

ANTIARMOR WEAPONS

Subcourse Number IN0546

Edition B

UNITED STATES ARMY INFANTRY SCHOOL
FORT BENNING, GEORGIA 31905-5593

5 CREDIT HOURS

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SUBCOURSE OVERVIEW

This subcourse is designed to teach you to identify the characteristics of opposing forces antiarmor weapons, current opposing forces antitank guided missiles, U.S. antiarmor weapons, (including TOW 2 mounts and carriers and TOW missile types and markings), and future antiarmor weapons (both US and opposing forces).

There are no prerequisites for this subcourse.

This subcourse reflects the doctrine that was current at the time it was prepared. In your own work situation, always refer to the latest publications.

The words "he," "him," "his," and "men," when used in this publication, represent both the masculine and feminine genders unless otherwise stated.

TERMINAL LEARNING OBJECTIVE

Action: You will be able to identify the characteristics of opposing forces antiarmor weapons, current opposing forces antitank guided missiles, U.S. antiarmor weapons, (including TOW 2 mounts and carriers and TOW missile types and markings), and future antiarmor weapons (both US and opposing forces).

Condition: Given the subcourse material contained in this lesson.

Standard: To demonstrate competency of this subcourse, you must achieve a 70 percent or higher on the subcourse examination.

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IN0546 Edition B Examination

Lesson 1

CURRENT U.S. ARMY ANTIARMOR WEAPONS

OVERVIEW

Lesson Description:

In this lesson, you will learn to identify the characteristics of the following current US Army antitank weapons: the Light Antitank Weapon (LAW); the Dragon Medium Antitank/Assault Weapon; and the Launcher Cartridge 84-MM, M136 (AT4), HEAT. In addition, you will learn to identify the characteristics of TOW/TOW 2 mounts and carriers and TOW/TOW 2 missile types and markings.

Terminal Learning Objective:

Action: Identify the characteristics and components of the following current U. S. Army antitank weapons: Light Antitank Weapon (LAW); Dragon Medium Antitank/Assault Weapon; and the

Launcher Cartridge 84-MM, M136 (AT4), HEAT. In addition, identify the characteristics of TOW/TOW 2 mounts and carriers and TOW/TOW 2 missile types and markings.

Condition: Given the subcourse material contained in this lesson.

Standard: Identify the characteristics of the Light Antitank Weapon (LAW); the Dragon Medium Antitank/Assault Weapon; and the Launcher Cartridge 84-MM, M136 (AT4), HEAT; and TOW/TOW 2 mounts and carriers and TOW/TOW 2 missile types and markings.

References: The material contained in this lesson was derived from the following publications:

FM 23-24
FM 23-25
FM 23-33
FM 23-34
FM 1-402

INTRODUCTION

The United States Army has a number of antiarmor weapons to use against the armored personnel carriers (wheeled and tracked) and tanks (as well as bunkers and other fortifications) of opposing forces. These antiarmor weapons include the light antitank weapon (LAW); the Dragon Medium Antitank/Assault Weapon; and the Launcher and Cartridge 84-MM, M136 (AT4), HEAT. In addition, the TOW Weapon System is used to engage enemy armor. This lesson will teach you to identify the characteristics of the LAW, the Dragon, and the AT4 as well as the characteristics of TOW/TOW 2 mounts and carriers and TOW/TOW 2 missile types and markings.

PART A - antiarmor WEAPONS

1. M72A2 Light Antitank Weapon (LAW).

The following paragraphs discuss the characteristics of the M72A2 Light Antitank Weapon (LAW).

- a. **Background.** The LAW (shown in Figure 1-1) is a lightweight, self-contained antitank weapon consisting of a rocket packed in a launcher. The launcher serves as a watertight packing container for the rocket and houses a percussion-type firing mechanism to activate the rocket.

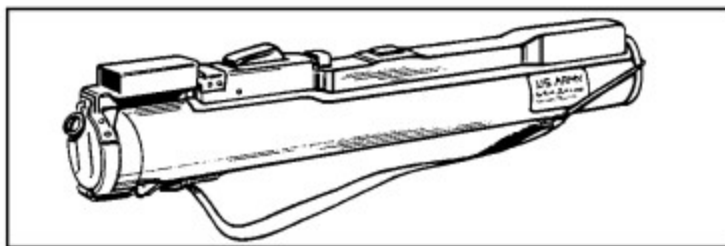


Figure 1-1. M72A2 LAW (Closed Position).

The launcher must be extended to the open position, as shown in Figure 1-2, for firing. The rocket is fixed inside the launcher and attached to it by the igniter.

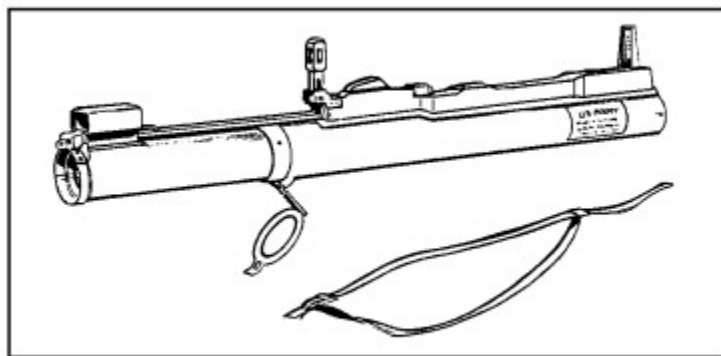


Figure 1-2. M72A2 LAW (Open Position).

The rocket (shown in Figure 1-3) is a percussion-ignited, fin-stabilized, fixed munition.

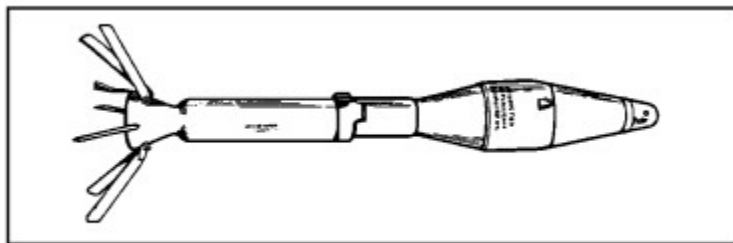


Figure 1-3. 66-MM High Explosive Antitank (Heat) Rocket.

The M72A2 rocket has a greater armor penetrating capability than the M72A1 rocket.

The LAW is used as ammunition rather than as an individual weapon. It is carried and employed by the soldier in addition to his basic weapon. Basic loads of LAW are assigned to units. Individuals assigned to units authorized a basic load of LAW should be trained in its use. LAW supplements other organic antitank weapons. It provides the primary means of antitank protection for the rifle squad and other units or installations which do not have organic antitank weapons. It may be used in the offense by assault elements or in the defense by any combat or other element of the Army.

b. Offensive Capabilities. In the attack, the LAW should be readily available to

influence the action where necessary. Due to its relatively short range, the LAW should be spread throughout the maneuver element. The LAW is employed primarily against the armored vehicle. It may also be used against:

- Light vehicles.
- Bunkers.
- Pillboxes.
- Other crew-served weapon positions..

The LAW's light weight and size make it the ideal weapon for armor-killer operations, ranger operations, and special forces missions.

The night vision sight (AN/PVS-4) (when available) can be attached to the LAW for operation during periods of reduced visibility or darkness.

c. Defensive Capabilities. LAWs should be positioned laterally and in depth to cover the most likely avenues of armored approach. Lateral dispersion is necessary to increase the probability of obtaining oblique fire on enemy armor approaching the defensive position. Due to its one-shot capability, more than one LAW should normally be assigned to troops designated to fire it. Since all riflemen may be given a LAW, consideration must be given to the backblast when siting and constructing fighting positions.

The LAW can be effectively employed at night by using artificial illumination. The 40-mm illumination round is good for LAW engagements. Illumination should be placed above and slightly beyond the target. Night firing is an essential part of LAW marksmanship training.

2. Launcher and Cartridge 84-MM, M136 (AT4), HEAT.

This paragraph discusses the characteristics of the launcher and cartridge, 84-mm, M136 (AT4), HEAT, or AT4.

a. Characteristics. The AT4 is a lightweight, self-contained antiarmor weapon. It consists of a free-flight, fin-stabilized cartridge packed in an expendable launcher. It is man-portable and fired from the right shoulder only. It is issued as a round of ammunition and requires minimal operator maintenance. The launcher (shown in Figure 1-4) serves as a watertight packing container for transportation and storage.

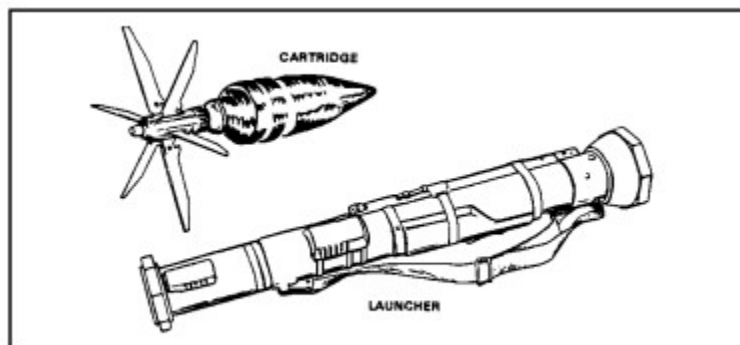


Figure 1-4. Launcher and Cartridge, 84-mm, M136 (AT4), HEAT.

b. Use. In addition to your weapon, you carry and use the AT4. It supplements other organic antiarmor weapons. It provides antiarmor capability for the rifle squad and other units or installations that do not have organic antiarmor weapons. The AT4 can be used in offenses by assault and support elements or in defenses by any element of the US Army.

c. Training Program. The recommended training program should be used by units to maintain the soldier's proficiency with the AT4.

d. Employment. The AT4 is mainly used against armored personnel carriers (APCs). However, it can be used against battle tanks when it is fired at the flanks or the rear. It can also be used as an assault weapon against bunkers, field fortifications, and other hard-point positions.

e. Environments. The AT4 is designed to withstand arctic, tropic, and desert conditions. It can withstand any combination of natural environments.

f. Visibility. The AT4 can be used during limited visibility. Target engagement, however, is limited by your ability, as the firer, to visually detect and identify the target and determine the range to the target.

g. Technical Data and Nomenclature. The following paragraphs list technical data concerning the AT4 system.

(1) Technical Data. These are the technical data regarding the AT4:

- Weight = 6.7 kilograms (14.8 pounds) (overall system); 1.8 kilograms (4 pounds) (cartridge)
- Caliber = 84 millimeters
- Length = 1,020 millimeters (40 inches)
- Muzzle velocity = 290 miles per hour (mph) (950 feet per second (fps))
- Operating Temperature Range = -40 degrees C to 60 degrees C (40 degrees F to 140 degrees F)
- Range = 2,100 meters (6,890 feet) (maximum)
 - Maximum effective range = 300 meters (985 feet)
 - Minimum arming range = 10 meters (33 feet)
 - Minimum target engagement range (training) = 30 meters (99 feet)

(2) Nomenclature. The nomenclature for the common names of the AT4 components are:

<u>Common Name</u>	<u>Nomenclature</u>
Tracer trainer	M287 9-mm tracer bullet training device

Forward safety	Safety lever
Trainer body assembly	Barrel assembly
Face and shoulder pad	Recoil pad
Front and rear sight covers	Protective housings
Lanyard	Chain assembly
Cartridge	M939 9-mm tracer cartridge

h. Ammunition. The AT4 is issued as a round of ammunition. The cartridge consists of the following parts:

Fin assembly with a tracer element.

Point-initiating, base-detonating, piezo-electric fuze.

Warhead body with liner.

Precision-shaped explosive charge (it is the only tactical ammunition for the AT4). The HEAT cartridge is shown in Figure 1-5..

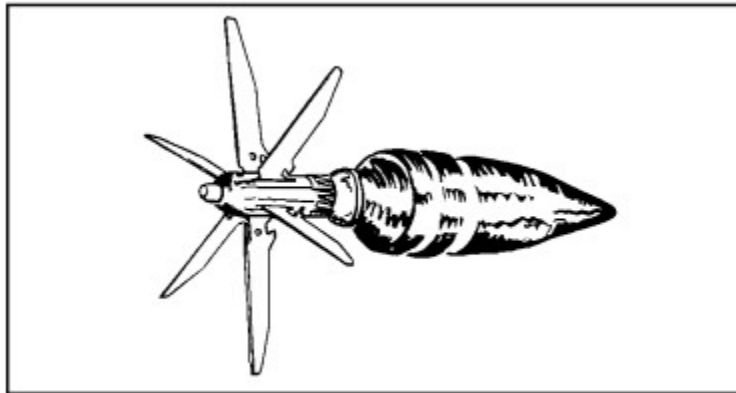


Figure 1-5. HEAT Cartridge

The AT4 is used mainly as an antiarmor weapon. However, it can be used against gun emplacements and bunkers.

i. Technical Data. The following technical data pertain to the tactical cartridge:

- Length = 460 millimeters (18 inches).
- Caliber = 84 millimeters.
- Warhead = HEAT (precision-shaped charge).
- Fuze = piezoelectric crystal.

j. Packaging. Five AT4s are packed in a wood container. Each AT4 is further protected by a plastic barrier bag. A pallet load must not be stacked higher than four containers per pallet because of weight stress on the containers.

Each wood container is checked for serial numbers for the individual launchers and classification (shown in Figure 1-6). The container is checked for damage. If it is damaged or punctured, the proper authority is notified.

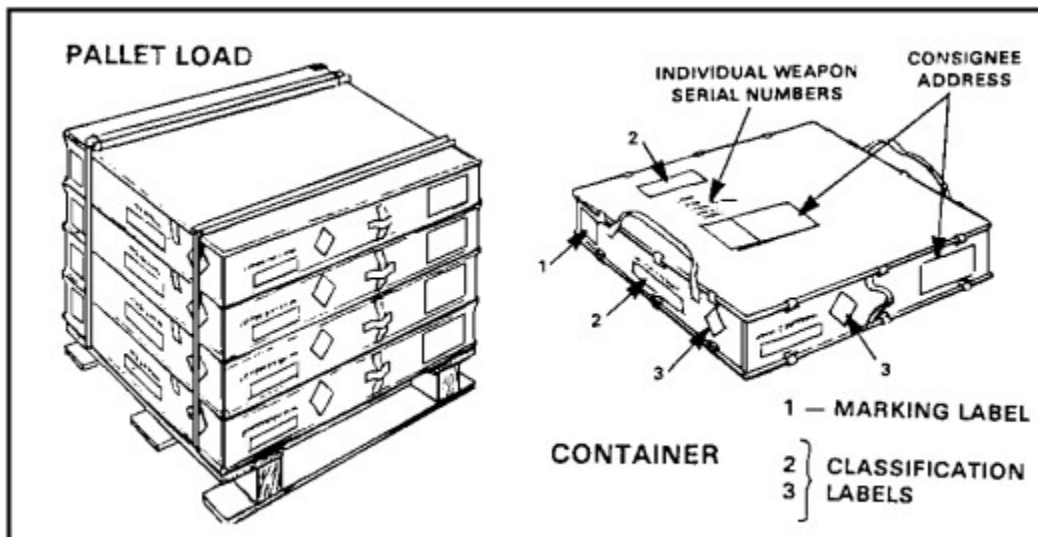


Figure 1-6. Ammunition Packaging.

k. Launcher Color-Code Band. The launcher color-code band is between the front and the rear sights (shown in Figure 1-7).

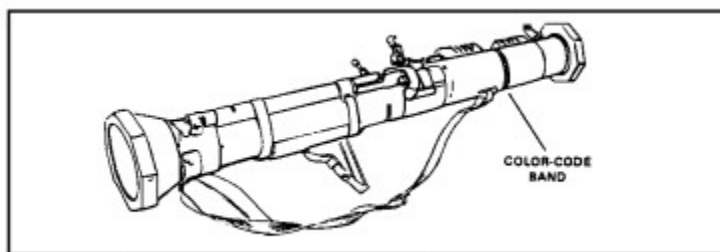


Figure 1-7. Location of Color-Code Band.

The color codes are:

- Black--with yellow band = high-explosive, antiarmor.
- Gold--field handling trainer.

NOTE: The M287 9-mm tracer bullet training device (TBT) has no color-code band.

l. Service Upon Receipt. Upon receipt of the wood container, open the container. Remove the plastic barrier bag from each of the five AT4s. Perform serviceability checks.

m. Weapon Capabilities. The AT4 has greater penetrating power and after-armor effect than previous light antiarmor weapons. The use of the AT4 is not limited to armored vehicles. It is effective against bunkers and field fortifications.

n. Target Vulnerability. An armored vehicle usually has its heaviest armor on the front slopes. By comparison, the top, rear, flanks, and bottom have much less armor protection. The weak points of armor for the T62, the Soviet fighting vehicle (BMP), and the BRDM are shown in Figure 1-8. Firers should try to engage an armored vehicle from the flank or the rear. The flank offers the largest possible target area for target engagement. Firers should always try to get a center-of-mass hit.

Armored vehicles can be disabled in three ways:

- Mobility Kill. The vehicle has stopped moving because a track or a road wheel has been blown off or the vehicle has been hit in the engine compartment. The vehicle is no longer mobile, but it can still return fire.
- Firepower Kill. The main gun cannot return fire because it has been hit in the turret and its capability of firing has been knocked out. The vehicle can still move and is able, therefore, to get away.
- Catastrophic Kill. The vehicle is destroyed. To obtain a catastrophic kill, firers should be prepared to fire a second or a third shot to destroy the vehicle..

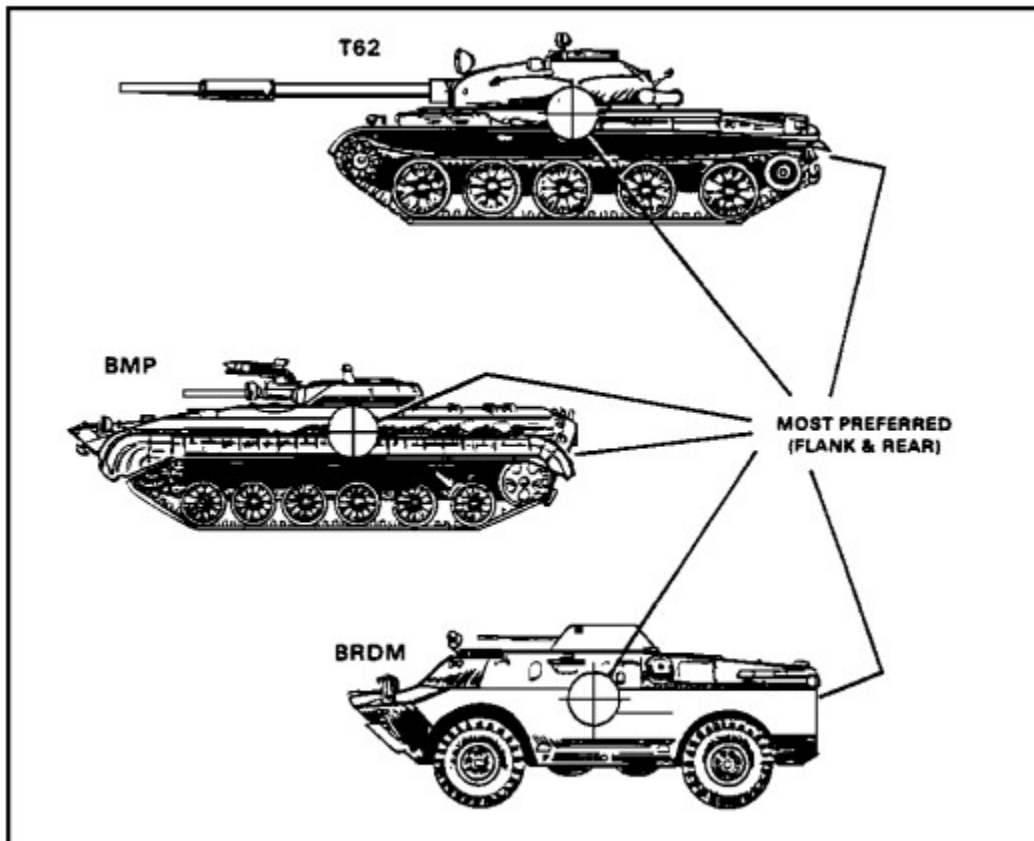


Figure 1-8. Armor Weak Points.

An armored vehicle without the protection of dismounted infantry is vulnerable to a close attack by well-armed infantry units. When an armored vehicle is buttoned up, the crew's visibility is restricted, as shown in Figure 1-9. This provides an opportunity for an armor-killer team to approach the vehicle with less risk of detection.

Natural or man-made obstacles force the vehicle to slow, stop, or bypass, thus enabling the firer to possibly achieve a first-round hit.

NOTE: Hitting an armored vehicle below center mass may stop the vehicle but not its turret or guns. The same is true of a rear shot. Firers should be ready to fire a second or a third shot to destroy the vehicle.

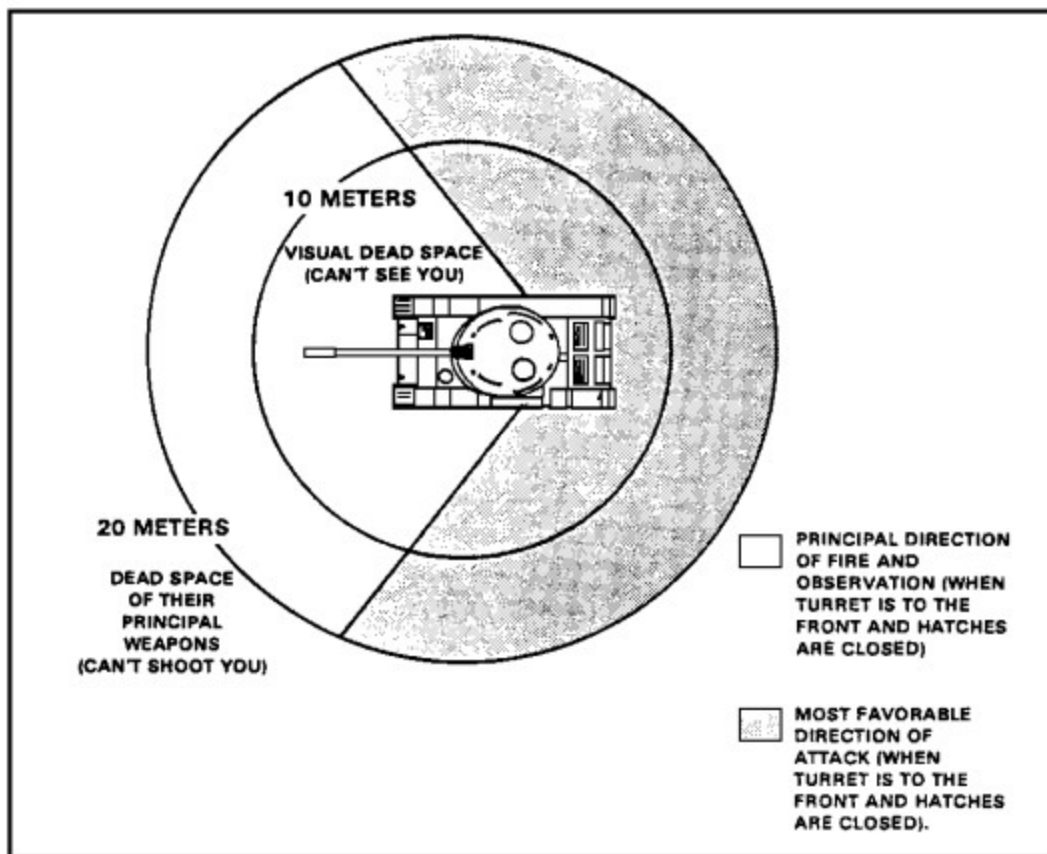


Figure 1-9. Limited Visibility of Armored Vehicles.

3. Dragon Medium Antitank/Assault Weapon.

This paragraph discusses the characteristics and components of the M47 Dragon.

a. Characteristics. The guided missile system, surface attack: M47 (Dragon), is a man-portable, shoulder-fired, medium antitank weapon referred to as the Dragon. Capable of defeating armored vehicles, fortified bunkers, concrete gun emplacements, and other hardened targets on the battlefield, it can be operated by the individual soldier or by a two-man team. When you use the Dragon with the

mechanized infantry, you can mount and fire it from the armored personnel carrier (APC) or you can mount and fire it from the M3 or the M122 machine gun tripod, using the M175 mount. You can fire the Dragon using either the day tracker or the night tracker. The Dragon night tracker (AN/TAS-5) increases the gunner's ability to engage targets during limited visibility. You can engage targets during daylight and during limited visibility, such as that caused by smoke, fog, or darkness.

b. Components. The Dragon consists of the components shown in Figure 1-10. These components are as follows:

- Day tracker.
- Night tracker.
- Round of ammunition.

The round is the expendable part of the system. The round has two major assemblies:

- Launcher.
- Missile.

The launcher serves as the handling and carrying container for firing the missile.

The tracker is the reusable part of the system. It is designed for fast, easy detachment from the round. The tracker (day or night) determines any deviation of the missile from the line of sight (LOS) and generates correcting signals. These correcting signals are sent to the missile control system by a wire link.

c. Defensive Capabilities. The Dragon is basically a defensive weapon that can be used in all weather conditions and in any type of terrain. It is organic to infantry, armor, and artillery units. The Dragon provides the mounted or the dismounted soldier with a defense against hostile armor during both day and night operations.

The Dragon can be used during the assault against field fortifications, heavy weapon emplacements, and other hard-point targets. With its light weight, rapid deployment, and ease of operation, it is particularly suited for airborne and air mobile operations.

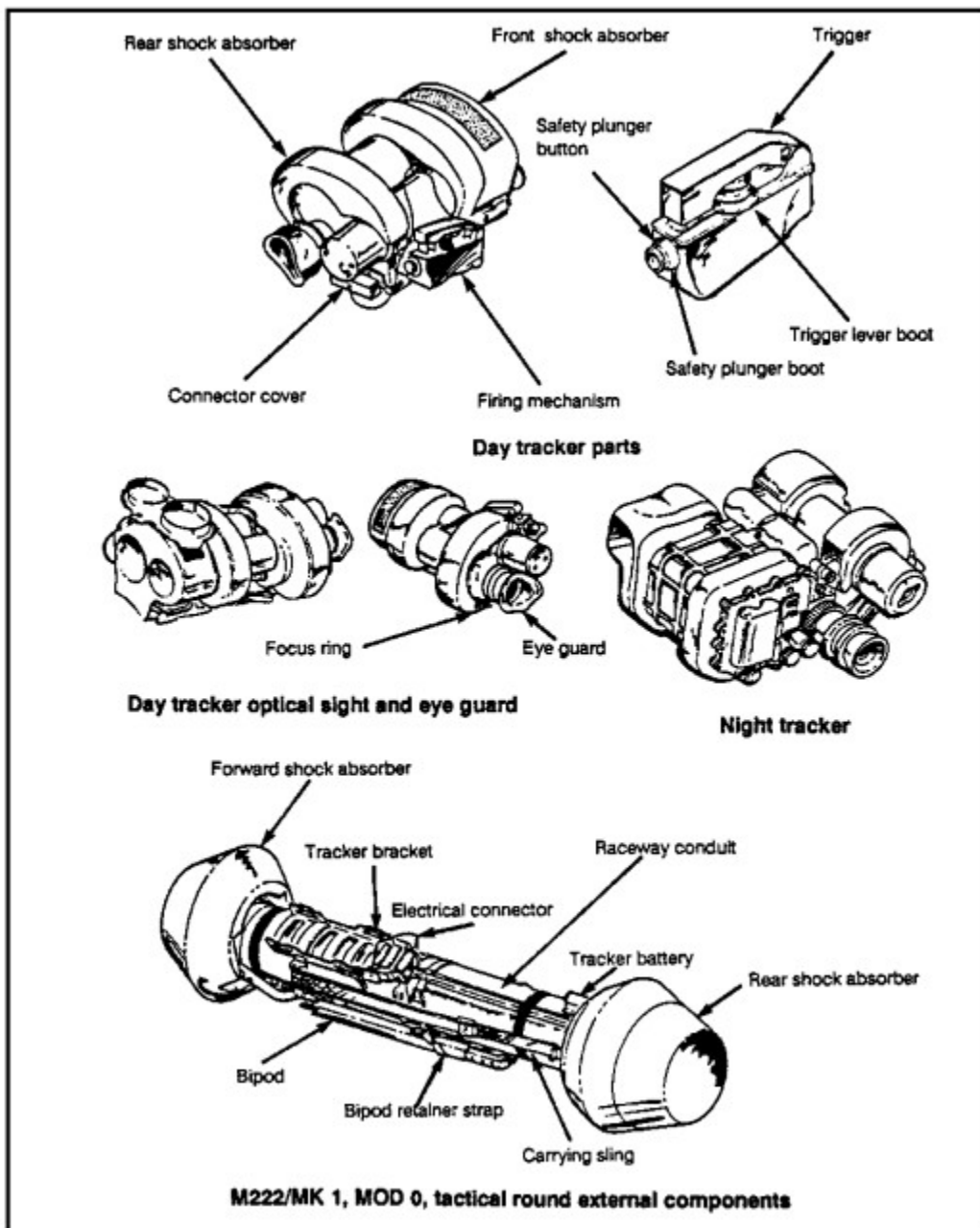


Figure 1-10. Dragon Components.

d. Tracking and Controlling Capabilities. The command line of sight guidance system of the Dragon provides a high probability of a hit. However, to achieve a hit, the gunner must be well trained concerning steady hold factors. The gunner acquires the target in the tracker (day or night) and sets and holds the sight cross hairs on the center mass on the exposed portion of the target. This provides a continuous line of sight for the tracker; other gunner control is required. The guidance and control are automatic until the missile impacts and the gunner

detaches the tracker, disposes of the expended launcher, and prepares to fire another round.

e. Mobility. The system can be hand-carried by one man. Therefore, the gunner/team chief can quickly displace to reduce the chance of detection or to engage targets that are not within the range of the primary fighting position.

f. Rounds. Three basic rounds are available for use with the Dragon: M222 and MK 1, MOD 0, tactical rounds (heat warheads), and M223 practice round (inert warhead).

All rounds use the same basic airframe, aerodynamic control system, command-link wire, and missile electronics design.

g. Equipment Data. The following data describe the general and the specific characteristics of the Dragon:

(1) General. The Dragon has the following general characteristics:

- Minimum range = 65 meters.
- Maximum range = 1,000 meters.
- Ammunition = high explosive antitank warhead and inert warhead.

(2) Specific. The Dragon has the following specific characteristics:

(a) Round: M222/M223 weight = 14.6 kilograms (25.29 pounds).

- Missile length = 744 millimeters (29.39 inches).
- Launcher length = 1,154 millimeters (44.1 inches).

(b) Round: MK1, MOD 0 weight = 16.2 kilograms (27.2 pounds).

- Missile length = 846 millimeters (33.32 inches)
- Launcher length = 1,154 millimeters (44.1 inches)

(c) Day tracker weight = 3.1 kilograms (6.7 pounds); length = 196 millimeters (7.72 inches)

(d) Night tracker weight = 9.82 kilograms (21.65 pounds); length = 368 millimeters (14.5 inches)

h. Night Tracker Coolant Cartridge and Battery Carrying Container. Mechanized infantry squad are issued five coolant cartridge packs and one battery carrying container full of components. A nonmechanized squad is issued five coolant cartridge packs and three battery carrying containers full of components.

i. Support Equipment (M113-Equipped Units Only). Units equipped with the M113 APC are authorized the following Dragon support equipment:

Guided missile launcher mount.

M175, M3/M122 machine gun tripods.

Vehicle storage kit.

(1) M175 Mounting Assembly. The guided missile launcher mount (shown in Figure 1-11) provides a stable platform for firing the Dragon missile from the M113 APC and the M3 or M122 machine gun tripods. The unit track mechanic installs the M175 mounting assembly on the APC. If the APC is turned in for overhaul or repair, ensure that the unit mechanic removes all support equipment.

The mounting assembly provides improved, stable firing and tracking conditions for the gunner, thereby increasing weapon system effectiveness.

The mount fires the M222/MK1, MOD 0, tactical rounds or the M233 practice round and accommodates the M54 launcher effect trainer (LET) and the M57 field handling trainer (FHT).

The round and the tracker are electrically mated through two connectors on the mount. Fire them using a remote firing mechanism on the right rear of the cradle.

Azimuth and elevation to reduce gunner and vehicle vibrations and assist the gunner in obtaining a firm, steady tracking action.

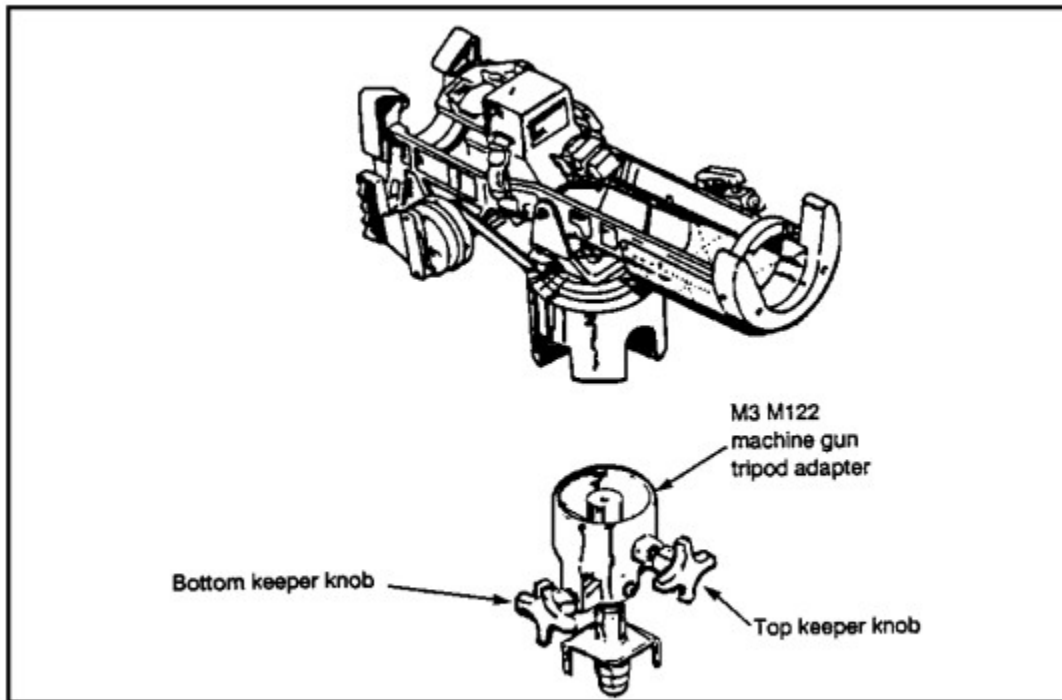


Figure 1-11. Guided Missile Launcher Mount.

(2) M3/M122 Machine Gun Tripod. Either the M3 or the M122 machine gun tripods (shown in Figure 1-12) can be used to fire the Dragon from a ground support position.

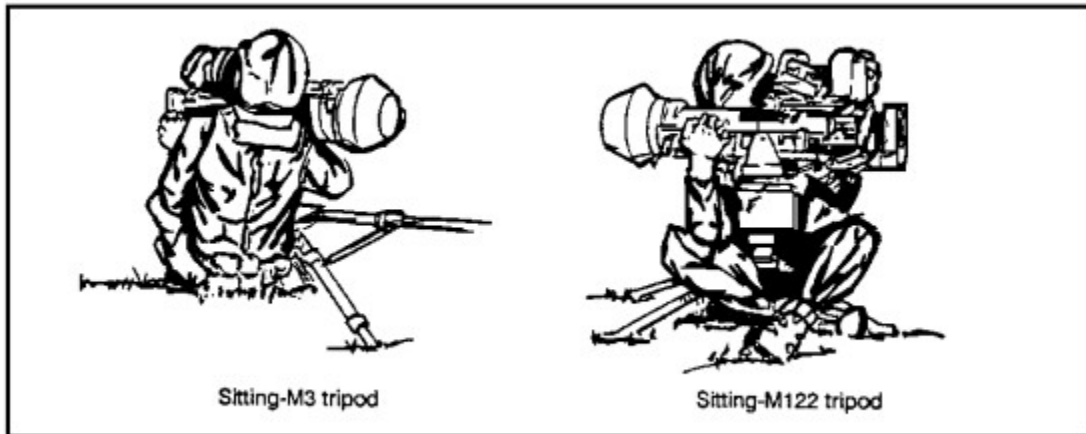


Figure 1-12. M3/M122 Machine Gun Tripods.

(3) Vehicle Storage Kit. The vehicle storage kit (shown in Figure 1-13) is installed in all M113 APCs assigned to mechanized infantry squads. It consists of the following night tracker support equipment:

- A night tracker storage rack, located just below the day tracker storage case, to secure the night tracker when it is not in use.
- A vehicle power conditioner to step down the power of the 24-volt battery.
- A battery charger rack and a PP-7382/TAS battery charger are also operated from the APC power source.
- Three coolant cartridge container storage racks and one battery container storage rack are under the personnel seats.

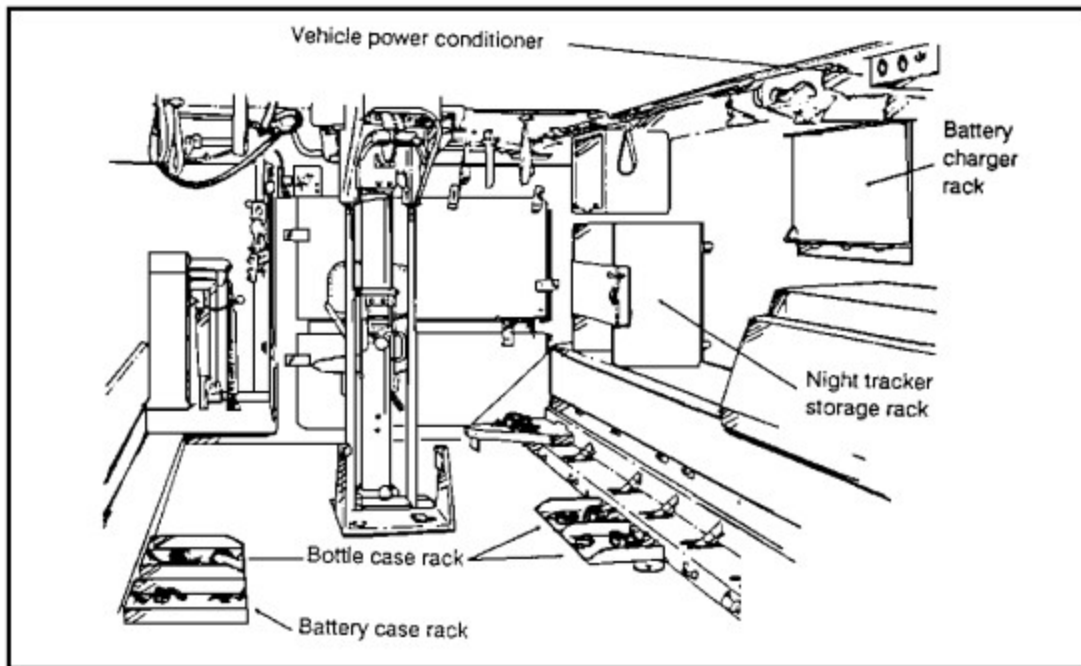


Figure 1-13. Vehicle Storage Kit.

PART B - TOW/TOW 2 MOUNTS AND CARRIERS

1. Introduction.

The tube-launched, optically tracked, wire-guided (TOW) weapon system has undergone several developments which have introduced significant improvements to the original (Basic) TOW, such as the Improved TOW (I-TOW) and the TOW 2 series (TOW 2, TOW 2A, and TOW 2B). The TOW/TOW 2 weapon system can be mounted on a tripod or carried on a number of carriers (M151A2, HMMWV, M113A2, M901A1, Cobra and Apache attack helicopters). Part B will teach you the characteristics of TOW mounts and carriers as well as the characteristics of TOW missiles and markings.

The tube-launched, optically tracked, wire-guided (TOW) is a crew-portable, heavy antitank missile weapon system. The TOW operates from

- the ground.
- armored, lightly armored, or unarmored multipurpose vehicles.
- helicopters.

The system consists of a guided missile and a launcher used to engage

- tanks.
- fortifications.
- other material targets.

The launcher is the hardware that initiates, tracks, and controls the flight of the missile.

This is done by guidance signals transmitted over a command-link wire that connects the missile with the launcher.

2. Characteristics.

The TOW weapon system has the characteristics identified in the following paragraphs.

a. Description. The TOW weapon system consists of a launcher which has tracking and control capabilities and the TOW, which is encased in a launch container. A night sight is also provided to aid in tracking during limited visibility. The launcher is equipped with self-contained, replaceable units.

b. Capabilities. The TOW weapon system can be employed in all weather conditions if the gunner can see his target through the optical sight or the night sight. The TOW is primarily an antitank weapon used to provide long-range engagement of all known armored targets. The TOW missile is capable of destroying targets at a maximum range of 3,750 meters (depending upon the type of missile).

The TOW also provides a long-range assault capability against

- heavily fortified bunkers.
- pill boxes.
- gun emplacements.

Components of the night sight are:

- AN/TAS-4 night sight.
- Boresight collimator.
- Night sight vehicle power conditioner.
- Batteries.
- Coolant cartridges.

The TOW missile is also a major component of the weapon system.

The TOW launcher has the following capabilities and features:

- It operates in all weather conditions in which the gunner can see the target through the optical sight or the night sight.
- It operates during the day and the night.
- It operates in temperatures of -32° to +60° C (-25° to +140° F).
- It operates at altitudes up to 3,050 meters (10,000 feet).
- It has a high first-round-hit chance against targets that stay still or move.
- The entire weapon system can be hand-carried by the weapons crew.
- It is easy to operate.
- Firing sites can be changed quickly to avoid being seen or to engage

targets not within the range of a single firing position.

- Mounting kits allow mounting on several different vehicles.
- It is easily removed or installed without the use of tools.
- The weapon system can be checked out by a self-test without the use of test equipment.
- Failed components can be replaced at the operating site by Direct Support personnel.
- The minimum and the maximum effective ranges of the missile are 65 to 3,750 meters. (Hit probability of extended range missile is reduced to 3,750 meters due to MGS circuitry design).

c. Tracking and/or Control Capabilities. The automatic missile tracking and/or control capabilities of the TOW weapon system provide a first-round-hit probability. To operate the system, the gunner performs the following actions:

- Places the cross hairs of the optical sighting system (either the optical sight or the night sight) on the target.
- Fires the missile.
- Keeps the cross hairs centered upon the image of his target until missile impact.

The optical tracking and command functions within the system guide the missile along the gunner's line of sight. The gunner does not apply lead, windage, or elevation.

d. Mobility. The TOW weapon system allows it to be mounted on a vehicle or to be emplaced on the ground (tripod-mounted) for operation. Missiles can be launched from either operational mode. The TOW weapon system appears in the following configurations:

- Tripod-Mounted TOW/TOW 2.
- M151A2-Mounted TOW/TOW 2.
- M966-Mounted TOW/TOW 2.
- M113A2-Mounted TOW (basic).
- M901-Series Improved TOW Vehicle.

A weapon crew can hand-carry the entire system. Therefore, emplacement sites can be changed quickly to minimize detection or to engage targets that are not within the range of one emplacement. The vehicle-mounted launcher has a greater degree of mobility and can be quickly prepared for use. The assembly and the disassembly of the launcher is accomplished quickly in the field without the use of tools. The operational condition of the assembled launcher can be checked any time by the use of built-in self-test circuits.

3. System Configurations.

The TOW weapon system comes in two configurations: the M220A1 (TOW) and the M220A2 (TOW 2).

a. M220A1 (TOW) Weapon System. The M220A1 TOW consists of the following major components (shown in Figures 1-14 and 1-15):

- Tripod.
- Traversing unit.
- Launch tube.
- Daysight tracker.
- AN/TAS-4 nightsight.
- Missile guidance set (MGS).
- A battery assembly housed in the compartment of the MGS.
- An encased missile.

The M220A1 weighs about 265.5 pounds with all its components and carrying cases. With the encased missile (BGM-71A), the M220A1 weighs 320 pounds.

The M220A1 TOW uses the following missiles:

- BGM-71A.
- BGM-71A-1.
- BGM-71A-2.
- BGM-71A-3.

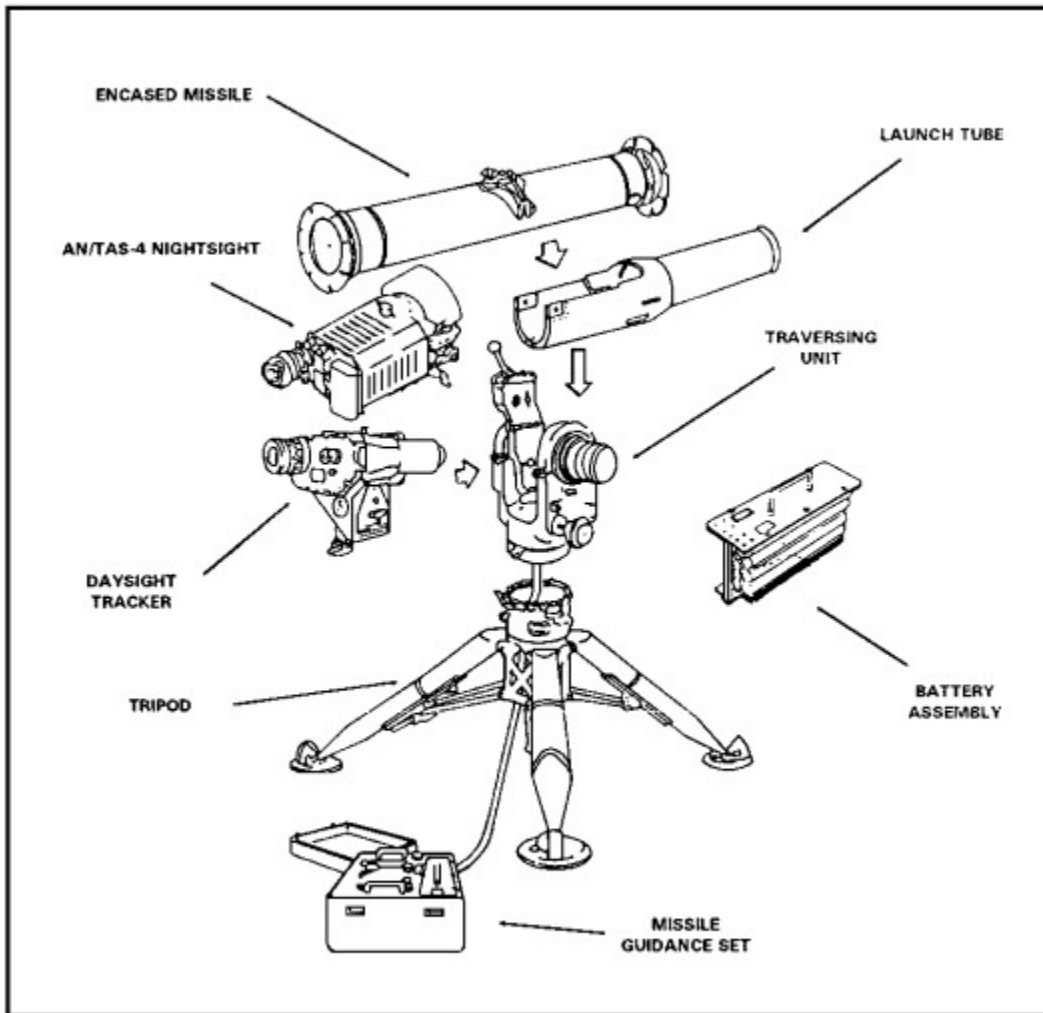


Figure 1-14. M220A1 TOW Components.

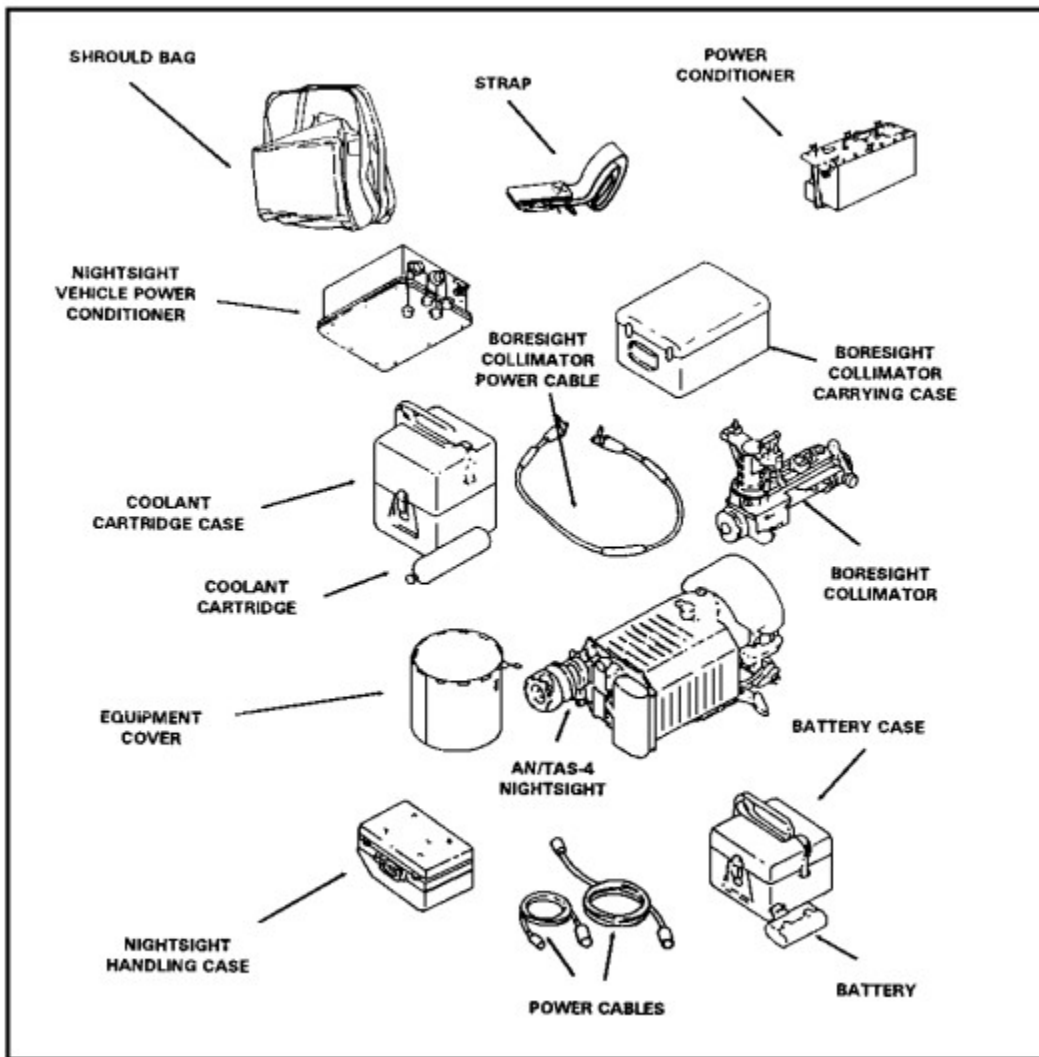


Figure 1-15. M220A1 TOW Components. (Continued).

It can also launch the BGM-71D (TOW 2) missile but lacks the capability to track the BGM-71D (TOW 2) through obscurants and countermeasures.

b. M220A2 TOW 2 Weapon System. The M220A2 is a combination of both a modification to the M220A1 TOW launcher and the addition of a new missile. The M220A2 TOW 2 launcher modified the M220A1 TOW components below (shown in Figure 1-16) to form the M220A2 TOW 2 launcher:

- Traversing unit.
- Digital MGS.
- AN/TAS-4A thermal night sight.

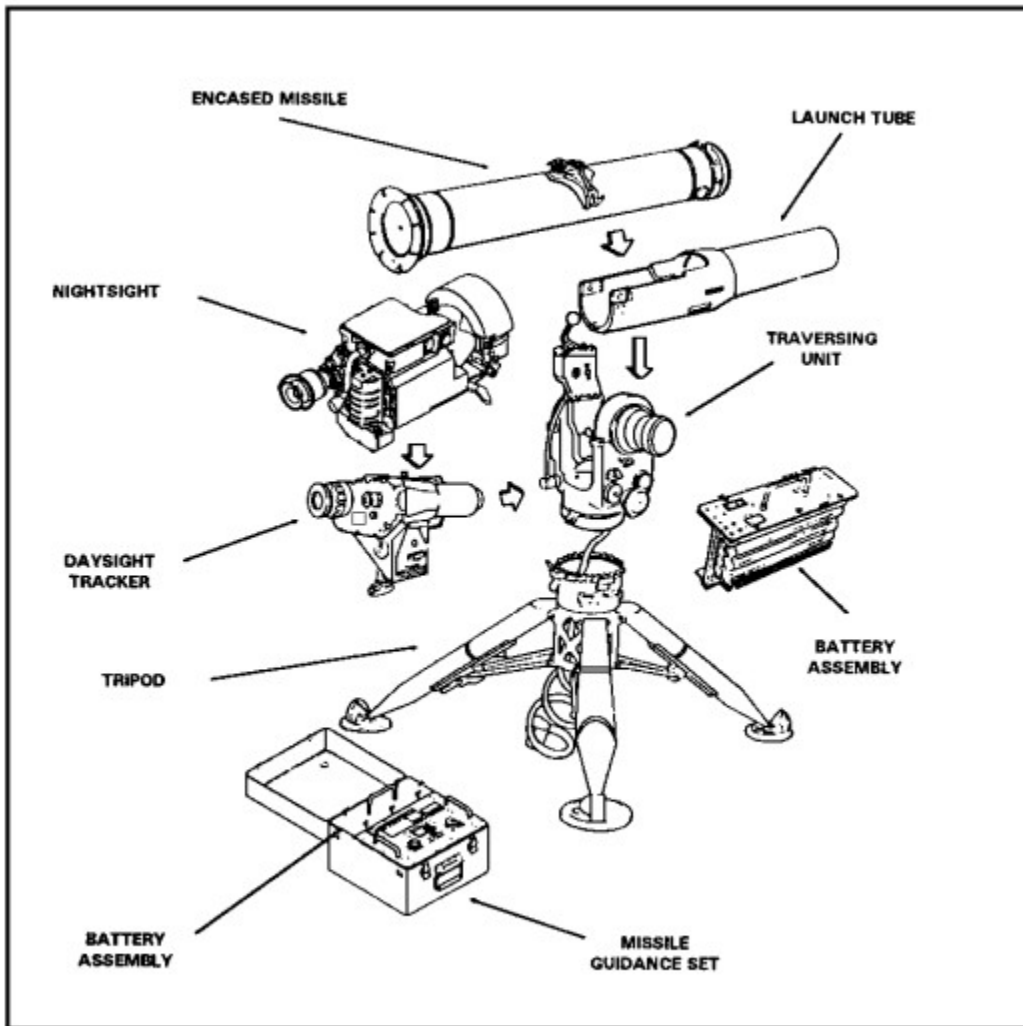


Figure 1-16. M220A2 TOW 2 Components.

The M220A2 TOW 2 weapon system weighs 256.5 pounds with all its components and carrying cases (shown in Figure 1-17). With the encased missile (BGM-71D), it weighs about 318.5 pounds.

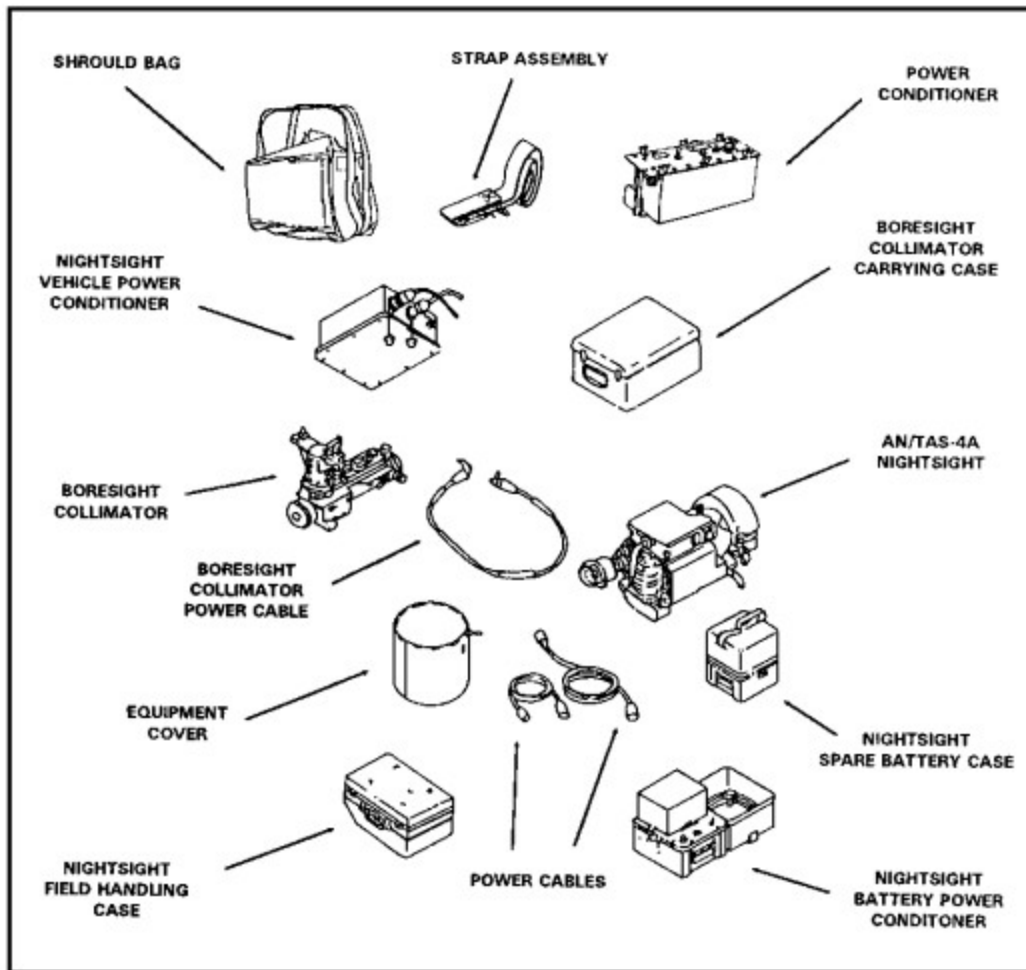


Figure 1-17. M220A2 TOW Components (Continued).

The TOW 2 missile (BGM-71D) improvements include the following items:

- New guidance-link.
- Full-caliber, six-inch warhead.
- Reloaded flight motor.
- Longer warhead probe.

The M220A2 TOW 2 launcher is compatible with all nine missile configurations. It can achieve a higher probability of hit against all types of targets through improved microprocessor-based electronics that use digital design techniques.

The TOW 2 weapon system introduces the following improvements to the TOW weapon system:

- TOW 2 Missile. The TOW 2 missile is engineered to be highly effective against heavy armor (tank) threats likely to appear on the battlefield in the late 1980s and early 1990s. It features a redesigned standoff probe, an

improved flight motor, a more robust warhead, and an additional tracking beacon.

- TOW 2 Warhead. The TOW 2 warhead, which is heavier, larger, and more powerful than the warheads of the I-TOW or the Basic TOW and occupies the full six-inch diameter of the missile. As with the I-TOW, the TOW 2 warhead incorporates a probe that extends after launch to provide standoff detonation and greater armor piercing effect.
- TOW 2 Flight Motor. To compensate for the increased weight of the TOW 2 warhead and other TOW 2 modifications, the TOW 2 flight motor is loaded with an improved propellant which provides a 30 percent greater impulse. Consequently, although the TOW 2 missile is heavier and more powerful than Basic TOW or I-TOW, its flight performance is not degraded by these modifications.
- Other Improvements. Improvements have been made to the following components of the TOW 2 weapon system, in addition to those made to the TOW 2 missile itself:
 - Guidance. The guidance for TOW 2 emphasized "hardening" the guidance link to overcome electro-optical countermeasures (EOCM) and stressed the development of system enhancements to permit day or night operation, even through dust, smoke, and other obscurants. These improvements, along with other ancillary changes, make the guidance system more accurate, flexible, and reliable.
 - Guidance Electronics. The missile guidance electronics are extensively upgraded for TOW 2. Dual digital microprocessors replace the analog computer used in the Basic TOW guidance electronics. The reengineered guidance electronics provide substantially greater computing capability, thereby providing more precise guidance. Additionally, the digital system offers the potential for more precise guidance equations, through software modifications, to accommodate new TOW missile developments such as TOW 2A and TOW 2B. Therefore, the Digital Missile Guidance Electronics are not only more powerful but also more accurate for all TOW missiles: Basic, I-TOW, TOW 2, and TOW 2A.
 - Sight/Sensor Assemblies. The basic functions of the sight/sensor assemblies are to provide the means target acquisition and target-missile tracking. Thus, the ability to guide the TOW 2 series missiles (TOW 2, TOW 2A, and TOW 2B) precisely through battlefield obscurants, day or night, is accomplished by the night sight. The night sight, employed in conjunction with the Optical Sight Sensor (OSS), provides dual, redundant tracking and guidance capability for the TOW 2 system.

- Tracking. As part of the TOW 2 system, a high-intensity thermal beacon is added to the aft (rear) end of the TOW 2 series missile designs to provide an infrared (IR) tracking source--different wavelength from the xenon beacon--visible to the night sight sensor. The xenon beacon of the Basic and the I-TOW designs is retained on the 2/2A missiles. As before, the distinctive infrared wavelength signature of the xenon beacon is used by the optical sight to track the TOW missile in clear visibility conditions. For maximum probability of a hit, the gunner need only choose one of the two sights to use. In either case, as the gunner tracks the target, the guidance loop senses the missile's deviation from the line-of-sight (LOS) to the target. These data are transmitted to the missile guidance electronics, which computes missile variance from the line-of-sight. Flight correction data are then transmitted to the missile via the wire link.

4. Missile Configuration.

Four configurations of TOW missiles may be used:

- BGM-71A.
- BGM-71A-1.
- BGM-71C.
- BGM-71D.

All missile configurations use the same basic airframe, aerodynamic control system, command-link wire, and missile electronic designs.

- a. The Basic TOW Missile (BGM-71A). The basic TOW missile (BGM-71A) has a range of 3,000 meters (later improved, as the BGM-71A-1, to 3,750 meters) and has a five-inch-high explosive, shaped-charge warhead.
- b. The Improved TOW (BGM-71C). The improved TOW (BGM-71C) has an improved five-inch warhead that includes an extensible probe to provide detonation at a greater standoff distance from the target and greater penetration effectiveness.
- c. The TOW 2 (BGM-71D). The TOW 2 (BGM-71D) has a six-inch full-caliber warhead that also includes an extensible probe. In addition to the infrared radiator of the basic and the improved TOW versions, TOW 2 has a second infrared radiator to provide hardened system performance against battlefield obscurants and countermeasures. This second radiator, called the thermal beacon, provides tracking link compatibility with the electro-optical infrared night sight, which is part of the TOW 2 launcher system.
- d. Destruction of the TOW Weapon System. In combat, it may be necessary to destroy the TOW components, vehicle, and missiles to prevent their capture. Destruction of parts by mechanical means, explosives, gunfire, or burning will make it useless to the enemy. The crew will destroy the weapon system only on

the commander's orders.

5. M151A2-Mounted TOW/TOW 2.

The M151A2-mounted TOW weapon system consists of two 1/4-ton vehicles: a firing vehicle and a missile carrier. The crew consists of four men: the squad leader, the gunner, the loader, and the driver-ammunition bearer. The squad leader and the gunner are on the firing vehicle. The loader and the driver-ammunition bearer are on the missile carrier.

a. Firing Vehicle. The M232A2 mounting kit equips the M151A2 firing vehicle (shown in Figure 1-18) for mounting and deploying the TOW. On the right side of the vehicle are special racks to carry two encased missiles. The traversing unit, the optical sight, the missile guidance set (MGS), the night sight, and the launch tube are installed in an operational ready state on the launcher mount. In preparation for travel, the launch tube is locked down in the eight-degree down position.

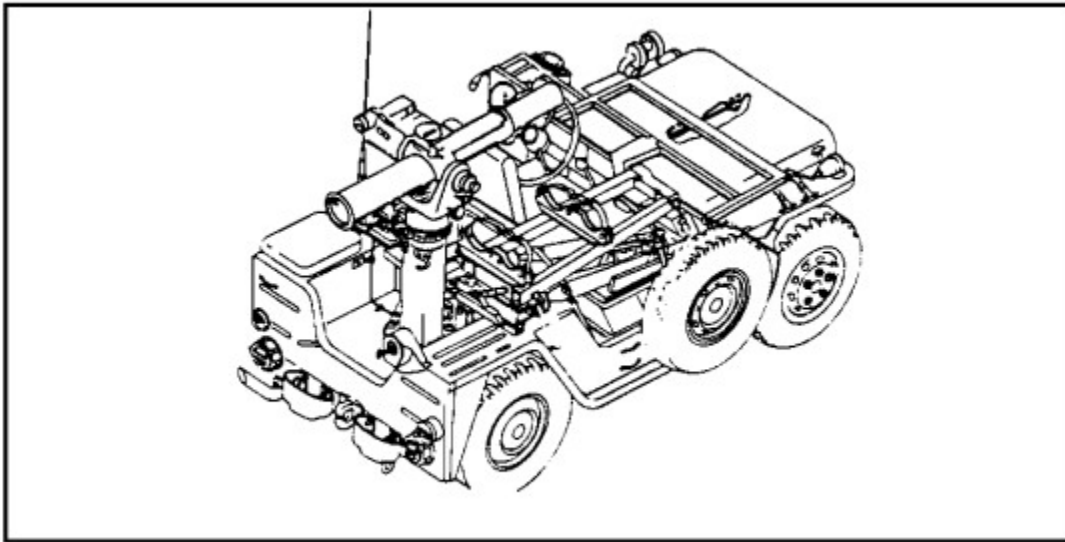


Figure 1-18. M151A2-Mounted TOW (Firing Vehicle).

The closed tripod is secured by straps in two supports beneath the missile racks. The missile racks pivot up to permit the removal of the tripod. The TOW vehicle power conditioner is stowed in the MGS, and the MGS is mounted on an elevated frame assembly on the floor of the vehicle, just forward of the launcher mount. The night sight spare battery power conditioner or coolant cartridge case is stowed under the radio mount behind the driver's seat. The night sight field handling case and storage rack is on the right side of the driver's seat, as shown in Figure 1-19. The launcher can be removed quickly from the firing vehicle for ground emplacement.

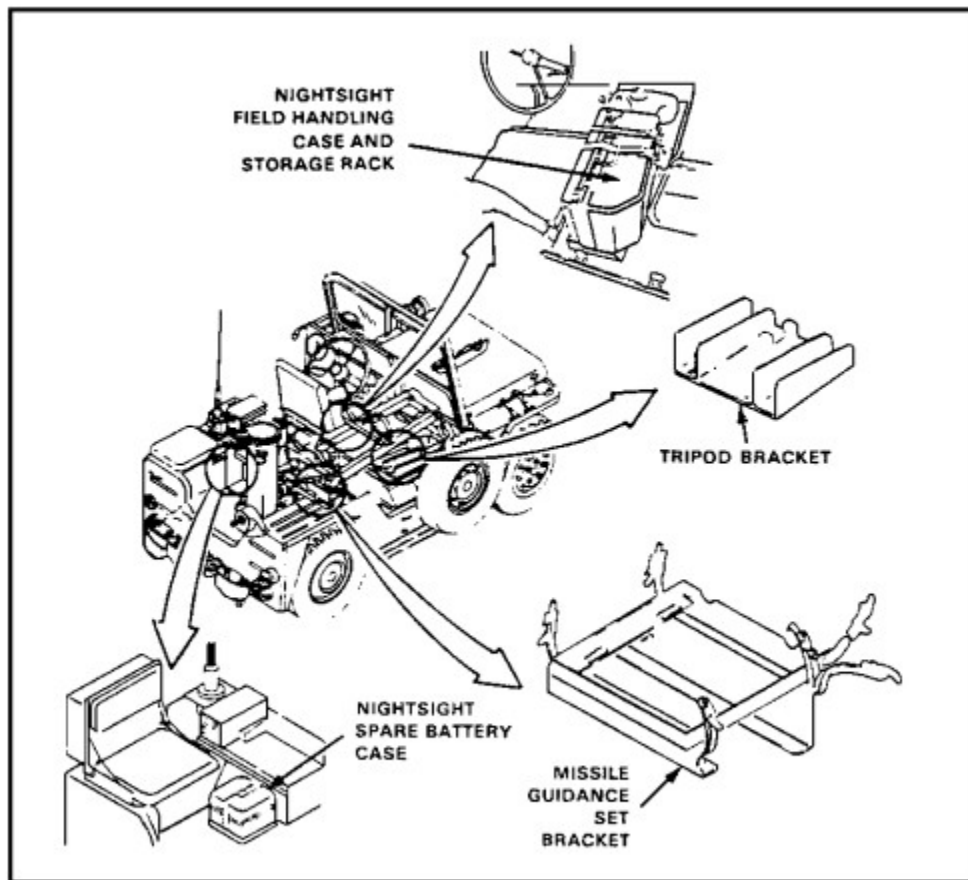


Figure 1-19. M151A2 Firing Vehicle and Equipment.

b. Missile Carrier. The M236A1 mounting kit equips the M151A2 missile carrier for carrying six encased missiles and a spare battery assembly. The mounting kit consists of the following components:

- Left rack assembly.
- Right rack assembly.
- Battery storage rack.
- Straps for the boresight collimator carrying case and the night sight battery and the coolant cartridge cases, as shown in Figure 1-20.

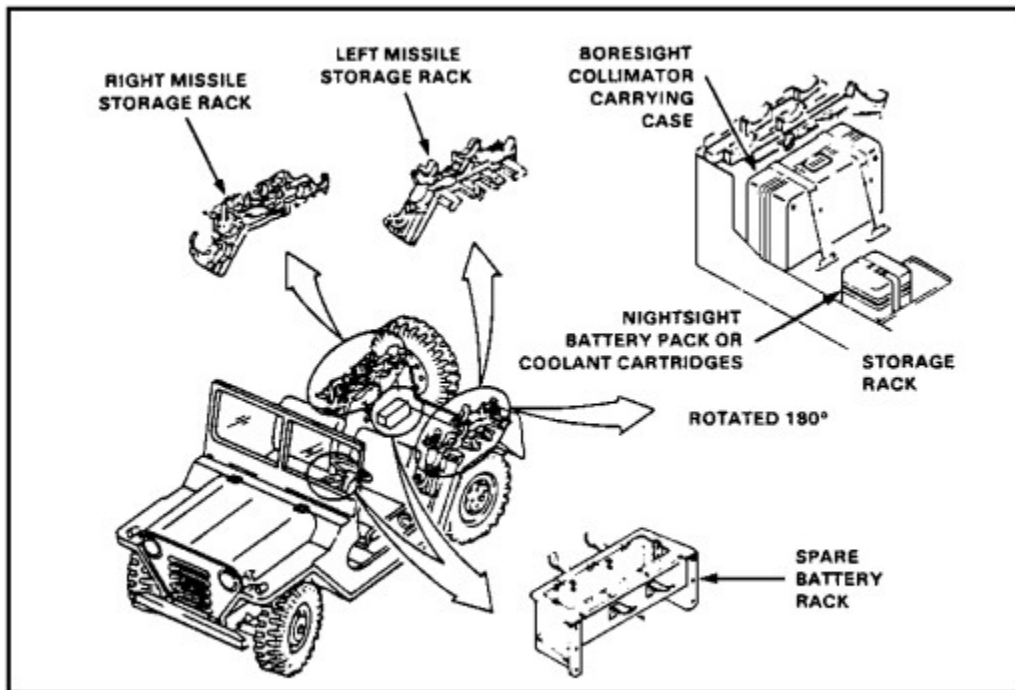


Figure 1-20. M151A2 Missile Carrier.

- (1) Left Rack Assembly. The left rack assembly mounts over the left rear wheel. The rack is used to tie down the aft end of the six encased missiles. It also has hooks to prevent the lateral sliding of the encased missiles while traveling.
- (2) Right Rack Assembly. The right rack assembly mounts over the right rear wheel. It is used to tie down the forward end of the six encased missiles.
- (3) Battery Assembly Storage Rack. The battery assembly storage rack mounts between the front seats and provides stowage of a spare battery assembly.
- (4) Boresight Collimator Carrying Case. The boresight collimator carrying case is strapped down in the left rear floor, under the missiles.
- (5) Night Sight Battery and Coolant Cartridge Cases. The night sight battery and coolant cartridge cases are strapped down opposite the collimator case.

6. M966-Mounted TOW/TOW 2.

The M966-mounted TOW is a one-vehicle (1 1/4-ton truck) system, as shown in Figure 1-21. It is a comprehensive wheeled combat system that is air-transportable, versatile, maintainable, and survivable.

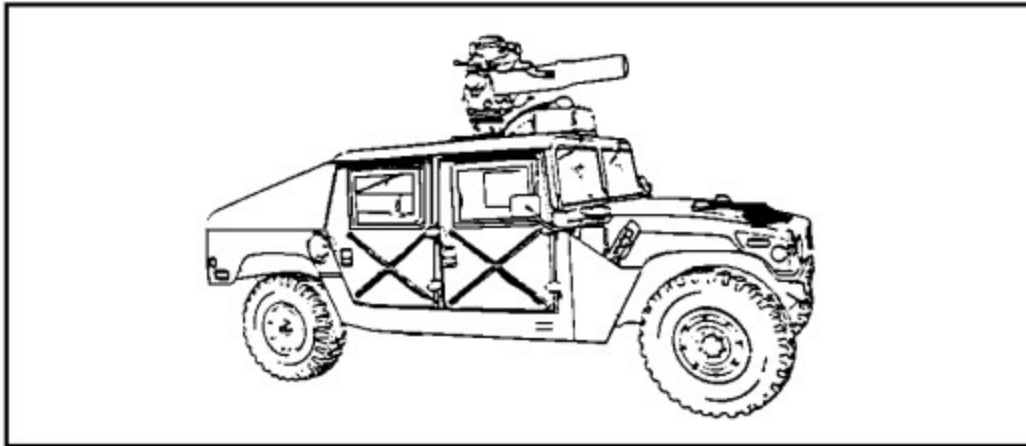


Figure 1-21. M966-Mounted TOW.

a. Characteristics and Capabilities. The following characteristics and capabilities provide the off-road mobility and speed that are needed in combat:

- 16-inch ground clearance.
- Four-wheel independent suspension.
- Steep approach and departure angles of 60-percent gradeability.
- Side slope of 40 percent.
- 30-inch (without kit) (60-inch, with kit) water-fording capability.

The vehicle carries one complete launcher system, six encased missiles, and a crew of three (squad leader, gunner, and driver-loader).

b. Equipment Storage. The TOW weapon system components are stored in the interior of the vehicle as follows:

- Six encased missiles are stowed in the missile racks on the left rear of the cargo area.
- The traversing unit is stowed on the traversing unit adapter behind the right front passenger seat.
- The missile guidance set is stowed on the gunner's platform, between the left and right rear passenger seat.
- The night sight and the collimator are stowed on the right cargo shelf.
- The launch tube is stowed on the right side of the cargo shell door.
- The battery power conditioner (BPC) and the spare battery pack or the night sight coolant cartridges and a 4.8-volt nickel cadmium battery are stowed on the floor bracket next to the right wall of the cargo shelf.
- The battery assemblies are stowed in the battery rack above the missile rack.

- The tripod is stowed retracted, lying across the rear of the cargo area.
- The TOW vehicle power conditioner (TVPC) is stowed in the missile guidance set.

7. M113A2-Mounted TOW (Basic).

The M113A2 Armored Personnel Carrier (APC) (shown in Figure 1-22) is a one-vehicle system equipped for mounting the TOW 2. The M113A2-mounted TOW weapon system has a crew of four:

- Squad leader.
- Gunner.
- Loader.
- Driver.

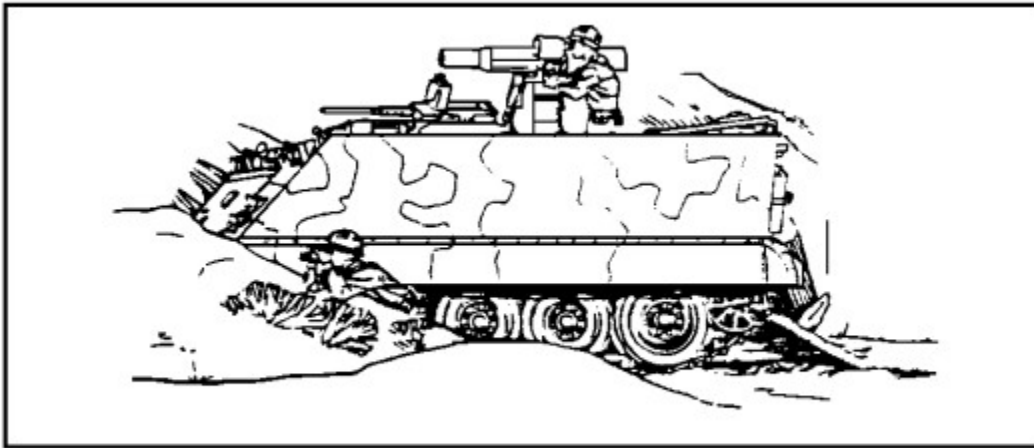


Figure 1-22. M113A2 Armored Personnel Carrier.

For protection against artillery and mortar fragments and small-arms fire, a TOW cover, artillery protection is installed.

a. M113A2 APC TOW System. The M233 mounting kit provides equipment for installing the TOW on the M113A2 and for stowing 10 encased missiles, a spare battery assembly, and all ground-emplacement components of the weapon system.

b. Equipment Storage. Equipment is stowed on the M113A2 APC in the following manner:

- Storing racks for the encased missiles are on the center, right side of the vehicle. You can easily remove and hand the missiles through the cargo hatch to the gunner on the gunner's platform.
- Stow the launch tube in the support mechanism just above the missile racks.
- Stow the closed tripod in an upright position so it is held by a quick-release clamp forward of the missile racks on the right side of the vehicle.

- The spare battery assembly is stowed in a storage rack just aft of the missile racks.
- The gunner's platform, in the raised position, provides the gunner with an elevated position, enabling him to operate the weapon system when the launcher is raised and ready to fire. The platform is hinged to the floor of the vehicle. Unlatch and lower it to the floor for more leg room during travel.
- Install the traversing unit and optical sight in an operational ready state on the telescoping pedestal. The pedestal mount provides stowage inside the vehicle and enables the gunner to raise the launcher onto a deck-firing position. The pedestal mount is mounted to double vertical rails that are pivoted at the vehicle floor. By unlocking these rails, the mount can be lifted aft and then elevated above and outside the deck of the vehicle. This requires some lifting effort by the operator, but this action is mostly supported by a set of constant tension springs which provide a counterbalance.
- The pedestal lock handwheel locks the pedestal into the pedestal locking bracket when the pedestal is in the lowered or the elevated position. The handwheel lock handle secures the pedestal lock handwheel.
- The telescoping pedestal release button is used in conjunction with the locking handle to lock the telescoping tube in the stowed (down) position. The locking handle locks the telescoping tube in any desired position from the stowed (down) position to the maximum telescoping height of 12 inches.
- The missile guidance set is installed in a bracket and strap assembly on the upper left side of the vehicle, just forward of the fuel tank and near the telescoping pedestal. The missile guidance set is electrically connected to the traversing unit by an 8 1/2-foot pedestal cable.
- The entire ground launcher system can be quickly removed from the vehicle for ground emplacement.

8. M901/M901A Improved TOW Vehicle (ITV).

The M901/M901A1 improved TOW vehicle is a one-vehicle weapon system. The M901 employs the M220A1 TOW. The M901A1 (shown in Figure 1-23) employs the M220A2 TOW 2. The improved TOW vehicle is manned by a crew of four:

- Squad leader.
 - Gunner.
 - Loader.
 - Driver.
- a. Characteristics. The M901-series improved TOW vehicle has the following characteristics:

- A complete M220-series TOW weapon system stowed and strapped in fixed mounting brackets. The optical sight and the night sight AN/TAS-4 or AN/TAS-4A are mounted in an operational ready state.
- A dual TOW missile launcher.
- M243 smoke grenade launchers.
- A 3X acquisition sight with a 25° field of view.
- Remote actuators that allow optical sight and night sight adjustments.
- An M60 machine gun mounted on a traversing rail.
- A hydraulically and electrically powered turret that can be operated manually.

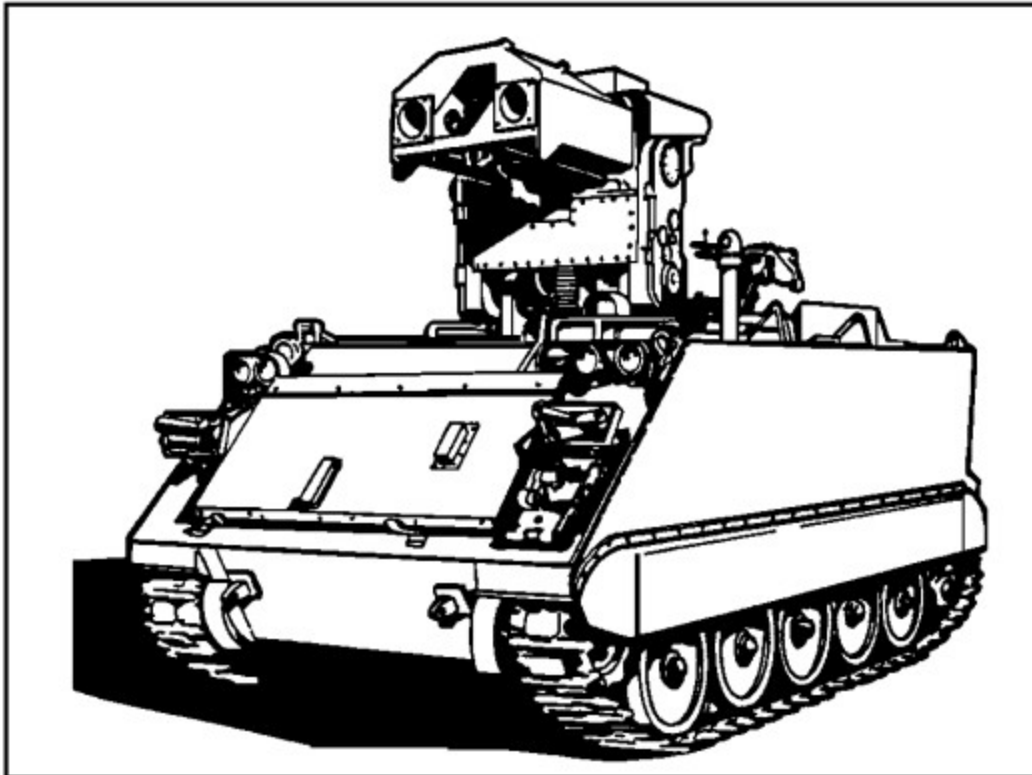


Figure 1-23. M901/M901A1 Improved TOW Vehicle (ITV).

b. Capabilities. The M901-series ITV has a high first-round hit probability with a rapid engagement rate. It provides the crew and weapon system protection from small-arms fire and artillery fragments. The squad leader has 270° viewing through the squad leader's periscope. The periscope enhances the ITV's capability to operate from concealed and full-hull defilade positions. The turret launcher has the capability for day and night acquisitions and tracking of targets and provides firing coverages of 360° in azimuth and +35° to -30° in elevation. The ITV has stowage provisions for tripod-mounted TOW components configured so that the

ground system can be dismounted and set up in three to five minutes. In addition, the ITV can ford small bodies of water (40 inches or less) and is air transportable.

9. AH-1S Cobra Attack Helicopter.

The AH-1S (G and S) Cobra helicopter (shown in Figure 1-24) is used in the support of military units as a combat gunship. Its primary mission is antiarmor, but the gunship can be used in close air support and air-to-air roles.

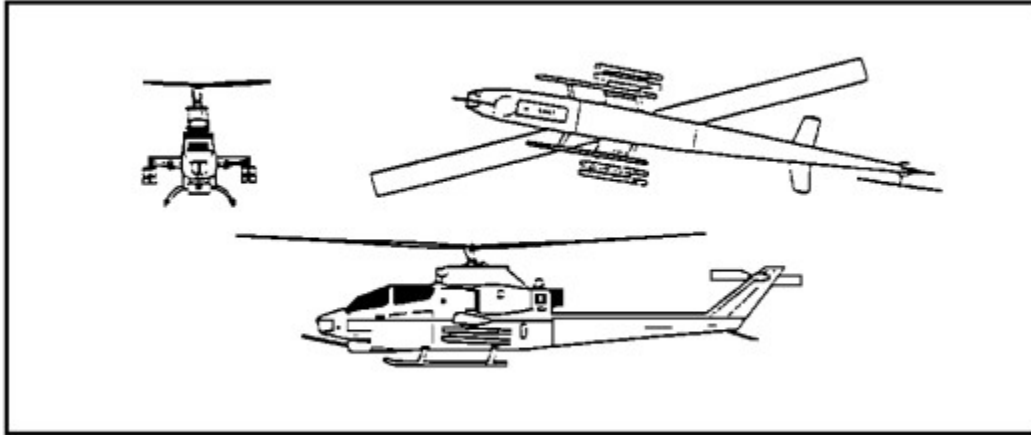


Figure 1-24. AH-1S Cobra.

a. Users. The AH-1S is used by the following countries:

- Iran.
- Israel.
- South Korea.
- Spain.
- United States.

b. Characteristics. The following characteristics of the AH-1S are used as recognition features:

- Two-bladed main rotor; two-bladed tail rotor.
- Single turbine engine.
- Long, slender fuselage with an integral chin turret.
- Swept-back vertical stabilizer.
- Small, tapered, swept-back wings aft of the canopy; the wings have armament stores.
- Seating capacity of two.

c. Capabilities. The capabilities of the AH-1S (speed, range, armament, weapon

range, and origin) are shown in Figure 1- 25.

Speed:	170 knots
Range:	410 km
Armament:	AH-1G Four 2.75-inch FFAR pods One 7.62-mm miniguns One 40-mm grenade launcher
	AH-1S Eight 130-mm TOWs Two 2.75-mm FFAR pods One 20-mm cannon
Weapon Range:	2.75-inch FFAR--5,500 meters (direct); 9,300 meters (indirect)
	7.62-mm gun--1,100 meters
	40-mm grenade launcher--2,000 meters
	13-mm TOW--3,750 meters (new Improved TOW)
	20-mm cannon--1,500 meters
Origin:	United States

Figure 1-25. Capabilities of the AH-1S Gunship.

10. AH-64A Apache Attack Helicopter.

The AH-64A Apache helicopter (shown in Figure 1-26) is a totally integrated weapons system. Firepower options include up to 16 Hellfire missiles, 76 70-mm aerial rockets, and 1,200 rounds of 30-mm ammunition.

The availability of armament options for the AH-64A provides mission flexibility. The AH 64A has the following armament options:

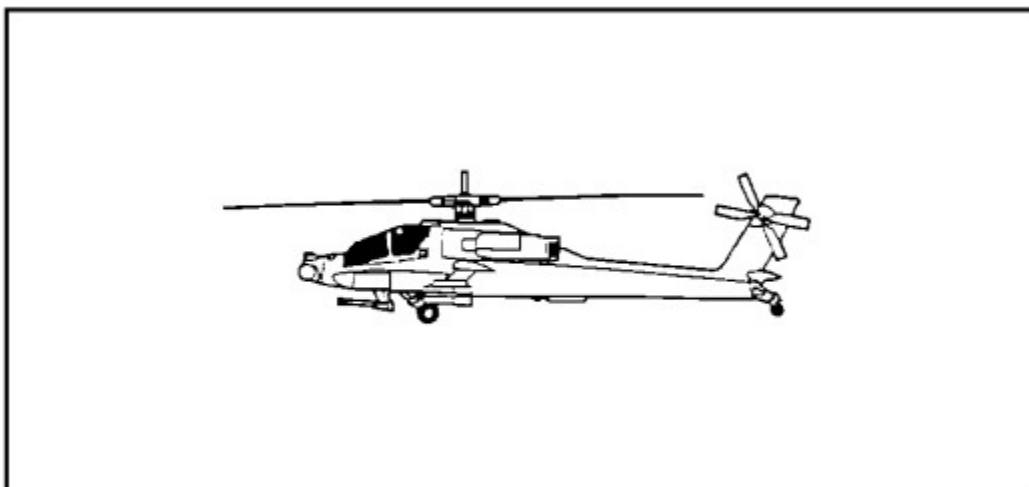


Figure 1-26. AH-64 Apache.

- Mission: antiarmor (Defense) Mid-East--Primary Mission 4,000 Feet/95 Degrees F. Four Hellfire missiles are under each wing of the helicopter, and the belly-mounted gun fires 320 rounds. Performance (based upon actual aircraft weight) is as follows:
 - Vertical rate of climb feet-per-minute (FPM) = 1,450.
 - Maximum level FLT speed KTS = 154.
 - Mission duration = 1.83 hours.
- antiarmor (Defense) Mid-East--4,000 Feet/95 Degrees F. Four Hellfire missiles are under each wing of the helicopter, and the belly-mounted gun fires 1,200 rounds. Performance (based upon actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 450.
 - Maximum level FLT speed (VH) KTS = 151.
 - Mission duration = 2.67 hours.
- antiarmor (Defense) Mid-East--4,000 Feet/95 Degrees F. Eight Hellfire missiles are under each wing and the belly-mounted gun fires 320 rounds. Performance (based upon actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 450.
 - Maximum level FLT speed (VH) KTS = 147.
 - Mission duration = 1.9 hours.
- antiarmor (Defense) Europe--2,000 Feet/70 Degrees F. Eight Hellfire missiles are under each wing of the helicopter, and the belly-mounted gun fires 1,200 rounds. Performance (based upon actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 990.
 - Maximum level FLT speed (VH) KTS = 148.
 - Mission duration = 2.5 hours.
- Covering Force (Air Cavalry) Mid-East--4,000 feet/95 Degrees F. Four Hellfire missiles are under each wing of the helicopter, and the belly-mounted gun fires 1,200 rounds. Performance (based upon actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 960.
 - Maximum level FLT speed (VH) KTS = 153.
 - Mission duration = 1.83 hours.
- Covering Force (Air Cavalry) Europe--2,000 Feet/70 Degrees F. Four Hellfire missiles and 19 rockets are under each wing of the helicopter, and the belly-mounted gun fires 1,200 rounds. Performance (based upon actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 860.

- Maximum level FLT speed (VH) KTS = 150.
- Mission duration = 2.5 hours.
- Airmobile Escort, Mid-East--4,000 Feet/95 degrees F. Nineteen rockets are under each wing of the helicopter, and the belly-mounted gun fires 1,200 rounds. Performance (based on actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 860.
 - Maximum level FLT speed (VH) KTS = 155.
 - Mission duration = 1.83 hours.
- Airmobile Escort, Europe--2,000 Feet/70 Degrees F. Thirty-eight rockets are under each wing of the helicopter, and the belly-mounted gun fires 1,200 rounds. Performance (based upon actual weight) is as follows:
 - Vertical rate of climb (IRP) FPM = 780.
 - Maximum level FLT speed (VH) KTS = 153.
 - Mission duration = 2.5 hours.

The Hellfire laser-guided missile subsystem is the primary armament, capable of defeating all currently known armored vehicles at significant standoff ranges. The use of Hellfire minimizes AH-64A engagement time and permits missile launching from concealed positions. Hellfire is employed using direct and indirect firing modes with single-fire, rapid-fire, and/or ripple-fire missile engagement. Normally, direct- and rapid-fire modes are fired autonomously by using the on-board laser to designate the target. Ripple- and indirect-fire modes are used in cooperative attacks with designation by other attack helicopters, laser-equipped scouts, RPVs, or remote ground designators. The indirect mode allows the Apache to destroy the armor of opposing forces while remaining masked and at extended ranges, enhancing effectiveness and survivability.

The 30-mm chain gun automatic cannon is the primary weapon subsystem, providing suppressive firepower and the capability to destroy lightly armored vehicles. The turreted cannon also provides self-protection from air threats. This weapon system is usually operated by the copilot/gunner, using the Target Acquisition Designation Sight (TADS), but it may also be directed by either crew member, using the helmet-mounted sight. The cannon uses high explosive dual-purpose rounds with exceptional terminal effects and is ADEN/DEFA ammunition compatible.

Another firepower option consists of 70-mm Folding-Fin Aerial Rockets (FFAR), which have been a standard U. S. Army and NATO munition for many years. However, new developments for the 70-mm FFAR--such as the Mark 66 motor, the Multipurpose Submunition Warhead, and articulating pylons--have significantly enhanced the effectiveness of this system. The aerial rockets may be fired either by either crew member with aiming and steering commands shown on the helmet display or in conjunction with the TADS for increased accuracy. The crew can select fuse ranges or tree heights to control detonation, as well as launching modes (single, pairs, or quads), launching rate, quantity launched, and zone launching.

All weapons systems are directed through a fire control computer which significantly

enhances target hit probability. By pre-pointing weapons and computing precise ballistic trajectories, the fire control computer reduces the time required to acquire targets and provides the best weapons system performance ever achieved in an attack helicopter.

The AH-64A Apache helicopter is used in the support of military units as a combat gunship. The primary mission of the AH-64A Apache is antiarmor, but the gunship can be used in close air support and air-to-air roles.

a. User. The AH-64A Apache helicopter is used by the United States.

b. Characteristics. The following characteristics of the AH64A Apache helicopter are used as recognition features:

- Four-bladed main rotor; four-bladed tail rotor.
- Twin turbine engines.
- Two-place tandem seats.
- Flat-plate canopy.
- Wheel-type landing gear.
- Fixed wings with armament stores.
- Belly-mounted gun.
- Seating capacity of two.

c. Capabilities. The capabilities of the AH-64A Apache (speed, range, armament, weapon range, and origin) are shown in Figure 1-27.

Speed:	140 knots
Range:	690 km
Armament:	One 30-mm chain gun One to four 2.75-inch FFAR pods One to 16 HELLFIRE modular missile systems (HMMSs)
Weapon Range:	30-mm chain gun--1,500 meters FFAR pods--9,600 meters HELLFIRE--6,000 meters (unclassified)
Origin:	United States

Figure 1-27. Capabilities of the AH-64A Apache Gunship.

PART C - TOW/TOW 2 MISSILE TYPES AND MARKING

1. Missile Types.

The TOW missile is the only ammunition used with the TOW/TOW 2 weapon systems. This missile is encased in a launch container (missile case) which is put into the launcher when it is ready to use.

a. Practice Types. The encased missile comes in four practice types. Each practice type contains an inactive (inert) warhead. The four practice types of TOW missiles are:

- BTM-71A (normal range).
- BTM 71A-1 (extended range).
- BTM 71A-2 (normal range) with the Missile Ordnance Inhibit Circuit (MOIC).
- BTM 71A-3 (extended range) with the MOIC.

b. Attack Types. The encased missile also comes in seven attack types, each of which contains a high-explosive warhead:

- BGM 71A (normal range).
- BGM 71A-1 (extended range).
- BGM 71A-2 (normal range, with MOIC).
- BGM 71A-3 (extended range, with MOIC).
- BGM 71C (with an improved, five-inch warhead).
- BGM 71C-1 (with an improved five-inch warhead and MOIC).
- BGM 71D (TOW 2).

Figure 1-28 shows the length, diameter, volume, weight, explosive weight (approximate), (warhead, launch and flight motor weights) for both the four practice- and the seven attack-type missiles.

	Guided Missile, Surface Attack, BGM 71A, BGM 71A-1 BGM 71A-2, BGM 71A-3 BGM 71C, BGM 71C-1 and BGM 71D	Guided Missile, Practice (Inert Warhead, Live Motor) BTM 71A BTM 71A-1, BTM 71A-2, and BTM 71A-3
Length	50.6 in. (128.4 cm)	50.6 in. (128.4 cm)
Diameter	8.6 in. (21.9 cm)	8.6 in. (21.9 cm)
Volume	1.7 cu. ft. (48.1 l)	1.7 cu. ft. (48.1 l)
Weight	54.2 lbs. (24.6 kg) 62.4 lbs.** (28.4 kg)	54.2 lbs. (24.6 kg)
Explosive Weight (approx.)		
Warhead	5.3 lbs. (2.4 kg) 4.5 lbs.* (2.0 kg) 6.8 lbs.** (3.1 kg)	None
Launch Motor	1.2 lbs. (0.55 kg)	1.2 lbs. (0.55 kg)
Flight Motor	5.6 lbs. (2.5 kg) 7.0 lbs. ** (3.2 kg)	5.6 lbs. (2.5 kg)
	* BGM 71C and BGM 71C-1	
	** BGM 71D	

Figure 1-28. TOW Encased Missile Data Chart.

2. TOW/TOW 2 Missile Types.

Since the development of the TOW missile, nine different types have been fielded.

a. Basic TOW. The first four (identified as Basic TOW) have basically the same characteristics, with an improvement in range from 3,000 to 3,750 meters.

b. Improved TOW (I-TOW). Two Improved TOW missiles (I-TOWs BGM 71C and BGM 71C) introduced an extended probe enhancing armor penetration.

Figure 1-29 lists the different types of TOW/TOW 2 missiles and shows the following information about each type:

- how it is designated.
- its maximum range.
- its type of warhead.

c. TOW 2-Series. The TOW 2-series of missiles represent still further improvements to the Basic and Improved TOW missiles.

To identify missiles by their types, refer to the missile case identification markings in Part C, paragraph 4.

3. Distinguishing Characteristics.

The TOW missile can destroy targets at a minimum range of 65 meters, up to a maximum

range of 3,750 meters. Five TOW missiles are of great concern:

a. Improved TOW (I-TOW). The I-TOW (BGM 71C) missile has a five-inch warhead which includes an extended probe to provide detonation at a greater stand-off distance from the target, thus increasing armor penetration.

NOTE: The perception of "standoff" to mean "engage armor vehicles beyond 2,000 meters to maximum range (3,750 meters)" is not always tactically feasible. Reasons include: (1) Tracking time beyond 2,000 meters increases the likelihood of gunner error and provides the enemy additional reaction time to maneuver against your position. (2) The probabilities of a hit at extended ranges are significantly lower, especially through thermal sights and obscuration. (3) Ranges beyond 2,000 meters decrease the probability of flank shot hits due to extended tracking time, the increased speed capability of modernized vehicles, and terrain restrictions.

Refer to Figure 1-29 for information concerning the targets for which TOW 2 missiles are most effective.

c. TOW 2 Missiles. There are three TOW 2-series missiles: TOW 2 (BGM 71D); the TOW 2A (BGM 71E), and the TOW 2B (BGM 71F). The distinguishing characteristics of these missiles are described in the following paragraphs:

- TOW 2 (BGM 71D). The TOW 2 missile (BGM 71D) has a six-inch, full caliber warhead which includes an extensible probe which enhances penetration, including the penetration of applique armor.
- TOW 2A (BGM 71E). The TOW 2A (BGM 71E) missile is an improvement to the basic TOW missile. It was developed to keep the TOW antitank system viable against advanced armor fielded by opposing forces. As all the other members of the TOW missile family, TOW 2A can be fired from any of the existing TOW platforms (the Bradley Fighting Vehicle, the High Mobility Multipurpose Wheeled Vehicle, the AH-1 helicopter, the M113 armored personnel carrier, and the tripod ground mount). However, to optimize TOW 2A capabilities, minor software changes to the missile guidance electronics have been developed. There are no additional training requirements for TOW gunners as a result of fielding the TOW 2A missile. The TOW 2A has all the capabilities of the TOW 2 missile. However, it contains an explosive charge in the tip of the probe to defeat reactive armor to allow penetration by the main warhead: The precursor warhead in the missile probe is designed to set off the explosive in a tank's reactive armor, clearing the way for the primary warhead to penetrate the tank. The primary warhead employed on the TOW 2A missile is the same as that used on the TOW 2 missile, and the two missiles are almost identical in appearance.
- TOW 2B (BGM 71F). Refer to Lesson Three, Part A, for information concerning the TOW 2B (BGM 71F) missile.

d. Basic TOW, Practice Round ((BTM 71A). The Basic TOW, practice (BTM 71A) has an inert warhead and is the standard training round.

Designator Type	HEAT	Inert Practice	Maximum Range (Meters)	Warhead	Comments
Basic TOW	BGM 71A	BTM 71A	3,000	5-Inch UNITARY	
Basic TOW	BGM 71A-1	BTM 71A-1	3,000	5-Inch UNITARY	
Basic TOW	BGM 71A-2	BTM 71A-2	3,000	5-Inch UNITARY	*
Basic TOW	BGM 71A-3	BTM 71A-3	3,750	5-Inch UNITARY	**
I-TOW	BGM 71C	NONE	3,750	5-Inch UNITARY W/PROBE	
I-TOW	BGM 71C-1	NONE	3,750	5-Inch UNITARY W/PROBE	
TOW 2	BGM 71D	NONE	3,750	6-INCH UNITARY W/PROBE	***
TOW 2A	BGM 71E	NONE	3,750	6-Inch TANDEM W/PROBE TIP CHARGE	** ***
TOW 2B	BGM 71F	NONE	3,750	FLYOVER, SHOOT DOWN	
* The MOIC (missile ordnance inhibit circuit) prevents the fly-back of a missile if a command link (wire) breaks.					
** The ECM (electronic countermeasure) is resistant when the missile is fired through the TOW 2 launcher/subsystem.					
*** The probe tip charge first penetrates the explosive reactive armor boxes and then allows the main six-inch warhead to penetrate the basic hull armor. An excellent means of engaging enemy tanks.					

Figure 1-29. Fielded TOW/TOW 2 Missile Types.

4. Missile Marking.

NOTE: The markings described in this paragraph and shown in Figures 1-30 through 1-35 are new; they are not yet used in the field.

TOW/TOW 2 missiles are identified by markings on their missile cases (shown in Figures 1-30 through 1-35). On the left side of the nose end of the missile case, an identification decal identifies the missile as being a 71A, 71A-1, 71C, 71D, 71E,

or 71F.

To the right of the identification decal, there is a two-inch-wide identification tape. This tape, which identifies the type of missile encased in the missile case, is either blue (71A) or yellow (71A1, 71C, 71D, 71E, and 71F).

At the middle of the left side of the missile case (to the right of the identification tape) is the Lot Number and Storage Temperature Limits. The Lot Numbers change, but the Storage Temperature Limits for all types of TOW/TOW 2 missiles is the same (-65 degrees F to +155 degrees F).

To the right of the Lot Number and Storage Temperature Limits data, toward the aft (rear) end of the missile case, is a two-inch-wide strip of brown tape.

On the rear end of the missile case is a circular stencil which again identifies the type of missile as being 71A, 71A-1, 71C, 71D, 71E, or 71F.

On the top side of the missile case, midway between the nose and the aft ends of the case is stenciled the missile type and its respective maximum range.

5. Missile Selection.

The improvement of the armor protection of opposing forces' vehicles has resulted in improved TOW missiles. Figure 1-35 recommends the best TOW missile to use against various types of targets. In all cases, flank shots increase the probability of a single shot kill and minimize detection and engagement from opposing forces' armor.

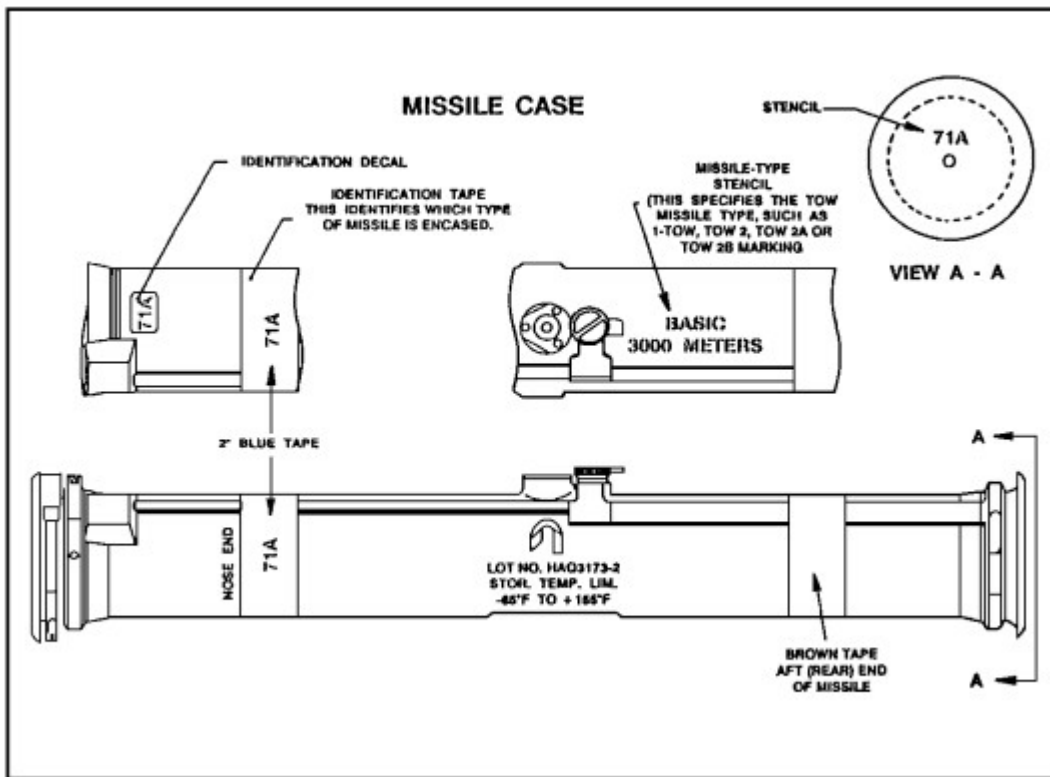


Figure 1-30. Missile Markings for Identification (BGM 71A).

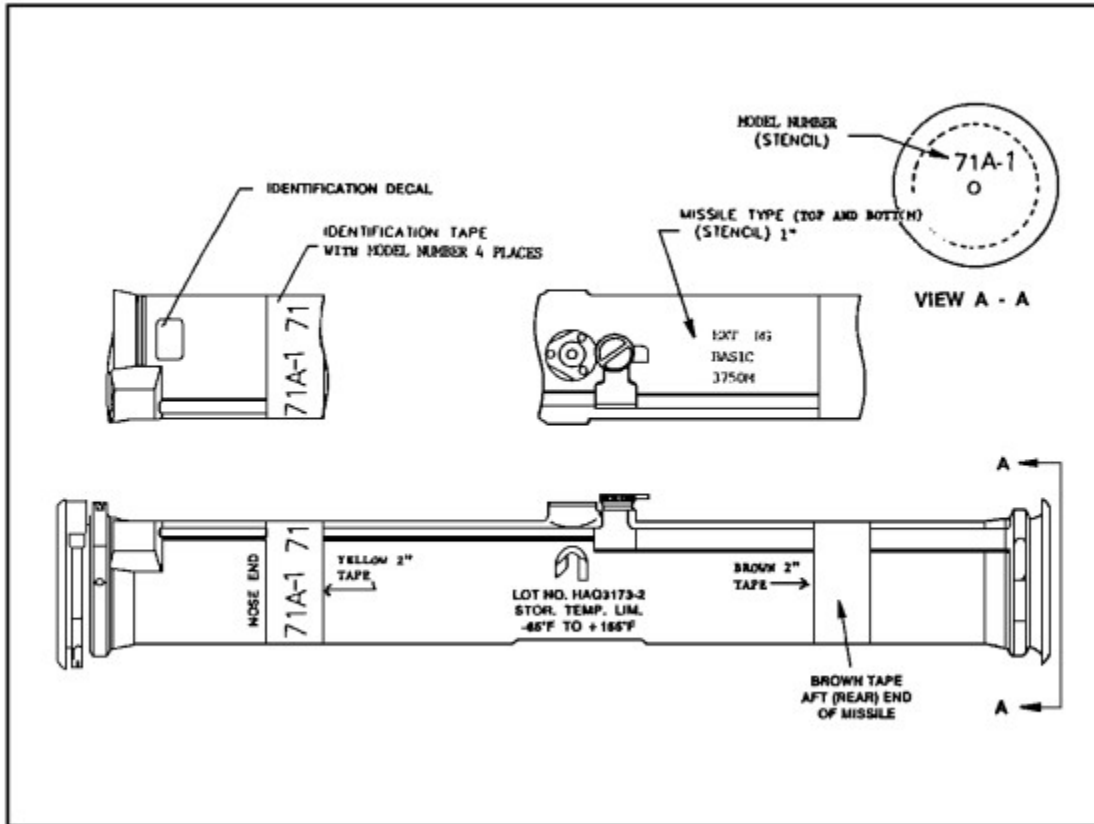


Figure 1-31. Missile Markings for Identification (BGM 71A-1).

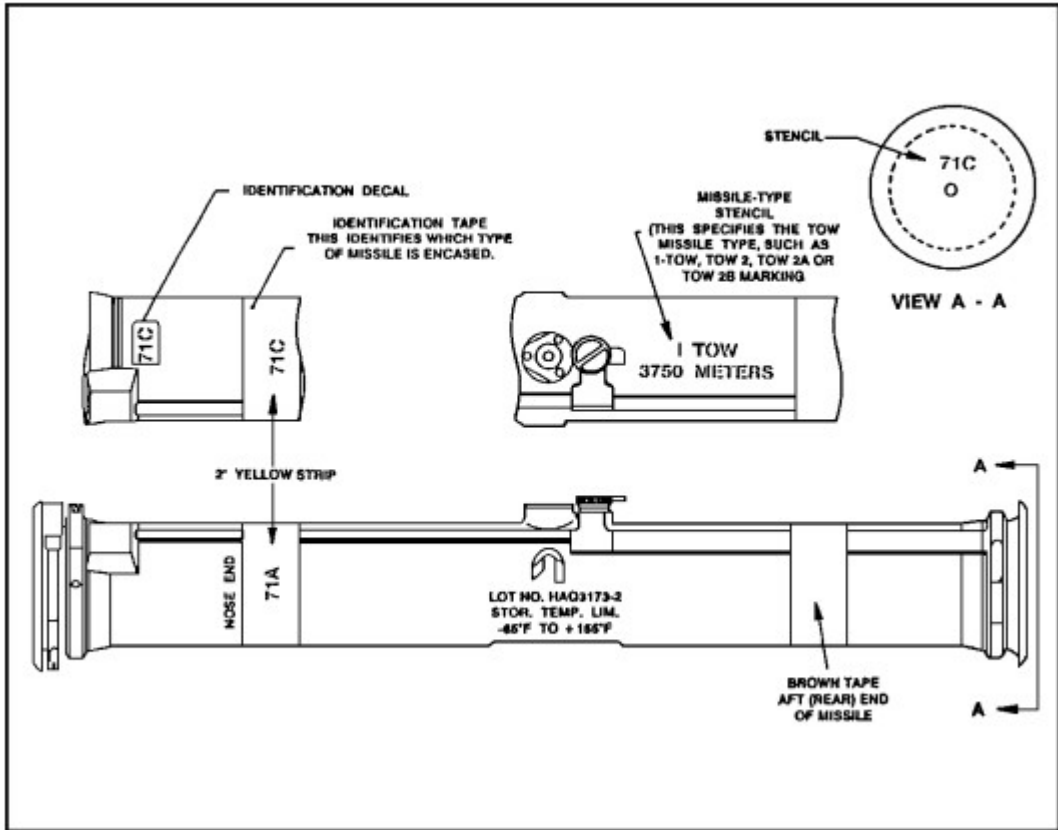


Figure 1-32. Missile Markings for Identification (BGM 71C).

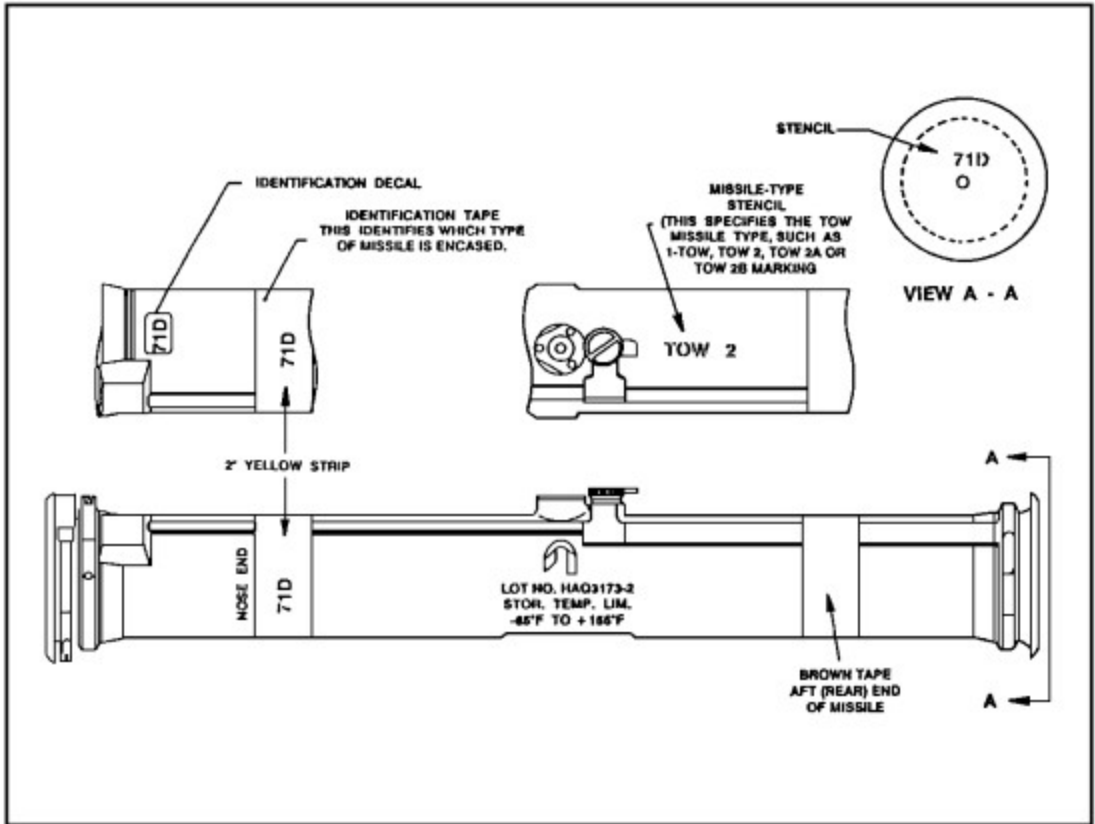


Figure 1-33. Missile Markings for Identification (BGM 71D).

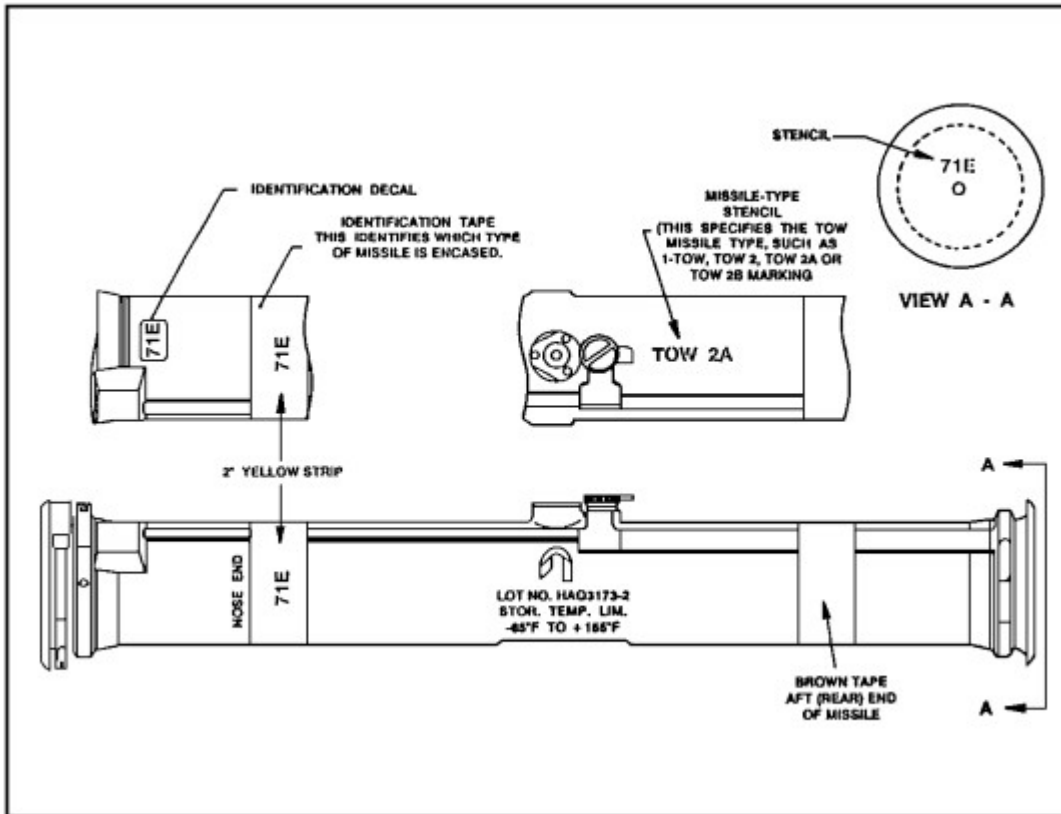


Figure 1-34. Missile Markings for Identification (BGM 71E).

Opposing Force's Vehicle Type Targets	TOW Missile Selection Priority			
	1st	2nd	3rd	4th
Tanks w/ applique armor	TOW 2	TOW 2A	TOW 2B	I-TOW
Tanks w/explosive reactive armor	TOW 2B	TOW 2A	TOW 2	I-TOW
Tanks without applique/ reactive armor	I-TOW	TOW 2	TOW 2A	TOW 2B
Light-armored personnel carriers	I-TOW	TOW 2	TOW 2A	TOW 2B
Light-armored wheel vehicles	I-TOW	TOW 2	TOW 2A	TOW 2B
Antiaircraft vehicles	I-TOW	TOW 2	TOW 2A	TOW 2B
Armored vehicles in hull defilade position	TOW 2B	TOW 2A	TOW 2	I-TOW
Bunkers/fortifications	I-TOW	TOW 2	TOW 2A	-----

Figure 1-35. Missile Selection Chart.

Lesson 2

CURRENT OPPOSING FORCES antiarmor WEAPONS

OVERVIEW

Lesson Description:

In this lesson, you will learn to identify the characteristics of the following opposing forces antiarmor weapons: RPG-7V Antitank Grenade Launcher; RPG-16D Antitank Grenade Launcher; RPG-18 Antitank Rocket Launcher; RPG-22 Rocket Launcher; SPG-9 Antitank Recoilless Gun; MT-12 Antitank Gun; AT-2/SWATTER; AT-3/SAGGER; AT-4/SPIGOT; AT-5 SPANDREL; AT- 6/SPIRAL; AT-7 SAXHORN; and AT-8/SONGSTER.

Terminal Learning Objective:

Action: Identify the characteristics of the following opposing forces antiarmor weapons: RPG-7V Antitank Grenade Launcher; RPG-16D Antitank Grenade Launcher; RPG- 18 Antitank Rocket Launcher; RPG-22 Rocket Launcher; SPG-9 Antitank Recoilless Gun; MT-12 Antitank Gun; AT-2/SWATTER; AT-3/SAGGER; AT-4/SPIGOT; AT- 5 SPANDREL; AT- 6/SPIRAL; AT-7 SAXHORN; and AT-8/SONGSTER.

Condition: Given the subcourse material contained in this lesson.

Standard: Identify the characteristics of the RPG-7V Antitank Grenade Launcher; RPG-16D Antitank Grenade Launcher; RPG-18 Antitank Rocket Launcher; RPG-22 Rocket Launcher; SPG-9 Antitank Recoilless Gun; MT-12 Antitank Gun; AT-2/SWATTER; AT-3/SAGGER; AT-4/SPIGOT; AT-5 SPANDREL; AT-6/SPIRAL; AT-7 SAXHORN; and AT-8/SONGSTER.

References: The material contained in this lesson was derived from the following publications:

FM 1-402
FM 100-2-3
FM 23-33
FM 23-34
FM 1-402

INTRODUCTION

The Soviet arsenal of antitank weapons ranges from grenade and rocket launchers through antitank guns and guided missile systems.

PART A - ANTITANK GRENADE AND ROCKET LAUNCHERS

1. Antitank Grenade Launchers.

The following are Soviet antitank grenade launchers:

- RPG-7V.
- PG-16D.
- RPG-7V.

a. RPG-7V Grenade Launcher. The following paragraphs discuss the RPG-7V Grenade Launcher (shown in Figure 2-1).

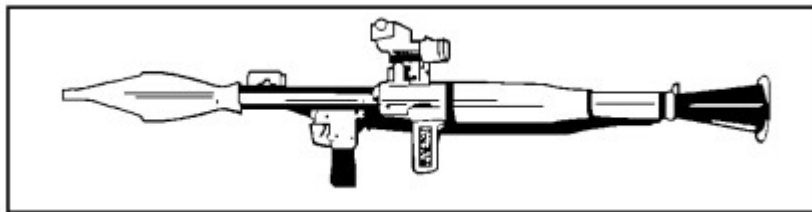


Figure 2-1. Antitank Grenade Launcher RPG-7V.

(1) Description. The RPG-7V is a recoilless, shoulder-fired, muzzle loaded, reloadable antitank grenade launcher. It fires an 85-mm (PG-7) or a 70-mm (PG-7M) rocket-assisted HEAT grenade from a 40-mm smooth-bore launcher tube. The launcher has two handgrips; a large optical sight; a thick, wooden heat guard around the middle; and a large, flared blast shield at the rear of the tube. The launcher is 953 millimeters long without the grenade, and 1,340 millimeters long with the PG-7 grenade. The launcher weighs 7.9 kilograms and the PG-7 grenade weighs 2.25 kilograms.

(2) Capabilities. The RPG-7V is light enough to be carried and fired by a single soldier. However, an assistant grenadier normally deploys to the left of the gunner to protect him with small-arms fire. The grenadier normally carries two rounds of ammunition and the assistant grenadier carries three additional rounds.

The RPG-7V is an improved version of the earlier RPG-2. The RPG-2 had only one handgrip; a smaller, simpler sight; a smaller blast shield; and no heat guards. It fired a smaller, 80-mm, non-rocket-assisted grenade. The internal rocket motor of the PG-7/-7M grenade ignites after traveling about 11 meters; this gives the projectile a higher velocity (sustained out to 500 meters), a flatter trajectory, and better accuracy. Further enhancing accuracy are four large, knife-like fins at the rear of the projectile which

unfold when the round leaves the tube, and smaller, offset fins at the very rear which impart a slow rotation. The maximum effective range is 500 meters for stationary targets and 300 meters for moving targets. Maximum range is 920 meters, at which point the projectile self-destructs (approximately 4.5 seconds after launch). The PG-7/-7M grenade, with a shaped-charge warhead can penetrate 330 millimeters of armor with a direct hit.

The current RPG-7V model can mount a telescope and both infrared and passive night sights. All RPG-7 models have optical sights which can be illuminated for night sighting. They also have open sights for emergency use. The RPG-7V is the standard squad antitank weapon in motorized rifle units (each squad has one weapon). The weapon is also found with reconnaissance units. Airborne units use the RPG-7D which separates into two sections.

(3) Limitations. The RPG-7V requires a well-trained and experienced gunner to accurately estimate ranges and lead distances for moving targets. Crosswinds as low as seven miles an hour can complicate the gunner's estimate and reduce first-round-hit probability to 50 percent at ranges beyond 180 meters. An RPG projectile screen of chain-link fence will completely neutralize 50 percent of the rounds and degrade the penetrating capability of the remaining rounds. Reloading and reaiming the AT grenade launcher takes a minimum of 14 seconds. The RPG-7V has a conspicuous signature: flash, smoke, and noise. The unprotected gunner is extremely vulnerable to suppressive fires.

(4) Remarks. The first Soviet recoilless AT grenade launcher, the RPG-2, was derived from the World War II German Panzerfaust. The Soviets first fielded it in the early 1950s. The RPG-7, introduced in 1962, is a second-generation weapon employing a rocket-assisted projectile. The current version, designated the RPG-7V, is in service throughout the Warsaw Pact with the exception of Czechoslovakia. The folding version for airborne forces, introduced in 1968, was initially known as the RPG-8, but later redesignated the RPG-7D. A third-generation weapon, the RPG-16D, incorporates further refinements resulting from battle testing the RPG-7V in southeast Asia and the Middle East. It has replaced the RPG-7D as the standard squad AT weapon in Soviet airborne forces.

b. Antitank Grenade Launcher RPG-16D. The following paragraphs discuss the RPG-16D Grenade Launcher (shown in Figure 2-2).



Figure 2-2. AT Grenade Launcher RPG-16D.

(1) Description/Capabilities. The RPG-16D is a reloadable antitank weapon. It is shoulder fired, either with or without the support of a bipod at the muzzle end. It has an optical sight above the tube, a single hand grip below the tube, and a conical blast shield at the rear. The 58.3-meter rocket-assisted HEAT projectile PG-16 has an increased range of 500 to 800 meters and a greater armor penetration capability of up to 375 millimeters, compared to the PG-7/-7M projectile of the RPG-1V (33-mm). As with the RPG-7, the RPG-16D grenadier probably carries two rounds of ammunition. The assistant grenadier likely carries an additional three rounds and protects the grenadier with his assault rifle.

(2) Limitations. The RPG-16D is heavier than the RPG-17V/-D -- but one person can still carry and fire the antitank weapon.

(3) Remarks. The Soviets introduced the RPG-16D in the mid-1970s as a replacement for the RPG-1D. Western observers also expected a one-piece version (RPG-16?) to replace the RPG-7V in motorized rifle units; however, the Soviets have not yet deployed such a weapon. To date, only the airborne forces have been observed with the two-piece airborne version designated the RPG-16D.

2. Antitank Rocket Launchers.

The following are Soviet antitank rocket launchers:

- RPG-18.
- RPG-22.

a. AT Rocket Launcher RPG-18. The following paragraphs discuss the RPG-18 Rocket Launcher (shown in Figure 2-3).

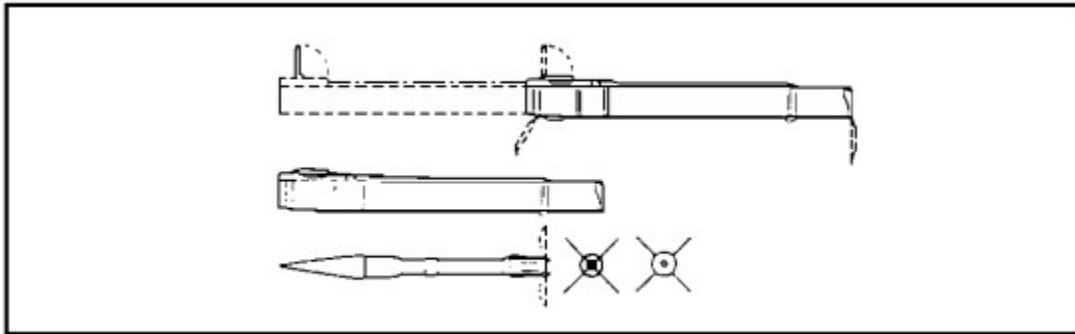


Figure 2-3. AT Rocket Launcher RPG-18.

(1) Description/Capabilities. The RPG-18 is a short-range, tube-launched, disposable infantry antitank rocket weapon system. It is somewhat similar to the U.S. light antitank weapon (LAW) system. The lightweight tube presumably consists of fiberglass-reinforced plastic. The operator carries the launcher in the collapsed position and extends the inner tube to make the weapon ready to fire. It fires a 64-mm rocket (PG-18) with an effective range of 200 meters and a HEAT warhead capable of penetrating up to 375 mm of armor. The fuze of the HEAT grenade activates two to 15 meters after leaving the muzzle and self-destructs after a flight time of four to six seconds. The trigger, safety catch, and rear peep sight are roughly in the middle of the extended tube, or at the rear end of the collapsed tube. The folding sight at the forward end of the tube is calibrated for ranges of 50, 100, 150, and 200 meters.

The RPG-18 is probably a squad-level weapon. Unlike the RPG-7V/-7D and the RPG-16D, the RPG-18 is not linked to a specific person; that is, to the antitank grenadier provided for in the table of organization and equipment (TOE). All soldiers in the squad train on the weapon. This increases the squad's capabilities to destroy tanks at short ranges.

(2) Limitations. The gunner should not fire the RPG-18 if friendly personnel are within a 90-degree sector within 30 meters behind the launcher. It also should not be fired if there are obstacles nearer than two meters in front of the muzzle, or if the height of the line of fire is less than 20 centimeters. Once the tube has been extended it cannot be shoved back together again.

(3) Remarks. The Soviets introduced the RPG-18 in the mid-1970s. It is widely distributed throughout the Soviet Army, including the airborne forces. For employment in airborne units, the RPG-18 comes with a cover which protects it during parachute jumps.

b. AT Rocket Launcher RPG-22. The following paragraphs discuss the RPG-22 Rocket Launcher.

Soviet troops in Afghanistan used the disposable light antitank weapon (LAW) designated RPG-22. Although primarily an antitank weapon, the RPG-22 was

used in Afghanistan against mujahideen strongholds.

(1) Description/Capabilities. Like the RPG-18, the newer RPG-22 is a short-range, tube-launched, disposable infantry antitank rocket weapon system, similar to the U.S. LAW system. The lightweight, collapsible launch tube consists of two parts:

- An outer tube made of fiberglass.
- A sliding inner tube made of aluminum.

The RPG-22 consists of a telescopic outer tube that is 850 millimeters long when extended for use. Simple pop-up sights are graduated for 50, 150, and 250 meters, and there is a temperature-compensating rear sight.

The aluminum inner tube extends 10 centimeters to the front of the outer tube in the firing position. It fires a 73-mm fin-stabilized rocket fitted with a chemical energy high explosive antitank warhead designed to penetrate 480 millimeters of armor at 90 degrees. However, the warhead has a much inferior capability against composite Chobham-type and reactive armor. The rocket has an effective range of 250 meters and a HEAT warhead capable of penetrating approximately 390 millimeters of armor.

The trigger and the pop-up rear peep sight are in the middle of the extended tube. The pop-up front sight is at the forward end of the outer tube. The front sight is calibrated for ranges of 50, 150, and 250 meters.

(2) Limitations. Instructions printed on the side of the RPG-22 launch tube indicate the back-blast covers a 90-degree sector out to 30 meters behind the weapon; that it should not be fired if a wall is closer than two meters behind it; and that the line of fire should be at least 20 centimeters above the ground.

(3) Remarks. The Soviets introduced the RPG-22 in 1985. In time, it will probably replace the RPG-18. As with the RPG-18, it has no dedicated grenadier; all soldiers train to fire the squad-level, throwaway weapon.

PART B - ANTITANK GUNS

Soviet antitank guns are

- SPG-9.
- MT-12.

These guns are described in the following paragraphs.

1. 73-mm Recoilless Gun SPG-9.

The following paragraphs discuss the SPG-s Recoilless Rifle (shown in Figure 2-4).

a. Description. The SPG-9 is a tripod-mounted, recoilless antitank gun firing a 73-mm fin-stabilized, rocket-assisted HEAT projectile. The launcher is 2,110 millimeters long and weighs 47.5 kilograms (59.5 kilograms with the tripod). The

projectile weighs 3.5 kilograms. Its great length is due to the propellant case attached behind the fins. The SPG-9 is also capable of firing a four-kilogram rocket-assisted HE round.

b. Capabilities. The SPG-9 is man portable, but a truck or armored personnel carrier (APC) usually carries the weapon. It must be dismantled and placed on its tripod for firing. It is normally served by a crew of three. Both infrared (IR) and passive night sights are available. The rocket-assisted HEAT projectile has an effective range of 1,000 meters and can penetrate 400 millimeters of armor. It has a high muzzle velocity (435 meters per second) which is increased to 700 meters per second by rocket assist. The SPG-9 is organic to the antitank platoon of the BTR-equipped motorized rifle battalion (MRB). The Soviets usually employ it with mutually supporting antitank guided missiles (ATGMs).

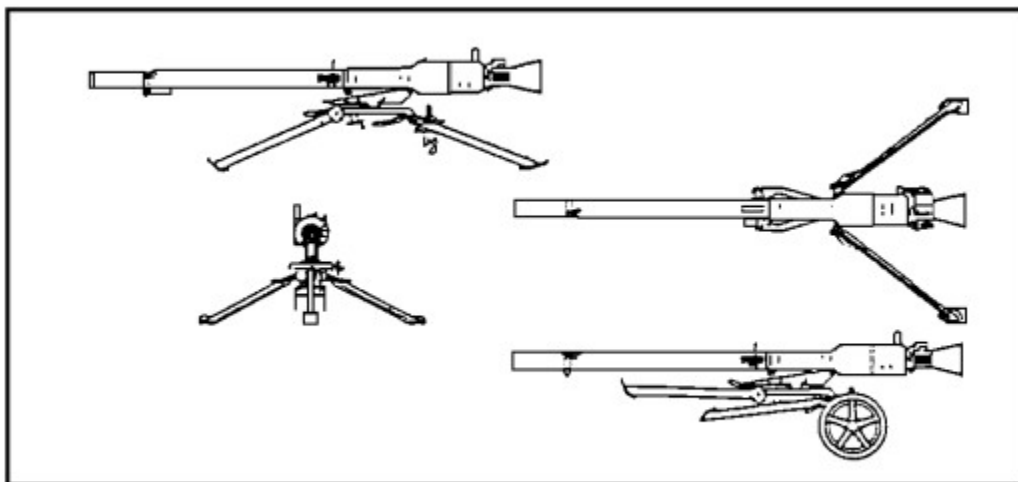


Figure 2-4. 73-mm Recoilless Antitank Gun SPG-9.

c. Remarks. The SPG-9 began replacing the previous recoilless AT guns (82-mm B-10 and 107-mm B-11) around 1970. It is now in service, not only in Soviet MRBs, but also in the Polish, Bulgarian, East German, and Hungarian armies.

2. 100-mm Antitank Gun MT-12.

The following paragraphs discuss the MT-12 Antitank Gun (shown in Figure 2-5).

a. Description. The T-12 is a 100-mm smoothbore AT gun mounted on a two-wheeled, split-trail carriage, with a single caster wheel near the trail ends. The long (8,484-mm) gun tube has a cylindrical, multi-perforated muzzle brake which is only fractionally larger in diameter than the thin barrel. The T-12 variant has a winged shield angled to the rear on both sides and an additional recoil cylinder above the breech on the right. Both versions frequently mount infrared night-sighting equipment.

b. Capabilities. The MT-12 is organic to the antitank battalion at division, army, and front levels. It fires fin-stabilized, non-rotating rounds similar to those of the 115-mm gun of the T-62 tank. Muzzle velocity is 900 meters per second (mps) for

HE and HEAT rounds and 1,500 mps for hyper-velocity, armor-piercing, fin-stabilized discarding Sabot round (HVAPFSDS) rounds. Maximum indirect-fire range is 8,200 meters for Frag-HE ammunition. The effective direct-fire range is approximately 1,000 meters (HEAT) or 2,000 meters (HVAPFSDS). Grazing range against a two-meter-high target is 1,880 meters with the HVAPFSDS round.

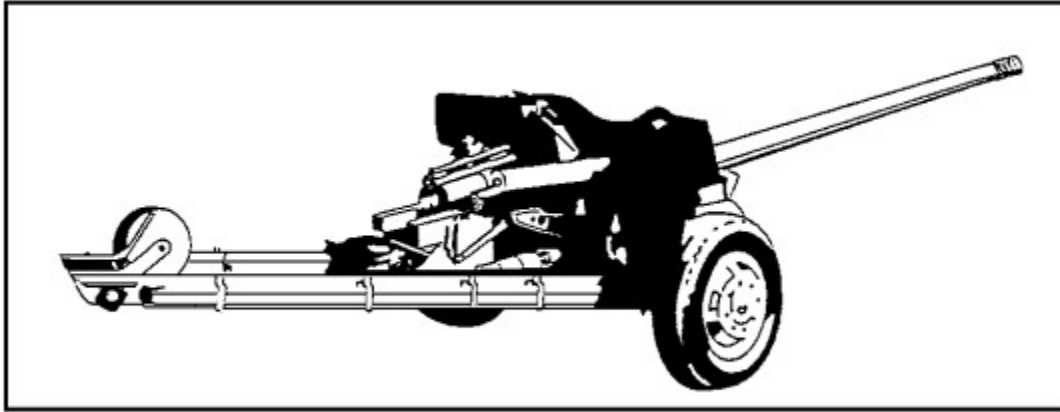


Figure 2-5. 100-mm Antitank Gun MT-12.

The HEAT round can penetrate about 400 millimeters of armor at any range; the HVAPFSDS round can penetrate about 225 millimeters of armor at 1,000 meters. The theoretical rate of fire is reportedly 14 rounds per minute; however, the rate for aimed fire is only six rounds per minute and the maximum practical rate of fire is 10 rounds per minute.

c. Limitations. The T-12 and the MT-12 can function as a field gun only under limited circumstances; this is due to the limited elevation capability, only +20 degrees. However, with trails dug in to provide 45-degree elevation, maximum range is extended to 16,000 to 21,000 meters.

d. Remarks. Since its introduction in about 1965, the MT-12 has replaced the older 100-mm field gun M1944 and the 85-mm antitank gun D-48 in most Soviet front-line units. The MT-12 variant was formerly called the T-12A. Like their predecessors, both can be towed by a truck or armored tracked artillery tractor. The MT-LB multipurpose armored tracked artillery tractor/APC usually tows them. They are in service in at least the Soviet and East German armies. In 1989, the Soviets began to introduce the MT-12 into motorized rifle regiments (MRRs).

PART C - ANTITANK GUIDED MISSILES

1. Antitank Guided Missiles.

These are the guided missiles in the Soviet arsenal:

- AT-2/SWATTER.

- AT-3/SAGGER.
- AT-4/SPIGOT.
- AT-5 SPANDREL.
- AT-6SPIRAL.
- AT-7/SAXHORN.
- AT-8/SONGSTER.

The following paragraphs discuss each of these guided missiles.

a. Antitank Guided Missile AT-2/SWATTER. The following paragraphs discuss the AT-2 SWATTER Guided Missile (shown in Figure 2-6).

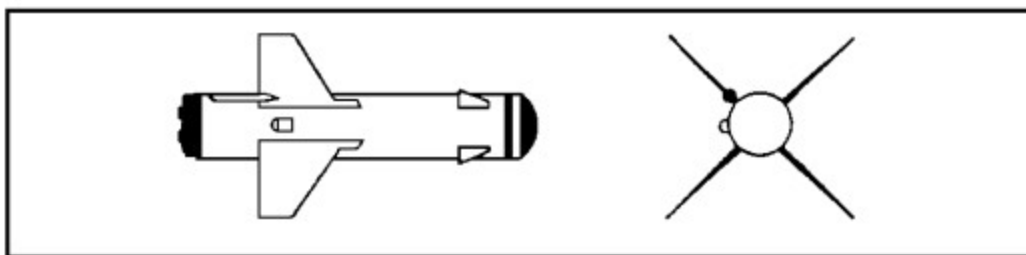


Figure 2-6. AT Guided Missile AT-2/SWATTER.

(1) Description. The SWATTER is a radio-guided antitank guided missile (ATGM) with a HEAT warhead. The missile exists in three versions designated A, B, and C. All versions are 1,160 millimeters long, and 148 millimeters in diameter. The A and B versions differ in weight (27 and 29 kilograms respectively). They both use manual command-to-line-of-sight guidance. However, the AT-2C/SWATTER has semi-automatic command-to-line-of-sight (SACLOS) guidance.

The SWATTER is mounted on BRDM/BRDM-2 scout cars with four launch rails on a traversable mount. When the launcher is raised for firing, armor plates on the BRDM move to the sides, while the launcher on the BRDM-2 attaches to the underside of a flat, retractable, armored cover.

The Mi-8T HIP E can mount two SWATTERS above each of its two external weapons racks. The Mi-24/HIND A and D mount two SWATTERS on wingtip launch rails on each of their two stub wings.

(2) Capabilities. The SWATTER A can engage targets at ranges between 500 and 2,500 meters. SWATTER B and C have maximum ranges of 3,500 and 4,000 meters respectively. All versions have a flight speed of 150 meters per second, resulting in the following flight times to maximum ranges:

- SWATTER A - 17 seconds to 2,500 meters.
- SWATTER B - 23 seconds to 3,500 meters.

- SWATTER C - 26-27 seconds to 4,000 meters.

Armor penetration capability is over 500 millimeters, and the probability of a first-round hit is 67 percent for the SWATTER A and B and over 90 percent for the SWATTER C.

The antitank batteries of the MRRs sometimes use the BRDM/BRDM-2 SWATTERs, although this role is more likely filled by the AT-3 or AT-5. However, SWATTERs, especially the AT-2c updated version, are still in wide use as helicopter-mounted missiles.

(3) Limitations. The SWATTERs with manual command-to-line-of-sight (MCLOS) guidance have a major disadvantage: the operator must track target and missile simultaneously and guide the missile to the target. The slow flight speed makes evasive action (by the target) an effective countermeasure, especially at long ranges.

(4) Remarks. The Soviets introduced SWATTER A in 1960, SWATTER B in 1965, and SWATTER C in 1968-70. The AT-5 SPANDREL is currently replacing the MCLOS-guided BRDM-mounted SWATTERs. The helicopter-mounted SWATTER C, retrofitted with a semi-automatic IR/radio guidance system, was apparently an interim measure pending full deployment of the longer-range, second-generation missile AT-6/SPIRAL.

b. Antitank Guided Missile AT-3/SAGGER (Figure 2-7). The following paragraphs discuss the AT-3/SAGGER Guided Missile.

(1) Description. The SAGGER is a wire-guided ATGM with a HEAT warhead. The missile is 864 millimeters in length, 120 millimeters in diameter, and 11.3 kilograms in weight. It has several launch configurations:

- Manpack.
- Armored Vehicle.
- Helicopter.

With the manpack version, the operator carries the SAGGER in a fiberglass "suitcase." He attaches it by a hinged support to the lid of the case. From that position, he launches the missile by means of a firing button on the control box (not shown). He then uses the control box's periscope sight and control stick to guide the missile to its target.

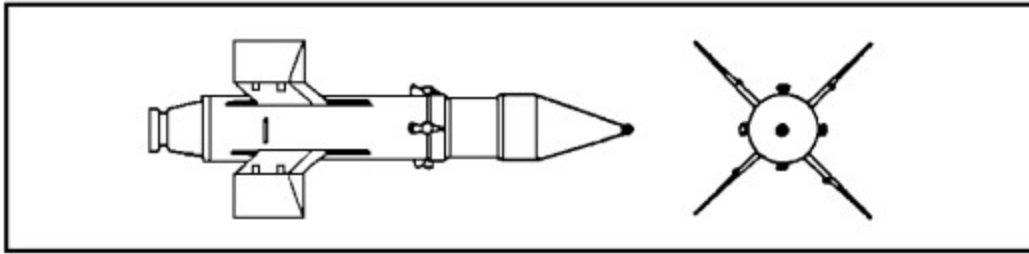


Figure 2-7. Antitank Guided Missile AT-3/SAGGER.

On BRDM/BRDM-2 scout vehicles, six launch rails are mounted on the underside of a retractable armored cover, with eight additional missiles carried inside the vehicle. The BMP-1 and BMD-1 combat vehicles both have a single launch rail mounted above the 73-mm main gun and carry a total of four and three missiles respectively.

The Mi-2/HOPLITE helicopter can carry two SAGGERS on each side of its cabin. The Mi-8TB/HIP F carries six SAGGERS.

(2) Capabilities. The SAGGER can engage targets at ranges of 500 to 3,000 meters and penetrate over 400 millimeters of armor. It employs a MCLOS guidance system in which the operator must observe both missile and target and guide the missile to the target. This wire-guided missile is invulnerable to electronic countermeasures (ECM) and has a very small percentage of malfunctions.

The retractable launcher on the BRDM-2 vehicle has the ability to traverse 70 degrees to the left or right with elevation varying from -3.5 to +17 degrees.

The AT-3/SAGGER C variant employs SACLOS guidance. It is mounted primarily on the BRDM-2, but it may also be mounted on the HIP F and HOPLITE helicopters. These heliborne systems provide greater flexibility to the ground command but at a greater risk and vulnerability cost to the launch platform.

The antitank platoon of a BTR-equipped MRB has two ATGM squads, each with two manpack SAGGER firing teams. Each three-man team has a control box, four SAGGER missiles, and a RPG-7V AT grenade launcher.

The gunner carries two missiles and the control box in suitcases. The assistant gunner carries two more missiles in suitcases. The backup gunner mans the RPG-7V.

The team can set up, check out, and fire one missile in five minutes or all four missiles in 12 to 15 minutes. Using a four-position selector switch on the control box, the gunner can fire up to four missiles consecutively. He can remotely fire missiles from positions up to 15 meters from the launchers.

For targets at ranges less than 1,000 meters, the gunner can guide the

missile by eye; for longer ranges he must use the eight-power magnifying periscope sight. The RPG-7V gunner is usually deployed 150 to 200 meters in front of the SAGGER position to cover targets inside the SAGGER's minimum range of 500 meters. The antitank platoon also has two SPG-9s which may be deployed with the manpack SAGGERS.

BRDM/BRDM-2 SAGGERS are organic to the antitank missile battery of motorized rifle regiments (MRRs) and airborne regiments; to the antitank battalion of motorized rifle divisions (MRDs); to the antitank regiment of combined arms armies (CAAs); and to the antitank brigade of artillery divisions.

The BRDM/BRDM-2 vehicles have a reaction time of only one minute to fire from a completely buttoned-up mode. The crew can fire six missiles without reloading, and the vehicle can carry eight additional missiles inside. Successive missiles can be fired and tracked within five seconds of the previous missile's impact. The gunner can operate either from within the vehicle or from a remote position up to 80 meters away. The vehicle has a two-man crew which includes the commander/gunner and the driver. They also have assault rifles and a RPG-7V antitank grenade launcher.

(3) Limitations. A SAGGER A gunner must visually track both target and missile simultaneously; this requires extensive training and constant practice. Although the missile leaves the launcher armed and can detonate and kill at very short range, it can be captured by the gunner only at ranges of 500 to 800 meters. Under combat conditions however, most gunners can successfully engage targets only between 1,000 and 3,000 meters. The missile has a very long flight time to the target:

- 12.5 seconds to 1,500 meters.
- 25 seconds to 3,000 meters.

Evasive action is effective against the SAGGER, especially at long ranges. Although the SAGGER produces a cloud of gray smoke and a loud roar when fired, its signature is difficult to detect on the battlefield.

(4) Remarks. The SAGGER, also known by the designation AT-3, was first seen in 1961. It is more compact than the earlier AT-1/SNAPPER and AT-2/Swatter ATGMs, but carries an equally powerful warhead. In recent years, the Soviets have retrofitted some SAGGER systems, designated the AT-3c, with semi-automatic IR wire-guidance systems. Only the vehicle- and helicopter-mounted missiles have been so retrofitted. This is obviously an interim measure pending the full deployment of the longer-range, second-generation AT-5/SPANDREL and AT-6/SPIRAL missiles. The AT-4/SPIGOT is replacing manpack SAGGERS as well as those mounted on the BMP-1 and BMD-1.

c. Antitank Guided Missile System AT-4/SPIGOT. The following paragraphs discuss the AT-4/SPIGOT Guided Missile System (shown in Figure 2-8).

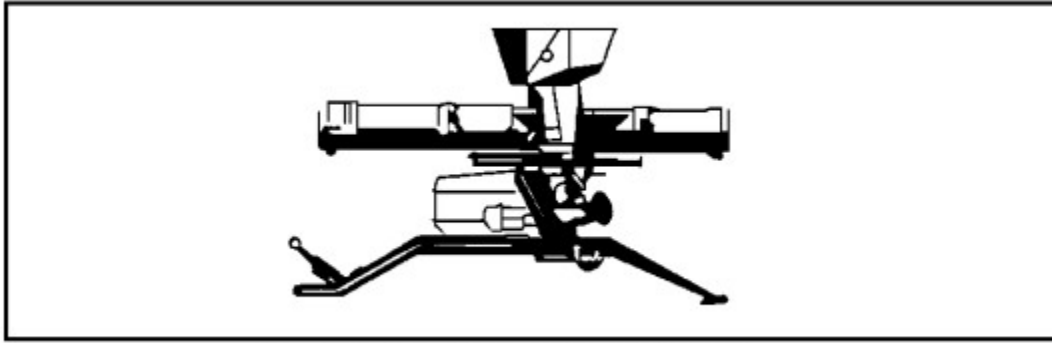


Figure 2-8. Antitank Guided Missile AT-3/SPIGOT.

(1) Description. The AT-4/SPIGOT is a tube-launched, wire-guided, (SACLOS), ATGM system, similar in many respects to the U.S. TOW (tube-launched, optically tracked, wire-guided) system. The AT-4 system consists of three major components:

- The SPIGOT missile.
- The launch tube.
- The missile launcher.

The missile itself is 863 millimeters long and 119 millimeters in diameter; it weighs 7.4 kilograms and has a HEAT warhead. The launch tube is 1,100 millimeters long, 130 millimeters in diameter, and 5.2 kilograms in weight. It serves to store and carry the missile. The tripod-mounted launcher for ground-launched employment has a periscope sight attached to its left side. The sight and missile tracker comprise a single unit, which is mechanically attached to the launch-tube connecting rail so both move together in elevation. A locking lever allows the complete periscope sight and missile tracker to be released and rotated into a folded position for transport. The monocular optical sight has four-power magnification and a 4.5-degree field of view.

The crew loads the SPIGOT missile by sliding the tube onto the launch supports from the rear until the electrical contacts and a mechanical catch engage; then the system is ready for launch. The Soviets originally designed the AT-4/SPIGOT as a ground-launched weapon system. However, the turrets of the BMP-1 and BMD-1 combat vehicles can mount the AT-4 launcher. The BRDM-2 launcher vehicle of the AT-5 system and the launcher on the BMP-2 can also fire the SPIGOT missile.

(2) Capabilities. The SPIGOT has a minimum range of only 70 meters and a maximum range of 2,000 meters. Missile speed is estimated at 185 meters per second, which gives the missile a flight time of 11 seconds to its maximum range. The warhead, which is probably smaller than the SAGGER's, can penetrate 500 to 600 millimeters of armor. Probability of a first-round hit should be at least that of the semi-automatic AT-3c/SAGGER, which is 90 percent.

The SACLOS guidance system increases accuracy and reduces operator training requirements since it is no longer necessary for the operator to keep track of both target and missile simultaneously. The gunner merely keeps his sight on the target while the missile is tracked automatically. The deviation between the missile's path and the operator's line of sight is measured by an IR tracking apparatus. (The IR source is in the missile's tail.) A device at the control site then generates guidance commands which are transmitted to the missile by the wire link, causing the missile to eliminate the deviation.

The AT-4 tracker is adequate, simple, and inexpensive. Its extremely narrow field of view makes it more difficult to decoy, since the decoy source must be inside the field of view.

The antitank platoon of the BTR-equipped MRB has four (or in high readiness units, six) AT-4/SPIGOT firing teams. In each three-man team, the gunner carries the folded launcher and tripod as a backpack, the two bearers each carry two launch tubes as backpacks. All three men carry their assault rifles. The team is not equipped with a RPG-7V since the SPIGOT does not have the 500-meter dead space of the SAGGER.

(3) Limitations. Since the SPIGOT launcher must stay with the aiming and tracking assembly, i.e., the gunner, it is not possible to move him to a remote location for safety. And since the gunner must establish and maintain visual contact with the target, any means of disrupting his concentration is an effective countermeasure. Such means include flash blinding, suppressive fires, and smoke screening. Besides being effective and inexpensive, smoke also attenuates the IR guidance link with the missile tracker.

(4) Remarks. The AT-4/SPIGOT system, given the nickname "Fagot" (In Russian "Fagot" means "Bassoon") by the Soviets, was introduced in 1974. It is operational in all Warsaw Pact countries. The interoperability of the SPIGOT missile on the AT-5 launch vehicle and BMP-2 provides a significant logistic and tactical advantage, however, use of the SPANDREL missile on the AT-4 portable launcher has not been confirmed.

d. Antitank Guided Missile AT-5/SPANDREL. The following paragraphs discuss the AT-5/SPANDREL Guided Missile (shown in Figure 2-9).

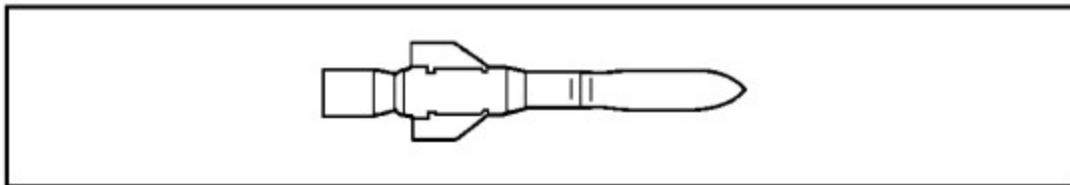


Figure 2-9. Antitank Guided Missile AT-5/SPANDREL.

(1) Description. The AT-5/SPANDREL is a wire-guided SACLOS, ATGM system mounted on the BRDM-2 amphibious scout vehicle

chassis. Dimensions and shape of the launch tube are similar to those of the AT-4/SPIGOT, but the SPANDREL missile is considerably heavier. The SPANDREL launch tube has a blow-out cap at the front, and it is flared at the rear. Five SPANDREL missiles, or any combination of SPIGOT and SPANDREL missiles, are carried on a traversable mount just behind the two front cupolas of the BRDM-2. A bowed hatch in the vehicle roof immediately behind the launcher allows the launcher to be folded backwards into the hull for reloading under armor protection. The vehicle carries an additional 10 reload missiles inside. A rotatable, optical, sighting/tracking periscope, similar in appearance to the periscope on the AT-4/SPIGOT launch apparatus, is mounted atop the gunner's hatch on the right front of the vehicle roof. A single AT-4 launch platform with an integrated optics/tracker housing is mounted atop the turret of the BMP-2 amphibious combat vehicle. As with the BRDM-2 launch pedestal configuration, this variant of the AT-5 system can launch either the SPIGOT or the SPANDREL missile. The basic on-board load for the BMP-2 is four missiles.

(2) Capabilities. The SPANDREL has a range of 4,000 meters. Other capabilities are essentially the same as those listed above for the AT-4/SPIGOT, except for time of flight.

(3) Limitations. The limitations of the AT-5/SPANDREL system are precisely those of the AT-4/SPIGOT, namely the requirement for the gunner to keep visual contact and concentration on the target. He can be distracted by fires or smoke screening; the latter can also disrupt the IR link.

(4) Remarks. The Soviets nicknamed the AT-5/SPANDREL system "Konkurs" or "contest." They introduced it around 1974 or 1975, although it was not displayed for public viewing until the Red Square Parade of 1977. The BRDM-2-mounted AT-5 system will eventually replace all vehicle-mounted AT-2 and AT-3 systems in the Soviet Army. The AT-5/SPANDREL system is currently operational in the Warsaw Pact countries.

e. Antitank Guided Missile AT-6/SPIRAL. The AT-6/SPIRAL Guided Missile (shown in Figure 2-10) is discussed in the following paragraphs.

(1) Description. The AT-6/SPIRAL is a tube-launched, SACLOS, ATGM mounted on the Mi-24/HIND E and F helicopters. It replaces the heliborne AT-2/SWATTER variants found on previous HIND models. Normally, there are I-shaped launch fixtures for two SPIRAL launch tubes on each wingtip of the HIND E and F. However, the HIND E and F may carry a second AT-6 launch platform on the outboard universal pylon on each wing. This allows them to mount a total of eight SPIRAL missiles. Also, some HIND E and F models have "stacked" AT-6 launch platforms on the wingtip pylons for a possible total of 16 SPIRALs. Unlike the AT-4/SPIGOT and AT-5/SPANDREL, this missile system is not wire guided.

The SPIRAL uses a SACLOS system with IR missile tracking and radio guidance which is similar to the uprated AT-2c/SWATTER C system. Also, it is much larger than previous Soviet ATGMs.

(2) Capabilities. The SPIRAL's maximum range is estimated to be 5,000 meters. Its minimum range may be similar to the earlier AT-2/SWATTER ATGMs; that is, 600 meters. Missile speed is probably about 450 meters per second. The warhead could weigh up to 10 kilograms with an armor penetration capability of 600 to 700 millimeters. First-shot-hit probability should be as good as the AT-2c -- 90 percent. The SACLOS guidance system probably operates the same as the AT-4/SPIGOT and AT-5/SPANDREL, except that the SPIRAL is not wire-guided.

(3) Limitations. During the flight time of the SPIRAL to the target (estimated to be about 11 seconds to 5,000 meters) the target can take evasive action but the helicopter launch platform has only a limited ability to take evasive action itself since the gunner must keep the target in his sight. This, of course, renders the helicopter vulnerable.

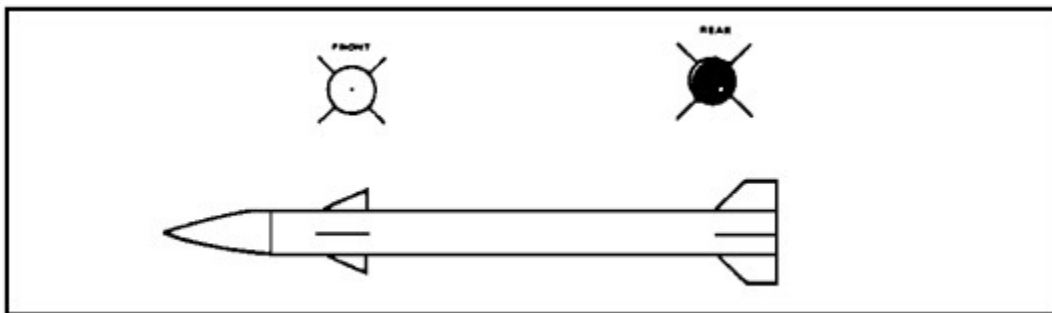


Figure 2-10. Antitank Guided Missile AT-5/SPIRAL.

(4) Remarks. Although introduced in 1973, the AT-6/SPIRAL system was not seen by Western observers until 1978 when it was spotted on a HIND E. Some sources credit the SPIRAL with a maximum range of 7,000 meters.

f. Antitank Guided Missile AT-7 SAXHORN. The following paragraphs discuss the AT-7 SAXHORN Guided Missile (shown in Figure 2-11).

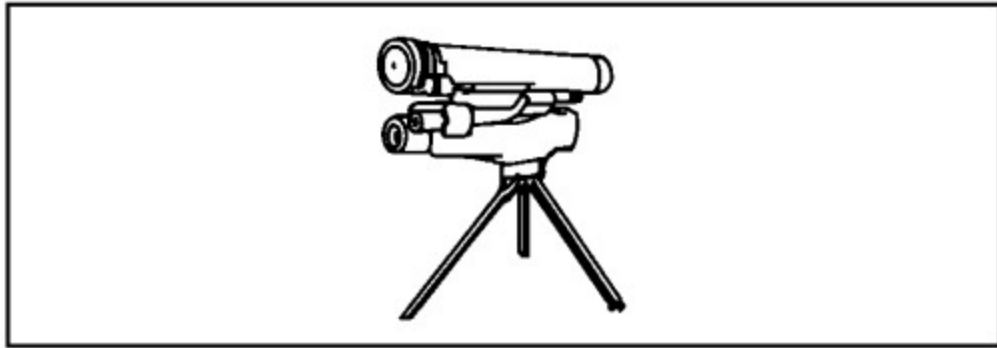


Figure 2-11. Antitank Guided Missile AT-7/SAXHORN.

(1) Description. The AT-7/SAXHORN is a tube-launched, SACLOS, ATGM system with a wire command link. One man can carry and operate the SAXHORN, but the crew normally will consist of two men. The second man probably carries additional missile canisters.

(2) Capabilities. The AT-7/SAXHORN is organic to the machine gun/antitank platoon of the BTR-equipped motorized rifle company (MRC). This platoon has three manpack launchers. The SAXHORN missile, with its HEAT warhead, has a maximum range of 1,000 meters. The operator tracks the target visually using a monocular scope. The missile is guided automatically to the target when the gunner keeps the crosshairs of his sight on the target.

(3) Limitations. Limitations of the AT-7/SAXHORN ATGM system are identical to those of the AT-4/SPIGOT system, namely the requirement for the gunner to keep visual contact and concentration on the target. He can be distracted by fires or smoke screening; the latter can also disrupt the IR link.

(4) Remarks. The AT-7/SAXHORN is generally considered to be in the same category as the U. S. Dragon missile. The AT-7/SAXHORN system was introduced in 1979 and is believed to have been placed on general issue in the early 1980s, but so far little information has appeared in the West.

The weapon appears to be the usual type of prepacked launch tube with the missile mounted upon a firing post with optical and electro-optical sights. The method of guidance is not known, although it is possibly a laser beam rider. The missile is believed to weigh about six kilograms and has a shaped charge warhead capable of defeating more than 500 millimeters of armor. The maximum range is probably 1,500 meters.

g. Antitank Guided Missile AT-8/SONGSTER. The AT-8/SONGSTER (shown in Figure 2-12) is discussed in the following paragraphs. The identification in the Soviet arsenal of an innovative (or even simply unconventional) weapon system with no direct counterpart in Western practice is almost certainly bound to spark

discussions and doubts as to its nature and purpose--if not about its very existence. Sometimes, there is concrete evidence immediately available to show that the system is no less real simply because Western planners and engineers have never concocted anything similar, and its reason for being is self-evident, as in the case of the VASILYEK automatic mortar and the PLAYMA grenade launcher. However, sometimes things are a little bit more difficult. There are many past examples, but, as of today, the single most difficult puzzle is perhaps the AT-8 cannon-launched missile, previously designated KOBRA (this could be the Soviet name, but there is no certainty) and which has now received the name SONGSTER.

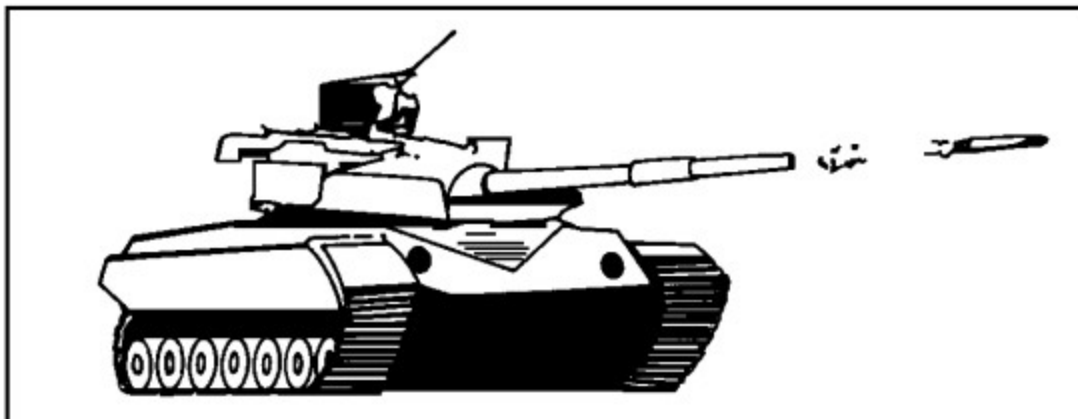


Figure 2-12. Antitank Guided Missile AT-8/SONGSTER.

The first hints in the press were put forward in November 1984 by the U. S. Army Scientific Bulletin. The weapon was subsequently mentioned in the 1985 edition of the Pentagon booklet, "Soviet Military Power." Since then, its existence has been taken for granted by most Western defense commentators strictly on the basis of the little information circulated by the Western defense intelligence community because, to our knowledge, no concrete evidence ever filtered outside strictly guarded circles (assuming that concrete evidence is indeed available somewhere).

(1) Description. The AT-8/SONGSTER is launched from the muzzle of a tank's main gun rather than a launch tube or rail. The ATGM has SACLOS guidance with a radio-frequency command link. It is known to be fired by T-64B and T-80 medium tanks.

(2) Capabilities. The SONGSTER missile has a maximum range of 4,000 meters. Its HEAT warhead has an impressive armor penetration capability of 700 to 800 millimeters. The missile is fired through the main-gun tube like a normal tank round; after launch however, it uses a sustain or boost/sustain motor to propel it to the target. The tank gunner tracks the target visually using a monocular periscope; the missile is guided automatically as long as the gunner keeps the crosshairs on the target.

(3) Limitations. SONGSTER missile limitations are the same as for other

SACLOS-guided system missiles except the gunner is less vulnerable to suppressive fires.

(4) Remarks. The AT-8/SONGSTER may have entered service with Soviet troops around 1981.

The exact nature and characteristics of SONGSTER are extremely difficult to visualize from both the operational and technical point of view. The assumption that a weapon such as the AT-8 does exist implies formidable conceptual and logical problems. The evidence available about the AT-8 (whatever its nature) is interpreted by Western intelligence agencies and defense commentators as follows:

- The AT-8 SONGSTER (KOBRA) is a guided missile intended to be launched from the 125-mm smooth-bore gun of the T-64B and T-80 MBTs, which are equipped with a modified version of the RAPIRA 3 125-mm gun standard on the T-64A/T-72 series. The missile is credited with a maximum speed of 1,500 meters per second and a range of about 5,000 meters. It is assumed that it is "fired" at low speed (150 meters per second) by a small charge, the main cruise motor igniting at a safe distance from the muzzle.
- There is considerable uncertainty regarding the guidance principle used. The AT-8 has been described so far as a laser-guided missile (either a beam-rider or a semi-active homer). The armored box placed in front of the commander's cupola on the T-64B and T-80 MBTs (and in all likelihood associated with the SONGSTER) was referred to as a "laser sight." However, new evidence (to which, again, we have no direct access) indicates that the box is not an optic or optronic device. In fact, it has no openings or ports.
- Originally, the SONGSTER was referred to as a long-range antitank weapon. This interpretation implies a whole series of major technological/operational inconsistencies. However, the Western defense intelligence has since changed its mind concerning the nature of the SONGSTER. The AT-8 is now considered to be mainly an anti-helicopter weapon, intended to ensure the self-defense of MBTs against Western combat helicopters carrying antitank missiles; antitank engagements cover only a secondary role. Additionally, several considerations suggest that the main ground targets are likely to be not MBTs but, rather, missile tank destroyers.

Seen in this perspective, the AT-8 does make some operational sense. However, three points still remain difficult to explain:

- The physical compatibility of the weapon with the tanks that are supposed to carry it.
- The operational implications.

- The guidance principle.

PART D - SOVIET TANKS IN THIRD WORLD NATIONS

1. T-72 Medium Tank.

The T-72 and its variants have greater mobility, better armor protection, and better firepower than the T-62. It has the same integral engine smoke-generating system as the earlier T-54/55/62, and it has smoke grenade launchers. The T-72 is used by the Soviet Union and its following allied countries:

- Poland.
- Czechoslovakia.
- Yugoslavia.
- India.

The following Third World countries also have the T-72 tank:

<u>Country</u>	<u>Quantity</u>	<u>Comments</u>
Algeria	300+	
India	650	Local production
Iraq	350-560	Includes Yugo T-84
Kuwait	200	Yugoslavian T-84 + UK
Libya	180	
Syria	1,100	

2. T-54/55 Modernized Tanks.

The Soviet Union and other countries, including China, Egypt, Romania, Czechoslovakia, Hungary, and Poland, have begun programs to modernize some T-54/55 tanks or the Chinese version, Type 59.

Improvements include new APFSDS ammunition. This ammunition has a muzzle velocity of 1,500 meters per second and armor penetration of 300 millimeters of RHA.

Other improvements include:

- A new computerized fire-control system to improve first-round-hit probability.
- Strap-on laser rangefinders.
- Add-on armor.
- Smoke grenade launchers.
- Track skirts.

- Upgraded mobility components (track and engine).

Czech T-55 improvements include:

- A crosswind sensor.
- Thermal guntube sleeve.
- Laser warning device that warns the crew when the vehicle is being lased.

The following Third World countries have the T-54/55 or Type 59 tanks:

<u>Country</u>	<u>Quantity</u>	<u>Comments</u>
Afghanistan	300-400	
Algeria	390	
Angola	300	
Bangladesh	70-100	
China	6,000	Type 59
Congo	35	Plus 15 Type 59
Cuba	650	
Egypt	1,040	Some with 105mm guns
Ethiopia	600	
India	800-950	
Iran	1,000	Plus 260-400 Type 59
Iraq	700	Plus some Type 59
Israel	300	Some with 105mm guns
Kampuchea	60	Some Type 59
Lebanon	50	
Libya	1,700	
Mongolia	100+	
Mozambique	150	
Nicaragua	130	
Nigeria	70	

North Korea	2,000	Includes 175 Type 59
Pakistan	1,151	Includes 1,100 Type 59
Peru	300	
Somalia	100	
Sudan	150	
Syria	2,100	
Vietnam	1,000-1,500	Plus 160 Type 59
Yemen, North	580	
Yemen, South	200	

3. T-62 Modernized Tank.

Soviet T-62 tanks used in Afghanistan had a number of modifications, including the following ones:

- Full-length track skirts.
- Curved, horseshoe shaped add-on armor sections mounted on the upper glacis.

The add-on turret armor provides additional protection against shaped charge antitank munitions.

These tanks carry a strap-on laser rangefinder mounted above the main gun. They also have smoke grenade projectors on the sides of the turret.

The following Third World countries have the T-62 tank:

<u>Country</u>	<u>Quantity</u>	<u>Comments</u>
Afghanistan	100	
Algeria	300	Local production
Angola	100+	
Cuba	300	
Egypt	500-600	Some with 105mm guns
Ethiopia	100	
Iran	150+	
Iraq	1,600	

Israel	120	
Libya	900-1,300	
Mongolia	100	
North Korea	600+	Plus locally produced
Peru	50	
Syria	1,000	
Vietnam	200	
Yemen, North	34	
Yemen, South	170	

Lesson 3

FUTURE antiarmor WEAPONS STRATEGY

OVERVIEW

Lesson Description:

In this lesson, you will learn to identify the characteristics of the antiarmor weapons strategy of the United States with regard to the Multipurpose Individual Munition (MPIM); the TOW Sight Improvement Program (TSIP) and the development of the TOW 2B. In addition, you will learn to identify the characteristics of opposing forces' future antiarmor weapons strategy with regard to the light-armored vehicles in the Third World.

Terminal Learning Objective:

Action: Identify future antiarmor weapons strategy of both the United States and its opposing forces.

Condition: Given the subcourse material contained in this lesson.

Standard: You will identify the future antiarmor weapons strategy of both the United States and its opposing forces.

References: The material contained in this lesson was derived from the following publications: COLLECTIVE TRAINING PLANS (DOTD) and OPERATIONAL AND ORGANIZATION

PLANS (DCD).

INTRODUCTION

Future antiarmor weapons strategy on the part of the United States includes improvements to the TOW Weapon System and the introduction of the new Multipurpose Individual Munition (MPIM). The improvements to the TOW Weapon System pertain to the employment of a new missile (the TOW 2B) and improvements which have been made to the TOW sight. Future antiarmor weapons strategy on the part of the Soviet Union and other opposing forces pertain to new light-armored personnel carriers (wheeled and tracked). This lesson will teach you to identify the characteristics of these future antiarmor weapons strategies U. S. and opposing forces.

PART A - FUTURE U.S. antiarmor WEAPONS STRATEGY

1. Development of TOW 2B.

A new missile is being developed for the TOW weapon system. It will be a tandem design which exploits new technology in Explosively Formed Penetrators (EFPs) and evaluating new metals for liners.

The TOW 2B has dual warheads and dual sensors for fly-over, shoot-down (top attack) capability which attacks the most vulnerable part of an armored vehicle. The TOW 2B will replace the TOW 2A via a production line cut-in 1990.

The model number for the TOW 2B missile is BGM 71F.

No further training is required for TOW gunners as a result of fielding the TOW 2B missile, which has a center mass aimpoint.

The TOW 2 missile can be fired from all existing firing platforms.

Currently, the overall TOW 2B program is on schedule for FY91 fielding.

The TOW 2B has a unique marking system (shown in Figure 3-1) for easy identification of it as a fly-over, shoot-down missile.

2. TOW Sight Improvement Program (TSIP).

Technological advancements have resulted in improvements to the TOW sight. These improvements will be applied to both the ground/HMMWV and the Bradley Fighting Vehicle (BFV) systems.

The principal improvements of the TOW Sight Improvement Program (TSIP) are as follows:

- A new Forward Looking Infrared (FLIR) sight.
- A new processor which replaces the Digital Missile Guidance Set (DMGS). The new processor incorporates automatic tracking and multiple launch capability.

- The visual telescope and the shortwave length infrared tracker will be upgraded.
- An eyesafe laser rangefinder.

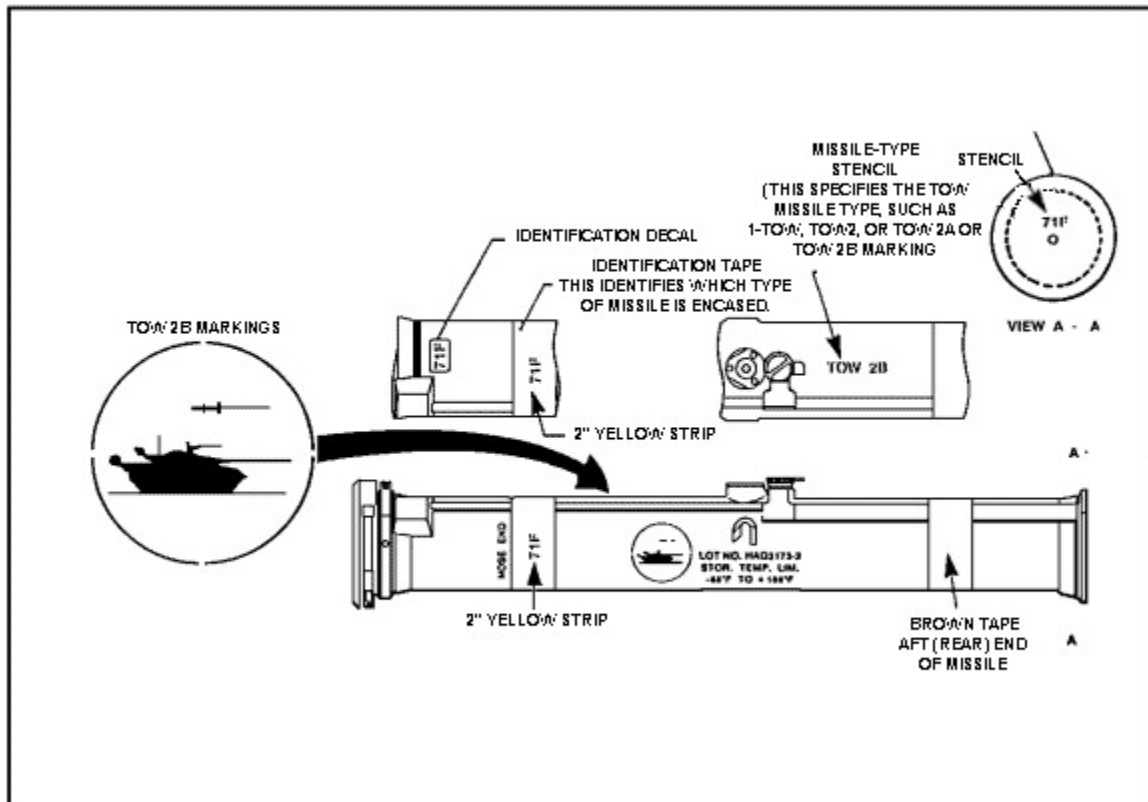


Figure 3-1. Missile Markings for Identification (BGM 71F).

The FLIR technology is being developed by the CECOM Center for Night Vision and Electro-Optics (CCNVEO). The two major CCNVEO technology programs are Standard Advanced Infrared Systems (SAIRS) and Advanced Longwavelength Infrared Circuit and Array Technology (ALICAT). The new processor incorporates automatic tracking and multiple launch capability. This technology is being developed in the Very High Speed Integrated Circuit (VHSIC) program. A portion of the critical technology will be the Kinetic Energy Missile (KEM) program. The new system also includes:

- An eyesafe laser rangefinder.
- Automatic boresight.
- TV display.
- Advanced signal processing MIL-STD-1553 software bus.
- ADA language.
- Automatic target cueing.
- Built-in training.
- Built-in test.
- Room for growth.

a. Ground/HMMWV. The new FLIR and redesigned telescope will be repackaged with the short wavelength Infrared (IR) tracker to make up an Integrated Sight Unit (ISU) for ground/HMMWV application. This will provide improved FLIR performance and single target engagement at increased ranges. Automatic boresight of the telescope, short wavelength IR tracker, and FLIR will be incorporated as well as target cueing (moving target indicator) and simultaneous multiple target engagement. The dismounted mode of employment will use a tripod to support the ISU and a single TOW missile. Batteries will provide power for operation of the system when dismounted. A power cable to use vehicle batteries and power for extended periods of operation at locations for the sight/launcher remote from the vehicle can be provided.

b. BFV (CFV). The Bradley Fighting Vehicle (BFV) ISU contains a visual telescope, a short wavelength IR tracker, a CCD camera, TV display, and a FLIR. The new FLIR and redesigned telescope will be repackaged with the short wavelength IR tracker to make up an ISU for the BFV application. This will provide FLIR performance and target engagement at increased ranges. Auto boresight of the telescope, short wavelength IR tracker and FLIR will be incorporated as well as target cueing (moving target indicator), simultaneous multiple target engagement, and multiple launch.

c. Benefits. The TSIP benefits include:

- Reduced target acquisition time.
- Wider field of view for search.
- Increased probability of a hit.
- Increased system/crew survivability.
- Increased rate of fire.
- Improved man-machine interface.
- Commonality of components between ground/HMMWV and BFV configurations.
- Improved combat effectiveness for the HMMWV and Bradley fighting vehicles due to a longer recognition range, automatic multiple target tracking, multiple missile launch, and improved fire control.
- Embedded training.
- Improved built-in test.
- Automatic boresight.
- Capability of firing all existing and future TOW missiles.
- Modular subsystems for maximum HMMWV and Bradley commonality.
- Retrofittable product improvement program.

3. MultiPurpose Individual Munition (MPIM).

The Multipurpose Individual Munition (MPIM) will enable the soldier to engage and defeat a variety of targets. The system will allow the individual soldier both to destroy light armor and incapacitate personnel within or behind structural barriers or field fortifications. It will be used by soldiers in all geographical areas under any climatic and battlefield conditions. Combat arms, as well as combat support and combat service support units, will use this weapon to accomplish their missions. The weapon will be employed as a round of ammunition and will not require any maintenance other than inspection and cleaning. The MPIM is a multipurpose weapon system that is projected to supplement and eventually replace the Launcher and Cartridge, 84-MM, M136 (AT4), HEAT and the M72A2/A3 Light Antitank Weapon (LAW).

Presently, two technologies are under consideration: a shoulder-launched munition and two rifle-launched munitions.

The MPIM will be a basic self-protection weapon for use against lightly armored vehicles for all Army units. It will be used as an assault weapon for combat arms use against enemy field fortifications and in military operations urban terrain (MOUT) environments. Tactical use is envisioned as being similar to the AT-4/LAW.

The MPIM will allow the individual soldier to engage targets and exploit his own firepower without dependence upon specialized support weapons.

The MPIM will be designed to replace the M72A2/A3 LAW and the AT4 with a single individual weapon/munition capable of defeating multiple types of targets in the close combat scenario.

The MPIM must incapacitate personnel inside or defeat the following multiple targets:

- Boyevaya Machina Pekhotnaya (BMP), BMP follow-on, and BMP postulated.
- 12-inch brick structures.
- Eight-inch concrete structures.
- Soviet field fortifications.

In addition, the MPIM can destroy or damage high-value material such as ammunition storage, POL, and communications.

PART B - FUTURE OPPOSING FORCES antiarmor WEAPONS STRATEGY

1. Wheeled Armored Personnel Carrier.

The most likely light armored vehicles that a US infantryman might encounter in the Third World in the future (1997-2007) is the wheeled armored personnel carrier.

This vehicle will be protected against 7.62-mm or .50 caliber armor piercing (AP) rounds and could have add-on armor that will reduce the effectiveness of 14.5-mm, 20-mm, and 25-mm ammunition. The vehicle will not have reactive armor.

The vehicle will have a night sight, either an image intensifier (II) or an active infrared (IR) system. This vehicle may also have a white light or an infrared searchlight.

The vehicle will be armed with a 7.62-mm coaxial machine gun and either a 12.7-mm (.50 caliber), a 14.5-mm, a 20-mm, a 23-mm, or a 25-mm gun. The vehicle may also have a 30-mm AFS-17 or a 40-mm Mark 19 automatic grenade launcher on it. The vehicle will have smoke grenade launchers. Examples of these vehicles are the

- Soviet BTR-152 (a Chinese copy Type 56).
- Soviet BTR-60 (copies of the BTR-60 are the Czech OT-64, the Romanian TAB-72, and the Polish SKOT-2).
- French Panhard M3.
- USA's Commando.
- West German UR-416.
- British Saracen.
- Brazilian EE-11.

These vehicles will appear on the battlefield in groups of three or four.

The size of the element dismounting will be eight to ten. In this element, there will be an antiarmor gunner with an RPG-7 type weapon and one or two light machine guns. Some of the characteristics of these vehicles are shown in Figure 3-2.

2. Tracked Armored Personnel Carrier.

The next most likely light armored vehicle that a US infantryman might encounter in the Third World in the future (1997-2007) is a tracked armored personnel carrier.

It will be protected against 7.62-mm or .50 caliber armor-piercing (AP) rounds. The vehicle will not have reactive armor.

The vehicle will have a night sight, either an image intensifier (II) or an active infrared (IR) system.

<u>Nomenclature</u>	<u>No. of Countries</u>	<u>Producer(s)</u>	<u>Crew/Pax</u>	<u>Wheels</u>	<u>Weapons</u>
BTR-152	33	USSR	2/17	6 x 6	12.7mm & 7.62mm or 2 x 14.5mm
BTR-60	29	USSR	2/8-14	8 x 8	14.5mm & 7.62mm
PANHARD M3	24	France	2/10	4 x 4	20mm & 7.62mm or 2 x 20mm
COMMANDO V-100, V-150, and V-300	23	USA	3/9	6 x 6	90mm or 25mm or 12.7mm, & one or two 7.62mm
UR-416	15	West Germany	2/8	4 x 4	20mm & 7.62mm
EE-11 (URUTU)	15+	Brazil	1/12	6 x 6	12.7mm
SARACEN	11	UK	2/10	6 x 6	2 x 7.62mm
OT-64/SKOT	7	Czech/Poland	2/15	8 x 8,	14.5mm, 7.62mm, & AT-3
VAB	10+	France	2/10	4 x 4	20mm or 12.7mm or 12.7 & 7.62mm
MOWAG PIRANHA	7	Swiss/Chile	2/8-13	4, 6, 8	90mm or ATGM or 7.62mm
FIAT 6614	5	Italy	1/10	4 x 4	12.7mm

The vehicle may be armed with a 7.62-mm coaxial machine gun and either a 12.7-mm (50 caliber) or a 14.5-mm machine gun. The vehicle may have smoke grenade launchers. Examples of these vehicles are the

- M113 (produced by the USA, Belgium, Italy, and Pakistan).
- Soviet BTR-50 (copies of the BTR-50 are the Czech OT-62 and the Chinese Type 77).
- Chinese YW 531 (the North Koreans make a copy called the M-1973).
- USA's M3 half truck.

The M113 is the most widely used of its type, and more than 80,000 M113s have been built and sold to 47 countries. Some countries have fitted their M113 vehicles with turret-mounted weapons, including 7.62-mm/12.7-mm machine guns and 20-mm or 60-mm cannons. When upgunned and equipped with AP/APDS ammunition, the vehicle will be able to engage and destroy light armored vehicles in addition to providing fire support to the infantry.

These vehicles will appear on the battlefield in groups of three or four. The size of the element dismounting will be eight to twenty. The element will include an antiarmor gunner with an RPG-7 type weapon and one or two light machine guns. Figure 3-3 lists some of the characteristics of these vehicles.

<u>Nomenclature</u>	<u>No. of Countries</u>	<u>Producers</u>	<u>Crew/Pax</u>	<u>Weapons</u>
M113	39	USA	2/11	12.7mm
BTR-50	22	USSR	2/20	14.5mm
M3 HALF TRUCK	16	USA	2/8	12.7mm, 14.5mm, & 7.62mm
OT-62	8	Czech	2/18	82mm, 14.5mm, & 7.62mm
YW 531 (Type 63)	9	China	4/10	12.7mm or ATGM

3. Armored Reconnaissance Vehicle.

The third most likely light armored vehicles that a US infantryman might encounter in the Third World in the future (1997-2007) will be an armored reconnaissance vehicle

It will be protected against .50 caliber armor piercing (AP) rounds. This vehicle will not have reactive armor. The vehicle will have a night sight, either an image intensifier (II) or an infrared (IR) system. The vehicle will be armed with a 7.72-mm coaxial machine gun, either a 12.7-mm (.50 caliber) or a 14.5-mm machine gun or a 30-mm, 37-mm, 60-mm, 76-mm, or 90-mm gun. The vehicle may have smoke grenade launchers. Examples of these vehicles are the

- Soviet BRDM-2 and BRDM-1 (copies of the BRDM are the Czech OT-65, the Hungarian PSZH-IV, and the Romanian FUG and FUG D-944).
- French AML-90 and AML-60.
- British FERRET, Scorpion, and Scimitar.
- USA's M8 armored car.
- Brazil's EE-9 Cascavel.

The size of the dismounting element may be three.

Figure 3-4 lists some of the characteristics of these vehicles.

4. Infantry Fighting Vehicle.

The least likely light armored vehicles that a US infantryman might encounter in the Third World (except in the Mideast) in the future (1997-2007) is the infantry fighting vehicle.

It will be protected against .50 caliber armor piercing (AP) rounds and could have add-in armor that reduces the effectiveness of 14.5-mm, 20-mm, and 25-mm ammunition. The vehicle will not have reactive armor. The vehicle will have an image intensifier (II) night sight. The vehicle will be armed with a 7.62-mm coaxial machine gun, either a 73-mm, 30-mm, or 25-mm gun, and possibly an ATGM. The vehicle will have smoke grenade launchers and a vehicle exhaust smoke system. Examples of these vehicles are the

- Soviet BMP-1 and BMP-2.
- Chinese BMP-1, NVH-1, and NFV-1.

<u>Nomenclature</u>	<u>No. of Countries</u>	<u>Producer</u>	<u>Crew/Pax</u>	<u>Wheels/Track</u>	<u>Weapons</u>
BDRM-1	10	USSR	2/3	4 x 4	12.7mm & 2 x 7.62mm
BRDM-2	41	USSR	2/3	4 x 4	14.5mm & 7.62mm
AML-90	32	France	3/0	4 x 4	90mm & 7.62mm
AML-60	29	France	3/0	4 x 4	60mm mortar & 2 x 7.62mm
FERRET	20	UK	2/3	4 x 4	7.62mm
M8 ARMORED CAR	16	USA	4/0	4 x 4	37mm, 12.7mm, & 7.62mm
SCORPION	14	UK	3/0	Track	76mm & 7.62mm
SCIMITAR	10	UK	3/0	Track	30mm & 7.62mm
EE-9 (CASCAVEL)	15+	Brazil	3/0	6 x 6	90mm and 7.62mm or 12.7mm & 7.62mm
BRDM-1	10	USSR	2/3	4 x 4	12.7 & 2 x 7.62mm

The BMP-1 was or is produced in the USSR, Czechoslovakia, and China. The BMP-1 is in service with the following Third World countries:

NOTE: The numbers in the parentheses following the name of the country

represent the number of vehicles each country has.

- Afghanistan (40).
- Algeria (650).
- Angola.
- Cuba (50).
- Egypt (220).
- Ethiopia (40).
- Finland (85).
- India (700).
- Iran (100+).
- Iraq (1,000).
- Jordan.
- North Korea (150).
- Libya (520).
- Mongolia (420).
- Syria (2,350).
- South Yemen (100).
- Yugoslavia.

The BMP-2 is in service in the following Third World countries:

- Algeria (50).
- Finland (20).
- India.
- Iraq.
- Kuwait (245 on order).

The Chinese version of the BMP-1 is called the WZ 501. The Chinese, in cooperation with the British, also produce and sell infantry fighting vehicles: the NVH-1 and the NFH-1, with a choice of the Rarden 30-mm, the Oerlikon 25-mm, or the Bushmaster 25-mm chain gun as the main armament.

Figure 3-5 lists some of the characteristics of these vehicles:

<u>Nomenclature</u>	<u>No. of Countries</u>	<u>Crew/ Pax</u>	<u>Night Vision</u>	<u>Weapons</u>
BMP-1	17	3/8	II	73mm, AT-3, & 7.62mm
BMP-2	5	3/7	II	30mm, AT-5, & 7.62mm
NVH-1	UNK	2/9	II	25mm & 7.62mm
NFV-1	UNK	3/8	II	25mm & 7.62mm