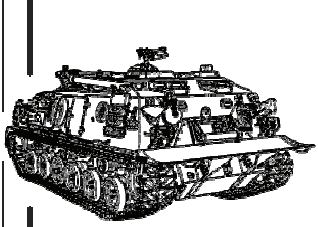
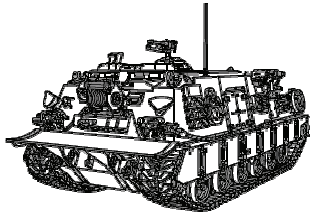
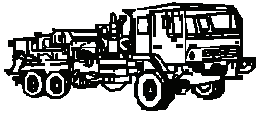
GTA 09-14-002

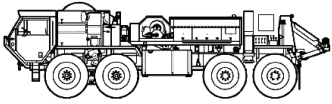
U S ARMY ORDNANCE CENTER & SCHOOL

ABERDEEN PROVING GROUND
MARYLAND









RIGGING CARD

FOR
VEHICLE RECOVERY

01 MAY 2006

RECOVERY PROCEDURES

RECONNOITER AREA	**ESTABLISH AREA SECURITY, THEN CHECK TERRAIN FOR BEST APPROACH ROUTE AND NATURAL ANCHORS**
ESTIMATE SITUATION	**DETERMINE RESISTANCE AND CAPABILITIES AVAILABLE**
CALCULATE	**DETERMINE MECHANICAL ADAVANTAGE REQUIRED**
OBTAIN RESISTANCE	**COMPUTE TOTAL RESISTANCE**
VERIFY SOLUTION	**DETERMINE LINE FORCES AND COMPARE WITH LINE CAPABILITES**
ERECT RIGGING	**ERECT RIGGING FOR DESIRED MECHANICAL ADVANTAGE**
RECHECK RIGGING	**ENSURE RIGGING IS READY FOR PROPER AND SAFE OPERATION**
YOU ARE READY	**MOVE TO A SAFE LOCATON: SIGNAL OPERATOR TO PAY IN WINCH CABLE AND RECOVER LOAD**

RECOVERY PRECAUTIONS

1. **WEAR GLOVES WHILE HANDLING CABLES**
2. **STEP ON - NOT OVER - SLACK CABLES**
3. **STAND CLEAR OF CABLES UNDER LOAD BY LENGTH OF PAID OUT CABLE AND OPPOSITE ANGLE OF PULL**
4. **BUTTON UP ALL HATCHES DURING WINCH PULLS**
5. **KEEP RECOVERY VEHICLE EXHAUST DIRECTED AWAY FROM FUEL SPILLAGE**
6. **GROUND GUIDE MUST BE LOCATED WHERE ALL VEHICLE OPERATORS CAN OBSERVE SIGNALS**
7. **INSPECT RIGGINGS FOR SAFE AND PROPER ATTACHMENTS**
8. **APPLY POWER TO WINCH CABLE GRADUALLY TO REMOVE SLACK IN RIGGING**
9. **PERFORM FINAL RIGGING CHECK PRIOR TO PAYING IN THE LOAD**
10. **KEEP ALL PERSONNEL OUT OF UNSAFE AREA**
11. **REPORT AND CLEAN UP ALL POL SPILLS**

RIGGING FORMULA (long)

LOAD RESISTANCE (LR) = Vehicle weight, plus the cargo weight, times the mire factor, minus reduction factor.

MECHANICAL ADVANTAGE (MA) = Load resistance divided by the winch capacity. If you have a remainder, always round up to the next whole number.

TACKLE RESISTANCE (TR) = Ten percent of the load resistance times the number of sheaves in the tackle system. The number of sheaves is one less than the mechanical advantage.

TOTAL LOAD RESISTANCE (TLR) = Load resistance plus the tackle resistance.

FALL LINE FORCE (FLF) = Total load resistance divided by the mechanical advantage. The fall line force must be less than the winch capacity in order to have a safe working capacity.

DEAD LINE FORCE = Fall line force times the mechanical advantage.

WINCH CAPACITY (WC) = Winch capacity or Available Effort will be given.

MIRE FACTORS

Track **Wheel**

WHEEL DEPTH MIRE

Up to the top of the road wheel but not over

Up to the center of the hub but not over

FENDER DEPTH MIRE

Over the top of the road wheel to the fender but not over

Over the center of the hub to the top of the fender but not over

TURRET OR CAB DEPTH MIRE

Over the fender to the turret

Over the fender to the cab

TRACK VEHICLE LOAD RESISTANCE REDUCTION FACTORS

10 Percent---Recovery in the opposite direction from which the mired vehicle was traveling

40 Percent---Applying power to the tracks of the mired vehicle

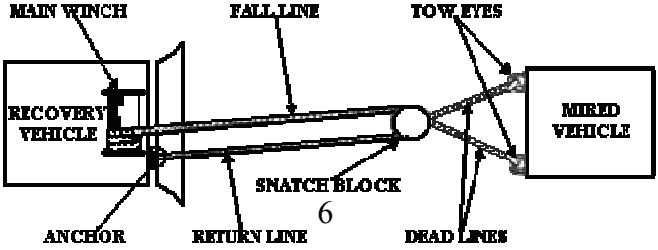
50 Percent---Combination of recovery in the opposite direction and applying power to the tracks of the mired vehicle

DETERMINING MECHANICAL ADVANTAGE

TOTAL LOAD RESISTANCE (Lbs) = REQUIRED
WINCH CAPACITY (Lbs) MECHANICAL ADVANTAGE

RIGGING EXAMPLE

2 : 1



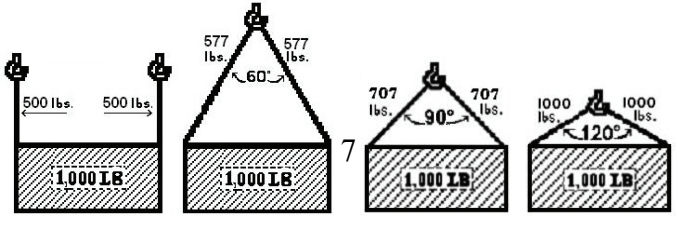
ROPE AND CHAIN CAPACITIES

DIAMETER (inches)	FIBER ROPE (sisal) $T = D^2$ (tons)	WIRE ROPE (IPS) AND CHAIN $T = 8D^2$ (tons)
3/8	0.140625	1.125
7/16	0.19140625	1.53125
1/2	0.25	2.0
5/8	0.390625	3.125
3/4	0.5625	4.5
7/8	0.765625	6.125
1	1.0	8.0
1-1/8	1.265625	10.125
1-1/4	1.5625	12.5
1-1/2	2.25	18.0

SLING LEG FORCES

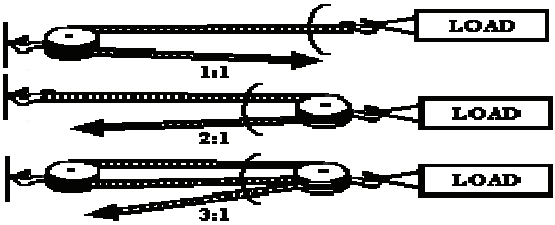
Force per sling leg (2-leg slings) per 1,000 lb. of total resistance

INCLUDED SLING LEG ANGLE (degrees)	SLING LEG FORCE (pounds)	INCLUDED ANGLE (degrees)	FORCE (pounds)
0	500	90	707
10	502	100	778
20	508	110	872
30	518	120	1,000
40	532	130	1,183
50	552	140	1,462



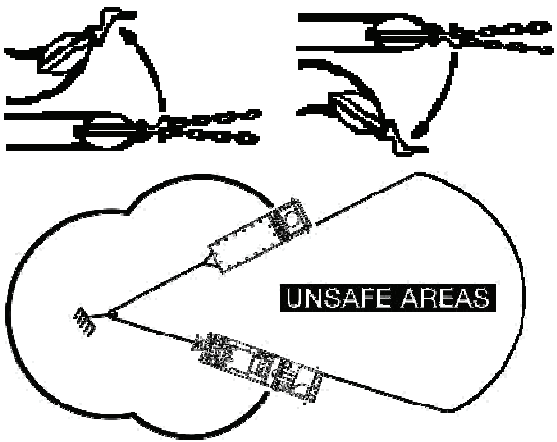
RIGGING FOR SAFETY

VARIOUS TACKLE
MECHANICAL ADVANTAGES

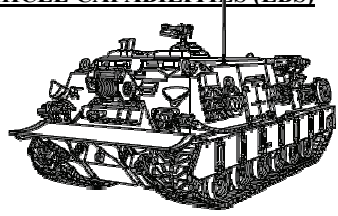


HOOK POSITIONS

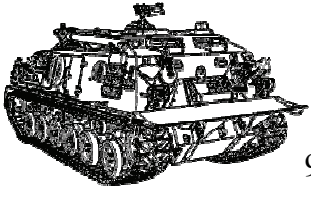
INCORRECT **CORRECT**



RECOVERY TRACKED VEHICLE CAPABILITIES (LBS)

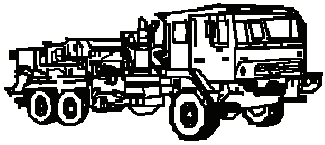


	HOIST CAPACITY	MAIN WINCH	AUX WINCH	TOW PINTLE
M88A2 RECOVERY VEHICLE	12,000 [1] 50,000 [2] 70,000 [3]	140,000	6,000	107,000
CABLE SIZE	3/4"	1-3/8"	3/8"	
M88A1 RECOVERY VEHICLE	12,000 [1] 40,000 [2] 50,000 [3]	51,400 [4] 90,000		90,000
CABLE SIZE	5/8"	1-1/4"		



1 Spade Up
2 Spade Up W/Lockout
3 Spade Down 4 Part Line
4 Full Drum Capacity

RECOVERY WHEELED VEHICLE CAPABILITIES (LBS)



	CRANE WINCH	MAIN WINCH	SELF RECOVERY WINCH	TOW PINTLE	LIFT TOW
M1089 FMTV WRECKER	11,000	30,000	15,500	21,000	20,000
CABLE SIZE	3/8”	3/4”	1/2"		
M984A1/A2 HEMTT WRECKER	14,000	60,000	20,000	100,000	25,000
CABLE SIZE	7/16”	1”	9/16”