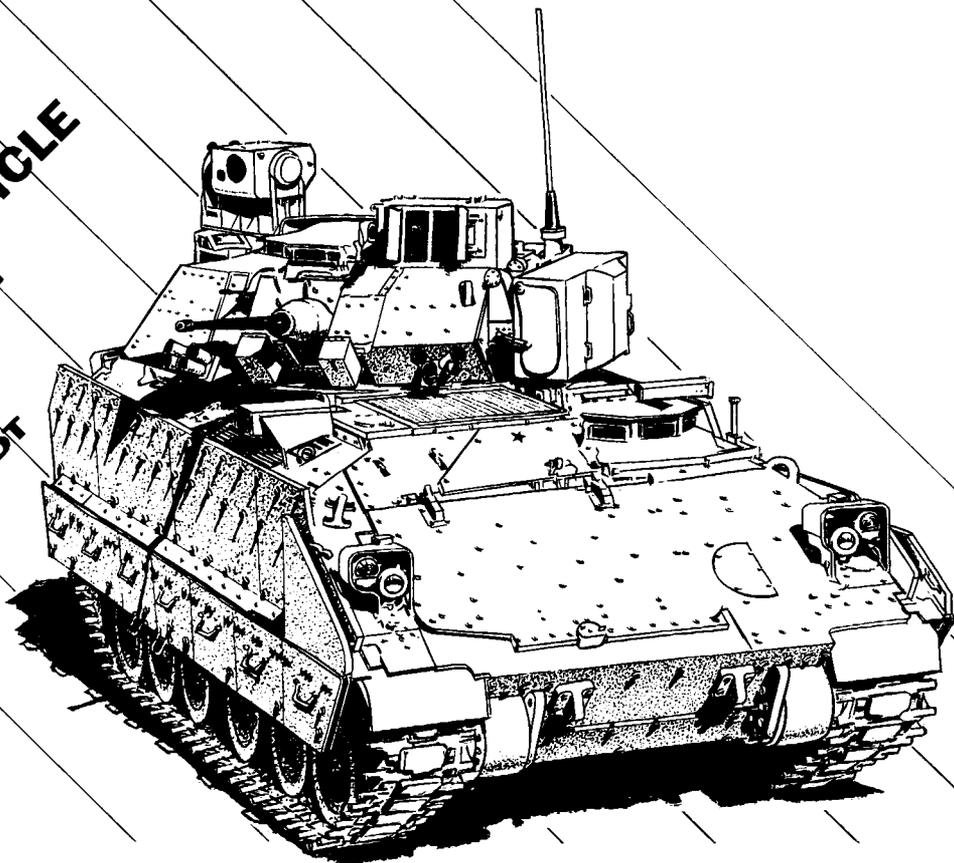


BRADLEY M2A3/M3A3 THE ARMY FIGHTING VEHICLE FOR THE 21st CENTURY

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The Bradley M2A3/M3A3 is the latest in a series of upgrades to the Bradley Fighting Vehicle System (BFVS) designed to keep the U.S. Army mechanized force ahead of all potential threats well into the 21st Century.

Past upgrades, which began with the original Bradley A0, were hardware oriented. The A0 offered significant advantages in maneuver, armor protection, and firepower over the M113 armored personnel carrier. The A1 version, which began fielding in 1988, included the improved TOW II missile, a gas particulate filter unit (GPFU) for the crew, an improved fire suppression system, and improved equipment stowage. In 1990 the A2 version offered improved survivability with an additional layer of armor protection, a spall liner, attachments for armored tiles, an upgraded power train (engine and transmission), and ammunition storage that reduces vulnerability from the impact of enemy munitions.

Lessons learned from Operation Desert Storm led to the A2 Operation Desert Storm (ODS) version of the BFVS, with an eye safe laser range finder, a digital compass system coupled with a precision lightweight global positioning system (GPS) receiver (PLGR), a driver's vision enhancer (DVE), a battlefield combat identification system (BCIS), a missile countermeasure device (MCD), and equipment restowage. The 3d Infantry Division at Fort Stewart, Georgia, is currently drawing the first M2A2 ODS vehicles.

The Bradley A3 program is a leader in the Army's Force XXI modernization effort. The A3 builds on the

capabilities of the A2 ODS and significantly upgrades the BFVS in command and control (C2), fire control, survivability, mobility, sustainability, and training. The A3 also derives most of its enhancements from the use of digital technology, and every A3 vehicle, from the squad leader's to the battalion commander's, will have the same capabilities. Improvements incorporated into the A3 variant will enable the infantry soldier to defeat the projected threat for many years ahead and make him fully compatible with all other modern digitized C2 systems on the battlefield.

Command and Control

Improvements in command and control provide greater situational awareness and operational flexibility so that units equipped with M3s can adjust rapidly to changing tactical situations. The enhanced C2 produces digital interoperability, along with greater operational effectiveness and lethality in mechanized infantry units, while at the same time, reducing the potential for fratricide. Through digitization, all elements of the vehicle system (C2, fire control, combat identification, communications) are integrated to work as a whole, with C2 as the controlling element. The Bradley A3's C2 capabilities also make it a vital link in the tactical internet.

Key to the A3's success into the 21st century are its compliance with the Army Technical Architecture (ATA) and its adherence to the Defense Information Infrastructure (DII) and Common Operating Environment (COE), which

set the basic standards for Army digital communications, mapping, user interfaces, operating environments, data rates, and the like. Compliance with the ATA and DII COE makes the A3 fully functional with all other digital platforms – other M2/M3A3s, M1A2 Abrams tanks, helicopters, and artillery and integrates them with the Army-wide digital C2, communications, intelligence, and logistics networks.

The A3 processes voice and digital data communications through the on-board SINCGARS (single channel ground air radio system) and the EPLRS (enhanced position location reporting system) to maintain a near real-time data link for reporting and receiving operational overlays, graphics, and friendly and enemy positions.

The commander's station has a flat panel display and keyboard that enable him to send and receive messages and reports. Force XXI adopted the Bradley A3 screen design as the baseline for all systems included in its digitization integration effort.

M2/M3A3 C2 meets the standards of MIL-STD 188/220, which means it can send and receive messages in variable message format (VMF). The vehicle commander uses his keyboard and flat panel display to scroll through a menu of pre-formatted reports (spot report, logistics report, call for fire) or to create a free-text message that is instantly linked with the appropriate digitized communication, C2, intelligence, or logistics networks. He can store and retrieve messages much like e-mail to help him manage the flow of information. And if it becomes necessary, he can instantly purge the data to prevent its capture.

With the integrated C2, intelligence, and logistics networks, the commander always has up-to-date information on the location and status of adjacent vehicles, units, and enemy forces. Graphics and orders can be updated instantly and distributed throughout the force. Through the use of an industry standard Type II/III PCMCIA card, the crew can load Defense Mapping Agency digital map products and display them for operational use. These capabilities will substantially reduce the preparation and adjustment time required to reorient the force to react to or take advantage of a change in the tactical situation.

Operational graphics and maps can automatically scroll on the display to stay current with the vehicle's location or can be moved or zoomed in and out to observe other areas of the battlefield. As the vehicle changes direction, the commander can choose to have his display rotate so that he views it in the direction of travel. The graphics will also remain oriented for easy recognition and reading.

Integration into the tactical digital C2 network enables the commander to transfer target data to other digitized platforms. The commander can observe and mark a target in the commander's independent viewer (CIV) and instantly send accurate target information to the appropriate weapon system, such as attack helicopters or his supporting artillery and mortars. (The CIV is the large sight box on the left of the turret as you look at the vehicle.)

GLOSSARY OF ACRONYMS

AGTS	Advanced Gunnery Training System
ATA	Army Technical Architecture
BCIS	Battlefield Combat Identification System
BDT	Bradley Desktop Trainer
BFVS	Bradley Fighting Vehicle System
CCTT	Close Combat Tactical Trainer
CIV	Commander's Independent Viewer
COE	Common Operating Environment
COFT	Conduct-of-Fire Trainer
DII	Defense Information Infrastructure
DVE	Driver's Vision Enhancer
EPLRS	Enhanced Position Location Reporting System
FLIR	Forward Looking Infrared
GPFU	Gas Particulate Filter Unit
GPS	Global Positioning System
HOTT	Hands-on Turret Trainer
IBAS	Improved Bradley Acquisition System
INU	Inertial Navigation Unit
ISU	Integrated Sight Unit
LRU	Line Replaceable Unit
MCD	Missile Countermeasure Device
ODS	Operation <i>Desert Storm</i>
PGS	Precision Gunnery System
PLGR	Precision Lightweight GPS Receiver
PNS	Position Navigation System
SINCGARS	Single Channel Ground and Airborne Radio System
SPORT	Soldier Portable On-System Repair Tool
VDMS	Vehicle Diagnostic Management Software
VIDS	Vehicle Integrated Defense System
VMF	Variable Message Format

In the back of the vehicle, the squad leader can view the same graphics and messages as the commander on his flat panel display. He can switch views between the CIV, the commander's flat panel display, the improved Bradley acquisition system (IBAS), and the DVE, when it is operational, and see the picture that is currently on that device. Thus, the squad leader can stay current with the situation and orient to the terrain before he dismounts.

Lethality

A primary technology for improving M2A3 lethality is the second-generation forward looking infrared (FLIR). With this FLIR, the crew has a day-and-night target acquisition and identification capability that far exceeds the maximum effective range of any on-board weapon system. With an improved ability to identify vehicles at such distances, the crew can better prepare for the engagement, or conduct a more effective target hand-off to the appropriate weapon system, or identify the target as friendly and avoid fratricide.

The crew can use the eye safe laser range finder to make sure the target can be engaged. If the target is outside the effective range of the selected weapon and ammunition, the range finder will provide a lighted warning signal in the sight reticle. Because the laser range finder is eye safe, the crew can use it during all training scenarios.

The M2/M3A3 fire control system uses the new FLIR hardware in two separate but integrated sight systems--the

IBAS gunner's sight and the commander's independent viewer (CIV). The IBAS replaced the integrated sight unit (ISU) and has a primary sight reticle, a back-up through-sight reticle in case the IBAS becomes inoperative, and a video picture to view the battlefield on a TV screen image.

The IBAS also provides the gunner with 4-power and 12-power magnification, a ballistic solution to compensate for weapon and ammunition characteristics at the determined range, and a kinematic lead capability that automatically compensates for a moving target. With the kinematic lead, all the gunner has to do is hold the reticle on the center mass of the target while engaging. The IBAS automatically compensates for a moving target's speed and direction.

The CIV gives the commander his own set of optics, separate from the gunner's optics—a biocular sight and through-sight optics to engage targets. He can view a day TV or FLIR image of the battlefield through his biocular sight.

The integration of the CIV and the IBAS makes the crew a "hunter-killer" team. The commander can designate a target in his CIV and hand it off to the gunner for engagement through the IBAS; he can continue to scan for additional targets through his CIV, as the gunner engages the first target.

Survivability

The Bradley A3 includes a number of improvements and additions that better protect the crew and the squad from battlefield hazards. The turret and the top of the chassis have additional armor plating for increased protection against air burst artillery munitions. The upgraded GPFU gives each of the crew and squad members a ventilated facepiece and a quick-disconnect hose for easy access. The

GPFU is compatible with the individual protective mask for dismounts. As an additional measure for reducing fratricide, the latest BCIS, as it is developed for the Army, will be fully integrated into the C2 and fire control systems.

Still under development are the vehicle integrated defense system (VIDS) and a covert missile countermeasure device (MCD). VIDS will give the crew a laser warning when the vehicle is acquired by a laser range finder, laser designator, radar, or millimeter wave, or when it is being interrogated by a combat identification system.

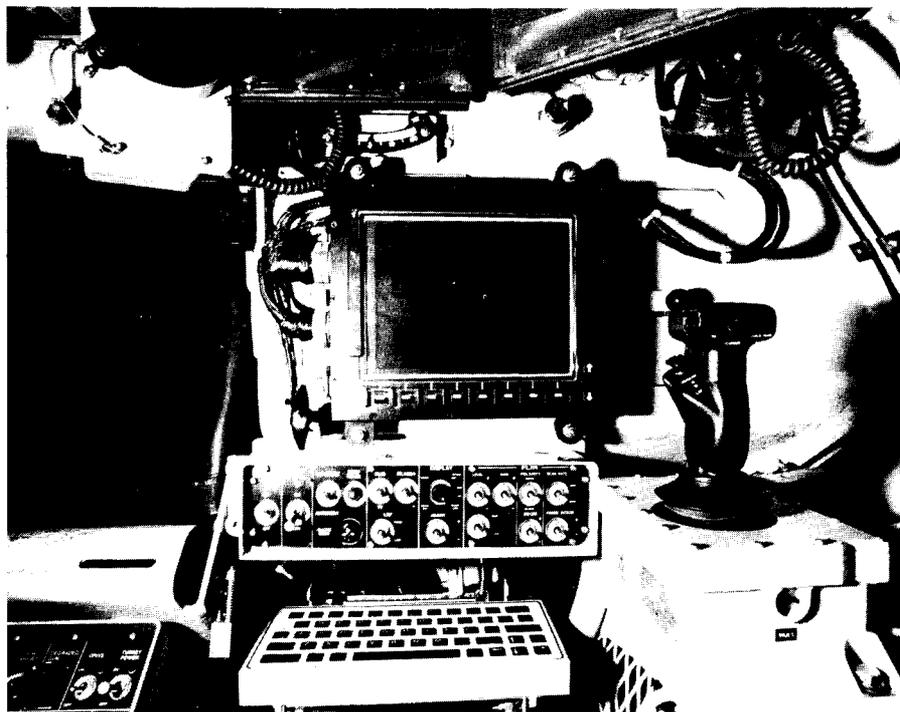
VIDS will be fully compatible with MILES 2000 to eliminate the need for MILES belts on the outside of the vehicle. When fully developed, VIDS will also be integrated with the MCD, a multi-salvo smoke grenade system, the C2 system, and the BCIS. The multi-salvo grenade launcher will contain multiple smoke canisters to eliminate the need to reload after each use. With VIDS, the crew receives an instant warning of a laser, its type or source, and its direction. The crew can then automatically engage with the appropriate weapon system, or it can fire smoke and evade the threat.

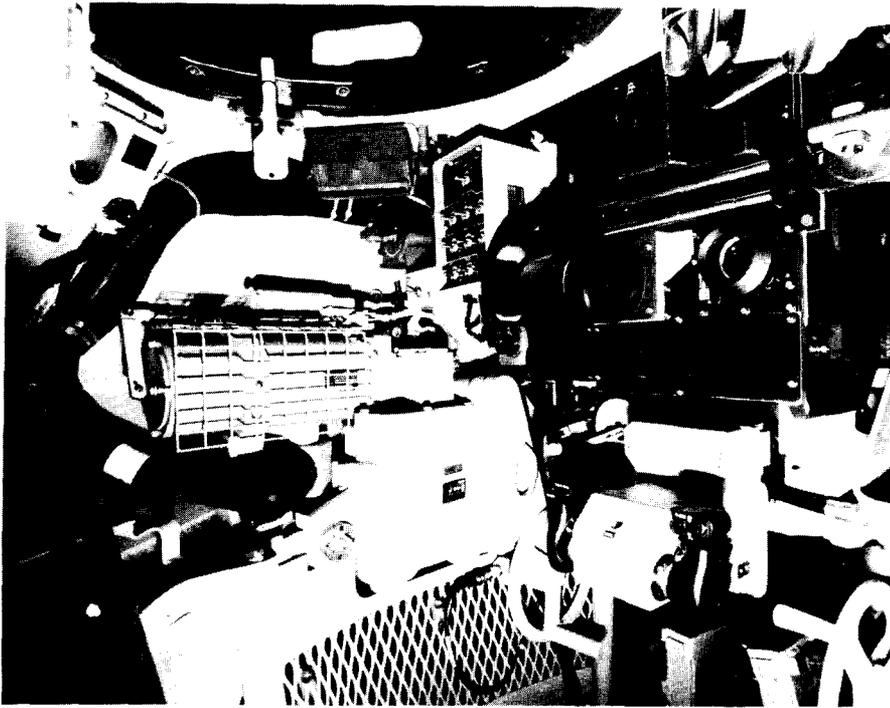
The MCD is an upgrade to the one currently mounted on the M2A2 ODS vehicle. The covert system under development will be integrated into the IBAS to reduce the MCD signature and increase the number of types of missiles it can defeat.

Mobility

A significant improvement to the navigational aids is the position navigation system (PNS), which includes an inertial navigation unit (INU) integrated with the GPS. The INU continuously updates the vehicle position based on its movement speed and direction. GPS uses satellites in space to triangulate vehicle positions. The GPS and INU work

The commander's station. The flat panel display swings out for access to the COAX, and the keyboard slides in when it is not needed.





The gunner's station. The toggle switch box to the upper left of the sights provides FLIR and day sight controls and adjustments.

together as a cross-check on position location and back-up should one or the other fail.

The commander, driver, and squad leader all have position readouts generated by the PNS. The system provides navigational data that include present location, vehicle heading, multiple waypoint and route capability, distance and bearing to waypoint, and steer-to commands. When the GPS is either denied or nonfunctional, the PNS provides a free inertial (dead reckoning) navigation capability. The PNS is fully integrated into the fire control system to support target hand-off to other weapon systems. It also supports fire control with data on vehicle attitude (pitch, roll, and yaw).

The DVE's thermal imagery gives the driver a flat panel display image that allows him to see clearly out to 150 meters and to assist in target detection at even greater distances. The DVE is a significant improvement over the AN/VVS-2; it improves the driver's depth perception and provides enhanced vision capability in all weather, day or night, and through battlefield obscurants such as smoke, haze, dust, blowing sand, rain, snow, sleet, and fog.

Sustainability

The M2/M3A3 has a complete built-in test system that queries all vehicle electronic subsystems for functionality when the vehicle is first powered-up. During operation it conducts a background sensing of the vehicle systems as they operate to give the crew a real-time vehicle status and indicate component malfunctions as they occur. When the built-in test detects a malfunction, maintenance personnel can activate the vehicle diagnostic management software (VDMS) to positively detect and isolate the fault.

VDMS will be able to isolate faults to the mission critical line replaceable unit (LRU) or cable 95 percent of the

time. Some of the electronic faults and most of the automotive faults will require additional testing to accurately isolate the source of the problem. In those cases, the soldier-portable on-system repair tool (SPORT) diagnostic system will augment the vehicle's extensive on-board built-in test and help the VDMS identify these faults.

SPORT, a laptop computer equipped with additional instrumentation, is used by the organizational mechanic to diagnose vehicle malfunctions. SPORT replaces the STE-M1/FVS test equipment currently used on the Bradley fleet. Although some of the cables and transducers from STE-M1/FVS are still needed to interface with the vehicle power train, more than 85 percent of this equipment is no longer needed. A mechanic plugs SPORT into the hull or turret data port and, in a few minutes, the VDMS has a complete vehicle diagnosis.

In the future, the mechanic will also use SPORT to load software upgrades into the vehicle LRUs as the hull and turret subsystems continue to develop and mature.

Training

Training and training devices will include all the best in training technology:

The advanced gunnery training system (AGTS) is the newest training device initiative under development. AGTS replaces the conduct-of-fire trainer (COFT) as the crew gunnery simulation trainer.

With AGTS, the commander and gunner work their way through a matrix of increasingly tough gunnery engagements in a simulated battlefield environment. The system will be mobile and deployable, a need identified during *Operation Desert Storm*. It permits training in normal, emergency, and degraded gunnery modes. It also simulates operational procedures, and target acquisition,

identification, and engagement using the primary and alternate sights. AGTS can be networked to conduct section and platoon level gunnery training in a free-play environment.

Another new feature on the Bradley A3 is a training device port that will allow the crew to use some devices from inside the turret.

One device that will use the training device port is the precision gunnery system (PGS)--an eye safe laser system that superimposes the ballistic flight of the ammunition onto the IBAS sights. The crew can observe ballistic flight characteristics and adjust sights on the basis of the resulting round dispersion. PGS simulates the main gun, the TOW, and the 7.62mm coaxial machinegun and can be used in maneuver training with MILES or other PGS-equipped systems.

The Bradley A3 is MILES-compatible and will be capable of integration with the MILES II and MILES 2000 upgrades. Again, once the VIDS is operational, the vehicle will not require MILES belts to sense MILES engagements.

Also in development is the Bradley desktop trainer (BDT), which will simulate the functions found on the commander's flat panel display. The BDT will help train vehicle commanders and unit leaders in battlefield situational awareness and the use of digital communications while in a classroom environment. BDTs can be networked to conduct unit leader training.

The close combat tactical trainer (CCTT) will provide full crew simulator modules that can be networked to battalion task force level. It assists in conducting battlefield coordination and maneuver training against a computer generated opposing force. Each crew station will create realistic weapon capabilities in a realistic battlefield scenario to test the complete task force C2, intelligence, and logistics systems.

The Bradley armor tiles training set will give crews an opportunity to practice emplacing tiles on the vehicle. The system will include a complete set of vehicle tiles and a video tape for instructions.

For maintenance training, the M2A3 system will have two supporting training aids--the hands-on turret trainer (HOTT) and the maintenance trainer console system. HOTT is a stand-alone turret trainer that can be programmed to simulate both normal conditions and malfunctions in the turret. A trainee can conduct all maintenance actions, including troubleshooting, replacing, or adjusting as the set conditions dictate.

The maintenance trainer console system provides simulated operating and malfunction conditions for the weapons, turret drive, IBAS, CIV, and C2 systems. Display panels graphically represent the appropriate stations in the vehicle and provide operational controls and indicators. Like the HOTT system, the console system can be programmed to imitate normal and malfunction modes in the vehicle and provide realistic system responses to the trainee's actions.

Bradley M2/M3A3 digitization provides an integrated C2, communications, fire control, and logistics system that gives the infantry soldier significantly more situational awareness and the ability to react quickly to changes. The improved fire control technology will help him see farther in all visibility conditions and to identify and engage targets more quickly and accurately.

With the integrated fire control and C2 systems, an infantry soldier will constantly know his location and that of the adjacent vehicles and units on the battlefield. Should the situation dictate, he can efficiently hand off a target to a weapons platform that is better suited to engage it.

The improved survivability suite will better protect the vehicle crew and squad from the effects of direct, indirect, and chemical weapons. It will also help the soldiers react effectively to modern laser engagement systems as well as identify friend or foe.

The M2A3/M3A3 is a complex system, but the automated training devices and accurate maintenance diagnostic systems will improve the infantry soldier's performance and readiness with this vehicle.

The technology for the 21st Century battlefield is here today in the Bradley M2A3/M3A3. Infantry soldiers who are in the first unit equipped in the year 2000 will have a set of advantages never before seen on the mechanized battlefield. The Bradley M2A3/M3A3 is the infantry's fighting vehicle for the 21st Century.

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