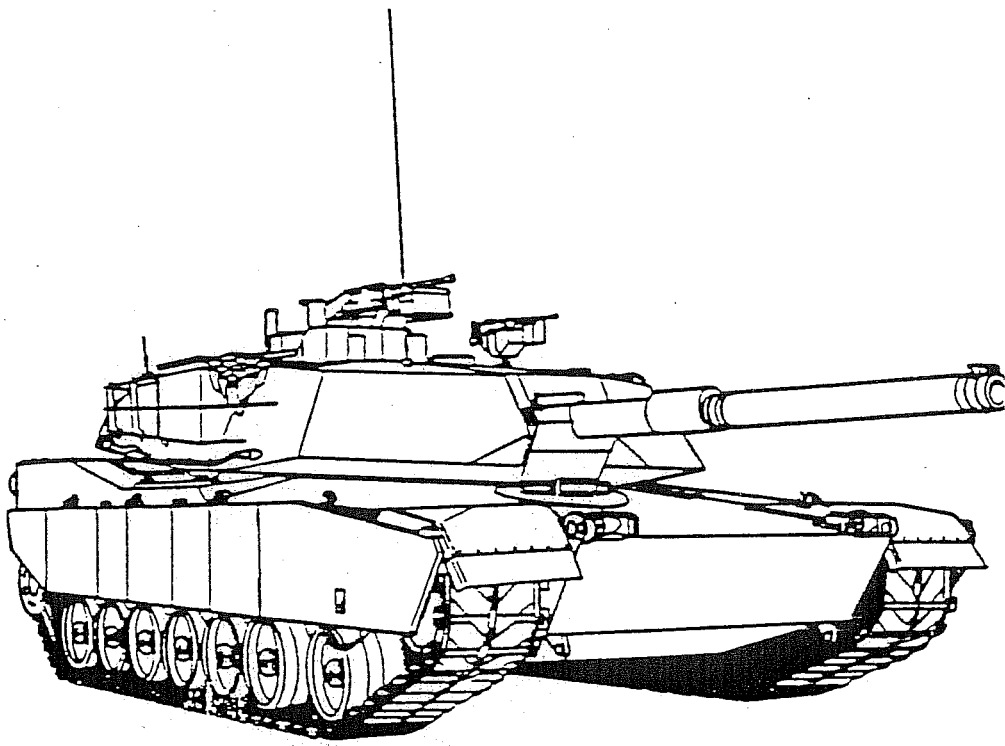
Project On Government Oversight

The Army's M1 Tank:

Has it Lived Up to Expectations?



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Foreword

The Project on Government Procurement has tracked the progress of the M1 tank since our founding in 1980. Because our observations on M1 tank performance have often been called, inaccurate, incomplete or out-of-date, we have released new Army M1 data to the public as it has become available. Since the M1 program may be coming to an end, this report is intended to be a useful summary of M1 performance claims and data. We have included U.S. Army and DoD statements made throughout the history of the program and compared them to data available then and now. We have included a detailed description of our source material, and how we calculated the statistics used in the report. Furthermore, in this updated version, we have included the rebuttal of General Dynamics, as it was sent to the Editor of the Detroit News. The rebuttal addresses an article based largely on a this report. You will find our response to General Dynamics' claims at the end of the report. If you have any questions about the M1 tank, or how we prepared this report, please contact us at the address or phone number printed on the cover.

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M1 OVERVIEW

Events in Europe may seem to make the issue of tank procurement anachronistic. Nevertheless, the Army is moving ahead not only with the new, more expensive and complicated A2 version of the M1, but also with an entirely new "armored family of vehicles". In addition, the U.S. Army is aggressively promoting sales of the M1 to our allies, including Britain and Sweden. So not only are we buying more new tanks in an era of budget cuts, we are buying more of a tank which has never met its basic requirements -- and is by far the most expensive tank in the world, according to published figures. For example, it costs far more than the German Leopard II, a tank which was built to the same original performance requirements. (see chart A, p.2) Recent data also shows that the M1 continues to fail its most basic requirements. Despite full knowledge of the M1's shortcomings, the Army has aggressively promoted it, and questioned the honesty and motives of its critics.

> **"Sir, I appreciate this opportunity to respond. The Army has been very much concerned at the unprecedented media attack on the M1 tank that has occurred in recent months. We would characterize much of that attack as being based on incorrect information, innuendo, selective reporting from test reports that are out of date with no balancing of information."** -- *General Maloney, testifying before the House Armed Services Committee in 1982 (hearings on HR 5968)*

The data presented here was gathered primarily from U.S. Army sources, and the congressional record. Some information was also taken from established trade journals. Additional information and clarification was requested of the Army in January of this year, but as yet there has been no response. This information was originally to include a briefing on M1 tank performance, as well as current U.S. Army positions on the M1 and tank warfare. The information we gathered shows some significant improvements, dramatic in the case of drivetrain reliability. Nevertheless, on the whole the M1 still appears to fall short of many of its basic requirements.

The M1 is the most expensive tank in the world, its $4.3 million price tag nearly doubling the $2.4 million cost of the German Leopard II. Furthermore, its cost may continue to rise as quantities purchased drop, and expensive options are added. It should be emphasized that the German price of $2.4 million per tank, is achieved at a production rate of only 70 tanks a year.[1] The M1's price has risen dramatically since quantities purchased fell from over 500 a year, to less than 250. It is conceivable that the Leopard II, if produced in such large quantities, its price would be even lower.

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[1]. Figures provided by the Federal Germany Liaison Office, Washington D.C..

The M1's high price does not guarantee top performance. There are several competitive tanks in production today that are produced at much less cost (see chart A, p.2). Again, the M1A1 was built to meet the same basic requirements as the Leopard II, but costs more, and uses 90% mores fuel when driven at a constant speed (In combat, it is likely that the M1 and M1A1 would consume much more.). And the Leopard II carries more ammunition. (see chart A, p.2) A common element among cheaper, more fuel efficient foreign tanks is that they are equipped with reliable, inexpensive diesel engines, rather than the costly, temperamental turbine engine of the M1 tank. Indeed, the M1 may be the only military land vehicle ever equipped with a turbine engine.

Chart A: Tank Capacities and Performance

Tank	Fuel Gal.	Range Miles	Gal/Mile at 25mph	Gal/Hr at Idle	Top Speed	Power HP/Ton	Gun mm	Ammo Rnds	89 Price $Million
M1A1	505	286	1.77	-	41.5	23.8	120	40	2.9[1]
M1	504	295	1.71	11.9[2]	41.5	24.6	105	55	-
M60A3	375	298	1.26	-	30.2	13.0	105	63	-
Merkava Mk1	238	248	.96	-	28.8	13.6	105	85[3]	1.8[4]
Merkava Mk3[5]	-	-	-	-	-	19.3	120	50	2.3
Leopard II	317	342	.93	4.0[6]	45.0	24.7	120	42	2.4[7]

Ranges and mileages given are for constant 25mph travel on level ground. Actual combat performance will be significantly different. M1's can consume as much as 8 gallons of fuel per mile. See Chart C, p.6.

M1 RELIABILITY REQUIREMENTS

"Test results show that the M1 meets or exceeds most reliability, availability, maintainability requirements established. It exceeds the combat mission reliability requirement by 10%, the system reliability requirement by 15%, and the maintenance ratio by 6%." -- *Maj. Gen Durad D. Ball, testimony before the House Armed Services Committee, hearings on HR 2287, 1984*

The M1 has in fact consistently failed five of its six Reliability, Availability, Maintainability and Durability (RAM-D) requirements, according to the last operational test, and actual use data collected in 1988 (see charts B, p.4 and C, p.5).

Many of the M1's reliability failures can be traced its turbine engine. Every other tank in the world is equipped with a reliable, inexpensive, efficient diesel or gasoline engine. Turbines are complex, temperamental and expensive. Yet the Army has been less than forthcoming in justifying the necessity of the turbine, particularly in light of its cost and fuel consumption.

IS A TURBINE NECESSARY?

> **"Obviously speed and agility are as much a means of survival as is armor protection. ... The ACT 1500 [turbine] engine used in the M1 provides that power."** - *Lt. Col. Michael D. Jackson, "Auxiliary Power Unit for the M1 Tank", Army Research, Development & Acquisition Magazine, May-June 1984, p.26*

In this statement, the Army suggests that a turbine engine is necessary to achieve the speed and agility of the M1. The German Leopard II is just as fast as the M1, because it has a 1500 horsepower diesel engine, the same horsepower as the M1's. (see chart C, p.5) And though mobility is important, it is not all-important. Jane's Armour and Artillery 1988 states:

> **"Israeli experience in the 1967 campaign proved that mobility was no substitute for armour protection..."** (p.40).

IS A TURBINE RELIABLE AND COST-EFFECTIVE?

> **"There are two categories of satisfaction with the [turbine] engine, Mr. Chairman. One is, does it meet the operational needs of the tank, and it meets those very well. The tank performs very well with that engine. Its failure rate is less than our experience with our older diesel engine tanks."** - *Maj. Gen. Durad D. Ball, 1983 hearing before the House Armed Services Committee.*

On the contrary, Army actual use figures show that the turbine-powered M1 requires unscheduled maintenance over five times as often as the diesel M60 tank.[2] Furthermore, the M1 and M1A1 tanks cost three to four times as much to maintain as does the diesel-engined M60.[3] (see chart C, p.5)

One should take note of the low maintenance figures in Chart B, p.5, Reliability, Availability, Maintainability and Durability (RAM-D) requirements. These seem to meet, or nearly meet the RAM-D requirements. However, if one goes to Chart C, "Actual Use Data", p.5, one can see that this low level of maintenance has a serious effect on the number of tanks available for use. In other words, the less time (maintenance hours) you spend maintaining your tanks, the less tanks there

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[2]. See the Army's Logistic Management Analysis Summaries, for the M60 and M1 tanks. Latest periods available are 10/85 - 4/86 for the M60, and 1/88 - 6/88 for the M1.

[3]. See the Army's Operation and Support Cost Study, Field Usage Summaries for M1, M1A1, and M60 for 1985 through 1988.

are to use on any given day.

Reference the last two columns in Chart C. As long as the numbers in the MH/H (maintenance hours per operating hour) figures are high, so are the availability (Avlb) figures. When the MH/H figures go down to 1.0 for the M1 and .7 for the M1A1 in the 3/88 period, only 81% of the M1's and 79% of the M1A1's are available. A high rate of availability (95% is the Army's frequent claim) is implicit in the maintenance ratio (MH/H) figure. Therefore, these low maintenance ratio figures should not be used when evaluating the M1's reliability and maintainability.

The turbine engine also manifests its delicate nature by requiring extra care when operating in less than ideal conditions. The M1's operator's manual specifically warns that falling leaves and/or snow can be sucked into the air intake during normal operations. Both can require organizational maintenance. And if the tank crew attempts to clear snow and ice from the intake system, they may damage it.[4]

Chart B: U.S. Army RAM-D Requirements

Category	Army Requirement	Actual Use M1	Actual Use M1A1
Combat Reliability: (min) *mean miles between failures*	320	110	152
System Reliability: (min) *mean miles between failures*	101	10	21
Maintenance Ratio: (max) *maintenance hours / operating hours*	1.25	1.4[8*]	1.23[9*]
Powertrain Durability: (min) *probability of going 4,000 miles without requiring powertrain overhaul*	50%	15%[10]	NA
Primary Weapon Life: (min) *rounds fired*	1,000	NA	NA[11]
Track Life: (min) *miles*	2,000	945	840

* Note - While this maintenance ratio nearly meets the required maximum of 1.25 maintenance hours per operating hour, it does so at a sacrifice of tank availability. (M1A1 availability drops to 79% from 92%.) In other words, it is assumed that the goal of maintenance is to have nearly all the tanks available for use every day. By skimping on one implicit availability requirement, the explicit maintenance requirement was met. (see note)

[4]. U.S. Army manual Technical Manual, Operator's Manual, Operation Under Usual and Unusual Conditions: Tank, Combat, Full-Tracked, 120-MM, M1A1, TM 9-2350-264-10-2, p.2-398.

IS A TURBINE FUEL-EFFICIENT?

> **"[I]f you had a diesel engine with the horsepower that you have with the turbine engine and the weight that you have, it would be about a 15-percent increase in fuel consumption by the turbine engine over the comparable diesel."** -- *1982 testimony before the House Armed Services Committee: General Rogers*

Again, the German Leopard II is just as heavy, (121,000 lb. for the Leopard II and 120,000 for the M1) and just as powerful as the M1 (1,500 horsepower for each), yet the M1 consumes **83% more fuel** more fuel than the Leopard II when driven at a constant speed (1.71 gal/mile for the M1 vs. only .93 gal/mile for the Leopard II). (see charts B, p.4 and C, p.5)

The amount of fuel consumption in an armored division is of paramount importance. The Army's field manual FM 100-5 observes:

> **"Today, it is estimated that one armored division equipped with M1 tanks will consume over 600,000 gallons of fuel per day, more than twice the consumption of Patton's entire army."** (and they ran out of gas!) (p. 60, chapter 4) (an M1 armored division has 348 tanks)

Chart C: Actual Use Data

Year	Tank	Gal/Mile	Gal/Hour	Mile/Hour	$/Mile	MH/Mile	Avlb	MH/H
1985	M1	8.6	20	2.42	21	.NA	NA	.NA
	M60A3	1.8	13	7.16	6	.NA	88%	.NA
1986	M60A3	2.0	20	10.02	6	.25	NA	1.8
3/87	M1	8.3	14	1.74	29	.78	NA	1.4
7/87	M1A1	7.1	20	2.82	17	.52	76%	1.5
9/87	M1	6.8	17	2.60	27	.63	94%	1.7
10/87	M1A1	5.3	20	3.82	17	.39	92%	1.5
3/88	M1	7.9	19	2.62	18	.38	81%	1.0[12*]
3/88	M1A1	7.3	16	2.02	26	.33	79%	.7[13*]
Average								
87-88	M1	7.7	17	2.32	25	.60	88%	1.4
	M1A1	6.6	19	2.89	20	.41	82%	1.2

* Note, while these figures are dramatic, notice how the number of tanks available for use declines to 81% from the 90% and 94% figures achieved earlier.
These actual use figures are important because they show how the M1, M1A1 and M60 tanks perform in actual use. Notice that whereas the M1 and M1A1 consume only 1.6 and 1.7 gallons per mile respectively when driven at a constant speed, they consume much more in actual use. Here we see figures ranging from 6.6 gallons to the mile to 8.6 gallons per mile. Notice also that the diesel M60's figures do not go up nearly so dramatically in actual use, rising from 1.26 to a maximum of 2 gallons to the mile. This is due to the large amount of fuel a turbine uses at idle - 12 gallons per hour according to the Army.

The Army has often contended that the bottom line in fuel consumption is the tank's capability of operating for a whole day without refueling. While this is important, it is also vital that sufficient fuel be available to accommodate daily refueling. As stated earlier, an M1 division is expected to consume roughly 600,000 gallons of fuel per day. To get this to the front requires a large supply train. And a tank battalion can only move as fast as its supply moves.

As a result of the M1's lack of fuel efficiency, the Army has had to increase the number of trucks that follow it. As of 1981, the army had to add the following equipment to each M1 tank battalion:

6 five-ton trucks	6 tank pump units
6 tank pump units	6 1.5 ton cargo trailers
1 semi-tractor with 5,000 gallon fuel trailer	

With the introduction of the M1A1, the fuel situation has worsened. The Army has had to add another four 10-ton, 2,500 gallon fuel carriers, according to Maj. Mazzia of the Army's Ft Knox Armor School. This totals 128 support vehicles assigned to each battalion of 58 M1A1 tanks. While the M1 may be able to move quickly across terrain, it must always wait for these vehicles to catch up. Nonetheless, in the past, Army officials have seemed unconcerned about the M1's fuel consumption:

> **"We don't even think about fuel consumption as a [tank crewman]. We don't care."** -- *Sgt. Kinney, hearings before the House Armed Services committee, 1982.*

Indeed, instead of combating the fuel consumption problem, the Army is making it worse: In an effort to standardize the fuel used by all Army vehicles, the Army will no longer use diesel to fuel the M1. Instead, a type of aviation fuel, which runs less efficiently in the M1, will be used by all Army vehicles.[5] General Patton emphasized the folly of disregarding tank fuel consumption in his famous statement:

> **"My men can eat their belts, but my tanks gotta have gas."**

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[5]. See David Evans, "Tanks Running on Poor Ideas and Bad Planning", Chicago Tribune, 9/1/89.

THE THREE BASICS OF TANK WARFARE

While reliability and fuel consumption are the M1's most dramatic failures, the M1 is has deficiencies in all of the three criteria by which a tank is judged: Mobility, Protection, and Firepower. Furthermore, there are a variety of state-of-the-art tanks available at much lower prices. (see chart C, p.5).

MOBILITY:

> **"A 1500-horsepower engine supplies the Abrams with double the power of its diesel-powered predecessor, the M60. Coupled with an improved suspension system, its agility is unsurpassed by any tank the in world today."** -- *Written testimony of Lt. Gen. Louis C. Wagner, Jr., in hearings on HR 1872, 1985.*

The M1's power to weight ratio and agility are matched by the M1's more fuel efficient **diesel contemporaries** (23.9 horsepower/ton for the M1A1 vs. 24.7 horsepower/ton for the Leopard II. see chart A, p.2). And while the M1 has a very powerful engine, and an advanced suspension, it is handicapped by its track (tread) system. The M1 is the only series of tanks in the world that has permanently bonded (non-removable) rubber track pads. While this saves over a ton in weight, it makes the M1 very difficult to maneuver in mud, snow or ice, according to Army test results.[6] On most other tanks, including the German Leopard II, the rubber pads are removable. This allows metal snow grousers to be substituted for greater traction. In addition, it means that the rubber pads can be replaced when they wear out. When the M1's pads wear out, the entire track shoe (section of track) must be replaced. In every M1 Quarterly Operation and Support Cost Study Report reviewed by the Project, more money was spent on track shoe assemblies than on any other part. (See appendices B and C in these reports)

In addition, the M1's suspension and track system suffers from a propensity for throwing the track off the tank. In particular, the armor that covers the top of the track system has a habit of trapping mud, snow and sand around the drive sprocket (the wheel which actually moves the track), which causes it to throw the track off the tank. Despite the Army's insistence that this problem has been solved, it was recently cited in a British Army review of the M1 tank.[7] That article cites:

* **Poor suspension when compared to the excellent system on the Challenger (British main battle tank)**

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[6]. See p.21 of U.S. Army Report IER-OT-058: Independent Evaluation of the M1 Main Battle Tank.

[7]. Maj. D.I. Viccars, Cdr. Sqn., 3d RTR, "A British Tank Squadron Tries the M1A1", Armor Magazine, U.S. Army Publication, September-October 1989, p.16

* **Short track life**

* **Rear skirting plate allows mud to build up around sprocket, thus encouraging a thrown track.**

PROTECTION:

> **"The future battlefield will be thick with antitank weapons. Therefore, the Abrams is protected by advanced armor. This, plus its low silhouette and agility, increases its survivability on the battlefield."** -- *Written testimony of Lt. Gen. Louis Wagner, House of Representatives 1985, see previous quote.*

Again, while the M1 has very advanced armor protection, and a low profile, so do other modern tanks. The M1 is unique, however, in suffering from an enormous heat signature. The heat signature (ability of the tank to be seen with infrared devices) of the M1 comes from the hot exhaust of its turbine engine. While the Soviets have reduced their tanks' thermal signature by roughly 24% in recent models[8], we have increased our heat signatures dramatically by adopting the turbine engine for the M1. The M1's exhaust is so hot that it can burn the paint off a car should it follow the tank too closely. The operator's manual repeatedly warns that the exhaust is "very hot and can burn personnel."[9] This means that the M1 is not only easily spotted, but is also positively identifiable at extremely long ranges with infrared equipment - being the only tank in the world with such a heat signature.

FIREPOWER:

> **"[The M1's] stabilized sighting system ensures that speed is combined with accurate firepower. Tankers are able to routinely hit 5-foot targets over a mile away while moving rapidly cross-country. This kind of shoot-on-the-move capability is made possible by design features of the fire control and improved suspension systems. ...the gunner need only squeeze the trigger to hit the target."** -- *Lt. Gen. Louis C. Wagner, congressional testimony, 1985*

All of the above capabilities are standard on most modern tanks. Furthermore, with the exception of the suspension system, all these features have been back-fitted to our M60 tanks. And the M1A1 carries less ammunition than any other tank in listed in this report (see Chart A, p.2). In addition, the M1's thermal sight is often cited as

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[8]. See Stephan P. Rosa and Sgt. 1st Class Thomas Lindley, "Tank Thermal Signatures: The Other Variable In the Gunnery Equation", Armor Magazine, September-October 1989, p.31.

[9]. U.S. Army M1A1 Operator's Manual, Op. Cit., p.2-408.

a serious deficiency, as it was in the aforementioned British review of the M1A1 in U.S. Army Armor magazine.[10]

Furthermore, to accomplish its mission, a tank needs more armament than just a good main gun system.

> **The tank's purpose is to bring machine-guns to bear on the enemy's unprotected rear, using speed and surprise. --** *General George S. Patton*

A tank's role is to break through enemy troop concentrations, and thereby lead assaults on their rear. While the main cannon is crucial to destroying enemy tanks blocking the initial breakthrough, the tank must then direct its attacks to infantry, and more-lightly-armored vehicles and equipment. For this it needs machine-guns.

The Army's last operational test of the M1 tank showed that the M1's machineguns were still limited in effectiveness.[11] This has been acknowledged in test reports, including OT III. The Army has admitted it has problems with the M1's machineguns, but has allowed them to go unattended. The Army believes that machineguns are largely unimportant, as is illustrated by this Army response to criticism of the M1's machine-gun effectiveness:

> **"The main gun gives the tank its punch. A lesson from the Yom Kippur war illustrates this. ... The Israelis quickly relearned the message of combined arms operations... The key to success was combined arms operations, not the machine gun."** -- *U.S. Army information paper, "Criticisms of the M1", 4/25/81*

Since the Yom Kippur war the Israelis have, among other things, made provisions for added heavier machineguns to their tanks, especially when operating in urban situations. Furthermore, both hatch-mounted machineguns are swivel-mounted, for easy operation by the crew.

The importance of tank support of infantry in urban areas was highlighted during the recent Panama invasion. The March-April issue of Armor magazine, an official U.S. Army publication, commented on this specifically. An article on M551A1 light tank performance in Panama states:[12]

> Sheridans (M551A1's) were absolutely critical to fighting in built-up areas by

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[10]. Maj. D.I. Viccars, Op. Cit.

[11]. See p. iv of U.S. Army report IE-OT-058: Independent Evaluation of the M1 Main Battle Tank.

[12]. This is not intended to be an argument for procuring M551A1 over the M1. The M551A1 is a light tank and is not designed to have the capabilities of a main battle tank. Nonetheless, it was the only Army tank available for Panama, and performed infantry support missions that the M1 could be called upon to perform in other situations.

providing direct fire support to infantry, as well as surgical fires capable of penetrating reinforce concrete buildings.

In built-up areas, the M2 .50 caliber machine gun on a flexible mount is superior to the weapons station found on M60- or M1-series tanks. Yes the [tank commander] is exposed, but it is easier for him to acquire targets and bring the .50 caliber to bear on those targets.

Satisfied with the performance of their .50 caliber machinegun, M551A1 crewmen also wanted another machinegun for the loader:

The M3A1 submachinegun is useless as a weapon for the loader. The loader needs a pintle-mounted machinegun (or an M16 [rifle] at minimum).

So, according to recent combat experience in Panama, at least two pintle-mounted machineguns are needed to effectively support infantry from a tank. At present, the M1 has one pintle-mounted machinegun, and the aforementioned deficient .50 caliber commander's automated machinegun weapons station. It should be noted that with the installation of the commander's periscope on the new M1A2, the field of view/fire of the loader's machinegun will be significantly restricted.

OTHER IMPORTANT CAPABILITIES:

"The problem is that neither the M1 nor the M60 or indeed neither any tank, has sufficient ground pressure to drive a [bulldozer] blade into even marginally hard ground. They are not bulldozers, they are tanks, whether you are talking about the M1 or the M60's. So if you are going to dig in a tank, you need to have some kind of equipment." *-- Frank Carlucci, in hearings before the House Armed Services Committee, 1982.*

It was discovered early on that the M1's drivetrain is too weak to push a bulldozer blade. This is important because most other tanks, including our older M60, and the Israeli Merkava, can and are often equipped with such blades to clear obstacles and dig in themselves and other tanks for defensive firing positions. While the above quote suggests that the Army has no dozer blade capability for the M60, or other tanks, the following statement from Jane's Armour and Artillery, 1988, details the M60's ability to be fitted with the M9 dozer blade kit (p.119):

"This was developed as a depot retrofit package and is used to give already fielded M60's bulldozing capabilities similar to those of the M728 Combat Engineer Tractor ... which is used for clearing obstacles and preparing [tank] fire positions."

The ability to clear obstacles was another important capability cited in Armor magazine's analysis of armored operations in Panama:

M551A1's were used to drive over or eliminate enemy roadblocks that were constructed of cars, trucks, buses, concertina wire, and rubble.

While the M1 is likely capable of performing these light obstacle clearing duties, heavier ones that previously could be easily cleared with a tank-mounted dozer blade, may present problems for the M1.

The full story of the M1 Abrams tank cannot be told in a memo such as this. We have enclosed some documents, listed below, but have many more in our files. Please contact us if you have questions, our would like to see further documentation.

Further Documentation Available Through the Project:

* The most recent U.S. Army Operation and Support Cost Studies for the M60, M1 and M1A1 tanks.

* The most recent U.S. Army Logistic Management Analysis Summaries for the M60, M1 and M1A1 tanks.

* Chapters from Jane's Armour and Artillery 1988 describing the M1, M1A1, M60, Leopard II and Merkava tanks.

* M1 Operational Test Report III, and Independent Evaluation

* Project on Government Procurement bibliography of Army quotes, footnoted with rebuttals

NOTES ON CHARTS

Chart A: Tank Capacities and Performance

The data in this chart is meant to reflect the official claims of performance and price by the countries involved. Much of this information comes from Jane's Armour and Artillery 1989. Jane's is a widely accepted source of such information. As is noted, other information was gathered from Israeli Defense Forces Journal, and the Pentagon's Procurement Programs (P-1) report to Congress. Further information regarding the Leopard II tank was obtained from the West German Liaison Office in Washington D.C., and from Kraus Maffei, the manufacturor of the Leopard II's engine.

Calculated figures, including "mileage", and "power", are direct calculations from the original figures. Mileage is arrived at by dividing the stated range by the stated fuel tankage. Tank "range" is generally taken to mean the distance a tank will travel on level roads at a constant speed of roughly 25 miles-per-hour. Power is simply the tank's stated weight divided by the power of the engine measured in horsepower. Weight, has been translated from metric to english tons (2,000 pounds = ton). Similarly, other weights have been converted from metric to english. Factors of conversion were taken from the Random House Dictionary of English Language, Second Edition.

We would like to emphasize that the range and mileage figures are generally taken to mean the distance a tank will travel on a level road, at a constant 25 mph. Actual combat involves much stopping and starting, and idle time with the engine running. (The M1 can only run on batteries for a very limited time, and has no auxiliary power unit, which means the weapons systems cannot be kept ready without the engine running. Even if there were an auxiliary power source, the main engine would have to be on most of the time, since starting it up requires an elaborate, time-consuming procedure. The crew would not want to be surprised with the engine off.) The M1 in particular consumes roughly 15 gallons per hour at idle. Chart C, "Actual Use Data", provides a more realistic view of fuel consumption.

Chart B: U.S. Army RAM-D Requirements

The data in this chart comes from three sources within the U.S. Army: Operational Test III of the M1 tank, the Logistic Management Analysis Summaries for the M1 and M1A1 tanks, and the Quarterly Operation and Support Cost Study Reports for the M1 and M1A1 tanks. The latest copies available are enclosed. Army Reliability, Availability, Maintainability and Durability (RAM-D) requirements were taken from the written testimony of Maj. General Durad D. Ball, submitted to the House Armed Services Committee for hearings on HR 2287 [HR 2969], 1984, p.1625.

Developing actual use data to determine whether or not these standards have actually been met was not a simple task. Since the Army has used a variety of values for M1 tank reliability, we are forced to try to compare those most similar in meaning. The Army's original Reliability, Availability, Maintainability and Durability (RAM-D) factors were stated in "Combat Mission" and "System" mean-miles-between-failure (MMBF). These are both values for the entire tank. What we have in our possession is a variety of figures which describe the components that make up the tank. They include mean-miles-between: "operational mission failure" (OMF), "essential maintenance actions" (EMA), and "unscheduled maintenance actions" (UMA), for each tank subsystem. By combining the values of all the subsystems, we can get total tank values for MMBOMF, MMBEMA and MMBUMA, respectively.

What is primarily in question is the definition of a "Combat Mission Failure" and a "System Failure". Once this is established, one need merely divide the number of miles traveled by that number, to get a mean-miles-between-failures value. Army test reports are very clear about what they consider generic "failures". In paragraph 6.1.1.1, page 119 of M1E1 OT II, the Army says:

> The results should be comparable to the demonstrated mean miles between unscheduled maintenance actions (MMBUMA) reliability levels for the M1 tank.

This is perfectly manageable since MMBUMA in one of the values we have in hand. So this is the value I have used for "System MMBF" as defined on p.124 of M1E1 OT II. However, combat mission failures are derived in a more complicated way: The Army breaks down the tank into subsystems relevant to the tank's mission. These subsystems are given "combat mission reliability factors" corresponding to their importance to the tank's mission. These values are multiplied by the number of actual failures. The number of miles is then divided by that derived number of mission failures. This is the Army's Combat Mission MMBF. (See p. 124, sec.2(U) para.6.1.3.1)

We cannot use this definition because the subsystems listed in our data are different than the ones graded by "combat mission reliability factor". For instance our data includes "gun mount recoil" in "turret hydraulics", rather than placing it in a separate category. For this reason, I have used an arguably more lenient standard for failures to be included in this category. The figures listed in the chart as "actual combat mission mean miles between failure" use the Army's "Mean-Miles-Between-Operational-Mission-Failures". Instead of including and grading failures which degrade the tank's performance, this value includes only failures that meet the following strict requirement found on page C-3 of the Army's 31 October 198 Logistic Management Analysis Summary for the M1A1 Abrams Combat Tank:

> An unscheduled maintenance incident where the mission was aborted due to the loss of its mission essential function (i.e., movement or power source). (Used to establish MMBOMF.)

In other words, the Army approximates actual mean miles between combat mission failures by recording failures which merely hamper the tank, and grade them so that they theoretically add up to the number of times the tank is actually unable to perform its mission. Our definition records precisely the actual failures which make it totally unable to perform its mission.

Bear in mind that our definitions and data are real world values, which indicate the actual performance of the tank. The Army's values are developed from the highly-controversial "scoring conferences" which disqualify any error attributable to crew or maintenance error, or which can be fixed later on in development. Remember, however, that the data we have involves well trained crews and maintenance personnel of active Army units, not people unusually fresh to the M1 system. And it involves production tanks which represent the actual performance of the M1 system, which, in some sense, the scoring conference was seeking to simulate (they didn't want the tank maligned by problems that would eventually be fixed.). It should also be noted that, as in Army test figures, the actual use figures we use disqualify any maintenance action that can be accomplished in less than 30 min. by the operator or crew using equipment and parts available on the tank.

Chart Citations

1. This is a 1990 price which comes from DoD's 1/9/89 version of Procurement Programs (P-1), which is a budget information package distributed to Congress.

2. This figure was submitted for the record and is included in the record of House Armed Services Committee hearings on H.R. 596 [H.R. 6030], p.371.

3. 85 rounds is a maximum. According to Jane's Armour and Artillery 1988, 62 is the normal load. Also, a squad of ten infantrymen can be substituted for 45 main gun rounds.

4. Associated Press, May 3, 1989

5. All data on the Mk3 comes from IDF Journal, issue #17, summer, 1989, "Israel Unveils Its Homemade Tank".

6. This figure was supplied by MTU of West Germany, the manufacturor of the Leopard II's diesel engine.

7. This price was given by the German Procurement Liaison Office, in Washington D.C.. The $2.4 million figure was given for the latest Leopard II's produced.

8. While this maintenance ratio nearly meets the required maximum of 1.25 man-hours per operating hour, it does so at a sacrifice of tank availability. "Availability" is the average number of tanks available for combat each day during a reporting period. The tank sample on which the 1.4 mh/oh rate is based had an availability rate of only 88%, far below the 95% figure the Army claims as standard.

9. Again, meeting this requirement meant sacrificing availability. This tank sample achieved only 82% availability. See previous quote.

10. See M1 Operational Test III. In this case the unadjusted figures was 15% likelihood of going 4000 miles without a major powertrain overhaul. These are the last operational test figures the Army ever released (1981). The adjusted figure, which the Army put forward at the time, was still only 22% (as opposed to the 50% requirement). If you have any questions regarding these "adjustments" please ask us for information on "scoring conferences".

11. While we have no numerical data on this, Maj. D.I. Viccars, Cdr. Sqn. 3d RTR, complains of "short barrel life" in his article, "A British Tank Squadron Tries the M1A1", Armor magazine, U.S. Army Publications, September-October 1989.

12. While this is an impressive figure, notice the effect this lack of maintenance has on availability. 81% is not nearly as good as the 95% often claimed by the Pentagon.

13. See previous note.

Project on Military Procurement

Dina Rasor
Project Director

613 Pennsylvania Avenue, S.E.
2nd Floor
Washington, D.C. 20003
(202) 543-0883

January 9, 1990

Maj. Barry Bomier
HQDA
Attn. SAPA-MR
Office of the Chief of
Public Affairs
Washington D.C., 20310-1507

Dear Maj. Bomier,

I am writing to request a briefing on the performance of the Army's M1 series tank (For the purposes of this letter, please assume I am speaking of both the M1 and M1A1 at all times, unless otherwise specified). The M1 program has matured considerably in the four years that have passed since our organization last looked at it in detail. I would like to bring my knowledge of it up to date. In this effort, I have recently received copies of the Army's Quarterly Operation and Support Cost Study Reports, and Logistical Management Analysis Summaries for the M1, M1A1 and M60A3 tanks. While these reports have been informative, I would like to give the Army the chance to lend perspective to the numbers these reports contain, and answer questions on other M1 tank issues.

Our primary interest is in the logistical end of the M1. We would like to know the current status of the M1's performance relative to its original RAM-D requirements. In particular, we would like guidance in relating maintenance measures used in the Logistical Management summaries to those original RAM-D requirements. In addition, there are both new and old questions regarding fuel consumption. Mileages listed in the reports go as high as 8 gallons to the mile (in actual use, which includes much idle time). Is the Army still seeking a standardized fuel for all vehicles, and how might this affect M1 fuel consumption? How will this affect the number of support vehicles attached to M1 battalions? These are the most important questions. A list of more general issues we would like to explore is attached to this letter.

Of course this would be a good time for you to bring up any other issues regarding the M1 that you feel are important. Please let me know if there are any other materials, briefings or demonstrations that might increase my understanding of the M1 and tank warfare.

Since the Project on Military Procurement is committed to collecting and providing information as accurately as possible, we would like the proposed briefing to be as well documented as possible. In the past this has meant that all meetings are tape-recorded, and supplemented with written material whenever possible. Of course, copies of all materials will be made

available to all involved. New Project Director Liz Galtney and I will be attending on behalf of the Project. Please let us know if there are any analogous Army regulations, protocols or traditions that we should be aware of. If possible, it would be most convenient for the briefing to occur sometime within the next two weeks (1/15 - 1/26). Feel free to call if you have any further questions. Thank you.

Sincerely,

Greg Williams
Research Associate

Attachments: 1

The following are examples of issues I would like to explore in this briefing:

RAM-D Requirements: The M1's original requirements are stated in such terms as "Combat Mission MMBF" and "System MMBF". The reports we have use somewhat different terms. Is their any way to compare them? Is their any other data we might use to determine the M1's performance relative to its original RAM-D goals? Further, what are the current life expectancies of the 105mm and 120mm barrels.

Suspension System: How has the new suspension system with its increased travel (relative to the old M60 series) affected tactics? How does the M1's suspension compare with foreign examples such as the Challenger, Leopard II and Merkava Mk.3? What is the status of the track-throwing problem?

Track System: Has the Army done anything to improve the M1's traction in snow, ice and mud? There are rumors that the Army is considering a Diehl-type track system that would have removable pads, and would allow the fitting of snow grousers. Is this true? Has their been any improvement in the life of the track shoes?

Mobility / Agility: How has the turbine engine changed, if at all, over the years? Is its maximum speed still governed? Have their been any improvements in power output? What are the current acceleration figures? How do they compare with the latest foreign tanks?

Armor / Protection: How has Chobham armor evolved in the past five years? How do the latest M1's compare with foreign systems in armor protection? What emphasis is placed on frontal vs. side/rear protection. How effective has the Army found the ammunition blast doors and the Halon fire suppression system?

Fuel Consumption: As has been noted in the past, the reports mentioned above show the M1 consuming as much as 8 gallons of fuel per mile. Are these representative figures? What is the rate of fuel consumption, under similar conditions, for the foreign tanks listed above? Also, recently the Army was considering converting its entire supply system to an Army standard fuel. Is this still being considered, and if so, how will it affect M1 fuel consumption? What is the current requirement for support vehicles in an M1 battalion?

Main Gun Effectiveness: How have the troops found the muzzle reference system relative to manual gun zeroing procedures? The 105mm gun has apparently required frequent zeroing in the past. Is this still a problem? Is the ammunition stowage considered sufficient with the new 120mm gun? I have read that a major

engineering effort was required to fit the new gun. Are there any lingering problems? How has the new gun increased the range and penetrating power of the M1? What is the status of projected improvements to the crew stations? What are the current configurations for the gunner's and commander's sights?

Machinegun Effectiveness: What is the current status of the commander's and loader's machinegun mountings? How far can they be depressed? How has the installation of the 120mm gun affected the performance of the coaxial machinegun?

Heat Signature: Has anything been done to reduce the thermal plume of the turbine engine exhaust? How does the M1's heat signature affect its detectability on the battlefield compared to foreign tanks, including Soviet tanks?

Reporter's Notebook

Hail To The...Queen: Although he wears the Army green, Lt. Gen. Ellis Parker, director of the Army staff, calls himself the "Queen of England" these days because he's often pressed into service to represent the Army at high-profile affairs of state.

The latest example occurred Tuesday when Nelson Mandela addressed a joint session of Congress. Parker, filling in for Chief of Staff Gen. Carl Vuono, who was in Korea, sat two rows from the Speaker's rostrum on the House floor.

Parker was in rarified company as he stood next to Marine Corps boss Gen. Al Gray and Joint Chiefs of Staff Chairman Gen. Colin Powell. Parker later told a reporter that he was the queen when it came to putting in the ceremonial appearance. Though impressed by Mandela's speech, Parker wasn't awed by being on the House floor with the bigtime politicos. He attended similar addresses to joint sessions by Czech President Vaclav Havel and Polish Solidarity leader Lech Walesa.

Like many attendees, Parker had trouble understanding some of Mandela's speech, so he ordered a copy of it.

Unanswered Mail: Two recent examples of Army bureaucratic muddling give credence to those who think that its public and congressional relations are sometimes guided by equal shares of arrogance and incompetence.

Here are two cases: The Army's public affairs office has yet to answer a Jan. 9 query letter submitted by the Project on Government Procurement for a briefing on M1 performance. It should be noted that the project is no friend of the tank and Army officials remember that the self-styled military reform group branded it a "gas-guzzler" in the early 1980s. The project has yet to get a reply to its three-page request.

Showing it plays no favorites, the Army for a year thumbed its nose at the General Accounting Office when it wrote last June asking then-Army Secretary John Marsh to temporarily stop buying a dangerous chemical decontaminant called DS2. The Army didn't respond until Tuesday, two days before Rep. Mike Synar (D-Okla.) held a hearing on the subject.

Turned On: The builder of the Navy's first DDG-51 destroyer recently achieved what some industry officials regard is a major milestone. Bath Iron Works Corp. engineers for the first time turned on the SPY-1D radar, a key component of the ship's Aegis anti-air warfare system.

"The SPY-1D started radiating on the 20th [of June]," said Bath spokesman Jim McGregor. The radar isn't up to full power, but "tests have been very successful," he said. One industry executive involved with the program said the radar successfully tracked commercial aircraft at great distances.

News of the radar tests was met with praise in those quarters of the defense industry hoping to deflect congressional criticism of Navy's newest destroyer. Rep. John Dingell (D-Mich.), chairman of the House Energy and Commerce Committee, complains the DDG-51 is running behind schedule and over cost. The radar milestone gives ammunition to destroyer supporters on Capitol Hill, said industry executives involved in the effort. It also comes as Defense Secretary Dick Cheney is mulling whether to scale back the $33 billion, 27-ship program.

Cheney Gives No Hint: After receiving a briefing on the results of the so-called major warship review, Defense Secretary Dick Cheney and his confidants are not tipping their hands.

Cheney was briefed on June 21 by Under Secretary John Betti on the review, which discusses the Navy's most costly shipbuilding programs of the decade—the SSN-21 attack submarine and the DDG-51 destroyer.

The review outlines several options for both programs. Said one source familiar with the briefing, "There is no indication how Cheney will go." Conventional wisdom has it Cheney will cut one destroyer and one submarine per year from the Navy's long-range budgets.

The Defense Secretary is expected to announce his decisions in July in time for the congressional mark-up of the fiscal 1991 defense bill.

Sex, Lies and Free Rides: Lest you think that the best sex scandal in town is unfolding in the drug trial of Washington Mayor Marion Barry, take a look at page 4-3 of the Pentagon's latest semi-annual inspector general report.

Readers will be treated to two fairly stilted paragraphs that tell of how an enlisted person of unspecified gender and military branch exchanged sexual favors for unauthorized plane trips when he/she should have been working. The libertine was also allowed by several service officials to attend college full-time while still on active duty.

One of the benefactors received a letter of reprimand, was fined $1,800 and drummed from the military. A second officer was forced to forfeit one month's pay. The enlisted person forfeited $466 and was forced out.

The Detroit News

Monday July 16, 1990 25c

Michigan-built tank a bad deal for Army, report say

By Michael Clements
Detroit News Washington Bureau

WASHINGTON — The M-1 tank, which Sen. Carl Levin is working to save from Pentagon budget-cutters, is an overpriced gas guzzler that has not met expectations, a report by a government watchdog group charges.

"Not only are we buying more new tanks in an era of budget cuts, we are buying more of a tank which has never met its basic requirements and is by far the most expensive tank in the world," the unpublished report by the independent, private Project on Government Procurement in Washington asserts.

The report by the group, which evaluates weapons and promotes Pentagon spending reform, contends the tank, built in Warren and at a plant in Lima, Ohio, performs poorly in snow and ice — conditions likely to be faced on a European battleground — and that its temperamental turbine engine requires frequent maintenance. The vehicle also can have problems crossing water as little as one foot deep, it said.

The manufacturer, General Dynamics Land Systems Division of Sterling Heights, contends the M-1 has a favorable performance record.

"Of every 100 tanks, 95 are available all the time," spokesman Donald Gilleland said. "That's a figure that's unheard of in the armored vehicle world. . . . This tank has incredibly high operational readiness rates."

Levin aide Ken Luongo said the criticism of the tank's turbine engine is not new and that "people all over the world think this is one of the best tanks in the world."

Levin declined to discuss the unpublished report Saturday because he hadn't been able to read it.

In January, Secretary of Defense Dick Cheney recommended the Army stop purchasing M-1 tanks after the 1991 budget year, which starts Oct. 1. Cheney's plan would force the eventual shutdown of the Warren and Lima plants, idling 1,200 and 1,300 plant workers, respectively.

Levin, a Detroit Democrat who is a member of the Senate Armed Services Committee, and other Michigan lawmakers have worked to persuade Congress to keep the production lines going.

On Friday, the Senate Armed Services Committee decided against buying new M-1 tanks after fiscal 1991, but it gave Levin a half-a-loaf victory by authorizing $149 million to upgrade 3,000 earlier models of the M-1 with newer technology and a more powerful cannon.

"I fought very hard for this outcome so we could keep an industrial base (for building tanks)," Levin said Saturday. "If the president's position on the tanks had been accepted, we would have no capability to produce a tank in a time of need."

The retrofitting — combined with a recently completed $3.1-billion sale of 315 new tanks to deliver to Saudi Arabia from 1993-95 — should provide enough work to keep the Warren and Lima plants open. But employment levels will be lower without new purchases from the Army, company officials have said.

The Senate committee approved the administration's 1991 request for a final order of 225 new tanks for the Army at a cost of $807 million, and it added 22 tanks for the Marine Corps. In a new policy that could undercut efforts to revive the 60-ton behemoth, the Senate committee said it would "emphasize lighter, more lethal, more mobile forces" and "product improvements over new starts."

The House Armed Services Committee is expected to take up the tank issue in September.

The study of the M-1 by the Project on Government Procurement argues that the tank has major design flaws. It was written by researcher Greg Williams and is based on his study of U.S Army reports, the Congressional Record and trade journals.

> "The M-1 is not only easily spotted, but also positively identifiable at extremely long ranges with infrared equipment."
>
> **Report**
> Project on Government Procurement

Among the report's criticisms:

- The M-1 is the only series of tanks in the world with permanently bonded rubber track pads or treads. Although the design saves one ton in weight, "it makes the M-1 very difficult to maneuver in mud, snow or ice," the report states. Other tanks, including Soviet and West German models, have removable pads that can be fitted with metal grippers for better traction in snow and ice.
- The M-1 has an "enormous heat signature" due to its turbine engine. The engine is so hot that its exhaust could burn the paint off cars or injure personnel. "This means that the M-1 is not only easily spotted, but also positively identifiable at extremely long ranges with infrared equipment."
- Although the tank is designed to cross up to four feet depths of water, it must be inspected after driving through as little as one foot. The tank's manual warns that if it is driven through water deeper than one foot, the crew should stop the engine and check the idler wheels and road-wheel hubs for signs of water in the oil.
- The turbine-powered tank quires unscheduled maintenance e times as often as its predecessor, ...e diesel-engined M-60. Although General Dynamics argues the M-1's powerful turbine enables it to accele e and travel faster, the project fo d the West German Leopard II gen.. ates the same amount of horsepower with a more fuel-efficient diesel engine and achieves a slightly hig r top speed of 45 mph.
- The M-1 consumes nearly 12 gallons per hour when the engine is idling, compared with four gal...s for the Leopard II. At a steady 5 mph, the M-1 consumes 1.7 gal s of fuel per mile, compared with nine-tenths of a gallon for the West German tank. But an Army studi...n 1987-88 found that in actual use, e M-1 consumes between 6.6 and 7 gallons per mile.

The tank's per-unit cost has risen from the $580,000 Congress man...ed in 1972 to the $2.9 million e Army projects this year, the Pe...gon said.

General Dynamics considers the current cost to be $1.9 million ...r tank, which is a lower real cost t n the 1972 price, when inflation d improvements are considered. Gilleland said. He said the Army uses a higher figure because it includes ...e costs of training and spare parts.

Levin has said the M-1 is ... e only tank which can destroy a Soviet tank." He has argued the tank factories should be kept open to main ...n the national capacity to proc e tanks in case of an emergency. ... Bob Davis, R-Gaylord, a member of the House Armed Services Committee, has called the M-1 the "best t k in the world."

However, even some who de d the tank's quality argue the United States does not need to buy more. Lawrence Korb, assistant secre y of Defense from 1981-85, said ie would rank the M-1 program is "right up there among the very best" of the Cold War. But he said he believes the 8,000 tanks in servic re enough, given the disintegratio n the Warsaw Pact in Eastern Eur e

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GENERAL DYNAMICS
Land Systems Division
P.O. Box 2074, Warren, Michigan 48090-2074

Donald L. Gilleland
Director, Communications

313-82

July 19, 1990

Mr. Robert H. Giles
Editor and Publisher
THE DETROIT NEWS
615 Lafayette Blvd.
Detroit, Michigan 48226

Dear Mr. Giles:

Your lead article on July 16, 1990, "Michigan-built tank a bad deal for Army, report says," was disappointing to our 7,000 dedicated employees who build zero defect tanks with pride and skill. The article is fraught with misinformation, myths, and outright errors, which we sincerely hope you will correct.

At a time when we are striving to preserve the industrial base necessary to maintain a warm production line and save jobs in Detroit, we cannot understand why the DETROIT NEWS would publish a devastating article creating such a false impression, based on accusations from Project on Government Procurement in Washington. That small "watchdog" group is notorious for its use of dated and inaccurate information to bash the defense establishment. Even your article acknowledges that the claims are attributed to an "...unpublished report..." based on periodic research of old studies, Congressional Record and trade journals. Dredging up irrelevant and misleading historical data to indict a proven, mature weapons system that is the envy of the Free World and the pride of the U.S. Army is unconscionable. It ignores the enthusiastic acceptance of this technically superior machine by U.S. soldiers and strong international interest in buying it. It is being purchased by Egypt and Saudi Arabia, and is being considered by the United Kingdom, United Arab Emirates, Kuwait, Sweden, Pakistan and Canada. It is recognized internationally as the best main battle tank in the world.

Project on Government Procurement in Washington is adept at carefully selecting bits of information from old reports to support their thesis, rather than objectively reporting positive and negative information. Their conclusions about this tank are absolutely wrong. Even though their

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charges against the M1 tank have been refuted time and again, here are the facts to offset their fiction:

Fiction: The M1 is shoddy.

Fact. The M1 tank is the highest quality tank in the world today. We routinely build "zero defect" tanks that are the envy of the world and we participate in the U.S. Army's Contractor Performance Certification Program, which is reserved for defense contractors which consistently exceed Department of Defense standards for excellence.

Fiction: The M1 tank is by far the most expensive tank in the world.

Fact: The M1 tank was designed to be affordable and, on an equivalent basis, is less costly than foreign competitors--considerably less than some. The initial price of the M1 tank in 1972 was $507,800. The price quoted by the Army is somewhat higher because they include the cost of training and spare parts. The acquisition cost of the M1 tank today, in constant 1972 dollars, when adjusted for inflation and changes like upgunning to a larger cannon, is $7,800 less than it was in 1972. The Abrams tank is an exceptional value.

Fiction: The M1 tank has never met its basic requirements.

Fact: The M1 tank had to meet its basic requirements before the Army would buy it. This includes reliability and performance. The Abrams tank is the centerpiece of the U.S. Army's force structure. It is the only Army weapon that is designed to withstand all forms of threats on the battlefield. Over 4,000 ballistic firings on the M1 and test sections have confirmed the robustness of the M1 design. It is the most survivable, most lethal, most mobile, and most supportable assault weapon in the Army's inventory. And it has consistently met or exceeded the Army's requirements.

Fiction: The bonded rubber track pads make the M1 difficult to maneuver in mud, snow, or ice.

Fact: Whether the track pad is bonded or replaceable has nothing to do with maneuverability in adverse environments. Metal grousers (grippers) can be fitted to either track, with equal improvements in traction on ice and snow, as demonstrated in competitive tests in Sweden this past winter. Also, the T-158 track which is a removable pad track, is currently in production.

Fiction: The M1 tank is unique in that it can be identified at extremely long ranges due to its "enormous heat signature."

Fact: While the volume of heated exhaust in the M1 is greater than that of a diesel powered tank, the temperature of the exhaust is lower than that of a diesel powered tank. The very sensitive infrared sensors available today can identify any tank at extremely long ranges. Regardless of engine type, exhaust treatments would be required to match sensor technology. Equally important, these treatments are available should threat projections require them. Of more immediate need on the battlefield, the turbine is characterized by a lack of smoke plume, as contrasted with the common white or black smoke plume of diesels. The gas turbine engine is also dramatically quieter than the diesel.

Fiction: The M1 tank is unreliable.

Fact: The M1 tank consistently has operational readiness rates above 95%, considerably higher than current diesel powered tanks.

Fiction: The turbine requires frequent maintenance.

Fact: The turbine engine was chosen specifically for its high reliability, low weight, good acceleration and low life cycle costs. Its low weight allowed for use of an additional 1,000 lbs of armor protection. Low life cycle costs are achieved with its high reliability, fewer parts, modular maintenance concept, and no scheduled overhaul. The U.S. Army is experiencing fewer engine returns and about one-half of the repair costs of diesel tanks.

Fiction: The M1 tank is a gas guzzler.

Fact: While it is a multifuel engine, the preferred fuel is diesel. Fuel consumption reports of 6.5 and 7.7 gallons per mile include the high percentage of idle time being experienced with obviously no miles being accumulated. Operationally in Europe, tanks are kept in a ready state and experience a high idle time. To address the idle time, changes have been made to improve idle fuel consumption by 20%. Also, since turbines can start at much lower temperatures, they do not have to be idled all night to start on cold mornings. Fuel costs are less than 1% of total operational and support costs and the turbine has resulted in higher reliability and more armor protection, which are more directly related to the basic mission of the tank.

Fiction: The vehicle also can have problems crossing water as little as one foot deep.

Fact: There are no restrictions on water crossings within the designed water limits of four feet, and all tanks pass fording tests prior to delivery. Any inspections after a water crossing are only precautions under unusual conditions and are not indications of problems.

Despite the fact that the Warsaw Pact threat is diminishing, a formidable threat still exists, and the Abrams tank still remains the only survivable Army assault weapon available for land battles.

I know this response is long, but the topic is extremely important to our company and to the nation. The kind of impression your article and its front page play created will certainly be difficult to change. At best it is not good for the morale of our employees; at worst it can damage the international reputation of the most successful acquisition in the U.S. Army's inventory.

We are proud of the quality we build into this tank, and we hope you will take appropriate editorial steps to remedy the wrong impressions created by the Michael Clements article.

Sincerely,

Donald L. Gilleland

DONALD L. GILLELAND

D

Project on Government Procurement

Liz Galtney
Project Director

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Washington, D.C. 20003
(202) 543-0883

August 2, 1990

Donald L. Gilleland
General Dynamics, LSD
P.O. Box 2074
Warren, MI 48090-2074

Dear Mr. Gilleland,

I read with disappointment your letter to the editor of The Detroit News. I am sorry you have chosen to see our report on the M1 tank as an attack on your company, and on armored warfare. In fact I take exception to most of the points you made in your letter. Let me address just a few now. The Project on Government Procurement notified the Army of our intentions *six months in advance of publication.* After extensive research, using up-to-date data, obtained through official U.S. Army channels, we solicited the Army's comments and suggestions. Despite repeated promises, the Army failed to respond. Our report was then initially offered, free of charge, to all requestors, of which there were many. I have enclosed a copy of the report for your review.

You will notice that the report includes detailed references to the data we used. Most of the pertinent reliability and operational cost data comes from the latest U.S. Army Operation and Support Cost Studies, and Logistic Management Analysis Summaries for the M1, M1A1 and M60A3 tanks. These studies were discontinued for the M1 series in 1988. I was told by the Tank Automotive Command that the Army felt these reports were representative of M1 series performance, which they did not expect to change significantly in the future.

We must apologize for not including recent developments in M1 track configuration. We specifically asked the Army about the status of the changes you mentioned. Unable to acquire official Army guidance, we interviewed Army maintenance personnel, and read the M1 and M1A1 operator's manuals as thoroughly as possible. None of these sources indicated any ongoing program to improve the M1 series track system.

The $507,800 1972 price you listed, inflated using the DoD-approved major commodity figures, is $1.66 million. The prices we used come from DoD Procurement Programs (P-1) budget document, provided to Congress. The most recent figure listed $4.4 million per tank. The German Procurement Liaison Office assured us that the last Leopard II tanks produced cost roughly $2.4 million without spares and training, and roughly $3 million per tank including these items. The Germans achieve this low cost level at a production rate of only 70 tanks per year.

The operational availability levels listed in the aforementioned Army M1 logistics and support studies average far lower than 95%. The relevant pages of these reports are included for your perusal. And while it is true that the M1's fuel consumption at idle has been reduced, M1 fuel consumption remains an issue. For the amount of fuel required to drive an M1 250 miles (@25mph), a Leopard II could be driven the same distance, and then idled, around the clock, *for the next two days.*

If you have any further criticisms or questions regarding our report, please document them, and send them to me personally. Thank you for your interest in an effective, efficient, U.S. defense.

Sincerely,

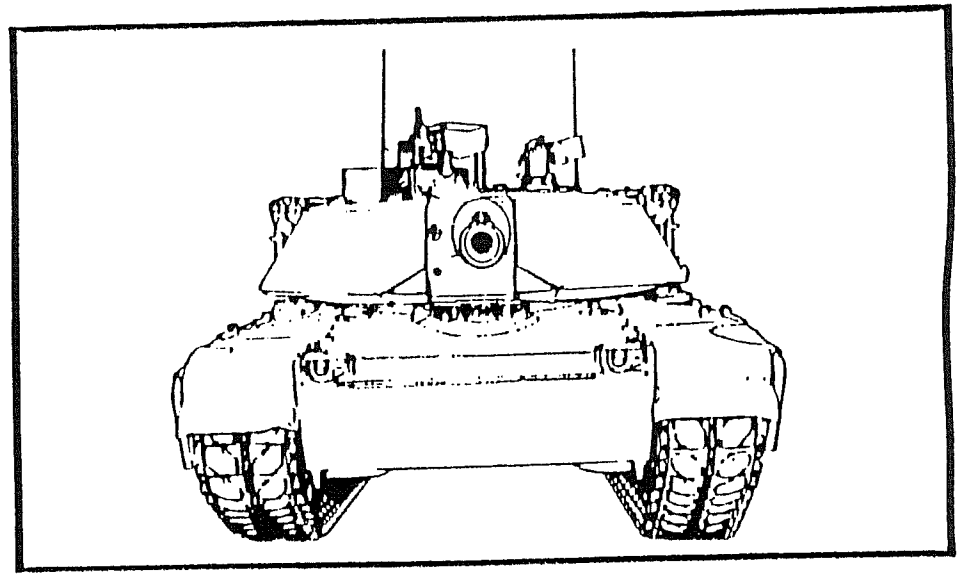
Greg Williams
Research Associate

cc - The Detroit News, U.S. Army Public Affairs, Senator Carl Levin

OPERATION AND SUPPORT COST STUDY
FIELD USAGE SUMMARY

M1A1 ABRAMS COMBAT TANK

US ARMY
MATERIEL COMMAND



REPORTING PERIOD
1 NOVEMBER 1987 – 31 MARCH 1988

RCS AMCSM-156
REPORT NUMBER: TAA-85538B

1 JUNE 1988

PREPARED BY PECO ENTERPRISES, INC.
FOR

U.S. ARMY TANK-AUTOMOTIVE COMMAND

3.10 Operational Availability

The following table portrays operational availability for the three reporting periods. Operational availability is calculated by dividing the available vehicle hours by the possible hours. Possible hours are based on twenty-four hours in a day and the number of days in the reporting period times the number of vehicles. Non-available hours are then totaled for the vehicles at the site. Available hours are the difference between these two.

TABLE 10. OPERATIONAL AVAILABILITY BY SITE (1)

LOCATION	CURRENT PERIOD (2) (1 Nov 87 - 31 Mar 88) AVAILABLE HOURS	CURRENT PERIOD (2) (1 Nov 87 - 31 Mar 88) OPERATIONAL AVAILABILITY %	PREVIOUS PERIOD (3) (1 Aug - 31 Oct 1987) AVAILABLE HOURS	PREVIOUS PERIOD (3) (1 Aug - 31 Oct 1987) OPERATIONAL AVAILABILITY %	PRIOR PERIOD (4) (1 May - 31 Jul 1987) AVAILABLE HOURS	PRIOR PERIOD (4) (1 May - 31 Jul 1987) OPERATIONAL AVAILABILITY %
FORSCOM B	106,128	71%	82,939	92%	57,354	63%
USAREUR S	177,532	84%	118,492	93%	62,288	94%
SDC FLEET TOTAL	283,660	79%	201,431	92%	119,642	76%

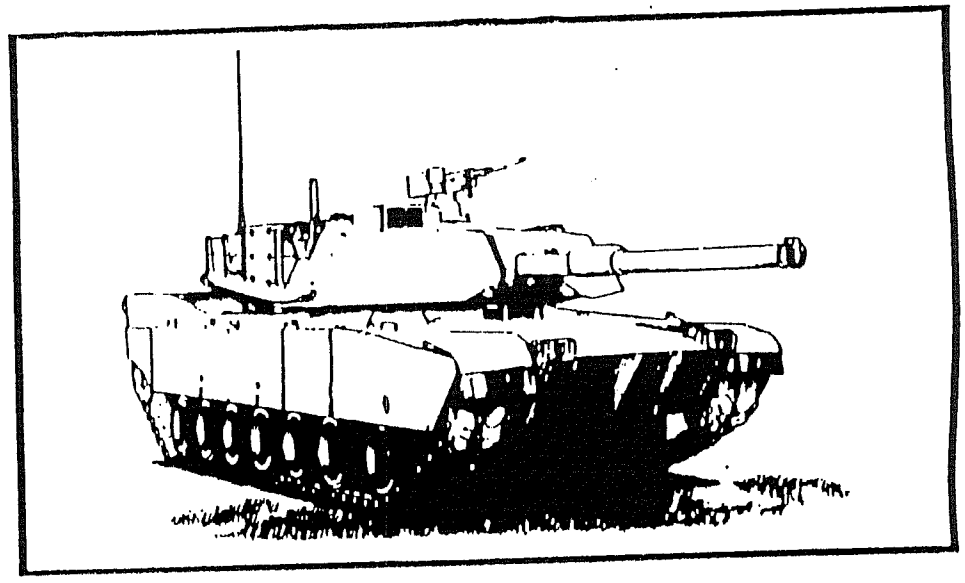
NOTES: (1) The data in this table do not equate to an operational readiness rate, but are based upon the "RAM Rationale Handbook," TRADOC/AMC PAM 70-11, and includes criteria that is not used to determine readiness rate.
(2) The current period possible hours for the SDC fleet during the current period 1 November 1987 through 31 March 1988 were 361,152 hours.
(3) The possible hours for the SDC fleet during the previous period 1 August through 31 October 1987 were 218,592 hours.
(4) The possible hours for FORSCOM during the prior period 1 May through 31 July 1987 were 160,234 hours.

One primary cause for the low operational availability of 71% for the 41 FORSCOM sample vehicles was the amount of repair part logistical delay hours. The repair part logistical delay hours account for 45% of the total nonavailable delay hours. The turret structure subsystem, which is part of the on-vehicle support cost group, is the leader in these delay hours incurring 40%. The leading delayed repair part in the turret structure subsystem again this period is the loader's seat pins (P/N 12325451).

OPERATION AND SUPPORT COST STUDY
FIELD USAGE SUMMARY

M1 ABRAMS COMBAT TANK

US ARMY
MATERIEL COMMAND



REPORTING PERIOD
1 OCTOBER 1987 – 31 MARCH 1988

RCS AMCSM-156
REPORT NUMBER: TAA-85539B

1 JUNE 1988

PREPARED BY PECO ENTERPRISES, INC.
FOR

U.S. ARMY TANK-AUTOMOTIVE COMMAND

3.10 Operational Availability

The following table portrays operational availability for the current and previous reporting periods only. Operational availability is not shown for the prior period because the Ao time line was not available in the MI data base until 1 April 1987. Operational availability is calculated by dividing the available vehicle hours by the approximate possible hours. Possible hours are based on twenty-four hours in a day and the number of days in each reporting period times the number of vehicles being considered. Nonavailable hours are then totaled for the same vehicles. Available hours are the difference between these two.

TABLE 11. OPERATIONAL AVAILABILITY BY SITE (1)

	CURRENT PERIOD (2)			PREVIOUS PERIOD			PRIOR PERIOD		
LOCATION	SAMPLE SIZE	AVAILABLE HOURS	OPERATIONAL AVAILABILITY %	SAMPLE SIZE	AVAILABLE HOURS	OPERATIONAL AVAILABILITY %	SAMPLE SIZE	AVAILABLE HOURS	OPERATIONAL AVAILABILITY %
FORSCOM									
C	58	141,054	82%	58	232,465	91%		N/A	
USAREUR									
S (3)	--	(NOT ACTIVE)		58	87,915	98%		N/A	
T	41	98,685	80%	41	172,573	95%			
TOTAL				99	260,487				
SDC FLEET TOTAL	99	239,739	81%	157	492,952	94%			

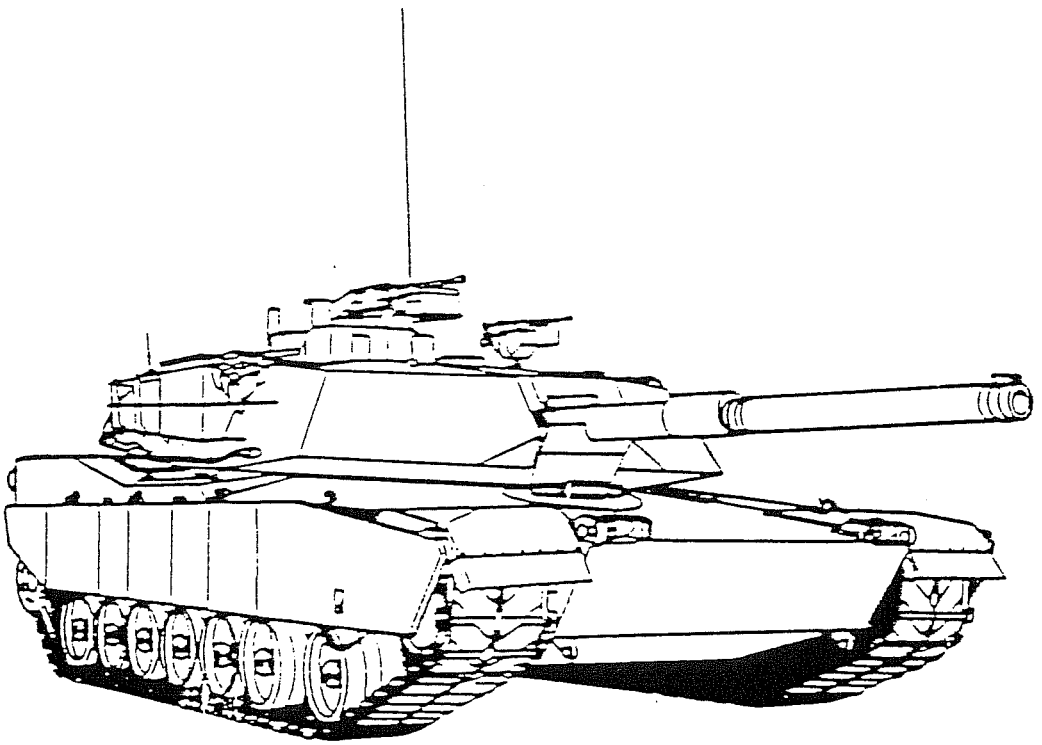
NOTES: (1) The data in this table do not equate to an operational readiness rate, but are based upon the "RAM Rationale Handbook," TRADOC/AMC PAM 70-11, and includes criteria that is not used to determine readiness rate.
(2) The SDC fleet possible hours for the current period 1 October 1987 through 31 March 1988 were 295,224.
(3) Site S terminated as an active MI SDC site on 10 June 1987.

Analysis of data base elements which affect operational availability show that the administrative delay category, "awaiting shop," and the logistic delay category, and "awaiting parts" were responsible for the lower operational availability at both FORSCOM and USAREUR SDC sites. The operational availability for the SDC fleet was also affected by these two categories and were responsible for the decrease in operational availability from 94% during the previous period to 81% during the current period.

U.S. ARMY TANK-AUTOMOTIVE COMMAND
SAMPLE DATA COLLECTION PROGRAM

LOGISTIC MANAGEMENT ANALYSIS SUMMARY

FOR THE



M1 ABRAMS TANK

1 JANUARY 1988 THRU 30 JUNE 1988

REPORT NUMBER TAA-85539G
PREPARED BY
PECO ENTERPRISES, INC. FOR
U.S. ARMY TANK-AUTOMOTIVE COMMAND

1 OCTOBER 1988

RCS AMCSM 156

4.11 Operational Availability

The following table portrays operational availability by site for the six-month reporting period. Possible hours are based on twenty-four hours in a day and the number of days in the reporting period, times the number of vehicles. Nonavailable hours are totaled for vehicles at the site. Available hours are the difference between these two. Operational availability is calculated by dividing the available hours by the possible hours.

TABLE 20. OPERATIONAL AVAILABILITY BY SITE
(1 January through 30 June 1988)

LOCATION	POSSIBLE HOURS	NONAVAILABLE HOURS	AVAILABLE HOURS	(1) OPERATIONAL AVAILABILITY
FORSCOM				
Site C	253,368	46,639	206,729	82%
USAREUR				
Site T	179,088	18,229	160,859	90%
SDC FLEET TOTAL	432,456	64,868	367,588	85%

NOTE: (1) The data results in this table do not equate to Operational Readiness Rate, but are based upon the "RAM Rationale Handbook," TRADOC/AMC PAM 70-11, and includes criteria that is not used to determine Readiness Rate.

The 82% operational availability for the 58 FORSCOM sample vehicles is primarily attributed to the amount of shop and part delay experienced this reporting period. Shop delay of 47% remained constant with the previous report period figure, while overall availability has improved 12% (82% vs. 73%).

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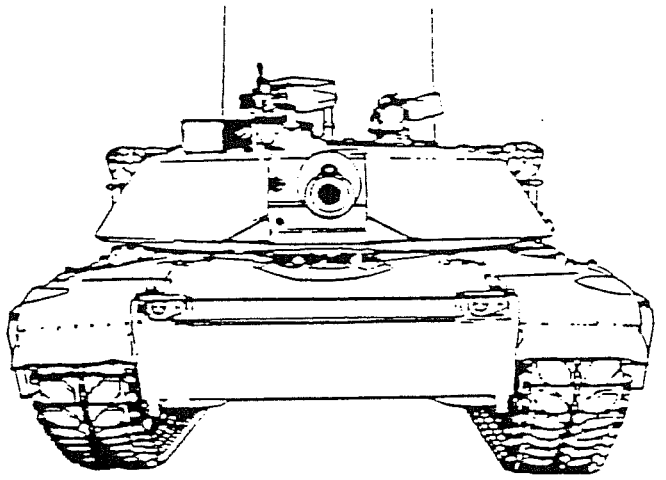
U.S. ARMY TANK-AUTOMOTIVE COMMAND
SAMPLE DATA COLLECTION PROGRAM

LOGISTIC MANAGEMENT ANALYSIS SUMMARY

FOR THE



M1A1 ABRAMS COMBAT TANK

1 FEBRUARY 1988 THRU 31 JULY 1988

REPORT NUMBER TAA-85538G
PREPARED BY
PECO ENTERPRISES, INC. FOR
U.S. ARMY TANK-AUTOMOTIVE COMMAND

31 OCTOBER 1988

RCS AMCSM 156

1 Operational Availability

The following table portrays operational availability by site for the six-month reporting period. Possible hours are based on twenty-four hours in a day, the number of days in the reporting period, times the number of vehicles. Nonavailable hours are totaled for vehicles at the site. Available hours are the difference between these two. Operational availability is calculated by dividing the available hours by the possible hours.

TABLE 20. OPERATIONAL AVAILABILITY BY SITE
(1 February through 31 July 1988)

LOCATION	SAMPLE SIZE	POSSIBLE HOURS	(1) NONAVAILABLE HOURS	AVAILABLE HOURS	(2) OPERATIONAL AVAILABILITY
FORSCOM					
Site B	41	149,568	35,464	114,104	76%
USAREUR					
Site S	58	211,584	29,607	181,977	86%
SDC FLEET TOTAL	99	361,152	65,071	296,081	82%

NOTES: (1) The nonavailable hours are based on a time line which measures only the longest amount of nonavailable time for each vehicle which is then subtracted from the possible vehicle hours.

(2) The results in this table do not equate to an operational readiness rate, but are based upon the "RAM Rationale Handbook," TRADOC/AMC PAM 70-11, and include criteria that is not used to determine readiness rate.

As shown above, the overall SDC fleet attained an 82% operational availability for this six-month period. The primary cause of the 76% operational availability for the 41 FORSCOM sample vehicles was the amount of delay hours attributed to "Parts" and "Other" delay categories. "Part," "Mechanic," and "Other" delay categories accounted for 67% of the total SDC fleet delay hours. The Suspension/Track subsystem accounted for 51% of "Part" delay hours.

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