Tactics Techniques and Procedures (TTP)

For Recovering the

MINE RESISTANT AMBUSH PROTECTED (MRAP) VEHICLE'S

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WARNINGS AND CAUTIONS

WARNING!
Only properly trained (Recovery (H8) skill identifier U.S. Army only) and licensed personnel are authorized to operate dedicated recovery equipment. Failure to comply may result in serious damage to equipment, injury or death.

WARNING!
Never connect the rigging or winch cables to bumpers, suspension components or add on armor panels and brackets. Always use the frame towing and tie down provisions or other solid frame structures. Failure to comply may result in severe damage to equipment, injury or death.

WARNING
When ballistic glass dissolves it makes a harmful powder, therefore respirator and eye protection is required. Ballistic glass contains lead and cadmium which is hazardous when exposed to extreme heat from exploded ordnance. Failure to comply may result in serious health hazards and or death.

WARNING
A disabled MRAP with caged brakes should never be like vehicle towed. In these situations dedicated recovery assets should be requested. In emergency situations where dedicated assets are not available and at the discretion of the commander; hold back braking methods may be employed by rigging equipment and devices to reduce the risk of overrunning the tow vehicle. When performing like vehicle towing operations, never proceed up or down grades greater than 20%. The weight of the disabled vehicle can push or pull the tow vehicle causing loss of control. Failure to fully assess the risks involved with towing can result in severe damage to equipment, injury or death.

WARNING
When using a wrecker while towing a vehicle with nonfunctional brakes, use extreme caution and reduce speed accordingly. Failure to comply may result in damage to equipment, serious injury, or death.

WARNING
Do not move towing vehicle without assistance of ground guide. Ground guide must be visible to operator at all times. Failure to comply may result in damage to equipment, serious injury, or death.

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

WARNING
When towing, ensure that all personnel are clear of vehicle before removing wheel chocks and starting vehicle towing. Use reasonable speeds for road conditions and caution when making turns. Prior to disconnecting tow bar,

ensure that vehicles are on level surface with wheels chocked. Failure to comply may result in damage to equipment, serious injury or death.

WARNING

The maximum speed limit when towing is 15 mph (24 km/h). Terrain, weather and other conditions may require reduced speeds. Avoid sharp turns and grades greater than 20%. On paved roads, speeds may be increased to 25 mph if conditions permit. Failure to comply may result in damage to equipment, serious injury, or death.

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.

WARNING

Before tow a disabled vehicle Disconnect towed vehicle batteries before towing for safety Failure to comply may result in damage to equipment, serious injury, or death.

CAUTION

Lift towing of the MRAP from the rear should be performed only under emergency conditions, when approved by the commander.

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1.0 INTRODUCTION

1.1 Purpose

The intent and purpose of this TTP is to provide guidance for safe and proper methods for conducting recovery operations for lift tow and flat tow of mired and disabled vehicles.

1.2 Scope

These recovery procedures were developed from tested and proven procedures conducted during automotive safety and performance testing at Aberdeen Test Center. All possible recovery rigging techniques are not listed. This TTP focuses on the most common recovery tasks that can be accomplished using HEMTT, LVSR and MTVR. These procedures can be modified and adapted to support other recovery missions.

1.3 References

Applicable References for the operation, doctrine, recovery and rigging procedures are listed in Table 1.

Table 1 List of References

NUMBER	TITLE
TM 9-2320-342-10	Operator's Manual for Truck, Wrecker, 8X8 M984A4
FM 4-30.3	Maintenance Operations and Procedures (July 2004)
FM 4-30.31	Recovery and BDAR Procedures Sept (2006)
GTA -01-14-002	Rigging Card May (1996)
TM 11321A-OR	System operation Manual Truck wrecker 10X10 MKR15
TM 10633A-10A	Operator's Manual. Medium Tactical Vehicle Replacement (MTVR) MK 36

2.0 RECOVERY SYSTEM

2.1 Description

The M984A4, LVSR MKR15 and the MTVR MK36 vehicles are used as a multipurpose vehicle capable of recovering and towing a full spectrum of loaded, wheeled vehicles. These vehicles have a lift and reach capability to perform maintenance assistance associated with removing and replacing power packs and heavy components from a wide range of wheeled and tracked vehicles.

2.2 Recovery Equipment Data

M984A4

Wrecker Curb Weight (without Armor)	54,100 lbs
Gross Vehicle Weight Rating (Without Armor)	155,000 lbs primary/114,000 off road
Wrecker Curb Weight (w/B-kit)	58,450 lbs
Gross Vehicle Weight Rating (W/B-kit)	155,000 lbs primary/114,000 off road
Wrecker Curb Weight (w/B&C kits)	61,430 lbs
Gross Vehicle Weight Rating (W/B&C kits)	155,000 lbs primary/114,000 off road
Retrieval Tower Lift capability (Stinger)	25,000 lbs

LVSR MKR15

Curb Weight (Without Armor)	67,840 lbs
Gross Vehicle Weight Rating (Without Armor)	101,000 lbs
Curb Weight (With Armor)	74,180 lbs
Gross Vehicle Weight Rating (With Armor)	106,000 lbs
Retrieval Tower Lift capability (Stinger)	25,000 lbs

MTVR MK36

Curb Weight	48,800 lbs
Gross Vehicle Weight Rating	49,300 lbs
Retrieval Tower Lift capability (Stinger)	20,000 lbs

MRAP Vehicle Weights

Variant	OEM	GVW	GVWR
MATV (UIK)	Oshkosh	31,620	37,000
MATV (SOCOM)	Oshkosh	31,700	37,000
Caiman Base	BAE-TVS	41,700	41,700
Caiman MTV*	BAE-TVS	62,760	73,000
Caiman MTV Ambulance*	BAE-TVS	59,000	72,000
RG31 A2 DO7 with ISS	GDLS-C	41,013	43,218
RG31 A3 with ISS	GDLS-C	36,332	47,984
MaxxPro Base	Navistar	40,240	43,500
MaxxPro MEAP	Navistar	46,480	53,000
MaxxPro Plus Solid Axle	Navistar	51,500	53,000
MaxxPro Ambulance	Navistar	49,920	53,000
MaxxPro Dash DXM (ISS)	Navistar	42,540	50,500
MaxxPro Wrecker*	Navistar	65,000	81,000
RG33 CAT I SOCOM A1 with ISS	BAE	42,332	49,000
RG33 SOCOM AUV*	BAE	54,200	73,000
Buffalo A1*	FPI	60,000	78,500
Buffalo A2*	FPI	60,000	78,500
Cougar CAT I A1	FPI	37,500	44,600
Cougar CAT I A2	FPI	41,500	44,600
Cougar CAT II A1	FPI	47,500	57,600
Cougar CAT II A2	FPI	51,500	57,600
Vehicles in RED or have a * are over the GCWR of all the wrecker's			

3.0 FUNDAMENTALS OF RECOVERY

Battlefield recovery is much more complex than just pulling up to a mired or disabled vehicle connecting a winch cable and pulling on it. Several factors must be considered first including location, terrain conditions, gross weight of disabled vehicle, the mire level and the capacity of the recovery device to be used – just to name a few. All of these factors contribute to the total rolling resistance which must be calculated prior to recovery. Safe and successful recovery operations begin with a careful assessment of the recovery mission. The first step in the recovery process is to consider mission, enemy, terrain and weather, troops and support available, time available civil considerations (METT-TC) U.S. Army; METT supply and logistics (SL) U.S. Marine Corps. Reconnoiter the area and conduct a risk assessment. Refer to FM 4-30.31 for guidance on each step of the recovery assessment process.

3.1 Rolling Resistance

Friction and gravity are the major contributors of resistance during recovery operations. A disabled vehicle with inflated tires has less rolling resistance than if all the tires were deflated. A vehicle that is mired or is at the bottom of an embankment may require greater pulling forces to overcome friction and gravity. For safe recovery it is extremely important to determine the total rolling resistance, the capability and capacity of the recovery equipment and the required mechanical advantage to overcome the resistance. Table-4 provides a sample quick reference worksheet for calculating total rolling resistance and required mechanical advantage. Refer to example for calculating total resistance:

Table-2 Quick Reference Recovery Worksheet

Quick Reference Recovery Calculation Card (QR^2C^2)		
Rolling Resistance		
Contributing Factors	**Level of Resistance (%)**	**Weight in (lbs)**
Combat Weight (GVW)	Gross Vehicle Weight (GVW) = 100% (GVW = Vehicle + payload – crew)	
Gradient Resistance	Up to 45% = 1X GVW (no damage. or mire) Gradient > 45% = (2X GVW or greater)	
Mire Resistance	(Wheel Depth) Mire level 1 = 1X GVW = 100% (Fender Depth) Mire level 2 = 2X GVW = 200% (Cab Depth) Mire level 3 = 3X GVW = 300%	
Overturned Resistance	On side = ½ GVW = 50% On roof = 1 1/4 GVW = 125%	
Water Resistance	Floating: = 1/64 GVW = 1.56% Submerged: = 2X GVW = 200%	
Damage Resistance	One half or less wheels M = 1/3 = 3.3% More than half wheels M = 2/3 = 66.6%	
Tackle Resistance	For each sheave used Add 10%	
Equipment Safety	For worn equipment Add 10 %	
Resistance Reduction	Subtract 10% for opposite direction of travel and power applied to tracks or wheels.	
	Total Rolling Resistance-	
Winch Capacity (Available Effort) **(See FM 4-30.31)**	**Constant Pull Winch-**	
	Variable Pull Winch-	
	1st Layer (5 wraps min.)	
	2nd Layer	
	3rd Layer	
	4th Layer	
Required Mechanical Advantage	1:1 Up to rated capacity (straight pull) 2:1 Double rated capacity (one block) 3:1 Triple rated capacity (two blocks)	

Example: Calculating Rolling Resistance

A column of five vehicles are conducting patrols and travelling on a makeshift cross country road. The column approaches a wet marshy area and the first two vehicles make it across without incident. The driver of the third vehicle hesitates during the crossing and becomes stuck in the ruts made by the previous vehicles.

The driver attempts to move the vehicle in reverse and then forward again but the wheels only dig deeper in the soft wet ground. The vehicle is now in a mire level two and requires extraction.

One of the vehicles in the column is a maintenance recovery vehicle equipped with a 50K main winch and trained crew. The other vehicles establish a security perimeter while the recovery crew assesses the best recovery approach. It was determined that extracting the vehicle in the opposite direction of travel (most always advised) would provide the best solution.

The recovery crew established from the data plate that the GVW of the mired vehicle was 60K. They also determined that a mire level two was equivalent to 2X the GVW. Rolling resistance was determined as follows:

Gross Vehicle Weight	**60,000 lbs**	**(Data Plate)**
Mire Level 2	**120,000 lbs**	**2 X GVW (Above Wheels)**
Rolling Resistance	**120,000 lbs**	

3.2 Mechanical Advantage

Once the rolling resistance is established the next step is to determine the total rolling resistance and the required mechanical advantage to safely perform the extraction. Mechanical advantage is needed whenever the rolling resistance is greater than the capacity of the available effort (winch or other device used for pulling).

Example: Calculating Mechanical Advantage

In this scenario the rolling resistance (120K) clearly exceeds the 50K winch capacity. To determine the required mechanical advantage, the rolling resistance (load) is divided by the winch capacity (available effort). Any fraction must be rounded up to the next whole number. Use the following example to calculate the required mechanical advantage:

Rolling Resistance	**120,000 lbs**
Winch Capacity	**50,000 lbs**
Mechanical Advantage	**120,000 / 50,000 = 2.4:1 = 3:1 (Rounded Up)**

A mechanical advantage of 3:1 requires the use of two snatch blocks. Resistance generated by the tackle requires adding 10% to the rolling resistance for each sheave used to determine the total rolling resistance.

120,000 lbs x 10% =	**12,000 lbs**	
12,000 lbs x 2 (blocks) =	**24,000 lbs**	
Rolling Resistance	**120,000 lbs**	
Tackle Resistance	**24,000 lbs**	
Total Rolling Resistance	**144,000 lbs**	**(120,000 lbs + 24,000 LBS)**
Required Mechanical Advantage	**3:1**	**(150,000 lbs)**
Safety Margin (approx.)	**6,000 lbs**	**(150,000 lbs – 144,000 lbs)**

The recovery crew determined that with proper rigging and tackle the 50K winch was capable of extracting a mired vehicle with a resistance equivalent to a 144K vehicle. They also kept in mind that a variable pull winch required moving the recovery vehicle periodically to maintain maximum pull on the first layer of cable on the drum.

With the successful extraction of the mired vehicle the remaining column crossed the marshy area using alternate paths to prevent a repeat of this scenario and joined the lead vehicles to continue with the mission.

3.3 Rigging and Tackle

Recovery cannot be accomplished without the use of rigging and tackle. Depending on the recovery scenario, rigging can be as simple as connecting a chain or winch cable directly to the mired or disabled vehicle. When the required mechanical advantage is determined the rigging can be set up and connected with the appropriate number of snatch blocks. The complexity of rigging and tackle is determined by each recovery scenario. Compound tackle systems reduce the length of useable winch cable and may not be practical in situations where the disabled vehicle is not in close proximity to the recovery vehicle. In these cases a different rigging strategy must be considered.

3.4 Winches

With few exceptions, the most common method used to extract or recover mired or damaged vehicles is with the use of winches. All dedicated recovery assets are equipped with high capacity (main) winches. There are generally two types of winches in the military – constant pull winches and variable pull winches. Constant pull (capstan style) winches provide the same amount of pulling force regardless of how many feet of cable are payed out or how many layers of cable are on the drum. The pulling capacity of variable pull winches on the other hand, decreases as the cable is payed in and the layers of cable on the drum increase. This type of winch is common on a variety of military recovery equipment and requires monitoring during recovery operations. A variable winch rated at 50K lbs with only five wraps of cable on the first layer of the drum looses almost half of the pulling capacity on the fourth or fifth layer of cable on the drum. Failure to calculate for line force losses can result in winch stall during the extraction or recovery process. This may require placing the disabled vehicle in the original position and making changes in the rigging or repositioning the recovery vehicle.

3.5 Anchors

Another very important element required during many recovery scenarios is the use of anchors. Without anchors the use of snatch blocks to up right overturned vehicles or provide the mechanical advantage necessary to recover heavy loads would be impossible. Anchors can be any fixed object (natural or manmade) that can be used to anchor a dead line or snatch block. The anchors must be stronger than the resistance of the mired or disabled vehicle. Large trees and boulders make excellent natural anchors. Sand parachute, picket holdfast, and log dead man are all examples of manmade anchors. When these anchors are not practical or readily available, vehicles can be used as anchors or scotch anchors. For additional information on anchor design and application refer to FM 4-30.31, FM 5-125.

3.6 Cribbing

When recovering battle damaged vehicles with suspension or drive train damage it may be necessary to use cribbing to allow recovery specialists to secure loose components prior to recovery of the vehicle. The BII of most recovery does not provide cribbing this has to be locally procured it can be rail road ties 6x6s. The cribbing can be used to stabilize damaged vehicles for hook up.

4.0 RECOVERY SPECIALISTS

All specialized recovery equipment including the ISRS/TDRT is designated as dedicated recovery systems. This type of equipment requires specially trained recovery specialists. These individuals must possess formal recovery training in Military Occupation Skill (MOS) 91B, 91S and 91H with a H8 identifier (US Army only) IAW ALARCT 450. Since most prime movers listed are U.S. Army Transportation Corps assets operated by MOS 88M, all individuals operating this system must be trained, certified, licensed and possess the ASI H8 in recovery operations. Commanders must not allow untrained personnel to operate any dedicated recovery asset including the ISRS/TDRT without proper training and licensing.

5.0 PREVENTIVE MAINTENACE CHECKS AND SERVICES (PMCS)

A safe and successful recovery mission begins with good preventive maintenance. When arriving at the recovery site is not the time to find out that the winches don't work, or that mission essential equipment, chains, or hardware are missing or broken. All of these issues must be identified and corrected prior to moving out and can only be accomplished through good PMCS. For operating procedures and inspection criteria refer to the proper Technical Manual (TM) or Commercial off the Shelf (COTS) Operators and Maintenance manuals. In addition to PMCS carefully review the following statements:

a. Upon completion of PMCS make sure the prime mover's air system is at normal operating pressure to ensure proper air volume and pressure is available to supply the recovery system.

b. Make sure the tires are inflated to the proper level prior to moving out. Low or deflated tires can break the seal between the tire and rim. This is especially true when making sharp turns which induce a side load on the wheels and tires.

c. Ensure all equipment is properly stowed and secured to prevent loss or damage to equipment and injuries to others during travel.

d. Only properly trained and licensed personnel are authorized to operate recovery equipment and prime movers.

e. Only properly trained and certified personnel will conduct recovery operations.

f. If you are not sure how to calculate rolling resistance or operate the equipment refer to the (RECOVERY VEHICLE) operator's manual or ask your supervisor for assistance.

6.0 Front Lift Towing

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

6.1 Front connectivity

WARNING

Do not use the MTVR Wrecker to front lift tow the Buffalo Cat III, vehicle exceeds the retrieval system lift capacity.

NOTE

Drive shaft must be removed if transfer case will not shift into neutral.

NOTE

If casualty vehicle has no air pressure, the rear brakes must be caged.

NOTE

Do not use the Multi Use Adapter (MUA) to front lift tow the Buffalo. Damage to lift cylinder and tow cylinders may occur.

NOTE

Drive shaft must be removed on the Buffalo.

NOTE

These pictures reflect retrieval system connectivity not a completed hook up with air and IV lines.

MAXXPRO

COUGAR

CAIMAN

MATV

RG31 with MUAs

RG31 with Tow Adapters

BUFFALO A2

BUFFALO A1/2

a. Install appropriate retrieval system adapters. (See Table Below for a list of adapters) Using cylinder controls, lower the cross tube to approximately 3 ft off the ground.
b. Using ground guides, slowly back the recovery vehicle and connect retrieval system to the disabled vehicle. Refer to chart below for applicable adapter and pin position.
c. If needed route chains around the front axle or support frame and connect to hook on the adapter
d. Hook safety chain around frame or front axle and connect to rear tow shackles or safety chain loop on wrecker. Ensure sufficient slack in safety chains to allow for turns.
e. Install air lines, electrical cable(s) and safety pins.
f. Install tow lights. Check rigging.
g. Place transfer case in neutral. Drive shaft must be removed if transfer case will not shift into neutral.
h. Push in the trailer air supply control on the recovery vehicle.
i. Push in the parking brake control on the disabled vehicle.
j. Raise vehicle so front wheels are 12-18 inches above ground, depending on terrain.
k. Recheck towing connections, air lines and chains.
l. Tow disabled vehicle. Use speeds appropriate for conditions and avoid sharp turns.

Adapter & Pin Chart	
Vehicle	**Adapter and Pin**
MAXXPRO	**MUA Provision Pin Slot 4 and 5**
COUGAR	**MUA Provision Pin Slot 4 and 5**
MATV	**MUA Provision Pin Slot 4 and 5**
CAIMAN	**MUA Provision Pin Slot 5 also must use chains to stabilize MUAs**
RG 31	**MUA Provision Pin Slot 6 also must use chains to stabilize MUAs or use RG31 tow adapters** **NSN 2540-01-590-7232** **Refer to: TB 9-2355-315-10-1**
Buffalo A1/A2	**Use HEMTT BII Adapter B** NSN 2540-01-226-3373 (L) NSN 2540-01-226-5266 (R)

7.0 Rear Lift Towing

7.1 Rear connectivity

WARNING

Do not use MTVR Wrecker to rear lift tow the MAXXPRO, CAIMAN and BUFFALO; vehicles exceeds the retrieval system lift capacity

WARNING

Recovering the MAXXPRO vehicle from the rear should be performed only in emergency 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.

CAUTION

Lift towing of the Mine-Protected Clearance Vehicle (MPCV) BUFFALO from the rear should not be performed. Vehicle exceeds retrieval system lift capacity

CAUTION

Lift towing of the MRAP from the rear should be performed only under emergency conditions, when approved by the commander.

NOTE

These pictures reflect retrieval system connectivity not a completed hook up with air and IV lines.

NOTE

1. Rear lift tow is not recommend without using the RG-31A2 lift tow adapters because of interference with Multi Use Adapters (MUA) and tow cylinders.

2. Rear lift tow can be done when using the RG-31A2 lift tow brackets as shown in the illustrations.

NOTE

When using MRAP tow brackets the following procedures were noted during the initial hookup of the Mk5E tow adaptors:

- **1.5 inch spacers were used on the inside of the stinger, between the center of the stinger and the inboard side of the tow adaptor.**
- **The end caps of the stingers did not fit normally on the stinger. Only one of the end caps fit on the normal way. The right side stinger end cap was able to be placed normally, but because of the width of the tow adaptors the stinger end cap on the left side had to be placed on the stinger in the reverse direction. This did not seem to present a problem with attaching the tow adaptors.**

MAXXPRO

COUGAR

MATV

RG31A2

a. Straighten and secure steering wheel before towing.
b. Curb Weight Install appropriate retrieval system adapters. (See Table Below for a list of adapters) Using cylinder controls, lower the cross tube to approximately 3ft off the ground.
c. Using ground guides, slowly back the recovery vehicle. Connect the retrieval system. Refer to chart below for pin position and adapter.
d. MUA adapters using position 6 and the 3½ inch tie down holes of the disabled vehicle.
e. If needed route chains around the rear axle and connect to hook on the adapter.
f. Hook safety chains around rear axle and connect to rear tow shackles or safety chain loop on wrecker.
g. Leave sufficient slack in safety chains to allow for turns.
h. Install tow lights. Check rigging.
i. Raise vehicle so rear wheels are 12-15 inches above ground, depending on terrain.
j. Recheck towing connections and chains.
k. Tow disabled vehicle. Use speeds appropriate for conditions and avoid sharp turns.

Adapter & Pin Chart	
Vehicle	**Adapter and Pin**
MAXXPRO	**MUA Provision Pin Slot 4 and 5**
COUGAR	**MUA Provision Pin Slot 5 also must use chains to stabilize MUAs**
MATV	**MUA Provision Pin Slot 4 and 5**
CAIMAN	**DO NOT REAR LIFT TOW**
RG 31	**Use RG31 tow adapters NSN 2540-01-590-7232 Refer to: TB 9-2355-315-10-1**
Buffalo A1/A2	**DO NOT REAR LIFT TOW**

8.0 Like Vehicle Recovery

WARNING

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

NOTE

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

NOTE

If using MTVR tow bar, it must be fully extended

NOTE

If the air supply of the casualty vehicle will not hold air pressure, request dedicated wrecker support.

NOTE

Drive shaft must be removed if transfer case will not shift into neutral.

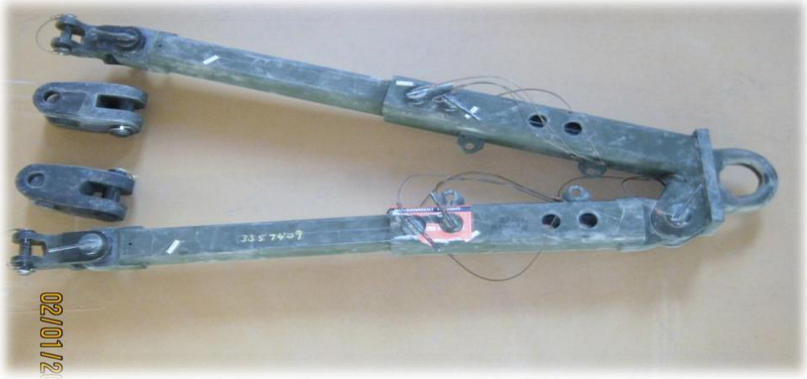
The below listed tow bars are the only approved tow bars for use with MRAPs

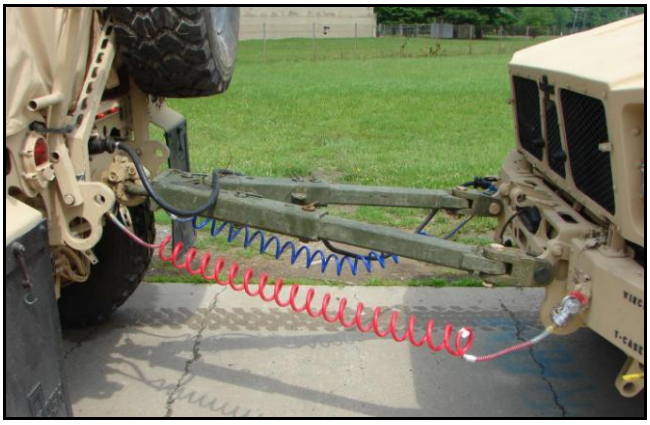
US Army Heavy	4910-01-267-2912
US Army Heavy	2540-01-434-8595
US Marine Corp Heavy	2540-01-558-3533
US Marine Corp Med	2540-01496-8356

U.S ARMY HEAVY DUTY TOW BAR NSN: 4910-01-267-2912
WEIGHT: 300 LBS.
LENGTH WITHOUT ADAPTER: 88 IN
CAPACITY: 112,000 LBS (weight of M88A1)
END ITEM: M88A1 (HEMTT AAL)

U.S ARMY HEAVY DUTY TOW BAR NSN: 2540-01-434-8595
WEIGHT: 282 LBS.
LENGTH WITHOUT ADAPTER: 88 IN
CAPACITY: 139,000 LBS (Weight of M88A2)
END ITEM: M88A2 (HEMTT AAL)

U.S MARINE CORPS MEDIUM DUTY TOW BAR NSN: 2540-01-496-8356
WEIGHT: 226 LBS.
LENGTH WITHOUT ADAPTER: 60 IN
CAPACITY: 83,000 LBS
END ITEM: MTVR MK36





a. Chock the wheels on the disabled vehicle to prevent it from moving until the tow bar is secured and ready for towing.
b. Install tow bar. (Refer to vehicle configuration bar chart below)
c. Install air lines, electrical cable(s) or tow lights, safety pins and safety chains. Leave sufficient slack in safety chains to allow for turns.
d. Place transfer case in neutral.
e. 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.**
f. Release the parking brake on the disabled vehicle.
g. Recheck towing connections, air lines and chains.
h. Tow disabled vehicle. Use speeds appropriate for conditions and avoid sharp turns.

8.1 **Like Vehicle Towing Configurations**

The chart below identifies which tow bar and associated adapter to use with each MRAP vehicle:

MRAP Flat Tow Recovery		
BAE SYSTEMS RG-33L 6x6		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	2.5 to 10 ton 2540-00-863-3153
	USMC 2540-01-558-3533	2540-00-863-3153
	MTVR 2350-01-496-8356	7 ton to 83,000 lb 2540-01-500-5325
BAE TVS Caiman 6x6		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	2.5 to 10 ton 2540-00-863-3153
	USMC 2540-01-558-3533	2530-01-520-6538
	MTVR 2350-01-496-8356	M809/939 to 78,000 lb 2530-01-520-6538
Force Protection Cougar 6x6		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	10-50 ton 5340-01-267-2908
	USMC 2540-01-558-3533	2540-01-500-5325
	MTVR 2350-01-496-8356	7 ton to 83,000 lb 2540-01-500-5325
Force Protection Cougar 4x4		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	10-50 ton 5340-01-267-2908
	USMC 2540-01-558-3533	2540-01-500-5325
	MTVR 2350-01-496-8356	7 ton to 83,000 lb 2540-01-500-5325

General Dynamics RG-31 4x4		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	10-50 ton 5340-01-267-2908
	USMC 2540-01-558-3533	2540-01-500-5325
	MTVR 2350-01-496-8356	7 ton to 83,000 lb 2540-01-500-5325
Navistar MaxxPro 4x4		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	2.5 to 10 ton 2540-00-863-3153
	USMC 2540-01-558-3533	2530-01-520-6538 5340-01-267-2908
	MTVR 2350-01-496-8356	M809/939 to 78,000 lb 2530-01-520-6538
MATV Base/UIK/SOCOM 4x4		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	10-50 ton 5340-01-267-2908
	USMC 2540-01-558-3533	2540-01-500-5325
	MTVR 2350-01-496-8356	7 ton to 83,000 lb 2540-01-500-5325
Force Protection Buffalo A1/A2		
	**TOW BARS**	**TOW BAR ADAPTERS**
	Heavy Duty Tow Bar 2540-01-267-2912	10-50 ton 5340-01-267-2908
	USMC 2540-01-558-3533	2540-01-500-5325

9.0 Mine Roller Kits

9.1 SPARK – Self-Protection Adaptive Roller Kit.

The SPARK mine roller kit comes in several configurations so it can adapt to the different MRAP variants below is a pictorial of the configurations.


SPARK Interface Bracket on the FPI Cougar 4x4 and 6x6 MRAP Vehicle.


SPARK Interface Bracket on the BAE TVS Caiman MRAP Vehicle.


SPARK Interface Bracket on the GDLS-C RG31A2 4x4 MRAP Vehicle.

SPARK Interface Bracket on the MaxxPro 4x4 MRAP Vehicle.

9.2 Flat Towing with the Mine Roller Brackets.

Refer to the tow bar installation procedures on page 18.

NOTE

The SPARK interface brackets for the FPI Cougar 4x4, FPI Cougar 6x6, BAE TVS Caiman, and GDLS-C RG31A2 4x4 MRAP vehicles are equipped with towing provisions; However, the towing provisions are not clearly identified as tow points.

NOTE

The SPARK interface bracket for the MaxxPro 4x4 MRAP vehicle did not include towing provisions. The MaxxPro 4x4 MRAP vehicle could not be flat towed from the front with the interface bracket installed.

Below is a pictorial of the Tow Bar configurations.

MK36 MTVR Wrecker Flat Towing the FPI Cougar 4x4 MRAP Vehicle.

M984A2 HEMTT Wrecker Flat Towing the FPI Cougar 4x4 MRAP Vehicle.

MK36 MTVR Wrecker Flat Towing the FPI Cougar 6x6 MRAP Vehicle.

M984A2 HEMTT Wrecker Flat Towing the FPI Cougar 6x6 MRAP Vehicle.

MK36 MTVR Wrecker Flat Towing the BAE TVS Caiman MRAP Vehicle.

M984A2 HEMTT Wrecker Flat Towing the BAE TVS Caiman MRAP Vehicle.

MK36 MTVR Wrecker Flat Towing the GDLS-C RG31A2 4x4 MRAP Vehicle.

M984A2 HEMTT Wrecker Flat Towing the GDLS-C RG31A2 4x4 MRAP Vehicle.

9.3 Front lift towing with Mine Roller Brackets.

Below is a table and procedures for lift towing the MRAP Vehicles with the Sparks brackets.

a. Install appropriate retrieval system adapters. (See Table Below for a list of adapters) Using cylinder controls, lower the cross tube to approximately 3 ft off the ground.
b. Using ground guides, slowly back the recovery vehicle and connect retrieval system to the disabled vehicle. If using MUA's or adapters refer to below chart for pin position or adapter.
c. If needed route chains around the front axle or support frame and connect to hook on the adapter
d. Hook safety chain around frame or front axle and connect to rear tow shackles or safety chain loop on wrecker. Ensure sufficient slack in safety chains to allow for turns.
e. Install air lines, electrical cable(s) and safety pins.
f. Install tow lights. Check rigging.
g. Place transfer case in neutral. Drive shaft must be removed if transfer case will not shift into neutral.
h. Push in the trailer air supply control on the recovery vehicle.
i. Push in the parking brake control on the disabled vehicle.
j. Raise vehicle so front wheels are 12-15 inches above ground, depending on terrain.
k. Recheck towing connections, air lines and chains.
l. Tow disabled vehicle. Use speeds appropriate for conditions and avoid sharp turns.

Adapter & Pin Chart	
Vehicle	**Adapter and Pin**
MAXXPRO	**DO NOT LIFT TOW with bracket installed**
COUGAR	**MUA Provision Pin Slot 6 also must use chains to stabilize MUAs also may use HEMTT adapter D**
MATV	**N/A**
CAIMAN	**MUA Provision Pin Slot 2 also must use chains to stabilize MUAs**
RG 31	**MUA Provision Pin Slot 6 also must use chains to stabilize MUAs**
Buffalo A1/A2	**N/A**

Below is a pictorial of the Front Lift Tow configurations.

NOTE
The SPARK interface bracket for the MaxxPro 4x4 MRAP vehicle did not include towing provisions. The MaxxPro 4x4 MRAP vehicle could not be lift towed from the front with the interface bracket installed.

MK36 MTVR Wrecker Lift Towing the FPI Cougar 4x4 MRAP Vehicle.

M984A2 HEMTT Wrecker Lift Towing the FPI Cougar 4x4 MRAP Vehicle.

MK36 MTVR Wrecker Lift Towing the FPI Cougar 6x6 MRAP Vehicle.

M984A2 HEMTT Wrecker Lift Towing the FPI Cougar 6x6 MRAP Vehicle.

MK36 MTVR Wrecker Lift Towing the BAE TVS Caiman MRAP Vehicle.

M984A2 HEMTT Wrecker Lift Towing the BAE TVS Caiman MRAP Vehicle.

MK36 MTVR Wrecker Lift Towing the GDLS-C RG31A2 4x4 MRAP Vehicle.

M984A2 HEMTT Wrecker Lift Towing the GDLS-C RG31A2 4x4 MRAP Vehicle.

10.0 Up Righting MRAPS

WARNING

On the MAXXPRO the lifting eyes are part of the armor panel that is bolted on and will fail if too much pressure or pulling force is put on one side panel.

When up righting MRAPs refer to FM 4-30.31 for doctrinal concept. For some MRAPs special attention needs to be taken to safely up right them, below is a procedure to assist the operator when rigging MRAPs.

When rigging MRAPS for up righting it is recommended that a chain be used to link both left and right lifting points (lifting eyes) together, this will provide a stronger and more secure lifting point. The reason for the chain is the lifting eyes have not been tested for up righting (And have failed in use).

The level of resistance during up righting of overturned vehicles depends on GVW and whether the vehicle is resting on its side or the roof. Up-righting resistance for a vehicle lying on its side on a fairly hard surface is approximately ½ or 50% of the GVW. The level of resistance for up righting an overturned vehicle end to end (on its roof) is approximately 1¼ or 125% of GVW.

Example:

Gross Vehicle Weight GVW = 60,000 lbs

Estimated Resistance ER (side) = ½ GVW

ER = 60,000 lbs / 2 = 30,000 lbs

GVW = 30,000 lbs

The ER for up-righting from a side rollover is approximately one half or 30,000 lbs GVW. This resistance is present until the vehicle reaches the tipping point at which time it will significantly drop as the vehicle rotates upright onto its wheels. Unless an adequate path is available the vehicle must also be extracted up the embankment.

To prevent serious damage to a vehicle's suspension and wheels it should never be allowed to slam to the ground. A hold back vehicle or a system of mechanical devices must be rigged to control the vehicle from the tipping point until the wheels rest on the ground. In many rollover cases vehicles sustain only external damage and remain operational. Make sure the vehicle is allowed to rest upright for several minutes to allow fluids to drain back or return to the reservoirs. Be sure to inspect for any fluids that may have leaked out, and before starting the engine and driving off check critical power train fluid levels.

11.00 Independent Suspension System Tie Up

11.1 Suspension tie up procedure for the independent suspension system on the MRAP FOVs is basically the same for all variants, the only deference is where and how to route the chain. Chaining up the suspension will gain between 2-6 inches in ground clearance.

WARNING

The major concern in Suspension tie up is the suspension spring. With the wheel and lower control arm fully detached, the spring may be wedged between the upper control arm and the ground. Raising the vehicle causes the spring to decompress which can fly out and cause serious injuries (or worse). Once the spring is fully extended it should be removed if possible and there is no need to secure the upper control arm. Failure to comply may result in damage to equipment, serious injury, or death.

CAUTION

When the wheel hub separates from the lower ball joint and the wheel assembly remains attached to the upper control arm, the wheel tends to rotate inward at the top often jamming under the vehicle. In this situation extreme caution must be exercised when securing the suspension. A careful inspection must be conducted to determine if there are any components under tension that can release unexpectedly. It may be necessary to raise the vehicle slightly to release tension from jammed components. Only when it is deemed safe should an attempt be made to secure the lower control arm to the ISS mounting supports. If towing long distances, it is advisable to remove the wheel assembly to prevent it from detaching from the upper ball joint and falling off during transport.

NOTE

Chaining procedures vary depending on the type of damage and vehicle model. Vehicle tie down provisions vary and some vehicles have none. Securing procedures for ISS were not validated during live fire.

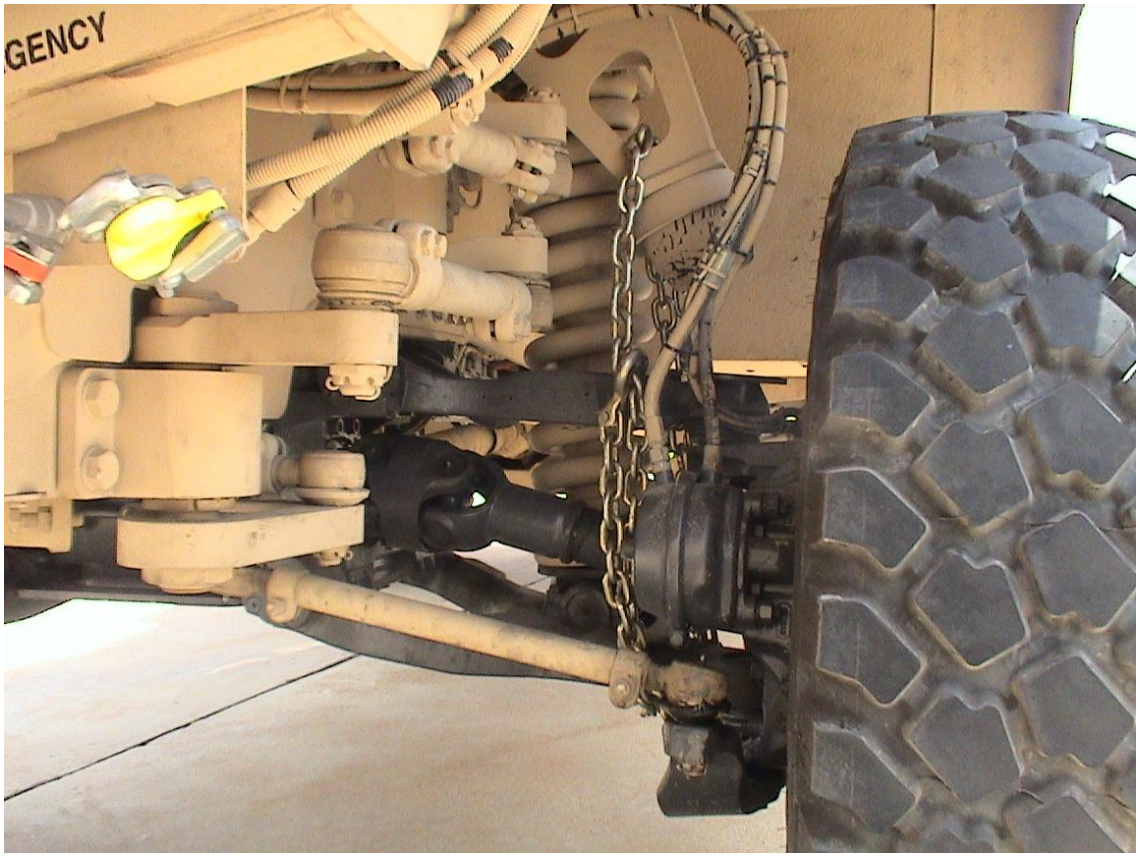
Below are the procedures for chaining up the MRAP independent suspension system.

1. Using the HEMTT, LVSR, or the MTVR connect the MUAs to the towing provisions the same way you would If you are front lift towing the vehicle (Refer to section 6 for adapter pin slots positions).
2. Collapse the suspension by extending the lift cylinder out and down.
3. Using a 3/8 inch chain with hooks, secure the chain around the suspension system.
4. Recheck your rigging.
5. Lift the vehicle and check wheel clearance. Repeat steps 1 to 3 if needed to get more clearance.
6. Install air lines, electrical cable(s) and safety pins.
7. Install tow lights. Check rigging.

8. Place transfer case in neutral. Drive shaft must be removed if transfer case will not shift into neutral.
9. Push in the trailer air supply control on the recovery vehicle.
10. Push in the parking brake control on the disabled vehicle.
11. Raise vehicle so front wheels are 12-15 inches above ground, depending on terrain.
12. Recheck towing connections, air lines and chains.
13. Hook safety chain around frame or front axle and connect to rear tow shackles or safety chain loop on wrecker. Ensure sufficient slack in safety chains to allow for turns
14. Tow disabled vehicle. Use speeds appropriate for conditions and avoid sharp turns.

Below is a pictorial of different MRAP suspension tie ups.


OSHKOSH


GENCY

Comparison Results

MRAP Independent Suspension System (ISS) tie up results when front lift towing							
Vehicle Type	****Clearance without chains**		**Difference**	****Clearance with chains**		**Difference**	**Travel Saved**
	Before Lift	**After Lift**		**Before Lift**	**After Lift**		
MATV	**17”**	**23”**	**6”**	**17”**	**18”**	**1”**	**5”**
RG31	**10”**	**15 ½”**	**5 ½”**	**10”**	**12 ½”**	**2 ½**	**3”**
RG33	*	*	*	*	*	*	*
MAXXPRO DASH	**14 ¼”**	**22 ¼”**	**8”**	**14 ¼”**	**18 ¼”**	**4”**	**4”**
FPI Cougar	**8”**	**12”**	**4”**	**8”**	**10”**	**2”**	**2”**
Caiman	**21”**	**26”**	**5”**	**21”**	**23”**	**2”**	**3”**