

**THE MILITARY CONSEQUENCES
OF A
COMPLETE LANDMINE BAN**

Prepared for:
Vietnam Veterans of American Foundation

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EXECUTIVE SUMMARY

In March 2001, *The Dupuy Institute* (TDI) was contracted by the Vietnam Veterans of America Foundation to prepare a historically based study on the military consequences of an antitank mine ban. So that its report would contain independent thinking, TDI analyzed selected modern campaigns showing the extent of antitank mine employment and damage resulting from it. Emphasis was placed on gauging the utility of antitank mines in campaigns that could be compared to emerging dynamic deep battlefield concepts with precision strikes followed up by rapid and decisive maneuver and on weapons employment that would minimize friendly losses.

TDI's in-depth analysis of World War II campaigns such as the British and Commonwealth offensive known as operation GOODWOOD, the southern portion of the German Kursk offensive, and Second El Alamein all point to some **delaying value** of antitank mines used by static defensive forces. However, determined pursuit of the attack in these examples was possible even with minimal mine clearing capabilities.

TDI has difficulty in estimating the merits of scatterable antitank mine employment since there are only a few instances of such use in the Persian Gulf War. Results of that use on Iraqi forces was unmeasured. Even so, it appears that scatterable mines hindered Allied maneuver. Scatterable mine capability when compared to historic application would indicate that, similar to World War II antitank mines, they could be used effectively as barriers. However, the effectiveness of scatterable mines used in new ways – blocking or impaling enemy armor or mechanized formations, exposing them to instant air, missile or artillery strikes – is unproved.

In this and in previous studies TDI also analyzed the use of all types of landmines in the defense of South Korea. The emerging conclusion from these is that US forces in any future scenario in Korea would only be hindered by their own use of “dumb” mines. South Korean forces may require some continued use of “dumb” antitank mines as barriers, but even that use would hinder counterattack options and would pose danger to refugees. Eventually various “smart” munitions discussed in this report should replace all “dumb” mines.

The proximate object of this analysis has been to generate an analytic non-governmental estimate of the impact of a total landmine ban. The historic cases and the doctrinal review mentioned above indicate that, South Korean defense considerations notwithstanding, the utility of dumb antitank mines is marginal at best in view of current and future operational concepts. Furthermore, logistic weight considerations add to the rationale to move more quickly to the already available and future “smart” antitank munitions.

This analysis also shows that there is a clear dividing line between what is considered a mine and what is a “smart” antitank munition such as the Hornet. There is no foreseeable reason that humanity will ever object to weapons that can be controlled in their use.

The current operational relevance of this study is its impact on risk thresholds contemplated by US decision-makers. TDI believes that its analysis is accurate enough to support conclusions that a total “dumb” landmine ban, including all antitank mines of that nature, would make operational sense and should be part of the revolution in military affairs. Such a move would enhance US dynamic battlefield capabilities, would lessen the logistic burden, and may well reduce American casualties. For similar operational effectiveness reasons, the United States should also study the consequences of eventually supporting a ban on scatterable mines. That may have to be conditional on other major manufacturing nations joining such an initiative.

INTRODUCTION

In 1996, at the request of the Joint Chiefs of Staff, *The Dupuy Institute* conducted a brief study on the "Military Consequences of Landmine Restrictions". The study, and the follow-on letter sent on 2 January 1997 by Major General Nicholas Krawciw, President of *The Dupuy Institute*, to General John M. Shalikashvili, the Chairman of the Joint Chiefs of Staff, recommended that the United States support a total ban on antipersonnel mines. The Vietnam Veterans of America Foundation published the study in its entirety in 2000.

Since then, *The Dupuy Institute* has completed three more studies related to landmines for the Vietnam Veterans of American Foundation. These include a study on the use of mines in a potential Korean War conflict, a study on the use of mines during the Gulf War and a survey of mine-breaching capabilities, focusing on the proposed Grizzly mine-breaching vehicle.

Since that time, the Vietnam Veterans of America Foundation considered expanding its support of the antipersonnel landmine ban to encompass a ban of antitank mines. As a result, they have contracted *The Dupuy Institute* to prepare a study on the military consequences of such a ban. This study is in effect, the antitank landmine counterpart to our antipersonnel landmine study. It represents the independent analysis of *The Dupuy Institute*. The contents, analysis and conclusions of this study are entirely that of *The Dupuy Institute*.

This study is primarily the work of Christopher A. Lawrence, Executive Director of *The Dupuy Institute*, and Richard C. Anderson. Nicholas Krawciw, Major General, USA, Ret., President of The Dupuy Institute supported us in our work.

CONCLUSIONS FROM PREVIOUS *DUPUY INSTITUTE* STUDIES

The decision by *The Dupuy Institute* to endorse the proposed antipersonnel mine ban was influenced by the nature of the conflicts in which the US routinely engages. Quite simply, the antipersonnel mine is a weapon used by the defender in conventional wars, the guerrilla in guerrilla wars, and hostile indigenous forces during interventions, peacekeeping operations or other types of contingency operations.

In a conventional war, a ban of antipersonnel mines would place the defender at a small disadvantage. Conversely, the attacker would gain an advantage. Over the last 100 years the US has spent far more time on the offense than the defense and it does not appear that this will change anytime soon. Thus, any form of antipersonnel mine ban would be of benefit to the US and would reduce US casualties over the long run.

Conventional forces in a guerrilla war have little use for antipersonnel mines. Conversely, guerrilla forces tend to make extensive use of them. In a guerrilla war, a ban on antipersonnel mines (if accepted by both sides) would significantly reduce casualties for the conventional force, giving them an advantage. If the US were to become involved in a guerrilla war (possibly as a result of an intervention) it would certainly be as the conventional force. Thus, any antipersonnel mine ban would be of benefit to US forces.

In operations other than war, especially those like peacekeeping operations, the intervening force has virtually no use for antipersonnel mines. They are often used by other parties, either against the intervening force or against others (including civilians). In operations other than war, a ban on antipersonnel mines will reduce casualties significantly for the intervening (or conventional) force and will probably give them a political advantage (in terms of support at home because of lower casualties).

Therefore, except in the case of conventional forces on the defense, a ban of antipersonnel mines is to the advantage of the US. Even a partially effective ban will result in fewer US lives lost in the long-term. Even if the ban were wholly ineffective, it would have no real negative impact on the US Army's ability to conduct offensive conventional operations, guerrilla war or operations other than war.

In 1997, the United States expressed a willingness to sign the Ottawa Convention, with two exemptions. One was for mixed-systems of scatterable mines (SCATMINES), and the other was for the use of antipersonnel mines in Korea.

Mixed systems are really a minor refinement to scatterable antitank systems. They return to the original purpose of antipersonnel mines, which was to obstruct attempts to clear antitank minefields. Mixed systems – artillery fired, air dropped, or ground dispensed – scatter a large number of antitank and antipersonnel mines across a wide area. As these are surface laid, they are relatively easy to detect and clear. The real purpose of all SCATMINE systems is to halt or delay mobile or armored forces – the antipersonnel mines within in the mixed systems are intended to make it more difficult to clear the antitank mines. However, since the antitank mines may also have anti-handling devices installed, then the practical need for the antipersonnel mines is limited. Overall, while the optimal "scatterable" system may be a mixed system, the marginal advantage gained from these scatterable antipersonnel mines is not sufficient to justify rejecting a comprehensive antipersonnel mine ban.

The Korean exception appears to be a “red herring.” The US currently has 909,999 landmine systems in Korea. Of those, 133,686 are SCATMINE systems, 562,341 are "dumb" antipersonnel mines, and 213,972 are "dumb" antitank mines. As a result of its study, *The Dupuy Institute* has determined that – with existing resources and time – the US could lay only thousands or tens of thousands of these “dumb” mines in a future Korean conflict. This appears to match current US planning, since the US 2nd Infantry Division in Korea is currently tasked as a mobile reserve and does not plan to lay mines during the initial stages of such a conflict. Furthermore, the primary reason for the US Army stockpile of "dumb" mines in Korea appears to be to hand them over to South Korea in the event of war. The US plans to transfer to the South Koreans 505,358 "dumb" antipersonnel mines (90 percent of the total of "dumb" antipersonnel mine stockpile), 176,481 "dumb" antitank mines (82 percent of the total of "dumb" antitank mines) but only 2,818 SCATMINE systems (2 percent of the total SCATMINE systems). Only 56,983 antipersonnel and 37,491 antitank “dumb” mines would be retained in US inventory under this scenario. Therefore it appears that the prime reason for the US Army maintaining "dumb" antipersonnel mines in Korea is to stockpile them for South Korean use and that any planned use of the stockpiled mines by US forces is a secondary consideration.¹

This planned transfer of mines to South Korea poses two questions:

First, South Korea reportedly has up to three million of its own mines stockpiled. This is clearly more than it can possibly emplace in any build-up period before a war or during the initial phases of such a conflict. That being the case, why does the US need to hold an additional 681,839 "dumb" mines for South Korean use?

Second, on 17 January 1997 the United States stated that it would observe a permanent ban on the export of antipersonnel mines. The existing plan to transfer over one-half million mines, *including antipersonnel mines*, to South Korea in the event of war violates this policy. To avoid the appearance of hypocrisy, this policy statement needs to be reversed or revised, or the US plan in Korea needs to be changed, or the mines in question need to be destroyed.

The "Korean exception" to the Ottawa Convention appears to be primarily for the purpose of warehousing mines for eventual transfer to South Korea. If the US were to sign the Ottawa Convention with a "Korean exception", then such a transfer would require the US to violate the treaty. Therefore, *The Dupuy Institute* must reject the "Korean exception."

Thus, for the reasons given in our original report, *The Dupuy Institute* is comfortable with its recommendation that the US should accept a complete ban on antipersonnel mines. Nothing has occurred in the last five years to change that recommendation. In fact, tensions in Korea have receded, and the two Korea's have de-mined a small section of their border. *The Dupuy Institute* conclusion that even a partially effective antipersonnel landmine ban would save American lives and enhance US combat power remains unchanged five years after our original report was submitted.

¹ A US Engineer officer, a member of the Combined Forces Command, briefed two VVAF representatives on 11/12 December 2000 and provided data on US mine inventories in Korea.

AN INTRODUCTION TO LANDMINES

The new initiative for banning antitank mines is partly due to a perceived flaw in the Ottawa Convention. Anti-handling devices were allowed to remain on antitank mines.² In some cases, these devices are sufficiently sensitive that even the slightest movement can trigger them. As a result, some antitank mines can be as easy to trigger and can pose as much of a threat to civilians as do antipersonnel mines. This perceived weakness in the Ottawa Convention has led the Vietnam Veterans of America Foundation (VVAF) to propose a complete landmine ban of both antipersonnel and antitank mines.

The origin of modern landmine warfare was the need to defeat a new weapon – the tank. Early landmines were developed in World War I by the Germans in response to the Allied Powers deployment of large numbers of tanks, a weapon that the Germans could not match. In effect it was a German asymmetric response to an Allied technology that they were incapable of matching. Later, the antipersonnel mine was created to defend the antitank mine from the threat of mine-clearing units. The primary threat to US forces deployed in a defensive posture is armor. The primary purpose of scatterable mines in non-defensive roles is to interdict the movement of enemy armor. An antipersonnel landmine ban would result in the loss of little combat capability for the US Army and in fact in the long run would reduce US casualties to landmines in most combat and near-combat environments. However, if one were to extend this ban to antitank mines then one must seriously consider the real military consequences of such a step. Currently "Landmine-type" munitions come in six basic varieties.

First are "dumb" antipersonnel mines, which are small, weighing between one to 3.5 kilograms, and easily buried (although they can be speedily surface laid). They are cheap, easy to use and abundant. They are the primary source of the landmine problem. They have very limited military utility for the US, and have been far more of a problem and a source of casualties for US forces since their invention in 1918 than they have been a help. The US has not made use of them in any operation in the last 25 years (including Desert Shield, the Gulf War, Panama, Grenada, and Bosnia). They are primarily conventional defensive weapons or weapons of terror. PDMs (Pursuit Deterrent Munitions), which are used mostly by Special Forces units, is the only one of this type known to be in the active US inventory outside of Korea. It is intended to support hit-and-run, ambush, harassing, and urban warfare missions. In effect, a PDM is a hand-emplaced ADAM round.

Second are scatterable antipersonnel mines, which are artillery fired, airdropped or ground dispensed. They are randomly scattered, surface-laid (i.e. unburied), and remain exposed after they are dispensed. The US Army currently fields three scatterable antipersonnel mine systems, ADAM (Area Denial Antipersonnel Munition) which is fired as a round of artillery, Flipper which is a mechanical device that can dispense M74 antipersonnel mines, and MOPMS which is deployed as a round of ammunition in a suitcase-like container and is activated by a remote-control unit. Once MOPMS is activated it functions in a dual capacity, deploying four antipersonnel and 17 antitank mines. Other than these, the US only utilizes antipersonnel mines in mixed systems. But, since antitank mines can be fitted with anti-handling devices, these mixed systems are of limited utility.

² The treaty contained language that was intended to ban those mines that contained anti-handling devices that could be detonated by an unintentional act. However, no common standard to determine which mines would fit that description exists.

The US has used scatterable antipersonnel mines in only one operation in the last 25 years, in the Persian Gulf War, and then only in conjunction with scatterable antitank mines.

Third are "dumb" antitank mines, which are the larger equivalent of the "dumb" antipersonnel mine. They weigh between 7.6 to 13.5 kilograms and are triggered by either a tilt rod or pressure fuse. Since the intended target is a vehicle, in most cases it is not triggered by a person stepping on it, so they pose much less of a humanitarian problem. Still, they will occasionally cause casualties to civilians on foot and they are definitely a source for civilian losses in vehicles. They are used to halt, delay, disrupt or block armor. Their value as an anti-armor weapon will be discussed in depth later. In any case, the US has not used them in any operation in the last 25 years. During the initial build-up of forces in the Gulf War, the 82nd Airborne Division alone faced a possible attack by armored and mechanized elements of the Iraqi Army; but the US did not emplace antitank mines. Even then it was apparently realized that the problem of dealing with the mines later (when the US attacked) did not justify their deployment. Furthermore, HRH Prince Khalid Ibn Sultan, co-commander of Coalition Forces during the Gulf War, ordered that mines not be laid in Saudi Arabia. *The Dupuy Institute* suspects many US commanders in similar situations will face this type of operational/political decision in the future. The "dumb" antitank mine has been far more of a problem and source of casualties to US forces than help since their invention in 1918. These weapons, like their "dumb" AP counter-parts, require considerable time and effort to deploy and are primarily defensive weapons.

Fourth are scatterable antitank mines, which can be air dropped, artillery fired or ground dispensed. They are deployed as mixed systems of both antitank and antipersonnel mines or are exclusively antitank. The US has only used scatterable antitank mines in the Persian Gulf War.³ These weapons clearly have major advantages over "dumb" antitank mines; including ease and speed of use, and the ability to drop them on, in front of, or behind enemy forces. As such, they are not only quick and easy to use defensive weapons; they also have some offensive capability. They are an improvement over "dumb" antitank mines in both flexibility and versatility. However, since they are surface laid, they can be easier to spot and clear. VVAF is proposing to add both "dumb" and scatterable antitank mines to the landmine ban.

Fifth are dedicated command-detonated systems that include the Claymore antipersonnel munition and SLAM (Selectable Lightweight Attack Munition). The Claymore originally was designed for either tripwire or command detonation. Those in US inventory now can only be command detonated. SLAM is designed to destroy unarmored and lightly armored vehicles and has little or no antipersonnel capability. It can be used as a conventional, magnetically or infrared-fused, anti-vehicle mine, as a timed demolition, or as a command-detonated munition. With the magnetic/infrared mine fuse deleted, SLAM would no longer fall under the strictures of the landmine ban.

Sixth are smart, anti-armor, "mine-like" systems currently under development. They include Hornet, which is a high-tech system that relies on seismic and acoustic sensors to detect, identify and track enemy targets. Hornet can be emplaced by hand or by the Army Tactical Missile System (ATACM). It appears to be an effective, superior substitute for scatterable antitank mines and will reduce the chance of fratricide since friendly forces can move freely through them. The last two types are "mine-like" systems that are not considered under the landmine ban.

³ It appears the US Army has only employed scatterable antitank mines twice, during Operation DESERT STORM. The US Air Force, Navy, and Marine Corps also used GATOR air dropped antitank mines during DESERT STORM as well. See "The Combat Value of Scatterable Antitank Mines" later in this report.

US ENGINEER ORGANIZATIONS AND ANTITANK MINE SYSTEMS

US Army Organization

Currently, the US Army fields five heavy divisions (1st Armored, 1st Cavalry, 1st Infantry, 3rd Infantry and 4th Infantry Divisions), four light divisions (10th Mountain, 25th Infantry, 82nd Airborne, and 101st Air Assault), the new Interim Brigade Combat Teams (IBCT) (3rd Brigade, 2nd Infantry Division and 1st Brigade, 25th Infantry Division – scheduled for conversion by December 2002) and one other division (the 2nd Infantry Division).

The Engineer Brigade of the "Army of Excellence" Heavy Division consists of a Headquarters & Headquarters Company (HHC) and three battalions. This organization currently exists in five divisions, but is being phased out over the next few years. The new "Force XXI" Mounted Expeditionary Division (a revised Heavy Division) does not have an Engineer Brigade. Instead, each of the three maneuver brigades has an engineer battalion, consisting of a HHC and three Engineer Companies. The Division Headquarters also has a Division Engineer Planning Section.

The Engineer Battalion of the Airborne Division, Air Assault Division, and Light Infantry Division are all organized with a HHC and three line companies. The IBCT has three Combat Mobility Platoons, while the proposed "Interim Division" will have an Engineer Regiment with at least three companies. In addition, currently there are other Separate Engineer Companies and Battalions assigned to armor cavalry regiments, separate brigades and corps.

Dumb Antitank Mines

The US inventory consists of three standard types of "dumb" AT mines. They weigh between 7.6 kilograms and 13.5 kilograms and contain from 4.95 to 9.9 kilograms of explosives. A tilt-rod or a pressure plate actuates them. The pressure plate is activated by a weight of 130.5 to 333 kilograms. The tilt rod is 61 centimeters in length (24 inches) and is activated by a deflection of 20 degrees or 1.7 kilograms of pressure.

"Dumb" antitank mines are no longer found in the active US inventory, except in Korea.

Scatterable Antitank Mines

Ground dispensers enable relatively rapid and accurate placement of mines. Ground systems include Volcano, Flipper, and MOPMS. Artillery and air systems are not as accurate as the ground dispensed systems, and are more difficult to mark and record. Air systems include the GATOR, which are dispensed from canisters carried by US Air Force or US Navy aircraft. Artillery systems include RAAM, which is dispensed by a 155mm-artillery projectile. Like all SCATMINE systems they tend to lay mines within a general area and in a random pattern. The mines are, of course, always surface laid. US Army ground and helicopter-deployed Volcano, Flipper and MOPMS scatterable antitank mine systems are normally found only in the engineer units organic to and supporting light divisions. RAAM is available to all Army artillery units. The US Army does not use GATOR.

All US SCATMINES self-destruct after a brief period of time (between three hours and 12 minutes to four hours for the shortest duration to between 12 and 15 days for the longest duration). This varies depending on the type of mine, and sometimes the setting. According to FM 20-32, it is estimated that one in 200 mines will self-destruct when arming and that about one in 10,000 mines

will not self-destruct and will remain potentially lethal. *The Dupuy Institute* has not reviewed the operational test data on this (especially any that use mines that have been "on the shelf" for while), so cannot comment on its validity. *The Dupuy Institute* does note that even with an estimated rate of failure of only one in 10,000, US units in the Gulf War were reluctant to move through known or suspected SCATMINE areas.

There are six types of scatterable antitank mines in the US inventory. They all weigh about 1.7 kilograms and contain 585 grams of explosive. They are magnetically fused. In three of the types, 20 percent are fitted with anti-handling devices. The other three types, although not fitted with anti-handling devices, are sensitive enough that movement may detonate them.

Ground Dispensed Scatterable Antitank Mine Systems

Volcano - The Volcano is a truck or helicopter mounted launcher rack that fires a canister containing six mines. The helicopter mounted (UH-60A Blackhawk) Volcano is intended to be used from very low altitude, so for most purposes, it is similar to the ground Volcano (the minefields are of similar density and size). The self-destruct time on the mines may be selected in the field (four hours, 48 hours or 15 days).

Ground Volcano systems are issued two per Combat Engineer Company, Light and Airborne and six per Headquarters and Headquarters Company, Airborne or Air Assault Division Engineer Battalion. At this scale of issue the Light Division has six ground Volcano systems and the Airborne and Air Assault Division has 12. The two engineer battalions of the 2nd Infantry Division also utilize the Ground Volcano system.

In addition to the ground Volcano system, three "air" Volcano rack mounts are issued to selected Assault Helicopter Companies. However, only one Aviation Company per division, corps or armored cavalry regiment is so equipped. US Army heavy divisions have no assigned ground-based Volcano systems. However, they may have "air" Volcano systems with any attached or assigned Assault Helicopter Company. This lack of a defensive antitank system in the heavy division is not surprising and is certainly in line with the purpose, use and doctrine of a heavy division. It clearly indicates that for a unit with sufficient antitank resources the need for antitank mines is indeed limited.

Volcano is intended to be employed offensively and defensively as point minefields and as deliberate minefields to delay enemy movement, isolate the battlefield, protect flanks, and reinforce friendly fires. However, it's almost exclusive employment with light divisions suggests that Volcano is also intended to compensate for the shortfall of antitank systems in these divisions

Normally, a US unit equipped with the Volcano system has two reloads. A Volcano system launches 160 canisters, each with either, five antitank and one antipersonnel mines, or six antitank mines (canisters procured after 1992 consist entirely of antitank mines). Each dispenser can lay two Turn or Block minefields of 555 meters by 440 meters or eight Disrupt or Fix minefields of 277 meters by 120 meters. An experienced crew can reload in 20 to 30 minutes. Overall, each Volcano launcher with three loads can lay 2,880 mines.

The US Army currently reports that there are 26,036 Volcano in Korea. None are planned for transfer to South Korean forces. It is uncertain whether these are 26,036 Volcano canisters (six mines per canister) or 26,036 Volcano mines, although it is most likely the former. In that case it works out to be 162.72 Volcano system loads, sufficient to support 54.24 Volcano launchers at a scale of issue of two reloads per launcher

The three Combat Mobility Platoons in the IBCT use a new, smaller Volcano system. It is trailer mounted using the MICLIC M200A1 trailer with only two racks (40 canisters per rack) and will be towed by an Engineer Squad Vehicle (ESV). Effectively it is a half-size Volcano. Each Combat Mobility Platoon will be equipped with one trailer mounted Volcano system, giving the IBCT a total of three half-size Volcanoes. The proposed "Interim Division" is planned to have three half-size Volcanoes per Combat Company in the Division Engineer Regiment, in addition to those with the Combat Mobility Platoons. The division would have 18 half-sized Volcanoes, plus those full-size systems in attached or assigned Assault Aviation Companies. This Volcano-system mine laying capability is about two-thirds that of a light division.

Flipper - The M138 Flipper is a manually fed dispenser operated by one soldier that can be mounted on a number of standard vehicles. It uses the same mines (M74 antitank and M75 antipersonnel) as the older, trailer-mounted M128 Ground Emplaced Mine Scattering System (GEMSS, which has itself been replaced by Volcano). Flipper is issued one per Combat Engineer Platoon in the Light Infantry Division Engineer Battalion and one per Combat Engineer Company in the Airborne and Air Assault Division Engineer Battalion, and two per Combat Engineer Company in the Corps Airborne and Light Engineer Battalion.

MOPMS – the Man-Portable Mine System (MOPMS) is a 162-pound suitcase shaped mine dispenser. It can place 21 mines (17 AT and four AP) from each dispenser by means of a hand-held radio control unit (RCU). These mines explode after four hours. It is intended to provide a simple, hasty, local mine defense with minimal manpower expenditure. MOPMS is a Class V item of issue (ammunition and explosives) and was fielded as a substitute for conventional mines in unit's authorized a basic load of mines. The M71 RCU is a TOE item and is issued four per engineer company, two per armor, infantry and cavalry company, and one per selected companies with a protective mining mission.

Artillery Dispensed Mine Systems

The US has only one artillery deployed scatterable antitank mine system, RAAM, and ADAM it's antipersonnel mine counterpart. ADAM and RAAM are delivered by 155mm howitzer projectiles. They are simply fired like any other artillery round, with the mines contained in the projectile and dispensed while the projectile is in the air. The effective range of the US M109 Howitzer is 17,500 meters while the M198 Howitzer is 17,740 meters. Each ADAM projectile contains 36 antipersonnel mines (pre-set by the manufacturer as to delay time), and as such are by the Ottawa Convention. Each RAAM projectile contains nine antitank mines of either M70 or M73 mines (pre-set by the manufacturer as to delay time).

According to the FM 20-32, an artillery battalion carries 32 ADAM and 24 RAAM rounds per artillery piece as part of its basic load. The short self-destruct version (4-hour) is usually carried, with the 48-hour version issued as required by an ASP (Ammunition Supply Point) to units.

Air Dispensed Mine Systems

GATOR is currently the only US air dispensed mine system. The mine is the same for US Air Force and US Navy systems (the BLU 91/B), but the USAF dispenser contains 72 AT mines and 22 AP mines, while the US Navy dispenser carries 45 AT mines and 15 AP mines. The self-destruct delay times are selectable in the field as four hours, 48 hours or 15 days. The GATOR can

be dropped by the USAF A-10, F-4, F-15, F-16, B-1 and B-52 aircraft, or USN/USMC A-6, A-7, F-4, FA-18 and AV-8B aircraft. The area covered by GATOR varies depending on aircraft speed, aircraft altitude, and the altitude that the dispenser opens.

The logistics load is handled by the US Air Force, the Navy or the Marine Corps air wings. As such, it is a convenient rear area logistics capability that allows mine laying without providing a logistics burden on the US Army and Marine Corps forward deployed ground combat units.

THE COMBAT VALUE OF “DUMB” ANTITANK MINES

“Dumb” antitank mines have been utilized in combat almost since the first tank was introduced to the battlefield. Soon after the first British tank was employed at Flers-Courcelette on 15 September 1916, the Germans began to develop countermeasures. One was the use of mortar (*Minenwerfer*) and artillery shells as simple antitank mines. These were placed in the ground with exposed contact fuses or were command detonated by electricity. These extemporized means were only marginally effective, and there does not appear to be any data available on the number of tanks lost to them in World War I. In any case, the vast majority of the early tanks were lost to mechanical breakdowns rather than to enemy weapons of any kind. However, between the wars the German Army placed great emphasis on developing antitank defenses, including antitank mines.

Antitank mines were used in two of the major pre-World War II conflicts, the Russo-Finnish “Winter War” and the Spanish Civil War. However, it was not until World War II that the use of antitank and antipersonnel mines became widespread. The use of mass armored formations in the offensive spawned the creation of vast mine “marshes” in North Africa, Russia, and Europe. The density of minefields steadily increased, as did the labor of manufacturing, transporting, and emplacing mines.⁴

Good data is available for the effectiveness of antitank mines in World War II. In the European Campaign, 6 June 1944 – 30 April 1945 (329 days) it was found that 173 of 803 (21.54 percent or 0.07 percent per day) US First Army tanks were lost due to mines.⁵ In the Normandy Campaign, 6 June – 10 July 1944 (35 days), it was found that four of 45 (8.89 percent or 0.25 percent per day) British tanks were lost due to mines.⁶ Also in Normandy, 6 June – 7 August 1944 (63 days), only one of 110 (0.91 percent or 0.01 percent per day) German tanks was lost due to mines.⁷ In the Okinawa Campaign, 1 April – 31 May 1945 (61 days), 64 of 221 (28.96 percent or 0.47 percent per day) US tanks were lost due to mines.⁸

Another report alleges that tank losses due to mines in World War II were much higher. It gives losses to mines as Allied (total) 22.7 percent, Allied (North African Campaign) 15.6 percent, Allied (Italian Campaign) 29.5 percent, Allied (Northern European Campaign) 22.2 percent, Germany (Battle of Kursk) 52.0 percent, and US (Pacific Campaign) 33.3 percent.⁹

⁴ See, *The Dupuy Institute, Military Consequences of Landmine Restrictions, VVAF Monograph Series, Vol. 1, Number 2.* (Washington, DC: Vietnam Veterans of America Foundation, 2000), pp. 35-61, for a detailed analysis of the history of mine warfare and the effectiveness of mines in combat. This monograph is a slightly revised reprint of a report prepared for the US Joint Chiefs of Staff by The Dupuy Institute in April 1996.

⁵ Trevor N. Dupuy, *Attrition: Forecasting Battle Casualties and Equipment Losses in Modern War* (Fairfax, VA: Hero Books, 1990), p. 80. A recent review of the data resulted in a slight change from 171 to 173 tanks in the First Army sample being lost to mines.

⁶ *Operational Research in North West Europe, The Work of No. 2 Operational Research Section With 21 Army Group, June 1944-July 1945*, “OR Report No.12, Analysis of 75mm Sherman Tank Casualties Suffered Between 6th June and 10th July 44,” pp. 199-201.

⁷ *Op.Cit.*, “OR Report No.17, Analysis of German Tank Casualties in France, 6th June 44-31st August 44,” pp. 202-203.

⁸ Russel H. Stolfi, *Mine and Countermine Warfare in Recent History, 1914-1970, Report No. 1582* (Aberdeen Proving Grounds, MD: US Army Ballistic Research Laboratories, 1972), p. 98.

⁹ William C. Schneck, *After Action Report Operation Restore Hope* (Fort Belvoir, VA: US Countermine Systems

Unfortunately, the source of the figures quoted and what was considered to constitute the temporal and geographic limitations of the samples is not stated. Furthermore, these figures simply cannot stand up to close examination. For instance, the 52 percent quoted for the Battle of Kursk cannot be reconciled with any known German reports of tank losses to mines in the Kursk Campaign. The highest known loss of German tanks to mines at Kursk is that of *Panzer Regiment von Lauchert*. Between 5 and 10 July (6 days) it lost 81 *Panthers* to battle damage (25 were a total loss while 56 were repairable) of which 40 were due to antitank mines (49.38 percent or 8.23 percent per day). Furthermore, only one of those lost to mines (2.50 percent) was a total loss. No other German unit reported such extremely high tank losses due to mines during the Battle of Kursk.

A similar discrepancy exists with the 33.3 percent loss reported for US tanks in the Pacific. The Okinawa Campaign saw the only extensive use by the Japanese of antitank mines – causing 28.96 percent of the tank losses inflicted on US tanks. However, in none of the other Pacific Theater battles has it been shown that antitank mines inflicted a significant number of losses on US tanks. In fact, it appears that Japanese mine warfare was most characterized by a lack of resources and training, and that the experience on Okinawa represents the zenith rather than the norm of the Japanese use of mines against tanks.¹⁰

That being said, it does appear that antitank mines were effectively used in World War II. However, effective use was limited to the defender in all of the cases. Significantly, except for the case of the German tank losses in Normandy, the examples above are all the result of attackers encountering enemy antitank mines. Furthermore, the use of antitank mines in the defense in World War II was typically in an effort to equalize widely disparate attacker versus defender tank strength ratios. The World War II cases that follow include diverse combat environments, unequal technological levels, and varying levels of success on the part of the attacker, as well as different degrees of antitank mine effectiveness.

US Tenth Army Tank Loses to Mines, Okinawa 1945

What immediately stands out in the Okinawa example is that the Japanese defenders had few tanks and antitank guns available and – of those – fewer still were effective against US armor. Japanese antitank weapons included only 73 20mm, 25mm, and 37mm AT guns (all of extremely limited value versus US medium tanks), 140 47mm guns (only marginally more capable), 18 75mm AA guns (immobile in fixed positions), and 44 medium and 13 light tanks.¹¹

The Japanese had few effective conventional resources for dealing with US tanks. Furthermore, it appears that the figures quoted as “mine” losses on Okinawa may include tanks lost to satchel charges used by Japanese “suicide” squads – a method of “command detonation” normally employed as weapons of last resort by less fanatical armies.¹² *The Ryukyus’ Operation*

Directorate, 1994), p. 55.

¹⁰ Stolfi, *op.cit.*, pp. 92-98, gives an excellent précis of the Japanese use – or lack of use – of mines in the Pacific.

¹¹ Japanese strength figures are derived from US Army G-2 Japanese Monograph Series, Nos. 53 and 135, Tenth Army G-2 Intelligence Monograph, Ryukyus Campaign, Pt. 1, Section B: Order of Battle, and from the Tenth Army After Action Report, Ryukyus, 26 March-30 June, 1945, Chapter 9, Section III – “Operational Material Damage to the Enemy.” In addition, 4 light tanks and 51 USMC medium tanks were destroyed, but no breakdown for the cause of loss has been found.

¹² Of the 221 medium tanks lost, 111 (50 percent) were to gunfire, 38 (17 percent) were to terrain hazards, and 8 (4 percent) were to miscellaneous causes (mostly sunk). Ninety-six (43.44 percent) were totally destroyed. Unusually, 25 of the 38 lost to terrain hazards were later destroyed by enemy action.

Report of the 763rd Tank Battalion gives some insight into how the tanks on Okinawa were actually lost. They reported “Tank Disabilities Due To Enemy Action” as one “SUNK,” 30 “MINES,” 18 “AT&ARTY,” one “SACHEL,” and 10 “STUCK-TRACK (Thrown).” Those destroyed were one “SUNK,” 13 “MINES,” eight “AT&ARTY,” one “SACHEL,” and seven “STUCK-TRACK (Thrown).” Significantly, five of the 13 destroyed by mines, one of the eight destroyed by antitank guns and artillery, and all seven of the seven mired tanks destroyed, were lost to Japanese “suicide” squads after they were immobilized. Effectively, 14 of the 30 destroyed (46.67 percent) were lost to Japanese “suicide” squads, an indication of just how parlous a state the Japanese antitank defenses were in.

Normandy, British Second Army Tank Losses in Operation GOODWOOD, July 1944

Following the invasion of Normandy on 6 June 1944, Allied forces engaged in a protracted series of battles in an effort to expand the lodgment area in France and defeat the German Army. One of the best known of these was the British and Commonwealth offensive known as Operation GOODWOOD (18-21 July 1944), which was designed to expand the British bridgehead on the east bank of the Orne River on the left flank of the Allied armies, to the east and south. UK forces began the battle with approximately 139,000 men, 1,369 tanks, and at least 732 artillery pieces. Losses were 4,120 men (2.97 percent or 0.74 percent per day) (844 KIA, 2,951 WIA, 325 MIA) and 493 tanks (36.01 percent or 9.00 percent per day). However, only 361 of the tanks were knocked out – that is, they were either written off or were so damaged as to require long-term repair, 132 were damaged – that is, they required less than 24 hours for repair. At the end of the battle British tank strength was 1,047.¹³

British tank losses due to mines are known for only one unit, the 11th Armoured Division for 18 and 19 July. It was the lead division in the British attack and suffered the highest tank losses on those two days. Significantly however, only five of the brigades 286 operational tanks (1.75 percent or 0.87 percent per day) were listed as being lost to mines. Another 108 were lost due to enemy action while seven were lost to mechanical failure. Thus only five of the 120 (4.17 percent or 2.08 percent per day) tanks lost were to mines, while 5.83 percent or 2.92 percent per day were lost to mechanical failure.¹⁴ Additional losses to German antitank mines in the other British armor units involved in GOODWOOD cannot be definitely excluded. However, it is interesting to note that no vehicles losses were recorded for the two specialized mine clearing units that participated in the battle (22nd Dragoons and 1st Lothians). Total personnel losses for those two units were only two KIA and 10 WIA, or 0.79 percent (0.26 percent per day) out of a total strength of 1,513. Engineer troop strength in the battle as a whole totaled 4,457, while engineer losses were only six KIA and 48 WIA, or 1.21 percent (0.40 percent per day).

However, one of the most interesting aspects of GOODWOOD is that a major cause for the eventual British failure was not German mines, it was the extensive *friendly* minefields that had been emplaced prior to the battle. These mines could not be effectively lifted in the three days that were available before the offensive began, and eventually the decision was made to

¹³ Department of the Scientific Adviser to the Army Council, *Military Operations Research Unit Report No. 23: Battle Study Operation “GOODWOOD”* (NP, October 1946). The tank strengths and losses were taken from the British 2 Army daily tank states.

¹⁴ British Public Records Office (PRO), WO 171/456, 11 Armoured Division “G” Reports. Interestingly, this report seems to indicate that the losses reported by British 2 Army in the Daily Tank States may have been exaggerated. The total losses for 11 AD in those reports for 18 and 19 July are 162 “not repairable in 24 hours” and 30 “repairable in 24 hours.”

treat them as if they were enemy minefields. The two mine clearing units mentioned above were actually utilized in clearing 18 gaps through friendly minefields – there is little evidence to show that they cleared enemy mines at all during the battle. When the battle began, the British were only able to pass a single armor battalion (the three armored divisions disposed of 12 armor battalions total, about 720 medium tanks) at a time through the gaps. Worse, the three divisions had only six bridges available to cross to get to the assembly area on the east bank of the Orne River. As a result, the leading armor battalion exited the gaps and crossed the startline as planned at 0745 hours on 18 July. However, the leading armor battalion of the last division to advance did not reach the front-line (approximately 11 kilometers from the startline) until 1800 hours that day, over ten hours later. Furthermore, the motorized infantry brigade of the last division was unable to begin crossing the Orne until 2330 hours on 18 July – 15 hours and 45 minutes after the advance began. The consequent loss of momentum gave the German defenders sufficient time to bring up reserves and eventually halt the British advance short of the most crucial objectives.

US Army Losses to Antitank Mines in the European Theater, 1944 - 1945

In what is perhaps a minor and yet still significant case, one of the first three losses of the US Army M4A3E2 Sherman *Jumbo* “assault” tanks in the European Theater was as a direct result of encountering a US antitank mine. On 22 November 1944, one of the 14 operational M4A3E2 tanks, newly assigned to the 3rd Platoon, C Company, 743rd Tank Battalion attached to the 30th Infantry Division, struck a US antitank mine when advancing on German positions near Franhoven, Germany. The mine destroyed the left front drive sprocket and broke the track, immobilizing the tank. A few moments later, after the crew had evacuated the tank, it was hit by six rounds of what was believed to be 88mm antitank fire at a range of 800 yards from the right front. The heavily armored tank survived hits to the turret side, mantlet, front slope and final drive, but one of two hits to the right front side of the hull, striking at an angle of 70 degrees, penetrated and caused the tank to burn. It appears likely that if the tank had not been immobilized it could have turned its less vulnerable front to the threat and quite possibly could then have neutralized the German antitank position.

The significance of this individual incident may be seen when it is realized that the 14 *Jumbos* constituted 36.84 percent of the battalion’s operational medium tank strength and that only one other *Jumbo*, and seven medium tanks in total, were lost between 20 and 25 November. In other words, 50 percent of the *Jumbos* lost, and 14.29 percent of the total tanks lost by the battalion during those six days, was as the result of an accidental encounter with a “friendly” antitank mine.¹⁵

In a more extensive analysis of 803 tanks lost by the US First Army from 6 June 1944 to 30 April 1945, it was found that 173 were lost to mines (21.54 percent). Of those, 31 were irreparably damaged (17.92 percent). However, three of the 173 (1.73 percent) were lost on US

¹⁵ Documentation on US tank loss experience is extensive, but has never been comprehensively analyzed. The primary source for this data are the decimal files of the ETO (US Army Forces in the European Theater) Armored Fighting Vehicle and Weapons Section, which may be found in the US National Archives (NARA) Record Group (RG) #492, Box #1-8. The *Jumbos* were extremely valuable assets. They were the only US tank at the time capable of going head to head with German tanks and antitank guns and surviving. Of 250 *Jumbos* deployed to the ETO, 61 (24.40 percent) were lost to all causes. On the other hand, of approximately 6,700 other types of Sherman tanks deployed, 3,155 (47.09 percent) were lost.

mines (the incident with the 746th Tank Battalion, described above, was not included in the First Army survey).¹⁶ In each of these cases, the US forces were on the offensive.

British Eighth Army Tank Losses to Mines in Italy, April 1945

In April 1945 the British Eighth Army defeated the German Tenth Army in Italy and pursued the remnants to Austria. Although it was a highly successful operation, effectively a pursuit and mopping-up operation in its latter stages, a considerable number of tank losses were incurred. Of 954 M4 Sherman tanks employed, the Eighth Army recorded the cause of loss for 121. Of those, it was found that 16 were lost to mines, with 12 damaged and four destroyed. Overall, 17.91 percent of those damaged, 7.41 percent of those destroyed, and 13.22 percent of those lost, were to mines. However, mines were only listed fourth in rank as a cause of loss. Tanks and antitank guns were the primary cause found, with 28 damaged (41.79 percent of those damaged), 31 destroyed (57.40 percent of those destroyed), and 59 lost (48.76 percent of those lost). Second were hand-held antitank weapons (*Panzerfaust* and *Panzerschreck*), which damaged seven (10.45 percent) and destroyed 16 (29.63 percent), for a total of 23 (19.01 percent). Third were artillery and mortar rounds, which damaged 17 (25.37 percent) and destroyed three (5.56 percent), for a total of 20 (16.53 percent). Air attack was the only cause of loss for fewer tanks, with three damaged (4.48 percent) and none destroyed, for a total of three (2.48 percent). Personnel casualties to all causes in the units involved were 520.¹⁷

North Africa

Other anecdotal accounts of the use of antitank mines in World War II exist. One of the earliest occurred at Halfaya Pass in Egypt, during Operation BATTLEAXE (15-17 June 1941). In that engagement the British lost four of 18 Infantry tanks to antitank mines, while 11 were lost to AT guns and enemy tanks. Another desert battle involving AT mines occurred at Sidi Omar during Operation CRUSADER (22 November 1941) when the British lost 16 or more Infantry tanks to mines out of 56 engaged and 48 lost to all causes. Also, at Tel el Eisa Ridge during the Battle of First Alamein (17 July 1942) British forces lost three of 18 armored infantry carriers to friendly minefields, suffering six casualties.

Best Case Scenarios for Conventional Antitank Mine Use: Battle of Kursk and El Alamein

Two of the most extensive uses of antitank mines in the history of warfare were at the Battle of Kursk (4 July – 23 August 1943) and the Battle of Second El Alamein (23 October – 4 November 1942). Mines of all types, and in particular antitank mines, were laid in unprecedented numbers and density. As such, these are the "best case" scenarios of measuring the effectiveness of the AT mine as a defensive weapon.

¹⁶ NARA, RG #331, Headquarters 12th Army Group, Special Staff, Armored Section Correspondence Files, Box # 1., Headquarters First United States Army, Armored Section, *Intelligence Report of Tanks Rendered Inoperative Due to Enemy Action, June 1944 – April 1945*. Additionally, 102 tanks were reported lost, but 101 were to unknown causes and one was as a result of a traffic accident. These have not been counted in the above. If all – including unknown – causes are included, then 19.12 percent were lost to mines.

¹⁷ British Public Records Office, WO 204/8003, Eighth Army War Diary, *Subject: Analysis of Casualties and Total RAC personnel casualties from 9 Apr to 2 May 45*, dated 25 May 1945.

Effectiveness of Antitank Mines at Kursk

In July of 1943 during World War II a huge battle occurred on the Eastern Front that has come to be known as the Battle of Kursk. It was fought at an area of the front where Soviet forces occupied a 150-kilometer deep and 200-kilometer wide bulge in the lines. The Germans attacked the bulge at its base from both north and south, the armored pincers were to meet east of the city of Kursk, thereby isolating and destroying the Soviet forces trapped in the bulge.

The three months on the Eastern Front before the battle were quiet, allowing the Soviets an unprecedented opportunity to prepare for the battle. Soviet positions at Kursk were far more extensive and heavily mined than any seen in the previous two years of fighting on the Eastern Front. It was the most extensive use of mines during four years of war on the Eastern Front, which was the largest military campaign in history. The Battle of Kursk offers a unique opportunity to analyze the effectiveness of mine warfare. It not only one of the two largest uses of antitank mines in history, it is also the largest armor battle in history. As such, it can provide a fairly definitive set of statistics on the degree of effectiveness that can be expected from antitank mines. Kursk is literally the best case antitank mine scenario.

A thorough examination of the Soviet use of mines at Kursk was included in our report on the *Military Consequences of Landmine Restrictions* presented to the US Joint Staff in 1996.¹⁸ We will not repeat the data presented in that report. Since that time, however, *The Dupuy Institute* has done further research into the battle focused on the southern German attack by nine armored and eight infantry on Voronezh Front from 4 – 18 July. Our analysis will be restricted to this sector and phase of the battle. The Soviet counteroffensive from 18 July – 23 August and the similar battle fought north of Kursk are not considered.

For what is known as the Defensive Phase of the Battle of Kursk (4 – 18 July) the Soviet Army laid at least 291,797 antitank mines and 284,378 antipersonnel mines in the defensive lines of Voronezh Front on the southern face of the Kursk salient. (It is probable that they also laid another 100,000 to 200,000 antitank mines and an equal number of antipersonnel mines in the defensive lines of Central Front on the northern face of the salient). In the south this produced the impressive average density of 1,779 antitank mines per kilometer, spread across 164 kilometers of front. Soviet secondary sources record similar densities (1,500 antitank mines per kilometer and 1,700 antipersonnel mines per kilometer) with the additional caveat that this was four times the density of mines used at Stalingrad (1942) and six times the density of mines used in the defense of Moscow (1941).

Soviet mines at Kursk were for the most part laid in two extensive belts, integrated into the first and second defensive lines. Infantry divisions, supported by antitank and armored units manned these two defensive lines. There was an additional third defensive line that incorporated minefields. It played a minor role in the battle. However, most of the mines encountered, most of the armor lost to mines, and most of the problems caused by mines, were in the fighting that occurred in the first two defensive lines.

The German attack from the south against the salient deployed three armored corps – from left to right: the XXXXVIII Panzer Corps (three armored divisions, including the *Gross Deutschland* Division), the SS Panzer Corps (three SS armored divisions) and the III Panzer Corps (three armored divisions). All three of the armor corps were supported by infantry units and there were supporting infantry corps on each flank.

¹⁸ *The Dupuy Institute, op.cit.*, pp. 40-46.

Prior to the Battle

One of 28 German veterans recently interviewed remembered that one of his platoon sergeants took a Russian box mine into his quarters to demonstrate how to defuse them to a group of junior noncommissioned officers. The mine blew up during the demonstration, killing the sergeant and two others and wounded the rest so badly that they were unable to take part in the attack.

4 July

During the late afternoon and evening of 4 July, infantry of six German armored divisions and two infantry divisions moved forward to clear the Soviet forward outpost line. The outposts were composed of platoon, company and (in at least one case) battalion-size defensive positions. In the sector of the *Gross Deutschland* division, extensive minefields were reported, including at the village of Butovo – the battalion-size defensive position. Still the attack objectives were all achieved by later that night. No German armor was either committed or lost in combat. One battalion commander of *Gross Deutschland* stepped on a mine and lost his leg.

5 July

The main attack began at dawn on the first defense line. All nine armored and five infantry divisions were committed. The corps operations and the effect that antitank mines had on the operations during the first days of the offensive follow.

XXXXVIII Panzer Corps (5 July)

The XXXXVIII Panzer Corps attack began at dawn with three armored and two supporting infantry divisions. Around noon, the 332nd Infantry Division commander was lost to wounds inflicted by mine fragments. He was one of two German division commanders who were casualties during the two-week offensive.

Extensive minefields, antitank ditches, and other defensive works in the area delayed all units of XXXXVIII Panzer Corps. The biggest problem was an area where a creek had flooded a ravine in the path of the advance. The soggy area was also mined and further obstructed by a deep antitank ditch. The attack went forward in the morning, but the armor was held up until the obstacles were breached. By noon, the German attack had broken through the first defensive line at several points along the front, but most of the armor wasn't across the swollen creek until late in the afternoon and some did not cross until after midnight. According to a veteran of the 3rd Panzer Division, the extensive minefield greatly limited their mobility and speed. Engineers worked round-the-clock in order to clear lanes for the tanks. Usually manpower was insufficient so the tank crews had to pitch in. The 3rd Panzer Division reported losing six tanks damaged to mines. One other was destroyed, and while the records do not explicitly so state, our assumption is that this one was also lost to mines.

Gross Deutschland Division seemed to suffer the worst as their attack went directly across the defended swampy Berezovyyi creek. The Fusilier Regiment *Gross Deutschland* and its supporting armor suffered heavy losses when they were held up in a previously undetected minefield and were shelled by artillery. A veteran of the 3rd Battalion claimed that 50 men were killed or wounded. They were forced to bring forward the engineers to clear the mines and to assist the supporting tanks mired in the swampy creek. Engineers also had to construct a second crossing place after mid morning when a heavy tank became mired, blocking the first crossing place. Meanwhile German armor was backed up on the road and came under Soviet air attack.

In the early afternoon, a route bypassing the ravine was reconnoitered but was also found to be heavily mined. Engineers were then sent to clear this route. By late afternoon, armor had crossed to the other side of the ravine and the division began to advance on its next objective (which it was supposed to have taken that morning). They then brought up the engineers to clear mines from the road in preparation for the next day's advance.

The division later reported substantial casualties and stated they were caused by having to make the attack without armor support because of the unfavorable terrain, and by encountering unexpected minefields, many of them more than 100 meters in depth. The "substantial casualties" totaled 401 men (64 killed, 332 wounded, and five missing), including seven officers killed and 11 wounded. The Panzer Regiment *Gross Deutschland* reported that it had lost five assault guns and about 20 tanks to mines. This armor loss to mines is the worst suffered by any of the divisions.

The 11th Panzer Division also had considerable problems with the heavily mined areas around Butovo, and had to request the entire corps engineer reserve (two companies) to help clear the mines. Still 11th Panzer and the neighboring 167th Infantry Division jumped off on schedule in the morning. By mid morning they had penetrated the Soviet positions and were advancing on further objectives. Most problems were reportedly caused by antitank ditches, clogged roads, a late afternoon rain, and Soviet antitank guns, mortar and artillery fire. The 11th Panzer Division, thanks to a Soviet deserter, also located a road free of mines (the Soviets needed a clear road for supply). They allowed part of *Gross Deutschland* to use this road to break the logjam at Berezovyyi Creek. Once past the first defensive line, the 11th Panzer Division does not appear to have encountered any more major problems with mines. At least four tanks were disabled during an engagement with the Soviet 245th Tank Regiment. The 245th Tank Regiment also reported losing four tanks in one company to mines (the company reported a total of six tanks lost), which were almost certainly Soviet laid (another instance of fratricidal losses to mines). The 245th Tank Regiment appears to have lost 33 tanks on 5 July, thus at least 12.12 percent of the loss was due to friendly mines. The 11th Panzer Division reported losing eight tanks on 5 July. It is unclear, but it appears that all of these were also lost to mines.¹⁹

Mines clearly were a hindrance to the three armored and the two infantry division of XXXXVIII Panzer Corps on the morning of 5 July. By mid day, the minefields had been crossed by two of the armored divisions, only *Gross Deutschland* had become tangled up with and had suffered serious damage from Soviet mines and supporting artillery and air. Overall, mines accounted for 25 tanks in *Gross Deutschland* and probably 15 more from the other two divisions. The minefields had delayed the operation by about one-half day.

The SS Panzer Corps (5 July)

The SS Panzer Corps faced much the same opposition as the XXXXVIII Panzer. However, the terrain was more favorable for the SS. The SS Panzer Corps lost 54 tanks on 5 July, which is not far from the total lost by the XXXXVIII Panzer Corps if Panthers are not counted (52 tanks and perhaps 79 Panthers).

The SS Panzer Corps attack was delayed first by rain, and then by antitank ditches and mines. Because of the weather, the infantry regiments executed the initial attack on Berezov. The

¹⁹ This report is part of a tabular listing of losses that includes those of the 3rd Panzer Division and *Gross Deutschland*. A note made to the tabulation indicates that all were lost to mines, but it is unclear that the note was intended to apply to all three divisions. See NARA Microfilm T313, R368, *Anlagen zum K.T.B. Pz.A.O.K. 4, Juli 1943* (Attachments to the 4th Panzer Army War Diary, July 1943), morning entry for 6 July.

assault gun of one veteran interviewed hit a mine at Berezov while moving on a lane which supposedly had been cleared by engineers. He was unhurt and was reassigned three days later to another tank. Overall, from the accounts, it appears that the SS Panzer Corps was also held up for about a half day, with the weather, antitank ditches and mines all playing a role. The SS unit reports and post-war interviews are not as extensive as those found for the XXXXVIII Panzer Corps,

The “Adolf Hitler” SS Division reported losing 20 tanks on 5 July, including six heavy Tiger tanks. The “Totenkopf” SS Division lost 12 tanks, including five Tigers. The record notes that these were "mostly from mines." This analysis assumes that all were in fact lost to mines. The “Das Reich” SS Division reported 12 tanks lost, including two Tigers. It was in the center leading the attack on Berezov. They do not report the cause of loss, but it is also assumed that most were from mines.

III Panzer Corps (5 July)

There are few reports of mine losses in III Panzer Corps, although there certainly were some. The one division (6th Panzer Division), which had a foothold on the opposite bank of the river had its attack stall out. The attack does not appear to have been pushed forward with much aggressiveness. The other two armored divisions and the two supporting infantry divisions had to execute an opposed river crossing. The biggest problem encountered appears to have been in the sector of the 7th Panzer Division where the crossing site at Solomino was reached only by crossing a German minefield that hadn’t been cleared by the unit responsible for it. This fratricidal incident caused "significant problems" according to the unit reports. By the end of the morning, despite heavy Soviet air attacks bombing the assault units, the bridgehead was firmly established and leading elements had advanced.

South of III Panzer Corps, there was another river crossing with two infantry divisions that suffered very heavy casualties.

Summary (5 July)

Overall, the six attacking armored divisions of the Fourth Panzer Army lost as many as 84 tanks to mines on the first day of the offensive, including one of which was destroyed. Although it is not explicitly stated, it does appear that most of the tanks reported lost on 5 July were all lost to mines. However, it does not appear that this report includes all of the tanks lost on that day. If the actual number of tanks ready for action on the evening of 4 July is compared with that of the evening of 5 July, it will be found that the total losses were probably 106.

Calculated Losses of XXXXVIII Panzer Corps and SS Panzer Corps

| | Calculated loss (total loss) 5 July | Reported loss (mine loss) 5 July | Mine loss as a percent of total loss |
|-----------------------|---|--|--|
| XXXXVIII Panzer Corps | | | |
| 3rd PzD | 10 | 7 | 70% |
| GD PzGrD | 30 | 25 | 83% |
| 11th PzD | 12 | 8 | 67% |
| SS Panzer Corps | | | |
| AH SS PzGrD | 20 | 20 | 100% |
| DR SS PzGrD | 19 | 12 | 63% |
| T SS PzGrD | 15 | 12 | 80% |
| | --- | --- | --- |
| | 106 | 84 | 79% |

Using the same methodology, the III Panzer Corps and the various tank and assault gun units attached to it and Corps Raus show a decline of 64 tanks on 5 July. Assuming that the same percentage was lost to mines, then another 51 tanks were lost to them. As is discussed in Appendix II, no clear report of losses due to mines on 5 and 6 July for the 39th Panzer Regiment has been found. It has been estimated as 38 tanks, with 19 on each day. Therefore, on 5 July it is estimated that the attacking Germans lost 154 tanks to mines, out of 249 recorded as damaged and destroyed on that day. That amounts to 78.64 percent of the tanks lost on that day and account for 10.09 percent of the total German tanks lost between 4 and 18 July. Of the 154, only one or two, including one Panther, were clearly destroyed by mines.

Most of the tanks lost to mines were damaged without loss to the crew. In many cases the tanks were repaired and put back into action within a few days. One division – 6th Panzer – was halted by what appears to have been a particularly strong Soviet defensive effort. One division – *Gross Deutschland* – had a difficult day caused by minefields, antitank ditches and a swollen creek. One division – 7th Panzer – was delayed by its own minefield. The other divisions apparently got through the 100-meter deep minefields without significant problems and were able to continue the attack.

6 July

Having broken through the first defensive line, the Germans then attacked and broke the second defensive line. Over one-third of the German armor losses during the 14-day offensive occurred on 5 and 6 July while breaking through these two defensive belts.

XXXXVIII Panzer Corps (6 July)

The advance of *Gross Deutschland* Division on this day depended on clearing mines from a road northeast of Butovo. The clearing was done from both directions at once, since the 11th Panzer Division was already well advanced. Some Soviet units, which had moved into nearby woods, hampered the clearing effort, but still it appears that this minefield was relatively undefended. As a result, the German tanks were able to move forward as the field was being completed. The mine clearing was complete by 0715 hours, and the German advance was able to proceed.

That morning the Germans moved up to attack the second defense line, which was also mined. During that advance, the *Gross Deutschland* Armor Regiment was held up by a minefield, causing the trailing 39th Panzer Regiment to halt and wait as well. While the 39th was waiting, it came under heavy artillery fire, which resulted in some tank losses (at least three Panthers). In the early afternoon, the XXXXVIII Panzer Corps encountered the Soviet second defensive line, which was also well supported by minefields. The engineers were deployed to clear the minefields, and the afternoon was spent fighting significant Soviet forces opposing them. By late afternoon, the main elements of the 11th Panzer Division had broken through the minefields and emplacements of the Soviet second defense zone and were advancing towards Dubrova. An hour later, the *Gross Deutschland* Division confirmed that it too, having overcome very dense minefields, barbed wire entanglements and antitank ditches, was also attacking Dubrova. The Germans were finally able to penetrate this well defended line by dawn the next day.

Overall, the Germans suffered casualties from a mixture of artillery, mines, antitank and tank gunfire, in addition to a large number of Panthers lost due to mechanical breakdown. The minefields seemed to particularly haunt the *Gross Deutschland* Division, which lost 40 tanks on this day. The attached 39th Panzer Regiment lost an estimated 79 tanks, 19 of which are calculated to

have been lost to mines.²⁰ The 11th Panzer Division had fewer problems, with 4 tanks lost this day. The 3rd Panzer Division halted its attack on a very strongly held position and only lost 7 tanks.

The SS Panzer Corps (6 July)

The SS Panzer Corps began to attack around 0730 hours; at 0945 units reported penetrating the strongly fortified, mined and barbed wired positions. Fighting hard to take each trench section, by early afternoon they had reached their local objectives. The SS Panzer Corps lost 79 tanks breaking the second defense line and in battles with Soviet armor. The record of these actions is sparse, and the number of tanks lost to mines is unknown.

The III Panzer Corps (6 July)

The III Panzer Corps spent the day exploiting the success of its river crossing. It did advance to the Soviet second defense line, but instead of attacking, the corps turned north and skirted the line. In the early morning, the armor group of the 19th Panzer Division came to an abrupt halt when it ran into a wide and deep minefield. Fourteen tanks were lost to mines and four more were knocked out by direct fire. It was unable to resume the attack until 1430 after a lane had been cleared through the minefield. By late afternoon, the division was again able to pursue its local objectives.

Summary (6 July)

Soviet mine placement was biased heavily to the first defensive belt. In the case of the 6th Guards Army, opposite the German XXXXVIII Panzer Corps and SS Panzer Corps, there initially were 68,987 antitank mines in the first belt and 19,274 in the second. Thus, 78.16 percent of the antitank mines were in the first belt (with 85.82 percent of the antipersonnel mines laid by the 6th Guards Army). The linear density of antitank mines in the first belt was 1,042 per kilometer, while in the second belt it was only 292 per kilometer.

The 7th Guard Army, opposite the III Panzer Corps and the assault gun units of Corps Raus, had an even greater forward bias, with 58,146 antitank mines in the first belt and only 8,668 in the second. The first belt contained 87.03 percent of the antitank mines and 95.64 percent of the antipersonnel mines laid. The liner density of antitank mines in the first belt was 1,057 per kilometer, in the second belt it was only 100 per kilometer.

There were some mines laid further to the rear, and some mines were laid during the course of the battle, but it appears that these two forward defense belts accounted for at least 90 percent of the mines in the area of the battle.

While we have a fairly good estimate of German tanks lost to mines on 5 July, when they were penetrating the first belt, we have poor accounts for 6 July, when they were primarily engaged with the second belt and intermediate positions. As we have had to develop an estimate of losses for 6 July based upon the percent of losses suffered to mines on 5 July, then the relative density of the first and second belts provide a basis for such an estimate.

In the case of the Germans facing the 6th Guards Army, the liner density of the second belt was 28.02 percent of that of the first belt. This figure was not used as is, because it is understood that there is not a linear relationship between number of weapon systems and opposing force losses. Quite simply, the mines tend to be concentrated on the major axis of advance. Therefore, a figure one-half (50 percent) of the loss rate for 5 July was used to estimate losses for 6 July in this sector.

²⁰ The remaining tanks lost were mostly to mechanical failures.

For the Germans facing the 7th Guards Army, the linear density of the second belt was 9.46 percent of that of the first belt. Unlike the two armored corps further north, on 6 July the III Panzer Corps had not cleanly penetrated the first defensive line. In fact, the 19th Panzer Division was still fighting on this line (when it recorded losing 14 tanks to minefields). The 7th Panzer Division had penetrated the first defensive line with the 6th Panzer Division following behind it. Thus, a figure 25 percent of that for the III Panzer Corps on 6 July was used for those tanks where a cause of loss was not recorded (the cause of loss for 18 of the 24 tanks lost by the 19th Panzer Division, including 14 to mines, is known).

Since the XXXXVIII Panzer Corps lost 51 tanks (not including Panthers) then approximately 20 tanks were lost to mines. For the SS Panzer Corps, resistance in the second defense line was certainly less than that faced by the XXXXVIII Panzer Corps. The XXXXVIII Panzer Corps was facing tanks from the bulk of two Soviet armored corps (divisions) in strong defensive positions. The SS Panzer Corps faced only two tank brigades detached from one of the armored corps and infantry, some of whom had just retreated the previous day after suffering heavy losses to the German attack. So, even though the strength of defensive works and minefields was probably about the same for both corps, the overall strength of the defense the SS encountered was less. Still, the SS Panzer Corps lost 79 tanks, partly while engaged in intense armor battles. If the same methodology is used, then 31 of them may have been lost to mines. For the III Panzer Corps and Corps Raus, 69 tanks were lost, of which 18 have been accounted for. Therefore – by again using the same methodology for the 51 where no cause is known – it is estimated that 10 tanks may have been lost to mines. Adding the estimated total of 61 to the 14 known in the 19th Panzer Division and 19 in the 39th Panzer Regiment results in an estimated total of 94 tanks lost to mines. That is 33.81 percent of the total of 278 lost on 7 July or 6.16 percent of the overall tank loss from 4 to 18 July. The attack of one XXXXVIII Panzer Corps division was delayed, but not halted by extensive minefields. Minefields delayed the SS Corps by two or more hours. Mines halted an armored task force from one division of III Panzer Corps for the better part of a day.

7 July

Since the second defensive line was clearly broken through in the SS Panzer Corps sector, and was being skirted in the III Panzer Corps sector, most of the problems caused by mines occurred in the XXXXVIII Panzer Corps sector again. This was because many of its units were still tangled in the works of the second defensive line, especially when the division attempted a close envelopment with the Panther regiment.

XXXXVIII Panzer Corps (7 July)

In the XXXXVIII Panzer Corps area, the *Gross Deutschland* Division continued to push forward, but still reported considerable delays and problems caused by mines. The crossing of the Pena River was further delayed because heavy Soviet resistance and air attacks coupled with extensive minefields prevented construction of a bridge over the Pena. The Fusilier Regiment *Gross Deutschland*, which had already suffered on the 5 July from the minefields at Berezovyyi Creek, found itself again tangled up in minefields around the Pena River ravine. This attack was pushed forward against the wish of the 1st Battalion commander, who wanted to conduct a careful reconnaissance because of the mines. A mine then wounded him.

The 52nd Panzer Battalion (Panthers) was also halted in its attack on the 7 July when it ran into yet another minefield and came under fire from dug-in Soviet tanks, antitank guns and artillery.

One veteran interviewed estimated that in a brief moment they lost 30 tanks due to Soviet fire, forcing them to withdraw. They then were able to then turn the Soviet flank and take the position, but this was a serious loss. The *Gross Deutschland* Division also reported problems with extensive minefields in the afternoon. While the division did achieve its local objectives by the end of the day, it was a slow advance with heavy losses.

The 11th Panzer Division reported minefields during its advance in the morning, but appeared to have had no real problem crossing them. There are no reports from the SS Panzer Corps, but at this point, the primary threat to it was from Soviet armor. In the III Panzer Corps sector, the 19th Panzer Division also reported continued problems with minefields. It had to clear lanes through them so as to be able to continue the attack. The 6th Panzer Division actually passed through a minefield in column, but apparently did so without a major delay. It does not appear that these minefields were properly covered by fire.

Subsequent Days

There are sporadic reports of minefields later in the fighting. In most cases they seemed to have caused a halt of a few of hours, then they were breached and the attack continued. There were no cases where a major attack halted, nor were there any reports of major losses like those of 5 to 7 July. The 3rd Panzer Division did report losing two tanks to mines on 13 July and this minefield prevented them from closing a gap in their lines.

There was one more incident of fratricide during the fighting from the 8-11 July, when the Soviet 86th Tank Brigade reported losing nine tanks to aircraft, 19 to artillery and one (3.45 percent of the tank losses) to what was almost certainly a Soviet mine.

German use of Mines

Even though the Germans were attacking, they also made some use of mines. Mines protected their front line infantry positions before the battle. In some cases, these had to be cleared before the Germans could attack, and in one case the failure to do so caused major problems for the attacking unit, as has already been mentioned.

Once the battle was underway, the Germans did not report laying mines until 10 July, when at least one and probably all three divisions of Corps Raus protecting the right flank began laying mines. These minefields actually were to protect the infantry and were not laid to protect the flanks of the attacking armor. The German armor units did not report laying any mines, even though they often had extended flanks to protect. However, two battalions of infantry and 28 tanks attacked the 167th Infantry Division, which was covering the flank of the SS Panzer Corps, on 16 July. They reported destroying five Soviet tanks, plus two that were knocked out by mines.

On 18 July, the Germans reverted to the defense, and certainly all units in the line made use of mines at that point.

Summary of German Tanks Lost to Mines at Kursk

It would appear that in a worst case estimate, the Germans lost 154 tanks to mines on 5 July and 94 tanks to mines on 6 July. This amounts to 47.06 percent of the armor loss for those two days and 16.26 percent of the total armor loss for 4 to 18 July. Losses to mines after those two days certainly decreased by an order of magnitude, and there were only two more losses to mines reported after 6 July.

It is likely that these estimates are high. The original records refer to "most" of the tank losses being a result of mine damage. If one assumes that "most" means only 75 percent lost to mines, then the figures are less. The XXXXVIII Panzer Corps loss to mines would remain at 40. The SS Panzer Corps loss to mines would lower to 33, the 39th Panzer Regiment to 14, and the III Panzer Corps and Corps Raus to 44, for a total of 131 on 5 July. For 6 July, the XXXXVIII Panzer Corps loss would lower to 18, the SS Panzer Corps to 27, the III Panzer Corps and Corps Raus to 18. Adding 14 for the 39th Panzer Regiment and 14 for the 19th Panzer Division would result in a total of 91 on 6 July. This is 42.13 percent of the armor loss for the two days and 14.56 percent of the total armor loss for 4 to 18 July.

After 5 July, only the XXXXVIII Panzer Corps was trying to break through heavily defended defensive works. Opposing the SS Panzer Corps were either poorly supported infantry or counterattacking Soviet armor. As a result, it is likely that the percent loss to mines was probably not as high as on the first day. In the case of the III Panzer Corps and Corps Raus, after breaking the first line, armor was not sent against the second line, but was instead turned north where it mostly encountered weaker blocking positions. As a result, they really did not become engaged on the second line on 6 July and their loss was probably not the same order of magnitude as on the first day. If "most" is assumed to mean 75 percent, and if it is also assumed that on 6 July the SS Panzer Corps, III Panzer Corps, and Corps Raus loss was at one-half the rate of the XXXXVIII Panzer Corps (except for the 14 reported by the 19th Panzer Division), then a total of 131 tanks were lost to mines on 5 July and 69 on 6 July. This is 37.95 percent of the armor loss for those two days and 13.11 percent of total armor loss for 4 to 18 July.

For many reasons, this last set of figures is considered to be the most reasonable. From them, one can conclude that the Germans suffered about 40 percent their total armor loss in the first two days of battle while breaking through the Soviet mine fields. After that, the percentage lost to mines declined to perhaps 5 percent or less for the subsequent days. Overall, mines probably caused around 15 to 20 percent of the German tank loss during the course of the battle.

Other losses to artillery and direct fire, where minefields or mines were a contributing factor in the loss, account for some 36 additional tanks. There were certainly more. In most cases, the minefields were integrated with other barriers (antitank ditches were a significant barrier), so it is difficult to measure the value of the barriers without mines. There was one German and five Soviet tanks reported lost to friendly mines. Certainly there were other similar cases not reported. Two Soviet tanks were reported lost to German mines.

If the number of antitank mines employed (291,797) is divided by the number of tanks lost (200), then it appears that about 1,459 mines were required to inflict damage on a tank. In most cases, it was track damage, usually without crew loss, and could be repaired within a few days.

There were three clear cases of tank loss to mines during the battle that may be taken as worst cases. First was *Gross Deutschland* on 5 July, when they lost 25 of 177 tanks or 14.12 percent of strength to mines. Second was the 19th Panzer Division on 6 July, which lost 18 of 87 tanks or 20.69 percent of strength, with 14 lost to mines and four lost to direct fire weapons covering the minefield. The third case was the 39th Panzer Regiment at Dubrova on 7 July, when they lost 30 of 43 tanks, mostly to direct fire, 69.77 percent of strength, because of being halted by a minefield in front of dug-in tanks and other antitank weapons.

There is no question that the defensive belts, including the minefields, delayed the attacking German forces for a half-day or more both on 5 and 6 July. There appears to have been two attacks

stopped cold by minefields, the 19th Panzer Division attack on the 6 July and the Panther attack on 7 July. Both of these caused significant losses and clearly hindered operations.

Battle of Second El Alamein

At Second El Alamein, the German-Italian Army made as great a use of mines as that of the Soviets at Kursk, although overall it was a much smaller battle. German and Italian engineers laid approximately 485,000 antitank mines and 15,000 antipersonnel mines across 70 kilometers of front, or 6,929 antitank mines per kilometer. In other words, at Second El Alamein the antitank mine density was almost five times that found at Kursk! With about one-half the time and one-fifth the manpower available to the Soviets, the German-Italian Panzer Army Africa managed to lay an equivalent number of mines.

However, this high-density minefield environment did not appear to ultimately affect the outcome of the battle, although it did influence the way the battle was fought. The relatively small number of antipersonnel mines used meant that clearing the antitank mines was a fairly straightforward operation.²¹ Of course, it was also highly dangerous for mine-clearing parties, but the limited numbers of Axis infantry available to cover the minefields with fire were inadequate to the task, given the extreme preponderance in strength of the British forces. Narratives of the battle indicate that antitank mines were a great hindrance to armored maneuver in the initial stages of the battle, even if they did not necessarily inflict a substantial number of direct losses. A survey of secondary accounts associated with the battle indicates that perhaps 25 to 30 tanks were lost to mines on 24 and 25 October.²²

Perhaps significantly, a complete analysis of the cause of loss for British tanks at Second El Alamein does not appear to exist. However, a partial comparison with Kursk may be made. The total number of British tanks deployed at the start of the battle was 1,038 (71.14 percent of the initial German tank strength of 1,459 at Kursk). In a report of 19 November 1943, the total number of “write-offs” – that is those totally destroyed – was given as 128 (the total destroyed for the Germans at Kursk were 202). The same report also gives 525 as the number operational, meaning that at least 385 were non-operational due to damage or breakdown (a report on 24 November gave the number non-operational as 342). Thus the reduction in operational strength, to all causes, was 45.28 percent over the course of the operation. The Germans ended the Battle of Kursk on 18 July with 796 tanks operational, meaning that 45.44 percent of the operational strength was lost to all causes.

Other, smaller, battles in World War II or after may have seen the use of minefields that were as dense and as deep as those at Kursk and Second El Alamein. However, there is nothing in military history that compares to the magnitude of those two battles for the breadth and number of antitank mines used in the defense. They not only have the distinction of using the highest number of antitank mines than any other battle – by an order of magnitude – but in the case of Kursk it is also the highest number of antipersonnel mines used in a particular battle. The linear mine densities used in these battles across wide fronts were much higher than has been experienced since.

²¹ As a comparison, the Germans also employed 15,000 antipersonnel mines in the coastal defense sector now known as OMAHA Beach, which was approximately seven kilometers wide – one-tenth the width of the Alamein battlefield.

²² US Army Engineer Agency for Resources Inventories, *Landmine and Countermine Warfare: North Africa, World War II* (Washington, DC: USGPO, 1972).

Both of these battles had one other common element, which was an extended period of calm before the battle. At Kursk the calm period lasted over three months. At Second El Alamein it lasted for about six weeks.

Post World War II

Post World War II data on the effectiveness of antitank mines is less complete. The assertion has been made that 56 percent of US vehicle losses in Korea, 70 percent of the vehicle losses in Vietnam, 60 percent of the vehicle losses in the Persian Gulf, and 60 percent of the vehicle losses in Somalia were due to antitank mines.²³ However, as before, this assertion is difficult to prove and, as in the Okinawa experience in World War II, the actual effectiveness of antitank mines is difficult to assess given the general lack of other antitank resources available to defender. For example, “during the early part of the Korean War, June 1950 to January 1951, approximately 40 percent of US armor losses were attributed to mines.”²⁴ US crews gave other sources of damage to US tanks as antitank guns, infantry action, artillery fire, and tactical abandonment. Significantly, enemy tanks were not listed as a causative agent.

On the other hand, there are examples in Vietnam of very high percentages of tanks and other vehicles being lost to antitank mines in Vietnam. For instance, the US 3rd Marine Division reported the number of M48 tanks lost between July 1968 and June 1969 as 63. Of these, three were lost to hand-held infantry antitank weapons (RPG or rocket-propelled grenades) (4.76 percent), three to artillery and artillery rockets (4.76 percent), while 57 (90.48 percent) were lost to antitank mines.²⁵ These percentages may be compared to the more extensive representative examples found from World War II, the US First Army tank losses (Europe), the British Eighth Army tank losses (Italy), and the US Tenth Army tank losses (Okinawa).

The comparison is more clear if only those losses that were caused by systems most similar to those found in Vietnam are included (in other words, losses to antitank and tank guns, air attack and unknown causes are excluded). In that case, for the US First Army, there were 173 losses to mines (45.17 percent), 90 losses to artillery and mortar fire (23.50 percent), and 120 losses to hand-held infantry antitank weapons (31.33 percent). A similar comparison with the British Eighth Army tank losses would be 16 to mines (27.12 percent), 20 to artillery and mortar fire (33.90 percent), and 23 to hand-held antitank weapons (38.98 percent).

The variance in the three conventional war samples is not great. The lowest – 27.12 percent (British Eighth Army) – occurred during what was effectively a month-long conventional breakthrough and pursuit operation. The next (US Tenth Army) – 28.96 percent – occurred during a three-month long conventional attrition battle against a fanatical defense. The third (US First Army) – 45.17 percent – occurred during 11 months of mostly offensive²⁶ conventional

²³ Shneck, *op.cit.*, p. 55; Harry N. (Hap) Hambric and William C. Shneck, “*The Vehicular Mine Threat*,” *Proceedings of the Sixth Annual TARDEC Combat Vehicle Survivability Symposium (U/C), Held March 28-30 1995, Volume I—Unclassified Session Papers*, (NP, May 1995), p. 54.

²⁴ Stolfi, *op.cit.*, p. 102. Note that this statement is made without corroborating reference in what is an otherwise well researched and heavily referenced work.

²⁵ US Marine Corps History and Museums Division, *3d Marine Division FMF (-) (Rein), Command Chronology*.

²⁶ That the majority of these US operations were offensive in nature is a point that is often missed. Since the end of the US Civil War 136 years ago, major US Army forces have not been on the defensive for longer than two weeks except in four significant cases. The cases are the Philippines for five months (8 December 1941 to May 6 1942), Guadalcanal for two months (August 21 to 25 October 1942), Korea for two and one-half months (5 July to 14 September 1950), and again Korea for two months (25 November 1950 to 24 January 1951). In all other cases, the US has been preparing for

operations and included breakthroughs, pursuits, and months-long attrition battles. Only the sample from Vietnam, which was the highest at 90.48 percent and which occurred during a year-long period of unconventional warfare, fought against a well-organized guerrilla force employing asymmetric means in an attempt to defeat a modern, technologically advanced, conventional force was radically different. However, in this case the sample of 63 tanks lost to all causes was also the smallest of the four.

The effectiveness of antitank mines in the Persian Gulf and in Somalia also appears to be very high. However, in these two cases the actual numbers of vehicles lost to mines was very small.

In the Persian Gulf, the 2nd Marine Division lost seven M60 tanks, two AAV (assault amphibious vehicles), and one M1A1 tank in breaching Iraqi defenses, apparently four of them to mines.²⁷ The 1st Marine Division lost one M60 mine-roller-equipped tank in breaching the Iraqi minefields, it lost no other tanks to any cause during the 100-Hour War.²⁸ The number of vehicles totally destroyed in MarCent were six M60 tanks, of which five were mine plows; and five APC, including three AAV and two Light Armored Vehicles (LAV). The XVIII Airborne Corps and VII Corps reported losing 11 M1A1 tanks, 15 M2 IFV, and two APC, a total of 38 vehicles lost. Other sources count 17 tank and 29 IFV/APC losses, a total of 46, but 27 of those are given as having been lost to friendly fire. No definitive count of losses to mine damage has been found, other than those given for the Marine Corps. However, a representative of General Dynamics Land Systems has claimed that only three M1A1 tanks, 27.27 percent, were lost to mines. All were mobility kills. It is interesting to note that this is almost exactly the same as that for the British Eighth Army in its breakthrough and pursuit operation in Italy in April 1945.

In Somalia antitank mines and command-detonated mines were responsible for the loss of 13 vehicles, of which seven were US (three HMMWV, two 2 ½-ton cargo trucks, one 5-ton tractor, and one M88 Armored Recovery Vehicle).

It is undisputed that the percent of vehicles lost to mines has increased dramatically from World War II (20.7 percent) to Korea (56.0 percent), Vietnam (70.0 percent), Somalia and the Gulf War (60.0).²⁹ However, neither the suggestion should be made, nor the implication taken, that this means that the antitank mine has increased in effectiveness since World War II. Rather, it appears that the increase in the raw percentages clearly reflects more a simple lack of other antitank means and, in the case of Vietnam, Somalia, and the Gulf, the relatively small number of losses of tanks to all causes.

an offensive or had been attacking. In all four of these cases the US forces eventually returned and attacked on the same ground that was first defended by – and which could have been mined by – US forces. In the case of the Philippines the attack did not occur until two and one-half years later, but in the other three cases the attack followed almost immediately. The mine is a weapon that has been used against US forces far more often than it has been used by US forces.

²⁷ LTC (USMCR) Dennis P. Mroczkowski, *US Marines in the Persian Gulf, 1990-1991, With the 2nd Marine Division in DESERT SHIELD and DESERT STORM*. (Washington, DC: History and Museums Division, Headquarters, US Marine Corps, 1993), p. 44, 51.

²⁸ LTC (USMCR) Charles H. Cureton, *US Marines in the Persian Gulf, 1990-1991, With the 1st Marine Division in DESERT SHIELD and DESERT STORM* (Washington, DC: History and Museums Division, Headquarters, US Marine Corps, 1993), pp. 75-78.

²⁹ Hambric and Schneck, *op. cit.*, page 54.

Conclusions

- 1) An extensively mined area can cause significant armor losses to attacking forces, and may account for up to 20 percent of an attacker's tank loss.
- 2) Scattered minefields are of considerably lesser value. At most they cause limited delays and minor attrition.
- 3) Minefields may be expected to delay operations by one-half day or more, if properly defended.
- 4) Undefined minefields may be breached in less than two hours, and often quicker than that. German breaching at Kursk was done entirely by hand. They had nothing equivalent to modern breaching equipment like the US MICLIC. Most of the mines facing the Germans were buried and camouflaged. From that it appears that undefined scatterable minefields could be breached faster. Thus, it may be estimated that the use of "interdiction" scatterable minefields is of limited value both for purposes of attrition and delay, unless the force "impaled" by scatterable mines is immediately attacked by air, missiles, or artillery.
- 5) It does not appear that any attack at Kursk was halted in cases where the Germans were prepared to execute a breach, although they did suffer attrition and delay. This also appears to have been true at Second El Alamein and may be said to have held true for all of the cases found.
- 6) The worst delays and losses at Kursk occurred when the Germans encountered a defended minefield that they were unaware of. This was the case in two of the three worst incidents they endured and held true for the other cases as well. This argues for the need for better equipment that can execute an "on-the-fly" breach in a hostile environment. The reaction cycle, when an unsuspected minefield is encountered, appears to have remained essentially unchanged for over 50 years.

THE COMBAT VALUE OF SCATTERABLE ANTITANK MINES

An accurate assessment of the value of scatterable antitank mines is almost impossible, given that the actual use of these in combat has been virtually nonexistent.³⁰ The only accurate accounting of SCATMINE use is from the Gulf War.

The US Air Force, Navy, and Marine Corps in the Gulf War expended a total of 1,314 GATOR munitions.³¹ Most were used to interdict Iraqi communications routes and to hinder movement.

Many GATOR were employed in an attempt to interdict the movement of Iraqi Scud ballistic missiles during the “Scud War.” And at least two missions on 27 and 28 February 1991 were intended to create a bottleneck at the approaches to the Al Rumaylah causeway and bridges in an effort to hamper the flight of Iraqi Republican Guards units from Kuwait. However, there is no objective way to assess the effectiveness of these measures.

Objectively, the “anti-Scud War” was ineffective. A total of 88 Scud missiles were fired at Saudi Arabia, Bahrain, and Israel during the course of the war from a maximum of about 36 mobile launchers.³² Only 11 MAZ-543 Transporter Erector Launchers (TELs) were sold to Iraq by the Soviet Union. In addition, a number of Saab-Scania tractor-trailers were modified by the Iraqis as Mobile Erector Launchers (MELs). A total of 1,459 anti-Scud air sorties were flown, apparently including GATOR-armed sorties.³³ In addition, Allied Special Forces were heavily tasked with locating and destroying the mobile Scud launchers. Allied Air Forces claimed the destruction of 80+ launchers and Special Forces an additional 20. However, few launchers appear to have been actually destroyed or even disabled by any means. Post-war analysis indicates that effective air strikes on observed launches occurred only eight times. It is quite possible that the 19 TELs and MELs that were destroyed post-war under UN supervision account for all of the Iraqi launchers and that none were in fact destroyed by Coalition forces. If it is accepted that 36 mobile Scud launchers were in Iraqi inventory before the war, and that 19 launchers survived the war, then – at most – 17 were destroyed.³⁴ The assessment was that:

³⁰ Much of the material in this section is adapted from Curt Johnson, “Landmines in the 1991 Gulf War: A Survey and Assessment” (McLean, VA: TDI, 2000), part of the ongoing studies in landmine warfare done by TDI for the Vietnam Veterans of America Foundation.

³¹ The Air Force CBU-89 GATOR munition dispenses 72 AT and 22 AP mines. The Navy version, the CBU-78, dispenses 45 AT and 15 AP mines. Thus, the 1,105 Air Force and 209 Navy/USMC GATOR dispensed a total of 88,965 AT and 27,445 AP mines. Note that the Air Force accounting of expenditures done post-war was very contradictory, the total as given on a daily basis was 2,533, while the total as given for the entire period was 1,107, both figures were from a 9 March 1991 final report compiled by RAND. The figure of 1,105 is from the Directorate of Supply HQ USAF/LGS, Combat Support Division (LGSP); 1990 Weapons File. How the three different figures were derived is unexplained. However, this basic inability to accurately count the number expended bodes ill for any attempt to account for the number and placement of GATOR in the future. See, Eliot A. Cohen, *et. al.*, *Gulf War Air Power Survey, Volume V, Part I, A Statistical Compendium*, (Washington, DC: US Air Force, 1993), p. 551-553, 598, 606.

³² The number of Scud launcher vehicles available to the Iraqis in 1991 remains in dispute; however, there is considerable confidence that 36 is the probable absolute maximum number of launchers available. See, International Institute for Strategic Studies, *The Military Balance 1989-1990* (London: Brassey’s, 1989), p. 101 and Cohen, *op. cit.*, *Volume II, Part II, Effects and Effectiveness*, pp. 317-322 and 330-340.

³³ *Ibid.*, p. 418.

³⁴ *Ibid.*, *Volume II, Part II, Effects and Effectiveness*, pp. 317-322 and 330-340.

*GATOR would seem to have been ideal for limiting and delaying Scud movement in and around hide sites and staging areas, although conclusions concerning effectiveness remain an area of speculation, barring access to Iraqi records.*³⁵

In any case, Scud launches continued until almost the last day of the war.³⁶

The employment of GATOR to inhibit the movement of Iraqi conventional forces was also fraught with problems. The threat of fratricide associated with GATOR was quite high. According to the US Army Engineer School:

Many units did not follow the doctrine for reporting, recording and marking of minefields. This was not only a joint problem between the Army and Air Force, but also an internal Army problem...

*CENTCOM Air Force (CENTAF) flew over 35 GATOR missions (the exact number is not known), without reporting, or recording missions...During the ground offensive, units found themselves maneuvering in GATOR minefields, without any knowledge of their existence.*³⁷

The Persian Gulf War also saw the first use of FASCAM (family of scatterable mines) in combat during the Battle of Khafji (29 January – 1 February 1991). At about the same time that Iraqi forces attacked Kahfji, elements of the Iraqi 5th Mechanized Division made a series of attacks on the 1st Marine Division reconnaissance screen line at Observation Posts (OPs) 4, 5, and 6. These were abandoned police border posts where cuttings through the border berm allowed the passage of vehicular traffic. The USMC defenders were Task Force Shepherd – the 1st LAV Battalion (-) (REIN). During this fighting the 5th Battalion, 11th Marines (consisting of 12 M198 towed 155mm howitzers, six M109A3 self-propelled 155mm howitzers, and six M110A2 self-propelled 203mm howitzers) fired a FASCAM mission in support of TF Shepherd during the evening of 30 January. A total of 360 rounds (288 RAAM and 72 ADAM) were fired, apparently in an effort to redirect an Iraqi mechanized force from another gap in the berm between OP 4 and OP 5 to the gap at OP 4 “where it was met by direct and indirect fires.”³⁸ There was apparently no attempt by Iraqi forces to actually attack across the FASCAM minefield, so it’s actual effectiveness – in terms of destroying armored vehicles – cannot be assessed. However, it did apparently succeed in diverting the Iraqi attack from the gap in the berm, so it may be termed as effective in its intended purpose.

The second confirmed use of FASCAM occurred after the cease-fire went into effect at 0500 hours 28 February. This mission was fired in support of the 24th Infantry Division in actions against retreating elements of the Iraqi Republican Guards on 2 March:

³⁵ *Ibid.*, Volume IV, Part I, Weapons, Tactics, and Training, p. 291.

³⁶ The most devastating single US loss in the war was the 28 KIA and 102 WIA in a Scud attack on 25 February.

³⁷ US Army Center for Army Lessons Learned (CALL) Newsletter No. 92-4, *Fratricide: Reducing Self-Inflicted Losses*, Ch. 3, “Fratricide Reduction Measures.”

³⁸ 5/11 Marines, Command Chronicle, 1 Jan-28 Feb 91.

LTC John Floris, the 1st Brigade fire support coordinator, called on three M109A3 battalions, an M110A2 battalion, and an MLRS battalion to fire a combination of scatterable mines and DPICM on the causeway and main body of the Iraqi column.³⁹

However, it is again difficult to assess the actual effectiveness of the FASCAM in this incident. The Iraqi column was attempting to retreat across a narrow two-lane, 2.5 kilometer-long causeway across the Euphrates River, through marshy terrain. Sometime about 0720 hours on 2 March, part of the Iraqi column apparently missed a turn and headed west instead of east, encountering C Company, 2-7th Infantry, which was advancing east to secure an area west of the causeway approaches. Between 0802-0807 hours the 1st Brigade, 24th Division duty log remarked that the Iraqi column had tried to turn back on itself and was aimlessly milling around in front of the US forces.

The collision shortly sparked a firefight, which steadily escalated in intensity. The Iraqis were initially engaged by the M2 Bradley Fighting Vehicles of 2-7th Infantry. Then, in quick succession, the AH1 Cobra helicopters of 2-4th Cavalry (0725 hours), the 24th Division artillery (about 0800 hours), the AH64 Apache helicopters of 1-24th Aviation, and the M1 Abrams tanks of 4-64th Armor (0940 hours) entered the fight. By 1407 hours the action apparently was over. The most detailed accounting of the results lists 81 Iraqi tanks, 95 APC, 8 BRDM, 5 artillery tubes, 2 BM21 MRL, 11 FROG SSM, and 23 trucks destroyed.⁴⁰ Other reports indicate that the destruction was even greater, remarking that 185 armored vehicles, 400 trucks, and 34 artillery pieces were destroyed.⁴¹ However, it appears that most, if not all, of this destruction was caused by direct fire and there is no evidence that the FASCAM caused either destruction or delay to the Iraqi column. Rather, it appears that the initial Iraqi incursion into the lines of the 24th Division resulted simply from it missing the turn onto the causeway. The congestion and delay at the causeway approaches may have been caused in part by the FASCAM deployment, but was as likely a result of simple confusion and the evident loss of traffic control on the part of the Iraqis. One US tank was damaged and one US soldier was wounded in the engagement.

One of the major problems encountered by the Coalition Forces during the 100-Hour War was unexploded ordnance (UXO). A major component of the UXO problem was dud cluster bomb munitions, improved conventional munitions (ICM), and GATOR. Lieutenant Colonel Frank D. Ellis, commander of the 20th Engineer Battalion (Combat) (Corps), which supported the 101st Airborne Division, described encountering an extremely hazardous environment near Al Bussayah at the time of the cease-fire:

And the road around Al Busayyah was literally just saturated with unexploded ordnance...American ordnance, ICMs and GATOR mines it appeared. And as we were...they were trying to cut a road past it, it was very slow going because they were clearing the road as they went. Because of the number of munitions that were on the road

³⁹ BG Robert H. Scales, Jr., *Certain Victory: The United States Army in the Gulf War* (Washington, DC: Office of the Chief of Staff, US Army, 1993), p. 312.

⁴⁰ Richard M. Swain, "Lucky War" Third Army in Desert Storm (Fort Leavenworth, KS: US Army Command and General Staff College Press, 1994), pp. 302-309 provides one of the most evenhanded and precise accounts of this controversial incident.

⁴¹ Scales, *op. cit.*, p. 314. Other claims that more than 700 vehicles were destroyed and that thousands of Iraqi soldiers and civilians died in this engagement are obviously inflated and are in any case irrelevant to this paper.

*that came out of the town, the decision was made by the group commander and the commander of the 37th, to try to grade a bypass around it. And this is what they were doing, and they held up traffic – rightly so – for several hours as they tried to get [around] this.*⁴²

Overall, it appears that one of the effects of scatterable antitank mines in the Persian Gulf War was to materially inhibit the movement of Coalition Forces and – possibly – to inflict casualties on Coalition personnel. It is likely that Iraqi forces were similarly effected; however, it is impossible to say to what degree the effect was greater than that on Coalition Forces.

However, the most curious aspect of Coalition mine warfare in the Persian Gulf War may well be the prohibition against the use of mines of any kind during the defensive DESERT SHIELD period prior to the opening of hostilities. Colonel Ellis remarked:

*Now initially, my concern was that I was about the most forward unit sitting there and were [sic] the Iraqis to come across Kuwait into Saudi Arabia, there was not much of a defensive plan. We were initially questioning why we were not out putting in mine fields and tank ditches and all the things that we had trained to do. We knew of the prohibition against mine fields and tank ditches, but we still felt that if the purpose was to keep the man from coming into Saudi Arabia, then we should be putting up something to prevent that. Well, apparently the guys that are paid to know this knew that he wasn't going to do this – or [at least] anytime soon, because it [the Iraqi Army] was putting in his defensive belt and continued to add to that. So we never did put up what I would consider a very serious defensive barrier there.*⁴³

There does not appear to have been any formal instructions or plans issued that prohibited the use of defensive minefields, but there is no doubt that the prohibition was in place. The initial deployment of the 82nd Airborne Division to Saudi Arabia, DESERT DRAGON I and DESERT DRAGON II, could have faced an Iraqi mechanized advance by as many as 1,000 T72 of the Republican Guard Forces Command. For that contingency, the 82nd depended solely upon utilizing terrain unsuitable for armored vehicles to canalize the advance, TOW missiles, artillery, a few M551 Sheridan ARV, and air power to stem an Iraqi attack until the heavy armor of the 24th Division arrived. These defensive measures are detailed in the most extensive history of the war.⁴⁴ However, no mention is made of mines in the context of the 82nd Airborne Division deployment.

⁴² Oral History Interview, DSIT AE 068, LTC Frank D. Ellis, Commander, 20th Engineer Battalion, Interview Conducted 15 March 1991 near Rafha, Northern Province, Saudi Arabia, Interviewer: MAJ Robert B. Honec, III (116th Military History Detachment).

⁴³ *Ibid.*

⁴⁴ Scales, op. cit., pp. 82-93.

Conclusions

- 1) Scatterable antitank mines appear to be effective as a barrier when used defensively. The extent of their usefulness could not be accurately determined, but is probably similar to that of the “dumb” antitank mines in World War II.
- 2) The effectiveness of scatterable antitank mines when used offensively was also difficult to measure. They hindered the movements of both enemy and friendly forces, but it is impossible to determine whether they hindered enemy forces more than they did friendly forces.
- 3) Scatterable antitank mines had limited effect at best during the “Scud War.” Their effectiveness is perhaps best measured by the likely fact that no more than 17 Scud launchers – at the absolute maximum – were destroyed by any means during the war. The costs associated with employing them in this manner may have outweighed any benefits gained.
- 4) The amount of post-war cleanup required by the presence of UXO (unexploded ordnance) of all types was massive. The degree that the SCATMINES contributed to that problem cannot be accurately measured.

The dominant lesson learned from the Gulf War experience is that scatterable antitank mines remain fundamentally a defensive weapon and function best in that role. The value of scatterable mines as an interdiction weapon – “impaling” enemy forces so that they may be destroyed by air, missiles, or artillery – remains unknown, but appears to be limited. The usefulness of these weapons in the offense is limited by the need to maneuver friendly forces through areas that have been mined – often with little or no record of where the mines have been employed or for how long their auto-destruct “life” was set. The usefulness in other roles such as interdiction and Scud suppression were not marked by any clearly measurable success and are probably limited at best.

US ARMY DOCTRINE AND SUBSTITUTIONS FOR ANTITANK MINES

“Dumb” Antitank Mine Doctrine

Currently, United States Army doctrine and planning for the use of "dumb" antitank mines only applies to Korea. The remaining US inventory of “dumb” antitank mines, except those utilized for training and the PDM with Special Forces, is in Korea. The US Marine Corps apparently has neither plans for nor inventory of "dumb" antitank mines.

"Dumb" antitank mines would be used strictly as a defensive weapon in Korea. The US 2nd Infantry Division, currently deployed to Korea, is designated as a mobile reserve force for Combined Forces Command and currently does not plan to initially lay mines in the event of a Korean conflict. Furthermore, 82 percent of the “dumb” antitank mines stockpiled by the US for use in Korea are earmarked for use by South Korean forces in the event of a conflict. In any event, the US reserves that would be rushed to Korea in the event of war, potentially up to 690,000 troops, are for a counteroffensive rather than for the defense. Current thinking now envisions that the defensive phase would end after a few weeks defensive fighting while US reserves are built up. As such, the only real use for "dumb" antitank mines in Korea would be during the first weeks of the initial defensive phase, so there are a limited number that could be laid in that time. *The Dupuy Institute* opinion is that for all practical purposes US mine laying in Korea would be very limited. Conducting mine operations in allied populated areas, especially when there could be a significant refugee flow, and with US plans predicated on a counteroffensive beginning soon after war starts would be the major limiting factors. As such, the practical value of maintaining "dumb" antitank and antipersonnel mines in Korea is very limited. This issue is addressed completely in our report “An Analysis of Rapid Mine Emplacement in a Threat Environment.”⁴⁵

The most recent example of the use of, or rather, non-use of “dumb” antitank mines by the US occurred during Operation Desert Shield in the Persian Gulf. The Iraqi Republican Guard Forces Command armor threat in Kuwait facing US forces as they deployed in August 1990 were assessed as nearly 1,000 T72 tanks organized into two armored divisions and a mechanized division, backed by four infantry divisions and six special forces brigades. Despite the threat, US military commanders did not perceive a need for minefields, even though US forces in the area initially amounted to a single light infantry division – the 82nd Airborne Division – and Allied forces consisted of the equivalent of roughly two divisions with about 550 tanks. Anecdotally, it has been said that requests by US Army commanders on the ground in Saudi Arabia for permission to construct obstacles – including emplacing mines – was denied in emphatic terms by General Norman Schwarzkopf. Ultimately, 15,531 Claymores, 21,800 “dumb” antipersonnel mines, 504 PDM, and 5,000 M74 GEMSS antipersonnel mines were shipped to the Persian Gulf in Operation Desert Storm. However, few if any were actually used.

Currently, the potential threat in Korea consists of the equivalent of about 40 divisions with roughly 3,500 tanks, most of them aging and in poor repair. They face a well-trained allied force of 22 divisions and 2,200 tanks, backed by additional Korean and US reserves.

Substitutions for “Dumb” Antitank Mines

There is no need to consider substitutions for "dumb" antitank mines for US forces other than in Korea. The US has stored in Korea 213,972 "dumb" AT mines, 176,481 of which are

⁴⁵ *The Dupuy Institute*, (McLean, VA: June 2000).

earmarked for use by South Korean forces. The US also would retain 26,036 Volcano canisters (five or six antitank mines each), 59,115 RAAM-S (nine antitank mines each), 15,832 RAAM-L (nine antitank mines each), 326 MOPMS (17 antitank mines each), and 1,648 GATOR (72 antitank mines each, assuming that all are USAF CBU-89). The total is 992,428 antitank mines (or 140,448 systems) of all types stored in Korea for US use. Thus, only 3.77 percent of the total number of antitank mines (as opposed to systems) are "dumb" antitank mines. Given the overwhelming number of scatterable antitank mines, there appears to be little need for "dumb" antitank mines in Korea. If both "dumb" and SCATMINES were banned, there would be some loss of capability since there is no clear substitute for the "dumb" mines other than the SCATMINES.

However, as was outlined in our report "An Analysis of Rapid Mine Emplacement in a Threat Environment," the entire basis of reasoning underlying the Korean exception remains questionable.

Scatterable Antitank Mine Doctrine

One of the major offensive advantages touted for scatterable mines is their use as flank protection or to interdict enemy units during offensive operations. While this may have some short-term value, mines cannot be relied upon exclusively to accomplish those missions. There is still a requirement that air or ground forces be in place to over-watch scatterable mines. Furthermore, given current doctrine based upon rapid and decisive maneuver and precision attack, once the enemy position is penetrated it is likely that friendly units may then move through the same areas where minefields were laid. However, US units in the Gulf War displayed a sensible reluctance to move through areas where UXO and scatterable mines were. It does not appear that the benefits of using scatterable mines for interdiction or flank security outweighs their inhibiting effect on friendly maneuver and the danger they present to friendly forces.

Substitutions for Artillery Fired Scatterable antitank mines

Artillery fired scatterable antitank mines are primarily intended for short-term, tactical purposes. They are used to rapidly create Turn and Fix or Block minefields in and around enemy units. In a sense, the modern artillery fired scatterable antitank mines (like the US RAAM) function more like antitank artillery rounds than as classic mines. They are often fired directly onto the target or in the path of the target, and will often have an immediate effect on the target. Classically, conventional mines are deployed on expected avenues of advance days – or even weeks – ahead of time. RAAM actually held by the divisional artillery are usually fitted with a four-hour self-destruct. These mines are specifically designed for crew kills rather than mobility kills and are not intended to be persistent. RAAM with a 48-hour self-destruct are only issued as required and are not normally part of an artillery unit's basic load.

RAAM may be replaceable by current and future artillery fired antitank systems. These include Copperhead, SADARM (Sense and Destroy Armor), and BAT (Brilliant Anti-Armor Submunition). Since future US Army doctrine plans for a reduced logistical tail the existence of the redundant capability of RAAM may be unnecessary. *The Dupuy Institute* believes that the capability currently provided by RAAM (and the antipersonnel version, ADAM) can be entirely replaced. ADAM can be replaced with DPICM or conventional high explosive artillery rounds.

Substitutions for Air Dropped Scatterable antitank mines

From a practical point of view, air dropped mines like GATOR are normally used to block or interdict the movement of enemy forces. GATOR with a four-hour self-destruct delay may have some value for local tactical use. However, because of the scattered nature of air dropped mines, the variable size of the minefield laid, and the general lack of precision locating, marking, and notification of friendly ground forces, its use close to friendly units may be fraught with danger. Some fratricide is likely to occur when using air dropped mines. Furthermore, since it is an air-delivered weapon, GATOR must be requested well in advance. As such, the short-term tactical usefulness of GATOR mines is extremely limited.

A better use of GATOR is to harass and interdict enemy force at an operational or strategic level as part of the deep battle. This is how they were used in the Gulf War – interdicting Iraqi supply lines and harassing Scud missile movement – and it is well suited to its 48-hour to 15-day delayed self-destruct time. However, this very persistence also can be a two-edged sword. In the Gulf War ground operations, US forces found that the indiscriminate nature of GATOR and the inability to properly record and mark its location, was a definite inhibiting factor for friendly maneuver on the ground.

There does not appear to be a direct substitute for GATOR currently available. As such it is a capability that would be lost as a result of a landmine ban. However, given that its actual effectiveness in the Gulf War may have been very limited, and considering the danger of fratricide, the question becomes: how much capability would actually be lost? The defensive value of GATOR in tactical terms is limited at best. In defensive operations, it is likely that aircraft loaded with precision guided weapons would have more effect than the same aircraft loaded with GATOR. What may remain irreplaceable is the interdiction capability of GATOR. However, in the Gulf War their interdiction value was a two-edged sword. The large number of GATOR scattered about the Iraqi rear hindered US offensive operations. Furthermore, the overall number of GATOR missions flown and the total number of GATOR dispensed remains unknown today. It is also obvious that little knowledge of GATOR locations was made known at the time to tactical ground commanders. As such, GATOR was just another UXO, a potentially deadly and long-term source of fratricide. There is no reason to believe – given the long history of the failure by even the best armies to properly mark and record minefields – that this “administrative” problem will ever be adequately fixed. Overall, even though the interdiction capability of GATOR cannot be entirely replaced, it appears to be of limited value.

Substitutions for Ground Deployed SCATMINES

The Volcano and Flipper mine delivery systems are much more traditional in design and intent, and have a definite defensive capability (but limited offensive capability). Because of the nature and use of the minefields laid, they tend to use mines with long self-destruct times, although Volcano can be set for a four-hour delay.

A major problem with Volcano and Flipper is the large logistical tail they require for support. Current and developing US Army doctrine calls for dominant maneuver, precision attack, increasing strategic mobility and responsiveness, and reducing the logistical footprint of units. An indication of the importance of this may be found in the weight of the systems found in a current airborne or air assault division, which totals less than 90 tons (not including vehicles). In contrast, the proposed “Interim Division’s” half-size Volcano systems will total less than 65 tons (not including vehicles).

Therefore, a complete land mine ban would result in some reduction in defensive capability, although the reduction in the logistical load may be of advantage in terms of improving strategic mobility. Whether or not this loss of defensive capability is balanced by improved mobility is a subject that should be further studied.

Summary

Under US Army doctrine there is currently no requirement for “dumb” antitank mines, except in Korea. However, as was outlined in our report “An Analysis of Rapid Mine Emplacement in a Threat Environment,” the entire basis of reasoning underlying the Korean exception remains questionable.

For all practical purposes the US can completely replace scatterable antitank mine systems with more effective anti-armor systems that currently exist or that are in development. The US will lose some interdiction and defensive capability from a ban of GATOR, but these weapons also have a negative impact on US offensive maneuver. Some loss of defensive capability will result from a ban of Volcano and Flipper, but these weapons are logistically demanding.

THE SLIPPERY SLOPE OF ARMS CONTROL

An argument has been quietly put forward, in private, that a US agreement to an antipersonnel landmine ban would open the door for other arms control agreements that might be to the disadvantage of the US. *The Dupuy Institute* senses that this may be the primary reason for some members of the US defense establishment being hesitant to agree to such a ban. This "slippery slope" argument is based upon the assumption that a slope exists, that it is slippery, that arms control moves inexorably forward from ban to ban, and that if one agrees to one ban, it will somehow prejudice their ability to disagree with a subsequent ban. However, a brief survey of the history of arms control reveals something quite different.

Arms control in Western European history effectively began with the Second Lateran Council of 1139, in which the Catholic Church outlawed the use of the crossbow against "Christians and Catholics." It also reaffirmed previous bans on fighting on Sundays and religious holidays.⁴⁶ It had very little success, and would stand for over 800 years as a testament to how difficult it is to institute meaningful arms control, even when the authority of the Catholic Church was at its peak and it held almost all of Western Europe under its sway.

Warfare in Western Europe for the next 700 years was occasionally controlled and limited by custom, good manners, church intervention, treaties between states, and some early basic tenants of what became known as "international law." However, there was no overall system of arms control agreements nor was there reliable enforcement of the few agreements that were in force between nations. The United States itself became party to its first arms reduction agreement with the successful Rush-Bagot Treaty of 1817,⁴⁷ wherein Britain and the US significantly reduced their naval forces (including dismantling warships) on the Great Lakes and Lake Champlain. The limit was for four ships of up to 100 tons burden, whose armament was limited to one eighteen-pounder cannon each. This arms control treaty remains in force today.

The first modern attempt at arms control was initiated by the Imperial monarchy of Russia, which was responsible for most of the earliest arms control conferences. In 1868 in Saint Petersburg, a declaration was promulgated renouncing the use of explosive projectiles under 400 grams in weight (less than a pound). This limited, and fairly useless, humanitarian-based arms control effort was signed by 17 states at the time, while three others later acceded to it (including Estonia as late as 1991). The US never signed this treaty and the manufacture and use of small explosive rounds (most rounds 20mm and larger would likely be banned) remains common throughout the world, even by some of the signatories.

The first major attempt at international arms control and codifying the rules of war since the Lateran Councils⁴⁸ began with the Hague Convention of 1899, convened at the initiative of Tsar

⁴⁶ The "Peace of God" resolutions, which ban attacking churches, robbing the poor and attacking clergymen date from the Synod of Charroux, 989 AD and were repeated in the canons (church laws) of most other major councils and expanded to include safe sanctuary in churches. The "Truce of God" resolutions, which banned fighting on religious holidays, date from the Council of Elne in 1027, and were repeated and expanded at a number of other councils, including the Second Lateran Council of 1139 and the Third Lateran Council of 1179.

⁴⁷ The Rush-Bagot Treaty was a follow on to the Treaty of Ghent of 1814, which ended the War of 1812.

⁴⁸ The Second Lateran Council in 1139 included the ban on crossbows. This does not appear to have been repeated in later councils, although the "Truce of God" and "Peace of God" type provisions were included in the Canons from the Third Lateran Council (1179) and the Fourth Lateran Council (1215).

Nicholas II of Russia. The conventions codified the laws and customs of land warfare, defined the status of belligerents and drafted regulations on the treatment of prisoners, wounded and neutrals. These conventions included a prohibition against "employ[ing] poison or poisoned arms" and "employ[ing] arms, projectiles or material of a nature to cause superfluous injury," bombarding undefended villages or towns, or pillaging them after capture. It also banned specific weapons in three separate declarations: 1) aerial bombardment by balloons or other means for the following five years, 2) the use of projectiles to deliver poison gas, and 3) dum dum (expanding) bullets. The US ratified the convention, but only signed (but did not ratify) the first declaration and neither signed nor ratified the other two.

The Second Hague Convention, also called by Tsar Nicholas II, was held in 1907. It restated the existing laws of war, modifying the provision forbidding the use of "arms, projectiles or materials calculated to cause unnecessary suffering." It renewed the expired ban on the discharge of projectiles and explosives from balloons or other aircraft, which was to remain in force until the Third Peace Conference (scheduled for 1915 or 1916). It banned the naval bombardment of undefended ports and towns. It also restricted the use of free-floating naval mines and forbade their use with the sole object of intercepting commercial shipping. The US ratified all the relevant portions of this convention. The US participated actively in both conferences and initiated the suggestion for the second conference. The third conference never occurred because of the outbreak of the First World War. Also related to Second Conference was the London Naval Conference of 1908-09, which initiated no new arms control efforts but did codify existing international naval law.

The Hague agreements are significant in that they were the only ban of non-naval, conventional weapons in the period between 1139 and 1980. This period of arms control from 1868 to 1907 were ended by the outbreak of the First World War. It would be another 73 years before arms control of non-naval, conventional weapons would be agreed to – the current anti-landmine campaign as developed in Geneva Conventions of 1980 and the "Antipersonnel" Ottawa Landmine Convention of 1997.

However, the end result was that only the prohibition against dum dum bullets had any effect, with the other banned weapons (aerial bombardment and poison gas) used extensively during World War I. The conventions concerning naval bombardment and naval mines were not always followed either. For the purpose of arms control, the Hague Conventions were ultimately a failure, although they had a permanent impact in other areas (they established the still extant Permanent Court of Arbitration).

It was witnessing their actual use during World War I that lead to the chemical warfare conventions that limited use of chemical weapons. The first was the Washington Treaty signed in 1922 that banned the use of submarines as "commerce destroyers" and the use of asphyxiating, poisonous or other gases, and all analogous liquids, material or devices in war. The US ratified this. The Geneva Protocol of 1925 forbade the use of biological and chemical weapons except in retaliation. Attributing the lack of use of chemical weapons in World War II solely to the conventions against their use may be questionable. However, it must be said that despite developing huge stockpiles of chemical weapons, none of the major powers in World War II made military use of them. Even ruthlessly amoral leaders like Adolf Hitler abided by the ban (perhaps influenced more by his own exposure to chemical weapons in the First World War), but Nazi Germany did use chemical agents against civilians. Even though there have been more than a dozen violations of this treaty since its inception, it does seem to have a major role in reducing the use of chemical and biological weapons in warfare.

The second major convention restricting these weapons was the Biological and Toxic Weapons Convention in 1972, some 47 years later. The US signed both it and the Geneva Protocol of 1925 in 1975, although it did observe the Geneva Protocol throughout the intervening fifty years. In 1993, the Chemical Weapons Convention was approved, which banned production, use, sale and storage of all chemical weapons. It mandates the destruction of existing stocks of weapons by 2005. There is no question that the use and manufacture of these two major categories of weapons (chemical and biological) has been severely restricted over time by the various arms control agreements.

The end of World War I resulted in the Versailles Treaty of 1919, where the wars' victors imposed disarmament conditions upon the losers. It also committed the Allied Powers (the victors) to disarmament, as did the Covenant of the League of Nations (which the United States initiated, but did not join). The most ambitious attempt was the World Disarmament Conference, 1932-37, which included proposals put forth by the United States (the Hoover Plan). This was an attempt to progressively ban offensive weapons. Little was accomplished, especially after Adolf Hitler withdrew Germany from the conference and the League of Nations in October 1933.

The one area where there was limited conventional arms control was the various naval treaties and conferences in the inter-war years. The Washington Naval Conference of 1921-22 resulted in several treaties, including a Five-Power Treaty that limited tonnage of aircraft carriers and capital ships and resulted in the US, Great Britain and France scrapping a number of ships. The ratio of capital ships was established between the five powers (Great Britain, France, Italy, Japan, and the US). A ten-year moratorium was placed on battleship building. These treaties were to remain in force until the end of 1936. The Washington Treaty also codified rules of warfare for submarines and outlawed the use of poison gas. A Geneva Conference in 1927 failed to reach further agreement on more comprehensive limits on warships. The London Naval Conference of 1930 resulted in a revision of the ratio of ships allowed among the powers (in favor of Japan). This conference also outlined the rules for submarine warfare. In 1934, Japan announced it would withdraw from the Washington Naval Treaty, and another London Naval Conference resulted in 1935. Japan withdrew from that conference when refused naval parity, although Britain, France and the US signed further treaties limiting ship size. In 1938, the size limits on capital ships was increased in response to Japan's continued building program. The entire effort to control naval armaments died with WWII and nothing significant has been done in the intervening 63 years.

Finally, the world also experienced an attempt to outlaw war with the idealistic Kellogg-Briand Pact of 1928, initiated by France and the United States. It was signed by 63 nations and renounced war as an instrument of foreign policy. It had no means of enforcement and no effect on international law or affairs. It was followed eleven years later by World War II. The UN Charter in 1945 also has certain "antiwar" and "disarmament" provisions and these were actually first exercised in 1950 with the UN (& US) intervention in Korea. Still, the overall effect of these efforts to outlaw war has been sorely disappointing, and nothing significant has been attempted in the last 50 years.

After World War II, no major arms control treaties were signed for almost fifteen years. The first was the Antarctic Treaty of 1959, which limited use of weapons (and new claims) in the Antarctic. Following the Cuban Missile Crisis of 1962, some progress was made on the control of nuclear weapons in the Limited Test Ban Treaty of 1963, the Outer Space Treaty of 1967, and the Tlatelolco Treaty of 1967, which banned nuclear weapons in Latin America. They were soon followed by the Nonproliferation Treaty of 1968, the Accidents Measures Agreement (AMA) of

1971, the Seabed Arms Control Treaty of 1971, and the Anti-Ballistic Missile (ABM) Treaty and Strategic Arms Limitation Talks (SALT I) of 1972. SALT II, which has not been ratified by the US, was signed in 1979. The Moon Treaty of 1979, the Intermediate-Range Nuclear Forces (INF) Treaty of 1987, the Threshold Test Ban Treaty of 1990, the Strategic Arms Reduction Treaty (START) of 1991 followed. Finally in 1993 there was the START II Treaty, which has not been ratified by Russia, and in 1999 the Comprehensive Test Ban Treaty, which the US Senate rejected. All of these treaties were primarily concerned with nuclear weapons. Overall, while they have had some success in limiting production, proliferation and development of nuclear arms, the decline in nuclear weapons stocks from their peak in the 1980s has been almost entirely due to the collapse of the Soviet Union and its subsequent impoverishment.

Besides the Antarctic treaty of 1959, the only major non-naval conventional warfare treaties (not nuclear, chemical or biological) signed since 1907 was the Conference on Security and Cooperation in Europe in 1985 (a treaty on confidence building measures) the Conventional Armed Forces in Europe treaty which was signed in 1990. Both of these treaties were quickly overcome by events as first the Warsaw Pact and then the Soviet Union dissolved. There were also the 1976 Weather Modification Convention and the 1980 Conference on Inhuman Weapons.

This latter conference in 1979 and 1980 generated a Convention on the use of certain conventional weapons that may be deemed to be excessively injurious or have indiscriminate effects. The actual convention banned no weapons, but the three attached protocols did. While 84 states (including the United States) signed the convention as of the end of 2000, only 83 signed the First Protocol (signed and ratified by the US). It prohibited the use of any fragmentation weapon in which the fragments lodged in the human body could escape detection by X-rays. The Second Protocol, signed by 76 parties (and signed and ratified by the US), prohibited directing mines, booby traps and other devices against civilian population. It also prohibited their indiscriminate use – meaning that they could not be specifically placed against a military objective or in a way that would be expected to cause incidental civilian casualties which would be excessive to the anticipated military advantage. Reasonable precautions had to be taken to protect civilians from the effects of such mines. It furthermore restricted the use of mines (other than remotely delivered mines), booby-traps and other devices in populated areas, requiring there to either be a valid military objective in the populated area or proper warning measures be taken. It further restricted the use of remotely delivered mines to only those areas that are military objectives or contain military objectives. Furthermore, their location must be accurately recorded and there must be a neutralizing mechanism in each mine. The Third Protocol was on the use of incendiary weapons, and was signed by 80 nations. It prohibited the use of such weapons against the civilian population and prohibited air attack with incendiary weapons of any military objective located within a concentration of civilians. Other uses of incendiary weapons in populated areas must minimize incidental loss of civilian life. It also prohibited targeting forests that are not military objectives. The US has not signed or ratified this last protocol. There was also a resolution adopted on small caliber weapons systems that had no legal force. A 1995 resolution added a Fourth Protocol to ban blinding laser weapons. The US has signed but not ratified this protocol, while stating that the US is in compliance with it. It has been agreed to by 56 states. Finally there was an amendment to the Mine Protocol (Protocol II) which was ratified by the US and 58 other states. This amendment (1996) prohibited anti-detection features, including prohibiting the use of non-detectable antipersonnel mines. It prohibited the use of antipersonnel mines that do not self-destruct or self-deactivate outside of marked areas. It prohibited the use of remotely delivered antipersonnel mines that do not self-

destruct. It imposed some constraints on the use of trip-wire operated Claymore-type mines. It prohibits the transfer of antipersonnel mines to states not bound by the protocol (neither North nor South Korea have agreed to this protocol) unless the recipient agrees to follow the protocol. It also requires removal of minefields after hostilities.

The 1980 Convention and the subsequent protocols in 1995 and 1996 did not actually ban major weapon systems (the ban applies to non-detectable (by X-ray) fragmentation devices, blinding lasers, non-detectable anti-personnel mines, and scatterable antipersonnel mines that do not self-destruct), but restricted their usage against civilians. It would be left to the Ottawa Convention of 1997 to actually ban antipersonnel mines.

Overall, with the exception of chemical and biological weapons and nuclear nonproliferation, few weapons have been halted or severely limited by arms control agreements. Over the last 900 years, there does not appear to have been much of a slope and friction appears to be a more dominant characteristic than slipperiness. No actual type of conventional weapon has been effectively banned since 1899. The idea that agreeing to a ban of one or two types of weapons will open the floodgates for other bans, has no firm basis in history.

This "domino theory" type argument seems to rest on the idea that once a treaty is agreed to more will shortly follow. In fact, history suggests that the reverse trend is the case, which is that once a treaty is agreed to, the demand and need for additional treaties decline. In many cases it appears that after the initial round of treaties and conventions in a given area, further agreements are 50 or more years in the future. This is indeed what happened between the first Chemical Warfare Convention in 1925 and the Biological and Toxic Weapons Convention in 1972, some 47 years later. There is also a pattern of declining activity with nuclear arms control. Seven treaties were signed between 1963 and 1972 (a 10-year period), but only six treaties between 1973 and 1993 (a 21-year period), and only one treaty in the last 8 years, which in fact was rejected by the US Senate. This has definitely been the case with conventional naval arms control, where after a period of activity from 1921 to 1938, nothing has been done in the 63 years since. The existence of a slippery slope for conventional land warfare weapons is even more tenuous. While the first major ban occurred in 1139, the second was not until 1899 and the third – the Ottawa Convention – wasn't until 1997.

All evidence points to the "slippery slope" argument being devoid of analytical support or precedence. As such, there appears to be no basis for this particular argument other than unreasoning fear. This does not seem to be a sound basis for making decisions on the national interests of the United States.

CONCLUSIONS

- 1) *The Dupuy Institute* reiterates its recommendation that the United States support current efforts to implement an antipersonnel landmine ban.
- 2) *The Dupuy Institute* is quite comfortable with extending the ban to include "dumb" antitank mines. Such a ban would not significantly reduce US capabilities. Furthermore, these weapons have already been effectively removed from US doctrinal use. The "dumb" mine is a weapon that will be used against US forces, rather than one that US forces will use.
- 3) The banning of antitank SCATMINE systems is a more difficult issue. There is no question that there will be some loss of capability, although the degree is not easy to measure.
 - a) US Army ground and helicopter-deployed SCATMINE systems (Volcano, Flipper, and MOPMS) are fundamentally defensive in nature and are only assigned to divisions and brigades which do not have a robust anti-armor capability. Banning them would effect the anti-armor defensive capability of those units. However, the capabilities of these systems may be replaceable by Hornet. The advantages gained would be a reduced logistical tail (definitely a critical issue for future Army planning), a reduced threat of fratricidal use, and a reduced chance of encountering the same or similar systems in the inventory of opposing forces, a very definite advantage.
 - b) US artillery launched SCATMINE systems (ADAM and RAAM) have both theoretical offensive and a practical defensive use. Since the rounds in the artillery basic load have a four-hour self-destruct, it is effectively an anti-armor system with a persistent effect, rather than a long-term barrier system. Its interdiction value is short-term. To be used most effectively it must be used in conjunction with other antitank weapons. Therefore, a complete antitank mine ban may result in some reduction in anti-armor capability. However, the actual armor killing capability of RAAM can be replaced by existing systems. The main advantages lost are the capability of temporarily freezing an opposing unit in place and persistence of its effect (up to 48 hours).
 - c) US airdropped SCATMINE systems (GATOR) have utility in interdicting an enemy. There does not appear to be another weapon system that would provide a complete substitute for that capability, especially for long term use (48 hours or 15 days). The downside of that capability, as was found in the Gulf War, is that this system interdicts both sides. GATOR may also be useful in freezing an opposing unit, which is then attacked with other assets in deep battle. However, SCATMINEs tactical defensive value is limited due to the method of deployment and the difficulty associated with marking and recording their location. They may also have some offensive value in protecting flanks.
- 4) If a revolution in military affairs is occurring, with the United States on the leading edge of the revolution, then the deployment of any conventional mine system is to our disadvantage. Fundamentally mines have more value to technologically inferior forces. They remain a simple, cheap, and easy means of attacking technologically sophisticated weapons systems while incurring little risk to the user.
- 5) Because of the nature of most US operations, the US is more often on the offense in conventional warfare than it is on the defense. Furthermore, they are not weapons that the US, as a conventional force, would have much use for in a guerrilla war. It is not a weapon that the

US has any use for in contingency operations, peacekeeping operations and operations other than war. The mine is still primarily a weapon of the defender and the guerrilla. As such, any landmine bans fundamentally favor the US military and reduce casualties.

- 6) The "Korean exception" appears to be a "red herring." It appears that the prime reason for the US Army maintaining "dumb" antipersonnel mines in Korea is to stockpile them for South Korean use and that any planned use of the stockpiled mines by US forces is a very secondary consideration. Korea is not a strong argument for refusing to participate in a landmine ban.
- 7) There appears to be a fairly clear dividing line between a mine and command detonated munition. Hornet and Claymore (as configured for US forces) would not be covered under a landmine ban. As such, banning landmines does not open the possibility that other US antipersonnel or antitank weapons would be lost in such a ban.

RECOMMENDATIONS

- 1) *The Dupuy Institute* again recommends that the US agree to an antipersonnel landmine ban.
- 2) *The Dupuy Institute* recommends that the US agree to a "dumb" antitank landmine ban.
- 3) *The Dupuy Institute* recommends that the US consider an antitank SCATMINE ban.

The Dupuy Institute understands that this would entail some loss in defensive capability, and possibly a minor loss in offensive capability. Still, the overall benefits of such a ban to US offensive capability – lower casualties and a reduced logistics tail – could make such a ban advantageous to US armed forces. This advantage would be predicated on at least partial, but not complete, effectiveness of such ban worldwide. Thus, the US may wish to make its participation in a ban on antitank SCATMINE systems conditional upon the participation of (or the participation of within a set period of time) certain other major manufacturing nations (i.e., Russia, China and India).

APPENDIX I: EXISTING US ANTITANK MINE SYSTEMS

"Dumb" Antitank Mines

| Mine | Fuse | Explosive Weight | Mine Weight | Notes |
|-----------------------------------|----------------------|------------------|-------------|--------------------------|
| M15 with M603 fuse with M624 fuse | Pressure Tilt Rod | 9.9 kg | 13.5 kg | Has anti-handling device |
| M19 | Pressure | 9.45 kg | 12.6 kg | Has anti-handling device |
| M21 | Tilt Rod or Pressure | 4.95 kg | 7.6 kg | Has anti-handling device |

None of these mines self-destruct. The tilt-rod fuse operates with 1.7 kilograms of pressure, and as such, can be set off by humans. The pressure plate fuse requires 130 or more kilograms of pressure and cannot be set off by a walking human.

Antitank SCATMINE Systems

| Mine | Delivery System | Fuse | Self-Destruct Time | Explosive Weight | Mine Weight | Number of Mines per Container | Notes |
|----------|------------------------|----------|---|------------------|-------------|----------------------------------|---|
| M73 | 155mm artillery (RAAM) | Magnetic | 48 hours | 585 grams | 1.7 kg | 9 per M718 projectile | 20% with anti-handling devices |
| M70 | 155mm artillery (RAAM) | Magnetic | 4 hours | 585 grams | 1.7 kg | 9 per M718 projectile | 20% with anti-handling devices |
| M75 | Flipper | Magnetic | 5 days or 15 days | 585 grams | 1.7 kg | 5 per sleeve | 20% with anti-handling devices |
| BLU 91/B | USAF (GATOR) | Magnetic | 4 hours or 48 hours or 15 days | 585 grams | 1.7 kg | 72 per CBU 89/B (USAF) dispenser | Detonate when moved. 22 AP mines (USAF) or 15 AP mines (Navy) Detonate when moved. Dispenser includes 4 AP mines. |
| M76 | MOPMS | Magnetic | 4 hours can be recycled up to three times | 585 grams | 1.7 kg | 5 per M87 canister | Detonate when moved. |
| Volcano | Ground or Helicopter | Magnetic | 4 hours 48 hours 15 days | 585 grams | 1.7 kg | 6 per M87A1 canister | M87 canister also includes 1 AP mine. |

APPENDIX II: THE 39th PANZER REGIMENT AT KURSK

Losses in the 39th Panzer Regiment at Kursk are confusing. On 4 July 1943 it had 200, and on 6 July 40 tanks, ready for action. But, a significant percentage of the tanks were broken down rather than combat losses. The regiment was attached to the *Gross Deutschland* Division during the battle. But it is uncertain whether the 20 tanks reported as lost to mines on 5 July were only from *Gross Deutschland* or included tanks of the 39th Panzer Regiment. We assume that it does not. The 39th Panzer Regiment was equipped with brand new Panther tanks that suffered from various teething problems which resulted in poor reliability. The number of Panthers available on the morning of 4 July is known (200), and the number that broke down during the march up on 4 July is also known (two or, possibly, six). The next reliable strength report available is for the evening 6 July, when 40 tanks were reported operational. Some of the 158-tank shortfall was due to combat losses (including mines), but many were due to mechanical failure.

There are two reports of mine losses for the Panthers. One was a Quartermaster report of 76 tanks lost to date on 10 July. Four were total losses, 54 were mechanical losses, and 18 were "minor failures (with most caused by mines)." The other was an after action report submitted to the Office of the Inspector General of Armor Troops in August 1943 from the regiment. It reported that on the evening of 10 July there were 10 Panthers left "facing the enemy", 25 total losses (including 23 hit and burned and 2 burned in the march to the front), 100 in the workshops (including 56 from gun damage and mines and 44 with technical problems). There were also 65 others being released or soon to be released from the repair facilities (cause of failure was not recorded in this report) for return to the front. This report also stated that "about 40 Panthers were lost to mines in the first days...In one example a total loss resulted when flames penetrated the turret basket and ignited the stored ammunition..."

Since the quartermaster report for 10 July understates Panther losses at that time, and tended to lag behind the tank loss reports, it is assumed to be a partial report. The IG report giving 40 tanks lost to mines is probably closer to the truth.

For 5 July there are no actual reports of Panthers being lost to mines or being in minefields. Of the two battalions of the regiment, one put at least 30 Panthers across the Berezovyyi ravine, and as a result, almost certainly took mine losses. Whether these were picked up in the *Gross Deutschland* report of 20 tanks lost is more difficult to determine. The other battalion did not get across the creek and probably suffered no losses to mines on 5 July.

The following day, they did encounter some mines, and also on 7 July and thereafter. If it is assumed that 18 of the 76 tanks reported as lost were all lost to mines, and that figure is used to account for all of the 158 estimated lost on 5 and 6 July (two them were accounted for on 4 July), then a total of 38 tanks were lost to mines. This is certainly the highest number that can be supported by the historical record. However, the actual number lost to mines may have been 10 or 20 tanks fewer.