttles the casualty on the spine board to the individual inside the vehicle.

Step 3. As the three-man team shuttles the casualty, the team will have to transition to an overhead carry (one behind the other) as they continue to load the casualty onto the litter that is already in place on the CCK. The team continues to slide the casualty onto the litter and makes final adjustments to ensure that the litter is secured to the CCK.

Step 4. Unload the casualty in reverse sequence.

2/101 BCT MRAP Vehicle Lessons Learned BAE RG33L CAT II CASEVAC

Issue: Using MRAP vehicle for CASEVAC

Recommendation: The best way to load a casualty is strapped to a backboard and placed in the center of the vehicle atop 2"x4" wooden boards or a combination of the cheater bars, tanker bar, and handles for the axe or sledge hammer. The items form a bridge by placing them on the seats across from one another.

The above plan will allow up to two casualties.

The backboard can be stabilized and prevented from shifting back and forth by using some simple straps fastened to the top of the seat.

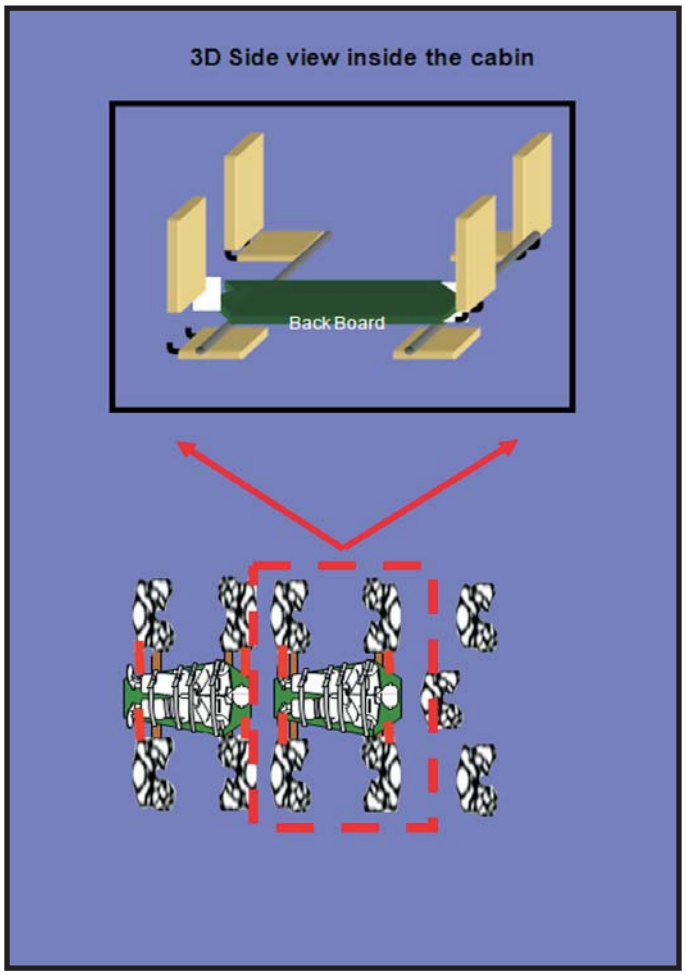

Figure 11-1

Task: Evacuate wounded from vehicle

Conditions: MRAP vehicle-equipped platoon/section is mounted either stationary or moving, conducting operations. A vehicle is disabled due to enemy contact. An occupant of the vehicle has been injured and must be evacuated.

Standards: Platoon suppresses the enemy, moves out of the engagement area if possible, and establishes security. Squad/team members conduct first aid and remove the casualty from the vehicle. Unit leader requests medical evacuation (MEDEVAC), if necessary, and reports to higher headquarters.

Task Steps: Remove Casualty:

- Unit suppresses the enemy and moves out of the engagement area, if possible.
- Once out of the engagement area or when the enemy is suppressed, unit establishes security.
- Designated Soldiers move to the vehicle to treat and evacuate the casualty.

Remove Casualty:

- Soldiers remove the casualty from the vehicle so as not to cause further injury (one Soldier at the head and one near the feet).
- Soldiers administer first aid.
- Unit leader requests MEDEVAC if necessary.
- Unit leader reports the contact to higher headquarters.

Transport casualty:

- Soldiers load and secure Soldier on backboard using straps available.
- One Soldier places items to bridge the casualty between the seats (cheater bar, axe handle, tanker bar).
- Soldiers load casualty head first, with one Soldier in the vehicle to receive the casualty, one Soldier on each side, and one Soldier at the feet of the casualty.
- Soldier in the vehicle guides the casualty over the backboard bridge and secures the backboard using straps or ropes.

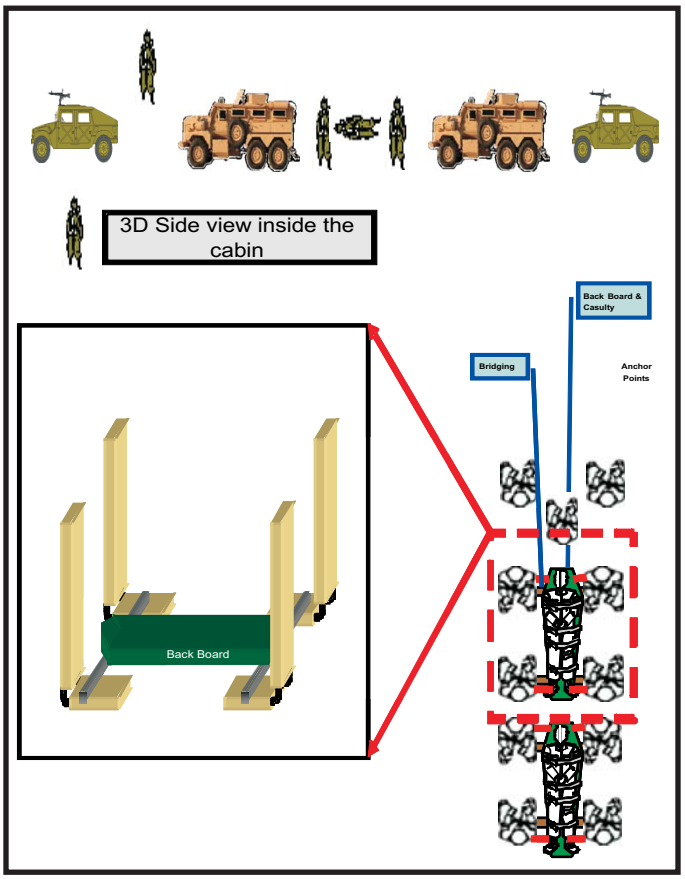

Figure 11-3

Task #	Task	Manual
07-3-D3991	React to Contact (Visual, IED and Direct Fire	ARTEP 7-1-DRILL
07-3-D3999	Establish Security at the Halt	ARTEP 7-1-DRILL
07-2-D5027	Conduct Consolidation and Reorganization	ARTEP 7-10
07-3-D3998	Evacuate Wounded Personnel from Vehicle	ARTEP 7-1-DRILL
07-9-0204	Treat and Evacuate Casualties	ARTEP 7-10

Chapter 12

Recovery and Towing Operations and Damage Reporting

(**Note:** See Appendix A for specific vehicle variants.)

Figure 12-1

Many recovery operations consist of self-recovery methods, either when the vehicle becomes stuck or when it has a mechanical failure or receives battle damage. Mine-resistant ambush-protected (MRAP) vehicle recovery is easiest when the tires still have traction and when crew members can help the vehicle move through the original tire tracks.

When the MRAP vehicle is stuck in snow, sand, or mud, the crew can lower tire pressure to increase traction. Using a second MRAP to help pull a stuck vehicle is normally the quickest recovery method. The unit should always carry tow bars or chains and shovels. It should have hooks or shackles attached to both ends for anchoring to the vehicles. If possible, the patrol carries at least one tow bar for each vehicle section to assist in long-range recovery.

When the MRAP vehicle is stuck in mud or sand, the unit uses pioneer tools to emplace dry or solid matter under the tires for traction. Sandbags or other materials can be dug into and under the wheels to assist traction. Units normally carry empty sandbags for this purpose.

When conducting recovery, one section provides security while the other vehicle makes the recovery. The recovery section decides before making the recovery where the vehicle can go after it breaks loose.

The commander should make contingency plans for vehicles that cannot be repaired or recovered. The company will make every attempt to recover the vehicle and return it to where it can be repaired, if needed. The commander should make contingency plans for vehicles that cannot be immediately repaired or recovered.

Figure 12-2

Recovery Basics

Recovery is retrieving (freeing) immobile, inoperative, or abandoned equipment from its current position and returning it to operation or to a maintenance site for repair. These actions typically involve towing, lifting, or winching. Towing is usually limited to moving equipment to the nearest forward operating base. The amount and type of equipment used as the source of effort during any recovery operation depends on the level of recovery. Drivers and crews should evaluate the situation and determine if the crew can recover the vehicle before calling on support from a higher level.

Levels of Recovery

Self-recovery

Self-recovery actions require using only the equipment's assets. Self-recovery starts at the location where the equipment becomes mired or disabled. The operator/crew uses basic issue items and authorized allowance list or on-vehicle equipment items to perform self-recovery. Self-recovery winches can be used to assist in a recovery effort by providing stabilizing or holdback capabilities. (Note: The current winch is not safe and should not be used in recovery operations.)

Procedures: See Appendix A.

Like-recovery

Like-recovery actions involve assistance (tow bar only) from a second, like, or heavier class vehicle. Like-vehicle recovery is used when self-vehicle recovery fails. Using like vehicles is usually the quickest method of recovery because they are readily available. The principle is to use another piece of equipment of the same weight class or heavier to extract or tow the mired equipment by using tow bars, chains, or tow cables. When self-recovery and like-recovery are not practical or are unavailable, use dedicated recovery assets.

Procedures: Before towing any vehicle, refer to the vehicle technical manual. The following are general rules for towing:

- Move towed loads at slow speed.
- Use a tow bar in preference to chains, ropes, or cables. Tow bars keep the towed vehicle from running into the towing vehicle.
- Proceed slowly at 5 to 10 miles per hour because the towed vehicle may skid on turns at higher speeds. Avoid quick stops.
- When using a tow bar, connect a safety chain between the two vehicles in case the bar breaks or becomes disconnected.
- Do not have a driver or crew member in any towed vehicle unless using a chain or cable.

WARNING

Never tow vehicles with caged brakes or damaged air brake systems using like-vehicle towing procedures. Immediately call for wrecker support.

Dedicated recovery

Dedicated recovery actions require assistance from a vehicle specifically designed and dedicated to recovery operations. Dedicated-recovery vehicles are used when self-recovery or like-vehicle recovery is not possible because of the severity of the situation, safety considerations, or the inability to use like-vehicle assets employed in their primary mission.

Procedures: See Appendix A

U.S. Army National Ground Intelligence Center Anti-Armor Task Force Battlefield Vehicle Forensics Program

The battlefield vehicle forensics (BVF) quick reference guide is designed to walk you through the procedures and techniques for good forensics collection. The guide and report form are located at the Reimer Digital Library and are available to active, guard, reserve, Department of Army civilians, and approved Department of Defense contractors on a case-by-case basis (go to <https://atiam.train.army.mil/soldierPortal/atia/adlsc/view/restricted/24835-1/TSP/AATF-BVF/AATF-BVF.PPT>.

The purpose of the program is to provide:

- Historical enemy attack data to deploying or deployed units for their future or current area of responsibility (AOR).
- Attack data for all weapon types used.
- Attack data on type of armor vehicle attacked.

- Subject matter experts (SMEs) on threat anti-armor weapon systems (small arms, rocket-propelled grenades, antitank guided missiles, anti-armor improvised explosive devices, etc.).

Battlefield Vehicle Forensics Program

Soldiers (support specialty team, explosive ordnance disposal team, and weapons inspection team) can be trained to collect high-value technical data from incident sites and vehicles and casualties at incident sites. This data can then be used to:

- Identify exact weapon used
- Identify exact lethal effects of the weapon
- Develop technical improvements
- Change friendly tactics to avoid enemy weapons' strengths and exploit weapons' weaknesses
- Collaborate with medical community
- Document the scene, measure the scene, photograph the scene, recover evidence, and check documents
- Put recovered material in context

Main topic areas covered in the slide show located in Reimer Digital Library cover the following topics:

- Overview of threat
- Battlefield vehicle forensics
- Attack scene investigation
- Sniper/small-arms attack scene investigation

Appendix A

Recovery and Towing Operations

(**Note:** Information in this appendix is provided by the TRADOC Executive Agency for Battle Damage Assessment Repair and Recovery.)

BAE Systems RG33 and RG33L

Figure A-1: BAE RG33

Figure A-2: BAE RG33L

General Information and Equipment Description

Due to the unique design of the BAE mine-resistant ambush-protected (MRAP) vehicles, recovery personnel face several challenges when attempting to recover these systems. These challenges include size, weight, route clearance, and design issues.

The intent of this section is to provide procedures for recovering disabled vehicles in emergency situations. These procedures were developed during live-fire test and evaluation (LFT&E) events at Aberdeen and Yuma Proving Grounds.

IMPORTANT NOTICE

Due to design, towing provisions may differ from vehicle to vehicle. Validate procedures in training prior to actual recovery missions.

Vehicle	Crew	Overall Length	Overall Width	Overall Height	Vehicle Curb Weight (VCW)	Gross Vehicle Weight (GVW)
BAE RG33 4X4	6	230 in.	94.5 in.	112 in. 139 in. with gunner protective kit (GPK)	33,000 lb.	37,000 lb.
BAE RG 33L 6X6	10	337 in.	94.5 in.	112 in.	44,000 lb.	48,000 lb.

Table A-1: BAE Vehicle Data

Recovery Procedures

Like-vehicle recovery

Like-vehicle towing must be accomplished using a vehicle of equal or greater weight.

Figure A-3: U.S. Army heavy duty towbar (NSN 2540-01-267-2912)

Figure A-4: BAE connected to a U.S. Army heavy duty towbar

Note: Connect the vehicle with the U.S. Army heavy duty towbar and 1 in. pin adapters (NSN 2540-00-863-3153). The lug provisions require a 1 1/2 in. pin and adaptors, but due to the bumper interference, the 1 in. pin adapters must be used. This setup will create excessive play between the pins and tow lugs.

WARNING

Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

Towbar connections:

- Install the towbar (refer to figures A-3 or A-4).
- Install the air lines, electrical cable(s), safety pins, and safety chains. Leave sufficient slack in the safety chains to allow for turns. Install the tow lights.
- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle. If the air supply on the casualty vehicle will not hold air, call for wrecker support.
- Push in the parking brake control on the disabled vehicle.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, front lift tow

Figure A-5: Heavy expanded mobility tactical truck (HEMTT) wrecker lift towing BAE 6X6

WARNING

Do not use the medium tactical vehicle replacement (MTVR) wrecker to front lift tow the BAE category (CAT) II; the vehicle exceeds the retrieval system lift capacity.

Note: If the casualty vehicle has no air pressure, the rear brakes will need to be caged.

Procedures:

- Install the appropriate retrieval system adapters (refer to figures A-6 or A-7). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle and connect the retrieval system to the disabled vehicle. If using multi-use adapters (MUAs), use 1 1/2 in. pin hole number 6.
- Route chains around the front axle and connect to the hook on the appropriate adapter.

WARNING

Vehicles with catastrophic damage to the front axle and suspension may require the axle to be properly secured to the chassis for safe recovery of the vehicle. Never attach safety chains to axles or suspension components that are no longer physically attached to the vehicle. Never cross the safety chains.

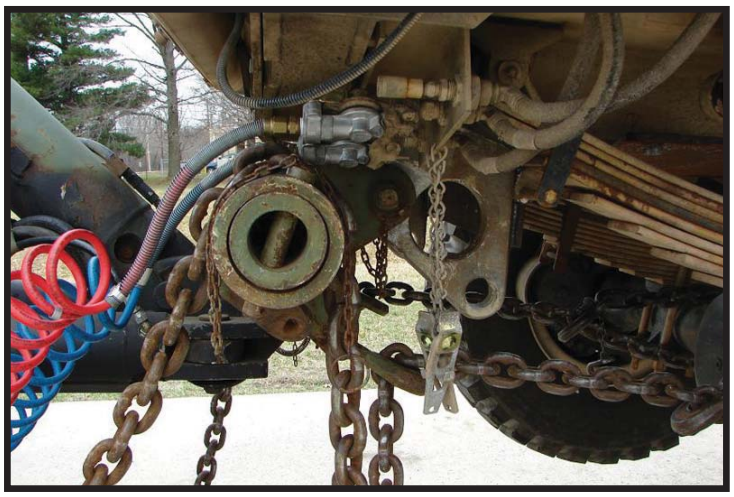

Figure A-6: HEMTT/MTVR wrecker front lift tow with HEMTT basic issue item (BII) adapter D (NSN 2590-01-226-3349 [L] and NSN 2540-01-226-7139 [R])

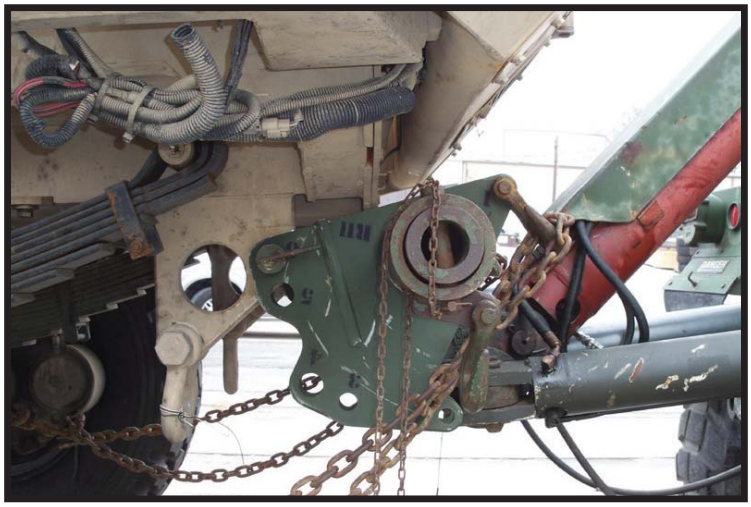

Figure A-7: HEMTT/MTVR wrecker front lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

- Hook the safety chain around the frame or front axle and connect to the rear tow shackles or the safety chain loop on the wrecker. Ensure sufficient slack in the safety chains to allow for turns.
- Install the air lines, electrical cable(s), and safety pins.
- Install the tow lights. Check the rigging.
- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle.
- Push in the parking brake control on the disabled vehicle.
- Raise the vehicle so the front wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, rear lift tow

Figure A-8: HEMTT/MTVR wrecker rear lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

Figure A-9: HEMTT/MTVR wrecker rear lift tow with HEMTT BII adapter D (NSN 2590-01-226-3349 [L] and NSN 2540-01-226-7139 [R])

WARNING

Recovering this vehicle from the rear should be performed only in emergency combat situations and with the commander's approval. Decrease speeds, and be extremely cautious.

WARNING

Do not use the MTVR wrecker to rear lift tow the BAE CAT I and CAT II; the vehicle exceeds the retrieval system lift capacity.

Procedures:

Note: Remove the rear step.

- Straighten and secure the steering wheel before towing.
- Install the appropriate retrieval system adapters (refer to figures A-8 or A-9). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle. Connect the retrieval system MUAs using a 1 1/2 in. pin through hole number 4 and connect to the rear tow lugs of the disabled vehicle.
- Route chains around the rear axle and connect to the hook on the adapter.
- Hook the safety chains around the rear axle and connect to the rear tow shackles or safety chain loop on the wrecker.

- Install the air lines and tow lights. Leave sufficient slack in the safety chains to allow for turns.
- Install the tow lights. Check the rigging.
- Raise the vehicle so the rear wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Warnings and Cautions

Warnings:

- If the brakes of the disabled vehicle are inoperable, do not flat tow the disabled vehicle. Call for wrecker support. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- When using a wrecker to tow a vehicle with nonfunctional brakes, use extreme caution and reduce speed accordingly. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not move the towing vehicle without assistance from a ground guide. The ground guide must be visible to the operator at all times. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.
- When towing, ensure that all personnel are clear of the vehicle before removing the wheel chocks. Use reasonable speeds for road conditions and caution when making turns. Prior to disconnecting the towbar, ensure that the vehicle is on a level surface with the wheels chocked. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- The maximum speed limit when towing is 15 miles per hour (mph) (24 kilometers [km] per hour). Terrain, weather, and other conditions may require reduced speed; avoid sharp turns. On paved roads, speed may be increased to 25 mph if conditions permit. Failure to comply may result in damage to equipment or serious injury or death to personnel.

Caution: Lift towing of the MRAP vehicle from the rear should be performed only under emergency conditions and when approved by the commander.

BAE-TVS Caiman

Figure A-10

General Information and Equipment Description

Due to the unique design of the BAE-TVS Caiman MRAP vehicle, recovery personnel face several challenges when attempting to recover these systems. These challenges include size, weight, route clearance, and design issues.

The intent of this section is to provide procedures for recovering disabled vehicles in emergency situations. These procedures were developed during LFT&E events at Aberdeen and Yuma Proving Grounds.

IMPORTANT NOTICE

Due to design, towing provisions may differ from vehicle to vehicle. Validate procedures in training prior to actual recovery missions.

Vehicle	Crew	Overall Length	Overall Width	Overall Height	VCW	GVW
BAE-TVS Caiman	10	337 in.	94.5 in.	112 in. 139 in. with GPK	44,000 lb.	48,000 lb.

Table A-2: BAE-TVS Caiman Vehicle Data

Recovery Procedures

Like-vehicle recovery

Like-vehicle towing must be accomplished using a vehicle of equal or greater weight.

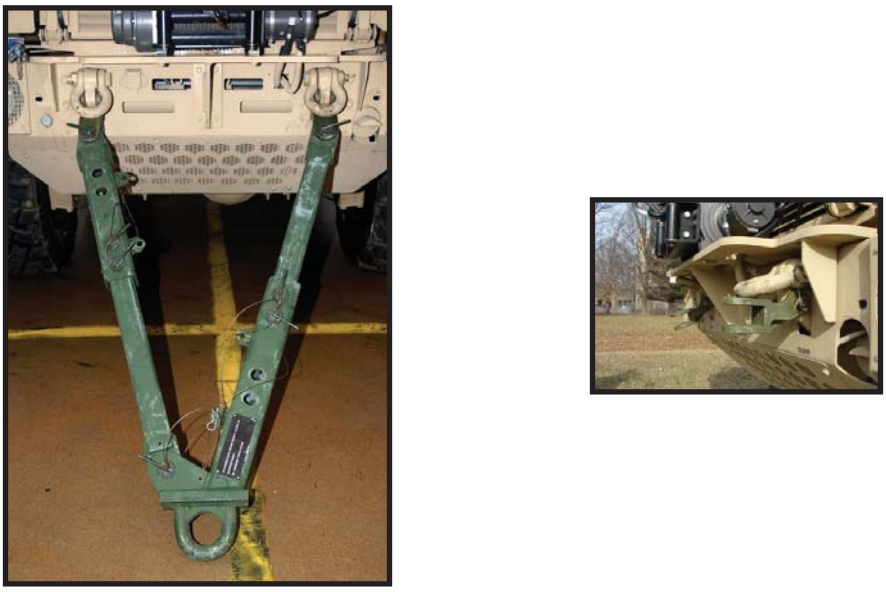

Figure A-11: USMC MTVR towbar (NSN 2350-01-496-8356) and adapter (NSN 2350-01-520-6358)

Figure A-12: U.S. Army heavy duty towbar (NSN 2540-01-267-2912) and adapter (NSN 2540-00-863-3153)

Figure A-13: BAE-TVS Caiman connected to a U.S. Army heavy duty towbar

Notes: (1) If using the MTVR towbar, it must be fully extended. (2) If using the BAE-TVS Caiman as a primary mover, remove the rear step.

WARNING

Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

Towbar connections:

- Remove the front winch bumper cover. Install the towbar (refer to figures A-11 or A-12).
- Install the air lines, electrical cable(s), safety pins, and safety chains. Leave sufficient slack in the safety chains to allow for turns. The like-vehicle tow pintle may vary in height; the winch mount plate causes pinching/interference with the towbar adapter or the safety chain. Recommend removing the top shackles of the vehicle tow lugs and route safety chains around the frame or front axle. The 24-volt receptacle provision for the IV cable is presently used by the winch.
- Install the tow lights.
- Turn the master power switch to the “ON” position. Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle. If the air supply on the casualty vehicle will not hold air, call for wrecker support.
- Push in the parking brake control on the disabled vehicle.

- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, front lift tow

Figure A-14: HEMTT/MTVR wrecker front lift tow with MUAs

Note: If the casualty vehicle has no air pressure, the rear brakes will need to be caged.

Procedures:

- Install the appropriate retrieval system adapters (refer to figures A-15 or A-16). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle and connect the retrieval system to the disabled vehicle. If using MUAs, use 1 in. pin hole number 2.
- Route the chains around the front axle and connect to the hook on the adapter.

WARNING

Vehicles with catastrophic damage to the front axle and suspension may require the axle to be properly secured to the chassis for safe recovery of the vehicle. Never attach safety chains to axles or suspension components that are no longer physically attached to the vehicle. Never cross the safety chains.

Figure A-15: HEMTT/MTVR wrecker front lift tow with HEMTT BII adapter F (NSN 2590-01-226-3351 [L] and NSN 2590-01-226-3350 [R])

Figure A-16: HEMTT/MTVR wrecker front lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

- Hook the safety chain around the frame or front axle and connect to the rear tow shackles or the safety chain loop on the wrecker. Ensure there is sufficient slack in the safety chains to allow for turns.
- Install the air lines, electrical cable(s), and safety pins.
- Install the tow lights. Check the rigging.
- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle.

- Push in the parking brake control on the disabled vehicle.
- Raise the vehicle so the front wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, rear tow lift

Figure A-17: HEMTT/MTVR wrecker rear lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

Figure A-18: HEMTT/MTVR wrecker rear lift tow with HEMTT BII adapter F (NSN 2590-01-226-3351 [L] and NSN 2540-01-226-3350 [R])

WARNING

Recovering this vehicle from the rear should be performed only in emergency combat situations and with the commander's approval. Decrease speeds, and be extremely cautious.

Procedures:

Note: To connect the adapters to the tow lugs, the tow pintle must be removed.

- Straighten and secure the steering wheel before towing.
- Install the appropriate retrieval system adapters (refer to figures A-17 or A-18). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle. Connect the retrieval system MUAs using a 1 in. pin through hole number 2 and connect to the rear tow lugs of the disabled vehicle.
- Route chains around the rear axle and connect to the hook on the adapter.
- Hook safety chains around the rear axle and connect to the rear tow shackles or the safety chain loop on the wrecker.
- Leave sufficient slack in the safety chains to allow for turns.
- Install the tow lights. Check the rigging.
- Raise the vehicle so the rear wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Warnings and Cautions

Warnings:

- If the brakes of the disabled vehicle are inoperable, do not flat tow the disabled vehicle. Call for wrecker support. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- When using a wrecker to tow a vehicle with nonfunctional brakes, use extreme caution and reduce speed accordingly. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not move the towing vehicle without assistance from a ground guide. The ground guide must be visible to the operator at all times. Failure to

comply may result in damage to equipment or serious injury or death to personnel.

- Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

- When towing, ensure that all personnel are clear of the vehicle before removing the wheel chocks and starting vehicle towing. Use reasonable speeds for road conditions and caution when making turns. Prior to disconnecting the towbar, ensure that the vehicle is on a level surface with the wheels chocked. Failure to comply may result in damage to equipment or serious injury or death to personnel.

- The maximum speed limit when towing is 15 mph (24 km/h). Terrain, weather, and other conditions may require reduced speed; avoid sharp turns. On paved roads, speed may be increased to 25 mph if conditions permit. Failure to comply may result in damage to equipment or serious injury or death to personnel.

Caution: Lift towing of the MRAP vehicle from the rear should be performed only under emergency conditions and when approved by the commander.

FPI Cougar 4X4 and FPI Cougar 6X6

Figure A-19: FPI Cougar 4X4

Figure A-20: FPI Cougar 6X6

General Information and Equipment Description

Due to the unique design of the FPI Cougar CAT I and CAT II MRAP vehicles, recovery personnel face several challenges when attempting to recover these systems. These challenges include size, weight, route clearance, and design issues.

The intent of this section is to provide procedures for recovering disabled vehicles in emergency situations. These procedures were developed during LFT&E events at Aberdeen and Yuma Proving Grounds.

IMPORTANT NOTICE

Due to design, towing provisions may differ from vehicle to vehicle. Validate procedures in training prior to actual recovery missions.

Vehicle	Crew	Overall Length	Overall Width	Overall Height	VCW	GVW
Force Protection 4X4	6	233 in.	102 in.	104 in.	32,000 lb.	38,000 lb.
				130 in. with GPK		
Force Protection 6X6	8	245 in.	105.5 in.	95 in.	40,000 lb.	52,000 lb.
				106.5 in. with GPK		

Table A-3: Cougar Vehicle Data

Recovery Procedures

Like-vehicle recovery

Like-vehicle towing must be accomplished using a vehicle of equal or greater weight.

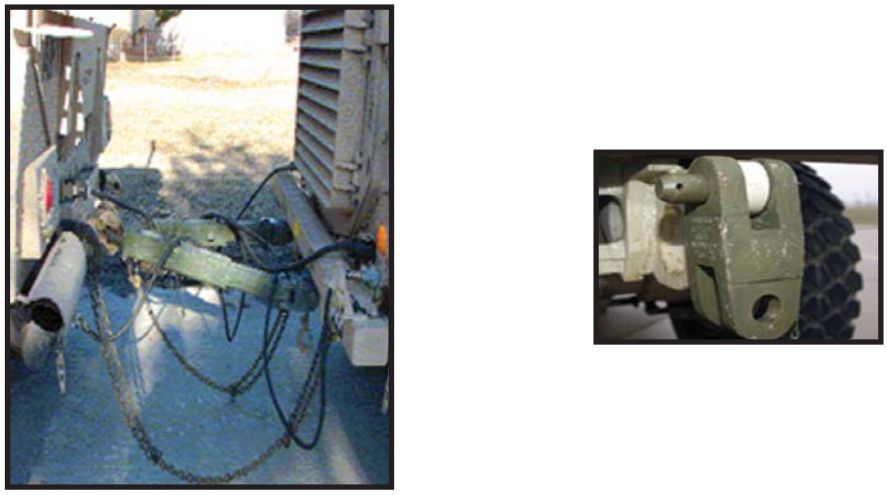

Figure A-21: USMC MTVR towbar (NSN 2350-01-496-8356) and adapter (NSN 2540-01-500-5325)

Figure A-22: U.S. Army heavy duty towbar (NSN 2540-01-267-2912) and adapter (NSN 5340-01-267-2908)

Figure A-23: Cougar modified front tow lug, 1.5 in. thick lug and 1.5 in. pin diameter

Note: If using the MTVR towbar, it must be fully extended.

WARNING

Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

Towbar connections:

- Install the towbar (refer to figures A-21 or A-22).
- Install the air lines, electrical cable(s), safety pins, and safety chains. Leave sufficient slack in the safety chains to allow for turns.
- Install the tow lights.
- Turn the master power switch to the “ON” position. Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
    - The manual neutral override is an alternate method to shift the transfer case to neutral. The switches are accessible by removing the cover between the driver and the passenger.
        - Remove the two Allen-head plugs located on the low/high cylinder switch and on the neutral shift cylinder switch.
        - Remove the two 9/16 cage bolts mounted on the low/high cylinder switch side.
        - Install one caging bolt in the low/high cylinder switch and one caging bolt in the neutral cylinder switch and tighten until the piston bottoms out (do not force or over tighten).
    - The neutral switch will indicate neutral engagement.
- Push in the trailer air supply control on the recovery vehicle. If the air supply on the casualty vehicle will not hold air, call for wrecker support.
- Push in the parking brake control on the disabled vehicle.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, front lift tow

Note: If the casualty vehicle has no air pressure, the rear brakes will need to be caged.

Procedures:

- Install the appropriate retrieval system adapters (refer to figures A-24 or A-25). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.

- Using ground guides, slowly back the recovery vehicle and connect the retrieval system to the disabled vehicle. If using MUAs, use pin hole number 4.
- Route the chains around the front axle and connect to the hook on the adapter.

Figure A-24: HEMTT/MTVR wrecker front lift tow with HEMTT BII adapter D (NSN 2590-01-226-3349 [L] and NSN 2540-01-226-7139 [R])

Figure A-25: HEMTT/MTVR wrecker front lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

WARNING

Vehicles with catastrophic damage to the front axle and suspension may require the axle to be properly secured to the chassis for safe recovery of the vehicle. Never attach safety chains to axles or suspension components that are no longer physically attached to the vehicle. Never cross the safety chains.

- Hook the safety chain around the frame or front axle and connect to the rear tow shackles or the safety chain loop on the wrecker. Ensure there is sufficient slack in the safety chains to allow for turns.
- Install the air lines, electrical cable(s), and safety pins.
- Install the tow lights. Check the rigging.
- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle.
- Push in the parking brake control on the disabled vehicle.
- Raise the vehicle so the front wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, rear lift tow

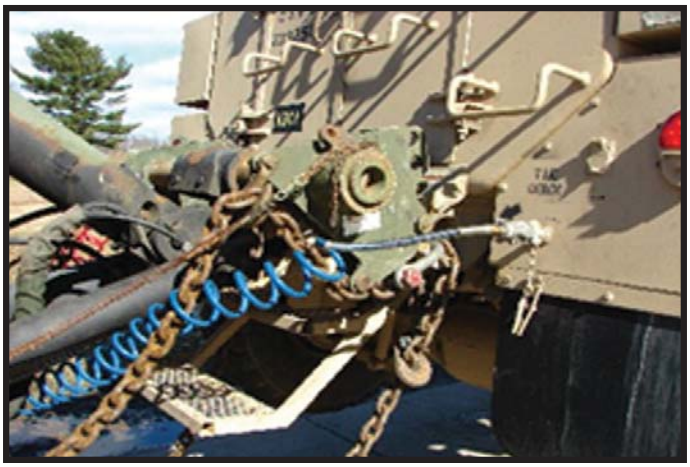

Figure A-26: HEMTT/MTVR wrecker rear lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

Figure A-27: HEMTT wrecker BII adapter D (NSN 2590-01-226-3349 [L] and NSN 2540-01-226-7139 [R])

WARNING

Recovering this vehicle from the rear should be performed only in emergency combat situations and with the commander's approval. Decrease speeds and be extremely cautious.

WARNING

Do not use the MTVR wrecker to rear lift tow the FPI CAT I and CAT II; the vehicle exceeds the retrieval system lift capacity.

Procedures:

- Straighten and secure the steering wheel before towing.
- Install the appropriate retrieval system adapters (refer to figures A-26 or A-27). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle. Connect the retrieval system MUAs using a 1 1/2 in. pin through hole number 4 and connect to the rear tow lugs of the disabled vehicle.
- Route the chains around the rear axle and connect to the hook on the adapter.
- Hook the safety chains around the rear axle and connect to the rear tow shackles or the safety chain loop on the wrecker.
- Leave sufficient slack in the safety chains to allow for turns.

- Install the tow lights. Check the rigging.
- Raise the vehicle so the rear wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Warnings and Cautions

Warnings:

- If the brakes of the disabled vehicle are inoperable, do not flat tow the disabled vehicle. Call for wrecker support. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- When using a wrecker to tow a vehicle with nonfunctional brakes, use extreme caution and reduce speed accordingly. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not move the towing vehicle without assistance from a ground guide. The ground guide must be visible to the operator at all times. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.
- When towing, ensure that all personnel are clear of the vehicle before removing the wheel chocks and starting vehicle towing. Use reasonable speeds for road conditions and caution when making turns. Prior to disconnecting the towbar, ensure that the vehicle is on a level surface with the wheels chocked. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- The maximum speed limit when towing is 15 mph (24 km/h). Terrain, weather, and other conditions may require reduced speed; avoid sharp turns. On paved roads, speed may be increased to 25 mph if conditions permit. Failure to comply may result in damage to equipment or serious injury or death to personnel.

Caution: Lift towing of the MRAP vehicle from the rear should be performed only under emergency conditions and when approved by the commander.

IMG MaxxPro

Figure A-28

General Information and Equipment Description

Due to the unique design of the IMG MaxxPro MRAP vehicle, recovery personnel face several challenges when attempting to recover these systems. These challenges include size, weight, route clearance, and design issues.

The intent of this section is to provide procedures for recovering disabled vehicles in emergency situations. These procedures were developed during LFT&E events at Aberdeen and Yuma Proving Grounds.

IMPORTANT NOTICE

Due to design, towing provisions may differ from vehicle to vehicle. Validate procedures in training prior to actual recovery missions.

Vehicle	Crew	Overall Length	Overall Width	Overall Height	VCW	GVW
IMG MaxxPro	6	260 in.	120 in.	112 in. 159 in. with GPK	32,000 lb.	41,600 lb.

Table A-4: IMG Vehicle Data

Recovery Procedures

Like-vehicle recovery

Like-vehicle towing must be accomplished using a vehicle of equal or greater weight.

Figure A-29: USMC MTVR towbar (NSN 2350-01-496-8356) and adapter (NSN 2530-01-520-6538)

Figure A-30: U.S. Army heavy duty towbar (NSN 2540-01-267-2912) and adapter (NSN 2540-00-863-3153)

WARNING

Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

Figure A-31: HEMTT wrecker flat towing IMG MaxxPro with USMC MTVR towbar

Note: If using the MTVR towbar, it must be fully extended.

Towbar connections:

- Install the towbar (refer to figures A-29 or A-30).
- Install the air lines, electrical cable(s), safety pins, and safety chains. Leave sufficient slack in the safety chains to allow for turns.
- Install the tow lights.
- Turn the master power switch to the "ON" position. Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle. If the air supply on the casualty vehicle will not hold air, call for wrecker support.
- Push in the parking brake control on the disabled vehicle.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, front lift tow

Note: If the casualty vehicle has no air pressure, the rear brakes will need to be caged.

Figure A-32: HEMTT/MTVR wrecker front lift towing IMG MaxxPro

Procedures:

- Install the appropriate retrieval system adapters (refer to figures A-33 or A-34). Using cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle and connect the retrieval system to the disabled vehicle. If using MUAs, use pin hole number 2.
- Route the chains around the front axle and connect to the hook on the adapter.

Figure A-33: HEMTT wrecker BII adapter F (NSN 2590-01-226-3351 [L] and NSN 2590-01-226-3350 [R])

Figure A-34: HEMTT/MTVR wrecker with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

WARNING

Vehicles with catastrophic damage to the front axle and suspension may require the axle to be properly secured to the chassis for safe recovery of the vehicle. Never attach safety chains to axles or suspension components that are no longer physically attached to the vehicle. Never cross the safety chains.

- Hook the safety chain around the frame or front axle and connect to the rear tow shackles or the safety chain loop on the wrecker. Ensure there is sufficient slack in the safety chains to allow for turns.
- Install the air lines, electrical cable(s), and safety pins.
- Install the tow lights. Check the rigging.
- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle.
- Push in the parking brake control on the disabled vehicle.
- Raise the vehicle so the front wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, rear lift tow

Figure A-35: HEMTT/MTVR wrecker rear lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

Figure A-36: HEMTT wrecker BII adapter D (NSN 2590-01-226-3349 [L] and NSN 2540-01-226-7139 [R])

WARNING

Recovering this vehicle from the rear should be performed only in emergency combat situations and with the commander's approval. The lack of rear lift tow provisions requires improvised rigging, which decreases the stability of the vehicle. Decrease speeds, and be extremely cautious.

WARNING

Do not use the MTVR wrecker to rear lift tow the IMG; the vehicle exceeds the retrieval system lift capacity.

Procedures:

- Straighten and secure the steering wheel before towing.
- Install the appropriate retrieval system adapters (refer to figures A-35 or A-36). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle. Connect the retrieval system MUA adapters using 1 1/2 in. pins through hole number 6 and the 3 1/2 in. tie down holes of the disabled vehicle.
- Route the chains around the rear axle and connect to the hook on the adapter.
- Hook safety chains around the rear axle and connect to the rear tow shackles or the safety chain loop on the wrecker.
- Leave sufficient slack in the safety chains to allow for turns.
- Install the tow lights. Check the rigging.
- Raise the vehicle so the rear wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Warnings and Cautions

Warnings:

- If the brakes of the disabled vehicle are inoperable, do not flat tow the disabled vehicle. Call for wrecker support. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- When using a wrecker to tow a vehicle with nonfunctional brakes, use extreme caution and reduce speed accordingly. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not move the towing vehicle without assistance from a ground guide. The ground guide must be visible to the operator at all times. Failure to comply may result in damage to equipment or serious injury or death to personnel.

- Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

- When towing, ensure that all personnel are clear of the vehicle before removing the wheel chocks and starting vehicle towing. Use reasonable speed for road conditions and caution when making turns. Prior to disconnecting the towbar, ensure that the vehicle is on a level surface with the wheels chocked. Failure to comply may result in damage to equipment or serious injury or death to personnel.

- The maximum speed limit when towing is 15 mph (24 km/h). Terrain, weather, and other conditions may require reduced speed; avoid sharp turns. On paved roads, speed may be increased to 25 mph if conditions permit. Failure to comply may result in damage to equipment or serious injury or death to personnel.

Caution: Lift towing of the MRAP vehicle from the rear should be performed only under emergency conditions and when approved by the commander.

GDLS RG-31

Figure A-37

General Information and Equipment Description

Due to the unique design of the GDLS MRAP vehicle, recovery personnel face several challenges when attempting to recover these systems. These challenges include size, weight, route clearance and design issues which may affect recovery efforts.

The intent of this section is to provide procedures for recovering disabled vehicles in emergency situations. These procedures were developed during LFT&E events at Aberdeen and Yuma Proving Grounds.

IMPORTANT NOTICE

Due to design, towing provisions may differ from vehicle to vehicle. Validate procedures in training prior to actual recovery missions.

Vehicle	Crew	Overall Length	Overall Width	Overall Height	VCW	GVW
GDLS RG31 MK5E 4X4	10	268 in.	98 in.	107 in. 134 in. with GPK	26,896 lb.	31,305 lb.

Table A-5: GDLS Vehicle Data

Recovery Procedures

Like-vehicle recovery

Like-vehicle towing must be accomplished using towing vehicle of equal or greater weight than the towed vehicle.

Note: Older vehicle tow lugs have pin holes less than 1 1/2 in. in diameter. Newer version vehicles are designed with 1 1/2 in. tow lug diameters. If the vehicle front tow lug diameter is less than 1 1/2 in., use shackle bolt (NSN 4030-01-187-0964) or use adapter (NSN 2540-00-863-3153), which uses a 1 in. pin.

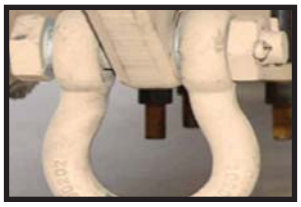

Figure A-38: Shackle bolt (NSN 4030-01-187-0964) and adapter (NSN 2540-00-863-3153)

Figure A-39: U.S. Army heavy duty tow bar (NSN 2540-01-267-2912) and adapter (NSN 5340-01-267-2908) and shackle pin

Figure A-40: USMC MTVR tow bar (NSN 2350-01-496-8356) and adapter (NSN 2540-01-500-5325) and shackle pin

Figure A-41: GDLS connected to a U.S. Army heavy duty tow bar

WARNING

Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.

Tow bar connections:

- Install the towbar (refer to figures A-38 or A-41).
- Install the air lines, electrical cable(s) or tow lights, safety pins, and safety chains. Leave sufficient slack in the safety chains to allow for turns.

- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle. If the air supply on the casualty vehicle will not hold air, call for wrecker support.
- Lift up and down on the parking brake control level on the disabled vehicle.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, front lift tow

Figure A-42: HEMTT wrecker lift towing GDLS

Note: If the casualty vehicle has no air pressure, the rear brakes will need to be caged.

Procedures:

- Install the appropriate retrieval system adapters (refer to figures A-43 or A-44). Using the cylinder controls, lower the cross tube to approximately 3 feet off the ground.
- Using ground guides, slowly back the recovery vehicle and connect the retrieval system to the disabled vehicle. If using MUAs, use 1 1/2 in. pin hole number 6 or HEMTT BII adapter D or F.
- Route chains around the front axle and connect to the hook on the appropriate adapter.

Figure A-43: HEMTT/MTVR wrecker front lift tow with HEMTT BII adapter D or F (NSN 2590-01-226-3349 [L] and NSN 2540-01-226-7139 [R])

Figure A-44: HEMTT/MTVR wrecker front lift tow with MUAs (NSN 5340-01-516-2058 [L] and NSN 5340-01-516-2059 [R])

WARNING

Vehicles with catastrophic damage to the front axle and suspension may require the axle to be properly secured to the chassis for safe recovery of the vehicle. Never attach safety chains to axles or suspension components that are no longer physically attached to the vehicle. Never cross the safety chains.

- Hook the safety chain around the frame or front axle and connect to the rear tow shackles or the safety chain loop on the wrecker. Ensure sufficient slack in the safety chains to allow for turns.
- Install the air lines, electrical cable(s) or tow lights, and safety pins.
- Check the rigging.
- Place the transfer case in neutral. The drive shaft must be removed if the transfer case will not shift into neutral.
- Push in the trailer air supply control on the recovery vehicle.
- Lift up and pull down on the parking brake control level on the disabled vehicle.
- Raise the vehicle so the front wheels are 6 to 12 inches above the ground, depending on terrain.
- Recheck the towing connections, air lines, and chains.
- Tow the disabled vehicle. Use speeds appropriate for conditions, and avoid sharp turns.

Dedicated recovery, rear lift tow

Note: Rear lift tow is not recommend because of interference with adapters and tow cylinders.

Warnings

- If the brakes of the disabled vehicle are inoperable, do not flat tow the disabled vehicle. Call for wrecker support. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- When using a wrecker to tow a vehicle with nonfunctional brakes, use extreme caution and reduce speed accordingly. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not move the towing vehicle without assistance from a ground guide. The ground guide must be visible to the operator at all times. Failure to comply may result in damage to equipment or serious injury or death to personnel.
- Do not put hands near the pintle hook when aligning the lunette eye with the pintle hook. Failure to comply may result in serious injury or death to personnel.
- When towing, ensure that all personnel are clear of the vehicle before removing the wheel chocks and starting vehicle towing. Use reasonable speeds for road conditions and caution when making turns. Prior to disconnecting the towbar, ensure that the vehicle is on a level surface

with the wheels chocked. Failure to comply may result in damage to equipment or serious injury or death to personnel.

- The maximum speed limit when towing is 15 miles per hour (mph) (24 kilometers [km] per hour). Terrain, weather, and other conditions may require reduced speed; avoid sharp turns. On paved roads, speed may be increased to 25 mph if conditions permit. Failure to comply may result in damage to equipment or serious injury or death to personnel.

Equipment Data Tables

Model	GCWR	VCW	Max Flat Tow Weight	Under Lift
M984A2	114,000 lb.	50,900 lb.	63,100 lb.	25,000 lb.
MK 36	98,100 lb.	48,800 lb.	49,300 lb.	14,000 lb.

Table A-6: US Army/USMC Wreckers

Towbar NSN	Type	Adapter NSN	Towbar Capacity
2350-01-496-8356 USMC	MTVR Medium duty	2540-01-500-5325 7 ton up to 83,000 lb.	83,000 lb.
2540-01-267-2912 U.S. Army	V- type, light, medium, and heavy duty	5340-01-267-2908 10-50 ton medium duty	112,000 lb. M88A1 GVW
		2540-00-863-3153 2 ½-10 ton light duty	

Table A-7: Tow Bars and Adapters

Branch	Chain	Grade	NSN	Working Load Limit
U.S. Army M984A1, A2	Sling, Multiple Leg, 16 ft. 5/8 in.	80	3940-01-270-3389	20,300 lb.
	Chain Assembly, Single Leg, 14 ft. 5/8 in.	80	4010-01-249-0548	20,300 lb.
	Chain Assembly, Single Leg, 12 ft. 3/8 in.	40	4010-01-250-5428	5,400 lb.
USMC MK36	Chain, Welded, 14 ft. 5/8 in.	80	4010-01-516-2095	20,000 lb.
	Chain Assembly, Single Leg, 12 ft. 3/8 in.	40	4010-01-519-2777	5,400 lb.

Table A-8: Chain Working Load Limits

Illustrations

Figure A-45: USMC MTVR tow bar kit (NSN 2350-01-496-8356)

Figure A-46: U.S. Army heavy duty tow bar (NSN 2540-01-267-2912)

Figure A-47: LVS tow bar (NSN 2540-01-183-4497)

MRAP Flat Tow Recovery

Vehicle Type	Tow Bars	Tow Bar Adapters	Primary Mover with Heavy Duty Tow Bar	Primary Mover with MTVR Tow Bar	Primary Mover with LVS Tow Bar
BAE Systems RG33L 6X6 **48,940 lb.**	**Heavy Duty Tow Bar**	2.5 to 10 ton	HEMTT Wrecker	MTVR Wrecker	LVS Wrecker
	2540-01-267-2912	2540-00-863-3153	BAE CAT II		
	MTVR				
	2350-01-496-8356				
	LVS				
	2540-01-183-4497				
Force Protection Cougar 6X6 48,860 lb.	**Heavy Duty Tow Bar**	10-50 ton	HEMTT Wrecker	MTVR Wrecker	LVS Wrecker
	2540-01-267-2912	5340-01-267-2908	FPI CAT II	HEMTT Wrecker	HEMTT Wrecker
	MTVR	7 ton to 83,000 lb.	BAE CAT II	FPI CAT II	FPI CAT II
	2350-01-496-8356	2540-01-500-5325		BAE CAT II	
	LVS	Clevis, rod end			
	2540-01-183-4497	5340-01-227-3521			
BAE-TVS Caiman 6X6 46,210 lb.	**Heavy Duty Tow Bar**	2.5 to 10 ton	HEMTT Wrecker	MTVR Wrecker	LVS Wrecker
	2540-01-267-2912	2540-00-863-3153	BAE-TVS	HEMTT Wrecker	BAE-TVS
	MTVR	M809/939 to 78,000 lb.	FPI CAT II	BAE-TVS	FPI CAT II
	2350-01-496-8356	2530-01-520-6358	BAE CAT II	FPI CAT II	
	LVS			BAE CAT II	
	2540-01-183-4497				

International IMG MaxxPro 41,600 lb.	**Heavy Duty Tow Bar**	2.5 to 10 ton	HEMTT Wrecker	MTVR Wrecker	LVS Wrecker
	2540-01-267-2912	2540-00-863-3153	BAE-TVS	HEMTT Wrecker	HEMTT Wrecker
	MTVR	M809/939 to 78,000 lb.	FPI CAT II	BAE-TVS	BAE-TVS
	2350-01-496-8356	2530-01-520-6538	IMG	FPI CAT II	FPI CAT II
	LVS		BAE CAT II	IMG	IMG
	2540-01-183-4497			BAE CAT II	BAE CAT II
Force Protection Cougar 4X4 36,100 lb.	**Heavy Duty Tow Bar**	10-50 ton	HEMTT Wrecker	MTVR Wrecker	LVS Wrecker
	2540-01-267-2912	5340-01-267-2908	BAE-TVS	HEMTT Wrecker	HEMTT Wrecker
	MTVR	7 ton to 83,000 lb.	FPI CAT I	BAE-TVS	BAE-TVS
	2350-01-496-8356	2540-01-500-5325	FPI CAT II	FPI CAT I	FPI CAT I
	LVS	Clevis, rod end	IMG	FPI CAT II	FPI CAT II
	2540-01-183-4497	5340-01-227-3521	BAE CAT I	IMG	IMG
			BAE CAT II	BAE CAT I	
				BAE CAT II	
General Dynamics RG31E 35,640 lb.	**Heavy Duty Tow Bar**	10-50 ton	HEMTT Wrecker	MTVR Wrecker	LVS Wrecker
	2540-01-267-2912	5340-01-267-2908	BAE-TVS	HEMTT Wrecker	HEMTT Wrecker
	MTVR	7 ton to 83,000 lb.	FPI CAT I	BAE-TVS	BAE-TVS
	2350-01-496-8356	2540-01-500-5325	FPI CAT II	FPI CAT I	FPI CAT I
	LVS	Clevis, rod end	GDLS	FPI CAT II	FPI CAT II
	2540-01-183-4497	5340-01-227-3521	IMG	GDLS	GDLS
			BAE CAT I	IMG	IMG
			BAE CAT II	BAE CAT I	BAE CAT I
				BAE CAT II	BAE CAT II

References

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FM 21-305, *Manual for the Wheeled Vehicle Driver*

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Training Circular 43-35, *Recovery and Training*

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TM 9-2320-279-10-2, M977 Series, *8x8 Heavy Expanded Mobility Tactical Trucks HEMTT*

TM 9-2355-106-10, *Operator Manual Commercial Off-the-Shelf (COTS) for International Mine Resistant Vehicle*

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TM 9-2355-108-10, *BAE RG33 and RG33L Operator Manual COTS*

TM 10001620, *Force Protection Industries, Inc. MRAP 4x4*

TM 10001625, *Force Protection Industries, Inc. MRAP 6x6*

TM 10633A-10A, *Truck, Wrecker, 7-Ton, MK 36*

TM 10867B-12&P, *Operator Manual for Medium Duty Towbar Kit (USMC)*

Appendix B-1

Rollover/Egress Procedures

The following information is taken from GTA 07-09-001: Mine Resistant Ambush Protected (MRAP) Family of Vehicles Emergency Rollover/Egress Procedures (proponent: U.S. Army Infantry School, Fort Benning, GA, May 2008).

Road Rollover/Egress Emergency Procedures

WARNING

Never attempt to leap from a rolling vehicle. It may roll over you. Ensure that the vehicle has stopped its roll before moving. Upon complete evacuation of all personnel, vehicle should be inspected for fire hazards such as leaking oil, fuel, and hydraulic fluid. Use the portable fire extinguisher when inspecting vehicle for leaks in case of fire, which could cause injury or death. If hazardous/explosive materials are involved, driver should take actions according to the DD Form 836 accompanying load. Notify emergency response personnel and remain at a safe evacuation distance (as determined by the commander on the ground) while securing accident site.

WARNING

Operating on single-lane and or steeply crowned rural roads, roads with no shoulders, roads with soft shoulders, and/or washouts around culverts, and especially any road bordering water (canal irrigation ditch/ponds) requires extreme caution. The majority of MRAP vehicle rollovers are due to the road/shoulder/bridge approach giving way under the MRAP vehicle's weight and high center of gravity.

Preventive measures:

- **Wear seatbelts.** Survive the rollover!
- **Watch for soft soil on shoulders.** Soft shoulders are prevalent after rain. When an MRAP vehicle goes off a road, it can overturn when it strikes a ditch or embankment or is tripped by soft soil. If you drive off the roadway, gradually reduce speed. Ease your vehicle back onto the roadway at a safe speed.
- **Slow down.** As the MRAP vehicle's speed increases, the centrifugal force or sideways force increases. Faster speeds also result in decreased driver response times. When maneuvering through curves or sudden traffic situations, an MRAP vehicle with a high center of gravity can easily turn over. Watch out for sharp curves or steep slopes (greater than 50 percent up/down slope and 30 percent side slope) that generate centrifugal forces, increasing the chance of rollover.

- **Avoid panic.** Many rollovers occur when the driver panics and jerks the steering wheel during an emergency. Jerking the steering wheel can cause loss of vehicle control.

- **Keep the vehicle center of gravity low.** The height of a vehicle's center of gravity and the length of the wheelbase determine the vehicle's stability. Load and secure heavier items low in the MRAP vehicle.

- **Load security.** All equipment inside the MRAP vehicle must be secured in accordance with the vehicle's and/or unit's load plan. Unsecured loads can become deadly projectiles. Improperly secured loads can change a vehicle's center of gravity and its stability.

- **Condition and prepare vehicle.** It is critical that the MRAP vehicle is in good operating condition before starting your mission. Pay particular attention to tire condition and air pressure. Worn and improperly inflated tires increase risk of rollover. Properly performed preventive maintenance checks and services is the best way to control this potential hazard.

Key points:

- **Egress rehearsal.** Rehearse vehicle evacuation as if only one exit is available.

- **Communication with the driver.** Work as a team and inform the driver of hazards such as road obstacles, pot holes, and soft shoulder roads. The gunner is often in a good position to alert the driver of potential road hazards. Use a ground guide whenever possible due to the vehicle's restricted visibility.

- **Combat door locks.** They are designed to keep the enemy out. When locked, they also make it extremely difficult for rescuers to enter the vehicle!

- **Locking doors.** Combat locks help keep the doors closed during an accident or combat action. Leaders must decide (based on the enemy situation) whether or not to keep the doors locked when operating near bodies of water. Know the locations of your combat door lock keys in each MRAP vehicle. If you have other types of MRAP vehicles in your patrol, have combat door lock keys for those as well.

Work as a team

There are multiple hatch locations, types, and operational configurations within the MRAP family of vehicles. Ensure all personnel fully understand the associated vehicle's egress points and operation and constantly rehearse egress drills as a team. Check your operator's manual for specific procedures for the various configurations and mission loads.

Communicate with the driver — tell the driver what is to the left, right rear, and overhead. Your gunner is your eyes and ears. The gunner may be the only crew member capable of seeing around the entire vehicle. Know your MRAP's dead space/blind spots. Overwatch and cover each other's dead space/blind spots.

Use the vehicle intercom system to pass visual information to the driver, but rehearse shouted voice commands and hand signals in case the intercom is inoperative.

Avoid hazards; use a ground guide whenever possible.

Rollover drill task steps and performance measures

All personnel in a seat or position with restraints will wear them!

1. Execute rollover drill:

- **Driver:**
    - Releases the accelerator.
    - Steers into direction of the roll.
    - Yells "Rollover, Rollover, Rollover!"
    - Keeps his hands on the steering wheel with extended and unlocked arms, tucks head and chin into chest, and braces for impact.
- **Vehicle commander:**
    - Yells "Rollover, Rollover, Rollover!"
    - Pulls gunner into cab (if applicable/able).
    - Tucks head and chin into chest and braces for impact.
    - Plants feet firmly on the floor while holding onto stationary object.
- **Gunner (if applicable):**
    - Yells "Rollover, Rollover, Rollover!"
    - Drops down from the hatch into the vehicle.
    - Tucks head and chin and braces for impact while holding onto stationary object.
- **Rear occupants or passengers:**
    - Yell "Rollover, Rollover, Rollover!"
    - Pull gunner into cab (if applicable/able).
    - Tuck heads and chins into chest and brace for impact.

- Plant feet firmly on the floor while holding onto stationary object.

2. After the rollover has stopped:

- Driver shuts down engine.
- Crew disconnects headsets.
- Crew releases seatbelts/restraints; uses caution if upside down.
- Crew unlocks combat door looks (if applicable). Exits vehicle.
- Assess injuries. (Address potential for post crash fire — if applicable.)
- Assist other personnel to exit and secure weapons.
- Establish security.
- Account for personnel.
- Provide first aid.
- Account for weapons, ammunition, and sensitive items.
- Assist in vehicle recovery.
- Report mishap to higher headquarters and request help and/or recovery as required.

Water Rollover/Egress Emergency Procedures

WARNING

Combat door locks on the MRAP family of vehicles keep the enemy out. When locked, they make it extremely difficult for rescuers to enter the vehicle. Commanders should determine when combat locks should be used when conducting operations near bodies of water. Combat/accident damage may also jam doors, making them impossible to open. If the doors cannot be opened and the vehicle is in water too deep to allow air in the vehicle, the likelihood of drowning is high. In this case, rescuers must immediately roll the vehicle on its side using all available means (tow straps, rope, winch cables, etc.) to gain access to the gunner's cupola Identify non-swimmers and assign them a buddy that is a swimmer. The body of water may be deep enough that you must swim to shore.

Preventive measures

When in the vicinity of water and tactical conditions permit:

- Reduce speed and stop vehicle.

- Inform all personnel that you are operating around potential water hazards.
- Conduct a risk assessment of the terrain and route before proceeding.
- Maintain secure seating position by wearing seatbelts.
- Unlock combat door locks, if enemy situation permits.
- Turn on filtered dome lights.

Rollover drill task steps and performance measures

All personnel in a seat or position with restraints will wear them!

1. Execute water egress drill: (when water entry is imminent)

- **Driver:**
  - Releases the accelerator.
  - Steers vehicle to control entry into water and to prevent rollover.
  - Yells "Water, Water, Water!"
  - Keeps his hands on the steering wheel with extended and unlocked arms, tucks head and chin into chest, and braces for impact.
- **Vehicle commander:**
  - Yells "Water, Water, Water!"
  - Pulls gunner into cab (if applicable/able).
  - Tucks head and chin into chest and braces for impact.
  - Plants feet firmly on the floor while holding onto stationary object.
- **Gunner (if applicable):**
  - Yells "Water, Water, Water!"
  - Drops down from the hatch into the vehicle.
  - Tucks head and chin and braces for impact while holding onto stationary object.

- **Crew:**
    - Yell “Water, Water, Water!”
    - Pull gunner into cab (if applicable/able).
    - Tuck heads and chins into chest and braces for impact.
    - Plant feet firmly on the floor while holding onto stationary object.

2. When the vehicle is stabilized:

- Driver shuts down engine.
- Crew disconnects headsets.
- Crew releases seatbelts/restraints; uses caution if upside down.
- Crew unlocks combat door locks (if applicable). Exits vehicle.
- Assess injuries.
- Assist other personnel to exit and secure weapons.
- Decide whether to remove load bearing equipment, body armor, and helmet.
- Get to safest shore.
- Establish security.
- Account for personnel.
- Provide first aid.
- Account for weapons, ammunition, and sensitive items.
- Assist in vehicle recovery.
- Report mishap to higher headquarters, and request help and/or recovery as required.

Water Rescue/Recovery

Water rescue drill task steps and performance procedures:

- Secure the accident site.
- Stay in contact with the vehicle, hold onto the vehicle, and kick/swim to high point in buddy teams.
- Rescuers tie a rope/cable to the vehicle to aid in rescue.

- Open doors and hatches.
- If door and hatches are not accessible, rescuers must immediately use all available means to turn the vehicle on its side to gain access to the gunner's cupola.
- Seek out the highest point on/in the vehicle.
- Ensure that all survivors have air and are able to breathe.
- Check for other injuries and apply first aid.
- Carefully move injured personnel to the highest point on the vehicle.
- Remove excess equipment, to include body armor, in deep water.
- Evacuate from vehicle high point to safest location, depending on:
    - º Enemy situation
    - º Water level and flow
    - º Water temperature
    - º Distance to water's edge
    - º Anticipation of rescue

MEDEVAC Request

Line 1: 6-digit unit training management (UTM) grid location of pickup site

Line 2: Radio frequency, call sign, and suffix of requesting personnel

Line 3: Number of patients by precedence: Urgent, Urgent-Surgery, Priority, Routine, and Convenience

A - Urgent (loss of life or limb within 2 hours)

B - Urgent Surgical (surgery required)

C - Priority (loss of life or limb within 4 hours)

D - Routine (evacuation within 24 hours)

E - Convenience (as assets are available)

Line 4: Special equipment required, as applicable: none, hoist, or stokes litter

Line 5: Number of patients by type: litter or ambulatory

Line 6: Security of pick-up site: determine possible or known threat in the area

Line 7: Method of marking pickup site: near, far, recognition devices

Line 8: Patient nationality and status: coalition military, U.S. contractor, enemy prisoner of war, etc.

Line 9: Terrain description

Report the Accident

An accident report is required by all service safety regulations. This report is different from the significant incident or activities reports which go through operations channels and should include the following:

- **Who:** Unit, individuals
- **What:** Accident or combat, date and time
- **Where:** 6-digit UTM grid
- **How:** What caused the rollover? Speed? Visibility? What was the cause of injury or death?
- **Follow up initial report with information regarding:**
    - Weather conditions
    - Were occupants wearing seatbelts?
    - Was fatigue a factor? Did occupants sleep prior to incident?
    - Was the driver able to see the hazard/other vehicle?
    - Was personal protective equipment (advanced combat helmet, body armor) worn by each occupant?
    - What was the level of operator training, experience, and license?
- **Complete appropriate service mishap report and forward to higher headquarters safety channels.**

Appendix B-2

Surviving Contact with High-Voltage Power Lines

Accidental contact (or close proximity) between a mine-resistant ambush-protected (MRAP) vehicle (especially its radio antennae) and high-voltage power lines can result in severe injury or death to vehicle occupants. The current (amperes) is the killing factor in electrical shock: at over four amps, tissue begins to burn, heart muscles clamp, and the heart stops beating. These events occur as a person's body provides a path for current flow (called gradient voltage/step potential and indicated by a tingling sensation felt in the feet), causing tissue damage and heart failure. Other injuries may include burns from the arc generated by accidental contact or close proximity.

When an energized line makes contact or arcs through the air from the power line through the MRAP vehicle to the ground, the earth becomes hot and the voltage dissipates in concentric rings away from the initial contact point. The power in the gradient voltage rings will vary based on soil composition and moisture content; there is no reliable way to tell how far the gradient voltage rings will emanate from the vehicle. Studies indicate gradient voltage extends from 10 meters in dry soil and up to 40 meters in wet soil.

Always keep in mind the following safety information:

- Always watch for overhead hazards like power lines, especially high-voltage lines.
- Always assume that overhead power lines have no have protective insulation, so any contact is dangerous.
- Work as a team: Soldiers should be on the lookout for possible contact between equipment and power lines.
- Nonmetallic materials can conduct electricity. These matrials include lumber, tree limbs, tires, and ropes.
- Electricity seeks one or multiple paths of least resistance, including passing through a person.
- Do not touch power lines.
- Stay away from fallen overhead wires. Report downed lines as a hazard to other units operating in the area.
- Plan a route using the most current trafficability and hazards map of the area of operations, if mission allows; avoid overhead power lines.

If the MRAP vehicle contacts a live power line (if tactical conditions allow):

- Stay in the vehicle until lines are disengaged or de-energized. Do not try to get out unless the vehicle is on fire.

- If able, disconnect from the power line. Back the vehicle away from the power line.
- A second vehicle should take steps to render the power lines safe. Get help from the power company (if possible). Make sure no one else approaches the vehicle.
- Do not leave the vehicle until the line is de-energized.

If the vehicle catches on fire, exit the vehicle carefully:

- Jump out of the vehicle. Do not worry about how far you jump, as long as you clear the vehicle.
- Be sure to land on both feet and keep your balance when you land. This factor is more important than how far away you jump.
- Do not touch anything with your hands (wires, vehicle, vegetation); use your hands for balance only.
- Keep both feet on the ground at all times. Hop away from the vehicle — be sure to keep both feet together. Keeping the feet together reduces the differences of gradients of voltage; use your hands for balance only.
- If you cannot hop, shuffle away (heel-to-toe) — and keep both feet on the ground at all times. Do not lift one foot off the ground to step forward. Instead, drag one foot forward keeping it in touch with the ground.
- Keep hopping or shuffling away until you get to where other people are standing safely or you do not have tingling in your feet.
- Do your 5-25-200 meter improvised explosive device-defeat checks, and set up security/cordon. Call for assistance.

Electrical Accidents

Rescue may pose as great a hazard for the rescuer as for the victim. Victims may be unable to move. Victims may be held to the circuit by muscles that have contracted. Victims must be rescued as soon as possible to survive. What action will you take when you find an electrical accident victim? Who will you call first? What tools or protective equipment will you need? What are your primary safety considerations? What will your first response be?

Electrical accident rescue techniques:

- Approach the accident scene cautiously. Never rush into an accident situation.
- Report the incident to higher as soon as possible.
- Get the aid of trained electrical personnel if possible.
- Examine the scene:

- Visually examine the victims to determine if they are in contact with energized conductors (metal surfaces, objects near the victim, or the earth itself may be energized).
- Do not touch the victim or conductive surfaces while they are energized.
- De-energize electrical circuits if possible — open a disconnecting device or circuit breaker to de-energize the fixed electrical equipment.
- Be alert for hazards such as stored energy, heated surfaces, and fire.

- If you cannot de-energize the power source, use extreme care:
  - Ensure that your hands and feet are dry.
  - Wear protective equipment such as low-voltage gloves and overshoes if available.
  - Stand on a clean dry surface if possible.
  - Use nonconductive material (shepherd's hook) to remove a victim from the conductor.

High-voltage rescue

Special training is required for rescues if high voltage is present:

- Wear protective equipment such as high-voltage gloves and overshoes.
- Use special insulated tools.
  - Use devices such as hot sticks or shotgun sticks to remove a victim from energized conductors.
  - In some cases, nonconductive rope or cord may be used to remove a victim from a conductor.
- Rescuing the victim:
  - Stand on a dry rubber blanket or other insulating material if possible.
  - Do not touch the victim or conductive material near the victim until the power is off.
  - Once power is off, examine the victim to determine if he should be moved.
  - Give first aid:

* A victim may require cardio-pulmonary resuscitation.
* If the victim is breathing and has a heartbeat, give first aid for injuries and treat for shock.
* Ensure the victim gets medical care as soon as possible.
* Provide medical personnel with information on voltage level, shock duration, and entry/exit points. The treating/attending physician must have detailed specific information to properly diagnose and care for the victim.
* Stay with the victim until help arrives.

Suggested equipment for electrical safety:

- Rubber gloves, 3,000 volts, sizes 9-12 (NSN 8415-01-158-449/9540/9451/9452)
- 25 ft. rope (NSN 4020-00-174-3031)
- Grounding stick
- Shepherd's hook

Electrical Arcs

(**Note:** The following information is extracted from the "Study Guide, Electrical Safety Hazards Awareness" provided by the Arizona Public Service Company.)

The current in high-voltage power lines can jump an air gap (depending on line voltage up to 13 feet) to the ground. Depending on a combination of atmospheric conditions—humidity, suspended particulate matter, and proximity of vehicle to the power line—a lightening-like arc will form between the vehicle (antennae) and the ground. If the vehicle continues to move away from the power line, the arc will cease. Damage can still occur that may disable the vehicle by blowing tires, setting off electrically primed ammunition, or causing other electrical malfunctions that may stop the vehicle within the arc-air gap distance, and current will continue to flow. This situation leads to the explosive effects known as electrical arc blasts.

In addition to an electrical shock and burns, another hazard to Soldiers is the blast effect that can result from arcing. If the current involved is great enough, these arcs can cause injury and start fires, explode tires, and set off electrically primed ordnance.

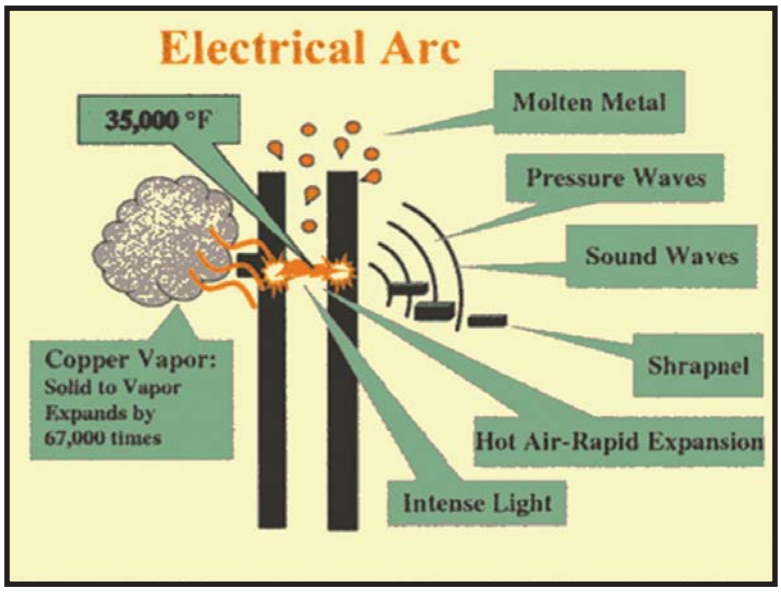

Figure B-2

Extremely high-energy arcs can damage equipment, causing fragmented metal to fly in all directions. Low-energy arcs can cause violent explosions or blasts in atmospheres containing explosive gases, vapors, or combustible dusts. The hot vaporized metal from the arc blast will combine with oxygen and become an oxide of the metal of the arc. These molten particles will stick to almost anything and actually melt into many surfaces. Clothing may ignite as a result of contact with this molten material, and a victim may receive serious burns. Also, your body has an instinctive reaction when you are suddenly startled to breathe in heavy or to gasp. Inhaling the hot vaporized particles will cause serious damage to your respiratory system by burning the lungs, throat, and esophagus.

The effects of an arcing fault, as seen in Figure B-2, can be devastating to an individual. The intense thermal energy released in a fraction of a second can cause severe burns. Molten metal is blown out and can burn skin or ignite flammable clothing. One of the major causes of serious burns and deaths to individuals is the ignition of flammable clothing due to an arcing fault. The tremendous pressure blast from the vaporization of conducting materials and superheating of air can fracture ribs, collapse lungs, and knock individuals off ladders or blow them across a room.

Appendix B-3

Necessary Precautions During Battlefield Vehicle Crew Rescue, Recovery, and Forensic Collection Efforts

In the event of a vehicle fire or combat damage, hazardous substances that require the use of protective measures remain in the vehicle/incident area. This appendix addresses protective measures needed to ensure that a safe and healthful environment is available for security, recovery, and forensic/investigation personnel.

Military vehicles are composed of advanced composite materials such as graphite, epoxies, plastics, Kevlar, wire insulation, and fiberglass. When a fire occurs during an accident or combat, fragmented composites, long-chain hydrocarbons, burned organic materials, and gases are generated. These composites include but are not limited to carbon monoxide, nitric oxides, sulfur dioxides, and hydrogen cyanide, as well as burned carbon/Kevlar/fiberglass fibers.

During rescue and recovery operations, biological hazards involving blood-borne pathogens may be present as well.

All of these substances pose potential health hazards to anyone close to or inside the combat damaged /burned-out vehicle. In the event of combat damage (with or without fire), be aware of sharp metal edges, sharp fragments, unexploded ordnance, and pulverized glass from ballistic windows (see section on ballistic glass on page 142).

Local emergency agencies serving an operational environment will most likely accomplish the fire fighting operations. The senior military person present assumes control of the area and ensures the following precautions are taken:

- Follow standing operating procedures (SOPs) to secure the area and accomplish the 5-25 checks. Minimize access for nonessential personnel to the site. Allow only rescue personnel to enter the immediate area until deemed safe.

- Set up a perimeter and restrict all unprotected personnel from assembling downwind of the wreckage. Cordon off the area and restrict entry to a single entry/exit point. In addition, restrict access to the immediate area where burnt composite fibers have been stirred or are currently being examined.

- If live munitions or explosives are involved, personnel will be restricted except those essential to effect immediate life-saving efforts. All other personnel will be restricted from entering the area until it has been cleared by the explosive ordnance disposal teams.

- Restrict recovery and investigative personnel from entering the site until they are equipped to prevent their exposure to body fluids, blood-borne pathogens, hazardous material, or airborne contaminants.

Personal Protection Equipment

Personnel required to access the wreckage site will be equipped and use personal protection equipment (PPE). This equipment will consist of a pair of heavy leather work gloves and the M40 protective mask (or in permissive environments an N-95 respirator for dust/particulate hazards) to provide adequate protection from airborne contaminates and fibers. A permissive environment constitutes a threat condition where maintenance/recovery operations may proceed, and access to guidance from an on-scene safety and health professional can provide definitive recommendations for respiratory protective equipment. All items of PPE will be worn when moving, handling, breaking, or ripping apart composite fiber components. Additional PPE will be used as appropriate.

Anyone handling compromised components will be equipped with and use an M40 protective mask (or when in permissive environments an N-95 respirator is adequate for dust/particulate hazards), eye protection, and leather gloves. All personnel involved should shower prior to going off duty or changing into a different set of clothing to help prevent the spread of airborne fibers and/or pulverized glass from the ballistic windows.

Transporting and Storing Damaged/Destroyed Vehicles

Storage of the damaged/destroyed vehicle will be at the discretion of the commander or SOP. Transportation requirements for recovering a fire-damaged/destroyed vehicle will be in accordance with the unit recovery SOP. The SOP should include the following measures to deal with the hazardous environment following a vehicle fire:

- The wreckage will be cordoned off and remain off limits to all personnel unless they are part of the accident investigation team or assigned to assist in recovery.
- The area will be cleared of all nonessential personnel prior to the wreckage entering the storage area.
- Essential personnel will wear a N95 respirator, safety eyeglasses with side shield, and leather gloves to prevent airborne contaminants and/or pulverized glass from entering the body.

A list of safety equipment is shown below:

Item	NSN
Leather Gloves	X-Small: 8415-01-394-0208
	Small: 8415-01-394-0209
	Medium: 8415-01-394-0210
	Large: 8415-01-394-0215
	X-Large: 8415-01-397-3937
Rubber Gloves	Size 8: 415-01-463-5927
	Size 9: 415-01-463-5934
	Size 10: 415-01-463-5928
Latex Gloves	8415-01-434-1781
Safety Goggles/Glasses	4240-01-292-2818
Dust Mask, High-Efficiency Respirators (N95 or better) (not for use near metal fires or organic material [paints, plastics, or composites] fires)	4240-01-463-5449
M40 Protective Gas Mask (Respirator)	4240-01-370-3822
Biohazard Bags	8105-01-148-0280
Garbage Bags	Light Duty 10 Gal: 8105-01-175-5533
	Light Duty: 37 Gal: 8105-00-579-8451
	Heavy Duty 25 Gal: 8105-01-183-9767
	Heavy Duty 59 Gal: 8105-01-221-3239
Bundle Ties	8135-00-846-8409
Footlocker	5140-00-226-9019
Coveralls, TYVEK	Small: 8415-00-L01-6122
	Med: 8415-00-L01-6123
	Large: 8415-00-L01-6124
Coveralls, TYVEK	XLarge: 8415-00-L01-6125
	2XLarge: 8415-00-L01-6126
	3XLarge: 8415-00-L01-6127
	4XLarge: 8415-00-L01-6128
	5XLarge: 8415-00-L01-6129

Table B-3

Ballistic Glass

(Note: The following information on the ballistic glass used in MRAP vehicles is taken from <http://www.autosafety.com/Ballistic%20Glass.htm>.)

The figure below shows a multilayer "sandwich," with the glass facing outside and the poly as the inner surface. As the projectile proceeds, the different layers act like a catcher's mitt in slowing down the round and then physically catching it in one of the layers. This is why B4 glass is typically 21-24-mm thick and B6 is 41-44-mm.

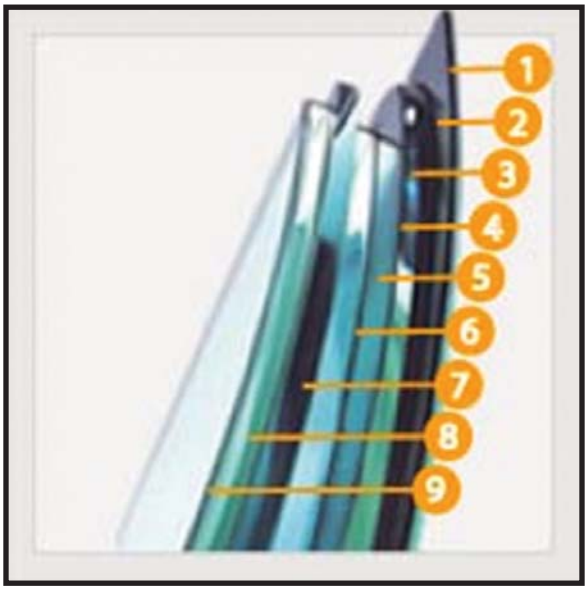

Figure B-3

Legend:
1. **Glass with ceramic frit:** This is the outer sheet of glass that looks very much like the original equipment glass in both shape and size.
2. **PVB:** This is the adhesive inner layer between sheets of glass.
3. **Glass**: Second sheet of glass.
4. **PVB:** This is the adhesive inner layer between sheets of glass.
5. **Glass:** Third sheet of glass.
6. **PVB:** This is the adhesive inner layer between sheets of glass.
7. **Glass:** Fourth and last sheet of glass. It is cut smaller and forms the channels that will interlock with a similar mating hard armor frame surrounding the door.
8. **Polyurethane:** This is the adhesive inner layer between glass and the polycarbonate, which acts as an anti-spall shield.
9. **Polycarbonate with abrasive resistant coating:** The polycarbonate acts as an anti-spall shield.

Appendix C

Warnings and Cautions Common to the Mine-Resistant Ambush-Protected Vehicle

The following warning messages from TM 9-2355-106-10, *Operator Manual Commercial Off-the-Shelf (COTS) for International Mine Resistant Vehicle,* provide information that can help prevent serious injury (loss of limb, hearing, or eyesight; burns; respiratory problems) or death to personnel, damage to vehicle components, or both.

Chemical Agent Resistant Coating

Vehicles are finished with a chemical agent resistant coating (CARC):

- CARC contains isocyanates, which are highly irritating to the skin and the respiratory system.
- Breathing of vapor or dried paint dust can cause cough, shortness of breath, a burning sensation in the throat and nose, watering of the eyes, pain during respiration, and chest tightness.
- Skin contact with particulates can cause itching or redness of the skin.
- Only qualified painters working in fully equipped facilities in protective gear and respirators should perform CARC painting operations.
- Never weld or cut CARC-coated surfaces.
- Grinding or sanding on CARC-coated surfaces will create harmful dust. All individuals in the area must wear high-efficiency air purifying respirators, protective goggles, gloves, and other protective clothing. Thoroughly wash all clothing before reuse.
- No persons who have lung or breathing problems or who have had a reaction to isocyanates should be in the area where isocyanates are used or where CARC dust particles are present. Individuals who are sensitive to isocyanates may experience increasing sensitivity on repeated exposure.

Maintenance

General items:

- When using compressed air for cleaning purposes, do not exceed 30 psi (207 kPa). Wear gloves and eye protection. Do not aim compressed air at yourself or other people.
- Remove all jewelry before conducting maintenance. Do not wear watches, rings, dog tags, or other jewelry that could short across battery terminals or catch on vehicle components.

- Always maintain three points of contact when climbing on the vehicle. Never jump from the vehicle. Use ladders during maintenance as applicable.

- Ensure cargo is stowed and secured in accordance with the load plan. Do not block fire sensors or extinguisher nozzles. Do not block egress paths.

- Do not exceed the rated payload of the vehicle.

- In extreme temperature environments, follow work-rest schedules as well as the guidance of TB-MED 507, Heat Stress Control and Heat Stress Management, and TB-MED 508, Prevention and Management of Cold Weather Injuries.

- Antennas emit radio frequency radiation. Do not touch an active antenna, and maintain proper standoff distances from an active antenna as specified in the radio equipment technical manual. Ensure radios are powered off before conducting fueling operations or maintenance activities.

- Rotating parts can cause severe injury to personnel. Ensure all guards are in place. Do not wear loose clothing when conducting maintenance. Always check to ensure area is clear of personnel and obstructions before starting the engine.

- Single hearing protection is required in and around an operating vehicle. Double hearing protection is required during weapons firing.

- Ensure tire pressures are maintained at the proper levels. Low air pressure can result in tire failure. Use tire cages during tire inflation.

- The wheel and tire assembly is heavy. Do not attempt to lift or catch the wheel and tire assembly without the aid of an assistant and a suitable lifting device:

    - Vehicle must be parked on hard, level surface where jacks will be level.

    - Attempting to change wheel/tire assembly on a non-level or soft surface may result in the jack/jack stand and/or vehicle falling.

- The doors are heavy. Use caution when opening or closing the doors, especially when the vehicle is parked on an incline.

- Before opening the hood, ensure there is enough room in front of the vehicle for the hood to open completely without pinning or pinching yourself or an assistant between the hood and any other structure.

- Hydraulic jacks are intended only for lifting the vehicle and not for supporting the vehicle while performing maintenance. Do not get under the vehicle after the vehicle is raised, unless it is properly supported with blocks or jack stands.

- Engine components become extremely hot during normal operation. Allow the engine to cool completely prior to performing any task. Do not touch the exhaust system components with your bare hands or with your body. Use protective work gloves and long sleeves.

- Do not disconnect any air line or fitting until the system pressure has been relieved. Air under pressure can penetrate the skin.

- Wear protective eye goggles or face shields. Air drain valves are under pressure. Do not place your face in front of the air drain valves while draining the air reservoirs. Open the air drain valves slowly to prevent a sudden blast of air.

- Before performing preventive maintenance checks and services, be sure that the parking brake is applied, the transmission is in neutral (N), and the wheels are chocked.

- Wear eye protection and gloves when working on or around hydraulic systems. Hydraulic hoses, fittings, and components can contain high pressure.

- Nuclear, biological, or chemical (NBC) contaminated air filters must be handled and disposed of only by authorized and trained personnel. The unit commander or senior officer in charge of maintenance personnel must ensure that prescribed protective clothing is used and prescribed safety measures and decontamination procedures are followed. The unit standing operating procedures (SOP) is responsible for the final disposal of contaminated air filters.

Gunner's hatch:

- The gunner's sliding hatch can only be opened or closed when the vehicle is stationary and on a level surface. Do not attempt to open or close the hatch when the vehicle is in motion. Keep arms and hands clear of the gunner's hatch when closing it.

- Ensure that the gunner's hatch is in the locked position before moving the vehicle. Use extreme caution when standing in the gunner's hatch while the vehicle is in motion; the gunner should be holding on to the weapon or other suitable handle to maintain a stable posture at all times.

- The vehicle must not be operated with the emergency roof hatch open. Keep arms, hands, and head clear of the emergency roof hatch when closing it.

- Roof hatches are heavy. Use caution when opening or closing the roof hatches. Ensure roof hatches are locked when in the open position.

- When opening or closing the gunner's hatch side lock latch, the vehicle must be stopped and on a flat level surface. The latch is spring-loaded and if there is any added tension on it, the gunner will not be able to release lever.

Engine cooling system:

- The engine cooling system is hot and pressurized. Do not remove the radiator cap while the engine is hot; steam and hot coolant can escape and burn personnel. Allow the system to cool, and remove the cap slowly to relieve pressure.
- Coolant is poisonous if ingested. Avoid skin and eye contact:
    - If skin contact occurs, wash the affected area immediately with soap and water.
    - If eye contact occurs, flush with water and seek medical attention.
- Do not touch extremely cold metal (below -26°F [-32°C]). Bare skin may freeze on cold metal.
- Cooling system components are very hot and pressurized during vehicle operation. Allow the cooling system to cool before checking hoses.

Batteries:

- Care must be taken when handling or working near batteries. Hydrogen gas emitted from the batteries is flammable and hazardous to your health. Do not smoke, have open flames, or make sparks around a battery.
- Battery acid (electrolyte) is extremely harmful. Wear acid-proof gloves, eye protection, and a rubber apron to prevent contact. In the event of skin or eye contact, flush with cold water and seek medical attention. Avoid inhaling battery vapors, and immediately discard all rags after wiping the batteries and battery box.
- Ensure batteries are disconnected when performing maintenance on or near batteries or electrical systems. Ensure stored voltage is discharged from equipment before conducting maintenance. Always remove negative battery terminals first. When reconnecting, always connect positive terminals last to avoid arcing or sparks that could cause an explosion. Do not allow tools to contact the battery box or other battery terminals when removing or installing terminals.
- Battery connector GAA is harmful to the skin. Prolonged or repeated contact with the skin or contact with the eyes may cause irritation. If the eyes are contacted, rinse thoroughly and contact a physician if irritation persists. If the skin is contacted, wash thoroughly with soap and water.
- Wear safety goggles, acid proof gloves, and a rubber apron in a well-ventilated area when performing battery maintenance.

Vehicle Operation

- Drivers are responsible for the safety of personnel riding in their vehicles:

- Drivers should refuse to move a vehicle if anyone is in an unsafe position or the vehicle has too many passengers (passenger load for Category [CAT] I vehicles is 6 persons and 10 persons for CAT II vehicles).
- The operator/driver must visually check to make sure all areas of the vehicle are clear of personnel prior to attempting to start the engine.
- Always use seat belts/shoulder harnesses when the vehicle is in operation.
- Ensure the driver side and passenger side mirrors are adjusted to allow for full range of vision prior to operating the vehicle.

- The driver's field of view is limited. Ground guides must be used when operating in congested areas or when operating in reverse. Ground guides must stand clear of the vehicle and remain within view of the driver.
- If the operator/driver leaves the vehicle, even momentarily, when the engine is running, the transmission must be placed in neutral (N), the parking brake set, and the wheels chocked. Unexpected or sudden vehicle movement may occur, which may result in damage to equipment and/or serious injury or death to personnel.
- The vehicle has a high center of gravity. Slow down for turns and other maneuvers. Approach slopes head on and avoid side slopes when possible.
- Do not attempt to ford water deeper than 36 inches. Ensure the bottom surface under water is hard. Reduce speed during fording. Ensure brakes are dry and operating correctly upon completion of the fording operation before commencing normal driving.
- Do not use the steering wheel for a hand grip to enter or exit the vehicle cab. Use of the steering wheel for a hand grip may cause sudden violent jerking of the vehicle. When entering or exiting the cab, use the three-point contact system.
- Increased effort may be required to turn the steering wheel if there is a failure of the power steering system or the engine stops running. Stop the vehicle as soon as road conditions permit. Operating the vehicle with impaired steering can result in damage to equipment and/or serious injury or death to personnel.
- The service brakes should always be used as the primary vehicle braking system. The exhaust brake should never be considered a substitute for the vehicle's service brakes. The exhaust brake cannot bring the vehicle to a complete stop. Only the service brakes can bring the vehicle to a complete stop. Using the exhaust brakes in place of the service brakes may result in damage to equipment and/or serious injury or death to personnel.

- Ensure (by looking out one of the small rear windows) that no one is behind the vehicle when lowering the rear door/ramp. Do not operate the rear door/ramp when the vehicle is in motion. Use extreme caution when using the emergency rear door/ramp release so that no one can be struck by the door as it falls open. Sound the horn before lowering the door/ramp. Keep arms and legs clear of the rear door/ramp when closing it.

- Do not allow the vehicle to coast in neutral, because the engine and transmission assist in slowing the vehicle. This is an unsafe operation.

- Rapid operation of the service brakes will consume the compressed air supply and may cause automatic spring brake application. Always observe air pressure gauges.

- Do not operate the vehicle with air pressure system loss; this is extremely dangerous. The vehicle has reduced or no braking capability and may not stop.

- Carbon monoxide is a colorless, odorless, poisonous gas that when breathed deprives the body of oxygen and causes suffocation. Failure to comply with the following precautions may result in permanent brain damage or death:

    - Do not operate the heater or vehicle engine in an enclosed area without adequate ventilation.

    - The auxiliary diesel heater must be switched off while any fuel tank on the vehicle is being filled.

    - Do not idle the vehicle for long periods of time.

    - Do not sleep in the vehicle with the heater operating or the engine idling.

    - Notify field maintenance if exhaust fumes are detected in the crew compartment while operating the vehicle.

    - Be alert at all times for exhaust odors and symptoms of exposure to carbon monoxide such as headaches, dizziness, loss of muscular control, apparent drowsiness, and coma. If symptoms are evident, move the affected personnel to fresh air, keep them warm, do not permit physical exercise, administer artificial respiration (if necessary), and seek immediate medical attention.

- Discharging large quantities of the dry chemical fire extinguisher in the cab may result in temporary breathing difficulty during and immediately after the discharge event. If at all possible, discharge the fire extinguisher from outside the cab. Ventilate and wash the cab thoroughly prior to reentry. If respiratory irritation or distress occurs, remove the victim to fresh air. Seek medical attention and perform the following first aid:

    - **Eyes:** Flush with cold water for no less than 15 minutes.

- **Skin:** Flush with large amounts of cold water until all acid is removed.
- **Internal:** If victim is conscious and alert, give two to three glasses of water to drink and DO NOT INDUCE VOMITING. Do not leave the victim unattended. To prevent aspiration of the swallowed product, lay the victim on his side with his head lower than his waist. If vomiting occurs and the victim is conscious, give water to further dilute the chemical.

Winch operations:

- To avoid injury to hands or fingers, always keep hands clear of the wire rope, hook loop, hook, and fairlead opening during installation, operation, and when spooling in or out.
- Always wear heavy leather gloves when handling a wire rope.
- Always remove all jewelry to avoid being caught in the wire rope, and wear eye protection.
- Never let a wire rope slip through your hands.
- Always be aware of possible hot surfaces at the winch motor, drum, or wire rope during or after winch use.
- Always use extreme caution when handling the hook and wire rope during spooling operations.
- Always use the supplied hook strap whenever spooling the wire rope in or out during installation or operation to avoid injury to the hands or fingers.
- Never use the wire rope as a hoist or to suspend a load. Never use to lift or move persons.
- Always inspect the winch installation and wire rope before operating the winch. Frayed, kinked, or damaged wire rope must be replaced immediately. Loose or damaged winch installation must be corrected immediately.
- Never winch with less than five wraps of wire around the drum; the wire rope could come loose from the drum.
- Never touch the wire rope or hook while in tension or under load. Never touch the wire rope or hook while someone else is at the control switch or during winching operations. Never touch the wire rope or hook while the remote control is plugged into the winch.
- Never exceed the winch or wire rope rated capacity.
- Never engage or disengage the clutch if the winch is under load, the wire rope is in tension, or the wire rope drum is moving.

- Always stand clear of the wire rope and load and keep others away while winching. Always require the operator and bystanders to be aware of stability during winching of the vehicle and/or load. Always keep the remote control lead clear of the drum, wire rope, and rigging. Inspect for cracks, pinches, frayed wires, or loose connections. Replace if damaged.

- If the recovery strap is used for anything other than to snatch or pull out a stuck vehicle, the strap can break, causing serious equipment damage or serious injury or death to personnel.

Towing:

- Prior to towing the disabled vehicle, ensure the brake lights, emergency flashers, turn signals, and air systems are operating on the disabled vehicle in conjunction with those on the towing vehicle.

- Do not position hands near the pintle hook while aligning or removing the towbar with the pintle hook on the towing vehicle.

- At night, the center of the towbar must be clearly marked to ensure that it is visible to other road users. The maximum speed limit when towing is 25 mph (40 km/h). Avoid sharp turns.

- The antilock braking system (ABS) function on a disabled vehicle is not operational when the vehicle is being towed. Do not rely on the ABS function of the disabled vehicle when being towed.

- The vehicle must not be driven with the brakes caged.

- When operating the vehicle in the transmission limp-home mode, the operator must stay in the vehicle and use only the service brakes to hold the vehicle into place.

- When towing, ensure that all personnel are clear of the vehicle before removing the wheel chocks and starting vehicle towing.

- Personnel must not occupy the vehicle being towed.

- Use reasonable speeds for road conditions and caution when making turns.

- Prior to disconnecting the towbar, ensure that the vehicle is on a level surface and the wheels are chocked.

- If the brakes of the disabled vehicle are inoperable, do not flat tow the disabled vehicle. Call for wrecker support.

Fuel:

- Fuel is flammable and can explode. Keep fuel away from an open flame and keep a fire extinguisher within easy reach when working with fuel.

- Do not work on the fuel system when the engine is hot; fuel can be ignited by the hot engine.
- Smoking is prohibited while working with fuel.
- Never use gasoline to clean parts.
- Do not fill the fuel tank with the engine running. Do not over fill the fuel tank. Clean fuel spills immediately. Ensure the fuel nozzle is grounded to the filler neck to prevent sparks.
- Be alert at all times for the smell of fuel. Hot engines and components can ignite fuel. If a fuel smell is detected while operating the vehicle, shut down the vehicle immediately and notify field maintenance.

Adhesives, solvents, sealants, lubricants, and spills:

- Adhesives, solvents, sealants, and lubricants are flammable and hazardous to your health:
    - Use in a well-ventilated area and away from sources of heat.
    - Keep a fire extinguisher within reach.
    - Wear gloves, a face shield, and protective clothing:
        - If contact with skin occurs, wash the affected area immediately with soap and water.
        - If eye contact occurs, flush with water and seek medical attention.
- Clean up all fluid spills. Spills can create slip and fire hazards. Dispose of materials in accordance with local hazardous waste disposal procedures.
- Anti-corrosion compound is toxic:
    - Use only in a well-ventilated area.
    - Use an approved respirator with dual organic vapor/mist and particulate cartridge.
    - Wear chemical safety goggles and a full face shield when using.
    - Avoid contact with skin, and wear rubber or plastic solvent-resistant gloves:
        - In case of contact, remove contaminated clothing and immediately wash the area with soap and water.
        - If eyes are contacted, flush the eyes with large amounts of water for at least 15 minutes and get immediate medical attention.

- If swallowed, DO NOT INDUCE VOMITING; contact a physician immediately.

- Electrical connector lubricant is harmful to the skin. Prolonged or repeated contact with the skin or eyes may cause irritation:
  - If the eyes are contacted, rinse thoroughly and contact a physician if irritation persists.
  - If the skin is contacted, wash thoroughly with soap and water.
- Adhesives, solvents, and sealing compounds burn easily, can give off harmful vapors, and are harmful to skin and clothing. Keep away from open fire and use in a well-ventilated area. If adhesive, solvent, or sealing compound gets on the skin or clothing, wash immediately with soap and water.
- Use care when working around or with ether canisters as they are pressurized and flammable. Read the label before installing. Keep away from flames; do not incinerate or puncture the canister. Keep away from temperatures above 120°F (49°C). Do not store spare in the cab; it contains hazardous materials and must be handled with care and disposed of in accordance with current directives. Do not allow ether liquid or vapor to contact the skin or eyes, and avoid breathing fumes. If swallowed, DO NOT INDUCE VOMITING. Immediately seek medical attention.
- Do not have or apply open flames to air lines or valves. This can cause internal damage to non-metallic parts of valves, melt or burn non-metallic air lines, or result in vehicle fire. Do not pour liquids or methanol into air lines or hose couplings; this can cause immediate and severe damage to the rubber components. Fluids poured into the system will wash lubricants out of the valves and collect in brake chambers and valves.

Government-Furnished Equipment Warnings (W) and Cautions (C)

Hazardous Electromagnetic Radiation to Fuel (HERF)

(W) The antenna emits radiofrequency (RF) radiation. Do not touch an active antenna mounted external to the vehicle. Maintain proper standoff distances of 4 feet from an active antenna as specified in the radio equipment technical manual (TM) and Safety of Use Message (SOUM).

(W) Do not broadcast during refueling operations or within 50 feet of fueling operations. Ensure radios are powered off before conducting fueling operations or maintenance activities.

Hazardous Electromagnetic Radiation to Personnel (HERP)

(W) The antenna emits RF radiation. Do not touch an active antenna mounted external to the vehicle. Maintain proper standoff distances of 4 feet from an active antenna as specified in the radio equipment TM and SOUM.

Hazardous Electromagnetic Radiation to Ordnance (HERO)

(W) The antenna emits RF radiation. Do not touch an active antenna mounted external to the vehicle. Maintain proper standoff distances of 4 feet from an active antenna as specified in the radio equipment TM and SOUM.

(W) Keep ordnance out of vehicle exclusion zones when command, control, communications, computers, intelligence, surveillance, and reconnaissance (C4ISR) systems in the vehicle are active. RF emissions may inadvertently initiate any ordnance occupying these zones.

(W) If transporting ordnance in a vehicle, HERO-susceptible and unsafe ordnance should be transported in either a sealed all-metal container or in an approved electrostatic discharge (ESD)/HERO barrier bag.

(W) All load plans for the proper storage of ordnance should be stored in accordance with the unit's SOP to prevent accidental sympathetic detonation.

(W) Any uncertainties regarding HERO shall be brought immediately to the attention of the unit's explosive safety officer (ESO) and explosive ordnance disposal (EOD) personnel.

Driver's Vision Enhancer (DVE)

(C) Reduce speeds to suit the prevailing operation's environment and terrain to maintain environmental and weather condition awareness.

(W) Immediately bring the vehicle to a safe stop to avoid collision if the following situations occur:

- Dead pixels – small dots that make up the display image become unserviceable
- Video noise – interference or static blot out the display

(C) Before operating the vehicle, ensure the manually verify DVE azimuth and elevation controls are in the forward and locked position.

(C) Ensure the DVE is looking straight ahead during movement. Helmets must always be worn while driving with the DVE installed.

(C) Remove the DVE display from its mount when not in use for extended driving operations to minimize the risk of head strike injuries.

(C) Ensure the locking knob teeth are fully engaged.

(W) Do not react instantly to rapidly changing scenery (shade to sun, sun to shade); require one or two seconds to compensate. If necessary, slow the vehicle in either auto level or auto gain modes.

Objective Gunner Protection Kit (OGPK)

(C) Push in ("OFF" position) the emergency stop switch before the joystick or other components are replaced.

(C) Turret rotation can cause the breakaway connection to separate. The system is designed to continue functioning on its own power. As soon as mission allows, the breakaway connectors should be reconnected to continue charging.

(W) The turret has no brake when the motor engagement control is in the "neutral" position.

(W) The weapon turret system (OGPK) can inadvertently fire into troops (friendly/non-hostile) exiting the vehicle. Leaders must ensure that proper gunner awareness and training is implemented.

(C) The emergency stop switch must be in the "ON" position to charge batteries.

(C) Turn the emergency stop switch to the "OFF" position prior to plugging in the joystick cable to prevent damage to equipment.

Chameleon Jammer

(W) Cumulative RF exposure hazard: Personnel should not be within 3 feet of high-frequency (HF) antenna SAS230 or low frequency (LF) antenna HP3512 for an extended duration when the system power is on. Maximum exposure is limited to six minutes for personnel within 3 feet.

(W) Do not touch the antennas before confirming the system power is off. Antennas pose a heat and RF shock hazard that may injure personnel.

(W) Do not touch any RF cables or connectors when the Gilbert-Elliott Channel Model (GECM) System is switched on.

(W) The potential exists for electromagnetic radiation to cause the ignition or detonation of volatile combustibles, such as gasoline. Do not operate the GECM System within 50 feet of motor gasoline or aviation gasoline fueling or storage operations.

(W) The potential exists for electromagnetic radiation to cause inadvertent initiation of electro explosive devices (EEDs). Do not operate the GECM System in the vicinity of exposed EEDs. Handle all HERO susceptible, HERO unreliable, and HERO unsafe ordnance in accordance with Naval Systems Command (NAVSEA) Operating Policy (OP) 3565, Volume 2.

(C) Maintenance should only be carried out by personnel who are trained and certified.

(W) Always test the GECM System using a handheld test unit (RF meter) before deployment. Failure to ensure the system is operating properly could endanger personnel.

(W) Due to potential injury from lightning strike, personnel should remain inside or away from the vehicle during electrical storms. Refrigerant R-134a air conditioning systems should not be pressure-tested or leak-tested with compressed air. Combustible mixtures of air and R-134a may form, resulting in fire or explosion, which could cause personnel injury or death.

(W) Use care to prevent refrigerant from touching the skin or eyes. When exposed to air, liquid refrigerant quickly evaporates and will freeze skin or eye tissues. Serious injury or blindness may result if you come in contact with liquid refrigerant.

Duke Jammer

(W) To prevent long-term exposure to RF radiation, do not stand within 8 inches of the dual-band antenna while the system is operating.

(W) Due to the weight of the primary unit, a two-person lift is required to prevent physical injury or damage to the equipment.

(W) If someone is a victim of electrical shock, perform the five safety steps below:

- Do not try to pull or grab the individual.
- If possible, turn off the electrical power.
- If you cannot turn off the electrical power, pull, push, or lift the person to safety using a dry wooden pole, a dry rope, or some other insulating material.
- Send for help as soon as possible.
- After the injured person is free of contact with the source of electrical shock, move the person a short distance away and immediately start artificial resuscitation.

VRC-103 and 110 Radio Systems

(W) Watch for low hanging power lines. Antenna contact with power lines can cause electrical shock and equipment fire hazard, which may result in personnel injury and damage or loss to equipment.

(W) VRC-103 and VRC-110 is usually safe if a distance of 1 foot is maintained away from the antenna. Do not touch the antenna of either the VRC-103 or the VRC-110 during transmission; it could potentially give RF burns.

(W) The VHF output for the VRC-103 and 104 is around 50 watts and is usually not a problem; however, practice a 1-foot safe distance discipline.

VRC-104

(W) The VRC-104 (HF) has very high voltage on the coupler output and should be protected from human contact.

(W) The HF antenna should be placed high enough to keep individuals from touching it during transmission.

(W) The output of the coupler and the antenna emit high radiation levels when transmitting. Maintain a 1-meter distance from the HF antenna and the coupler output when transmitting at 150 watts.

(W) There is 150 watts being delivered to the antenna. This level of wattage requires at least 1-meter distance for radiation hazard. The output of the coupler and antenna when operating below 3 Megahertz can have as much as 7,000 volts.

(W) The voltage from the VRC-104 is too high in frequency to stop the heart (unlike the 60 Hertz in the wall sockets), but it will give you a bad burn if touched.

(W) DANGER HIGH VOLTAGE warning labels are normally supplied with the HF coupler. Do not remove.

(W) Watch for low hanging power lines. Antenna contact with power lines can cause electrical shock and equipment fire hazard.

Rhino II

Mechanical Safety Issues

(W) Use a two-person lift during system assembly, disassembly, and when lifting or lowering the Rhino to its deployed and stowed configurations.

(W) The Rhino hot box and extension assembly can fall rapidly if not supported. Keep all hands and fingers clear of pinch points and exposed sharp edges.

Electrical Safety Issues

(W) Inspect for damaged or broken electrical wires and connections. Damaged wiring and connectors can lead to potential electrical shorting, electrical arching, and the potential for personnel injury due to electrical shock.

Operational Safety Issues

(C) The Rhino can be extended up to 7 feet in front of the vehicle. Drivers must use caution when approaching and maneuvering in the vicinity of barriers, stopped vehicles, and other ground obstructions.

(C) Use caution when operating the Rhino on non-paved surfaces.

(C) The Rhino must be turned off when the vehicle is not running. Failure to turn off the Rhino will drain the battery, and the vehicle will not re-start.

(C) The Rhino heater box will get extremely hot immediately after the system is powered on.

(W) Do not come into contact with the heater box until it has sufficiently cooled. Serious burns can occur if it is not allowed to cool prior to handling.

(C) The vehicle must be running before the Rhino convoy protection device is powered on.

(C) For the Rhino system convoy protection device to be effective as an IED countermeasure, the heater box must be connected to the health and safety monitor via the connector at the front bumper of the vehicle and in the deployed configuration.

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CSI is a military history "think tank" that produces timely and relevant military history and contemporary operational history. Find CSI products at <http://usacac.army.mil/CAC/csi/RandP/CSIpubs.asp>.

Combined Arms Center-Training: **The Road to Deployment**

This site provides brigade combat teams, divisions, and support brigades the latest road to deployment information. This site also includes U.S. Forces Command's latest training guidance and most current Battle Command Training Program Counterinsurgency Seminars. Find The Road to Deployment at <http://rtd.leavenworth.army.smil.mil>.

Combined Arms Doctrine Directorate (CADD)

CADD develops, writes, and updates Army doctrine at the corps and division level. Find the doctrinal publications at either the Army Publishing Directorate (APD) <http://www.usapa.army.mil> or the Reimer Digital Library <http://www.adtdl.army.mil>.

Foreign Military Studies Office (FMSO)

FMSO is a research and analysis center on Fort Leavenworth under the TRADOC G-2. FMSO manages and conducts analytical programs focused on emerging and asymmetric threats, regional military and security developments, and other issues that define evolving operational environments around the world. Find FMSO products at <http://fmso.leavenworth.army.mil/recent.htm> or <http://fmso.leavenworth.army.mil/products.htm>.

Military Review (MR)

MR is a refereed journal that provides a forum for original thought and debate on the art and science of land warfare and other issues of current interest to the U.S. Army and the Department of Defense. Find MR at <http://usacac.leavenworth.army.mil/CAC/milreview>.

TRADOC Intelligence Support Activity (TRISA)

TRISA is a field agency of the TRADOC G2 and a tenant organization on Fort Leavenworth. TRISA is responsible for the development of intelligence products to support the policy-making, training, combat development, models, and simulations arenas. Find TRISA Threats at <https://dcsint-threats.leavenworth.army.mil/default.aspx> (requires AKO password and ID).

United States Army Information Operations Proponent (USAIOP)

USAIOP is responsible for developing and documenting all IO requirements for doctrine, organization, training, materiel, leadership and education, personnel, and facilities; managing the eight personnel lifecycles for officers in the IO functional area; and coordinating and teaching the qualification course for information operations officers. Find USAIOP at <http://usacac.army.mil/CAC/usaiop.asp>.

U.S. Army and Marine Corps Counterinsurgency (COIN) Center

The U.S. Army and Marine Corps COIN Center acts as an advocate and integrator for COIN programs throughout the combined, joint, and interagency arena. Find the U.S. Army/U.S. Marine Corps COIN Center at: <http://usacac.army.mil/cac2/coin/index.asp>.

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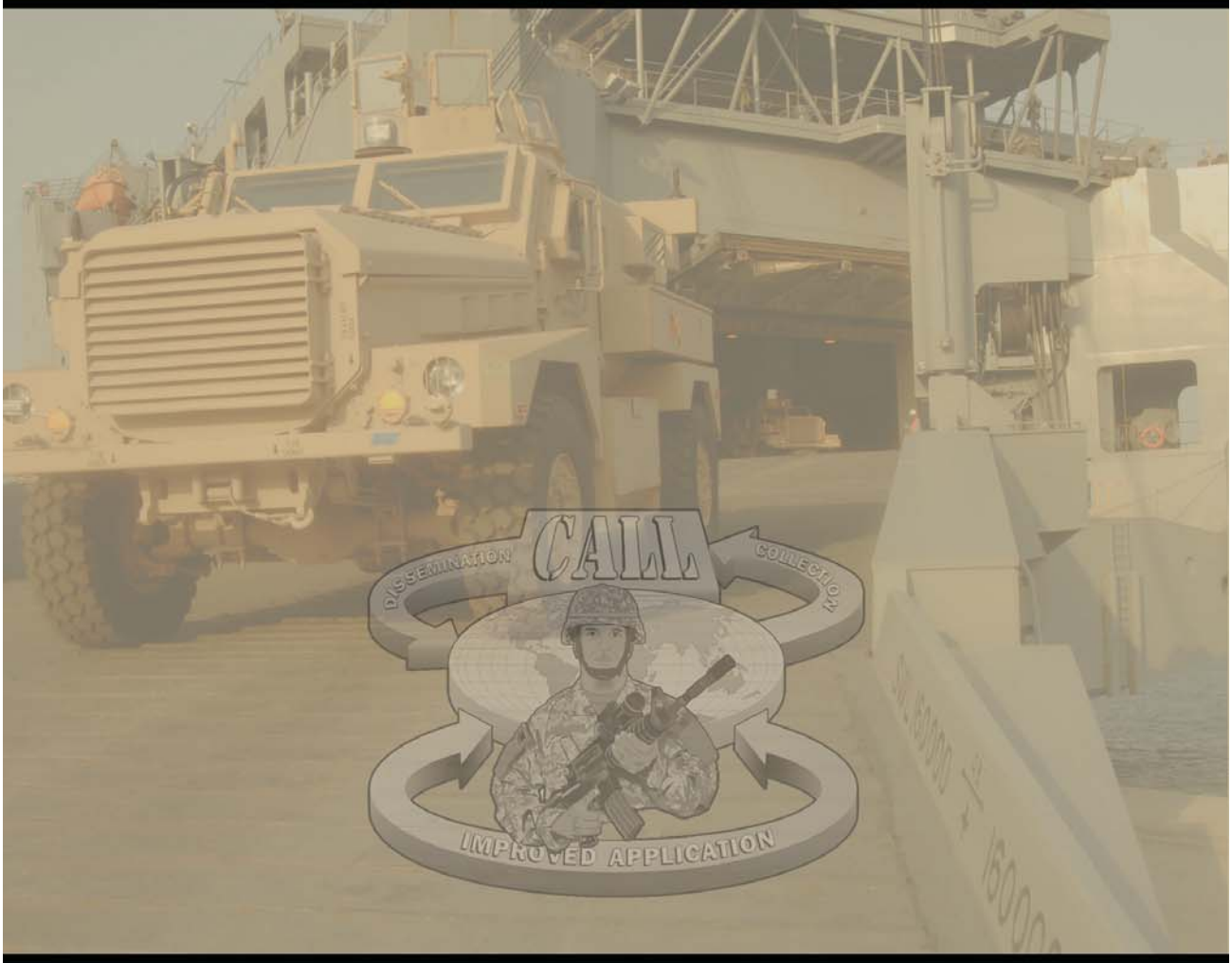

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