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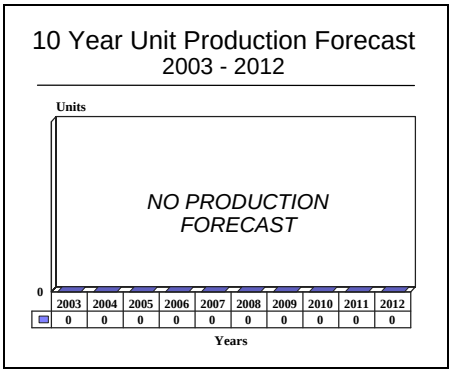
United States Armored Engineering Vehicles - Archived 10/2004

Outlook

- Production of existing programs ceased
- Operation Iraqi Freedom placed new burdens on combat engineers
- Demands for lighter, more deployable forces continue
- New program starts expected over next few years



Orientation

Description. Tracked and wheeled vehicles.

Sponsor. The development and procurement of United States armored engineering vehicles is sponsored by the United States Department of Defense through the United States Army Belvoir Research and Development Center, Defense Logistics Agency, United States Army Tank-Automotive and Armaments Command, and United States Air Force Logistics Command.

Contractors. The contractors involved in the manufacture of United States engineering vehicles include Caterpillar Incorporated/Defense and Federal Products (the Deployable Universal Combat Earthmover – 30/30 Engineer Support Tractor); Freightliner Corporation (the Small Emplacement Excavator); and United Defense Limited Partnership (the M9 Armored Combat Earthmover, Grizzly, and Sapper Vehicle).

Licensees. Samsung Techwan is assembling the M9 Armored Combat Earthmover under license in the Republic of Korea.

Status. Development through procurement.

Total Produced

Sapper Vehicle: As of January 2003, two Sapper Vehicle prototypes had been fabricated for contractor and operational testing. The vehicle was in production for an unknown export customer.

Small Emplacement Excavator: In 1985, the Tank-Automotive and Armaments Command procured 922 Small Emplacement Excavators with a 200 percent overbuy option. A total of, 2,206 have been delivered. In addition, 120 Heavy Mobility Material Handling Vehicles have been delivered for service use and six High Mobility Entrenchers have been delivered for operational evaluations.

Combat Engineer Squad Vehicle. This vehicle is based on the stretched chassis of the M113 (similar to the Mobile Tactical Vehicle-Light). Several are in production for an unknown export customer.

M9 Armored Combat Earthmover: A total of 667 M9 Armored Combat Earthmovers have been manufactured for delivery to the United States. These include the 17 preproduction prototypes built by PACCAR. Additional sales have been made on the export market.

Grizzly: Two developmental prototypes of the Grizzly have been delivered for extended operational evaluations.

30/30 Engineer Support Tractor/Deployable Universal Combat Earthmover: Two developmental prototypes of the 30/30 Engineer Support Tractor have been fabricated for evaluations, and 43 production vehicles have been manufactured for service deliveries.

Stryker Engineer Vehicle. At least one prototype of the Stryker Engineering Vehicle has been fabricated.

Application. Specialized vehicles designed to perform various military engineer functions.

Price Range. Based on the procurement of 132 vehicles, the M9 Armored Combat Earthmover had a listed unit price of $683,195 in Fiscal 1992 dollars; based on a similar procurement, the unit price was $1,102,000 in Fiscal 2001 dollars. The Small Emplacement Excavator unit price was last listed in the procurement documents at $302,200 in Fiscal 1990 dollars. Before its cancellation, the projected unit price of the Grizzly, based on the procurement of 300 units, was $6.804 million. The unit price of the 30/30 Engineer Support Tractor/Deployable Universal Combat Earthmover was listed in the Fiscal 1999 documents as $408,173 but works out to $422,807 in the Fiscal 2002 documents.

Technical Data

The following data are for the three most recent armored engineer vehicle production programs in the United States except the Stryker Engineer Vehicle. The production of the M728 Combat Engineer Vehicle was completed in 1985. The manufacture of the M8 series of bulldozer kits for the M48 tank was completed years ago, but the system remains in service in the United States and many other nations. The M9 bulldozer kit (not the M9 Armored Combat Earthmover) for the M60 and the M113 dozer kit are manufactured on an as-needed basis.

Grizzly

Dimensions. A crew of two operates the Grizzly vehicle (formerly called the Combat Mobility Vehicle-Breacher). The excavating arm has a 9.2 meter (30.18 foot) reach and 5.26 meter (17.25 foot) digging depth. The dozer blade can dig to 38.1 centimeters (15 inches).

	SI units	**U.S. units**
Maximum length:	10.62 meters	34.84 feet
Maximum width:	3.66 meters	12.00 feet
Maximum blade width:	4.02 meters	13.19 feet
Maximum height:	3.59 meters	11.78 feet
Maximum weight:	63.9 tonnes	70.43 tons

Performance. The following data are based on the use of the AGT 1500 gas turbine powerplant. The mine clearing speed is 9.3 kilometers per hour (5.78 miles per hour).

	SI units	**U.S. units**
Maximum speed:	66.6 kilometers per hour	41.4 miles per hour
Minimum range:	483 kilometers	299.9 statute miles
Step:	1.07 meters	3.51 feet
Trench:	2.74 meters	8.98 feet

Engine. The Grizzly uses the AGT 1500 vehicular gas turbine provided by AlliedSignal Engines. This engine is rated at 1,119 kilowatts (1,500 horsepower), giving a power-to-weight ratio of 17.51 kilowatts per tonne (21.29 horsepower per ton).

Gearbox. The X-1100-3B gearbox used in the Grizzly is provided by the Allison Transmission Division of General Motors Corporation. This hydrokinetic automatic gearbox has four forward and two reverse gear ratios.

Suspension and Running Gear. The Grizzly uses the same suspension and running gear components as the M1 tank. Certain components, such as those related to the torsion bar, are strengthened for the Grizzly application.

Armament. The Grizzly mounts the M2HB 12.7 millimeter machine gun, with a Mark 19 automatic grenade launcher optional; a 7.62 millimeter machine gun is the secondary armament. At least four smoke grenade launchers will be fitted to the production vehicles.

M9 Armored Combat Earthmover

Dimensions. The following data are for the current production standard.

	SI units	U.S. units
Length:	6.25 meters	20.51 feet
Width		
With dozer wings:	3.2 meters	10.5 feet
Without dozer wings:	2.79 meters	9.15 feet
Over tracks:	2.69 meters	8.83 feet
Height		
Windshield raised:	3.0 meters	9.84 feet
Windshield stowed:	2.7 meters	8.86 feet
Ground clearance:	34.3 centimeters	13.5 inches
Track width:	45.7 centimeters	18 inches
Weight		
Travel mode:	16.33 tonnes	18 tons
Gross, ballasted:	24.49 tonnes	27 tons
Fuel capacity:	507 liters	133.8 gallons

Performance. The following data are based on the use of the M9 in the travel mode. The maximum speed in water is 4.8 kilometers per hour (2.98 miles per hour).

	SI units	U.S. units
Maximum speed:	48.3 kilometers per hour	29.9 miles per hour
Minimum range:	322 kilometers	199.9 statute miles

Engine. The M9 Armored Combat Earthmover is fitted with the Cummins V903C eight-cylinder diesel engine rated at 220.1 kilowatts (295 horsepower) at 43.34 revolutions per second (2,600 revolutions per minute).

Gearbox. The Clark model 13.5 HR 3610-2 gearbox used in this vehicle has six forward and two reverse gear ratios.

Small Emplacement Excavator

Dimensions. The following data are for the latest production standard.

	SI units	U.S. units
Length:	6.35 meters	20.83 feet
Width:	2.44 meters	8 feet
Height:	2.58 meters	8.46 feet
Ground clearance:	43 centimeters	17 inches
Track width:	1.63 meters	5.35 feet
Wheelbase:	2.38 meters	7.81 feet
Weight:	7.23 tonnes	7.98 tons
Fuel capacity:	114 liters	30.3 gallons

Engine. The Small Emplacement Excavator is equipped with the DaimlerChrysler OM 352 four-stroke direct injection diesel engine rated at 82.1 kilowatts (110 horsepower) at 46.67 revolutions per second (2,800 revolutions per minute). The maximum road speed is 80 kilometers per hour (49.7 miles per hour).

Variants/Upgrades

Variants. The vehicles covered in this report are often modified into specialized variants by the user in the field. Any manufacturer-developed variants are described below.

Modernization and Retrofit Overview. Minor upgrades are constantly being integrated into the vehicles covered in this report. Major upgrades are detailed below.

Program Review

Background. The United States Army's requirement for armored and other specialized engineer vehicles is largely satisfied by the purchase of commercial equipment, especially for normal construction tasks. Besides commercial equipment, the United States Army's Belvoir Research Development and Engineering Center develops specialized engineering equipment for both conventional construction and dedicated military engineer (also called pioneer) or non-construction (such as the counter-obstacle and counter-mine) mission areas. Despite the recent declines in funding, the involvement of the United States forces in the Balkan region and Afghanistan highlighted the continued need for specialized engineer vehicles. Funding of late has been focused on the development and procurement of selected armored engineer vehicles and equipment to augment existing inventories. But most recently, the development and procurement of engineer vehicles has been heavily impacted by the U.S. Army's transformation process.

United States Armored Engineer Vehicles

M9 Armored Combat Earthmover. The M9 Armored Combat Earthmover program began in 1971 as the Universal Engineer Tractor. (Then) Pacific Car & Foundry company won the development contract for this new, specialized earthmoving vehicle. The development costs totaled about $15 million. The M9 was type classified in 1977, but the program subsequently had problems in gaining congressional support. Attempts to fund 155 vehicles in Fiscal 1980 came to naught when Congress zeroed the funding line, and the Army was again set back in Fiscal 1981 due to budget pressures.

Finally, in Fiscal 1982, procurement funding was allocated for 36 M9 Armored Combat Earthmovers; this later was cut, however. On November 8, 1982, the Army awarded Pacific Car and Foundry a $28.9 million contract for 15 preproduction vehicles. In 1984, the procurement plan was revised to include 514 M9 vehicles, with an option for the procurement of additional vehicles.

A Request for Proposals was issued to industry in April 1986 and resulted in offers from ADCOR, Bowen-McLaughlin-York (then FMC Corporation), the Diesel Division of General Motors of Canada, Ingersoll-Rand, and PCF Defense Industries (now Paccar). Bowen-McLaughlin-York (subsequently called BMY Combat Systems and then United Defense) was awarded a multiyear contract on April 2, 1986, for 434 vehicles to be built between 1986 and 1990 at a cost of $210 million. There was an option (not exercised) for 132 additional vehicles. The contract also allowed the first 100 vehicles to be procured immediately. BMY conducted the initial production testing phase from June through August 1988 at Aberdeen Proving Ground. The results were used to determine whether the vehicle could be used in the combat engineering mode.

The United States Marine Corps subsequently decided to procure the M9 Armored Combat Earthmover to meet its Combat Excavator requirement. A total of 91 vehicles were to be procured with Fiscal 1993 funding. This total was subsequently reduced to 87. The United States armed services have procured a total of 590 M9 Armored Combat Earthmovers. In addition, 18 vehicles have been sold to the Republic of China.

The U.S. Army's M9 ACE System Improvement Plan is a multiphased program designed to improve the performance, durability, readiness, and MANPRINT characteristics of the vehicle. The multiphased nature of the program is necessitated by the available funding stream. Phase 1 of the program involved the production of bolt-on front track retainers, steel skid plates, high-pressure hydraulic filters, battery box deflectors, scarifier blade uplocks, scarifier blades for half the fleet, inserts for improved winches, ejector debris shields, and modified rear bump stops. Kits were applied by Anniston Army Depot. Phase 2 of the program, completed in 2000, involved the production of thicker roadarm retainers, preformed radiator hoses, lengthened oil-drain lines, redesigned parking brake linkage and steering rods, vent fan filters, tachometer/speedometer grease fittings, inclinometers, and steel CB/GS linkages.

A Phase 3 enhancement program was recently developed. Details are provided below:

Hardened Track Pin with Modified Track Shoe: Current track pins bend, causing equipment down time in two different ways. They deform the bushings, resulting in track maintenance, and they are difficult to remove when bent. Harder track pins will allow higher torque, which will reduce bending moment. This will reduce the frequency of track failures and make pin removal easier when track needs to be separated. In addition to the hardened pins, future buys of track will also have a larger pocket for the track pin nut. This will make it easier to get a socket on the nut even after the track edges become worn.

Hydraulic Troubleshooting Procedures: All hydraulic troubleshooting procedures will be reformatted to simplify fault isolation. The M9 has an extensive and complex hydraulic system. Insufficient hydraulic troubleshooting expertise is the single largest contributor to the vehicle's downtime. Good components are inadvertently removed and replacements

ordered unnecessarily. Unit mechanics require detailed troubleshooting procedures which are easy to implement. The goal is to cut the troubleshooting time and eliminate ambiguous or faulty troubleshooting paths. No hardware changes to the vehicles are included in this project.

Actuator Mounting Rings: A stronger mounting system is being provided for the rotary actuators. Currently, actuator mounting bolts screw into steel inserts in the aluminum hull. The inserts pull out, resulting in loose actuators, hull damage, hydraulic line failures, and damage to roadarms and actuators. Under this project, steel rings will be fastened inside the hull. The actuator bolts will pass through the existing mounting points and screw into the steel rings. Rings are installed at the front actuator station only; however, the rings can be installed at the three other stations as well if those hull inserts should come loose.

Bowl Access Plates: Easy access will be provided to the front actuators for troubleshooting and maintenance. Front actuators, accumulators, and hydraulic lines require both scheduled and unscheduled maintenance. Currently, mechanics must perform troubleshooting and repairs from underneath the vehicle, working in dark and cramped conditions. This increases the maintenance time and leads to leaking hydraulic fittings. Access through the bowl floor will decrease maintenance time and eliminate most causes of actuator hydraulic leaks.

Hydraulic Filtration Improvements: Hydraulic cleanliness is critical on the M9. To achieve the cleanest possible hydraulic system, a more efficient return line filter and a high-pressure filter at the compensating pump output will be added. Three hydraulic test points are being added at the location of the high-pressure filters. Also as part of this project, the two compensating pump suction hoses will be modified to prevent collapse and cavitation. Finally, the compensating pump adjustment will be improved by replacing the existing adjusting clamp with an adjusting screw and jam nut.

Hub and Sprocket Redesign: The current hub requires two unique sprockets. The outer one tends to bend and is difficult to fabricate, resulting in production delays and lengthy downtime. This project will eliminate the current outer sprocket and permit use of the inner sprocket in both positions. The goal is to eliminate shortages and the relatively high cost of outer sprockets, and to reduce maintenance. Also, the hub will be piloted onto the final drive output shaft, reducing the shear load and resultant mounting bolt failure.

Semi-Automatic Track Tensioner/Adjuster: Currently, the operator checks and manually adjusts track tension using a grease gun before each mission. The new system will allow the operator to adjust track hydraulically from within the driver's compartment. With the manual system, the tension setting is a compromise, since the track needs sufficient slack to allow the suspension to go from sprung mode (travel) to unsprung mode (dozing). The semi-automatic track tensioner will relax the track to change between sprung and unsprung and then re-tension the track, allowing a tighter envelope. This will reduce the number of track throws and associated damage and wear to the suspension components and hull components.

Final Drive Improvements: An oil-level indicator will be developed and the output shaft modified. Operators cannot assess the condition or amount of oil because there is no method to check oil level. This project will permit water, contamination, or loss of oil to be detected. Also, the output shaft will be modified to accommodate the redesigned sprocket hub.

Improved Winch: With the current winch, the M9 has a limited ability to self-recover. This project will increase winch rating from 25,000 pounds to 35,000 pounds, double the cable length from 30.48 meters (100 feet) to 60.96 meters (200 feet), and add a friction brake to enable the M9 to hold a load on a slope.

Steel Dozer Blade: A steel replacement will be developed for the existing aluminum dozer blade. The current aluminum blade suffers damage when used in rocky terrain, is marginally suited for use with scarifier teeth, and generally wears down. Repair is difficult and involves time-consuming aluminum welding, resulting in extensive mission downtime. The complex hollow-box design also means that replacement blades are expensive and have long lead times. A steel dozer blade will be less expensive, more resistant to wear, and easier to repair if damaged.

Phase 4. A Phase 4 enhancement for the M9 was recently developed. This is an automatic blade folder that lets the operator remotely fold or unfold the dozer blade from the crew compartment. This procedure previously took up to one-half hour to perform, required crew to be exposed, and stopped the ongoing mission. Failure to fold the blade during cross-country travel could result in vehicle damage or operator injury.

In 1995, a decision was made to assemble the M9 Armored Combat Earthmover under license in the Republic of Korea. The contractor is Samsung Aerospace. The procurement objective is 207 vehicles.

Counter Obstacle Vehicle. What was originally designated the Counter Obstacle Vehicle was conceptualized in 1981-1982. The vehicle was intended to clear obstacles, both man-made and natural, from the battlefield. The Counter Obstacle Vehicle was a joint effort between the United States Army and Israel, with (then) Bowen-McLaughlin-York of York, Pennsylvania,

being the prime contractor for development. The vehicle design was based on the M88 armored recovery vehicle chassis and came in several configurations: bulldozer, mine plow, mine roller, telescoping bucket and grapple, and mine clearing line charge, plus a vehicle designed to deploy the Clear Lane Marking System. Before the program was terminated, only two Counter Obstacle Vehicles had been fabricated, one in the United States and the other in Israel. The program was effectively terminated in 1986.

Combat Mobility Vehicle. Following the demise of the Counter Obstacle Vehicle program, the U.S. Army still had a requirement for a vehicle of this type. The requirement was made a component of the then-ambitious Heavy Forces Modernization program. It was decided to base the Combat Mobility Vehicle on the chassis of the M1 Abrams tank. The vehicle was to be fitted with various systems to meet user requirements on the battlefield. These systems would include an excavating arm, a dozer blade, and a mine clearance system.

There were three contenders for the program: Bowen-McLaughlin-York Combat Systems; General Dynamics, Land Systems Division; and General Motors Corporation, Military Vehicle Operations. Bowen-McLaughlin-York was selected in April 1991 and was awarded a $10,945,000 incremental contract. The total contract value was then projected at $20 million. The Army had been expected to order up to 249 vehicles initially, with a potential for 700 vehicles.

The Counter Mobility Vehicle was originally expected to be fielded by the late 1990s. However, the Fiscal 1992/1993 budget supporting documents revealed that this program was to be deferred and technology gained from it transferred to the M1 Breacher program.

Grizzly – M1 Breacher/Breacher. The M1 Breacher (recently named the Grizzly) was a new-start program beginning in Fiscal 1993. The development of the vehicle has been funded under Program Element number 0603649A – Engineer Equipment Development-Advanced Development, Project DG24.

The Grizzly has been developed around the M1 tank chassis and integrates a versatile/survivable mine clearing blade, an automatic digging depth control, and a commander's armored control station. Once fielded, the Grizzly will provide combat engineer units with significantly improved mission effectiveness and crew/vehicle survivability while clearing minefields and removing complex natural and man-made obstacles at the forward edge of the battle area. The Grizzly will be capable of moving with and be as survivable as the force it is supporting. BMY Combat Systems (since early 1994 a component of United Defense Limited Partnership) is the contractor.

Contractor testing of the first two prototype vehicles was completed in 1995, and the vehicles were delivered for operational testing. Low-rate initial production of the Grizzly was originally expected to begin in 1997; however, the program suffered technical problems with the microwave-based sensor system designed to survey the terrain in front of the vehicle to alert the crew of obstacles.

The U.S. Army canceled the Grizzly program outright in late 1999 in order to free up funding for the new medium combat brigades, creating quite a stir. But in May 2000, to the relief of the program's supporters, both the House and Senate Armed Services Committees restored procurement funding for the Grizzly.

The Grizzly program again became a football in the deliberations over the Fiscal 2002 defense budget. It was canceled in the first budget request, only to be reinstated by Congress. In early 2001, U.S. Secretary of Defense Donald Rumsfeld released the funding for the M104 Wolverine Heavy Assault Bridge program, but did not release the $15 million in Fiscal 2001 funding for the Grizzly. While Congress approved the funding for continued research, test and evaluation, the Defense Secretary held onto the money pending the results of the *Quadrennial Defense Review*. This review doomed the program, as the U.S. Army opted to terminate its requirement for the system. So the Grizzly program remains at the prototype stage with no procurement anticipated. The Army has requested that Congress reprogram the money to operations and maintenance.

The first Grizzly vehicles has originally been expected to be fielded in 2002. The last stated projected procurement objective was 366 units. The procurement numbers for this system were somewhat lower than those expected for the earlier Combat Mobility Vehicle.

The Marines and the Grizzly. The U.S. Marine Corps has stated that it has an urgent need for a new engineer/breaching vehicle. The Service was originally interested in procuring 32 Grizzly vehicles but was frustrated by the Army's cancellation of the program. In order to address their requirement, the Marines are now looking at several off-the-shelf solutions. One option is a watered-down version of the Grizzly with some of the high-technology (read expensive) components deleted. Another option is the integration of several mine clearance and marking technologies with the Marines' M1A1 tank. While some sources indicated that the Marines had found funding to procure the original version of the Grizzly, the effective termination of the program has made this moot.

Small Emplacement Excavator. The Small Emplacement Excavator is based on the four-wheel-drive Mercedes UNIMOG U900 truck outfitted with tools such as a dozer blade, front-end

loader, and backhoe. The vehicle is used to excavate small nonlinear defense positions. It can also trench and grade, and power hydraulic tools. In 1985 Freightliner was awarded a multiyear contract to produce 922 Excavator vehicles, with options. The initial 922 vehicles were quickly purchased, and up to 2,206 vehicles have since been procured.

Variants of the Small Emplacement Excavator include the High Mobility Material Handling Vehicle, which utilizes a front-mounted forklift, and the High Mobility Excavator, which has a dozer blade in front and an entrencher in the rear. It can be used to carry the Tactical Explosion System. Along with the Army, the National Guard, the U.S. Marine Corps, and the U.S. Air Force have acquired the Small Emplacement Excavator.

Freightliner received its last contract on January 5, 1989, for 491 Small Emplacement Excavators for $33.8 million. The Small Emplacement Excavator production run is complete, but the vehicle is available for additional orders. Earlier reports indicated that the Army had a problem with the black-out lights and the headlights being blocked when the loader bucket mechanism was being operated. Freightliner subsequently corrected the problem.

Low Cost Emplacement Excavator. The Low Cost Emplacement Excavator program is developing equipment that can be used to rapidly excavate small combat defenses such as foxholes. The plan is to examine both trailer and truck-mounted excavators that can dig and cover individual fighting positions in less than five minutes. If it moves ahead, this requirement is expected to be met by a commercial system.

Robotic Obstacle Breaching Assault Tank. The Army allocated full-scale developmental funding for the Robotic Obstacle Breaching Assault Tank in 1984. A prototype vehicle based on a surplus M60A2 tank was tested in 1981-1982 to examine concept feasibility. The Robotic Obstacle Breaching Assault Tank was expected to be fitted with a mine roller or mine plow, a mine clearing line charge, and a cleared lane marking system. The vehicle was to be remote controlled by a radio link. Initial funding for the procurement program was expected in Fiscal 1986. A total of 140 vehicles were to be constructed by the Anniston Army Depot. However, the program fell prey to budget cuts and has been put on the shelf to await a future decision.

Caterpillar 30/30 Engineer Support Tractor/Deployable Universal Combat Earthmover. This equipment was developed by Caterpillar as a private venture for a military requirement. It is a high-speed combat support machine that is air transportable by C-130 class aircraft. Unique to the rear-engine design is the Mobile-Trac System. This system features a rubber track and advanced-design hydropneumatic suspension system, allowing for off-road speeds of up to 53 kilometers per hour (32.9 miles per hour). The engine used in the 30/30 Engineer Support Tractor is the Caterpillar 3208 diesel. The 30/30 Engineer Support Tractor has a crew of one and has a 3.25 meter (10.66 foot) hydraulically operated dozer blade which can be angled. Bulletproof windows and a fire detection and suppression system are fitted as standard equipment.

Following the operational test phase, which ran into 1993, the Caterpillar 30/30 Engineer Support Tractor was accepted to address the U.S. Army's Deployable Universal Combat Earthmover mission. Service deliveries of this vehicle are ongoing. The original 184-unit procurement objective has been reduced to 136 units.

Sapper Vehicle. This vehicle, developed in 1992, is based on a new-production stretched version of the M113 armored personnel carrier. The vehicle components are based on the M113A1/A2 Fitter's Vehicle and technology developed in Canada. The Sapper Vehicle is basically the stretched M113 fitted with a hydraulically operated dozer blade and auger. In 1998, the serial production of this vehicle began for an export customer; deliveries commenced in 1999. (Further details are provided in the "M113" report in Tab B.)

Combat Engineer Squad Vehicle. This is a further development of the Engineer Squad Vehicle (covered in detail in the "M113" report). This vehicle is based on an existing M113 vehicle that has been stretched and converted – the Mobile Tactical Vehicle-Light.

Stryker Engineer Vehicle. This program is one of the premier engineer vehicle programs of the United States. It is one of the 10 versions of the Category III Piranha that is being procured by the U.S. Army as the Stryker for its new medium combat brigades. As such, this program is covered in the "Piranha" report in Tab C. At least one prototype of the Stryker Engineer Vehicle has been fabricated.

Bulldozer from Hell. At an exhibition organized by the Marine Corps Systems Command in mid-1998, several pieces of interesting new equipment were displayed. Among them was the "Bulldozer from Hell," more properly known as the Joint Amphibious Countermeasures System. This is a Caterpillar D7 bulldozer that has been extensively modified with appliqué armor, a mine rake, a deployable mine clearing net with a small shaped-charge lethal mechanism, a clear lane marker, and a magnetic influence device for the detonation of mines ahead of the vehicle. In addition to conventional operation, the "Bulldozer from Hell" can be remotely operated, enhancing the safety of the operator. The Joint Amphibious Countermeasures System has been

evaluated for possible procurement by the Marine Corps, but no procurement plans have been announced.

High Mobility Excavator Program. For the Fiscal 2001 Foreign Comparative Testing program, the U.S. Army evaluated two engineer vehicles from Australia and Germany. This project seeks to meet the Army's requirement for a more transportable/mobile engineer vehicle which also directly supports an Army Chief-of-Staff initiative. The project is evaluating candidate excavator vehicles developed by ADI of Australia and Mercedes-Benz of Germany for the following characteristics: C-130 deployability, all-wheel drive, diesel engine driven with backhoe, bucket loader, and designed to accept multiple attachments.

High Speed Engineering Vehicle. This is a relatively new engineering vehicle that has generated a good deal of interest on the international market. Developed by ADI Limited of Australia, the High Speed Engineering Vehicle is equipped with a bucket and backhoe and, despite its all-terrain capability, can attain a road speed of 100 kilometers per hour (62.5 miles per hour). In production for Australia, the High Speed Engineering Vehicle is being evaluated by Canada and the U.S. Army.

Funding

U.S. FUNDING

	FY91		FY92		FY93		FY94	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
Army Procurement								
M9	132	61.5	-	-	-	-	-	-
Breacher								
DEUCE	-	-	-	-	-	-	-	-
Marines Procurement								
M9	-	-	-	-	87	63.7	-	-
National Guard Procurement								
M9	-	-	-	-	35	25.0	-	-
Total	132	61.5	-	-	122	88.7	-	-

	FY95		FY96		FY97		FY98	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
Army Procurement								
M9	-	-	-	-	51	51.0	-	-
Breacher	-	-	-	-	-	-	-	-
DEUCE	-	-	15	9.5	21	7.7	23	8.2
Marines Procurement								
M9	-	-	-	-	-	-	-	-
National Guard Procurement								
M9	-	-	-	-	-	-	-	-
Total	-	-	15	9.5	72	58.7	23	8.2

	FY99		FY00		FY01		FY02	
	QTY	AMT	QTY	AMT	QTY	AMT	QTY	AMT
Army Procurement								
M9	-	-	-	-	-	-	-	-
Breacher	-	-	-	0.5	-	TBD	-	-
DEUCE	24	9.2	53	21.0	57	24.1	-	-
Marines Procurement								
M9	-	-	-	-	-	-	-	-
National Guard Procurement								
M9	-	-	-	-	-	-	-	-
Total	24	9.2	53	21.5	57	24.1	-	-

TBD = to be determined.

Note: In the Fiscal 2000/2001 documents, $0.4 million was planned for Fiscal 2001 for "Breacher training devices." Also, the Fiscal 2000 and 2001 requests indicated $19.7 million and $79.4 million, respectively, for the "Breacher system (mod)."

	FY93		FY94		FY95	
	QTY	AMT	QTY	AMT	QTY	AMT
Army Research and Development						
PE#0603645A						
DB86 Combat Mobility						
Vehicle	-	0.0	-	0.0	-	0.0
PE#0603649A						
DG24 Breacher	-	14.5	-	29.4	-	15.4
PE#0604609A						
DG25 Breacher	-	-	-	-	-	-
PE#0604804A						
DH01 Combat Engineer						
Equipment Engineering						
Development	-	4.4	-	4.6	-	4.1
Total	-	18.9	-	34.0	-	19.5

	FY96		FY97		FY98	
	QTY	AMT	QTY	AMT	QTY	AMT
Army Research and Development						
PE#0603645A						
DB86 Combat Mobility						
Vehicle	-	-	-	-	-	-
PE#0603649A						
DG24 Breacher	-	135.9	-	0.5	-	-
PE#0604649A						
DG25 Breacher	-	6.5	-	34.1	-	40.7
PE#0604804A						
DH01 Combat Engineer						
Equipment Engineering						
Development	-	-	-	8.8	-	-
Total	-	142.4	-	43.4	-	40.7

	FY99		FY00		FY01	
	QTY	AMT	QTY	AMT	QTY	AMT
Army Research and Development						
PE#0603645A						
DB86 Combat Mobility						
Vehicle	-	-	-	-	-	-
PE#0603649A						
DG24 Breacher	-	-	-	-	-	-
PE#0604649A						
DG25 Breacher	-	58.0	-	58.2	-	37.7
PE#0604804A						
DH01 Combat Engineer						
Equipment Engineering						
Development	-	-	-	-	-	-
Total	-	58.0	-	58.2	-	37.7

	FY02		FY03		FY04	
	QTY	AMT	QTY	AMT	QTY	AMT
Army Research and Development						
PE#0603645A						
DB86 Combat Mobility						
Vehicle	-	-	-	-	-	-
PE#0603649A						
DG24 Breacher	-	-	-	-	-	-
PE#0604649A						
DG25 Breacher	-	-	-	-	-	-
PE#0604804A						
DH01 Combat Engineer						
Equipment Engineering						
Development	-	-	-	-	-	-
Total	-	-	-	-	-	-

Note: All dollar amounts in the above table are in millions. The Fiscal 1991 research and development funding for PE#0603645A was $11.4 million. This was the last funding, as the program transitioned to PE#0603649A in Fiscal 1993, and then to PE#0604609A in Fiscal 1995.

Recent Contracts

The following contracts have recently been awarded to BMY Combat Systems, since early 1994 a component of United Defense Limited Partnership.

Contract	Date	Amount	Procurement
DAAAE07-91C-R056	1993/03/29	$8,700,605	For continuing developmental work, including the fabrication of a second prototype of the Breacher vehicle.
DAAAE07-93C-A038	1993/09/30	$78,208,787	For the procurement of 121 M9 vehicles.
DAAAE07-91C-R056	1994/02/14	$14,483,521	For additional development work on the Breacher vehicle.
DAAAE07-97C-X071	1997/09/10	$45,670,682	For 51 M9 Armored Combat Earthmovers.
DAAAE07-97C-X001	1997/12/23	$29,442,621	For engineering and manufacturing development of the Grizzly.
DAAAE07-97C-X001	2000/04/21	$9,000,000	For engineering and manufacturing development of the Grizzly.

The following contracts have been awarded to Caterpillar:

Contract	Date	Amount	Procurement
DAAAE07-95C-X056	1998/02/10	$8,146,105	For 23 Deployable Universal Combat Earthmovers.
DAAAE07-95C-X056	1999/02/02	$8,671,176	For 23 Deployable Universal Combat Earthmovers.
DAAAE07-95D-X056	2000/02/01	$17,902,780	For 47 Deployable Universal Combat Earthmovers.
DAAAE07-00D-T083	2000/10/17	$5,339,796	For 88 Deployable Universal Combat Earthmovers.

Timetable

Month	Year	Major Development
	1971	Universal Engineer Tractor program begun
	1977	M9 type classified
	1981-1982	Counter Obstacle Vehicle conceptualized
	1985	Freightliner awarded contract for 922 Small Emplacement Excavators
April	1986	BMY awarded contract to produce 566 M9 vehicles
	1991	BMY selected to produce Combat Mobility Vehicle
	1992	Combat Mobility Vehicle deferred; M1 Breacher program revealed; Sapper Vehicle program begun
Early	1995	First two Grizzly vehicles completed
Early	1998	Sapper Vehicle enters production for export
June	1998	Joint Amphibious Countermeasures System unveiled
Late	1999	Grizzly program canceled
May	2000	Grizzly program funding restored
	2000	U.S. Army deletes Grizzly requirement
	2003	Development/testing of various engineer technologies continues; production of M9 and Deployable Universal Combat Earthmover completed.

Worldwide Distribution

The M9 Armored Combat Earthmover, Deployable Universal Combat Earthmover, and Small Emplacement Excavator are in service with the **United States Army and Marines**. The Deployable Universal Combat Earthmover (15) has been sold to the **United Kingdom.** In April 1990, BMY Combat Systems announced that it had won its first export order for 18 M9 Armored Combat Earthmovers to the **Republic of China**. Shortly thereafter, another 68-unit order of the M9 was exported to the **Republic of Korea**; the order, which includes the licensed assembly of the M9, was worth $8 million.

Forecast Rationale

The infantry have an old saying, "The spade is brother to the rifle," meaning that skill in digging-in is as essential as skill with basic small arms. By extension, the armored forces could well claim that "the armored engineer vehicle is brother to the tank." It could be argued that most of the major military victories won over the last few decades have essentially been engineering successes; certainly the assault crossing of the Suez Canal by the Egyptians in 1973 falls into that category. While the role of engineering vehicles may not be as publicized as those of the major combat vehicles, their functions and services are every bit as decisive.

Traditionally, armored engineer vehicles have undertaken two roles in shaping a battlefield. These are, first, creating obstacles by digging firing positions and trenches, and destroying road and transport facilities and engineering berms to prevent enemy tactical movement. The other traditional role has been to remove obstacles by digging through natural or artificial obstructions, rebuilding bridges and roads and generally easing the advance of the combat forces. Combat operations invariably show that, just as navies are always short of frigates, armies are always short of engineers.

Over the last decade, a variety of peacekeeping operations have highlighted a third role for armored engineer forces that throws unexpected demands on their capabilities. This is reconstruction; the rebuilding of a society that has been ravaged by war, by inept and incompetent government, by economic collapse or all of the above. Operation Iraqi Freedom (more correctly, the Iraqi Campaign that forms part of the war of terrorism) has showcased this capability. From using an armored engineer vehicle to help local citizens pull down a statue of Saddam Hussein to using armored bulldozers to rebuild water, electrical and other public facilities, U.S. armored engineer equipment has been at the forefront of the task of rebuilding Iraq.

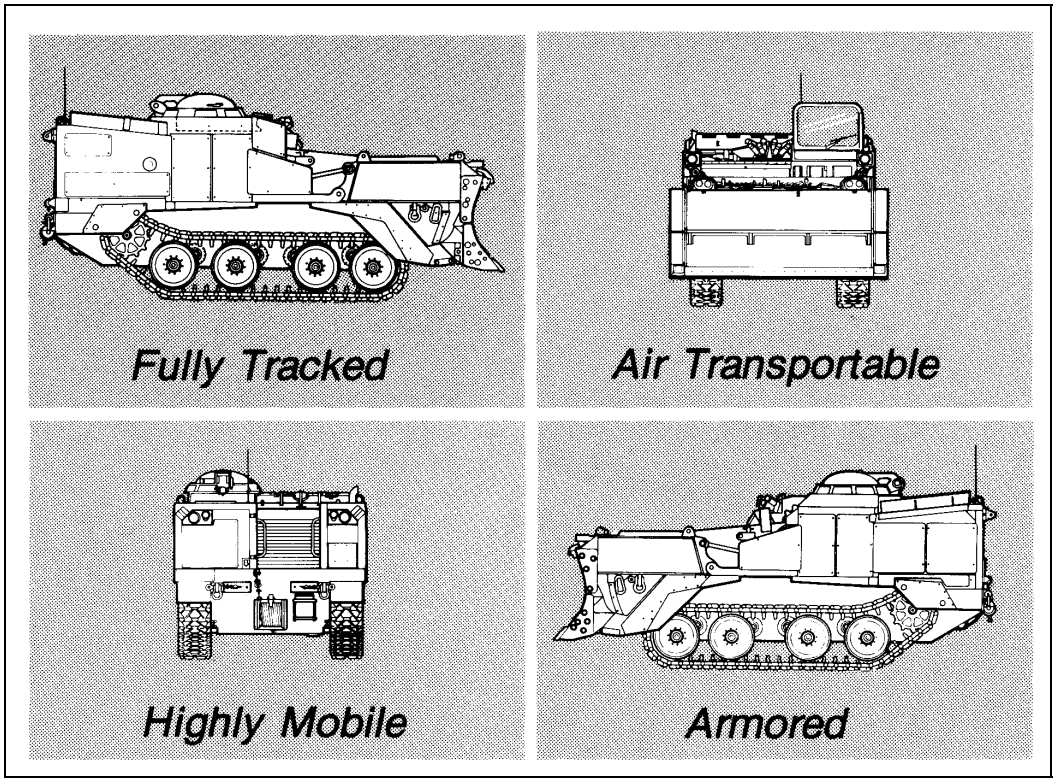
The lessons learned as a result of these efforts may serve to improve the status of United States engineering vehicle programs which, until recently, were rather bleak. The U.S. Army has effectively terminated the Grizzly program in order to fund the transformation

effort. The serial production of the M9 Armored Combat Earthmover program is now dormant following the fulfillment of the latest orders from the Marines and National Guard. The serial production of the Deployable Universal Combat Earthmover is winding up, another victim of the transformation process. The question that must now be asked is whether the extensive demands on U.S. military engineering capability will cause some of these decisions to be amended. Afghanistan and Iraq have stretched U.S. capacity; a further major commitment may require substantial new investment to become viable.

A further aspect of the U.S. Army's engineering vehicle efforts is the demand to increase mobility and deployability. Existing vehicles have been criticized on grounds that they require too great a commitment of logistics assets for their transport to a desired theater. Among other requirements, the focus of future developments is to produce lighter vehicles. Examples of these are the Stryker Engineer Vehicle and the High Mobility Excavator Program. The Stryker Engineer Vehicle is, for the present, covered in the Piranha" report in Tab C. The High Mobility Excavator Program is still so new that an exact inventory requirement has yet to be established. Therefore, we have yet to include separate line items for these programs. It is probable that both the Stryker Engineer Vehicle and the High Mobility Excavator Program will be covered in greater detail in next year's update or possibly in an interim update of this report. For detailed information on the Sapper and Engineer Squad Vehicle programs, please see the "M113" report in Tab B.

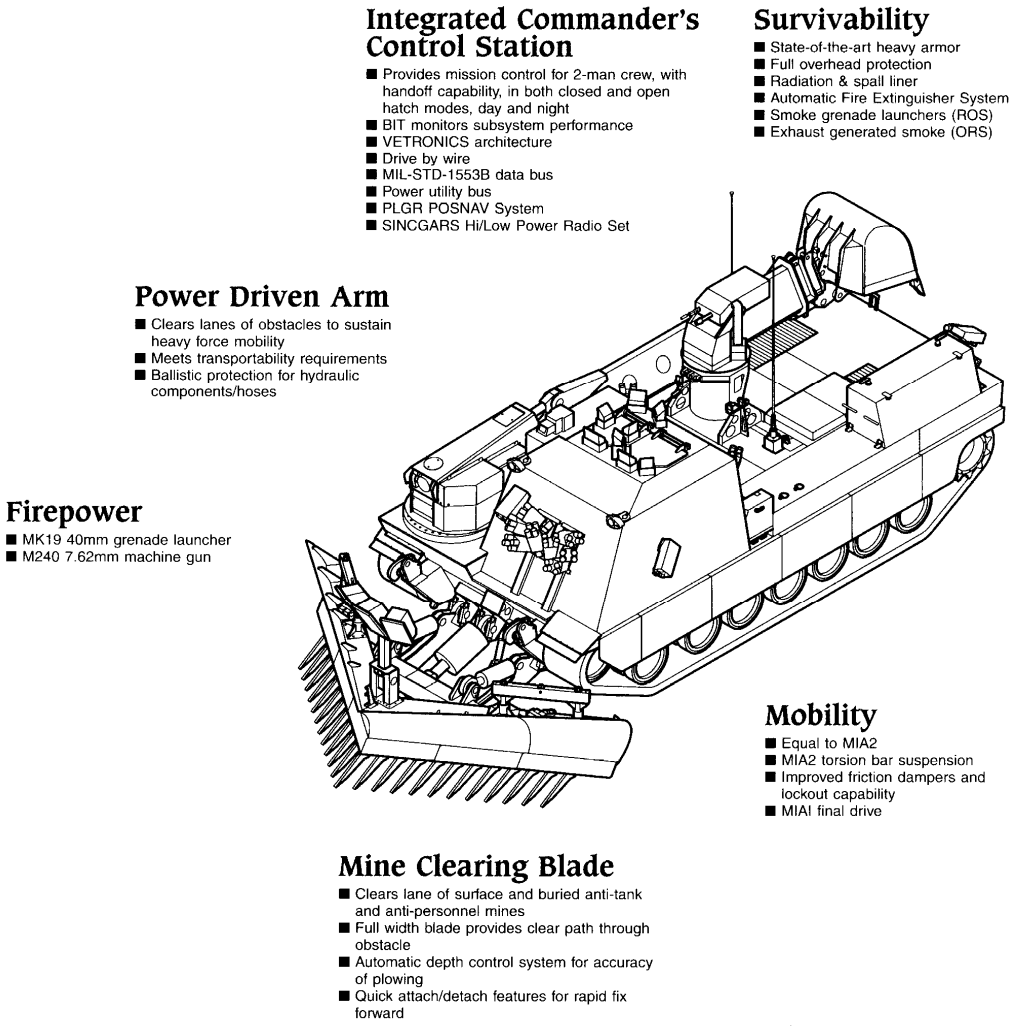
Ten-Year Outlook

At the moment, no procurement of additional U.S. armored engineering vehicles is projected. For this reason, there is not Forecast Chart.



M9 Armored Combat Earthmover

Source: United Defense



GRIZZLY

Source: United Defense