




**Current U.S. Practices in Mine Protection**





  
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**Current U.S. Practices in Mine Protection**

This brief will consider logistic and light armored vehicles since medium and heavy combat vehicles are more easily able to have mine protection due to their massive structure...






Mine protection is a minor but important part of their original design. It is not particularly efficient or interesting, but it is there...


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**Current U.S. Practices in Mine Protection**






This brief only considers protection of the occupant from mine effects. Protection of vehicle function or reparability is not a high priority.





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**Current U.S. Practices in Mine Protection**

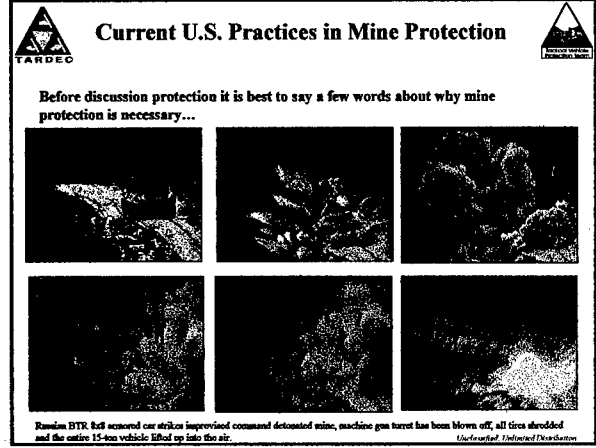
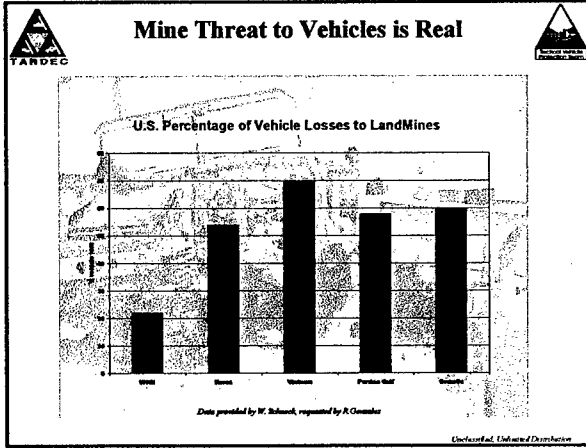



- Mines are only one part of the threat to U.S. vehicle occupants.
- In well designed systems mine protection is integrated into a comprehensive protection package.

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### Current U.S. Practices in Mine Protection

Why not obviate the need for mine protection by knowing where the mines are and avoiding them?

- The rate of movement allowed by detectors is far too slow for conventional maneuver warfare, and it will neutralize the agility advantage upon which the Objective Force is dependent.
- Detection can usually be defeated by small changes in enemy tactics.
- The resources required to secure all transit areas after sweeping are far in excess of those available to the Objective Force. If an area is not secured, it must be re-swept.

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### Current U.S. Practices in Mine Protection

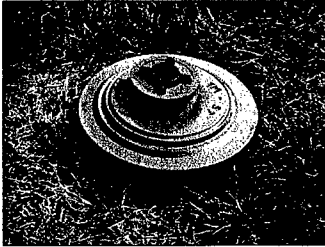
Why not clear the mine and be done with it?

- The rate of movement effected by mine neutralization (such as plows, rollers and flails) is too slow for the agility-dependent Objective Force.
- Plows are great for breaching operations but not generally suitable for clearing logistic routes since trucks have limited mobility on disturbed soil.
- Rollers are truck-compatible friendly but are not as dependable as one might expect.
- Clearance vehicles are vulnerable to enemy mine employment tactics which specifically target them.
- Electronic neutralization techniques can be expected to be effective only briefly, since the enemy is expected to have an effective communication network, they can be expected to compensate.
- The energy/fluid requirements of neutralization are severe for a light force.
- The resources required to secure all transit areas after clearance are far in excess of those available to the Objective Force. If an area is not secured it must be re-cleared.

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**Current U.S. Practices in Mine Protection**

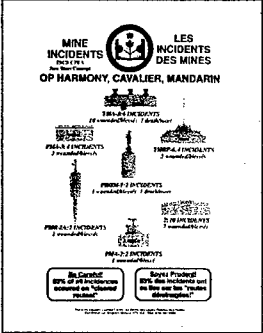
Why not outsmart the mine fuse using low ground pressure and electronic devices?  
 For every attempt to finess the threat, there is a tactical counter, usually at a very small cost to the enemy...



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**Current U.S. Practices in Mine Protection**


Despite the considerable effectiveness of detection and neutralization, there is no substitute yet for the confidence that well designed mine protection gives



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**Current U.S. Practices in Mine Protection**

Mine survivability in the U.S. has progressed steadily for the last decade, with the result that trucks employing recent mine protection technology are sometimes more survivable than light combat vehicles of the previous generation...



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**Current U.S. Practices in Mine Protection**

As the U.S. focus is on the protection of personnel, rather than the protection of the vehicle, the protective measures will be discussed within the context of the traditional occupant injury mechanisms...



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**Current U.S. Practices in Mine Protection  
Fragmentation**

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**Current U.S. Practices in Mine Protection  
Fragmentation**

Fragments – all fragments are kept out with ballistic material such as this armor aluminum floor plate.

Floor armor during M-939 Kit development

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**Current U.S. Practices in Mine Protection  
Fragmentation**

Fragments – alternatively ballistic blankets are employed on the floor for grenade-class fragment threat

"Ballistic Protection Blanket" – employed on the floor, seats, and firewalls

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**Current U.S. Practices in Mine Protection  
Blast**

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**Current U.S. Practices in Mine Protection**  
**Blast**

Blast- Keep out blast with armor panels

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**Current U.S. Practices in Mine Protection**  
**Blast**

- Blast injury to ears is considered to occur at 2+ psi overpressure.
- U.S. Army does not consider eardrum rupture itself to be incapacitating.
- U.S. Army considers Bowen's threshold for lung damage as injury tolerance.
- There are several instances where ear damage is the principal injury to occupants and sometimes occupants of adjacent vehicles.
- NATO is considering recommendation of some type of hearing protection in logistic vehicles.

Alternative predictive methodology by Axelsson et al (Sweden) using chest wall velocity as predictor of non-auditory blast injury in complex wave environment

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**Current U.S. Practices in Mine Protection**  
**Deformation**

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**Current U.S. Practices in Mine Protection**  
**Deformation**

Deformation - Prevention of deformation is approached in two ways blast shield and blast deflectors...

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**Current U.S. Practices in Mine Protection**  
**Deformation**

**Blast Shields**- rigid plates and structures that resist deformation by their strength...



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**Current U.S. Practices in Mine Protection**  
**Deformation**

**Blast Deflectors**- structures that are not required to be rigid, and deform while deflecting gasses away from the occupants...



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**Current U.S. Practices in Mine Protection**

Both approaches usually employ a secondary enclosure such as a false floor to prevent the occupant from coming in contact with the rapidly deforming plate.



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**Current U.S. Practices in Mine Protection**  
**Loss of Vehicle Control**



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**Current U.S. Practices in Mine Protection**  
**Loss of Vehicle Control**

Loss of control- keeping all vehicle occupants in restraints greatly reduces out of position injury, and injury from being ejected from the vehicle.

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**Current U.S. Practices in Mine Protection**  
**Gross Vehicle Movement**

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**Current U.S. Practices in Mine Protection**  
**Gross Vehicle Movement**

First Generation mine protective seating limits the loads transmitted to the seat occupant (using material that deforms when stressed beyond an engineering limit.)

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**Current U.S. Practices in Mine Protection**  
**Gross Vehicle Movement**

Second Generation mine protective seating limits the acceleration that the occupant experiences by exerting a relative force proportional to the input velocity. This seating also recovers from the blast induced compression quickly enough to function a second time when the vehicle hits the ground.

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**Current U.S. Practices in Mine Protection**  
**Gross Vehicle Movement**

Third Generation mine protective seating is under development...

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**Current U.S. Practices in Mine Protection**  
**Shaped Charges**

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**Current U.S. Practices in Mine Protection**  
**Shaped Charges**

Shaped Charges- Protection against shaped charges requires armor of substantial weight.

Shape Charge and Plate Thrower Mines vs Reference Armor

Type	Estimated Weight (pounds) of armor to protect
BLAKE (C7)	~10
WV-17 (C7)	~15
WV-17 (C8)	~20
WV-17 (C9)	~25
WV-17 (C10)	~30
WV-17 (C11)	~35
WV-17 (C12)	~40
WV-17 (C13)	~45
WV-17 (C14)	~50
WV-17 (C15)	~55
WV-17 (C16)	~60
WV-17 (C17)	~65
WV-17 (C18)	~70
WV-17 (C19)	~75
WV-17 (C20)	~80
WV-17 (C21)	~85
WV-17 (C22)	~90
WV-17 (C23)	~95
WV-17 (C24)	~100
WV-17 (C25)	~105
WV-17 (C26)	~110
WV-17 (C27)	~115
WV-17 (C28)	~120
WV-17 (C29)	~125
WV-17 (C30)	~130
WV-17 (C31)	~135
WV-17 (C32)	~140
WV-17 (C33)	~145
WV-17 (C34)	~150
WV-17 (C35)	~155
WV-17 (C36)	~160
WV-17 (C37)	~165
WV-17 (C38)	~170
WV-17 (C39)	~175
WV-17 (C40)	~180
WV-17 (C41)	~185
WV-17 (C42)	~190
WV-17 (C43)	~195
WV-17 (C44)	~200
WV-17 (C45)	~205
WV-17 (C46)	~210
WV-17 (C47)	~215
WV-17 (C48)	~220
WV-17 (C49)	~225
WV-17 (C50)	~230
WV-17 (C51)	~235
WV-17 (C52)	~240
WV-17 (C53)	~245
WV-17 (C54)	~250
WV-17 (C55)	~255
WV-17 (C56)	~260
WV-17 (C57)	~265
WV-17 (C58)	~270
WV-17 (C59)	~275
WV-17 (C60)	~280
WV-17 (C61)	~285
WV-17 (C62)	~290
WV-17 (C63)	~295
WV-17 (C64)	~300
WV-17 (C65)	~305
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WV-17 (C78)	~370
WV-17 (C79)	~375
WV-17 (C80)	~380
WV-17 (C81)	~385
WV-17 (C82)	~390
WV-17 (C83)	~395
WV-17 (C84)	~400
WV-17 (C85)	~405
WV-17 (C86)	~410
WV-17 (C87)	~415
WV-17 (C88)	~420
WV-17 (C89)	~425
WV-17 (C90)	~430
WV-17 (C91)	~435
WV-17 (C92)	~440
WV-17 (C93)	~445
WV-17 (C94)	~450
WV-17 (C95)	~455
WV-17 (C96)	~460
WV-17 (C97)	~465
WV-17 (C98)	~470
WV-17 (C99)	~475
WV-17 (C100)	~480

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**Current U.S. Practices in Mine Protection**  
**Shaped Charges**

Shaped Charges- Specialized armor materials can significantly reduce the weight of shape charge/explosively formed penetrated protection.

Research into protection against this type of threat is ongoing, with the goal of greatly reducing the weight of protection.

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**Current U.S. Practices in Mine Protection  
Summary**

The U.S. possesses technology for mine protection and have fielded effective MP systems for support vehicles.

However, we also regularly employ more traditional mine protection techniques.

Diagram illustrating mine protection components on a vehicle:

- SIDE ARMOR PLATES
- ESCAPE HATCH
- REAR ARMOR PLATES
- ROOF ARMOR
- ARMOR WINDOW/SCREEN
- WHEEL BLAST DEFLECTORS
- CENTER BLAST DEFLECTOR
- FRONT BUNGEE GUARD
- EMERGENCY ABANDONING SEAT
- ARMOR DOOR

Diagram illustrating a mine protection technique: Proper Placement of Sandbags in the Cab.

Diagram illustrating a mine protection technique: Sandbagged 4-ton M53 cargo truck.

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**OPSEC REVIEW CERTIFICATION  
(AR 530-1, Operations Security)**

**I am aware that there is foreign intelligence interest in open source publications. I have sufficient technical expertise in the subject matter of this paper to make a determination that the net benefit of this public release outweighs any potential damage.**

**Reviewer Name: Gregory J. Wolfe Grade: GS-13**

**Title: General Engineer**

**Signature: *Gregory Wolfe* Date: 8 Sept 2003**

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**x An abstract, summary, or copy of the information reviewed is available for review.**

**Reviewer's Determination:**

- 1. Unclassified Unlimited
- 2. Unclassified Limited, Dissemination Restrictions IAW
- 3. Classified. Cannot be released, and requires classification and control at the level of

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**Concur/Nonconcur Signature: *J. J. Reynolds* Date: *8 Sep 03***

**Public Affairs Office ( )::**

**Concur/Nonconcur Signature: *Margaret Crompton* Date: *Sep 10, 2003***