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The Soviet T-64B Tank: An Updated Assessment

An Intelligence Assessment

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The Soviet T-64B Tank: An Updated Assessment

Key Judgments

Information available as of 1 August 1984 was used in this report.

The Soviet T-64B tank (figure 1) can fire both antitank guided missiles (ATGMs) and conventional tank ammunition through its main gun. The T-64B has only minor external changes and is thus indistinguishable at normal combat ranges (1 to 2 kilometers) from other T-64 tanks that do not fire ATGMs. The ATGM—designated AT-8 by NATO—appears to have been developed specifically for firing from tanks. The T-64B retains a powerful kinetic-energy tank destruction capability

we believe the ATGM probably has a secondary role against helicopters and low-flying aircraft.

the AT-8 missile is loaded by the automatic loader like the conventional ammunition and thus, like the conventional ammunition, is in two parts to fit the loader. We believe the AT-8 probably replaces the high-explosive antitank (HEAT) rounds carried in Soviet non-missile-firing tanks. Those tanks carry five to six HEAT rounds and thus we believe the T-64B carries five to six missiles.

we assess the T-64B's armor protection to be identical to the T-64A's except for the top armor

T-64B to have a new fire-control system that:

- Provides semiautomatic, command-to-line-of-sight guidance for the AT-8 ATGM, with a radiofrequency command link.

Figure 1. The Soviet T-64B tank

- Probably has a laser rangefinder.

- Has a new ballistic fire-control computer for greater accuracy in firing conventional munitions. The new computer, like the latest Western tank computers, compensates for ballistic variables in addition to range to improve accuracy. Previous Soviet tank computers accepted only range inputs for trajectory calculations.

[ ] the T-64B night sights are not linked to the AT-8 guidance system. The sight used to guide the AT-8 can be used only during the daytime or at night with auxiliary battlefield illumination. Thus, the AT-8 can only be fired under these conditions

[ ] we assess that the T-64B's automotive components and other internal subsystems—the commander's sights, the radio/intercom, and most of the autoloader parts—are the same as the T-64A's.

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The Soviet T-64B Tank: An Updated Assessment (U)

Introduction

[redacted] designed to fire antitank guided missiles (ATGMs) through its main gun in addition to conventional ammunition (figures 2 and 3).[1] In addition, [redacted] has enabled us to derive new information about the details of the T-64B weapon and fire-control system by comparing the components inside the turret with components seen inside T-64A and T-72 tanks (figure 4).[2]

Since the early 1960s, Soviet military writers have discussed the advantages of missile-firing tanks, and [redacted] that such tanks have been under development for years in the USSR. In the late 1970s [redacted] reported that the T-64B was similar in concept to the US M-60A2, which fired the Shillelagh ATGM. He reported the T-64B fired an ATGM called KOBRA through a short-barreled main gun.

[redacted] suggest the Soviet military probably initiated the T-64B tank development requirements in 1963. The Soviets seemed to have pursued two distinct firepower options: one, a short-barreled, large-caliber gun/missile launcher, and the other, a conventional tank cannon capable of firing ATGMs. However, they apparently produced only the tank with a standard-length tank cannon. No T-64 tanks with short-barreled main guns have been seen [redacted] actually seen a short-barreled T-64.

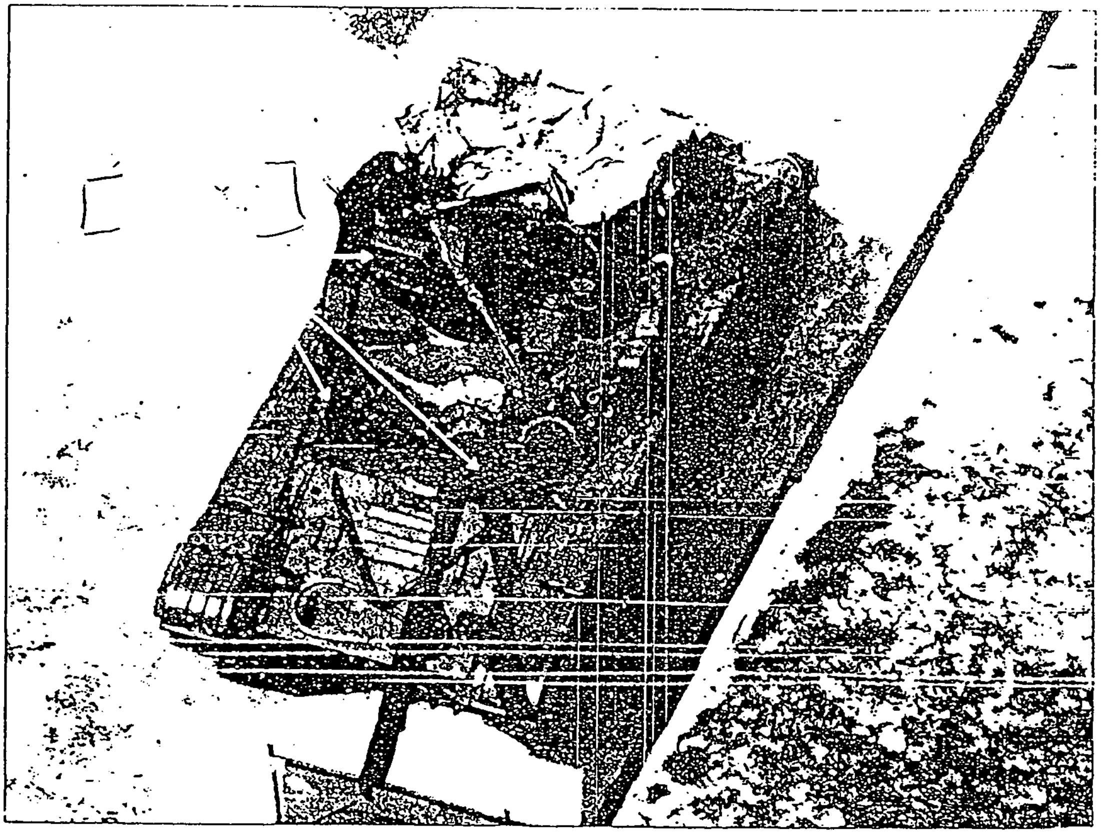
If the early reports of a short-barreled, large-caliber gun/missile system are accurate, the Soviets probably chose to drop this concept in favor of a gun/missile system that retained the standard T-64A 125-millimeter (mm) gun. By choosing the standard 125-mm gun, the Soviets derive significant tactical advantages. First, they gain the capability to score hits at long range without sacrificing the ability to fire high-velocity kinetic-energy (KE) rounds at shorter ranges. Figure 5 compares the hit probabilities of a typical ATGM and KE munition as a function of range to illustrate this point. Second, because missile-firing tanks would be virtually indistinguishable externally from non-missile-firing tanks, opponents would have to be cautious and treat all T-64s as if they were equipped with ATGMs.

In 1980 NATO observers spotted modified T-64 tanks deployed with the Soviet Southern Group of Forces (SGF). The new tanks were given the NATO designator M1980/2. In July 1981 similar tanks were observed in the Group of Soviet Forces, Germany (GSFG), and given the NATO designator M1981/1. We have concluded that the tanks seen in the SGF and GSFG were the same type of tanks. The observable changes in these tanks from the T-64A were side skirting plates and a single left optic for the fire-control system (see figure 2). The use of an enlarged gunner's optic indicated a change in the fire-control system from that of the T-64A, possibly reflecting a requirement to fire and guide ATGMs.

Sufficient [redacted] evidence was available by September 1982 to assess that a missile-firing tank, called the T-64B by the Soviets, did exist and was deployed in the GSFG. We concluded that the tanks known to NATO as M1980/2 and M1981/1 are the Soviet T-64B tanks

1 [redacted]

2 [redacted]



Figur' ' T-64B [ ]
hull

T-64B and AT-8 Characteristics

General

The T-64B retains the powerful lethality of the 125-mm smoothbore gun, which, firing the 1970-vintage BM-9 round, can penetrate 350 mm of rolled homogeneous armor (RHA) at 2,000 meter range. We estimate that the later BM-23 round, now known to be deployed in the GSFG, can penetrate 410 to 440 mm of RHA at the same range [ ]

[ ]

We estimate that the T-64B's ATGM—designated the AT-8 by NATO—can penetrate 700 to 800 mm of RHA and can be guided accurately to targets at 4,000 to 5,000 meter range [

[ ]

[ ]

Figure 4
Comparison of T-64A and T-64B Turret Interiors

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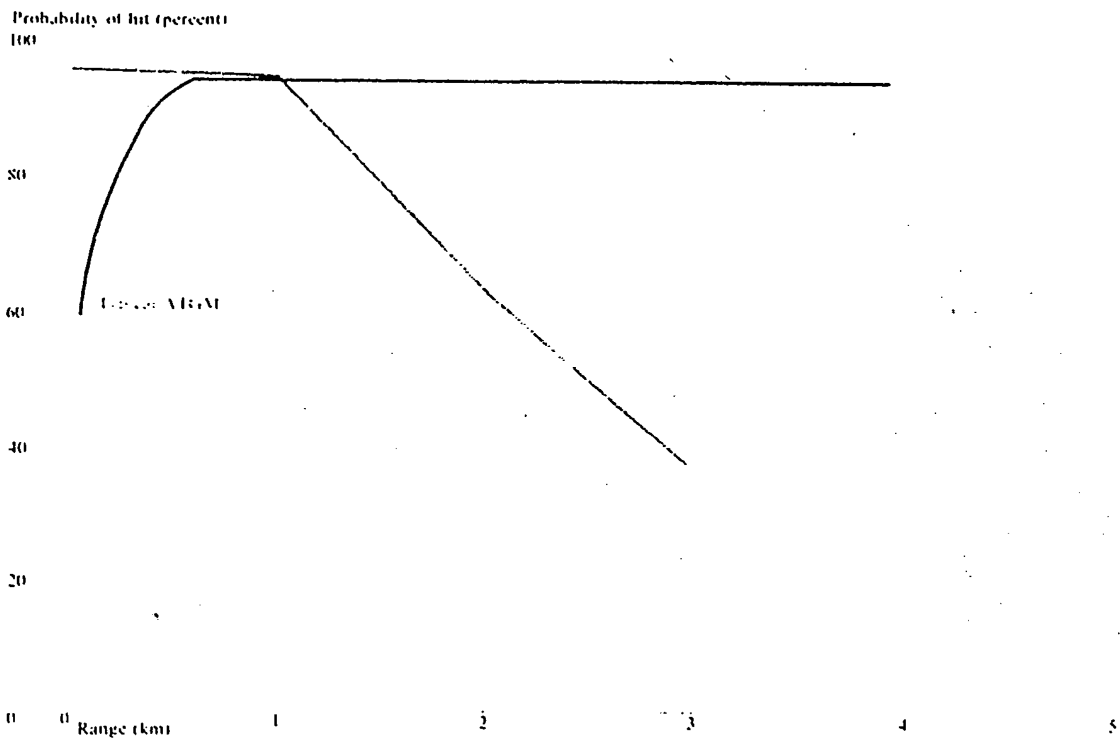
Figure 5
Probability of Hit: Comparison of Soviet ATGM and 125-mm Munitions



We believe the AT-8 missile has a secondary role against helicopters and low-flying aircraft. The missile's probable maximum range is longer than the expected average tank-to-tank engagement range on the Central European battlefield, indicating that it can be fired at airborne targets. Soviet training with other ATGMs against helicopters has been confirmed [redacted], and the Soviet press and other open sources have indicated that some Soviet ATGMs are intended for an antihelicopter role. Such a role is further suggested in the 1980 publication *Tanks and Tank Troops*, edited by Chief Marshal of the Armored Troops A. Kh. Babadzhanyan, which states: "Arming a tank with ATGMs increases its capabilities of hitting at considerable range . . . moving antitank weapons, including helicopters.'

[redacted] we assess the T-64B's armor protection to be identical to the T-64A's [redacted]

Table 1
Technical Characteristics of
the T-64A and T-64B Tanks

Crew	3—commander, gunner, driver
Mobility	
Weight	38 tons
Power	750-horsepower diesel engine
Top speed	85 kilometers per hour
Firepower	
Main gun	125-mm smoothbore, automatically loaded
Coaxial machinegun	7.62 mm
Dual-purpose machinegun	12.7 mm
Front armor protection [a]	
Against KE	370- to 440-mm RHA [b]
Against HEAT	500- to 575-mm RHA

[a] [redacted]

[b] [redacted]

[redacted]

Table 2
Postulated Characteristics
of the AT-8 ATGM

Range	4,000 to 5,000 meters
Velocity	Supersonic: Mach 1.5
Penetration	700- to 800-mm RHA
Propulsion	Eject, boost/sustain; or eject, boost/coast
Guidance	
Type	Semiautomatic, command to line of sight, with radiofrequency command link
Target tracking	Visual, 0.4 to 0.7 micron, spectral region
Missile tracking	Infrared, 1 to 3 microns, spectral region
Command link	9 to 13 GHz or 35 GHz, pulse-position modulation with coded pulse triplets [a]

[a] See text.

[redacted]

Technical characteristics of the T-64A and T-64B tanks are shown in table 1. The T-64B's crew and armament characteristics are known [redacted] to be identical to the T-64A's. We assess the T-64B's mobility characteristics to be the same as the T-64A's.

General characteristics of the AT-8 missile system are shown in table 2. The analysis on which our assessment of the system is based is provided in appendix B.

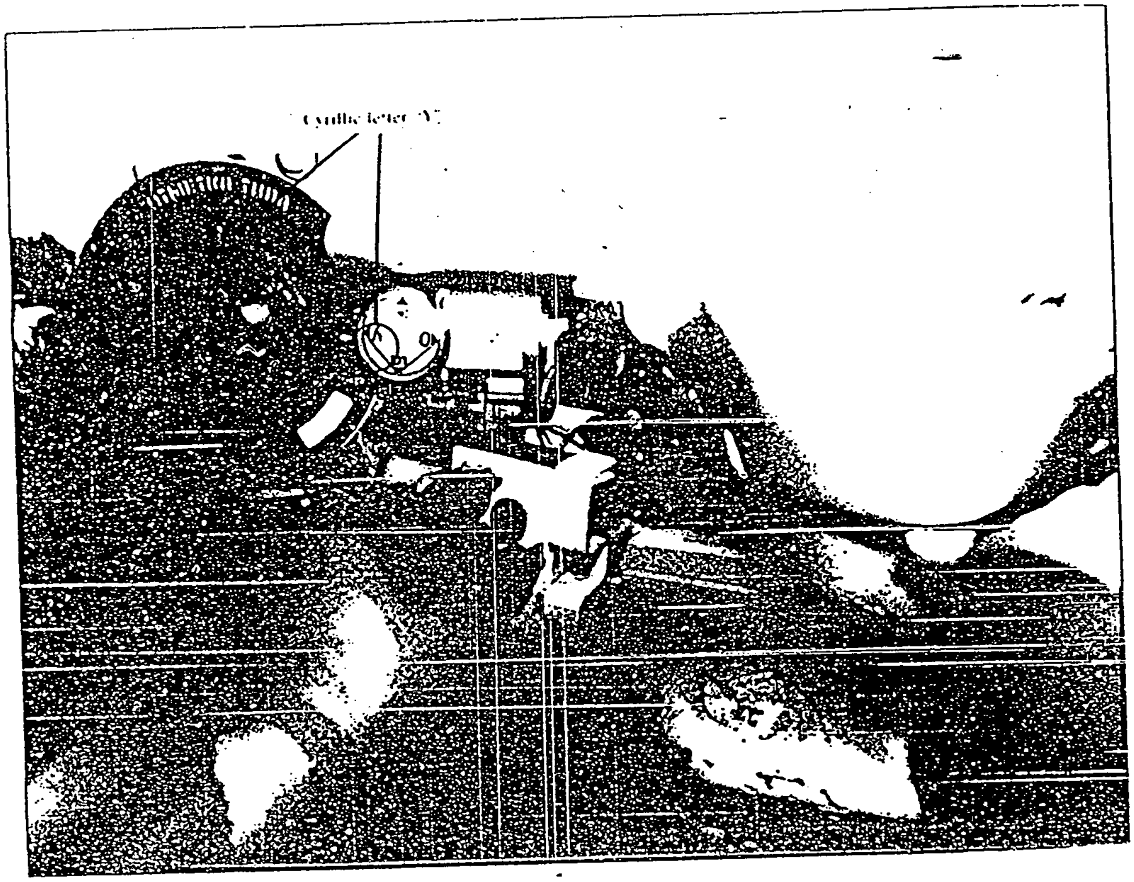


Figure 6. ATGM symbol on T-64B autoloader programer

Fire-Control System and Autoloader
[redacted] direct proof that the T-64B tank fires a radiofrequency (RF)-guided ATGM through its main gun. [redacted] he T-64B has a new fire-control system that is entirely different from that of the T-64A to allow it to fire conventional munitions and to guide ATGMs. The T-64B's conventional daytime gunnery subsystems are more elaborate than the T-64A's. Other internal T-64B subsystems—the commander's sights, the radio/intercom, and most of the autoloader parts—are the same as the T-64A's.

[redacted]

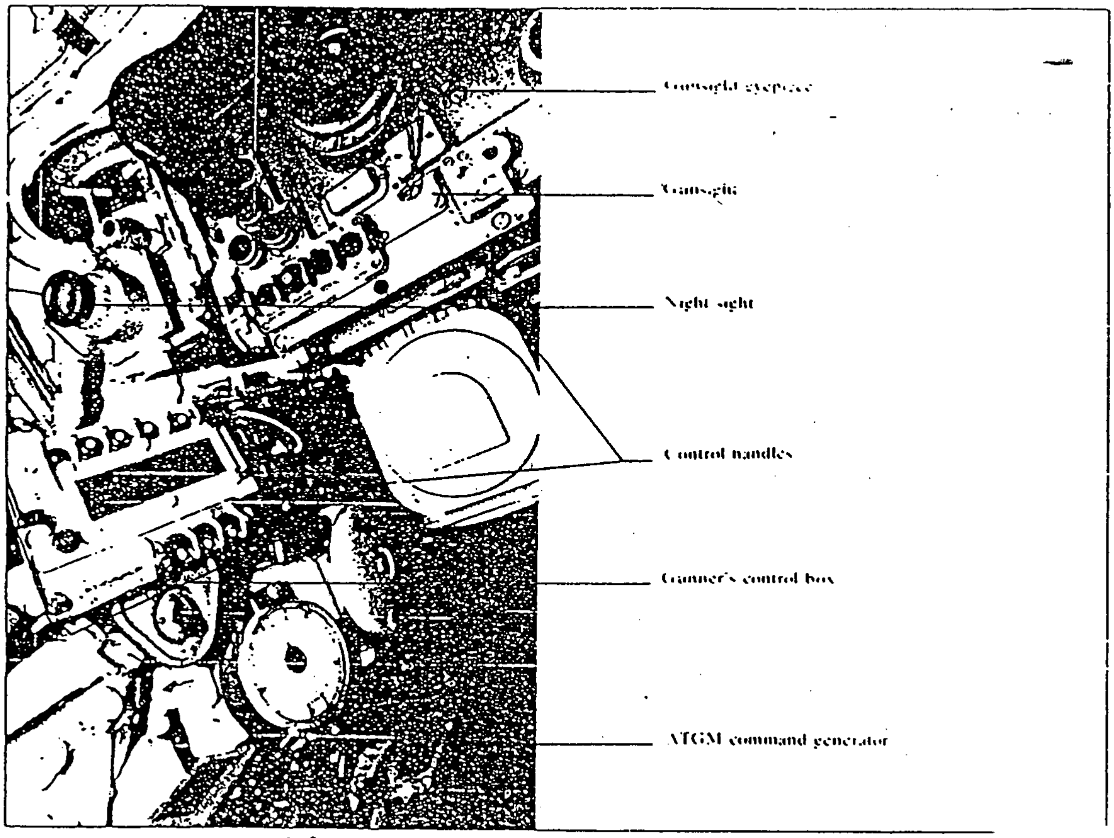


Figure 7. T-64B gunner's position

[redacted] T-64B autoloader's ammunition handling components are identical to the T-64A's and have not been modified for ATGMs. The electrical controls are slightly different from the T-64A's. The T-64A and T-64B autoloaders [redacted] indicating that the AT-8 is a two-part missile. [redacted]

[redacted] The AT-8 missile system in the T-64B uses semiautomatic, command-to-line-of-sight (SACLOS) guidance with an RF command link, a technique used in the Soviet AT-2C and AT-6 ATGM systems. The AT-8 missile is commanded by the T-64B fire-control system to fly toward the line of sight between the T-64B gunsight and a target. All the gunner needs to do after firing the ATGM is keep the gunsight on target. The devices in the T-64B gunner's position are consistent with this type of guidance (figure 7). [redacted]

[redacted]

An electrical box, [redacted], is mounted to the gunner's left on the turret wall and has switches associated with the ATGM, autoloader, rangefinder, computer, and gyroscopes used with the gun-drive stabilizer. The ATGM-launch button is on this undesignated box

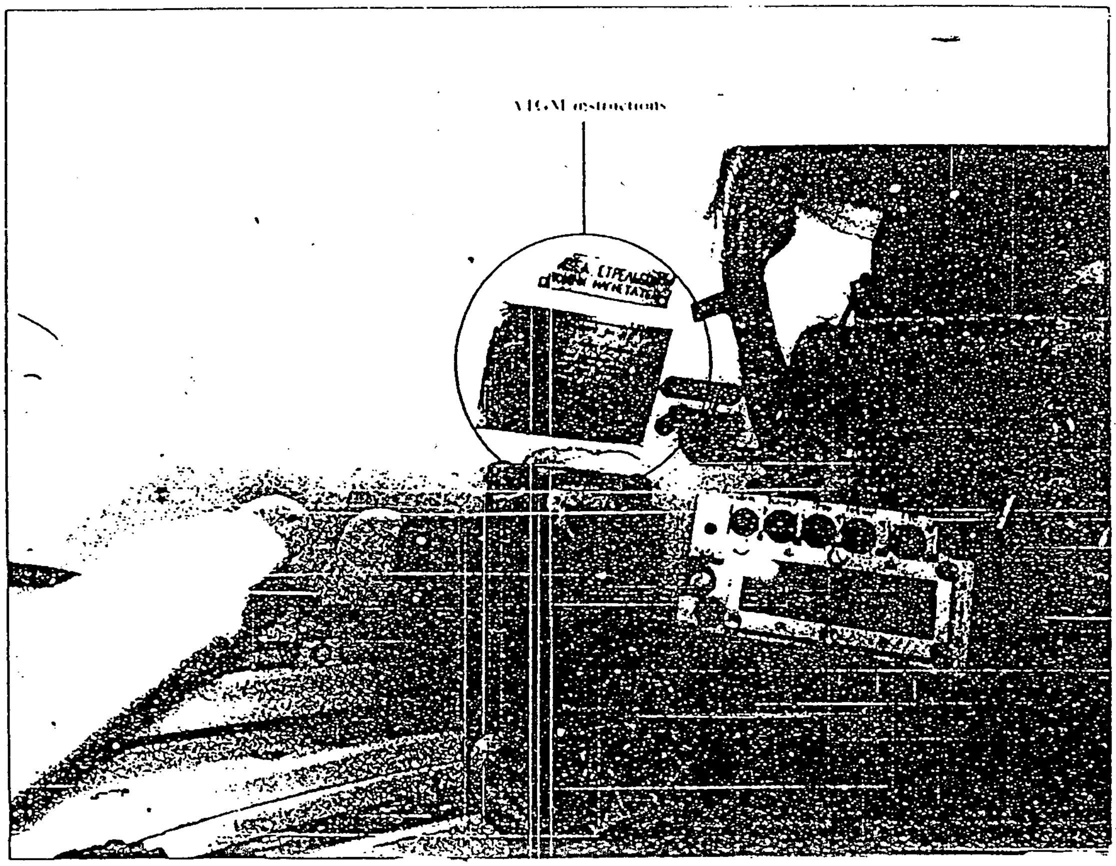


Figure 8. T-64B panel with ATGM instructions

Target sighting and ATGM tracking probably are accomplished by two parallel optical channels inside the daytime gunsight (GTN-25). The optical head for the gunsight, seen outside the turret, has two lenses. We believe one lens is for the gunner's visual sighting and aiming at a target through the single eyepiece of the gunsight, and that the other lens is for an infrared (IR) channel that tracks the ATGM as it flies downrange. The IR channel probably is sensitive to IR rays in the 1- to 3-micron region and is designed to track a bright IR-emitting lamp on the ATGM. The gunsight does not have a night-firing capability because the gunner can see only into the visual channel, which has no IR capability. The gunner probably uses the control handles under the gunsight to keep an aiming mark on the target image in the visual channel. The IR channel probably provides a signal indicating the deviation of the ATGM's IR beacon from the aiming mark

A SACLOS guidance system includes a guidance computer that accepts the deviation signal and generates a sequence of commands to steer the ATGM toward the line of sight. The AT-8 guidance system in the T-64B contains a device [redacted] that probably is the guidance computer.

[redacted]

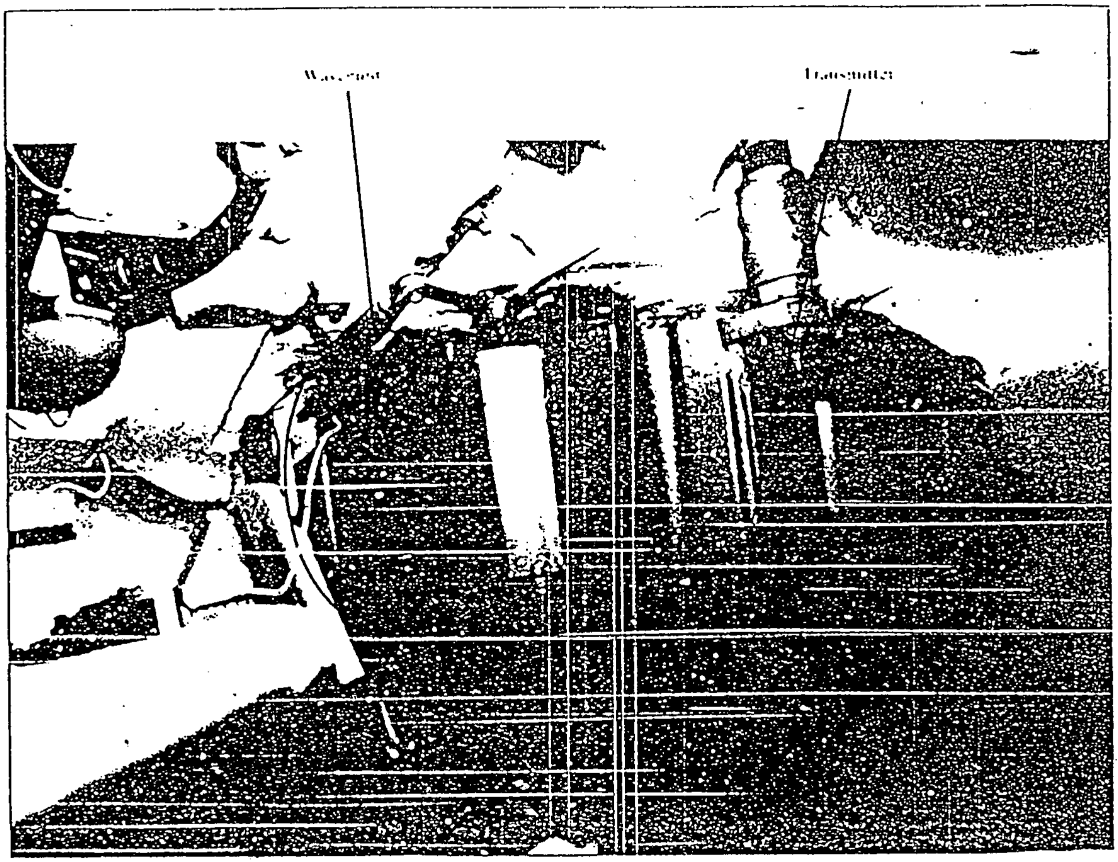


Figure 9. T-64B RF-command components

The RF transmitter (GTN-2) is located behind the gunner. A waveguide exits the transmitter and extends across the turret ceiling to the antenna housing mounted externally on the right side of the turret (figure 9). The transmitter modulates an RF carrier with the pulse-coded commands from the command generator. The command-modulated RF signal exits via the waveguide and external antenna and is transmitted to the ATGM

The frequency of the command link is unknown. We originally postulated it to be in the 9- to 13-gigahertz (GHz) range. The waveguide , however, may be small enough to operate at millimeter-wave (MMW) frequencies (about 35 GHz). The Soviets have fielded a number of military MMW devices, but, because of our assessment of the development period for the AT-8, we would be surprised if MMW technology was available in time to be incorporated into the missile. A 9- to 13-GHz or a 35-GHz command link would provide the same missile system performance because the necessary commands could be carried on either frequency range

We believe that the AT-8 command signal would be similar to the command signal of the Soviet AT-2C ATGM, which consists of pulse triplets using pulse-position modulation to convey command information.

We further believe that the T-64B gunsight contains a laser rangefinder. A laser rangefinder can provide more accurate range readings than other types of rangefinders used in tanks, but may also provide false range readings. Gunners can be trained to select the most likely readings

and a 1979 training manual refers to a "sight/rangefinder" in connection with Article 447 (the T-64B). The T-64B rangefinder must operate out of the single optical head of the gunsight. A laser or stadiametric rangefinder [4] would meet this requirement.

The T-64B gunner's control handles probably are used in the same manner as those of the T-64A and T-72, with the handle movements controlling turret traverse and gun elevation, the triggers on the fronts of the handles firing the main gun and coaxial machinegun, and the thumb buttons on the handles operating the tank rangefinders. The only exception is that the thumb buttons in the T-64A and T-72 operate coincidence rangefinders,[5] and the thumb buttons in the T-64B probably fire and reset the laser rangefinder.

The T-64B probably does not use the same computer for conventional ammunition ballistics and ATGM guidance. The nature of the calculations and the calculating speed requirements for conventional ballistics and missile guidance are different.

the T-64B's ballistic computer for firing conventional ammunition is more complicated than the T-64A's or the T-72's (figure 10). The input panel is mounted on the commander's side and has knobs for atmospheric pressure, air temperature, ammunition temperature, muzzle-velocity variation, manual range estimate, and an unidentified measurement. These variables influence ballistic trajectories. Soviet firing tables for the 125-mm gun used in T-64 and T-72 tanks list elevation angles as functions of range and include correction factors for the variables other than range. The ballistic computers in the T-64A and the T-72 are mechanical camshafts that accept range as their sole external input. Other aiming corrections have to be estimated by the gunner using the firing tables. The panel is the first device we have seen in a Soviet tank that provides for the entry of variables other than range into the ballistic computer, indicating that the T-64B uses a more complicated fire-control algorithm than the T-64A and the T-72. Western tanks typically use multiple-input algorithms to provide b---- gunnery accuracy than range-only algorithms.

[4] A stadiametric rangefinder operates on the principle that an object looks smaller as its range from the viewer increases. A stadiametric rangefinder measures the apparent size of an object at a distance to determine the range to the object

[5] Coincidence rangefinders measure the small angle between the lines of sight from two separated objective lenses to a distant object. The angle is called the parallax angle and decreases with the range to the object

Figure 10.

The T-64B commander probably would adjust the input knobs on the [redacted] panel periodically to compensate for changing conditions. The panel probably is only an input device and not the actual ballistic computer. We believe that the ballistic computer probably is inside the GTN-25 gunsight, or it could be [redacted] on the left turret wall. The gunsight would be the best location for the ballistic computer if the computer must mechanically drive an aiming reticle for the gunner (as is the case in many Western tanks designed concurrently with the T-64B;

Because of this probable similarity, we believe the elevation gyroscope steadies the gunner's view through the gunsight as the tank moves. The gyroscope probably is directly linked to the mirror inside the gunsight, causing the mirror to remain on a steady inertial elevation

The imperfect pointing, tracking, and stabilizing capabilities of the T-64B gun drive probably limit the accuracy improvement afforded by the new ballistic computer. We anticipate a new gun drive system will appear on future Soviet tanks to fully exploit the capabilities of the new computer:

The T-64B night-firing capabilities are lower than the daytime-firing capabilities because its night sight is not linked to the ballistic computer or the AT-8 guidance system. Night firing of conventional ammunition is conducted by using a simple firing table affixed to the night sight. The AT-8 missile cannot be guided at night without visible artificial illumination. The Soviets may introduce a night sight that can be coupled to the AT-8 guidance system to give the AT-8 a night-firing capability without artificial illumination. The day gunsight used to guide the AT-8 does not have any night capability (other than providing an illuminated reticle for twilight firing), and there are no other sights in the tank that could be used for night firing of the ATGM

The T-64B probably has slightly better gunner's night vision than the T-64A and T-72. All of these tanks have the TPN1-49-23 gunner's night sight. The sigh amplifies IR light of a wavelength of about 1 micron reflected from a target. The sight needs a source of artificial IR light. The T-64B has an IR searchlight, designated the L-4A; the T-64A's and T-72's original IR searchlights were designated the L-2. The L-4A may use a xenon tube that is brighter in the 1-micron region than the tungsten bulb of the L-2. If the L-4A is brighter than the L-2, the T-64B has a longer night-vision range than the T-64A or T-72. Soviet manuals specify the maximum range for the gunner's night sight with the L-2 searchlight to be 800 meters. The specification does not further qualify the target or ambient illumination characteristics or indicate whether the range is a detection, recognition, identification, or engagement range. The night sight used with the L-4A in the T-64B probably does not have a range much greater than 800 meters because the night-firing range table in the T-64B covers the same ranges specified in the T-64A and T-72

The [illegible] gunner has one more electrical switch box on the turret wall that has not been seen in T-64A tanks. The switch box is simple—having a knob, three switches, and a "fire" button. We believe this box is for firing the T-64B's smoke grenades, with the knob and switches providing for selectable single or multiple firings of the 12 external launcher

ATGM Load

We do not know the number of ATGMs the T-64B will carry in its basic load of ammunition, but we believe each tank probably would carry five to six ATGMs. Ammunition stowage space is limited inside the T-64B, and the basic load of ATGMs has to occupy space allocated to standard ammunition in the T-64A. The number could range from a minimum of three to five missiles to a maximum of 40. The maximum number is based on the assumption that the basic load of ammunition is replaced by ATGM round

A more realistic maximum probably would involve replacing all the conventional HEAT rounds with ATGMs. The Soviets may not consider HEAT rounds necessary in a tank armed with KE rounds and ATGMs. [redacted]

The obscured position may be an off or empty-cell position, like that of the T-72 selector. The Soviet T-64A and T-72 tanks have basic HEAT loads of five or six HEAT rounds. If ATGMs replace HEAT rounds in the T-64B, then a reasonable maximum load for it would be five or six missiles.

Appendix A

T-64B Armor Analysis

Engineering analysis of the armor protection of all T-64s (the T-64, T-64A, and T-64B) has continued since 1977 when [redacted] indicated the tank had a laminate glacis and cored turret. [redacted] that the T-64 turret is cast steel and contains hollow spaces that are filled with a nonmetallic material, presumably glass or ceramic. The estimated protection levels are based on an analysis of internal space requirements, exterior dimensions, and comparisons with the T-72 tank. We do not know why the T-72 tank, which entered production six years after the T-64, still uses the laminate glacis armor but not the cored-turret armor like the T-64. We assess that the T-64's cored turret provides more protection against HEAT munitions than an equal weight of steel [redacted]

[redacted] we assess its glacis to use a technology similar to that of the T-72.[3] We believe, however, that the center layer of the T-64's glacis is a more effective material than the glass-reinforced plastic center layer of the T-72's glacis. The T-64's glacis probably provides a protection level similar to that of the T-64 turret's cored armor. Modern armors, like those used in the T-64's glacis and turret, provide better protection against some munitions than RHA of equal weight. The degrees of protection to KE-type rounds or HEAT-type rounds that are offered by a given modern armor are different. The T-64's armor, like the US M-1's, provides enhanced protection against HEAT rounds [redacted]

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Appendix B

AT-8 ATGM Analysis

The AT-8 program probably was influenced by contemporary Western developments—the French ACRA ATGM and the US SWIFTIE ATGM. Although neither of these missiles was deployed, from the mid-1960s through the mid-1970s the Soviets were able to observe considerable Western emphasis, planning, and development effort related to arming tanks with gun-launched missiles. Both the ACRA and the SWIFTIE were supersonic, gun-launched systems. The ACRA was designed to be launched from a conventional 142-mm gun, and the SWIFTIE was designed to be fired from the standard US 105-mm tank gun. ACRA development began in 1961 and was demonstrated to potential buyers, worldwide, in the early 1970s. The SWIFTIE was in development in the early 1970s, and was intended as a follow-on to the Shillelagh. It was designed to be effective against helicopters and, to a lesser degree, against fixed-wing aircraft, in addition to its antiarmor role

Range and Velocity

In view of the effectiveness of standard tank ammunition to about a 2-km range, the use of a tank-launched guided missile with a range less than 4,000 meters would be unlikely. Likewise, considering the battlefield environment where the AT-8 would be used, and considering line-of-sight restrictions, a range greater than 4,000 meters probably would not be useful for a ground-launched missile fired at a ground target. If, however, the missile is intended to have a secondary, antihelicopter role, a greater range, perhaps to 5,000 meters, might be expected, which is longer than the expected average tank-to-tank engagement range on the Central European battlefield

Soviet military writers state that one drawback of ATGMs is that their long flight times make the launcher susceptible to countermeasures and allow the target to take evasive action. We expect the AT-8's velocity to be high to minimize this drawback. The Soviet heliborne AT-6 ATGM is supersonic. The advantages of supersonic velocity, the demonstrated capability of the AT-6, and the contemporary Western development of the supersonic ACRA and SWIFTIE systems support the supersonic postulation.

Propulsion

A feasible propulsion system for the AT-8 missile would include an eject charge to provide a soft boost. This charge would eject the missile from the gun tube at about 75 to 100 meters per second. The missile motor would then ignite, providing an average velocity of about 500 meters per second, with either a boost-sustain or a boost-coast thrust profile.

Guidance

With SACLOS guidance, the gunner is required only to track the target with his optical sight. An electro-optical tracker aligned with the gunner's optical sight tracks an IR beacon on the rear of the missile and determines the missile's deviation from the gunner's line of sight to the target. Launcher electronic circuitry then computes flight correction commands, which are transmitted to the missile by the radio command link

As with the Soviet AT-4 ATGM, the tracking beacon probably is not modulated; the AT-8—like the AT-4—probably relies on very narrow missile tracker fields of view for protection from IR countermeasures.

The RF command link for the AT-2 ATGM on the Soviet Mi-8 HIP-E and Mi-24 HIND-A helicopters uses a simple horn antenna having an aperture of approximately 80 by 80 mm. The antenna housing mounted on the right side of the T-64B turret (the same location where one optic of the coincidence rangefinder was installed on T-64A tank models) probably contains a similar horn antenna. The shape of the antenna housing indicates a relatively narrow beam width in azimuth and a broad beam width in elevation.

Warhead

Estimates of AT-8 warhead performance can be reasonably bounded by the known capabilities of other contemporary Soviet antitank missiles and the T-64 tank's conventional chemical-energy round, the BK-14, fielded in 1970. A convenient means of normalizing penetration data to allow comparison of warheads of different diameters is the measure of armor penetration in charge diameters (CD), rather than in total millimeters of penetration. CD penetration is the total armor penetration divided by the diameter of the shaped charge. The BK-14 round, then, has about a 5.75-CD penetration capability.

Assuming a 115-mm shaped-charge diameter for the AT-8 warhead (the shaped-charge diameter is slightly smaller than the overall missile diameter) and the technology available in its 1970-75 development period (a 5.75- to 7-CD capability), penetration bounds of 660 to 805 mm of RHA are calculated. We believe, however, that the AT-8's penetration capability is probably at the upper end of this boundary, in the 800-mm range because the BK-14 is an earlier development

This estimate of 700 to 800 mm is based on conventional, currently fielded Soviet shaped-charge technology and is probably conservative; the AT-8 or a later variant may exceed this bound. We believe additional warheads may be available for the AT-8—or that new missiles with new designators may exist. Evidence of other warheads would indicate an attempt to improve system lethality by use of more sophisticated shaped-charge technology in response to Western armor developments, or to increase system flexibility by providing multipurpose warheads with, for example, enhanced antipersonnel or antihelicopter capabilities.