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Report 2019

ARMY COUNTERMINE MOBILITY EQUIPMENT SYSTEM (ACMES)

by

David A. Vaughn
and
Robert Felts

November 1971

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U. S. ARMY MOBILITY EQUIPMENT RESEARCH AND DEVELOPMENT CENTER
FORT BELVOIR, VIRGINIA

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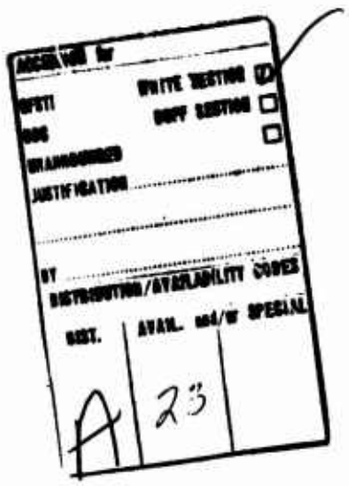

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The mechanism of mobility kills of combat, armored, tracked vehicles by harassment mining is examined in a total-system context. Measures of effectiveness are postulated and alternative approaches are synthesized. These alternative approaches are then evaluated and ranked on an effectiveness scale. From the visible rationale, thus developed, conclusions are derived and future relevant tasks are presented.

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Independently Mobile						
Remote Control						

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U. S. ARMY MOBILITY EQUIPMENT
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ARMY COUNTERMINE MOBILITY EQUIPMENT SYSTEM (ACMES)

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November 1971

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SUMMARY

The mechanism of mobility kills of combat, armored, tracked vehicles by harassment mining is examined in a total-system context. Measures of effectiveness are postulated, and alternative approaches are synthesized. These alternative approaches are then evaluated and ranked on an effectiveness scale. From the visible rationale thus developed, conclusions are derived and future relevant tasks are defined.

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ARMY COUNTERMINE MOBILITY EQUIPMENT SYSTEM (ACMES)

I. INTRODUCTION

The use of harassment mines against mobility equipment is highly resource-effective from the viewpoint of the mine layer. This condition arises from the practical difficulties of accomplishing effective detection and then neutralization under field combat conditions. Relatively small, simple explosive charges set off by contact, delay, influence, or command fuzing will almost certainly break the vehicle track and thus inflict a mobility kill. There is also a high probability that additional damage from the blast will be limited to the first and second road wheels of the vehicle, while the engine, power train, weapons, crew, and remaining wheels will generally be intact and operable. But, in spite of the relatively minor structural damage that is incurred from a mine hit, the critical function of mobility is lost. After loss of mobility, the vehicle and crew then become highly vulnerable to destruction by artillery, antitank weapons, and sappers.

This study begins with the proposition that future improvements in the theory and practice of mine detection and mine neutralization may not influence to any significant extent the enemy resource effectiveness of harassment mining. From this proposition, it is postulated that a balanced Army Countermine System should also include a capability to maintain mobility independent of the detection and neutralization limitations that may be imposed upon the total system. This approach has the potential to reduce mobility losses where little or no detection and neutralization capability per se is present. Then, in the event that detection and neutralization capabilities become significantly improved, effective countermine systems could be rapidly tailored to meet a variety of threats and threat combinations.

The general concept for a countermine total system is outlined in Fig. 1. This approach to a total countermine system emphasizes the maintenance of vehicle mobility in the "press on" mode. With this concept, neutralization either blindly or after detection and bypassing after detection are considered to be functions of other subsystems.

II. APPROACH TO THE PROBLEM

The top-level function flow diagram presented in Fig. 2 depicts the total countermine system (vehicular) as a series of optional functions and outcomes. The heavy line on this diagram indicates the thrust of the study where a mine is encountered and a hit is incurred. The relationships do not imply that detection and neutralization were employed but only that a damage-producing hit was taken by the vehicle.

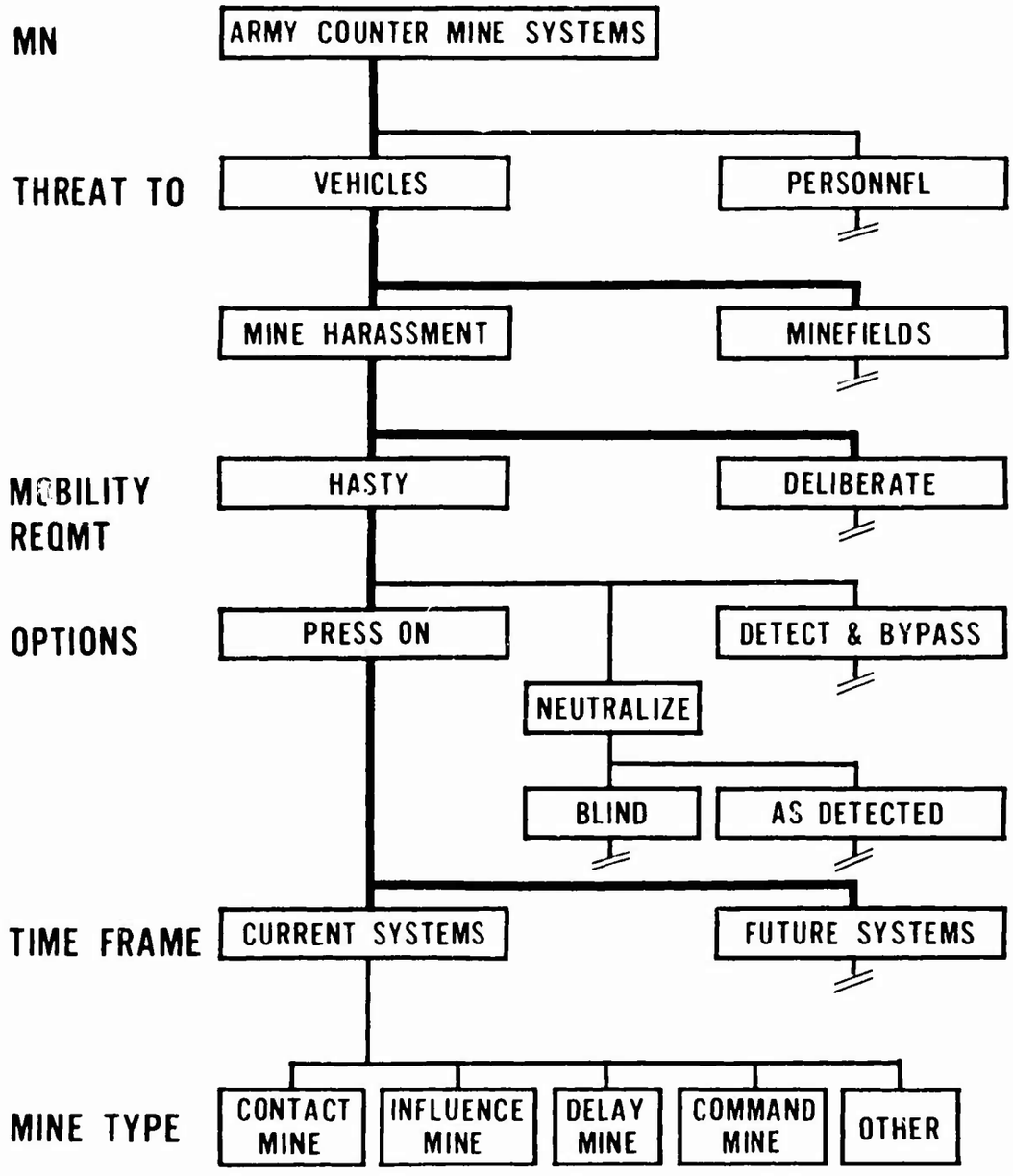


Fig. 1. Countermine total-system concept.

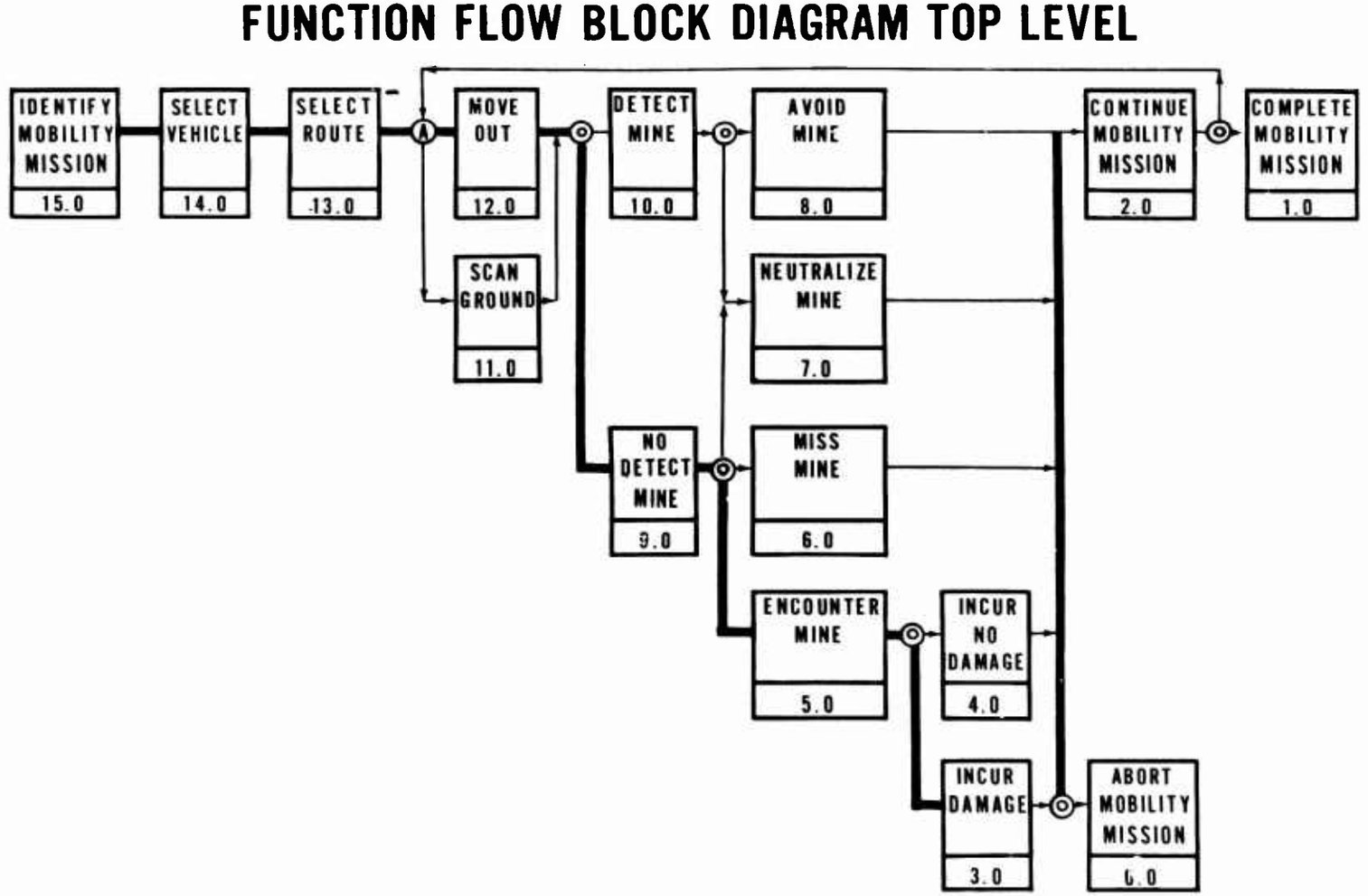


Fig. 2. Vehicle countermine system—function flow block diagram.

This diagram provides a degree of perspective to the system behavior and establishes a framework for some tentative observations:

a. If function 11.0, "Scan Ground," imposes a penalty upon vehicle mobility by necessitating a slow advance, then the threat system effectiveness is high. In some situations, scanning activity might also cause preoccupation and distraction from the prime mission.

b. If function 7.0, "Neutralize Mine," is performed only after function 10.0, "Detection," then function 2.0, "Continue Mobility Mission," is a conditional probability ($P_{Detect} \times P_{Neutralize} = P_{Continue}$) that has severe state-of-the-art limitations. If function 7.0, "Neutralize Mine," is performed without first detecting the mine, i.e., blindly, then $P_{Continue}$ would be higher and more favorable but costly in time, materiel, and other resources. The threat-system effectiveness would be reduced sharply, however, if blind neutralization can be accomplished rapidly and without a mobility penalty.

c. The idea of taking a mine hit with no loss or serious degradation of vehicle mobility (function 5.0 to function 4.0) is highly attractive, but this leads directly to the historical trade off between vehicle mobility and vehicle armor. Each specific armored vehicle design represents a compromise solution and will remain so until ballistic protection can be obtained without inert weight.

This problem is much too complex for discussion here; so, for simplicity, it will be assumed that armored vehicles in the current inventory are optimum in regard to mobility vs armor for their intended mission.

d. The sequence from function 5.0, "Encounter Mine," to function 3.0, "Incur Damage," to function 2.0, "Continue Mobility Mission," should be examined in detail. With this objective, the outcomes of function 3.0, "Incur Damage," are shown in Fig. 3. From this, the problem may be stated.

III. STATEMENT OF THE PROBLEM

Loss of armored vehicle mobility due to encounter with a mine and subsequent destruction of critical mobility components.

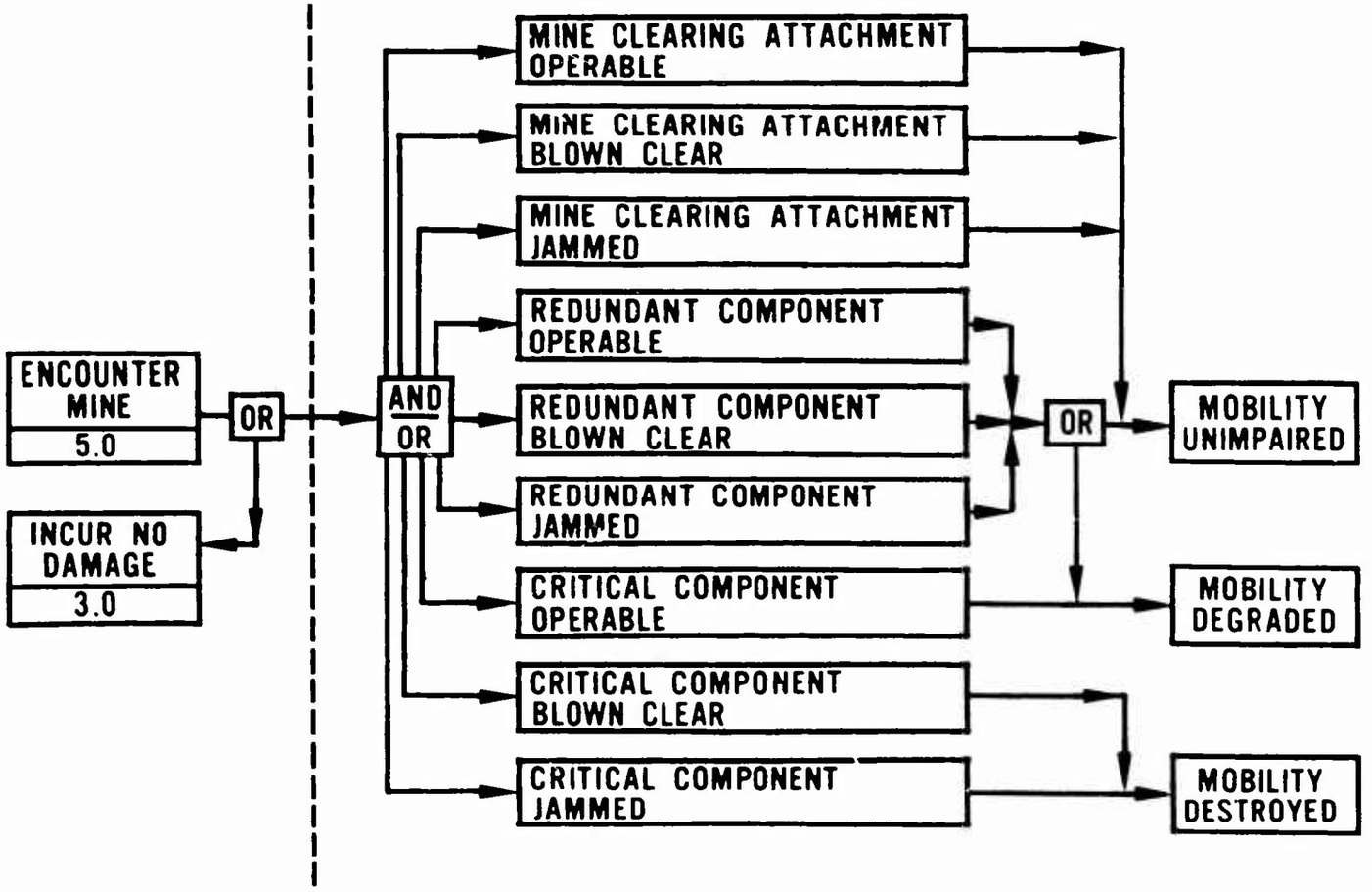


Fig. 3. Outcomes of function 3.0, "incur damage."

IV. STATEMENT OF THE MATERIEL NEED (MN)

Provide combat, armored, tracked vehicles with the capability to maintain mobility after encounter with a mine. Assume that mobility after the encounter can be ___% of the original mobility.

V. ANALYSIS OF DATA

Before the synthesis of alternative approaches is begun, two tasks must be accomplished to provide an information base:

1. Identification and assessment of the credible modes of mobility impairment or mobility loss due to mine damage.

2. Identification of measures of effectiveness that will assist in the evaluation of alternative approaches to the problem.

For the identification and assessment of modes of mobility impairment due to a mine encounter, the Battle Damage Assessment Reporting Program (BDARP) from the Republic of Viet Nam for June 1969 to July 1970 is particularly helpful.

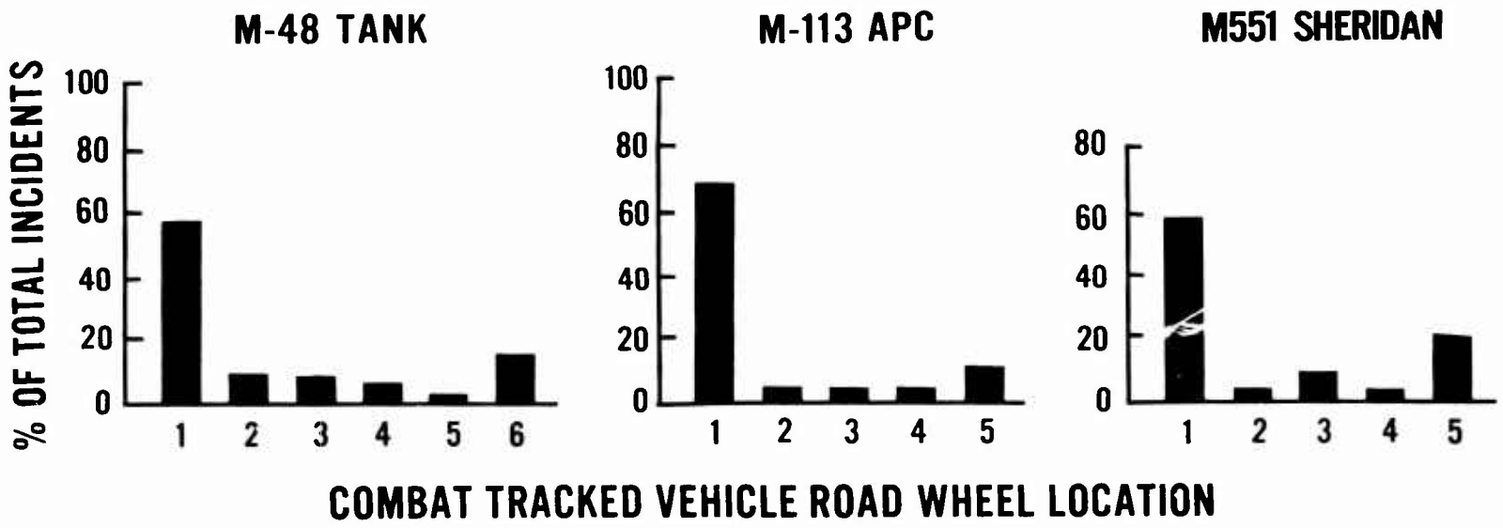
As a part of the countermine study, the BDARP individual incident data sheets were studied for mine-hit location and hit severity on combat, tracked vehicles. These data encompassed:

M-48 Tank incidents	80*
M-113 APC incidents	230*
M-551 Sheridan incidents	70*

Hit location for these incidents is presented in Fig. 4. The horizontal axis depicts road-wheel location, from vehicle front to rear, and the vertical axis expresses the incidents with a specific wheel hit as a percentage of the total number of incidents. The chart shows that about 70 percent of all vehicle hits occur on the first and second road wheels. The percentage is slightly higher when rear-wheel hits are regarded as first-wheel hits when the vehicle is backing up.

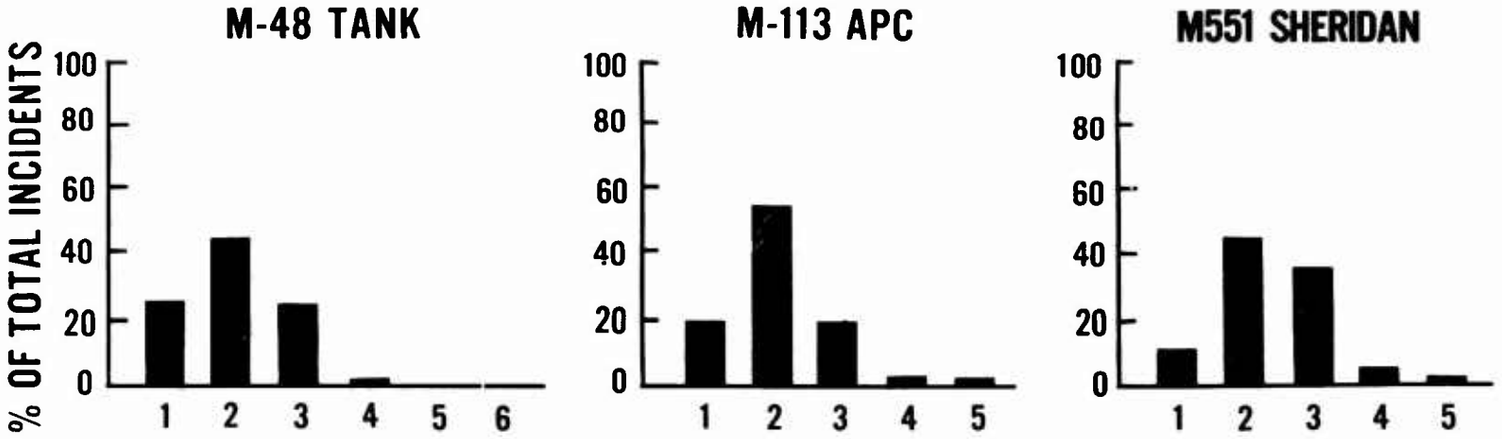
Hit damage for these incidents is presented in Fig. 5. The horizontal axis depicts the number of road wheels damaged or removed by a single hit, and the vertical axis

*Approximate numbers



* DATA SOURCE: BATTLE DAMAGE ASSESSMENT REPORTING PROGRAM (BDARP)-JUNE 69-JULY 70, REPUBLIC OF VIETNAM

Fig. 4. Mine hit location on combat, tracked vehicles.



NOTE: IN OVER 90% OF ALL MINE INCIDENTS INCLUDING COMBAT TRACKED VEHICLES, THE TRACK IS DAMAGED OR BROKEN AND THE SUSPENSION IS DAMAGED RESULTING IN MOBILITY KILL ON THE VEHICLE.

* DATA SOURCE: BATTLE DAMAGE ASSESSMENT REPORTING PROGRAM (BDARP) - JUNE 69- JULY 70, REPUBLIC OF VIETNAM

Fig. 5. Single mine hit damage to combat, tracked vehicles.

again expresses the percentage of total incidents. In more than 90 percent of all mine incidents involving tracked vehicles, the track is either broken or thrown off.

Photographs from typical BDARP reports are reproduced as Figs. 6, 7, and 8. The corresponding BDARP raw reports are reproduced in Appendix A. Summarizing, these data support the conclusion that harassment mining in the SEA environment produces a mobility kill by removing or destroying track and the first two road wheels in 60 to 70 percent of all incidents.

VI. MEASURES OF EFFECTIVENESS

The measures of effectiveness (MOE) by which the degree of attainment of system goals is evaluated are postulated as follows:

1. **Mobility before Hit.** This MOE is based upon the position that the countermine system should not impose a penalty upon the mobility of the vehicle. If, for example, the vehicle has a capability to move at 20 mph in a given environment, the countermine system should also function effectively at 20 mph. Otherwise, the mine is undesirably resource effective from the time standpoint.

2. **Mobility after Hit.** This MOE is based upon the belief that the mobility vehicle should have the capability to take a moderately sized hit and still be able to either move to shelter or continue the mission. The capability to continue the mission after loss of two road wheels and corresponding track on one side or the other is, of course, a prime objective of this study. This MOE may be regarded as an effort to again avoid the armor weight versus mobility trade off.

3. **Resistance to a Mobility Kill.** The purpose of this MOE is to place a premium upon alternative concepts that will reduce the enemy benefits of minefields and harassment mining when used against armored, tracked, combat vehicles.

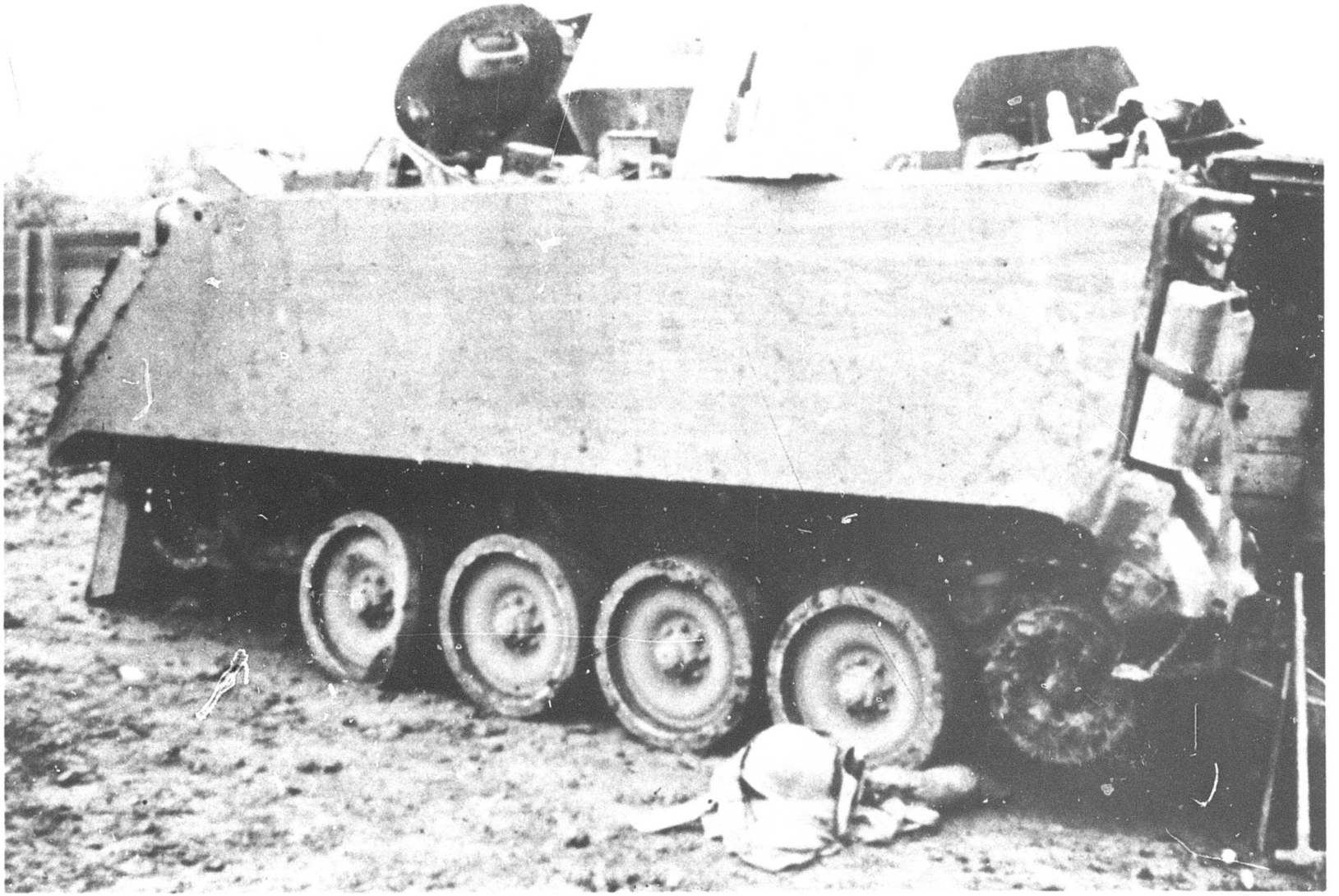
4. **Cost Exchange Ratio (CER).** The word "cost" in the CER refers to the resource or resources most valued by the blue and red forces. It may encompass money, time, men, political impact, and other values. For example:

Minefield Installation Time (RED)	0.01 HR/M^2
Minefield Location Time (BLUE)	0.09 HR/M^2
Minefield Clearing Time (BLUE)	0.12 HR/M^2

$$\text{Then: } \frac{\text{Time to Install (RED)}}{\text{Time to locate and clear (BLUE)}} = \frac{0.01}{0.09 + 0.12} = \frac{1}{21}$$

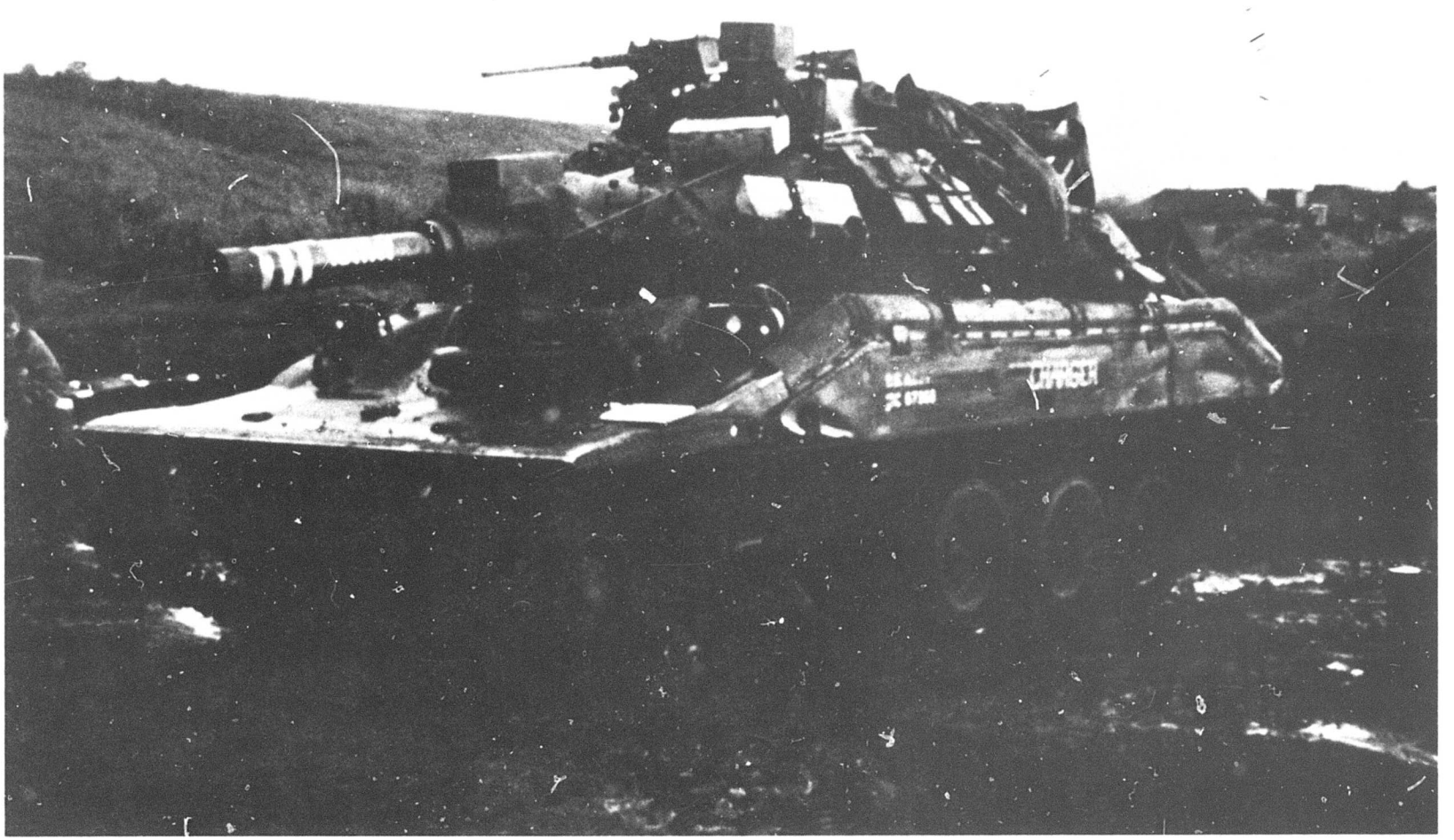
T12732

Fig. 6. Battle damage assessment reporting program: tank hit.



T12736

Fig. 7. Battle damage assessment reporting program: armored personnel carrier hit.



T12741

Fig. 8. Battle damage assessment reporting program: Sheridan vehicle hit.

Then, the cost exchange ratio of 1/21 indicates a time-effective advantage of mining. For another example of the CER concept for measuring effectiveness, consider a red mine costing $50.00 destroying a blue vehicle costing $500,000.00.

$$CER = \frac{\text{Red Cost}}{\text{Blue Cost}} = \frac{50}{500{,}000} = \frac{1}{10{,}000}$$

5. Other Factors. "Effectiveness" is generally defined as the product of availability, dependability, and capability. In this initial study, capability is being emphasized and consideration of availability, dependability, and CER is deferred. The CER concept, schedule, and other cost considerations will get more attention in future studies especially where the impact of red counter-countermeasures upon the countermine system is examined.

VII. ALTERNATIVE APPROACHES

In this initial study, 17 conceptual approaches have been selected for examination and comparison. The selection encompasses a broad range of ideas some of which can be traced to the beginnings of armored-vehicle design. To provide for a high degree of potential applicability, much attention was given to concepts that could be reduced to practice by retrofit or field modification. The concepts that require intensive redesign or modification of the base vehicle are included more to stimulate total system thinking than to presume capability for the design of armored vehicles.

An arbitrary scale of effectiveness (E) has been applied to each concept using numbers from 1 to 10: for a low estimated effectiveness, E=1; and for a high estimated effectiveness, E=10. Intermediate numbers have a more or less linear relationship. These estimates were derived from judgments of the probable outcome of a vehicle when encountering either contact, delay, influence, or command mines. Then, in order to arrive at a simple, credible basis for comparison and selection, the numerical values assigned to each of the three measures of effectiveness were combined by addition. The numbers have not been weighted or otherwise manipulated.

For an example of the rationale used, Fig. 9 presents a comparison of baseline vehicle configurations using the M-48 tank, the M-113 armored personnel carrier, and the M-551 Sheridan reconnaissance vehicle. Each of these vehicles is judged to have a high mobility before hit, E=10; and zero mobility after hit, E=0. Their overall countermine effectiveness is then rated as 10 + 10 + 10 + 10 = 40.

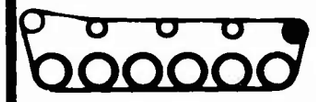
BASELINE DESCRIPTION	M-48 TANK 				M-113 ARMORED PERSONNEL CARRIER 				M551 SHERIDAN RECON. VEHICLE 			
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL	INF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	10	10	10	10	10	10	10	10	10	10	10	10
MOBILITY AFTER HIT	0	0	0	0	0	0	0	0	0	0	0	0
RESISTANCE TO MOBILITY KILL	0	0	0	0	0	0	0	0	0	0	0	0

Fig. 9. Effectiveness of baseline vehicles M-48, M-113, and M-551.

In Fig. 10, three outboard, ground-contacting, countermine vehicle accessory concepts are presented and rated by estimated effectiveness against hits from the same four mine types.

1. **Concept 1 — Plow.** When mobility before hit is evaluated, the plow is assumed to be deployed in a mine-clearing mode. This deployment severely limits cross-country speed of the vehicle, and the concept carries a heavy "Before Hit" mobility penalty. When the deployed plow encounters a mine, the mine is removed from the vehicle path unless anti-handling fuzing is used. Then, depending upon whether the encounter is destructive or nondestructive, the plow may be discarded, raised, or held in the mine-clearing position. Mobility is maintained. Since the plow effectiveness is generally insensitive to mine type, the concept is regarded as having a high resistance to mobility kill. One plow concept is shown in Fig. 11.

2. **Concept 2 — Roller #1.** This concept embodies a single-axis roller which clears mines by duplicating the ground-pressure signature of the vehicle that it precedes. The roller will also have an inherent magnetic and seismic signature that might be deliberately enhanced to provide a capability against influence-fuzed mines. The roller must "track" with the vehicle it is protecting, and this may tend to limit vehicle mobility somewhat. However, roller mobility appears higher than plow mobility in most situations. After a single mine hit, the vehicle will discard the roller and continue the mission with mobility unimpaired. A sample expendable roller concept is shown in Fig. 12.

3. **Concept 3 — Roller #2.** This concept is similar to the concept of the single-axis roller just described except that two banks of rollers are employed as a tandem unit. With its greater mass and size, this roller has a higher effectiveness than a single roller against influence mines, and its effectiveness against delay and command mines should be slightly better. The greater mass and size also work a penalty upon vehicle mobility before a mine hit.

Figure 13 presents two additional outboard, ground-contacting accessory concepts. These units are independently driven and thus differ significantly from the vehicle-powered accessories just described.

4. **Concept 4 — Forward-Wheel Signature Duplicator.** This is a tracked, independently powered outboard accessory. It clears mines from the path of the vehicle it precedes by duplicating the pressure, seismic, magnetic, or impulse signature of the combat vehicle. Several operational options are attractive with this concept. For example, in mobility operations, this accessory could be rigidly fixed to the basic vehicle and constrained to track with it (Fig. 14). The accessory vehicle would then serve to improve vehicle mobility. Delay or command mines would be expected to hit either

the accessory or the vehicle, but vehicle mobility would, in each case, be maintained. Additionally, the outboard accessory could be made to operate in a unique mine-clearing mode independent of the prime or basic mobility vehicle (Figs. 15, 16, 17). (The use of multiple, remote-mode, accessory units in wedge, line, column, or echelon formation is attractive but beyond the scope of this study.)

5. **Concept 5 – Roller #3.** This concept is similar to Concept 3 except that independent power is added to provide higher mobility before a mine hit. In summary, each of these outboard, ground-contacting accessory concepts will maintain much of the original vehicle mobility after a single mine encounter. However, severe penalties are incurred in mobility before the mine encounter in concepts 1 and 2.

6. **Other Concepts.** The remaining concepts are directed to envisioning the ways in which vehicle-drive redundancy may be achieved. Three variations of two tracks with only one track driven (on each side) are presented in Fig. 18. The black disc represents the vehicle drive sprocket. With the exception of the M-551, these concepts represent major modifications to equipment in the current inventory. A simple, shop-modification split track to the M-551 Sheridan is shown in Fig. 19. In each of these variations, mobility before a hit is greater than with unpowered, outboard accessories. Mobility then decreases with the number of ground-contacting, track-driven road wheels. To evaluate mobility after a hit implies that some degree of mobility remains. For this, the rear track and drive must be operable and the vehicle balance must not be seriously disturbed. For the evaluation of resistance to a mobility kill, BDARP data was used. It is important to note that resistance to a mobility kill decreases with reduced vulnerable target area.

Figure 20 depicts three variations of two driven tracks on each side of the vehicle. These concepts are definitely not in the "quick fix" category and would most likely require new vehicle design. The additional drive mechanism in these concepts increases mobility before hit to well above the three single-drive concepts just discussed. However, in either single drive or dual drive with double track, mobility after a hit is the same, but the double-drive, split track is much superior in terms of resistance to a mobility kill. (Again, the vulnerable target area has been reduced.)

Figure 21 depicts three variations of the Christie concept of independently driven road wheels. Mobility before a hit has been rated as equal to the mobility of the split-track, single-drive concepts. With two driven wheels, mobility after a hit is rated as quite low. An attractive feature of the Christie concept is the high resistance to a mobility kill when more than two road wheels are independently driven. Here, destruction of all mobility by a single mine is quite remote.

BASELINE DESCRIPTION	1. PLOW, TRACK WIDTH 				2. ROLLER, TRACK WIDTH, SINGLE WHEEL. 				3. ROLLER, TRACK WIDTH, TWO WHEELS (TRACKED). 			
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	1	1	1	1	3	3	3	3	2	2	2	2
MOBILITY AFTER HIT	10	10	10	10	10	10	10	10	10	10	10	10
RESISTANCE TO MOBILITY KILL	10	10	10	10	10	1	2	1	10	2	4	2

Fig. 10. Effectiveness of outboard, ground-contacting countermine accessories.

T12515

Fig. 11. Mine-clearing plow.

S1499

Fig. 12. Mine-clearing roller.

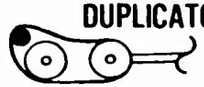
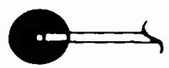
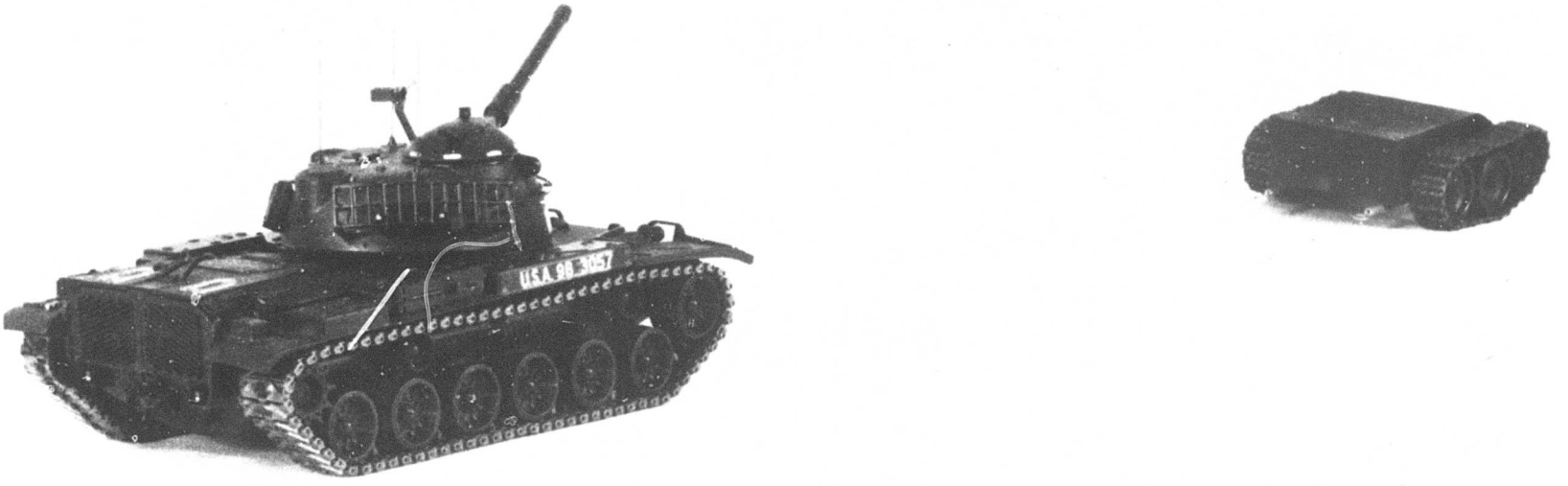
BASELINE DESCRIPTION	4. COMBAT TRACKED VEHICLE FRONT END SIGNATURE DUPLICATOR. 				5. ROLLER, TRACK WIDTH,POWERED. 							
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	10	10	10	10	8	8	8	8				
MOBILITY AFTER HIT	10	10	10	10	10	10	10	10				
RESISTANCE TO MOBILITY KILL	10	2	10	4	10	1	2	1				

Fig. 13. Effectiveness of outboard, ground-contacting countermine accessories—independently driven.

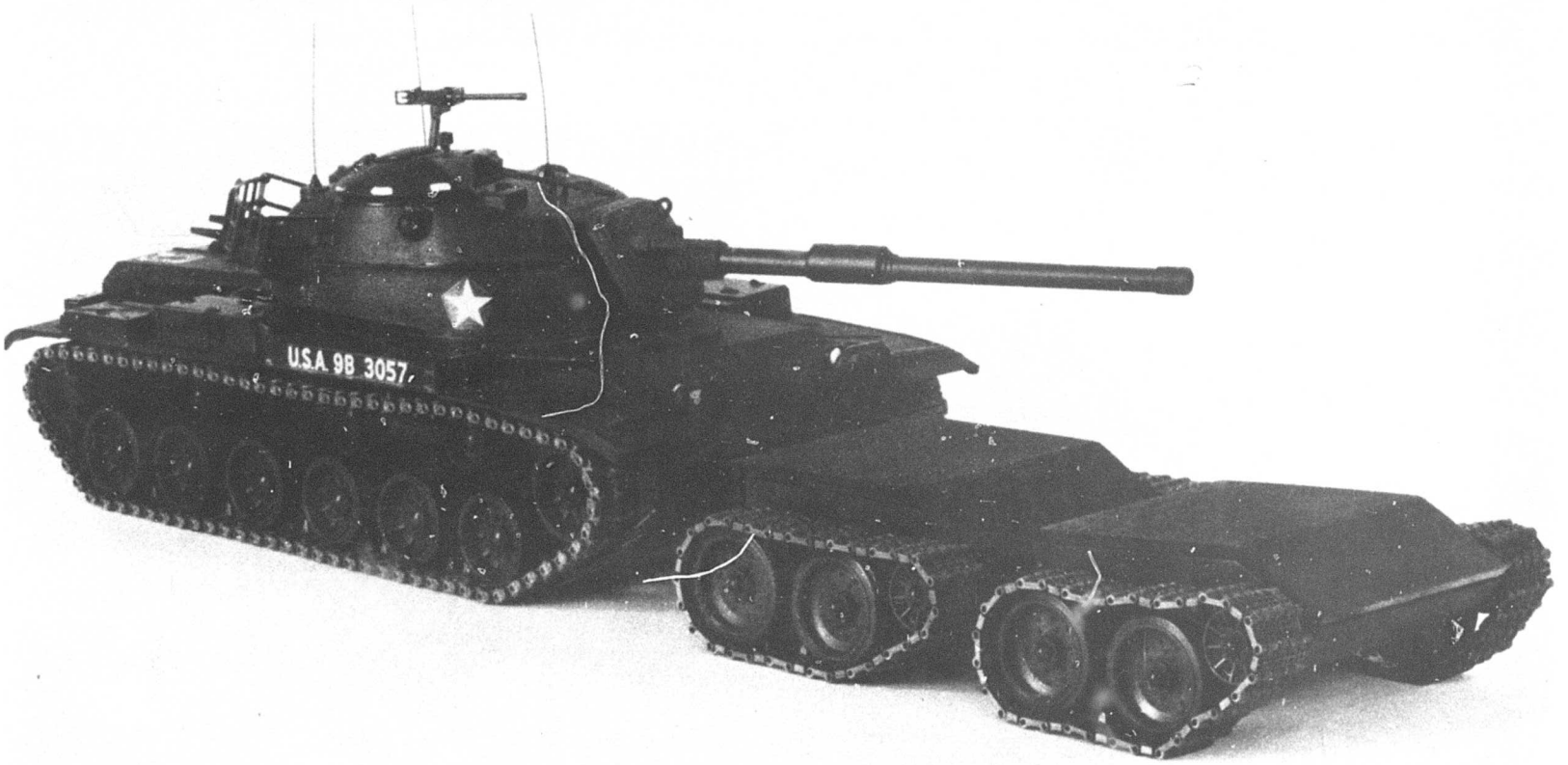
T12149

Fig. 14. Forward-wheel signature duplicator—independently driven, in close-coupled mode.



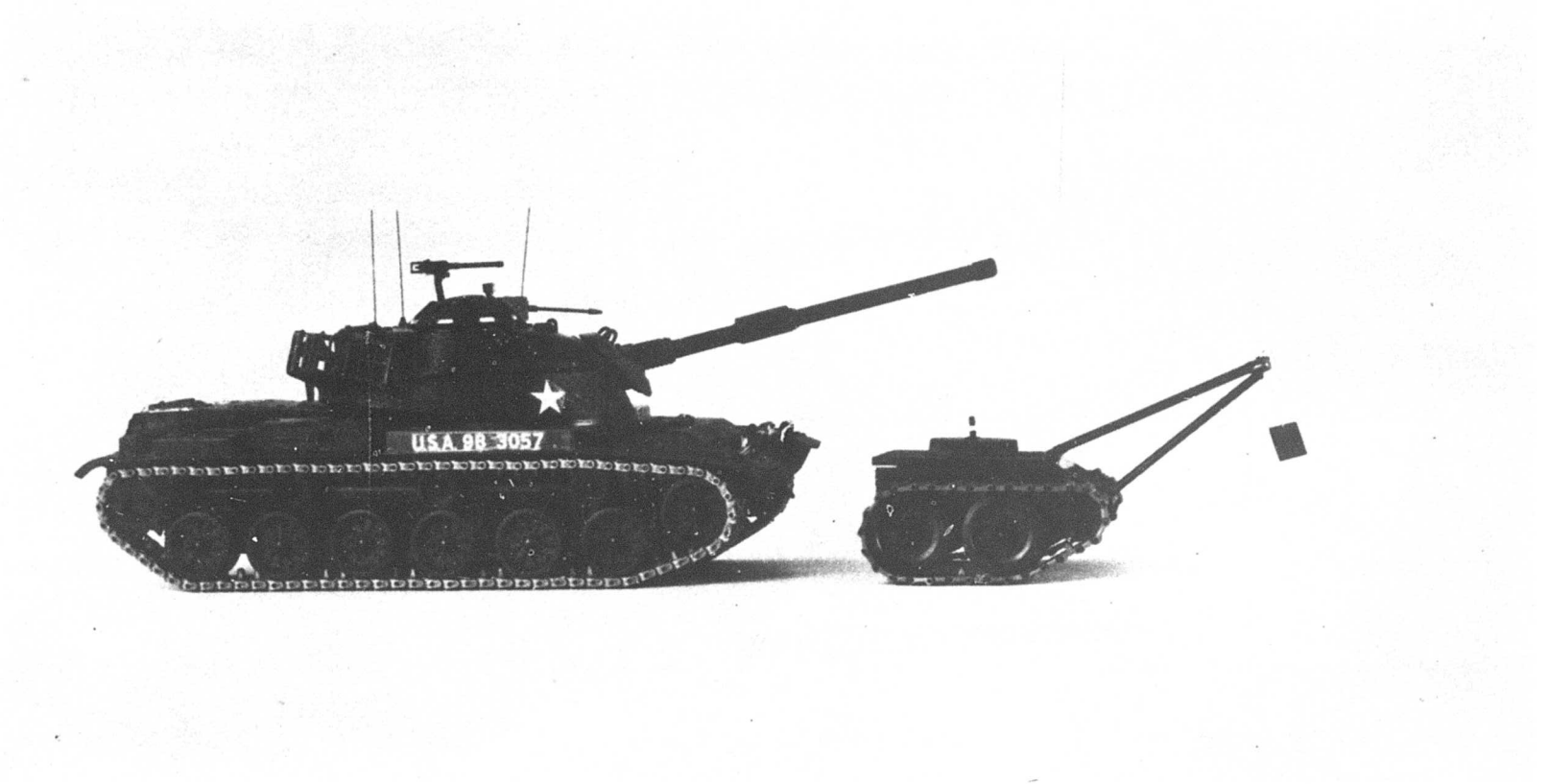
T12145

Fig. 15. Forward-wheel signature duplicator—independently driven, in remote mode.



T12152

Fig. 16. Forward-wheel signature duplicator—independently driven, in high-density threat mode.

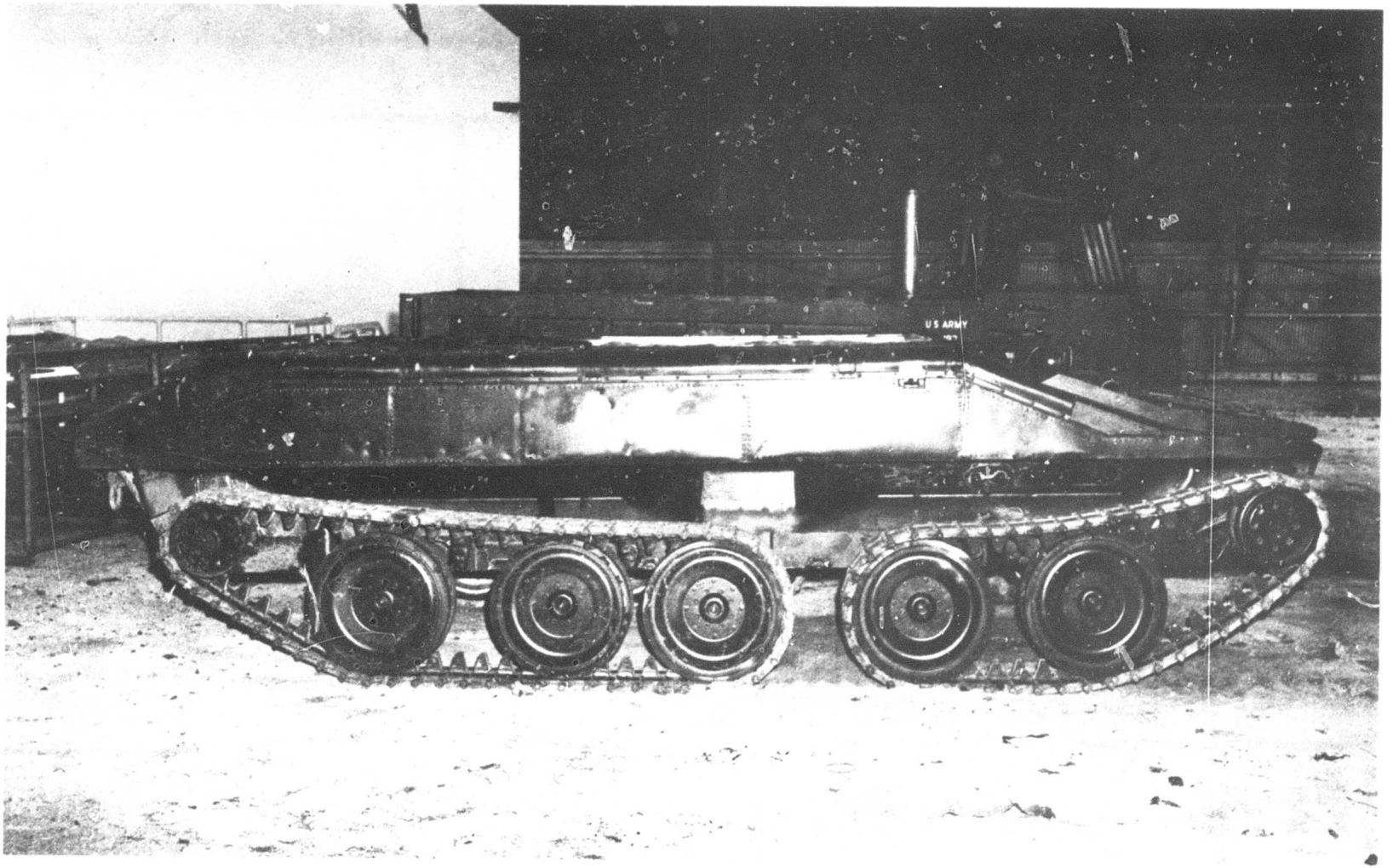


T9562

Fig. 17. Forward-wheel signature duplicator—independently driven, as a platform for detection and neutralization equipment.

BASELINE DESCRIPTION	6. 1 WHEEL FORWARD				7. 2 WHEELS FORWARD				8. 3 WHEELS FORWARD			
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	7	7	7	7	6	6	6	6	5	5	5	5
MOBILITY AFTER HIT	7	7	7	7	6	6	6	6	5	5	5	5
RESISTANCE TO MOBILITY KILL	2	2	2	2	7	3	3	3	9	4	4	4

Fig. 18. Effectiveness of single-drive, two-track mobility redundancy.



T9545

Fig. 19. Single-drive, two-track shop modification of Sheridan tank hull for mobility evaluation.

BASELINE DESCRIPTION	9. 1 WHEEL FORWARD				10. 2 WHEELS FORWARD				11. 3 WHEELS FORWARD			
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	7	7	7	7	8	8	8	8	9	9	9	9
MOBILITY AFTER HIT	7	7	7	7	6	6	6	6	5	5	5	5
RESISTANCE TO MOBILITY KILL	3	5	5	5	8	6	6	6	10	7	7	7

Fig. 20. Effectiveness of two-drive, two-track mobility redundancy.

BASELINE DESCRIPTION	12. 2 WHEELS DRIVEN ●⊙⊙⊙⊙●				13. 3 WHEELS DRIVEN ●⊙●⊙⊙●				14. 4 WHEELS DRIVEN ●⊙●●⊙●			
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	iNF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	5	5	5	5	6	6	6	6	7	7	7	7
MOBILITY AFTER HIT	2	2	2	2	5	5	5	5	8	8	8	8
RESISTANCE TO MOBILITY KILL	9	6	6	6	10	8	8	8	10	10	10	10

Fig. 21. Effectiveness of Christie-drive mobility redundancy.

BASELINE DESCRIPTION	15. 2 WHEELS DRIVEN				16. 3 WHEELS DRIVEN				17. 4 WHEEL'S DRIVEN			
MINE TYPE	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.	CON.	DEL.	INF.	COM.
EFFECTIVENESS:												
MOBILITY BEFORE HIT	10	10	10	10	10	10	10	10	10	10	10	10
MOBILITY AFTER HIT	2	2	2	2	5	5	5	5	8	8	8	8
RESISTANCE TO MOBILITY KILL	9	6	6	6	10	8	8	8	10	10	10	10

Fig. 22. Effectiveness of independently driven, tracked wheels for mobility redundancy.

TRADE STUDY SUMMARY

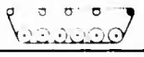
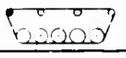
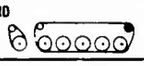
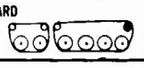
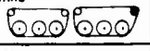
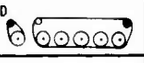
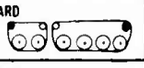
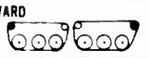
CONCEPT DESCRIPTION	EFFECTIVENESS	RELATIVE RANK
A M-48 TANK 	40	~~15~~ 16
B M-113 APC 	40	~~15~~ 16
C M-551 RECON VEHICLE 	40	~~15~~ 16
1 PLOW TRACK WIDTH 	84	7
2 ROLLER TRACK WIDTH SINGLE WHEEL 	66	12
3 ROLLER TRACK WIDTH TWO WHEELS TRACKED 	66	12
4 COMBAT TRACKED VEHICLE FRONT END SIGNATURE DUPLICATOR 	106	2
5 ROLLER TRACK WIDTH POWERED 	86	6
6 1 WHEEL FORWARD 	64	13
7 2 WHEELS FORWARD 	64	13
8 3 WHEELS FORWARD 	61	14
9 1 WHEEL FORWARD 	74	11
10 2 WHEELS FORWARD 	82	8
11 3 WHEELS FORWARD 	87	5
12 2 WHEELS DRIVEN 	53	~~17~~ 15
13 3 WHEELS DRIVEN 	78	9
14 4 WHEELS DRIVEN 	96	3
15 2 WHEELS DRIVEN 	75	10
16 3 WHEELS DRIVEN 	94	4
17 4 WHEELS DRIVEN 	112	1

Fig. 23. Comparison of relative effectiveness of concepts.

Figure 22 depicts three variations of tracked, independently driven road wheels. The only difference in effectiveness between these and the Christie concepts of Fig. 21 is higher mobility before a hit. This is due to the use of a track.

From this treatment of effectiveness against a specific threat, the 17 alternative concepts for a countermine mobility system may be compared and evaluated. The comparison is presented in Fig. 23. Three current vehicles, the M-48, M-113, and M-551, are included to serve as a baseline. At this point, it should again be emphasized that the assignment of numbers to the postulated measures of effectiveness is by no means absolute. These numbers are based upon engineering judgment made at this point in the study and will be revised and refined as the data base is strengthened. It does appear, however, that the conclusions to be derived from this treatment are relatively insensitive to the specific numerical values of effectiveness that have been assigned to the various conceptual approaches.

VIII. CONCLUSIONS

The following tentative conclusions appear to be credible and intuitively acceptable:

1. Outboard, independently driven, ground-contacting, signature-duplicating countermine accessories are:

   a. Significantly more effective than similar unpowered units.

   b. More effective than redundant tracks and drives.

   c. As effective as three or more independently driven road wheels.

2. The use of such countermine outboard accessories can significantly improve and expand the mobility of the current family of armored, tracked, combat vehicles in a broad variety of missions where minefields or harassment mines may be encountered.

3. Although costs have not been formally considered in this study, it appears that the life-cycle costs of outboard countermine accessories would be quite low in comparison to vehicles incorporating redundancy of mine-susceptible drive components.

IX. PROPOSED FUTURE PLANS

The ACMES concept should be further examined and evaluated by means of the following tasks:

1. Design and build an experimental test model of a self-powered, tracked accessory that will duplicate the mine signature of a selected combat, armored, tracked vehicle.

2. Conduct an analysis/engineering study to further quantify and refine measures of effectiveness appropriate to both harassment mines and minefields.

3. Determine the relative cost of the most appropriate concepts presented in the present study.

4. Identify and evaluate power plants suitable for the ACMES concept as it may evolve.

5. Expand the current analysis to include multiple hits.

6. Prepare "design to" system engineering documentation for an independently driven, tracked, track-width, mine-clearing roller.

7. Initiate formal staffing of the first draft proposed materiel need (IDPMN) contained in Appendix B.

APPENDIX A

BATTLE DAMAGE ASSESSMENT AND REPORTING TEAM (BDART) REPORTS

Completion Date 26 SEP 69

1. Case No. ABD 02. 69082 CO

~~2. Number of Incidents:~~ _____

3. Total Exhibits: 10

   a. Photos 9

   b. Fragments/Missiles 0

   c. X-Rays 0

   d. Other Exhibits 1

4. Incident Recapitulation:

   a. Materiel 1

   b. Personnel 0

5. Remarks:

Only one personnel available for interview

EQUIP M113

Weapon: 60-LB Mine

CASE NO. AFD 02 69082 00

DATE 26 SEP 69

INCIDENT COVER SHEET

Table of Contents		Quantity
Section A		
Part I	- Case Scenario	1
Part II	- Equipment Damage	1
Part III	- Personnel Injuries	1
Part IV	- General	1
Part V	- Observer Interview	1
Part VI	- Sketch	0
Section B		
Set II	- Wounding Agent Data	
Set IV	- Autopsy Supplement	
Set V	- Medical Evaluation and Treatment	
Set VI	- Interview of Casualty	
Set VII	- Interview of Others	
Set VIII	- Burn Supplement	
Set IX	- Body Armor	
Set XI	- Troop Interview	
Section C		
1.	Photographs (or negatives)	9
2.	X-Rays	0
3.	Recovered Missiles	0
4.	Photo Caption Sheet	1
5.	Other Exhibits vehicle diagram	1

FILM CAPTION DATA

CASE NO. ABD 02-69082-00

ROLL/PACK NO:	FILM TYPE	DATE
11	Ektachrome	10 Sep 69

Location of Photo Coverage

Quan Loi

Photographer	Camera Number	Lens Number
SSG Jones	4000	Zoom

Frame No.	CAPTION
1	Slate
2	Left side
3	Final drive assembly
4	#1 roadwheel and hull damage
5	#2 roadwheel
6	Engine access area (door blown off)
7	"
8	Driver's seat --edge broken off by blast
9	"

BATTLE DAMAGE ASSESSMENT AND REPORTING TEAM I-11

PART I - Case Scenario

SOURCES OF INFORMATION

Miller Paul F E-5
(Job Title or Position of Person Interviewed)

479 - 62 - 8369 T.C
(Job Title or Position of Person Interviewed)

(Job Title or Position of Person Interviewed)

CASE # ABD-02-69082-00

TEAM MEMBER SFC. GALE

DATE 10 SEPT 69

__SITREP

__INSCOM

__AFTER ACTION REPORT

(Other source of information)

(Other source of information)

1. Service involved: ✓Army __Navy __Marines __Air Force

2. Type Equipment:

✓M113 APC	__¼ T Trk	__105 Howitzer	__Aircraft (specify)
__M551	__3/4 T Trk	__155 Howitzer	
__M48 Tank	__2½ T Trk	__8" Howitzer	
__M88 VTR	__Other	__175mm Gun	
__M106 Mortar Carrier		__40mm "Duster"	
__M577 CP		__Towed	
__M548 Cargo		__SP	
__Other		__Other	

3. Federal Stock Number

4. USA Serial, Hull, or ~~Tail~~ Number 12A 62668

5. Unit Identification: a. 1-LD 3/11 ACR

b. APO 96257 c. CTZ I II (III) IV

6. Date/Time Group: a. Start of Mission 080800 SEPT 69

b. End of Mission

c. Of Incident 081100 SEPT 69.

NOT REPRODUCIBLE

CASE # AFT- 02-69082-00

7. Location of Incident: a. UTM Coordinates XT 711 828

b. Geographical Name AN LOC

c. Map Sheet Number 6332 III

8. Name of operation or mission number UNK

Brief description of maneuver during engagement, if possible, and remarks (sketch map oriented to north, time oriented, and direction of movement). Use Set 6 or reverse side of this page.

9. Equipment mileage or hour reading: a. Odometer or ~~hour~~ reading 2894

b. Mission mileage or time estimate UNK

10. Has this incident been reported by other means __Yes ✓No __Unknown

11. If so, describe or identify report(s) N/A

12. Size of friendly force: a. __Squad b. __Platoon c. __Company

d. __Battalion e. __Brigade f. __Other (specify)

1 TRP M-113 AND 1 COMPANY OF TANKS

13. Size of enemy force: a. __0-14 b. __15-60 c. __61-250 d. __251-700

UNK e. __700-1500 f. __1501-3500 g. __Over 3500

14. Type of enemy force: __VC __NVA __Other UNK

15. Estimated range in meters between forces at start of engagement:

a. __0-25 b. __25-50 c. __50-100 d. __100-150 e. __150-200

f. __200-300 g. __Over 300 (specify) MINE DAMAGE ONLY

16. Type mission: a. __Search & Destroy b. __Recon c. __Photo

d. __Clearing e. __Ambush f. __Securing g. __Combat Patrol

h. __Inactive i. ✓Recon in force j. __Other (specify)

17. Deployment: a. __Road March b. __Covering c. __Base Camp Defense

d. __Landing e. __Other (specify) COLUMN

CASE # AF- 02-69082-00

18. Terrain Contour: a. __Mountainous b. __Hilly c. __Gently Rolling
b. ✓Level e. __Other (specify) _____

19. Vegetation type: a. __Jungle b. __Clear Forest c. __Brush d. __High Grass e. __Tropical Swamp Forest f. ✓Plantation g. __Cultivated Area h. __Marsh i. __Swamp j. __Paddy k. __Other (specify) _____

20. Soil Type: 2. __Sandy b. __Silt c. ✓Clay d. __Gravel e. __Other (specify) _____

21. Soil Condition: ✓Wet __Dry

22. Equipment Speed: Was Equipment Moving when hit: ✓Yes __No
a. If moving, how fast 2-3 MPH
b. If speed was limited, Why? (1) __Terrain
(2) __Other than Terrain
(3) ✓Explain JUST START TO MOVE

23. Weather information:
a. Type: __Rain ✓HIGH Fog __Clear __Overcast __Other (specify) _____
b. Temperature: 90 °F e. Wind velocity NONE
d. Wind direction N/A e. Barometer reading _____
f. Relative humidity high

24. Visibility: a. Cloud cover ✓Yes __No b. Height 300 feet
c. Visible range 1000 METERS d. If night: __Full Moon __Half Moon __Quarter Moon __Star-light __Artificial illumination (specify type) _____

25. Direction of attack: a. __Frontal b. ✓Left Flank c. __Right Flank d. __Rear e. __Other (specify) _____

26. Was enemy detected before he engaged? __Yes ✓No

02-69082-00

27. How soon after sighting enemy did you fire: a. __Immediately b. ✓Did not return fire e. __Other (specify) _____

28. Who fired first: a. __Friendly b. ✓Enemy c. __Unknown

29. Intensity of enemy fire: a. __Light (1-10) b. __Moderate (10-25) c. __Heavy (Over 25) d. __Other MINE ONLY

30. Was cover and concealment used by friendly forces for personnel and/or equipment __Yes ✓No If yes, How? _____

31. What unused sources of cover and concealment were available: NONE

32. Acquisition information:

a. How was enemy detected: __Sight __Hearing __Sensor device (specify) WAS NOT DETECTED

b. What sensor (or sensor characteristics) would have detected the enemy earlier MINE DETECTOR

c. How accurate was fix on enemy firing positions: __10 meters __25 Meters __50 Meters __100 Meters __Over 100 Meters

d. How was fix determined NO FIX MADE

e. How long did it take you (or other crew members) to locate specific targets? NONE LOCATED

f. If night, was night observation device used? __Yes XNo

g. If Yes, specify type? N/A

33. Aircraft: a. Altitude _____ b. Dive angle used _____

c. Airspeed ___ Knots d. Evasive action used _____

e. Type weapons delivered _____

f. Type formation during flight _____

02-68082-00

Escort aircraft __Yes __No If yes, list below:

TYPE	NUMBER	MODEL
Fixed Wing		

h. Ground AA Fire information:

(1) Was firing source observed? __Yes __No

(2) Aircraft heading _____degrees

(3) Direction of source from aircraft (o'clock) _____

(4) Source: Identified __Yes __No Attacked? __Yes __No

If identified, what (type weapons)? _____

_____

02-69082-00

PART II - EQUIPMENT DAMAGE

1. Equipment was __Damaged ✓Destroyed

2. Equipment was damaged or destroyed by:

   a. __Direct fire
   b. __Indirect fire
   c. ✓Mines
   d. __Missiles
   e. __AA Fire
   f. __Accident (combat oriented)
   g. __Other (specify) _____

   Belly armor was installed!

3. What was mission of equipment? RECON IN FORCE.

4. Number of hits for which collected data is described below 1

Hit Number	1	2	3	4
a. Weapon/Mine Type & Model	MINE			
b. Round size/ mine weight	60			
c. Round type (AP, HE, etc).	HE			
d. Fuze type/ identification: (airburst, ground-burst)	PRESSURE			
e. Estimates of where fuze functioned	ON CONTACT			
f. Range of weapon to target (in meters)	0			
g. Hit location (Station No., Frame #, General Description	1ST ROAD WHEEL			
h. Attack angle of projectile to equipment				
Azimuth	0			
Elevation	-90			

i. Damaged major parts __engine __transmission __transfer case
✓Suspension system ✓Drive train __Fire controls __Main Armanent
✓Communications equipment __Radiator ✓Wheels __Other (specify)

Hit Number	1	2	3	4
j. Depth of Penetration (in inches)	N/A			
k. Did round perforate	Yes/No	Yes/No	Yes/No	Yes/No
l. If Yes continue Dimensions & shape of hole at entrance & exit	N/A			
m. Did spall occur	Yes/No	Yes/No	Yes/No	Yes/No
n. Effects of spall on personnel and components	N/A			
o. Path of penetrator/ perforation in equipment	N/A			
p. Projectile performance against spaced plates	N/A			

FIRE DAMAGE

5. Did a fire occur? __Yes ✓No

6. Cause of fire: __Mine __Direct fire weapon __Indirect fire
__Other (explain)

7. Location of fire damage

8. Damage caused by fire

FIRE DAMAGE (CONTINUED) CASE # ATD- 02-6902-00

9. Level of fuel (at time of incident: a. __¼ b. __½ c. __3/4 d. __Full

10. Material supporting combustion: a. __Gasoline b. __Diesel c. __Ammo

11. Was fire suppression equipment available? __Yes __No

12. Was there time to operate fire suppression equipment? __Yes __No

13. Was the fire suppression equipment used? __Yes __No

14. What type of fire suppression equipment was used __Installed __Portable

__Other (specify) _____

15. Was the fire suppression equipment effective? __Yes __No

16. Was there time to evacuate? __Yes __No

17. Did the crew evacuate?

Driver	Veh Comdr	Gunner	Loader
Pilot Lt Seat	Pilot Rt Seat		
__Yes __No	__Yes __No	__Yes __No	__Yes __No

Others (crew members only _____

__Yes __No __Yes __No __Yes __No __Yes __No

EXPLOSION DAMAGE (On or within the vehicle)

18. Did an internal explosion occur? __Yes ✓No
as a result of fire __Yes __No __Unknown

19. Was explosion __Immediate __Delayed. If delayed, how long _____

20. What was the cause of the explosion? __Ammo __Fuel __Other (specify)

_____

21. Damage caused by the explosion: _____

_____

BLAST DAMAGE

22. Was equipment damaged by an external blast: ✓Yes __No

23. What was the distance from blast to equipment (in meters)? a. X 0-10
b. __10-20 c. __20-30 d. __Over 30 e. __Other (specify) _____

24. Was equipment moved by the blast? ✓Yes __No If yes, how far? MOVED AHEAD 1 METER

25. Was equipment overturned by the blast? __Yes ✓No

26. Was equipment damaged by fragments due to the blast? __Yes ✓No

BLAST DAMAGE (CONTINUED) CASE # APP- 02-6908-00

27. Other damage caused by the blast? SEE BOTTOM OF PAGE

28. Describe fragment damage (if not covered elsewhere in form) N/A

29. Were doors or hatches open on equipment when damaged? Yes No

Left Side:
FINAL DRIVE AND SPROCKET BLOWN OFF
1ST ROAD WHEEL AND ROAD WHEELARM BLOWN OFF
DENT IN SPONSON 1 METER LONG X 7CM AT WIDEST POINT
HULL WARPED BETWEEN 1ST AND 2ND ROAD WHEEL
BOTH LATERALS DAMAGED
DRIVER SEAT BACK BLOWN OFF
BENT 50 CAL GUN SHIELD DOWN.
INTERNAL WIRING DAMAGED FOR RADIO

PART III - Personnel Injuries

1. Number of casualties (crew members only) __None __KIA 3 WIA __DOW
__MIA __MBI __DNHA

2.

	CASUALTY				
	Driver Pilot Lt Seat	Veh Condr Pilot Rt Seat	Gunner LEFT	Leader	Other Specify
a. Hit Number	/	/	/		
b. Casualty was KIA, WIA, MIA, or DOW	WIA	WIA	WIA		
c. Location of wound (head, neck, hand, torso, etc.)	LEG.	ARM.	BACK		
d. To what extent did each wounded perform his mission	0	80	0		
e. Where was casualty's assigned station	DRIVER'S HATCH	TC CUPOLA	LEFT GUN		
f. Was casualty at his assigned station (YES or NO) If not, where was he	YES	YES	YES.		
g. Was casualty evacuated (YES or NO) If yes, by whom If yes, when	YES TO REAR AREA	YES TO REAR AREA	YES. TO REAR AREA		
h. Was casualty wearing portective clothing If yes, specify type of protective clothing, i.e. body armor, flak jacket, etc.	NO	YES	YES		
i. Did protective clothing prevent injury or reduce injury	N/A	YES	YES		
j. What caused casualty (1) Penetrator (2) Fragment (3) Blast (4) Shock (5) Other (specify other)	BLAST	BLAST	BLAST		

CASE # AED- 02-69082-00

3. Number of casualties (passengers only) ✓ None __KIA __WIA __MIA
__DOW __NBI __IRHA

PART IV

CASE # ABT-C2-6905-00

1. Was equipment and/or major components operating when damaged? ✓ Yes __ No

Check equipment or components	Operating when damaged YES	NO	Continued to operate YES	NO	Remaining Capability (time related)	If shut down why?
__ Engine						
__ Transmission						
__ Transfer case						
__ Frame	✓			✓		SPROCKET blown OFF
__ Suspension	✓			✓		↓
__ Drive train	✓			✓		↓
__ Fire controls						
__ Main armament						
__ Communication equipment	✓			✓		
__ Radiator						
__ Wheels	✓			✓		SPROCKET OFF
__ Other (specify)	SEE PAGE 9.					

2. Was damaged equipment subsequently destroyed by friendly forces? __ Yes ✓ No

3. If equipment was damaged and had to be destroyed by friendly forces, was it used to aid in mission prior to destruction? __ Yes __ No N/A

4. If yes, how? N/A

5. Was damaged equipment repaired in field before mission was completed? __ Yes ✓ No If yes, estimate repair time (man hours) _____

6. Was equipment able to return to base or retreat to a safe location under its own power? __ Yes ✓ No If no, how retrieved TOWED BY VTR.

CASE # ABD- 02-6908-00

7. Was standard "On Vehicle Equipment" (OVE) in place on vehicle? ✓Yes __No
If no, where was it located? _____

8. What was composition and location of cargo? NONE

9. What additional items were on/or in the damaged equipment? NONE.

10. Action of the equipment after receiving the hit:

Ground vehicle/equipment reaction to hit:

a. __Continued its activity in an operable state.

b. __Discontinued activity but remained in operable state

c. ✓Was rendered inoperable

d. __Scrapped

Aircraft Reaction to hit:

e. __Continued to fly; mission completed.

f. __Continued to fly; mission not completed

g. __Forced to land; inspection/quick fix/took off

h. __Forced to land; later destroyed

i. __Forced to land; later recovered

j. __Crashed; aircraft recovered

k. __Crashed; aircraft not recovered

11. Is equipment repairable: __Yes ✓No If repairable, at what echelon?
a. __Organizational b. __DS Unit c. __GS Unit d. __Depot e. __CONUS
f. __Other (specify) N/A

12. Estimate total down time for repairs (man hours) N/A

PART V

CASE # ABT- 02-69052-00

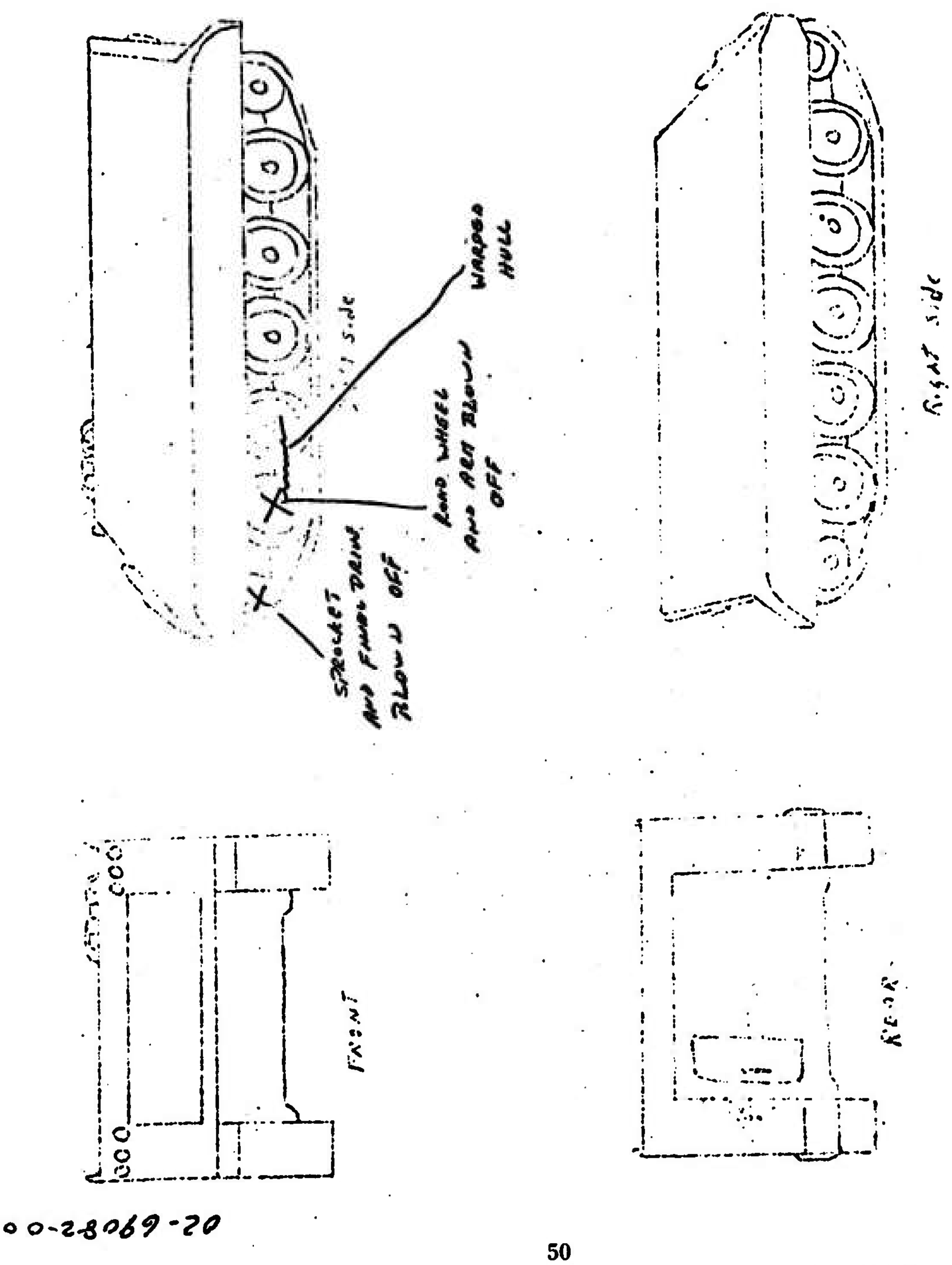
NAME/RANK MILLER PAUL F. E-5 UNIT ITRP 3/11 ACR

SSAN~~UNIT~~ 479-62-8369

1. Responsibility of person interviewed TC- M-113 (I 11)
2. Location of person interviewed at time of impact (relative to equipment damaged) TC- CUPOLA
3. Activity of person interviewed at time of impact GIVING DRIVER INSTRUCTIONS
4. Was the person interviewed wounded or injured as result of impact YES
5. Activity of the equipment at the time it was hit JUST STARTING TO MOVE.
6. What type of protection is inherent at point of damage MINE KIT
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred MINE KIT
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO
10. Approximate distance from: a. Weapon to equipment 0 meters
    b. Detonation of munition to equipment ___ meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) BLAST
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? __Yes ✓No Explain AVERAGE FOR MINE TYPE

    Could damage have been prevented? __Yes ✓No How ___

    Was the answer to above based on definite knowledge ✓, possible knowledge ___, or no knowledge ___.
15. Does damage present a secondary hazard to personnel? __Yes ✓No If yes, explain ___



HL

BDART(V)

(F)

Completion date: 30 OcT 69

1. Case Number: ABD-02-6916S-00
2. Total Exhibits: 16
   a. Photographs: 16
   b. Fragments/Missiles: 0
   c. X-Rays: 0
   d. Other Exhibits: 0
3. Recapitulation:
   a. Materiel: 1
   b. Personnel: 0
4. Remarks:

Equipment: M551

Weapon: 50-LB Mine

CASE NO. ARD 02-69108-00

DATE 30 OCT 69

INCIDENT COVER SHEET

Table of Contents		Quantity
Section A		
Part I	- Case Scenario	1
Part II	- Equipment Damage	1
Part III	- Personnel Injuries	1
Part IV	- General	1
Part V	- Observer Interview	2
Part VI	- Sketch	1
Section B		
Set II	- Wounding Agent Data	0
Set IV	- Autopsy Supplement	0
Set V	- Medical Evaluation and Treatment	0
Set VI	- Interview of Casualty	0
Set VII	- Interview of Others	0
Set VIII	- Burn Supplement	0
Set IX	- Body Armor	0
Set XI	- Troop Interview	0
Section C		
1.	Photographs (or negatives)	16
2.	X-Rays	0
3.	Recovered Missiles	0
4.	Photo Caption Sheet	1
5.	Other Exhibits	VEHICLE DIAGRAM

FILM CAPTION DATA

CASE NO. ABD 02-69108-00

ROLL/PACK NO:	FILM TYPE	DATE
Roll-30	High Speed Ektachrome	22 Oct 69

Location of Photo Coverage
Quan Loi, Vietnam

Photographer	Camera Number	Lens Number
SFC Cantu	3269	Zoom-in lens

Frame No.	CAPTION
1.	Slate
2.	Left rear view of vehicle
3.	Left front view of vehicle
4.	View of damage to vehicle
5.	Damage to idler wheel and track adjuster on left side. Track adjuster broken from 1st road wheel on left side.
6.	Damage to 1st road wheel on left side, road wheel blown off and road wheel arm warped
7.	Close view of road wheel arm and part of road wheel
8.	Damage to shock absorber on left side and 2nd road wheel arm warped and road wheel blown off. Bolts from road wheel arm mounting bracket were removed, no damage to mounting bracket.
9.	Damage to shock absorber on left side
10.	Front view of damage to shock absorber on left side
11.	Damage to 2nd road wheel mounting on left side
12.	Damage to sponson on front left side
13.	Damage to sponson from front to rear on left side
14.	Same as # 13
15.	Same as # 13
16.	Same as # 13
	(Measurement device graduated in cm.)

BATTLE DAMAGE ASSESSMENT AND REPORTING TEAM

PART I -- Case Scenario

SOURCES OF INFORMATION

~~TRACK COMMANDER DRIVER~~ (Job Title or Position of Person Interviewed)

CASE # ASD-02-67108-00

TEAM MEMBER SFC GIFT

(Job Title or Position of Person Interviewed)

DATE 22 OCT 69

(Job Title or Position of Person Interviewed)

__SITREP

__INSCOM

__AFTER ACTION REPORT

(Other source of information)

(Other source of information)

1. Service involved: ✓Army __Navy __Marines __Air Force

2. Type Equipment:

__M113 APC	__¼ T Trk	__105 Howitzer	__Aircraft (specify)
✓M551	__3/4 T Trk	__155 Howitzer	
__M48 Tank	__2½ T Trk	__8" Howitzer	
__M88 VTR	__Other	__175mm Gun	
__M106 Mortar Carrier		__40mm "Duster"	
__M577 CP		__Towed	
__M548 Cargo		__SP	
__Other		__Other	

3. Federal Stock Number 2350-873-5408

4. USA Serial, Hull, or Tail Number USA 12C67368 C-37

5. Unit Identification: a. CTRP VICTOR

b. APO 96257 c. CTZ I II (III) IV

6. Date/Time Group: a. Start of Mission 210930 OCT 69

b. End of Mission UNK

c. Of Incident 211230 OCT 69

[illegible] AF-02-69108-00

7. Location of Incident: a. UTM Coordinates XU854857

b. Geographical Name AN Loc

c. Map Sheet Number 6332 III Series L7014

8. Name of operation or mission number UNK

Brief description of maneuver during engagement, if possible, and remarks (sketch map oriented to north, time oriented, and direction of movement). Use Set 6 or reverse side of this page.

9. Equipment mileage or hour reading: a. Odometer or hour reading Speedometer BROKEN

b. Mission mileage or time estimate UNK

10. Has this incident been reported by other means __Yes ✓No __Unknown

11. If so, describe or identify report(s) N/A

12. Size of friendly force: a. __Squad b. __Platoon c. ✓Company

d. __Battalion e. __Brigade f. __Other (specify)

13. Size of enemy force: a. __0-14 b. __15-60 c. __61-250 d. __251-700

MINE DAMAGE e. __700-1500 f. __1501-3500 g. __Over 3500

14. Type of enemy force: __VC __NVA __Other UNK

15. Estimated range in meters between forces at start of engagement:

a. __0-25 b. __25-50 c. __50-100 d. __100-150 e. __150-200

f. __200-300 g. __Over 300 (specify) MINE DAMAGE

16. Type mission: a. __Search & Destroy b. __Recon c. __Photo

d. __Clearing e. __Ambush f. __Securing g. __Combat Patrol

h. __Inactive i. XRecon in force j. __Other (specify)

17. Deployment: a. __Road March b. __Covering c. __Base Camp Defense

d. __Landing e. XOther (specify) ON-LINE RIFT

CASE # ARP-02-69108-20

18. Terrain Contour: a. __Mountainous b. __Hilly c. __Gently Rolling
b. ✓Level e. __Other (specify) _____

19. Vegetation type: a. __Jungle b. __Clear Forest c. __Brush d. __High Grass e. __Tropical Swamp Forest f. ✓Plantation g. __Cultivated Area h. __Marsh i. __Swamp j. __Paddy k. __Other (specify) _____

20. Soil Type: 2. __Sandy b. __Silt c. ✓Clay d. __Gravel e. __Other (specify) _____

21. Soil Condition: __Wet ✓Dry

22. Equipment Speed: Was Equipment Moving when hit: ✓Yes __No
a. If moving, how fast 3 MPH
b. If speed was limited, Why? (1) __Terrain
(2) XOther than Terrain
(3) __Explain NORMAL FOR RIET

23. Weather information:
a. Type: __Rain __Fog ✓Clear __Overcast __Other (specify) _____
b. Temperature: 80-85 °F e. Wind velocity NONE
d. Wind direction NONE e. Barometer reading UNK
f. Relative humidity High

24. Visibility: a. Cloud cover __Yes ✓No b. Height _____ feet
c. Visible range INDEFINITE d. If night: __Full Moon __Half Moon __Quarter Moon __Star-light __Artificial illumination (specify type) _____

25. Direction of attack: a. __Frontal b. __Left Flank c. __Right Flank
d. __Rear e. __Other (specify) MINE DAMAGE

26. Was enemy detected before he engaged? __Yes ✓No

ABD-02-69108-00

27. How soon after sighting enemy did you fire: a. __Immediately b. __Did not return fire c. __Other (specify) N/A

28. Who fired first: a. __Friendly b. __Enemy c. __Unknown MINE DAMAGE

29. Intensity of enemy fire: a. __Light (1-10) b. __Moderate (10-25) c. __Heavy (Over 25) d. __Comments N/A

30. Was cover and concealment used by friendly forces for personnel and/or equipment __Yes __No If yes, How? N/A

31. What unused sources of cover and concealment were available: N/A

32. Acquisition information:

a. How was enemy detected: __Sight __Hearing __Sensor device (specify) NOT Detected

b. What sensor (or sensor characteristics) would have detected the enemy earlier MINE SWEEP

c. How accurate was fix on enemy firing positions: __10 meters __25 Meters __50 Meters __100 Meters __Over 100 Meters N/A

d. How was fix determined? WAS NOT

e. How long did it take you (or other crew members) to locate specific targets? NONE LOCATED

f. If night, was night observation device used? __Yes __No N/A

g. If Yes, specify type? N/A

33. Aircraft: a. Altitude _____ b. Dive angle used _____

c. Airspeed _____ Knots d. Evasive action used _____

e. Type weapons carried/delivered N/A _____

f. Type formation during flight _____

02-6908-20

g. Escort aircraft __Yes __No If yes, list below:

	TYPE	NUMBER	MODEL
Rotary Wing			
Fixed Wing			

h. Ground AA Fire information: N/A

(1) Was firing source observed? __Yes __No

(2) Aircraft heading _____degrees

(3) Direction of source from aircraft (o'clock) _____

(4) Source: Identified __Yes __No Attacked __Yes __No

If identified, what (type weapons)? _____

_____

ABD 02-69105-00

PART II - EQUIPMENT DAMAGE

1. Equipment was ✓ Damaged __ Destroyed ARMOR KIT INSTALLED

2. Equipment was damaged or destroyed by:

a. __ Direct fire
b. __ Indirect fire
c. ✓ Mines
d. __ Missiles
e. __ AA Fire
f. __ Accident (combat oriented)
g. __ Other (specify) _____

3. What was mission of equipment? RIFT

4. Number of hits for which collected data is described below? 1

Hit Number	1	2	3	4
a. Weapon/Mine Type & Model	ANTI-TANK MINE			
b. Round size/ mine weight	50-lb			
c. Round type (AP, HE, etc).	HE			
d. Fuze type/ identification: (airburst, ground-burst)	PRESSURE TYPE			
e. Estimates of where fuze functioned	ON CONTACT			
f. Range of weapon to target (in meters)	0			
g. Hit location (Station No., Frame #, General Description	LEFT FRONT 1st Road-wheel			
h. Attack angle of projectile to equipment				
Azimuth	90°			
Elevation	-90			

[illegible] 02-6908-00

i. Damaged major parts __engine __transmission __transfer case
✓Suspension system __Drive train __Fire controls ✓Main Armanent
__Communications equipment __Radiator __Wheels __Other (specify)

Hit Number	1	2	3	4
j. Depth of Penetration (in inches)	N/A			
k. Did round perforate	Yes (No)	Yes/No	Yes/No	Yes/No
l. If Yes continue Dimensions & shape of hole at entrance & exit	N/A			
m. Did spall occur	Yes (No)	Yes/No	Yes/No	Yes/No
n. Effects of spall on personnel and components	N/A			
o. Path of penetrator/ perforation in equipment	N/A			
p. Projectile performance against spaced plates	N/A			

FIRE DAMAGE

5. Did a fire occur? __Yes ✓No

6. Cause of fire: __Mine __Direct fire weapon __Indirect fire
__Other (explain) N/A

7. Location of fire damage N/A

8. Damage caused by fire N/A

FIRE DAMAGE (CONTINUED) CASUALTY NO. 02-69108-00

9. Level of fuel (at time of incident: a. 1/4 b. 1/2 c. 3/4 d. Full N/A

10. Material supporting combustion: a. Gasoline b. Diesel c. Ammo N/A

11. Was fire suppression equipment available? Yes No N/A

12. Was there time to operate fire suppression equipment? Yes No N/A

13. Was the fire suppression equipment used? Yes No N/A

14. What type of fire suppression equipment was used Installed Portable

Other (specify) N/A

15. Was the fire suppression equipment effective? Yes No N/A

16. Was there time to evacuate? Yes No N/A

17. Did the crew evacuate? N/A

Driver Pilot Lt Seat	Veh Comdr Pilot Rt Seat	Gunner	Loader
Yes No	Yes No	Yes No	Yes No
Others (crew members only			
Yes No	Yes No	Yes No	Yes No

EXPLOSION DAMAGE (On or within the vehicle)

18. Did an internal explosion occur? Yes ✓No
as a result of fire Yes No Unknown

19. Was explosion Immediate Delayed. If delayed, how long N/A

20. What was the cause of the explosion Ammo Fuel Other (specify)
N/A

21. Damage caused by the explosion: N/A

BLAST DAMAGE

22. Was equipment damaged by an external blast: ✓Yes No

23. What was the distance from blast to equipment (in meters)? a. ✓0-10
b. 10-20 c. 20-30 d. Over 30 e. Other (specify) *

24. Was equipment moved by the blast? ✓Yes No If yes, how far? RAISED OFF GROUND APPROX 12 INCHES

25. Was equipment overturned by the blast? Yes ✓No

26. Was equipment damaged by fragments due to the blast? Yes ✓No

BLAST DAMAGE (CONTINUED) CASE # ARD-02-69108-00

27. Other damage caused by the blast: Spowson bent, 1st + 2nd Roadwheels Blown off, Idler Arm, #1 Shock Arm + Roadwheel Arms (2)

28. Describe fragment damage (if not covered elsewhere in form) N/A

29. Were doors or hatches open on equipment when damaged? X Yes __ No

(27 CONT'd): damaged. 11 Rounds of Ammunition Broken. ALL Broken where powder casing meets projectile. Ammo stored in racks in Driver's Hatch.

Armament: Main Gun will not elevate or Depress.

Idler Arm separated from Idler wheel

#1 Shock separated from Roadwheel

Track Adjusting Arm torn loose from #1 Roadwheel Area.

ABD-02-69105-00

PART III - Personnel Injuries

1. Number of casualties (crew members only) ✓ None __KIA __WIA __DOW
__MIA __NBI __IRHA

2. CASUALTY

	Driver Pilot Lt Seat	Veh Cmdr Pilot Rt Seat	Gunner	Loader	Other Specify
a. Hit Number					
b. Casualty was KIA, WIA, MIA, or DOW					
c. Location of wound (head, neck, hand, torso, etc.)					
d. To what extent did each wounded perform his mission					
e. Where was casualty's assigned station					
f. Was casualty at his assigned station (YES or NO) If not, where was he					
g. Was casualty evacuated (YES or NO) If yes, by whom If yes, when					
h. Was casualty wearing portective clothing If yes, specify type of protective clothing, i.e. body armor, flak jacket, etc.					
i. Did protective clothing prevent injury or reduce injury					
j. What caused casualty (1) Penetrator (2) Fragment (3) Blast (4) Shock (5) Other (specify other)					

CASE # AFD-02-69108-00

3. Number of casualties (passengers only) ✓None __KIA __WIA __MIA
__DOW __MBI __IRHA

CASE # ABD-02-69108-00

1. Was equipment and/or major components operating when damaged? ✓Yes __No

Check equipment or components	Operating when damaged YES	NO	Continued to operate YES	NO	Remaining Capability (time related)	If shut down why?
__Engine						
__Transmission						
__Transfer case						
__Frame						
✓Suspension	✓		✓		NONE	TRACK blown off
__Drive train						
__Fire controls						
✓Main armanent	✓		✓		NONE	
__Communication equipment						
__Radiator						
✓Wheels	✓		✓		NONE	
__Other (specify)						

2. Was damaged equipment subsequently destroyed by friendly forces? __Yes ✓No

3. If equipment was damaged and had to be destroyed by friendly forces, was it used to aid in mission prior to destruction? __Yes __No N/A

4. If yes, how? N/A

5. Was damaged equipment repaired in field before mission was completed? __Yes ✓No If yes, estimate repair time (man hours) _____

6. Was equipment able to return to base or retreat to a safe location under its own power? __Yes ✓No If no, how retrieved ANOTHER M561 TOWED IT IN WITH TOW BAR

CASE # AMD-02-69108-00

7. Was standard "On Vehicle Equipment" (OVE) in place on vehicle? ✓Yes __No
If no, where was it located? _____

8. What was composition and location of cargo? PERSONAL GEAR ON CARGO RACK ON REAR OF TURRET

9. What additional items were on/or in the damaged equipment? NONE

10. Action of the equipment after receiving the hit:

Ground vehicle/equipment reaction to hit:

a. __Continued its activity in an operable state.

b. __Discontinued activity but remained in operable state

c. ✓Was rendered inoperable

d. __Scrapped

Aircraft Reaction to hit:

e. __Continued to fly; mission completed.

f. __Continued to fly; mission not completed

g. __Forced to land; inspection/quick fix/took off

h. __Forced to land; later destroyed

i. __Forced to land; later recovered

j. __Crashed; aircraft recovered

k. __Crashed; aircraft not recovered

11. Is equipment repairable: ✓Yes __No If repairable, at what echelon?
a. __Organizational b. __DS Unit c. ✓GS Unit d. __Depot e. __CONUS

f. __Other (specify) _____

12. Estimate total down time for repairs (man hours) UNK

CASE # ABD-02-69108-00

NAME/RANK SPIRES, JAMES E. SS.N 265-86-9299

UNIT C TRP 4/11TH ACR

1. Responsibility of person interviewed DRIVER

2. Location of person interviewed at time of impact (relative to equipment damaged) DRIVER'S COMPARTMENT

3. Activity of person interviewed at time of impact DRIVING

4. Was the person interviewed wounded or injured as result of impact NO

5. Activity of the equipment at the time it was hit MOVING FORWARD

6. What type of protection is inherent at point of damage MINE PLATE UNDER SPONSON

7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred YES - MINE PLATE

8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO

9. Would any equipment modification reduce the degree of damage EXTEND MINE PLATE FURTHER FORWARD

10. Approximate distance from: a. Weapon to equipment ___ meters

b. Detonation of munition to equipment 0 meter

11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) MINE DAMAGE

12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? ___Yes ✓No Explain LOSS DUE TO MINE PLATE

13. Could damage have been prevented? ___Yes ✓No How ___

14. Was the answer to above based on definite knowledge ✓, possible knowledge ___, or no knowledge ___.

15. Does damage present a secondary hazard to personnel? ___Yes ✓No If yes, explain ___

PART VI

NAME/RANK SP5 Dennis E. Lujan (Person drawing sketch)

SSAN 265-86-9297

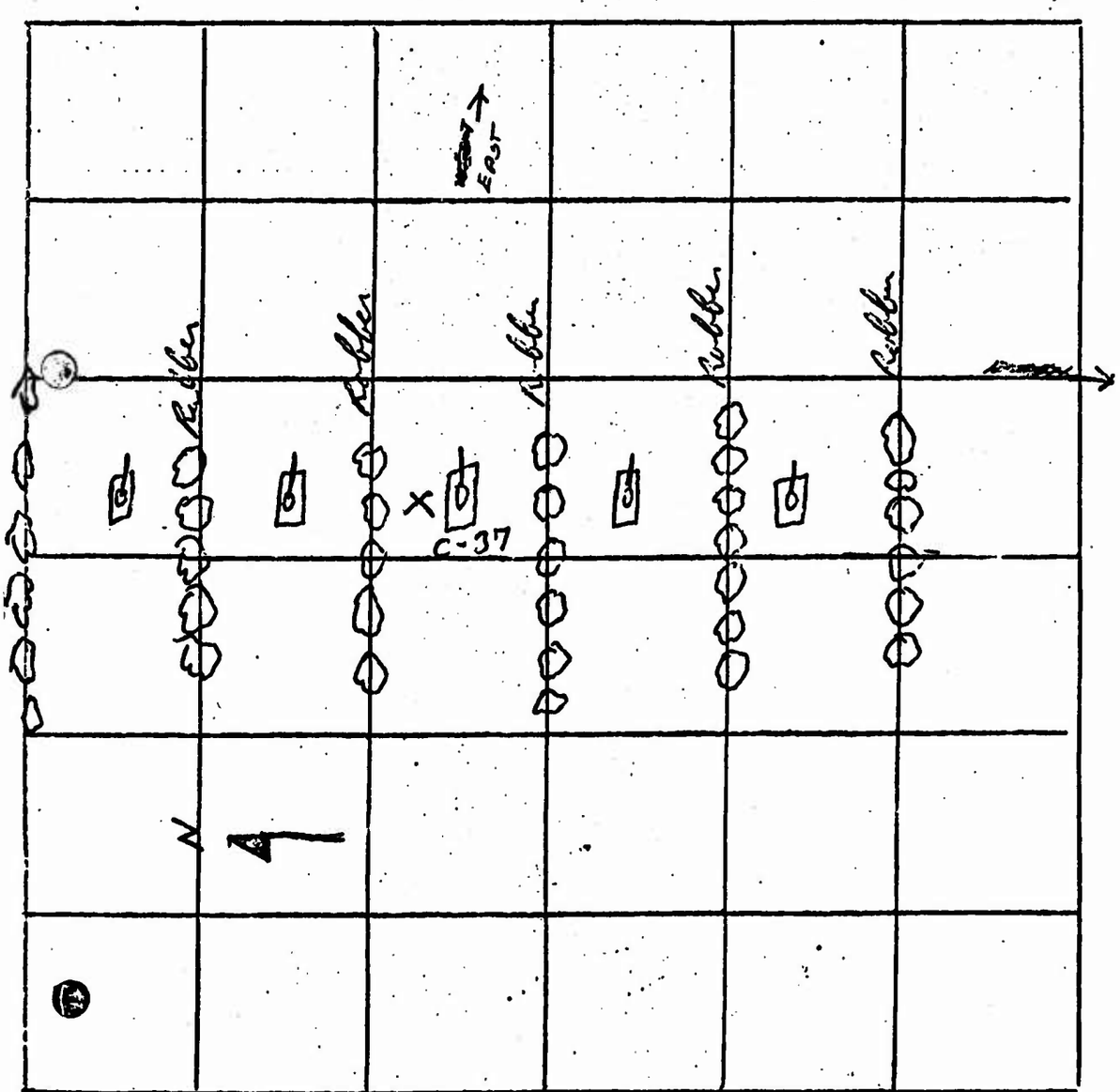
COORDINATES XU 854857

CASE NO. 02-69108-00

TEAM MEMBER SFC. GIFT

DATE 22 Oct 69.

SKETCH



NAME/RANK PFC SCOTT PFC CASE NO. ABD 02-6908-00

SN 527-43-8558

PART V - Observer Interview Form

1. Responsibility of person interviewed Leader

2. Location of person interviewed at time of impact (relative to equipment damaged) Leader's HATCH

3. Activity of person interviewed at time of impact Observing

4. Was the person interviewed wounded or injured as result of impact NO

5. Activity of the equipment at the time it was hit Recon in Force

6. What type of protection is inherent at point of damage ~~body~~ Vehicle Armor

7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO

8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO

9. Would any equipment modification reduce the degree of damage yes
Explain extended Sponson armor all the way to the rear

10. Approximate distance from: a. Weapon to equipment 0 meters
b. Detonation of munition to equipment 0 meters

11. What type of damage did the equipment receive? (Fire, explosion, missle impregnation, etc.) BLAST

12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? ____Yes ____No Explain FIRST mine hit

13. Could damage have been prevented? ____Yes ✓ No How

14. Was the answer to above based on definite knowledge ✓, possible knowledge ____, or no knowledge ____

15. Does damage present a secondary hazard to personnel? ____Yes ✓ No
If yes, explain ____

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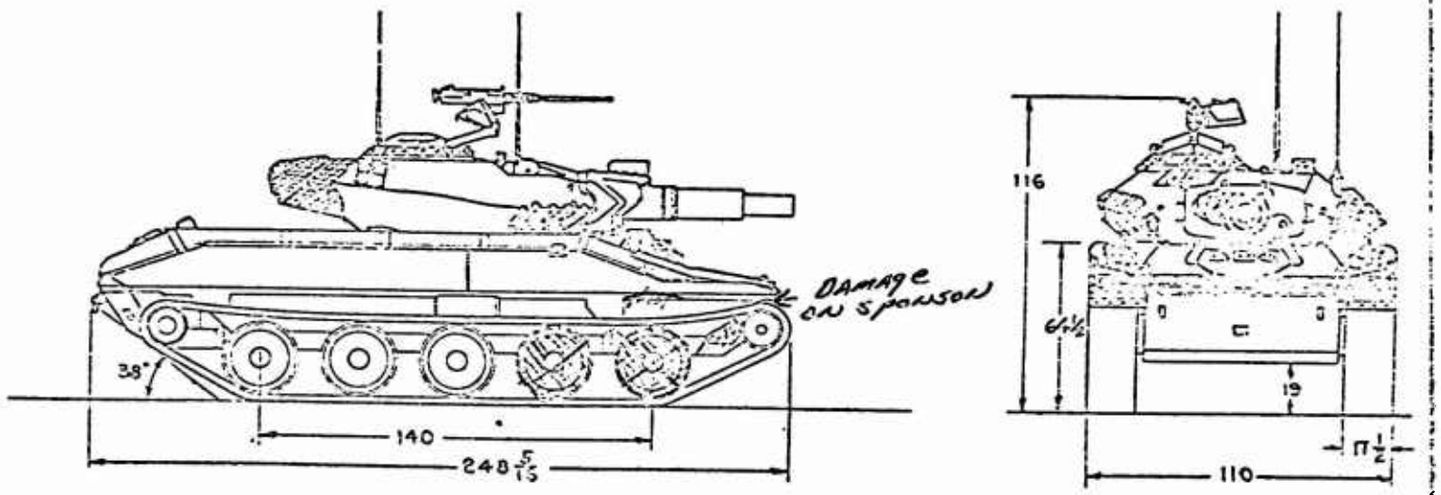


NOT REPRODUCIBLE

70

ABD 02-69108-00

BDART(V)

70002-00

(F.)

Completion date: 21 Jan 70

1. Case Number: ABD-02-[redacted]

2. Total Exhibits: 19

   a. Photographs: 17

   b. Fragments/Missiles: 0

   c. X-Rays: 0

   d. Other Exhibits: 2

3. Recapitulation:

   a. Materiel: 1

   b. Personnel: 0

4. Remarks:

EQIPMENT - M48

WEAPON - 20-LB MINE

CASE NUMBER: ABD-02-70002-00

DATE:

INCIDENT COVER SHEET

Table of Contents		Quantity
Section A		
Part I	- Case Scenario	1
Part II	- Equipment Damage	1
Part III	- Personnel Injuries	1
Part IV	- General	1
Part V	- Observer Interview	3
Part VI	- Sketch (Optional)	1
Section B		
Set I	- Body Diagrams	1
Set II	- Wounding Agent Data	1
Set III	- Wound Tract Data	1
Set IV	- Autopsy Supplement	1
Set V	- Medical Evaluation and Treatment	1
Set VI	- Interview of Casualty	1
Set VII	- Interview of Others	1
Set VIII	- Burn Supplement	1
Set IX	- Body Armor	1
Set XI	- Troop Interview	1
Section C		
1. Photographs (or negatives)		17
2. X-Rays		0
3. Recovered Missiles		0
4. Photo Caption Sheet(s)		1
5. Other Exhibits	Vehicle Diagram	1

6 October 1969

BATTLE DAMAGE ASSESSMENT AND REPORTING TEAM

PART I - Case Scenario

SOURCES OF INFORMATION

TC. (Job Title or Position of Person Interviewed)

(Job Title or Position of Person Interviewed)

(Job Title or Position of Person Interviewed)

CASE # ABD-02-70002-00

TEAM MEMBER SFC GIFT

DATE 7 JAN 70

___SITREP

X INSUM

___AFTER ACTION REPORT

(Other Source of Information)

(Other Source of Information)

1. Service involved: ✓ Army ___Navy ___Marines ___Air Force

2. Type Equipment:

___M113 APC	___1/4 T Trk	___105 Howitzer	___Aircraft (Specify)
___M551	___3/4 T Trk	___155 Howitzer	
X M48 Tank	___2-1/2 T Trk	___8" Howitzer	
___M88 VTR	___Other	___175mm Gun	
___M106 Mortar Carrier		___40mm "Duster"	
___M577 CP		___Towed	
___M548 Cargo		___SP	
___Other		___Other	

3 Federal Stock Number 2350-895-9154

4. USA Serial, Hull, or Tail Number USA 0789067 M22

5. Unit Identification: a. M Co 3/11th ACR

b. APO 96257 c. CTZ I II (III) IV

6 Date/Time Group: a. Start of Mission 051815 JAN 70

b. End of Mission 05 1825 JAN 70

c. Of Incident 051825 JAN 70

CASE # ABD-02-70002-00

7. Location of Incident: a. UTM Coordinates XT583933

b. Geographical Name AN LOC

c. Map Sheet Number 6332 III Series 7014

8. Name of Operation or Mission Number UNK

Brief description of maneuver during engagement, if possible, and remarks (sketch map oriented to north, time oriented, and direction of movement). Use Set 6 or reverse side of this page.

9. Equipment mileage or hour reading: a. Odometer or ~~hour~~ reading 912 MILES

b. Mission mileage or time estimate 10 MINUTES

10. Has this incident been reported by other means ? Yes ___No ✓Unknown

11. If so, describe or identify report(s) CORDED-V

12. Size of friendly force: a. __Squad b. ✓Platoon c. __Company
d. __Battalion e. __Brigade f. __Other (Specify)

13. Size of enemy force: a. ___0-14 b. ___15-60 c. __61-250 d. __251-700
N/A e. ___700-1500 f. ___1501-3500 g. ___Over 3500

14. Type of enemy force: ___VC ___NVA ___Other N/A

15. Estimated range in meters between forces at start of engagement:
a. ___0-25 b. ___25-50 c. ___50-100 d. ___100-150 e. ___150-200
f. ___200-300 g. ___Over 300 (Specify) N/A

16. Type mission: a. __Search & Destroy b. __Recon c. __Photo
d. __Clearing e. __Ambush f. ✓Securing g. __Combat Patrol
h. __Inactive i. __Recon In Force j. __Other (Specify)

17. Deployment: a. ✓Road March b. __Covering c. __Base Camp Defense
d. __Landing e. __Other (Specify)

CASE # ABD-02-70002-00

18. Terrain Contour: a. __Mountainous b. __Hilly c. __Gently Rolling
d. ✓Level e. __Other (Specify) _____

19. Vegetation Type: a. ✓Jungle b. __Clear Forest c. __Brush d. __High grass e. __Tropical Swamp Forest f. __Plantation
g. __Cultivated Area h. __ Marsh i. __Swamp
j. __Paddy k. __Other (Specify) _____

20. Soil Type: a. __Sandy b. ✓Silt c. __Clay d. __Gravel e. __Other (Specify) _____

21. Soil Condition: __Wet ✓Dry

22. Equipment Speed: Was equipment moving when hit: ✓Yes __No
a. If moving, how fast 10-15 MPH
b. If speed was limited, Why? (1) __Terrain
(2) __Other than Terrain
(3) __Explain _____

23. Weather information:
a. Type: __Rain __Fog ✓Clear __Overcast __Other (Specify)_____
b. Temperature: 80-82 °F c. Wind Velocity UNK
c. Wind Direction UNK e. Barometer reading UNK
f. Relative Humidity Low

24. Visibility: a. Cloud Cover __Yes ✓No b. Height UNK feet
c. Visible Range UNLIMITED d. If Night: __Full Moon
__Half Moon __Quarter Moon __Star-light __Artificial illumination (Specify Type) _____

25. Direction of attack: a. __Frontal b. __Left Flank c. __Right Flank
d. __Rear e. __Other (Specify) LINE OF SIGHT

26. Was enemy detected before he engaged? __Yes __No N/A

CASE # ADD-02-70002-00

27. How soon after sighting enemy did firing commence: a. __Immediately
b. __Did not return fire c. __Other (Specify) N/A

28. Who fired first: a. __Friendly b. __Enemy c. __Unknown N/A

29. Intensity of enemy fire: a. __Light (1-10) b. __Moderate (10-25)
c. __Heavy (Over 25) d. __Comments
N/A

30. Was cover and concealment used by friendly forces for personnel and/or equipment __Yes __No If yes, how? N/A

31. What unused sources of cover and concealment were available:
N/A

32. Acquisition Information: N/A
a. How was enemy detected: __Sight __Hearing __Sensor Device (Specify)

b. What sensor (or sensor characteristics) would have detected the enemy earlier

c. How accurate was fix on enemy firing positions: __10 meters __25 meters __50 meters __100 meters __Over 100 meters

d. How was fix determined?

e. How long did it take you (or other crew members) to locate specific targets?

f. If night, was night observation device used? __Yes __No

g. If yes, specify type?

33. Aircraft: a. Altitude b. Dive angle used
c. Airspeed Knots d. Evasive action used
e. Type weapons carried or delivered
f. Type formation during flight

CASE # ABD-02-70002-00

g. Escort aircraft __Yes __No If yes, list below:

	TYPE	NUMBER	MODEL
Rotary Wing			
Fixed Wing			

h. Ground Fire Information: N/A

(1) Was firing source observed? __Yes __No

(2) Aircraft heading _____degrees

(3) Direction of source from aircraft (o'clock) _____

(4) Source: Identified __Yes __No Attacked __Yes __No

If identified, what (type weapons)? _____

_____

CASE # ABD-02-70002-00

PART II - EQUIPMENT DAMAGE

1. Equipment was ✓Damaged __Destroyed Battle loss warped Hull

2. Equipment was damaged or destroyed by:

   a. __Direct Fire
   b. __Indirect Fire
   c. ✓Mines
   d. __Missiles
   e. __AA Fire
   f. __Accident (combat oriented)
   g. __Other (Specify)_____

3. What was mission of equipment? SECURING mine sweep team

4. Number of hits for which collected data is described below? 1

Hit Number	1	2	3	4
a. Weapon/Mine Type & Model	T-46 MINE			
b. Round Size/ mine weight	20 lbs	INSUM Reports other mines same size and type found in immediate area		
c. Round Type (AP, HE, Etc.)	HE			
d. Fuze type/ Identification: (airburst, ground-burst)	PRESSURE PLATE			
e. Estimates of where fuze functioned	ON CONTACT			
f. Range of weapon to target (in meters)	0			
g. Hit location (Station No., Frame #, General Description)	Right side FIRST ROAD wheel			
h. Attack angle of projectile to equipment				
Azimuth	90			
Elevation	-90°			

CASE # ABD-02-70002-00

i. Damaged major parts __engine __transmission __transfer case
✓Suspension system __Drive train __Fire Controls __Main Armament
__Communications equipment __Radiator ✓Wheels ✓Other (Specify) N/A

Hit Number	1	2	3	4
j. Depth of Penetration (in inches)	N/A			
k. Did round perforate	Yes/(No)	Yes/No	Yes/No	Yes/No
l. If Yes continue Dimensions & Shape of hole at entrance and exit	N/A			
m. Did spall occur	N/A			
n. Effects of spall on personnel and components	N/A			
o. Path of penetrator/ perforation in equipment	N/A			

FIRE DAMAGE

5. Did a fire occur? __Yes ✓No
6. Cause of fire: __Mine __Direct fire weapon __Indirect fire
__Other (explain) N/A
7. Location of fire damage
8. Damage caused by fire

CASE # ABD-02-70002-00

FIRE DAMAGE (Continued)

9. Level of Fuel (at time of incident): a. __1/4 b. __1/2 c. __3/4 d. __Full

10. Material supporting combustion: a. __Gasoline b. __Diesel c. __Ammo

11. Was fire suppression equipment available? __Yes __No

12. Was there time to operate fire suppression equipment? __Yes __No

13. Was the fire suppression equipment used? __Yes __No

14. What type of fire suppression equipment was used __Installed __Portable

__Other (Specify) _____

15. Was the fire suppression equipment effective __Yes __No

16. Was there time to evacuate? __Yes __No

17. Did the crew evacuate?

Driver		Veh Comdr		Gunner		Loader	
Pilot	Lt Seat	Pilot	Rt Seat				
__Yes	__No	__Yes	__No	__Yes	__No	__Yes	__No

Others (crew members only)_____

__Yes __No __Yes __No __Yes __No __Yes __No

EXPLOSION DAMAGE (On or within vehicle)

18. Did an internal explosion occur? __Yes ✓No
as a result of fire __Yes __No __Unknown

19. Was explosion __Immediate __Delayed. If delayed, how long _____

20. What was the cause of the explosion? __Ammo __Duel __Other (Specify)____

_____

21. Damage caused by the explosion: _____

_____

BLAST DAMAGE

22. Was equipment damaged by an external blast?: ✓Yes __No

23. What was the distance from blast to equipment (in meters)? a. ✓0-10
b. __10-20 c. __20-30 d. __Over 30 e. __Other (specify)_____

24. Was equipment moved by the blast? ✓Yes __No If yes, how far? bounced up 2 FT

25. Was equipment overturned by the blast? __Yes ✓No

26. Was equipment damaged by fragments due to the blast? __Yes ✓No

CASE # ABD-02-20002-00

BLAST DAMAGE (Continued)

27. Other damage caused by the blast BLEW OFF 1st Roadwheel
KNOCKED 1st Roadwheel Arm Housing Loose From

28. Describe fragment damage (if not covered elsewhere in form)
N/A

29. Were doors or hatches open on equipment when damaged? ✓ Yes ___ No

27 cont'd: Hull, 4cm 2d Roadwheel ARM Housing SEPARATED FROM Hull! 2cm Coil Spring Housing DAMAGED 2d Coil Spring blown off. SHOCK ARM blown OFF FROM 2d Roadwheel. 1st SHOCK ARM bent.

CASE # ABD-02-70002-00

PART III - PERSONNEL INJURED

1. Number of casualties (crew members only) 1 None __KIA __WIA __DOW __MIA __NBI __IRHA

2.

	CASUALTY				
	Driver Pilot Lt Seat	Veh Comdr Pilot Rt Seat	Gunner	Loader	Other Specify
a. Hit Number					
b. Casualty was KIA, WIA, MIA or DOW					
c. Location of wound (head, neck, hand, torso, etc.)					
d. To what extent did each wounded perform his mission					
e. Where was casualty's assigned station	N/A				
f. Was casualty at his assigned station (YES or NO) If not, where was he		N/A			
g. Was casualty evacuated (YES or NO) If yes, by whom If yes, when					
h. Was casualty wearing protective clothing If yes, specify type of protective clothing, i.e. body armor, flak jacket, etc.					
i. Did protective clothing prevent injury or reduce injury					
J. What caused casualty (1) Penetrator (2) Fragment (3) Blast (4) Shock (5) Other (Specify Other)					

CASE # ABD-02-70002-00

3. Number of casualties (Passengers Only) ✓None __KIA __WIA __MIA
__DOW __NBI __IRHA

CASE # ABD-02-70002-0.1

PART IV - OPERATIONAL DATA

1. Was equipment and/or major components operating when damaged? ✓Yes __No

Check equipment or Components	Operating when damaged YES NO	Continued to operate YES NO	Remaining Capability (time related)	If shut down why?
__ Engine				
__ Transmission				
__ Transfer case				
__ Frame				
✓ Suspension	✓	✓		See page 91
__ Drive Train				
__ Fire Controls				
__ Main Armament				
__ Communication Equipment				
__ Radiator				
✓ Wheels	✓	✓		
__ Other (Specify)				

2. Was damaged equipment subsequently destroyed by friendly forces? __Yes ✓No

3. If equipment was damaged and had to be destroyed by friendly forces, was it used to aid in mission prior to destruction? __Yes __No N/A

4. If yes, how? N/A

5. Was damaged equipment repaired in field before mission was completed? __Yes ✓No If yes, estimate repair time (man hours) _____

6. Was equipment able to return to base or retreat to a safe location under its own power? __Yes ✓No If no, how retrieved M88 TOWED

NOT REPRODUCIBLE

CASE # ABD-02-70003-00

7. Was standard "on vehicle equipment" (OVE) in place on vehicle? ✓Yes __No
If no, where was it located? _____

8. What was composition and location of cargo? NONE CARRIED

9. What additional items were on/or in the damaged equipment? PERSONAL GEAR

10. Action of the equipment after receiving the hit:

Ground vehicle/equipment reaction to hit:

a. __Continued its activity in an operable state.

b. ✓Discontinued activity but remained in operable state.

c. __Was rendered inoperable

d. __Scrapped

Aircraft Reaction to hit: N/A

e. __Continued to fly; mission completed.

f. __Continued to fly; mission not completed, flew _____minutes.

g. __Forced to land; inspection/quick fix/took off

h. __Forced to land; later destroyed

i. __Forced to land; later recovered

j. __Crashed; aircraft recovered

k. __Crashed; aircraft not recovered

11. Is equipment repairable: ✓Yes __No If repairable, at what echelon?
a. __Organizational b. __DS Unit c. __GS Unit d. __Depot
e. ✓CONUS f. __Other (Specify) Unit is moved to Depot

12. Estimate total down time for repairs (man hours) unk

CASE # ABD-02-20005-00

PART V - PERSONAL INTERVIEW

NAME/RANK [illegible] E-6 SSAN 431-41-5387

UNIT M/Co 3/11th Mech

1. Responsibility of person interviewed? Track Commander
2. Location of person interviewed at time of impace (relative to equipment damaged) TC Hatch
3. Activity of person interviewed at time of impact Riding
4. Was the person interviewed wounded or injured as result of impact No
5. Activity of the equipment at the time it was hit moving down road
6. What type of protection is inherent at point of damage NORMAL ARMOR
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred No
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred No
9. Would any equipment modification reduce the degree of damage No

10. Approximate distance from: a. Weapon to equipment _____ meters

    b. Detonation of munition to equipment 0 meter

11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) Mine Blast
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? __Yes ✓No Explain BECAUSE OF GROUND CONDITIONS
13. Could damage have been prevented? ✓Yes __No How HAD A BETTER MINE SWEEP OPERATION
14. Was the answer to above based on definite knowledge ✓, possible knowledge ___, or no knowledge ___.
15. Does damage present a secondary hazard to personnel? __Yes ✓No If yes, explain _____

NOT REPRODUCIBLE

M-22.

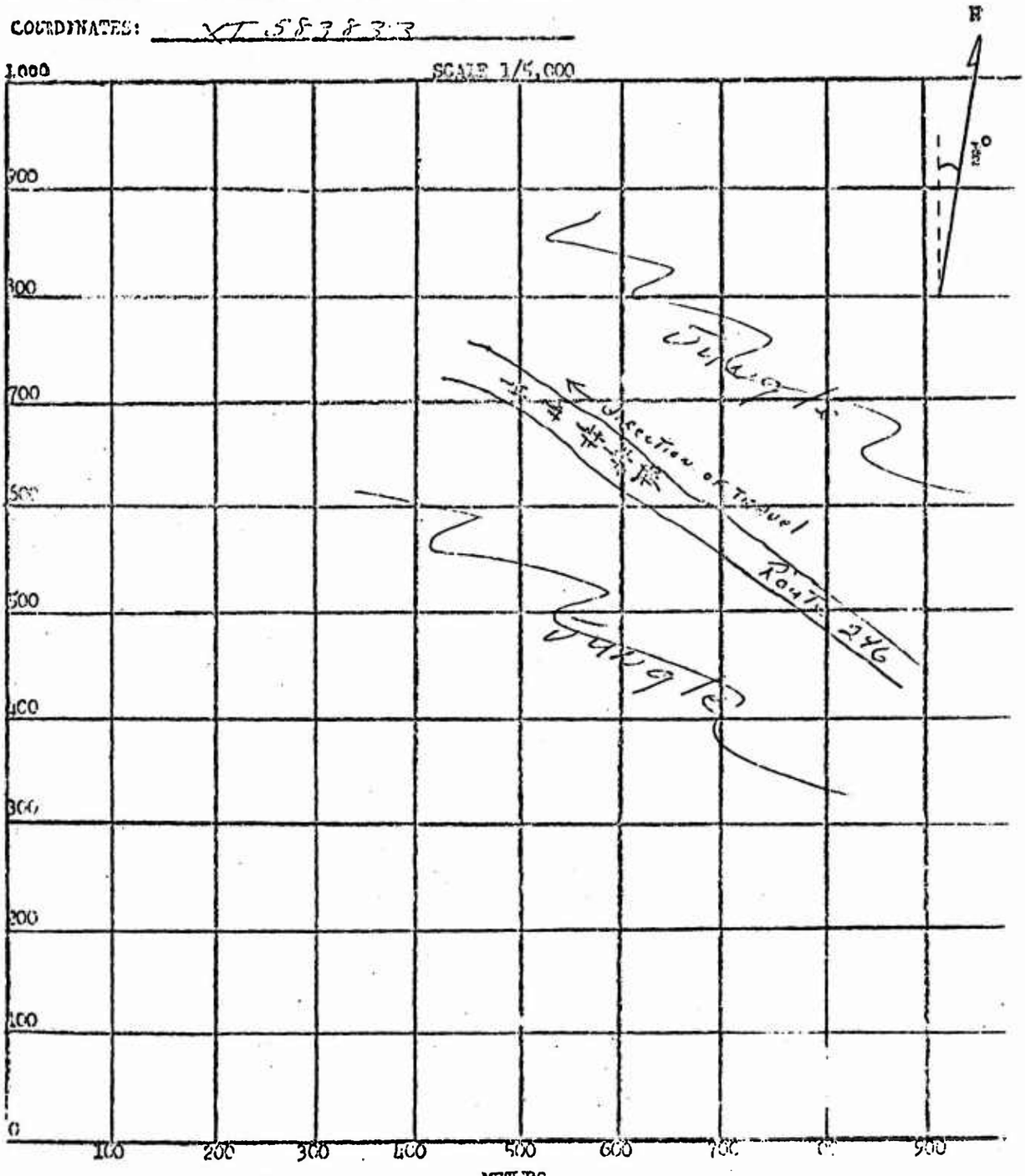
PART VI - SKETCH

NAME/RANK WEBER Joseph C E6 CASE NO. AFD-02-70002-00
LAST, FIRST MI RANK

SSAN: 433/44/5387 INTERVIEWER SFC GIFT

UNIT: III Co. 3/11 Arty

COORDINATES: XT 583833



NOT REPRODUCIBLE

M-22

CASE # ABD-01-70002-CXX

PART V - PERSONAL INTERVIEW

NAME/RANK HARDING, LAWRENCE L. E-5 SSAN 572-60-7999

UNIT M Co 3/11TH ACR

1. Responsibility of person interviewed? DRIVER
2. Location of person interviewed at time of impace (relative to equipment damaged) DRIVER'S HATCH
3. Activity of person interviewed at time of impact DRIVING
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit Moving down Road
6. What type of protection is inherent at point of damage ARMOR ARMOR
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO

10. Approximate distance from: a. Weapon to equipment _____ meters

    b. Detonation of munition to equipment 0 meter

11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) MINE BLAST
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? __Yes ✓No Explain GROUND WAS HARD & BLAST WENT STRAIGHT UP.
13. Could damage have been prevented? ✓Yes __No How Better sweep of Road
14. Was the answer to above based on definite knowledge ✓, possible knowledge ___, or no knowledge ___.
15. Does damage present a secondary hazard to personnel? __Yes ✓No If yes, explain _____

M-22

CASE # ABD-02-70001-05

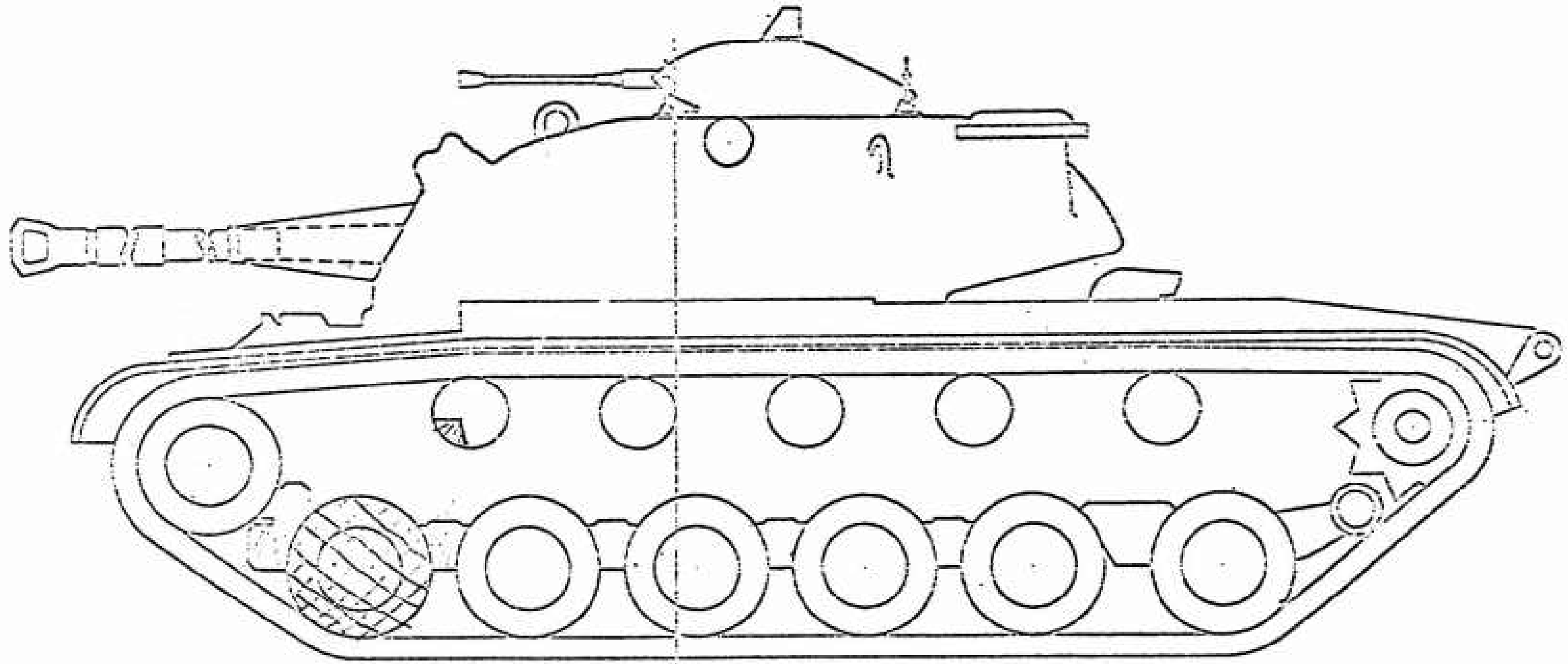
PART V - PERSONAL INTERVIEW

NAME/RANK Mills, Dennis E PFC SSAN 520-50-8418

UNIT A/Co 3/11th Mar

1. Responsibility of person interviewed? Gunner
2. Location of person interviewed at time of impact (relative to equipment damaged) LOADERS HATCH
3. Activity of person interviewed at time of impact Riding
4. Was the person interviewed wounded or injured as result of impact NO
5. Activity of the equipment at the time it was hit Moving Down Road
6. What type of protection is inherent at point of damage NORMAL ARMOR
7. Was any extraordinary protection afforded to the equipment which prevented damage that would ordinarily have occurred NO
8. Was any standard protection lacking which allowed extensive damage beyond that which would ordinarily have occurred NO
9. Would any equipment modification reduce the degree of damage NO
10. Approximate distance from: a. Weapon to equipment _____ meters
    b. Detonation of munition to equipment C meter
11. What type of damage did the equipment receive? (Fire, explosion, missile, impregnation, etc.) Mine blast
12. Was damage caused extraordinary in view of the weapon/projectile causing the damage? __Yes ✓No Explain Due To HARD Ground
13. Could damage have been prevented? __Yes ✓No How _____
14. Was the answer to above based on definite knowledge ✓, possible knowledge ___, or no knowledge ___.
15. Does damage present a secondary hazard to personnel? __Yes ✓No If yes, explain _____

ABD 02-70002-00



Right Side

M48 Tanks

DESTROYED
DAMAGED

NOT REPRODUCIBLE

FILM CAPTION DATA

CASE NO. ABD-[illegible]

ROLL/PACK NO.	FILM TYPE:	DATE:
20	[illegible]	7 Jan 70
Location of Photo Coverage		
Camp Lol		
Photographer:	**Camera Number**	**Lens Number**
SSG Mann	[illegible]241	Zeiss

Frame No.	CAPTION
1	Blank.
2	Front View
3	Rear view
4	Right side
5	Right rear
6	Right front
7	#1 prosthesis arm rewinding bracket blown away from hull—4 ea
8	Side view of rewinding bracket
9	#1 prosthesis and hip blown off —side view
10	" Rear View
11	" Front view
12	Volute spring clearing
13	Side view of #2 prosthesis arm rewinding bracket separated from Hull—2 ea
14	#2 shock absorber missing
15	#1 sprocket roller damaged—side view
16	" Rear view
17	" Front view

NOT REPRODUCIBLE

APPENDIX B

DRAFT PROPOSED MATERIEL NEED (1DPMN)

Army Countermine Mobility Equipment System (ACMES)

18 July 1971

US Army Mobility Equipment Research & Development Center
Fort Belvoir, Virginia

I. NEED

There is a need for mobility equipment that has a high resistance to loss of mobility after a mine encounter. It is particularly desirable to decrease the single-hit, mobility kill vulnerability of combat armored vehicles such as the M-48, M-60, M-113, and M-551. This need is supported by data from the Battle Damage Assessment Reporting Program (BDARP) presented in Appendix A.

This proposed materiel need does not envision basic design of the vehicle at this time but is directed more to the development of accessories and retro-fit kits that are suitable for application to vehicles in the current inventory. Such kits should be compatible with the improved mine detection subsystems that will be available in the same near term.

It should be emphasized that mines are highly cost effective from the threat standpoint and that the means to counter the mine threat must then also be cost effective.

II. JUSTIFICATION

a. Threat

The use of mines by current and potential threats against mobility equipment such as tanks and armored personnel carriers is increasingly cost effective from the enemy viewpoint. This condition arises from the fact that a relatively small explosive charge set off by either contact, delay, influence, or command will almost certainly break the vehicle track and thus inflict a mobility kill. It is also almost a certainty that additional mobility damage will tend to be limited in most cases to the first and/or second road wheels of the vehicle while the engine, power train, weapons, and crew are generally intact. Thus, in spite of the relatively minor structural damage that is incurred, the critical

function of mobility is lost, and the vehicle becomes easy prey to a variety of subsequent enemy options while the mobility mission itself is lost. It is recognized that the science of mine detection is improving but the countermine effort should maintain a balanced effort by continuous and critical examination of the vehicle itself. By this concept the detection subsystem and vehicle subsystem become a countermine vehicle system with mutual enhancement.

b. This draft proposed materiel need takes the position that the almost certain loss of mobility incurred by tanks and armored personnel carriers after a single mine encounter constitutes a serious operational deficiency. This growing degradation of capability has encouraged and stimulated and will continue to encourage and stimulate the use of mines to impair and destroy mobility missions. There is a need for a broad variety of flexible countermine materiel quite separate and distinct from improved vehicles and detection per se. It is desirable that the current operational deficiency be overcome by providing commanders with a variety of materiel options so that countermine efforts may be selected to match the threat.

III. OPERATIONAL CONCEPT

It is postulated that the operational deficiency be countered by providing the field commander with materiel that will significantly increase or maintain mobility after encounter with a mine. Usage of such materiel would be intermittent rather than continuous and consistent with the magnitude of the mine threat.

It is recognized that deployment of a countermeasure eventually forces the enemy to also deploy a counter-countermeasure, but the subject materiel should have sufficient versatility to counter a broad variety of potential threats.

IV. ORGANIZATIONAL CONCEPT

V. LOGISTICAL CONCEPT

VI. CHARACTERISTICS

a. Performance

1. The system shall not degrade mobility of the vehicle to which it is applied by more than 20% or otherwise impair or degrade the critical functions of the vehicle before a mine encounter.

2. After the loss of a track and the corresponding front two road wheels of the vehicle, the system shall have mobility at least 10% of the original mobility and

shall be otherwise suitable for either unassisted return to base or continuation of the mission.

b. Physical Characteristics

Generally, the physical characteristics of this subsystem should be consistent and compatible with a specific mobility vehicle system. Factors such as weight, volume, ruggedness, transportability, configuration, maintenance characteristics, integrated logistics support, and personnel will require further attention and definition during development.